IOT IMPLEMENTATION FOR SMART CITY DEVELOPMENT

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APPROVAL

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We hereby declare that, this project has been done by us under the supervision of **Mr. Md. Rakib Hasan, Lecturer** Department of CSE Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Population growth is increasing day by day. To handle the increasing population, hyper-urbanization and globalization as well as to ensure economic and environmental fixity, cities are now focusing to become smart cities. Internet of things (IoT) is the collection of electronics devices which enable us to data collection, sense, and management and monitor the system without being physical with the devices. These systems consist of networks, sensors, computer systems and storage devices. Connected technologies with IoT solutions play an important role in changing cities into smart cities. The concept of **"IoT Implementation for Smart City Development"** is an extensive and layered infrastructure that ensure the need of projects related to smart city and in this way allowing cities to fulfill urban networking in order to increase economic power and build more efficient, unique technological solution to cope up with the numerous challenges of the city. In this modern era smart city is the outcome of advanced development of information technology. Smart home automation, Smart weather and water management, Smart road and traffic management system are the main building blocks and the internet of things (IoT) is the core of smart cities. Implementing smart city with IoT and connected technology helps to increase the performance, quality, and interactivity of urban services, optimize resources and reduce costs. In this paper we are focusing on the different applications of internet of things in agriculture system, water resource management, and smart home automation system.

TABLE OF CONTENTS

LIST OF FIGURES

FIGURES **PAGE**

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Who doesn't want to live in a smart city in this technological era? Everyone wants to enjoy the facilities of smart city. A city is called smart while an urban area that uses many types of electronic data collected from various types of smart device integrated with sensor and actuator which is used to analyze and processed the collected data from smart device and give an output to monitor and control smart home automation, traffic management, water and weather management system etc. Smart home, traffic management, water and weather management system, smart surveillance system are the sub division or portion of a smart city.

There are three major arenas for IoT applications in the consumer, industrial, and public sectors. Recent interest has mainly focused on the consumer side, including consumer appliances, home area networks and other applications. Industrial applications are promising to improve business outcomes for many sectors, including manufacturing, asset management and healthcare. In the case of public sector applications, the Internet of Things is a major enabling concept to accelerate the development and deployment of smart city solutions. This article discusses the overall architecture of IoT and the issues of current practice of smart city deployments.

1.2 Motivation

In this era of modern technology, internet is the only gateway to make our life better and easier. There are lots of device and things are connecting to each other through internet can make our everyday life much better and developed countries are already having those facility by developing the IoT field, they are making their city smart day by day. But due to shortage of resource and lack of proper research and development of the field of internet of things, our country is lagging behind from other countries. Though our country is an under developing country we have lots of issue on home security, traffic management problem, water problem, waste management problem etc.

around us. We cannot make our city smart with resolving those issue. From those issue a question arises in our mind, can we not be free from these issues with the development of IoT? This question has motivate us to do such kind of research project. And also having very much interest in the field of internet of things, this project has given us the opportunity to explore the world of IoT.

With IoT sensors offering a substantially cheaper price point and with new, battery powered networking solutions like LORA becoming available, the price barrier is significantly reduced. Using this kind of low cost components, we will make our city smart.

1.3 Rationale of the Study

Now day by day people are becoming dependent on the internet. Other developed countries and making smart cities so why our country will be lagging behind from other country. Bangladesh is a least developed country application of IoT is not properly implemented yet. We still use remote control and Bluetooth which are very limited in range. So our thought was if we can research and develop our smart city and monitor, control, analyze the data from long distance it would not bad. We need to ensure our home security and home automation. We can ensure the safety of fire, gas leakage and other problem using IoT.

Water scarcity is the lack of available water resources to meet the demands of water usage within a region, which is, according to the "United Nations Development Program" caused mainly by poor management of those resources, affecting around 1.2 billion people around the world.

Population in Bangladesh is increasing by geometrical progression. But the agricultural production is increasing by arithmetical progression. The production of food cannot keep pace with our increasing people. So, there is the shortage of food in our country. Every year a large quantity of food is to be imported from abroad. Population growth in Bangladesh are in alarming point. Our farming land is reduced day by day but food lacking is increasing. So, we have to make much food in same land. The Internet of Things as a technology holds great potential to solve life-threatening problems in various angles of our daily life like water management problem, agriculture problem.

1.4 Research Questions

Smart cities are modern creation of smart technology so the implementation of IoT is not an easy task to do. The main hindrance to develop our agriculture is weather prediction, land choice and lack of proper knowledge of cultivation. We all know, “Water is elixir of life". But, how efficiently you are using it? And how to ensure home security and automation together using IoT? Yes, the answer to this question is our project. The project “IoT implementation for smart city development in Bangladesh”, as the name says it all is about management of water supply, home security, and home automation and also for irrigation system.

1.5 Expected Output

Smart city consists of lots of smart devices connected among each other through the internet and share data. Our expectation is controlling, monitoring, analyzing, visualizing based on the data which is send or received from the device and the main server.

The expected output of the project are as follows,

- Controlling and monitoring home appliances like light, fan, ac, fridge etc. from an admin panel
- Making the home appliances automated
- Monitoring and controlling the doors lock from the server using finger print.
- Identifying known person and send the person’s information to the server.
- Sending notification and alert while detecting unknown person
- Monitoring home temperature and humidity in the server and visualize in the dashboard
- Monitoring water tank status and automatic motor on off
- Monitoring gas leakage and automatic on off the main gas line
- Controlling exhaust fan using kitchen temperature.
- Automatic light on off using light sensor and get the light status in server and can also be controlled from server.
- Motor pump will start automatically
- Water leakage detection

- Which area are suffered for water and water car give service for that area
- Water waste calculation
- Amount water will show in window automatically
- More efficient systemic water management

Water pump will run when water tank is empty in a certain level. Auto on/off switch can also be handled by operator. If motor becomes dead then it will be sent a notification to the control office of WASA. How much water are hoisted will store in database and operator will be seen this data in real time. If any leakages are occurred, it can also detect it.

For agriculture system, sensor will detect the soil moisture, soil temperature, air temperature, humidity, uva etc. It will show this data automatically in web application. These data will also store in database as a result it will give predictive base suggestion for better cultivating system.

1.6 Report Layout

This Project is organized as follows:

Chapter 1 introduces the project "IoT implementation for smart city development". Also explain its objectives and methods.

Chapter 2 reviews the literature of IoT implementation for smart city development in Bangladesh.

Chapter 3 analyzes and deals with the IoT components. The circuit diagram and flow chart gives an overview of the whole system. Then, each of the components is studied individually.

In Chapter 4 we have describes the hardware development part of the different unit of the project. Also describes the basic operation of the IoT devices. A step-by-step analysis is presented on the actions that would take in the whole system of IoT base smart city development.

Chapter 5 presents the result and its discussions. We then study the flowchart and block diagrams. It summarizes the logic involved in the complete operation of this project. It also concludes the work performed so far. The possible limitations in proceeding research towards this work are discussed. The future work that can be done in improving the current scenario is mentioned.

CHAPTER 2

BACKGROUND

2.1 Introduction

IoT Implementation and development of a smart city is a vast and huge project. So we have divide the project into subproject, Smart home automation, water and weather management system and agriculture management system. We have searched for IoT implementation of those portion but unfortunately we did not get any proper IoT implementation. Home is our only place where we feel safe and secure. So it is insistent needs to be a home smart and secured for our better life. It's often said that water is the world's most valuable commodity, but in many Western countries water has been so cheap and accessible that many people don't even think about its cost. But with rapid urbanization nearly 70% of the world's population lives in cities it is estimated that almost half of the population will live in water stressed areas by 2025. This means that water will become one of the biggest expenses for cities in the future and will directly impact on economies.

2.2 Related Works

Although many research are done and those are going on in the areas of smart home automation, smart water and smart water management, a few have ventured in developing viable systems that are field deployable. Continuous environmental monitoring and management through the integration of IoT and WSN is an active topic for researchers, engineers and public administrators. Noticeable works in the area of water management includes an investigation into Sustainable Water Distribution Strategy with Smart Water Grid [1] which explains how to bridge the gap between connecting various water resources and optimizing management of the system with new information technology solutions. The paper titled Internet of Things for Smart cities [2] provides an insight into realization of IoT network along with the required back end network and services. The paper also describes the protocol stack used in the architecture. Micro-water Distribution Networks describes about sustainably building a water distribution system in Indian villages, considering the local factors like labor, local community needs, climate and time for implementation [3]. The paper gives an

idea about the various challenges that had to be faced while building such a system in India. An Integrated System for Regional Environmental Monitoring and Management Based on Internet of Things is also a similar work incorporating IoT, cloud computing, global positioning system etc. to monitor the environment. They have put forward an architecture that can handle huge data. DataSoft is also establishing 10,000 smart homes in Tokyo, Japan using the next generation IoT solutions what can be termed a spectacular leap for the country's IT industry. They also signed an agreement with the Ministry of Transport and Communication Channels of Democratic Republic of Congo (DRC) to advise and install IoT-based toll management solution for its Matadi Bridge.

Cloudly InfoTech, being the first AWS partner in the country, is also gaining credibility for its Business and Consumer IoT products and services such as Smart home, Smart building, Smart factory, Smart farming, Smart warehouse, Smart Campus in the local and global market with Indian, American and Chinese partners providing devices, installation and maintenance services.

AplombTech is another local company that provides smart switch, different types of smart lights, smart camera, smart curtain and smart tank.Walton has introduced smart air conditioner recently; Gadget & Gear is selling smart home assistants like Google Home, Amazon Alexa while Samsung has brought smart washer in the country.

In order to overcome these challenges, an executive suggests for the government to convert hundreds of government-commissioned homes to smart homes. Other required support is already available. Also, investments, specifically for the IoT technology can be encouraged by the government from various public and private sectors. Regardless of all these challenges, companies like DataSoft, Cloudly InfoTech, AblombTech and Walton are trying to lay the foundation for IoT industry in Bangladesh [4].

