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CUSTOMER SEGMENTATION USING MACHINE LEARNING

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SCHOOL OF COMPUTING AND SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

Certified that this project report "**SMART HOME AUTOMATION SYSTEM**" is the bonafide work of "**ANURAG SINGH(1613112009)**" who carried out the project work under my supervision.

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ABSTRACT

The project named – Smart Home Automation System. It is a technique, method, or system of operating or controlling a process by electronic devices so that human involvement is reduced to a minimum. The need of building an automation system for an office or home is increasing day-by day with many benefits. Industrialist and researchers are working to build efficient and affordable automatic systems to monitor and control different devices like lights, fans, AC based on the requirement. Automation makes an efficient and an economical use of the electricity and water and reduces much of the wastage.

IoT grants people and things to be connected anytime, anyplace, with anyone, ideally using any network and any service. Automation is a further important use of IoT technologies. It is the monitoring of the energy utilization and controlling the environment in buildings, schools, offices and museums by using various sensors and actuators with the intention of controlling lights, temperature, and humidity.

A Smart home system is designed with the focus on occupant's need and convenience.

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CHAPTER 1
INTRODUCTION

1.1 What is Smart Home all about?

Smart Home or Home automation is a technique, method, or system of operating or controlling a process by electronic devices so that human involvement is reduced to a minimum. The need of building an automation system for an office or home is increasing day-by-day with many benefits. Industrialist and researchers are working to build efficient and affordable automatic systems to monitor and control different devices like lights, fans, AC based on the requirement. Automation makes an efficient and an economical use of the electricity and water and reduces much of the wastage.

IoT grants people and things to be connected anytime, anyplace, with anyone, ideally using any network and any service. Automation is a further important use of IoT technologies. It is the monitoring of the energy utilization and controlling the environment in buildings, schools, offices and museums by using various sensors and actuators with the intention of controlling lights, temperature, and humidity.

A Smart home system is designed with the focus on occupant's need and convenience. In Smart Home System there are four key layers:-

1. Data Collection Layer
2. Action Layer
3. User Interaction Layer
4. Control and processing layer

Data Collection Layer consists of sensors which collect the environmental data such as lightings, ambient temperature, humidity, air quality etc. These sensors are placed in various parts of home, data is fed to the local processing unit which could choose to act or relay the data to central server which may further process it, send it to user or take action on another device.

Action Layer consists of devices which control various equipment i.e. Electrical and mechanical appliances.

User Interaction Layer or UI layer is responsible for the interaction of user with the System. UI layer outputs the data of Data Collection Layer to the user and is responsible for prompting user for some decision or action if necessary.

Control and processing Layer is responsible for controlling and managing all the above layers. It takes data from various sensors of the system and takes action accordingly which may be either to relay data to user or take action autonomously.

1.2 Purpose

The basic idea about the project is to build a home prototype where user can control the lighting of the home using his mobiles, the lighting in turn should respond to ambient light. The system monitors room temperature and generates fire alarm. It is integrated to user's mobile phone and the mirror. So, any notification is published to these devices can be further channelized.

The main objective is to implement a system which will automate home appliances such as light and fan. Smart home can be controlled and monitored remotely over the cloud. And it provides the security when the user is not in the home.

1.3 Operations

The Home automation system that uses Wi-Fi technology. System consists of three main components; web server, which presents system core that controls, and monitors users' home and hardware interface module(Arduino PCB (ready-made), Wi-Fi shield PCB, 3 input alarms PCB, and 3 output actuators PCB.), which provides appropriate interface to sensors and actuator of home automation system. The System is better from the scalability and flexibility point of view than the commercially available home automation systems. The User may use the same technology to login to the server web based application. .If server is connected to the internet, so remote users can access server web based application through the internet using compatible web browser. The application has been developed based on the android system. An interface card has been developed to assure communication between the remote user, server, raspberry pi card and the home

Appliances. The application has been installed on an android Smartphone, a web server, and a raspberry pi card to control the shutter of windows. Android application on a Smartphone issue command to raspberry pi card. An interface card has been realized to update signals between the actuator sensors and the raspberry pi card.

1.4 Challenges

To build a smart home system where we can control light and fan based on my mobile, to implement a system which notify us in our absence if there is an intruder in home also to implement a fire alarm system such that in our absence it can notify us if there is a fire in our home in that case we can build a controller which we can control through mobile. We can have a fire alarm system that can put buzzer but we cannot combine both of them into single internet architecture with the present system. Many devices can communicate with internet. Currently we can control the things through the internet but there is no internet connectivity.

CHAPTER 2
LITERATURE SURVEY

2.1 Evolution of the System

In this section, we have discussed different Home Automation System with their technology with features, benefits and their limitations.

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The application has been developed based on the android system. An interface card has been developed to assure communication between the remote user, server, raspberry pi card and the home Appliances. The application has been installed on an android Smartphone, a web server, and a raspberry pi card to control the shutter of windows. Android application on a Smartphone issue command to raspberry pi card. An interface card has been realized to update signals between the actuator sensors and the raspberry pi card.

It has been implemented with Raspberry Pi through reading the subject of E-mail and the algorithm. Raspberry Pi proves to be a powerful, economic and efficient platform for implementing the smart home automation. Raspberry pi based home automation is better than other home automation methods is several ways. Shih-Pang Tseng et al proposed Smart House Monitor & Manager (SHMM), based on the ZigBee, all sensors and actuators are connected by a ZigBee wireless network. They designed a simple smart socket, which

can remote control via ZigBee. PC host is used as a data collector and the motion sensing, all sensing data are transferred to the VM in the cloud. The user can use the PC or Android phone to monitor or control through the Internet to power-saving of the house.

Arduino microcontroller to receive user commands to execute through an Ethernet shield. Our house network used together both wireless ZigBee and wired X10 technologies. This system followed smart task scheduling with a heuristic for the Resource-constrained-scheduling problem (RCPSP). The mobile device can be either wired to the central controller through USB cable or communicates with it wirelessly, within the scope of the home. Arduino contains the web server application that communicates through the HTTP protocol with Web-based Android application. The system is highly flexible and scalable and expandable. The home network which monitors the appliances and sensors and transmits data to the cloud-based data server which manages the information and provides services for users by transmitting data and receiving user commands from mobile application. The proposed system has good modularity and configurability characteristics with very low power consumption in cost efficient way.

Application developed using the Android platform controlled and monitored from a remote location using the smart home app and an Arduino Ethernet based micro web-server. The sensors and actuators/relays are directly interfaced to the main controller. Proposed design offers are the control of energy management systems such as lightings, heating, air conditioning, security, fire detection and intrusion detection with siren and email notifications.

Embedded system Raspberry Pi to serve as a communication gateway between mobile devices and Konnex-Bus (KNX) home automation systems. Store the information of all actors and sensors within a Smart Home, instead of using separate profiles. Ensures energy-consumption could be reduced, compared to a standard desktop computer.

Dual tone multi frequency (DTMF) used in telephone lines. There are three components in the system DTMF receiver and ring detector, IO interface unit, PC. The PC detects the ringing of the line and then authenticates the user and uses the keypad tones to control the devices as required. An example of stepper motor control is taken up. This system has the advantage of being secure and allowing international standardization. This is because the

DTMF tones are the same all over the world. But it suffers from the drawback that the number of appliances is limited by the number of keys in the keypad.

