



# ***Online Smart Security With Remote Monitoring Facilities***

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**Declaration**

This Thesis Submission to the Department of Computer Science and Engineering BRAC University, Dhaka, submitted by the authors for the purpose of achieving the degree of Bachelor in Computer Science and Engineering. We, hereby announce that, this thesis is based on the results we have found by ourselves. Resources taken from any research done by other researchers are mentioned through reference. This Thesis, neither in whole nor in part has been previously submitted for any other degree or any other publication.

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## **Abstract**

Where home security problem has integrated to daily life, there technology has already become an efficient solution for this issue, and this project has come up with all possible technical solution to home security issue. This paper has proposed the combination of android and firebase to ensure remotely control security system and a complete compilation of various sensors (e.g. sonar sensor, motion sensor, smoke sensor etc.) and Web camera to give it a more efficient embedded finishing. Solving the draw backs of existing home security systems and makes a fast, inexpensive and irrefutable solution was the main goal of this paper. For an excellent home security system which is very important that is real time dynamic alerts. The most demanding criteria are this dynamic alert has to be fast and correct. Focusing on this the system has programmed to save the real time photos to the Google drive for future preference with the help of web camera. The moment it gets any signal or violation a pop notification will be shown to user mobile. The goal is to make this project as reasonable as possible so that people from every economic background can afford and use for their home security purpose.

*Keywords*-Smart lock, remotely monitoring, Raspberry Pi, Android, Home security system, Ardiuno, Real-time communication.

## **Chapter: 01**

### **Introduction**

Going through the recent newspapers, a very general issue has come to light “home invasion” [1]. From the different corner of the world the same problem has become a headache for general people. And most of this accidents occurred when people were outside their home. Ostensibly trapped into home and appliances damage because of natural disaster like rain or storm, is another vital security concern. This paper was planned to come up with a fast and worthy solution to this problem. Technology based system which can be faster and effective in this issue is the core of this paper.

. Researching on the existing systems, this paper’s purpose was the progression of previous state and also establishes a absolute solution for home security convention. Very important feature for a security system is to response fast. This paper and accomplished work has put more effort on user experience and fast response of the system so that user can take action accordingly.

Two major components with two mode feature this system has enough efficiency to become a reliable security system for society. 1<sup>st</sup> major component is the hardware setup which consists of a lock, arduino, raspberry Pi and its modules collaborating with various sensors and camera. 2<sup>nd</sup> major component is the mobile application to control the hardware system remotely. Mobile application has been chosen to remotely control the hardware because now a day’s android application has become very popular and android phones can be found in a very cheap rate.

4 very effective sensors have been used to make this project more useful. Sonar, motion, vibration, smoke sensor would make sure if there is any unwanted movement or person in the house when user is out of home. A fixed camera will send photos of user’s total house in every 15 minutes to the Google drive and will save it there to inform the user about their house information on real time. This all over compact project has been planned and implemented to make user tension free when they are outside home.

## **Chapter: 02**

### **Objective**

In this paper the term “Security” will accomplish various types of security, security from abductor, security from natural calamities like rain and storm, security in case of being trapped , security in case of any appliances damage etc. this paper has planned to provide an absolute solution for security at home and outside home.

In case of fire exaction (because of electricity short circuit), this system will be work as helping hand. This should turn off all the home appliances power individually to secure the home from fire or any other harmful occurrences. An Android app has been planned to implement for monitoring all the appliances of home from anywhere the user stay. This project will help the aged society a lot. We kept that in our mind that this security system should be useful for aged people and kids.

Sometimes it’s very tough to look after windows while it’s raining. In this case this app and the total system will be planned to the way to close the windows during calamities. Mobile notification services and auto door and window monitor will be included in this service so that the user doesn’t have to face any security problem during rain. Keeping seasonal effects on head, we have tried to build a solution which will help its user with almost all security measurements.

Mostly this project has planned to save home from the looter. To prevent looter to enter your house and also necessary precautions in case the looter already entered the house. For both situations this project will be effective.



## Comparative Crime Statistics: 2008 – 2014

Year	Robbery	Murder	Women & Child Repression	Kidnapping	Burglary	Theft	Smuggling	Police Assault
2008	1583	4099	15246	817	4552	12188	7962	296
2009	1298	4219	13997	858	3456	9171	7817	357
2010	1059	3988	17752	870	3101	8529	6363	473
2011	1069	3966	21389	792	3134	8873	5714	581
2012	964	4114	20947	850	2927	8598	6578	659
2013	1021	4393	19601	879	2762	7882	6437	1257
2014	1155	4514	21291	920	2809	7660	6788	702

Source: Bangladesh police

Adill Shaakir

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Figure1: comparative crime statistics 2008-2014 by Bangladesh Police

Collecting the statistics of comparative crime during last 6 years this was very minatory for us to build a smart security solution which will be affordable and effective. If we look for the robbery and theft rate we will observe that the rate has increase in last year's. This is very alarming. Before ensuring security outside home we have to make sure the security of our home. This is the place where we spend more time, mostly our family and kids. The implemented version of this proposed project will make sure a good system as absolute solution of home security.

## **Chapter: 03**

### **Literature Review:**

Before starting with our ideas we decided to research on the ideas which are already in the market and providing house security systems. As this is a very general issue we got a bunch of companies working on this. So we decided to go to the root people just to talk and ask them how they would like to have a home security system. What would be their requirements and suggestions? The 2<sup>nd</sup> form was too much productive for us. We got more ideas to work with.

