Smart Home Architecture for Smart Energy Consumption

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Abstract

A significant step toward energy conservation is integrating control systems to automate responses and data input. Electricity and lives can be saved by issuing warnings for misuse and electrical problems. Finding energy wastage and making repairs might make things simpler for people. Comparing a structure's energy usage to those of other networks in comparable climates can lead to poor management of energy in structures. Decreasing energy waste and wastage to make a more environmentally friendly world. In this project, we've created an architecture for a home automation that will utilize a smart energy-use approach for different individuals. We intend to automate all power consuming gadgets using IoT-based technology. That will substantially optimize electricity usages. Using a Cisco packet tracer simulator, we created the network architecture for smart homes as part of our project. It is a new version of the program that incorporates a number of IoE devices that were used for intelligent home automation. After establishing the architecture, we connected up all household devices to the home gateway that will allow us to use IoT to control our devices. Additionally, we displayed simulation (motion) images of the employees' working environments and home gateway management.

Acknowledgements

Without the contributions and assistance of many people throughout the previous two trimesters, this effort would not have been possible. Everyone that helped in some manner is appreciated, and we want to say thank you. Special thanks to our honourable mentor Dr Mohammad Mamun Elahi and our respected academic advisor Dr Hasan Sarwar. We also want to thank the previous researchers for their works that have inspired us to do this project.

Finally, our gratitude goes to our respected family members for being with us throughout the project.

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Chapter 1

Introduction

1.1 Project Overview

Power wastage is a big concern for a least developing country like Bangladesh. Even in the 21st century, there is a shortage of electricity supply throughout the country. That's why hourly scheduled load shedding is applied to cover the crisis.If we can lower electricity waste. Since IOT based appliance industry is booming worldwide, it is our scope to come forward with an idea to implement automation on regular electrical devices. Turning our homes into smart homes can reduce electric power consumption. The automation of appliances will assist us in getting accurate data on power consumption. Our government has set the goal "Smart Bangladesh, Vision 2041". We can make a significant mark by implementing IoT in our regular appliances. Our project aims at a system for users to control their electric components with a device. Even if the user is far away from his home or office, he can control the appliance with an app.

1.2 Motivation

Electricity prices are increasing at an exponential rate for years. This year per unit electricity price increased by 58We choose Cisco Packet Tracer as Simulation tool which will provide to different network appliance, which can also simulate in authentication of network, contrivances would then need to be interconnected.

1.3 Objectives

We want to build a system where an admin will be in charge of a building. He can distribute the control among other users. A user can check the data on the power consumption of his house. Our system will also support automation. The appliances will be turned on or off automatically at a person presence in a room.

1.4 Methodology

We have built a smart home architecture with a microcontroller(SBC-PT), a solar-powered battery, a motion detector, a fire detector alarm, and a temperature monitor. For testing purposes, we used AC, a ceiling fan, and a light. We gathered details and then created a circuit diagram using these components. Then our work was to design a prototype of the project. Users will get notifications of their home appliances by smartphone. The data of the home appliances will be saved in a MySQL database, and the process will be automated by JavaScript. After accomplishing the mentioned tasks, we tested each feature and functionality of the system. We found some vulnerabilities in the system then we worked on those bugs. Then our project was ready to be launched.

1.5 Project Outcome

The outcome is to enhance the users' living standards in terms of convenience, ease, and safety. By enabling control of appliances by smartphone, the system will minimize the need for manual intervention and simplify user management of daily routines. To provide clients with a better experience, the system will also be built with safety measures including automatic shut-off mechanisms in case of a power loss or emergency. The completion of this project will produce a cutting-edge smart home system that will make daily life simpler and give its users a safer and more pleasant life quality.

1.6 Organization of the Report

The whole report is in six parts. Each part has its own impact on our project. The first chapter is about the introduction of our project.

The background is explained in Chapter 2. It provides preliminary information, a review of related literature, and several applications that are comparable to the ones we discussed in our study. It also provides a thorough gap analysis of our project's limitations and suggestions for resolving them. Chapter 3 discusses the design stage and the number of requirements needed to finish our project. It provides use cases and functional and non-functional requirements. This chapter also includes the use case diagram and context diagram. The last portion of chapter 3 contains the project concept and thorough methodologies for our entire report.

Standards and design limitations are briefly summarized in Chapter 5. A brief description of why our project is a complex and challenging engineering problem has also been provided,along with standards, design constraints,Environmental ethics and benefits and cost analysis.

And the last chapter 6, we ended the report with future improvements and the conclusion of our entire undergraduate project.

Chapter 2

Background

2.1 Preliminaries

IoT: The community of bodily objects, or "things," which are implanted with sensors, software, and different technology for the cause of speaking and replacing statistics with different gadgets and structures via the net is known as the Internet of Things (IoT). These devices encompass something from not unusual home objects to high-tech business gear. Today, there are greater than 7 billion related IoT gadgets, and in step with analysts, there may be 10 billion via way of means of 2020 and 22 billion via way of means of 2025.

Database: A database is a collection of data that has been organized to make it simple to manage and update. Data records or files containing information, including as sales transactions, customer information, financial data, and product information, are often aggregated and stored in computer databases.

Any type of data can be stored, maintained, and accessed using databases. They gather data on individuals, locations, or objects. It is gathered in one location so that it can be seen and examined. You might think of databases as a well-organized collection of data.

Packet Tracer: Cisco's simulation tool is called Cisco Packet Tracer. In addition to testing and simulating abstract networking principles, it may be used to build complex network typologies. It serves as a learning environment for networking, and the experience is quite similar to that of computer networks.

Students may build complex and enormous networks with Packet Tracer, which is frequently not practical with physical hardware due to cost constraints. The operating systems Linux, Windows, MacOS, Android, and iOS all support Packet Tracer.

To build simulated network topologies, users of Packet Tracer can drag and drop routers, switches, and other network components.

Gateway: Among the different network connecting devices, a gateway in networking can be regarded as the most intelligent equipment. Operating intelligently in terms of transmission velocity, error prevention, data packet routing, etc. Both hardware and software components are present in it.

The gateway serves as a conduit for protocol communications between two applications, enabling them to share data on the same or different systems. In light of this, a gateway also functions as a protocol converter and can be used at any OSI model layer.

2.2 Literature Review

2.2.1 Similar Applications

On smart building management, numerous websites, mobile applications, and apps are being developed. Currently, these are the ones that are most well-known:

Wholegrain digital: You may get more details at **"wholegraindigital.com"**.

Energisme: You may get more details at **"Energisme.com"**.

Stellater: You may get more details at **"stellarfoodforthought.net"**.

WBDG: You may get more details at **"wbdg.org"**.

Energy Foundation: You may get more details at **"ef.org"**.

Maintworld: You may get more details at **"maintworld.com"**.

Watt Analytics: You may get more details at **"watt-analytics.com"**.

Interact: You may get more details at **"interact-lighting.com"**.

2.2.2 Related Research

In this paper they address the issue of movement in this study in order to give the data required for smart home appliance control. They suggest a method that merely makes use of passive infrared sensors, which are frequently used in lighting control systems. They tested our method by running experiments in a real house that had sensors installed, and they were able to confirm that for two occupants who were free to wander throughout the house, room-to-room movement was detected with an accuracy of 0.82.[1] A fuzzy decision-making method that will be applied to a brand-new architecture. To provide an effective energy control approach based on power consumption and its appropriate management, a fuzzy system has been designed. By using consumer optimization tactics for both the utility and the end user, the SmartCoM end-to-end architecture is described in depth.[2]The proposed Electronic Device Sleep Scheduling Algorithm is used to measure energy usage while the proposed method is tested on actual electronic appliances (EDSA). Additionally, the EDSA is in charge of managing the actions of the sensors while they are

in the active, sleep, and idle states. The outcomes demonstrate that the suggested architecture outperforms straightforward Wireless Sensor Network (WSN) based technologies in a heterogeneous environment. In order to enhance efficiency and cut down on processing time, the data is also processed utilizing the Hadoop Ecosystem.[3]For remote monitoring and maintenance of IoT sensors and equipment using the artificial intelligence (AI) concept, a long range (LoRa) based SH system is presented. We provide a quick description of the functions that LoRa can accomplish in SH networking. This study also introduces an AI-based data flow system for IoT servers and the cloud.[4]The primary goal of the paper is to develop an IoT-based smart home automation system that will transform a conventional home into a smart home capable of remote access and appliance management using an Android-based smart phone app. To be more precise, they want to use the Internet of Things (IoT) to create a low-cost, expandable, flexible wireless smart home automation system that allows users to operate a variety of devices from remote locations thanks to a user-friendly interface and ease of installation.[5]Without having to replace the existing appliances, programmable smart plugs with integrated ZigBee (IEEE 802.15.4) are introduced in this work. Over a TCP/IP platform, the developed software enables programming, controlling, and real-time monitoring. To effectively use the energy usage, the system framework also suggests an energy management system with smart plugs.[6]In order to dramatically increase the identification accuracy of complicated everyday activities in multi-inhabitant smarthomes, they build CACE (Constraints and Correlations mining Engine). CACE uses both person-specific sensor data (produced by wearable devices) and person-independent ambient sensor data to take advantage of the implicit linkages between the actions of several persons, viewing these relationships as a strength (generated by ambient sensors). In order to make the most of these couplings, CACE first determines the number of distinct users and extrapolates their individual movement trajectories using a multi-target particle filtering technique over movement data collected by ambient sensors.[7]The Home Energy Management System (HEMS) is essential for determining how much power is used at the customer premises level and for optimizing that use. The focus of this effort is on the design and development of smart sockets with wireless capabilities that can estimate various power parameters and compile information on the specific household appliances' real-time power usage. When HEMS is configured, a ZigBee transmitter and receiver node facilitates data exchange and creates the Home Area Network (HAN). The appliances can be scheduled and prioritized using real-time data collected at the central node[8]. Using the network simulator tool Cisco packet tracer, design a network with an emphasis on the bus, star, and mesh topologies to comprehend many ideas, including how to create a network's structure, configure IP addresses, and send information as packets within a single network.[9] The Internet of Things (IoT) standardized structure is used to develop an emergency response system for fire dangers. A low-cost Expressive wi-fi module (ESP-32), flame sensor, smoke sensor (MQ-5), flammable gas sensor, and one GPS module are used to execute the suggested design. By communicating the position of the hazard to the cloud-service through which all are connected, the sensors identify