PIC16F887 microcontroller for home appliances controls with GSM for control of the appliances. It has high availability, coverage and security but the cost of SMS. AT commands can be sent through the GSM network to controls the home devices. The system does not does not have any state information related to the devices and expects the user to keep track of it.

Arduino board is the controller used to control the appliances by using GSM technology. It uses certain peripheral drivers and relays to achieve this interfacing. The application on Smartphone generates SMS messages based on the user commands and sends it to the GSM modem attached to the Arduino and controls the home appliances. The system has drawbacks of cost and reliability of SMS. An interface cannot be customized based on devices.

It has been designed Arduino board with Bluetooth board were developed for home automation. Python program is used on the cell phone to provide the user interface. The Bluetooth board has

I/O ports and relays are used for interfacing with the devices which are to be controlled and monitor. The Bluetooth is password protected to ensure that the system is secure from intruders. The Bluetooth has a range of 10 to 100.

IoT is basically cloud of interconnected devices. In very simple terms devices like microcontrollers, microprocessors when connected to internet in such a way that each of these devices can communicate with every other device. We call this entire infrastructure as Internet of Things. IOT is set of devices which are connected to internet through specific protocols like MQTT, web sockets, https in such a way that this device can send information not only to a server or cloud server or can intercommunicate with each other.

For example, your mobile is connected to internet. A mobile can communicate back with another mobile. A mobile can send some data to cloud and can also receive data from cloud. Would you call a mobile a mobile an IOT device? Technically, no that’s because by definition IOT is not only interconnection of devices over a network but the devices that

can also communicate with the physical world. So when we elaborate the IOT discussion IOT is defined as an infrastructure where the devices that can communicate with the physical world can intercommunicate with each other.

The basic meaning of the physical world is any physical device like light, fan, and any sensors. Whereas mobile cannot control a light directly or cannot control a relay directly or cannot sense an agricultural data or water data directly we do not really categories mobiles as IOT devices. But because as definition IOT is interconnection of the physical world connecting devices in a cloud and mobile can get connected with the cloud. Mobiles, just like PCs forms the client side of IOT mechanism which means that mobile can put data into the cloud which is connecting the IOT devices and it can gather data from the cloud which is a cloud of connecting devices. For example raspberry pi, Intel Edison, are considered to be most common IOT devices.

These devices more or less runs certain version of Linux and they can get connected with the internet, they can exchange messages with web services, they can call web services, they can respond to a web service, they can get connected with common IOT protocols like MQTT by means of which two machines can interact data amongst them. They can take commands from mobile; they can send some data back into the mobile. Now this is what IOT infrastructure is. So if you have to imagine an IOT infrastructure various numbers of IOT devices like Intel Edison are connected with relays sensors, and with each other putting data back into the cloud. This data can be processed by tremendous processing ability at the cloud. The result of processing can be further integrated to a machine learning or data visualization framework and can then be made available to the users either in mobiles or in PCs.

Whenever we talk about IoT, it gives this kind of infrastructure so the devices now can get connected with the cloud services can exchange data can put the data into data gathering services , that data can be analyzed by machine learning services , the data can be visualized by visualizing services. Because it is utilizing a cloud no matter however number of devices increase you don’t have to worry about the underneath infrastructure of what’s been going on. As you keep on increasing the devices the cloud takes care of the entire load and as well as it ensures that performance of all the devices are extremely up to the mark.

CHAPTER 3
SYSTEM ANALYSIS

3.1 Introduction

Smart Home is arguably one of the most commonly heard buzz words in IoT. Connecting home devices with cloud to bring out better capabilities of the devices is one of the areas which have evolved from the desks of DIY hobbyists to serious commercial products. Devices that can respond to gestures, voices, mobile commands, devices that can sense and take decisions, devices that are connected with the user's social accounts are increasingly becoming popular.

Smart Home is commonly referred to a home where the devices are connected to cloud. It can be seen as a system which uses smart phones, PCs to control, monitor, instruct or interact with the appliances of home. It eases the human work.

In this project we are going to show you, how to build a smart home prototype in quick and fast ways using Intel Edison board, Node-Red (The visual programming language for IoT) and Android phone. We are going to integrate three important aspects of the smart home system: Security, Monitoring and Controlling.

The basic idea about the project is to build a home prototype where user can control the lighting of the home using his mobiles, the lighting in turn should respond to ambient light. The system monitors room temperature and generates fire alarm. So, any notification is published to these accounts which can be further channelized to multiple accounts using gateways.

User can monitor the electronic devices of home by sitting anywhere. This system gives security to the user by sending notification. If the user is not in the home and intruder comes to home then sound sensor recognizes there is an intruder and notify the particular user. Also if there is a fire in the home in the absence of anybody then the user gets the notification. These notifications are mitigated through MQTT protocol. This system is

developed by using the Intel Edison. The system receives commands from mobile, analyzes data from Light, Temperature and Sound sensors and based on threshold values from the sensors takes appropriate switching decisions and sends the notification to the user. The system is connected to internet through WiFi.

3.2 Feasibility Study

Feasibility study is defined as an evaluation or analysis of the potential impact of a proposed project or program. The primary goal of the system analysis stage is to identify problems and determine how they can be solved with the computer system. In formal SDLC methodologies, the first step in system analysis is feasibility study. A feasibility study is the quick examination of the problems, goals, expected cost of the system. The objective is to determine whether the problem can reasonably solved with a computer system. In some cases, maybe there is a better alternative, or perhaps is simply short term annoyance and will gradually disappear. In other cases, the problem may turn out to be more complex than was thought and involves users across the company. Also, some problems may not be solvable with today's technology. It might be better to wait for better technology. In any case, you need to determine the scope of the project to gain the better idea of cost, benefits, and objectives. The feasibility study is typically written so that non-programmers can easily understand it. It is used to "sell" to the upper management and as a starting point for the next step. Additionally it is used as a reference to keep the project on track, and to evaluate the progress of project team. Is the project cost effective or there is a cheaper solution? Will the proposed system improve the operation; will complicating factors prevent it from achieving its goals? Does the technology exist and does the firm have the staff to make the technology work? When the proposal is determined to be feasible, the team leaders are appointed and a plan and schedule are created. The schedule contains a detailed listing of what parts of the project are completed at each time. Of course, it extremely difficult to estimate the true cost and completion dates. Nonetheless, the schedule is an important tool to evaluate the status of the project and the progress of the team.

Steps In Feasibility Analysis Are:

1. Identify deficiency by pinpointing, missing functions, unsatisfactory, performance, excessive cost of operations.
2. Set goals to remove these deficiencies.
3. Goals must be quantified, realizable within the constraints of an organization, broken down into sub goals agreeable to all concerned.
4. Set goals not only to remove deficiencies but also to effectively meet competition. For instance, goals must be based on what competitors do.

3.2.1 Technical Feasibility

Technical feasibility is one of the first studies that must be conducted after the project has been identified. Consequently, technical feasibility looks at what is practical and reasonable. Technical feasibility addresses three major issues:

1. Is the proposed technology or solution practical?
2. Do we currently possess the necessary technology?
3. Do we possess the necessary technical expertise, and is the schedule reasonable?

