IoT Based Industrial Load Control

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This report is presented in partial fulfillment of the requirements of the degree of Master of Science in Computer Science and Engineering

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APPROVAL

This Project titled "**IoT Based Industrial Load Control**" submitted by by Md. Rifat Ahmed, ID No: 193-25-838 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of M.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 22nd December 2020.

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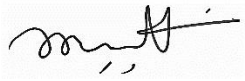

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We hereby declare, this project has been done under the supervision of Md. Tarek Habib, Assistant Professor, Department of Computer Science and Engineering, Daffodil International University. We also declare that neither this thesis nor any part of this thesis has been submitted elsewhere for award of any degree or diploma.

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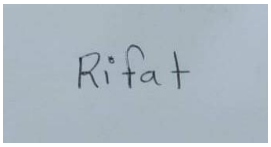

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ABSTRACT

Internet of things (IoT) is the network of interconnected devices, digital machines, vehicles, industrial appliances and other objects embedded with sensors, software, switches and connectivity which enable these things to connect to a network and collect and exchange data. The system creates the scope of connecting the non-internet-enabled physical devices and machines to be connected over the internet and remotely monitored and controlled. This research intends to propose architecture for industrial automation using near field and mobile communication along with a mobile application. The basic architecture or framework consists of connecting devices which will use protocol (esp8266 or Nodemcu) to connect edge gateway; and cloud stores the data information using backend storage system. Along with smart control of the appliances, we will be focusing on controlling machines like industrial lightings, exhaust fans, motors etc.

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CHAPTER 1 OVERVIEW

1.1 Introduction

Web of Things (IoT) is the organization of interconnected gadgets, mechanical and computerized machines, vehicles, modern apparatuses and different articles installed with sensors, programming, switches and availability which empower these things to interface with an organization and gather and trade information. The framework makes the extent of associating the non-web empowered actual gadgets and machines to be associated over the web and distantly observed and controlled. A thing in the Internet of Things can likewise be an individual with a heart observing insert or a car with snag sensor or mechanical apparatuses associated with an application stage. This is likewise appropriate to modern machines like drill of an oil rig or a stream motor of a plane. These things are allocated to an IP address and can move information over web. Fundamentally, this is the idea of interfacing any gadgets or machines we can consider today with the web.

Beforehand, modern motorized devices were fairly fundamental and essential, with decisions running from light timekeepers to programmable indoor controllers. By and by, these structures are combining data from modern activities, neighborhood atmosphere systems to say the least; to adapt to ideal lifestyle and help for better arrangement with ventures. Far superior, they can interface with each other to shape a firm unit to empower to work whole house.

This exploration expects to propose engineering for mechanical computerization utilizing close to field and versatile correspondence alongside a portable application.The fundamental design or structure comprises of interfacing gadgets which will utilize convention (MQTT or Zigbee) to associate Edge door; and cloud stores the information data utilizing backend stockpiling framework. Alongside keen control of the apparatuses, we will zero in on energy utilization the executives framework through which customers can diminish abundance energy utilization by distantly controlling the gadgets. This can save unreasonable utilization of any apparatus energy, time and all the while lessen additional abundance use.

1.2 Internet of Things (IoT) Basic Concept

The intercommunication between gadget to gadget or AI associated through the web with inserted innovation frameworks utilizing remote sensors, actuators which is distantly controlled, screen and upgraded by the client for mechanization is alluded as Internet of things (IoT). Here the expression "Things" signifies actual gadgets, for example, chips, cameras, sensors and other such gadgets. These actual gadgets are capable to impart, gather data and trade information by interfacing an organization. The implanted innovation of these actual gadgets makes this trade of data each other conceivable. There are an arrangement of modern robotization incorporates that can help making life at mechanical progressively invaluable and less difficult to administer, especially for involved, immense families. Assume you could therefore oversee and control the contraptions that you usually turn on and off every day. With a modern computerization structure, you can oversee apparatuses when you're out of the house and contemplating whether you made sure to kill light or not, savvy framework will be there to address the inquiry. The creating proximity of the Internet of Things in person's lives has made turn of events and progression in the clever mechanical space,

empowering customers to relate their devices through the web to their telephones and tablets, and improve than at any other time benefits for nuclear families. Also, as house proprietor are changing their devices to one central application, device or focus, they further comprehend the value these modern robotization things can bring to a family. It is the network separated from the regular gadgets utilizing web, for example, work area, PCs, Smartphone, tablets and so on.