Now if we come to the 1<sup>st</sup> pattern, the market research then companies like Canary, IControl, Vivint, SkyLinkNetetc has already this existing system with their individual and few common features. Some companies are giving more focus on the lock and other features some are focused about their UI, handling Android device. There is another issue only few companies are selling it in a very low range. Our concept was to make it affordable with good quality. So we were looking for some specific existing systems that can help us with our motivation. This market has gotten really competitive and it was a tough pick but Intrution's referral worked out for us. Their system isn't dependent on an internet connection or landline and it's portable. The monitoring isn't that expensive either. There is not a lot of home security companies featured in this roundup. Vivint is a really expensive option and from what we've heard they lack customer service skills. Simplisafe doesn't have the best hardware setup and is expensive for what they offer in terms of hardware. iSmart is still good but has its limitations and we don't know too much about SkylinkNet. [Intrution.com](http://Intrution.com) introduced us to some great companies and they helped us to get a wireless, tamper-resistant security system.

People from many institutions from all over the worlds have worked with the same issue and have come up with some outstanding ideas and implementations. To follow the legacy and know the recent demands and trend we have looked for the relevant papers to our topics. And it was very glad to know that students and researchers have really implementable ideas. Researching on amid generation, who are very much concern about the home security criteria, especially for old citizens. Home Security System for Alone Elderly People [5], was a standard

concept to study on. Moreover we have studied many relevant topics to understand the new ideas and trend which will help the progression of user interface.

Proficient hardware implementation and knowledge about sensors were another keyword for study. Looking forward to the fasted real-time response, this paper follows more on the papers who have worked, or more should say, bend with sensors a lot [6].



Figure2: companies working for home security system

## Chapter: 04

### SYSTEM DESIGN

Considering the entire mythology and recruitments user this paper has been accomplished to design the application as simple as possible. So this was very important to make the entire feature easy to access. Mostly this paper put focus on the application user interface.

On the other hand, this paper has put focus on the hardware part more complex according to design, but from a user's point of view this would be very easy to use.

Firstly when the project has started we gave more focus on the Lock, moreover the hardware and also the android control. So we have first implemented our lock which we can operate with the help of our android device. This android app seeks for a user authentication which is connected to cloud. If the user is already registers it gives a lock screen. By tapping which one user can open the lock. And also can close it.

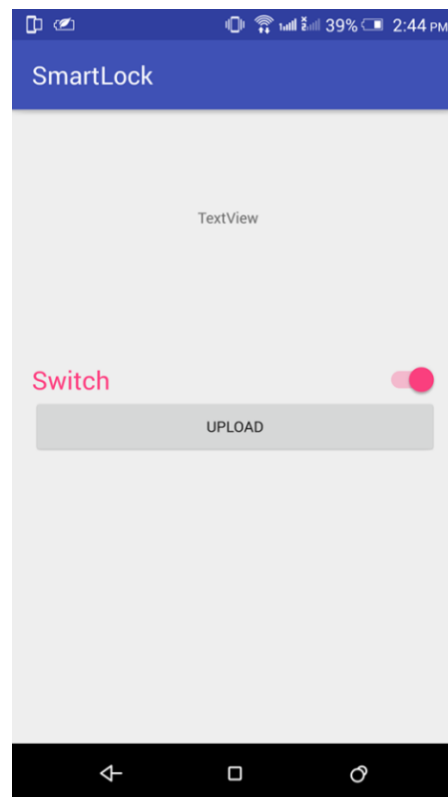


Figure3: First look of the implemented app

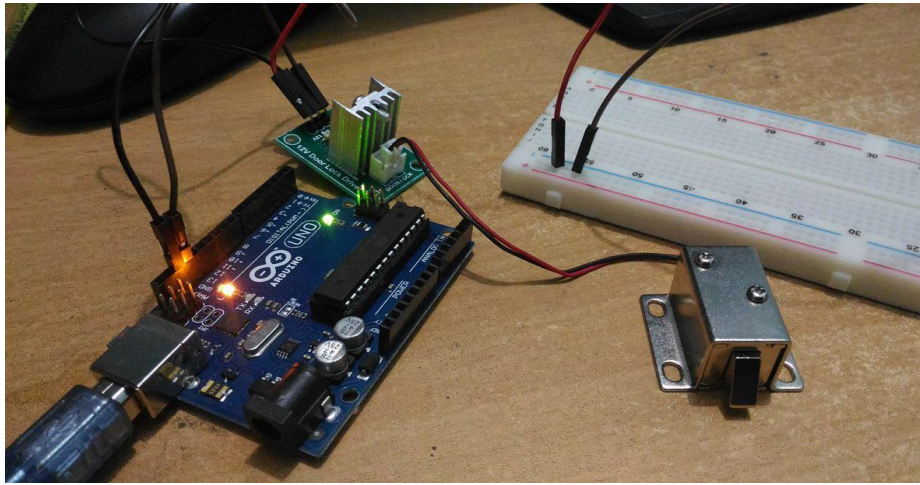


Figure4: First implemented lock

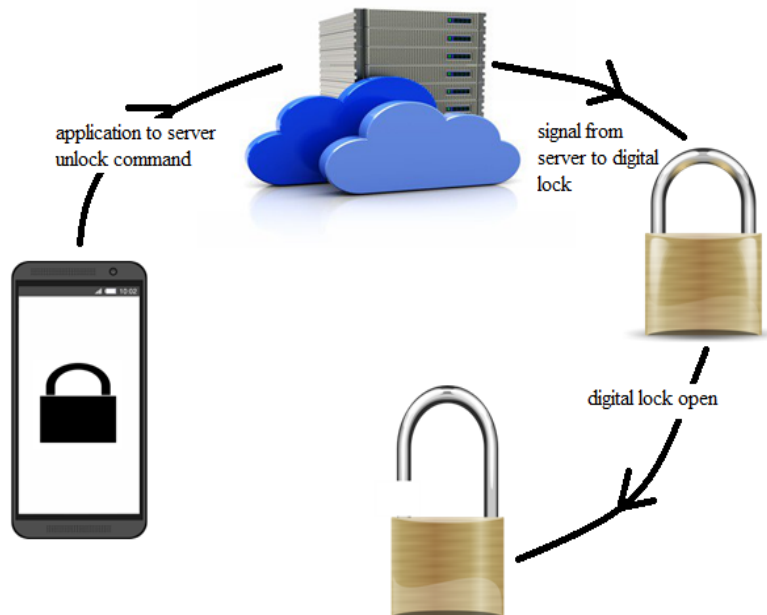


Figure5: work flow with image

After the lock implementation we divert our focus to the other security features. Many questions arrive and we lead our works answering those questions one after another.