Is The Proposed Technology Or Solution Practical?

The technology for any defined solution is normally available. The question whether that technology is mature enough to be easily applied to our problems. Some firms like to use state-of the-are technology, but most firms prefer to use mature and proven technology. A mature technology has a larger customer base for obtaining advice concerning problems and improvements.

Do We Currently Possess The Necessary Technology?

Assuming the solution's required technology is practical, we must next ask ourselves, is the technology available in our information systems shop? If the technology is available, we must ask if we have the capacity. For instance, will our current printer be able to handle the new reports and forms required of a new system?

Do we possess the necessary technical expertise, and is the schedule reasonable?

We must ask ourselves, can we get this technology? The technology may be practical and available, and, yes, we need it. But we simply may not be able to afford it at this time.

Although this argument borders on economic feasibility, it is truly technical feasibility. If we can't afford the technology, then the alternative that requires the technology is not practical and is technically infeasible.

3.2.2 Economical Feasibility

Economic analysis is the most frequently used technique for evaluating the effectiveness of a proposed system. More commonly known as cost/benefit analysis; in this procedure we determine the benefits and savings that are expected from a proposed system and compare them with costs. We found the benefits outweigh the costs; we take a decision to design and implement the new proposed system. During the feasibility phase, broad alternatives solutions are examined. For each alternate solution the cost and benefits have to be examined before designing one of the alternatives.

Broad solutions will consist of:

1. Specifications of information to be made available by the system.
2. Description of what will be done manually and what the computer will do.
3. Specification of new computing equipment needed or specification of expansion of an existing computer.

3.2.3 OPERATIONAL FEASIBILITY

It is mainly related to human organizational and political aspects. The points to be considered are:

- What changes will be brought with the system?
- What organizational structures are disturbed?
- What new skills will be required? Do the existing staff members have these skills?
- If not, can they be trained in due course of time?

Generally project will not be rejected simply because of operational infeasibility but such considerations are likely to critically affect the nature and scope of the eventual recommendations. For operational feasibility study we appointed a small group of people who are familiar with information system techniques, who understand the parts of the business that are relevant to the project and are skilled in system analysis and design process.

3.3 Requirement Analysis

The Requirement Management deals with analyzing, developing, maintaining, documenting, and verifying customer requirements. The customer's requirements need to be tracked throughout the project life cycle to ensure that the final product meets all the requirements. Requirement Outputs, such as Software Requirement Specifications or any other document may be produced.

The analyst (or a team) determines the requirements of the customer or end user. A variety of techniques may be used to study the requirements such as evaluation of similar orders etc. So as to be used effectively and efficiently, all computer software needs certain basic software and hardware requirements.

3.3.1 Hardware Requirements

- Arduino
- Raspberry pi 3
- ESP8266(Wi-Fi module)
- Pi Camera
- MQ2(gas sensor)
- Raindrop Sensor
- Piezoelectric sensor
- LM235 based temperature sensor
- Two way mirror

3.3.2 Software Requirements

- MqTT
- JAVA
- Python
- Android
- Raspian Jessie
- Apache

CHAPTER 4
TOOLS AND TECHNOLOGY

4.1 Core Technology

TOOLS:

- ARDUINO MEGA 2560
- SENSORS

ARDUINO MEGA 2560:

The Arduino Uno is the most popular one among other Arduino development boards. It is based on the microcontroller ATmega328. The factor which make Arduino Uno differ from others is that it does not use FTDI USB-to-serial driver chip. Instead it uses a microcontroller Atmega16U2 (Atmega8U2 up to version R2) which is programmed as USB-to-serial converter. Its peripheral features includes 14 digital input/output pins (of which 6 can provide PWN outputs), 6 analog inputs, a 16MHzcrystal oscillator, a USB connector, a power jack, an ICSP header and a reset button.

SENSORS

Sensor is an object which takes input such as temperature, gas, light and finds events and then generates appropriate outputs. It provides numerous outputs but generally it takes electrical signals. Sensors are now a day used in almost everywhere, like in mobile, calculator, in robotics, health care centers, cars etc.

TECHNOLOGIES:

- Wi-Fi
- MQTT

WIFI:

Internet of Things is connection of several devices which uses internet. Internet of things is used in almost everywhere such as in hospitals, in agriculture, in home, in business etc. In

this the data is stored on cloud. IoT is a growing technology; it allows connection of two or more devices into a single architecture.

In this microcontroller and microprocessors are connected with other devices so that they can communicate with each other. Through specific protocols devices can communicate with each other using internet. It also uses protocols such as web socket, http. In IoT devices which can communicate with physical devices can also communicate with each other.

MQTT:

It is an acronym for Message Queuing Telemetry Transport Protocol. This is used to send message to the device in queue in the form of command such as On/Off, Lock/Unlock etc. It is used for messaging by publishing or by subscribing. With the small code it can communicate with other devices in remote locations within a network. Connection can be performed when the server establishes a connection. The TCP/IP disconnects the connection only when the user completes his work.