2.3 Research Summary

Smart city gives us the opportunity to access, control and monitor data of our desired device. There are several kinds of technique out there but they are traditional and works only on short distance so we thought different and we have research and studied on the long rang devices. The devices can be access from anywhere in the world. Home will be more secure and safe with automated system.

The Internet of Things offers new solutions for improving water management, to maximize efficient use of this precious resource. Comprehensive water management strategies can reduce water costs by up to 20%, which has a real impact on cities. Water projects can be particularly complex since many cities rely on aging infrastructure, and the IoT also presents opportunities for municipalities to reduce operational expenses around construction, maintenance, and more.

2.4 Scope of the Problem

Natural disaster like flood, drought, excessive rain and other natural disaster are barrier to meet the expected level of production. Especially the natural disasters mentioned above are mostly harm crop production, home and accommodation. The flood destroys huge area of crop fields and home.

The farmers don't have the accessibility to weather report that creates serious problem in crop production. The most dangerous crisis occurred in2007's rice production. That year because of cold wave and not reporting to farmers about it the national rice production faced a crisis; the farmers got "Chita" rice.

2.5 Challenges

This section deals with the typical challenges raised by the application of the IoT-based smart cities. When all the data are collected and analyzed in a common IoT platform, the system can be subjected to several attacks like cross-site scripting, and side-channel. Besides, such a system is exposed to important vulnerabilities. There are some reliability issues that have arisen in the IoT-based system. For instance, because of the vehicles' mobility, the communication with them is not reliable enough.

Furthermore, the presence of numerous smart devices will cause some reliability challenges in terms of their failure. Some specified scenarios require the interactions between large numbers of embedded devices which are possibly distributed over wide area environments. The IoT systems provide a suitable platform that can analyze and integrate data coming from different devices. However, such large scale of information requires suitable storage and computational capability collected at high-rate which makes typical challenges harder to overcome.

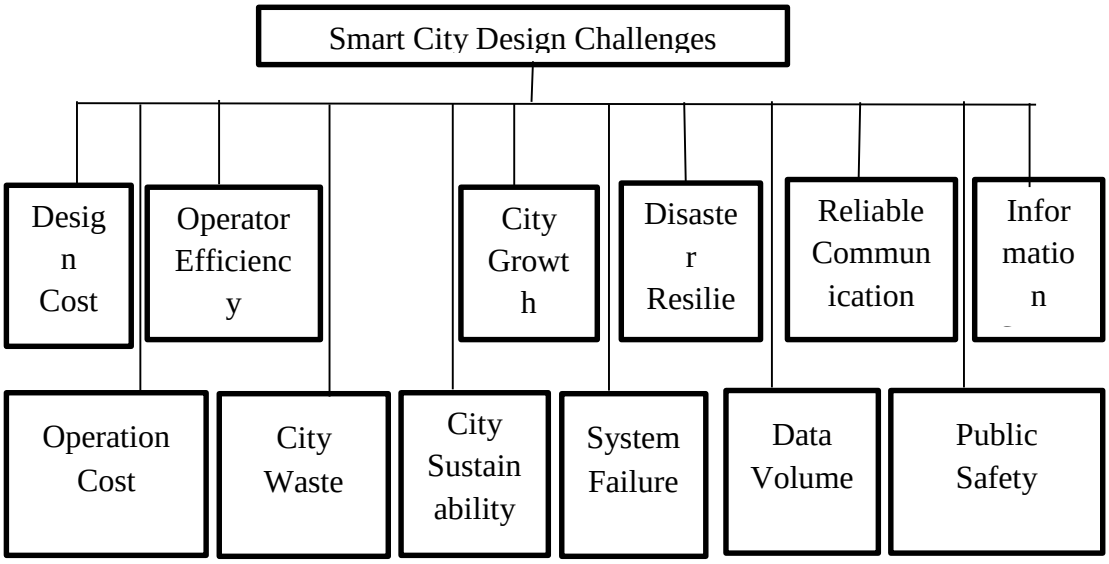

Figure 2.5.1: Challenges for smart city development

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Although this project is a research based project, without development and implementation of IoT the project would remain uncompleted. So we have done our research by building a demo environment. We have study lots about different types of device, sensor and module. We tried to send, received, analyze data and control device individually and part by part which is quite tough and challenging.

3.2 Research Subject and Instrumentation

To implement IoT for develop a smart city we have to study in several kind of portion we have focused on smart home automation system, water and weather management system, which are the first needs of our daily life [6]. Then smart agriculture system. The research field are much wider to us though but we took the whole project part by part. We have study on how the IoT can ensure the home security and automation. To ensure that we had to study on some device and instruments that is help us to do our research project

TABLE 3.2.1: COMPONENTS LIST

SL	**components**	**Description**
Water management system		
1.	ESP8266 Wi-Fi module	The ESP8266 is a really useful and cheap Wi-Fi module for controlling devices over the Internet. It has two GPIO pin.
2.	Pump motor	Pump is a standard mechanical device used to force a liquid or a gas to move forward inside a pipeline or hose using suction or pressure or both.

3.	water level sensor	Level sensors are used to detect the level of substances that can flow. Measurements can be used to determine the amount of materials within a closed container or the flow of water in open channels.
4.	Arduino Uno R3	The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.
5.	LCD Display 16X2 with Header	LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.
6.	Vero/dot board	Vero board is a brand of strip board, a pre-formed circuit board material of copper strips on an insulating bonded paperboard
7.	Bread board	A breadboard is a construction base for prototyping of electronics.
8.	jumper wire	A jump wire is an electrical wire, or group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other

		prototype or test circuit, internally or with other equipment or components, without soldering.
9.	wire	Electrical wire is used to connect components.
Agriculture system		
10.	Water pump	Pump is a standard mechanical device used to force a liquid or a gas to move forward inside a pipeline or hose using suction or pressure or both.
11.	Lm35 temperature sensor	The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35device is rated to operate over a −55°C to 150°C temperature range.
12.	Soil Moisture Sensor	Soil moisture sensors measure the volumetric water content in soil.
13.	DHT11 humidity sensor	The DHT11 measures relative humidity. Relative humidity is the amount of water vapor in air vs. the saturation point of water vapor in air. At the saturation point, water vapor starts to condense and accumulate on surfaces forming dew.
14.	DS18B20 water temperature sensor	This is a waterproofed Temperature sensor. Handy for measure something far away, or in wet conditions.
15.	NodeMcu Lua Wi-Fi with CP2102	NodeMcu is the Development Kit based on ESP8266, integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board. It

		has got Micro USB slot that can be directly connected to the computer or other USB host devices.
Smart Home automation		
16.	Raspberry pi 3 b+	It is used for the main server and face detection
17.	Arduino Uno	It is used as an end device
18.	NodeMcu	For controlling lots of switch with one device
19.	ESP8266	It is used for connecting to the internet
20.	DHT22	DHT22 can send temperature and humidity data
21.	Light Sensor	It is used for sending the day and night value
22.	PIR Sensor	For detecting motion and movement
23.	Finger Print Sensor	It is used for finger print lock
24.	16x2 LCD Display	Show the device status
25.	Door Lock Switch	It is used for door lock
26.	Raspberry pi Camera	Pi camera used for detecting person
27.	Smoke Sensor	It detect smoke and send the data to the server
28.	CH_4 Gas Sensor	It detect CH_4 Gas which is used to our gas oven
29.	Relay switch	To control AC Switch

3.3 Data collection procedure

Where there is Internet of things there is lots of smart device and sensor connected among each other. We collect data from those device and send to the main server and store it. We analyzed the stored data and take an action against it. Suppose we have a temperature sensor it sends the temperature data to the server and based on the temperature data we can set the critical value and switch on off the AC or fridge.

The data is send from the sensor through wireless device to a router or a gateway then it send to the main server using the MQTT protocol [7]. The data is send as an array of object through JSON and the whole packet of data called payload. Inside the payload massage all data and command are stored like device status, device control method, device id etc.

When water tank will empty in a fix point, it will detect using water level sensor. This information will go to Esp8266 Wi-Fi module. It will turn on motor pump. When water level sensor will detect tank is full then pump will switch off automatically. User will get pump on/off option using manually for other serious cases. All kind of this information will store in database. We will calculate, how much water is pumping in a day base on motor running time. If water output valve is off but water level is decreasing, then we can easily say that there is any water leakage is happened. Calculating total pumping water and output water, we will find total amount of uses water. For agriculture system we use some sensors to collect data from land [5]. All these data will store in our server database using NodeMcu Wi-Fi module. Using these real time data, user will get more accurate weather prediction. As data is stored in a database so using these data analysis, we can get which time which crops will be benefited for land.

3.4 Statistical Analysis

Statistical analysis of data defined as a way which is used to analyze and examine big and small data sets with different types of da attributes which is extracted from the sensor data. Smart home data can be used to monitoring the internal devices which are connected to the main server [7]. From a home temperature data we can measure the electricity consumption, with the time series data of a device we can maintain a good

balance of our daily life. With a finger print door access we can analysis the time of entering and exiting of a user.