the threat and notify neighborhood emergency rescue groups like fire departments and police.[10] Use of Cisco Packet Tracer is the fundamental concept of smart homes. When electronic gadgets are turned on and off, one is necessary to establish a smart house. The creation of a smart house is accomplished by simulation using a testing system, network configuration, and wireless home gateway computer. network hardware needed for a smart home network using an Internet of Things (IoT)/IoE command from Cisco. Cisco Packet Tracer, the program used for the simulations, excels in providing a wide range of network components that accurately depict a real network. These components can then be connected and configured to form a network. The most recent version of the platform from Cisco includes (IoT) functions, making it easy to connect all smart devices, sensors, actuators, and devices that mimic microcontrollers like Arduino or Raspberry Pi to the network. Every IoT device can run on generic software or be customized using Java, Python, or Blocky programming. As a result, Cisco Packet Tracer is the ideal technique for creating useful IoT simulations.[11]

2.3 Gap Analysis

There is a need for an open-source energy management system that is simple to deploy and operate by any user with any level of technical knowledge if home energy management systems are to be primarily used by homeowners in the smart grid era. Since the system is open-source, other developers and manufacturers are free to incorporate any features they see fit, including support for new smart devices, communication protocols, and desired capabilities. Systems for managing residential energy use are able to keep an eye on and manage specific appliances. Nevertheless, they can only support devices that employ specific communication protocols, and they typically are unable to make use of user energy consumption data. They could not detect device wise energy cost. They don't control devices on a priority basis.

2.4 Summary

Major antecedents that support our literature review and validate our issue have been discovered in this chapter. We also included the findings of the survey we did. In our section on relevant research, we summarized various publications that we reviewed. After looking over several papers, we came up with a strategy to fill in the gaps. So, we put our plan into action to close the gap.

Chapter 3

Project Design

3.1 Requirement Analysis

Goal:The purpose of this paper is to serve as a guide for users, administrators, designers, testers, and developers who are responsible for creating the Smart Home Architecture for energy optimization (Smart Electro). Users should receive all the information required for the software's conception, creation, testing, and use.

Scope: In this document the space for Smart Electro has been elaborately discussed. All functional, non-functional requirements and necessary design has been manifested here. System Overview: In this system there are panels one for the admin, any other for the user. Each panel can connect with the server and send requests in step with the user's needs. Those servers are linked with the hardware thru an electricity relay which allows them to reveal the electricity intake and manipulate their gadgets through sending remarks messages to the user. The user and admin will have the control over the system by the mobile application through the WIFI or mobile network.

3.1.1 Functional and Nonfunctional Requirements

Functional Requirement:

Area \Field	Remarks	Requirement
User Authentication	Valid users can only access the system	Users need to create an account with their credentials
Network Access	To access our platform, the user's devices and the Internet must be connected.	A cellular or WIFI connection has to be set up to have a flawless and incessant data transmission

Non functional Requirement:

Area	Remarks	Requirement
Mobile Integration	Valid user can Operate/control their devices remotely	User need to download our smart Electro app and login with proper credentials.
Performance Constraint	Need to check the readings of the power user per month.	If it gives wrong data it needs to be informed to the system engineer

3.1.2 Context Diagram

In our fig 3.1 user we are trying to reflect how we use our system. User can use the system by registration process log-in.Then engineers can maintain the whole system if any problem occurs to run the process engineers will fix this.Admin will enter the system by login process, after that process completed admin will monitoring the whole system.

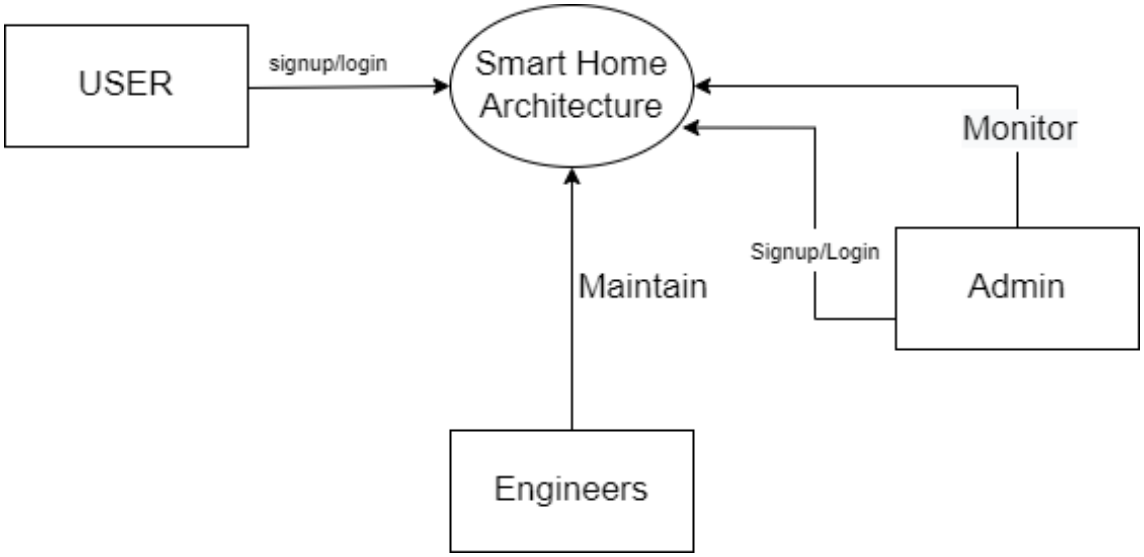

Fig 3.1: Context Diagram

3.1.3 Data Flow Diagram

In fig 3.2 we are trying to show how the user login and admin login data flow in the system. Also we are trying to reflect how the user and admin monitor, prioritize, add/remove the device from the information device,the data stored in the information device.

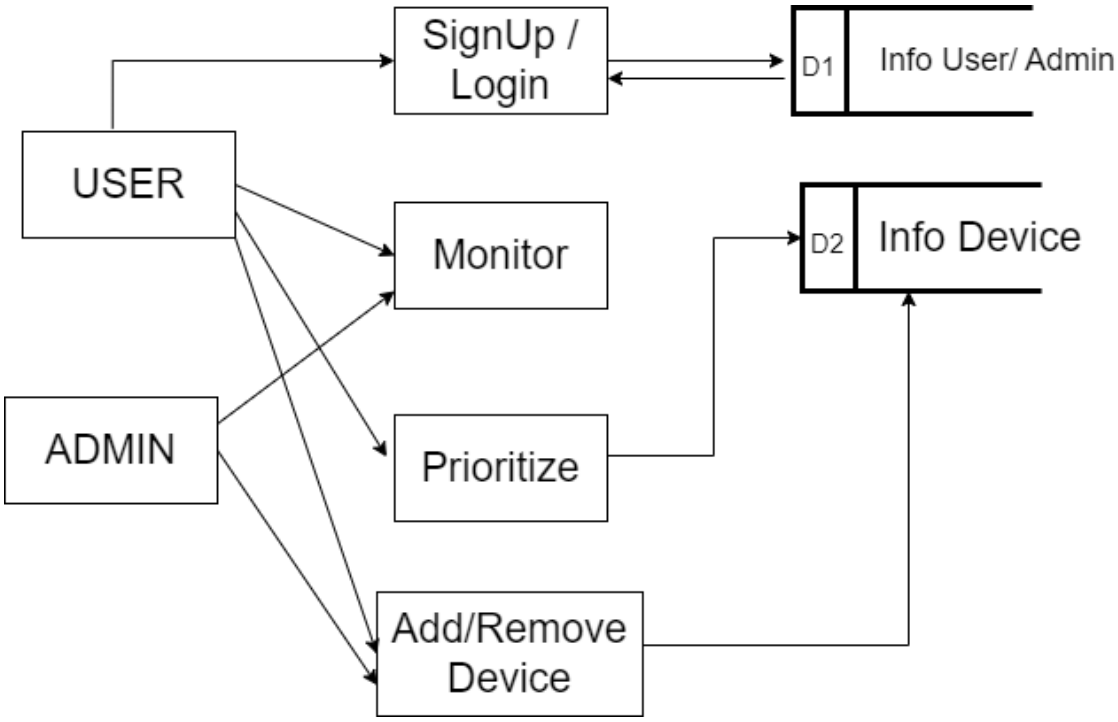

Fig 3.2: Data Flow Diagram

3.1.4 Use Case Diagram

Fig 3.3 describes in order to connect to our platform, this aids users and administrators. A user or administrator cannot access our services if they are not linked to our platform. Users must open the software and log in with a valid User ID and password to view their individual profiles. There isn't a different route.