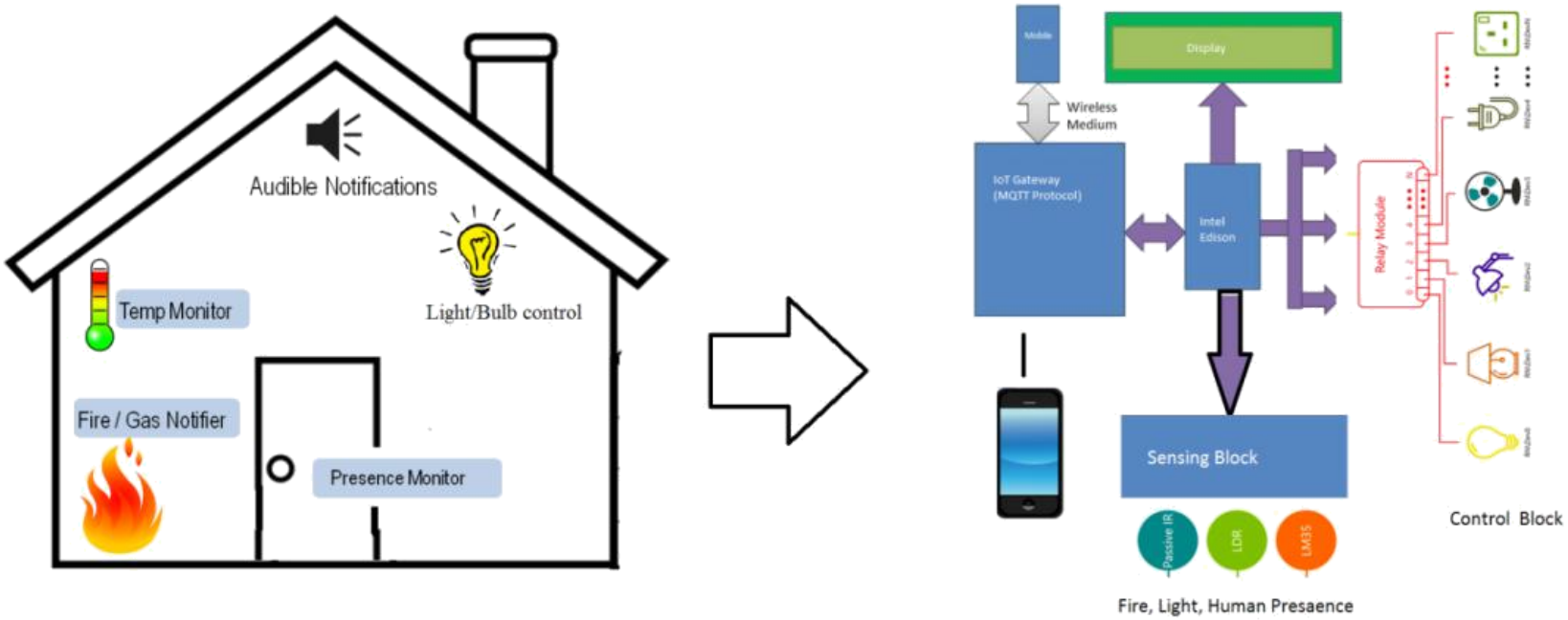


Figure 1: Block Diagram of the Proposed System

CHAPTER 5
SYSTEM DESIGN

5.1 Introduction

The design of smart home system is based on what all devices we want to automate. Smart home includes automation of light, bulb, fan, refrigerator, geyser and security of home by means of fire notify, presence monitor etc.

Once the user needs are recorded, it is easy to design the system. Based on this what type of protocols to be used and what all sensors are required is calculated. The basic requirement in a smart home system is the combination of certain hardware and software. The interface and the communication protocol between the hardware and software to send notification to the user.

We are developing a smart home system where we can control the light and fan based on my mobile also I want to implement a fire alarm system such that in my absence it can notify me if there is a fire in my home in that case I can build a controller which I can control through mobile. I can have a fire alarm system which can put some buzzer but I cannot combine them into single internet architecture with present system.

Therefore we are proposing an IoT based smart home system. We are going to connect one light and one fan with this device to start it. We should be able to control both the lights and fan through our mobile. This whole thing should have a location awareness that means when we come closer to our home we could turn on the light and when we go away from home the light could be turned off.

We are going to put a security system for example we are going to put a fire alarm system whenever there is a fire at home it is going to respond to our mobile. In case our mobile numbers are in silent mode if there is a fire at home not always we are going to see the alarms. Through IoT system we are going to put the same data to our Gmail account and tweeter account so that even if we are not aware that our home has got fire someone from

our friend or someone from twitter followers would be aware that there is a fire and could take appropriate action.

Basically we are doing a security system with fire, a physical world system with light and bulb control. A security system if there is an intruder in home. We are also going to control them with mobile interface. We are also going to control them through our location awareness.

5.2 Methodology

Who is the system for?

Firstly we need to establish who the system will be used by. Establishing who the system is for will enable us to get a grip and start to detail what is required across the home.

Deciding type of Interface

The most basic and crucial requirement in a home automation system, the interface is the basic communication protocol and hardware combination used for sending and receiving messages between devices and the user. Designers have many options for executing communication between devices, the user, and the overall system, depending upon the system, range, size of house, ease of use, etc. If a user wants to control the home appliances through the Internet, the designer needs to add an Ethernet/Wi-Fi interface to connect the system to the home network. If the user wants to control the system using Bluetooth from a cell phone, the designer needs to add a Bluetooth interface to communicate with the device.

Deciding sensing requirements

The designer needs to determine the sensing requirements of the user and decide upon the required sensor to perform the task. He or she also needs to assess the sensor specifications required for different needs and usability in different environments. The range of sensors that should be considered included:

- Thermostats can be used to control air conditioners, refrigerators, geysers, heating system, or in case of fire.
- Humidity sensors sense the moisture level in the environment.

- Gas sensors can be used to detect gas leaks.
- Light sensors can be used to detect the luminous intensity in the house.

The information provided by these sensors (after signal conditioning) is used by the processor to make several important decisions regarding the appliances and when to switch them ON or OFF.

Deciding Type of topology

Topology defines the way home automation control units interact with each other. A star type topology is the most commonly used as it makes use of a central control unit (CCU) interacting with all the available remote control units (RCUs) and taking over decision making responsibilities. The role of the RCUs is to send data fetched from the sensors back to the CCU. After it has assessed the input from the sensors and made any necessary decisions, the CCU sends the command back to the RCU to take a specific action.

Another topology to be considered is a mesh topology, which has no CCU and makes use of a constellation of control units of roughly equal intelligence and capability connected with each other. Each unit sends information on the network which is shared by all the units. Each Unit is independent and makes its own decisions based on the shared information. The choice of system topology governs the selection of communication interfaces such as ZigBee, RF, Bluetooth, etc.

Depth of automation:

System design is affected by the requirements ranging from simple control of lights in the house to controlling all appliances and the security system. Each requirement affects the overall design, and developers need to determine the most optimized way to perform all the tasks with the lowest cost and complexity. Despite the internal system complexity, the system should be easy to use and not pose barriers to its operation by a household user.

Cost

This is the most important aspect of system design as system complexity and depth of automation determine the cost. A highly complex - and thus costly - system can deter customers from purchasing and installing it in their house.

The cost of the system is directly linked with the number of components, interface used, and complexity of design of firmware and hardware. While there should be no compromise on the quality of hardware and software, the number of components in the system can be decreased to reduce the overall cost and system size as well.

Central Control Unit:

The Central Control Unit is the hub and brain of a home automation system. Common features of a central control unit are:

- Measuring the current environmental conditions using the various sensors and control the lights and fans of rooms accordingly
- Receiving instructions from a remote user over Wifi or Ethernet and controlling an appliance in a specific room as per the received instructions
- Controlling appliances based on time, such as automatically switching off a television at a specific time
- Relaying data to user Interface devices for monitoring and control.