The very first question was want to see our app to the final stage? What would be the design to make it more users friendly? With these questions our app has designed to ensure home security with highest user comfort.

Designing an interface considering all aged people as your user is quite challenging. More or less, individual group of people seeks for a different pattern of interface. But, as this is a home security application so people of every age is user group.

*a) Color:* Few very light warm color which are blue, pale green, light pink, has been chosen as the application general color. Considering the fact if user is a color blind they can also distinguish and monitor the app. Because combination of these colors are pretty perfect in color blind sense.

*b) Touch panel:* Working on touch panel, the implemented application has a list of UX designed buttons. Which looks more pretty and very easy for the users to findout.

*c) Text Characteristics :* Different styles has been used in different places of the front around 12-14 , according to the design demand.

*d) Button Specifications:* the buttons has been designed according to the system flow. And few unique buttons has been used to percieve the legacy. For example calling button to call the police or the person who concern and red danger button to play the alarm to the building.

*e) Multimodal communication technique:* Multimodal communication refers to representing the same content in different formats. For example, calling buttons always represent with call icon with text description. These techniques may use multisensory to perceive information which can reduce workload of short term memory.

For technologies and APIs, there are 6 of technologies and APIs which are:

*Sinch*: is used for real-time voice communication.

*PubNub*: is used to publish the message between the applications according to PubNub is the API that provides a service to use Google Cloud Messaging (GCM).

*Microsoft Azure*: is used for the cloud database of the application.

*SQLite*: is used for the local database for the application due to offline used is required to access the homepage of the application.

*OpenCV*: is used to manage the image from the Raspberry Pi camera module by convert the image to byte array and bitmap for sending and display proposes.

*ZXing*: is used for QR code which QR code is represented the id in the system.

Then comes the questions that how we want to implement our hardware? What would be its features? What are the most essential modules that this system would have? The answers of these questions have shown us the exact pathway.

This paper and the implemented work is a combination of Raspberry pi and Arduino. To make the system cheap and simple Raspberry pi has been used to make the system communicate with the cloud database and control other microcontroller like Arduino . This has also been used to take and process real-time pictures of the secured area and send it to database.

Raspberry Pi model B+, a small type of computer with built in RAM, Wi-Fi module. This board run via an operating system named Raspbian. 2mA input current has taken via USB port from computer or 2mA charger via micro-USB port. Both works equal way but providing power from computer does not give accurate 5 volt as output. So 2mA micro-USB charger was used.

Arduino microcontroller is used for input and output of different data. The implemented work has all its sensor, keypad and lock connected to it. As numbers of pins were required for input and output Arduino mega 2560 was selected in this purpose. C++ is the programmed code for this controller. Table1 has all specification of this controller. This program has a portable version named Ardunio nighty. In this implemented security system the portable version has been used.

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.

PIRs are basically made of a pyro electric sensor (which you can see above as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion (change) not average IR levels. The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will swing high or low.

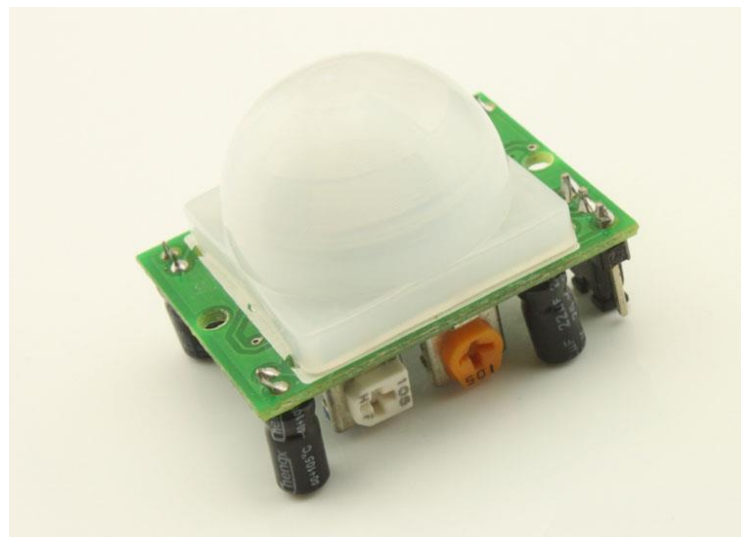


Figure6: PIR Sensor

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.



