Low Cost IoT Based Green Home

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

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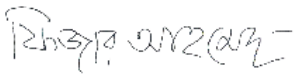

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We hereby declare that, this project has been done by us under the supervision of **Mohammad Jahangir Alam, Lecturer, Department of CSE,** Daffodil International University. We also declare that neither this project nor any part of this project has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

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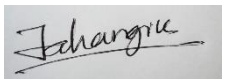

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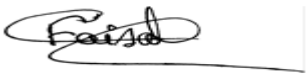

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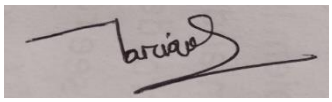

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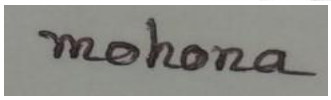

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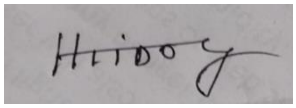

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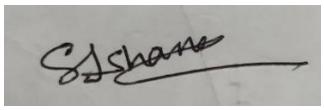

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We are really thankful and wish our profound our indebtedness to **Md. Jahangir Alam**, **Lecturer**, Department of CSE, Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "*Internet of Things*" to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to Dr. Syed Akhter Hossain, Professor and Head**,** Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patience of our parents.

ABSTRACT

Our idea is to make a green home containing IoT advantages, at low cost comparatively. This project represents the design, model, structure, program, management and evaluation of our idea. We are working on the facts of smart parking which can allocate our land properly and make the best use of it by multi floored parking, ensuring security and privacy by multiple alarms and authentication with advanced components, preventing wastage of electricity as we can operate them by not being at home through our mobile phone, making smart farming available and that can help us to be with nature as with the urbanization we are losing that touch of nature.

Basically, we are attempting to live a modern and secured life with the use of modern technologies and make the accurate use of our properties. So, we are going to make a home which will be green enough with the touch of smart farming and comfortable and safe with all the advanced technologies and low costed comparatively.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Modernism and technology are heading away with a remarkable agility and with the advancement of these terms, mechanization has occurred to be a part of our lives. Now-a-days we expect the possible best scenario for our living. As a result, term like living comfortably with the use of technology is no longer a luxury rather it's smart choice. If it's possible to have facilities like automation, smart parking, smart gardening and proper security under the same roof and also in a low price comparatively, that's something we all can be excited about and that can also make our life easier. That's why we have taken the targets and by combining them together, we have built a very comfortable and modern home for us. At a time, urbanization has driven us away from the touch of nature. It is a small step also to be in the touch of nature by having the opportunity of smart gardening.

It is not something that unique that we haven't heard before but we are presenting all the features together which is an attempt of dictation. We are providing all these together and that's why it is well-organized and lower costed as well. Developed countries are already living their lives in this way from quite a time. Ours one is also being digitalized day by day. So, it's better to be late than never. Simultaneously we don't need to export components rather we have built it and that's why we can provide this at low cost comparatively.

1.2 Motivation

We need to make the best use of our things which is possible by combining with the internet to cope with the digitization of era. By using our system, we ensure proper use of our space/land for parking and even farming which is getting affected by urbanization gradually. Our system also concerns about best usage of electricity and it provides high security (fire alarm, smoke alarm, incompetence interference and so on). Basically, we are doing this project to cope with the modernization and making our life more comfortable and easier and updated.

1.3 Objective

Our objective is to solve various problems through our system like:

- Parking area consumes a lot of our space. Our system will park a lot of vehicles in a small space by allowing multi floored parking.
- Security issue will also be considered by using several alarms and authentication.
- Wasting electricity is going to be shrank by using automation in utensils like fan, light etc.
- With the urbanization farming is being rare and we are losing touch with nature. Our system will provide farming availability on the rooftop so at a time farming and urbanization both are not affected and we can be in touch of nature.

1.4 Expected Outcome

Finally, this system execution will be evaluated by multifloored parking opportunity to proper utilization of space. Ensure high security by RFID card for authentication, several alarms like fire alarm, smoke alarm, laser protection for preventing incompetence interference. Automation of room staffs to prevent waste of electricity (switching lights, fans etc.). Farming availability like watering and balancing temperature. In fine, we are going to have a proper digitized green home in low costed comparatively

1.5 Report Layout

This report of ours presents everything about our work. We have arranged it in six various parts to represent our idea properly.

The Primary Part shows Presentation, Inspiration, and Expected outcome. So, it provides the basic idea of our attempt.
The Second Section depicts about background history and related works. That's why we can get the difference of our one's in comparison with the previous versions.

The Third Section portrays Determination and Specification of the prerequisite elements of our work and the purpose why we have used them.

The Fourth part depicture the structure through various models and designs.

The Fifth Section portrays the usage and outcome of the complete assignment.

Section Six portrays the conclusion and the future opportunities.

CHAPTER 2

BACKGROUND

2.1 Introduction

This project of ours is a representation of the most talked term in the field of technologies of current time, **"IoT** which is **'Internet of Things'."** Though this concept is aged by around 22 only, the actual thought had been practiced in 70's even, which was about connected devices. It used to name then "embedded internet" or "pervasive computing". However, the veritable term of "Internet of Things" was raised by Kevin Ashton while his assignment at Procter & Gamble in 1999. During the practice of supply chain optimization, he expected to gain senior management's deliberation to a unique exciting technology which is called by RFID. As the internet was buzz word in 1999 and somehow the term corelates, he named his portrayal "Internet of Things." Though he succeeded to attract attention but the term was still neglected for many years [1].

Hence, smart home technology utensils became receivable to consumers between 1998 to early 2000s.User could control and monitor their home using smart devices like smart phone, smart home apps or other networked devices. Smart gardening is highly popular as click & grow term. APS (automated parking system) was proposed in 1905 in Paris and the idea is to park more cars in less spaces.

2.2 Related Work

Our assignment is not something we haven't heard before. There remains plenty of works and experiments regarding this. Report says, at the time of 2018 the number of IoT devices were & billion while during 2020 the number is estimated to be 31billion and we are also a part of the number. There are various companies who are working with home automation like *August Smart Lock* which provides automated locking system for a home at a huge price range, *Notion* which combines terms like alerting for door open, water leaking, lights on/off and mane more. There are plenty of others like these companies [2].

Smart gardening is also provided by companies like *Agrilution* which grows herbs,

salad, green leafy etc. completely in automated way, *AVA Technologies* uses seed pots and software to produce plants. Smart garden technology is also provided by various teams [3].

There are many startup companies were noticed till 2017 who work with smart parking system. *SpotHero* is one of them which provides services on online and offline both and user can reserve their place on it. Again, *ParkiF*i uses sensor to make know the consumer whether parking slot is available or not and we are also providing this feature in ours project. The number is quite long and provide different type of features [4].

So, we can see that many different companies around the world provide features similar to us partially but not entirely. We are combining them together as a package and providing at a low cost comparatively in our country.

2.3 Comparative Studies

We can say that we are introducing the package idea to our country. There are many companies in our country like *MicroDreamIT, Datasoft, Ascii System* and many more. *Robi intelligent solutions* is also improving [5]. In spite of being a known topic, no one has come up with all the features together like us and in our price range. We are providing home automation, smart gardening, smart parking all at a time and we are not compromising with the quality. We have studied, reviewed papers on this topic and able to build our own equipment which will ensure user's comfort.

2.4 Scope of the Problem

If we look at the statistics of penetration of IoT technology, we can see that by 2025 it is assumed that the number of IoT devices will be more than 75 billion connected with the web. We can guess that the world is paying huge attention on this area so we might not lack behind. If we talk about the revenue for the IoT market, in 2016 the cost was $737billion while the assumption for 2026 is estimated to be $1.1 trillion.[6]. So, it's not wise to ignore this market place and its chances. We will need to face a lot of issues

to set up our project. There remains scope of device and driver inconsistency and there requires a vast library to connect sensors with smart devices without including third party module. The sensors and devices will use duplicate data themselves.

2.5 Challenges

Power Supply is a huge challenge to run the whole system. We cannot use more power that can ruin our work again we can't apply less power because that will not make our intension fulfilled. We need to provide the particular amount which is challenging enough. We have used alternatives for that purpose. Maintaining smoothness is also a big issue as we cannot wait for long that will make our project a lazy one. We need to be speedy on real time performance otherwise our performance will be a poor one. There must not any compromise in performance in a good assignment. With all these we are providing a lot of data in our project so security is a concern here. Our passwords might not weak or guessable or hardcoded. We must ignore insecure and unnecessary network services. Our device management must be organized and default settings must be proper. The server may cause problem in our project also and that can create device failure.

CHAPTER 3

DESCRIPTION OF COMPONENT

3.1 Introduction

For our project, hardware section has played a vital role. We have used various kinds of components to form our idea to be a structure. We are providing various features through our work like smart parking, smart gardening, smart home. For each of the feature we needed to play with several utensils. For smart home, there's facts like switching fan/light or maintaining temperature or preventing incompetence interference and that is the output of combinational success of equipment. For smart gardening or parking the same process has continued.

3.2 List of Components used in Circuit:

In this table, we are providing the list of the components of our project and the number of amounts which has been used for them. All these are being shown in the table 3.1.

Table 3.1: List of Components used in Circuit

ITEM	NEEDED	Usage
Arduino UNO	1	To simulate code.
LED Display (16*2) & i2c driver	1	Displays the result.
Temperature & Humidity Sensor (DHT-11)	1	To know room temperature & humidity.
Motion Sensor (PIR sensor)	2	Switches light on/off detecting human motion.
Soil Moisture Sensor	1	Provides idea on amount of water in soil and gives analog output.
Flame Sensor	1	Used in flame alarms. Provides analog output
Gas Sensor (MQ-5)	1	For gas leakage detection. Can detect H2, LPG, CH4, CO

Smoke Sensor (MQ-2)	1	Detects the absorbency of combustible gas in the air and outputs digital value.
Sonar Sensor	1	By using sonar determines distance.
RFID Card & Reader (RDM6300)	2	Used in home for identification and in parking, user's car will be come down by provided reading when parking by it.
LED	3	For ensuring different scenario.
Servo Motor (mg996r)	2	Used for open/close door of home and in parking it can rotate the belt.
DC Pump	1	To provide water in the root of cultivators.
Pulley	8	To make smooth the performance of timing belt & prevent it from slipping.
Timing Belt	1	To prevent belt slipping.
DC Cooler	1	It has been used as a demo for electronic fan.
Adapter 9V	1	Supply voltage.
NodeMCU	1	Contains ESP8266 built in. Connects Wi-Fi and provides value to database.
Relay	5	Can turn on/off the fan.
Jumper wires	100	For connection.

3.3 Arduino Nano

The Arduino Nano is small and subjected to the Microchip ATmega328P (Arduino Nano

V3.x) Microcontroller board which is developed by Arduino.cc. It is consistent, flexible and breadboard friendly. It is widely used is various projects of robotics and embedded system especially where automation is a must part. It is smaller than Arduino UNO but provides the same functionality. Its operating voltage is 5V though input voltage varies from 7V to 12V. It contains 14 digital pins of them 8 analog pins, 2reset pins & 6 power pins. Though these digital & analog pins main function is to configure input or output, they are assigned with multiple functions also. While interfaced with sensors they are acted as input. It has a crystal oscillator of 16 MHz. It can't take external power from battery. We have used it in our work as a simulator of code. The devices which don't need to be online have been runed by Arduino like we have switched on/off the light of corridor through it. This item is viewed in figure 3.1.

Figure 3.1: Arduino Nano

3.4 Display (16x2)

LCD module is one of those items which are mostly used in various embedded projects. The reason of its being mostly popular is, it is cheap in price as well as programmer friendly and quite available. We all have come in touch of this in our daily life, whether as PCO's or calculator. 16*2 refers that it has 16 column and 2 rows which size has been used for ours one. The display has other size variety like 8*2/8*1 etc. It works between operating voltage 4.7 to 5.3V. It is alphanumeric which says that it can display

alphabets and numbers. Custom generated characters can also be displayed by it. It is consisting of two rows and the rows can print 16 character each. It can work on different mods like 8-bit, 4-bit. It has 16 pin and they provide different purpose. We haven't completed the conditions of displaying so we can't read the value from it now but we will accomplish the task eventually and would be able to read the values from the display. Though we haven't output read from the voltage, it has been acted currently as a decorative part of the circuit which would play role in future. The item is shown on figure 3.2.

