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IOT BASED INDUSTRIAL MACHINE MANAGEMENT SYSTEM

An Undergraduate CAPSTONE Project
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IOT BASED INDUSTRIAL MACHINE MANAGEMENT SYSTEM

A CAPSTONE project submitted to the faculty of Engineering Sonargaon university (SU) in partial fulfillment of the requirements for the degree of bachelor of science in their mentioned respective programs.

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DECLARATION

This is to certify that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. Any material reproduced in this project has been properly acknowledged.

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APPROVAL

The CAPSTONE Project titled "**IOT BASED INDUSTRIAL MACHINE MANAGEMENT SYSTEM"** has been submitted to the following respected members of the Board of Examiners of the Faculty of Engineering in partial fulfillment of the requirements for the degree of Bachelor of Science in the respective programs mentioned below on **September 2022** by the following students and has been accepted as satisfactory.

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ABSTRACT

In this project, simulated and hardware design of IoT based system is presented. This project satisfies the goal of modern science and technology which provides comfort and convenience to the user. The main objective of this project was to increase the production efficiency of industrial grains which can be controlled, monitored in industrial automation and reduce operating costs and save energy, time and money. The industry will benefit from our project and it will be effective for the environment as well as the society. In this project, all the structural design fritzing, proteus and Matlab software were created. The whole process of this project was electronically simulated in Proteus 8.11 Professional and a part of the simulation was also applied to Matlab Simulink. The microcontroller (ESP-32) is considered the main brain of the system. Other necessary components were imported and the process was created using Proteus 8.11 Professional. Proteus spontaneously described everything but could not design correctly for high loads so the Matlab is used to design VFD. Another software, the V1000 programming simulator is used here as a VFD drive. This was quite simple because all the simulation and hardware design was done step by step which anyone related to the engineering field could understand by all the simulation and hardware data, search and limitations were properly observed. This proposed system can perform multiple working units such as controlling, monitoring, fire protection and gas protection and can store the entire data in the cloud and show it on display. These decisions were programmed into ESP-32 which collected all the data from different sensors. This IoT based industrial machine management system will work independently with IoT connections and minimize labor and save the time and money required. This book illustrates how the IoT-based industrial management system works and gives a broad idea about this project.

Chapter 1

INTRODUCTION

1.1. Overture

"**IOT based Industrial Machine Management System**". The internet of Things is ending up being a distinct advantage for some, robotization organizations. Modern mechanization organizations can understand new advantages utilizing IoT arrangements. The internet of Things (IoT) makes new advances to tackle issues, improve activities and increment usefulness. IoT must be portrayed as an association with a realized electronic gadget utilizing Web Convention (IP), web administrations, and distributed computing utilizing Web 'information plumbing'. The effect of IoT on mechanical mechanization is gigantic and it enables us to utilize tablet PCs, advanced mobile phones and practical frameworks and information distributed storage and significantly more.

1.2. Significance of the Project / Research Work

In the traditional automation system can never monitoring globally, also there is no facility to reporting system so that, we can find out the working hours every day, month, and yearly in a machine. To solve this problem, we are thinking to develop a system.

1.2.1. Related Research Works

Geetesh Chaudhari [1] "Industrial Automation using sensing-based application"-The system makes use of microcontroller and various sensors to control the industrial devices using Bluetooth.

Ashwini Deshpande [2] "Industrial Automation using Internet of Things"-The industrial devices are controlled using cloud server which alerts the admin about uneven conditions using Bluetooth.

Dr.V. Ramya [3] “Raspberry Pi Based Energy Efficient Industrial Automation System”- Sensors such as gas sensor, temperature sensor is used to detect the faulty conditions. Raspberry Pi is connected through the LAN cable to the server PC in the Control Unit.

1.3. Engineering Problem Statement

IoT system is the latest technology in the world. We want to work this technology industrial machine management. This project involves communication between hardware and online software. This system has some challenging work

i) First Problem: To Extract the information from the existing system. To observe the machine, we have to sense the operating voltage, current, RPM, and different types of sensor value.
   By the using of different sensor problem become solved.

ii) Second problem: Interfacing between hardware and software and send the data over cloud.
iii) Finally, it has solved the problem by using the MQTT broker and Ubidots IoT platform.

1.4. Objective of this Work

To develop a system that naturally monitors mechanical applications and generates alerts and warnings or takes insightful choices using the concept of IoT. And besides, plan the framework to take in clever choice and control gadgets.

1.4.1. Primary objectives

- Find the related research work.
- To manage all components.
- To design the whole system.
- To simulate the whole system.

1.4.2. Secondary Objectives

- To make the whole system.
- To run the whole system
- To stabilize the system accessible and cheap

1.5. Comparison with Traditional Method

TABLE 1.1: COMPARISON WITH TRADITIONAL METHOD

SL. No	Facilities	Traditional System	IoT System
1	Controlling system	Manual and Physical Control	Can be controlled remotely
2	Monitoring system	Need to physically monitor in person	No need to physically present
3	Cloud data storage facilities	Use local physical drives to store data	Use remote drives to store data
4	Auto reporting system	Physically interaction is needed to operate	No need to physically interaction
5	Email & Mobile communication system	Physical act of transferring information	Can be transferred information remotely

1. Advantages

- Easy to controlling in industrial automation.
- Easy to monitoring all information in an industry.
- Store all the machine related information and can be analysis the information daily, weekly, monthly, yearly.
- Auto reporting system.
- Easy to find out the ON time and OFF time of machine in an industry.

2. Disadvantages

- This system is depending on the internet.
- Security
- Lagging
- Instants decision
- Intelligent Decision
- Bugs
- Training
- Expensive

1.6. Innovation / Scope of the Project

In existing industrial automation system, there is no online monitoring system, as the result management is difficult to monitoring a large industrial area. Also, there is no facility online reporting system; they are using hand reporting system. But hand reporting system is not authentic, they can manipulate as their wish. Management team can never exact report to the owner of the company, how long time ON/OFF their machine in every day, every weak, every month or yearly. But our system is more reliable reporting system. There is no scope for manipulating the reporting. This system is automatically calculating the operating time and send to the web server.

This system has email and mobile communication reporting facilities. This reporting process is completely automatic, no need to use any operator.

1.7.Impact of Project on Society

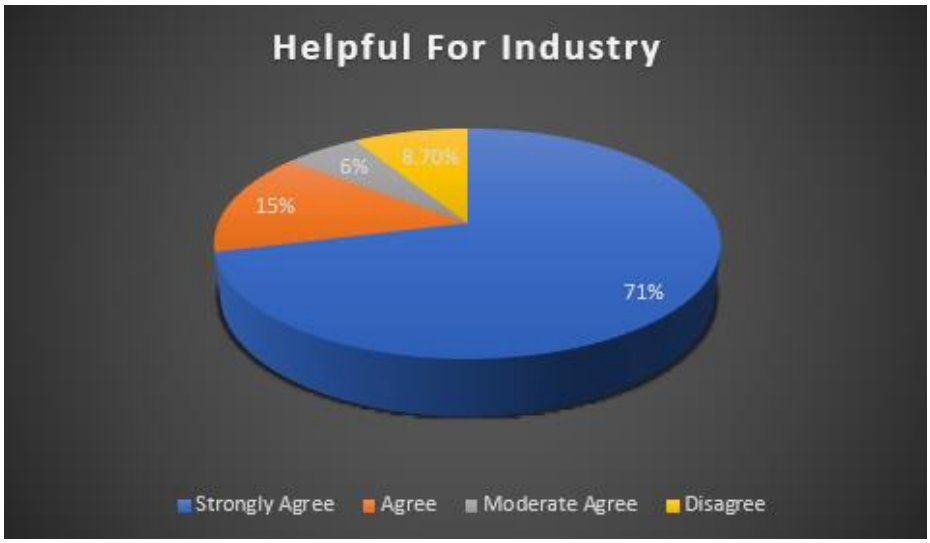
Concerning the IoT (Web of Things), we are entering a basic period where major and problematic changes in the public eye will before long arrive. One just needs to glance back at the improvement of the "Web of Individuals" to perceive how fundamentally and quickly it has changed society, admittance to data, and upset plans of action.

i) Tough industrial facilities that improve energy use, protect and prevent individuals from fire, and a positive use of such IoT.
ii) Management activities becomes easier and more reliable with low cost.
iii) This system can be monitoring globally, as the result worker will be more relaxation.
iv) This system is easy to diagnoses for electrical hazard.

1.7.1. Survey Data Analysis:

Survey question with graphical representation of the results:

1. Do you think that the system is helpful for industry?



This Pie chart provides information about the helpful issue in the system for industry. We can see that according to most people think that the system is helpful for industry.

We started this project with the idea that industries need to be more modern in this age of industrial revolution. From this pie chart around 71% people strongly agree that the system is helpful for industry. 15% people agree that it is helpful and 6% people moderate agree that the system is helpful. But 8.20% people disagree.

2. Do you think this system will confirm our safety?



This Pie chart provides information about the safety issue for industry. We can see that according to most people think that the system is safe for industry.

Our project has been implemented using the latest technology in which it is much safer and more usable. From this pie chart around 64% people strongly agree that the system is safe for industry. 25% people agree that it is safe and 5% people moderate agree that the system is safe. But 7.20% people disagree.

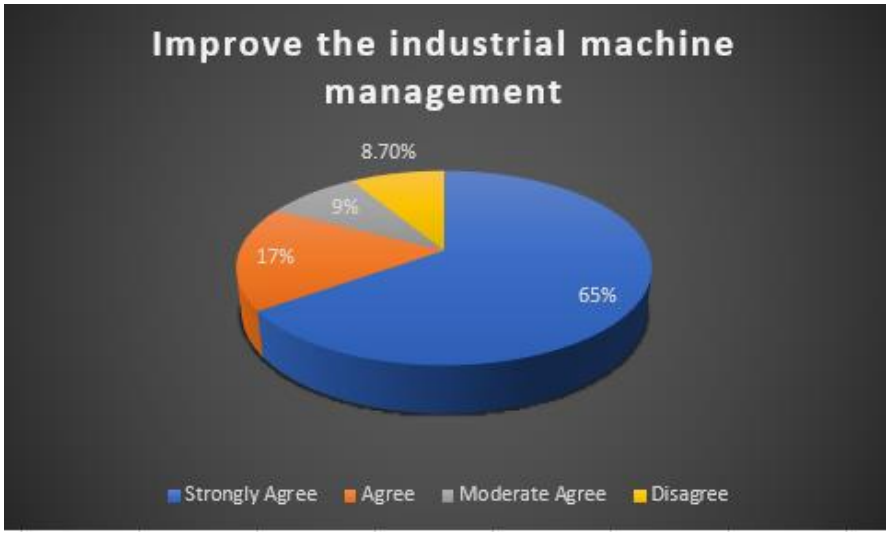
3. Do you think this will be cost effective?



This Pie chart provides information about whether it is cost effective or not for industry. We can see that most people think that the system is cost effective for industry.

Our project is built on the latest technology, which is available in the market at low prices. Any company can use it in their factory and any company will benefit financially from using this project. From this pie chart around 67% people strongly agree that the system is cost effective for industry. 20% people agree that it is cost effective and 6% people moderate agree that the system is cost effective. But 7.20% people disagree.

4. Do you think this system will improve the industrial machine management?



This Pie chart provides information about improvement of industrial machine management system. We can see that most people think that this system will improve the industrial machine management.

Our project will bring a lot of changes in the machine control of the industry. There will be no delay in machine control through the use of this project. There will be a huge improvement in the machine management system as there is automatic control. From this pie chart around 65% people strongly agree that the system will improve the industrial machine management. 17% people agree and 9% people moderate agree that it will improve the machine management. But 8.70% people disagree.

1.8 Organization of the book chapter

Chapter-1: Introduction part of this project, where overture, objective of the project, innovation of the project, engineering problem statement and impact of the project in the society are discussed in this chapter.

Chapter-2: Literature Review with in-depth investigation, historical background, earlier research andrelated research works are discussed in this chapter.

Chapter-3: Project Management, SWOT analysis, PEST analysis & cost analysis and individual activities are described here.

Chapter-4: Methodology and Modeling, Block Diagram, Flow Chart and Simulation are described in this chapter.

Chapter-5: Implementation of Project is described in this chapter.

Chapter-6: Results Analysis & Critical Design Review in this chapter.

Chapter-7: Conclusion

Chapter 2

LITERATURE REVIEW WITH IN-DEPTH INVESTIGATION

2.1. Introduction

Internet of Things (IoT) is quickly expanding innovation. IoT is the organization of actual articles or things installed with gadgets, programming, sensors, and organization network, which empowers these items to gather and trade information. In this paper, we are fostering a framework which will naturally screen the modern applications and produce Cautions/Alerts or take savvy choices utilizing idea of IoT. IoT has given us a promising method to fabricate incredible modern frameworks and applications by utilizing remote gadgets, Android, and sensors. A primary commitment of this survey paper is that it sums up employments of IoT in ventures with Knowledge to screen and control the Business.

2.2. Historical Background

The device is set up to gather the mechanical information through different sensors and this information are goes about as a contribution to the program grouping to refresh the yield. The sensors get simple information from the different machines which is changed over into computerized without anyone else and afterward shipped off the worker with the assistance of the ESP32 module where all the information are put away in the cloud [5]. The framework cycle should be possible dependent on the succession given in figure. The framework checking the air sense esteem continuously and log information to a far off worker, and keeps up the information refreshing over the web. Worth estimations have taken dependent on the sensors voltage measurements and examined. The outcome is shown on the presentation interface and could be

gotten to through the cloud on keen cell phones utilizing Ubidots. On the off chance that the edge esteems for sensor levels are surpassed, the application sends notices to the clients.

The users ready to screen the deliberate boundaries on their advanced cells. The framework estimations are shipped off the cloud worker in each one-minute stretches. The figure 1 shows the rundown of parts utilized in the proposed framework.

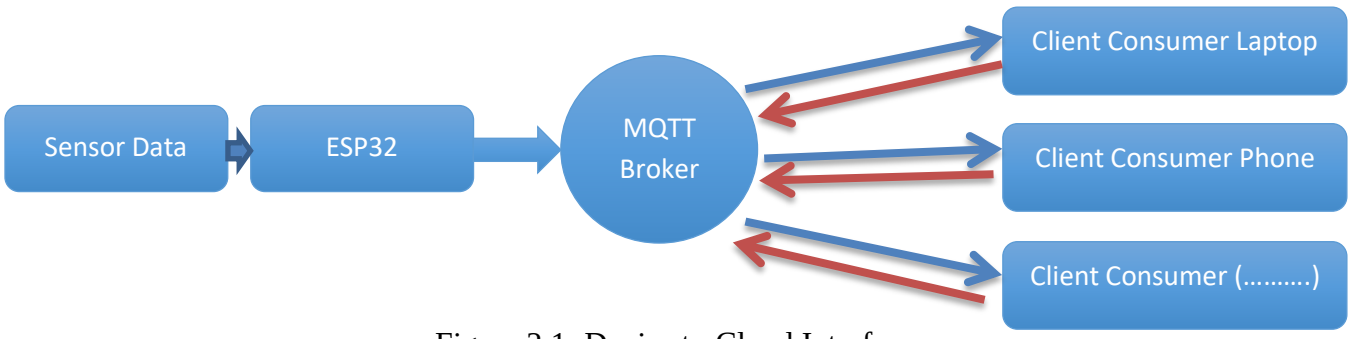


Figure 2.1: Device to Cloud Interface

Sensors are used to sense the presence of voltage, current, speed, amp, etc. All the information is changed based on the load and supply.

2.3 Earlier Research

We first think collectively to create a block process of the system and create a schematic diagram. Next, we make a list of what it might take to make it and register the items we need in the list. Later we started collecting the necessary goods from various online shops. When all the goods reach us, we start researching them and we start searching on Google about how each component works. By researching from Google, we learn to use sensors. First of all, we are tested the entire component, as our test we think that all are ok. Now we are trying to develop the system as our schematic diagram.

2.4. Related Research/Published Works

A recent executive survey conducted by Forbes Insights found that the biggest challenge in building out IoT capabilities is the quality of IoT technology. Many companies are facing problems with the adoption of industrial IoT during identification of automated process for achieving highest effectiveness (Raj Ven, 2018). Adopting IoT technology in the manufacturing industry is one of the shot ways for getting competitive advantages and it helps to create enterprise value in the process (Toya Peterson, 2016). Press release of IoT Analytics (2018) said that the 4th industrial revolution (I4.0) employs a combination of multiple technologies that manufacturers are implementing to realize key use cases for improving efficiencies, generating revenues and reducing risks. The product and service market of I4.0 is predicted to grow to $310 billion by 2023. As per the survey conducted by the Accenture, Business insider & SAP (2015) of 1400 owners of business, 60 percent of the global manufacturers will use connected devices to analyses and optimize processes, 36 per cent of the business leaders understand IIoT, out of this, only seven per cent are able to implement it. Also, it is found that $70 billion would be capitalized by manufacturers in IIoT by 2020 and product development and assembly costs can be reduced to 50 per cent.

2.5. Critical Engineering Specialist Knowledge

We have faced many problems while doing this project, one of the problems is online communication and data storage. After studying all the work has been done online before, we have found some way to solve the problem. But most of the solution is expensive and difficult. After long time searching in online, we have found an easy way for student package. Ubidots is an internet of Things (IoT) information examination and representation organization. We transform sensor information into data that is important for business-choices, machine-to-machine connections, instructive exploration, and increment streamlining of worldwide assets.