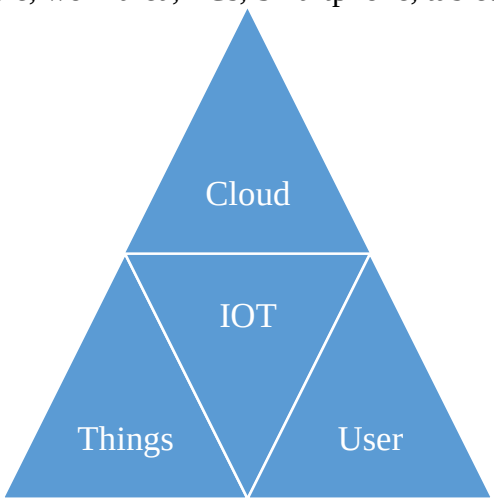

Figure 1.1: IoT Basic Concept

1.3 IoT Characteristics

IoT is one of the most well known terms in this cutting edge time of the world. Web of things (IoT) clarifies the organization of various gadgets like mechanical machines or office works that contains programming, hardware, sensor and availability to permit them to trade information with associations. A few sensors and actuators are utilized to interface those gadgets and give an input to them concurring self-activities. IoT has persuaded the world with its overall highlights and individuals are completely reliable on it. Sooner rather than later, this IoT will have an incomprehensible effect on the day by day life of people which will make the life of human simpler, more brilliant and safe. As of now, it has just gotten the promising and enormous computerized fields of modernization which is quickly expanding.

The quality of IoT incorporates the blend of equipment and programming keeping complex calculation and calculation method which insight approves them to act constantly in like manner to the circumstances. The availability of IoT gadgets permits interfacing different items by making organization and far reaching knowledge framework. The dynamic idea of IoT gadgets tells the condition of gadget whether it is on or off. An IoT gadget additionally gathers dynamic difference in information data from its neighboring climate. The pith of IoT is variety and heterogeneity due to utilizing unmistakable stage and organization. At last, security issues of IoT are by and large significant as a result of its sensitive data and huge move being made to forestall security issues. In future IoT segments tremendousness will increment in such level so it turns out to be hard to bargain or oversee it.

