HOME AUTOMATION WITH EYE-BLINK FOR PARALYZED PATIENTS

BRAC UNIVERSITY

Inspiring Excellence

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DECLARATION

This thesis submission to the Department of Computer Science and Engineering, BRAC University, Bangladesh. We thus announce that this proposition has the outcomes completely in view of our discoveries. Help taken from any part of work thoughts led by different analysts are said through reference. This theory has not been beforehand submitted for any degree.

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ABSTRACT

The constant demand to improve daily living standards for paralysis patients or general people serves as a motivation to develop newer technology. The tasks once performed by big traditional computers are now solved with smaller smart devices. The study here talks about the development of a blink sensor device which used for automated home designs for disable people. This sensor is able to detect an intentional blink from a normal blink, which is useful for the paralysis patients especially Tetraplegic patients to regulate their home devices at ease without any help. In addition, this device is also embedded with Bluetooth Module so that patient's assistance can also get the notification and updates without detach it from patient body. This helps save a lot of electricity and can be installed into automated home devices easily.

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Lastly, we can never be too grateful to our loving parents for their blood, sweat and tears. We will always remain in debt of what our parents have provided us with. They have always encouraged us to gain knowledge. It is because of them and their effort we have reached this far.

So, we dedicate our effort to our dear parents, our respectable supervisor, every other single being that have assisted us practically and impractically.

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CHAPTER 01

INTRODUCTION

In the era of modern technology, automation is taking place everywhere. From Home to Industries, the blessing of automated system has improved the efficiency by a large magnitude. One of the great examples of the Automation System is the Home Automation. Some of the largest tech giants like, Google, Amazon etc. already have flooded the market with the smartest home automation systems. Though, the automation is meant for simplifying our daily life however, a very targeted group of people have always been overlooked by all of these companies. Therefore, we mainly focused on this group of people who are physically challenged or paralyzed. As, this group of people are physically challenged, they mostly rely on other people's assistance. Even, they have to rely on someone else for day to day tasks. Therefore, any innovative and effective home automation technologies can be a great help for the senior citizen, disabled people and paralysis patients. As mostly these patients have limitations on physical movement, they even cannot move their hands or even talk. Furthermore, there has not been any significant medical improvement to remedy this type of disability. Though, in many cases, physical exercises and proper medication can benefit the patient, but again thesis a very lengthy process and the success rate is very negligible. Consequences are lifelong physical disability. However, the only controls they have are their eyes. Therefore, we decided to work on an automation technology, which they can control easily using their eyes.

The existing home automation systems are mostly designed and developed for general a person who has the access to any device by physical movement. This is not useful for a paralysis patient.

Hence, to develop a home automation system for patients which could be used with least or minimal effort to control the home appliances such as light, fan, air conditioner and other communication devices for emergency sms and call[1]. In this paper we have worked on a Home Automation Project mainly aimed for paralyzed people to develop an IR based eye blink sensor which will be used to control electronic devices as mentioned earlier. The solo purpose of our work is to make a sustainable and effective solution for people with physical disability [2].

1.1 MOTIVATION

The advancement of the technologies has always fascinated us. On the other hand, we also found that, there are not significant researches on automation devices for physically challenged or disabled people. Therefore, we started to look into the published papers and innovations around us. Now-a-day's medical science improving day by day. On this developing procedure human beings innovating greater strengthen scientific accessories such as smart belt which locate patient respiration as well as electro dermal activity (EDA) sensors to sequentially display for physiology symptoms of seizures at night time. Medical operations are now getting easier. Newly developed high-tech gadgets implemented in patient's body to restore normal activities. Especially paralysis patients, such as Tetraplegic Patients who suffering a lot for their physical disabilities. It's now highly important to develop a system which may help paralysis patients like Tetraplegic Patients. Moreover, people are highly interested to digitize their daily life with less physical movement. To fulfill both requirements it's high time to develop a system which may help Tetraplegic Patients as well as people who are interested to use for efficient and comfortable life.

After researching a lot in lab and over the internet, we found an Idea to develop such a system which may help a person to control any appliance which we use in our daily life by less physical effort. We found a concept to develop such a system which we can use by eye blink to automate our home electrical appliance. Though, there are many prototypes developing earlier but most of them are not user friendly or not innovative solutions. The Project aims to develop a system eye blink based sensor for home automation which is compact hardware and simple to use for control home electricity appliance. This will also help to reduce electricity wastage and help a paralysis patient to control light and fan without any assistance of other person.

1.2 OVERVIEW

Our system is the solution for the paralysis patient to help them to operate various electric devices and peripheral using their eye blinks. Our system will detect patient's intentional blinks and understands the signal by predefined algorithm and operate the specified device as per instruction.

We also have developed android based mobile application through which the patient can send emergency SMS Notification for assistance. Our goal was to build a system with high accuracy with minimum development costs so that, anyone can afford the technology and use it. To keep the cost low yet a scalable and efficient system, we used the open source Arduino platform for the hardware and Android for the controller application.

1.3 OBJECTIVE

- **Develop user friendly sustainable appliance control system:**

  Developing a system that relies on minimum effort of learning curve but works efficiently. As our targeted groups of peoples are physically disabled, therefore we decided to work with eye motion. So, depending on a pattern and series of eye blinking, the system can be activated, take command and execute.

- **Reduce Electricity Bills:**

  This device will also help to reduce electricity wastage as the patient has no need to call anyone to switch off or on any electronic device as this system will help them to do all these tasks instantly without any third person's assistance so, as the system works instantly, it reduces electricity wastage by saving the time between arrival of assistance and performing tasks.

- **Design innovative solutions:**

  This system communicates over wireless technology so that wire hassle is reduced. Moreover, various sensors and modules shape up this as an innovative solution.

- **Provide hands free control system:**

  This system helps a person or patient to operate almost everything with eye blinks so that there is no need of helping hands for physically disabled person or paralysis patients.

- **Provide unique feature to control different appliance:**

  Our system can perform at least 24 commands and follow the pre-defined instruction as predefined. Moreover, we use android application to notify the supervisor for an emergency Call or SMS. For this project, we decided to work on 4 commands set due to the limitation of hardware. However, the system can be equipped with 24 commands at least efficiently. Though, we are using 4-bit sequential data pattern as we are using only one set of sensor for right eyes, but the system is capable of processing two sensors on both of the eyes. In that case we can process any combination of 4-bit data pattern. If we consider each eye can separately blink, then we can get patterns like 0000 or 0101 or 1100 or 1010 etc. This enables us to control a huge number of appliances just by using eye blink.

CHAPTER 02

BACKGROUND STUDY AND LITERATURE REVIEW

Now-a-days, the rapid growth of technology has made our PC become outdated. The tasks that once we used to do with PC are now being handled by mobiles or other smart devices. Introduction of network enabled devices or IOT devices have led to advanced home automation systems. However, the usage is limited for people with physical disorders as remote control of an appliance becomes difficult. In this paper the project is about for those people who are suffering from Paralysis (As example, Tetraplegia Patients) and the difficulties which they face while controlling home appliances. Tetraplegia Paralysis is brought about by harm to the cerebrum or the spinal line this patient; client needs to control the appliance. We try to take care of their issue utilizing eye blink sensor. An eye blink sensor is a transducer which detects an eye blink, and gives a yield voltage at whatever point the eye is shut. This project is about eye blinking for instance, in systems that monitor a paralyzed human so that he/she can operate home appliances, such as- light, fan, Air Condition and so on. Also, this is connected with Android Smartphone Bluetooth radio, so that patients can communicate with others in case of emergency via sending text SMS, just by blinking their eyes.

2.1 EYE BLINKING

Eye blinking is partly subconscious fast closing and reopening of the eyelid. There are multiple muscles involved in eye blinking. Two main muscles are orbicular is oculomotor and levitator palpebral superiors that control the eye closing and opening[3].The main purpose of eye blinking is to moisten an eye cornea. It also cleans the eye cornea when eyelashes do not capture all the dust, and dirt gets into the eye. There are two types of unconscious blinking. The spontaneous blinking is done without any obvious external stimulus. It happens while breathing or digesting. The second involuntary blinking is called the reflex blinking. It is caused by contact with the cornea, fast visual change of light in front of the eye, sudden presence of near object or by a loud noise. Another type of blinking is the voluntary blinking, which is invoked consciously under the control of the individual.

2.2 PARALYSIS

Paralysis is most often caused by damage in the nervous system, especially the spinal cord. Other major causes are stroke, trauma with nerve injury, poliomyelitis, cerebral palsy, peripheral neuropathy, Parkinson's disease, ALS, botulism, spine bifida, multiple sclerosis. There are many types of paralysis. The degree of paralysis varies depending on the nature of the injury, the extent to which you've undergone rehabilitative therapy, and oftentimes on factors that are not yet well-understood—maybe even a bit of luck. Most doctors now use the term tetraplegia to denote this injury. Tetraplegia is caused by damage to the brain or the spinal cord at a high level C1–C7—in particular, spinal cord injuries secondary to an injury to the cervical spine [4].The injury, which is known as a lesion, causes victims to lose partial or total function of all four limbs, meaning the arms and the legs. Tetraplegic is defined in many ways; C1–C4 usually affects arm movement more so than a C5–C7 injury; however, all Tetraplegic have or have had some kind of finger dysfunction. So, it is not uncommon to have a Tetraplegic with fully functional arms but no nervous control of their fingers and thumbs.

It is possible to suffer a broken neck without becoming tetraplegic if the vertebrae are fractured or dislocated but the spinal cord is not damaged. Conversely, it is possible to injure the spinal cord without breaking the spine, for example when a ruptured disc or bone spur on the vertebra protrudes into the spinal column. Patient’s loss of motion created by ailment or damages to a human that outcome in the incomplete or aggregate loss of utilization of every one of their appendages. The loss is usually sensory or motor, which implies that both sensation and control are lost.

2.3 MICRO-CONTROLLER

Micro controller itself has the components of executing any task without the help of external devices[5].Arduino is by far the most used micro controller, especially by the people who like to experiment varieties of project ideas, some use it merely because of their hobbies as well. So basically micro controller is a computer integrated in a single chip. This single chip contains a central processing unit, memory registers and input output peripherals [6].

Arduino is very easy to operate and work with, even though it is a very powerful computer like gear [7].Arduino is open source electronic gear meaning it costs an affordable price for its hardware and the software for running the micro controller is free for everyone.

Arduino can be connected with various sensors or other electronic component to build a device, which will able to do certain functionality.

2.4 OPERATIONAL INSTRUCTION

A buzzer is attached with glass frame, that helps a patient to identify various device status by providing a pattern of beep sounds. If eye is consistently closed for 4 seconds, the buzzer will make a long beep sound which means this device is ready to take action. After activated to take action, the user will get 5 seconds to provide any series of eye blinks to control the peripherals. Though due to the development purpose, we worked with up to FOUR (4) eye blinks. Upon activation, user can blink 'Once' to send a SOS SMS to a predefined number, can blink 'Twice' and wait to turn on any electric peripherals connected with the receiver device, can blink 'Thrice' and wait to turn on another electric device connected with the receiver and can blink 'Four Time' and wait to turn on another electric device connected with the receiver. Five seconds after activation, the device should make two consecutive 500 milliseconds beep sounds, which confirms that, the command has sent over the receiver device and ready for the next activation. Upon any malfunctions, tapping the reset button or closing the eyes consecutively Two times for one second will reset and recalibrate the device.

2.5 INSTALLATION

As the receiver end hardware interfaces with HIGH VOLTAGE ALTERNATIVE CURRENT, therefore supervised personal, experienced with related fields are recommended to install the device. On the other side, the Main device is an easy to wear, Glass, which can be directly put over user eyes without any supervision of experience personal.

CHAPTER 03

WORKING METHODOLOGY

The system consists of four major embedded electronics: TCRT 5000 as the Eye Blink sensor, Arduino compatible Micro-controllers, RF LINK Pair modules and Bluetooth. Additionally, a rechargeable lithium ION battery is attached with the both Transmitter Glass Frame Module and the Receiver Module. Both Transmitter Glass and Receiver Modules are connected wirelessly over RF LINK modules. The TCRT 5000 sensor is a Reflective Optical Sensor which can measure the intensity of IR bounced back on the eye or eyelid. As of its' cheap price and availability it suits best for our needs. When the eyes are closed the reflection value gets lower than when the eye lids are open[8].Therefore, we can easily identify whenever the user closes the eyes for a specific interval. Additionally, we can also detect eye blinks. As eye blink is a natural process of human body, therefore, we specified a pattern to activate the system. Whenever the user closes the eyes for 4 seconds, the system identifies it as the start for taking action and gets ready. Otherwise it will take the eye blink as usual unintentional human behavior and the system will do nothing. Here the input will take after the system is ready to take the action after triggering the IR sensor and this system will work as per instructions.

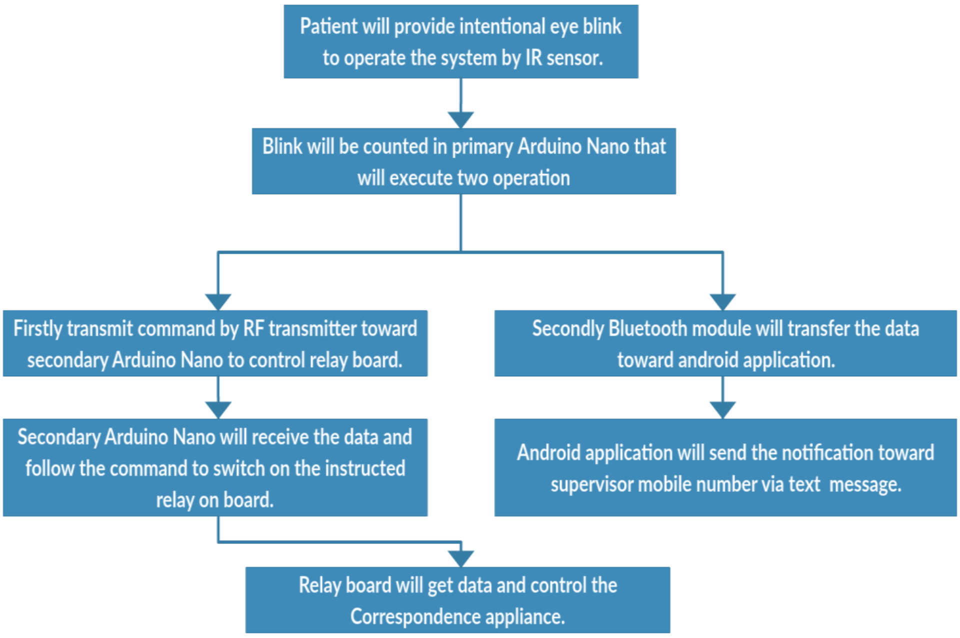

Figure 3.0: WORK FLOW OF THE SYSTEM

3.1 WORKFLOW

As the entire system is developed for physically disabled people, therefore we have prepared the system and the interaction easy enough that takes minimum to no effort to adopt and operate for a new user. As there are two major parts of the system, one is the wearable glass frame module, which also is actually a transmission device. And the second one is the electrical peripheral control unit, which is actually a receiver module. Furthermore, we have also developed an Android Application for the configuring the device itself.