2.6. State of the art technology

"Now we can collect data from our climate, infrastructures, companies, and even ourselves," said Alicia Asn, CEO of Liberium. "This massive volume of data is creating a new ecosystem

of market opportunities around its storage, analysis, and accessibility." IoT is a fascinating industry that promises to make life easier. The market cooperative and mechanical specialists with the IIoT guarantees huge development and they are anticipating a ton of saving expense, high efficiency, and assessed financial plan to reach $123.89 Billion by 2021 [18]. A few organizations like Honeywell, Cisco, Emerson, Take-up, Yokogawa, and GE are giving completely incorporated savvy processing plants frameworks utilizing IIoT stages, however their degree is to cover huge scope exercises like rail route coordination, power age and appropriation, oil and gas activities, and avionics armada [19]. As indicated by the report, the IIoT and IDA have expanded income, consumer loyalty, and item nature of the shrewd production lines up to 33.1%, 22.1%, and 11.0%, individually. Besides, the report says that 68% of assembling organizations have their nearby IDA methodology, 46% have some likely authoritative stages, and just 30% have achieved genuine IDA projects. That implies 70% of the organizations actually don't have standard information securing and investigation stage to make their business more astute and productive. Although many industries are as of now utilizing the IIoT widely yet there is parcel of room to do more work in this field. As indicated by a review directed by PwC in [21], only 33% of makers in the US is gaining and utilizing information produced by savvy gadgets to improve their working and assembling measures. The IIoT is contributing in practically all spaces of present day fabricating measures including production network, measure control, coordination, upkeep and framework [22]. An exploration study given by Heymann in [23], anticipated the change cost of current businesses into keen ventures (Industry 4.0) might be as much as 267 Billion Euros of the German economy by 2025. Notwithstanding, embracing IIoT as a savvy fabricating arrangement can confront a portion of the enormous security and information protection issues. Jayasri et al. [24]

2.7. Summary

The Industrial IoT (IIoT) framework permits the business to gather and examine a lot of information that can be utilized, adapted and improve the general exhibition of the frameworks for giving new kinds of administrations. In this paper, we have featured the most recent cutting edge research endeavors in IIoT. Especially, three spaces of examination including IIoT structures and systems, correspondence conventions and information the executives procedures are investigated

exhaustively. We introduced different empowering advances identified with IIoT. In addition, significant open examination challenges are identified for the fruitful arrangement of IIoT. This examination reasons that the achievement of IIoT is obstructed by various difficulties featured in this investigation which incorporate effective information the board plans, joint efforts between heterogeneous IIoT frameworks, hearty and flexible huge information insightful advancements, trust on IIoT frameworks, concurrence of remote advances and conventions in IIoT, empowering decentralization on the Edge, specific working frameworks and public wellbeing in IIoT. These difficulties can be overwhelmed by proposing suitable arrangements. This examination can be used as a rule to address a portion of the uncertain difficulties in the field of IIoT. Our future examination means to investigate the exploration patterns in empowering customized producing in IIoT frameworks.

Chapter 3

PROJECT MANAGEMENT

3.1. Introduction

Internet of Things could be a later advancement that causes a worldwide to coordinate of machines and contraptions that are capable of conveying and exchanging data with one another through the web. There's a differentiation between the internet of Things and the internet. Internet of Things can make information around the related items, dissect it, and settle on decisions; at the end of the day, one can tell that the web of Things is sharper than the Internet. Surveillance cameras, sensors,

vehicles, structures, and PC program are outlines of things that can exchange data among one another. Hence, project the executives is important to tackle this significant Capstone project. In this section, P.E.S.T. examination, S.W.O.T. investigation and cost examination will be talked about. In this section there will likewise examine about the commitment and the declarations.

3.2. S.W.O.T. Analysis of the Project

SWOT could be a strategic arranging instrument. S.W.O.T. Analysis, where S stands for Strengths, W stands for Weaknesses, O stands for Opportunities, and T stands for Threats. It includes indicating the objective of the venture. It is additionally distinguishing the inside and outside variables. Those variables which are favorable and unfavorable to accomplishing that objective. The qualities and shortcomings as a rule emerge from inside an organization and the openings and dangers from outside sources. SWOT investigation for extend administration is a successful handle. SWOT moreover permits the extend chief to recognize the zones that must advancement. By using the SWOT analysis, we will to progress the total venture or person assignments. By taking after the SWOT effectiveness can be picked up. SWOT too mitigates dangers with the assignments.

Strengths:

- This system is very user friendly.
- Global controlling and monitoring system.
- Data storage system.
- Live data monitoring system.
- Fire protection system.
- Gas leak protection and detection system.
- It is possible to minimize the power loss any industrial systems.
- Auto reporting system.

Weaknesses:

- Without internet facilities it is not possible to provide the services.
- Need the skill person to operate and customize the system.

Opportunities:

- More sensors can be extension easily.
- It is possible to transfer Device to device data transmitting.
- Multi factory's data can be possible to summarize and controlling in the system.

Threats:

This project has several opportunities as well as it has also some particular threats which are given below:

- The system is not biasing which is small factories.
- Initial cost high to develop the IIoT system of the industries.
- Without internet facilities the system will not working.
- Digital security system must be secured without it may danger.
- Without skill person it's not possible to customize the system.

3.3. Schedule Management

Project Schedule (Gantt chart) Group 16

We had a long haul orchestrate finishing the whole meander work effectively. From the inquisitive of the semester we are working agreeing to our very much arranged mastermind. We had made convey graph and effectively finishing the tasks.

TASK	2nd Nov 2020	12th Nov 2020	7th Jan 2021	14th Jan 2021	17th Jan 2021	21th Jan 2021	10th May 2021	22th May 2021	28th May 2021	31th May 2021	3rd June 2021
Orientation											
Submission of Proposal (Online)(Google link)											
Submission of Draft Chapter 1 & 2 and Progress Report to Supervisor for review											
Upload Chapter 1 & 2, Progress Report (approved by supervisor) Online											
Upload Video Presentation (After approval of Supervisor) Online(Google link)											
Online Progress Defense (in MS Teams)											
Submission of Draft Project Book to Supervisor for review											
Submission of Draft Project Book to External for review											

Submission of Book, Poster and Summary to supervisors											
Upload Video Presentation											
Final Defense											

Figure 3.1. Gantt chart of the project

3.4. Cost Analysis

Table 3.1: Cost Analysis of This Project

Serial Number	Components	Specification	Quantity	Unit Price (Taka)	Total Price (Taka)
1	ESP32	Built in Wi-Fi	1	900	900
2	Power Supply	24Watt	2	300	600
3	ACS712	5A	1	350	350
4	Resistor 10K	Variable	3	15	45
5	Vero board	Separated dot	1	30	30
6	Motor Drive	Dual Bridge	2	350	700

7	Motor	12V	1	100	100
8	Motor with Fan	12V	1	100	100
9	Bread Board	Big Size	1	100	100
10	Jumper Wire	M-M,M-F,F-F	3-set	90	270
11	LED	5mm 3V	3	5	15
12	Variable Voltage source	12V/5V/3.3V	1	200	200
13	Resistor	10k,100k,220	10	1	10
14	Glue Stick	Big size	5	20	100
15	Fan Base	Plastic	1	50	50
16	PVC Sheet	2’ By 2’	1	200	200
17	Super Glue	4 ml	1	50	50
18	Green Connector	2 Pin	4	20	80
19	Gas Sensor	MQ Series	1	350	350
20	Flame Sensor	Small PCB size:3.2CM*1.4CM	1	88	88
21	Display	OLED	1	280	280
22	Current Sensor	ACS712-30A	1	219	219
				Total	**4837Tk**

3.5. P.E.S.T. Analysis

P.E.S.T. Analysis, where P stands for Political, E stands for Economic, S stands for Social, T stands for Technological.

- **Political:** The Public authority of Bangladesh has reported 'Vision 2021' with an objective to shape Bangladesh as a middle compensation country using Information and Correspondence Development (ICT) and improvement of positive trade climate for innovative organizations. ICT has been considered as a pushed division. Government has taken various exercises to achieve the objective. Among them favorable trade climate for Howdy Tech Ventures is mentionable.

- **Economic:** Opportunities are opening up for new researchers with the necessary funding for that skills-oriented jobs play an active role in the economic development of a country. Private companies are investing their money in latest technologies with their research capabilities [10].

- **Social:** Through this technology, it will be able to keep pace with the efficient and new technology of this country. As a result, world class engineering will be developed.

- **Technological:** The Internet of Things will demand an extensive range of new technologies and skills that many companies haven't yet mastered. Private and public industries are investing money for researching Industrial IoT to achieve the industrial 4.0 revolution.

3.6. Individual Accountabilities

For Simulation and Hardware Part:

- **Moon Md. Abdul Muttalib:** He gave the idea to build ‘Design and Implementation of IOT base Industrial Machine Management System. He was involved in our project book writing. He was also involved in the project simulation and the project implementation.
- **Nishan Julquernine:** He was involved in writing code for ESP-32. He was also involved in project simulation and implementation.
- **Hosen Sazib:** He was involved in hardware buying and project implementation.

- **Azad Md. Abul Khair:** He was also involved in hardware buying project, implementation and project book writing.

Overall, all the group members were involved until the end of this project in everything from the concepts to hardware implementation. And our project was completed within the stipulated time.

3.7. Multidisciplinary Components Management

For a project to be effective, a group or an individual must have certain characteristics related to the task assigned to it. Now this section will discuss the use of the management systems.

Managerial Function

- Planning: Defining goals and strategy for implementing the project. The strategy is converted into appropriate co-ordinations.
- Organizing: Determining the requirements of a project. Implementation of a structure in a group with assigned task.
- Leading: A leader who is going to lead a group. The leader of a project team must be visionary and precise.
- Controlling: Identification of mistakes in the execution of a project. Quality control is necessary for expecting better output. Analyzing the data obtained from the simulation and the hardware. Analyzing pros and cons after the completion of the project.

Multidisciplinary Skills

- Conceptual Skills: It is important for an engineer to provide innovating ideas before implementing any complex project just like ours.
- Interpersonal Skills: It is important for an engineering to maintain balanced relationship between his or her group and external organization. In other words, a project and a material supplier.
- Professional Skills: It is important for a group have decision-making skills and cognitive skills at the critical stages of completing the project.
- Technical Skills: An engineer or group of engineers must have an advanced engineering knowledge that is associated with this project. These are:

i. Software: Arduino and Proteus software was applied to implement the project. For Arduino, 'C' programming language was required to embed the controlling system of the project.

ii. Industrial Internet of Things Technology: In order to implement a project, types of IIoT technology and its property must be known to an engineer before implementing any project.

iii. Control System: In order to build a proper and functioning device, types of control system must be identified whether open-loop or closed-loop system will fulfill the requirements of the project.

iv. Power Electronics: The subject that with power electronic devices such as dc to dc converter, motor driver, etc.

3.8. Project Lifecycle

This project has its own parameters and features or characteristics. This projects lifecycle passes through four phases, and those are discussed in below:

- **Initiating:** Setting goals and strategies for project execution. Risk assessment includes cost analysis, advantages and disadvantages for the project.

- **Planning:** Schedule and rescheduling of project implementation. Tasks are assigned to a person in a group.

- **Monitoring and Controlling:** The project needs to be constantly quality tested to get a desired output. It is very important to cross-check the fault also. To keep an eye on each task assigned individually is also very important. Overcoming errors with maximum efficiency is an important part of the project planning process.

- **Executing:** There are some criteria that need to be followed in this project management.
  - ✓ Human resources.
  - ✓ Communications.
  - ✓ Time.

- ✓ Quality.
- ✓ Cost.
- ✓ Procurement.
- ✓ Risks. Etc.

Block Diagram of Project lifecycle:

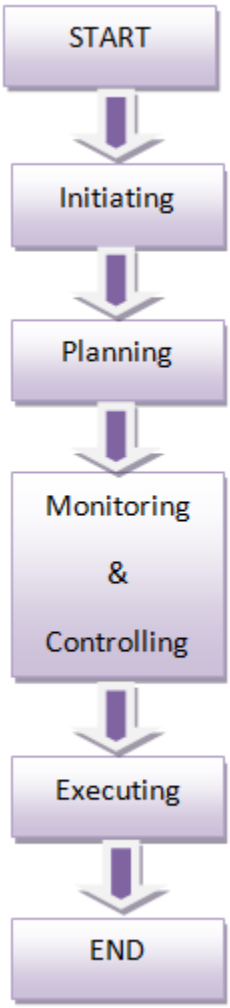


Figure 3.2: Block Diagram of Project Lifecycle

3.9. Summary

In this chapter, the management of the schedule with the help of Gantt charts was discussed in detail. The Gantt chart shows the task and the scheduled date. The cost was analyzed with the help of mathematical formulas related to the standard deviation between the estimated price and the market price. S.W.O.T and P.E.S.T.E.L analysis were discussed. The chapter also deals with the contributions and testimonials of the group members involved in the implementation of the project. Individual accountability as well as various management functions and skills were discussed.

Chapter 4

METHODOLOGY AND MODELING

4.1. Introduction

In this chapter, describe the simulation and planning of the project implementing. Then created a dual-axis solar panel system that can rotate with the sun. And it can turn around. First prepare its block diagram, flowchart to create it. Next assemble the hardware. And used ESP development kit in this project, know that ESP32 is the most used node series microcontrollers. Here Node MCU microcontrollers have been used in ESP32. Using Arduino IDE software to program. This is a free software. In between sort out the instructions for this project through C and C plus programming.

4.2. Methodology

In this section, block diagram and flow chart of the chart will be discussed in details. And will also be discussed about the circuit connection and the simulation result.

4.2.1. Block diagram

Below the block diagram is represented the individual application of the objectives of this project. The block diagram describes the main goal of this project which is the working process of the whole device.

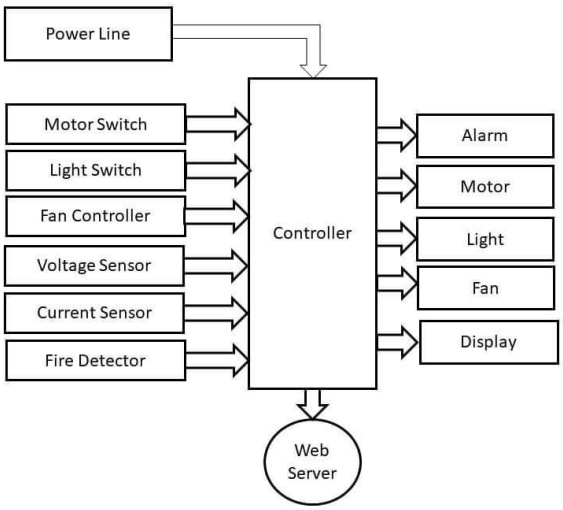


Fig. 4.1. Block diagram

This block diagram in figure 4.1 explains the main working principle of our project. Here, this project is divided into two parts. The first is the input and the other is the output. Here the input parts connected with esp32 are gas sensor, flame sensor, light regulator, fan regulator. And the output parts are display, cloud, motor, fan & light. Here AC to DC converter has been done after taking AC source. Again Dc source has been converted from 12 volts to 5 volts through Dc to Dc Buck converter. Gas sensor, flame sensor are all connected to DC Buck Converter to activate them. Ac to Dc converter is connected to motor driver. The current sensor is connected to the motor driver for the light and the light is connected to the current sensor. Similarly for motor and fan, the motor is connected to the motor and the fan is connected to another motor driver. The output of the flame and gas sensor and also motor, light and fan will show on the display and will be stored in the cloud as data. Also, all this data will be sent to the authority automatically via email. If the light regulator is rotated, the intensity of the light will change and it will be stored as cloud data. Similarly rotating the fan and motor regulator will change the speed of motor and fan and all this data will be stored in the cloud. With all this data, power and energy consumption will automatically be measured.

4.2.2. Planning

Creating an idea for Design and construction of IoT Based Industrial Machine Management System. And designing a block diagram & circuit diagram to know which components need to construct it. Collecting the all components and programming for the microcontroller to controlled the system. Setting all components in a PCB board & soldering. Then assembling the whole block in a board and finally run the system & checking.