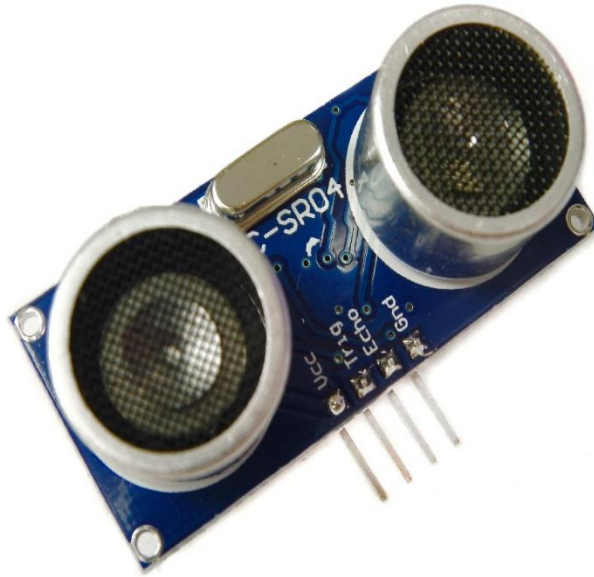


Figure7: Sonar Sensor

Vibration sensor from Measurement Specialties is often used for flex, touch, vibration and shock measurements. A small AC and large voltage (up to +/-90V) is created when the film moves back and forth. A simple resistor should get the voltage down to ADC levels. Can also be used for impact sensing or a flexible switch

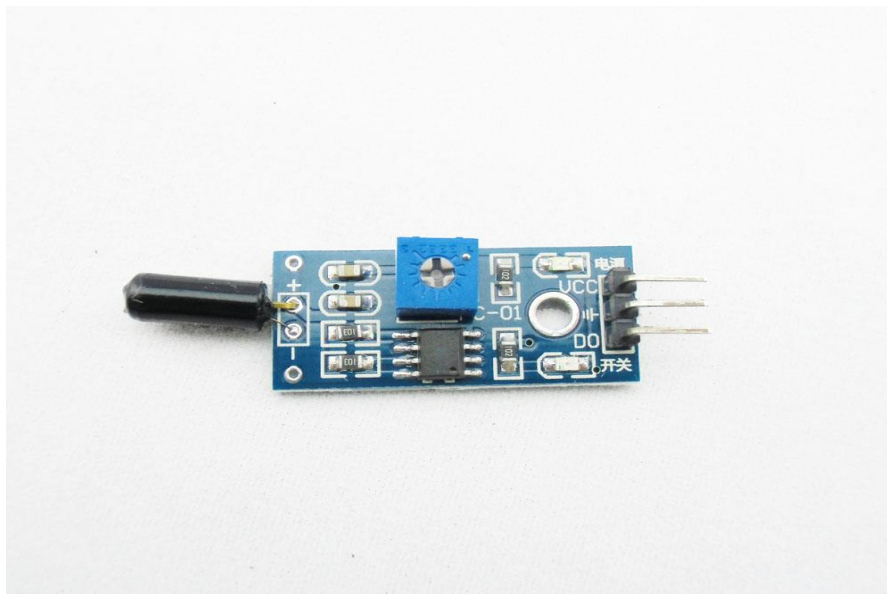


Figure8: Vibration Sensor

The working principle behind the MQ-5 gas sensor is as follows: The sensor has a sensitive filament made of SnO<sub>2</sub>. In the presence of clean air, this filament tends to have lower electrical conductivity. When a combustible gas such as LPG is introduced, the filament's conductivity rises, and the amount of change in its conductance/resistance can be used to indicate the equivalent gas concentration. This effect tends to be particularly pronounced at higher temperatures, and resistive heating element is present as well. SnO<sub>2</sub> is particularly sensitive to Methane, Butane and Propane, but is also sensitive to other combustible gases as well.



Figure9: MQ-5

An option to unlock the system manually has been built in case of any application failure or network failure. In the system Along with 12 volt magnetic lock, vibration sensor, PIR sensor, sonar sensor and smoke sensor has been used to detect different types of thief movement or accident that may occur. Web camera has been used to monitor the secured zone instead of Close Circuit cameras to avoid high cost.

The whole system is connected via firebase, raspberry pi and wire. The entire sensor is connected to arduino via wire. Those wires are also transfer power to the sensors. Arduino and raspberry pi can be connected with wire or via Bluetooth module. For this project connecting via wire was the best option. As raspberry pi get suspicious situation it connects with server, Firebase. And server sends notification to mobile application. This entire step is connected through internet.

This system also has one offline keypad option just to open the door. This would be useful for the user in case they lose their phone.

A model house has been made and the total system with all the sensors, controller and microprocessor has been attached to this model house for a proper project finish.