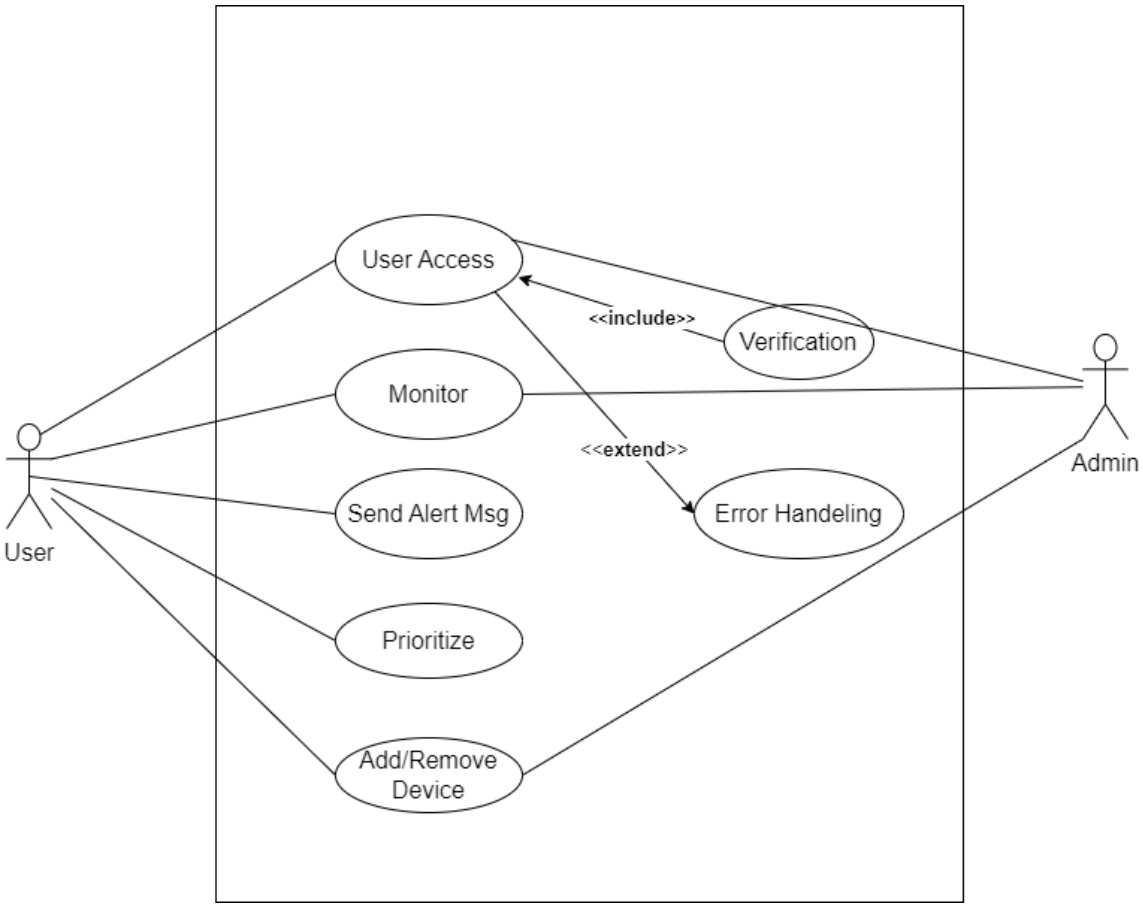

Fig 3.3: Use Case Diagram

3.2 Detailed Methodology and Design

In this project our main goal is to optimize energy consumption in a home. We design a new architecture for smart some, which include web server, smart socket, PIR sensor, micro-controller and interconnection with the different electrical and electronics device through the wi-fi. This is our proposal design for smart home-

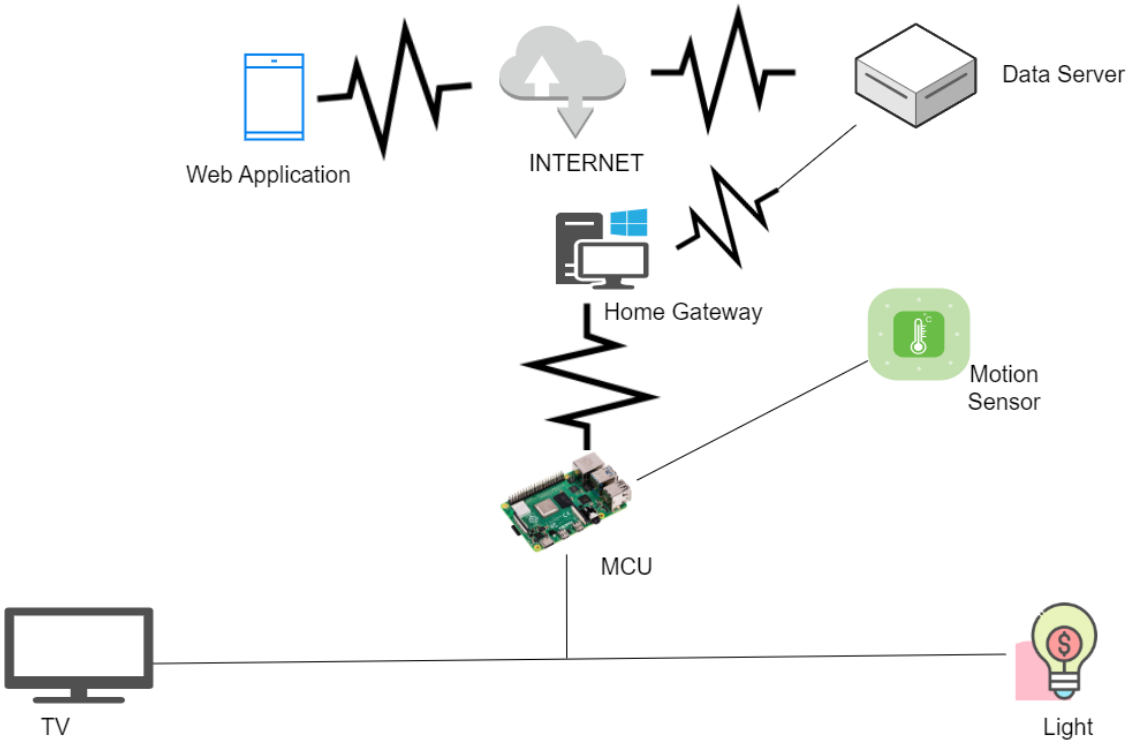

Fig 3.4:Proposed Architecture

In our proposed architecture it shows the IoT devices is connected to home gateway.The Home Gateway has a wireless channel 6 contact point with the "Home Gateway" SSID and four Ethernet connections.Businesses can set up WEP, WPA-PSK,or WPA2 to secure wireless connectivity for connections.Through the internet the data of IoT is passed through the data server, where remotely the data is saved. Once the motion is detected by the motion sensor camera is turn on.Micro controller unit named SCB is used to wirelessly data transformation of every device.Then the data server can be used by user and admin to manipulate device manually and automatically.

3.3 Project Plan

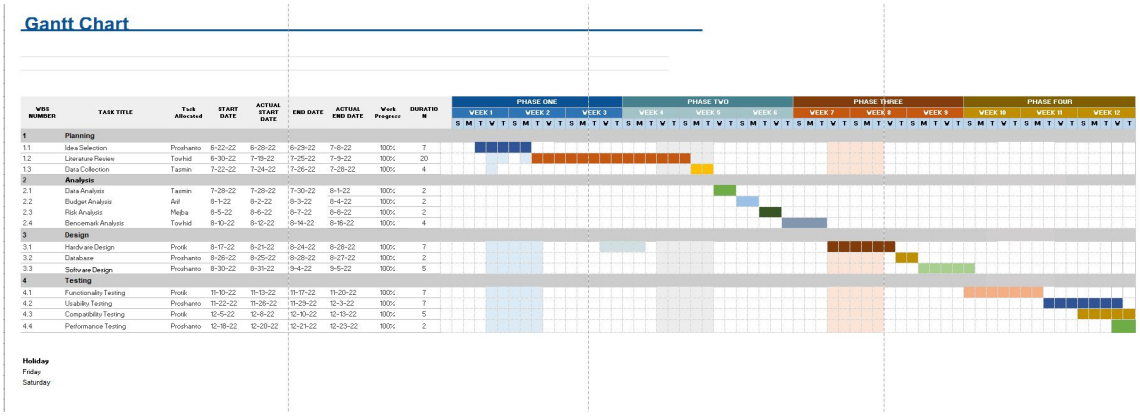

Fig 3.5:Gantt Chart

3.4 Task Allocation

We chose to complete every aspect of the assignment as a six-person team, but each of us took the lead in a different task, as shown in the Gantt chart. We contributed in each part equally but along with these each of us has worked in the respective area .