GLASS FRAME CONTROL UNIT: The glass frame is the unit that the user will be using to control the entire system. When powered on the embedded Infrared Reflection Sensor will calibrate itself by reading thousands of values for Five seconds. Then it determines the average value by doing a simple math

Read Avg. Value, Sum of Reflection Values, Total Number of Readings;
Avg. Value = (Sum of Reflection Values / Total Number of Readings);

After it determines the average value, it then creates a Two seconds long beep to indicate that the system is on and running. From this phase, the system takes continuous reading of Infrared Reflection values from the sensors and checks if the value is less than the value of Average value. Therefore, whenever the user closes the eye lids, the reflection value usually drops by 60 (sixty) to 130 (one hundred and thirty) so, the system can identify this as ‘The Eyes Are Closed’ or a ‘Blink’.

if (Current Reflection Value < (Average Value – Offset Value)) {
take action;
…}

As the skin tone or the surrounding lighting condition may vary significantly time to time, therefore we have to introduce a Biased Value which in this case is the offset value. So that, in any condition we can identify the closing eyes or the blink more accurately. The system then also takes a record of last value of ‘System Time in Milliseconds’. We record it in order to trigger the **Action Mode** manually. As eye blinking or closing eyes is a very generic human behavior, therefore we have to trigger the Action Mode in a more specific way. Therefore, if the user keeps closes his eyes for more than 4 seconds but less than 5 seconds, the system determines it as an Action Code and starts the Action Mode.

```
if ( (eyes closed == true) && (current system milliseconds >= (last action taken time +
4000) )){
//play a small beep for 100 milliseconds to open the eyes
delay (500);
if(current system milliseconds >= (last action taken time + 4000)){
//do nothing, user is sleeping
else{
//start taking action
```

By this time, the system makes a very tiny beep to so that the user can open his/her eyes. However, if the user keeps the eyes shut even longer by this time, the system identifies it as the user behavior of resting or sleeping. Otherwise, the system plays two 500 Milliseconds long beep to indicate that, it is ready to take ‘Blink Action’. By this time, user can blink his/her eyes for any number of times for the desired action. The system will then make a beep to indicate that the blink has been registered. The system takes any number of blink commands during the period Four seconds after starting action mode and registers all the blinks. When the counter finishes the four seconds mark then the system interprets the blink command. If then checks, how many times the user blinked.

Depending on that, the system decides whether to send the command to the RF Link or to the Bluetooth Module. As for our testing, we configured the system in such way so that, if the user blinks once, it sends a SOS Message from the Android Smartphone to any predefined number. Other than that, any blinks up to four corresponds to the electrical components connected sequentially with the receiver module.

ELECTRICAL COMPONENTS CONTROL UNIT: This control unit is equipped with the RF receiver module, power supply and a 5 Volt D.C. to 220 Volt A.C 4 Channel relay. With each relay output, user can attach any preferred electrical components like, Fan, Light, Air Conditioner etc. This system always runs and checks the RF receiver buffer if there are any buffer available or not. Whenever, if finds any buffers, it decodes the stream, processes the byte array with bit shifting and then executes the corresponding command.

ANDROID APPLICATION: To configure the Glass module, we have also developed a very easy to use and intuitive Android Application. Using the Android application, user can configure the S.O.S emergency number, on which the message will be sent and all the command sequences and their specific actions.

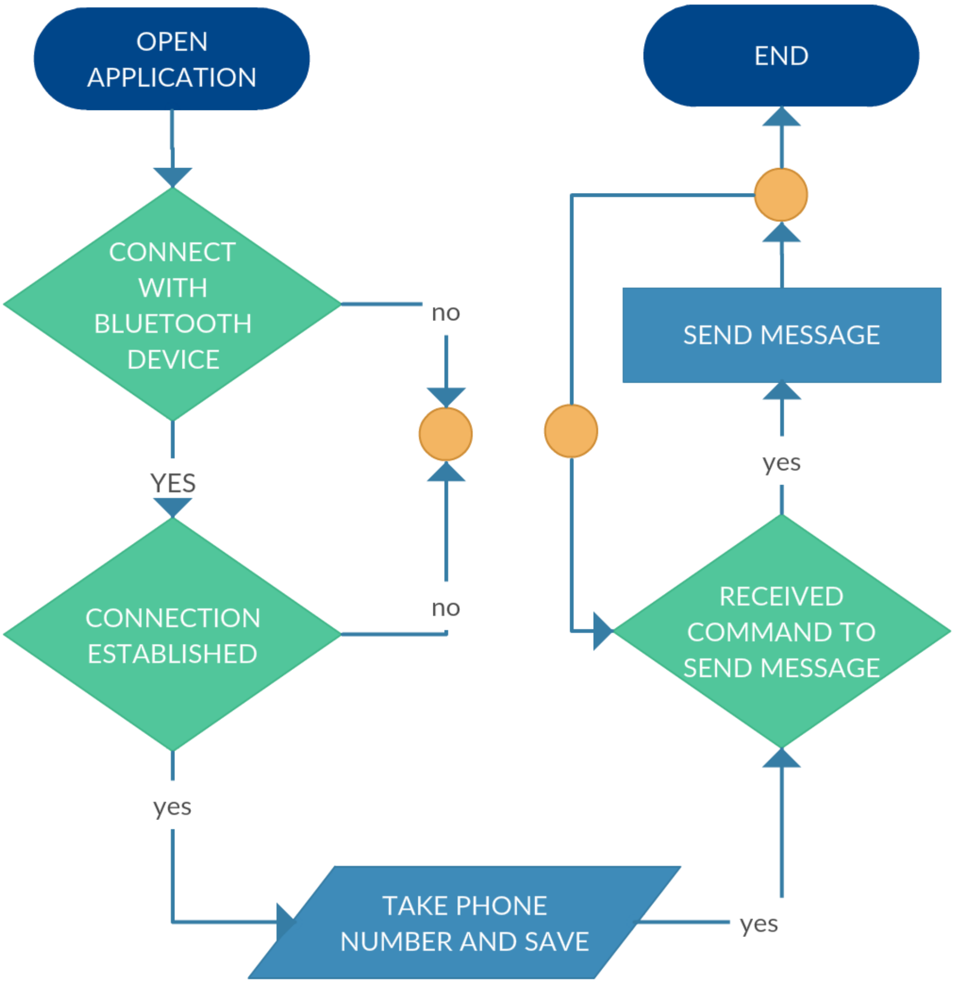

Figure 3.1: ANDROID APPLICATION FLOWCHART

The Android application working process is very simple which is described above in the flowchart. There will be a dedicated android mobile phone for patient that will be in the range of device's Bluetooth so that patients can send the signal through the device and mobile detects the signal and installed application will send the text message to the predefined number for supervisor's attention for emergency.

3.2 SYSTEM MODEL

Our framework predominantly comprises of two separate parts. The initial segment conveys glass outline which IR sensor associated with Bluetooth module and Micro controller to gather information from eye blink. IR sensor comprises of transmitter and Receiver to measure the intensity of light to decide flickering both deliberate and regular.

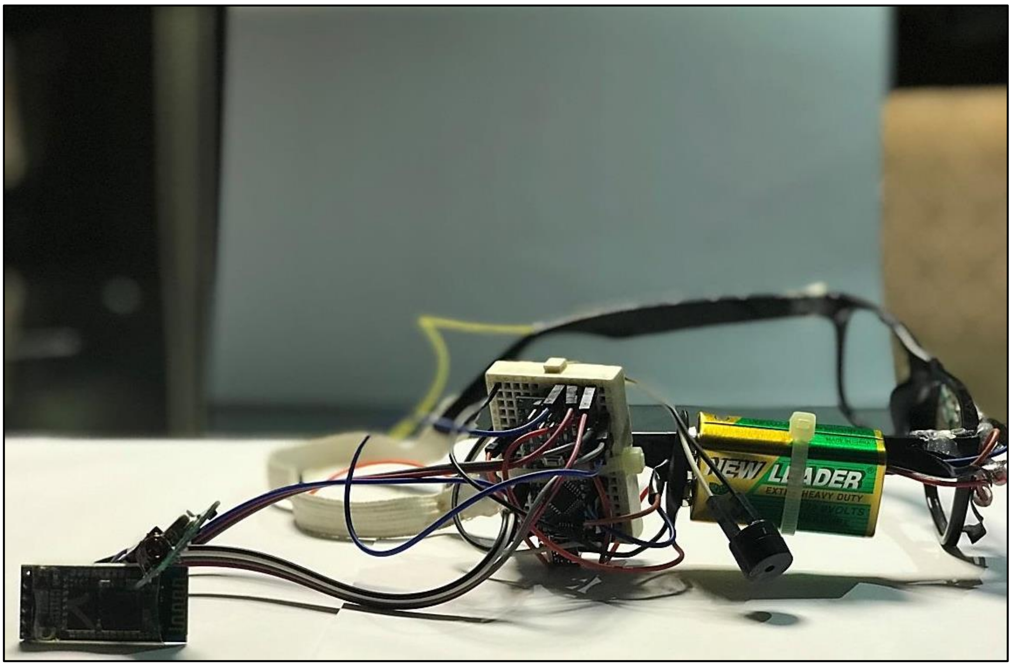

Figure 3.2.0: IR SENSOR ASSOCIATED PRIMARY SEGMENT

The Micro controller unit is associated with a RF-Link to exchange the gathered information to other bit of the framework.

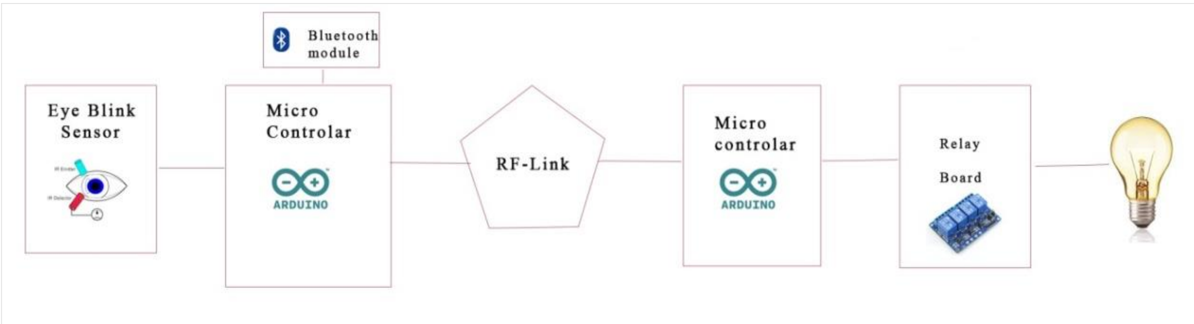

Figure3.2.1: SYSTEM MODEL

The second segment of the framework can be characterized as recipient and processing part. It comprises of another RF-Link module which gets information sent from the initial segment of the System. In this part a Relay board is associated with another Micro Controller to show the system Output.

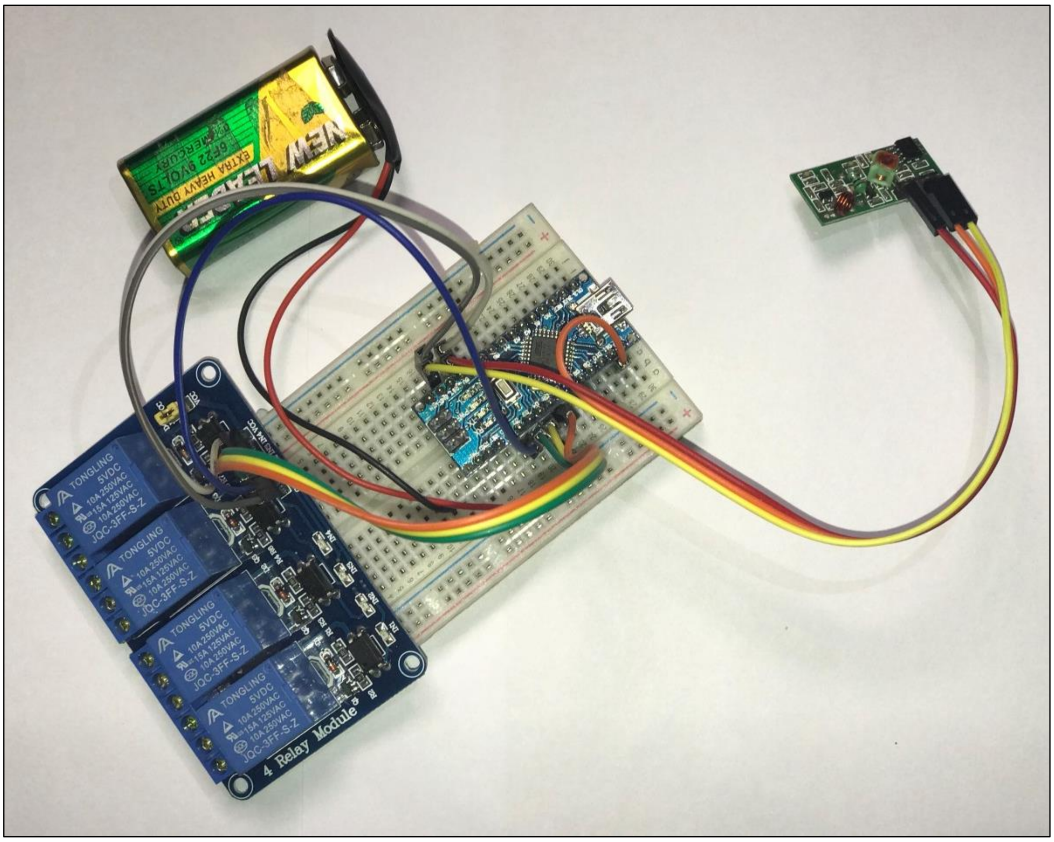

Figure 3.2.2: RELAY BOARD ASSOCIATED SECONDARY SEGMENT

This structure moreover composed with Bluetooth so the patient can send message. This Bluetooth will be related neighboring android devices that worked by android application. The android application will save one emergency contact. The patient can send messages to the saved contact in case of emergency.

The Bluetooth associated with the primary micro controller goes about as the functional unit of our android application by conveying SMS to the paired phone by measuring the instruction from the Relay board.

3.3 HARDWARE IMPLEMENTATION

In hardware part we have two units where first one used Sensors (IR), Micro-controller, RF Transmitter, Buzzer and Bluetooth Module to establish a wireless connectivity between secondary Micro Controller (Arduino Nano) as this part connected with relay board which receive data with RF receiver. The device will be wearable for a patient and the collected data will be sent from primary Arduino to secondary Arduino continuously. The device can be configured in such a way that it sends data after a time period. In the next content the description of used equipment are given.