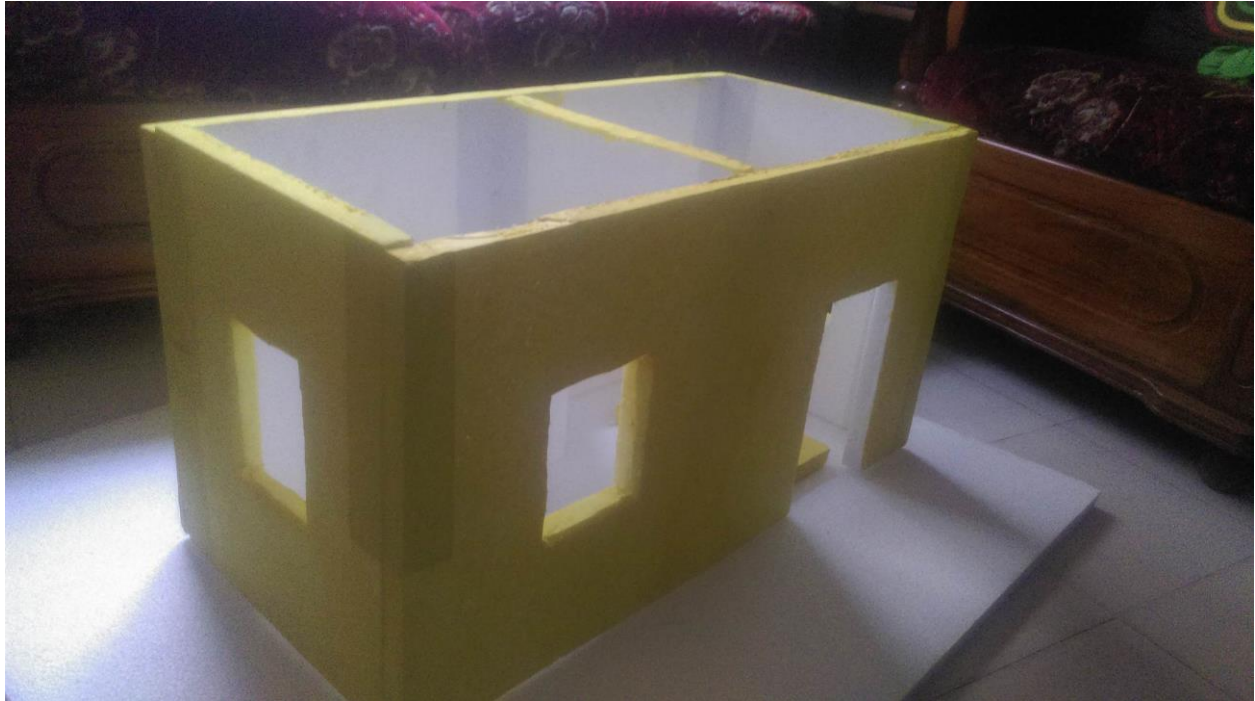


Figure10: Model house

## Chapter: 05

### Implemented work

From the fruition of this paper, the vision was only the most user-friendly easy system. So this paper has enlightened all the dreams which has been exhume from the core of user needs.

This system works in two ways. The very first one is from the hardware. During the system on mode, the sensors keep checking the movement of the room. Occurrence of any movement, which wasn't meant to be at that period of time, will send a signal to the server via arduino. Server at the real time following the microcontroller and microprocessor signal will send a real time notification on the application. Application therefore, has options to take actions according to the notification. User can take photo with the help of their phone which directly monitor the web camera set. That photo will be saved to the user's Google Drive. User can also call to the nearby police station with the help of the application SOS button.

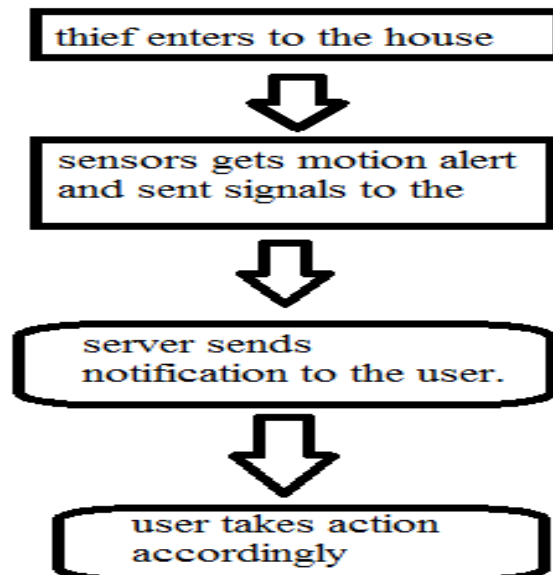


Figure11: hardware to application dataflow

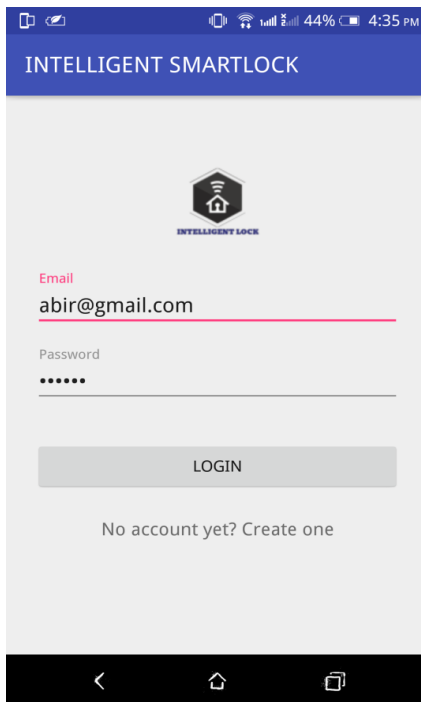
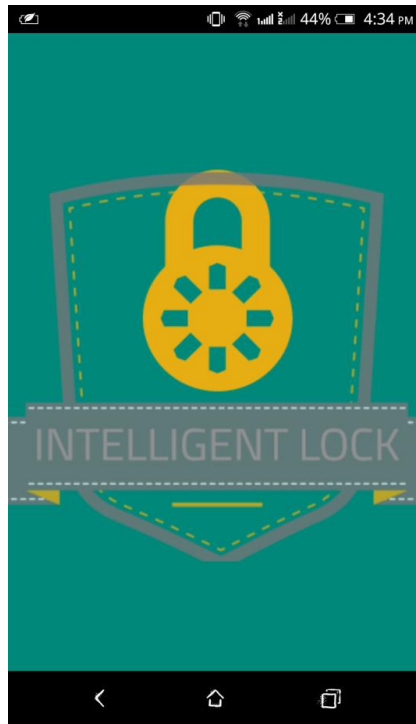