3.5 Summary

We have discussed our objectives and scopes while analyzing our functional and non-functional needs in this chapter. Additionally, we supplied the required diagrams. This includes Dfd, Use case, Context and Proposed architecture. The diagrams show the internal and external actors, databases, and system operations. Additionally, we have outlined our task breakdown structure with advancement here. We have also referred some future extendable work in this part.

Chapter 4

Implementation and Results

4.1 Environment Setup

including a wide range of smart appliances used for smart home automation, such as fans, lights, doors, air conditioners, servers, ceiling sprinklers, webcams, and different sensors. Home Gateway is used to provide a programming environment for controlling linked objects and sensors, as well as control mechanisms through the registration of smart home gateway devices.

Home Gateway: Through a home gateway or a network database, IoE Things can immediately sign up for the IoE service. The Home Gateway has a wireless channel 6 contact point with the "Home Gateway" SSID and four Ethernet connections. Companies can set up wireless links to be secure for connections using WEP, WPA-PSK, or WPA2. The home gateway is connected to the internet using the WAN Ethernet connector. The Home Gateway's (LAN) internal IP address is 192.168.25.1

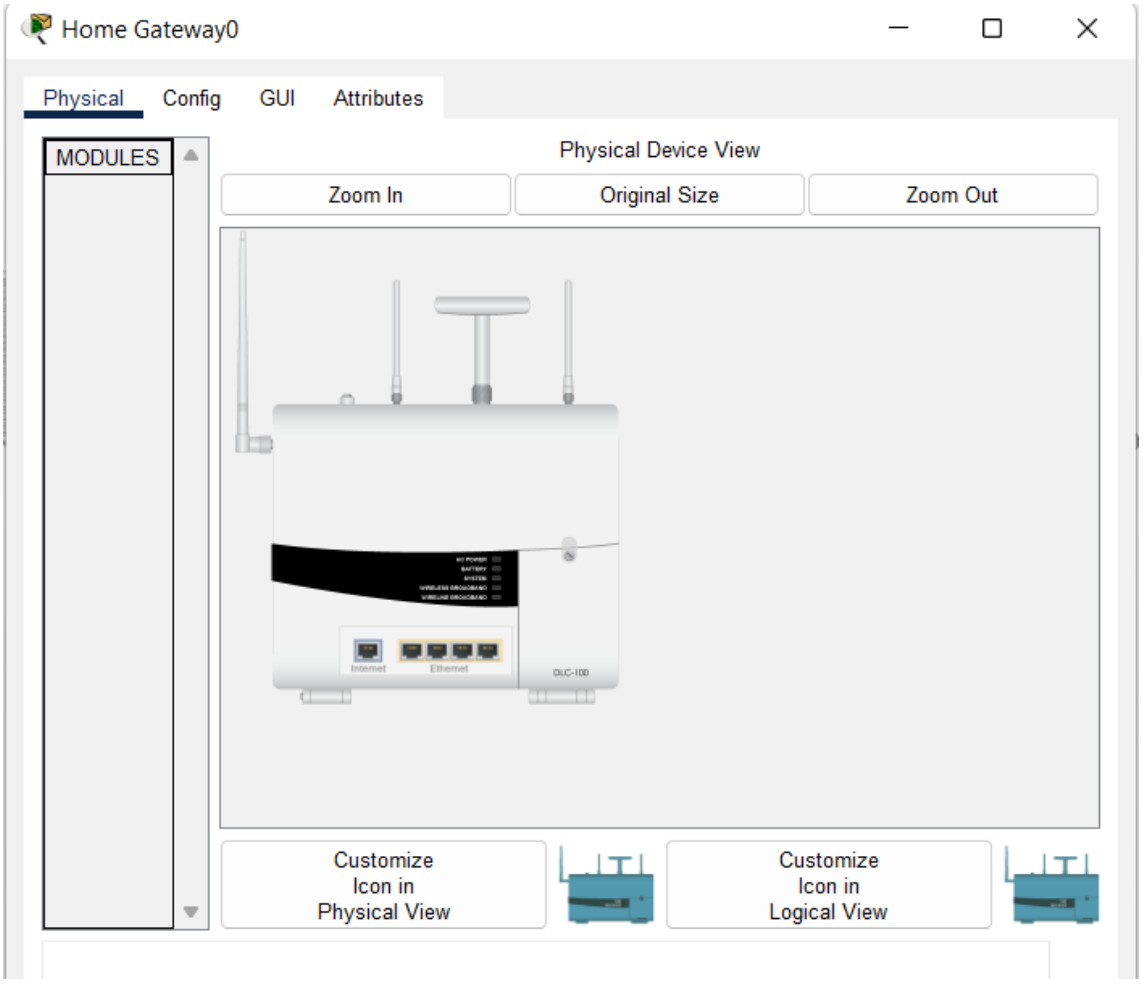

Fig 4.1.a: Home gateway Internet and Ethernet port.

This figure-4.1.b displays 11 IOE items connected to a Home Gateway. This figure also shows how smart objects are connected to the home gateway using Ethernet cable and wireless technology for both local and remote smart device control. Any connected smart device is given an IP address by the home portal, which also serves as a Static server.

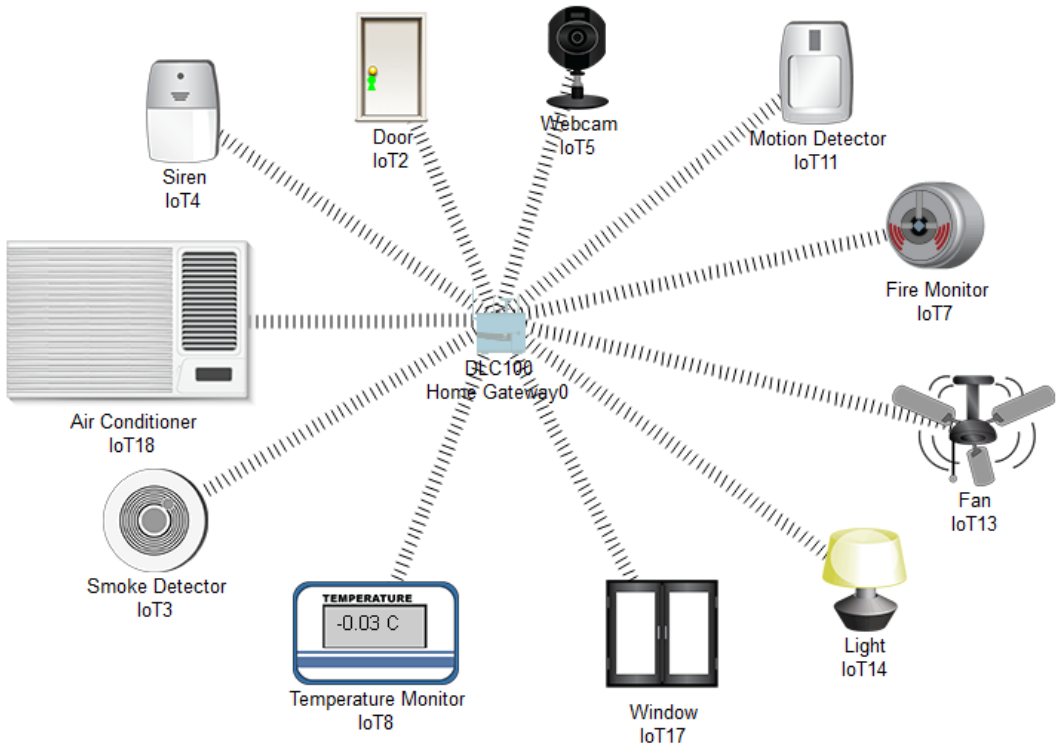

Fig 4.1.b: Home portal with linked smart devices

Figure-4.1.c indicates the home architecture that uses wireless and wired media to connect to each other.