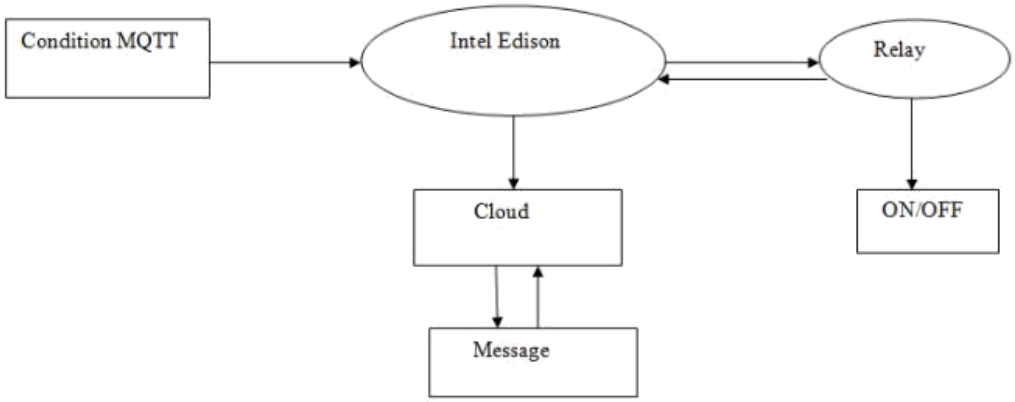
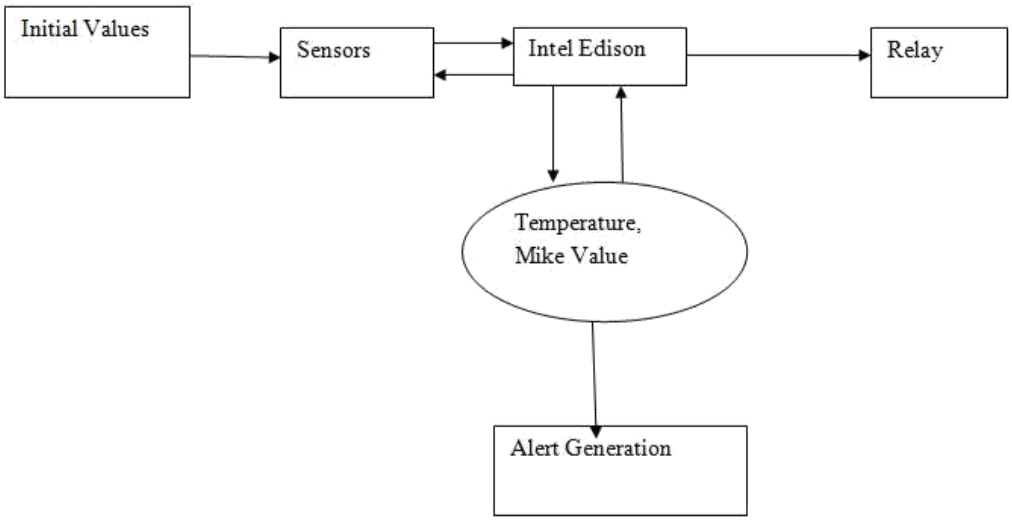


Figure 2: LEVEL 1 DFD



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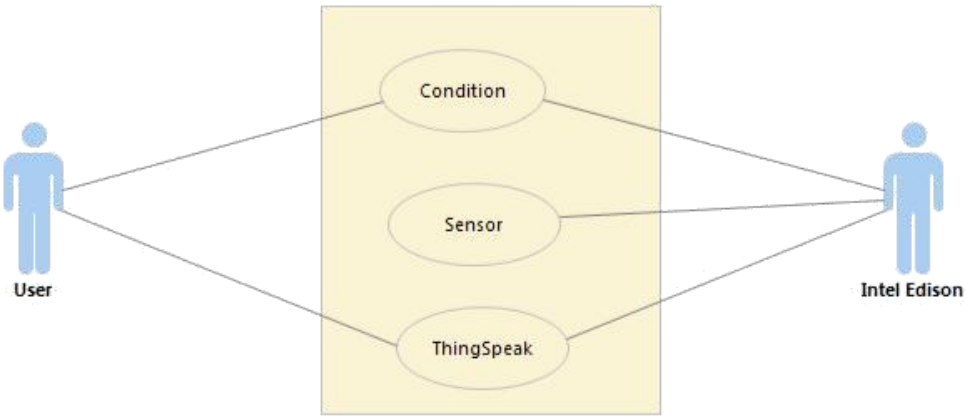

Figure 4: USE CASE DIAGRAM

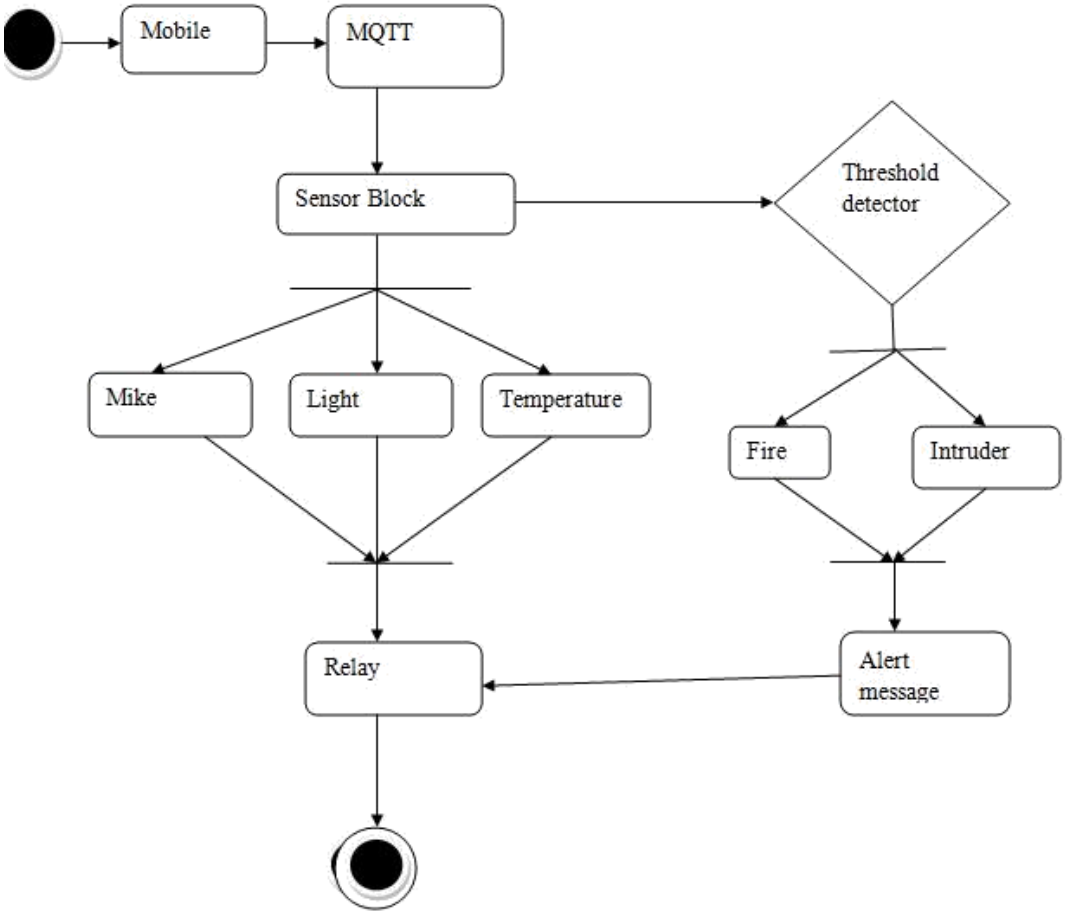

Figure 5: ACTIVITY DIAGRAM

CHAPTER 6
PROJECT DESCRIPTION

6.1 Introduction

Project Design involves the analysis and design of the necessary hardware and software components. Purpose is to create a solution that satisfies the requirements of the system. Challenge is to translate the information into technical specification that accurately describes the system design and that can be used as an input to the system.

Use Case Diagram

Use case diagrams are considered for high level requirement analysis of a system. So when the requirements of a system are analyzed the functionalities are captured in use cases. So we can say that uses cases are nothing but the system functionalities written in an organized manner. Now the second things which are relevant to the use cases are the actors. Actors can be defined as something that interacts with the system.

Use Case Diagram show the various activities that a user can perform. It provides the user point of view of the system.

Actor: An actor is the user who performs some particular roles.

Use case: It as an activity which a user performs on the system.

Relationship: It is simply the line connecting the actors.