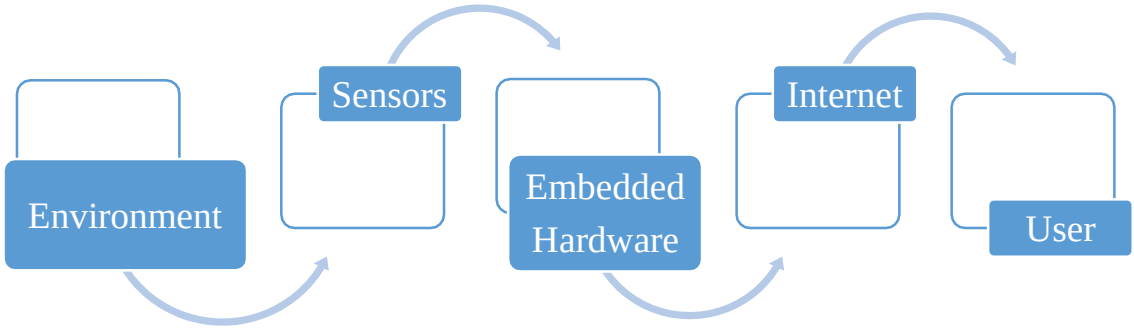

Figure 1.2: IoT Operating Technique

1.4 Why IoT is Booming?

Lately, IoT assumes an earth shattering part to diminish human efforts. Quick development of IoT gadgets and application step by step expanding which is focused by utilizing web and individuals are getting profited. The extent of IoT is the combination of actual world into PC base by intensifying adequacy of innovation, subside human diminish and monetary advantages. The essential qualities of IoT gadgets are almost indistinguishable and shared yet innovation behind each gadget determine starting with one gadget then onto the next. Due to its having climate insight and obvious control makes IoT more well known now-a-days. In coming days, trend setting innovation of IoT gadgets turns out to be more wise, impossible, programmed arranged, non-resolved to work freely envisions on conditions and air.

Web of Things (IoT) will be fruitful and famous in not so distant future. As the media transmission area is turning out to be more productive and broad, remote and broadband web association is presently generally accessible. With the approach of more modern manufacture innovation it is currently a lot less expensive to deliver gadgets and sensors with worked in WiFi abilities making interfacing gadgets less exorbitant [1]. Above all, the advanced cell utilization has been expanded to quite a level that it is being utilized to each conceivable part of our life now a days. With respect to the IoT based frameworks there is no need of isolated correspondence framework rather we can utilize the current innovation through the advanced cells which makes the framework less expensive and profoundly attainable. In light of this innovation now we can think about a completely mechanized modern or an entire brilliant city with the checking of energy utilization rate or a traffic observing framework for higher proficiency.

1.5 IoT Architecture

The essential design of IoT comprises of certain stages including gadget, passage network, information preparing and cloud or UI. Initially, actual gadgets, for example, sensors, machines, gadgets and actuators collect crude information from neighboring climate and convert it into valuable information. Actuator and sensors function as a transducer which changes energy into one structure over to another structure are utilized in IoT design. Actuators convert energy into movement other than sensor which is a gadget that gets and react to flag. Meanwhile, there comes web entryway. Sensors utilize explicit convention like Modbus, ZigBee, Bluetooth, close to handle correspondence (NFC), Wi-Fi or alongside that restrictive convention to interface Edge entryway.

Edge passage changes crude information from simple over to computerized utilizing information securing framework other than information total. The web door got amassed information as an illustration preprocessing and gives steering confining availability to cloud utilizing framework for example web attachments, the occasion center point, edge examination, advance informing lining convention (AMQP), Message lining telemetry convention (MQTT), Constrained application convention (COAP) or haze figuring. Further, subtleties dissecting of information and handling by IT frameworks on location or offsite. At last, information put away in the information base or cloud. The cloud application handles the correspondence which unfolds in all stages [2].