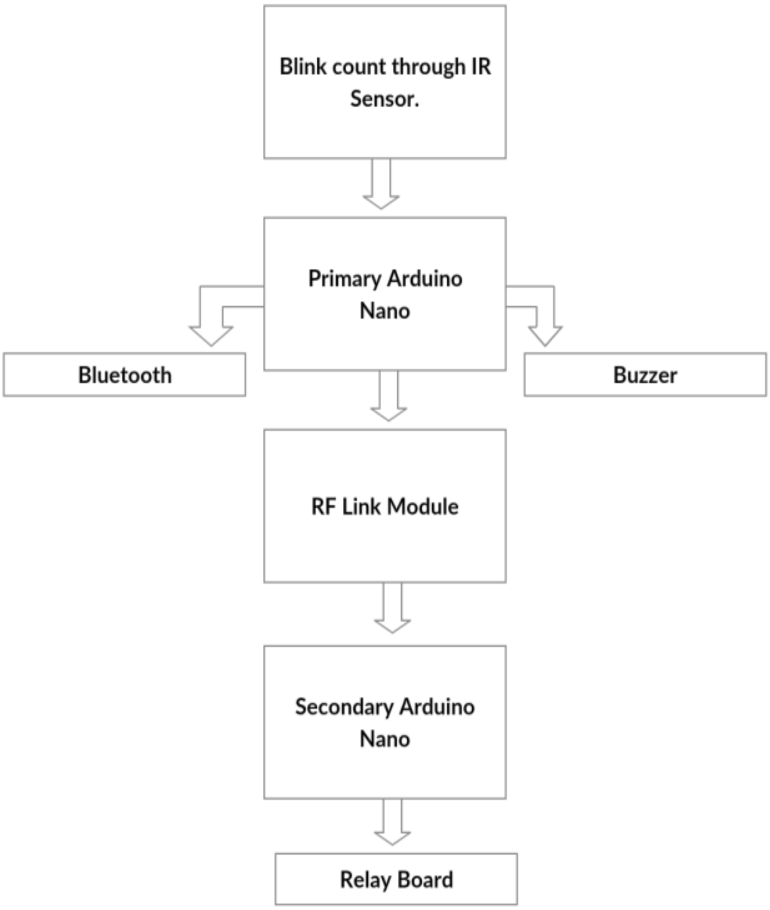

Figure 3.3: BLOCK DIAGRAM OF THE SYSTEM

3.4 EQUIPMENTS

To build this device we have used very few things. Also this project is very cheap. The lists of equipment's in this device are mentioned below:

a. **Glass frame:**

Figure 3.4.1: GLASS FRAME

Ordinary glass frame without glass to setup IR sensor so that IR reflects on the eye and receiver can receive the signal and Arduino Nano with a five volt battery and RF Transmitter to transmit data to another Arduino to control Relay.

b. Jumper Wire:

Figure 3.4.2: JUMPER WIRE

Jumper wires are used for making connections between items on your breadboard and your Arduino's header pins. Use them to wire up all the circuits.

c. 2 pieces 9v Battery:

Figure 3.4.3: BATTERY 9V

Power up the system externally so that there is no DC adapter needs to provide continuous power supply.

d. Buzzer:

Figure 3.4.4: BUZZER

This buzzer generates a continuous beep usually when supplied with power but, we generate a single beep to provide user hints when he should blink to operate the system and it also confirm that the command executed or not by double beep tone.

e. 4 Channel 5V Relay Module:

Figure 3.4.5: 4 CHANNEL 5V RELAY MODULE

This is a 5V 4-Channel Relay interface board, be able to control various appliances, and other equipment with large current. It can be controlled directly by ant Micro-controller. We use this for our prototype.

f. RF Link Module 315/433 MHz:

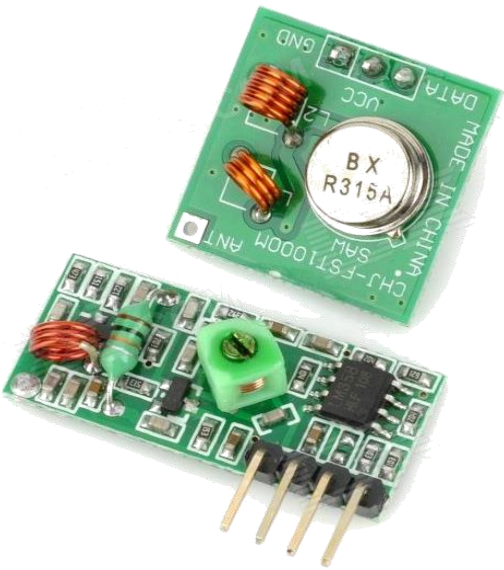

Figure 3.4.6: RF LINK MODULE 315/433 MHZ

This Radio Transmitter & Receiver pair is perfectly matched to control items from a distance up to 500 feet wirelessly. Connecting the transmitter to the Arduino Nano, this is connected with eye sensor and the receiver to another Arduino Nano which is connected to relay board. Both the transmitter and receiver are in tune to the same Radio Frequency so that when the transmitter emits a signal, the receiver will hear it wirelessly. This component is great for easy and simple wireless control.

g. IR Sensor TCRT5000:

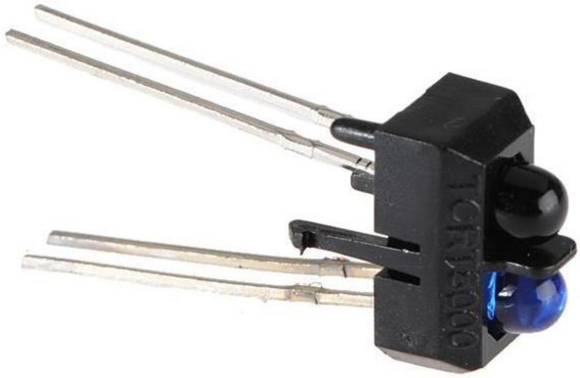

Figure 3.4.7: IR SENSOR TCRT5000

The TCRT5000 and TCRT5000L are reflective sensors which include an infrared emitter and phototransistor in a leaded package which blocks visible light. The package includes two mounting clips. TCRT5000L is the long lead version.

h. Bluetooth Module HC-05:

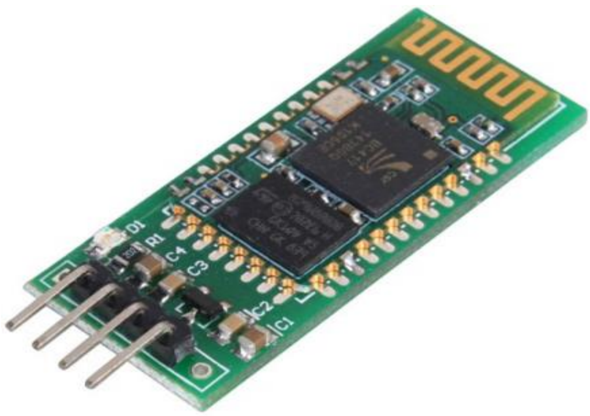

Figure 3.4.8: BLUETOOTH MODULE

There are many Bluetooth modules and even Arduino shields: we choice HC-05, this is a class-2 Bluetooth module that acts like a serial port with no need of any software configuration on the Arduino. This module is available in several configurations. The one we need to make the connection between Arduino and the Android phone is a Slave Module.

i. 2 Pieces Arduino Nano:

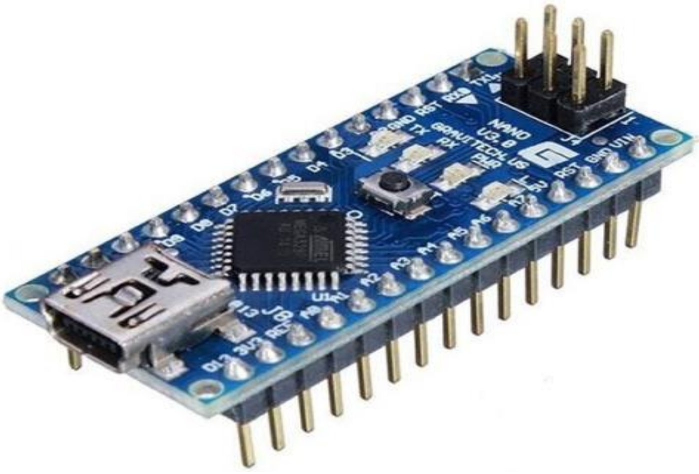

Figure 3.4.9: ARDUINO NANO

Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is the smallest, complete, and breadboard friendly. It has everything that Decimal/Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack. The Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper.

Nano's got the breadboard-ability of the Boarduino and the Mini+USB with smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, and GND on one top, power, and ground on the other).

This new version 3.0 comes with ATMEGA328, which offer more programming and data memory space. It is two layers. That make it easier to hack and more affordable.

j. 2 Breadboard:

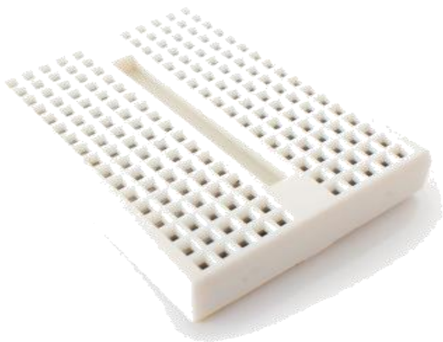

Figure 3.4.10: BREADBOARD

A breadboard is an array of conductive metal clips encased in a box made of white ABS plastic, where each clip is insulated with another clips. There are a number of holes on the plastic box, arranged in a particular fashion. A typical bread board layout consists of two types of region also called strips.

Bus strips and socket strips. Bus strips are usually used to provide power supply to the circuit. It consists of two columns, one for power voltage and other for ground. Socket strips are used to hold most of the components in a circuit.

Generally it consists of two sections each with 5 rows and 64 columns. Every column is electrically connected from inside. Nickel Silver clips hold the components.

k. Computer:

Figure 3.4.11: DESKTOP PC

In order to coding and check the serial monitor data and develop android application we need a computer.

Some other hardware devices we need are USB cable to connect system with Computer and power supply. Arduino can be connected to a PC/Laptop and get its power from that.

3.5 MOBILE APPLICATION IMPLEMENTATION

The primary task of our project was to take data from sensors and send those data using RF module to control relay board for appliance secondly, Bluetooth module will connect near android device to communicate with supervisor phone over the SMS. To achieve this result, we have also made a mobile application. For the mobile application we have chosen android platform. As of being open source and most widely adopted portable Operating System, Android has always been the best choice for us. Expanding on the Linux community with more than 300 hardware, software equipment, Android has quickly turned into the quickest developing portable operating system **[9].**

As our primary targeted group of people are from developing countries. Therefore, it was another reason to choose Android mobile application. As it offers more flexibilities and already ready to go user base, Android is the best suit for our project.

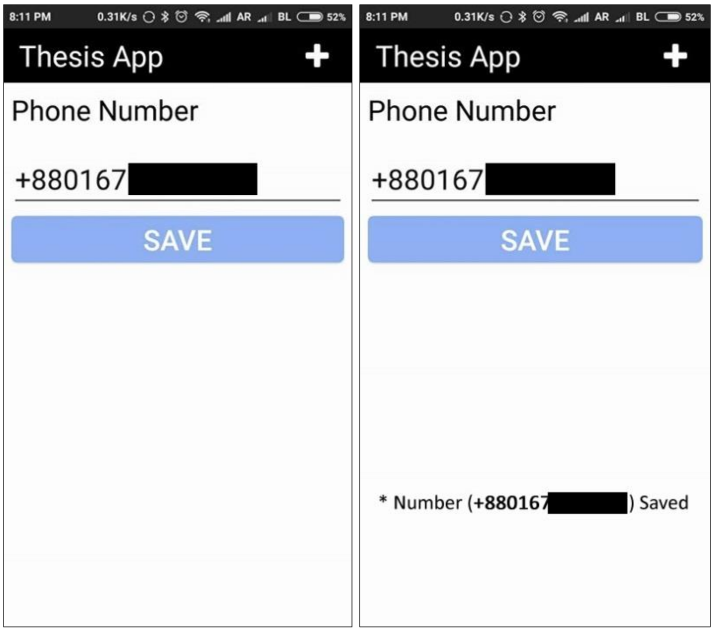

Figure 3.5: THESIS APP INTERFACE

3.6 TECHNICAL SPECIFICATIONS

- JDK JRE 8.0
- Min SDK version 15 (API support level 14 and above)
- Target SDK version 24
- Android Studio
- Arduino Nano or Any 8-bit 16MHz ATMEGA chip. Preferably ATMEGA328P
- Windows, Linux or Mac Operating System
- Android level permission:
    1. Bluetooth
    2. SMS

Algorithm for Arduino Transmitter Module:

As the wearable module, which computes the value and detects the eye blink is the main part of this project. Therefore, here are the details of the code samples. We have used some third party libraries in our code so that the RF Module communication is easier to maintain and to handle the Serial connection with Bluetooth module is easily made.

Arduino transmitter pseudo:

Start system and initialize the variables, objects and streams
Step 1: Calibrate the system average value calculated from continuous value reflected from the sensors
Step 2: Check current sensor value and determine whether it is below the average value or not
Step 3: If the current sensor value is below the average value, then trigger on the action sequence and also start timer for 4 seconds
Step 4: Check if user blinks or not and adjust the blink counter
Step 5: After 4 seconds, process the action sequence and check the command received
Step 6: If the command is equal to sequence 0001 then check the Bluetooth connection
Step 7: If Bluetooth communication is established with the Android smartphone, send SOS SMS request to the connected device
Step 8: Otherwise convert the action sequence in to byte and check if RF transmitter can communicate with the RF receiver or not
Step 9: If RF link is established, then send the command bytes to the receiver
Step 10: Loop to Step 1

Other than this part, we have also a receiver module and an Android application. However, the receiver module that connects with the electric components are very self-explanatory. As it only takes the stream and depending on the Input Stream it executes the appropriate condition to switch the relay.

3.7 WORK FLOW OF MOBILE APPLICATION

We have created an android based simple application for our project. Our application will need a cellphone number where this should send the text and the mobile will be connected with our system with Bluetooth module.

This Application will collect data from connected Bluetooth and send the appliance number to the supervisor. This will only use mobile network and no need of internet access. Our application only runs in android phone.

Chapter 04

CONNECTION SET-UP

The whole process will work successfully when the entire components connected successfully. There are many individual components, all of them are performing different task. Here is the clear connection scenario of every individual with each other as small parts and later on all the parts connected together and work as a whole system.