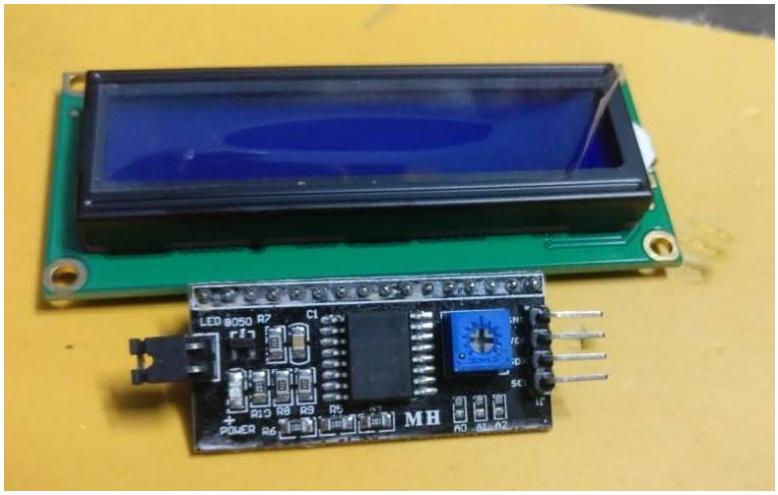


Figure 3.2: LCD display (16*2)

3.5 Temperature & Humidity Sensor

This equipment is popular to measure temperature and humidity for it's being easy in use and low cost. It's a basic sensor and it measures the surrounding air by using capacitive humidity sensor and a thermistor. It spits out on the data pin a digital signal. It provides updated data on every 2 second. It uses 3V to 5V and used as I/O with containing 4 pins. Its sampling rate is 1Hz. Usually 15.5mm*12mm*5.5mm in size. It is suitable for 20-80% humidity readings with 5% accuracy and 0-50 degree C temperature value with +/- 2degree C accuracy [7]. In our assignment we have used this to get our room temperature and humidity value. Item is being presented in figure 3.3.

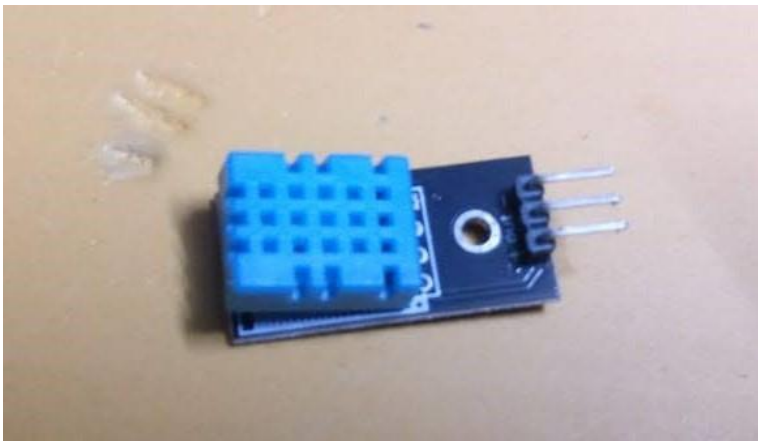


Figure 3.3: Humidity Sensor (DHT11)

3.6 Sonar Sensor

HC-SR04 Ultrasonic Sensor is a module which consists 4 pin and they are Vcc, Trigger, Echo and Ground. This sensor is quite popular in the case of measuring distance or sensing objects and widely used in various projects on this purpose. The module forms Ultrasonic transmitter and Receiver by its two eyes of the front. It works following the formula, Distance = Speed * Time. The device works through ultrasonic wave which is transmits from ultrasonic transmitter. While roaming in the air, if the wave is objected by any material it gets reflected back. This reflection is observed by the ultrasonic receiver module. To have the calculation of distance we need two parameters which are time and speed according to the following law. As it is performing with wave, the speed of it is 330m/s. Time is calculated by the inbuilt circuitry which counts the come back time and for that same particular time turns on the echo pin high for it. So, getting the required terms we can have our required value of distance. It usually measures distance within the range of 2cm to 400cm theoretically but practically the range varies from 2cm to 80cm. and accuracy is around 3mm. It is used in various applications like ignore and find out obstacles in projects of robotics, mapping the objects surround of the sensor, finding depth of places like wells or pits as the wave can act within water also. Its operating voltage is +5V and measuring angle covers <15 degree. We have used this sensor in the stairs of corridor to detect human presence which will assist the lights switching. This module is shown in figure 3.4.

Figure 3.4: Sonar Sensor

3.7 Motion Sensor

PIR sensor is a pyro electric sensor which is able to detect levels of infrared radiation. This sensor is amazing in the area of needing discovering whether an individual has left or entered in a range of are, this area is ranged by 5m-12m, 10m in average. With them we can get flat control with minimal effort and it has a wide lens range, at a time it is simple to interact with. It is a three pined component including ground, signal and power. Power us usually up to 5V. It provides digital output. It is a dual element sensor Which have low noise and high sensitivity. Its delay time is adjustable and it provides Standard TTL output [8]. We have used this for switching on/off light by detecting human motion. We can see the element in figure 3.5.

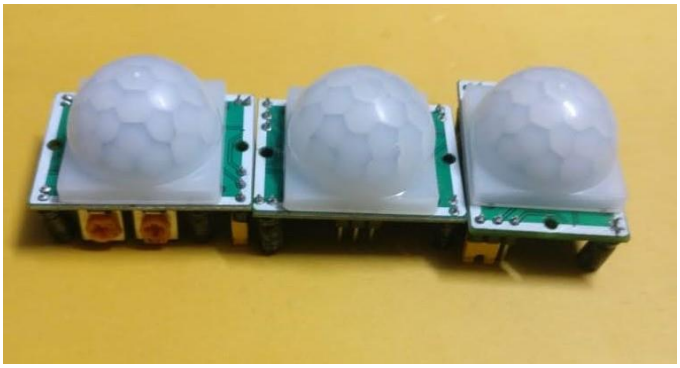


Figure 3.5: Motion Sensor

3.8 Soil Moisture Sensor

This device is used to find out the moisture of the soil. It detects the volumetric measurement of the water inside the soil and provide us the moisture level as output. It can provide both analog and digital output. It contains four pins and they are for work like, the Vcc is for powering the module usually uses +5v, the GND for supplying power ground, the DO digital out pin is for digital output and the AO analog out pin is for analog output. Its operated voltage differs from 3.3V to 5V and operating current is 15mA. Usually 3.2cm* 1.4cm in size and it is flexible to use with microcontrollers and with normal digital/analog IC also. For its being small, cheap and easily available, it is used randomly for different projects of embedded system. We have used it on the root of tree which will made the task easy of pump by providing reading about the quantity of water in soil. So, for smart gardening this has been used in our project. It has been shown on figure 3.6.

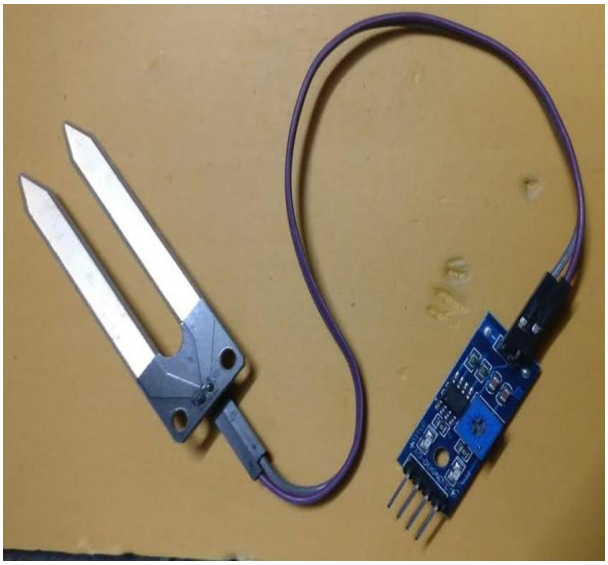


Figure 3.6: Soil Moisture Sensor

3.9 Flame Sensor

A flame sensor is that device which can detect the presence of fire source and any other bright light sources also. There is a black object at the front of the device which is a transistor. The sensor is sensitive to infrared radiation which belongs to the range of wavelength of 760nm to 1100nm. It can be used to detect infrared light up to a distance of 100cm and the angle of detection will be 60 degree. It can be used in various applications like Car or automobile, firefighting Robots, Garage safety or warehouse and so on. It also contains various pins and can provide both digital or analog reading as output. In our work, if there's flame detected by the sensor the user and admin will get notification immediately. The component is shown on figure 3.7.

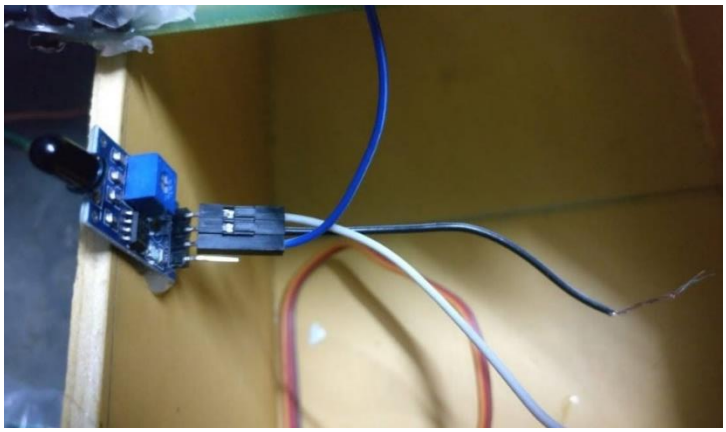


Figure 3.7: Flame Sensor

3.10 Gas Sensor

MQ-5 gas detection sensor is a sensor that can detect various gas like LPG, Propane(C3H8) and Methane (CH4) gas in the range of 100 ppm ~ 3,000 ppm.
For it's this particular characteristic it is widely used for domestic gas leakage alarm as a portable gas detector. The sensor is Semi- conductor in type. Its supply voltage is 5V and it provides digital and analog output. It has three pins like Vcc, GND & Input Pin. We have used it in our home to detect if there is any leakage of gas. If such thing occurs then it would provide danger signal which is turning on the Red LED and user would get notification on their android app and website. This sensor is shown in figure 3.8.

Figure 3.8: Gas Sensor (MQ-5)

3.11 Smoke Sensor

MQ-2 has been used here as a smoke sensor. This equipment can detect gas and smoke both but as we have used a different gas sensor for the purpose of detecting leakage of gas, its purpose is to detect smoke only in our work. It provides digital value as output but I can be used as both digital or analog sensor. Its operating voltage is +5V and pre-heat duration takes time of around 20seconds. It would provide alarm while excessive smokes exist around. By controlling sensitivity, the quantity of the smoke can be determined. We will use it mainly in our kitchen but for now in our demo it has been arranged with the other sensors in a room. Being shown on figure 3.9

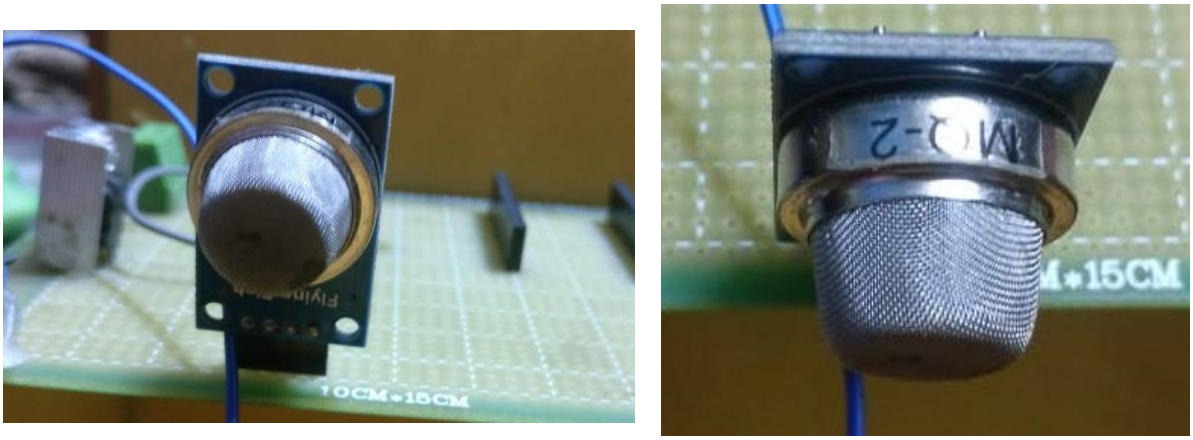


Figure 3.9: Smoke Sensor (MQ-2)

3.12 RFID Card & Reader

RFID card uses radio frequency identification technology and thus do not directly contact with the card rather uses antenna built in it to communicate. By this antenna, the communication between card and reader is happened and card can get the reading and writing of card through it. This card is used in various kinds of applications like used as parking cards, several electronics passports, identification and many more. It is of various kinds of frequencies like low frequency, high frequency and ultra-high frequency [9].

