COW HEALTH MONITORING AND DISEASE DETECTION

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A Final Year Design Project (FYDP) submitted to the Department of Electrical and Electronic Engineering in partial fulfillment of the requirements for the degree of B.Sc. in Electrical and Electronic Engineering

Department of Electrical and Electronic Engineering
Brac University
May 2023

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Declaration

It is hereby declared that

1. The Final Year Design Project (FYDP) submitted is our own original work while completing degree at Brac University.
2. The Final Year Design Project (FYDP) does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The Final Year Design Project (FYDP) does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. We have acknowledged all main sources of help.

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of Fall, 2022 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of B.Sc. in Electrical and Electronic Engineering on 15th December 2022.

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Ethics Statement

Our final year design project report entails 5% plagiarism.

Abstract/ Executive Summary

This abstract presents an IoT based Cow Health Monitoring and Disease Detection. The system uses different sensors to monitor cow health parameters. Moreover, the health parameters data is then transmitted to IoT analytics platform via IoT connectivity for further analyzation, visualization of cow health and anticipation of cow diseases. The system is also intended to be highly effective and affordable, making it a feasible option for large-scale application in diverse cow farms. A variety of farmers can utilize the system because it is made to be user-friendly and simple to setup. By giving access to regular cow health monitoring, this suggested IoT-based Cow Health Monitoring and Disease Detection system has the potential to improve cow health and farm quality.

Keywords: Cow; IoT; Farming; Diseases; User-friendly.

Dedication

Special appreciation to our ATC Chair, Dr. A.S. Nazmul Huda for his guidance during the project.

Acknowledgement

We would like to thank our ATC Chair Dr. A.S. Nazmul Huda, Raihana Shams Islam Antara, and Nahid Hossain Taz for their tremendous guideline and unbelievable support in this project. The technical guidance under his presence is something that we can always remember to motivate us. Also, we would like to extend our thanks to Dr. MD. Bayzer Rahman who is working as a Principal Scientific Officer at Bangladesh Livestock Research Institute for his guidance and expertise to find out common diseases in Bangladesh and methodology to detect that specific range of diseases. We are truly grateful to these two respectful people for their unbelievable support, which greatly benefited our team and helped us a lot to complete each tough task easily.

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List of Acronyms

IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
pH	Potential of Hydrogen
OLED	Organic Light Emitting Diodes
PCB	Printed Circuit Board
USB	Universal Serial Bus
DHT	Dihydrotestosterone
MPU	Memory Protection Unit
GPS	Global Positioning System

Glossary

Sensor:	A piece of equipment or gadget that can read signals produced by a device that detects changes in physical quantities.
IoT:	The term "Internet of Things" describes a network of actual machines, vehicles, buildings, and other objects that are equipped with connectivity, electronics, software, sensors, and other components that allow them to communicate and share data with other objects, the internet, and other machines.
C programming:	With more control over the computer's hardware, C is a general-purpose procedural programming language that is closer to machine language.
Cloud Server:	A virtual server that is generated and maintained using software and accessible remotely via the internet. It works on a cloud computing platform.
Data Set:	A group of information arranged for a particular use or purpose, frequently in tabular form.

Chapter 1: Introduction

1.1 Introduction

According to recent statistics from Banglapedia, the number of available milking cows and dry cows (cows without milk) in Bangladesh are approximately 3.53 million and 2.61 million [1]. Various diseases and disorders that are directly connected with significant socio-economic losses to the farmers and dairy farm owners imperil these huge cow populations in Bangladesh. The two biggest hindrances in the development of the dairy farming industry are cow diseases and the lack of in-depth knowledge of cow health monitoring systems. The impacts of animal diseases on human health can be both socioeconomic and health. Due to the bad health conditions of cows, stakeholders often have to face production losses; productivity and profitability get lower, and disruption and bad reputation to local markets, as well as internal trade too. Also, animal diseases are a huge threat to the human body, such as zoonotic diseases and food-borne illnesses [2].

1.1.1 Problem Statement

Cow diseases and the lack of health monitoring system are the major hindrances in the development of the dairy farming industry in Bangladesh. Cow farming has a vital role in the development of our country and therefore it's growing at a faster rate than national income. Therefore, it is necessary to develop such reliable monitoring systems that can report a range of cow health conditions to the farmers in a timely manner, and based on these data, diseases can be detected early. In Bangladesh, such systems are still unavailable, it is becoming essential to develop a monitoring device that can notify the farmers on time, and based on different health parameters, diseases can be predicted so that the farmer can go to veterinarians to give proper treatment to his infected cow. In our project, we have developed a cow health monitoring system that will check cow health parameters and upon those data will anticipate cow diseases.

1.1.2 Background Study

Starting with the individual monitoring of cow health, it is quite unusual thinking for farmers to keep track of the health condition of each cow on a farm. Health condition plays a vital role in the development of a cow farming industry since it is the only parameter that can allow the farmers to predict whether the cow is infected by any diseases or not. Hence the importance of monitoring cows' health condition for predicting a disease at an early stage arise here.
Dairy farming has a vital role in the development of Bangladesh. To avert poverty in Bangladesh, dairy farming has worked amazingly. Most importantly, cows are the main source of milk in Bangladesh and cows fulfill 90% demand for milk in our country [3]. As the population is increasing every year in Bangladesh, the demand for milk and milking products and the need for nutritional food are increasing. Milk production and appropriate nutritional standards for dairy cows depend on many factors, such as climate change, proper monitoring of cow health daily, and appropriate treatment given to the diseased cow. As a diseased cow can cause less milk yield production compared to a healthy cow, it can disrupt the expected profit of a farmer. In rural areas,

the number of veterinarians is still rarely visible. On the contrary, they do not even have the minimum basic knowledge about a cow's health condition and as a result when they understand that the cow is in a bad condition and unfortunately if the detection is delayed, then, it can disintegrate the farmers business and their mentality as well. In response to that, people with their cows go a considerable distance to visit veterinarians, which costs them a lot of money.
Therefore, to keep track of the health condition of cows, we will employ an IoT (Internet of Things) based system to monitor the health condition of cows and detect a disease at an early stage by putting different sensors on different body parts of cows. The collected data from sensors will then be compared with the healthy cow parameters and predict an approximate disease by turning on an LED light on the cloud server.

1.1.3 Literature Gap

If we simply describe literature gap it is an unanswered question or unresolved problem. This happens due to lack of existing research in that particular sector/project. There are various types of literature gap. And most commons that we encounter those are

I. The classic literature gaps
II. The disagreement literature gap
III. The contextual literature gaps
IV. The methodological literature gaps.

Firstly, the classic literature gap comes when there is new concept or idea that has not been studied that much or unexplored. Secondly, the disagreement literature gap will be present when there are contrasting or contradictory findings are found in existing research. Thirdly, the contextual; literature gap can be found when there is a specific context is missing from the research. Lastly, the methodological gap with exists when the existing studies or ideas or model is lacking is some parts or missing certain perspective.
In every project there are literature gap can be found and that is why the scope of future updates are essential. While going through other literature paper and comparing them with ours we have some more or less common literature gaps. Now, we will try to highlight some of the literature gaps which we have found out.

- **Cow's ruminants' pH measurement:** Cow's ruminant pH plays a vital role in cow's health. Procedure of measuring ruminant pH is very backdated because we have to insert a plastic tube in cow's stomach in order to measure the pH. Also, there is another method that is we can use is make the device wireless and set it inside the stomach of cow. But over the time that device might be dead and the debris will remain in cow's stomach and we have to clean that. This feature will be added in near future.

- **More variation of diseases:** While searching for parameters for our project we face some difficulties to get the exact accurate value of the cow's. For that, we had to conduct some on field work to gather data and collaborate those data on our project. So, we have

limited the number of diseases by three diseases. So, that we can complete our project on time. Therefore, we will add more options and diseases parameter in our device in future studies so that we can use the device for various range.

- **Machine learning algorithm:** In today's world accuracy is one of the top most priority. And through machine learning we can achieve that and is has been widely used. In our project, we have showed the probable diseases by comparing data from the data base. In future when we incorporate the machine learning we will be able to tell the used about his cow's condition more precisely.

1.1.4 Relevance to Current and Future Industry

When it comes to engineering-based problem first thing we have to think of is the stake holder. Also, we have to see the current market situation of that section and what opportunity in lying behind for the future industry. In Bangladesh the technology in farming sector is still developing and there is lot more things to introduce in this industry. For cow health monitoring there is no available device that can be found in country. But in our neighbor country India there have been similar kind of facilities are being provided. Therefore, we have the opportunity to make something new for our country's perspective. We are going research from the current industry's product and come up with criteria and will do analysis on future industry. By researching market, we can compare our project with current industry and future industry.

- **Current Industry:**

In our country, Cattel farming is happened in traditional method. There is no touch of very few touches of the technology in this cow farming sector. But in this era, everything is getting globalized. And people can control things from far distance. Besides that, our neighbor country India is also implementing technology advancement on cow farming.
While researching we have come across this company named Allflex Livestock Intelligence. Here they have different plans for different kinds of cow. Such as health monitoring, reproduction monitoring, group monitoring. Our project is quite related to the health monitoring segment of the Allflex Livestock Intelligence company. But their device does not have any app or mobile based support. Their device must operate through PC.
Also, they did not mention anything about the parameter of their device and working procedure of their device which certainly turndown for the customer. As the customer deserves to know what they are purchasing.

Reference link: https://www.allflex.global/na/product_cat/dairy-cow-monitoring/

Additionally, their device is higher in price. Farmer won't be able to afford them. From indiamart website we got to learn that such device will cost 3.5lac rupees and that price is very high for the farmers.

Reference link: https://www.indiamart.com/proddetail/cow-monitoring-technology-for-heat-health-detection-22250475230.html

- **Future Industry:**

There are huge number of customers and potential customers who will be using the cow health monitoring system. More people will be interested in this cow farming sector with the help of this device. If we can ensure farmers their profit that would bring more entrepreneurs in this sector. And that will bring us more possibilities of future improvement of this device. With the help of the cow health monitoring a huge amount of labor work will decrease and this will benefit in stake holder as their work will be lessened. To further improve in future industry, we think this update should contain:

1. **Various disease detection and solution:** In the near future when we will be able to gather more information on cows' other health parameters and using machine learning more accurate disease detection can be provided. Also, we will be also suggesting to the user the solution of the disease.
2. **Bacterial related detection:** As cows' bacterial disease causes lower milk production and sickness in cows. In future industry we will consider this factor and make improvements in the industry.

In conclusion, our project is quite relevant to current and future industry whereby improving the device we can make our farming industry smarter and more efficient.

1.2 Objectives, Requirements, Specification, and Constant

1.2.1 Objectives

- **Designing a cow health monitoring system to keep track of the individual cow health condition**

  Data will be collected digitally by the sensors so that an app or website can monitor it.

  Health parameters data will be collected from the use of digital sensors at all times and will be easy to use as a result on the cloud server window. Hence, our system can visualize the temperature and humidity, heart rate, and rumination rate of a cow in a timely manner and anyone with basic computer operating knowledge can keep track of their cow's health condition from the IoT cloud server.

- **To alert farmers when cows are in abnormal conditions and predict cow sickness in advance**

  As we have used different sensors to get data on different health parameters from a cow, these collected will then be compared to a healthy cow's health parameter to know whether the cow is in a healthy condition or in an abnormal condition. Based on that, diseases related to those parameters will be predicted at an early stage.

- **To ensure a good amount of milk production on the farm**
  If a farmer can monitor the condition of each cow on a farm, it will help him to predict any abnormal activities of any cow and according to the activities he can treat the cow later by visiting a veterinarian. Therefore, the detection of diseases at an early stage will result in a significant amount of milk production on the farm.

- **To raise awareness about cow illnesses and prevent cow deaths on far**

  In Bangladesh, this sort of technology is still uncommon and there has not been any sufficient research on a proper cow health monitoring system, unlike the traditional one that is assessing cows' behavior from a veterinarian. Therefore, it will raise about cow illness as this sector plays a huge impact on the economy of Bangladesh since many people take it as their way of earning. Finally, this reliable monitoring system can report a range of cow health conditions to the farmers promptly, and based on these data, diseases can be predicted so that the farmer can go to veterinarians to give proper treatment to his infected cow that will prevent cow deaths on far.

1.2.2 Functional and Non-Functional Requirement

The user's perspective is used to identify requirements, and there are two categories of requirements: functional and non-functional.
Functional requirements are product or device feature and those features must ensure to execute their required tasks properly. And non-functional requirements are not related to the system functionality rather it defines that how the system will work and how it can improve the overall system. These functional and non-functional requirements come from the users.

Table 1.1: Requirements from user.

Requirements From the User	**Functional Requirement**	Sensors to collect and process data from cow
		Display to show data
		Collar to keep the device in suitable spot
		Uninterrupted internet connection
		Low power Consumption
		Notification Alert System
	Non-functional Requirement	Flexibility
		Light in weight
		Vibrant color
		Water & Dust resistance
		Manually maintenance

Functional Requirements:

Sensors: Our main components are sensor and processing unit. Because of that we are able to collect all the required data from the cow and by processing those data we can get our required output.

Display: In order to see output instantly we need a small display attached to the device.

Collar: As we are designing cow health monitoring system. Our equipment will need to be attached to the cow's convenient place. And Collar is the most convenient option we have found.

Uninterrupted internet connection: As the data taken from cow will be send to the cow owner to inform about the health status of the cow. Thus, the uninterrupted internet is essential that way owner will get his update about his cow farm whenever he wants.

Low power consumption: As the device will be attached to the cow and to make things convenient the equipment attached to cow will run on battery. So, to make battery last long and we have to make design that consumes less power.

Notification Alert System: The device should notify the user immediately if there are any abnormal changes are happening.

Non-functional Requirements:

Flexibility: As the collar will be fit to cow and will stay on it almost all the time. It would be comfortable for cow if it is flexible and would not interrupt in their daily activity.

Light in weight: As the Components will be somehow attached to cow and the cow will be doing its regular activity. Thus, it is important to keep the device as much light weight as possible so that cow does not face any problem while wearing it.

Vibrant color: Collar should be vibrant color like red. Because if somehow collar falls off it would be easier to spot out it.

Water & Dust resistance: While doing regular activities the cow will face water and dust frequently. So, to make device long lasting we have to make it dust proof and water proof in this way components will be safe.

Manually maintenance: As electric equipment attracts dust and due to this dust on camera's lens, we might get inaccurate value from that. That is why we need to keep the equipment clean in order to get accurate value.

Conflicting Requirements:

A conflicting requirement occurs when a requirement is inconsistent with another requirement. We have got some conflicting requirements as well.

1. Everyone wants a low budget device that gives better performance and also durable. But it is hard to meet up with all the needs with in low budget.
2. As the Cow farmers are mostly Undereducated about technologies that's why it would be difficult to introduce with this new device and talk about its functionalities.

1.2.3 Specifications

In this segment we will be discussing about the requirements and specifications of our system and give an over view of the components that we have used in our prototype.

Table 1.2: Shows the system specifications, requirements, and components to be used.

System	System Requirement	Component	Specification	Description
IoT Based Cow health monitor and disease detection	Central processing Unit & Wi-Fi module	WeMos D1 Mini With ESP8266	Operating Voltage 3.3V Digital I/O Pins 11 Analog Input Pins 1(3.2V Max) Clock Speed 80/160MHz Flash 4M Bytes Size 34.2*25.6mm Weight 3g	Able to gather information from the sensors, process data and take decisions accordingly. Also, have Wi-Fi module built-in with it.
	Temperature & Relative Humidity Sensor	DHT11	Input Supply Voltage (VDC): 3.3 ~ 5 Supply Current (mA): measurement 0.3 mA, standby 60 uA Temperature Range (°C): 0 ~ 50 Temperature Measurement Error: ±2°C Humidity Measurement Range: 20% ~ 95% RH Humidity Measurement Error: ±5 % RH Output form: Digital Output Length: 28 mm Width: 13.5 mm Height: 7 mm Weight: 448.5 gm	To observe the temperature of cow and humidity of the atmosphere

	Heart rate sensor	Heart Rate & Pulse Sensor Module	Combination of a simple optical heart rate sensor with amplification and noise cancellation. Power: 3-5 V Diameter: 16 mm Magnification: 330	To measure pulse and heart rate of cow.
	Rumination sensor	Three Axis Accelerometer (MPU6050)	Input Supply Voltage (VDC): 3 ~ 5 Wide Temperature Range: − 40°C to +85°C X-Axis Sensitivity: 28.6 LSB/g Y-Axis Sensitivity: 31.2 LSB/g Z-Axis Sensitivity: 34.5 LSB/g Communication: I2C/IIC Protocol Length: 20 mm Width: 16 mm Weight: 0.01 gm	To measure the rumination rate of cow
	Power Source	Lipo Battery 2500 mA	Capacity: 330 mAh Weight: 190 gm Length: 72 mm Width: 34 mm Height: 17 mm Output Voltage (VDC): 11.1 Charge Rate: 1~ 3 C Maximum Charge Rate: 5 C	To supply power to the system
	IoT Analytics Platform	ThingSpeak	Displaying data in form of graphs and histograms	Analyzation of the data from IoT development kit
	OLED Display	OLED Display	Resolution: 128X64 Working temperature: -30-80 degrees Backlight: Blue Input Voltage: 3.3V-5V DC	To observe the output and parameters.

1.2.4 Technical and Non-Technical Consideration and Constraint in Design Process

While doing our project we faced some various types of situations and we have encountered them and tried to solve them. Even though some more problem may arise. Those problems are.

Technical Constraints:

- Wi-Fi sensor's working ability was interrupted due to a bad internet connection
- Error data was seen several times from sensors
- Existing data can be read twice because of the software employed for algorithm creation
- As our database values are well pre-defined, so a change in any conditional value would require to change in the database value as well

- The concession of cow health monitoring and disease detection might fall for not having enough data sets
- As we are using lithium battery, so over time the device will run out of charge. And we have to charge again to use the device.

Non-Technical Constraints:

- **Water-Related Damage:**

Since we are carrying out this project on a dairy farm, there is a great possibility that the electrical components will be affected by water. As a solution to this issue, we are going to cover the essential components with a bag that is impermeable.

- **Problems with the Server:**

It is not uncommon for the IoT analytic platform to be unresponsive during specific periods of the day. In addition, there is a possibility that the IoT analytics platform ThingSpeak will crash and become unable to connect to, the internet or website pages will stop loading for a certain period of time.

- **Interrupted Net Connection:**

The intermittent loss of internet connection is a widespread issue in our country. It is possible for the internet connection to be lost while data is being transferred to Thingspeak from the WIFI module. In addition to that, this could make it difficult to monitor related data in ThingSpeak.

1.2.5 Applicable Compliance, Standards, and Codes

Table 1.3: Applicable codes and Standards

Required Device/Technology	Standard/ Code Number	Definition	Solution that the code dictates
Internet of Things	IEEE 2413-2019	Concerns shared by IoT system stakeholders across different domains inspired the design framework definition (transportation, healthcare, Smart Grid, etc.). The shared concerns as a collection of architecture views are extended to create the body of the framework description, and a conceptual underpinning for the notion of things in the IoT is supplied.	According to the standard, by analyzing the viewpoints of IoT, body of the framework description is formed. We will use this standard while making our IoT based cow health monitoring and disease detection system.
Rechargeable battery	IEEE 1625-2008	This standard specifies design standards for the certification, quality, and dependability of rechargeable battery systems for multi-cell mobile computing devices.	This standard is used to improve the reliability of battery operation and user experience.
Wireless network	IEEE 802.11-2016	Technical corrections and clarifications to IEEE Std 802.11 for wireless local area networks as well as enhancements to the existing medium access control and physical layer functions are specified in this revision	This technology is used to connect devices wirelessly.
Transistor	IEEE 256-1963	This Standard recommends and describes methods of measurement of the important electrical characteristics of semiconductor diodes.	This standard is applied when assessing rumen pH status with MOSFET.

1.3 Systematic Overview/Summary of the Proposed Project

In Bangladesh cow plays a very huge role as a livestock product and maintains strong agricultural economy of Bangladesh. However, in current scenarios price hike of dairy goods and meats are happening rapidly. This is the result of less interested in dairy/cow farming. Also, there are some basic problems like breeding cattle, feeding, management and marketing became one of the barriers. To eliminate this problem, we have proposed this project. Our cow health monitoring device will help farmer in various way. This cow health monitoring device will tell the live condition of the cow from remote location. Also, this device will tell the probable diseases of the cow so that farmer can take precaution to prevent losses. As a result, this device will have good effect on countries economy and make more people grow interest in cow farming.

1.4 Conclusion

From the research and literature review we can see cow farming plays a vital role in our countries economy and its demand is increasing day by day. Therefore, in order to solve the problem of farmer and stakeholders we are introducing this cow health monitoring device in our FYDP (Final Year Design Project). Our device will ensure to trac the health parameters of the cow, and send those data to stakeholder by email or server. Also, it will detect the disease before had so that farmer can take proper steps before hand to take preventive steps. Thus, this device will save farmers time and money and will be able to make them some good profits.

Chapter 2: Project Design Approach

2.1 Introduction

Dairy cow farms and the production of milk in a sustainable manner are dependent on the physical and mental well-being of the animals housed there. However, it is quite challenging to keep tabs on the health of animals daily, especially on large farms where workers may not have the opportunity to personally examine animals and notice the earliest signs of illness. The health of a cow may be threatened if its behavior suddenly changes. Moreover, early discovery of these abnormalities in conjunction with prompt response aids in minimizing the formation of health problems, hence preventing the potential need for medical treatment, a decrease in milk supply, a reduction in fertility, culling, or even death.

2.2 Identify Multiple Design Approaches

I. IoT Based Cow health monitoring and disease detection
II. Cow Health monitoring by measuring Rumen pH in Ruminants.
III. Cow Health Monitoring and Early Disease Detection Based on Image Processing.

2.3 Describe Multiple Design Approach

1. IoT Based Cow health monitoring and disease detection

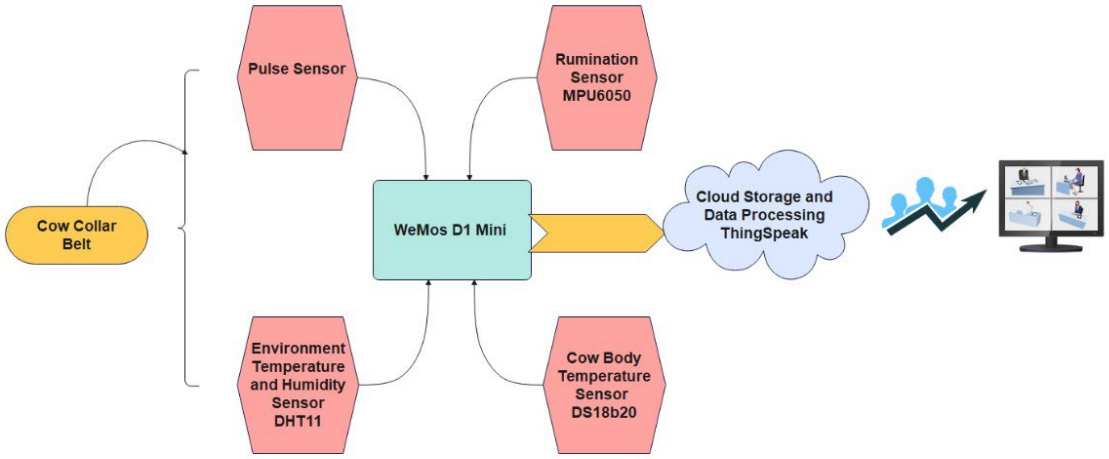


Figure 2.1: Block diagram of Approach 1

For this design approach, WeMos D1 Mini was selected as the main board. In addition, the environment temperature and humidity sensor DHT11, cow body temperature sensor DS18B20, the Rumination sensor MOU6050, and the heart rate Pulse sensor are connected with WeMos D1

Mini pins. Moreover, DHT11 has the capability of measuring both the temperature and the humidity of the environment and it will be placed in our prototype. Moreover, DS18B20 or body temperature sensor will place into the neck of the cow, and it will measure both the cow's body temperature. We employed an MPU6050 which is a three-axis accelerometer with high resolution to measure rumination rate, and it will be placed near the cow's jaw to monitor chewing movement. We will be using a Pulse sensor for measuring the cow's heart rate and it will be attached to the neck of the cow.

2. Cow Health monitoring by measuring Rumen pH in Ruminants:

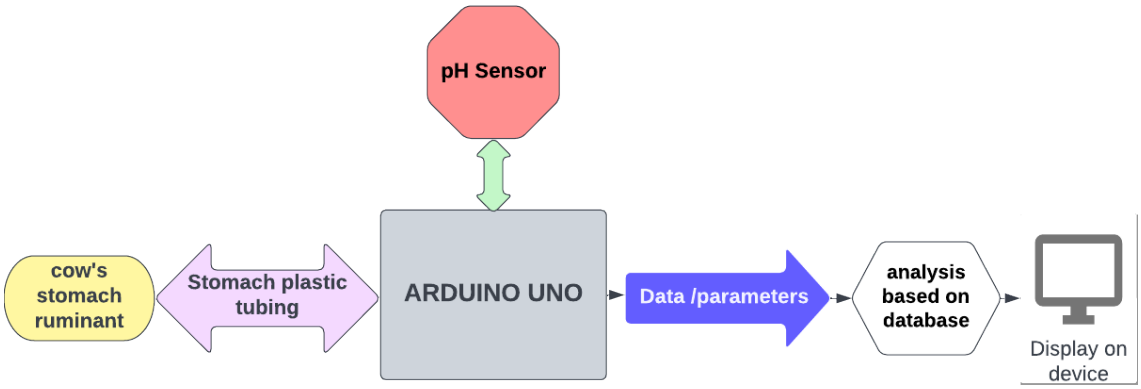


Figure 2.2: Block diagram of Approach 2

For this design, the Arduino Uno was selected as the main board. Additionally, the pins of the Arduino Uno are connected to the PH signal conversion board. Moreover, we have linked a PH sensor to a signal conversion board. The pH sensor is built out of glass and has the shape of a rod. At the bottom of the rod is a bulb that contains the sensor. A buffer solution with a known PH is contained within this membrane. This electrode design ensures that an environment is created on the interior of the glass membrane that has a continuous binding of hydrogen ions and other ions. The dipping of the probe into the solution to be tested causes hydrogen ions in the test solution to begin exchanging places with other positively charged ions on the glass membrane. This results in the creation of an electrochemical potential across the membrane, which is then fed to the electronic amplifier module, which measures the potential difference between the two electrodes and converts it to PH units. In addition, because the Arduino board did not have sufficient pins, we had to make use of an 8-bit input/output expander in order to connect the display. A pipe will also be used to put the glass membrane of the PH electrode into the rumen of the cow.

From there, we can determine the PH level of a cow's rumen. After conducting several surveys and performing some research, we decided to select three of the most prevalent diseases. Now, whenever the PH level matches a disease's datasheet, the corresponding led will light up, and we will be able to simply anticipate the diseases.

3. Cow Health Monitoring and Early Disease Detection Based on Image Processing.

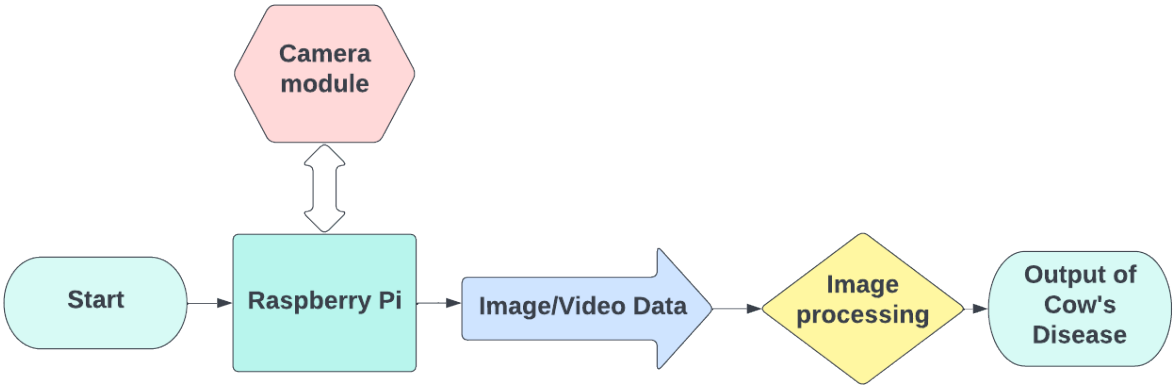


Figure 2.3: Block diagram of Approach 3

This design approach is based on the image processing method. In this approach, raspberry pi is selected as the main board. The raspberry pi RGB camera module will be connected to the raspberry pi board and from the image or video input from the RCB camera module we will be applying the image processing with help of raspberry pi. In the raspberry pi their python script for image processing is installed that way image processing is happening and output is shown in the display that is connected to the raspberry pi. Additionally, in image processing, we have used python script. Over there we used the TensorFlow library to train datasets and we used OpenCV to see the output from a given input image or video. Even though we did not get enough datasets from any source, so we manually collected some pictures from the internet and took some pictures in real to use in our data library and we analyzed them with help of TensorFlow. And through OpenCV, we get our desired output. With this approach, we can only detect cow surface problems. Such as skin disease or disease that is seeable. However, sometimes due to a pattern of the cow's color, image processing shows the wrong output.

2.4 Analysis of Multiple Design Approach

1. **IoT Based Cow health monitoring and disease detection:** In this approach Mainboard will be attached to the cow's neck by a collar and the whole system will be placed in a 3D-printed box. Moreover, Sensors will be placed in different parts of the cow body[4]. Sensors will monitor cow health in real-time and send collected data into the cloud.

   Here disease detection process is quite simple and as we are using multiple sensors and a single main board to measure health parameters in real-time it has more component efficiency. Furthermore, it has the lowest error rate since it comes after analyzing a lot of parameters and comparing them with the ideal health parameters of a cow to predict a specific disease and visualize them on the cloud server with graphs and a red light for the

indication of diseases. Here, we are using Thingspeak as the cloud server [5]. Moreover, it has the highest data accuracy. Furthermore, the components are available in the local market, and easy to build the whole prototype. As there is only one mainboard connected with some digital sensors. The collected data from the digital sensors would send to the cloud server in a form of a graph. Users don't need to monitor all day long to check their cow's health condition as data will be saved there in a real-time manner so no hassle to maintain all day long. Furthermore, it costs much less than other approaches.

2. **Cow Health monitoring by measuring Rumen pH in Ruminants:** In this approach, a PH sensor will be inserted in the cow's ruminant to measure the cow rumen PH. And based on the PH we will anticipate cow disease.