4.1 CONNECTION

i. Glass frame with Arduino Nano:

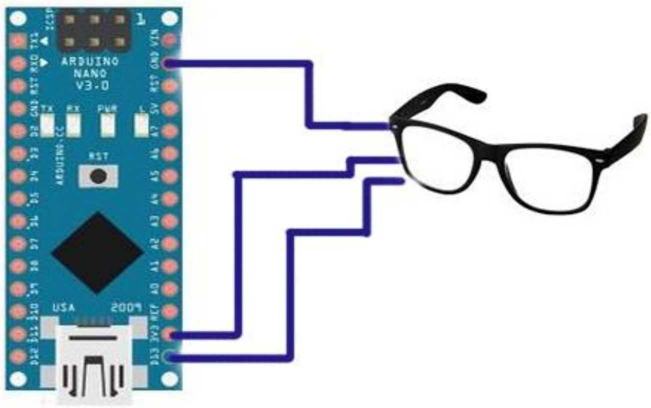

Figure 4.1.1: GLASS FRAME WITH ARDUINO NANO

A simple wearing glass frame is needed to operate the whole process. This glass-frame is attached with TCRT-500 IR, and this IR is connected with Arduino Nano. IR receiver part is connected with Arduino Nano's A3, and IR transmitter part is connected with 3V3. In addition a cable from IR is connected to Arduino Nano's GND.

ii. Arduino Nano with RF Link:

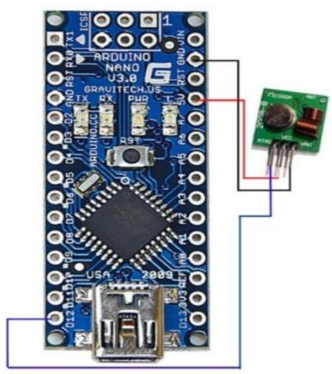

Figure 4.1.2: ARDUINO NANO WITH RF LINK

Arduino Nano is connected with one portion of RF link that transmit. RF links ADATA, VCC, and GND is connected with sequence with D12, +5v, and GND.

iii. Arduino with Bluetooth:

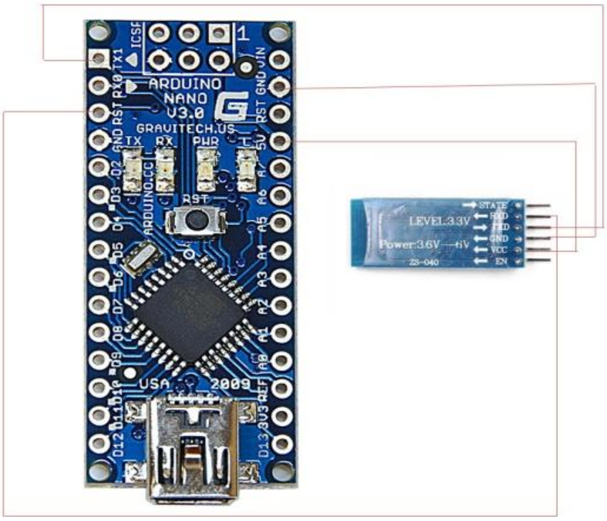

Figure 4.1.3: ARDUINO WITH BLUETOOTH

Arduino Nano is connected with one Bluetooth HC-05 that connects with android phone. Bluetooth's Rx, Tx, +5V and GND is connected with sequence with Rx, Tx, +5v, and GND.

iv. Arduino with RF Link:

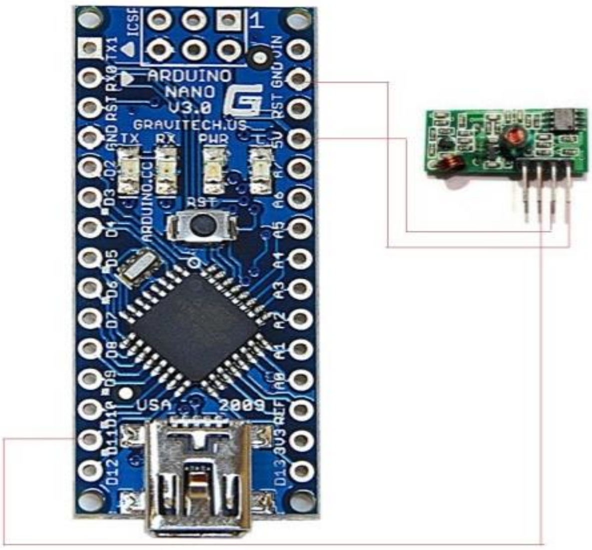

Figure 4.1.4: ARDUINO WITH RF LINK

Another Arduino Nano is connected with another portion of RF link that receive the signals. RF links VCC, DATA and GND is connected with sequence with +5v, D11 and GND.

v. Arduino With Relay-Board:

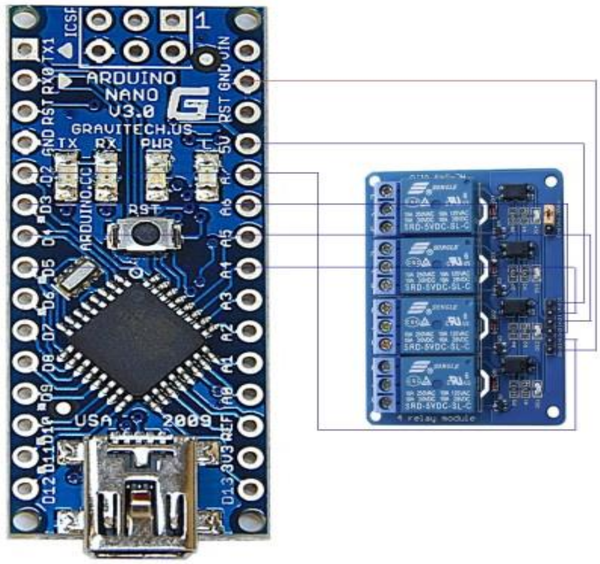

Figure 4.1.5: ARDUINO WITH RELAY-BOARD

Relay-board's GND, IN1, IN2, IN3, IN4, and Vcc is connected with Arduino Nano's GND, D2, D3, D4, D5, and +5v.

4.2 PROCEDURE

Firstly, after powering on the system and wearing the glass frame the IR sensor will calculate the lux. Lux measures light intensity. Surroundings light, Lux (IL luminance) measures the light intensity. It is equal to 1 Lumen per square meter. After calculating the lux it takes the average value.

This value will compare with the value while we blink our eye as long or short. So for IR sensor it is become easier to detect either our eyes are closed (short) or open (long).

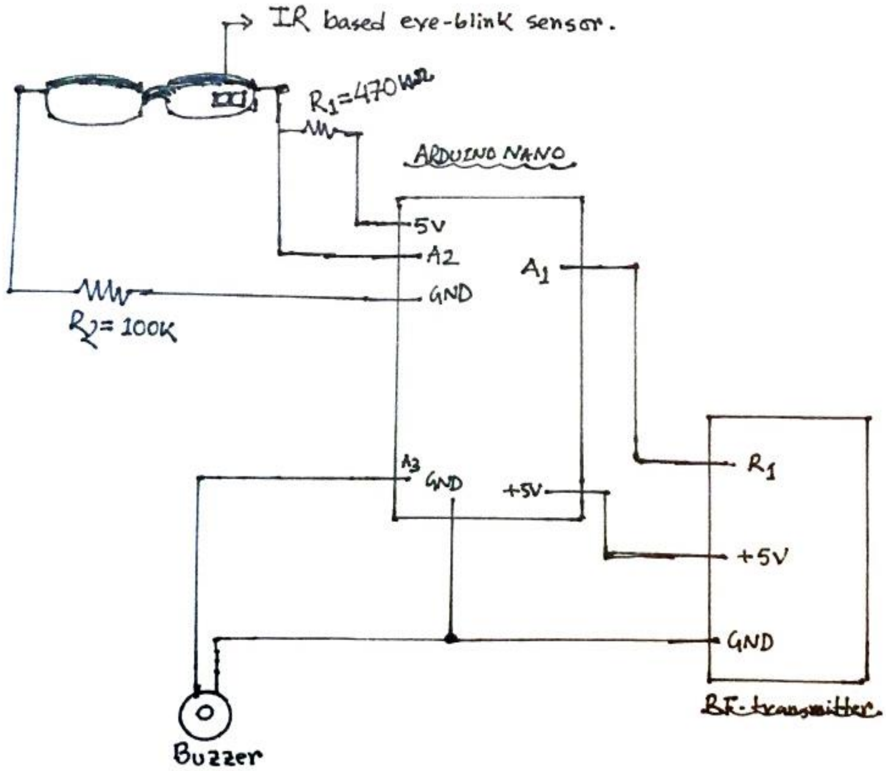

Figure 4.2.1: CIRCUIT DIAGRAM PRIMARY UNIT

Secondly, though the system does not get interrupted during normal blinking but intentionally if we want to activate the system then the eye need to be closed for approximately 4 seconds, the buzzer will make sound, it means the system is ready to take action. This action taking time period is 5seconds. An instruction requires a blink of an eye. Meanwhile, patients will have to blink their eye for which the function they need to get operated accordingly. They can turn the Switch ON/OFF their home appliances or can send a message in case of emergency.

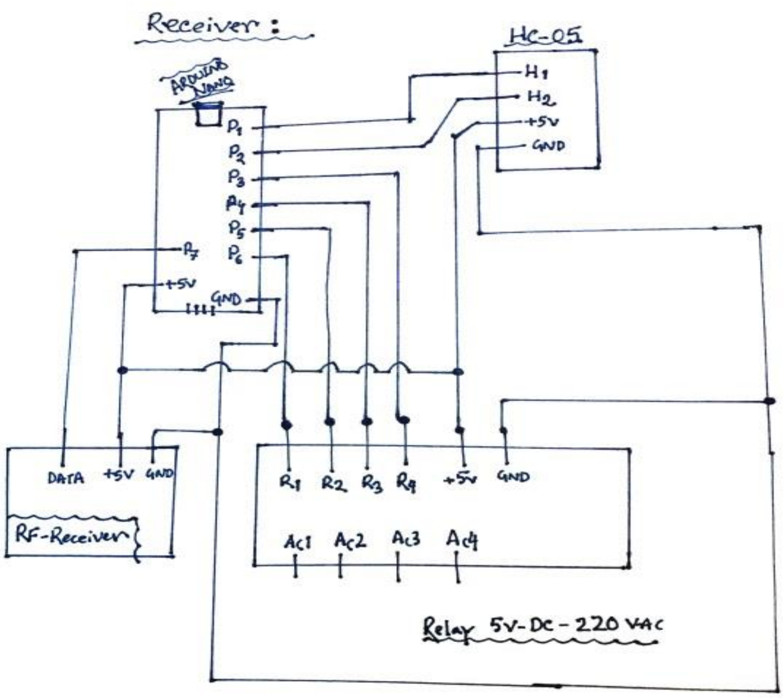

Figure 4.2.2: CIRCUIT DIAGRAM SECONDARY UNIT

Finally, let us take an illustration that if the patient wants to switch on the Number-1 switch that is connected with a light then the patient has to blink his/her eye once after the action taking mode is activated. Now the function will flow to RFID module. Then another micro controller (Arduino Nano) activates the Relay-1 of the Relay board. Thus, the relay will turn ON the light as per the function of the module. If the patient decides to turn OFF the light then the patient has to blink his/her eye once again after action mode is activated. This system also configured with Bluetooth so that the patient can send message. This Bluetooth will be connected nearby android devices that operated by android application. The android app will save one emergency contact. The patient can send messages to the saved contact in case of emergency. This procedure is same as previous one; the patient has to blink his/her eyes for once after the activation of action taken mode. There a Bluetooth is connected with primary micro-controller. After connected with any android phone the instruction will apply relay board.

In hardware part we have used sensors (IR), a micro controller, a RFID module to establish a wireless connectivity between to micro controllers (Arduino) , Bluetooth , buzzer. The device will be wearable for a patient and the collected data will be sent to primary Arduino continuously. The device can be configured in such a way that it sends data after a time period.

4.3 FEASIBILITY ANALYSIS

Many new initiatives rely on technology to manage or monitor patients or disable person nearby us. This system may be developed contracted through without wire results in easier to operate. This functionality must be integrated with our future plan. Additionally, functionality must be considered in order to give accurate data and response.

Therefore, this system needs to meet the needs within the determined timeframe and budget. It should be noted that while using this device patient have learn the operating processes. This system maintains a wireless connection, Bluetooth connection with android mobile, and the latest software. With the addition of an e-commerce portal it is low maintenance in costs.

4.4 TECHNICAL ANALYSIS

At the beginning of this project we had come up with lots of critical situation like- we did not find any eye-blink sensor in the market. So we had built our one eye-blink sensor that is IR based eye-blink sensor by simply using (TCRT-5000) IR sensor.

In addition, when we tried to make this project wireless then again many problem arisen. After using Bluetooth to make this wireless, once our system burn because of power mismatch. After that we used RF Link to make this project wireless and became success over it.

CHAPTER 05

RESULT AND DATA ANALYSIS

In this chapter we will be discussing about our result from our project. Previously we have discussed about the demo version of our system. How the device was built, how the data is sent to the application by Bluetooth module and how the application "**Thesis app**" works.

5.1 RESULT ANALYSIS

To verify whether our IR sensor is working or not we check the Serial Monitor output value for Average Flux. As we will detect the intentional blink we need appropriate Light for flux value. IR takes some continues value of light counting the lux (intensity of light) then it sets an average value a scenario describe bellow:

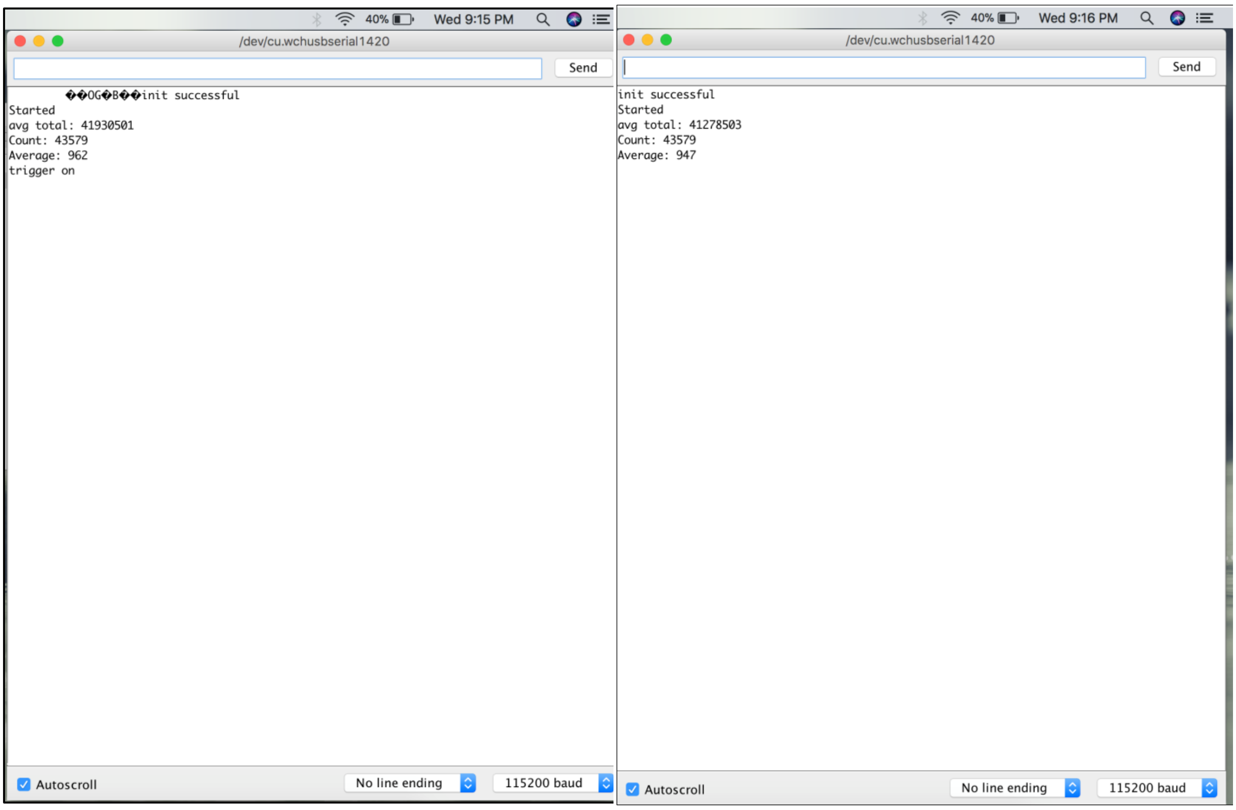

Figure 5.1: **FLUX AVERAGE VALUE AND TRIGGER STATUS**

Average Value (Flux): 805then, it works as following:

Table 5.1.1: FLUX AVERAGE VALUE AND TRIGGER CONDITION

STATE	CONDITION
Average Value < Flux Received	Eyes Closed
Average Value > Flux Received	Eyes Open

This system will take action for 5 seconds after action taken mode is ON. In this period of time, patients have to give instruction as they want to operate. Patients have to give valid eye blinks.