RFID system generally consists of four major components like Readers, Antennas, Tags and Cables. An RFID reader or interrogator can be called the brain of the whole system and without it the function can't be processed. This device receives and transmits radio wave for the sack of communication. The types of readers are different on the determining terms like connectivity, antenna ports, processing capabilities etc. But mostly they are categorized either fixed or mobile reader. There is various type of readers like Cellular RFID readers, Integrated RFID readers, Wi-Fi RFID readers etc. We have used it for identification on door for room and also in parking as user will need this while parking and would be able to see the compartment in which the car is and by showing RFID card the car will come to down automatically. This product is shown on figure 3.12.

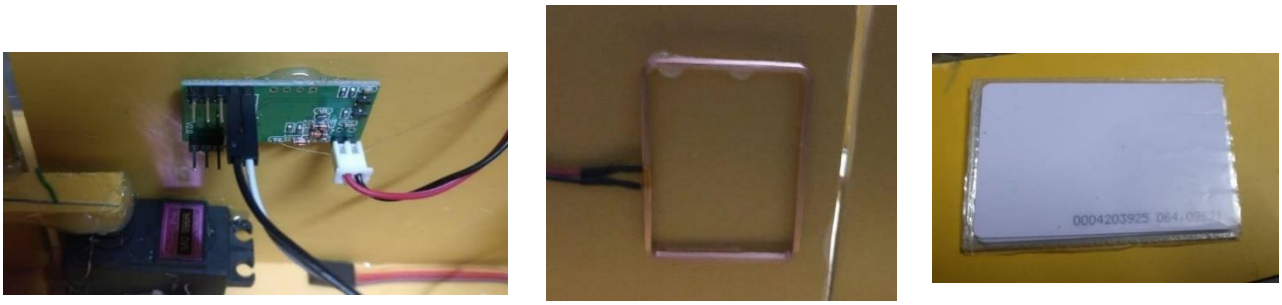


Figure 3.10: RFID Card & Reader

3.13 LED

An LED is a two-lead semiconductor source of light which casts light when activated. When a required voltage is applied to the LED terminal, the device releases energy in the forms of photons. It is usually 5mm round. Its forward voltage is 1.8V to 2.4V and reverse voltage is 5V and forward current is 30mA. Its operating temperature is -30 degree C to +85 degree C and amount of storage temperature is -40 degree C to + 100 degree C. The intensity of luminous is 20mcd. It has feature like UV resistant Eproxy. This device is popular in Indication, Toys & games, Lighting products and various Electronic products. We have used red, yellow and green color in our project. This item is shown on figure 3.11.

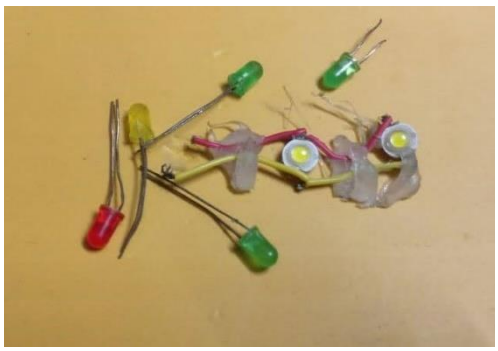


Figure 3.11: LED

3.14 Servo Motor

A servo motor is that motor which is a self-contained electrical device which rotates parts of a instrument with high efficiency and eminent precision. Regular motor can't be moved to a regular angle or position or velocity but servo motor's output can do all these. By utilizing a regular motor and coupling it with a sensor, servo can get positional feedback. The most important term of servo motor is its controller. Its mechanism is closed loop which incorporates positional feedback for controlling the speed and position either rotational or linear. An electrical signal controls the motor which can be analog or digital and it determines the quantity of movement that results in as a final command position for the pit. Speed and position feedback are served by a sensor

providing encoder. This circuitry is built to make the motor performing. Servo motor is used in robotics to work as a joint for the performance of precise angle or movement. It is also used in camera auto focus and in various embedded projects. It has shown on figure 3.12.

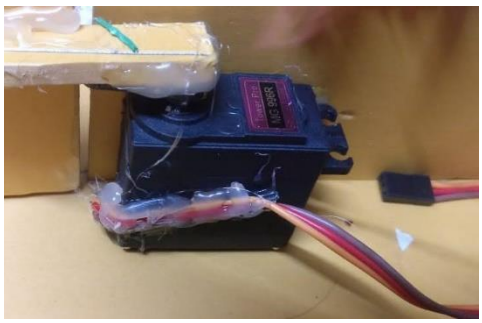


Figure 3.12: Servo Motor

3.15 DC Pump

This item is called mini water pump of which DC voltage varies in the range of 2.5V-6V. Its maximum lift range is 40-110cm. This item is light weighted, small sized but its efficiency is high. It is low consumption and makes low noise. The item is widely used in our day to day life in household works including cooking, batching, cleaning, space hating etc. It is also used for watering flowers. We have used this item for watering the root in smart farming. It is shown in figure 3.13.

Figure 3.13: DC Pump

3.16 Pulley

For lifting heavily objects easily, a mechanical object is used which is named by pulley. It is a simple machine and usually two or more are used together. Its main function is to change the direction of force. It is usually wrapped around a wheel as a rope or wire. It can be used for pulling things together also. There are several pulley systems like boomvang, mainsheet etc[10]. We have also used some number of this components in our smart parking to shrunk the heavy load of car. The components are being shown on figure 3.14.

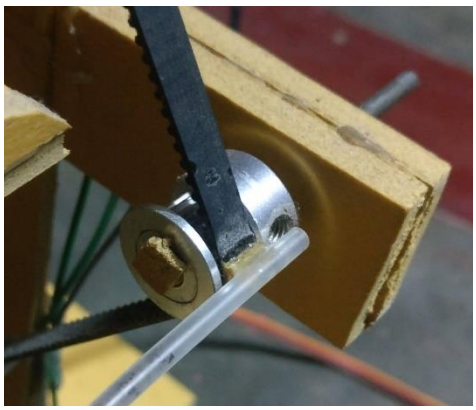


Figure 3.14: Pulley

3.15 Timing Belt

The timing belt or chain is a medium that joins the camshaft and the crankshaft together in a vehicle engine and it can also coordinate the opening and closing of the engine's valves. It is small and cheap comparatively to the transmission or engine. But it is an essential component for a car. It is usually made of rubber. It is shown in figure 3.17

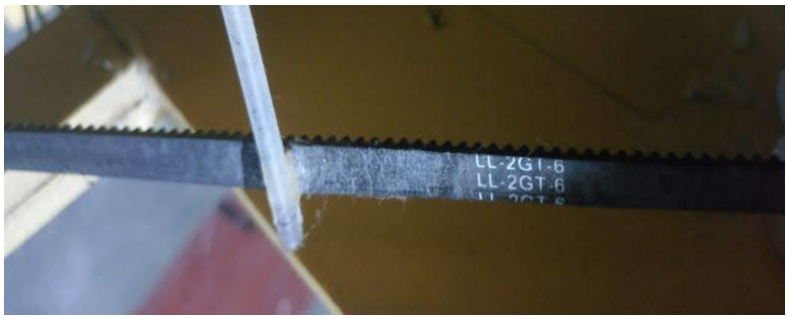


Figure 3.15: Timing Belt

3.18 DC Cooler

This item is known as 12V dc cooler fan which is 3*3 inch by size and contains & blades. Its material is hard plastic and it makes very low noise. Speed is usually 3000 RPM. This item is used for various kinds of purposes. In our project we have used it as a demo for electronic fan. The item is being shown on figure 3.16.

Figure 3.16: DC Cooler

3.19 Adapter9V

This utensil is hugely popular for supplying current in various kinds of projects in embedded system. The adapter type is switching. Its frequency range is 50/60 Hz. The output voltage is 9V dc and output power is 18w. It can take maximum load 2A. We have used this item as our power source. Power supply is very concerning while it can ruin the whole system. So, the measurement of required power and provide the exact amount is mandatory. We have used this adapter for our power supply in the system. The adapter is being shown on figure 3.17

Figure 3.17: Adapter 9V

3.20 NodeMCU

This item is an extraordinary development board for the IoT based applications. It has ESP8266 built in within it. It is an open source firmware. Its operating voltage is 3.3V. Input voltage varies from 7-12V. Being small in size is its advantage to be a part of IoT projects. It is used in various network projects or prototyping of IoT projects or for low power battery operated applications or projects where there is requirement of multiple I/O interfaces with Wi-Fi or Bluetooth functionalities. We have used it for the last reason. We have uploaded the value on database by connecting Wi-Fi through it. Simply, we have online our data by mean of it. The board is displayed in figure 3.18.

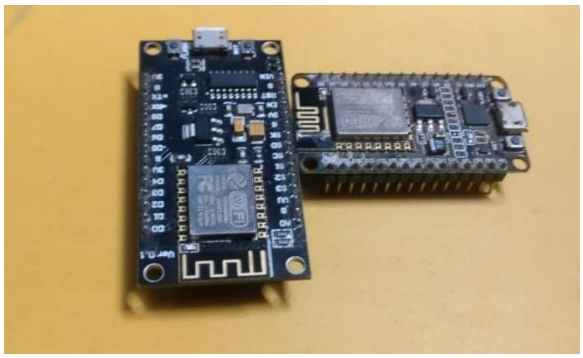


Figure 3.18: NodeMCU

3.21 Relay

5V 5Pin relay module is widely used in embedded system projects. Generally, its trigger voltage which means voltage across coil is 5V dc and trigger current which means nominal current is 70mA. The quantity for maximum AC load current and DC load current is 10A @ 250/125V AC and 10A @ 30/28V DC respectively. Its 5- pin is used in configuration with plastic moulding. Its operating time is approximately 10msec and release time is 5msec. Mechanically maximum switching rate is 300 operating/minute[11]. This item is being shown on figure 3.19.

Figure 3.19: Relay

3.22 Jumper Wires

A bounce wire also called as jumper wire, jumper interface (and many more names) is an electrical wire which assembles them in a connection and relating each other with other components makes the whole system performing. It is basically the relationship connector with the devices and the Arduino. They have variations like male /female and use in the field accordingly. In any kind of work including Arduino it is often a must item. This is the connection maker. We have also used this item to forming connection between the sensors, components and the Arduino board to form our system. Is being shown on figure 3.20.

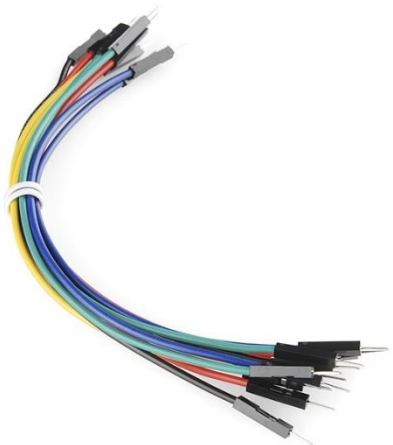


Figure 3.20: Jumper Wire

CHAPTER 4

DESIGN SPECIFICATIONS

4.1 Introduction

In this section we are going to portray how our system is working through various models like use case diagram, DFD modeling, various flow charts etc. We have talked about its idea, inspiration, assumptions, history, related works, prerequisite and many more. Now we will see how the structure has been made. We can see the demonstration of the structural view of the assignment through this part.

4.2 System Description

'Low Cost IoT based Green Home' is a combo package of home automation, smart gardening and smart parking. The procedure of this whole system is an Arduino based work. All values of sensors will remain null in the initial stage and with the process continuing the values will be updated in the database. For different sub-system like home automation or parking the procedure is going to different but the main fact remains same that sensors will take input and by processing with connection and database, appropriate output will be functioned. We have worked with Arduino Software and the opening image of the software is provided in figure 4.2.1

Figure 4.2.1: Arduino Software (Opening Image)

In the software we have used the library of C++ Arduino as our programming language for the project. Our project is an open source one and for database we have used firebase which provides Json data. The software is connected through the hardware section as well as the database part. The hardware is not directed connected to the database. There are software parts like website and app also which are also connected to the database. Getting and updating values through software the database makes change in the hardware segment.

Figure 4.2.2 is representing Arduino screenshot of the sample code and here also a screenshot of firebase database for our assignment.