   Here, the disease detection process is quite more complex than before as we have to put a pipe in the cow's rumen to measure the PH level. Here, we use a single sensor for measuring rumen pH along with a single Arduino Uno board to detect diseases related to rumen pH, so component efficiency is less [6]. Furthermore, it has a moderate error rate as it only predicts disease on specific health parameters that too even by injecting a plastic tube which might damage the internal organ. Moreover, the components are available but hard to build the prototype as there should arise a concerning issue for the quality of the pipe which will be injected into cow's ruminant through its mouth. As the pH of the cow is measured by inserting a pipe, the pipe must be replaced after each measurement. Moreover, we have to reorganize the entire system
   again. Therefore, maintenance is somewhat complicated. Additionally, it cost more than the first approach but less than the third approach.

3. **Cow Health Monitoring and Early Disease Detection Based on Image Processing:** In this approach camera sensor module is used to detect diseases and its based-on image processing.

   Here, the disease detection process is quite complex as image processing has to analyze thousands of pictures. Moreover, it has the highest error rate since it requires thousands of pictures to be added to the database so that those can be compared with the photos of cows that are taken by cameras, which can also provide faulty pictures as cows can get scratched to their body with millions of reasons [7]. Furthermore, here we must ensure electricity 24/7 for our system to keep running and, we have to use a high-resolution camera, so the operating cost is much higher than another approach. Moreover, we have to constantly ensure that the cows are positioned inside the camera's optimal viewing distance. Additionally, we must provide sufficient storage capacity. Therefore, maintainability is the most complex of the three designs. Additionally, it cost more than all the other approaches.

After the analysis, we selected Approach 01 as our optimal solution. Here's the SWOT analysis of the optimal solution:

With the help of SWOT analysis, we will be observing the sustainability of our project.

SWOT Analysis

	Beneficial	Harmful
Internal	**Strength** • Reliable and Durable product • Its saves time of farmers • Gives constant update of cow's health status • Low power consumption • Portable and light in weight • User friendly	**Weakness** • It is hard to educate/ introduce people with new products. • Product might get faulty due to over usage. • There is a great possibility that the electrical components will be affected by water.
External	**Opportunity** • As in the Bangladesh market these products are new, thus there are no competitors. • As Bangladesh is getting digitalized and lots of tasks are done through technology this will attract lots of potential customers.	**Threats** • There is a foreign product that can easily enter Bangladesh's market. • As a new product people might not show interest. • In the beginning this product might be complex for some extent users.

A weighted average of each activity of the SWOT Analysis is given below:

	Activity	Rating	Weight	Weighted Score	Short Term	Intermediate Term	Long Term
S1	Reliable and durable at a low cost	3	0.10	0.30			✓
S2	Saves time	5	0.16	0.80		✓	
S3	Constantly gives update	5	0.03	0.15			✓
S4	Low power consumption	5	0.05	0.25		✓	
S5	Portable and light in weight	5	0.08	0.40	✓		
S6	User friendly	5	0.03	0.15		✓	
O1	New products in the market	5	0.12	0.60			✓
O2	Can get customers easily	2	0.06	0.12		✓	
W1	Labor might be needed	3	0.03	0.09	✓		
W2	Expensive	3	0.03	0.09		✓	
W3	Introduce people to new product	4	0.03	0.12	✓		
W4	Faulty due to over usage	5	0.08	0.40	✓		
T1	Foreign competitor	5	0.08	0.40			✓
T2	A new product may not interest people	3	0.07	0.21	✓		
T3	Time to adjust	2	0.05	0.10		✓	
Total Score		60	1	4.18			

Here, from S1 to S6 row is for strengths, O1 to O2 row is for opportunities, W1 to W2 row is for weaknesses, and the T1 to T4 row is for threats. After discussing among ourselves and doing some

research, we have come up with the rating, weight, and weighted score. Here, the total sum of the rating is 60, the weight is 1 and the weighted score is 4.18. As the weighted score of strengths(S1-S6), and opportunities (O1-O2) are more than the summation of weaknesses (W1-W4) and threats (T1-T3) our project is sustainable.

2.5 Conclusion

The analysis of the three methods revealed that, despite functional differences, they are all well-structured. In addition, they have different ways of finding diseases. IoT-based cow health monitoring is mostly based on data from different sensors, while the second method is based on the pH of the rumen, and the third method is based on collecting images [8]. In spite of the fact that each of their methods is unique, they are all successful in diagnosing the same diseases. Different times are needed to complete disease detection using each of the three methods because of differences in their functionality and equipment.

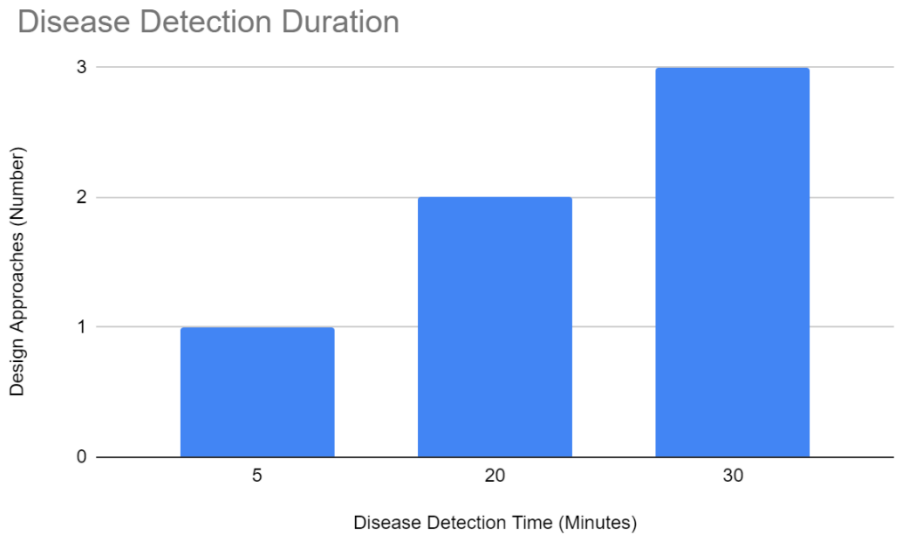


Figure 2.4: Estimated duration to detect diseases in three approaches.

Moreover, here we can see our optimal approach or approach 01 takes less time or an average of 5 minutes to measure disease. However, Design approach 2 and 3 take more time as their functionality is much more complex than approach 01.

Chapter 3: Use of Modern Engineering and IT Tool

3.1 Introduction

Although modern engineering is a part of technology. It is also an area of interest with the advancement and development of modern and useful technological systems along with their product's effectiveness and appropriateness. However, methods that are not related to the technical part are a big concern. Multiple modern engineering tools have been implemented in our project to get the best possible solution [9]. Firstly, we went through an enormous learning effort to learn how these tools are used, then analyzed those to comprehend topics in relevant courses, and then finally applied them to develop, design, implement, and demonstrate for individual work. This thorough process allowed us to get proper knowledge of selection tools. Proper explanations of each tool we have used are given here.

3.2 Select Appropriate Engineering and IT Tools

To complete or do any engineering complex problem first, one needs to research thoroughly and examine the selected criteria to select the appropriate modern engineering tools. Similarly, we have gone through some thorough research and examined certain criteria related to our project to meet the appropriate modern engineering tools. As a result, we have found some topnotch engineering that will be used for our complex engineering project's hardware and software purpose.

Hardware

WeMos D1 Mini

The major component for our project "Cow Health Monitoring and Disease Detection" is WeMos D1 Mini – ESP8266-based WiFi module. We have selected this as our main board. The programming language it requires is C++. It has a built-in WiFi module that passes all the collected data from the sensors to the cloud server ThingSpeak. The most beneficial part of this board is it has a memory storage of 16MB whereas Arduino Uno has a memory storage of only 32KB [10]. Another advantage is that it has a built-in WiFi module that didn't make us buy another WiFi module, which eventually helped minimize the cost.

DHT11

DHT11 is a temperature and humidity measurement sensor. We have used this sensor to measure the environment temperature and relative environment humidity. This sensor has the ability to measure temperature between 0°C to 50°C and it can measure humidity from 20% to 90% where the accuracy is ±1°C and ±1%. DHT11 sensor has an NTC which can measure temperature and it is an 8-bit microcontroller where the output of temperature and humidity comes as serial data.

DSB18B20

We used a waterproof digital temperature thermal probe sensor to measure a cow's body temperature. This sensor is effective in wet conditions and as cows can seat in wet spaces that's why we have decided to use this digital temperature thermal probe to get the accurate temperature from a cow's body.

Pulse Sensor

This pulse sensor is used to measure the heart rate of cows. This sensor provides real-time heart rate data. The most important part of this sensor is that it is very small and easily clips onto the fingertip or earlobe.

MPU6050

This 3 – axis accelerometer sensor is used to measure the rumination rate of cows. This sensor can detect motion along all three axes.

OLED

To display the value that we get from sensors, we used an OLED panel because of its usefulness and cleanliness.

Lithium-ion Battery 2500 mah:

We have used a 2500 mah battery to keep on our device on. The reason for choosing this battery is because of its longer durability and it is cheaper compared to other batteries. The major benefit of this battery is it is highly portable and for our project, we have made a type-c port to charge up the battery.

Software

Fusion 360

This is an online 3d modeling and CAD program software that is free to use for all users. The usability of this software is very easy and adaptable. For our project, we wanted to put everything inside a box and because of this purpose we first came to an agreement that we would make a 3D-printed box and all our equipment will be inside that box. So, we chose this Fusion 360 software to design our 3D box.

Proteus

When it comes to electronic design automation, the Proteus Design Suite stands out as a must-have set of proprietary software tools. Electronic design experts and technicians use the program to make circuit boards and other electronic components from scratch using schematics and electronic prints created in the program. It has in-built assembly compilers of 8051, AVR, PIC, etc., allowing you to compile your microcontroller's assembly language and edit it, as well as

simulate it at the source level. However, the circuit's data calculation is inadequate, therefore it has its limitations. We have decided to use this Proteus program for our project simulation because it's the most compatible option available to us.

Coding

Arduino IDE

Our main board "WeMos D1 Mini" assembles with the Arduino IDE software for coding. All the necessary and relevant coding for our project is written on this Arduino IDE to successfully run each sensor.

3.3 Use of Modern Engineering and IT Tools

We have used Proteus Simulation Software for our project simulation. The following table represents the software comparison that we analyzed in our previous semester –

Table 3.1: Software comparison.

Name of Software	Portability	System Requirements	Resources Import	Expense	Issue of Crashes	Graphs	Naming of equipment	Resources of Library
LabVIEW	Yes	Moderate	Yes	High	No	Yes	Yes	High
Sci-Lab	No	Low	No	None	No	Yes	Yes	Moderate
Proteus	Yes	Moderate	Yes	High	Yes	Yes	Yes	High
Tinkercad	No	Moderate	Yes	None	No	No	Yes	Moderate
MATLAB	No	High	No	High	Yes	Yes	Yes	Moderate
PSpice	No	Moderate	No	High	Yes	No	Yes	Low

Here, after analyzing the table it is clearly visible that the proteus simulation software has the most available resource and its online forums are also very user friendly which made it easier to use appropriately.

3.4 Conclusion

To conclude, we have gone through a lot of research papers to get an idea for selecting the appropriate tools. Thorough research helped us to select the best modern engineering tools to complete our project “Cow Health Monitoring and Disease Detection”.

Chapter 4: Optimization of Multiple Design and Finding the Optimal Solution

4.1 Introduction

For our Cow health Monitoring and Disease Detection project we have chosen three different approaches. Moreover, we have chosen few criteria to find the best design approach. Furthermore, finding the most ideal recommended design that would meet our wants, demands, and specifications was our main goal.

4.2 Optimization of Multiple Design Approach

To optimize the various design techniques used here, we went through several test scenarios.

Design Approach 1: IoT Based Cow health monitoring and disease detection

In the first approach, we affixed an ADXL345, heart rate generator and a DHT11 sensor to Arduino Nano board. As there is no built-in library for ADXL345, we used a variable potentiometer and pulse width modulation for the heart rate generator. In addition, by using Serial Communication process we send our data to Thingspeak with the help of ESP8266 module. In serial communication, data transmission takes place when information is sent one bit at a time in a predetermined order through a communication channel. The rumination rate, humidity, heart rate, and temperature are all displayed in the form of graphs in the thingspeak channel, and these graphs are updated in real time. Consequently, whenever parameters match our data sheet, certain button in thingspeak goes red to show particular disease.

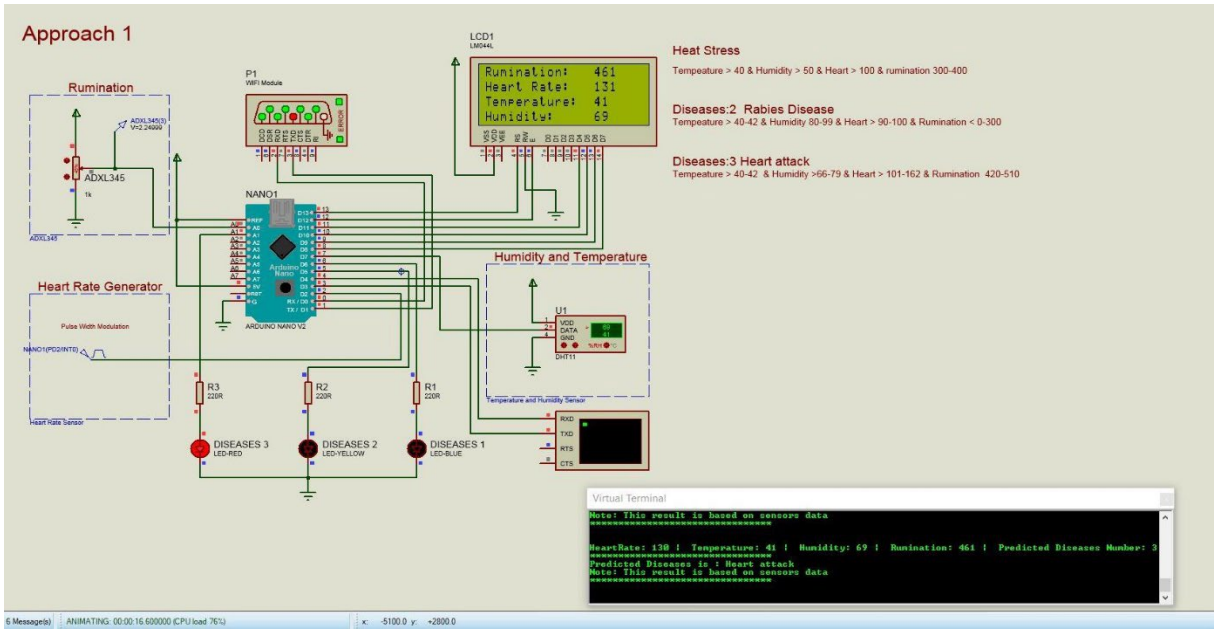


Figure 4.1: Monitoring cow health and detecting Heart Attack disease

Data Sheets for test cases:

Table 4.1: Datasets for cow disease parameter.

Diseases	Parameters			
	Temperature (℃)	Humidity (%)	BPM	Rumination rate (min/day)
Heat Stress	>40 ℃	50%	>100	300-400
Rabies	40°- 42° C	80% - 99%	90-100	< 300
Heart Attack	40°- 42° C	66%-79%	101-162	420-510

Moreover, we have come up with this parameter after going through many research papers and after consult a veterinarian, Dr. MD. Boyzar Rahman. Though we did three test cases in our last semester through proteus, we are only showing one test case for the optimization of design approach 01. Furthermore, after analyzing the market and different test case scenarios we have changed some of our components. We have used MPU6050 instead of ADXL345, WeMos D1 mini-Pro instead of Arduino Nano, DS18B20 sensor to measure cow's body temperature and OLED Display instead of LCD to display result.

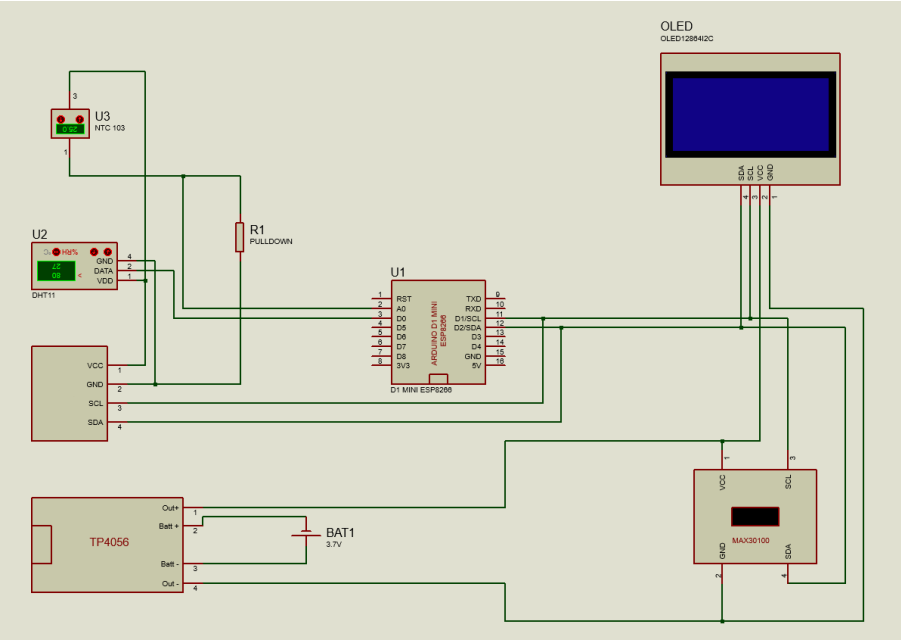


Figure 4.2: Schematic Diagram of Design approach 1 (after changing the components)

ThingSpeak Output:

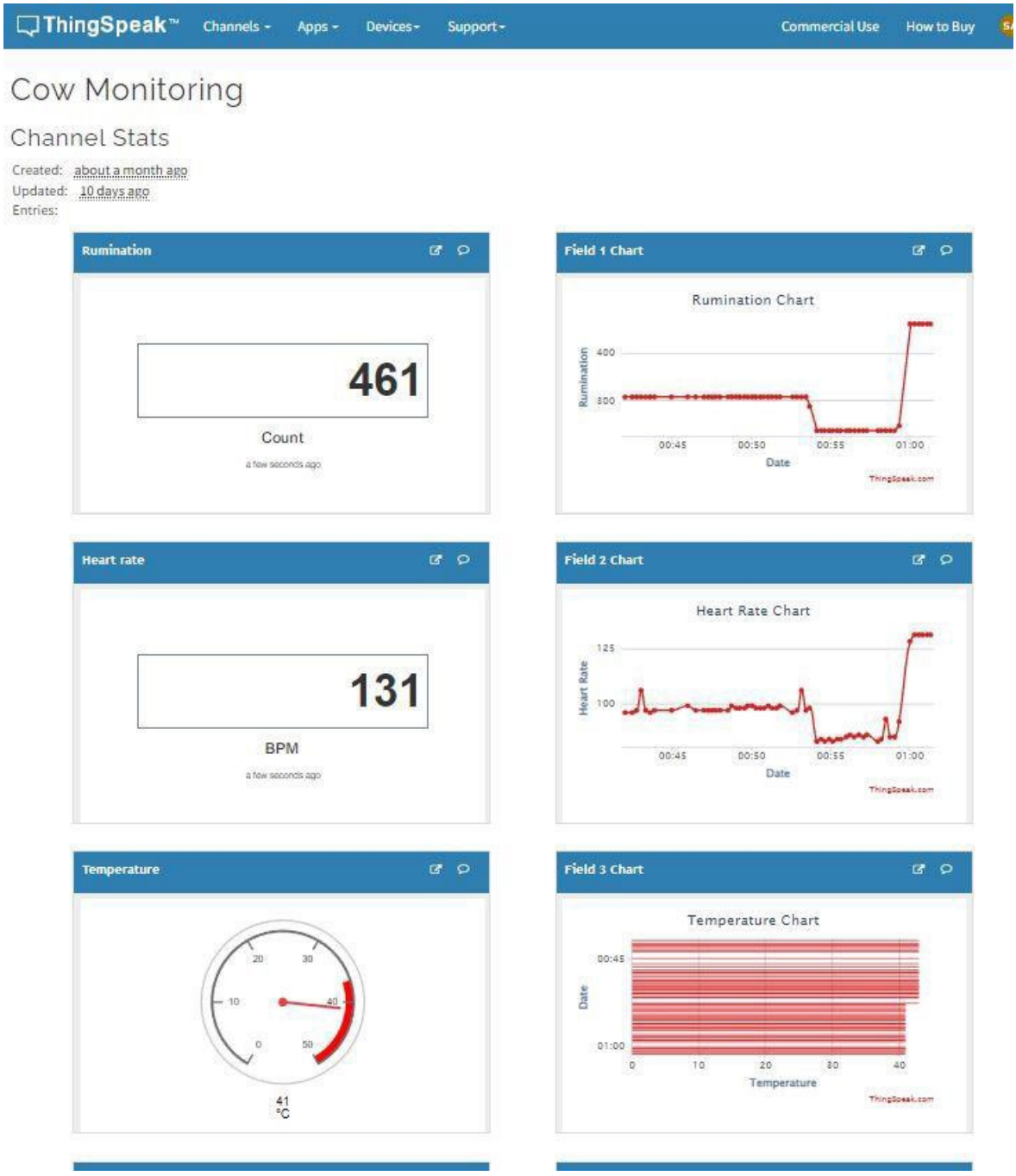


Figure 4.3: Parameters and Graphs of cow health monitoring.

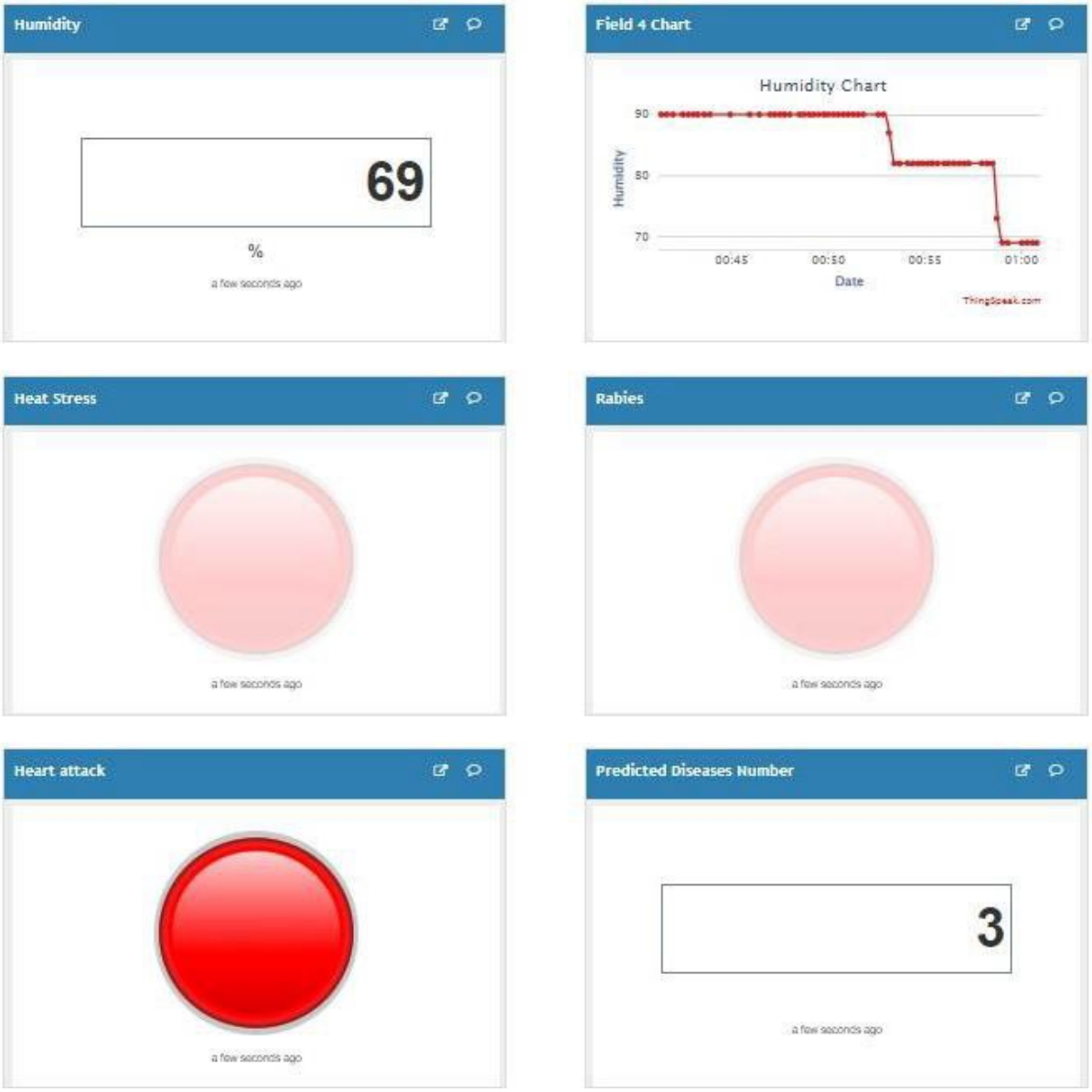


Figure 4.4: Heart Attack detection in ThingSpeak.

Design Approach 2: Cow Health monitoring by measuring Rumen pH in Ruminants.

Our design 2 is about Cow Health monitoring by measuring Rumen pH in Ruminants. To execute this approach, we have used proteus to simulate our approach. In Proetus we have used, Arduino UNO and with Arduino Uno we have connected with pH sensor in order to get value of cow's ruminant pH we have installed pH sensor library from online. We have calibrated the founded data of the healthy cow parameters and diseased cow parameters. And coded those parameters condition in the Arduino. Also, there is a LED monitor is attached with the Arduino UNO to see the values we are getting from pH sensor. As we have set two kinds of disease for this approach, so we used three kinds of LED (Yellow, Red, Green). When green Led lights up it gives us indication of that the cow is healthy. And when yellow light lights up it give us indication of rabies disease. And when the red light lights up it gives us the indication of the heat stress.

Test case 1: For Rabies disease condition

When, pH is less than 6.00

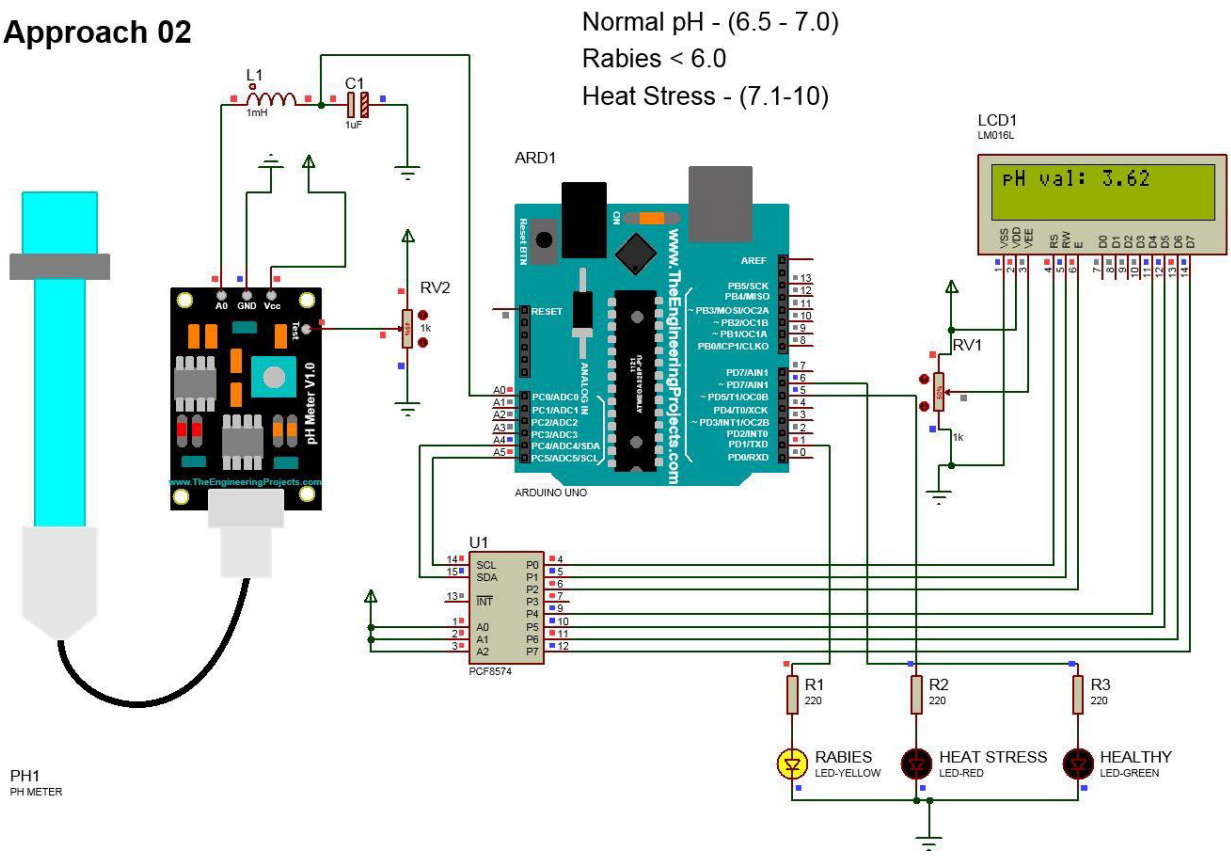


Figure 4.5: Monitoring Rabies disease by pH parameter

Here, as the pH is less than 6 which is the parameters of the Rabies therefore yellow light lights up to indicate the farmer that cow has reached the parameters of Rabies.