Figure12: LOGIN Page of Application

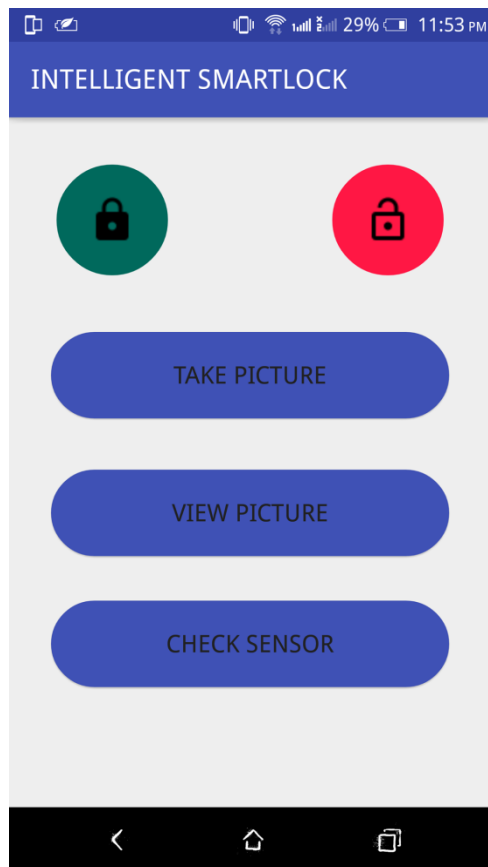


Figure13: Application

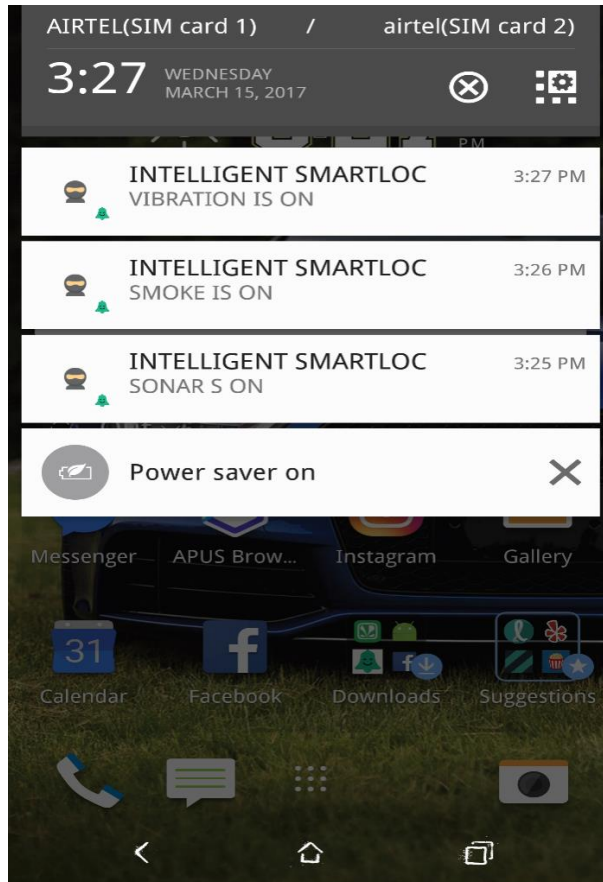


Figure14: Screen Shot of Receiving Notification.

On the other hand, user can open their house main door lock with the application unlock button after 4 digit authentication only. This makes the system more secure because except the user no other people will be aware about the pin code. User can automatically open door, windows and cartons using application. On the time user opens the lock with application it turn off the sensors automatically. User can keep their sensors on while they are at home if they want.