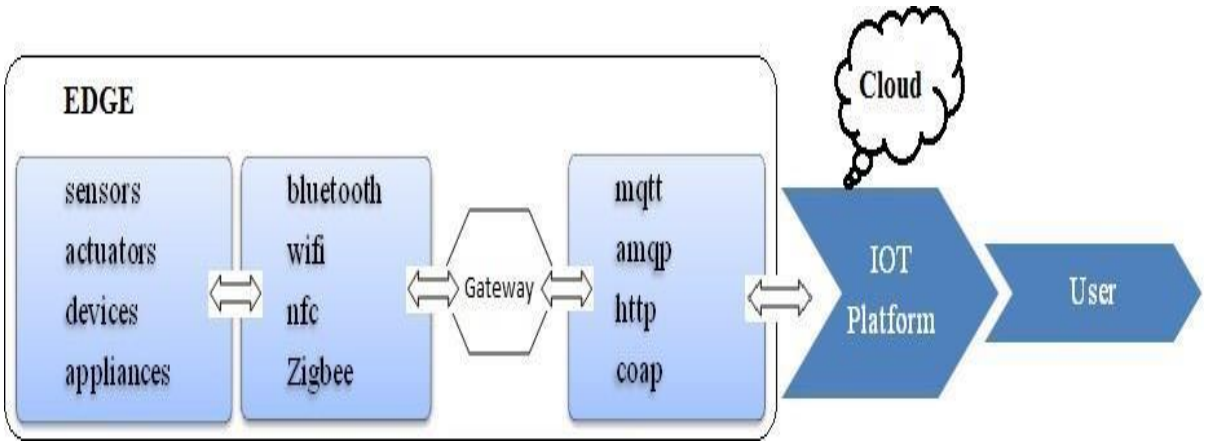

Figure 14.3: IoT Architecture

1.6 IoT Applications

IoT application transforms us and made our life simple, agreeable and basic. The area and zone that IoT covers are immense. IoT have broad applications in various areas for example business, mechanical, and clinical and shoppers. In every one of these cases IoT left its impression and in future it amazes more. Here a portion of its genuine application illuminates, which are keen modern, shrewd city (leaving, squander the executives), utilities (savvy network, brilliant metering), wearable devices, Transports and coordinations (associated vehicles, armada the board, products following), mechanical (measure checking and control, fabricating, support), agribusiness (farming observing, atmosphere, domesticated animals following), telemedicine and medical services, senior consideration, and environment(environment checking.

Keen mechanical among them is the most needed area that individuals are attempting to get in more modernized manner step by step. We are zeroing in on savvy mechanical robotization framework to oversee additional utilizations of energy and observing. A shrewd modern methods robotized mechanical which could oversee and control keen gadget and other mechanical machines consequently or physically by the client. A savvy mechanical comprises of countless things like as lighting, warming, cooling, homegrown robot, indoor regulator, remote speaker, modern security and checking, smoke alarm, water finder, clothes washer, and fridge. The force utilization of keen modern electrical gadget unquestionably change request reaction (DR) to buyer and discover great match interest for power as well as for supply. DR really answerable for finding better match by changing force against supply encourages shopper to reclaim helper expense.

Shopper assumes extremely indispensable function to lessen additional force utilization by taking an interest and directing their family unit.

At this current stage, people are devouring an ever increasing number of energies like electrical or different areas. The quick developments of individuals are required of these energies which is a piece of their life. This limitless burn-through of energies are being referred to as these energies are likewise in misfortune. Straightforwardly or in a roundabout way, individuals are abusing energy like turning on power in an empty space for a few times and so forth IoT is attempting to diminish this energy misfortune that can make this more productive. By utilizing IoT gadgets, we can without much of a stretch control the energy of a modern naturally from a removed spot. Our essence isn't compulsory however a web association can make it conceivable with robotization to lessen the abundance energy misfortune and burn-through more viable energy. Like in the official hour, we don't have to turn on the gadgets of our modern consistently. We can control it from our office by utilizing an IoT framework or gadget just through web or remote association. That will save the energy unquestionably.

By doing ideal planning aptitude, client can save more energy and their additional cost of cash simultaneously. IoT modern energy the executives framework gives client greatest fulfillment against least expense. The interest model utilizing request reaction gives higher delight utilizing time stretch enhancement. Here and there booking isn't pertinent for all clients so require balance. This sort of favorable circumstances not exclusively can save the energy yet in addition make our time more productive for considering more things. Subsequently, we discover the idea IoT based energy saving mechanical robotization framework which is examined in this paper in a simple and cost devouring manner. We are zeroing in on value reaction, season of utilization evaluating (TOUP), ongoing estimating (CPP), basic pinnacle valuing (CPP) and request side administration (DSM).