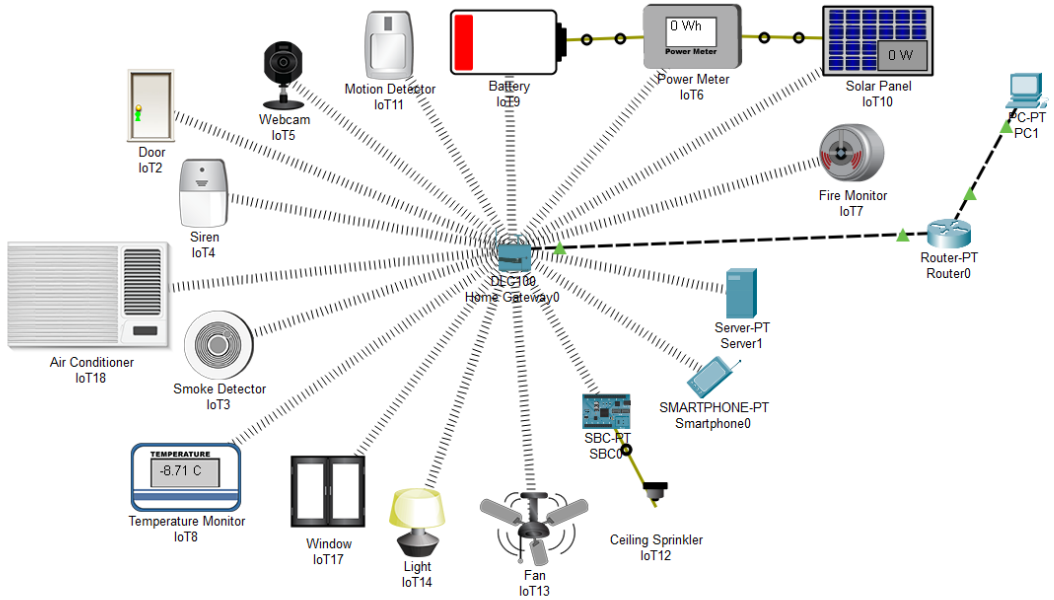

Fig 4.1.c: Smart Home Architecture.

Figure-4.1.d indicates how IOE device can be registered to Home Gateway. The home gateway has the default username and password for accessing the registered IOE device via the web.

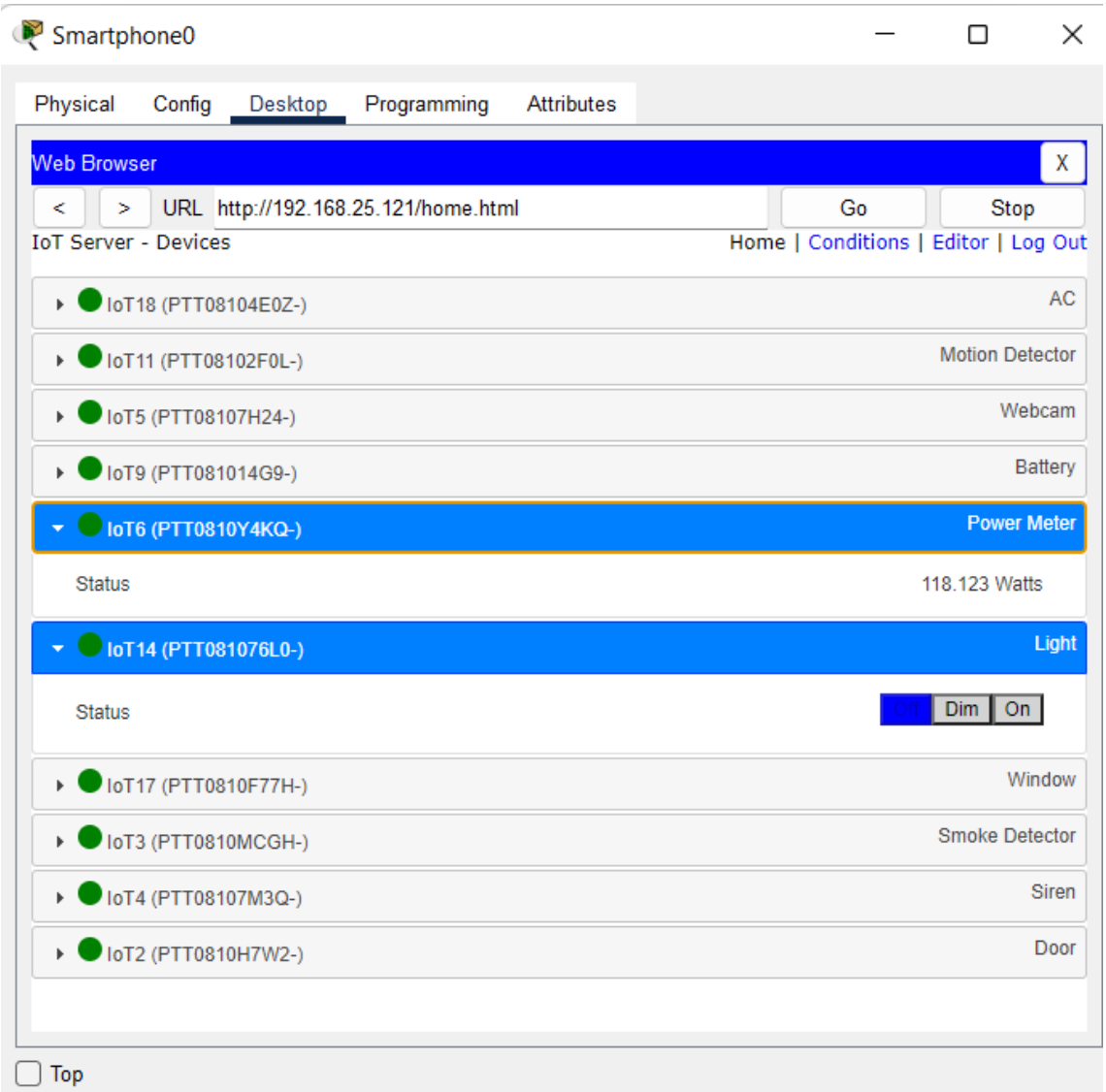

Fig 4.1.d: Registering Io devices to Home Gateway

Table 1.Device used for deployment

S.NO	Devices	Functions
1	Router	Used to link home to the network of cellular.
2	Home Gateway	Used to register smart objects and provide smart objects with IP addresses.
3	Server	To monitor intelligent things that are recorded on it and to have specific database features.
4	MCU	Used to connect different intelligent things.
5	PC	Link to your home destination to access intelligent objects.
6	Fan	Used for ventilating the home environment on the basis of certain circumstances.
7	Webcam	Control the home.
8	Siren	Provide sound at home for some case.
9	Light	Provide Light.
10	Motion Detector	Link to your home getaway and detect motion.
11	Smart Door	Link to your home getaway and provide an event based on functions.
12	Smoke Sensor	Used to sense the smoke level.
13	Ceiling Sprinkler	Used to ventilate home environment At a speed of 0.1 cm per second, water level affects.
14	Smart Window	Used to remotely control the window impacts Argon, Carbon Monoxide, Carbon Dioxide, Hydrogen, Helium, Methane, Nitrogen, O2, Propane, and Smoke.
15	Temperature Sensor	To Monitor the temperature of home.
16	Smart-Phone	Used to control the home from outside.
17	Battery	Show how much power are left.
18	Solar-Panel	For power supply.
19	Power-Meter	Show how much power consume.

Figure-4.1.e Shows if motion detector detect any motion, the webcam is automatically on and recorded a video.

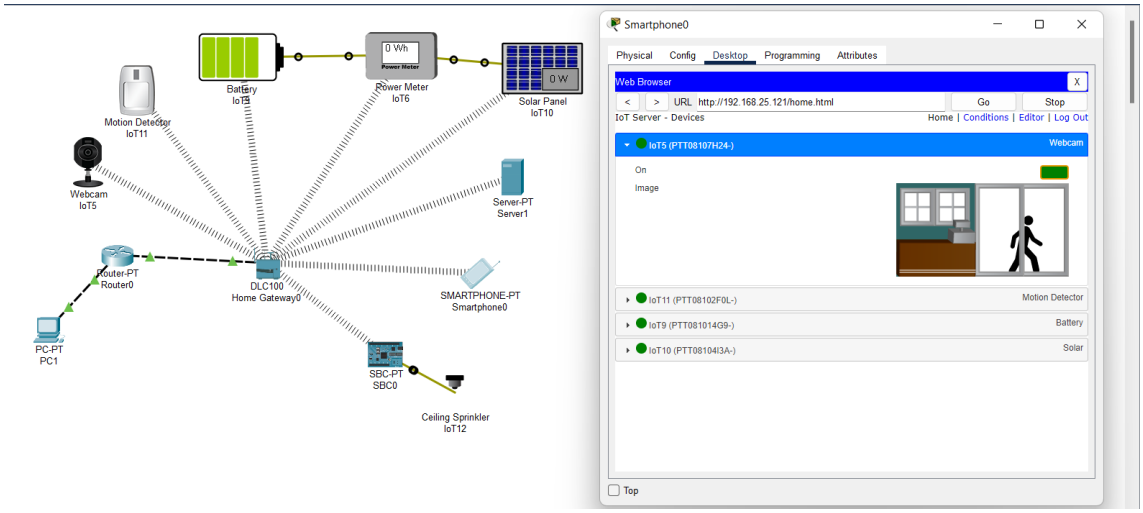

Fig 4.1.e: Detect Motion and automatic on webcam.

Figure-4.1.f shows when the smoke detector detect smoke at high level, doors and windows are automatically open and for an alarming the siren warning us via ringing.