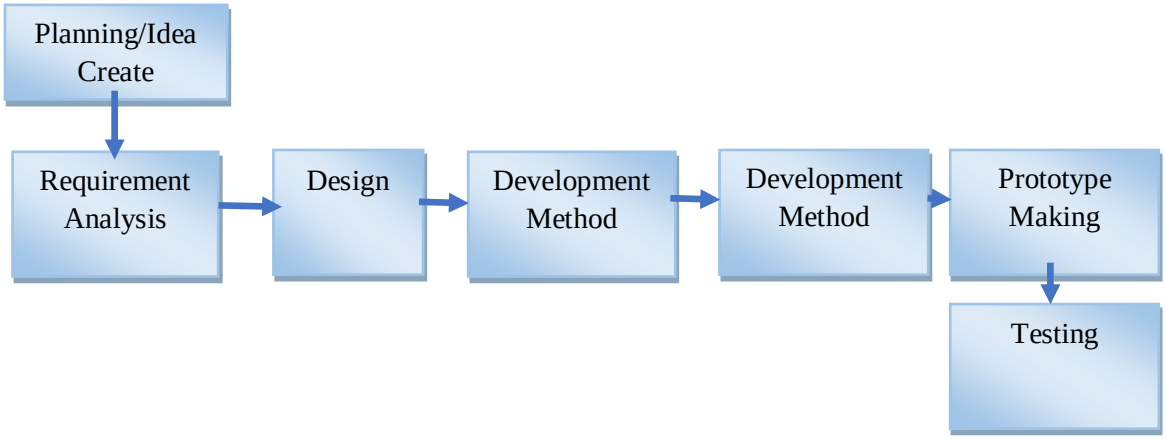
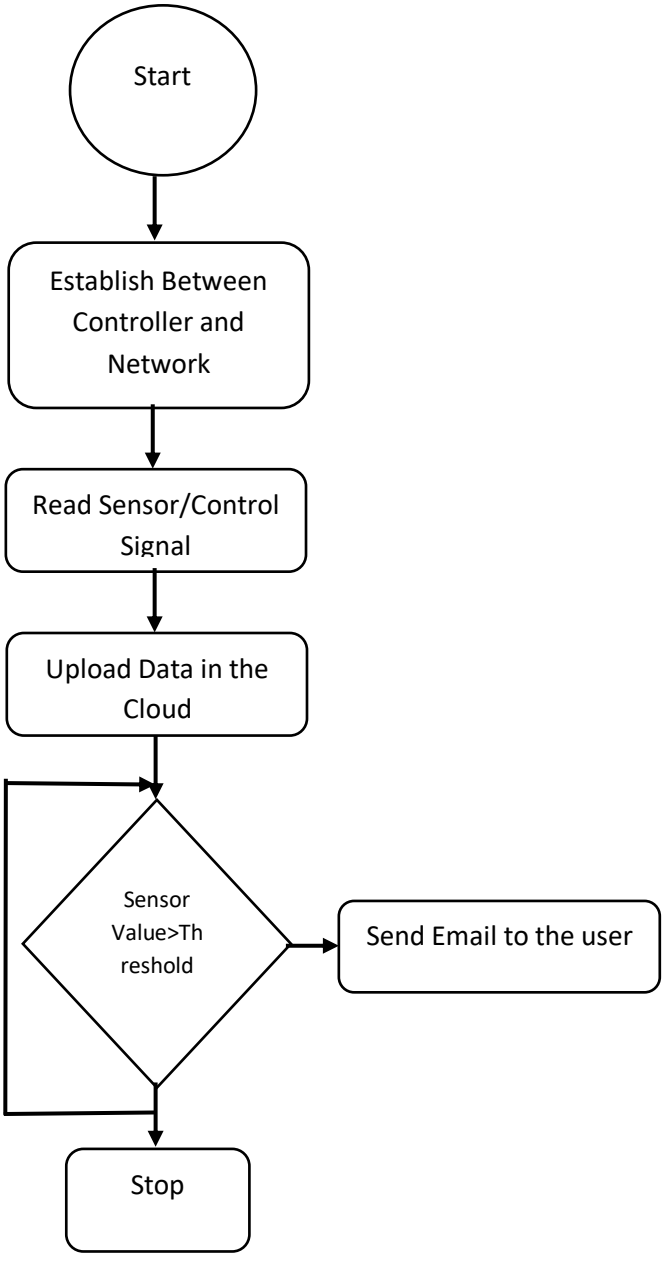


Figure 4.2: System Planning Diagram.

First think about IoT system. What is IoT and Industrial IoT system? Then started to find out the IoT services software and hardware. After finding the web service and hardware move to know about the programming. Here used C and C++ language to write the programming. At learned about the interfacing the hardware and software communication without web services. When experiment has done as our expectation then move to the web services.

4.2.3. Flow Chart:



A flow is represented the process of the system. At first start the program then it's connected with controller and internet. All the input signal and output signal is connected to the controller. Sensors and control signal is act as the input parameter. The controller takes data from different sources and upload the data in the cloud. Then the action step, where used different types of sensors to protect the industrial environment. When unexpected value is present in the system and exceed permit table value the system sends the email to the user, otherwise the system is okay.

4.3. Software Requirements

- Fritzing Software.
- Arduino Software IDE.
- Proteus 8.9.
- MATLAB 2016.
- V1000 Programming Simulator.
- Ubidots (Web interface).

4.3.1. Fritzing Software:

Fritzing is an open-source drive to foster novice or diversion computer aided design programming for the plan of gadgets equipment, to help planners and specialists prepared to move from trying different things with a model to building a more perpetual circuit. The complete framework was planned by Fritzing programming.

4.3.2. Arduino Software:

The smart microcontroller unit named as Arduino Uno can be customized with the Arduino programming. There is no any prerequisite for introducing other programming as opposed to Arduino. We have composed our code in this software.

4.3.3. Proteus 8.11 Professional

The Proteus Design Suite is a restrictive programming apparatus suite utilized fundamentally for electronic plan computerization. The product is utilized primarily by

electronic plan architects and specialists to make schematics and electronic prints for assembling printed circuit sheets. The entire venture is mimicked by proteus 8.11.

4.3.4. MATLAB R2016a

The motor driving system simulated by the proteus and MATLAB software. We designed VFD drive in Matlab R2016b

4.3.5. V1000 Programming Simulator:

The V1000 programming simulator is used here as a VFD drive.

4.3.6. Ubidots (Web interface)

Ubidots is an internet of Things (IoT) information examination and representation organization. We transform sensor information into data that is important for business-choices, machine-to-machine collaborations, instructive exploration, and increment streamlining of worldwide assets. Ubidots exists as a simple and reasonable intends to incorporate the force of the IoT into your business or exploration. Cloud computing is the act of utilizing far off workers on the web to oversee store and cycle information as opposed to utilizing a PC.

4.4. Simulation:

Simulated results and description of the circuit will be explained details in this section.

4.4.1. Circuit Design of the Project (For Low Load):

The motor driving system was simulated by the proteus software. Moto and fan are the same parameter of the circuit. Motor and fan are connected to the output of the L298 motor driver. The motor driver is given 12 volts to run the motor and fan. The input is given five volts which will be connected to esp32. That means 5V is given at the input to mean connected to the motor and fan regulator.

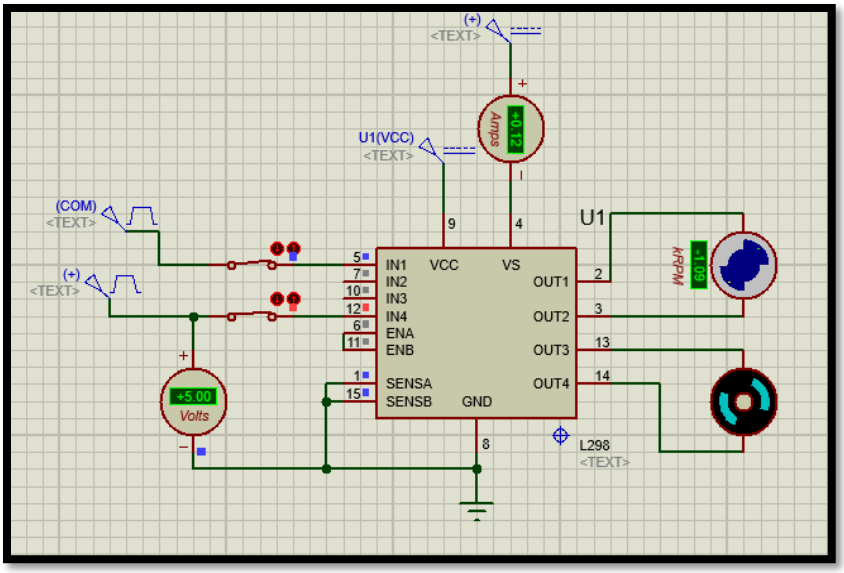


Figure 4.4: Circuit Design of a motor and fan controlling

The second experiment was done by lighting system. When change the potentiometer value the brightness of the light and power consumption be changed.

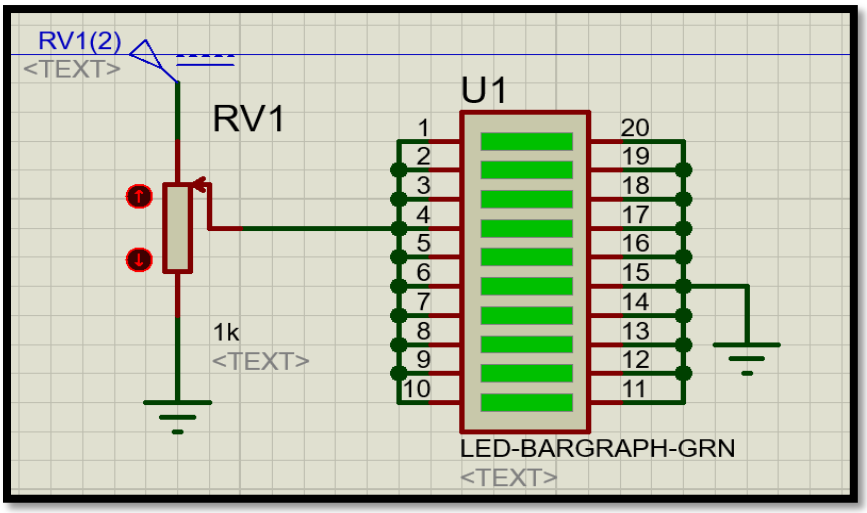


Figure 4.5: Simulation of light controlling.

In the third experiment it's used flame sensor, Gas sensor and controller. It was working perfectly as the condition logic.

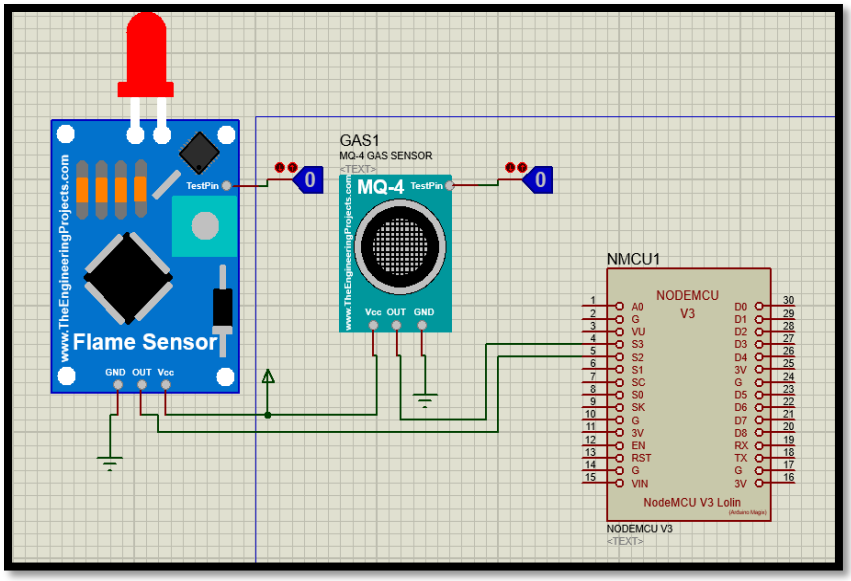


Figure 4.6: Simulation of Fire, Gas

In the fourth experiment it's used gas sensor, flame sensor and controller with display. Here the toggle logic of flame and gas sensor has been used. That is, in case of film sensor, if it is '0', it will show 'No Fire and if it is logic '1', it will show 'Fire'. And in the case of gas sensors, if the logic is '0', then it will show 'Natural Gas'. And if logic is 1 then it will show 'Gas is detected'.

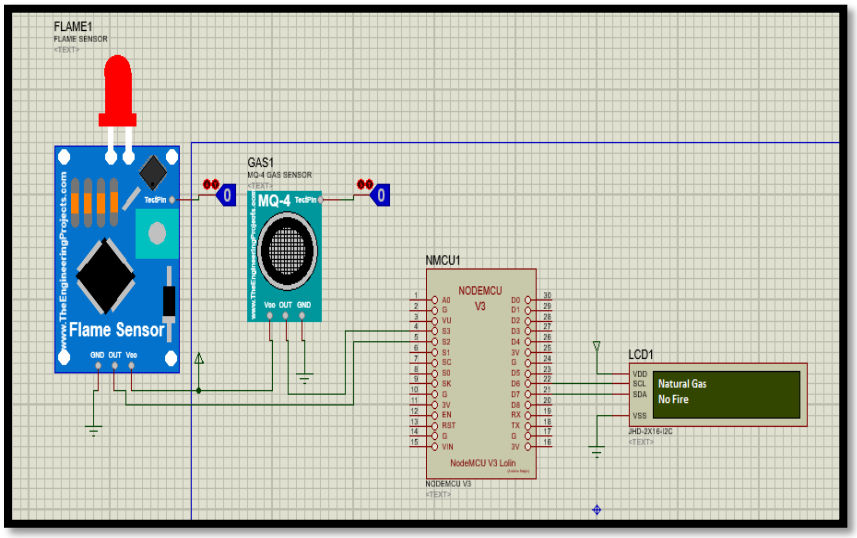


Figure 4.7: Simulation of Fire, Gas and Display

In the last experiment used all the component as our requirement and it's performed perfectly. Here in the input of the microcontroller are connected three potentiometers called RV1, RV2, and

RV3 as well as a sensor called flame sensor and MQ-4 gas sensor. On the other hand two motor drivers and a display are connected to the output of the microcontroller (NODEMCU). The first motor driver is connected to the current sensor again. The LED bar graph is connected to the current sensor. Motor and fan connected with the second motor driver.

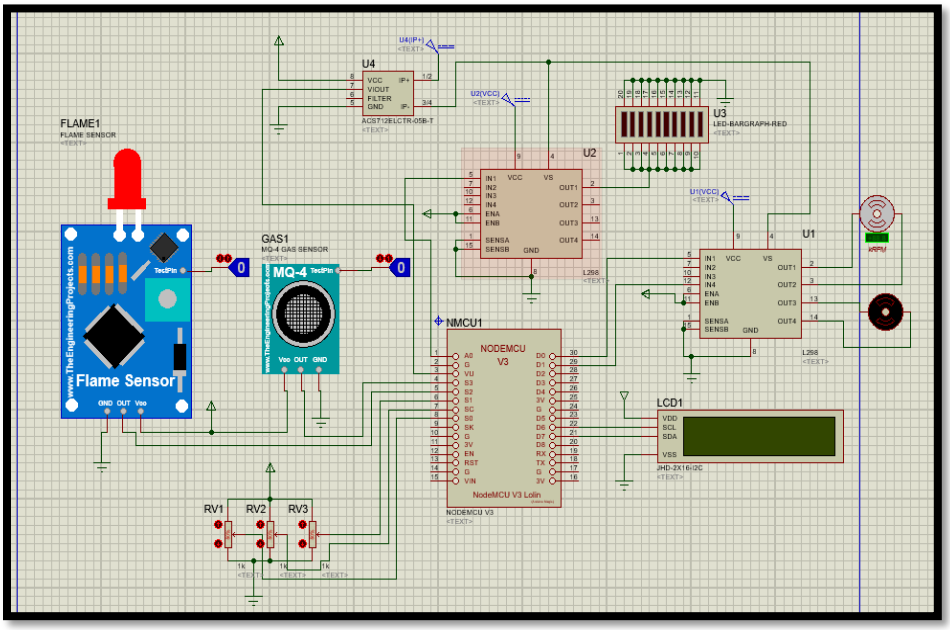


Figure 4.8: Project simulation

4.4.2. Circuit Design of the Project (For High Load):

The total system was designed by Fritzing software and the motor driving system simulated by the proteus and MATLAB software. Moto and fan are the same parameter of the circuit. By the changing the pulse width modulation the motor and fan be controlled. By the changing the input signal of the motor driver it changes the speed and power consumption.

Here the input parts connected with esp32 are flame sensor, light regulator, fan regulator. And the output parts are display, cloud, motor, fan & light. Here AC to DC converter has been done after taking AC source. Again Dc source has been converted from 12 volts to 5 volts through Dc to Dc Buck converter. Gas sensor, film sensor are all connected to DC Buck Converter to activate them. Ac to Dc converter is connected to motor driver. The current sensor is connected to the motor driver for the light and the light is connected to the current sensor. Three phases Ac source is

connected to VFD and VFD connected with motor driver and induction motor and fan are connected with VFD. The output of the flame sensor, gas sensor, motor, light and fan will show on the display and will be stored in the cloud as data. Also, all this data will be sent to the authority automatically via email. If the light regulator is rotated, the intensity of the light will change and it will be stored as cloud data. Similarly rotating the fan and motor regulator will change the speed of motor and fan and all this data will be stored in the cloud. With all this data, power and energy consumption will automatically be measured.

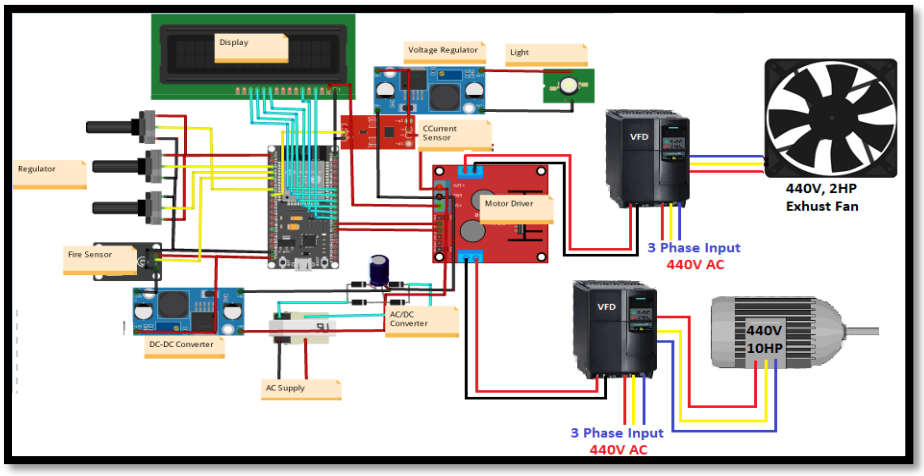


Figure 4.9: Project Design

Here in the input of the microcontroller are connected three potentiometers called RV1, RV2, and RV3 as well as a sensor called flame sensor and MQ-4 gas sensor. On the other hand two motor drivers and a display are connected to the output of the microcontroller. The first motor driver is connected to the current sensor again. The LED bar graph is connected to the current sensor. The motor driver's output will be connected to the VFD.