The inputs to the micro-controller are classified used on Table 5.1.2, for these corresponding appliances will be switch ON/OFF or will send message.

Table 5.1.2: EYE BLINK INTERACTIVE APPLIANCE

TIMES	BINARY VALUE	APPLIANCES NUMBER	BLINK LENGTH
1x	0001	#1 (Sending Message)	Short
2x	0011	2nd Appliances ON/OFF	Short
3x	0111	3rd Appliances ON/OFF	Short
4x	1111	4th Appliances ON/OFF	Short

5.2 RESULT DISPLAY

It takes around four seconds to get ready to take data, and then sensor sends data to Micro Controller. Output is perfect as its detecting eye blink. It shows the status. Finally, we get a confirmation by getting a message of data receiving.

Table 5.2: FLUX VALUE AND SENSOR DATA

INPUT (LUX)	AVERAGE (LUX)	ACTION	NOTE	BINARY INPUT
785 777 792 745 753 . . .	≈ 805	Trigger On	Eye Closed For 4-5 Sec	
790 789 773 778 . . .	≈ 805	Action Taken Action Taken Action Taken Action Taken	Blink 01 Blink 02 Blink 03 Blink 04	
946 1021 1023 1021 . . .	≈ 805		Eyes Open	
1023	≈ 805	Action Over	4 No Relay Switch On	1111
957 995 980 . . .	≈ 962	Trigger On	Eye Closed For 4-5 Sec	
801 820 795 652	962	Action Taken Action Taken Action Taken Action Taken	Blink 01 Blink 02 Blink 03 Blink 04	
1027 1102 . . .			Eyes Open	
1021		Action Over "1111"	4 No Relay Switch Off	
805 890 950 . . .	≈ 881	Action Taken Action Taken	Blink 01 Blink 02	0011

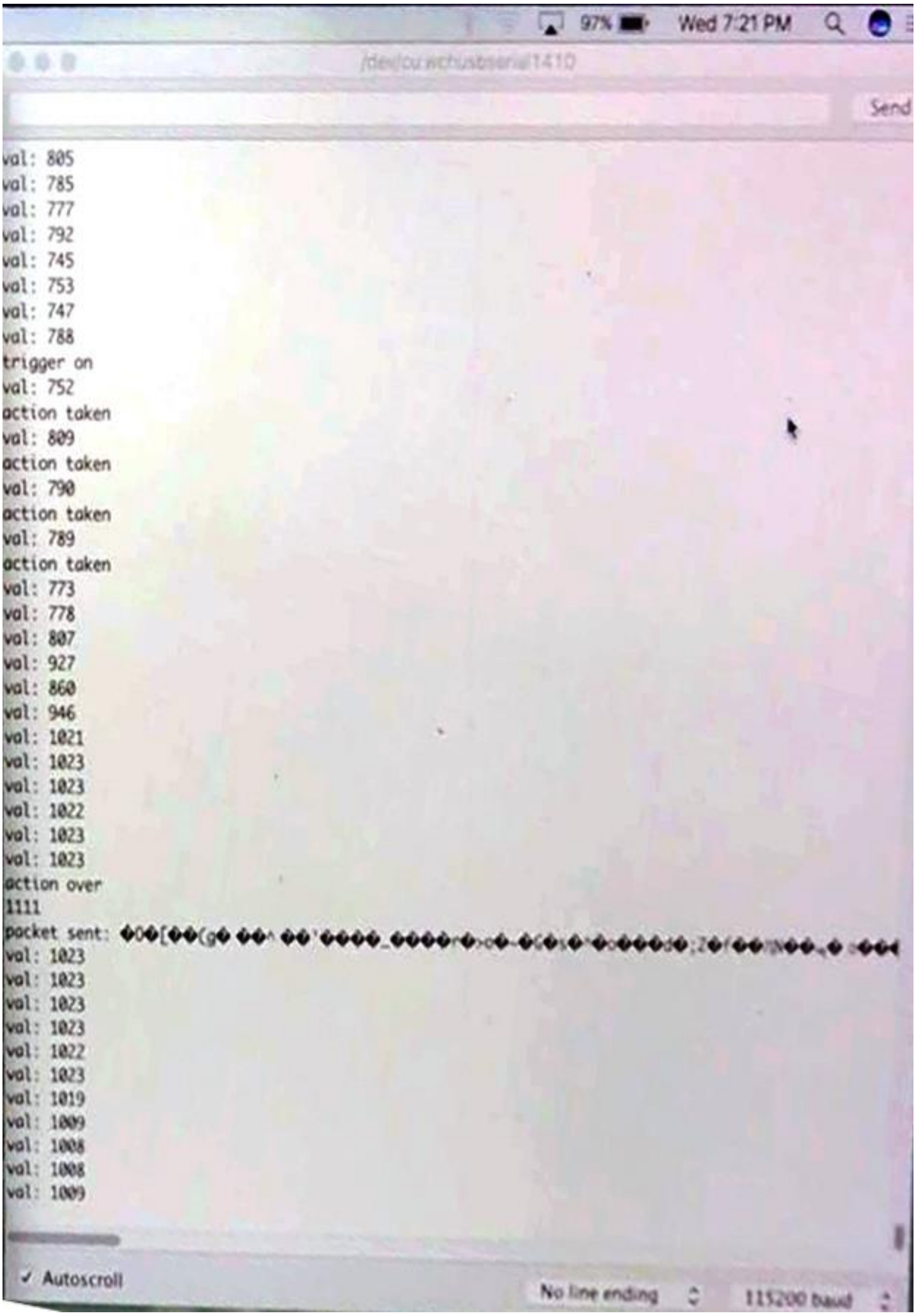

Figure5.2: FLUX VALUE AND SENSOR DATA

5.3 ANDROID APPLICATION

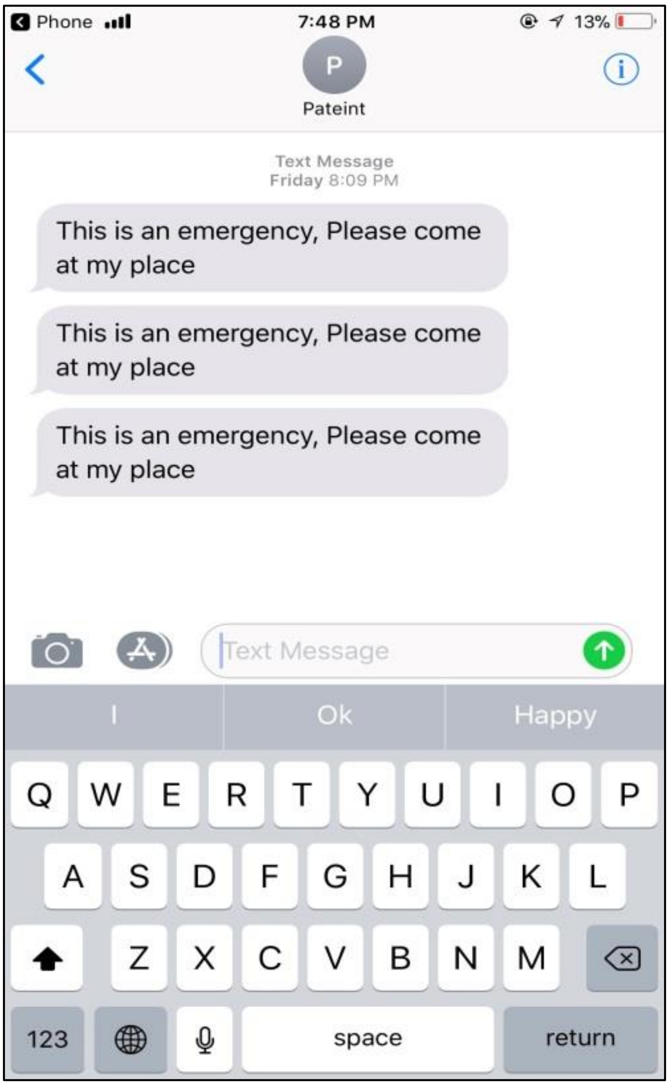

Figure 5.3: SMS SCREENSHOT

If patient blink once after trigger on then, the action will be transferred to Bluetooth instead of relay board. The Bluetooth will send SMS to Paired device of the given number. Supervisor will get this text message from that connected device.

Device Range: device has two parts primary and secondary both are wirelessly connected via RF link. This link will work up to 100 meters without any other foreign signal interference such as mobile, radio frequency etc.

Bluetooth Range: Device is connected with Android mobile via Bluetooth for text messaging service for emergency. In test trials, this device's Bluetooth module can work within 15-20 meters without any interruption.

5.4 ACCURACY RATE ANALYSIS:

Our system is currently providing above 70 percent accuracy on the test trial with minimal foreign signal interface depending on various light environment.

We discuss accuracy analytical data on three light environments bellow.

1. Day Light.
2. Room Light.
3. No Light (Dark).

Table 5.4.1: TEST ANALYSIS FOR BINARY SEQUENCE 0001 DAY LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
Day Light (Test 01)	Action 01	☑	☒	Among 7 Actions 3 failed and 4 succeeded. Accuracy: $(\frac{4}{7} \times 100)$ **= 57.14 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
Day Light (Test 02)	Action 01	☑	☒	Among 7 Actions 2 failed and 5 succeeded. Accuracy: $(\frac{5}{7} \times 100)$ **= 71.42 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
Day Light (Test 03)	Action 01	☑	☒	Among 7 Actions 4 failed and 3 succeeded. Accuracy: $(\frac{3}{7} \times 100)$ **= 42.85 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☑	☒	
	Action 07	☒	☑	
Average Accuracy in Daylight: $\frac{57.14+71.42+42.85}{3} = 57.14\% \approx 58\%$				

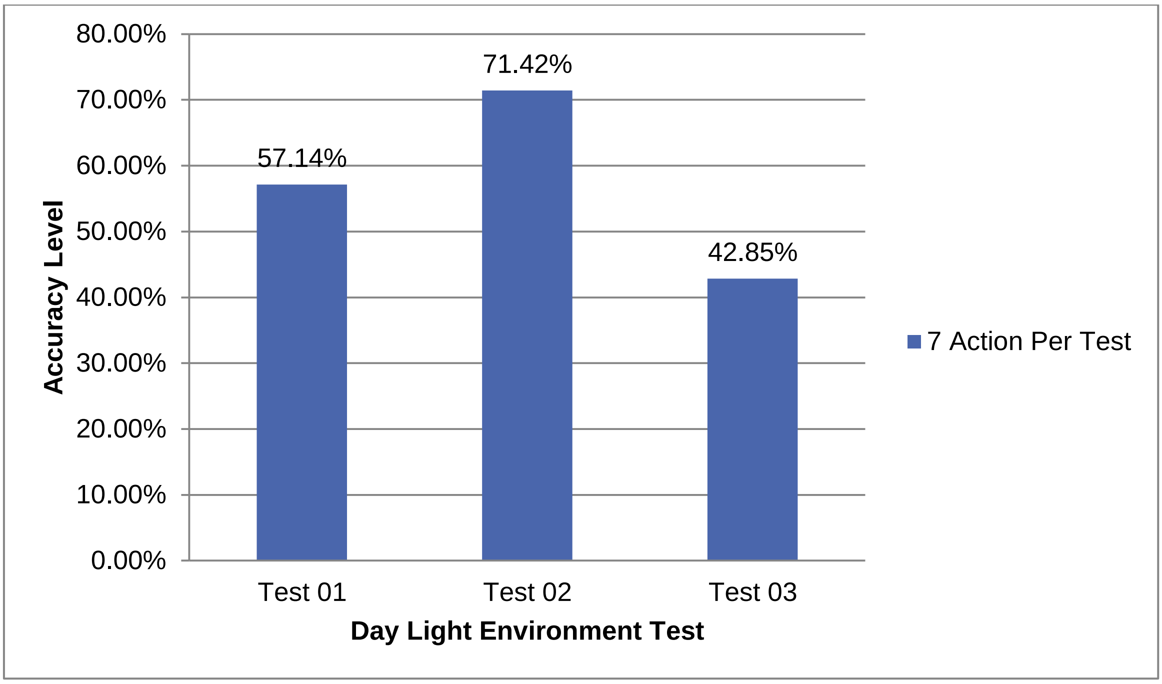

Figure 5.4.1: DAY LIGHT ACCURACY TEST FOR SEQUENCE 0001

Table 5.4.2: TEST ANALYSIS FOR BINARY SEQUENCE 0001 ROOM LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
Room Light (Test 01)	Action 01	☑	☒	Among 10 Actions 4 failed and 6 succeeded. Accuracy: $(\frac{6}{10} \times 100)$ = **60 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☒	☑	
	Action 09	☑	☒	
	Action 10	☑	☒	
Room Light (Test 02)	Action 01	☒	☑	Among 10 Actions 4 failed and 6 succeeded. Accuracy: $(\frac{6}{10} \times 100)$ = **60 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
	Action 08	☒	☑	
	Action 09	☑	☒	
	Action 10	☑	☒	

Room Light (Test 03)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ **= 70 %**
	Action 02	☑	☒	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☒	☑	
	Action 10	☑	☒	
Average Accuracy in Daylight: $\frac{60+60+70}{3}$ = 63.33% ≈ 64%				