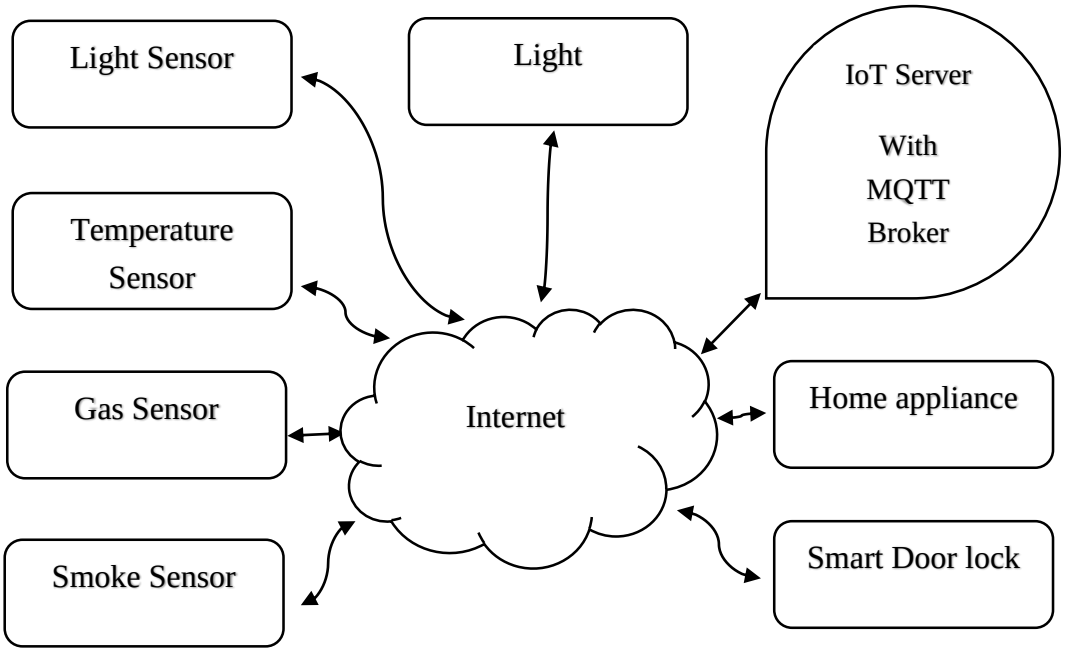

Figure 3.4.1: Smart Home Automation Block Diagram

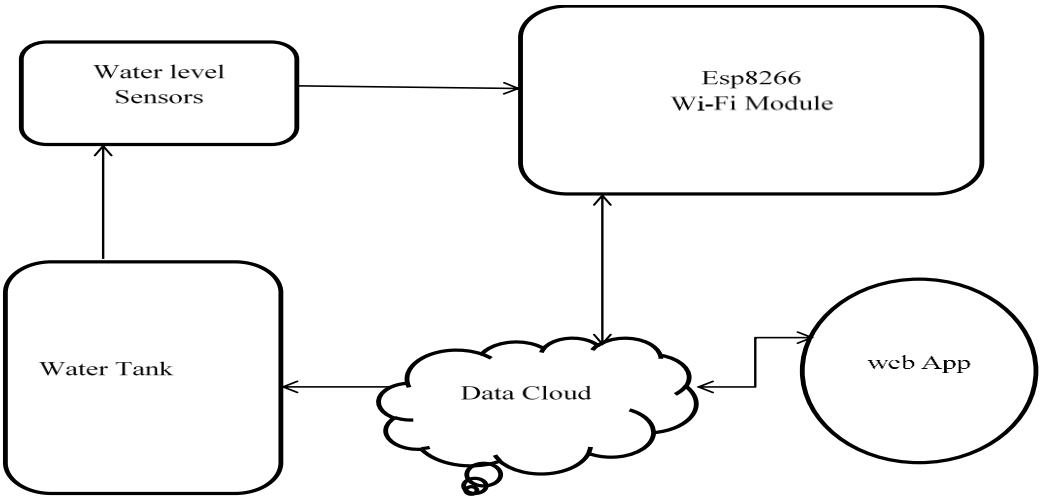

Figure 3.4.2: Smart Water management system Block Diagram

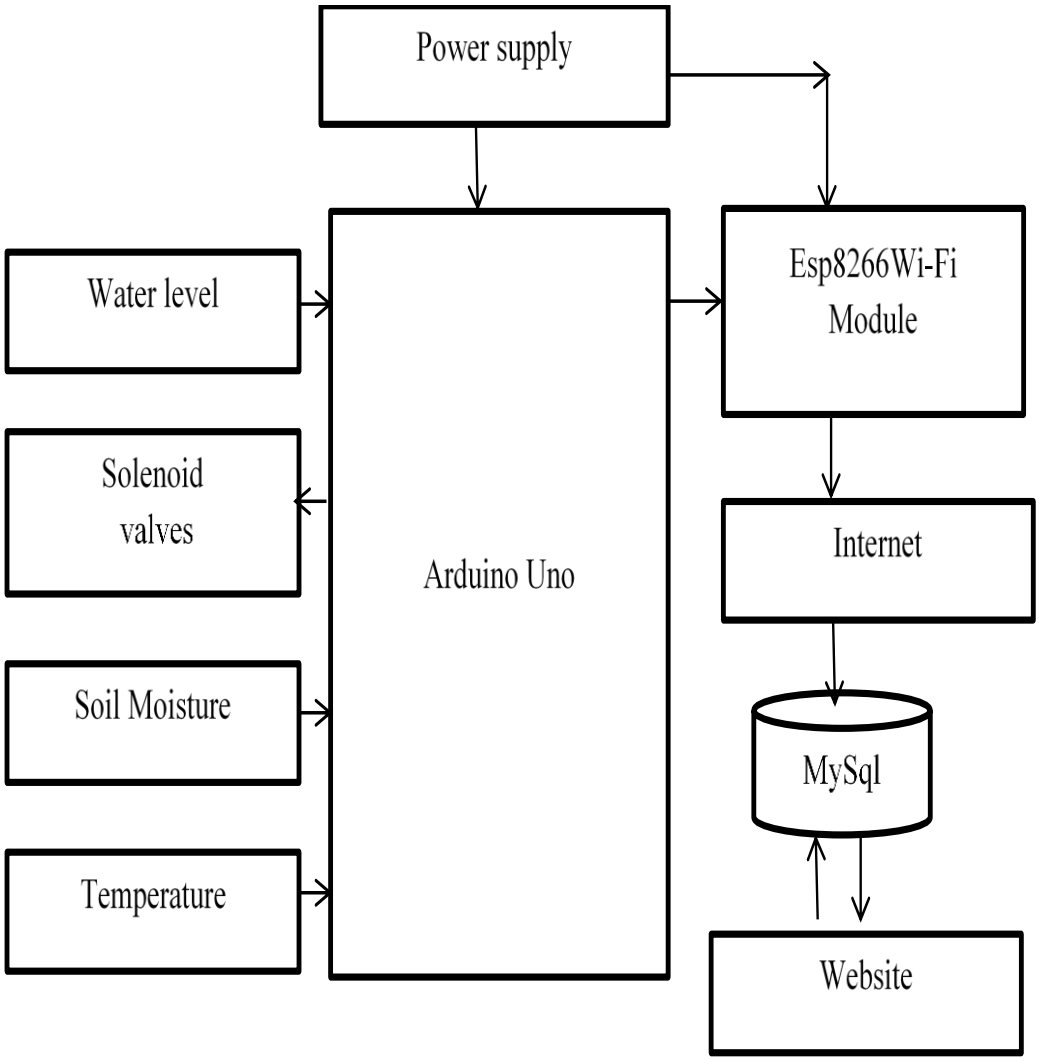

Figure 3.4.3: Smart Agriculture management system Block Diagram

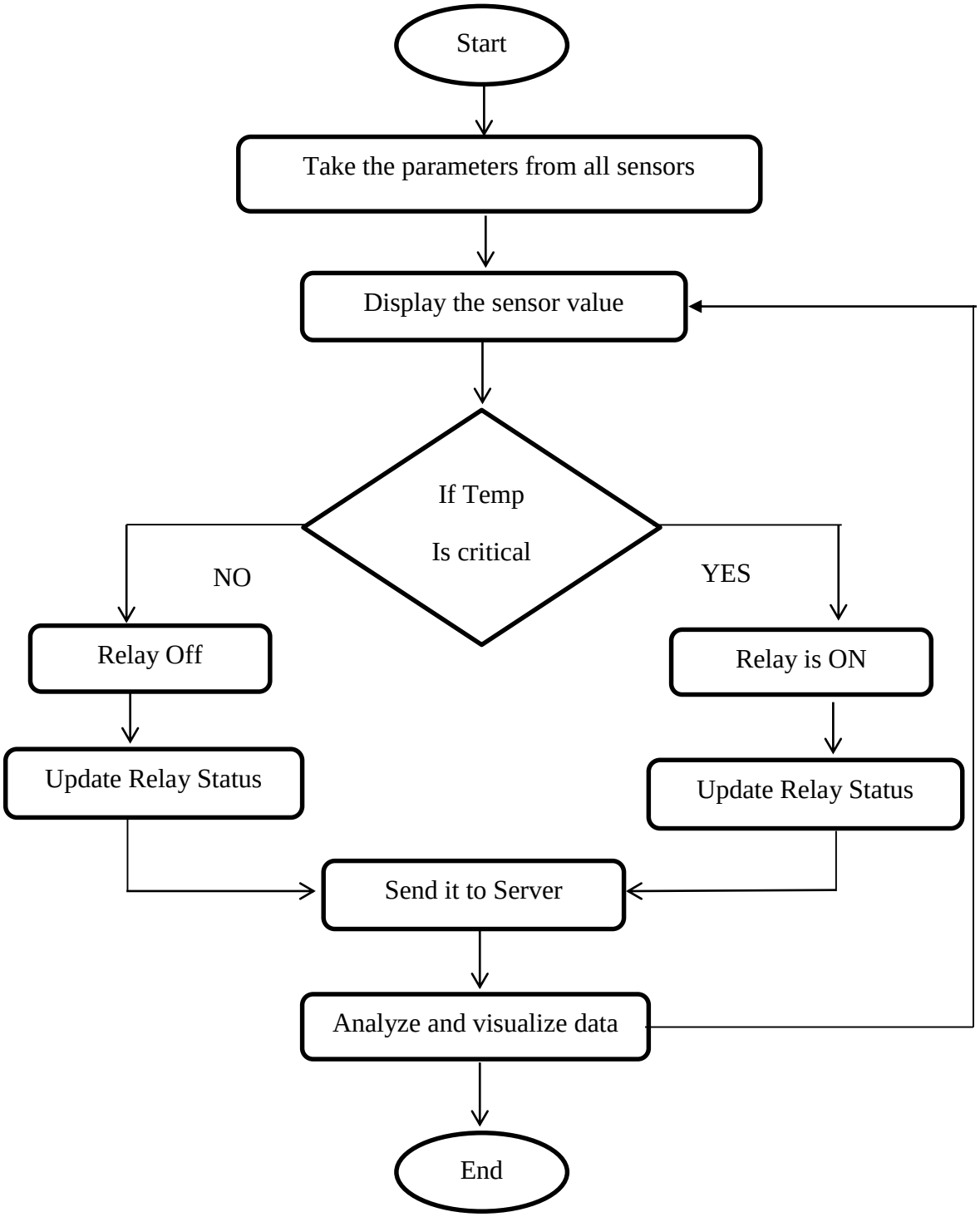

Figure 3.4.4: Flow Chart of Temperature device for Smart Home Automation

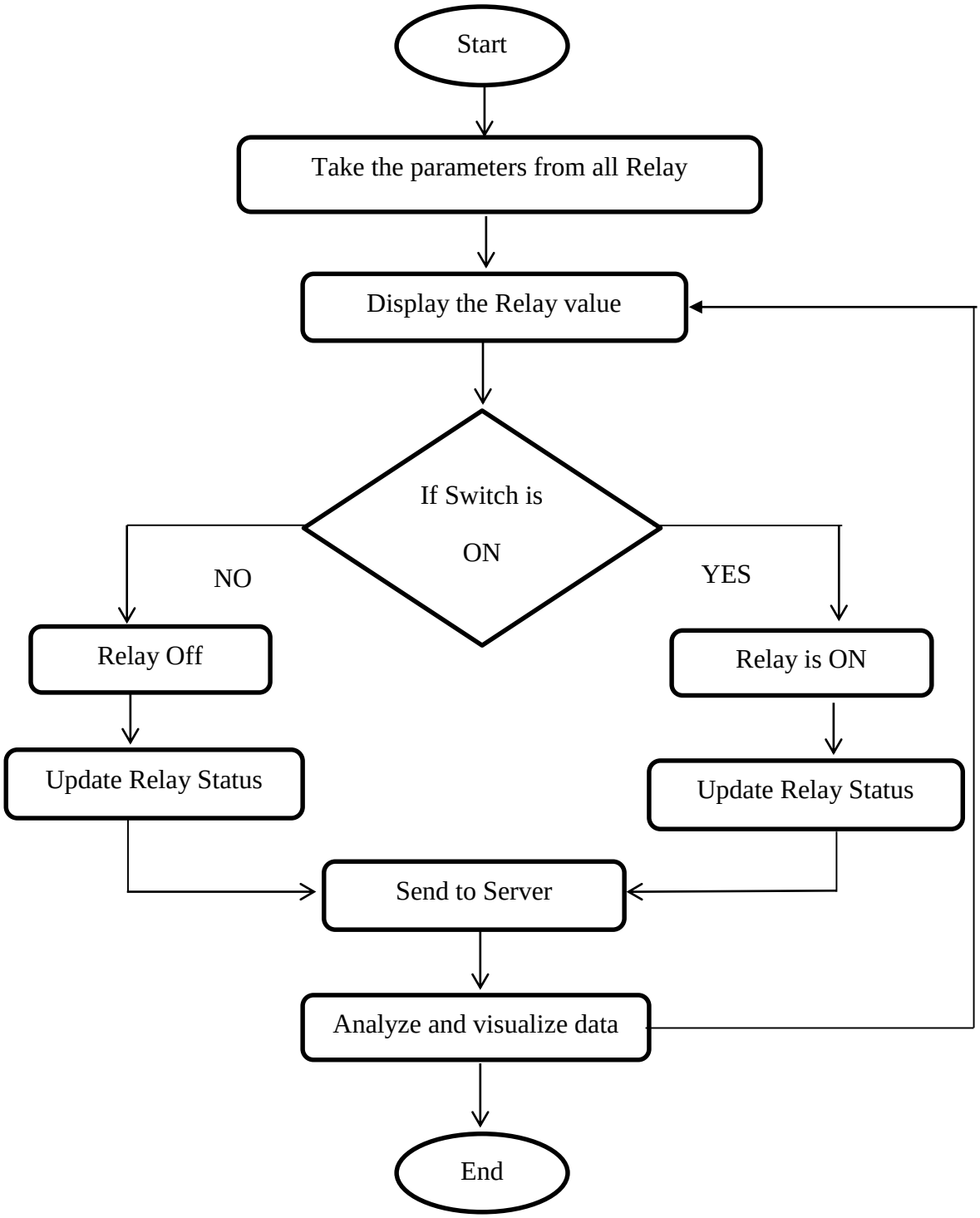

Figure 3.4.5: Flow Chart of Switch controlling for Smart Home Automation

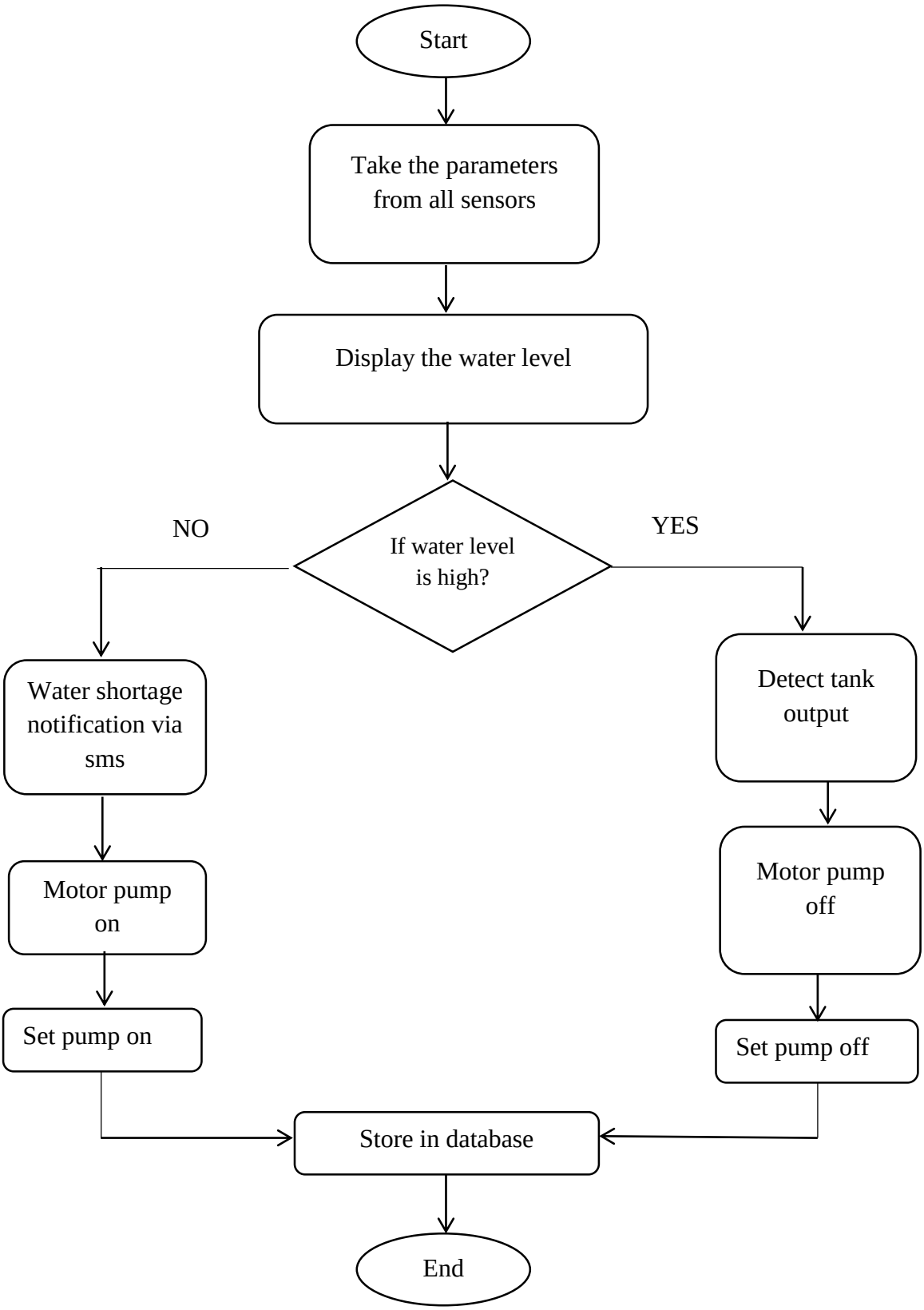

Figure 3.4.6: Flow Chart of Smart Water Management System

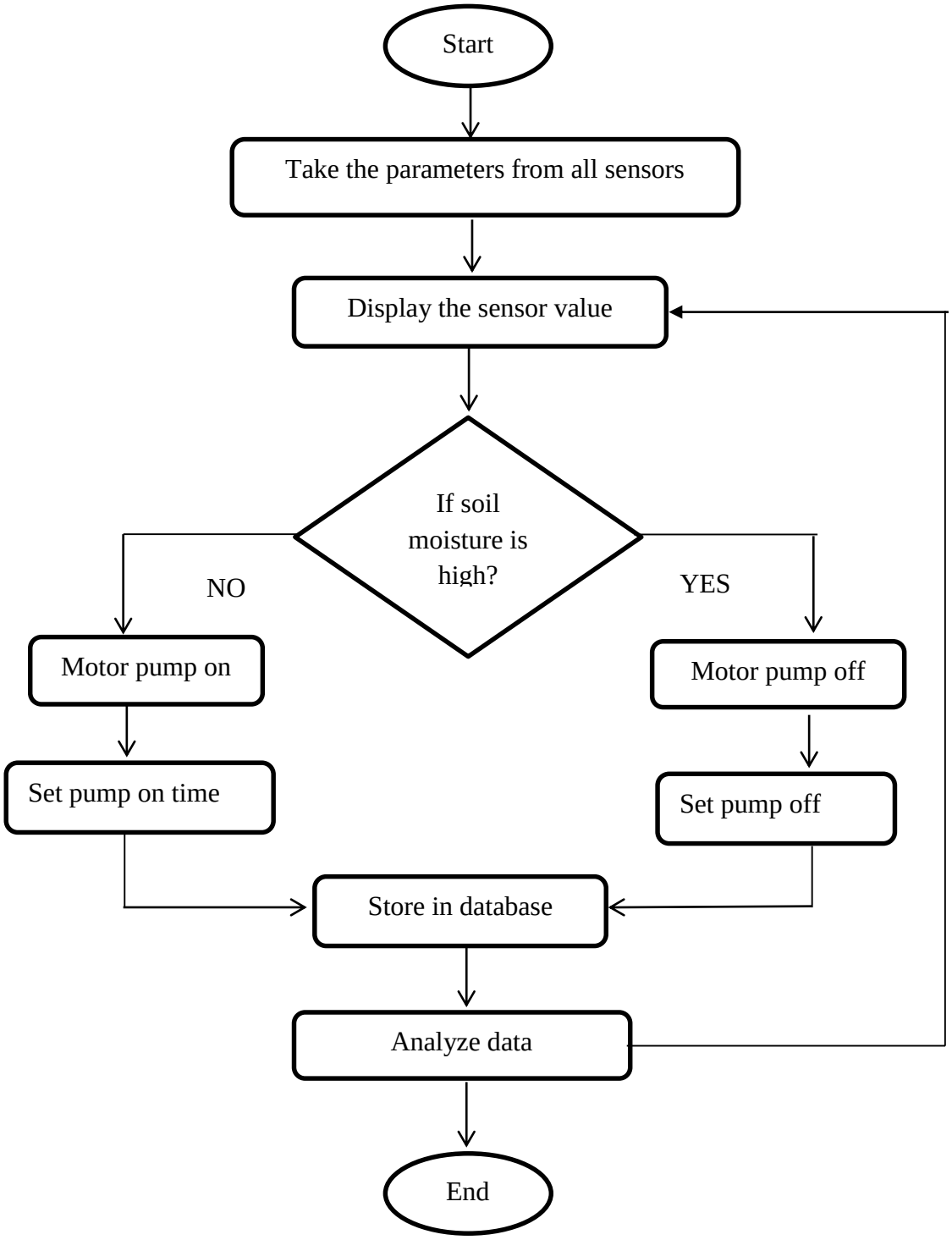

Figure 3.4.7: Flow Chart of Smart Agriculture System [8]

3.5 Implementation Requirements

For implementation of the project to our real life many components, hardware, software are required. We have study on this field and find out the requirements. As our project is Internet base (IoT), so where there is no internet, our device will not work properly. There is another option to use GSM (Global System for Mobile) module instead of NodeMcu or Esp8266 Wi-Fi module, where there is no internet to store data in online server. Our device working voltage is 5V. If power source fault is occurred then some data will be missing to store database. We made a visualize web application for showing data graphically. It is more user friendly for user [9].

CHAPTER 4

EXPERIMENTAL RESULT AND DISCUSSION

4.1 Introduction

Whatever and how the experiment was but we get some result and that is most important to us. The result define our works. We work hard to do better in getting data from the devices and analyze them and based on the analyzed data we take action to the actuator devices and we succeed. We can control devices from anywhere in the world, we can get data from various device. We can detect unknown person for our home security. We can detect the gas and smoke leakage and take action against it.

One of the crucial challenges of water management, as well as conservation in a city, is to determine the amount of water that any particular city is going to utilize during the next day. This can be calculated to precision with the use of predictive analytics. This is done by keeping a track on the history of water consumption in the city on any given day. When we know the amount of water that is required for overall consumption in a city on any given day, it becomes easy for the water authorities to maintain the level of water in a water reservoir/ tank and then pump the water into overhead tanks as required throughout the day. Based on the historical data collected and analyzed by predictive analytics and combined with the weather in that city, authorities can determine suitable crops in a particular season

4.2 Experimental Result

After doing lots of study and research we found the appropriate result that we can send data from sensor to the server and server to the sensor. We can analyze the data which is read from the sensor and made the system automated. Here some of our result which we get from the research,

- We can control home appliance from long distance, no more Bluetooth or short distance
- We can get and monitor data

- Our home appliance are become automated based on the sensor data
- We can do anything by using amazon web service and we can control things using alexa smart home assistant with voice command.
- Even we can talk or gossip with amazon alexa.
- If we want we can override the automated appliance via our main server