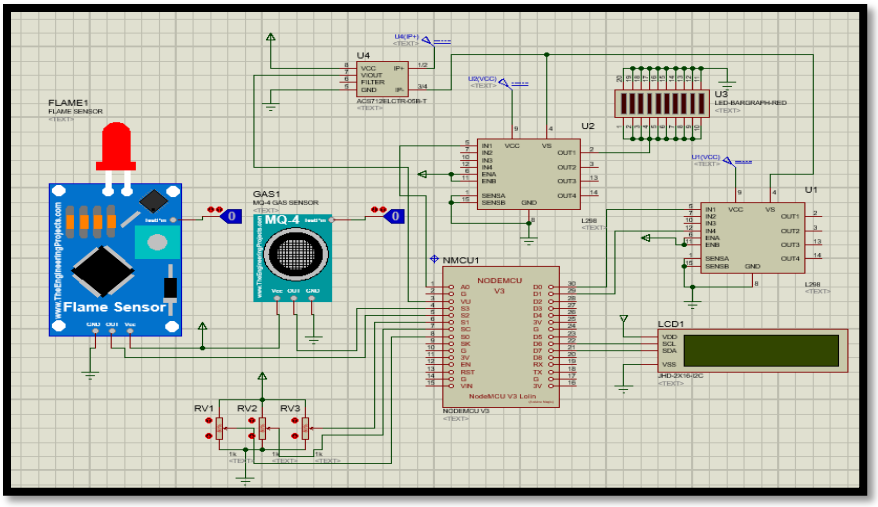


Figure 4.10: Project Simulation without VFD

Pulse width modulation (PWM) uses digital signals to control power applications, as well as converting back to analog with minimal hardware is fairly easy. Analog systems, such as linear power supplies, tend to generate large amounts of heat as they carry large amounts of currents, essentially variable resistors.

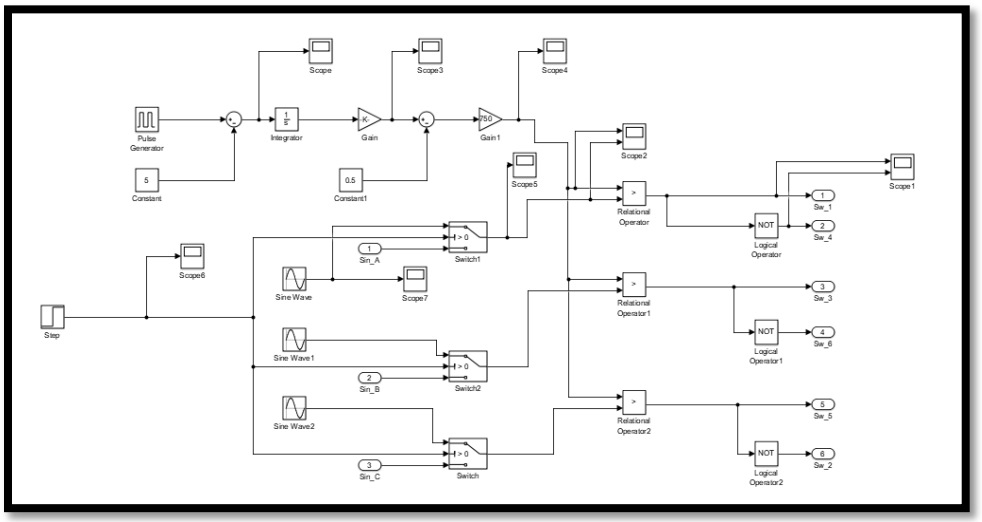


Figure 4.11: PWM

An inverter controls the recurrence of control provided by an AC engine to control the turn speed. Without an inverter, the AC engine will run at full speed as before long as the control supply is turned on.

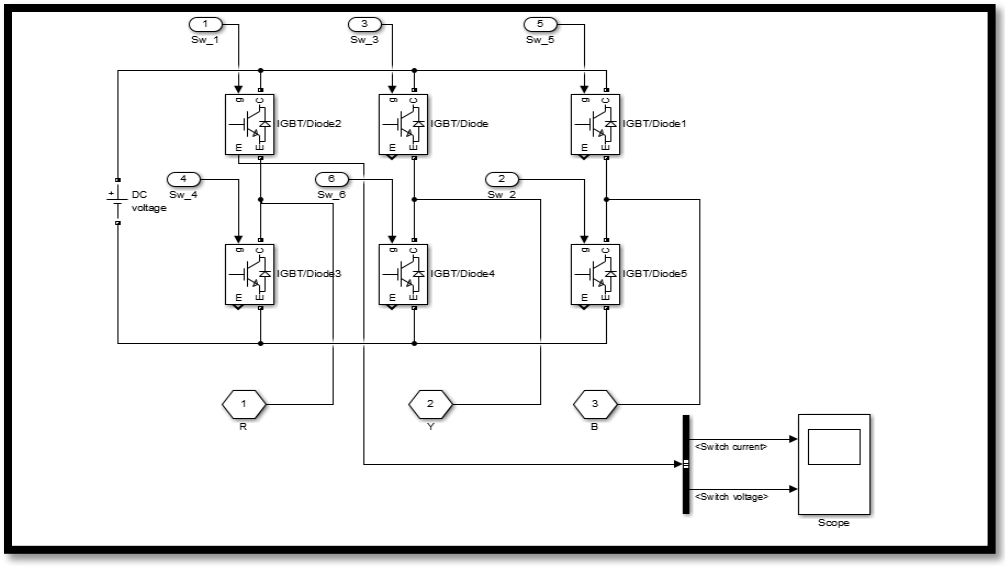


Figure 4.12: Inverter

The converter section uses subsystem2, Ramp, Constant, Saturation, Gain1, Gain2, Relation Operator, Switch, and Product to convert Ac input voltage to Dc voltage. The PWM is to create a sine wave current waveform output to deliver force in the motor. And inverter convert Dc to Ac voltage.

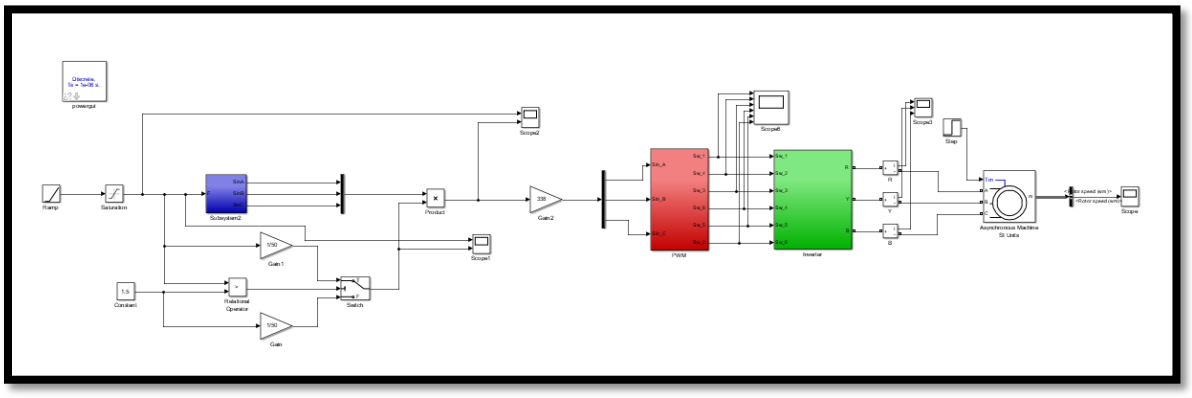


Figure 4.13: VFD Simulation

When a 3 phase voltage is applied to rotate the stator to start the induction motor, the high inertia current magnets the air gap between the stator and the rotor. Due to the rotating magnetic field an induced amp is formed in the rotor winding of the induction motor. So graph in Figure 4.14 shows

that the speed of the rotor was higher at once. Then it slowly starts to decrease and gradually it goes into saturation.

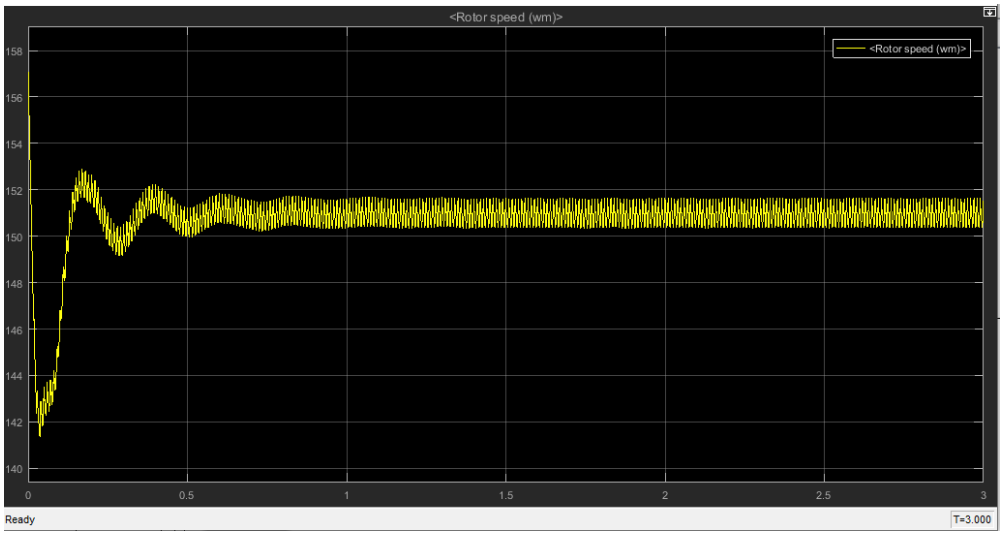


Figure 4.14: VFD Simulation Result

The V1000 programming simulator is used here as a VFD drive. Here it is seen that the application of 50 Hz in VFD causes the motor speed to rotate smoothly at 1500 rpm.

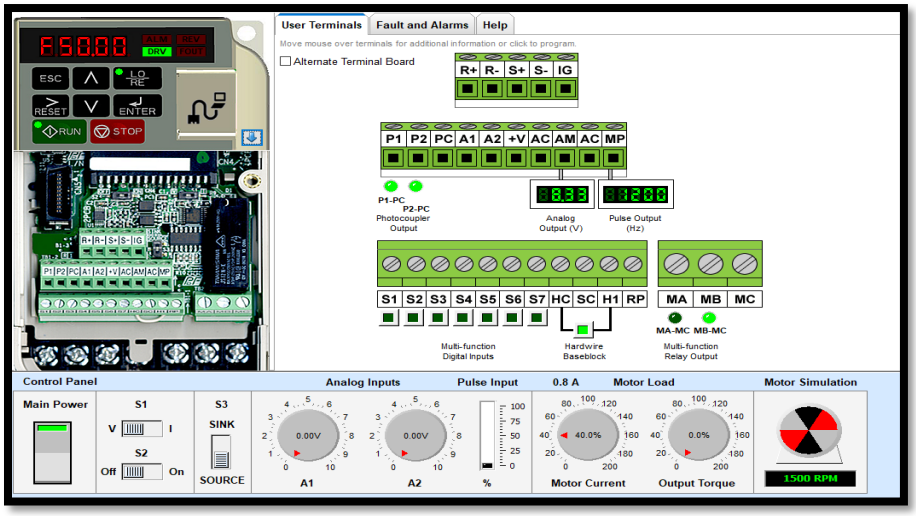
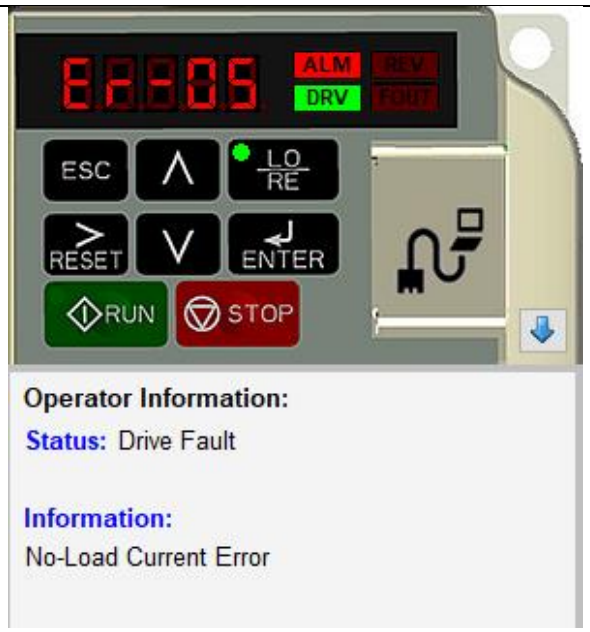
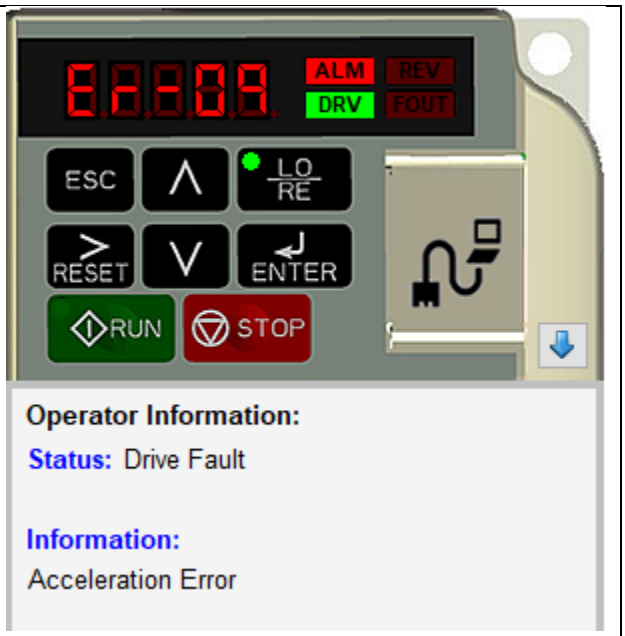


Figure 4.15: VFD Simulator

Fault analysis can be done very easily through VFD drive. There are many types of faults in the industry such as No load current error, acceleration error, motor speed error, current detection error

etc. can be easily identified. Motor no-load current is only an estimating the engine current without interfacing any mechanical loads in short structure "shaft will be driven by hand unreservedly". Likewise at no heap, the force factor turns out to be poor. Since engine draws high responsive current instead of the dynamic current. Speed increase estimates legitimate beginning and running of motor on load with given system without causing stumbling or insecurity in the system. The impact of the system voltage during beginning and building up whether the motor will turn over sufficiently and come up to speed. When the speed increases time is short then we can see acceleration error. If the maximum voltage of the motor is not given the motor will not rotate at proper and maximum speed. This is called motor speed error.





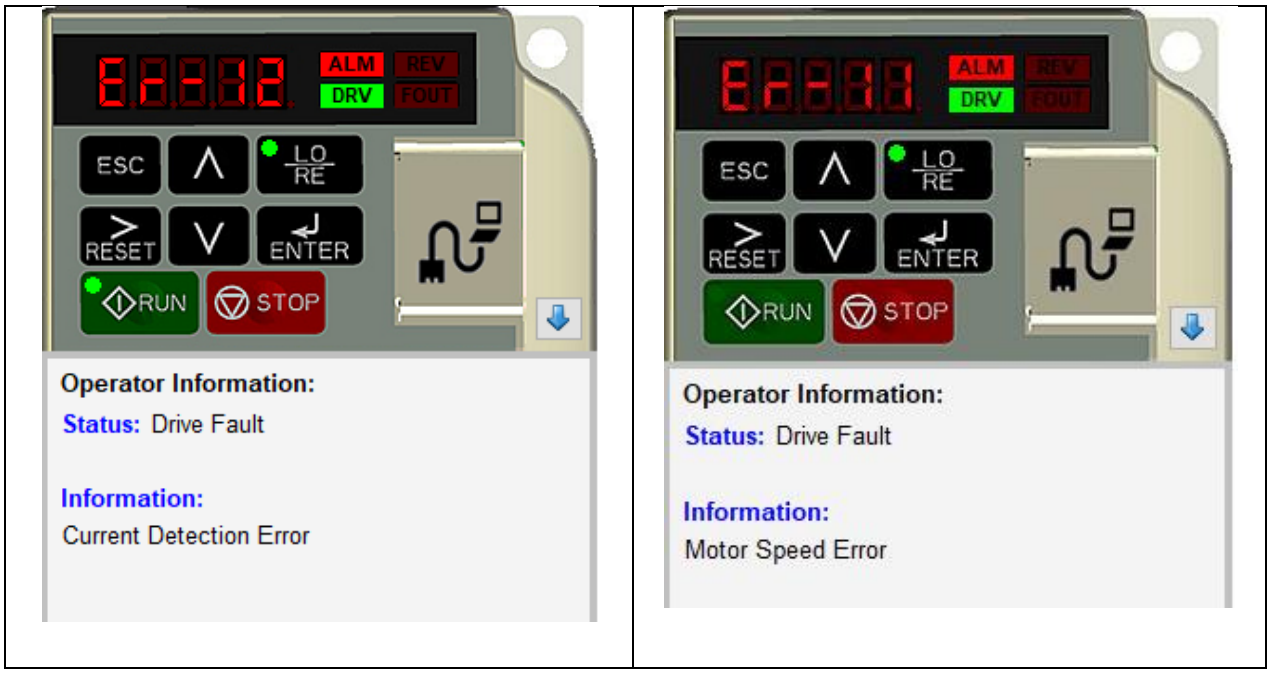


Figure 4.16: VFD Fault Analysis

4.5. Working Procedure:

In this project has two parts, one is local system and others is the global system. All the information of the project can control and monitoring in the project area and by the global system it is possible to controlling and monitoring all over the world.