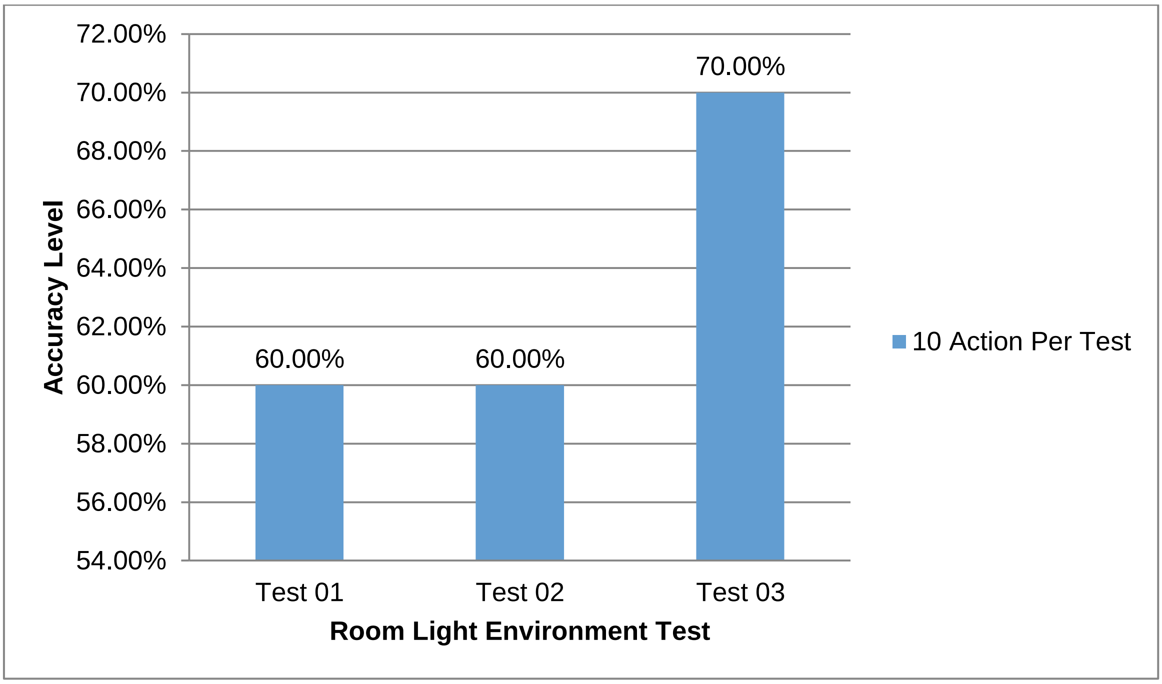

Figure 5.4.2: ROOM LIGHT ACCURACY TEST FOR SEQUENCE 0001

Table 5.4.3: TEST ANALYSIS FOR BINARY SEQUENCE 0001 NO LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
No Light (Test 01)	Action 01	☑	☒	Among 10 Actions 2 failed and 8 succeeded. Accuracy: $(\frac{8}{10} \times 100)$ **= 80 %**
	Action 02	☑	☒	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☒	☑	

No Light (Test 02)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ **= 70 %**
	Action 02	☑	☒	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☒	☑	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	
No Light (Test 03)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ **= 70 %**
	Action 02	☑	☒	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
	Action 08	☒	☑	
	Action 09	☑	☒	
	Action 10	☒	☑	
Average Accuracy in Daylight: $\frac{80+70+70}{3}$ = 73.33% ≈ 74%				

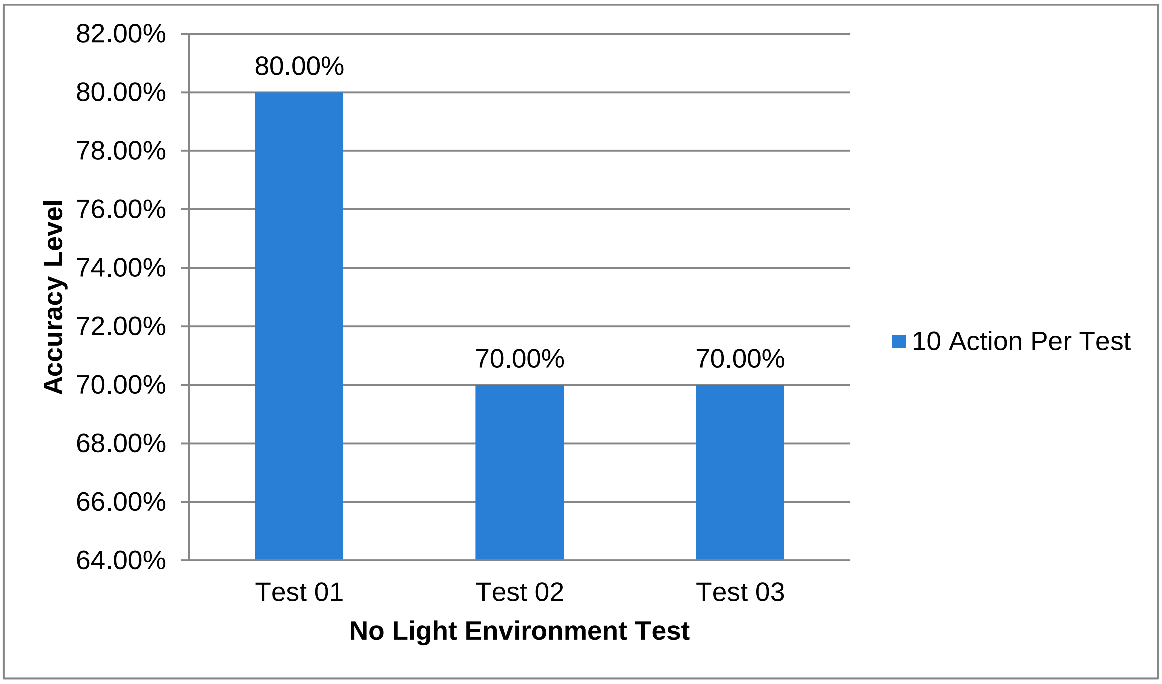

Figure 5.4.3: NO LIGHT ACCURACY TEST FOR SEQUENCE 0001

Table 5.4.4: TEST ANALYSIS FOR BINARY SEQUENCE 0011 DAY LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
Day Light (Test 01)	Action 01	☑	☒	Among 7 Actions 3 failed and 4 succeeded. Accuracy: $(\frac{4}{7} \times 100)$ = **57.14 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
Day Light (Test 02)	Action 01	☑	☒	Among 7 Actions 4 failed and 3 succeeded. Accuracy: $(\frac{3}{7} \times 100)$ = **42.85 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☑	☒	
	Action 07	☒	☑	
Day Light (Test 03)	Action 01	☑	☒	Among 7 Actions 2 failed and 5 succeeded. Accuracy: $(\frac{5}{7} \times 100)$ = **71.42 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
Average Accuracy in Daylight: $\frac{57.14+42.85+71.42}{3}$ = 57.14% ≈ 60%				

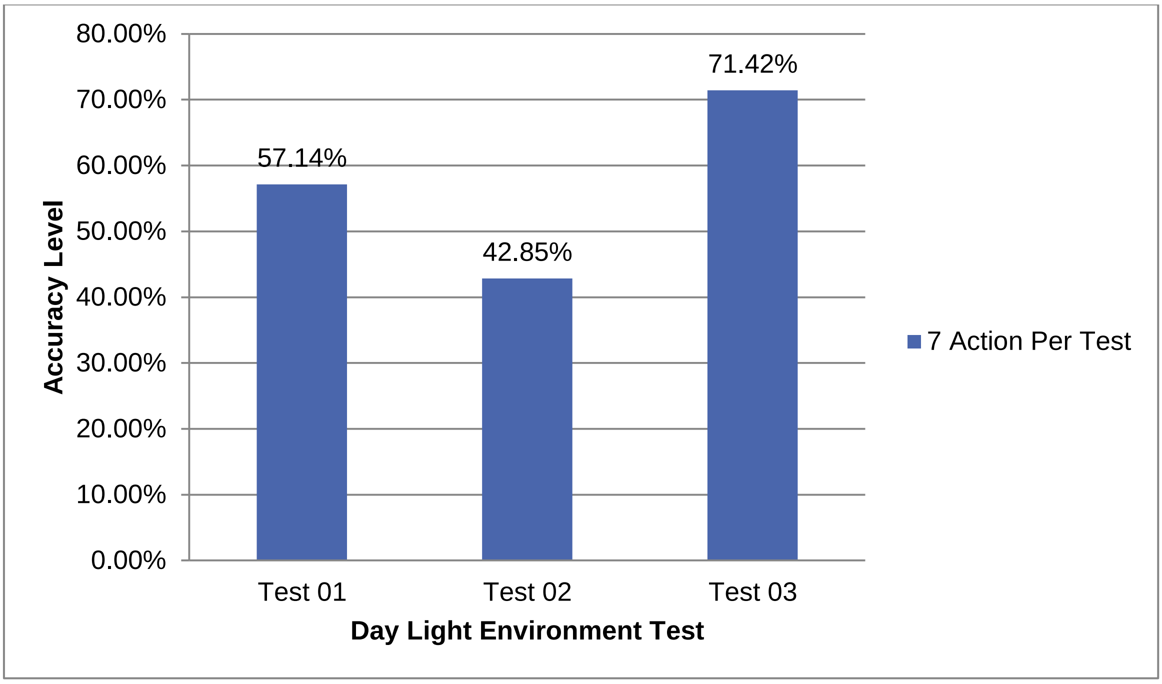

Figure 5.4.4: DAY LIGHT ACCURACY TEST FOR SEQUENCE 0011

Table 5.4.5: TEST ANALYSIS FOR BINARY SEQUENCE 0011 ROOM LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
Room Light (Test 01)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ **= 70 %**
	Action 02	☑	☒	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	
Room Light (Test 02)	Action 01	☒	☑	Among 10 Actions 5 failed and 5 succeeded. Accuracy: $(\frac{5}{10} \times 100)$ **= 50 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
	Action 08	☒	☑	
	Action 09	☑	☒	
	Action 10	☒	☑	
Room Light (Test 03)	Action 01	☑	☒	Among 10 Actions 4 failed and 6 succeeded. Accuracy: $(\frac{6}{10} \times 100)$ **= 60 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☒	☑	
	Action 10	☑	☒	
Average Accuracy in Daylight: $\frac{70+50+60}{3}$ = 60%				

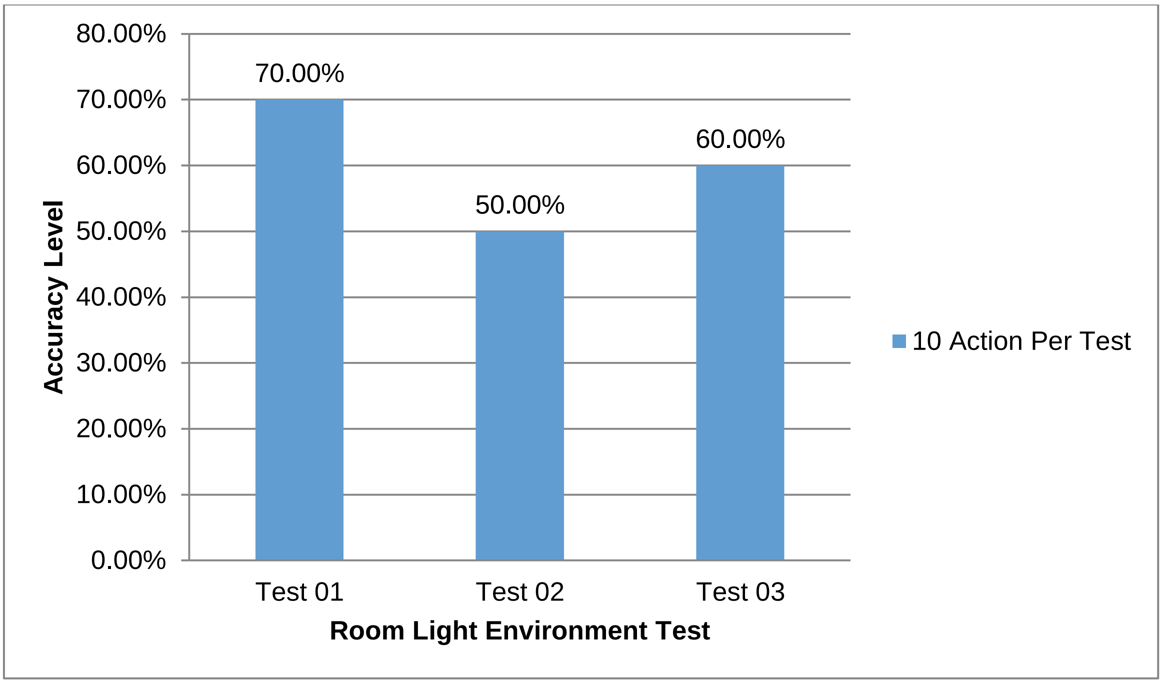

Figure 5.4.5: ROOM LIGHT ACCURACY TEST FOR SEQUENCE 0011

Table 5.4.6: TEST ANALYSIS FOR BINARY SEQUENCE 0011 NO LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
No Light (Test 01)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ = **70 %**
	Action 02	☑	☒	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☒	☑	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	
No Light (Test 02)	Action 01	☑	☒	Among 10 Actions 2 failed and 8 succeeded. Accuracy: $(\frac{8}{10} \times 100)$ = **80 %**
	Action 02	☒	☑	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	

No Light (Test 03)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ **= 70 %**
	Action 02	☑	☒	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
	Action 08	☒	☑	
	Action 09	☒	☑	
	Action 10	☒	☑	
Average Accuracy in Daylight: $\frac{70+80+70}{3} = 73.33\% \approx 74\%$				

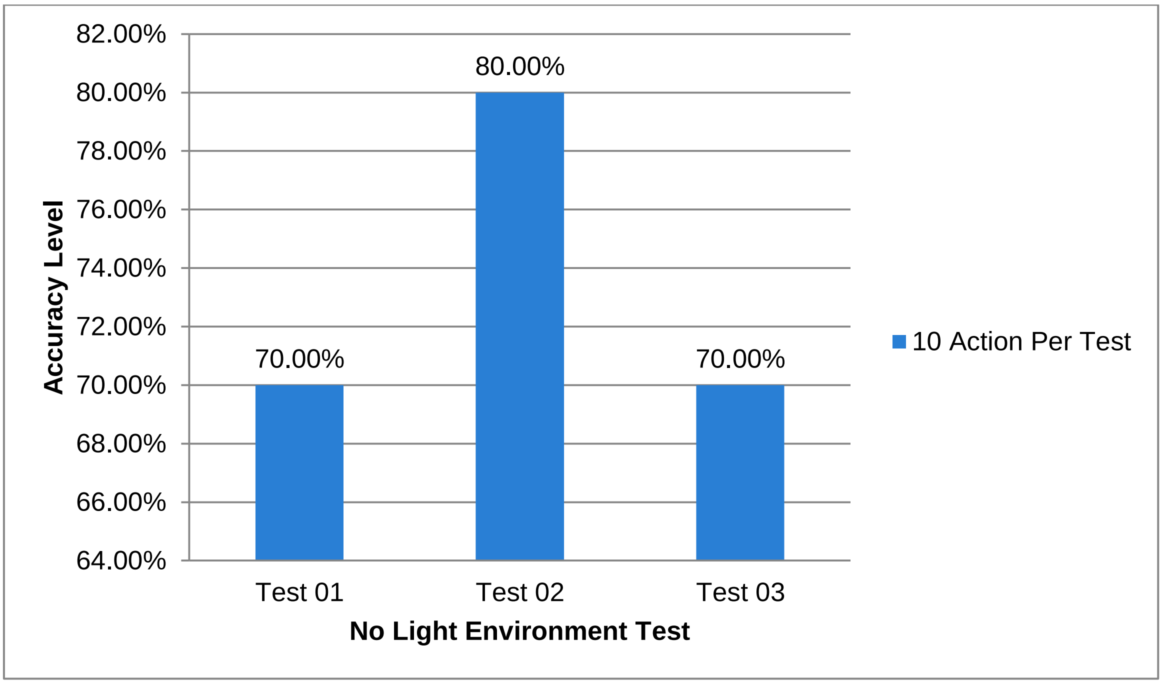

Figure 5.4.6: NO LIGHT ACCURACY TEST FOR SEQUENCE 0011

Table 5.4.7: TEST ANALYSIS FOR BINARY SEQUENCE 0111 DAY LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
Day Light (Test 01)	Action 01	☑	☒	Among 7 Actions 3 failed and 4 succeeded. Accuracy: $(\frac{4}{7} \times 100)$ **= 57.14 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	