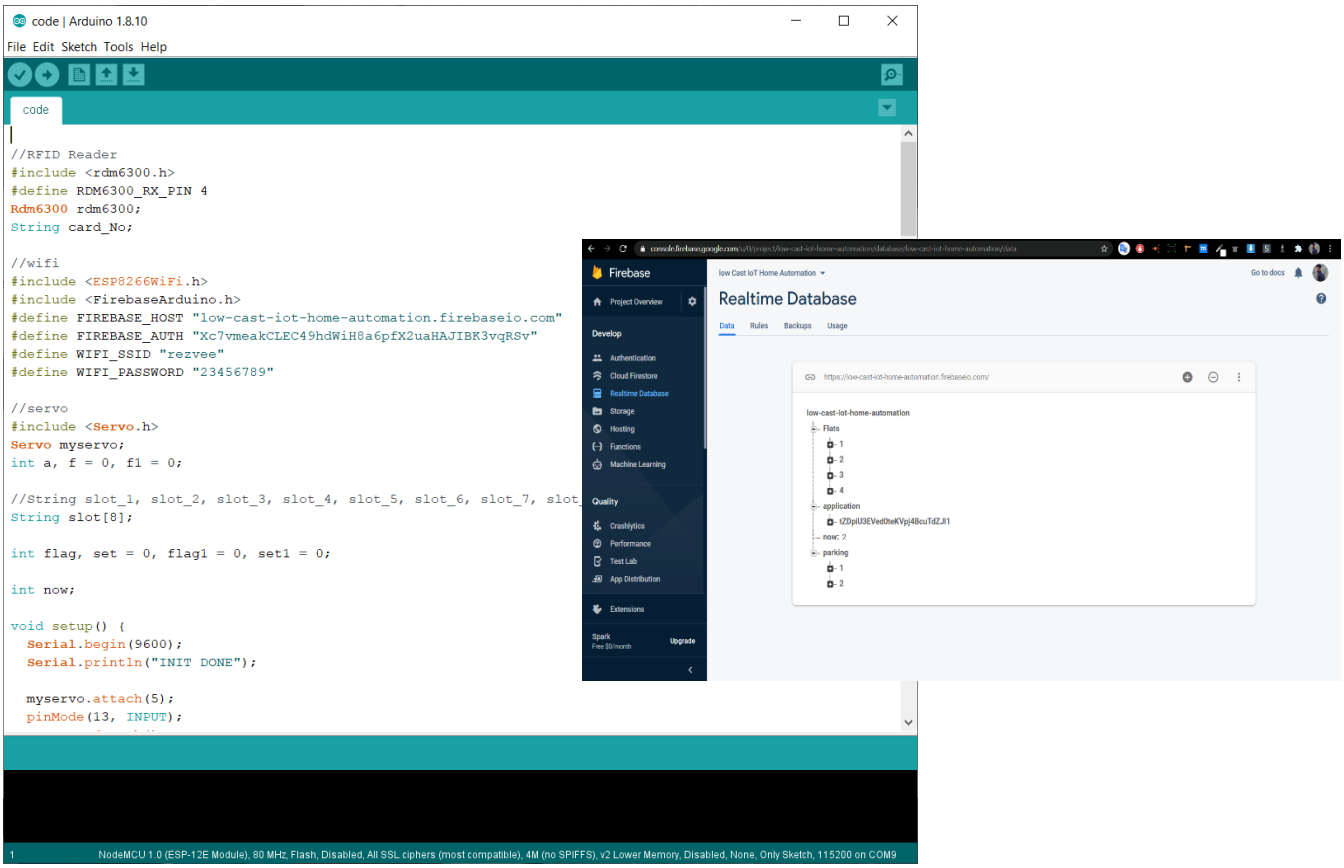


Figure 4.2.2: Arduino & Firebase Screenshot(partial)

4.3 Proposed Methodology

Designing electronic formation by the embedded system is the main idea behind our proposed methodology. We have used different components to perform our task which has been already defined and by using them we are making an electronic structure which will play with various inputs and will provide regarding output. We have sensors to take input and read data. Our sensors will take input of identification of persons in the case of room, will read temperature reading, humidity reading, moisture reading in the case of farming and will use RFID for providing features like identification, parking, checking compartment of the car in smart parking. As we can see we have various sectors to work with, there remains several more tasks to perform by our components. Through the design by flowchart of the methodology we can gain a primary idea and knowledge about what our utensils are playing in our assignment. The design of flowchart is being provided in figure 4.3.1 (for room & garden) and 4.3.2 (for parking).

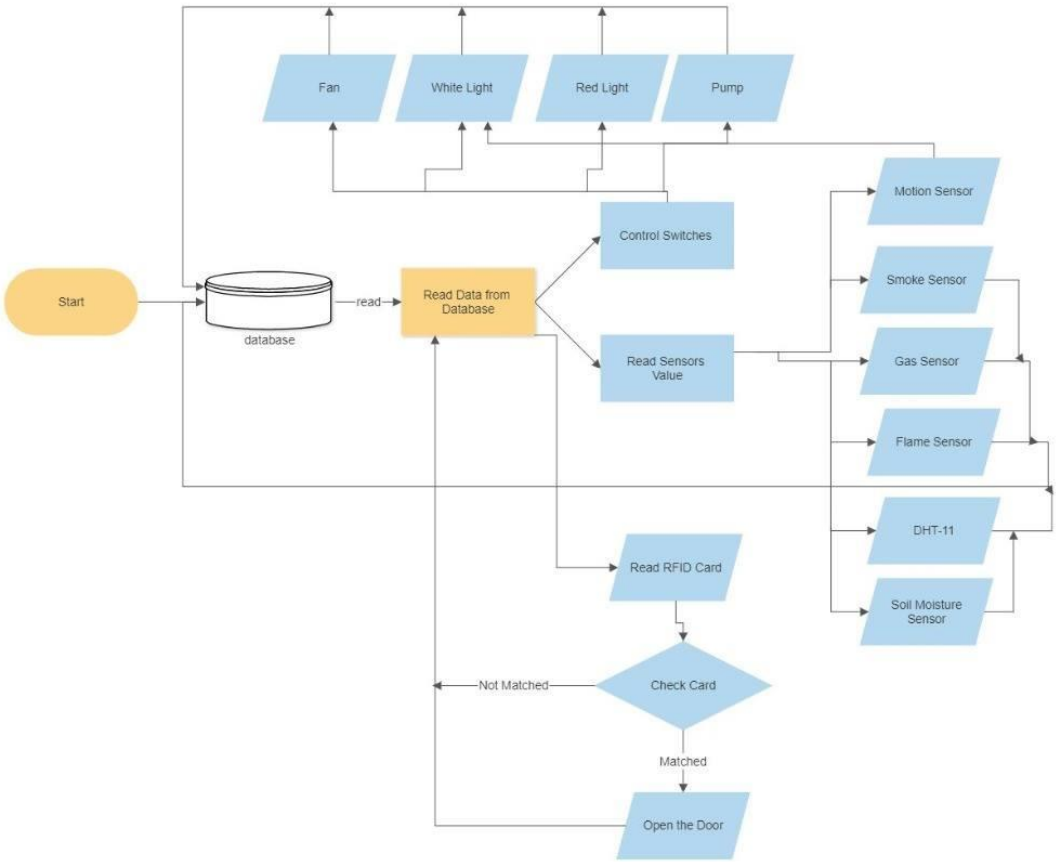


Figure 4.3.1: Flowchart (Home & Gardening)

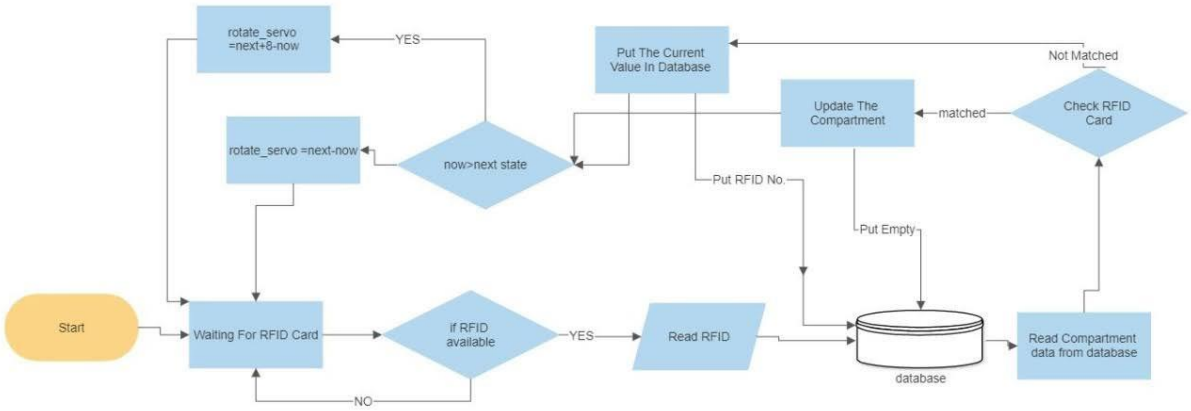


Figure 4.3.2: Flowchart (Parking)

4.4 Use Case Modeling

In our assignment we have various functionalities for different purposes and we have a good number of actors also. Here we are presenting the basic use case diagram for two actors who are User and Admin. The diagram is shown on figure 4.4.1

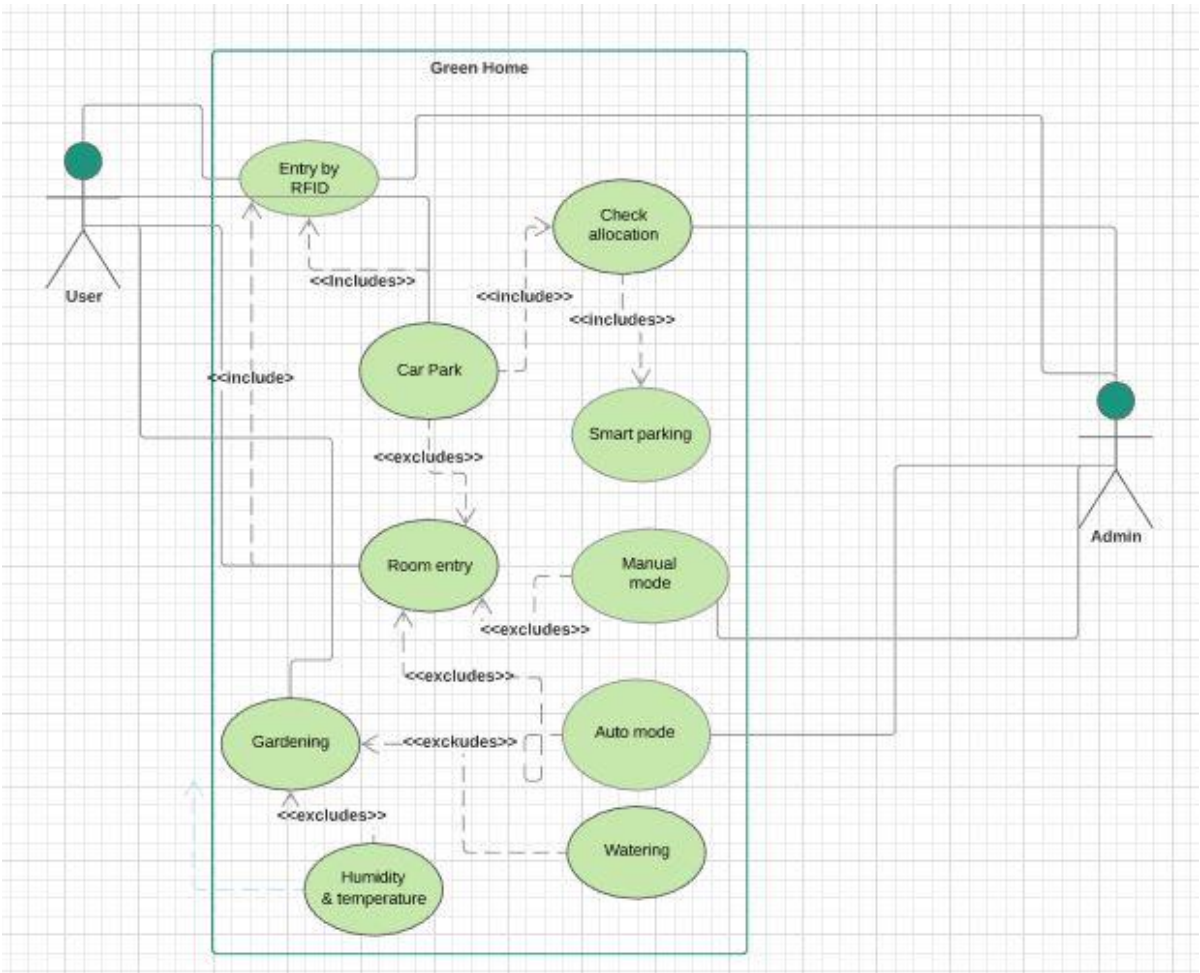


Figure: 4.4.1: Use Case Modeling

4.5 DFD Modeling

For projects related with software, DFD model is a way to present the data flow between the external entities, processes and databases. As we are working with hardware, android app and website, we have provided our project's DFD model in figure 4.5.1 (level 0) and figure 4.5.2 (level 1).