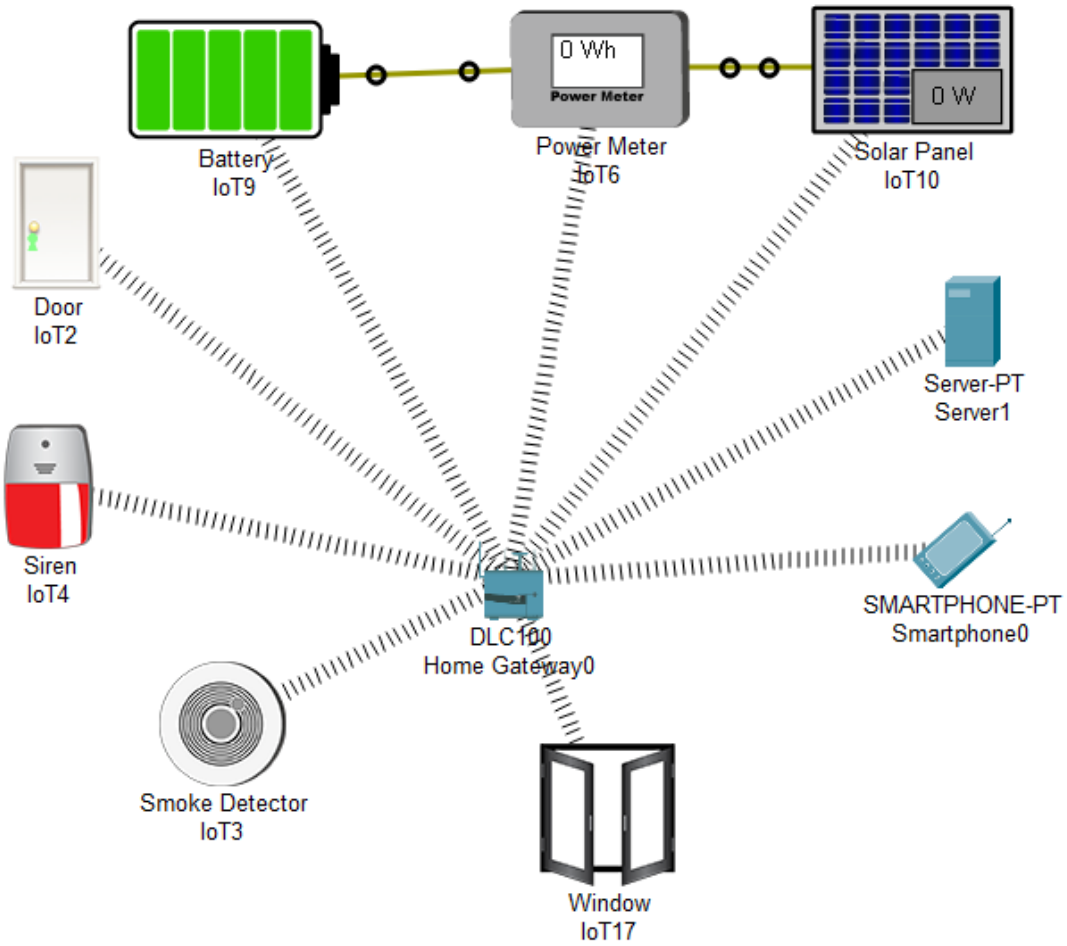

Fig 4.1.f: When Smoke detector detect smoke, door and windows are automatically open and ring the siren.

4.2 Testing and Evaluation

SBC-PT SBC0: Physical objects used to connect single-board computers(SBC-PT).They usually lack a network interface and must rely on the SBC-PT for network access.These are straightforward devices that only communicate via their analog or digital slots.A Thing is a special device used to create self-contained physical objects such as motion sensors or smoke alarms. This resulted in the creation of network interfaces for communicating with other devices in the home.

Motion Sensor: Here motion sensor is used to detect nearby people or objects. Whenever it detects a motion,it stimulate the camera and camera is turn on immediately.

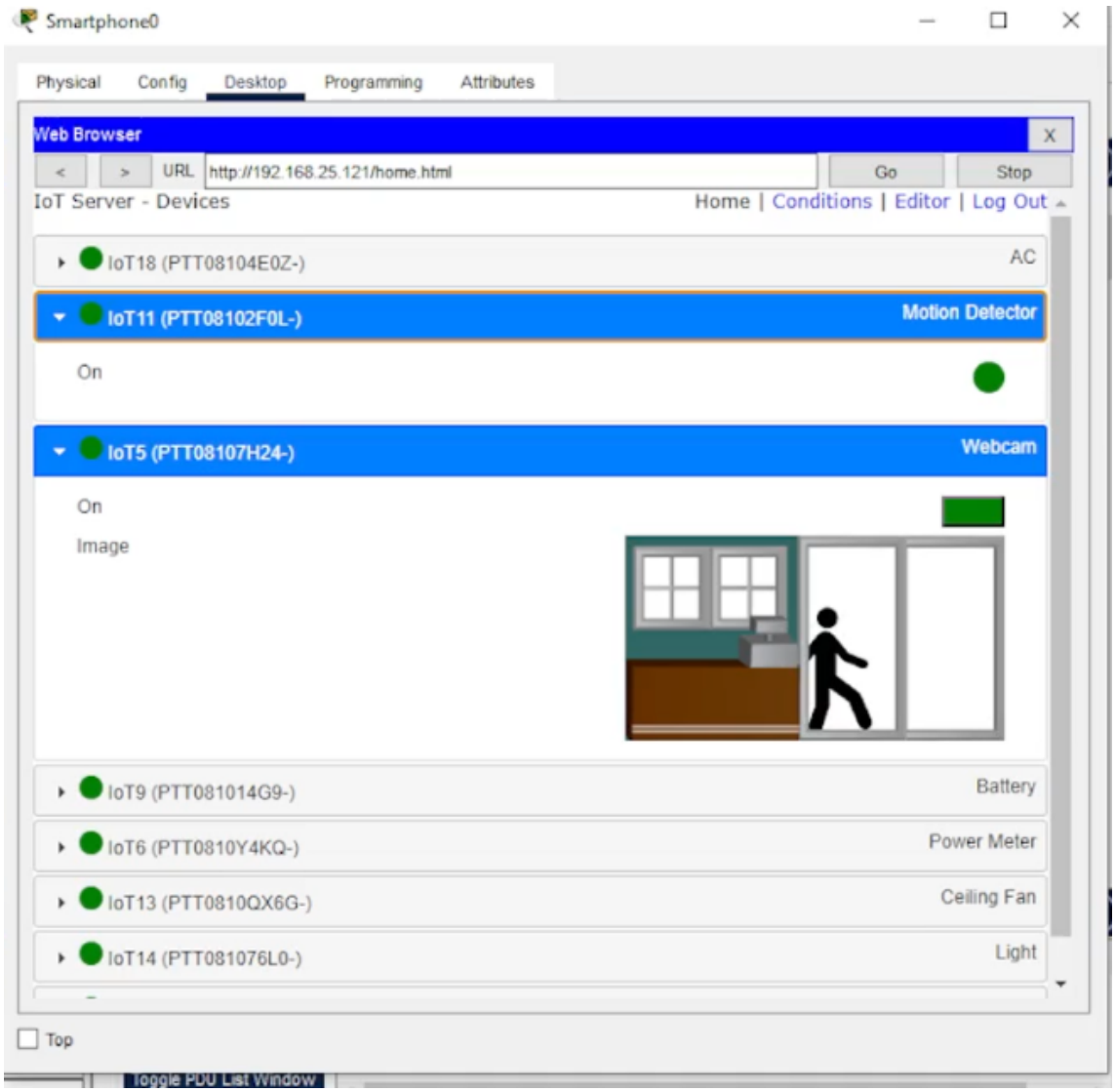

Fig 4.2:Motion sensor activates the camera

Solar Panel Iot 10: Solar energy harvesting for Internet of Things (IoT) applications is progressing from the realm of hobbyists and makers to mainstream

professional IoT applications. The primary reason for utilizing solar energy is to alleviate the pain of inaccessibility and the cost of maintenance. This solar panel is the source of energy here . Once the battery get power source from solar panel then it charge up the battery. At once the other device get ON.