Test case 2: For healthy cow condition

When, pH is in between (6.5 - 7.00)

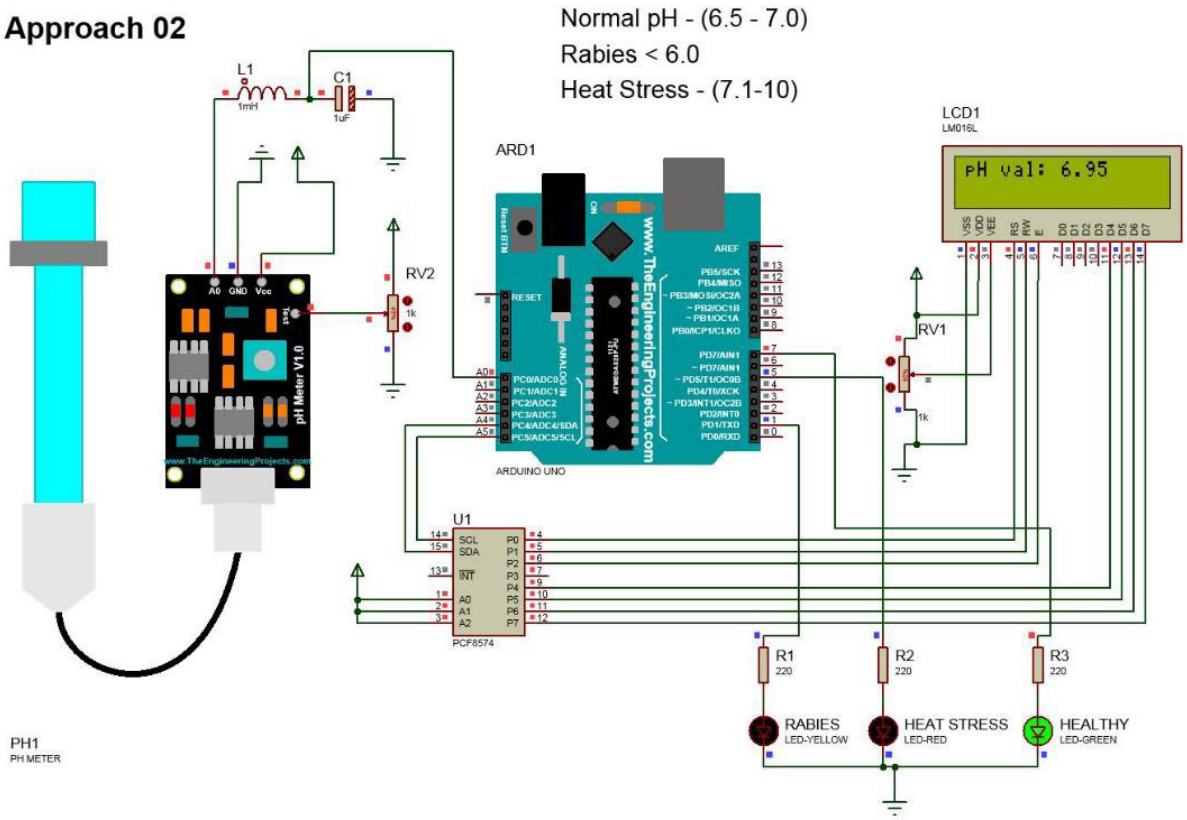


Figure 4.6: Monitoring healthy cow by pH parameter

Here, as the pH is in between (6.5 - 7.00) which is the parameters of the healthy cow. Therefore, the green light lights up to indicate the farmer that cow is healthy.

Design Approach 3: Cow Health Monitoring and Early Disease Detection Based on Image Processing.

Our design approach 3 is cow health monitoring by image processing. In this approach, we are going to use RGB camera module with Raspberry pi. We are going to install python script in raspberry pi. When raspberry pi is going to take picture or videos with its camera module then process the image data and give output to an attached screen [11].
For this approaches simulation we only did software part that is we only build python script. After giving a picture as an input it will tell the disease of the cow.

Test case 1: For Healthy cow condition

Give a picture of a healthy cow as input,

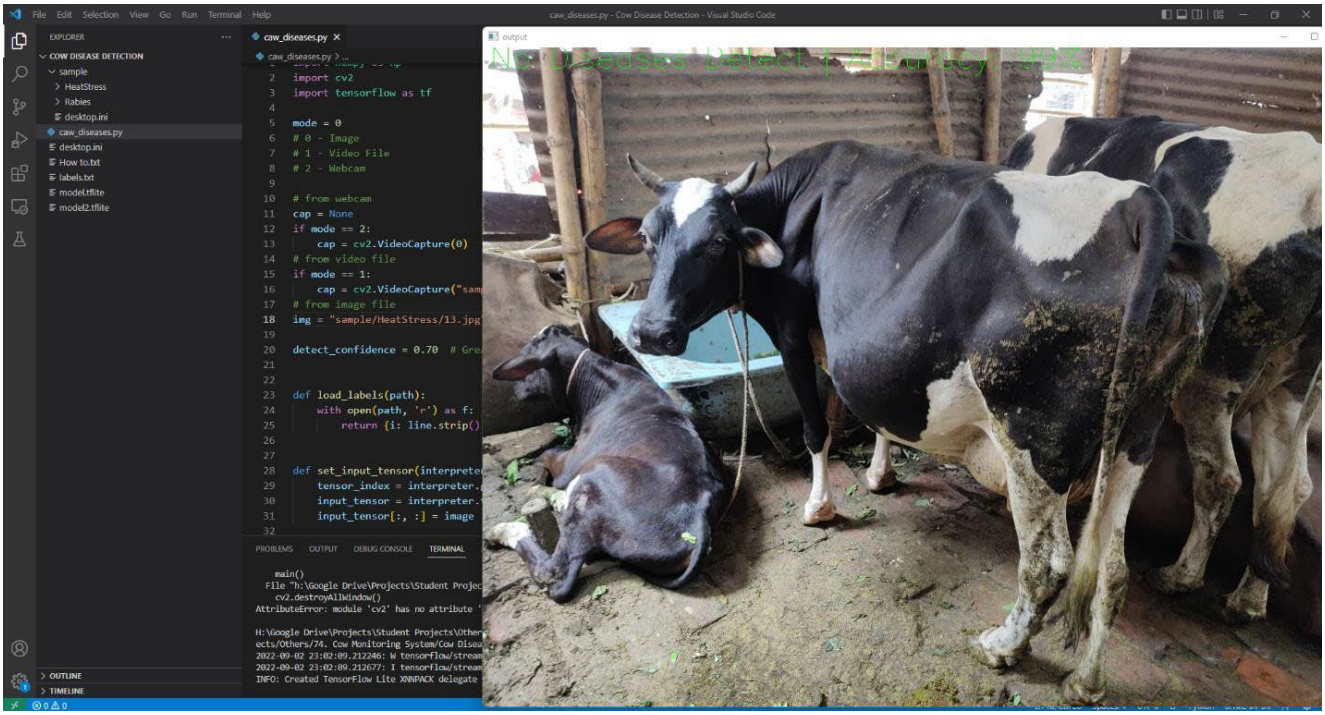


Figure 4.7: Showing healthy cow output by using image processing.

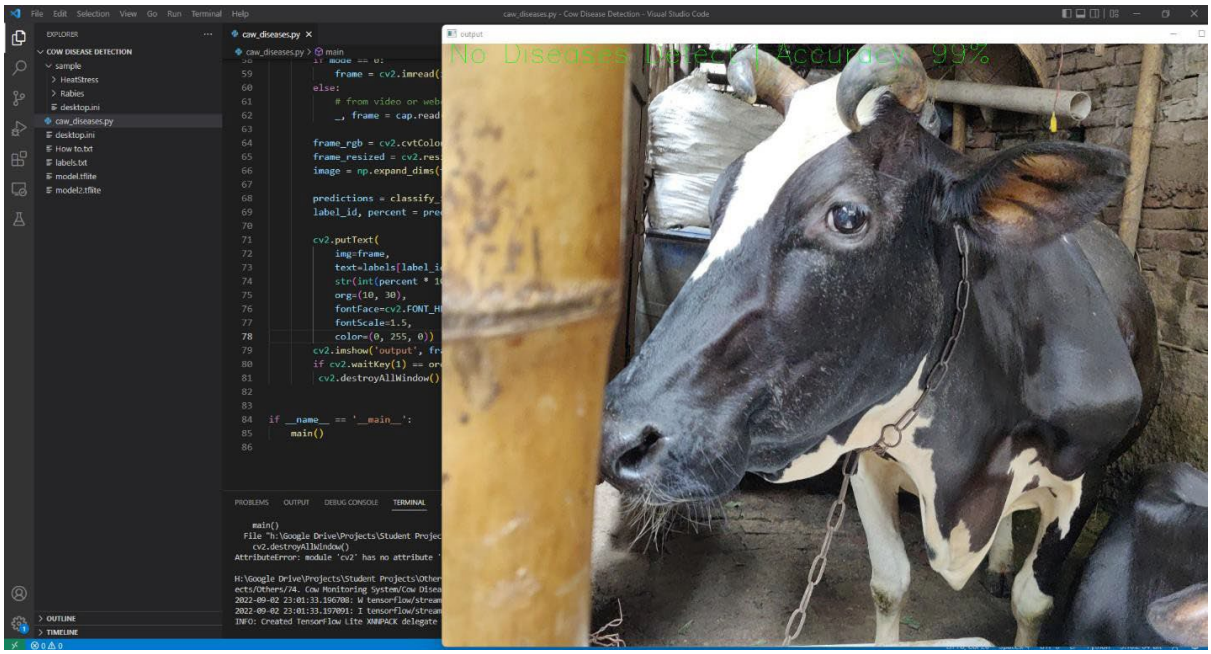


Figure 4.8: Showing healthy cow output by using image processing.

Test Case 2: For Rabies diseased cow condition

```python
import numpy as np
import cv2
import tensorflow as tf

mode = 0
# 0 - Image
# 1 - Video File
# 2 - Webcam

# from webcam
cap = None
if mode == 2:
    cap = cv2.VideoCapture(0)
# from video file
if mode == 1:
    cap = cv2.VideoCapture("samples/video.mp4")
# from image file
img = "sample/HeatStress/5.jpg"

detect_confidence = 0.70  # Greater than 70%


def load_labels(path):
    with open(path, 'r') as f:
        return {i: line.strip() for i, line in enumerate(f.readlines())}


def set_input_tensor(interpreter, image):
    tensor_index = interpreter.get_input_details()[0]['index']
    input_tensor = interpreter.tensor(tensor_index)()[0]
    input_tensor[:, :] = image


def classify_image(interpreter, image, top_k=1):
    set_input_tensor(interpreter, image)
    interpreter.invoke()
    output_details = interpreter.get_output_details()[0]
```

Figure 4.9: Showing Rabies diseased cow output by using image processing.

We have given a Rabies Diseased cow photo as input, and as an output, we are showing that the cow is attacked with Rabies disease using our image processing method.

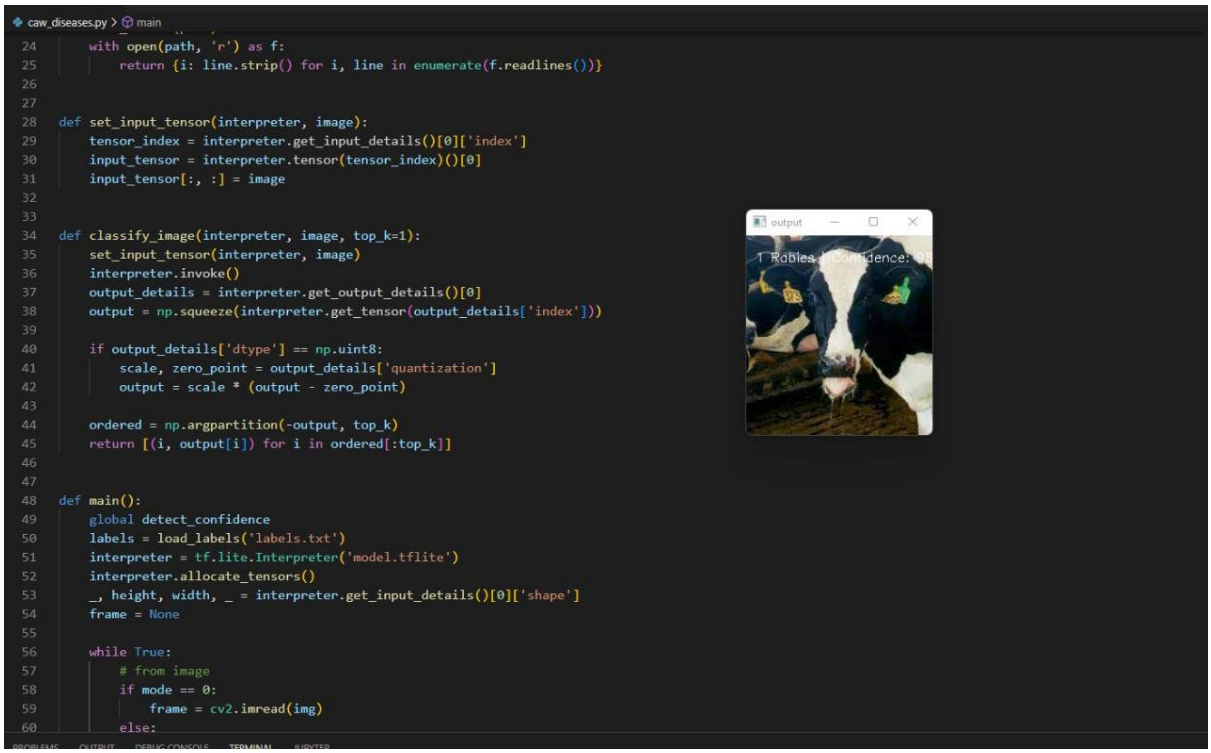


Figure 4.10: Showing Rabies diseased cow output by using image processing.

Test Case 3: For heat-stress diseased cow condition

We have given a Heat-Stress Diseased cow photo as input, and as an output, we are showing that the cow is attacked with Heat-Stress disease using our image processing method

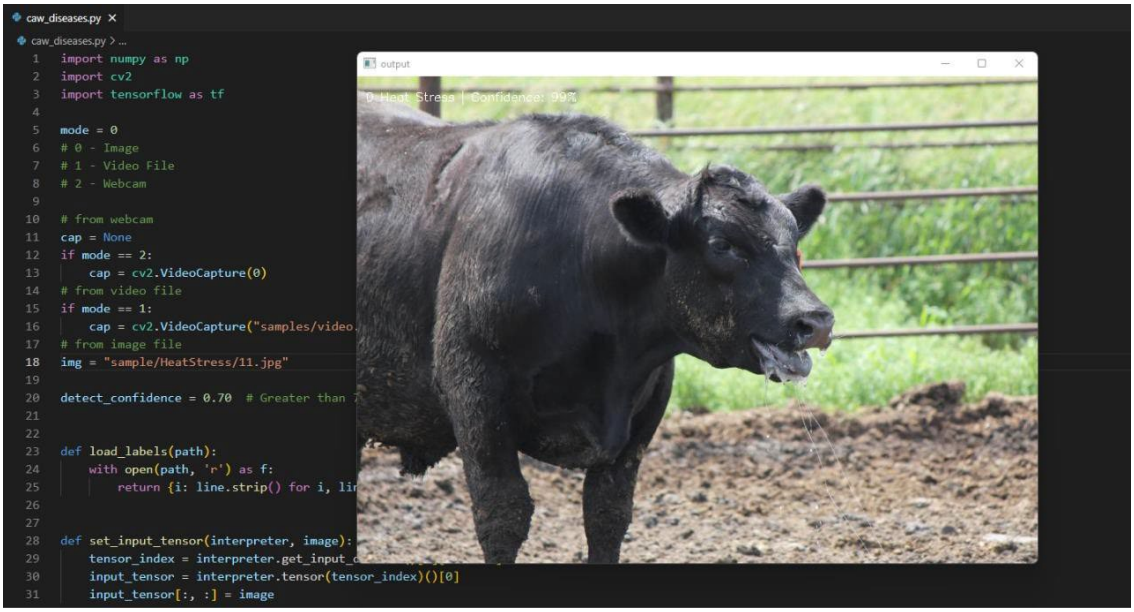


Figure 4.11: Showing Heat-Stress diseased cow output by using image processing

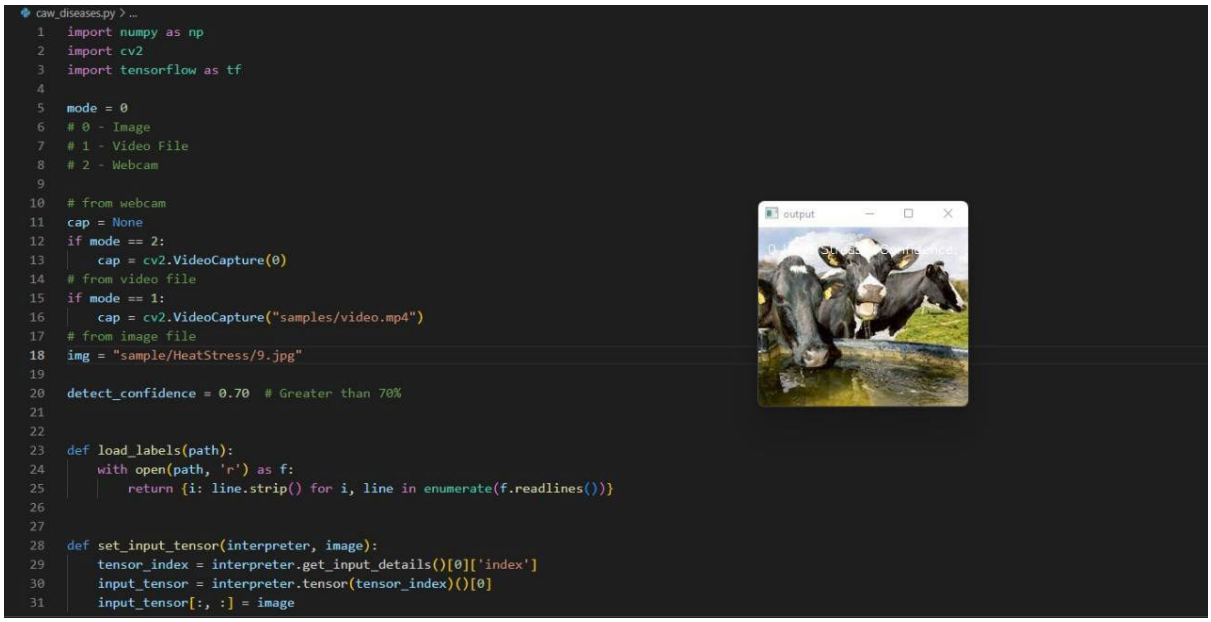


Figure 4.12: Showing Heat-Stress diseased cow output by using image processing.

In this approach we have determined two kinds of disease and healthy cow condition. Those disease are Heat-Stress and rabies. We have built the library by using TensorFlow. As there was no previous library for cow health monitoring, we have to make it. Due to short of diseased cow images we could not make a strong library. But in terms of the healthy cow, we were able to get pictures and make library easily. To get the proper output we have use OpenCV.

In our case 1 we have determined healthy cow condition which is 99% accuracy. In case 2, we have determined Rabies diseased Cow and in case 3 we have determined Heat-Stressed diseased cow. And the accuracy is low for both case 2 and 3. To get e accurate outcome we have to run the process for multiple times.

4.3 Identification of the Optimal Design Approach

For our project's design methods, we have chosen a variety of criteria taking into account factors like cost, efficiency, usability, manufacturability, impact, sustainability, maintainability, etc. Moreover, we have compared these criteria and found out our optimal design approach among the three.

Table 4.2: optimal design solution.

	Design 1	Design 2	Design 3
Component Efficiency	Uses multiple sensors and a single Wemos D1 Mini pro board to measure health parameters in real-time	Uses a single sensor for measuring rumen pH along with a single Arduino (Uno) board to detect diseases related to rumen pH	Uses camera sensor modules to detect diseases based on image processing
Data Accuracy	Lowest error rate since it comes after analyzing a lot of parameters and comparing them with the ideal health parameters of a cow to predict a specific disease and visualize them on the cloud server with graphs and a red light for the indication of diseases	Moderate error rate as it only predicts disease upon specific health parameters that too even by injecting a plastic tube which might damage the internal organ	It has the highest error rate since it requires thousands of pictures to be added to the database so that those can be compared with the taking photos of cows by the cameras, which can provide faulty pictures as cows can get scratches to their body with millions of reasons
Manufacturability	The components are available in the local market and easy to build the whole prototype. In addition, data can be visualized on the cloud server easily.	The components are available but hard to build the prototype as there should arise a concerning issue for the quality of the pipe which will be injected into cow's ruminant through its mouth.	This is based on image processing where cameras should be with high resolution
Maintainability	There is only one WeMos D1 Mini pro board connected with some digital sensors. The collected data from the digital sensors would send to the cloud server in a form of a graph. Users don't need to monitor all day long to check their cow's health condition as data will be saved there in a real-time manner so no hassle to maintain all day long	As the pH of the cow is measured by inserting a pipe, the pipe must be replaced after each measurement. Moreover, we have to reorganize the entire system again. Therefore, maintenance is somewhat complicated.	When using the third design, we must constantly check that the cows are positioned inside the camera's optimal viewing distance. Additionally, we must provide an uninterrupted supply of electricity and sufficient storage capacity. Therefore, maintainability is the most complex of the three designs.
Usability	Everything will be stored on the cloud server and can be accessed in real-time and the	As we have to enter a pipe into the rumen of a cow, we must do it safely. Moreover,	For our third design, the image processing process may be interrupted due to a

	projected disease will be notified by the red light going on when the health metrics surpass the standard value. Therefore, it is quite easy for the user to monitor their cows.	we may require the assistance of a veterinarian during insertion. Therefore, usability is pretty complex.	system or camera fault, so the process must be monitored by an experienced technician. Furthermore, an uninterrupted internet connection is required for image processing to function properly.
Budget	7900	11435	39440

After analyzing the comparison, we have decided to select design approach 1 as our optimal design solution.

4.4 Performance Evaluation of Developed Solution

Some changes were done in the hardware section for the implementation of the optimal design solution as we came to know some other alternative devices which would be a better replacement for those used sensors compared to performance, cost, and other key factors.

4.4.1 Implementation of the Selected Design Solution

In our selected design approach, we have made some changes of components. Moreover, In our optimal design solution, we found out that design approach 1 gives us a more accurate result than the other two approaches. In our design approach1, we have used “Arduino Nano” as our main board. However, later after researching more on the internet and on the field search as well we found a better replacement for “Arduino Nano” which is the “WeMos D1 Mini”. In our hardware implementation, we have used WeMos D1 Mini because it comes with an ESP8266 Wi-Fi module which is an extra advantage of this kit because we did not have to buy a Wi-Fi module to share our data in the cloud server.

The comparison of the major two boards is:

Table 4.3: Comparison between Arduino Nano and WeMos D1 Mini

		Arduino Nano	**WeMos D1 Mini**
General	Dimension (mm) L x W x H	45 x 18 x 5	9 x 7 x 2
	Price	730	440
Computing	Microcontroller	Atmega328	Tensilica LX106
	Clock Speed	16 MHz	160 MHz
	Flash Memory	32 KB	96 KB
	SRAM	2 KB	64 KB
Additional Feature	Wi-Fi	No	ESP8266

Moreover, previously we have used "ADXL345" and in our hardware design "MPU6050" because this sensor comes with a "Digital Motion Processor (DMP)" which would give more accuracy as cows' motion and 3-axis movement both will be collected when they ruminate. Furthermore, we have use OLED display instead of LED display which keeps us more accurate visual experience and also small in size. Furthermore, for OLED display interface type is I2C and for LCD interface type is I2C. Additionally, OLED display consumes less voltage than LCD, OLED consumes 3.3 volts and LCD consumes 5 Volts. So, we selected OLED display.

4.5 Performing Tests of the Implemented Solution

We have implemented our design in a PCB and then covered the whole prototype with a 3D printed white box.

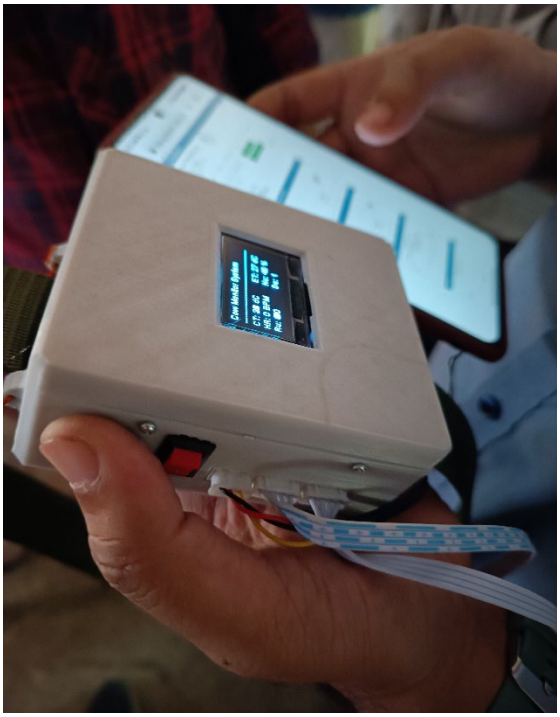


Figure 4.13: Cow Health Monitoring Device

After building our final prototype we have gone to “Partex” group cow farm near BRAC University. We wanted to make more tests to make our result more accurate, but they did not give us the permission to test more on cows’ body due to their time limitation as we had taken 30 to 35 minutes to test our validity on each cow to get the most accurate result.

Figure 4.14: Cow wearing our device

Figure 4.15: Output in the Display

4.5.1 Evaluating the Performance of the Implemented Solution

We were able to make the validation test on seven cows. Performing the validation test on seven cows' it was found that five cows are healthy, and no disease was predicted. However, there were two sick cows, and their health parameter exceeds the healthy cow parameter and disease was predicted. From the test result, cow 3 was suffering with "Rabies" disease as the health parameter matches with this specific disease. Again, cow 6 was suffering with "Heat Stress" disease. All the disease were just an assumption that a cow might facing.

We also can anticipate the cow health by the graph and data that we collected from the thingspeak.

Thingspeak output for Cow 1:

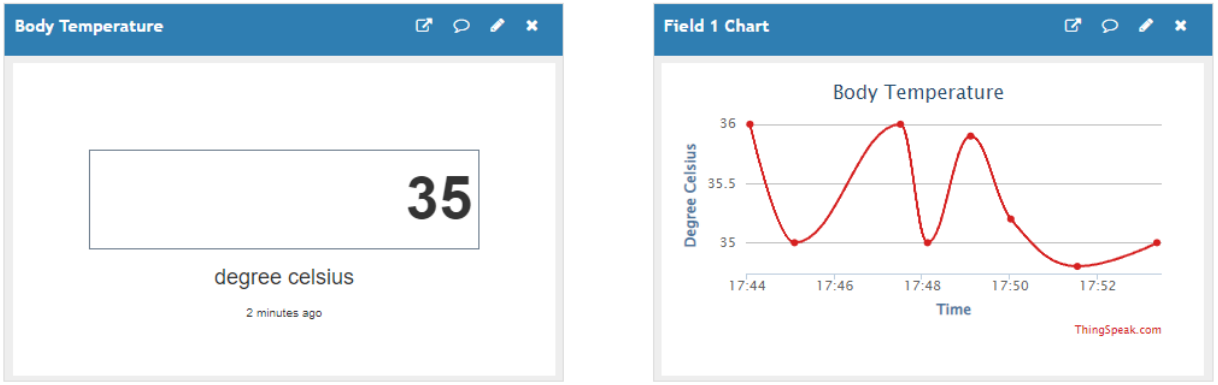


Figure 4.16: Body Temperature of Cow 1

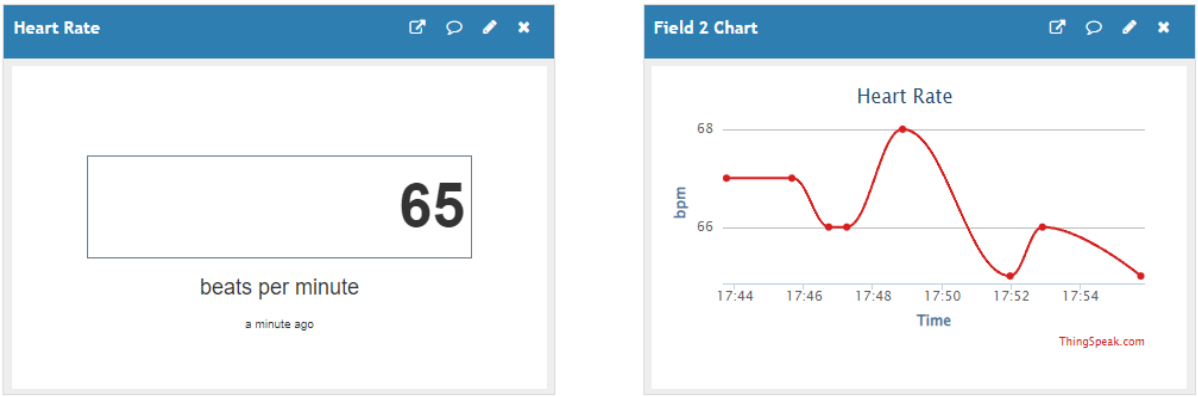


Figure 4.17: Heart Rate of Cow 1

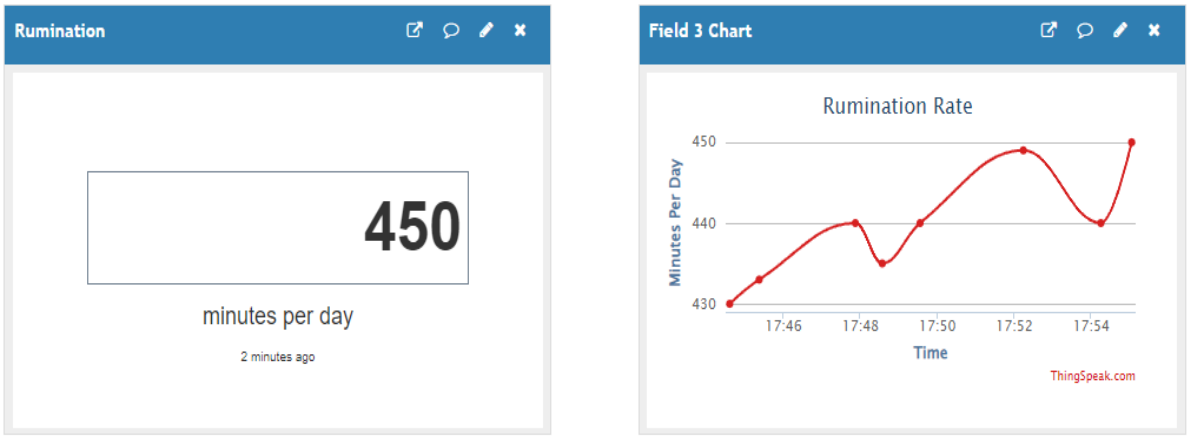


Figure 4.18: Rumination rate of Cow 1

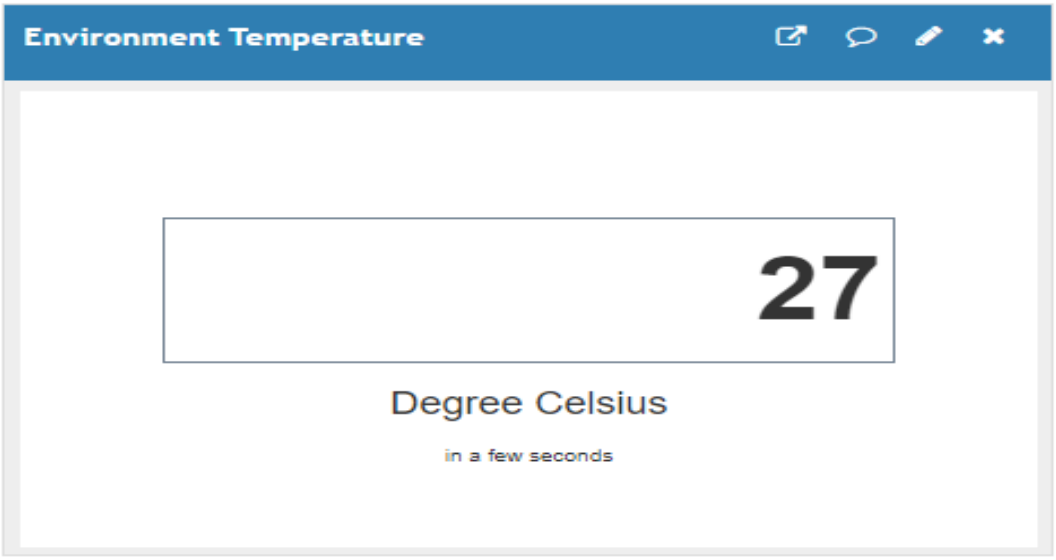


Figure 4.19: Environment Temperature

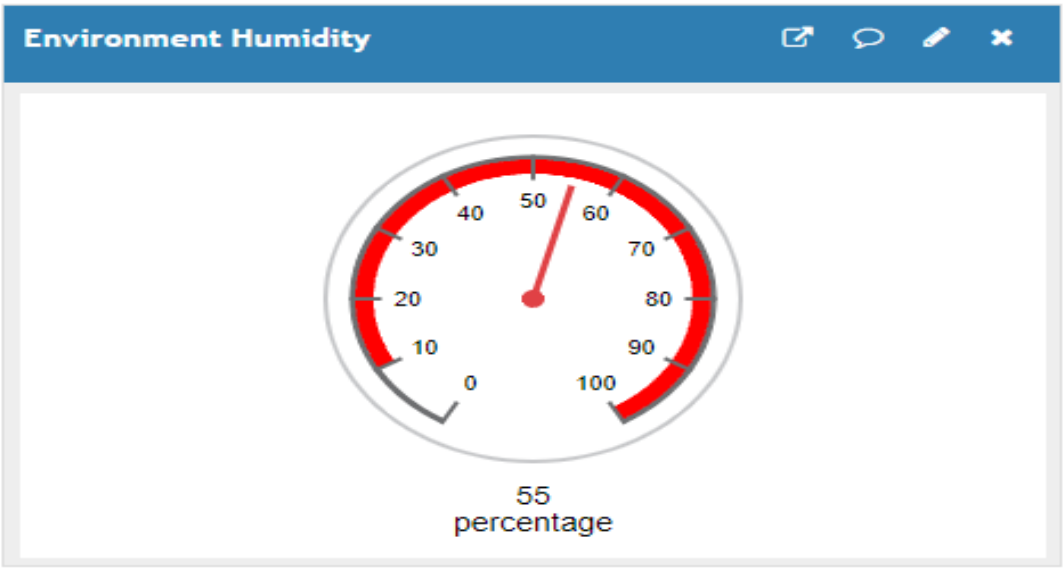


Figure 4.20: Environment Humidity

Moreover, after testing 7 cows we found out that,

Table 4.4: Health monitoring of Seven cows.