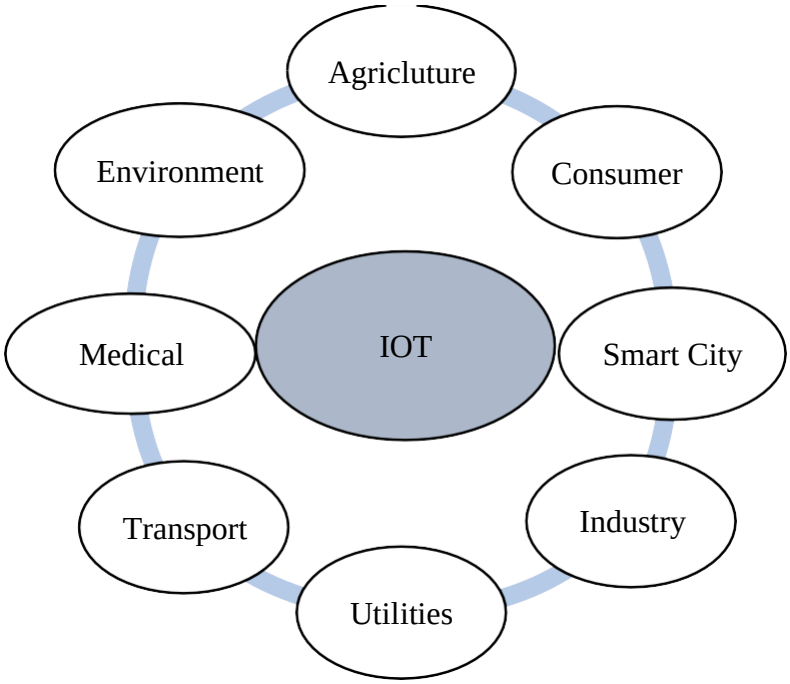

Figure 15.4: IoT Applications

1.7 Industrial Automation

Mechanical Automation is the cycle which all the modern machines can be controlled, observed and kept up naturally by the insight of gadget a long way from plant in any case is commonly called modern computerization which makes industry brilliant. It interfaces everything in the organization through web. House being completely automated used to be various. By and by, it is a reality. Savvy businesses and entering modern things are conspicuous considering the way that they offer more convenience. Client can check the update status of a gadget time to time. These devices can pass, on target and send information, and respond as indicated by client order. In this innovation we can control modern machines like lighting, AC, Exhaust fan, engines, security framework and so forth By utilizing man-made reasoning, it can likewise act naturally controlled and checked without anyone else. These systems also help augmentation modern's imperativeness adequacy, which can diminish essentialness bill.