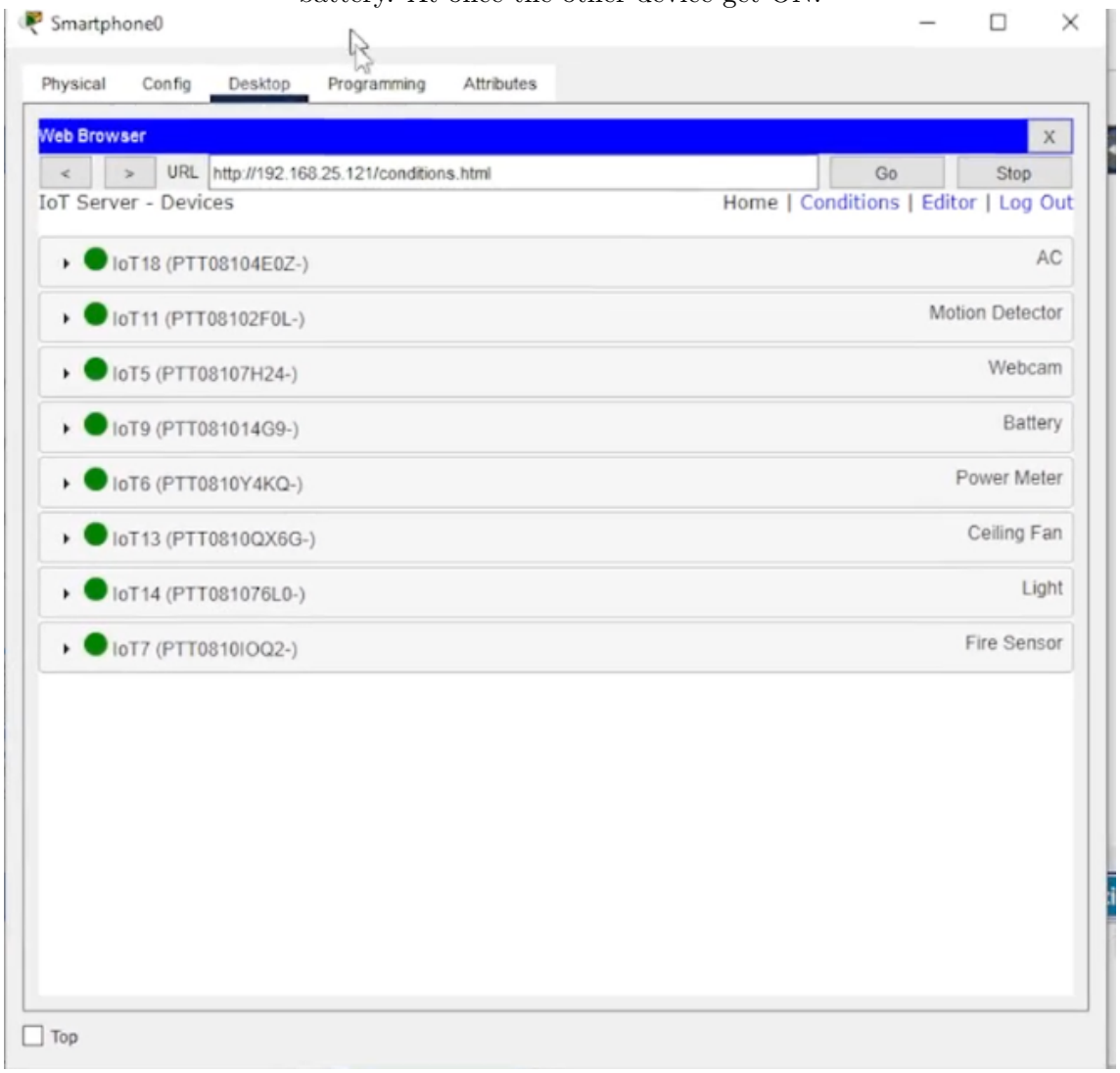

Fig 4.2:Webcam electrical appliances

Power Meter: This power meter notices the power consumed by each device . It measures the voltage (V) in watts and current (A) and derives from these the most important power results Which device consumes how much energy is obtained from this Power meter. Our one of the target is to get the appliances wise data and to safe them in database. The data for each device is stored in the MySqL data base. This sort of data is saved on Daily Basis.

SMTP Protocol: An SMTP server is a computer program or device in charge of email transmission. It follows the Simple Mail Transfer Protocol in its operation (SMTP). Emails are sent to an SMTP server by the email client. Once another SMTP email server

receives them, it passes them on to the incoming mail server. In this case, the user is notified when the threshold is reached. Here, a threshold is established so that the user will receive a notification to take the appropriate action when the battery has 30

```php
<?php
use PHPMailer\PHPMailer\PHPMailer;
use PHPMailer\PHPMailer\SMTP;
use PHPMailer\PHPMailer\Exception;

require_once "vendor/autoload.php";

$available = $_GET["available"];

$servername = "localhost";
$username = "root";
$password = "";
$database = "iot";
// Create connection
$conn = new mysqli($servername, $username, $password, $database);

$ac = $conn->query("SELECT consumed FROM ac WHERE `date` = CURDATE()")->fetch_object()->consumed;
$cam = $conn->query("SELECT consumed FROM cam WHERE `date` = CURDATE()")->fetch_object()->consumed;
$fan = $conn->query("SELECT consumed FROM fan WHERE `date` = CURDATE()")->fetch_object()->consumed;
$light = $conn->query("SELECT consumed FROM light WHERE `date` = CURDATE()")->fetch_object()->consumed;
$motion = $conn->query("SELECT consumed FROM motion WHERE `date` = CURDATE()")->fetch_object()->consumed;

$mail = new PHPMailer(true);
```

Fig 4.2: Notify snippets of code

```php
$mail->SMTPSecure = "tls";
//Set TCP port to connect to
$mail->Port = 587;

$mail->From = "fydp12@gmail.com";
$mail->FromName = "FYDP UIU";

$mail->addAddress("protikkanu111@gmail.comm");

$mail->isHTML(true);

$mail->Subject = "IOT Power Consumption";
$mail->Body = "<i>Alert! Power Consumed: ".$available.". Take necessary action.</i><br>";
$mail->Body .= "AC consumed: ".$ac." Watts<br>";
$mail->Body .= "Cam consumed: ".$cam." Watts<br>";
$mail->Body .= "Fan consumed: ".$fan." Watts<br>";
$mail->Body .= "Light consumed: ".$light." Watts<br>";
$mail->Body .= "Motion Detector consumed: ".$motion." Watts<br>";
//$mail->AltBody = "Alert! Power Consumed: ".$available.". Take necessary action.";

try {
    $mail->send();
    //echo "Message has been sent successfully";
} catch (Exception $e) {
    //echo "Mailer Error: " . $mail->ErrorInfo;
}
```

Fig 4.2: Notify snippets of code

4.3 Results and Discussion

Data Retrieval: The most challenging task in this project is to get data as per the usage from every electrical appliances. After configuration in packet Tracer It is considered that data is represented in a structured way, and there is no ambiguity in data. In order to retrieve the desired data we present a set of criteria by a query. Successfully the data per day is achieved.

```php
<?php

$servername = "localhost";
$username = "root";
$password = "";
$database = "iot";
// Create connection
$conn = new mysqli($servername, $username, $password, $database);

$device = $_GET["device"];

$rowexists = "SELECT * FROM $device WHERE `date` = CURDATE()";
$rowexistsresult = $conn->query($rowexists);

if ($rowexistsresult->num_rows > 0) {
    // output data of each row
    $currentdata = $rowexistsresult->fetch_assoc();
    $newdata = $currentdata["consumed"]+$_GET["consumed"];
    $updatedata = "UPDATE $device SET consumed=$newdata WHERE `date`=CURDATE()";
    $conn->query($updatedata);
} else {
    $zeroinsert = "INSERT INTO $device (consumed, `date`) VALUES (0, CURDATE())";
    if ($conn->query($zeroinsert) === TRUE) {
        $currentdata = $rowexistsresult->fetch_assoc();
        $newdata = $currentdata["consumed"]+$_GET["consumed"];
        $updatedata = "UPDATE $device SET consumed=$newdata WHERE `date`=CURDATE()";
        $conn->query($updatedata);
    }
}

?>
```

Fig 4.3: Snippets of code to fetch the daily data

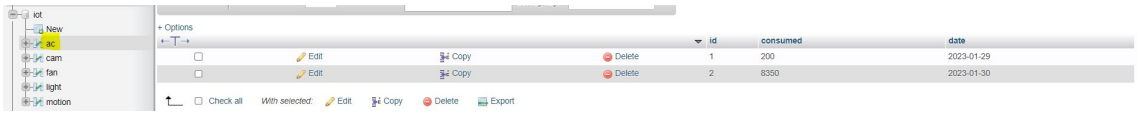

Fig 4.3: AC

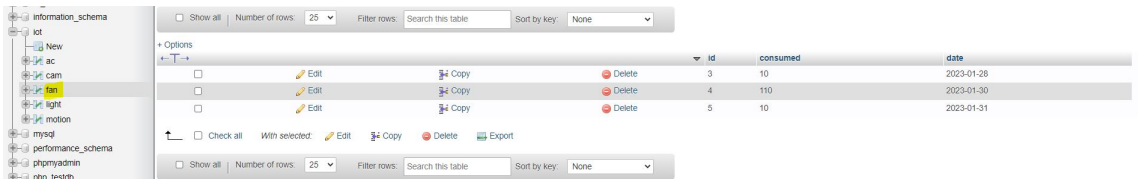

Fig 4.3: FAN

Our system has Server-PT which serve a remote database. This remote database holds

all the data related to power consumption. This database can be view from anywhere. Real time data is accesses for the electrical devices power consumption. Wireless communication for client -server is established. The data is driven through home gateway DLC100 Home gateway. The gateway combines the entry point for internet connections with the distribution point, eliminating the need for a dedicated modem and router.