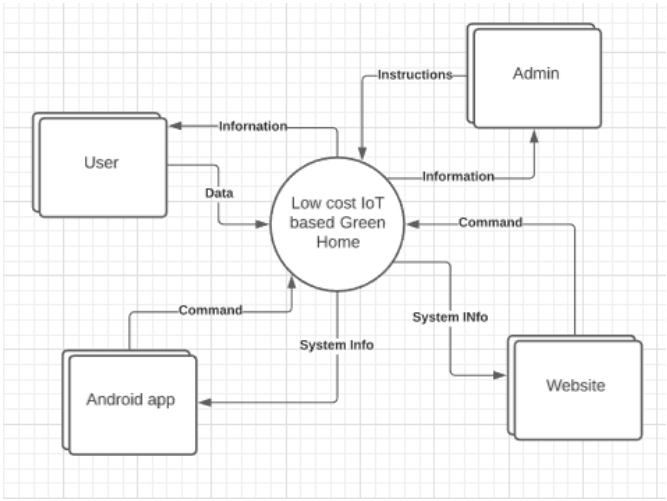


Figure 4.5.1: (DFD Model Level 0)

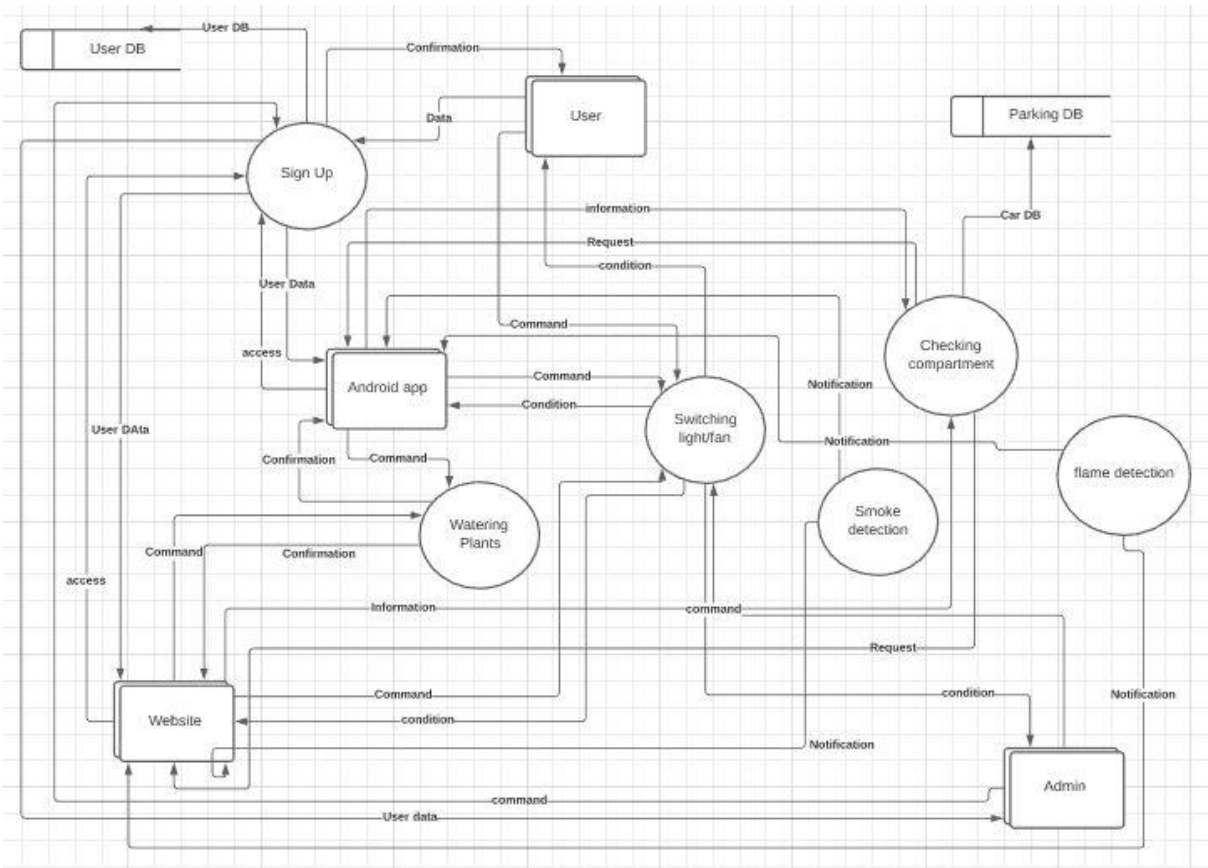


Figure 4.5.2: (DFD Model Level 1)

4.6 System Design

Our system includes both hardware and software systems. For hardware, we have Arduino based circuit and for software, we have android app and website to use. We have used 'Firebase' as our database to store and update different information of users and system through multiple sensors. Our system is completely an open source project. We are going to provide different figures for different sub-system below.

Figure 4.6.1, 4.6.2 is the circuit diagram for the room and figure 4.6.3 is the circuit diagram for the parking.

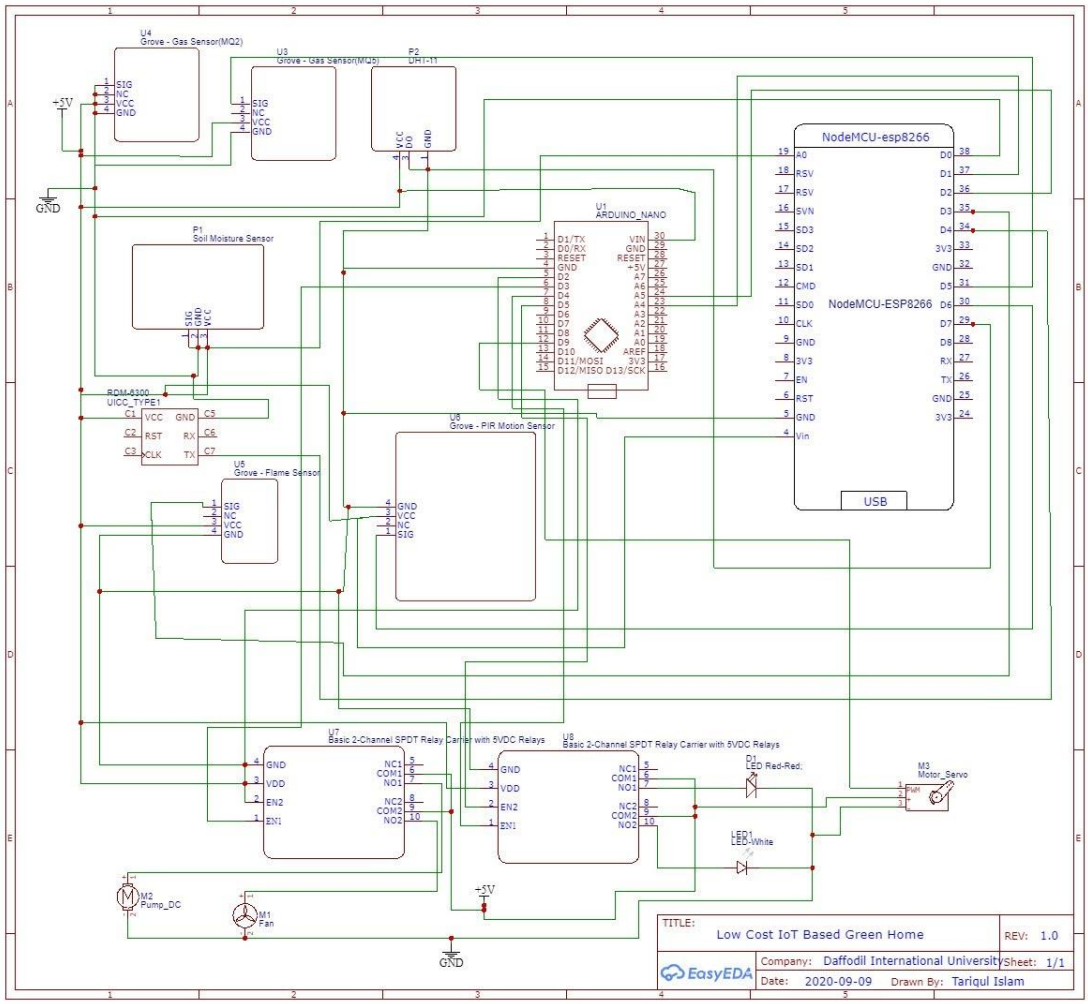


Figure: 4.6.1: Circuit Diagram i

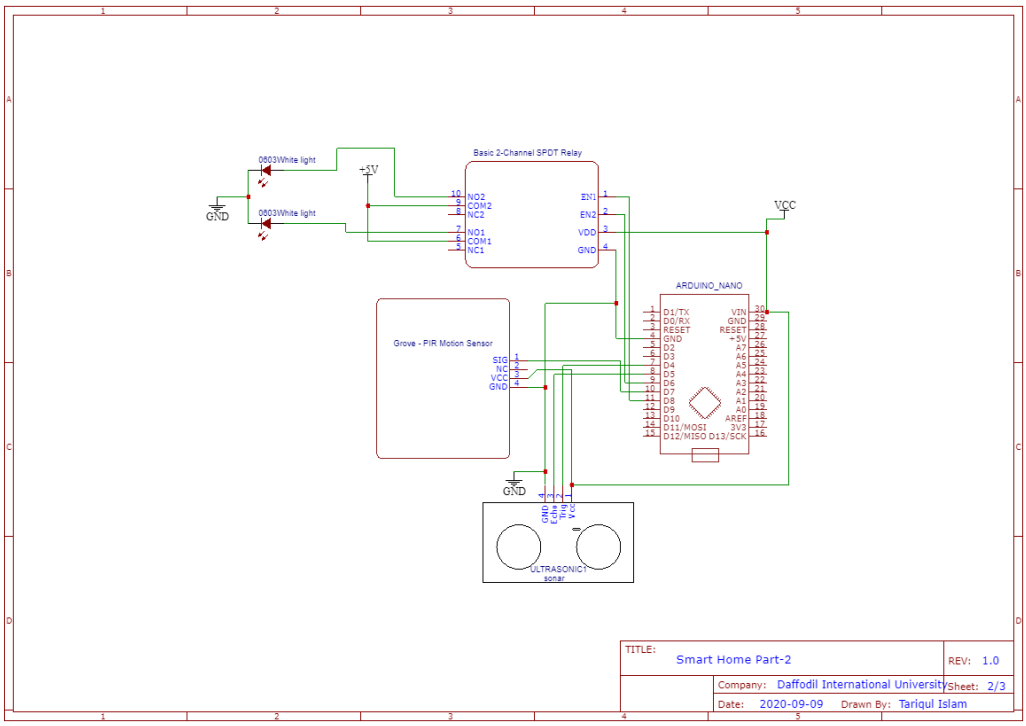


Figure:4.6.2: Circuit Diagram ii

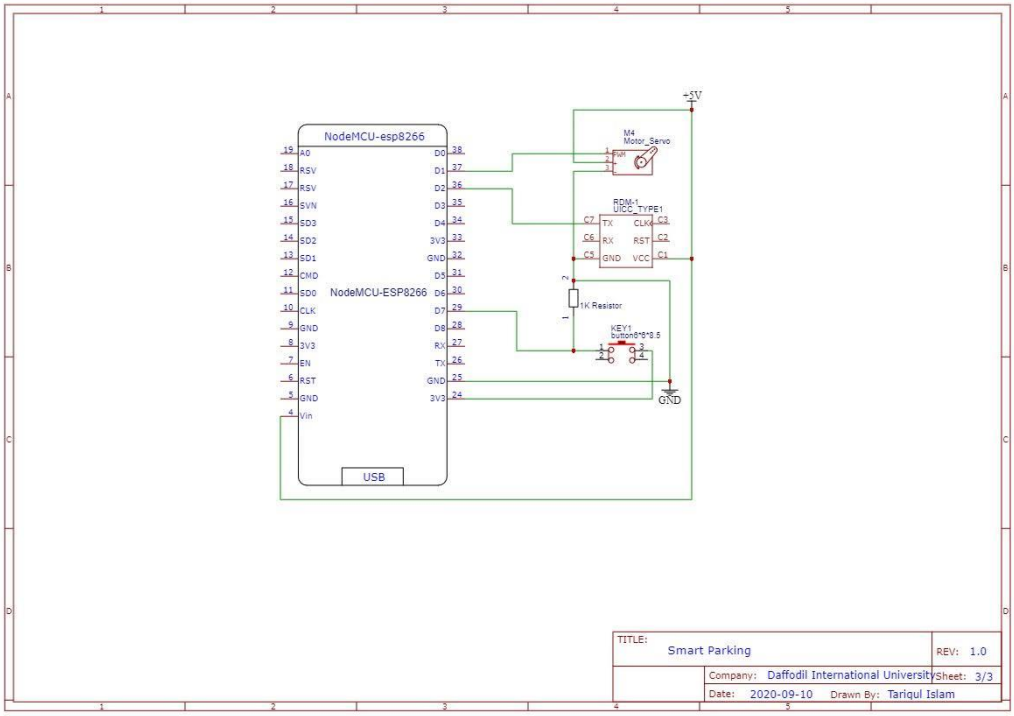


Figure 4.6.3: Circuit Diagram iii

As combining three different systems we have made our combinational package, we have quite a lot things to present. Figure 4.6.4 shows our android app interface regarding to the project.