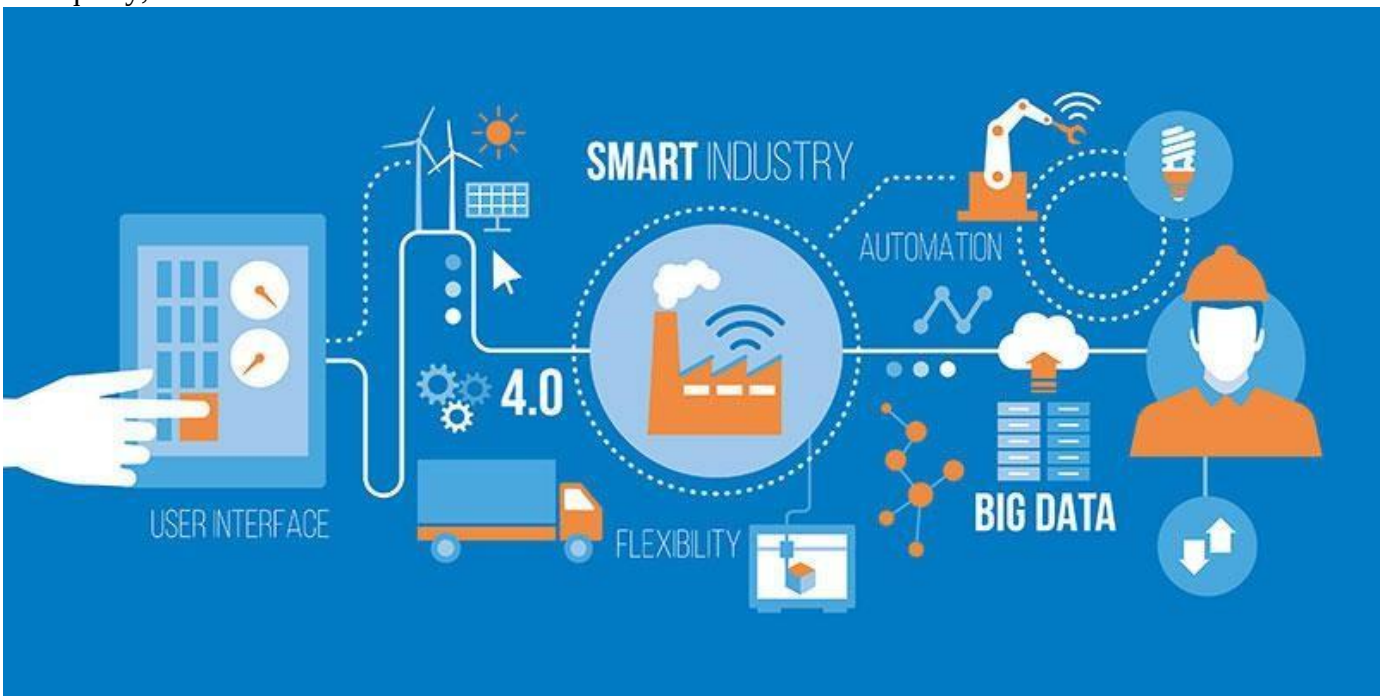

Figure 1.5: Industrial Automation

1.8 Project overview

The primary focal point of this undertaking is – modern apparatus control from its man-made brainpower coordinateness of upkeep as indicated by the need. A clever framework which given ideal update about the pinnacle and off-top hours; in light of this whenever applied, client can save more than foreordained energy, the robotization framework which permits to helps the client. In the wake of keeping up the proposal appearing in the showcase about pinnacle and offtop hours, the more the assistive force and money simultaneously will be saved relatively. Absolutely, there will be a fundamental need of certain machines which client can't disregard which implies that whatever the pinnacle hour or greatest cost of intensity is, client can utilize it. For dealing with the present circumstance, the reinforcement of environmentally friendly power energy age will offer help that specific time for reserve the machines [3]. After that the client will either not to be permitted to help utilizing apparatuses from lattice power. This will be accomplished for setting aside additional money of the client.

Toward the start of the task, a robotization strategy which is utilized for the apparatuses for overseeing and upkeep apparently plying inside model occupant for equipment's. This was done to dodge bother free family unit contraption the executives with observing and above all discovering all segments together without having any issue, which can be tedious for business client. On the accompanying the age of efficient power energy age for the current framework to actualize the computerization procedure works in a planned way. After establishment of the contraption and estimation of their temperament, the model went under test where its achievable execution was tasted and its productivity over other comparable robotization venture were accepted utilizing functional information.

1.9 Summary

In the second section of this paper is examined about the mechanical mechanization and its tremendous territory, the current improved models and conventions likewise the administration of energy for modern, booking and contrast of nearby planetary group and supply intensity of close planetary system proficiency. Following that third part portrays about the computerization cycle and its qualities. At that point part four is about the equipment and programming execution cycle and strategy. Afterward, section five is improvement of control calculations. Relating to every one of this procedure the sun oriented force age and reenactment measure are being examined in section six. From that point onward, the energy the board, planning and force utilization computation and relationship analyze in section seven. Unexpectedly, the uniqueness, validate objective and how customer will get profited by this undertaking filter canvas in section eight. At long last, in section nine the paper was compacted edifying the modern customization with power organization and the impending work on this designing.