Sample Test	Temperature (°C)	Humidity (%)	Heart Rate (BPM)	Rumination Rate	Health Status	Disease
Cow 1	35	65	65	450	Healthy	No
Cow 2	39	65	70	399	Healthy	No
Cow 3	42	65	95	33	Sick	Rabies
Cow 4	38	65	67	412	Healthy	No
Cow 5	36	65	65	385	Healthy	No
Cow 6	41	65	104	397	Sick	Heat Stress
Cow 7	39	65	69	424	Healthy	No

Moreover, by testing seven cows in farm, we found out two cows are sick. Furthermore, the doctor available their also told us that our test result was correct, and cow really has rabies and heat stress. Additionally, he also told that other cows that we tested are in good health. For instance, in our project we are basically implementing the idea that a vet whenever tries to measure a cow health, he basically tests the body temperature from cow anus, measure the cow heartbeat and also ask the cow farmer if the cow is eating or not, basically that he assumes the rumination rate of the cow. In our project we are implementing this idea and we are measuring cow body temperature, heart rate, rumination rate and humidity and by this we are anticipating cow diseases.

4.6 Conclusion

After analyzing the market and going through many research papers we have made some changes to our components for the optimal design solution. However, some of the equipment's that we changed are cheaper than before that doesn't mean their effectiveness also got reduced. Moreover, after building our prototype we have tested on several cows and got there are health parameters. We verified the health parameters from the veterinarian doctor and got assurance from him that our result is kind of accurate. Furthermore, to get accurate result we had to calibrate some of the sensors such as rumination sensor, heart rate sensor, body temperature sensor.

Chapter 5: Completion of Final Design and Validation

5.1 Introduction

In order to facilitate a seamless workflow and ensure the successful completion of the Cow health monitoring and disease detection project, the tasks were segmented into numerous categories. In addition, after reading numerous research papers and analyzing the market, we identified the ideal components for our project. In addition to that, we calibrated our sensors to ensure that we were getting the most accurate readings possible. In additament, we constructed a 3D-printed enclosure to protect our prototype from external harm and implemented our design on a PCB board. Finally, we connected our device with Thingspeak to monitor cow health parameters and detect the probable disease.

5.2 Completion of the Final Design

Our team has defined the necessary steps for implementing the cow health monitoring and disease detection project. A work breakdown structure was designed to keep track of all the progress done and to update it as necessary. The progression was documented in a logbook for further analysis. Additionally, we had to follow different steps two finish our final design. Moreover, after selecting the sensors we had to implement the design in a PCB board. As our prototype had to be placed in a cow's neck, we couldn't use breadboard. Though breadboard is cheaper than PCB, it's kind of fragile and can easily be damaged. After that, as we will be using the prototype in a cow farm, we had to model a 3D printed box to cover our prototype.

5.2.1 Farm Model Design

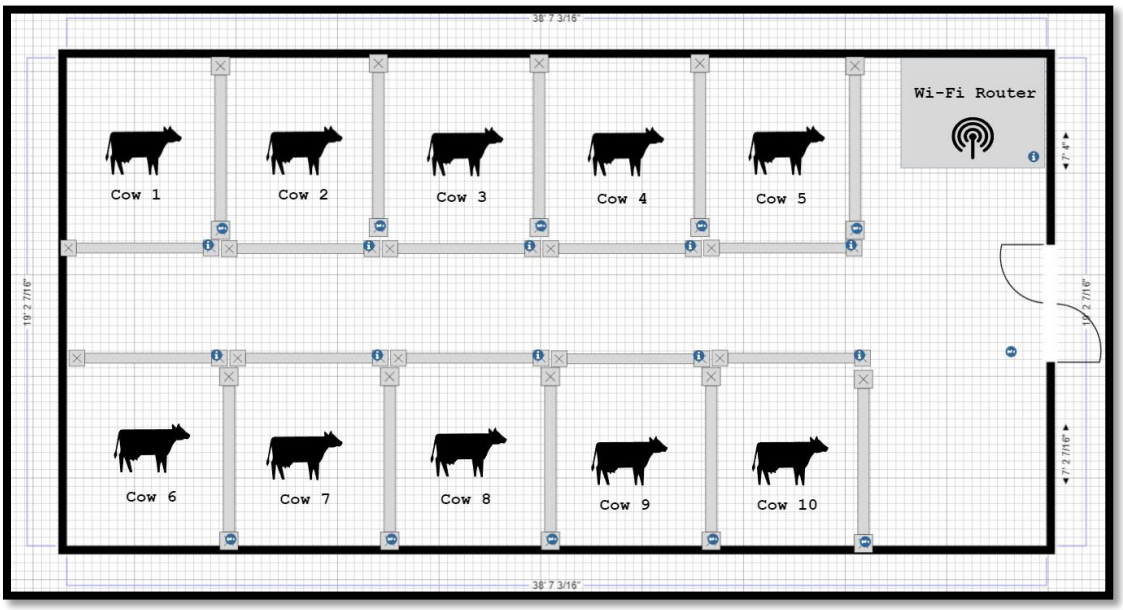


Figure 5.1: Blueprint of cow farm model for 10 cows

This is the blueprint of cow farm model for 10 cows. For each cow there will be allocated space and every cow will be worn our device and the device will be connected to Wi-Fi router. So that parameters and other data of the cow can be sent to the Thingspeak and farmers can access the farm from another location. Over Thingspeak data of the cows over time will be stored and will also be shown in graphs so that user can notice the change of the cow's health condition. We have surveyed different places and people and found that most investors or business initiators starts with 10to 20 cows to start their farm. Therefore, we have built this schematic blueprint for them. Also, if the farm size increases, we can scale up our blueprint and additional router will be added to keep the device connected with the Thingspeak server. Apart from that, when comes to electricity bills there will not be that much consumption cause a router maximum uses 10 watt to operate.

5.2.2 Individual Hardware Testing and System Integration

On our project we have used WeMos D1 Mini as out mainboard, DHT11 as relative temperature and humidity sensor, DS18B20 as our cows' body temperature sensor, MOU6050 as rumination sensor and heart rate pulse sensor. These sensors have been calibrated for our project.

WeMos D1 Mini: To keep connection with all the sensors and send the data/parameters from the sensors to Thingspeak we have used WeMos D1 Mini. Also, these is built in Wi-Fi feature in WeMos D1 mini that will help us to upload data in Thingspeak. And we don't have to add any additional Wi-Fi module for it. We have connected the WeMos D1 mini to our pc with USB and we have run some test code from Arduino IDE and checked the port and led if its working properly.

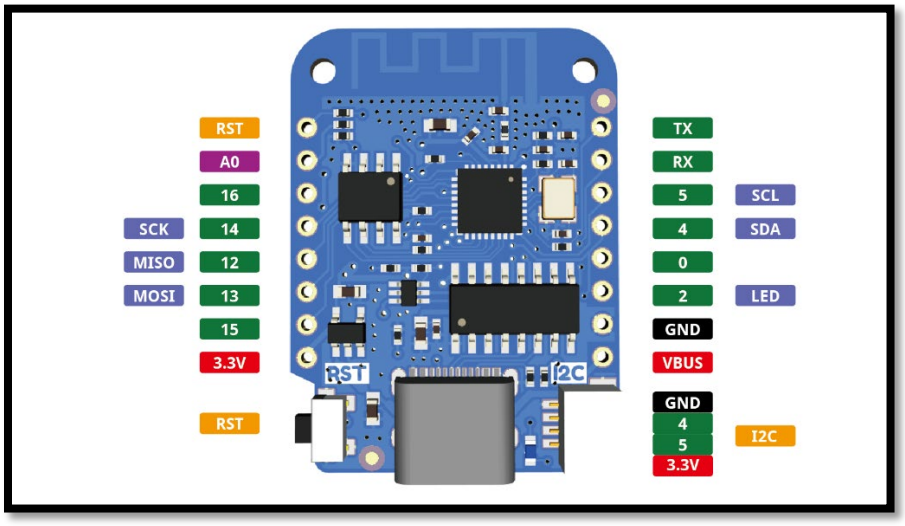


Figure 5.2: WeMos D1 Mini, mainboard used in our prototype

DHT11 (Relative Temperature and Humidity sensor)

We have connected this sensor to WeMos D1 mini for test run. After connecting WeMos to our PC we opened Arduino and updated the library for this sensor and we run the code from library and the sensor was started to work after several trial[12]. On instruction it says this sensor requires 3.5V but it does work in 3.3V with any problem.

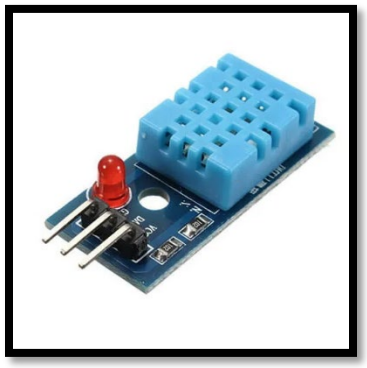


Figure 5.3: DHT11, Relative Temperature and Humidity sensor

DS18B20 (Temperature sensor)

In order to test the sensor, we have connected the sensor with WeMos D1 mini and This sensor requires only one input port. After connection we have connected WeMos D1 mini to our PC and after installing library in Arduino IDE we have tested the sensors measurement comparing with thermometer and we have adjusted some parameter for better accuracy output.

Figure 5.4: DS18B20, Temperature sensor

MOU6050 (Rumination sensor)

This MOU6059 has the gyroscope and accelerometer together. In order to test the sensor, we connected the sensor with WeMos D1 mini and connected to pc and run Arduino IDE then installed library [13]. After that we have run an example code from there and the sensors were working but value were not accurate. For that we had to map in the code.

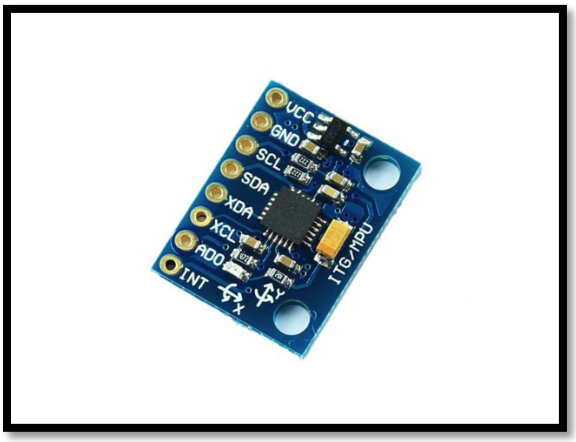


Figure 5.5: MOU6050, Rumination sensor

Heart rate pulse sensor

To test the heart rate sensor, we have connected the sensor with WeMos D1 mini and after connecting it to pc and installing library in Arduino ide we have put some test run code on sensor. But the value that we were getting is not useable. So, after maping the code we were able to use the sensor and get the accurate data for it.

Figure 5.6: Heart rate pulse sensor

Thingspeak for remote access

We have accumulated a ThingSpeak server with the cow health monitoring device. All the data and parameters are received from the cow is being send to Thignspeak server through Wi-fi, so that stakeholder can access the data from remote access. In Thingspeak the data will be also shown in graph format. And over 30 days data will be stored for used convenience so that he can check the changes in his cow. Lastly, data of the Thingspeak can be access though any point of the world only internet connection in needed, with only browser used can get access to all the data.

5.2.3 Design Methodology and Design Process

After researching and selecting the suitable sensors for our project, we did the software design in proteus.

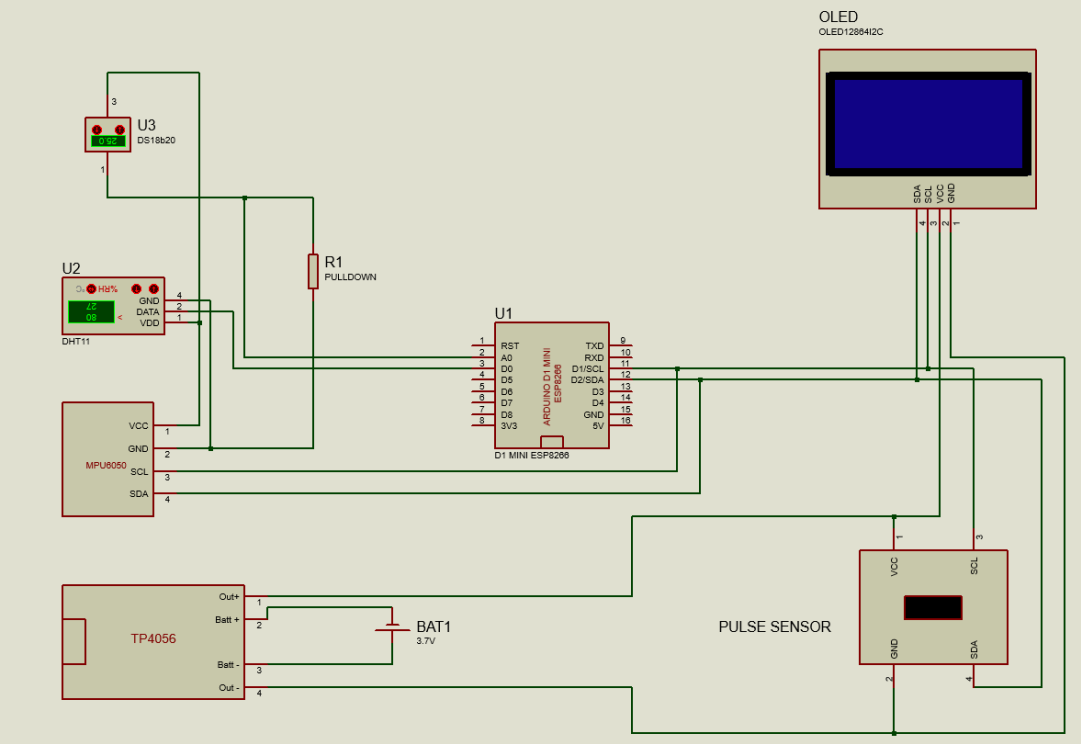


Figure 5.7: Proteus Schematic of our Final design

In proteus we have connected WeMos D1 mini pins with temperature sensor DSB18B20, heart rate measurement Pulse Sensor, environment temperature and humidity measurement sensor DHT11, rumination rate measurement sensor MPU 6050. Additionally, we also connected an OLED display to show the output that we are getting from the sensors.

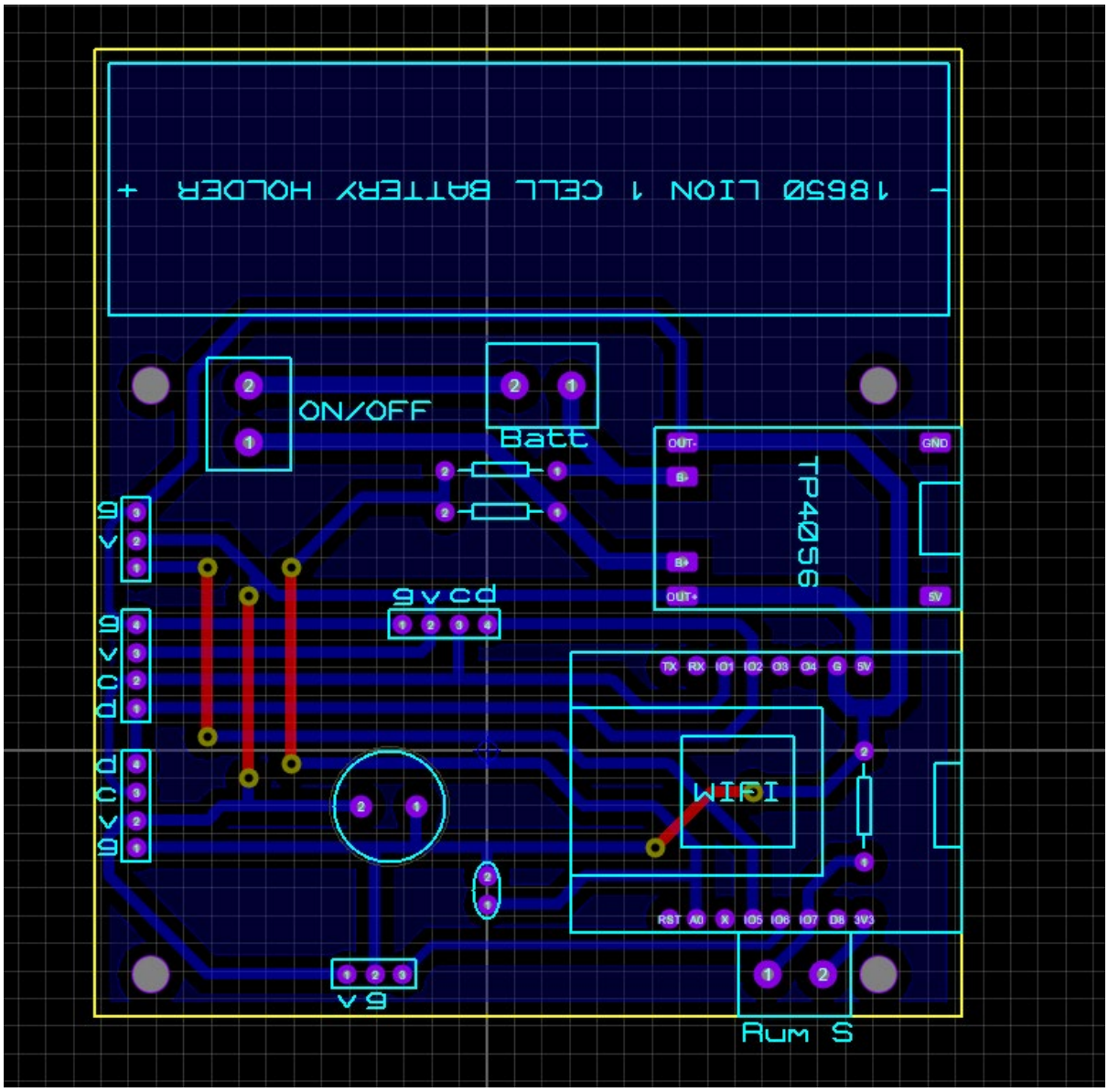


Figure 5.8: PCB Design Layout

After that we designed our PCB board model in proteus. From the layout we can see the connections of TP4056 charging module that helps us to charge the 2500mah Li-ion battery. Next to it the connection of WeMos D1 mini main board. Moreover, we designed the connections of On and off button to turn off and turn on the device. Additionally, we also designed the connecting points for the sensors to easily connect and remove them from the main PCB board. Additionally, we gave a place for the 2500mah Lithium-Ion battery holder.

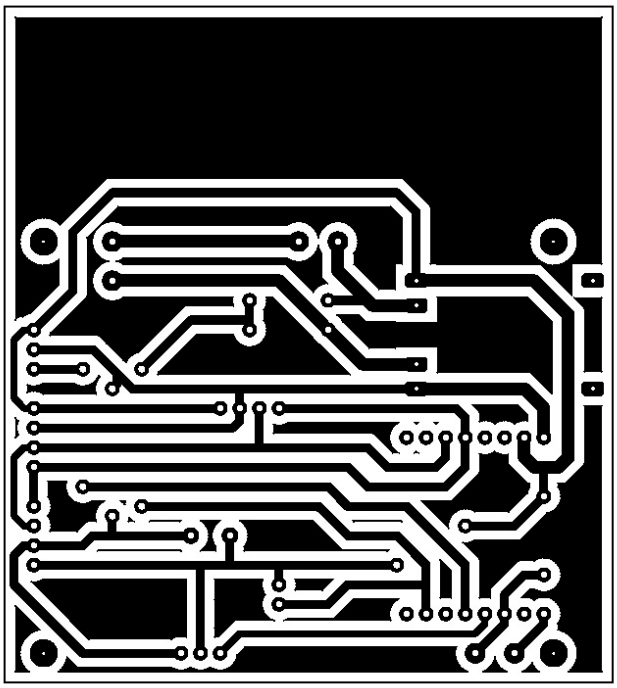


Figure 5.9: Connections in PCB Design

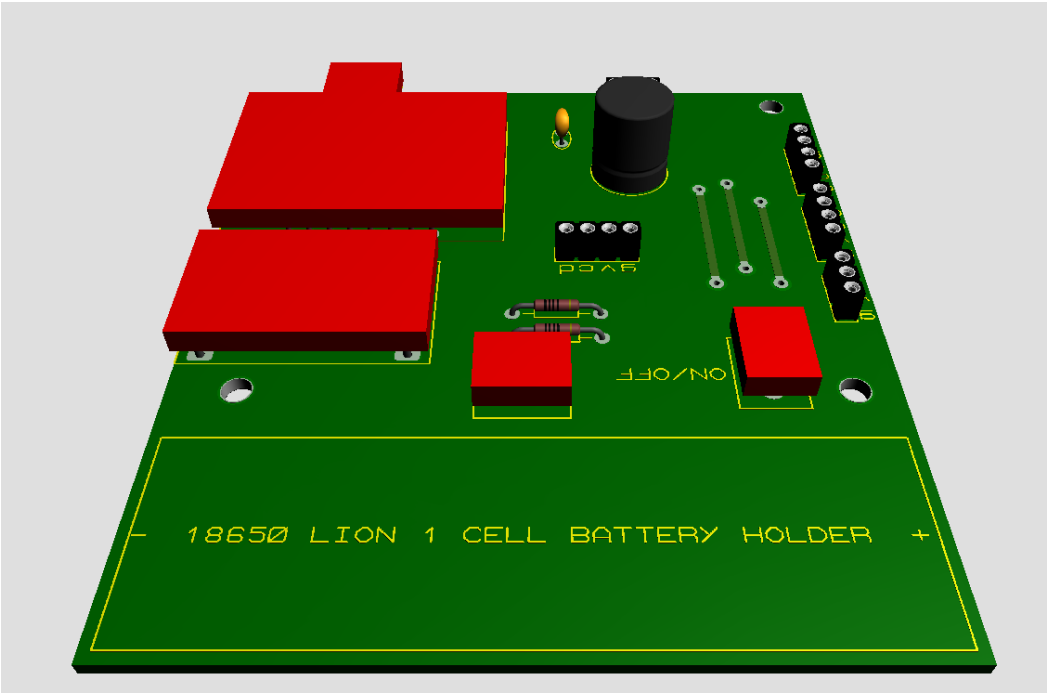


Figure 5.10: 3D Visualization of PCB Design

Moreover, here we can visualize our PCB Design layout with all the connections.

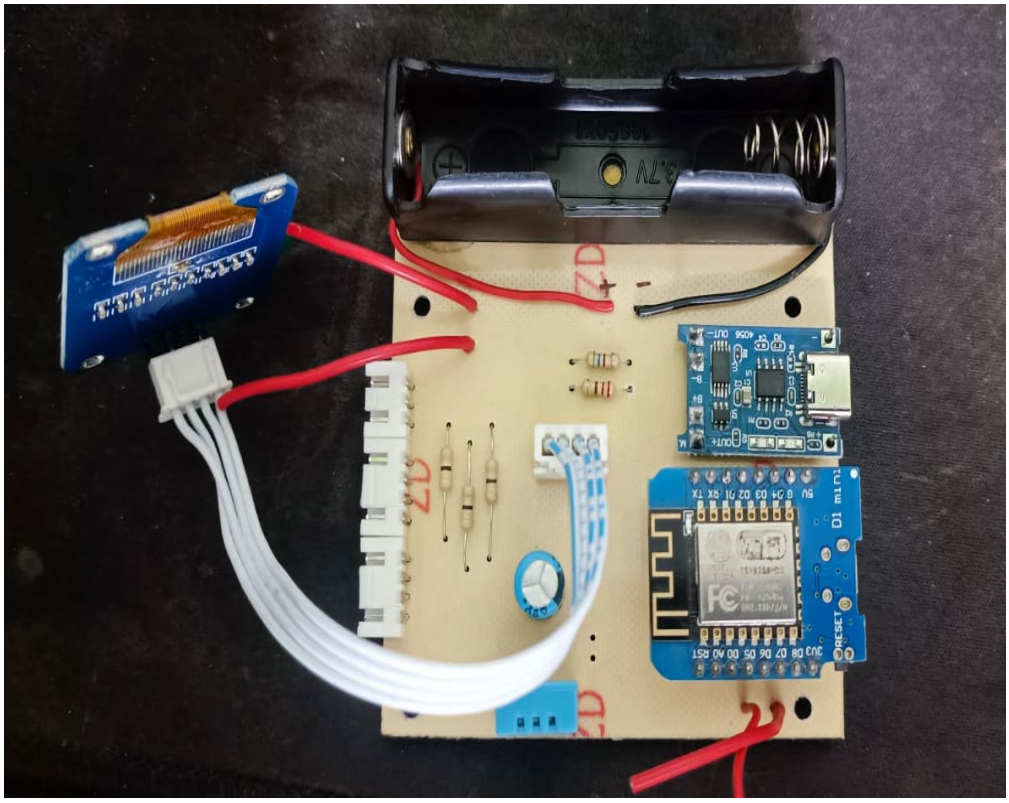


Figure 5.11: PCB Board without sensor connection.

In PCB Board, we soldered We Mos D1 Mini pro main board, charging module and battery holder. Furthermore, we also soldered connection points for the sensor and 5 resistors of 4.7k Ω and 1 capacitor of 220uF and 63 volts.

Furthermore, to protect our device from external damage and make our prototype durable we have designed a 3D printed box. The box is 3.5 inch in length and 3.5 inch in width. Moreover, we selected white color for the 3D printed box. Additionally, we used Fusion 360 for designing our 3D printed box. By leveraging fusion 360, we have access to sophisticated 3D design and modeling tools, which enables an automated method to designing complicated product designs and enables intelligent feature settings to improve product performance. So, we used Fusion360 to design our 3D prototype.

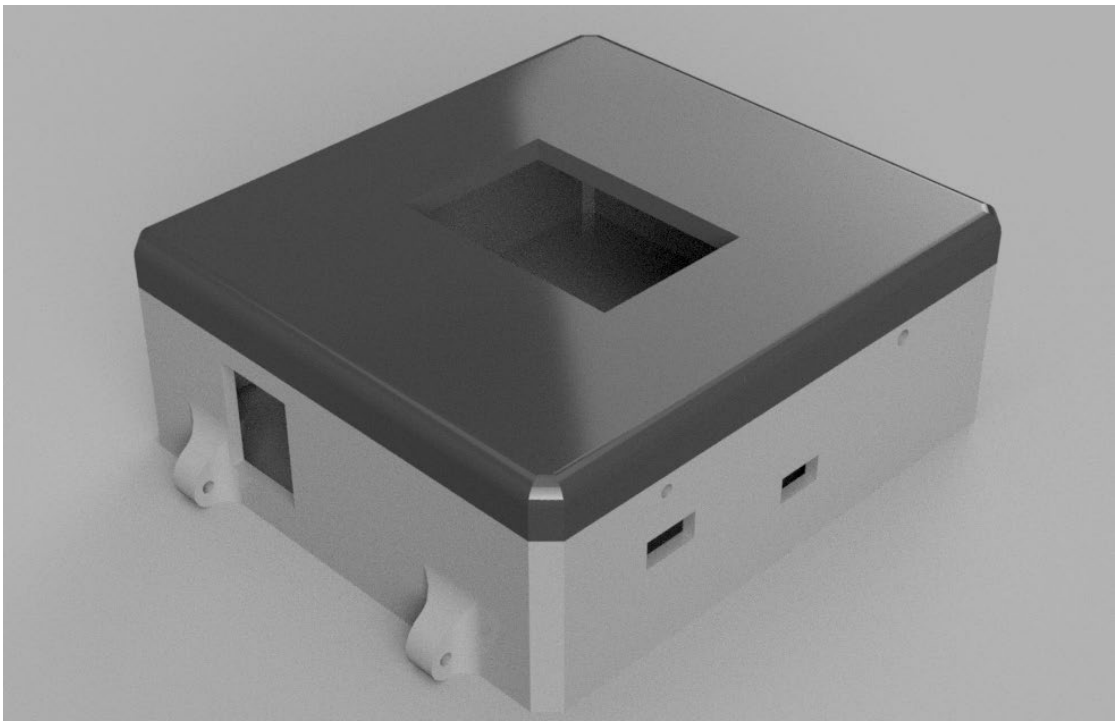


Figure 5.12: 3D Printed render model done by Fusion 360.