Use cases focus on the users of the system, not the system itself, thus the real system needs are brought to light early on. Since a use case consists mainly of narrative text, it is easily understandable by all stakeholders, including customers, users and executives, not just developers and testers. By including all the stakeholders during the early planning stages of a project, you bring in people who best understand the problems at hand, promote a sense of buy-in from end users, and eliminate surprises when the system is deployed.

Each use case describes one way the system is used, but one of the big benefits of use case modeling is that it also describes all of the things that might go wrong. Identifying exceptions to a successful scenario early in the project saves a lot of time by finding subtle requirements.

Data Flow Diagram

DFDs only involve four symbols. They are:

- Process
- Data Object
- Data Store
- External entity

Process

Transform of incoming data flow(s) to outgoing flow(s).

Data Flow

Movement of data in the system.

Data Store

Data repositories for data those are not moving. It may be as simple as a buffer or a queue or a sophisticated as a relational database.

External Entity

Sources of destinations outside the specified system boundary.

Context Diagram.

A context diagram is a top **level** (also known as "**Level 0**") **data flow diagram**. It only contains one process node ("Process **0**") that generalizes the function of the entire system in relationship to external entities.

CHAPTER 7
IMPLEMENTATION

7.1 Introduction

The Home automation system that uses Wi-Fi technology. System consists of three main components; web server, which presents system core that controls, and monitors users' home and hardware interface module(Arduino PCB (ready-made), Wi-Fi shield PCB, 3 input alarms PCB, and 3 output actuators PCB.), which provides appropriate interface to sensors and actuator of home automation system. The System is better from the scalability and flexibility point of view than the commercially available home automation systems. The User may use the same technology to login to the server web based application. .If server is connected to the internet, so remote users can access server web based application through the internet using compatible web browser.

7.2 Implementation Procedure

The application has been developed based on the android system. An interface card has been developed to assure communication between the remote user, server, raspberry pi card and the home Appliances. The application has been installed on an android Smartphone, a web server, and a raspberry pi card to control the shutter of windows. Android application on a Smartphone issue command to raspberry pi card. An interface card has been realized to update signals between the actuator sensors and the raspberry pi card.

CHAPTER 8
CONCLUSION

Smart Home System has been one of the popular areas of automation and embedded electronics, over past several decades we have used various different techniques for generating alarm, security and automating the home devices it includes usage of radio technology such as IR devices, RC devices, etc,.

Smart Home System also has several other components like safety and security, many safety devices like fire alarm device and automatic fire extinguisher is been proposed in the past. Most of the existing alarm systems are based on GSM and GPRS based techniques which are slow in latency as well as quite expensive as the messages and voice mail are not free, in this work we have proposed a novel architecture to offer safety, and automation of the home over IoT architecture.

The proposed system can alert the user in case home catches fire or in case there is an intruder at home, when he is absent. The system also allows the user to operate his home devices purely through his mobile. The entire control and notification system is based on IoT infrastructure, MQTT as well as Gmail and twitter are free sites and it can operate over the Wi-Fi data, this significantly reduces cost as SMS and GPRS are not been used over here.

The result shows that the proposed system meets the objective and can respond to fire, intruder with bare minimum latency and can mitigate the alert to multiple channel simultaneously.

This work can be further improved by incorporating other home automation concepts such as home security through face recognition and other advanced machine learning techniques. The framework can also be improved by incorporating the control of other home devices such as air conditioner, washing machine etc.

8.1 Advantages

Adding Convenience to your Daily Life –

When you convert your home into a smart home, you'll have all of your products programmed to your specific needs. Additionally being able to control your home, no matter where you are, can be extremely beneficial.

Customization –

There are many smart products on the market right now and you certainly don't need to buy all of them at once. As the consumer it's up to you to decide which product you want most, determine if you like it, and then add on to your collection of smart home products as you go.

A good product to start with would be a thermostat or home security system if you're in the market for either of those.

Security

Smart home security systems allow you to view your home no matter where you are. You can have cameras installed, motion detectors, locks, etc, and you will be notified immediately if something is out of the ordinary. Many of these systems will even let you know of any unexpected temperature changes so that you're alerted if there is a possible fire.

Ease of Use

Almost all smart home products can be installed without much hassle; many of them don't even require you to bring someone into your home. Additionally if you're already someone who's tech savvy, learning how to use most of these products is a breeze.

Save Money and the Environment –

Smart homes feature products like thermostats, air conditioners, and lighting. Having the ability to put these things on a timer, or turn them on and off when you're away from home will likely help you save money on your electricity bills. Many of these products allow you to track your energy usage and expenditures.

8.2 Disadvantages

Cost

Most families are able to purchase smart home products, but that doesn't mean it won't leave a dent in your wallet. You can purchase the products one at a time and it won't seem like too much, $50 here, $300 there, but by the time you have the smart home system you want, you will likely have spent a larger sum than you would have if you had purchased non-smart products.

Slight Learning Curve

I know I stated in the advantages that most smart home systems are actually very easy to use, but at the same time there is still somewhat of a learning curve for most people. For anyone already immersed in technology, converting your smart home will be a breeze, but for anyone not so tech savvy, it may make for a lot of time spent reading manuals.

If you think you might have trouble learning how to use a smart home device, the answer may be simple. Ask for help! Asking someone to show you how to run your smart home can far less confusing than trying to make heads or tails of an instruction manual.

Reliability

A smart home will be extremely reliant on your internet connection. If your connection drops you'll be left with a lot of smart products that won't work. Additionally, wireless signals can possibly be interrupted by other electronics in your home and cause some of your smart products to function slowly or not at all.

There are plenty of pros and cons to consider when deciding whether you'd like to convert your home into a smart home. Smart homes aren't for everyone. They can help bring down your electricity bills, simplify your daily tasks, and help to give you a feeling of security. But for some people smart home product will simply turn into an economic burden. It's ultimately up to you to decide which category you fall into.