- No more gas leakage, No more smoke and fire it will notify us and automatically shut down the gas switch.

The IoT based water monitoring data are analyzed to measure their performance metric in terms of accuracy as well as response time. During the experimental design, the distance between the water and ultrasonic is converted into centimeters (cm Higher water level will indicate as danger level and trigger the buzzer alarm configured as part of the proposed system. the result of the water level detection on distance versus time taken during the sampling periods.

4.3 Descriptive Analysis

We are becoming increasingly dependent on the internet to improve our daily lives. Life is no longer limited to remote control or Bluetooth system now. We are now becoming the part of global village. We can control, monitor or analyze a device with the help of the internet from anywhere in the world. It doesn't matter today how the distance is. With the help of IoT we can almost do anything that we want.

As water flows, the usage of water is sent to cloud and through cloud sent to mobile application, the application will be the update for user to know how much of water they have utilized and how much extra charge they will pay for extra usage of water which is set value for all users. Agriculture system analysis device will read all sensor value then it will send it to the online database. This data will show in graphical view. Using this data farmer will get more accurate weather information

Our study and research given us the opportunity to make our city smart. A smart city have plenty of smart home device connected through internet and the server is the brain of the system. Using this server we can get the data, we can control and monitor the home devices. We can make an ordinary home to smart home with automation system

with the IoT. The server will collect the data and status of the device and the environment from the sensor and store the data to the main server's database and we can do anything based on the data to the device. We can control any kind of switch, device or home appliance, we can monitor the environmental temperature or the surveillance system from the server. So this is how we can implement IoT and develop our smart city.

4.4 Summary

Our study has been proposed the idea of IoT implementation for smart city development can support lots of city to make theme smart with smart home automation, smart water and weather management system etc. This project can help people to stay safe and secure in their home and outside also. Smart home automation of this project will ensure that as the features of home automation are limitless.

We will build an IoT based Smart Water Monitoring System that can detect the flow of water and record the volume of water that flows through the pipe for a given period of time. The data is then sent to the cloud for storage and analysis. By placing this system in a smart building, we will be able to collect and analyze the water usage patterns of the residents and save a lot of water from wastage.

IoT based agriculture system can be useful for monitoring, tracing and manage the remote location valves and meters. In conventional systems a person is employed for such remote location management. The aim is to focus on various applications of IoT in agriculture system which reduces the human effort and overcome the drawbacks in the conventional system.

CHAPTER 5

SUMMARY, CONCLUSION, RECOMMENDATION AND IMPLICATION FOR FUTURE STUDY

5.1 Summary of the Study