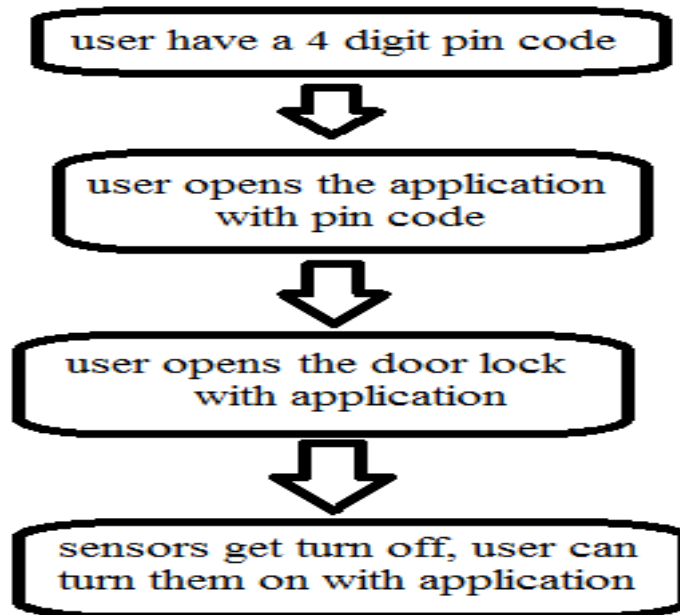


Figure15: Application work flow

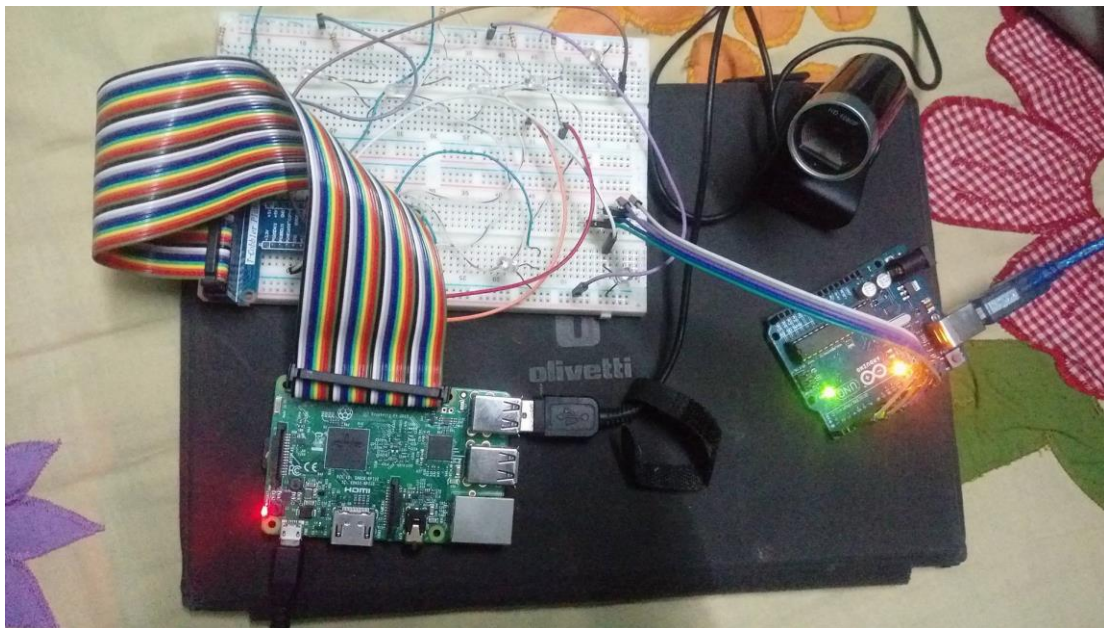


Figure16: Application work flow



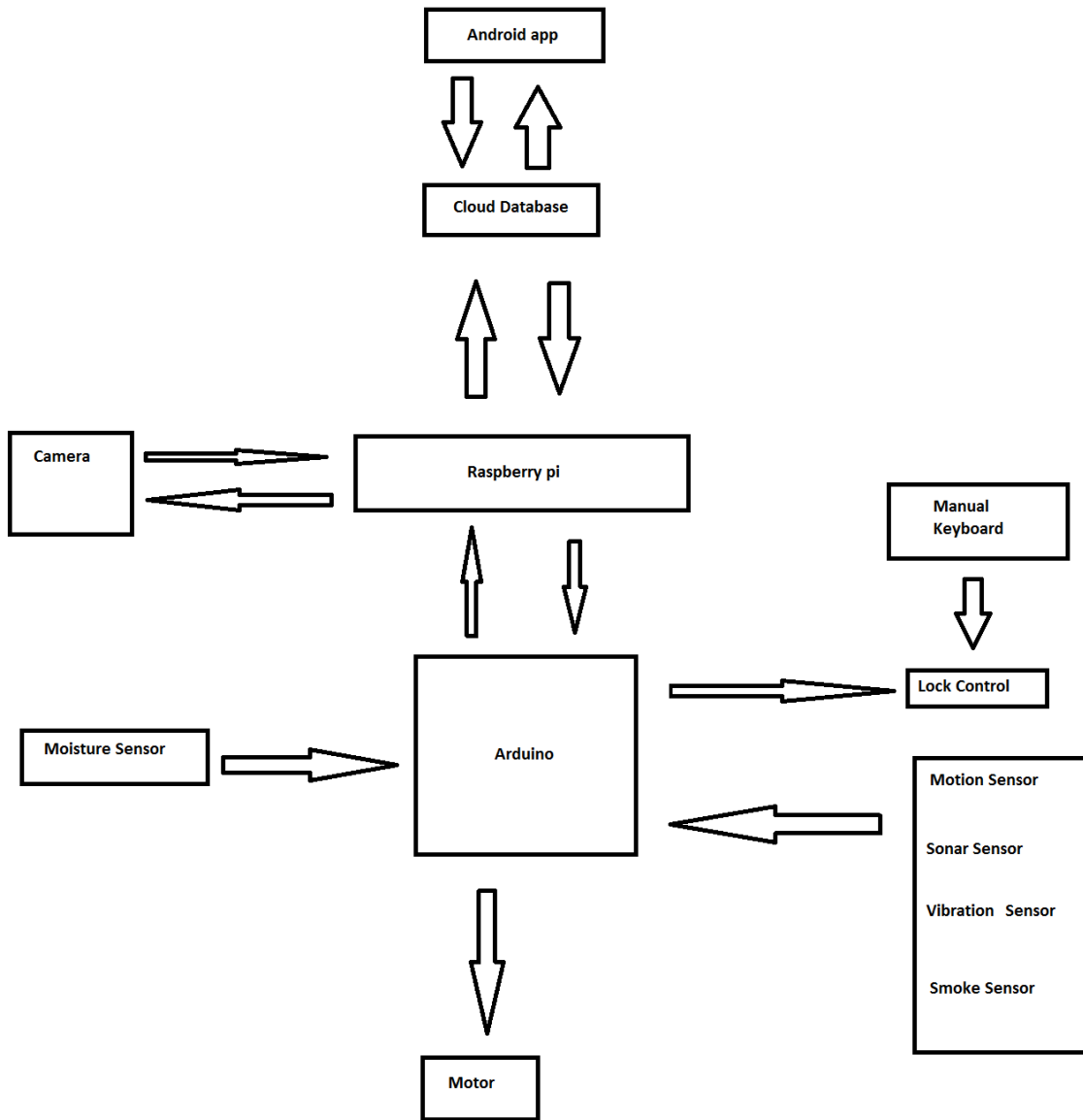


Figure17: System Diagram

Android and hardware are connected with few steps. As user run an option, command goes to Firebase. Then instantly data transfer to Raspberry-Pi which control lock, lights, windows and doors.

### Android to Hardware Control

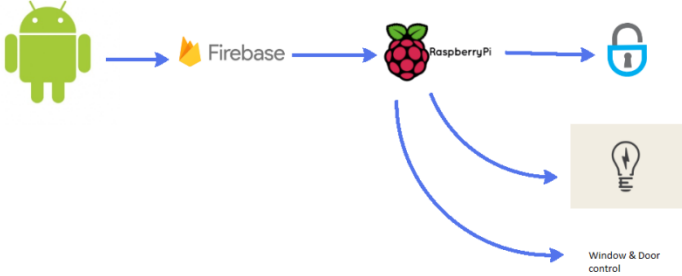


Figure18: Work Flow of Android to Hardware Control

User’s home is secured with different sensors. Sensor can be connected to Raspberry PI but to reduce the price of system, it is connected to ardiuno which send data to Raspberry PI. Then the flow of data is go to android via Firebase.