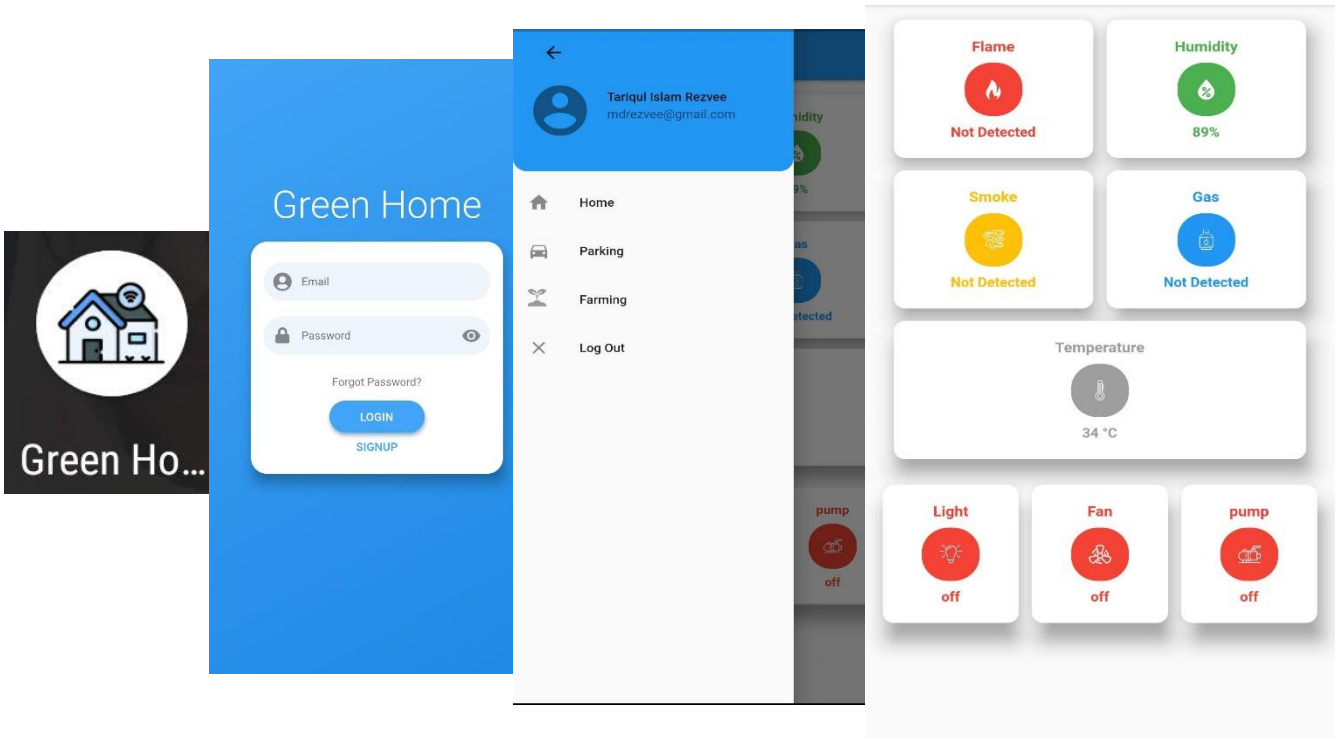
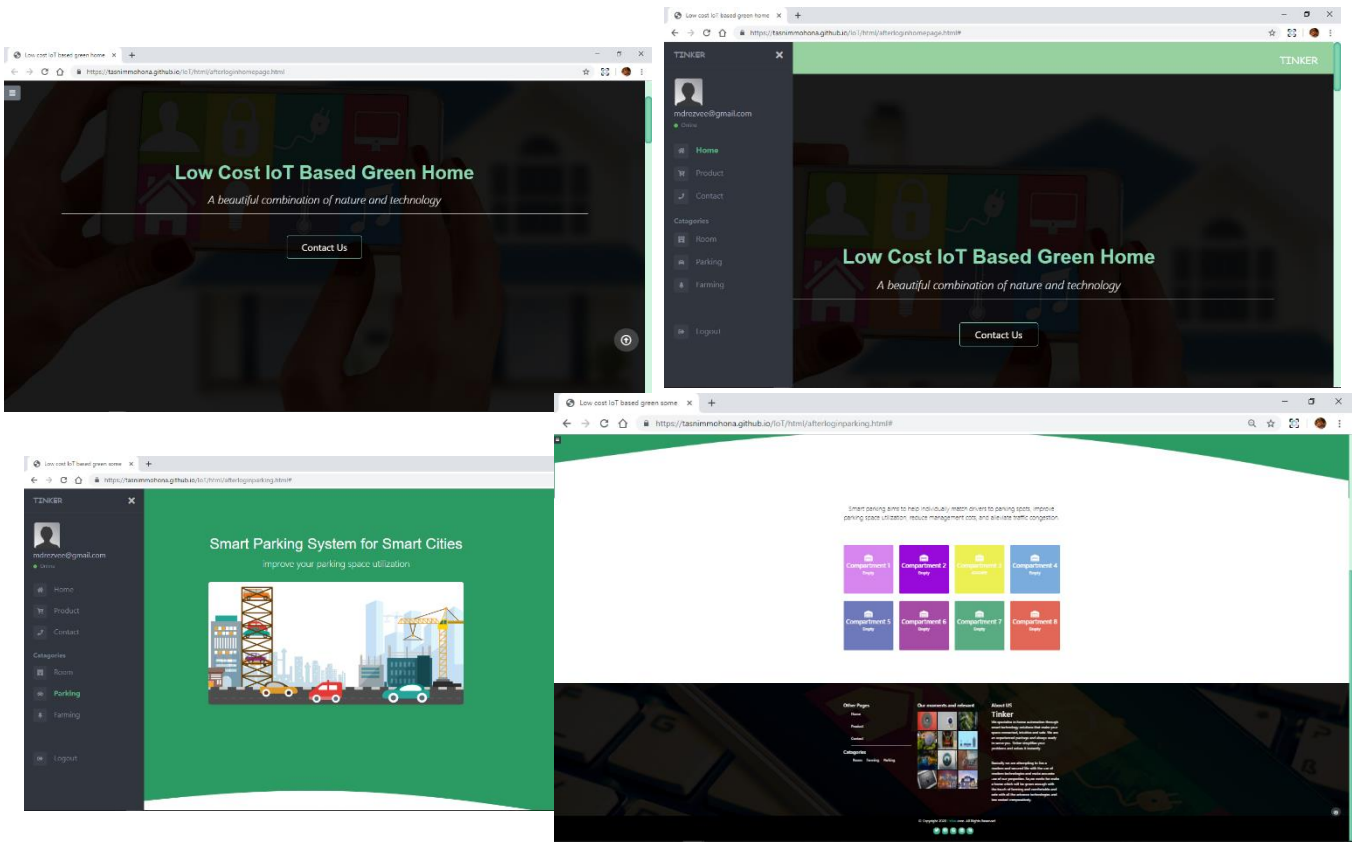


Figure 4.6.4: Screenshot of Android app (Partial)

Figure 4.6.5 is presenting the Website view regarding to our assignment.



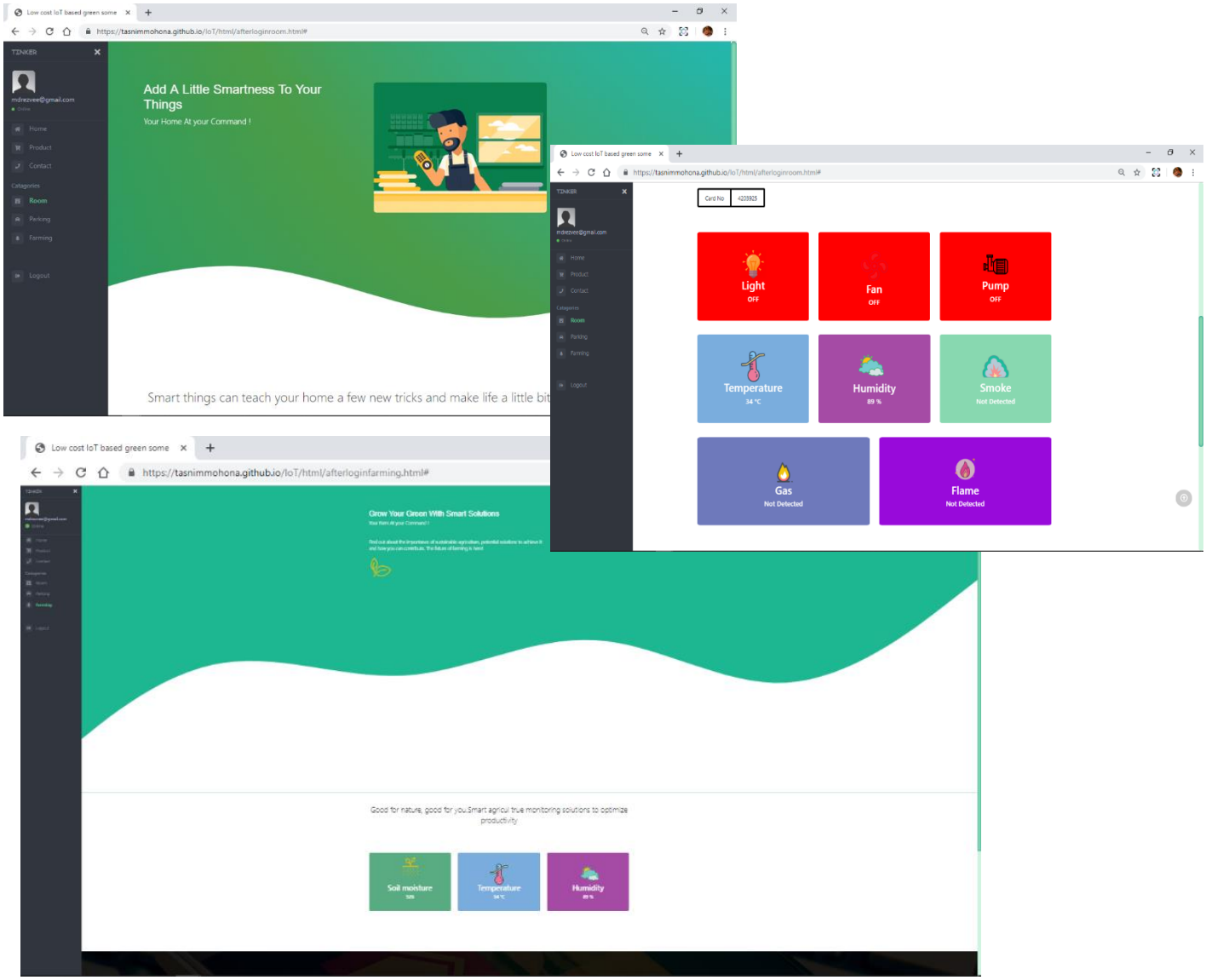


Figure 4.6.5: Website Interface

CHAPTER 5

IMPLEMENTATION & PERFORMANCE ANALYSIS

5.1 Introduction

This section is for narrating our whole system's performance analysis. We have seen the design part even on the previous chapter and now we will discuss the final result of the whole system and find out how the system is performing. This section is the way of finding out whether the whole assignment is performing enough or not.

5.2 System Implementation

We have known that this system contains both circuit diagram and android app and Website. The three ways do the implementation in a different manner.

- Circuit Implementation: We have three different circuit diagrams. Different diagrams contain different sensors and thus perform in a different way. Common fact is all circuit is started with power supply. For circuit iii (provided in 4.6.3) there is NodeMCU, servo, RFID and push button. Here RFID has been used as 'read only'. We could write also but that wasn't needed for ours assignment. This has been used in parking portion. For circuit ii (provided in 4.6.2) there are PIR and sonar sensor and this circuit is used in the corridor and staircase area. For circuit i (provided in 4.6.1), it represents the circuit for whole house functionalities and gardening part also. Here there are NodeMCU, Arduino nano and several sensors like MQ2, MQ5, DHT11, Soil moisture sensor, flame sensor and so on. The voltage has been used 5V in every circuit. Circuits are made with appropriate pin connection regarding to the requirements. The pin of the components has been discussed in chapter 3. Thus, several sensors have been used properly and connected in the circuit to make the project successful.

- Android App Implementation: The android app will allow user to sign up/log in through previous information. It will provide the three section of 'room, farming and parking'. For room user are allowed to get the condition of flame, smoke, humidity and gas. They will get notification if any of this item is detected. Temperature can be checked also. User can turn on/off the light, fan and pump here. For parking user will be able to see the compartment position that which one is empty or not and also check in which compartment his car is parked through RFID card number. For gardening soil condition like humidity, moisturizer and temperature can be checked.
- Website Implementation: The website provides the same features as the android app. It has also sections for room, parking and gardening separately and the tasks are same as app. User will get notification on website also and they can check the sensors and turn on/off light, fun and pump even. The pump is supposed to work automatically when needs but if doesn't work automatic somehow, we can use website or app on that purpose that time.