To build a smart city research and study is a must. With study we find out the basic needs of the smart city then tried to analyze the problem, how we can get the data from the sensor and how we utilize the data in the server and make them valuable to us. Now we can get the data from various device and based on the data we can take action and control them. We ensure the security and safety of smart home and make them automated.

By this project, it can be hoped that as stated in the aim of this project that using this setup, we can measure the accurate water usage efficiently. And as living beings are facing the problems of inefficiently the usage of water, humans can minimize the wastage by optimizing the usage of water in an opulent manner. The technology used in designing has development board and the sensors, which is sui generis and efficient.

In every part of the agriculture system, IoT can be utilized to manage all resources better and reach efficient and optimal results.

5.2 Conclusions

As we have very much interested on the field of internet of things this was the major motivation to us that we have to figure it out how all the sensor, device, server are works, and now we got this. A detailed study on Internet of Things and Predictive Analytics is made and its relevance in the context of Smart City has been discussed. Different technologies that can be used for a Smart home automation, Smart water management system and Smart Agriculture system is also discussed. A study has been made on various IoT based cloud platforms. A design for a cost-effective Internet of Things based Smart City has been proposed.

In this paper, we have been discussing about the elements of smart city. We have used ESP, Ultrasonic and various sensor which reduces cost effectively and makes this project economical. Also, this project doesn't require any special or different system to successfully implement this project.

5.3 Recommendation

The field of internet of things is spacious and the recommendation sectors of IoT in smart city are also spread. We have study and research our project from different stage and different point of view. We can use this project not only controlling and monitoring device but also we can get data from the sensor and use the data to utilize more resource and power. In our daily life those data can be more valuable to us and we can utilize our resource. So we can use the system in home automation for building smart city.

This project has enormous applications. It can be installed in the following areas:

1. Private houses or bungalows

2. Housing societies

3. Apartments

4. Institutions like schools and colleges, hostels

5. Hospitals

6. Offices

7. Municipal overhead tanks (with slight changes in hardware)

5.3 Implication for Further Study

We had to study very hard to knew about the sensor, device and the software and how the works together. We have succeed but as our project was research based project we could not implement all the device with our real life. In future we will study about more device and more features

Some of them are as followed,

- Will be available in mobile applications although it can be access via mobile browser

Our IoT based water management system solution is now developing step. We will try to build a product so that we can keep an inescapable step for water problem solution. This project when developed on a larger scale can be practically implemented in the Municipal Corporation of any village, town or city. The same system can be implemented for automated town electricity management system.