CHAPTER 9
SCREENSHOTS

Figure 6: Soil Humidity Sensing

Figure 7: Realistic View of Mirror Interface Visible to the User

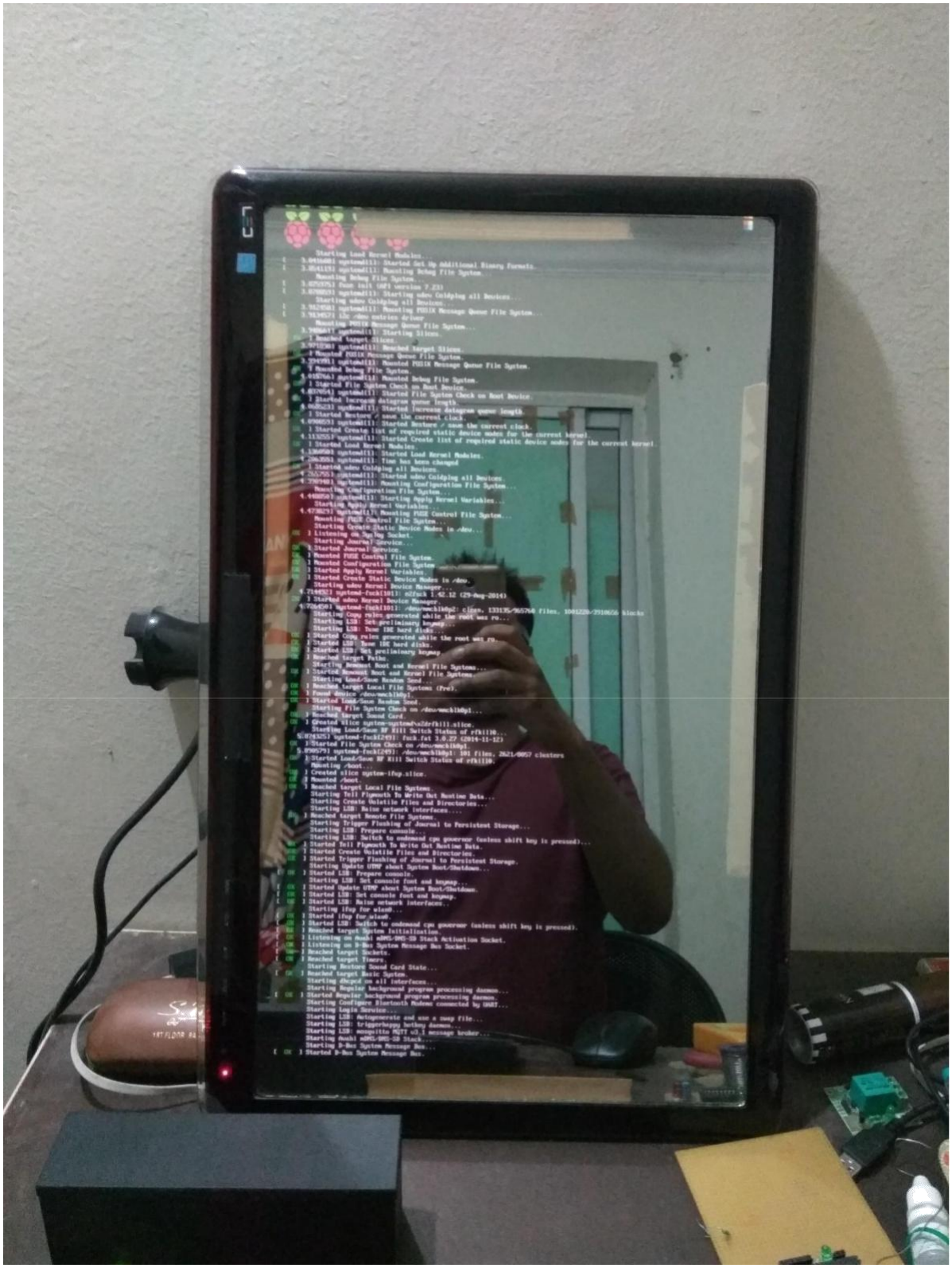

Figure 8: RASPBIAN Coding Interface on Mirror

Figure 9: Door Image Detection Module