### Sensor to Android notifications

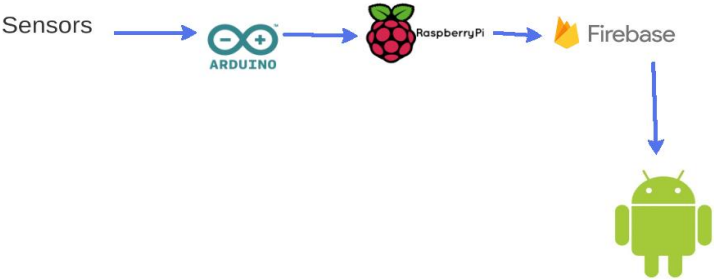


Figure19: Data Flow for Notification

People in this country have tendency to keep the window open. As a tropical monsoon country rain can take place any time. This situation make home wet. This problem can be solved just by closing the window. So automatic window control option is available in the system.

### Automatic Window control

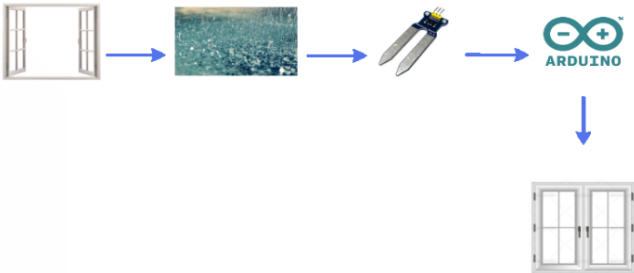


Figure20: Controlling Windows.

This system has monitoring option. A high resolution camera is available which save real time picture to mobile and also save those picture for future use in Google Drive. So a camera is attached to Raspberry PI. Via picture is saved in drive and can be seen from user smart device.

### Camera to Android

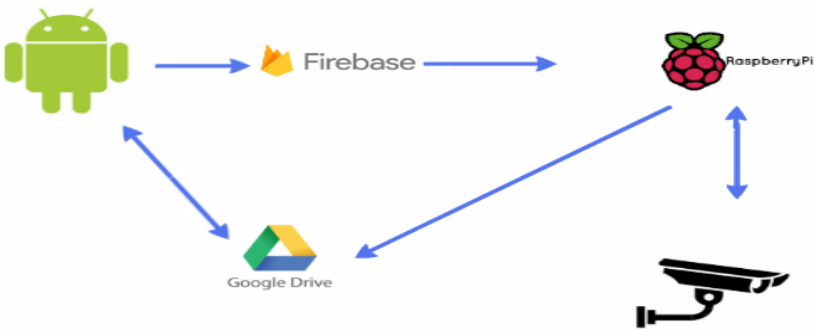


Figure21: Steps of Picture Transferring.

This system also has one moisture sensor which has been added to the system keeping the current rainy season on head. This sensor parse a notification to the application that rain has come so the user should close the window. It's kind of weather alarm. User can actually close the window with the help of application or the window will open automatically with the help of motor.

An automatic door open feature has been added to using motor and server control to make sure the door to open for any disable person and kids.

## **Chapter: 06**

### **Conclusion**

At the conclusion this can be said that this project introduced a methodology for a powerful feature surveillance in the current framework; this overcomes the conventional Surveying where Human intercession is needed and needs to watch definitely for staying informed concerning the whole fabric. This paper has tried to leave a framework for the people who want to work with the similar topic. The project has implemented for the people with minimum financial status. Its user friendly interface and motive makes it more perfect solution for security. We have tried our best to make it an absolute solution. Moreover this is very important to find out latest technologies to prevent home invasion. This paper has set a goal initially and accomplished its all goals by implementing a standard security solution for home. This paper always will demand for the progression of its work. Because this is what technology is all about? Always comes up will something new and cozy. In such era, where security has become a brutal fact, this paper has tried to come up with a nice comfortable and easy solution to prevent it.

## **Chapter: 07**

### **Future Plans**

Home is always first priority in everyday life. The accomplished mobile application already ensures that if anything goes wrong in home, the application will get a notification in real time.

Presently, the system has some specific sensors such as vibration sensor, motion sensor, smoke sensor moisture sensor and sonar sensor to parse signal to the server, On the other hand, to make it more accurate, timely and convenient the future plan is to use image processing system. Using this process the application will be able to differentiate the face of the owners of the house and the outsiders. At first the system will take a picture of the owner and save it in the database. For the owner or saved any photo match, the system will immediately open the door automatically without any button press.

Anybody else whose picture is not authorized, if tries to open the smart lock will fail to do so and the owner will get a pop up notification in his cell phone screen. The owner can save expected guest images too.

Moreover, the next plan is to make the security system encrypted. Hence it will be impossible to break the security system. After adding all this security system this application is going to be a better one, it can be guaranteed. The owner of the house will feel safe using this application. Every single moment will be observed by the application, will notify if something happens and the owner may take right decision at the very moment.

Making this whole system an offline system is a biggest challenge in front of us, and we have deep desire to implement this as we want our system to work under any network situation. Also our main motive it to operate this from anywhere of earth. It could be top of the mountain or down at the ground parking. Where ever it is if your house is in danger you will be notify or respective people will be inform about this(i.e. building security in charge, local police station etc)

Beside the already implemented three automation features we want to implemented an absolute automation system for all the appliances to monitor them during voltage irregularity and power failure

Revealing all the concepts our target is to bend the technology as much possible to ensure the perfection of our home security system.

The requirements of the fundamental security benefits in the IoT(internet of things) such as integrity, confidentiality and authenticity are the final outcome of both security and performance analysis of the proposed scheme.

This project has many advantages, in future upgrade this into the following levels that is not just by simply seeing the sight picture, also see the whole cut of what happened and what has been caught. This will be carried out exactly at the spontaneous minute, in seconds, of the activity have been happening at the site.

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