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APPENDICES

Appendix A:

Source Code: Home Automation

```
#include "DHT.h"
#include <WiFiEspClient.h>
#include <WiFiEsp.h>
#include <WiFiEspUdp.h>
#include <PubSubClient.h>
#include "SoftwareSerial.h"
#define WIFI_AP "Sky_Net"
#define WIFI_PASSWORD "astra1234"
#define TOKEN "YOUR_ACCESS_TOKEN"
#define DHTPIN 4
#define DHTTYPE DHT22
char thingsboardServer[] = "192.168.0.10";
WiFiEspClient espClient;
DHT dht(DHTPIN, DHTTYPE);
PubSubClient client(espClient);
SoftwareSerial soft(2, 3); // RX, TX
int status = WL_IDLE_STATUS;
unsigned long lastSend;
void setup() {
  Serial.begin(9600);
  dht.begin();
  InitWiFi();
  client.setServer( thingsboardServer, 1883 );
  lastSend = 0;
```

```
}
void loop() {
  status = WiFi.status();
  if ( status != WL_CONNECTED) {
    while ( status != WL_CONNECTED) {
      Serial.print("Attempting to connect to WPA SSID: ");
      Serial.println(WIFI_AP);
      status = WiFi.begin(WIFI_AP, WIFI_PASSWORD);
      delay(500);
    }
    Serial.println("Connected to AP");
  }
  if ( !client.connected() ) {
    reconnect();
  }
  if ( millis() - lastSend > 1000 ) {
    getAndSendTemperatureAndHumidityData();
    lastSend = millis();
  }client.loop();
}
void getAndSendTemperatureAndHumidityData()
{ Serial.println("Collecting temperature data.");
  float h = dht.readHumidity();
  float t = dht.readTemperature();
  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
return;
```

```
  }
  Serial.print("Humidity: ");
  Serial.print(h);
  Serial.print(" %\t");
  Serial.print("Temperature: ");
  Serial.print(t);
  Serial.print(" *C ");
  String temperature = String(t);
  String humidity = String(h);
  Serial.print( "Sending temperature and humidity : [" );
  Serial.print( temperature ); Serial.print( "," );
  Serial.print( humidity );
  Serial.print( "]   -> " );
  // Prepare a JSON payload string
  String payload = "{";
  payload += "\"temperature\":"; payload += temperature; payload += ",";
  payload += "\"humidity\":"; payload += humidity;
  payload += "}";
  char attributes[100];
  payload.toCharArray( attributes, 100 );
  client.publish( "v1/devices/me/telemetry", attributes );
  Serial.println( attributes );
}
void InitWiFi()
{ soft.begin(9600);
  WiFi.init(&soft);                                  // check for the presence of the shield
  if (WiFi.status() == WL_NO_SHIELD) {
```

```
    Serial.println("WiFi shield not present");                    // don't continue
    while (true);
  }Serial.println("Connecting to AP ...");        // attempt to connect to Wi-Fi network
  while ( status != WL_CONNECTED) {
    Serial.print("Attempting to connect to WPA SSID: ");
    Serial.println(WIFI_AP);                      // Connect to WPA/WPA2 network
    status = WiFi.begin(WIFI_AP, WIFI_PASSWORD);
    delay(500);
  }Serial.println("Connected to AP");
}
void reconnect() {
  while (!client.connected()) {
    Serial.print("Connecting to ThingsBoard node ...");
    if ( client.connect("Arduino Uno Device", TOKEN, NULL) ) {
      Serial.println( "[DONE]" );
    } else {
      Serial.print( "[FAILED] [ rc = " );
      Serial.print( client.state() );
      Serial.println( " : retrying in 5 seconds]" );
      delay( 5000 );
    }
  }
}
```

Appendix B:

Source Code: Agriculture and Water Management

```
#include <ESP8266WiFi.h>
#include <dht.h>
const char* ssid     = "Avengers";
const char* password = "chapai12345";
const char* host = "onlinesendreceive.000webhostapp.com";
int outputpin= A0;
dht DHT;
#define DHT11_PIN 2
#include <DallasTemperature.h>
#include <OneWire.h>
#define ONE_WIRE_BUS 4                    //D1 pin of nodemcu
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);      // Pass the oneWire reference to Dallas Temperature.
void setup() {
  Serial.begin(115200);
  delay(100);
  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
```

```
    Serial.print(".");
  }
  Serial.println ("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
  Serial.print("Netmask: ");
  Serial.println(WiFi.subnetMask());
  Serial.print("Gateway: ");
  Serial.println(WiFi.gatewayIP());
  sensors.begin();
}
void loop()       //main loop
{Serial.print("connecting to ");
  Serial.println(host);
  WiFiClient client;
  const int httpPort = 80;
  if (!client.connect(host, httpPort)) {
    Serial.println("connection failed");
    return;
  }String url = "/info.php?request=10";
  Serial.print("Requesting URL: ");
  Serial.println(url);
  client.print(String("GET ") + url + " HTTP/1.1\r\n" +
               "Host: " + host + "\r\n" +
               "Connection: close\r\n\r\n");
  delay(500);
```

```
 while(client.available()){
   String line = client.readStringUntil('\r');
   Serial.print(line);
 } Serial.println();
 Serial.println("closing connection");
 delay(6000);
 int analogValue = analogRead(outputpin);
 float millivolts = (analogValue/1024.0) * 3300;
 float celsius = millivolts/10;
 Serial.print("in DegreeC=   ");
 Serial.println(celsius);
 float fahrenheit = ((celsius * 9)/5 + 32);
 Serial.print(" in Farenheit=   ");
 Serial.println(fahrenheit);
 delay(1000);
 int chk = DHT.read11(DHT11_PIN);
 Serial.print("Temperature = ");
 Serial.println(DHT.temperature);
 Serial.print("Humidity = ");
 Serial.println(DHT.humidity);
 delay(1000);
 sensors.requestTemperatures();              // Send the command to get temperatures
 Serial.println("Temperature is: ");
 Serial.println(sensors.getTempCByIndex(0));
 delay(500);
}
```

Appendix C:

Project Works

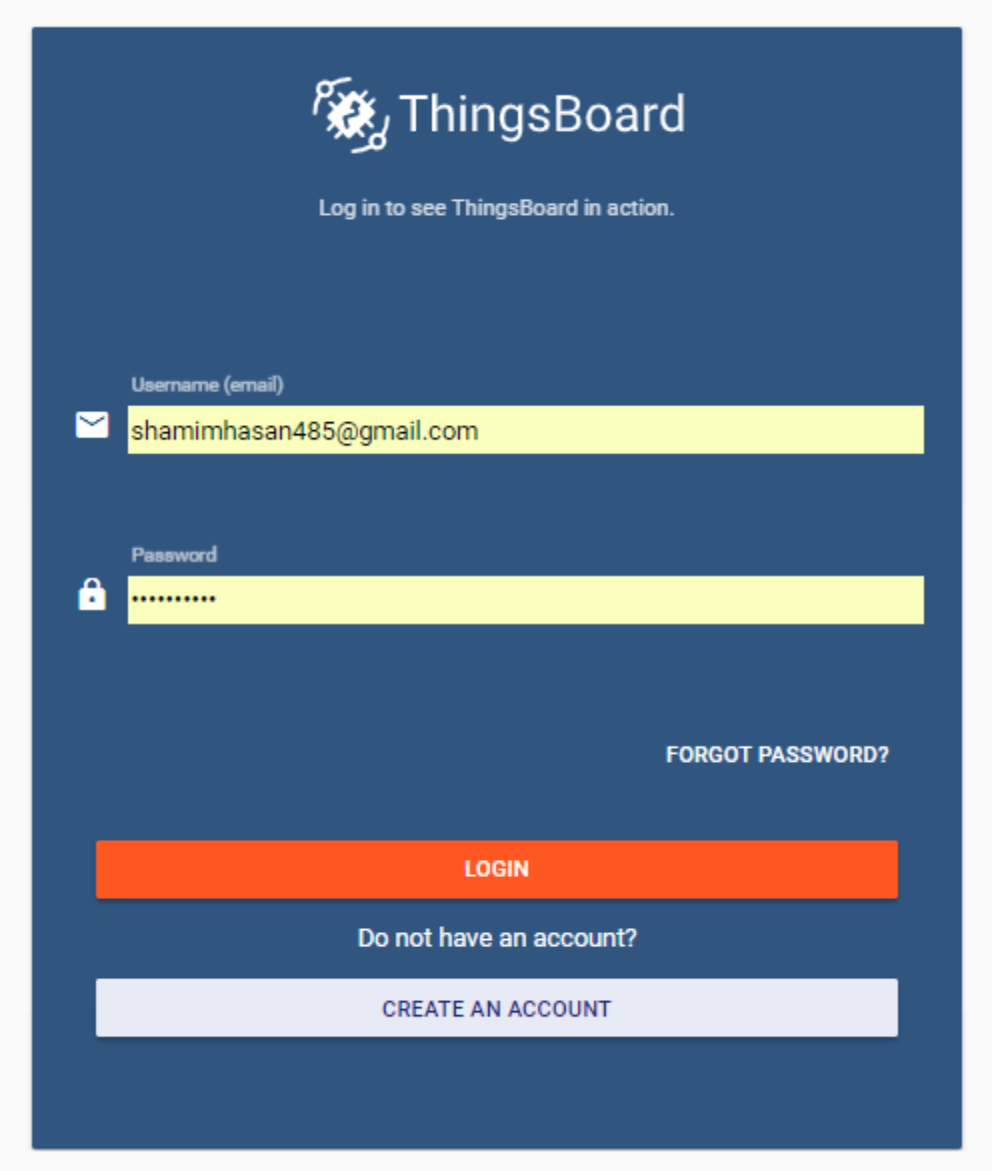

Figure C1: Login Panel of the IoT Server

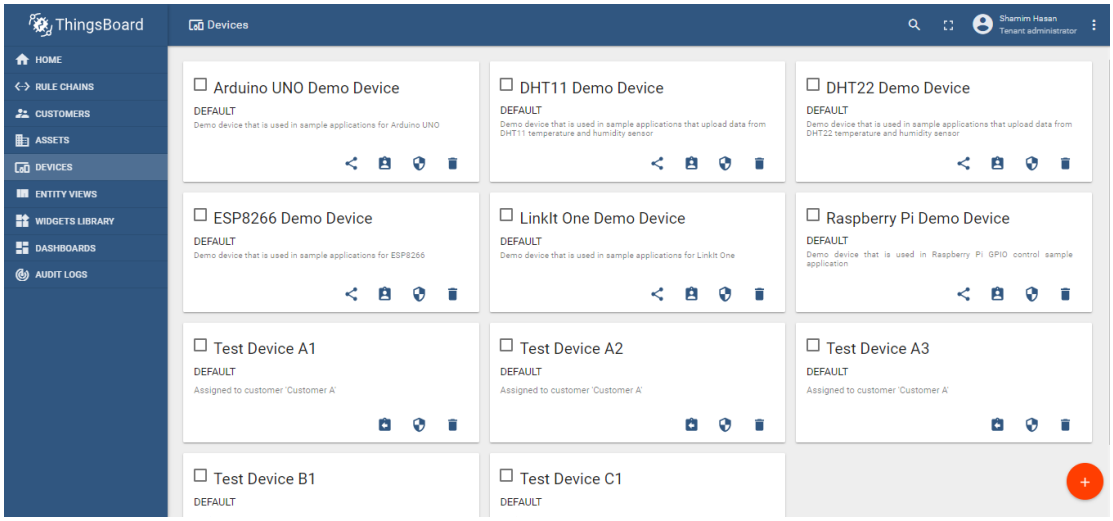

Figure C2: All Device Management Dashboard

Figure C3: Device Status and data visualization in Dashboard

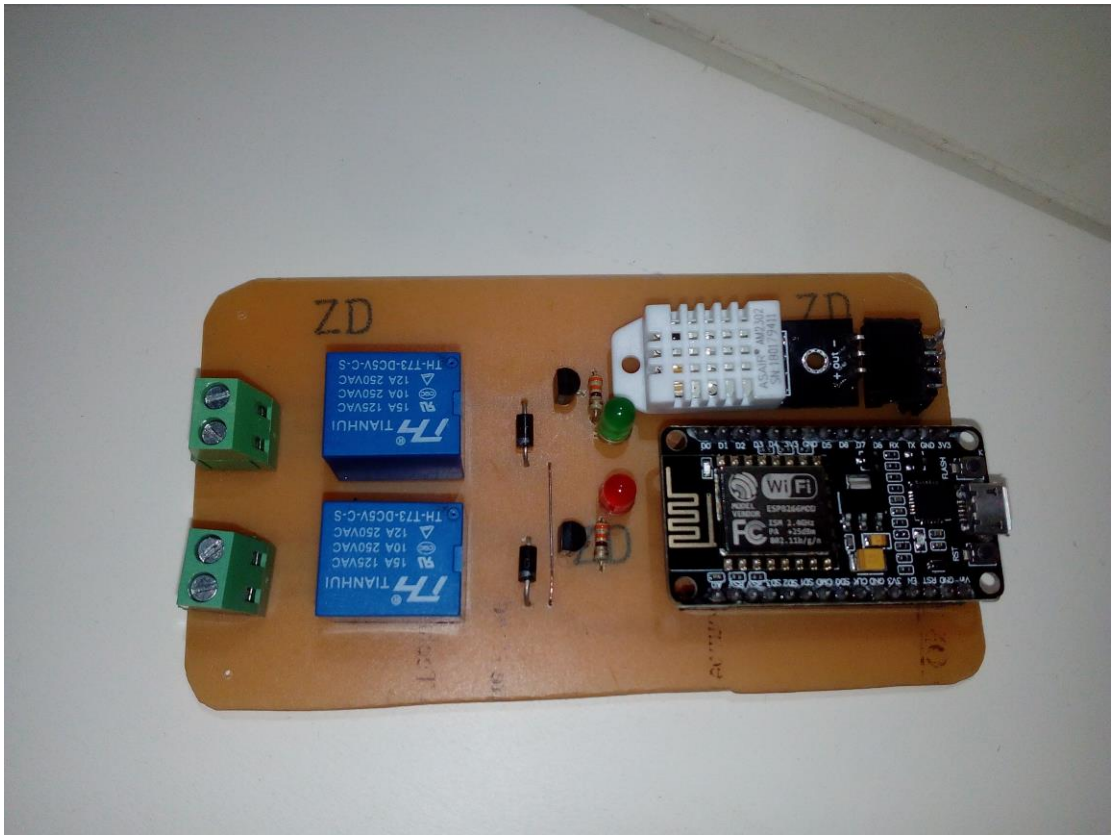

Figure C4: Temperature and humidity relay prototype circuit

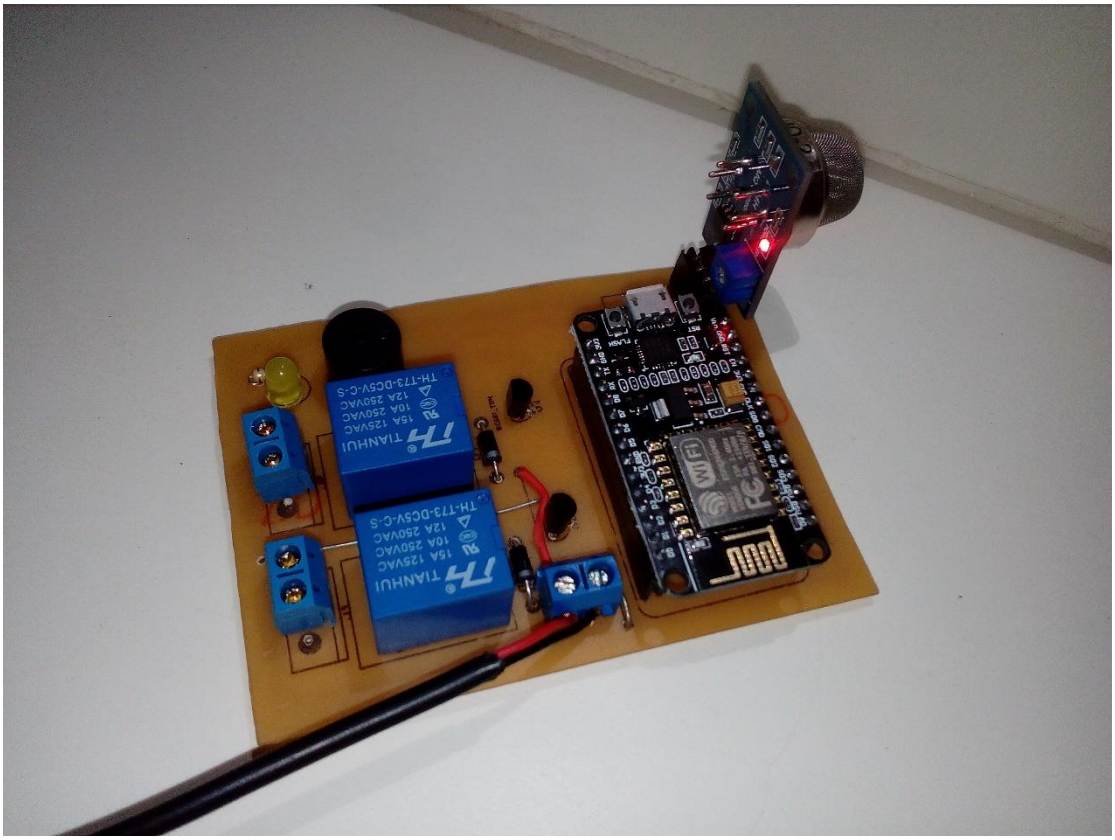

Figure C5: Gas leakage Detector prototype

Figure C6: Automated water management system for smart home