Every automation system has three types of parameter input, processing and output. All the sensor and controlling sections are act as the input device and esp32 is represented as the processing system and all the loads are act as the output devices. All the information are send to the web site over the internet.

4.6. Summary

In this chapter, the project block diagram and flow chart are displayed and described in details. Circuit diagram of the simulation was shown and explained thoroughly along with its mechanism. Application of software in the project implementation was shown. In this chapter, Proteus software

was used to integrate the circuit and obtain the desired result. After the connection was completed the circuit simulation was simulated and described in details.

Chapter 5

PROJECT IMPLEMENTATION

5.1. Introduction

In this chapter, it shows implemented of Industrial IoT system. The project is basically what is think collectively to create first. Then think about what additional features can add to the project. After much deliberation, came to the conclusion that the project would follow the sun to the fullest. At first fixed the goal of the project. Then first make a list of what need to make this project. Then order goods from the online shop as per the list. Once the components are in hand, then test them and do research on them on various online platforms. Then continue to experiment with the components according to the information. At one time did not learn how to work with all those components or how to work with them. Then combined all the components to form a structure. This project is basically made with ESP. After performing the best result in the local operations move to the web services.

5.2. Hardware Requirements

Among the many raw materials has used to make this pack are Arduino, a series of circuit boards with a series of atmega328p microcontrollers. Used some more electronics components which are highlighting below step by

5.2.1. ESP32 Devkit V1:

The DOIT Esp32 DevKit v1 is one of the improvement board made by DOIT to assess the ESP-WROOM-32 module. It depends on the ESP32 microcontroller that flaunts Wi-Fi, Bluetooth, Ethernet and Low Force support all in a solitary chip. As referenced before, the chip utilized with

this board has 48 GPIO pins, however all pins are not available through advancement sheets. ESP32 devkit has a day and a half and 18 on each side of the board as demonstrated in the image above. It has 34 GPIO pins and each pin has numerous functionalities which can be designed utilizing explicit registers. There are numerous kinds of GPIOs accessible like computerized input, advanced yield, simple info, and simple yield, capacitive touch, UART correspondence and numerous different highlights referenced previously.

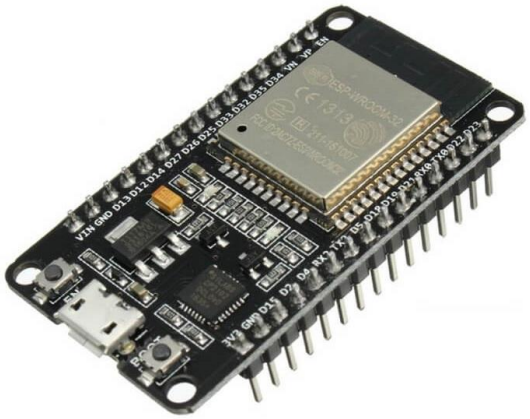


Figure 5.1:ESP32 Development Kit [13]

5.2.2. DC-DC Converter

This is a LM2596 DC-DC buck converter venture down power module with high-exactness potentiometer, fit for driving a heap up to 3A with high productivity, which can work with ESP, Arduino, other main boards and fundamental modules. At the point when the yield current keeps more prominent than 2.5A (or yield power more noteworthy than 10W), kindly add a warmth sink on it.



Figure 5.2: DC-DC Converter. [14]

5.2.3. DC Motor:

Motors are the least complex engines to utilize. They can arrive at a high rotational speed that is subject to the info voltage. In any case, it can't deal with the situation as one would with a servomotor or a stepper engine. At long last, to change the force of a DC engine, it is important that to utilize gearbox.

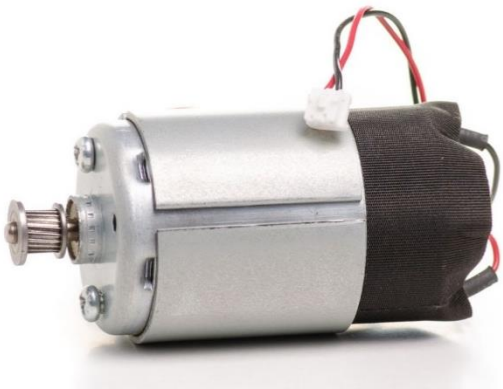


Figure 5.3: DC Motor [15]

5.2.4. Motor Driver

The L298 Driver is a high voltage, high flow double full extension driver intended to acknowledge standard TTL rationale levels and drive inductive loads such transfers, solenoids, DC and venturing engines. Two empower inputs are given to empower or incapacitate the gadget autonomously of the info signals. The producers of the lower semiconductors of each scaffold are associated together the relating outside terminal can be utilized for the association of an outer detecting resistor.

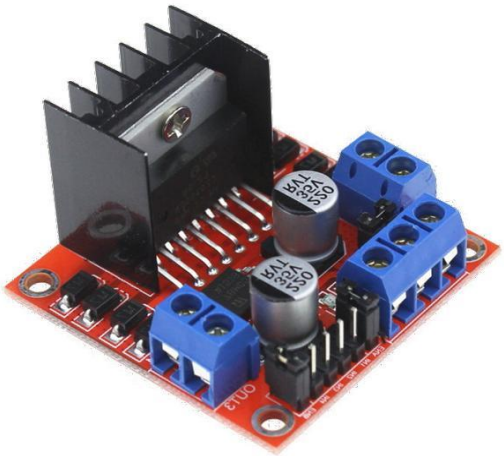


Figure 5.4: Motor Driver [16]

FEATURES

- Operating supply voltage up to 46 V
- Total DC current up to 4 A
- Low saturation voltage
- Over temperature protection.
- Logical "0" input voltage upto1.5 V (HIGH NOISE IMMUNITY)
- Two motor direction indicator LEDs
- An onboard user-accessible 5V low-dropout regulator
- Schottky EMF-protection diodes ,Screw-terminals for power and motor connections.

5.2.5. Power Supply Unit

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. Examples of the latter include power supplies found in desktop computers and consumer electronics devices.



Figure 5.5: 12V, 2A AC/DC Power Supply [17]

Voltage Regulator IC

Voltage sources in a circuit may have variances coming about in not giving fixed voltage yields. A voltage controller IC keeps up the yield voltage at a steady worth. 7805 IC, an individual from 78xx arrangement of fixed straight voltage controllers used to keep up such changes, is a well-known voltage controller incorporated circuit (IC). The xx in 78xx demonstrates the yield voltage it gives. 7805 IC furnishes +5 volts directed force supply with arrangements to add a warmth sink.

7812 IC Rating

1. Input voltage range 14V- 35V
2. Current rating $I_c = 1A$
3. Output voltage range $V_{Max=} 12.5, V_{Min=} 4.8V$

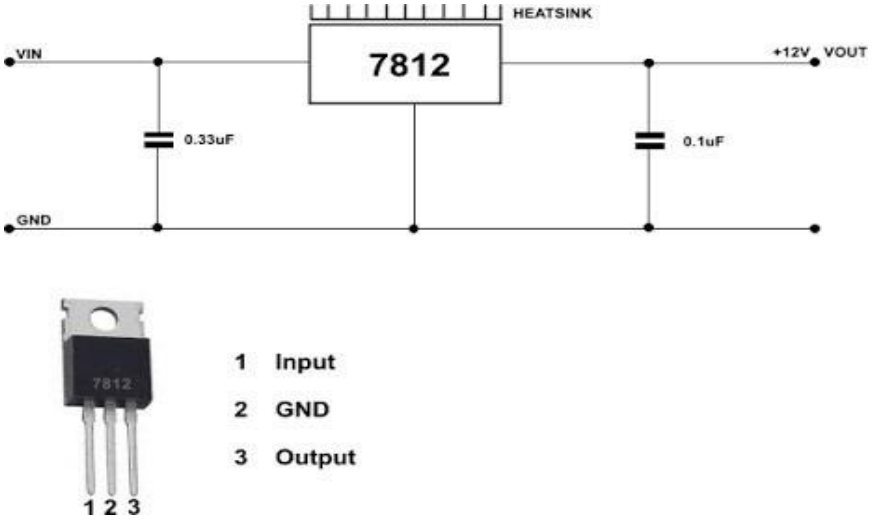


Figure 5.6: Voltage Regulation Internal Connection [18]

Table 5.1: Pin Details of 7812

Pin No.	Pin	Function	Description

1	INPUT	Input voltage (14V-35V)	In this pin of the IC positive unregulated voltage is given in regulation.
2	GROUND	Ground (0V)	In this pin where the ground is given. This pin is neutral for equally the input and output.
3	OUTPUT	Regulated output; 12V	The output of the regulated 12V volt is taken out at this pin of the IC regulator.

5.2.6. MQ-4 Gas Sensor

MQ-4 Gas Sensor distinguishes the convergence of methane gas noticeable all around and yields its perusing as a simple voltage. The focus detecting scope of 300 ppm to 10,000 ppm is reasonable for spill recognition. For instance, the sensor could distinguish on the off chance that somebody left a gas oven on however not lit. The sensor can work at temperatures from - 10 to 50°C and devours less than 150 Mama at 5 V.

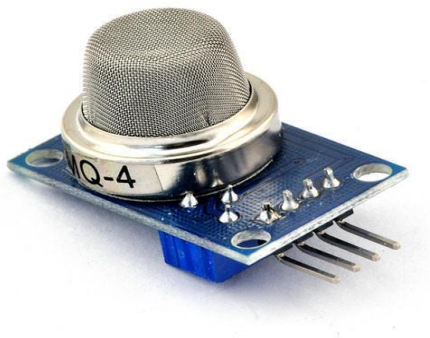


Figure 5.7: MQ4 Gas Sensor. [19]

MQ-4 Gas Sensor Specifications

- Sensor Type Semiconductor
- Power requirements: VCC - 5V±0.1

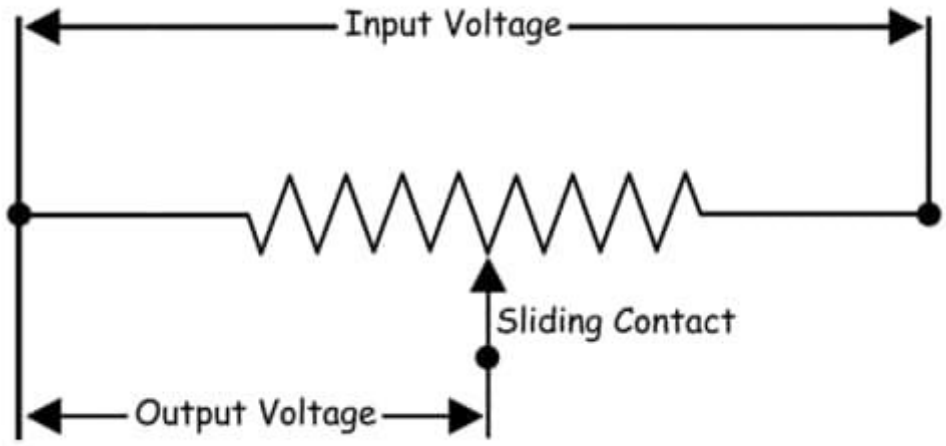
- DO output: TTL digital 0 and 1 (0.1 and 5V)
- AO output: 0.1-0 .3 V (relative to pollution), the maximum concentration of a voltage of about 4V
- Detection Gas: Natural gas/Methane
- Detection Concentration: 200-10000ppm (Natural gas / Methane)
- Interface: 1 TTL compatible input (HSW), 1 TTL compatible output (ALR)
- Heater consumption: less than 750mw
- Operating temperature: 14 to 122 °F (-10 to 50°C)
- RH Related humidity less than 95%Rh
- O2 Oxygen concentration is 21% (standard condition) - Oxygen concentration can affect sensitivity
- Load resistance: 20KΩ
- Sensing Resistance Rs: 10KΩ- 60KΩ (1000ppm CH4)
- Preheat time: Over 24 hours
- Standard Encapsulation Bakelite, Metal cap

5.2.7. Potentiometer:



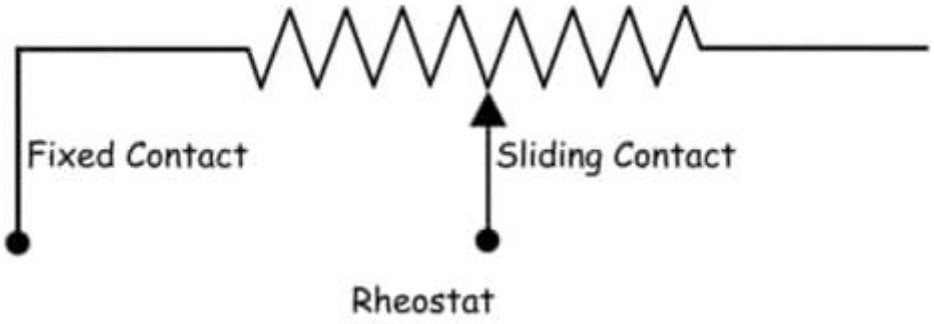
Figure 5.8: Potentiometer. [20]

A potentiometer is an aloof electronic segment. Potentiometers work by differing the situation of a sliding contact across a uniform opposition. In a potentiometer, the whole info voltage is applied across the entire length of the resistor, and the yield voltage is the voltage drop between the fixed and sliding contact as demonstrated under neat.



A potentiometer has the two terminals of the input source fixed to the end of the resistor. To adjust the output voltage the sliding contact gets moved along the resistor on the output side.

This is different to a rheostat, where here one end is fixed and the sliding terminal is connectedto the circuit, as shown below.



This is a fundamental instrument utilized for contrasting the emf of two cells and for adjusting ammeter, voltmeter, and watt-meter. The fundamental working standard of a potentiometer is very straightforward. Assume we have associated two batteries in equal through a galvanometer. The negative battery terminals are associated together and positive battery terminals are likewise associated together through a galvanometer as demonstrated in the figure underneath.

5.2.8. Current Sensor:

The ACS712 Module utilizes the popular ACS712 IC to gauge current utilizing the Corridor Impact standard. The module gets its name from the IC (ACS712) utilized in the module, so for you end results utilize the IC straightforwardly rather than the module. These ACS712 module can quantify current AC or DC current going from +5A to - 5A, +20A to - 20A and +30A to - 30A. You need to choose the correct reach for your undertaking since you need to compromise exactness for higher reach modules. This modules yields Simple voltage (0-5V) in view of the current coursing through the wire; subsequently it is exceptionally simple to interface this module with any microcontroller.

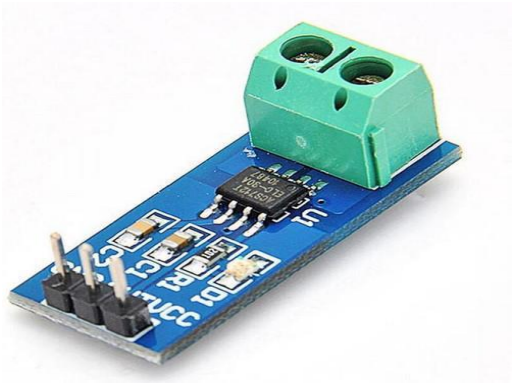


Figure5.9: ACS712 Current Sensor [21]

Pin Configuration

TABLE 5.2: PIN CONFIGURATION FOR FIG. 5.9

Pin Number	Pin Name	Description
1	Vcc	Input voltage is +5V for typical applications
2	Output	Outputs Analog voltage proportional to current
3	Ground	Connected to ground of circuit

T1	Wire In	The wire through current has to be measured is connected here
T2	Wire Out	

Specifications

- Measures both AC and DC current
- Available as 5A, 20A and 30A module
- Provides isolation from the load
- Easy to integrate with MCU, since it outputs analog voltage
- Scale Factor

5.2.9. Display:



Figure 5.10: OLED Display [22]

OLED 0.91 inch is a monochrome realistic display module with an inherent 0.91 inch, 128X32 high-goal show. OLED 0.91inch can work in spite of the shortfall of backdrop illumination. In a dull climate, differentiation of OLED show is higher than LCD show. This gadget is I^2C or SPI viable. Because of its ability in showing, it is regularly utilized in different application for occurrences, savvy, MP3, work cell phone, convenient wellbeing gadget and numerous others.

Specifications

- Driver: SSD1306
- Interface: I2C
- Display color: White
- Resolution: 128x32
- Viewing angle: >160°
- Operating voltage: 3.3V / 5V
- Dimension: 36 x 12.5 (mm)

5.2.10. Flame Sensor:



Figure 5.11: Flame Sensor [23]

A flame sensor module that comprises of a fire sensor (IR recipient), resistor, capacitor, potentiometer, and comparator LM393 in a coordinated circuit. It can recognize infrared light with a frequency going from 700nm to 1000nm.The far-infrared fire test changes over the light distinguished as infrared light into current changes. Affectability is changed through the locally available variable resistor with a discovery point of 60 degrees. Working voltage is somewhere in the range of 3.3v and 5.2v DC, with an advanced yield to show the presence of a sign. Detecting is adapted by a LM393 comparator.

Specifications

- Spectrum range: 760nm ~ 1100nm

- Detection angle: 0 - 60 degree
- Power: 3.3V ~ 5.3V
- Operating temperature: -25℃ ~ 85℃
- Dimension: 27.3mm * 15.4mm
- Mounting holes size: 2.0mm

5.3. Implementation of the Project:

To implement the project, first connect all the sensors to the ESP32. Once they are connected, first create a separate program for the sensor. Then upload the program to the microcontroller and check if the sensors are working properly. Then when the sensor works properly and others components are working properly then connect with web server. Potentiometers are connected to esp32 in 36 (Motor Controller), 39 (Fan Controller), 39 (Light Controller) and gas sensor is connected to the 35-number pin.