5.3 System Execution:

The system will execute in different ways for home automation, smart gardening and Smart parking. Here we are providing it in two sections, one containing automated room and the smart gardening portion and the other holds smart parking system. The figure of first portion is displayed on figure 5.3.1.

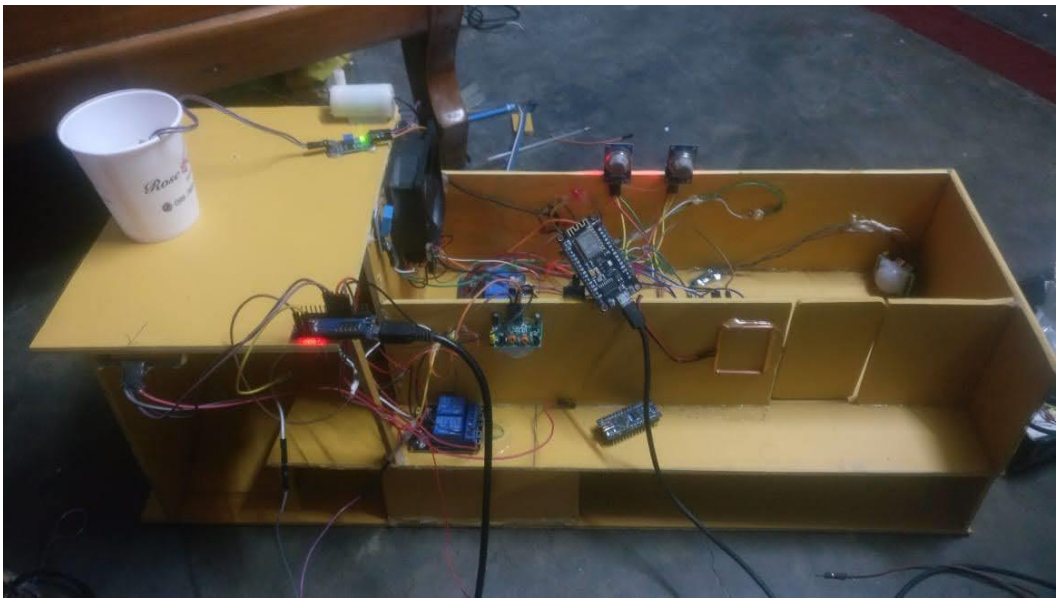


Figure 5.3.1: Execution of home automation and smart gardening

We have a different Arduino connected segment in our part of corridor and staircase to detect human presence and motion. On the staircase, sonar sensor and on the corridor PIR sensor has been used. Here we have used relay for controlling lights which can flow 125A current. We have a fixed distance measurement and if any human reaches within that, a light will be urn on automatically. While leaving the area, the light will turned off again. Motion sensor of the corridor is capturing motion and it can be reset in 6seconds.Once motion is captured it remains detected for 3seconds. Then we have RFID card for the user to entry in the room. After entering the room PIR sensor will turn on a light detecting motion and after 3 seconds the light will turn off automatically. We have MQ5 to detect LPG gas and MQ2 which can detect CO also and for security we have another sensor which is flame sensor. So, whenever gas/smoke/flame is detected a red LED light will turn on to alert and by this alarm we can reduce the chance of accident in our home for gas leakage or for flame or smoke. We have soil moisture sensor for getting the moisture value on the soil. If moisture is not enough the dc pump will start. There is DHT11 sensor which measures humidity and temperature. Then there is a relay shell containing 4 relays which allows pump, DC cooler fan, the red LED and the white LED to be turned on or off. This is our manual system but using android app and website we can perform all these actions using database and for connection NodeMCU has been used.

Now figure 5.3.2 is displaying the portion of smart marking system.

Figure 5.3.2: Execution of smart parking

Smart parking system allows to park multiple cars at a place. We have 8 compartments in our demo model which means we are able to park 8 cars on the place of one single car. We need RFID card for parking. We need to entry it and if it is entried already then showing it will put down the car parked using the card instantly. Suppose initially all compartments are empty. If 'RFID card 1' is shown the card number will be stored in the database and will count as a parking and that compartment is assumed to be not empty. If 'RFID card 2'is provided, the card number will be saved for another compartment.] Now if the 'RFID card 1' is shown again the compartment will come down. User can check compartment status from app and website also.

5.4 Final Outcome

Consequence of the project has already been discussed and now the outcome overview is being portrayed. The entire aftereffect of the system looks like figures provided below on figure 5.4.1.

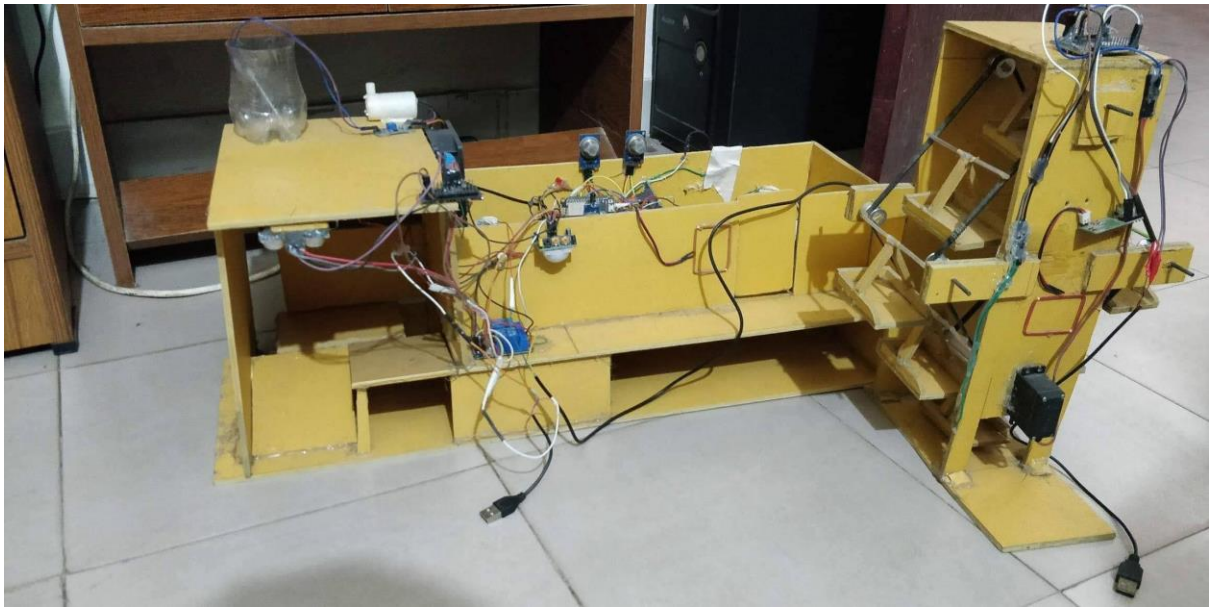


Figure 5.4.1: Low cost IoT based Green Home

5.5 Advantage

Here, we are having all updated terms like home automation, smart farming and smart parking all together. Home automation ensures our privacy, security and chances of accident is shrunked. Usage of electricity can be reduced also. For smart gardening we can be with the touch of nature which is hardly difficult now-a-days due to urbanization and for smart parking, we can park multiple vehicles on the same place where we could do single. This combination is worthy enough to make our life digitized and comfortable. The main advantage of the project is that it is low costed comparatively. If we want to have the features separately, we will need to cost much more than this system is costing. At a time, we are building these and that's why it is not needed to import such mechanism and that is that is reason why we are able to provide it in a low cost comparatively.

CHAPTER 6

CONCLUSION

6.1 Conclusion

Our country is a developing country. The government has taken the project of making 'Digital Bangladesh'. From that time the concept of ICT is being widely popular in our country. We have now various scopes on this field in our country even, at that point having features available like smart parking, smart farming, home automation as a combo package under one roof is something worthy. At the same time, we are providing it by ourselves, not from exporting. Now a days many people in our country cost much for living cozy life. We believe they can afford our assignment and it would make their life much digitized as well as we will have less wastage of our properties like land, electricity. Our user's security will be highly concerned and protected and they would be able to be in the touch of nature as well according their wishes. We have tried our best for a targeted market of our country to make the life more digitized and comfortable with various amazing facilities and make lives more comfortable. For making the assignment user friendly we have an android app as well as we have support of a web version also included.

6.2 Future Scope

Our system is providing its requirement but adding some more features we wish to make the assignment more convenient in future. We will work to include several more features in our system like:

1. We are limited with android app only. We will include IOS app as well in future.

2. We will work to show the output reading to the display to make it more user free.

3. We will add laser security to make the privacy more ensured.

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APPENDIX

CODE SEGMENT

```
//DHT11
#include <dht11.h>
dht11 DHT11;
#define DHT11PIN 13

//Flam Sensor
#define flamPin 0
int flam;

//motion sensor
int pin = 12;
int value = 0;

//Smoke & Gas sensor
#define smokePin 16
#define gasPin 14
int gas, smoke;

//Soil sensor
#define soilPin A0

//RFID sensor
#include <rdm6300.h>
#define RDM6300_RX_PIN 2

Rdm6300 rdm6300;
String key;
String masterKey = "4208420";
String card_no = "";

//i2c
#include <Wire.h>

//flag
int card_flag = 0, motion_flag = 0, pump_flag = 0, smoke_flag = 0, gas_flag = 0;
int flam_flag = 0;

//wifi
#include <ESP8266WiFi.h>
#include <FirebaseArduino.h>
#define FIREBASE_HOST "low-cast-iot-home-automation.firebaseio.com"
#define FIREBASE_AUTH "Xc7vmeakCLEC49hdWiH8a6pfX2uaHAJIBK3vqRSv"
#define WIFI_SSID "rezvee"
#define WIFI_PASSWORD "23456789"
```

```
//firebase variabel

String f_fan, f_pump, f_redLed, f_whiteLed;
int f_whiteLedFlag = 0;
int i = 0, j = 0, k = 0, l = 0;

void setup()
{
  Serial.begin(9600);

  //i2c
  Wire.begin(5, 4);

  //RFID sensor
  rdm6300.begin(RDM6300_RX_PIN);
  Serial.println("\nPlace RFID tag near the rdm6300...");

  //flam sensor
  pinMode(flamPin, INPUT);

  //Motion Sensor
  pinMode(pin, INPUT);

  //Smoke & Gas Sensor
  pinMode(gasPin, INPUT);
  pinMode(smokePin, INPUT);

  //Soil sensor
  pinMode(soilPin, INPUT);

  //  wifi
  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("connecting");
  while (WiFi.status() != WL_CONNECTED)
  {
    Serial.print(".");
    delay(500);
  }
  Serial.println();
  Serial.print("connected:");
  Serial.println(WiFi.localIP());
  Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);



}
```

```
 void rfidReader() {

 if (rdm6300.update())
 {
  Serial.println("New Card Found");
  key = rdm6300.get_tag_id();
  Serial.println(key);

  rdm6300.begin(RDM6300_RX_PIN);
  Serial.println("\nPlace RFID tag near the rdm6300...");

 }

 delay(10);
}


float temp, hum;
void valDHT()   //DHT11 sensor value read
{
 int chk = DHT11.read(DHT11PIN);

 temp = (float)DHT11.temperature;
 hum = (float)DHT11.humidity;

//  Serial.print("Temp: ");
//  Serial.print(temp);
//  Serial.println(" C");
//
//  Serial.print("RelF: ");
//  Serial.print(hum);
//  Serial.println(" %");
//
//  delay(2000);
}


void valFlam()//Flam Sensor
{
 flam = digitalRead(flamPin);
 //Serial.print("Flam Value= ");
 //Serial.println(flam);
 if (flam == 0)
 {
  // Serial.println("Flame Detected ");
  Wire.beginTransmission(8);
  Wire.write("rLedOn");
  Wire.endTransmission();
  delay(1000);
  flam_flag = 0;
 }
```

```
if (flam == 1)
  {
    if (flam_flag == 0)
    {
      //Serial.println("Flame not Detected ");
      Wire.beginTransmission(8);
      Wire.write("rLedOff");
      Wire.endTransmission();
      delay(1000);
      flam_flag++;
    }
  }

}


void valMotion()//motion
{

  value = digitalRead(pin);

  if (value == HIGH) {
    Serial.println("Motion Detected!");
    Wire.beginTransmission(8);
    Wire.write("wLedOn");
    Wire.endTransmission();
    delay(1000);
    motion_flag = 0;

  } else {
     Serial.println("Motion Ende!");
    if (motion_flag == 0 && f_whiteLedFlag == 0) {
      //Serial.println("Motion Ende!");
      Wire.beginTransmission(8);
      Wire.write("wLedOff");
      Wire.endTransmission();
      delay(1000);
      motion_flag++;
    }

  }
}

int gas_value, smoke_value;
void valSG()
{
  gas = digitalRead(gasPin);
  Serial.print("Gas= ");
  Serial.println(gas);
  smoke = digitalRead(smokePin);
```

```
   Serial.print("smoke= ");
  Serial.println(smoke);
  delay(100);
if (gas == 0)
  {
    gas_value = 1;
    //Serial.println("Gas Detected");
    Wire.beginTransmission(8);
    Wire.write("rLedOn");
    Wire.endTransmission();
    delay(1000);
    gas_flag = 0;
  }
  else
  {
    gas_value = 0;

    if (gas_flag == 0)
    {
      // Serial.println("No Gas Detected");
      Wire.beginTransmission(8);
      Wire.write("rLedOff");
      Wire.endTransmission();
      delay(1000);
      gas_flag++;
    }
  }

  if (smoke == 0)
  {
    smoke_value = 1;
    //Serial.println("Somke Detected");
    Wire.beginTransmission(8);
    Wire.write("rLedOn");
    Wire.endTransmission();
    delay(1000);
    smoke_flag = 0;
  }
  else
  {
    smoke_value = 0;

    if (smoke_flag == 0)
    {
      //Serial.println("No Somke Detected");
      Wire.beginTransmission(8);
      Wire.write("rLedOff");
      Wire.endTransmission();
      delay(1000);
      smoke_flag++;
    }
  }
}
```

```
int sv;
void valSoil()
{
  sv = analogRead(soilPin);
  Serial.println(sv);

  if ( sv <= 570  )
  {
    if (pump_flag == 1) {
      Serial.println("No Need Water");
      Wire.beginTransmission(8);
      Wire.write("pumpOff");
      Wire.endTransmission();
      delay(1000);
      pump_flag = 0;
    }
  }
  else
  {
    Serial.println("Need Water");
    Wire.beginTransmission(8);
    Wire.write("pumpOn");
    Wire.endTransmission();
    delay(1000);
    pump_flag = 1;
  }

  delay(200);
}


//Checking RFID card No.
void checkKey()
{

  if (key == card_no)
  {
    Wire.beginTransmission(8);
    Wire.write("doorOpen");
    Wire.endTransmission();
    delay(3000);
    Serial.println("Enter as Owner");
    key = "";
    card_flag = 0;
  }
  else if (key == masterKey)
  {
    Wire.beginTransmission(8);
    Wire.write("doorOpen");
    Wire.endTransmission();
```

```
    delay(2000);
    Serial.println("Enter as Admin");
    key = "";
    card_flag = 0;
   }
   else
   {
    if (card_flag == 0)
    {
     Wire.beginTransmission(8);
     Wire.write("doorClose");
     Wire.endTransmission();
     delay(2000);

     card_flag++;
    }
   }
}


//firebase
void firebasereconnect()
{
  Serial.println("Trying to reconnect");
  Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
}


void firebaseRead()
{
  card_no = String(Firebase.getInt("/Flats/1/rfid/"));
  f_fan = Firebase.getString("/Flats/1/switch/fan/");
  f_pump = Firebase.getString("/Flats/1/switch/pump/");
  f_redLed = Firebase.getString("/Flats/1/switch/redled/");
  f_whiteLed = Firebase.getString("/Flats/1/switch/whiteled/");

  Serial.println(card_no);
  Serial.println(f_pump);
  Serial.println(f_redLed);
  Serial.println(f_whiteLed);

  //fan
  if (f_fan == "on" && i == 0)
  {
    Serial.println("fan on");
    Wire.beginTransmission(8);
    Wire.write("fanOn");
    Wire.endTransmission();
    delay(1000);
    i = 1;
  }
```

```
if (f_fan == "off" && i == 1)
 {
  Serial.println("fan off");
  Wire.beginTransmission(8);
  Wire.write("fanOff");
  Wire.endTransmission();
  delay(1000);
  i = 0;
 }

 //pump
 if (f_pump == "on" && j == 0)
 {
  Serial.println("pump on");
  Wire.beginTransmission(8);
  Wire.write("pumpOn");
  Wire.endTransmission();
  delay(1000);
  j = 1;
 }
 if (f_pump == "off" && j == 1)
 {
  Serial.println("pump off");
  Wire.beginTransmission(8);
  Wire.write("pumpOff");
  Wire.endTransmission();
  delay(1000);
  j = 0;
 }

 //red light
 if (f_redLed == "on" && k == 0)
 {
  Serial.println("Red Led on");
  Wire.beginTransmission(8);
  Wire.write("rLedOn");
  Wire.endTransmission();
  delay(1000);
  k = 1;
 }
 if (f_redLed == "off" && k == 1)
 {
  Serial.println("Red Led off");
  Wire.beginTransmission(8);
  Wire.write("rLedOff");
  Wire.endTransmission();
  delay(1000);
  k = 0;
 }
```

```
//white light
  if (f_whiteLed == "on" && l == 0)
  {
    Serial.println("white Led on");
    Wire.beginTransmission(8);
    Wire.write("wLedOn");
    Wire.endTransmission();
    delay(1000);
    l = 1;
    f_whiteLedFlag = 1;
  }
  if (f_whiteLed == "off" && l == 1)
  {
    Serial.println("White Led off");
    Wire.beginTransmission(8);
    Wire.write("wLedOff");
    Wire.endTransmission();
    delay(1000);
    l = 0;
    f_whiteLedFlag = 0;
  }

}


void firebaseSetData() {
  Firebase.setFloat("/Flats/1/temperature/", temp);
  Firebase.setFloat("/Flats/1/humidity/", hum);
  Firebase.setInt("/Flats/1/flam/", flam);
  Firebase.setInt("/Flats/1/soil/", sv);
  Firebase.setInt("/Flats/1/gas/", gas_value);
  Firebase.setInt("/Flats/1/smoke/", smoke_value);
}

void loop()
{

  if (Firebase.failed())
  {
    Serial.print("setting number failed:");
    Serial.println(Firebase.error());
    firebasereconnect();
    return;
  }

  firebaseRead();
```

```
 valDHT();
  valFlam();
  valMotion();
  valSG();
  valSoil();
  rfidReader();
  checkKey();

  firebaseSetData();

}

#include <Wire.h>

void setup() {
 Wire.begin(8);                /* join i2c bus with address 8 */
 Wire.onReceive(receiveEvent); /* register receive event */
// Wire.onRequest(requestEvent); /* register request event */
 Serial.begin(9600);           /* start serial for debug */
}

void loop() {
 delay(100);
}

// function that executes whenever data is received from master
void receiveEvent(int howMany) {
 while (0 <Wire.available()) {
    char c = Wire.read();      /* receive byte as a character */
    Serial.print(c);           /* print the character */
  }
 Serial.println();             /* to newline */
}

// function that executes whenever data is requested from master
void requestEvent() {
 Wire.write("Hello NodeMCU");  /*send string on request */
}

//corridor

int pin = 7;

const int trigPin1 = 4;
const int echoPin1 = 5;

int motionValue = 0;

void setup() {
  Serial.begin(9600);
  pinMode(pin, INPUT);
```

```
  pinMode(8, OUTPUT);
  pinMode(5, INPUT);
  pinMode(6, OUTPUT);
  pinMode(trigPin1, OUTPUT);
  pinMode(echoPin1, INPUT);
  digitalWrite(8,1);
  digitalWrite(6,1);
  Serial.println("Waiting For Ready");
  delay(60000);
  Serial.println("Ready");


}

long microsecondsToCentimeters(int mic)
{
  return mic/29/2;
}

void loop() {

  motionValue = digitalRead(pin);

  if (motionValue == HIGH) {
    digitalWrite(8, 0);
    Serial.println("Motion Detected!");


  } else {
    digitalWrite(8, 1);
    Serial.println("Motion Ende!");
  }

  long duration1, cm1;

  digitalWrite(trigPin1, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin1, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin1, LOW);

  duration1 = pulseIn(echoPin1, HIGH);

  cm1 = microsecondsToCentimeters(duration1);

  Serial.print("Distance=");
  Serial.println(cm1);
  delay(200);
```

```
 if(cm1>20 || cm1<18)
  {
    digitalWrite(6,0);
  }
  else
  {
    digitalWrite(6,1);
  }

}


//parking

//RFID Reader
#include <rdm6300.h>
#define RDM6300_RX_PIN 4
Rdm6300 rdm6300;
String card_No;

//wifi
#include <ESP8266WiFi.h>
#include <FirebaseArduino.h>
#define FIREBASE_HOST "low-cast-iot-home-automation.firebaseio.com"
#define FIREBASE_AUTH "Xc7vmeakCLEC49hdWiH8a6pfX2uaHAJIBK3vqRSv"
#define WIFI_SSID "rezvee"
#define WIFI_PASSWORD "23456789"

//servo
#include <Servo.h>
Servo myservo;
int a, f = 0, f1 = 0;

//String slot_1, slot_2, slot_3, slot_4, slot_5, slot_6, slot_7, slot_8;
String slot[8];

int flag, set = 0, flag1 = 0, set1 = 0;

int now;

void setup() {
  Serial.begin(9600);
  Serial.println("INIT DONE");

  myservo.attach(5);
  pinMode(13, INPUT);
  myservo.detach();
```

```
WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("connecting");
  while (WiFi.status() != WL_CONNECTED)
  {
    Serial.print(".");
    delay(500);
  }
  Serial.println();
  Serial.print("connected:");
  Serial.println(WiFi.localIP());
  Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);

  rdm6300.begin(RDM6300_RX_PIN);
  Serial.println("\nPlace RFID tag near the rdm6300...");


}



void ser() {
  Serial.print("Set= ");
  Serial.print(set);
  while (set > 0)
  {
    myservo.attach(5);
    a = digitalRead(13);
//    Serial.print("a= ");
//    Serial.println(a);
    if (a == 1)
    {
      if (f == 0)
      {
        set--;  // de-bounceing problem
        Serial.print("Set = ");
        Serial.println(set);
        f = 1;
      }
    }
    else
    {
      f = 0;
    }
    myservo.write(0);
    delay(10);
  }
  set = 0;
  f1 = 0;
  delay(420);
  myservo.detach();
}
```

```
void firebasereconnect()
{
  Serial.println("Trying to reconnect");
  Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
}


void loop() {

  if (Firebase.failed())
  {
    Serial.print("setting number failed:");
    Serial.println(Firebase.error());
    firebasereconnect();
    return;
  }

  rfidReader();

}
void readValue() {
  now = Firebase.getInt("/now/");
  for (int z = 0; z < 8; z++)
  {
    String str = "/parking/1/stole_" + String(z + 1) + "/";
    slot[z] = Firebase.getString(str);
  }
  now = Firebase.getInt("/now/");
  Serial.print("now= ");
  Serial.println(now);
  for (int z = 0; z < 8; z++)
  {
    Serial.println(slot[z]);
  }
  delay(500);
}


void rfidReader() {

  if (rdm6300.update())
  {
    Serial.println("New Card Found");
    card_No = rdm6300.get_tag_id();
    Serial.println(card_No);
    readValue();
    String del = " ";
    for (int k = 0; k < 8; k++)
    {
      if (slot[k] == card_No)
      {
```

```
if (now < k+1)
      {
       set =  k + 1 - now;
       Serial.print("Set From Delete if= ");
       Serial.println(set);
       Firebase.set("/now/", k + 1);
      }
      else if (now > k+1)
      {
       set =  k + 1 - now + 8;
       Serial.print("Set From Delete else= ");
       Serial.println(set);
       Firebase.set("/now/", k + 1);
      }
      String str = "/parking/1/stole_" + String(k + 1) + "/";
      Firebase.setString(str, "Empty");
      del = "deleted";
      break;
    }
  }

  int p;
  if (del != "deleted")
  {
   for (int k = now-1; k < 8 + now-1; k++)
   {
    if (k >= 8)
    {
     p = k - 8;
    } else {
     p = k;
    }
    if (slot[p] == "Empty")
    {
     if (now < p+1)
     {
      set =  p + 1 - now;
      Serial.print("Set From Put if= ");
      Serial.println(set);
      Firebase.set("/now/", p + 1);
     }
     else if (now > p+1)
     {
      set =  p + 1 - now + 8;
      Serial.print("Set From Put else= ");
      Serial.println(set);
      Firebase.set("/now/", p + 1);
     }
```

```
        String str = "/parking/1/stole_" + String(p + 1) + "/";
        Firebase.setString(str, card_No);
        break;
       }
      }
     }


    ser();
    rdm6300.begin(RDM6300_RX_PIN);
    Serial.println("\nPlace RFID tag near the rdm6300...");
   }
}
```

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