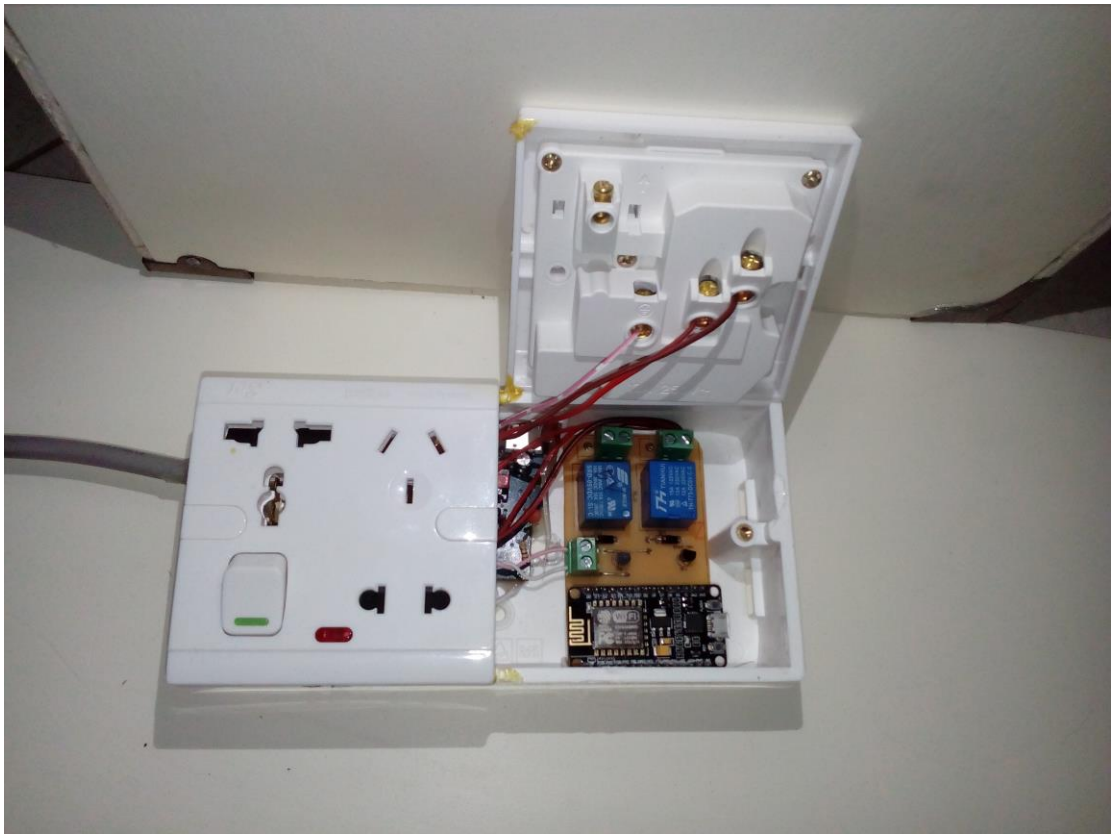

Figure C7: Smart multi plug for alexa home automation

Figure C8: Smart fingerprint lock for home security

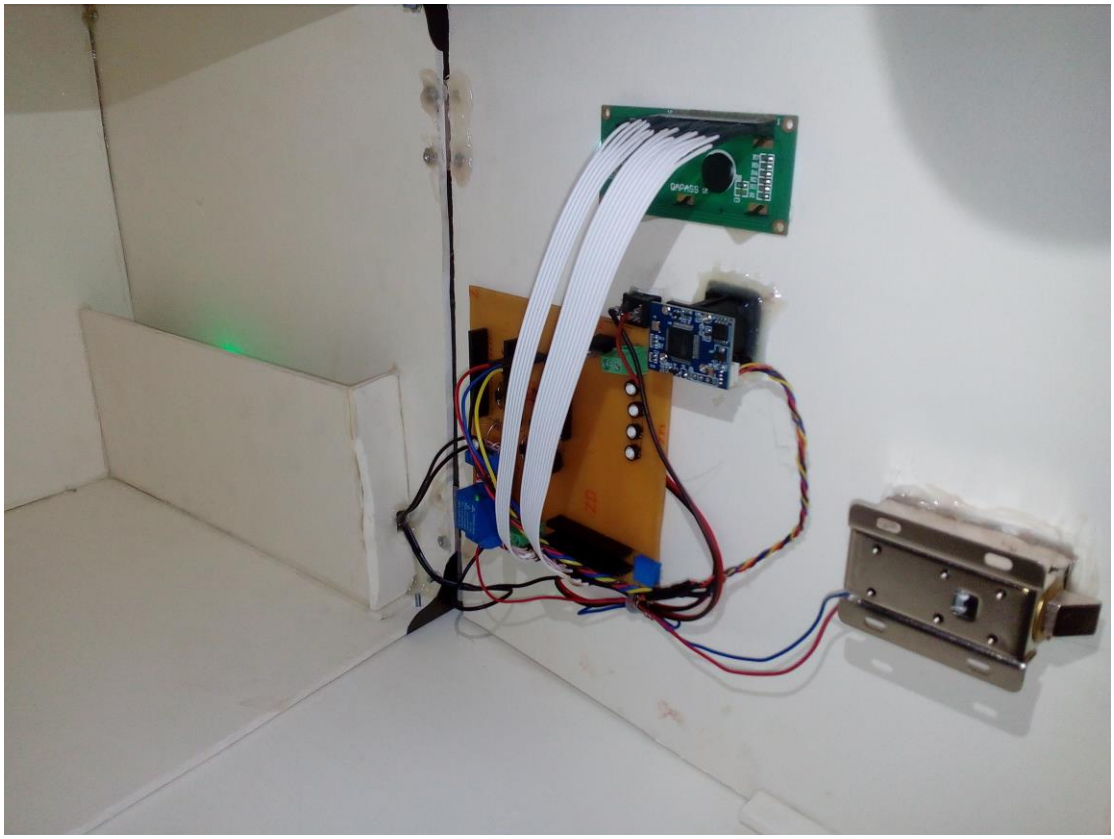

Figure C9: Inside of smart fingerprint lock

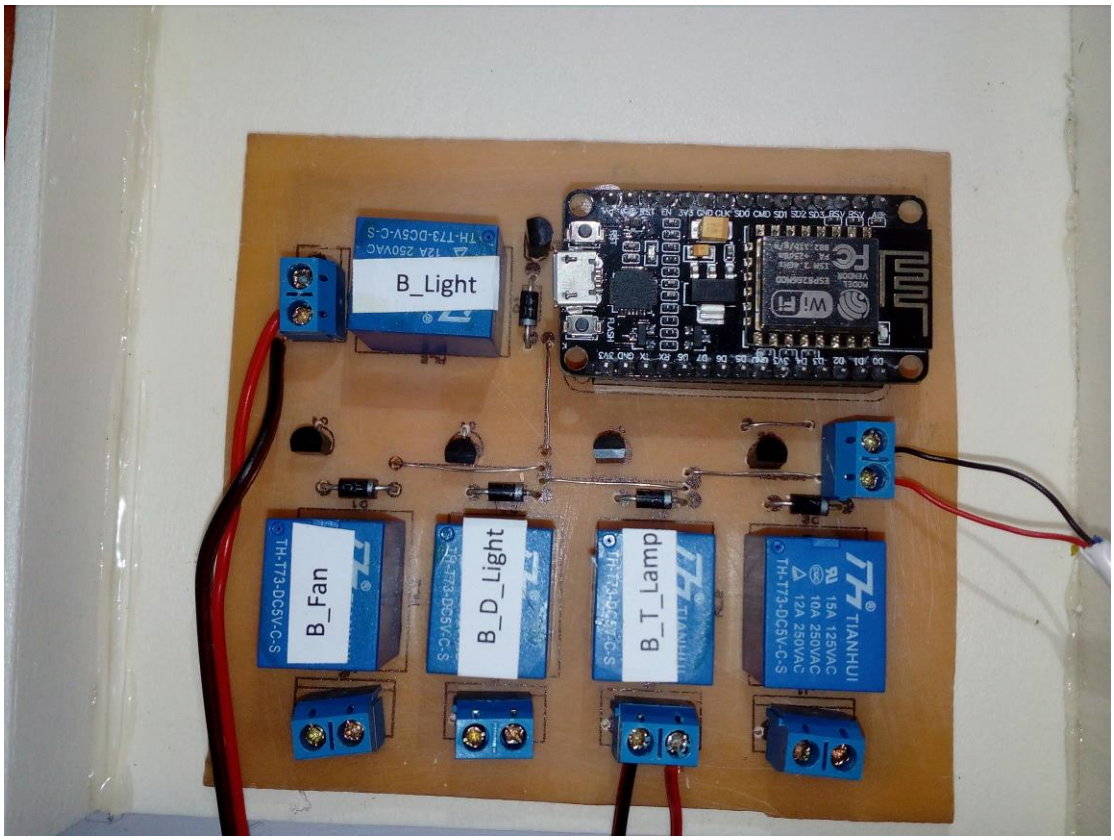

Figure C10: Alexa controlled NodeMcu relay board prototype

Figure C11: Dashboard for agriculture and water management system

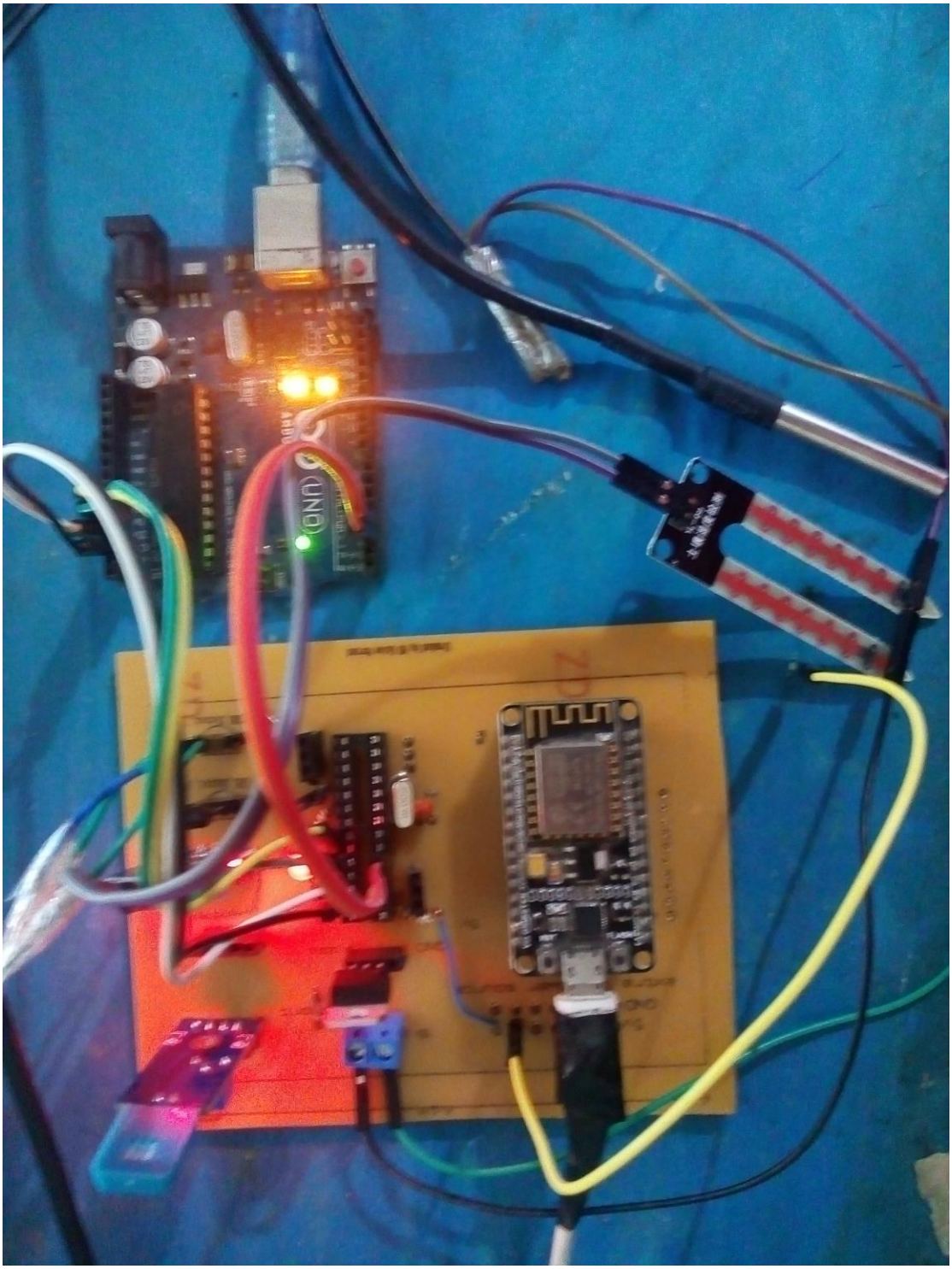

Figure C12: Hardware for agriculture and water management system