Day Light (Test 02)	Action 01	☑	☒	Among 7 Actions 2 failed and 5 succeeded. Accuracy: $(\frac{5}{7} \times 100)$ **= 71.42 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
Day Light (Test 03)	Action 01	☑	☒	Among 7 Actions 4 failed and 3 succeeded. Accuracy: $(\frac{3}{7} \times 100)$ **= 42.85 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☑	☒	
	Action 07	☒	☑	
Average Accuracy in Daylight: $\frac{57.14+71.42+42.85}{3} = 57.14\% \approx 60\%$				

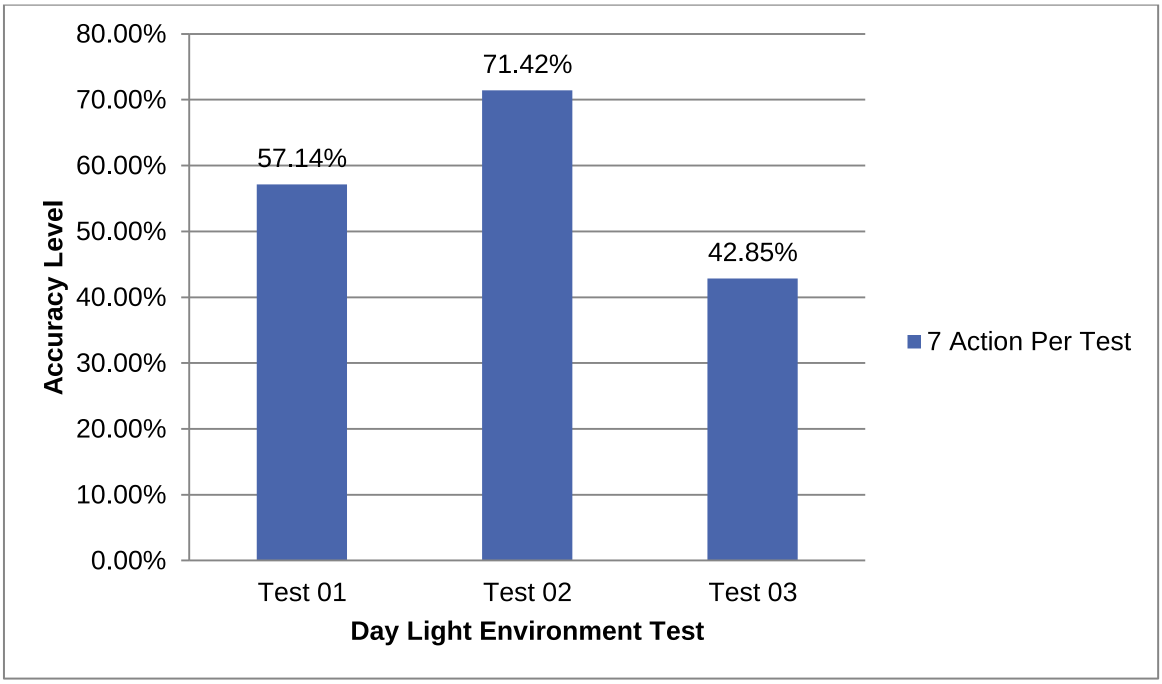

Figure 5.4.7: DAY LIGHT ACCURACY TEST FOR SEQUENCE 0111

Table 5.4.8: TEST ANALYSIS FOR BINARY SEQUENCE 0111 ROOM LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
Room Light (Test 01)	Action 01	☑	☒	Among 10 Actions 6 failed and 4 succeeded. Accuracy: $(\frac{4}{10} \times 100)$ = **40 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☒	☑	
	Action 05	☒	☑	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☒	☑	
	Action 09	☑	☒	
	Action 10	☑	☒	
Room Light (Test 02)	Action 01	☒	☑	Among 10 Actions 4 failed and 6 succeeded. Accuracy: $(\frac{6}{10} \times 100)$ = **60 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
	Action 08	☒	☑	
	Action 09	☑	☒	
	Action 10	☑	☒	
Room Light (Test 03)	Action 01	☑	☒	Among 10 Actions 2 failed and 8 succeeded. Accuracy: $(\frac{8}{10} \times 100)$ = **80 %**
	Action 02	☑	☒	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	
Average Accuracy in Daylight: $\frac{40+60+80}{3}$ = 60%				

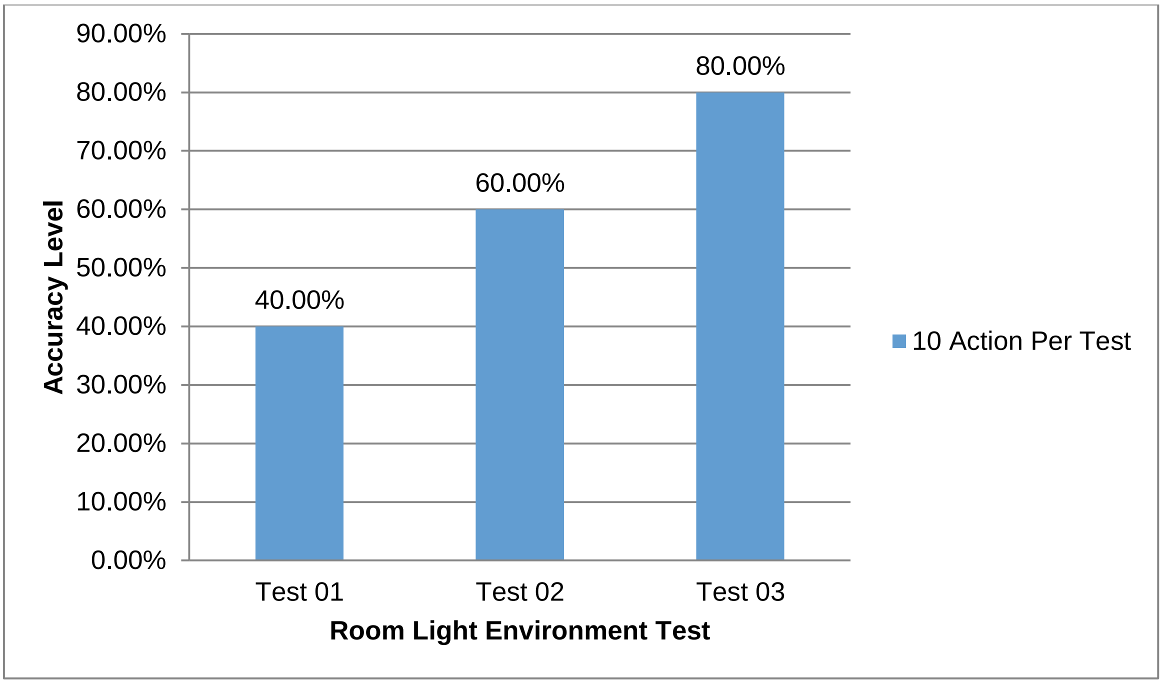

Figure 5.4.8: ROOM LIGHT ACCURACY TEST FOR SEQUENCE 0111

Table 5.4.9: TEST ANALYSIS FOR BINARY SEQUENCE 0111 NO LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
No Light (Test 01)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ = **70 %**
	Action 02	☑	☒	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☒	☑	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	
No Light (Test 02)	Action 01	☑	☒	Among 10 Actions5 failed and5 succeeded. Accuracy: $(\frac{5}{10} \times 100)$ = **50 %**
	Action 02	☒	☑	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	

No Light (Test 03)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ **= 70 %**
	Action 02	☑	☒	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
	Action 08	☒	☑	
	Action 09	☒	☑	
	Action 10	☒	☑	
Average Accuracy in Daylight: $\frac{70+50+70}{3} = 63.33\% \approx 64\%$				

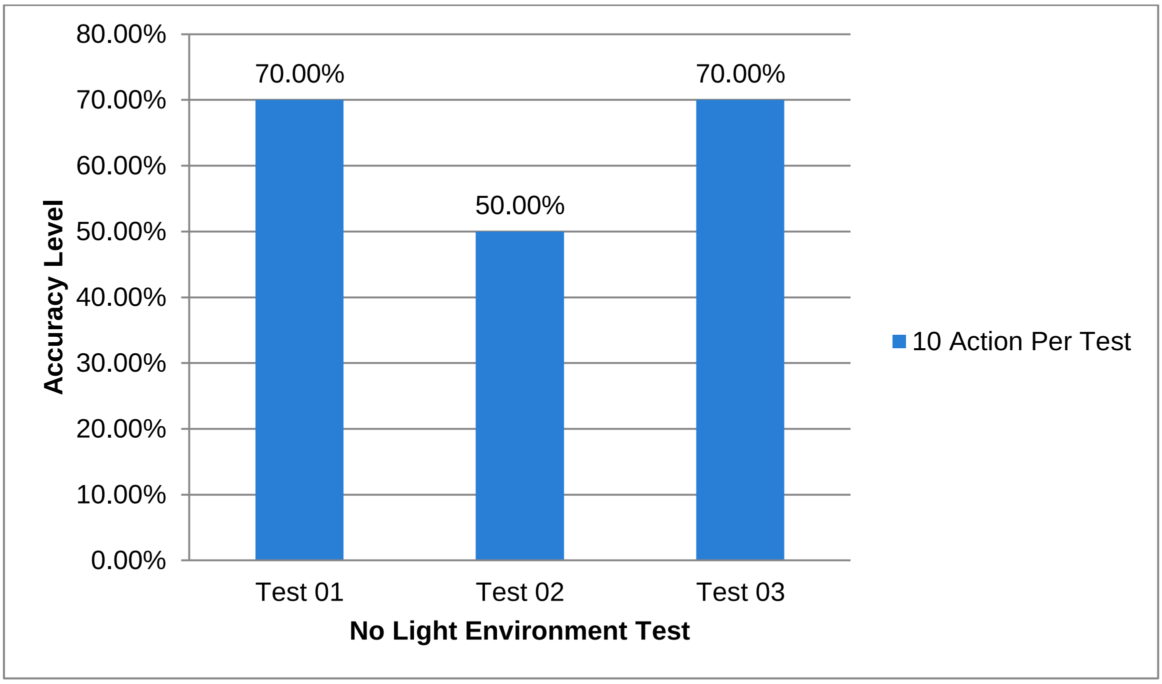

Figure 5.4.9: NO LIGHT ACCURACY TEST FOR SEQUENCE 0111

Table 5.4.10: TEST ANALYSIS FOR BINARY SEQUENCE 1111 DAY LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
Day Light (Test 01)	Action 01	☑	☒	Among 7 Actions 4 failed and 3 succeeded. Accuracy: $(\frac{3}{7} \times 100)$ **= 42.85 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☑	☒	
	Action 07	☒	☑	

Day Light (Test 02)	Action 01	☑	☒	Among 7 Actions 3 failed and 4 succeeded. Accuracy: $(\frac{4}{7} \times 100)$ **= 57.14 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
Day Light (Test 03)	Action 01	☑	☒	Among 7 Actions 2 failed and 5 succeeded. Accuracy: $(\frac{5}{7} \times 100)$ **= 71.42 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
Average Accuracy in Daylight: $\frac{42.85+57.14+71.42}{3} = 57.14\% \approx 60\%$				

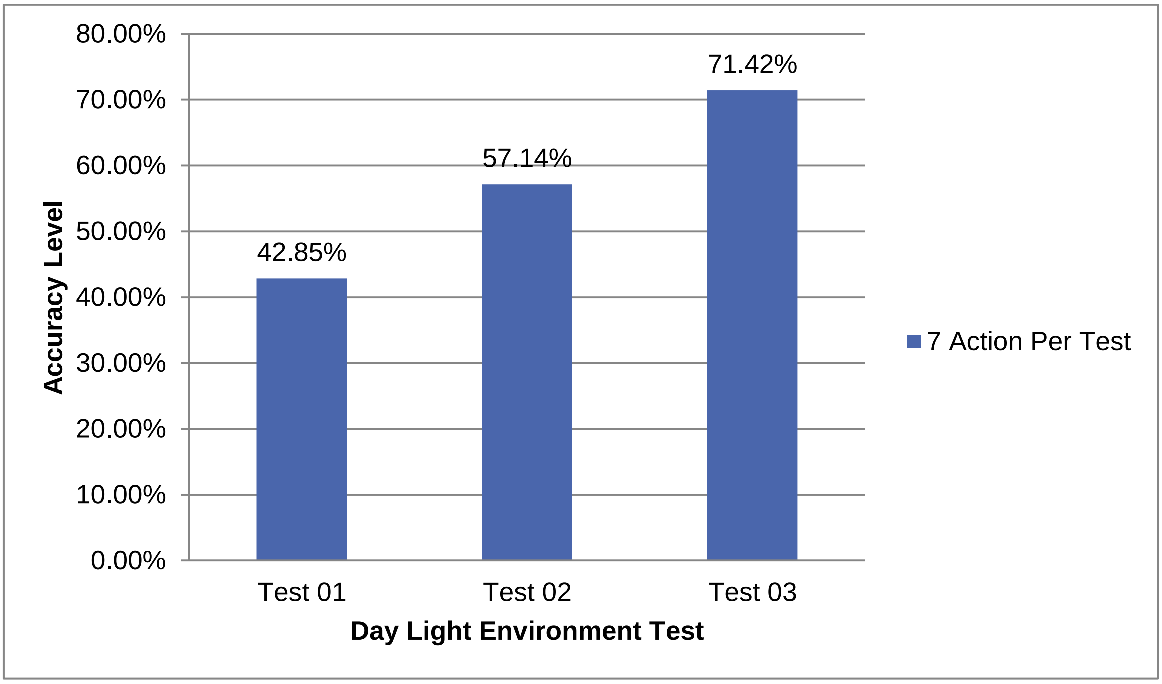

Figure 5.4.10: DAY LIGHT ACCURACY TEST FOR SEQUENCE 1111

Table 5.4.11: TEST ANALYSIS FOR BINARY SEQUENCE 1111 ROOM LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
Room Light (Test 01)	Action 01	☑	☒	Among 10 Actions 4 failed and 6 succeeded. Accuracy: $(\frac{6}{10} \times 100)$ **= 60 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☒	☑	
	Action 09	☑	☒	
	Action 10	☑	☒	
Room Light (Test 02)	Action 01	☒	☑	Among 10 Actions 4 failed and 6 succeeded. Accuracy: $(\frac{6}{10} \times 100)$ **= 60 %**
	Action 02	☒	☑	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
	Action 08	☒	☑	
	Action 09	☑	☒	
	Action 10	☑	☒	
Room Light (Test 03)	Action 01	☒	☑	Among 10 Actions 6 failed and 4 succeeded. Accuracy: $(\frac{4}{10} \times 100)$ **= 40 %**
	Action 02	☑	☒	
	Action 03	☒	☑	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☒	☑	
	Action 09	☒	☑	
	Action 10	☑	☒	
Average Accuracy in Daylight: $\frac{60+60+40}{3}$ = 53.33% ≈ 54%				