5.3.1. Implementation of DC to DC Buck converter:

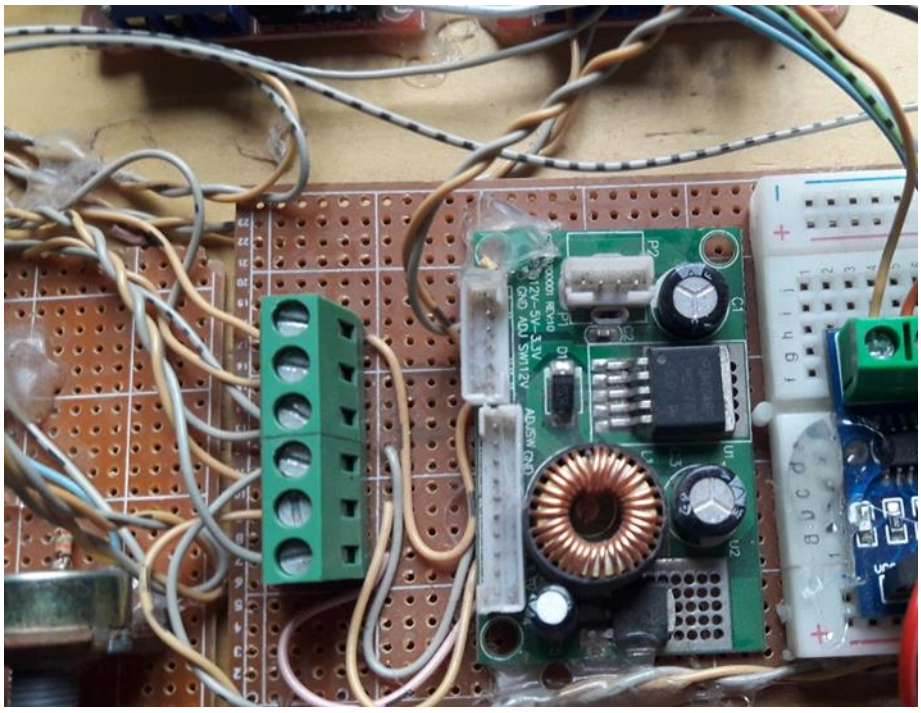


Figure 5.12: Implementation of DC-to-DC buck converter

DC to DC boost converters is effectively used to produce a controlled voltage from a source that may or may not be well regulated at a load that may or may not be static. This section will briefly introduce DC to DC buck converters, discusses important parameters and applications of a DC-to-DC buck converters. A DC-to-DC buck converter is a high-frequency power conversion circuit that uses high frequency switching and inductors, transformers and capacitors to smooth the noise of switching to control the DC voltages. Closed response loops maintain constant voltage output even after changing input voltage and output currents. At 90% efficiency, they are usually much more efficient and smaller than linear controllers [17]. The disadvantages of a dc-to-dc controller are noise and complexity. This converter is makes it different voltage source 12V dc supply to convert 3.3V and 5V dc source.

5.3.2. Project Implementation:

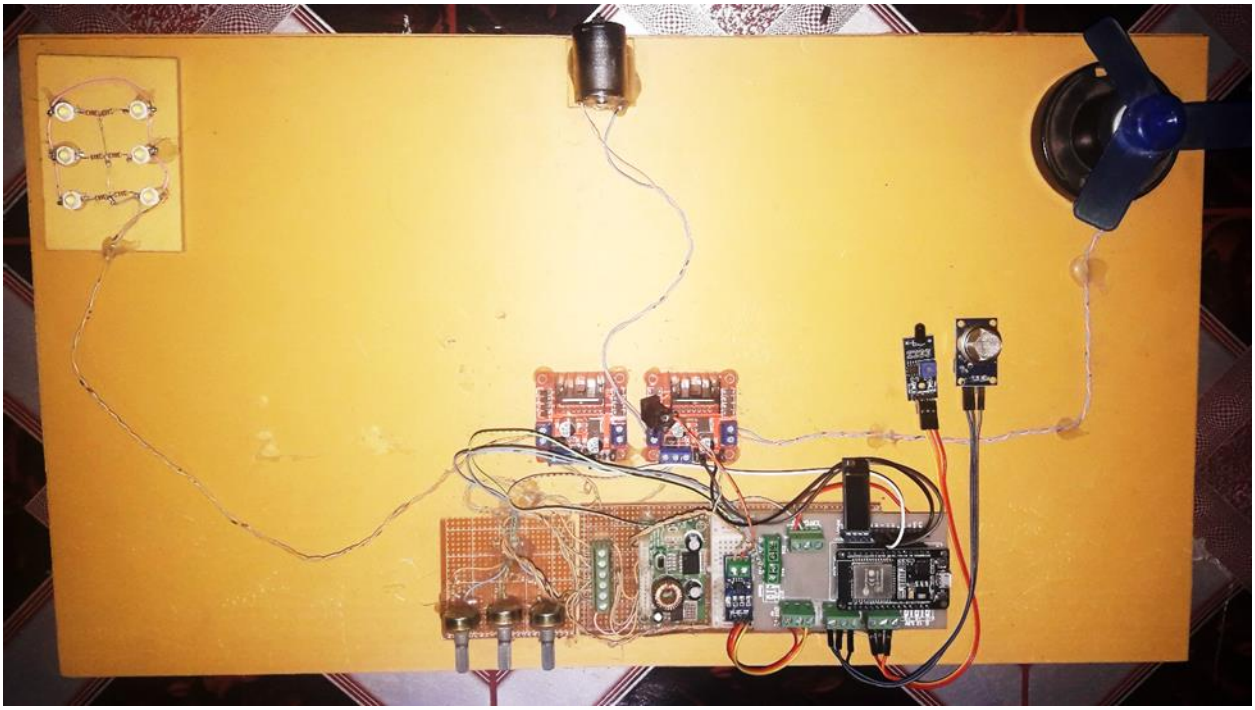


Figure 5.13: Electronic connections of this project.

Here the input parts connected with esp32 are gas sensor, flame sensor, light regulator, fan regulator. And the output parts are display, cloud, motor, fan & light. Here AC to DC converter

has been done after taking AC source. Again Dc source has been converted from 12 volts to 5 volts through Dc to Dc Buck converter. Gas sensor, flame sensor are all connected to DC Buck Converter to activate them. Ac to Dc converter is connected to motor driver to run the motor and fan. The current sensor is connected to the motor driver for the light and the light is connected to the current sensor. Similarly for motor and fan, the motor is connected to the motor and the fan is connected to another motor driver. The output of the film and gas sensor will show on the display and will be stored in the cloud as data. Also, all this data will be sent to the authority automatically via email. If the light regulator is rotated, the intensity of the light will change and it will be stored as cloud data. Similarly rotating the fan and motor regulator will change the speed of motor and fan and all this data will be stored in the cloud. With all this data, power and energy consumption will automatically be measured.

After completing the design part, firstly tested the offline controlling system.

5.4. Summary:

In this chapter, showed the list of components those were used in this project implementation. It was discussed in detailed about each material which are used in the implementation process along with their basic characteristics and properties. In this project, electronic circuit connections were shown and explained. The procedure of the project implementation was shown with details along with its mechanism.

Chapter 6

RESULTS ANALYSIS & CRITICAL DESIGN REVIEW

6.1. Introduction:

In this chapter, the power consumption of the system can be calculated also it can be represented the load condition and control the total system by the IoT server. The critical design of the project will be discussed in detail.

6.2. Result Analysis:

All the information's of the system can be monitoring by the web server.



Figure 6.1: Online Monitoring System

6.2.1. Motor:

Power consumption in milli watt (mw) range. Motor consumption power can be changed by the varying the motor speed. The motor speed changed by the change of potentiometer. All the information about how much power to receive at each moment is stored.

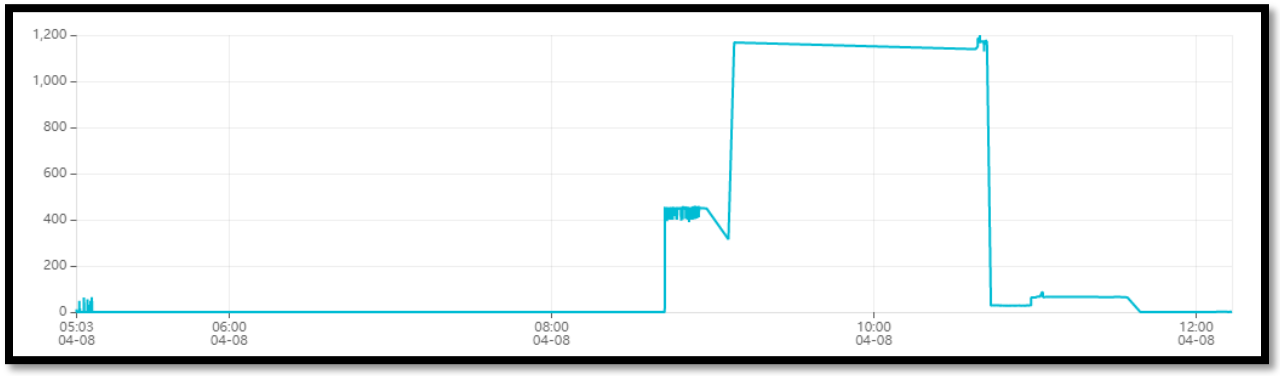


Figure 6.2: Motor Power Consumption (mw)

6.2.2. Fan:

Power consumption in milli watt (mw) range. The power consumption of the fan is regulated by the change of fan speed. The potentiometer is used to control the voltage range. All the information about how much power to receive at each moment is stored.

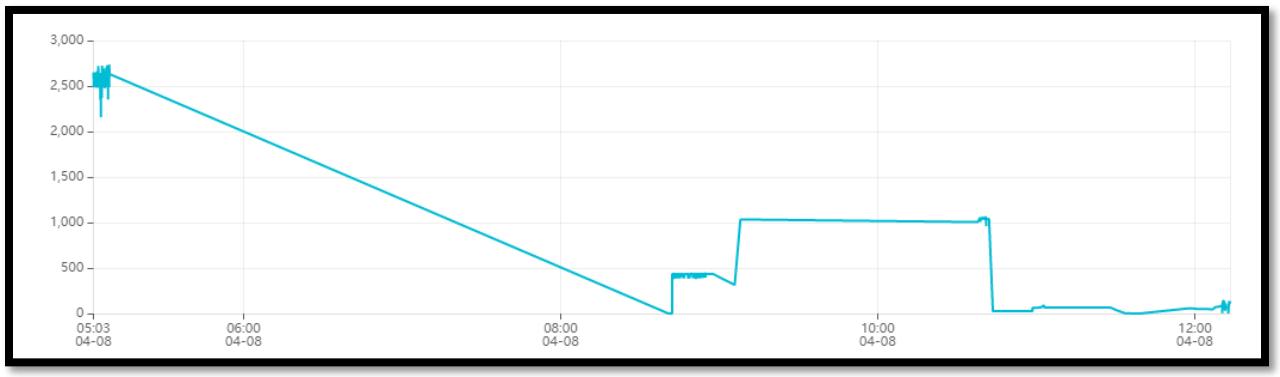


Figure 6.3: Fan Power Consumption (mw)

6.2.3. Light:

Power consumption in miliwatt (mw) range. Light consumption power can be changed by the varying the light intensity. The light intensity can be varied by the changing the voltage level. All the information about how much power to receive at each moment is stored.

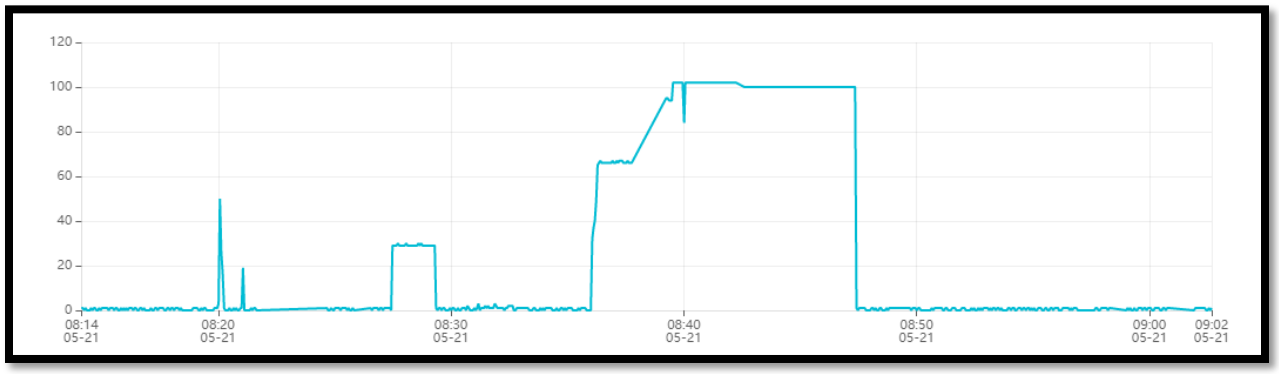


Figure 6.4: Light Power Consumption (mw)

6.2.4. Gas Sensor:

Gas sensor is used to detect the CH_4 in the environment. The sensor sensing limit is 200-10000ppm.

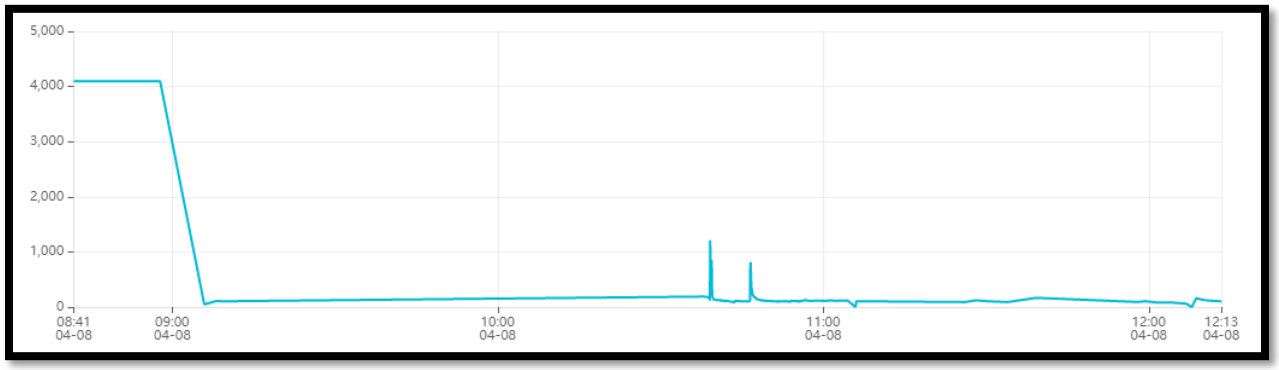


Figure 6.5: Gas Detection

6.2.5. Flame Sensor:

The sensor is used to detect the fire. Normally the sensor provides high signal when fire detect it's provided low signal.

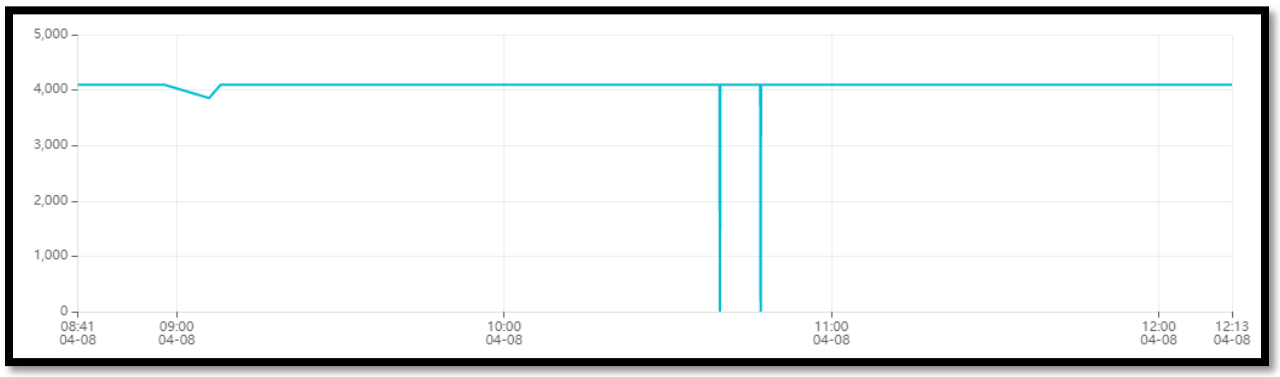


Figure 6.6: Fire Detection

6.2.6. Power consumption:

The total power consumption of the system is represented by the graph according to the load varying with respect to the time.

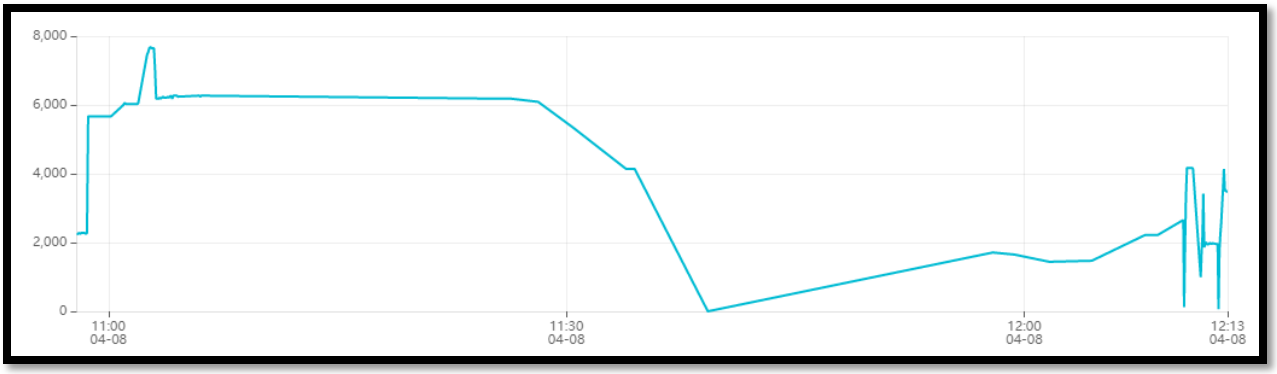


Figure 6.7: Graphical information's of power consumption

Power consumption in miliwatt (mw) range. The information's are updated every 5 second later.