After 3D printing our model, we placed our prototype in 3D printed box. We used Philips's type screw to adjust the box cover. Moreover, DHT11 sensor as it's measuring the environment humidity and temperature, we placed it inside the 3D printed box.

Furthermore, we also used a switch to turn on and off our prototype. We also used an additional push button to control the rumination rate. Additionally, after researching some papers and visiting some cow farms we found out that cows are given food daily 2 to 3 times. Furthermore, while taking the food cow stops the rumination. And it continues for about 30 to 45 minutes. So, we used a push button to stop monitoring the rumination for that particular time period. Although rumination sensor stopped working for that particular time frame, other sensor will be working perfectly and show output result in the OLED display.

We also connected the display and MPU6050, DSB18B20 and pulse sensor with an extension cable. On the other end of the extension cable our sensor is placed. We used extension cable to easily remove the sensor's connecting points from the PCB board and to easily replace them if any unexpected occurrence occurs as we placed it in the cow neck.

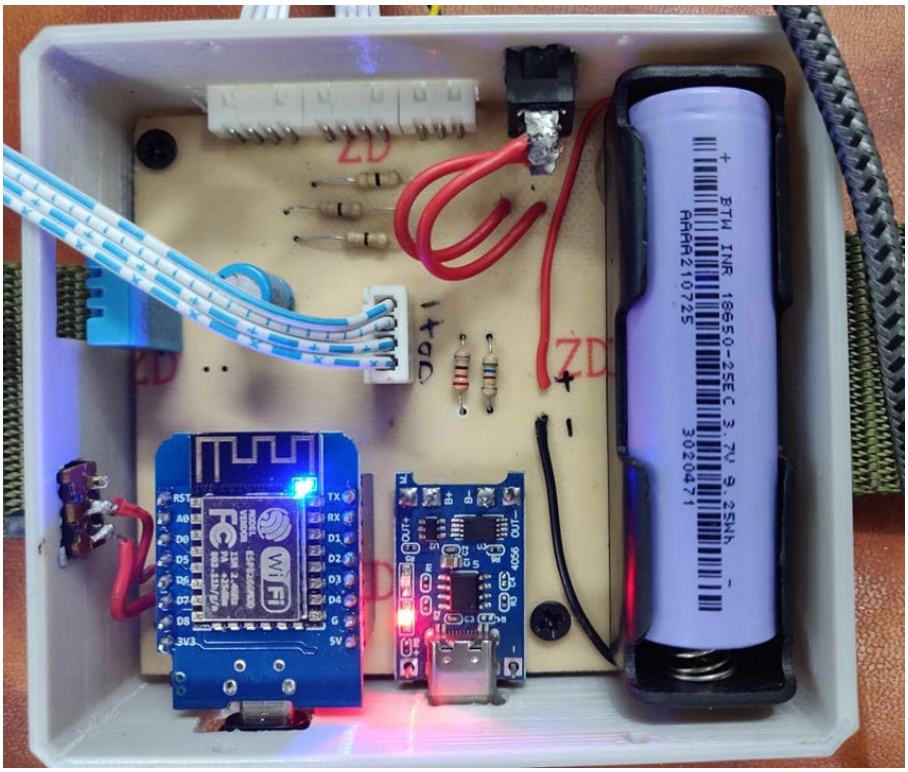


Figure 5.13: Placing the PCB board in the 3D printed Box

Moreover, we adjusted the whole PCB board in the 3D printed box with screws.

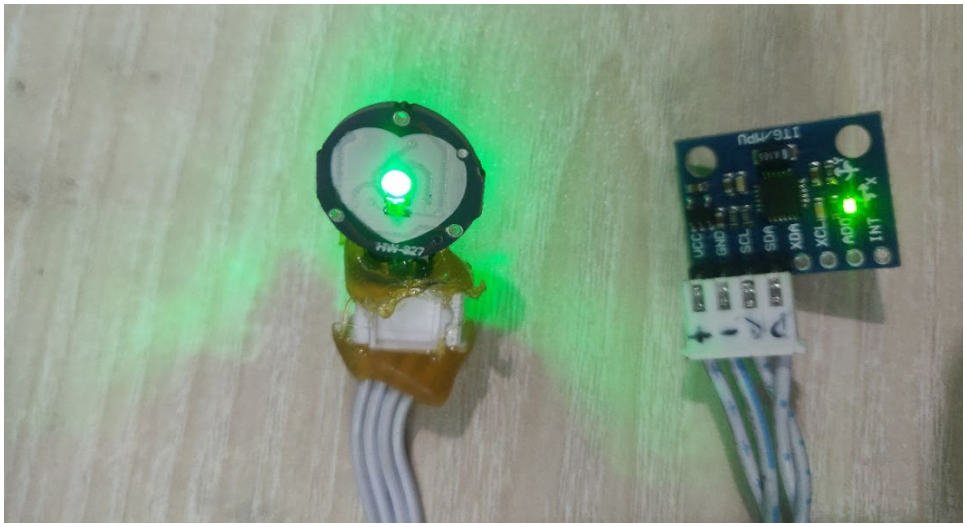


Figure 5.14: Sensors connected with extension cables

Here, soldering and adhesive were utilized to connect sensors to the extension cable. In contrast to this, we made certain that the sensor would not become dislodged from the extension cable under any circumstances.

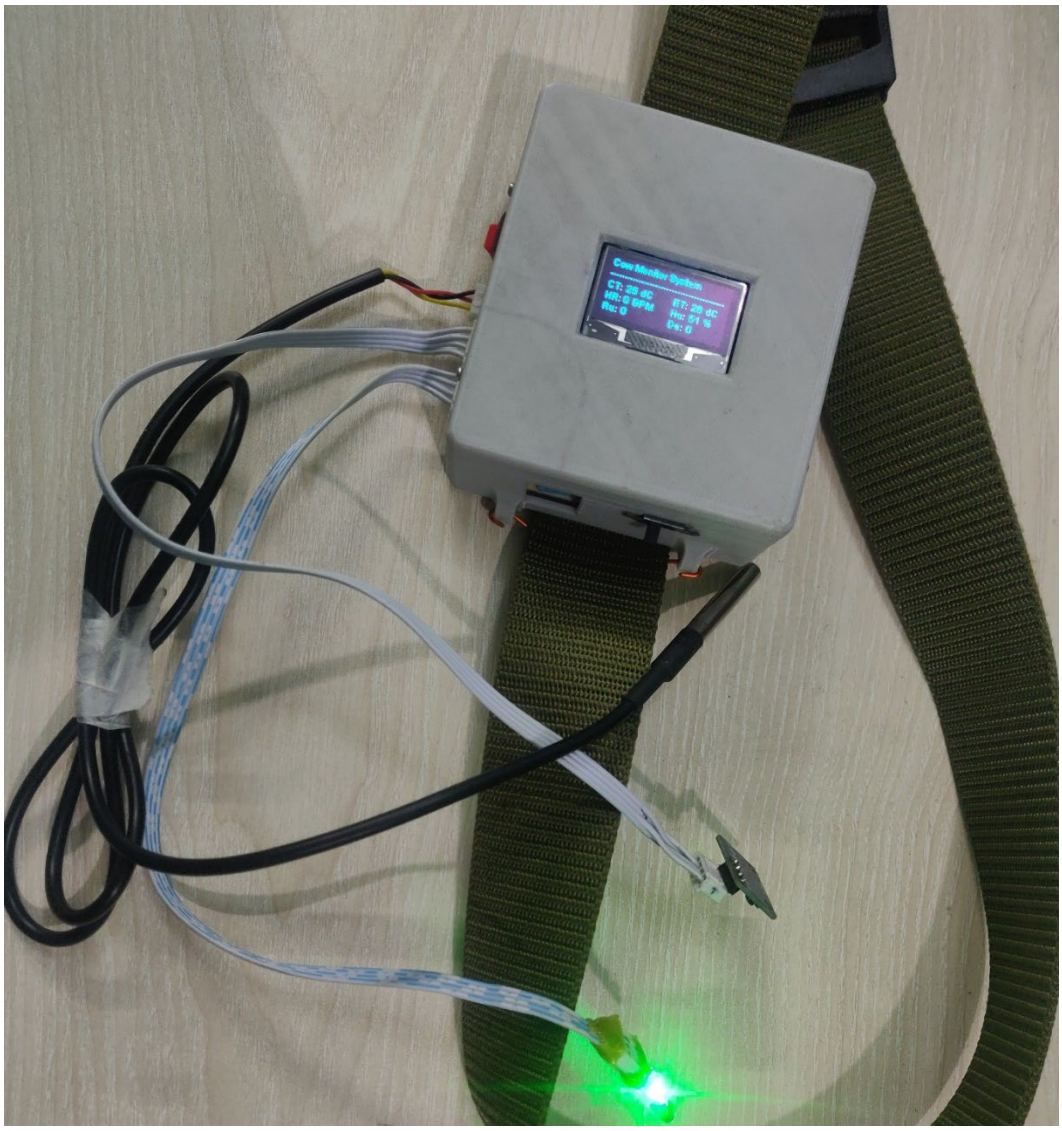


Figure 5.15: Cow health monitoring device

In this instance, we utilized a nylon belt in order to secure our prototype to the cow's neck. In additament, nylon belts generate less tension than other belts, making them more comfortable for the cow. Correspondingly, the belt is adjustable so that it can be placed on cows of various shapes. At last, we finished by inserting the nylon belt into the box that we had previously 3D printed and securing it there.

5.3 Evaluate the Solution to Meet Desired Need

Our design project has only one aim that is keep the user about his cow farm. With the cow health monitoring device, we can check the cows' health condition and give some probable disease output if the disease parameter intersects in our research range. Also, we tried to keep our system as simple and precise as possible so that user can understand the function easily. Now, we are going to point out the key results and user demands:

Table 5.1: User desired solution chart

Objectives	**Procedure**	**Results**	**Desired demand fulfilled (Yes/No)**
Cow Temperature Measurement	We have placed the DS18B20 temperature sensor under cow collar belt to keep it contact to cows' skin to get measurement.	Got the Cows body temperature accurately.	Yes
Cow Humidity and Relative Temperature Measurement	We have placed the humidity sensor (DHT11) attached to cow's collar along with main board. From there it will collect data respectively.	The sensor has collected data from the surrounding cows' neck and face area. And shows the humidity in percentage also environment temperature.	Yes
Cow Rumination Measurement	We placed the MOU6050 sensor to the cow's chin are to measure the movement of its chin.	When cow ruminates its jaw moves and MOU6050 detects the movement count it and over the we jeep count of it to track the health condition of cow.	Yes
Cow Heart Rate Measurement	We place the heart rate sensor on the facial artery which passes over the mandible near the angle of the jaw to measure heart rate.	We were able to get constant heart rate from the cow.	Yes
Data Accessibility	With the help of WeMos D1 mini we transmit all the data and parameters to Thingspeak.	User can See the cow health condition just by login in Thingspeak any location of the world. he just needs the internet connection.	Yes

Disease detection	From the all the parameter comparing with our collected database we can detect 3 types of major disease of our country.	User will get alert if his cow is sick or in abnormal condition.	Yes
Display to see the data	A display is also attached to our prototype if the user wants to see the result instantly without using inter connection.	User can see the data from the cow directly if he wants.	Yes

5.3.1 Thingspeak Server Development

We have built a Thingspeak server for our cow health monitoring. In order to make the server we had to create account and from there we will get direction how to make a channel. As Thingspeak is quite popular and their interface is simple and understandable. Also, there privacy and security are strong that is why we have chosen this platform to see the data of the cows. With this server customer can check the condition of the cow from any device as long as there is a net connection and device has a Web browser. Apart from just observing the data we have also added some features that will help the user. Now, we will discuss what sort of feature will use be experiencing,

Figure 5.16: Thingspeak Server

Figure 5.17: Thingspeak Server

Parameters monitoring: User will be able to see all the parameters live update from the Thingspeak server. Parameter sensors such as heart rate, humidity and relative temperature, temperature, rumination sensors data will be transmitted through WeMos D1 mini's built-in Wi-Fi feature. And the user will get live update.

Graph: As the user will not be able to observe all the time so we have kept a graph plot over time that will keep the previous 30 days data noted. So that user can notice the difference.

Disease Detection: From the parameters we get from the sensors and by comparing it with our database we will be able to detect probable disease. When the parameter will be matching with the disease condition parameter the LED will light up of that particular disease [14]. Also there has extra slot has been kept if the cow in not in disease para meter also not in healthy cow's parameter we have labeled that as abnormal condition.

Data security: To operate server one has to open account and that account should be secured with highly protected password. So that no one from outside can beach the data. Therefore, user do not have to worry about the Security of their farm's data.

5.3.2 Power Consumption Calculation

For DHT11 sensor,
When DHT11 in idle mode, it utilizes 3 volts and .06 milli amperes current.
So, power consumption in idle mode = (3 volts *.06 milli amperes) = .18 milli watt
When DHT11 in operating mode, it utilizes 5.5 volts and .3 milli amperes current.
So, power consumption in operating mode = (5.5 volts *.3 milli amperes) = 1.65 milli watt

For We Mos D1 mini main board,
When We Mos D1 mini in idle mode, it utilizes 3.3 volts and .15 milli amperes current.
So, power consumption in idle mode = (3.3 volts *.15 milli amperes) = .495 milli watt
When We Mos D1 mini in operating mode, it utilizes 3.3 volts and 70 milli amperes current.
So, power consumption in operating mode = (3.3 volts *70 milli amperes) = 231 milli watt

For DS18b20 sensor,
When DS18b20 in operating mode, it utilizes 5.5 volts and 1 milli amperes current
So, power consumption in operating mode = (5.5 volts *1 milli amperes) = 5.5 milli watt

For Pulse Sensor,
When operating power consumption of pulse sensor at Heart rate of 60bpm is .0434 milli watt.

For OLED Display,
When OLED Display in operating mode, it utilizes 3.3 volts and 12 milli amperes current.
So, power consumption in operating mode = (3.3 volts *12 milli amperes) = 39.6 milli watt

From the above calculation we have decided to choose 2500mah battery to run our prototype it will give backup for long period of time.

5.3.3 The code for the System

Below we have shown a simplified version of code flow chat to understand how our device is operating.

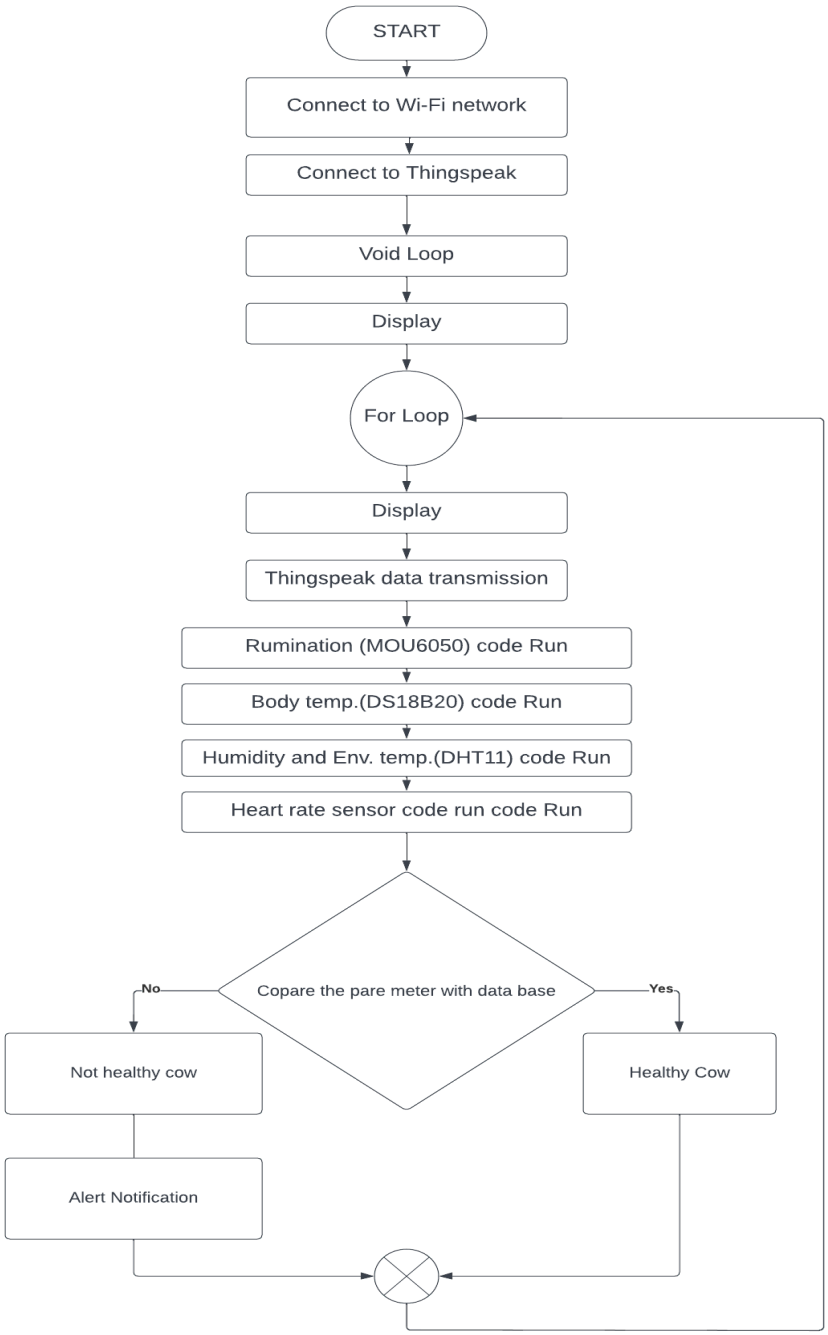


Figure 5.18: Flowchart for overall showing structure of the code.

5.3.4 Validation of the Prototype

For the test run of our prototype we have selected Partex farm to visit. There we have test run our device on some cows. Now, we will discuss about some of the test case from that farm:

For Test Case 1:

Figure 5.19: Device implementation on cow 1

Figure 5.20: Output data for cow 1

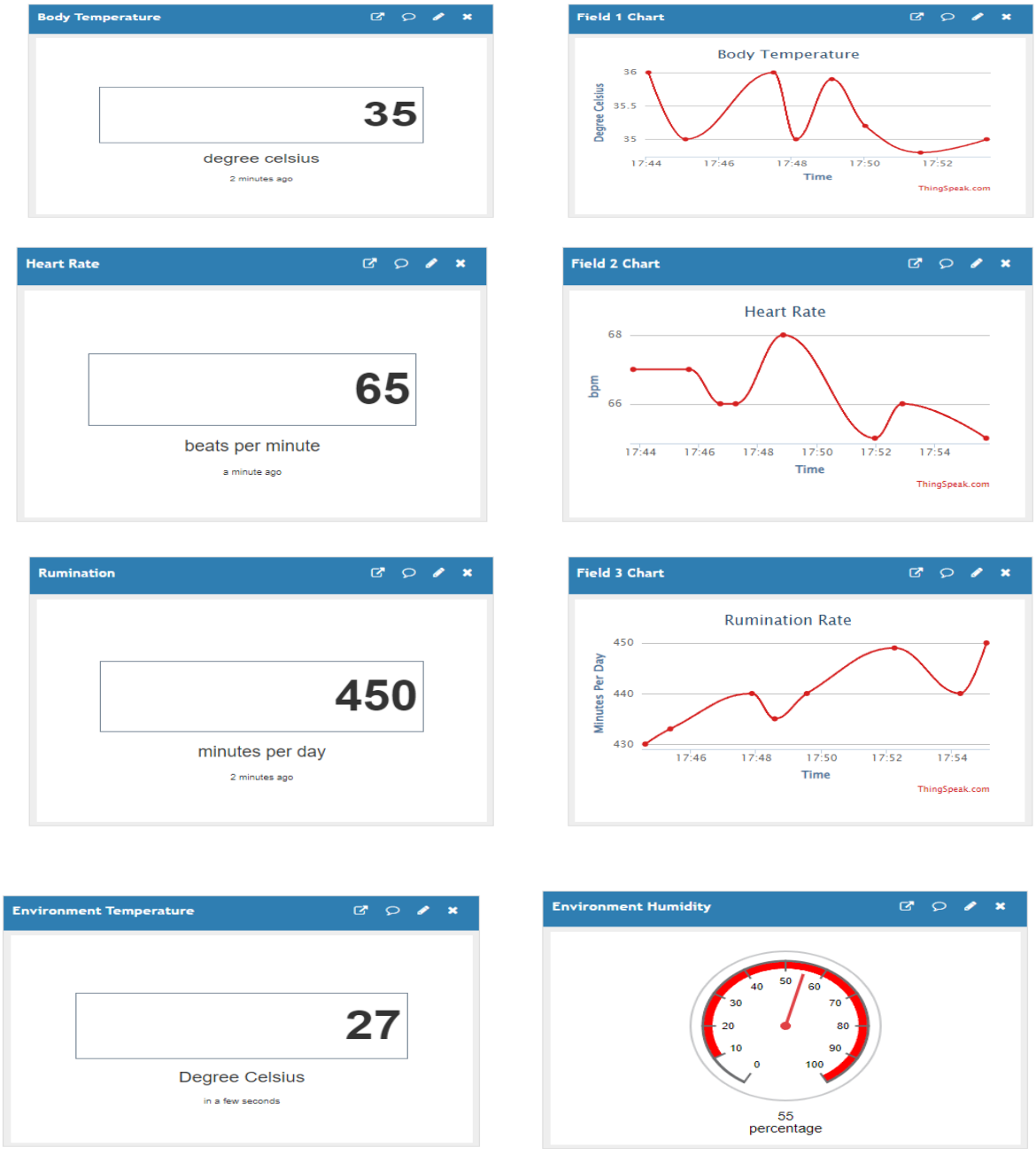


Figure 5.21: Thingspeak Output

For test case 1 we have chosen this female cow. And the we have placed our prototype on the cow and measure the data for about 6 hours. The data we got from the device and the we are getting in thing speak is similar. Cow's body temperature was 35 degrees Celsius, heart rate was 65 BPM, rumination 450min, environment temperature 27 degree Celsius and humidity was about 55%. As we have tested the device for 6 hours, for rumination we have to scale up the value to get the desired outcome. After the test we can say that the cow was healthy.

For Test Case 2:

Figure 5.22: Device implementation on cow 2

Figure 5.23: Output data for cow 2

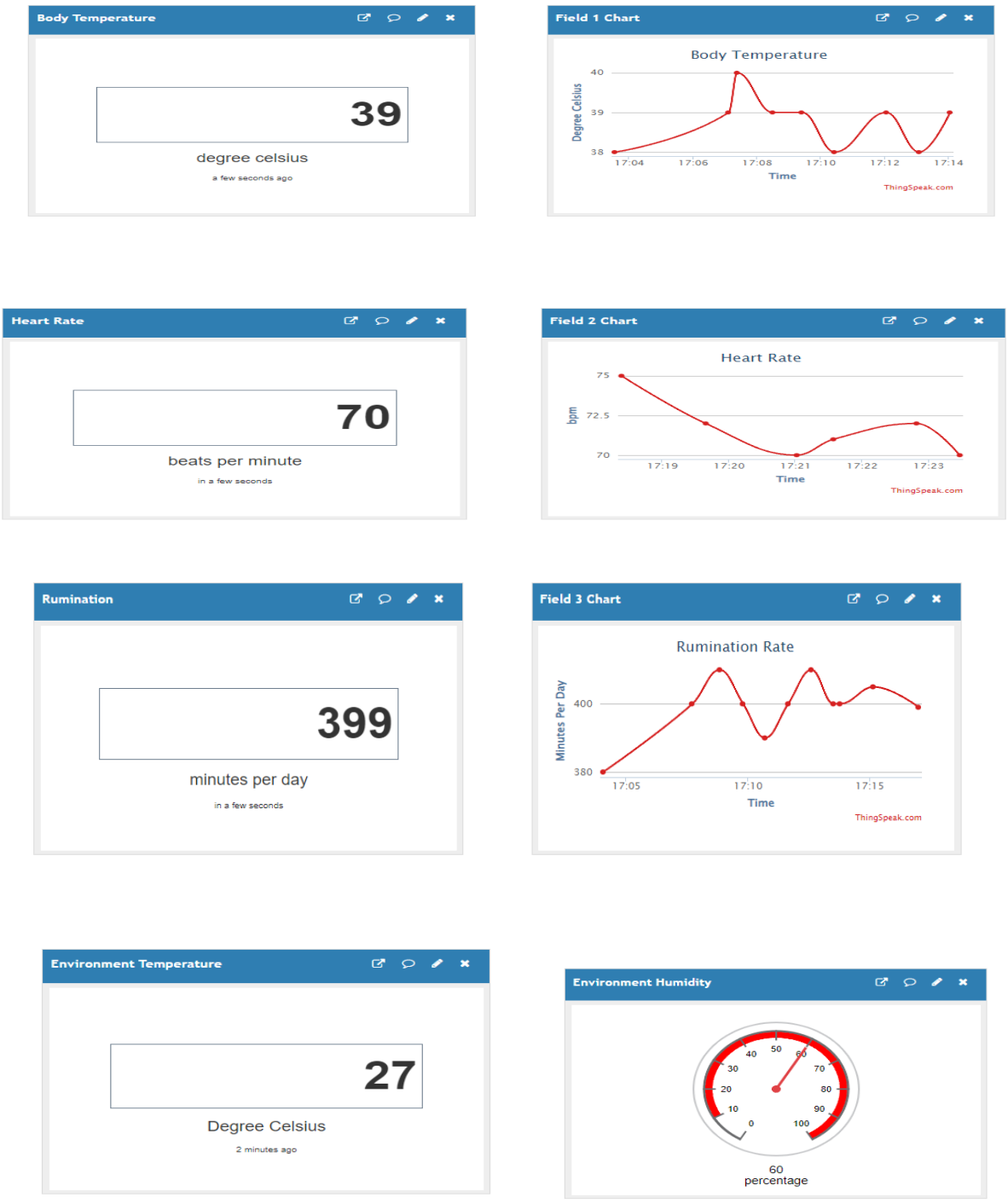


Figure 5.24: Thingspeak Output

For test case 2 we have chosen this male cow. And the we have placed our prototype on the cow and measure the data for about 6 hours. The data we got from the device and the we are getting in thing speak is similar. Cow's body temperature was 39 degrees Celsius, heart rate was 70 BPM,

rumination 399min, environment temperature 27 degree Celsius and humidity was about 60%. As we have tested the device for 6 hours, for rumination we have to scale up the value to get the desired outcome. After the test we can say that the cow was healthy. The value was different from the first cow because it was besides a water body and that is why humidity was relatively high.

For Test Case 3:

Figure 5.25: Device implementation on cow 3

Figure 5.26: Output data for cow 3

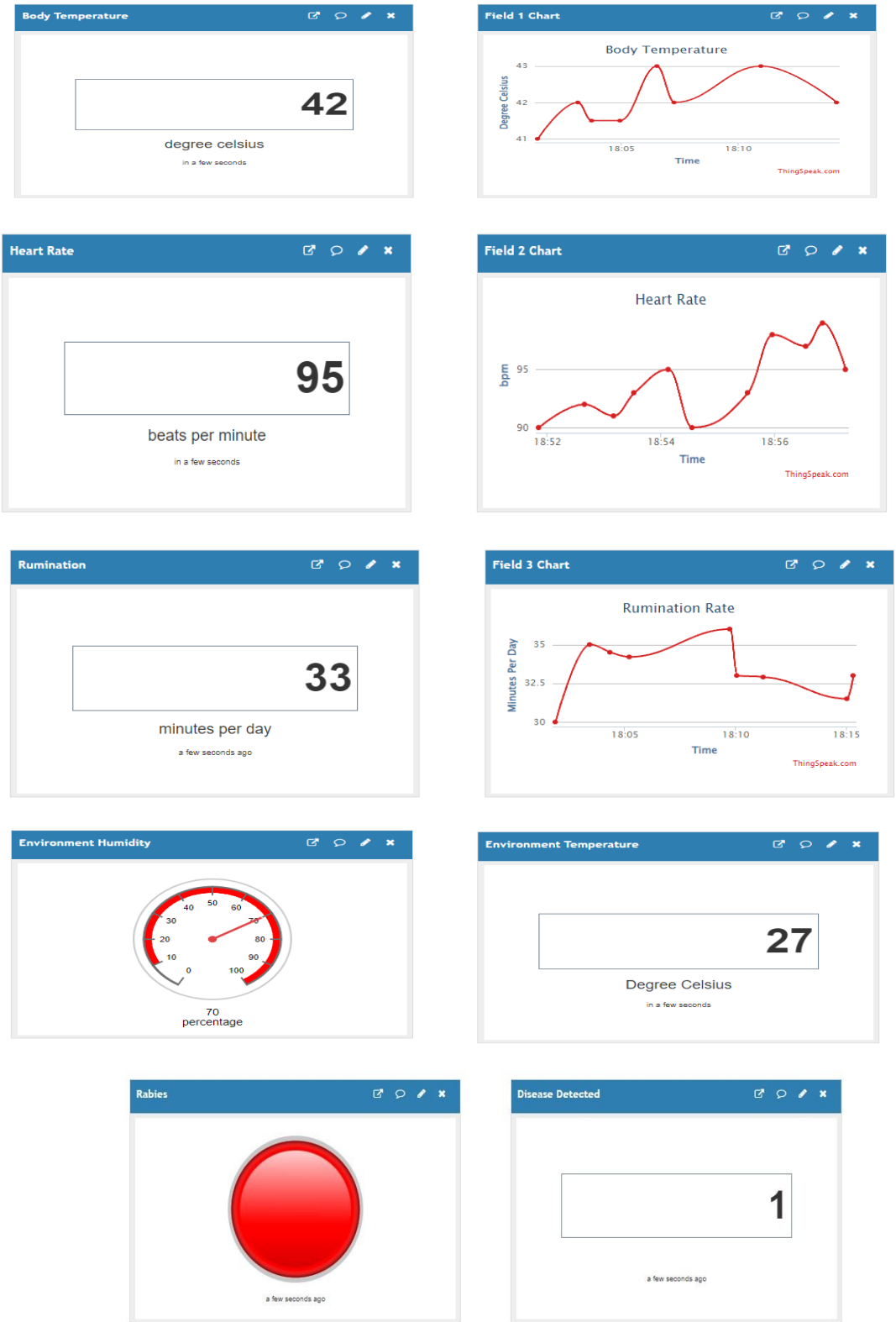


Figure 5.27: Thingspeak Output

For test case 3 we have chosen this male cow. And the we have placed our prototype on the cow and measure the data for about 6 hours. The data we got from the device and the we are getting in thing speak is similar. Cow's body temperature was 42 degrees Celsius; heart rate is not measurable as the pule was very low, rumination 33min the cow could hot eat anything our device was just detected some movement is its jaw muscle area, environment temperature 27 degree Celsius and humidity was about 70%. As we have tested the device for 6 hours, for rumination we have to scale up the value to get the desired outcome. After the test we can say that the cow is affected by rabies. And we have validated our output with Mr. Boyzer Rashman and our output was verified.
Later on, we have run some more test and the data from there is given below:

Table 5.2: Health monitoring of Seven cows.