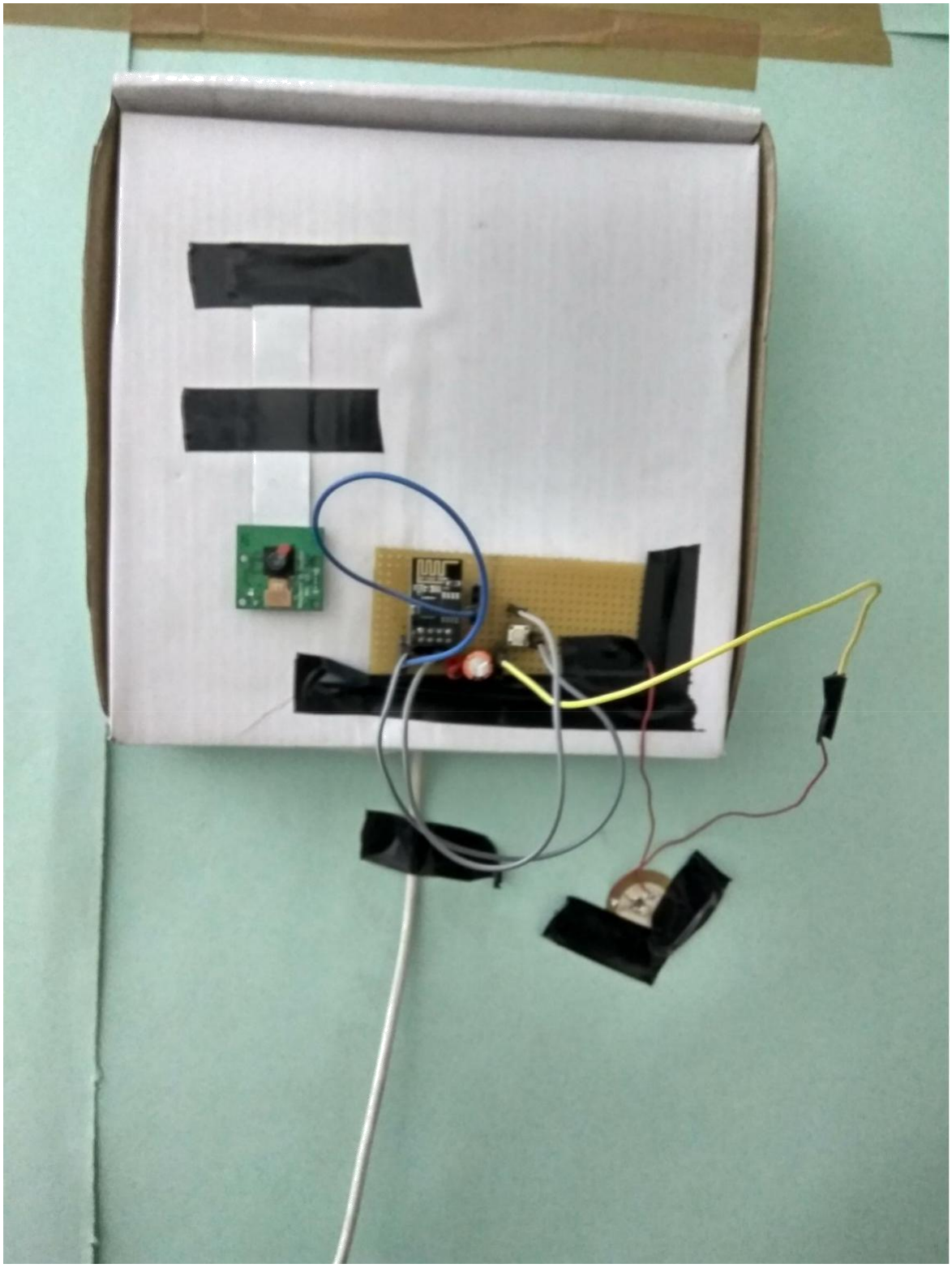

Figure 10: Door Knock Sensing

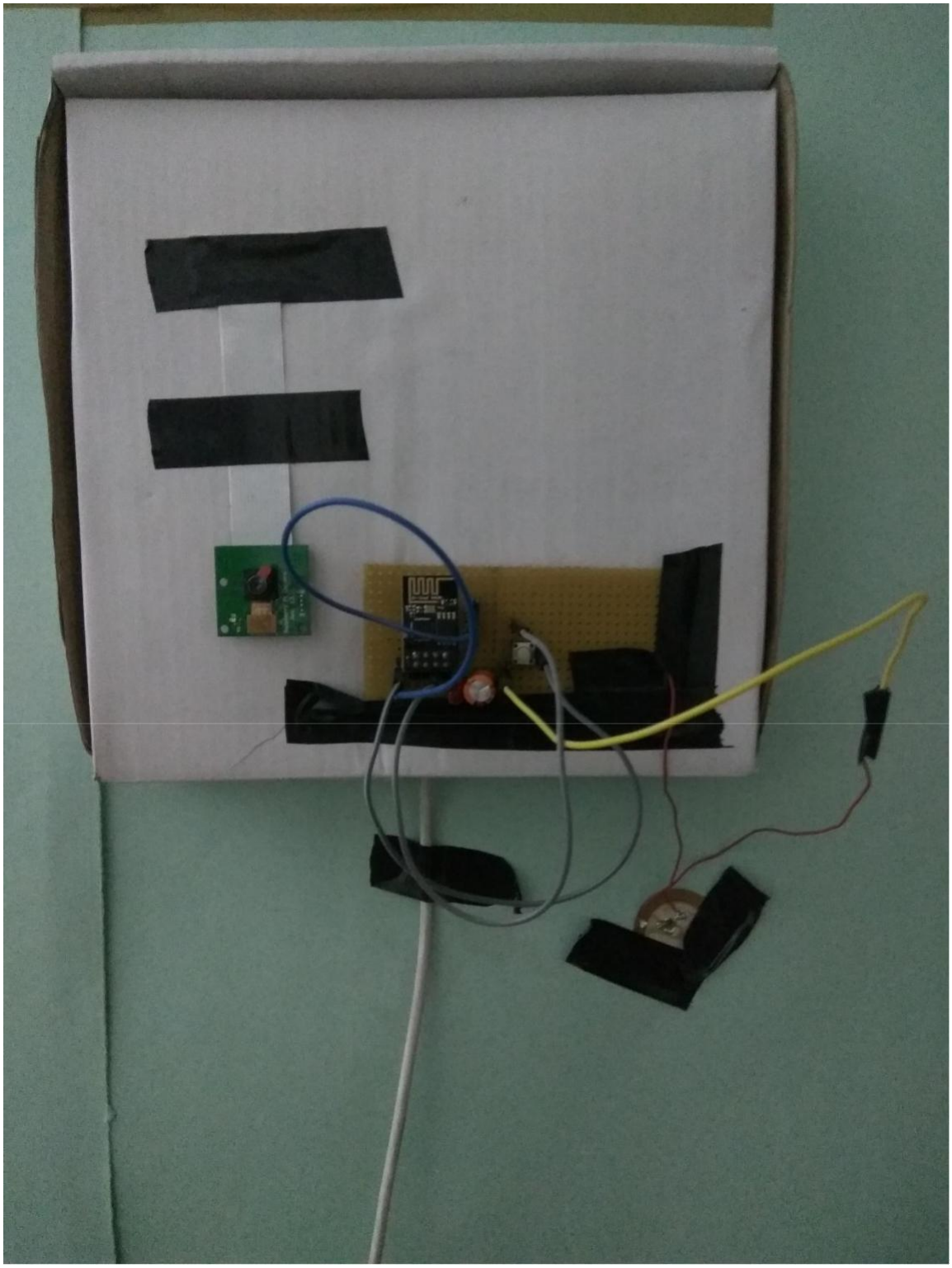

Figure 11: Door Knock Sensing

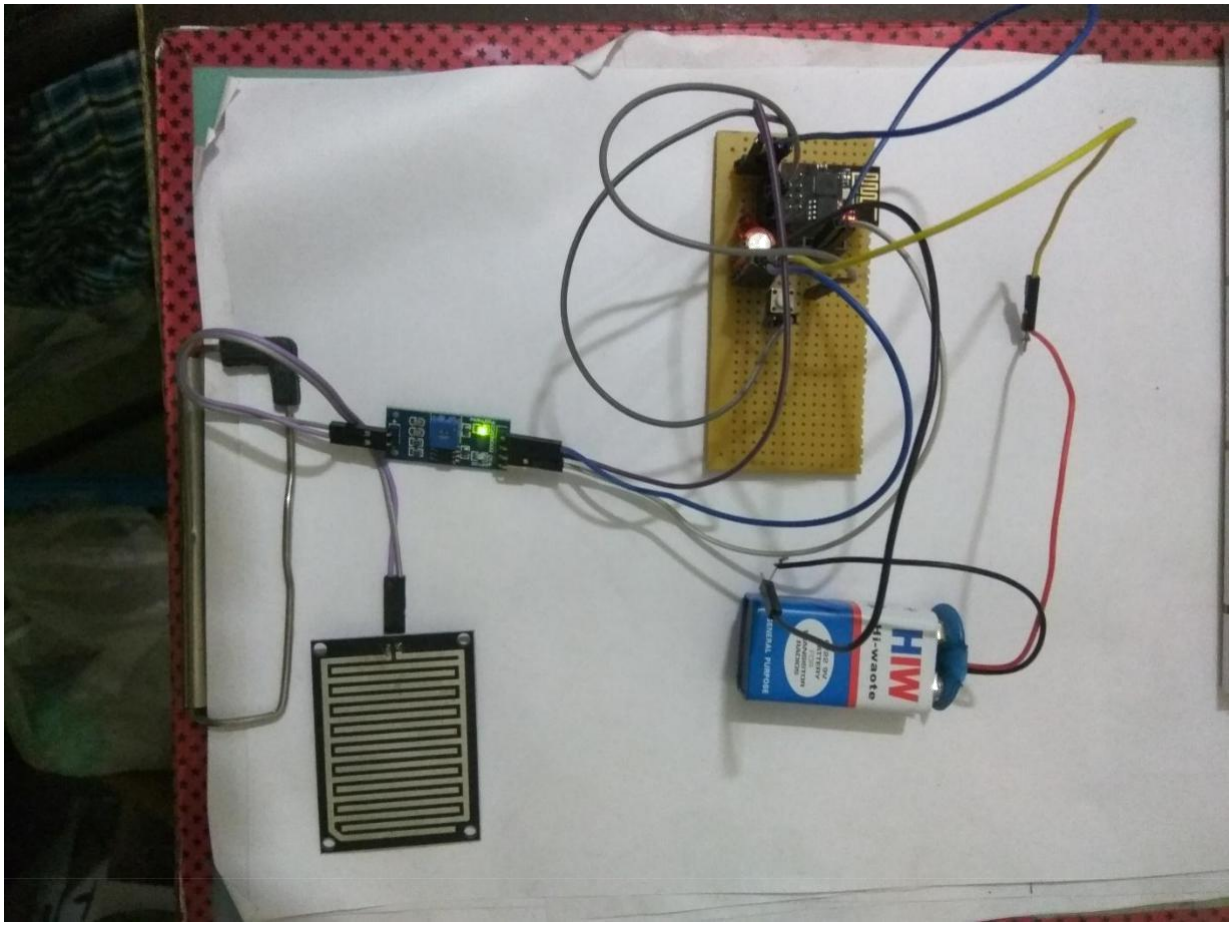

Figure 12: Rain Detection Module

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