Notify User To prioritize the device: When the motion sensor detects the user motion then at once it turn on the camera. Electrical appliances starts running as per the demand of user. The battery gets power by the solar panel and keeps acting as the power source of devices . As long as it consumes 70

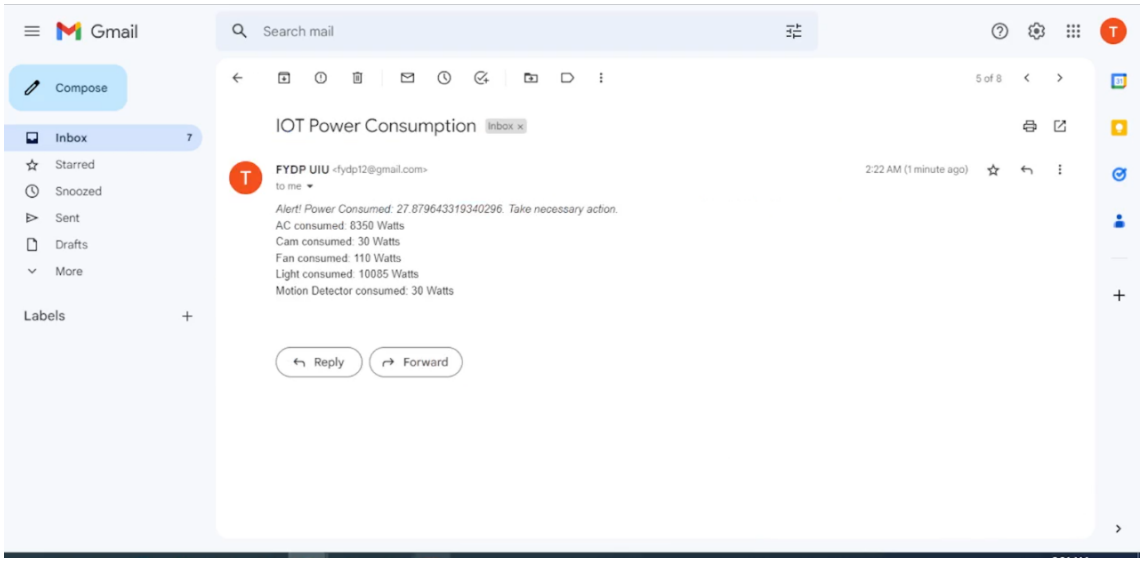

Fig 4.3: Screenshot of sending notification to user

Performance: The most crucial factors to check in order to assess the performance of our system will be processing time, which includes reading, storing, and data transfer. The processing speed increases as processing time decreases. We can determine whether there are voltage fluctuations so that we can produce information about when the peak energy use will occur. Analysis of the voltage distribution's minimum and maximum is simple. We checked the data that is being process, stored has been transferred within the desired limited time. Once the user prioritize the device the data of appliances is stored as per that situation.

4.4 Summary

This chapter provides a summary of the operation of our system. We have talked about the tools and programs we maneuvered as well as the algorithms that powered our project. The conclusions and findings of our testing and evaluation have also been discussed.

Chapter 5

Standards and Design Constraints

5.1 Compliance with the Standards

5.1.1 Software Standards

Packet Tracer: Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks. The software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface. Packet Tracer makes use of a drag and drop user interface, allowing users to add and remove simulated network devices as they see fit. The software is mainly focused towards Cisco Networking Academy students as an educational tool for helping them learn fundamental CCNA concepts. Basically we use it to control our project network of smart home automation system.we make a smart home automation system network by using Packet Tracer.The disadvantage of Packet tracer is we can't implement mobile application in it, mobile application is one of the vital part of our project.

XAMPP: XAMPP is a free and open-source cross-platform web server solution stack package developed by Apache Friends, consisting mainly of the Apache HTTP Server, MariaDB database,and interpreters for scripts written in the PHP and Perl programming languages.Since most actual web server deployments use the same components as XAMPP,it makes transitioning from a local test server to a live server possible.XAMPP helps us to create and control our project database.

5.1.2 Hardware Standards

Motion Sensor: A sensor is a device that generates an output signal in order to detect a physical phenomena. Motion sensor,is an electronic device that uses a sensor to detect nearby people or objects.In our project when motion sensor detect a people or object the camera will be on automatically.

Smoke detector: Smoke detector works by detecting light that is reflected off parti-

cles from a light beam inside the sensing chamber.We use it in our project to detect smoke when it detect smoke the siren will be on automatically and the ceiling sprinkler will spray water continuously.

Home gateway: Home gateway communicates with your Internet service provider (ISP), receives data, sends it to the router to translate and distribute to your wireless devices. In our project we connect all the component with home gateway.

MCU: we used MCU to connect different intelligent things

Webcam: When motion sensor detect a object or people web cam will be automatically on that will control the home.

Solar panel: when AC current will fail to provide the current solar panel will make sure to run our system.

Temperature monitor: temperature sensor sense the temperature of the room and show it in the monitor.

Ceiling sprinkler: Provide water in case of smoke/fire detect.

5.1.3 Communication Standards

We will use WiFi,Ethernet,GSM,Node-MCU.We use WiFi will to access people in our platform. Advantage of WIFI is cost effective and easy to set up but WIFI range is restricted. We use Ethernet to connects devices in a wired local area network. Global System for Mobile communication cellular-wireless telecommunications standard or network which is used by mobile devices such as phones and tablets. Node-MCU used in our system to store and send data to the server.

5.2 Design Constraints

5.2.1 Economic Constraint

when we start our system it takes time, patience, money and other things.We can implemented our project anywhere but whether it will be cost efficient that's the matter. Our system will be better for commercial buildings than housing society, government office, University. The project setup costs a big deal at the beginning but in the long run it saves both electricity and money. To save the electricity one day it will helps our economical budget and GDP.

5.2.2 Environmental Constraint

The devices we use in our project, when a producing company produce these materials that will little bit harmful for our environment. But the impact of our project in the environment is a huge beneficial for biodiversity. If we can minimize electricity consumption that gives less air pollution,soil pollution, water pollution because more producing energy gives environment pollution. Less producing energy means less carbon emission that will

helps to protect the natural disasters like, flood,earthquake,thunderstorm,cyclone. so we can easily say our project has a great impact in environment.

5.2.3 Ethical Constraint

constraints mean that I am working within accepted norms of society and I have to behave what is considered in the right way without offending anyone.our project we don't harm any one of the society on the other hand we are trying to help the society by doing our project.

5.2.4 Health and Safety Constraint

Every engineer should take care about the health and safety issue when they doing their project. So we are gathering knowledge and getting good skill in electric devices, electric wiring and connections. we are always to be careful while implementing the system in a building as lack of awareness might lead to electric shock.By our system we are reducing air pollution that will help us to improve our health issue

5.2.5 Social Constraint

Our system is easy to use a people can easily use it like an mobile banking app.In our society people are used to use mobile banking app so they can easily handle our system mobile application to control our system.

5.2.6 Political Constraint

By our system we will minimize energy consumption and that reduce load shedding and now a days load shedding is a big political issue. Our system also help government in increasing national GDP.

5.2.7 Sustainability

Our system is a sustainable project. Our system blessing for the upcoming generations. Because if we minimize energy consumption that means energy producing will be reduce. So we will preserve our natural resources like coal, oil, natural gas for our future generation, that will be a great sustainability of our project.

5.3 Cost Analysis

Cost calculation:

Motion sensor: 85 Taka
Smoke detector: 700 Taka
Web-camera: Rapoo C260 USB Full HD Webcam : 2850 Taka
Temperature monitor: 180 Taka

Solar panel: 1079 Taka
Ceiling sprinkler (5pc): 2000 Taka
Home gateway: 4000 Taka
MCU: 500 Taka

5.4 Complex Engineering Problem

5.4.1 Complex Problem

Mapping with Complex Engineering Problem.

Depth of Knowledge Required	ok
Extent of stakeholder involvement and Need	ok
Depth of Analysis Required	ok
Familiarity of The Issues	x
Extend Of Applicable Codes	x

Depth of Knowledge Required:

Energy usage measurement
Communication protocol
Heuristic algorithm
Cloud data retrieval
OS handling

Extent of stakeholder involvement and Need:

Consumer: Need to have responsible consumption

Distributor: Need to have smart grid approach

Government: Need to apply strategy/law to ensure system automation

Depth of Analysis Required:

Control devices manually automate
Multiuser detection
Energy efficiency
Cost-benefit analysis

5.5 Summary

In this chapter, we examined the potential constraints on our project. We talked about the project's sustainability and determined the total project costs.

Chapter 6

Conclusion

We'll work to aid others because it's a crucial component of what it means to be a person. For this and the following generations, our platform will serve as a growing source of useful advice. All future electrical plans to save and save electricity will use this as their sustainable architectural model.

6.1 Summary

By implementing this project our task is to save energy,cost efficiency and user detection.We may try to save energy as much as we can by our project.Then we can calculate our cost consumption and utilize that properly.

6.2 Limitation

Saving energy is related to our project. We are implementing our project utilizing packet tracer software, we are unable to connect with a smart phone. We may unable to implement our project everywhere because of the environmental situation.

6.3 Future Work

We intend to create a platform-specific application for you. We currently use email as a notification system, but we are trying to switch to an app that will alert us to all information relevant to our needs. We will make a hardware-based model too. To increase effectiveness, we wish to do additional research and enhance our platform. With the aid of our government, we intend to upgrade our platform.

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