Sample Test	Temperature (°C)	Humidity (%)	Heart Rate (BPM)	Rumination Rate	Health Status	Disease
Cow 1	35	65	65	450	Healthy	No
Cow 2	39	65	70	399	Healthy	No
Cow 3	42	70	95	33	Sick	Rabies
Cow 4	38	65	67	412	Healthy	No
Cow 5	36	65	65	385	Healthy	No
Cow 6	41	65	104	397	Sick	Heat Stress
Cow 7	39	65	69	424	Healthy	No

These data were validated by Dr. Boyzer Rahman who is and principal scientific officer of animal welfare Institute. There, fore we can say our device works and give us accurate data.

5.4 Conclusion

We have selected this project viewing that Bangladesh is facing major problem to fulfill demanding the needs of food. And when it comes to food meat and dairy product are essential cause they have higher amount of nutrition. For that reason, we have focused on cow farming and tried to solve the farmer and stakeholders' problem and came up with an engineering point of view solution. In order to solve the problem, we have dived the work procedures to make sure everything works properly. We have gone through lots of literature review and examine datasheets of the components to learn details of the component. Then we have calibrated the sensors and linked it with the Thingspeak server. While doing sensor calibration we were not getting desired output there we had to map in the code to make the sensors usable. In The Thingspeak server we have made it such way that it can store the data of previous 30days and all the parameters can be shown in graph format so that user can easily identify the changes. Finally, we have made the device user friendly and made the notification system in such way that user can notice it when it triggers.

Chapter 6: Impact Analysis and Project Sustainability

6.1 Introduction

Cow health monitoring device is the newest for cow farmers in Bangladesh as such technology were not available so far in our country. This device can bring a revolutionary change for the cow farmer as it can help to find cow diseases at an early stage. Due to that reason, the cow death ratio will be reduced, and farmers will be profited from doing cow farming. The new farmers will also be interested in this project. As cow farming is increasing day by day in our country, this will get a good impact on our country's economy and also fulfill our people's demands. Therefore, our CHMD (Cow Health Monitoring Device) is beneficial for cow farmers. From our on-field research, we get information from the cow farmers that most of the time their cows die for not getting treatment in time. Moreover, they also added that it is difficult to monitor all the cows in 24 hours, for this reason, they did not call the veterinary doctor in time. That is why cows did not get treatment in time. So, from their information, we make this CHMD and we successfully make it. On the field test, we get data from the cow's body temperature, rumination, and heart rate. Our CHMD is mainly capable to collect data on cows' body temperature, heart rate, and rumination rate. CHMD sends 24 hours' data on our devices like mobile or laptops. If we find any difference from normal data, we immodestly call a veterinary doctor. In this way, our CHMD can easily save a cow's life from an early death.

- **Getting data about cows through CHMD**

At first, we tie our CHMD to the collar of the cow's neck. CHMD collects data from different parts of the cow's body such as cow's heart rate, cow rumination, and cow's body rate temperature through different types of sensors that are connected to our device. We built our CHMD using a different type of sensor like heart rate sensor, rumination sensor, and body temperature sensor. These sensors collect data from the cow's body for 24 hours. Our device is small and lightweight and for that reason, it makes no problem for the cows and is easy to fit with the cow's body. Cows do not feel any type of disturbance from our device.

- **Sending data about cows**

Our cow health monitoring device always sends data from the cow's body through ThingSpeak which is an IoT base application. And we get this data information through our mobile application and laptop or monitor. This helps farmers for monitoring their cows 24 hours and save time. They do not need to keep an extra man for monitoring cows and also no need to monitor them all the time on the farm. They easily can operate their devices anywhere and keep monitoring their cows as our device sends data 24 hours to the farmer. If our device finds any kind of unavoidable data, it sends an immediate notification to farmers, so that the farmers can find the problem and get in contact with the veterinary doctor as soon as possible so the cow will get treatment in time.

6.2 Assess the Impact of the Solution

Regarding the project's major attraction, the cow's data will be monitored all the time. It will influence all the impacts on the environment. The data on the cow's body will be collected from the different sensors. This surveillance model system will be more practical and cost-effective than earlier monitoring model systems. In our country, fewer devices can monitor cows' health. This device costs high and the operation is costly. Farmers cannot bear the extra cost.
On the other hand, our CHMD is a cost-effective device and its operating system is easy. Because today all men at least have a smartphone and our device can operate this smartphone. We also contact a veterinary doctor and discuss our device and show the data information. He agreed with us and approved our device as the best surveillance of cow health motoring device. Another important thing is, our device is not harmful to society and the environment. In the future, our CHMD will be more accurate and will provide efficient data.

- **Social impact**

The cow health monitoring system is not only helpful for the farmers but also helpful for society. In our country, most of the village people have animal husbandry, especially cows. So that, general people also use our product and they get benefited. Society will change without any harm and this project will run for a long time. Cow milk is a balanced diet food and it has all kinds of vitamins and proteins that are very important to our body. At the same time, cow's meat is a very tasty food and it fulfills our protein demand. If cows are not available, how can we get cows' milk and how to fulfill the milk demand for the people? So, our CHMD is beneficial to all societal people and this device is not harmful to cow bodies. The effect on individuals and communities that occurs as a result of an action, activity, or initiative can be characterized as social impact. Implementing our system will create awareness about the vital cow diseases among farm owners. Sometimes we saw that some of our diseases came from sick cows. It will hamper our society, many cow farmers are fear to farm cows, but if we implement our project successfully cows disease rate will decrease, and cow farmer's firm cows without any hesitation.

- **Heath impact**

Heath is wealth and it is the key to success. If your body is not healthy you will not be able to do any work with proper concentration. If you want to be a successful man, you need a healthy body. Milk can give you this opportunity. Most of the milk comes to us from cows. If cows are not available, we cannot get enough milk. Everyone suffers from sickness. So first, we need to ensure the cow's health and safety. If cows are healthy, we can get enough milk and fulfill our milk demand. Nowadays most cows died at early ages without getting proper treatment in time. The main reason behind this is that the farmer is not available all the time to monitor their cows [15]. For that reason, if cows are sick, they do not get any idea about it. So, cows die sometimes from

simple diseases. Our CHMD helps farmers to identify cows' diseases at an early stage and sent notifications to the farmer on their devices, and farmers instantly provide treatment in time. In this way, the early cow death rate can be reduced. By implementing our project, milk production will increase and it will help to fulfill the lack of nutrients such as Calcium, riboflavin, Vitamins, etc. As well as cow meat contains several essential nutrients including protein, iron, zinc, selenium, riboflavin, niacin, vitamin B6, vitamin B12, phosphorus, pantothenate, magnesium, and potassium so that we can say to improve our health Cows keep a great impact.

- **Safety Impact**

Safety is the main purpose of our project. If the device is harmful to the cow's body it would be regretful for us. Because we make this device for examining the cow's health. So, we use environment-friendly sensors that are not harmful to the cow's body and also to the farmer. We always ensure every electric product checks whether the sensors we have used in our device are harmful or not. Another important thing is that the veterinary doctor makes sure that our CHMD is safe for the cow and people also.

- **Legal Impact**

We have mentioned that our cow health monitoring device (CHMD) is not harmful to the cows as well as our environment, society, and also for people. It is only a rechargeable operating device. This device is made with a hybrid board and some sensors for detecting cow disease. This sensor is available in our country's market and also these electric products approve by the IEEE society. So, our government can easily approve our device for marketing. Therefore, the solution is that our CHMD is legal for the farmers. In the context of an act, agreement, or contract, legality is the condition of following the law, or of being lawful or unlawful in a certain jurisdiction as well as the construction of power. As we are mainly focusing on cows to implement our project, we have to follow "The animal welfare Act 2019" accordingly and take permission from the responsible authority before implementing. We all know that any kind of animal harm is an offensive crime. Our project will make for cows' lives, not death. Our product helps cow farmers to detect cows' early diseases for that reason many cows did not die at an early age, and cow production will increase.

- **Economic Impact**

Economic impact refers to economic growth or productivity growth by saving money, avoiding debt, increasing turnover, etc. With a cow health monitoring system, farm owners can predict cow diseases earlier, so it will help them to find out sick cows easily and treat them appropriately by visiting a veterinarian. Moreover, as farmers can detect sick cows at an earlier stage, there will be a low percentage of cow death on the farm. Additionally, there will be more milk production and

it will make cow farming more profitable. Besides that, Cow meat is delicious and very much popular food all over the world. Farmer also earns money by selling cow meat.

- **Cultural Impact**

Cultural impact refers to the impacts on human populations of any governmental or private policies and activities that significantly influence their norms, values, beliefs, practices, institutions, and the way people live, work, socialize, and organize themselves as part of their cultural life. At present, there's a little number of farms that are digitalized in Bangladesh. However, implementing our system and making farm digitalization will bring a huge cultural change in the cow farming community in Bangladesh. If we successfully implement our product, it will make a great change in our society. If the cow death rate decreases on the other hand cow farmers increase and it will change a huge in our culture.

6.3 Evaluate the Sustainability

Environmental sustainability is the responsibility to conserve natural resources and protect global ecosystems to support health and well-being, now and in the future. So many decisions that impact the environment are not felt immediately, a key element of environmental sustainability is its forward-looking nature. Standards for environmental sustainability vary greatly, based on local economic, social, and environmental conditions. Exponential population growth has led to increased farming, which leads to greater greenhouse gas emissions and deforestation. Industrial and technological growth means we need more power than ever [16]. Environmental sustainability is important because of how much energy, food, and human-made resources we use every day. Rapid population growth has resulted in increased farming and manufacturing, leading to more greenhouse gas emissions, unsustainable energy use, and deforestation.

Sustainability

A cow is a domestic animal, and it exists from the beginning of the world and lasted until we want. Nowadays cow death rate is high because cows cannot get proper treatment in time. The cow is an essential animal in our society, it helps to balance the food chain of the environment. If there are no cows left in the world what will happen can you imagine? We will suffer from different diseases for not getting cow's milk and meat. So, we need to take care of these animals, that is why we make our CHMD for monitoring cows. It is not only a monitoring device but also it helps us to detect diseases from the cow's body.

Manufacturability

It is easy to manufacture because we follow just simple steps to make our device. For making this device we use a temperature sensor, heart rate sensor, rumination sensor, lipo battery, aluminum wire, charger cable, and hybrid board. Assemble all the elements then cover them up. And we make this cover by using a 3D printer name fusion 360.

Maintainability

Our Cow Heath Monitoring Device (CHMD) is easy to operate, and farmers can easily maintain our device. Because it has no extra charge for maintenance. Just regularly it needs to recharge. Our CHMD has a c type of cable charger port and this cable is available everywhere in our country. Our device is a cost-effective product and it is small also light in weight. So, it can be easily moveable. It is also water resistance device, so no need to fear at the time of rain. Farmers get the data through their mobile phones. Now a day every person has a smartphone, so he can easily monitor his cows at any place.

6.4 Conclusion

Finally, we can state that our Cow Health Monitoring Device (CHMD) is very much helpful for farmers, it can bring revolutionary to our country's farmers and the new farmers will be interested in cow farming because using our CHMD no cow will alert the farmers early to treat the sick cow in a proper way. Hopefully, cow's death rate will be reduced and production will increase. Farmers will be economically benefitted which would help to avail the unemployment problem in our country. So, our device is not only a cow health monitoring device but also a profitable device for farmers, sellers, and the government. The successful completion of our project would help to reduce the cow death ratio which would benefit the farmers.

Chapter 7: Engineering Project Management

7.1 Introduction

To accomplish any task first we need to have a clear management process and proper planning for executing that specific target goal. No targets can be accomplished without a proper management system. Engineering project management is a part of project management that completely focuses on engineering projects. The main aim of this project is to keep track of the project's progress, budget, and all other relevant specifications.
In this modern era, engineering is never constant. Actually, it was never constant at all. Engineering is a field that changes constantly according to people's needs [17]. Therefore, the project managers who are responsible for maintaining the engineering project management should focus on some key factors like making the engineering field flexible and understandable for them to work comfortably. For our final year design project, we have gone through a number of topics that is related to engineering project management, we have made a Gantt chart to make the time and plan flexible for us, we have assigned task fairly among our team members, and finally, we have evaluated our project success by setting different parameters of criteria.

7.2 Define, Plan, and Manage an Engineering Project

Definition of engineering project

Engineering Project Management includes proper planning and communication with the target audience as it contains the identification of our project objectives, requirements, conflicting requirements, specifications, and risk management contingency plan.

Planning of the engineering project

In our EEE400P we have created a plan to successfully complete our project which we have updated each semester. We have breakdown our project idea into some sub-sections in the beginning. We changed our initial plan accordingly as per our needs. We have also made Gantt chart each semester to keep track of our progress and we changed it accordingly based on our working schedule. All the details are given below –

Figure 7.1: Workflow for each semester

This was the initial workflow plan for our project. We have created this in our EEE400P so that we can have a clear visualization of what we want to achieve and how we should approach to reach the goal.

7.2.1 Gantt Chart

To keep track of our project plan and project progress we have created a Gantt chart each semester. A Gantt Chart means an in-details explanation of the process of how we demonstrate our work for the rest of the semester within the deadline.

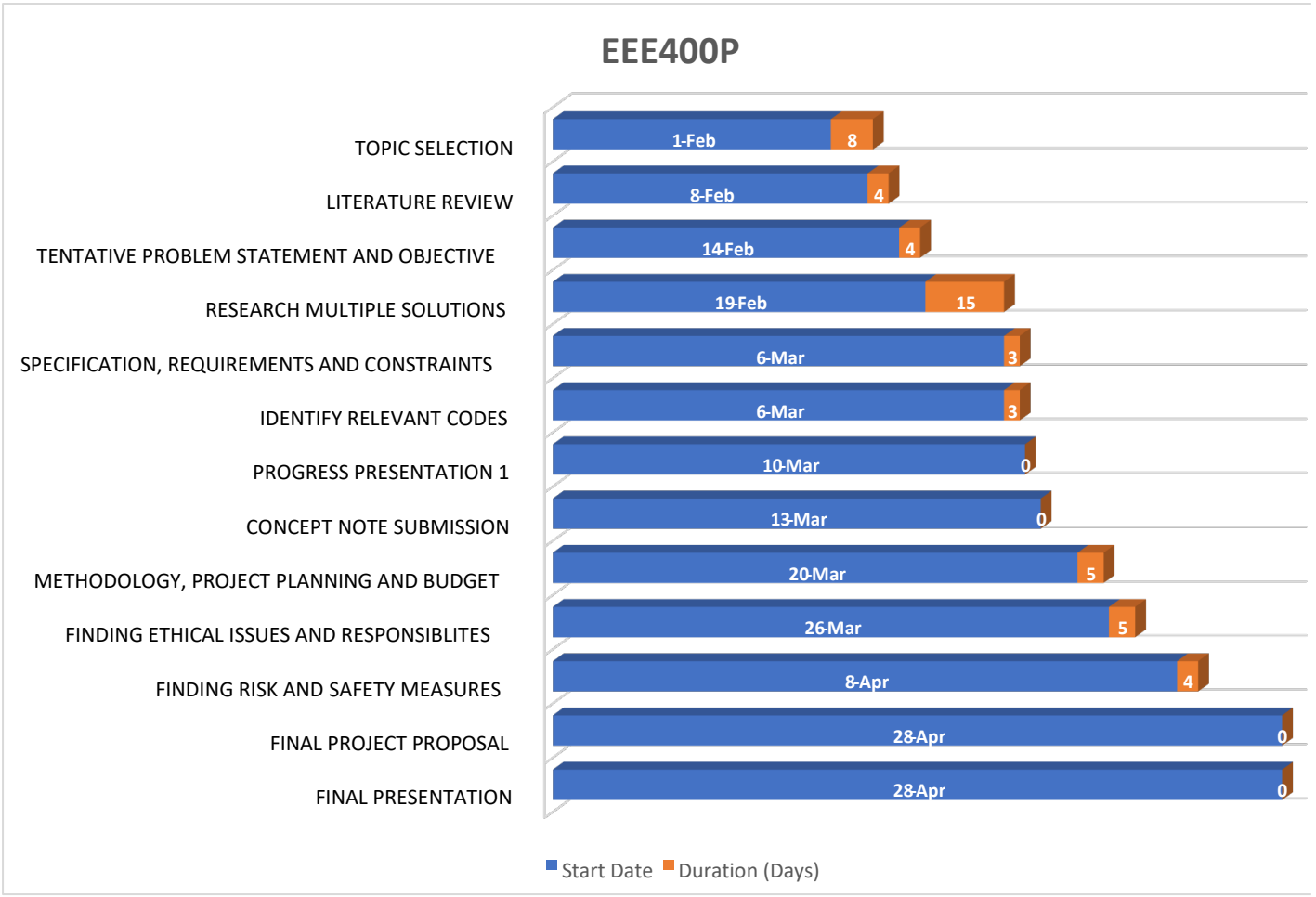


Figure 7.2: Gantt chart for FYDP_P

Our responsibilities were distributed among the members of the group. We had to replan and reschedule several times. From the second week of the month, we started working on our project. Our topic was decided by group discussions and recommendations from our ATC Panel. Sazzad and Tanjim worked on the Tentative Problem Statement and Objective section. Sazzad, Tanjim, Safayet, and Khelafat were in charge of the multiple-design approaches. Additionally, Sazzad, Tanjim, Safayet, and Khelafat worked on the specification, requirements, and constraints. Tanjim prepared to identify suitable code parts. Furthermore, Sazzad handled the methodology, Tanjim handled the project planning, and Safayet handled the budget. Khelafat, Safayet, and Ananda. Tanjim completes the risk management part.

EEE400D Gantt chart

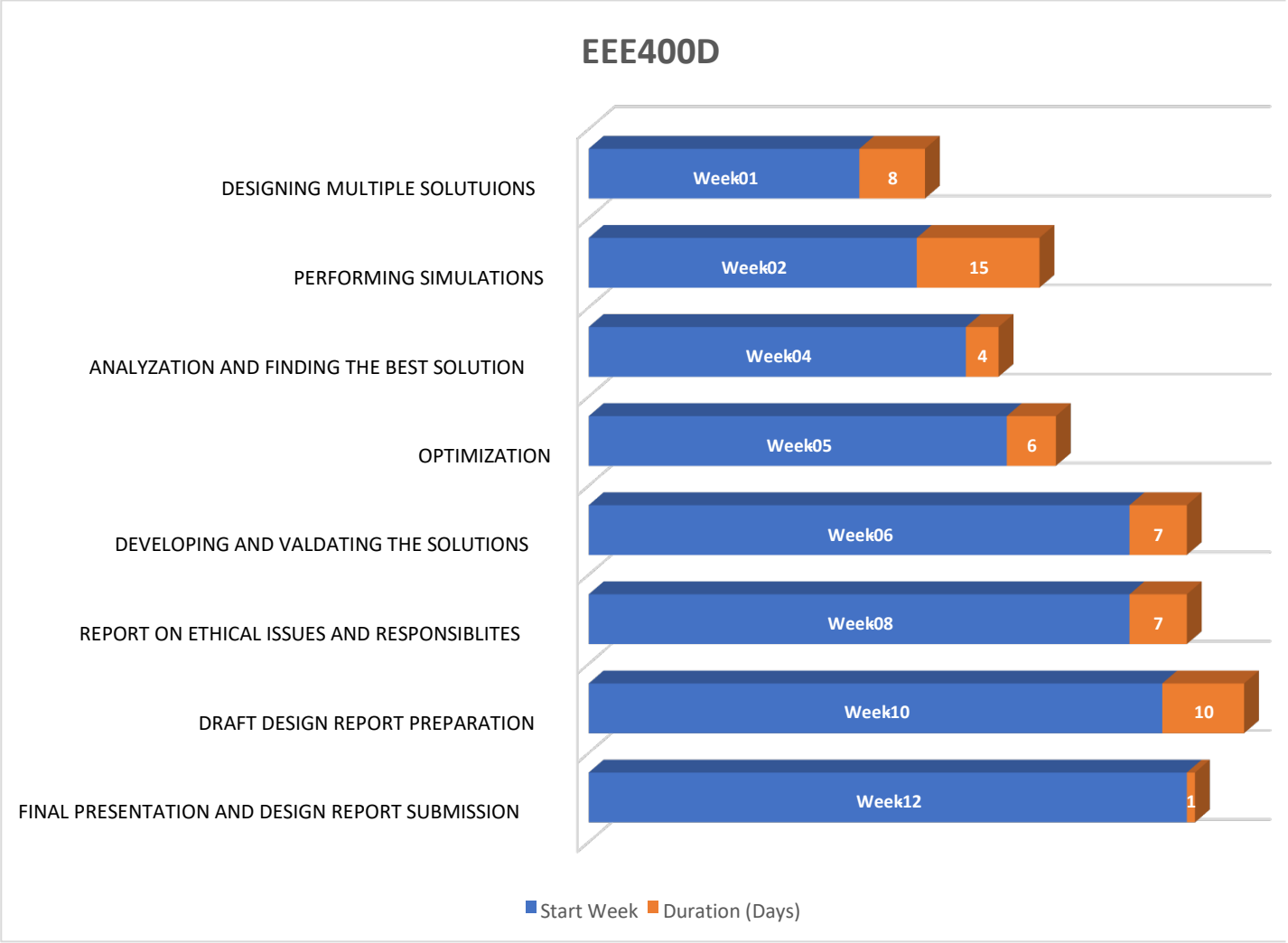


Figure 7.3: Gantt chart for FYDP_D (Previous Estimation)

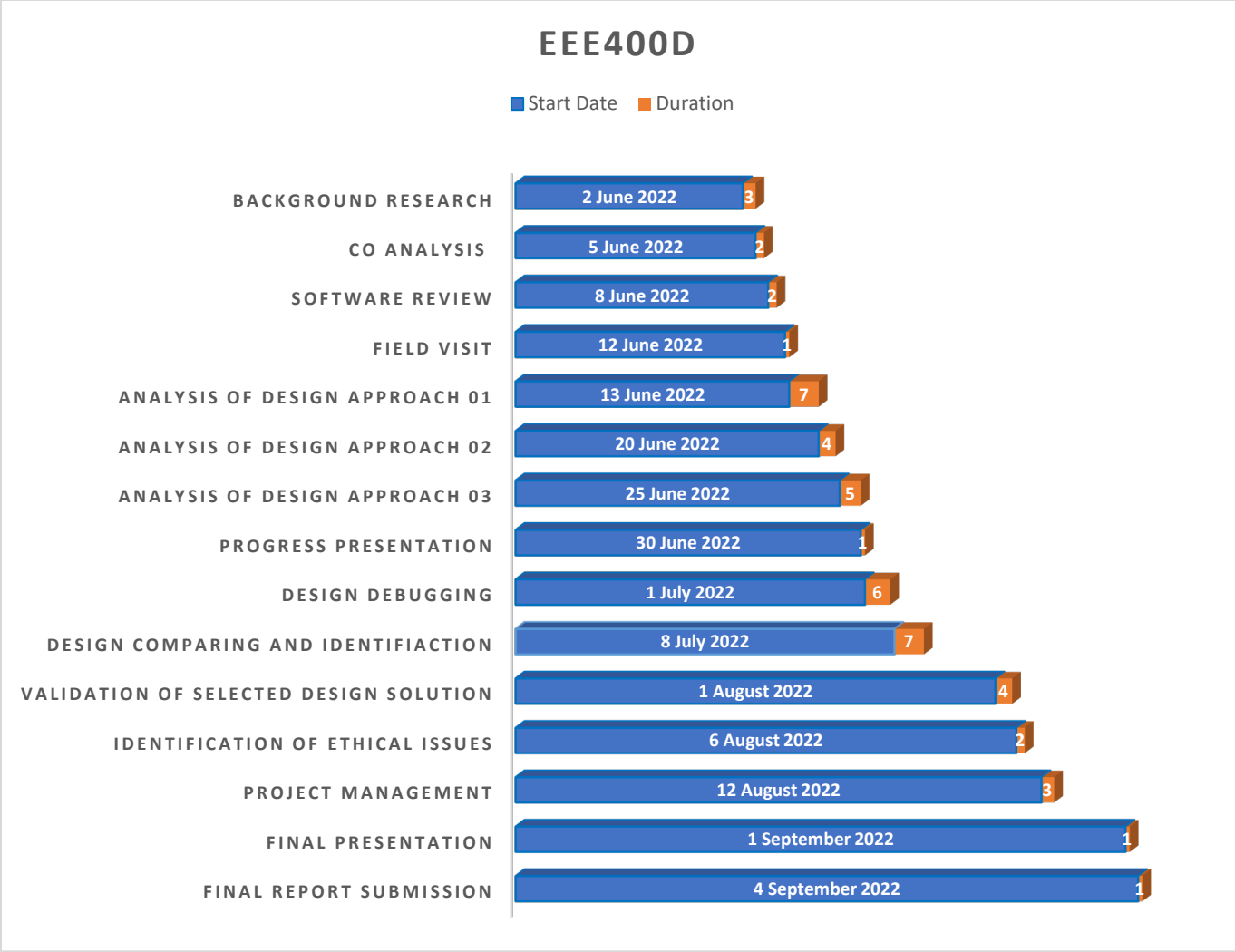


Figure 7.4: Gantt chart for FYDP_D (Updated Estimation)

We started working from the first week on. Apart from Ananda, all the group members conducted background research. Then, Tanjim, Sazzad, Safayet, and Khelafat tackled the CO analysis. The relevant software for putting our project into action was then assessed by Tanjim and Sazzad. Aside from Ananda, the entire group ventured out to a local farm for a field visit. Tanjim, Sazzad, and Safayet additionally analyzed the design methods. Tanjim and Sazzad worked on debugging the design. Safayet, Sazzad, and Tanjim were in charge of the design comparison and identification process. Sazzad did the work of identifying the ethical concerns. Moreover, using a Gantt chart and a logbook, we will assess project progress against the project plan. There will also be rescheduling, and plan adjustments made for the project if necessary.