DATE	VALUE	CONTEXT
2021-04-08 23:13:19 +06:00	3480.00	{}
2021-04-08 23:13:15 +06:00	3480.00	{}
2021-04-08 23:13:12 +06:00	3510.00	{}
2021-04-08 23:13:08 +06:00	3510.00	{}
2021-04-08 23:13:05 +06:00	4140.00	{}
2021-04-08 23:13:02 +06:00	3630.00	{}
2021-04-08 23:12:58 +06:00	3120.00	{}
2021-04-08 23:12:54 +06:00	2610.00	{}
2021-04-08 23:12:51 +06:00	2220.00	{}
2021-04-08 23:12:47 +06:00	1770.00	{}

Figure 6.8: Cloud data storage of power consumption

6.2.7. Energy Cost:

Energy cost of the system is stored in the cloud services.

DATE	VALUE	CONTEXT	ACTIONS
2021-04-08 12:13:19 -05:00	1.11	{}	
2021-04-08 12:13:15 -05:00	1.11	{}	
2021-04-08 12:13:12 -05:00	1.12	{}	
2021-04-08 12:13:08 -05:00	1.12	{}	
2021-04-08 12:13:05 -05:00	1.32	{}	
2021-04-08 12:13:02 -05:00	1.16	{}	
2021-04-08 12:12:58 -05:00	1.00	{}	
2021-04-08 12:12:54 -05:00	0.84	{}	
2021-04-08 12:12:51 -05:00	0.71	{}	
2021-04-08 12:12:47 -05:00	0.57	{}	

Figure 6.9: Cost Analysis for Total System

6.2.8. Auto Email System:

If any unexpected conditions occurred in the system, the system send the email to the authority by the internet.

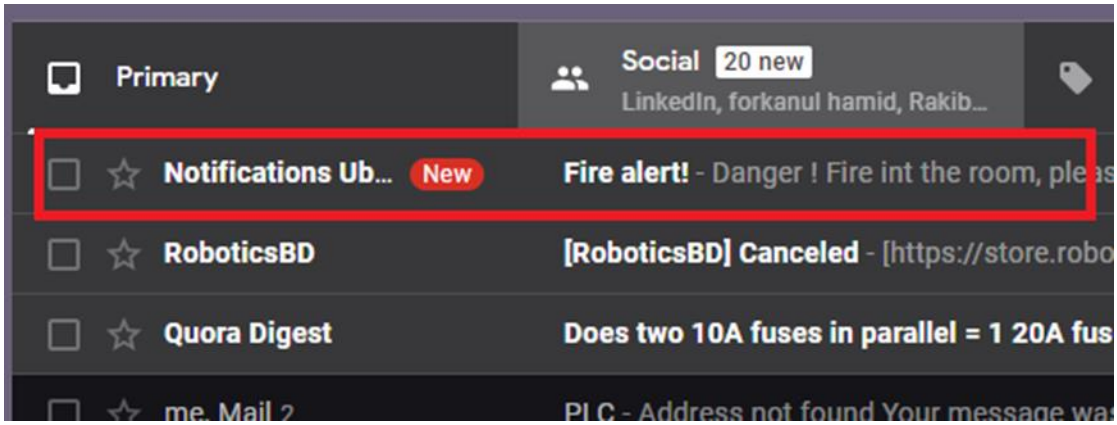


Figure 6.10: Auto Email System

6.2.9. Display Result:

When Wi-Fi is connected to the device the display unit shows the information.

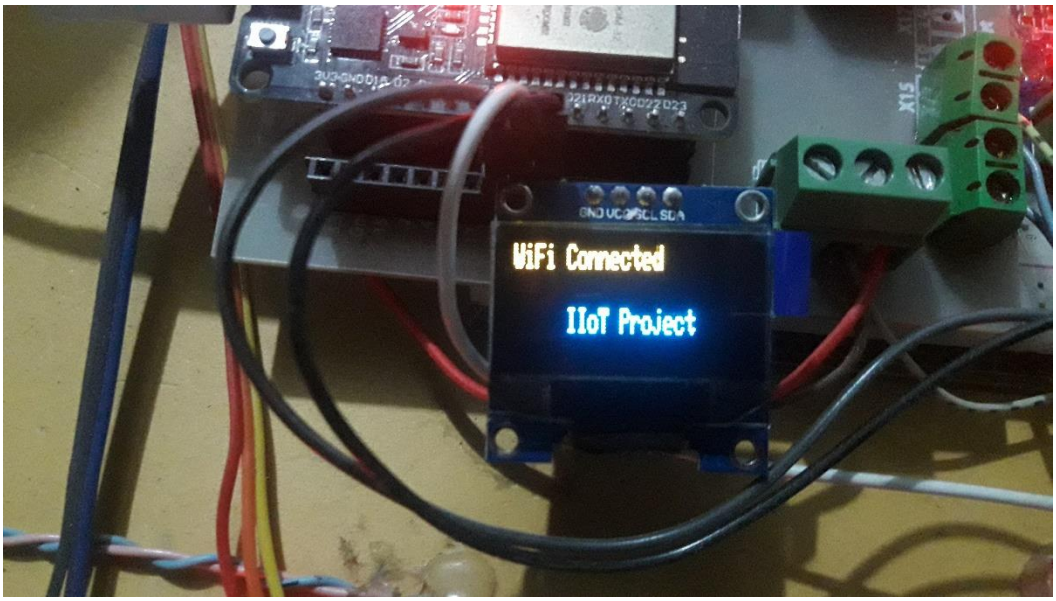


Figure 6.11: Display interface

Result:

The display unit shows all the information.

Here,

- L is representing the % of intensity of the light.
- M is representing the % of speed of the motor.
- F is representing the % of speed of the Fan.
- P is representing the total power consumption in mw unit.
- Fr is representing the fire signal, when Fr value is 1 its means fire detect and 0 means no fire.
- G is representing the gas intensity.

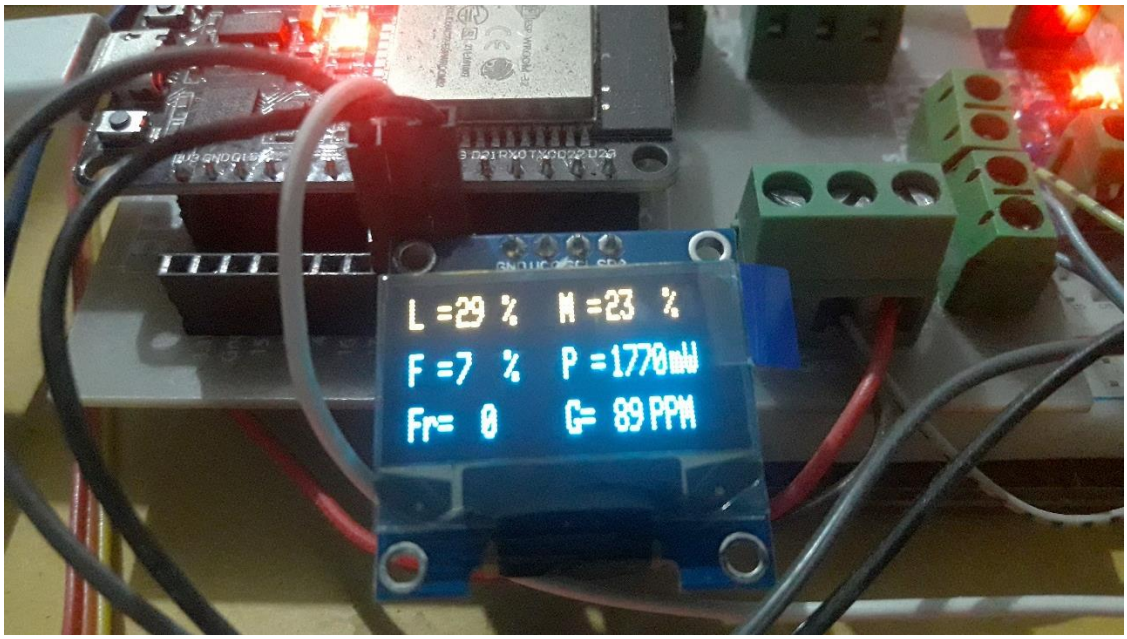


Figure 6.12: Display Result

6.3. Critical Design Review:

In this project, the simulation was conducted before the implementation process. There were a industrial internet of things system. In order to implement all project, studying and analysis of each generating sources was done thoroughly. For the simulation purpose Proteus 8.9 was used to overcome software errors that exist in this project. One of the drawbacks that was discovered is the unavailable of the internet. So, it's should be ensuring the available of internet facilities.

6.4. Summary

In this project firstly took three types of load these are motor, fan and light. Then all the load are connected to the ESP32. Three variable resistors are used to regulate the voltage of the load. It was made a dc power supply where contain 9V, 5V, and 3.3V dc voltage line. Fire and gas sensors are connected to the system. The esp32 is connected to the web server as the result all the information are monitoring by the internet. All the information is stored in the web server, as the result it is easy to analysis the information. So, it's easy to make a decision in any problem.

Chapter 7

CONCLUSION

7.1. Summary of Findings:

Some improvements can be made through the replacement of ordinary solar panels. Have tried through the project to make maximum use of sunlight to generate maximum solar power in one day. Doing this through the dual-axis solar panel system. With which the maximum amount of solar power can be generated in one day by utilizing sunlight. Since the solar panels currently in use are stationary in one place, maximum electricity can be generated only when the sun comes in its direction. But when the sun is tilted in different directions, less energy is produced. So created the dual-axis solar panels to overcome this problem. This will also benefit people economically in the world market through our project.

7.1.1. Advantages of this project:

- Easy to controlling in industrial automation.
- Easy to monitoring all information in an industry.
- Store all the machine related information and can be analysis the information daily, weekly, monthly, yearly.
- Auto reporting system.
- Easy to find out the ON time and OFF time of machine in an industry.
- Easy to find out the power consumption of the industry.

7.1.2. Disadvantages of this project:

Everything has both advantages and disadvantages. The designed project is no exception. The designed project has advantages as well as disadvantages. The disadvantage is that,

- This system is depending on the internet.
- Security
- Lagging

- Instants decision
- Intelligent Decision
- Bugs
- Training
- Expensive

7.2. Project Finance:

Table 7.1: Project Finance Analysis

Serial Number	Components	Specification	Quantity	Unit Price (Taka)	Total Price (Taka)
1	ESP32	Built in Wi-Fi	1	900	900
2	Power Supply	24 Watt	2	300	600
3	ACS712	5A	1	350	350
4	Resistor 10K	Variable	3	15	45
5	Vero board	Separated dot	1	30	30
6	Motor Drive	Dual Bridge	2	350	700
7	Motor	12V	1	100	100
8	Motor with Fan	12V	1	100	100
9	Bread Board	Big Size	1	100	100
10	Jumper Wire	M-M, M-F, F-F	3-set	90	270
11	LED	5mm 3V	3	5	15
12	Variable Voltage source	12V/5V/3.3V	1	200	200
13	Resistor	10k,100k,220	10	1	10

14	Glue Stick	Big size	5	20	100
15	Fan Base	Plastic	1	50	50
16	PVC Sheet	2’ By 2’	1	200	200
17	Super Glue	4 ml	1	50	50
18	Green Connector	2 Pin	4	20	80
19	Gas Sensor	MQ Series	1	350	350
20	Flame Sensor	Small PCB size:3.2CM*1.4CM	1	88	88
21	Display	OLED	1	280	280
22	Current Sensor	ACS712-30A	1	219	219
23	PCB Design		1	300	300
				Total	**5137 tk**

7.3. Novelty of the work:

For this project probable to compact Industrial IoT System. This project plan was accomplished to confirm that this is allowable to setting at any industrial equipment without any change of devices. In this project ESP32, buck converter, gas sensor, fire sensor, variable resistor, motor driver, voltage controller is used. In this system ESP32 are used for process all the information and send the data to the web server, Motor driver is used for the motor and fan controlling. Gas sensor is used for the gas detection and fire sensor is used for the fire detection. The dc to dc converter is used for the voltage regulation as our requirement.

7.4. Final Impact of This Project:

The main objective of the implementation of this project is to protect the environment, to transcend natural resources decreased with energy conservation.

7.4.1. Survey on Industrial Impact:

According to the mission of industrial 4.0 revelations it is possible to impact all the industrial activities.

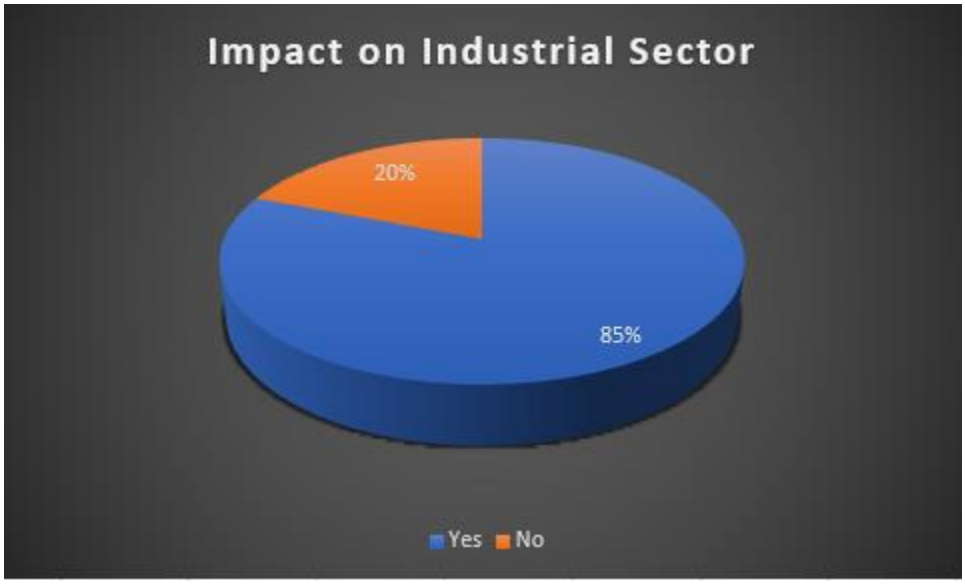


Figure 7.1: Pie chart related to Impact on Industrial Sector

This Pie chart provides information about the impact on industrial sector. We can see that our project will have significant impact in the industrial sector.

The current era of global industrialization, the number of industries is increasing every year. We are hopeful that our project will play a significant role in taking the industrial sector one step further. This pie chart shows that most of the people around 85% of people believe that our project will have a good impact in the industrial sector. But according to some people around 15%, think that our project will not have much of an impact on the industrial sector.

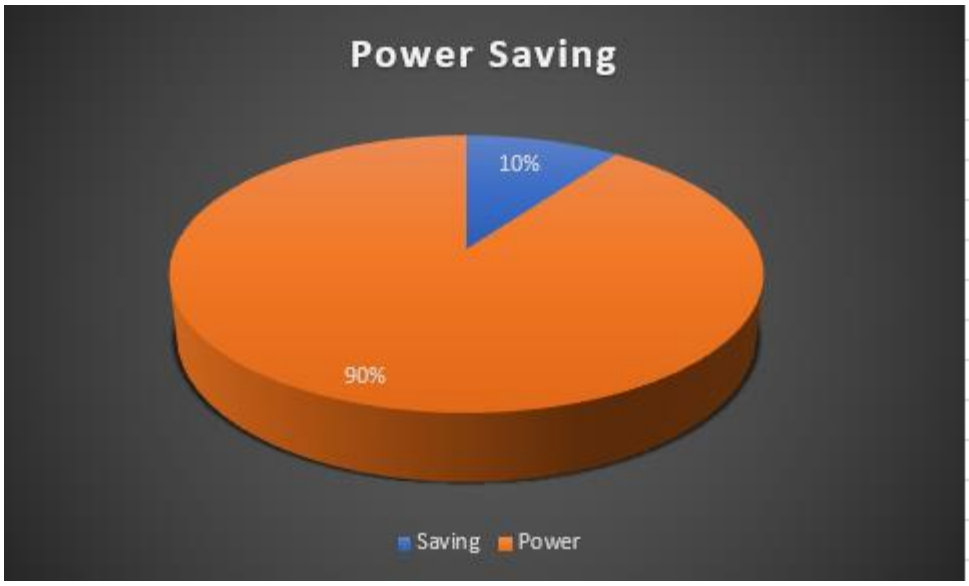


Figure 7.2: Pie chart on power reduction.

This Pie chart provides information about the power saving of the industrial sectors. We can see that our project will capable to saving power.

Different load machines are used in a factory. It consumes a lot of power to run these machines. In a factory, running a machine for ten seconds without any reason is considered a loss to the company. If the authorities of companies want to control these machines manually, they need some time, which will lose power. But if they run the factory through our project, there is no chance of wasting a second and it is able to save power. This pie chart shows that this project is able to save around 10% power.



Figure 7.3: Pie chart regarding reduction in management cost.