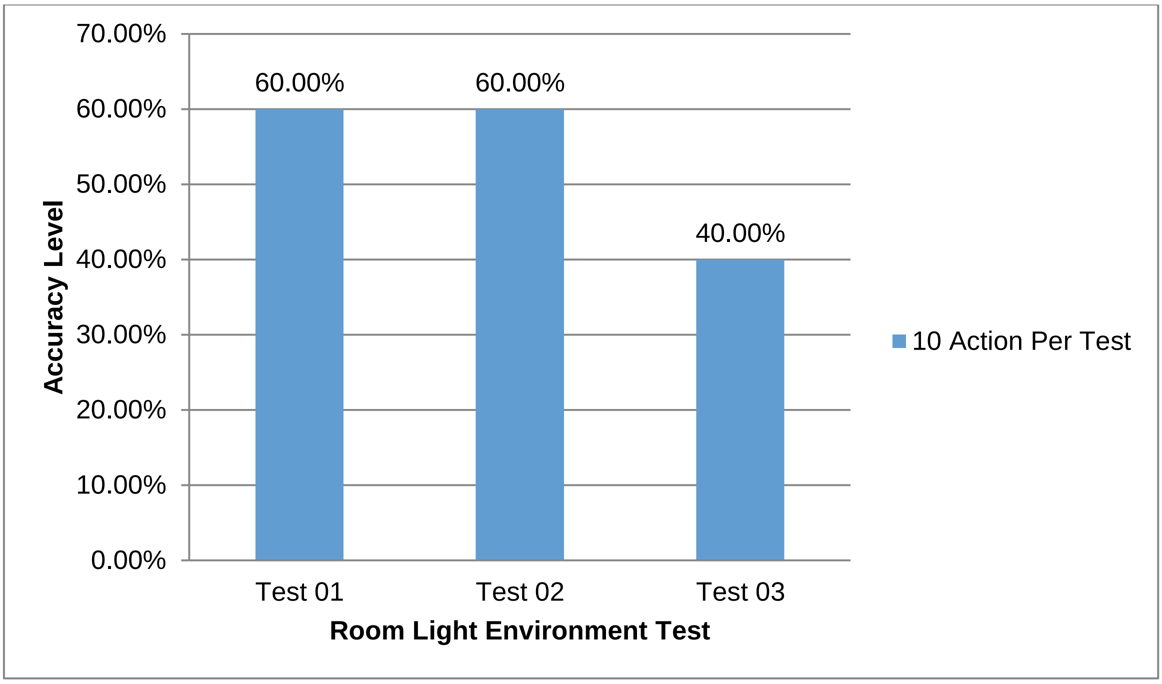

Figure 5.4.11: ROOM LIGHT ACCURACY TEST FOR SEQUENCE 1111

Table 5.4.12: TEST ANALYSIS FOR BINARY SEQUENCE 1111 NO LIGHT

Environment Condition	Sample Data	Success	Fail	Comments
No Light (Test 01)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ = **70 %**
	Action 02	☑	☒	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☒	☑	
	Action 06	☒	☑	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	
No Light (Test 02)	Action 01	☑	☒	Among 10 Actions 3 failed and 7 succeeded. Accuracy: $(\frac{7}{10} \times 100)$ = **70 %**
	Action 02	☑	☒	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☑	☒	
	Action 08	☒	☑	
	Action 09	☒	☑	
	Action 10	☒	☑	

No Light (Test 03)	Action 01	☑	☒	Among 10 Actions 2 failed and 8 succeeded. Accuracy: $(\frac{8}{10} \times 100)$ **= 80 %**
	Action 02	☒	☑	
	Action 03	☑	☒	
	Action 04	☑	☒	
	Action 05	☑	☒	
	Action 06	☑	☒	
	Action 07	☒	☑	
	Action 08	☑	☒	
	Action 09	☑	☒	
	Action 10	☑	☒	
Average Accuracy in Daylight: $\frac{70+70+80}{3} = 73.33\% \approx 74\%$				

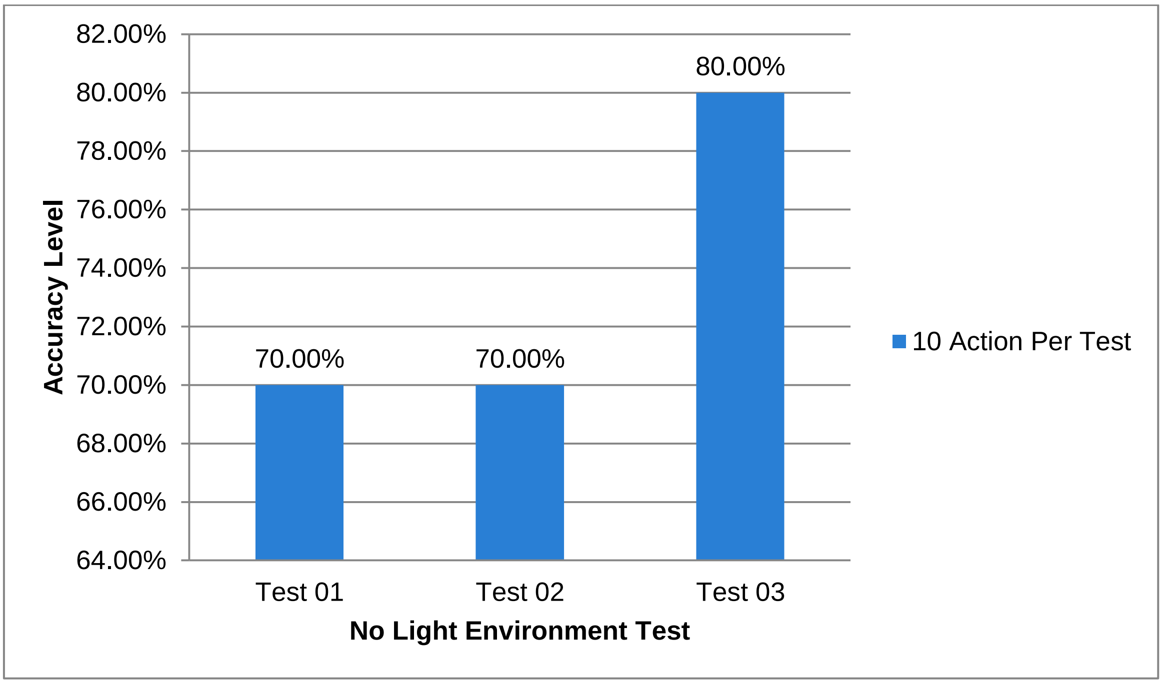

Figure 5.4.12: NO LIGHT ACCURACY TEST FOR SEQUENCE 1111

Table 5.4.13: AVERAGE ACCURACY (%) COMPARISON

Sequence	Day Light (%)	Room Light (%)	No Light (%)
0001	58	64	74
0011	60	60	74
0111	60	60	64
1111	60	54	74

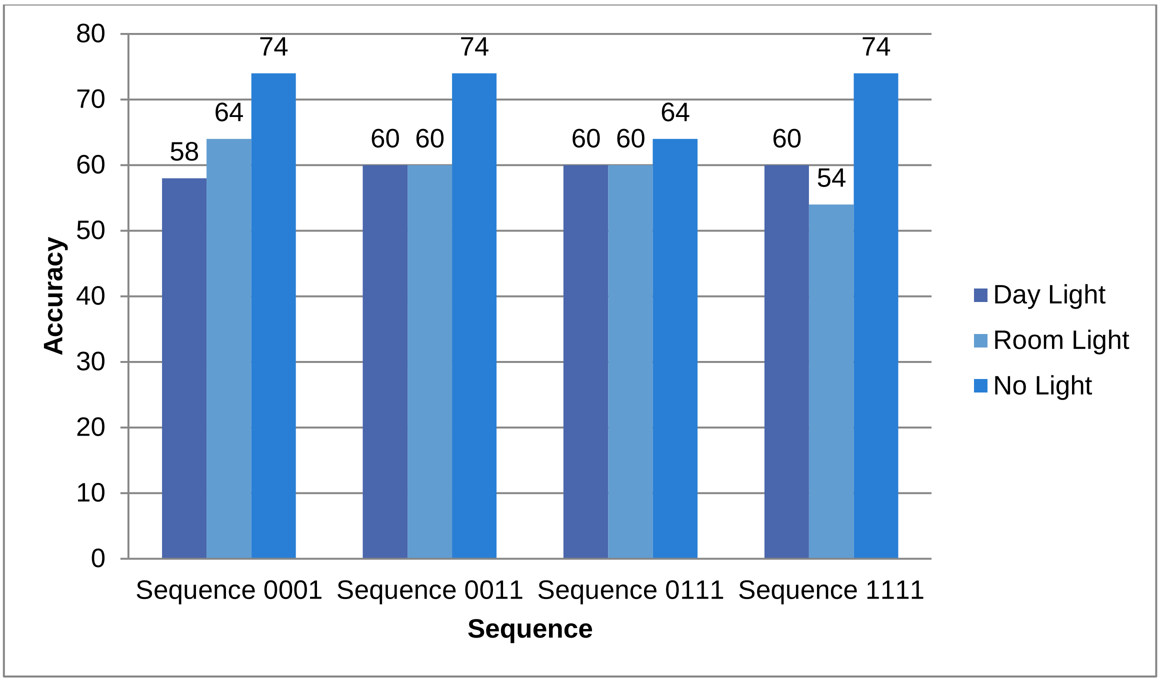

Figure 5.4.13: AVERAGE ACCURACY COMPARISON

According to our test trial our device works most efficiently in No light condition with accuracy more than 70 percent, because in no light there is less amount of foreign reflection rather than the reflection from eyes.

Secondly it works better on Room light environment with accuracy of 64 percent. Lastly it shows 60 percent of accuracy in Day light situation.

5.5 COST ANALYSIS

In our modern era market many new health equipment are there, but in our country Bangladesh, this system based equipment is rarely found. If anything found nearly similar to our system then it would cost very expensive. Though many people will not be able to buy or will get distracted from this equipment.

But we ensure quality equipment in a very cheap price. So that anyone can afford our system. It is actually unbelievable that this project took very cheap price to be built.

To build the device we used Arduino Nano, RF Link, Bluetooth, Buzzer, IR Sensor, and Relay-board, bread board, glass-frame and jumper wires.
For our device the cost was nearly 2,500/=

Table 5.5: INITIAL COST CALCULATION

COMPONENTS	PRICE
Arduino Nano with cable (2Pc's)	1,000/=
Relay-board	500/=
Buzzer	20/=
RF Link	150/=
Bread-board	80/=
Glass-frame	200/=
IR	20/=
Bluetooth	160/=
Jumper-wires set	100/=
Others	500/=
Total:	**2,780/=**

CHAPTER 06

CONCLUSION

This venture is essentially for paralysis patients who endure a great deal. We are attempting a little bit through this venture so that at any rate they can control the home appliances. We have additionally plan to enhance this venture with better showing advantages an eye blink sensor is transducer which detects an eye blink, and gives a yield voltage at whatever point the eye is shut that can help the patient to control the home apparatus and others, for example, switch on off the light or control the fan speed and also call for assistance.

To sum up we want to say this is doing works using Arduino Nano and various sensors was a great experience as we got to know many valuable things. Our project will be useful mainly for the paralysis patients and senior citizen. Though we are thinking about prototype of the project our model has implemented and tested but to introduce it in real life a lot more improvements and also equipment are needed. One of the main motives of our project was to help patient to make their life easier and our system will be fulfilled when we can use the system in real life and people will be benefited.

6.1 CHALLENGES

Our aim is to create eye blink detector, which could be used in real-time blink detection system. In case of low blink rate and various brightness of light will create problem to a user to blink more frequently. The algorithm is successful mostly when the head is directly facing to the IR sensor. However, this approach has problems with detecting blinks when eyes are quickly moving up and down. The eyelid movements are estimated by normal flow instead of optical flow in. It is the component of optical flow that is orthogonal to the image gradient. Different distance indicates closed or opened eye. The problem of arc extraction arises while the person is looking down [10]. Some major challenges discussed below which we have to overcome for hardware efficiency and compatibility.

Signal interference: Two parts (primary and secondary) of this project communicating with each other using RF-LINK wirelessly. RF-LINK frequency is around 485 MHz though it’s a long range coverage but it also wide channel so that, this frequency matches with surrounding foreign frequencies such as Radio, Mobile Device, Electric Devices. In that circumstance this creates interference to the signal passing through our transmitter and receiver. So that the reason of signal loss and accuracy error.

Not easy to wear: We have developed a prototype with our idea rather than focusing on the device compatibility. Moreover, as this project is still under development, we had to be cost effective. So in our prototype there are lots of random wires this become hassle to wear. The overall weight of the glass is also higher because of adding batteries as a power source. So the device is initially not user friendly and comfortable.

Re configuration: Because of having a lots of unorganized wires and the IR sensor is connected with those random wires, so it needs to be re adjusted for different user as the position and size is different from person to person.

Single threaded architecture: Our device is currently working in a single threaded architecture using sequential processing. So that this is unable to perform multiple tasks at same time such as when it takes input from IR the other operations like: Bluetooth, RF- link etc. remain in a halt condition.

6.2 FUTURE WORK PLAN

This system is working only for patients or disables persons that can make their life more comfortable. Through this system they can operate the home appliances by blinking their eyes, even then can also send message. Our motive is not only the controlling of the home appliances or sending message, but also this project has long way to go. Our focus on patients or disable person, so our future long way also depends on their comfortable lifestyle.

In future we have clear view that a patient can run their own wheel chair by blinking their eyes for that we are planning to control motor sensors by sending instruction & through eye blinking. In that case, both eyes will be covered by IR sensor; if left eye closed for a while then wheel chair will go to the left and vice versa. Normal blinking will do nothing. Long blink will move for forward, and short blink will move backward.

Besides this we can improve our project by adding patient's health monitoring option. So that we can have overall health condition report of the patient's like- body temperature, blood pressure, sugar level, and so on. In addition, we can make our system more efficient by adding more sensors on the development of the android applications we will include emergency calling or SOS [like: helpline 911] directly to avoid any kind of total causality in sudden fire break down, earthquake etc.

Usually the radio channels consisting range of 0-950 MHz have now became obsolete as this rage is vastly crowed. The recent innovation is 2.5 GHz of radio channels with shorter range but wide channels that decreases foreign signal interference. So to overcome the signal interference in future we will use RF-LINK if that range becomes cheaper and available. We will also integrate our device into PCB board with rechargeable battery to reduce weight and make it comfortable and user friendly.

To improve the processing power we will also implement multi-threading processing system to reduce the computational error.

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