EEE400C Gantt chart

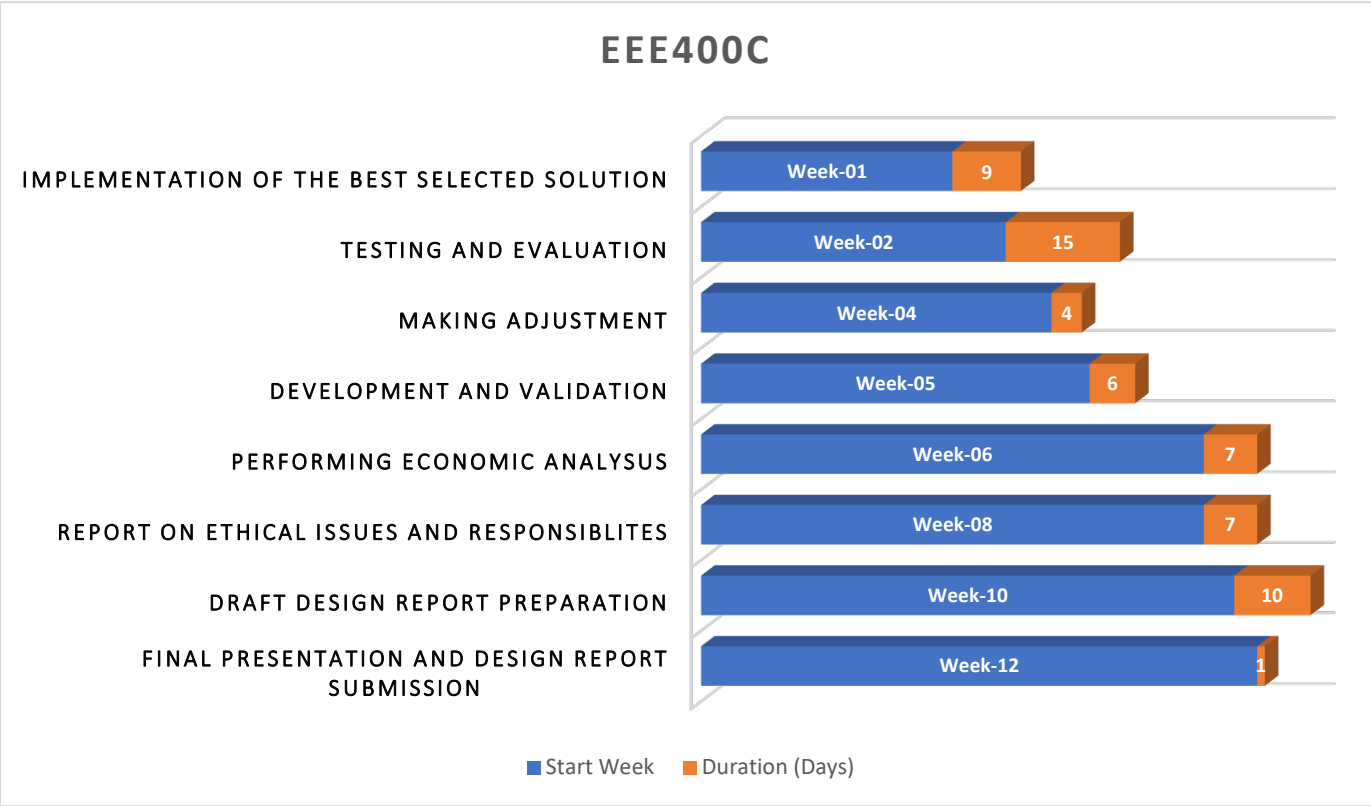


Figure 7.5: Gantt chart for FYDP_C (Previous Estimation)

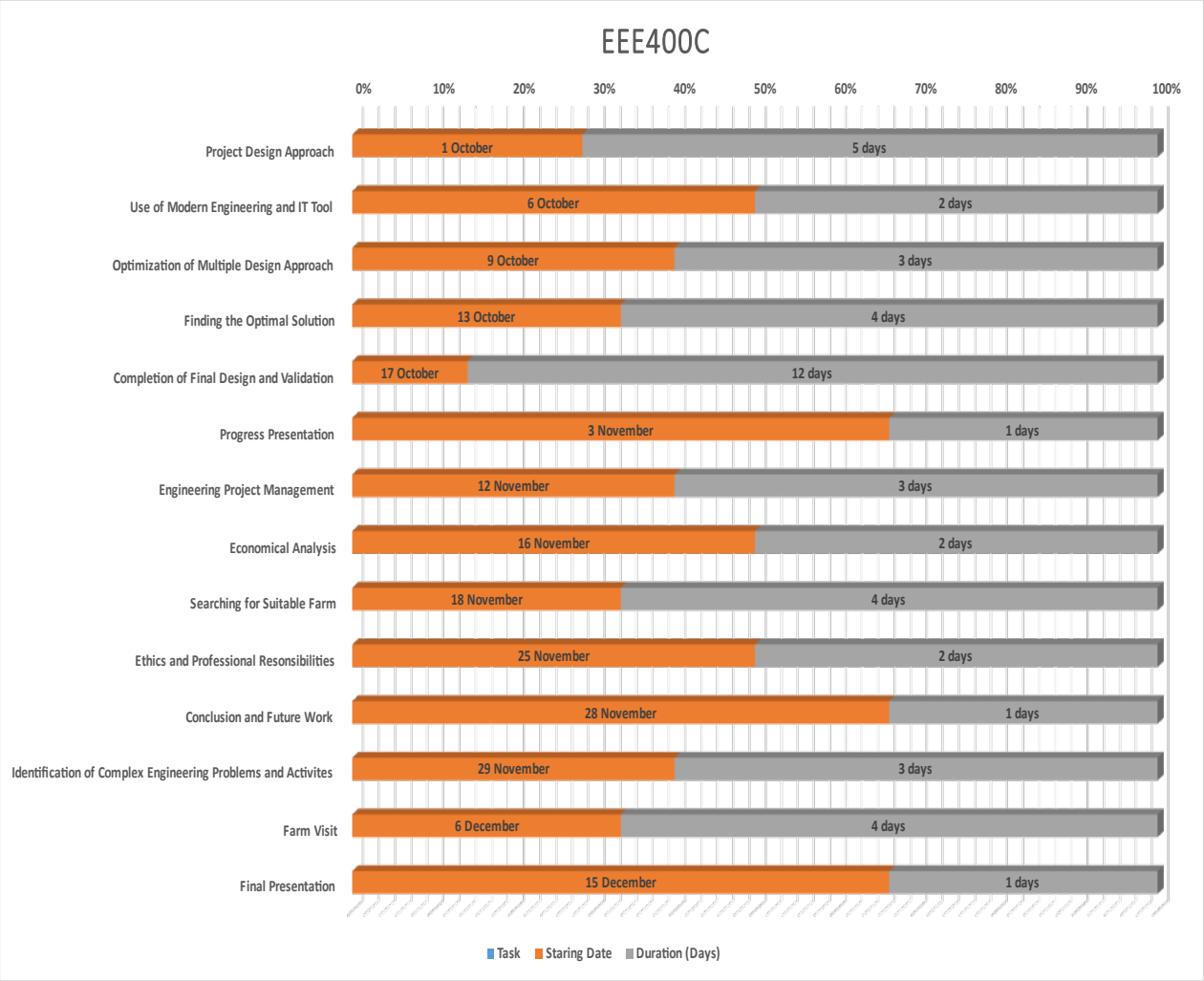


Figure 7.6: Gantt chart for FYDP_C (Updated Estimation)

We started working from the first week on. All the group members conducted background research for selecting better alternate sensors. Then, Tanjim, Sazzad, Safayet, and Khelafat tackled the CO analysis. The relevant sensors for putting our project into action was then assessed by Tanjim and Sazzad. Aside from Ananda, the entire group ventured out to a local farm for a field visit. Tanjim, Sazzad, and Safayet additionally analyzed the design methods to build the prototype to do a practical experiment. Tanjim and Sazzad worked on completing the model design. Safayet, and Khelafat were in charge of the sensor calibration. Sazzad and Tanjim did the work of collecting datasets for a healthy and non-healthy cow. Moreover, Safayet, Khelafat, and Ananda appointed a date on a farm to do our test case. All the group member then visited a veterinarian to validate the result.

7.3 Evaluate Project Progress

We have done enough necessary steps for the successful completion of our project. Throughout the whole 3 semesters, we have distributed our project work equally among our team members. Here, some are of the steps we have taken to aggregate the project work accordingly.

- Proper Gantt chart to complete the task in due time.
- Actively maintaining of logbook to keep track of individual's working progress,
- Completing Peer-evaluation forms to evaluate our team members in each semester based on their contribution.

Table 7.1: Contribution of individual group member

- Tanjim - Sazzad - Safayet	- Safayet - Khelafat	- Khelafat - Ananda - Safayet	- Tanjim - Sazzad	- Tanjim - Sazzad - Khelafat - Safayet - Ananda
Device model completion	3d module design using Fusion360 online software	Draft report writing following the instructions from the ATC panel	Sensor Calibration	Final report writing based on the work divided among us
Developing device model for prototype testing	Presentation slide making	Real-time data analysis	DHT11 (Temperature & Humidity) sensor check	
Manually collecting cow's different health parameters by visiting veterinarians and animal doctor specialist	Building the 3d module prototype	ThingSpeak App	DSB18B20 thermal probe sensor testing	
			MPU6050 rumination sensor testing	
			PCB Design Schematic	

7.4 Conclusion

In the end, we can say honestly that we have tried our best to analyze all aspects of project management skills and criteria. We have added all those important points to our FYDP (Final Year Design Project). Therefore, by keeping track of the logbook properly, the Gantt chart, and Peer-evaluation form helped us to distribute our project work equally and fairly among our team members to complete the project in due time and make it budget-friendly.

Chapter 8: Economical Analysis

8.1 Introduction

Economic feasibility analysis is the main focus of engineering economics. It’s an important branch of economics and the immediate nature of the expenditures in this case is the primary concern. Economic analysis is to assess the financial costs and benefits of a project to the society or economy by taking into account the opportunity costs of the resources used and the project's private and societal expenses. To finish an engineering project, a certain set of economic analysis requirements must be met. By analyzing and evaluating these factors, a developer of a project could detect the economic impact on his project. As a result, we examined several factors to make our "Cow health monitoring and disease detection" project more economical and cost-effective.

8.2 Economic Analysis

There are many facets of each engineering project that assist the manufacturer of the project in determining the relation of economic factors. These facets may be found in almost every engineering project. The following are the analysis points:

Microeconomics:

Microeconomics is the subfield of economics that examines the decision-making processes of individual economic units, such as consumers and producers, as well as businesses, when faced with limited resources that may be put to a variety of different purposes [18]. It examines the choices that are made on a local or regional scale in the economy. Comparisons between original and final product characteristics, as well as those features' effects on local dealers, stakeholders, and service providers, are at the core of microeconomics.

Macroeconomics:

Macroeconomics is a more comprehensive field of study because it examines the state of economies on a national and international scale. In this context, it also encompasses the more general aspects of the engineering industry, such as GDP and fiscal policy, amongst other things. The economics of a project's environment are emphasized as an external aspect. Moreover, the field of macroeconomics examines the economy as a whole, including its actions, results, and choices. It takes a wide and general view of the economy.

Budget Estimation

Engineers need to go through several phases to estimate the budget of the project. This phase includes initiation and concept, planning and development, implementation and delivery, or termination.

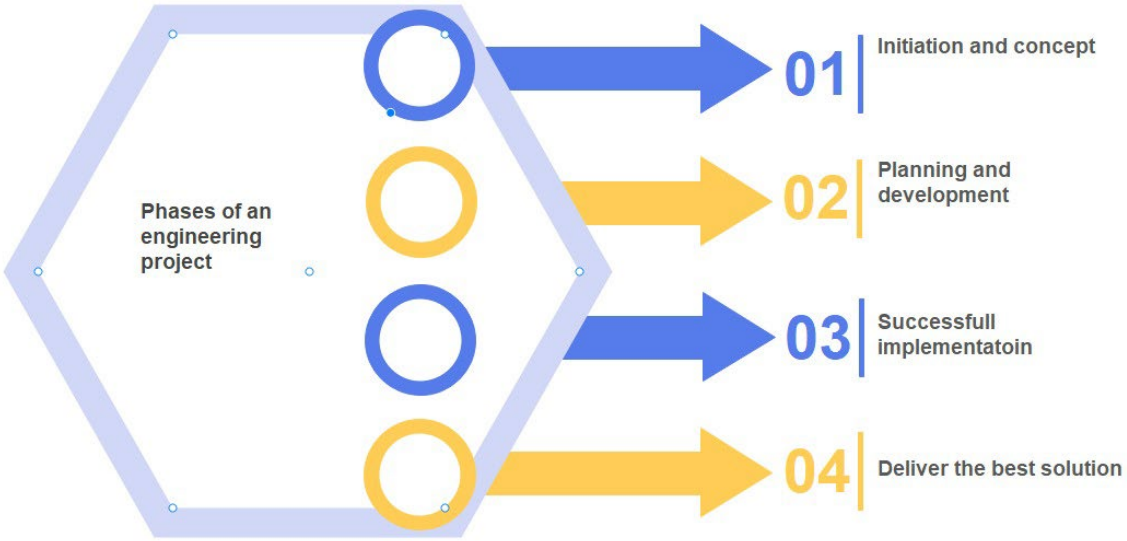


Figure 8.1: Phases of Budget Estimation

Economical Planning

This section contains a variety of criteria that assist us in determining and analyzing the economic aspects of any engineering project.

1. **Cost estimation:** Cost estimation is a preliminary estimate made by engineers at the start of a project. Here, information, data, and real-world scenarios are used to establish cost estimates throughout the development process. Cost estimation is an important factor of economical planning as it helps an engineer to successfully implement a project and select materials as per estimated cost [19].

2. **Cost breakdown structure**: Cost breakdown structure or CBS is a hierarchical breakdown of a project's costs. It's also another important factor in economical planning. Moreover, the engineer determines the project's budget using the CBS. The terms "materials," "labor," "equipment," etc., can all be used to describe various cost components.

3. **Risk management system:** Uncertainty and risk are always present in each project while it is being carried out. To tackle some unpleasant situations, engineers must learn risk management systems properly. Moreover, Engineers should think about backup strategies if the project is questionable.

4. **Continuous evaluation:** The engineer must continuously track the increases and decreases in the expected cost after establishing the project's budget and overall cost. To keep track of the project's overall costs, they can utilize a chart. By doing continuous evaluation engineers can get the respective project done.

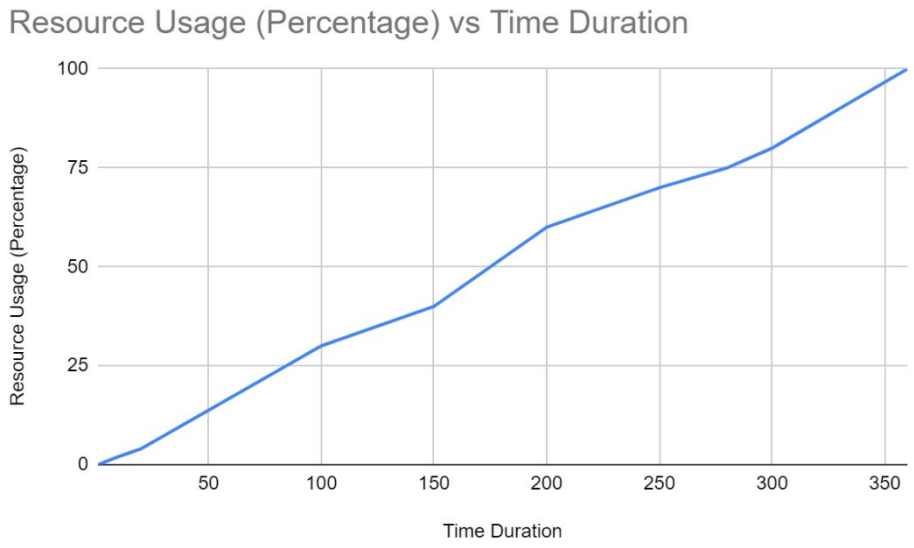


Figure 8.2: Evaluation of resource usage over time

8.3 Cost Benefit Analysis

A cost-benefit analysis of any engineering project is a systematic technique in which ideas are reviewed to determine if the benefits outweigh the costs, and in what amount. While analyzing the cost-benefit of any engineering project, we must consider several elements.

Balance Sheet: The key to effectively finishing a project is thought to be methodical procedures and well-organized work. Here, the engineers must create a balance sheet and budget sheet in order to make a project cost beneficial. On these sheets, they may keep track of the costs and expenses incurred during the entire process.

The cost impact on the development process: Cost has a big influence on the development of the project. Moreover, the project development process can change for the cost to increase or decrease. Furthermore, Engineers need to assess the process of creation and comprehend how costs will affect the project's final cost.

8.4 Evaluate Economic and Financial aspects

We analyzed different articles on engineering project economics and also did some cost analysis to evaluate the economic and financial aspects of our final-year design Project. Moreover, after doing some analysis and after going through many research papers we have chosen some criteria to assess the economic and financial features of our cow health monitoring and disease detection project.

Evaluation of Economical aspects

Macroeconomics and our project: Macroeconomics are an external branch of the economy. Furthermore, it is an important part of any engineering project and has a significant role in our economy. The macroeconomy is based on external factors and that’s the reason external factors are also added to our project. According to the survey of the department of life stock services, there are about 1.4 million dairy farms in Bangladesh. And a majority of the cow farms have 1-3 cows. [1] Moreover, farmer faces huge loss for the death of cow on their farm every year. The majority of the farmer who runs the farm are illiterate and they do not have huge knowledge about cow diseases. Although Vets are also not available in many rural places in our country so many cows do not get proper treatment and also their diseases cannot get detected in an early state. So, it's a huge problem. But by implementing our design farmers can get to know cows’ health condition by monitoring the display in Thingspeak. More farmers can also know the death-threatening diseases early. So, it's a huge advantage for them. As a result, the farmer can consult

with the vets early and so there will be fewer sick cows on the farms. Furthermore, there will be more milk production and the income of the farm will also increase so it's a huge advantage for them. In addition, our project will be a huge positive impact on our nation's microeconomics, which will ensure more milk production and fewer sick cows on the farms.

Microeconomics and our project: The interrelationship between every individual engineering project's local dealer, service providers, and stakeholders is explored in terms of "microeconomics." Another key component of this type of economic factor is the attention placed on the start and final products of any project, as well as how they affect the economic phase. Furthermore, in our final year design project, we tried to make a connection with microeconomics. Microeconomics is a smaller term or smaller branch of economics. Moreover, by implementing our project there will be fewer cow death in the firm the profit will be much higher than before. So, more people in our country will be interested in cow farming and that will also benefit our nation by ensuring more economical benefits as well as by fulfilling the demand for nutrition. Finally, it will have a huge impact on our country's macroeconomics.
Budget Estimation of our project: For fulfilling a successful project we need to adjust the budget first. Moreover, we divided our tasks into many segments and worked on them from beginning to conclusion. In addition, we scrutinized the phases to establish and then routinely update our project budget. We divided our phases of project duration and budget into three phases, including phase one phase, two and phase three. Furthermore, 400P and 400D has

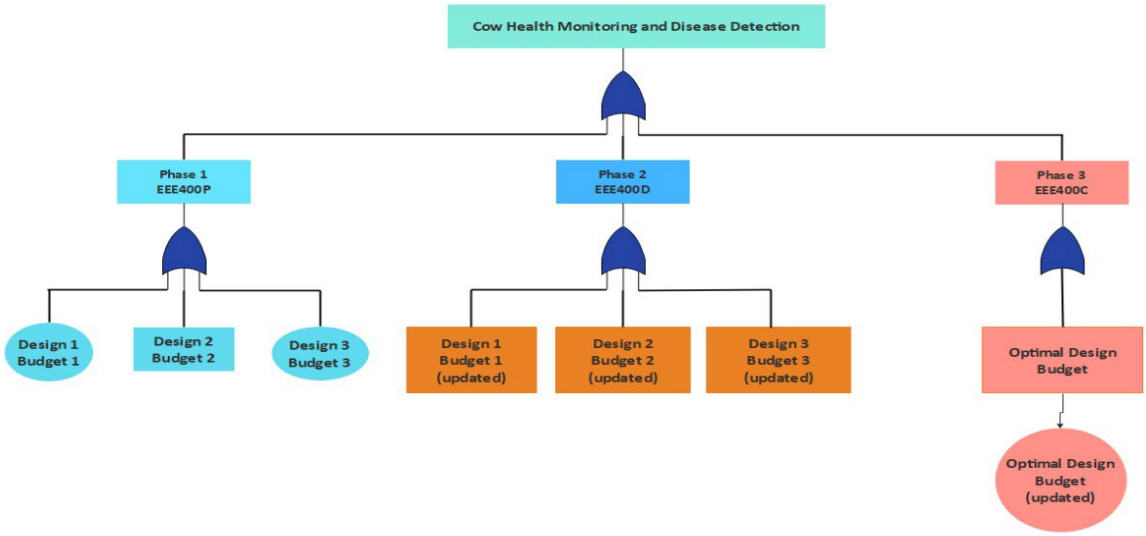


Figure 8.3: Project duration and budget phases.

three segments individually and 400C has one segment or the optimal design budget. As a result of studying the project stages, we were able to manage our project expenditures to achieve our project objectives.

Estimation of Cost: From semester to semester, we projected the entire project cost for our FYDP project. As the project progresses, the cost of our project fluctuates as a consequence of data, unanticipated occurrences such as sensor burst, damaged components, and market instability for componentry, and defective PCB design [20]. Furthermore, the Cost Breakdown Structure generates the engineering project's cost estimation. This method was utilized to estimate the expenses of our project in this case.

Risk management system: A risk in a project is an unpredictable occurrence that may or may not occur throughout the course of the project. Moreover, engineers have to always be ready for the uneven outcome of a project and for the ways to tackle them. Conversely, a project risk can have either a direct or an indirect effect on progress toward project objectives. We may also encounter dangers such as component malfunction, system failure, and so on. From the initial day of project work to its conclusion, we observed these events and put them into practice. In order to deal with unforeseen circumstances including economic concerns, we have allocated group members.

Table 8.1: Risk management responsibility chart.

Risk Management System			
Occurrence	**Description**	**Backup Plan**	**Responsible person**
Component failure	Due to improper inspection, defective and dysfunctional components may be purchased. As a result, because it is unusable, it will add to the budget.	Keeping all of the store's purchase receipts allows us to acquire replacement parts or reimbursement from the store if any of the components are defective.	**Tanjim, Sazzad**
Components Scarcity	The availability of components in the market might vary for a variety of reasons, causing the price of the components to rise.	We've examined and looked for stores and websites where we can get the components for a fair price in order to avoid using expensive components.	**Sazzad, Safayet**

Component Damage	Short circuits might cause our components to rupture or damage when collecting data and experimenting with our system, causing an issue with our project budget.	As is obvious, such an incident may occur during the project. As a result, we kept extra components on hand to avoid any unexpected scenarios.	**Khelafat, Ananda**
PCB Failure	As we are implementing our design in PCB while placing the mainboard and charging module PCB can get damaged and it will increase the cost.	So, we did multiple PCB design for any unexpected occurrences	**Tanjim, Safayet**
3D Print Problem	3D printing takes huge time, we have to print the cover perfect size, otherwise, it will not be placed in our prototype, so it's a huge problem and it can increase our cost.	So, we have taken the perfect measurement of the PCB before 3d printing.	**Sazzad, Khelafat**

Continues evaluation: We consciously decided on a budget for three design approaches in our final year design project, and then we started to adjust the budget for them. As a result, after deciding on the best design, we used an excel balance sheet to track the budget and expenditures on a regular basis. Additionally, in order to be cost-effective and assess our projects past and present budgets, we have updated and maintained our balance sheet as an engineering project.

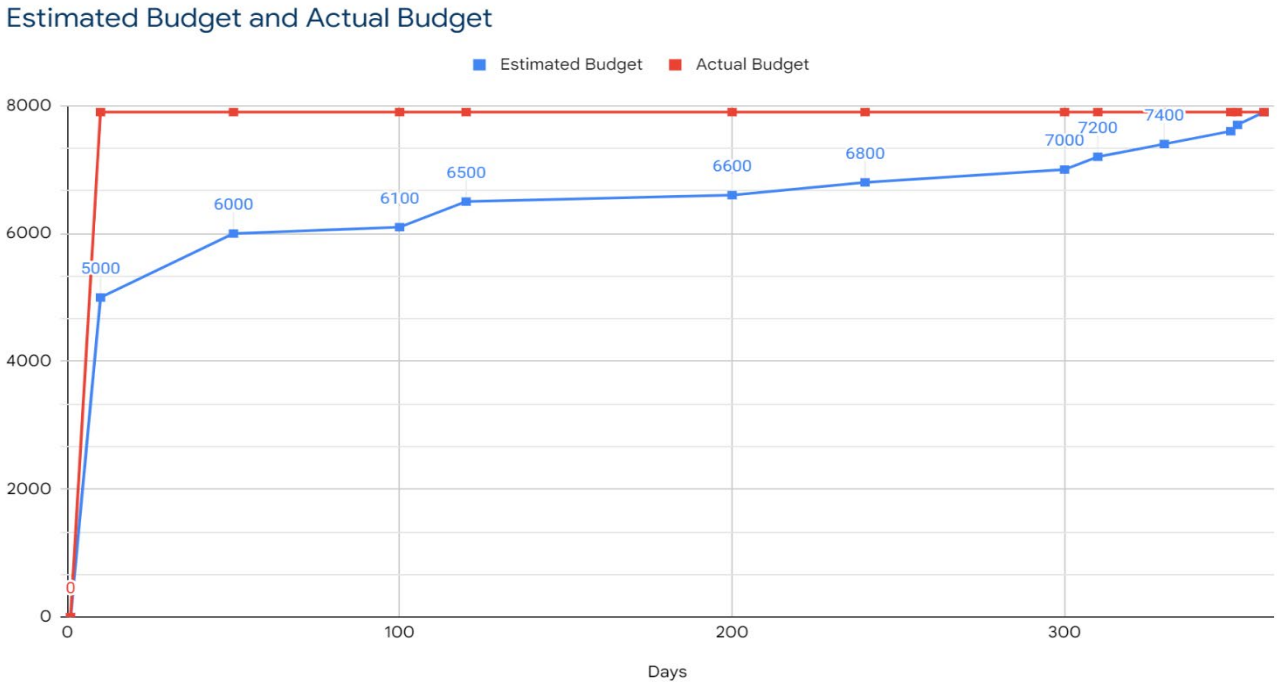


Figure 8.4: Budget evaluation

Here, we can see how our budget changed from 400P to 400C. However, our budget was much lower at the beginning of 400P but it increased more as we go through different websites and also analyze the market. Moreover, there is also a scarcity of different items for the COVID-19 hit and many types of equipment are not coming from China so there is also an increase in price. In the initial stages, we thought we will not design our prototype in PCB but as time goes by and we researched more we found out that we have to implement our design in PCB, so it also increased our budget a lot. Additionally, we also designed a 3D printed box to cover our prototype and it also increased our budget.

Evaluating Financial Aspects: We studied the viewpoints of our project's stakeholders in every engineering project. In this section, we've identified several components of our project that will assist customers in keeping track of their financial situations in numerous ways.

By implementing our project farmers can easily monitor the cow's health in the thingspeak and as a result, they can know the health condition of individual cows. Additionally, he can also know when to call the Veterinarian and when not to call them. Moreover, he can analyze the situation of the cow by himself. for that, he also saves his money because a veterinarian takes a lot of charge to visit a farm and to anticipate cow health condition. In our project, we used 2500 mah battery and which is easy to charge, and it will consume lower power so it will also help to save more electricity. So, our prototype will bring benefit to each farm and each farmer so their financial condition will also improve.

8.5 Conclusion

Dairy farming has a vital role in the development of Bangladesh. Moreover, Dairy farming is growing at a faster rate than national income. To avert poverty in Bangladesh, dairy farming has worked amazingly. Therefore, we should focus on improving this sector, as it plays a significant role in the development of our country. As a result, we have proposed a project in which farmers may obtain information about their cows' health parameters and expected disease based on those parameters so that they can visit a vet doctor as soon as possible to avoid big losses in their business. Moreover, by implementing our design cow farm owners will be financially benefitted and will observe economic growth to their business.

Chapter 9: Ethics and Professional Responsibilities

9.1 Introduction

In any project, ethics and professional responsibilities are essential because a certain criterion has to meet in order to have the project's acceptability. Therefore, for our FYDP (Final Year Design Project) we have gone through various criteria. Such as professional ethics, responsibility, consent, applicable codes, standards etc. These criteria helped us to build our project more robust and environment and human friendly.

9.2 Identify Ethical Issues and Professional Responsibility

While executing our project we have to keep in mind of the ethical issues and professional responsibility. For that we have to do extensive research and have to look through others perspective to understand the environment and its surrounding people. From out projects perspective we will describe some of the ethical condition and professionalism that we have followed:

Honesty: While doing our project we have maintained honesty through and through. Strongly stand against plagiarism. Also, we have been honest about out project with the stakeholders.

Carefulness: We have been very cautious while making out prototype so that we can prevent any unwanted accidents. Also, while working with solder iron and dangerous components we have been very caution and took some premeasurement steps.

Openness: Throughout the project we have been collecting ideas from whatever source we can reach to. And we were up for new ideas. Also, we shared our idea with our ATC and got feedback accordingly and took measurement based on that.

Confidentiality: While visiting Partex cow farm we have been told to be confidential about their farm. And we followed their saying and with their permission we took the video and data records that we needed only.

Considering Publication: In future we will do further research on this project and will publish them. This work might be help to some other person as well as it will help us in personal career.

Courtesy Toward people: We have been very respectful towards each other and also respectful towards the people who was related with our project.

Socially Responsible: While taking survey and collecting data and parameters of the cow we have been to lots of people and we did not create any chaos while interacting with peoples. And we have be well behaved to all the people. Also, we did not do any kind of discrimination towards any kind of people.

Legality: We have been abided by law and what is illegal we did not do that. Also, we have been stood against any illegal action.

Animal Welfare: As our project's topic is cow health monitoring and disease detection. Here we are dealing with animals, in our case it is cow. We will treat animal properly and we won't hurt them intentionally in any way.

Protection of human privacy: As we are working in other people's cow farm. So, they might have some confidential information or things they don't want share outside. We have protected people's privacy and maintained them. So that any kind of harm could not come to them by us.

These are some of the ethical consideration and professional responsibility that we have followed to make our project successful.

9.3 Apply Ethical Issues and Professional Responsibility

According to the professional ethics and responsibilities related to engineering practice, we are expected to demonstrate the greatest level of honesty and integrity, and we must prioritize the public's safety, health, and welfare, as well as the environment. And most importantly we also have to ensure the animal rights and treat them well.

Consent of the owner

Ethical issues like anonymity, confidentiality, informed consent have to be addressed. We have tried to address these ethical issues through a consent form. So, before taking part in the project, the stakeholders will have to go through a consent form and agree to its terms. We have taken the consent of our stakeholders with this consent form. which is given below:

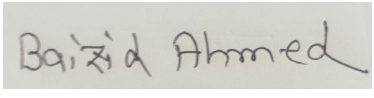
Cow health monitoring device usability test Consent form

Please read it before signing this form

In this usability test:

- Your cows need to wear / put on the health monitoring device to the test
- Data from your farm and surrounding of it will be taken
- Images of you regular cow and diseased cow will be taken
- You will be given basic training to know about the operation of the device and will be able to operate them.
- You will provide necessary feedback and other information to improve the cow health monitoring system

Participation in this usability test is entirely optional. All information will be kept private. The descriptions and results could be used to improve the smart cane. However, your name or any other identifying information will never be utilized. You have the right to withdraw your permission to participate in the study at any time.
Please email at safayet.ahmed@g.bracu.ac.bd if you have any queries.
I have read and fully understand the information on this form and have had all of my questions answered.



28.09.2022

Signature Date

Cow health monitoring device usability test Consent form

Please read it before signing this form

In this usability test:

- Your cows need to wear / put on the health monitoring device to the test
- Data from your farm and surrounding of it will be taken
- Images of you regular cow and diseased cow will be taken
- You will be given basic training to know about the operation of the device and will be able to operate them.
- You will provide necessary feedback and other information to improve the cow health monitoring system

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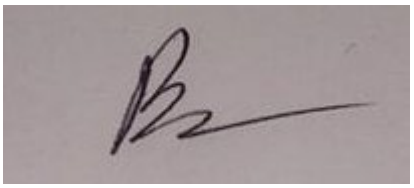
Please email at safayet.ahmed@g.bracu.ac.bd if you have any queries.

I have read and fully understand the information on this form and have had all of my questions answered.



12.10.2022

Signature

Date

Figure 9.1: Stakeholder's visiting card

Safety of the animals

While using out device on cows we will be cautious about that it does not hamper the cow in any way. For example, we will be aware of device thoroughly so that cow does not get electrocuted due to faulty connections. And device also have to be water resistant and water cannot go inside the electrical component part, that way we can prevent short circuit and accidents related to that.
In our design approach 2 we will be using tube to insert in cow rumen to take pH measurement. While doing that we have to be aware that we do not do any damage to internal organs of cow. For that purpose, we will be taking help from veterinary to perform the procedure and take data if needed be.
In our third design approach we are using IR thermography camera. The problem with IR thermography is that as the density increases it affects badly on cows' bodies. Another problem associated with this approach is that if the scanner does not work in its normal way, then the radiation level will be too high for the cows. To counter that problem, we will limit the usage of the device. And test the device before running on cow so that it can be ensured that the device is performing accurately.