This Pie chart provides information about the reduce management cost of industrial sector. Managing a factory requires manpower in different fields. A large part of the company has to spend money to pay these workers. Our project is capable of automatic factory control, so in some cases it will not require much manpower. This will reduce the cost of the management system an IoT. From this pie chat we can see, about 85% people think that it can able to reduce management cost. Very few people around 10% think that there is no chance to reduce the cost. On the other hand there are a few of people around 5% think that it may happen.

All the information is stored in the web server so reporting cost can be minimized.

7.4.2. Project Sustainability:

In this system used different types of electrical and electronic component which is more reliable and lower expensive. There is no moving part in this system so; the life time of the system is higher.

7.4.3. Recommendations on Future Developments:

This experiment performed in a demo industrial platform. In future it is possible to controlling and monitoring multi-industries in a platform and whole system can be developed by the IoT technology.

7.5. Limitations:

- This system is depending on the internet, so without internet it is not possible to global controlling and monitoring.
- Without skill person it is not operating and controlling whole system.
- Controlling system is temperature sensitive so, environmental of the control unit should be maintain.
- Handling each of the electric and electronic material was challenging during the implementation process.

7.6. Ethical concerns:

The main purpose of creating this project will not harmful for the user and government. The system should be minimizing the lower voltage and highly insulated, so that it is not bad impact of the operator. Protection system must be ensuring in the system.

7.7. Conclusion:

Another upheaval is happening inside industry. It is an upheaval coming about because of the combination of mechanical frameworks with cutting edge registering, sensors and universal correspondence frameworks. It is a groundbreaking occasion where innumerable mechanical gadgets, both old and new, are starting to utilize Web Convention (IP) correspondence innovations. We allude to this new unrest as the Modern Web of Things. The Modern Web of Things is a subset of what we have come to know as the Web of Things (IoT). The IoT is a theoretical thought that catches a development that began when we started incorporating figuring and correspondence innovation into a significant number of the "things" that we use at home and work. The primary achievement of this undertaking is to make individuals' day by day life simpler and better.

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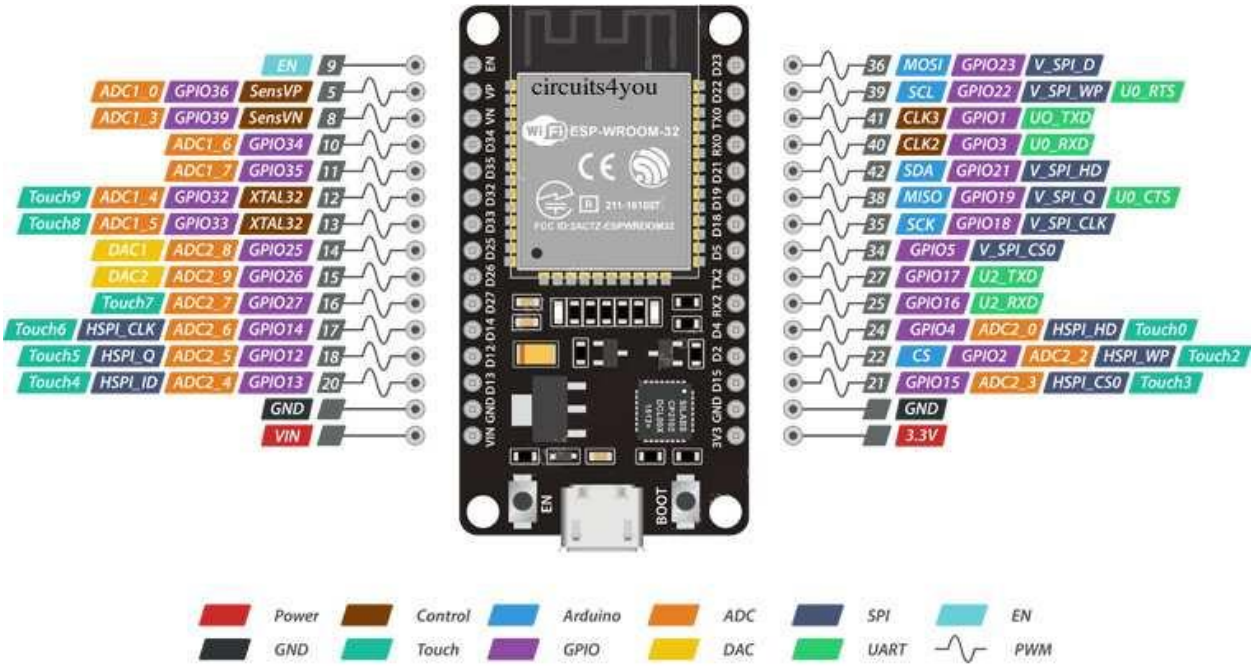
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Appendix

Pin out of the ESP



Code:

```
#include <PubSubClient.h>
```

```
#include <WiFi.h>
#include <analogWrite.h>
#include <stdio.h>
#define WIFISSID "AndroidAPt" // Put your WifiSSID here
#define PASSWORD "12345678" // Put your wifi password here
#define TOKEN "BBFF-A6OgqHTo1Djx2UUIs75C8dHk4f8uw1" // Put your Ubidots' TOKEN

/**************************************
  Define Constants
 **************************************/
#define VARIABLE_LABEL1 "light"
#define VARIABLE_LABEL2 "motor"
#define VARIABLE_LABEL3 "fan"
#define VARIABLE_LABEL4 "gas"
#define VARIABLE_LABEL5 "fire"
#define VARIABLE_LABEL6 "power"
#define VARIABLE_LABEL7 "s7"
#define VARIABLE_LABEL_SUB_1 "relay1"  // Assing the variable label to subscribe
#define VARIABLE_LABEL_SUB_2 "relay2" // Assing the variable label to subscribe
#define DEVICE_LABEL "esp32" // Assig the device label to subscribe
#define MQTT_CLIENT_NAME "Abdullah" // MQTT client Name, put a Random ASCII
#define R1 2 // Load -1
#define R2 26 // Load-2
int j=0,k=0,Time=500;

//////////////////PWM ////////////////////
constintledPin = 19;  // 16 corresponds to GPIO16
constint ledPin2 = 18;
```

```
constint ledPin3 = 5;

// setting PWM properties

constintfreq = 5000;

constintledChannel = 0;

constint ledChannel2 = 1;

constint ledChannel3 = 2;

constint resolution = 8;

////////////////////////////////////


charmqttBroker[] = "industrial.api.ubidots.com";

////////////////// For 2 Load ////////////////////////////////

constint ERROR_VALUE = 65535;         // Set here an error value

const uint8_t NUMBER_OF_VARIABLES = 2; // Number of variable to subscribe to( Number of Load)

char * variable_labels[NUMBER_OF_VARIABLES] = {"relay1", "relay2"}; // labels of the variable to subscribe to


float CONTROL1; // Name of the variable to be used within the code.

float CONTROL2; // Name of the variable to be used within the code.


float value; // To store incoming value.

uint8_t variable; // To keep track of the state machine and be able to use the switch case.

////////////////////// for 7 Sensor ////////////////////////

char payload[2000]; //The maximum payload size supported by Ubidots is of 10000 bytes.

char topic1[150];

char topic2[150];

char topic3[150];

char topic4[150];

char topic5[150];
```

```
char topic6[150];
char topic7[150];
char topic8[150];

//Space to store values to send
char str_sensor1[60];
char str_sensor2[60];
char str_sensor3[60];
char str_sensor4[60];
char str_sensor5[60];
char str_sensor6[60];
char str_sensor7[60];
char str_sensor8[60];
/////////////////////////////////////////////////////////////
/****************************************
Initializate constructors for objects
 ****************************************/
WiFiClientubidots;
PubSubClientclient(ubidots);
/****************************************
Auxiliar Functions
 ****************************************/
////////////////////// No Need to Change //////////////////////
void callback(char* topic, byte* payload, unsigned int length)
{
char* variable_label = (char *) malloc(sizeof(char) * 30);;
get_variable_label_topic(topic, variable_label);
value = btof(payload, length);
```

```
set_state(variable_label);
execute_cases();
free(variable_label);
}

// Parse topic to extract the variable label which changed value
voidget_variable_label_topic(char * topic, char * variable_label) {
 // Serial.print("topic:");
 // Serial.println(topic);
sprintf(variable_label, "");
for (inti = 0; i< NUMBER_OF_VARIABLES; i++) {
char * result_lv = strstr(topic, variable_labels[i]);
if (result_lv != NULL) {
uint8_tlen = strlen(result_lv);
char result[100];
uint8_ti = 0;
for (i = 0; i<len - 3; i++) {
result[i] = result_lv[i];
     }
result[i] = '\0';
    // Serial.print("Label is: ");
    // Serial.println(result);
sprintf(variable_label, "%s", result);
break;
   }
 }
}
```

```
// cast from an array of chars to float value.
floatbtof(byte * payload, unsigned int length)
{
char * demo_ = (char *) malloc(sizeof(char) * 10);
for (inti = 0; i< length; i++) {
   demo_[i] = payload[i];
 }
returnatof(demo_);
}

// State machine to use switch case
voidset_state(char* variable_label) {
variable = 0;
for (uint8_t i = 0; i< NUMBER_OF_VARIABLES; i++) {
if (strcmp(variable_label, variable_labels[i]) == 0) {
break;
   }
variable++;
 }
if (variable >= NUMBER_OF_VARIABLES) variable = ERROR_VALUE; // Not valid
}

// Function with switch case to determine which variable changed and assigned the value accordingly to the code variable
voidexecute_cases() // Load condition execute
{
switch (variable) {
case 0:
```

```
    CONTROL1 = value;
digitalWrite(R1,value);
delay(100);
//     Serial.print("CONTROL1: ");
//     Serial.println(CONTROL1);
//     Serial.println();
break;
case 1:
    CONTROL2 = value;
digitalWrite(R2,value);
delay(100);
//     Serial.print("CONTROL2: ");
//     Serial.println(CONTROL2);
//     Serial.println();
break;
default:
Serial.println("default");
//     Serial.println();
 }

}
////////////////////////// No Correction ///////////////////
void reconnect()
{
  // Loop until we're reconnected
while (!client.connected()) {
   // Serial.println("Attempting MQTT connection...");
```

```
   // Attempt to connect
if (client.connect(MQTT_CLIENT_NAME, TOKEN, "")) {
    // Serial.println("connected");
delay(1000);
   } else {
Serial.print("failed, rc=");
Serial.print(client.state());
Serial.println(" try again in 2 seconds");
  }
 }
}
////////////////////////////////////////////////////

/***************************************
  Main Functions
 ***************************************/

void setup() {
Serial.begin(115200);
pinMode(R1, OUTPUT);
pinMode(R2, OUTPUT);
 ////////////////////// PWM ///////////////////
 // configure LED PWM functionalitites
ledcSetup(ledChannel, freq, resolution);
 //Serial.begin(9600);
 // attach the channel to the GPIO to be controlled
ledcAttachPin(ledPin, ledChannel);
ledcAttachPin(ledPin2, ledChannel2);
```

```
ledcAttachPin(ledPin3, ledChannel3);
////////////////// No Correction //////////////////////
WiFi.begin(WIFISSID, PASSWORD);
Serial.println();
Serial.println();
Serial.print("Wait for WiFi... ");

while (WiFi.status() != WL_CONNECTED) {
  // Serial.print(".");
delay(500);
 }

Serial.println("");
Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
client.setServer(mqttBroker, 1883);
client.setCallback(callback);
}
/////////////////////////////////////////////////////////////////
void loop() {

if (!client.connected()) {
reconnect();
  ////////////////////// Sensor-1 ////////////////////////////////////////
   // Subscribes for getting the value of the control variable in the temperature-box device
char topicToSubscribe_variable_1[200];
sprintf(topicToSubscribe_variable_1, "%s", ""); // Cleans the content of the char
```

```
sprintf(topicToSubscribe_variable_1, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
sprintf(topicToSubscribe_variable_1, "%s/%s/lv", topicToSubscribe_variable_1,
VARIABLE_LABEL_SUB_1);
//    Serial.println("subscribing to topic:");
//    Serial.println(topicToSubscribe_variable_1);
client.subscribe(topicToSubscribe_variable_1);
delay(Time);
Serial.println("Load-1");
 ////////////////////// Load-2 ////////////////////////////////////////
char topicToSubscribe_variable_2[200];
sprintf(topicToSubscribe_variable_2, "%s", ""); // Cleans the content of the char
sprintf(topicToSubscribe_variable_2, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
sprintf(topicToSubscribe_variable_2, "%s/%s/lv", topicToSubscribe_variable_2,
VARIABLE_LABEL_SUB_2);
//    Serial.println("subscribing to topic:");
//    Serial.println(topicToSubscribe_variable_2);
client.subscribe(topicToSubscribe_variable_2);
Serial.println("Load-2");
delay(Time);


 }




 ////////////////////// sensor pin ////////////////////////////
int sensor1 = analogRead(33); // Light
int sensor2 = analogRead(35); // Motor
int sensor3 = analogRead(32); //Fan
```

```
int sensor4 = analogRead(39); //Gas
int sensor5 = analogRead(34); //Fire
int sensor6 ;
int sensor7 = analogRead(14);

sensor1 = map(sensor1,0,4000,0,100);
sensor2 = map(sensor2,0,4000,0,100);
sensor3 = map(sensor3,0,4000,0,100);
sensor6 = (sensor1+sensor2+sensor3)*30; // Total Power
////////////////////////// Light, Motor, Fan Action /////////////////
ledcWrite(ledChannel, 2*sensor3); // Fan
ledcWrite(ledChannel2, 2*sensor1); // Light
ledcWrite(ledChannel3, 2*sensor2);  // Motor
Serial.println(2*sensor3);
////////////////// Sensor value conversion//////////////////
/* 4 is mininum width, 2 is precision; float value is copied onto str_sensor*/
dtostrf(sensor1, 4, 2, str_sensor1);
dtostrf(sensor2, 4, 2, str_sensor2);
dtostrf(sensor3, 4, 2, str_sensor3);
dtostrf(sensor4, 4, 2, str_sensor4);
dtostrf(sensor5, 4, 2, str_sensor5);
dtostrf(sensor6, 4, 2, str_sensor6);
dtostrf(sensor7, 4, 2, str_sensor7);

 ////////////////////// Sensor-1 ////////////////////////////////////////
sprintf(topic1, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
sprintf(payload, "%s", ""); // Cleans the payload
sprintf(payload, "{\"%s\":", VARIABLE_LABEL1); // Adds the variable label
```

```
sprintf(payload, "%s {\"value\": %s", payload, str_sensor1); // Adds the value
sprintf(payload, "%s } }", payload); // Closes the dictionary bracket
//  Serial.println("Publishing data to Ubidots Cloud");
//  Serial.println(payload);
client.publish(topic1, payload);
Serial.println("Sensor-1");
delay(Time);

 ////////////////////// Sensor-2 ////////////////////////////////////////
sprintf(topic2, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
sprintf(payload, "%s", ""); // Cleans the payload
sprintf(payload, "{\"%s\":", VARIABLE_LABEL2); // Adds the variable label
sprintf(payload, "%s {\"value\": %s", payload, str_sensor2); // Adds the value
sprintf(payload, "%s } }", payload); // Closes the dictionary bracket
//  Serial.println("Publishing data to Ubidots Cloud");
//  Serial.println(payload);
client.publish(topic2, payload);
Serial.println("Sensor-2");
delay(Time);
 ////////////////////// Sensor-3 ////////////////////////////////////////
sprintf(topic3, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
sprintf(payload, "%s", ""); // Cleans the payload
sprintf(payload, "{\"%s\":", VARIABLE_LABEL3); // Adds the variable label
sprintf(payload, "%s {\"value\": %s", payload, str_sensor3); // Adds the value
sprintf(payload, "%s } }", payload); // Closes the dictionary bracket
//  Serial.println("Publishing data to Ubidots Cloud");
//  Serial.println(payload);
client.publish(topic3, payload);
```

```
Serial.println("Sensor-3");
delay(Time);
 ////////////////////// Sensor-4 //////////////////////////////////////////
sprintf(topic4, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
sprintf(payload, "%s", ""); // Cleans the payload
sprintf(payload, "{\"%s\":", VARIABLE_LABEL4); // Adds the variable label
sprintf(payload, "%s {\"value\": %s", payload, str_sensor4); // Adds the value
sprintf(payload, "%s } }", payload); // Closes the dictionary bracket
//  Serial.println("Publishing data to Ubidots Cloud");
//  Serial.println(payload);
client.publish(topic4, payload);
Serial.println("Sensor-4");
delay(Time);
 ////////////////////// Sensor-5//////////////////////////////////////////
sprintf(topic5, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
sprintf(payload, "%s", ""); // Cleans the payload
sprintf(payload, "{\"%s\":", VARIABLE_LABEL5); // Adds the variable label
sprintf(payload, "%s {\"value\": %s", payload, str_sensor5); // Adds the value
sprintf(payload, "%s } }", payload); // Closes the dictionary bracket
//  Serial.println("Publishing data to Ubidots Cloud");
//  Serial.println(payload);
client.publish(topic5, payload);
Serial.println("Sensor-5");
delay(Time);

 ////////////////////// Sensor-5//////////////////////////////////////////
sprintf(topic6, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
sprintf(payload, "%s", ""); // Cleans the payload
```

```
sprintf(payload, "{\"%s\":", VARIABLE_LABEL6); // Adds the variable label
sprintf(payload, "%s {\"value\": %s", payload, str_sensor6); // Adds the value
sprintf(payload, "%s } }", payload); // Closes the dictionary bracket
//  Serial.println("Publishing data to Ubidots Cloud");
//  Serial.println(payload);
client.publish(topic6, payload);
Serial.println("Sensor-6");
delay (Time);
 ////////////////////////////////////////////////////////////
client.loop();
delay(Time);
 }
```

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