Durability of the components

Damage in electrical components are all possible scenarios. We will disassemble the system again and try to fix the loose wire connection. We will restart the system and examine the wire connections for system freeze and short circuit. We will replace the malfunctioning sensor with a new one if it fails. We will use a waterproof bag to protect against liquid damage.
Lastly, we will try to make our device as much durable as possible so that I can withstand dust, water, other form of liquids and heat.

Personal Security Protection

When we are collecting Data of a specific farm and using them for the purpose of our project or for the device, we will be keeping the data to ourself it will not be able to accessed by any third party. To ensure the farther protection on farm, the data that will be founded by device will only can be accessed by the owners and the us. If we get any in formation like data is getting leaked any other is outside thread is trying to get data from the devices the device will automatically turned off and it will alert us immediately. Therefore, without proper authorization from admin data access will be denied and all these are possible with help of advance coding in our devices.

Assuring significance for both businesses and society

As our protein and dairy need is increasing every day, and cow is one of the largest proteins consume chain in country. So, there will be new investor and entrepreneur in this section. To make their cow farming more profitable and easier this device will help them to monitor their cows and get live update from them. This way the business will increase, also the supply and demand will meet. Due to this demand is fulfilled the society will be benefited greatly and people will get proper daily nutrients.

Applicable Standards and Codes

Table 9.1: Applicable Standards and codes.

Required Device/Technology	Standard/ Code Number	Definition	Solution that the code dictates
Internet of Things	IEEE 2413-2019	Concerns shared by IoT system stakeholders across different domains inspired the design framework definition (transportation, healthcare, Smart Grid, etc.). The shared concerns as a collection of architecture views are extended to create the body of the framework description, and a conceptual underpinning for the notion of things in the IoT is supplied.	According to the standard, by analyzing the viewpoints of IoT, body of the framework description is formed. We will use this standard while making our IoT based cow health monitoring and disease detection system [21].

Rechargeable battery	IEEE 1625-2008	This standard specifies design standards for the certification, quality, and dependability of rechargeable battery systems for multi-cell mobile computing devices.	This standard is used to improve the reliability of battery operation and user experience.
Wireless network	IEEE 802.11-2016	Technical corrections and clarifications to IEEE Std 802.11 for wireless local area networks as well as enhancements to the existing medium access control and physical layer functions are specified in this revision	This technology is used to connect devices wirelessly.
Transistor	IEEE 256-1963	This Standard recommends and describes methods of measurement of the important electrical characteristics of semiconductor diodes.	This standard is applied when assessing rumen pH status with MOSFET.

9.4 Conclusion

To conclude, by abiding all the ethical conditions and professional responsibilities we have conducted our project. We have collected knowledge about all the ethics and responsibilities and we have prioritized the need, safety and privacy of the stakeholders. Also, to make our project more environment friendly we have followed some standards. And also make it socially acceptable we have maintained some procedures.

Chapter 10: Conclusion and Future Work

10.1 Project Summary/Conclusion

Bangladesh is highly populated country and has lots of demands of meat and dairy products. Yet for past decade ta price hike in meat and dairy goods are rising exponentially every year. One of the major reasons is due to lack of proper monitoring farmers are not getting desired outcome from their farm. And they are facing losses. Sometime the loss is so great that farmer quit cow farming. Mostly farmer is not aware of cow diseases at early stage if they could see that cow is becoming sick, they will be able to take precaution before it's too late. From that perspective we have come up with our project idea and developed it. We have kept this project as simple as possible that a farmer can easily understand and can use it easily [22]. As our project will help farmers greatly that will have some positive impact on economy and society. With the help of our product farmer will be able to,

- Live monitor cow's health parameter
- It will give the probable disease detection of the cow.
- If the cow is sick the used will be notified through mail
- It will store previous 30 days data to monitor the heath of the cow.

10.2 Future Work

As world is advancing day by day so the technology is also advancing and new thing are coming up every day. Every project has its scope of improvement. Basically, future work indicates that there is a new direction and new path of discovery to do. And that can lead to improvement of our current project. On this project we have built a prototype that can measure of cow's health parameters and monitors them and gives output of probable diseases. In near future we want to update our project both hardware and software aspect. These future works will be beneficials for user as their will be less scope of errors. Now, we will discuss about some of our future works,

1. **More range of disease detection:** Currently or device can only detect 3 types of diseases in cow those are Heat Stress, Rabies, Heart Attack. But there are variety range of disease in cows that might occur. And in future we will incorporate those disease on our device.

2. **Bacterial disease detection:** Now our device can only detect the diseases that can be mentioned from the sensors. There is a high chance that cow's bacterial disease causes a dramatic change in milk production and meat quality.

3. **Rumen pH measurement:** Cow's rumen pH plays a vital role in cow's health monitoring. But measuring rumen pH is quite problematic we have to insert a pH tester device in to cow's stomach to test the rumen pH. In future we will try to come up with idea that won't be required much labor.

4. **Monitoring Pregnant Cow:** We will upgrade our device in such way that I will be specialized for pregnant cow so that mother cows survive the labor while giving birth.

5. **GPS connection:** we will keep GPS connection with our device so that we can measure the movement also is the cow is lost we can find it easily.

6. **Software update:** As we are now getting notification system as mail later, we will be able to move it as our mobile software of message system to keep the farmer updated about his farm daily.

Chapter 11: Identification of Complex Engineering Problems and Activities

11.1 Identify the Attribute of Complex Engineering Problem (EP)

	Attributes	**Put a tick (√) as appropriate**	**Description**
P1	Depth of knowledge required	√	We need to have in-depth knowledge of each component we are using in our project, as it is a very sensitive one.
P2	Range of conflicting requirements	√	Different stakeholders will have different requirements for each approach.
P3	Depth of analysis required	√	Thorough analysis and study of sufficient research papers are mandatory that we need to have throughout the whole project.
P4	Familiarity of issues	√	The problem we have chosen is a complex engineering problem and in our normal course subject we usually do not solve such problems.
P5	The extent of applicable codes	√	We must ensure that our project follows an existing standard**.**
P6	The extent of stakeholder involvement and needs	√	It is necessary to attract different stakeholders to make the project more impactful.
P7	Interdependence	√	The solution for this problem includes a combination of different subsystems.

11.2 Provide Reasoning How the Project Address Selected Attribute (EP)

	Attributes	**Put a tick (√) as appropriate**	**Description**
A1	Range of resource	√	This project will necessitate a wide range of resources such as funding, equipment, technology, components, and important opinions from stakeholders. However, to manage everything, resource management skill is a must one to have each team member for proper management.
A2	Level of interaction	√	Communication with different stakeholders is required to get proper information and feedback
A3	Innovation		
A4	Consequences for society and the environment	√	Proper and effective evaluation along with communication of the impact of the project on legal, health, cultural, social, and economic.
A5	Familiarity	√	The problem we have decided to solve is a new thing for us and not related to our course curriculum hence we needed to do enough research and found a bunch of additional resources that would help further.

11.3 Attributes of Complex Engineering Activities (EA)

	Attributes	**Put tick (√) as appropriate**
A1	Range of resource	√
A2	Level of interaction	√
A3	Innovation	
A4	Consequences for society and the environment	√
A5	Familiarity	√

11.4 Provide Reasoning How the Project Address Selected Attribute (EA)

A1: Range of resources

We have studied numerous research papers, articles, journals, books, and other materials for the development of our cow health monitoring and disease detection project. These resources helped us refine our understanding of the project, its design concept, and the steps required to construct the prototype [23].

A2: Level of interaction

For this project, the level of participation is essential. Moreover, we have visited many farms and talked with many farm owners and farm employee for better understanding about cow related problems and collect data. We also talked to two veterinarians about the cow's different illnesses. Moreover, we had to get the Farm owner's approval before we could visit and conduct tests on the cows. Consequently, interaction was essential for our project.

A4: Consequences for society and the environment

By our project, cow farmers will be benefited as they can monitor the cow health parameters and know when to call the vet. As a result, there will be less sick cow and farmers will be economically benefitted. So, more people will be inspired to come into cow farming occupation. In addition, as we made lower power consumption prototype, there will be minimal heat dissipation, which will have a favorable effect on the environment.

A5: Familiarity

In our project we are dealing with familiar problems of cow diseases. In addition, by implementing our project, farmers will be able to monitor the health of their cows and anticipate diseases in their cows simply by looking at the screen of their smartphones. In addition, we are using Thingspeak and its a free site and as farmers can easily detect cow diseases using Thingspeak, there will be a significant savings in terms of money as well.

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Logbook

FYDP – P Logbook:

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
06.02.2022 10.00 AM Facebook	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain	1. Opened messenger group and got introduced with each other and go the contacs of everyone.	Equal Contribution	N/A as it was an introductory meeting.
08.02.2022 1.00 PM Facebook platform	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain	1. Discussed possible problems we could think. 2. Eleminated the topics that seemed uninteresting and might requre more than 1year time.	Equal Contribution	It was a discussion session previously no task was assigned.
10.02.2022 9.00 PM Google meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Discussed about probable topics and based on those topics we came with some research paperss as ground and after that we mailed outr atc panel to arrage a meeting for us. 2. We have decided to come up with atleast two topics and those topics related research paper.	Task 1: everyone will atleast bring two topics and those topics related research paper	task 1: completed, everyone bought up with atleast two topics
12.02.2022 11:00 – 11:45 AM	1. Safayet Ahmed 2. Tanjim Rahman	1. We presented our ideas to previous ATC panel and but ATC chair sir was	No task was assigned	not applicable

Google meet	Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	more interested on communication related topics. 2. We had to rethink about our topics or we have to request for change the ATC panel.		
16.02.2022 7.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. We discussed our problems and topics with Mohsin Sir and sir suggested us to narrow down to three topics.	Equal Contribution	Not applicable
21.02.2022 9.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain	1. We discussed our topics with Mohsin Sir and sir suggested us to narrow down to three topics. 2. Based on those topics we researched for meterials from IEEE website and Google scholar.	Task 1: everyone Task 2: Niloy, Safayet, Sazzad, Khelafat	Task 1: Completed Task 2: Completed
24.02.2022	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. ATC panel changed to ATC-06	not applicable	not applicable

25.02.2022 10.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain	1. We discussed the findings of our topics and shared them to make them presentable.	Equal Contribution	task completed
1.03.2022 10.00 AM On campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. We discussed with Our ATC chai and finalized our topic 2. Based on the topic we are searching for report and read them and annotated them to find the ideas of design approaches	Task 1: everyone Task 2: Niloy, Safayet, Sazzad, Khelafat, Kazi	Task 1: Completed Task 2: Partially Completed
2.03.2022 7.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain	1. we started to work on concept project proposal and divided work on among ourself. 2. Problem statement 3. Design Approach, specification requirements. 4. Tentative Objectives, Conclusion, Constrains	Task 1: everyone Task 2: Khelafat Task 3: Niloy, Sazzad, Safayet Task 4: Kazi Ananda Shams	Task 1: Completed Task 2: Failed to Complete Task 3: Completed Task 4: Failed to complete
6.03.2022 10.00 AM On campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. We started to merge our work and started to focus on unfinised work 2. started to work on Slides 3. Worked on Problem statement again 4. Worked on tentative objectives again	Task 1: Everyone Task 2: Niloy, Safayet Task 3: Sazzad, Safayet Task 4: Niloy	Task 1: Completed Task 2: Partially Completed Task 3: Completed Task 4: Comnpleted

8.03.2022 10.00 AM On campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain	1. Got feed back on out design approaches from ATC panel and need to chage lot of thing like design method and have come up with totall three seperate kind of objective.	Task 1: Niloy, Safayet, Sazzad	Task 1: Completed
9.03.2022 9.00AM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain	1. Started to Work on Slides and slide points	Task 1: Niloy, Safayet, Sazzad	Task 1: Completed
10.03.2022 11.00 AM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Presented the progress presentation-1 infront of FYDP commitee.	Task 1: Everyone	Task 1: Completed
17.03.2022 9.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Worked on tentative objectives on report. 2. Worked on Problem Statement. 3. Worked on Constrains and Conclusion	Task 1: Sazzad Task 2: Niloy Task 3: Kazi Ananda, Safayet	Task 1: Completed Task 2: Completed Task 3: Completed
20.03.2022	1. Safayet Ahmed 2. Tanjim Rahman	1. Submitted the Final Year Design Project Concept Note	Task 1: Everyone	Task 1: Completed

	Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams			
21.03.2022 9.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Started to Work on Draft project Proposal and had discussion among us.	Task 1: Everyone	Task 1: Completed
22.03.2022 10.00 AM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Got feedback from the Final Year Design Project Concept Note and out presentation. 2. Changed the things suggested accordingly and worked on our projects parameter.	Task 1: Everyone Task 2: Niloy, Safayet, Sazzad	Task 1: Completed Task 2: Completed
24.03.2022 7.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	divided the work of Project Proposal accordingly, 1. problem Statement 2. Design approaches 3. Specifications 4. Impacs 5. Sustainability 6. Outcome	Task 1: Sazzad Task 2: Niloy, Safayet, Sazzad Task 3: Safayet Task 4: Kazi Ananda Task 5: Khelafat Task 6: Niloy	Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Failed to Complete Task 5: Failed to complete Task 6: Completed

1.04.2022 7.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1.Started to merge our work. 2. Started to Create Final Project proposal 3. looked on eatch other's work and keept ourself updated.	Task 1: Sazzad Task 2: Niloy, Safayet, Sazzad Task 3: Everyone	Task 1: Completed Task 2: Completed Task 3: Completed
4.04.2022	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. We submitted our draft project proposal 2.Based on that we got feedbacks and changed accordingly.	Equal Contribution	Task 1: Completed Task 2: Completed
19.04.2022 6.00 PM Google meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Major flaws were found in Sustainability and impacts and severe plagiarism were found. 2. Started to make Slides	Task 1: Khelafat, Kazi Ananda Task 2: Niloy, Safayet	Task 1: Failed to correct those problem and could not able to contribute anything from that just copied from article and different sources. Task 2: Partially Completed.
26.04.2022 9.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat	1. Gave Mock presentation to Nahid Hossain Taz sir and got some feedback. 2. Improve the slides and presentation accordingly	Task 1: Everyone Task 2: Safayet	Task 1: Completed Task 2: Completed.

	Hossain 5. Kazi Ananda Shams			
27.04.2022 8.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain	1. Did the Sustainability part again from scratch for Final Project Proposal report. 2.Did the Impact part again from scratch for Final Project Proposal report. 3.Updated the Slides Accoedingly.	Task 1: Niloy, Safayet, Sazzad Task 2: Niloy Task 3: Safayet	Task 1: Completed Task 2: Completed Task 3: Completed.
28.04.2022 11.15 AM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Gave Final Year Design Project Proposal's Final presentation	Equal Contribution	Task Completed

FYDP – D Logbook

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
02.06.2022 10.00 AM Facebook	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	It was an introductory class for 400D.	Equal Contribution	N/A as it was an introductory meeting.
04.06.2022 9.30 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Visited Taz Sir for the consultation time and some suggestion about the procedure of the 400D procedure	Equal Contribution	N/A
06.06.2022 9.30 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Introductory meeting and dicussed the procedure and probable ways to execute.	Equal Contribution	N/A
12.06.2022 9.30 PM	1. Safayet Ahmed 2. Tanjim Rahman	1. Discussion of Project COs (dividing the tasks to identify the	Task1: Niloy -CO5, CO9, CO11 Sazzad- CO9,	Task 1: Completed Task 2: Completed

Google Meet	Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	terms) 2. Software Analysis/Review (Researching the advantages and disadvantages of several softwares) 3. Creating Survey form	CO11, CO13 Safayet- CO9, CO11, CO15 Sazzad- CO6, CO9, CO15 Task 2: Everyone - completed Task 3: Safayet	Task 3: Incomplete
15.06.2022 9.30 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Reseached about approach 2 and planned how to excecute the simulation.	Looked kor way to do approach 2 and seached of the libraries that could be found.	
17.06.2022 9.30 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1.Disscussion on software (Modern IT Tools) 2.Review on Background Research (Projects similar to ours)	Everyone partially completed	
23.06.2022 9.30 PM On Campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi	Discussion on approach 1 (things speak) procedure and make some draft plan about our work.	Bring up with proper components that is findable in our country.	Completed

	Ananda Shams			
28.06.2022 9.30 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Calibrated the pH and heart sensor data fround from internet source.	Sensors code compilation , pH sensor code analysis, Things speak implement	Completed
30.06.2022 2.00 PM Ofline	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Gave Progress presentation	Equal Contribution	Completed
07.07.2022 1.00 PM Google meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Progress discussion on assigned tasks 2. Creating Survey form	Task 1: Tanjim partially done Sazzad- partially done Khelafat- not started yet Safayet- partially done Task 2: Safayet	Task 1: Partially completed Task 2: Incomplete
14.07.2022 9.00 PM Google meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain	1. CO term discussion 2. Software review 3. Creating Survey form	Task 2: Everyone Task 3: Safayet	Task1: Completed Task 2: Partially completed Task 3: completed

	4. Khelafat Hossain 5. Kazi Ananda Shams			
21.07.2022 11:00 – 11:45 AM Google meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1.CO Analysis 2.Software Review 3.Collecting Equations for Project 4. Gantt Chart 5. Field Survey	Task1: Everyone Task 2: Everyone Task 4: Tanjim Task 5: Safayet	Task1: Everyone Completed Task 2: Everyone Partially completed
28.07.2022 7.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Field Suvey 2.Discussed and reformed progress plan. 3. Update on Design approach 2	Task 1: Safayet Task 2: Niloy, Sazzad Task 3: Safayet	Task 1: Partially completed Task 2: Completed Task 3: completed
04.08.2022 9.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1.Update on Design approach 1 2.Update on Design approach 2 3.Update on Design approach 3	Task1:Niloy, Sazzad Task2:Safayet Task3:Tanjim, Sazzad, Safayet	
11.08.2022	1. Safayet Ahmed 2. Tanjim Rahman	1. Image processing Modifications 2. Code Update	Task1:Tanjim, Sazzad, Safayet Task2:Safayet, Tanjim	

	Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams			
18.08.2022 10.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Test case for 3 design approach 2. Finding error for all designs	Task 1- Completed Task 2- Partially Done	
25.08.2022 10.00 AM On campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Approach 1 thingspeak update 2. Report Update	Task1: Tanjim Task 2 : Everyone	task 1- done task 2- partially done
27.08.2022 7.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Report Update	Task 1: Everyone	partially done

29.08.2022 10.00 AM On campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Test case for 3 design approach 2. Finding error for all designs	Task 1: Checked Task 2: Checked and updated	
27.04.2022 8.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Update on slide 2. Update on Report	Task 1 : Safayet Task2 : Everyone	
1.09.2022 2.30 PM On campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Gave Final Year Design Project Design's Final presentation	Equal Contribution	Task Completed
03.09.2022 2.30 PM On campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Submitted the FYDP_D report	Equal Contribution	Task Completed

FYDP – C Logbook

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
29.09.2022 11.00 AM Class Room	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	It was an introductory class for 400C. Also as a final Class of this course.	Equal Contribution	N/A as it was an introductory meeting.
01.10.2022 9.30 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Introductory meeting and dicussed the procedure and probable ways to execute.	Equal Contribution	N/A
06.10.2022 08.30 AM Faculty Room	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Visited Dr. A.S. Nazmul Huda sir for the consultation time and some suggestions about the procedure of the 400C procedure	Equal Contribution	Sir gave us the weekly consultation time and room number also give suggestion on 400C

09.10.2022 9.30 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Discussion of Project COs (dividing the tasks to identify the terms) 2. Software Analysis/Review (Researching the advantages and disadvantages of several softwares) 3. Discus about applicable compliance, standards, and codes.	Task1: Niloy - CO5, CO6 Kazi Ananda- CO1, CO2 Khelafat- CO9, CO10 Sazzad- CO6, CO9 Task 2: Everyone - completed Task 3: Safayet, Niloy	N/A
11.10.2022 10.30 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Finalising our hardworking place. 2. Discuss our working Software and hardware 3. Talks about how to get or buy our hardware equipment	Task1: Everyone Task 2: Everyone Task 3: Everyone	
13.10.2022 8.30 AM ATC Meeting (Physical Meeting Nazmul Huda Sir's Room, UB5)	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Discuss the COs and POs on FYDP-400C 2. Updating about our project progress	Task1: Niloy, Khelafat, Sazzad Task2: Niloy, Khelafat, Sazzad	1. Give a broad lecture about 400C's COs and POs. 2. Help us by giving suggestions and sharing his ideas and methos.
14.10.2022 11.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy	1. Discussion on ATC's meeting and hardware. 2. Choosing IEEE	Task1: Everyone Task 2: Everyone	

	3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	standards Modern IT tools.		
19.10.2022 11.00 AM (Physical Meeting Thesis LAB, UB5) On Campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Discussion on Project, things speak software, procedure and how we can assemble our hardware part.	Equal Contribution	
20.10.2022 8.30 AM ATC Meeting (Physical Meeting Nazmul Huda Sir's Room, UB5)	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Sharing our working progress. 2. Updating our final software choice. 3. "Sensors code compilation, pH sensor code analysis,Things speak implement".	Task1: Niloy - CO7, CO6 Khelafat-CO9 Sazzad-CO8, CO9 Task 2: Safayet-CO7, CO8 Task 3: Safayet, Niloy	Task1: completed Task 2: completed Task 3: completed sir, gives us suggestion about our hardware components.
22.10.2022 3.00 PM (Physical Meeting, UB5) On Campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Gooing patuatuli for buying our project components (heart rate sensor, rumination sensor, temperature sensor, Battery, Arduino and others tools)	Task: Khelafat, Safayet	
25.10.2022 3.00 PM	1. Safayet Ahmed	1. Progress discussion on	Task 1: Everyone Task 2: Tanjim-	

(Physical Meeting Thesis LAB, UB5) On Campus	2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	assigned tasks 2. Start to assemble components. ("Calibrated the pH and heart sensor data found from internet source.")	partially done Sazzad- partially done Khelafat- partially done Safayet- partially done Kazi Ananda- partially done	
27.10.2022 9.00 PM ATC Meeting (Physical Meeting Nazmul Huda Sir's Room, UB5)	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. COs term discussion 2. Software review 3. Discussion on hardware progress	Task 1: Everyone Task 2: Safayet, Niloy Task 3: Everyone	Task 1: Done Task 2: Done Sir advise us to bring up proper componentsthat is findable in our country.
1.11.2022 11:00 – 11:45 AM Google meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Making progress presentation slide 2. writing progress report	Task1: Everyone Task 2: Everyone	
03.11.2022	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi	**Progress Presentation**	Equal Contribution	

	Ananda Shams			
05.11.2022-10.11.2022		**Midterm Week**		
17.11.2022 9.00 PM ATC Meeting (Physical Meeting Nazmul Huda Sir's Room, UB5)	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Progress presentation 2. Progress Report 3. Collecting Equations for Project 4. Gantt Chart 5. Field Survey	Task1:Everyone Task2:Everyone Task3: Safayet, khelafat Task4: Sazzad, Niloy Task5: khelafat, Niloy, kazi Ananda	First, give us solutions about our progress presentation as well as the project progress report. then tell us about the cow's firm inside Partex and give us advice on how can we get entry into the cow's firm.
19.11.2022 (Physical Meeting Khelafat's House)	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Making our project Prototype 2. Code Update 3. Gantt Chart updated	Task1: Everyone Task2 : Niloy, Safayet Task3: Everyone	
24.11.2022	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	**Attending ICEPE International Conference**	Equal Contribution	
26.11.2022 10.00 AM	1. Safayet Ahmed	1. Thingspeak update 2. Report Update	Task1: Tanjim, Niloy	

(Physical Meeting Khelafat's House)	2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	3. Complete our Prototype 4. Testing Wireless module for Data transferring System information	Task2: Everyone Task3: Everyone Task4: Everyone	
30.11.2022 3.00 PM (Meeting with veterinary Doctor Boyzer sir)	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Fixed the time and meeting place (Meeting with veterinary Doctor Boyzer sir)	Khelafat, Niloy	
01.12.2022 3.30 PM ATC Meeting (Physical Meeting Nazmul Huda Sir's Room, UB5) on campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Discuss our prototype and its working progress 2. Discuss on Cow Farm visit 3. Consult with a veterinary doctor 4. Talks about total cost to make our prototype	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Niloy - CO8, CO9 Kazi Ananda- CO3, CO4 Khelafat- CO11, CO12, CO13 Sazzad- CO7, CO14 Safayet- CO13, CO2	Task1: working properly Task2: give a suggestion on farm visiting. Task3: Take a verification from veterinary doctor. Task4: Talk about our final total cost and give suggestion.
07.12.2022 10.30 AM Visiting the Cow's farm (Partex Cow Farm)	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi	1. Test our prototype 2. Check the data 3. Finding cow diseases 4. Consult with veterinary doctor	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Niloy - CO11, CO14 Kazi Ananda- CO12 Khelafat- CO3, CO4 Sazzad- CO7, CO8	

	Ananda Shams		Safayet- CO2, CO13	
08.12.2022 3.30 PM ATC Meeting (Physical Meeting Nazmul Huda Sir's Room, UB5) on campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Report the testing data 2. Successful work on our prototype 3. Recheck by a veterinary doctor and our testing data match the diseases	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone-successfully work	Task 1: Done Task 2: Done Task 3: Done Task 4: Successfully work Finally, sir satisfied with our works and gives us some suggestions about our project future work.
13.12.2022 8.00 PM Google Meet	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	1. Making our final presentation slide 2. Update on Final Report	Task 1 : Everyone Task2 : Everyone	
15.12.2022 3.45 PM On campus	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	Gave Final Year Design Project Design's Final presentation	Equal Contribution	Task Completed

25.12.2022 2.30 PM Google Classroom	1. Safayet Ahmed 2. Tanjim Rahman Niloy 3. Sazzad Hossain 4. Khelafat Hossain 5. Kazi Ananda Shams	**Submitted the FYDP 400C Final Report**	Equal Contribution	Task Completed

Appendix

Related Code/theory

```
#include <Wire.h>
#include <Adafruit_Sensor.h>
#include <DHT.h>
#include <SH1106.h>
#include <OneWire.h>
#include <DallasTemperature.h>
#include <Adafruit_MPU6050.h>
#include <ESP8266WiFi.h>
#include <ESP8266HTTPClient.h>

const char *ssid = "NoAccess";
const char *pass = "qazwsxedc123";
const char *host = "http://api.thingspeak.com/update";
const char *apiKey = "VAZ683D6W2KXR3S9";

WiFiClient client, client2;
HTTPClient http;

#define temPin 14
#define dhtPin 12
#define button 13

Adafruit_MPU6050 mpu;
DHT dht(dhtPin, DHT11);
SH1106 display(0x3C, SDA, SCL);
OneWire oneWire(temPin);
DallasTemperature sensors(&oneWire);
```

```
byte disease = 0;
int temp, tempC;
double x, y, z, oldX;
int oxi, heart, humidity, rum = 0;
int minT, maxT;
long prevMs;
bool connection;

void setup() {
  Serial.begin(9600);
  pinMode(button, INPUT);
  randomSeed(analogRead(A0));
  sensors.begin();
  dht.begin();

  if (mpu.begin()) {
    mpu.setHighPassFilter(MPU6050_HIGHPASS_0_63_HZ);
    mpu.setMotionDetectionThreshold(1);
    mpu.setMotionDetectionDuration(20);
    mpu.setInterruptPinLatch(true);
    mpu.setInterruptPinPolarity(true);
    mpu.setMotionInterrupt(true);
  }

  display.init();
  display.resetDisplay();
  display.init();
```

```
  display.flipScreenVertically();
  display.setColor(WHITE);
  display.clear();
  delay(1000);

  WiFi.begin(ssid, pass);
  display.drawString(0, 0, "WIFI...");
  display.display();
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println(WiFi.localIP());
  display.drawString(30, 48, "WIFI CONNECTED");
  display.display();
  delay(1500);
  home();

  Serial.println("Started");
  prevMs = millis();
}

void loop() {
  ESP.wdtFeed();
  int adc = analogRead(A0);
  if (adc < 50) heart = random(60, 80);
  else if (adc == 1024) heart = 0;
```

```
if (mpu.getMotionInterruptStatus()) {
  sensors_event_t a, g, temp;
  mpu.getEvent(&a, &g, &temp);
  x = a.acceleration.x;
  y = a.acceleration.y;
  z = a.acceleration.z;
}

if (digitalRead(button)) {
  if (x != oldX) {
    rum++;
    oldX = x;
    delay(500);
  }
}

if (millis() - prevMs >= 1000) {
  sensors.requestTemperatures();
  tempC = sensors.getTempCByIndex(0);
  if (dht.readTemperature() < 100) temp = dht.readTemperature();
  if (dht.readHumidity() < 100) humidity = dht.readHumidity();

  String link = (String)host + "?api_key=" + apiKey;
  link += (String) "&field1=" + tempC;
  link += (String) "&field2=" + heart;
  link += (String) "&field3=" + rum;
  link += (String) "&field4=" + temp;
  link += (String) "&field5=" + humidity;
```

```
    link += (String) "&field6=" + disease;
    if (http.begin(client, link.c_str())) http.GET();
    else if (http.begin(client, link.c_str())) http.GET();  // retry

    String logg = (String) "Temp: " + tempC + "\n";
    logg += (String) "Heart: " + heart + "\n";
    logg += (String) "Rum: " + rum + ", X: " + x + "\n";
    logg += (String) "E.Temp: " + temp + "\n";
    logg += (String) "Humi: " + humidity + "\n";
    logg += "--------------";
    Serial.println(logg);

    showDisplay();
    prevMs = millis();
  }
}

void showDisplay() {
  display.setColor(BLACK);
  display.fillRect(85, 24, 43, 40);
  display.fillRect(20, 24, 43, 40);
  display.setColor(WHITE);

  display.drawString(20, 24, (String)tempC + " dC");
  display.drawString(20, 36, (String)heart + " BPM");
  display.drawString(20, 48, (String) "   ");
  display.drawString(20, 48, (String)rum + "  ");
```

```
  display.drawString(90, 24, (String)temp + " dC");
  display.drawString(90, 36, (String)humidity + " %");
  display.drawString(90, 48, (String)disease + " ");
  display.display();
}

void home() {
  display.clear();
  display.drawString(0, 0, "Cow Monitor System");
  display.drawString(0, 12, "----------------------------------------");
  display.drawString(0, 24, "CT: ");
  display.drawString(0, 36, "HR: ");
  display.drawString(0, 48, "Ru: ");

  display.drawString(70, 24, "ET: ");
  display.drawString(70, 36, "Hu: ");
  display.drawString(70, 48, "De: ");
  display.display();
}
```