CHAPTER 2 LITERATURE REVIEW 2.1 Introduction

Living in the time of web, life has gotten more brilliant and more helpful for us today. The web has brought inconceivable and noteworthy alternatives for the person that is associating us with the consider building programmed brilliant framework. The programmed savvy framework idea came from quick spread of web can decrease the risk in any framework just as the human association. The overall investigates are proceeding to devour the intensity of an electrical framework or gadget proficiently so the misuse of it made by human contribution physically can be decreased. The productivity of such energy the executives framework can take us to the fitting objective of robotization framework that can be utilized constantly with security without the contribution of individuals. For this overall promising idea in electrical area, an arranging was going in our psyche to chip away at this that can be valuable around there. Web of Things (IoT) framework has a huge zone to research or chip away at. The mechanical computerization framework is one of the most loquacious, promising and overall investigating areas of IoT. This modern computerization framework has just made a huge effect in our innovative territory that is presently searching for decreasing the absolute force wastage decrease hypothesis. Mechanical Energy Management System (HEMS) is presently in feature to direct decrease of the deficiency of intensity, risky framework catastrophe and the existence loss of people. Thus, many examination papers and a few ventures from IEEE and online distributed sides share an expansive and significant thought on these things that how we can save our energy and lessen the peril of framework. These ideas and their exploration made us to think on the vision of our examination all the more broadly. That is the way the mission and objectives to chip away at for this

examination paper has been pointed. These papers and diaries ideas imagined the subtleties of IoT, its applications and immense territory of exploration, modern computerization, keen apparatuses at mechanical, modern energy the board framework, shrewd meters, booking with savvy machines, distinction between provided power and sunlight based force, the force utilization of our nation. Every one of these ideas are successful for this proposition paper to reach a determination and settle on a choice on the undertaking of absolute energy saving administration.

2.2 IoT and Industrial Automation

As the IoT has a tremendous chamber to examine on referenced before, it has been depicted quickly in a moderate manner to show the idea of it in a few exploration papers. A diary on "IoTIndustrial Automation" explored by S Bharat et al., distributed on International Journal at Computer Technology and Research (IJCTR) in 2016 demonstrated a detail modern robotization machine with short and clear view composing [4]. The preferences on modern computerization, for example, - decreased establishment cost, framework solidness, simple augmentation, aesthetical advantages, combination of mobiles gadgets are examined here. The apparatuses of modern mechanization like light and gadgets, webcam observation, attractive entryways and so on are should have been available. A portion of the equipment and programming based applications and segments like Radio Frequency Identification (RFID), Wireless Sensor Networks (WSN), tending to plans are talked about as well. This paper additionally recommends a model of usage of modern computerization apparatuses appropriately at on and off-top hours. Another paper on "Exploration and Applications on the Smart Industrial-Based Component
Technologies and Internet of Things" composed by Baoan Li and Jianjun Yu found in Sciverse Science Direct has extravagantly talked about these RFID and WSN apparatuses [5]. The current exploration of USA, Europe, China, Korea and Japan on nanotechnology, sensor-based apparatuses, knowledge implanted innovation, RFID's future machines, and ocean figuring applications are in effect right away engaged with this paper to give us the possibility of the wide application scope of RFID. The paper zeroed in on the security and knowledge arrangement of modern and workplaces of the far off countries that have been creating step by step. Family programmed apparatuses, clinical machines, natural programmed apparatuses are likewise referenced here. Another paper on "The Internet of Things: How the Next Evaluation of Internet is Changing Everything"- created by Dave Evans essentially centered around the IoT viewpoints and its future. The creator demonstrated how the effect of IoT are is snatching individuals and how the client of shrewd mechanical apparatuses are expanding from 500 million to 50 Billion inside only a long time from 2005 to 2020. It additionally centered around the IoT covered fields, for example, - business, instruction, transport, energy, modern, earth and so forth In a word, there are not really alternatives that can't be covered by IoT or might be undetectable. The writer wound up with the arising of IoT from the early second when the PC and spread of its apparatuses to the present tremendous territories of IoT based gadgets and areas. There are likewise a few diaries and the dependable sources from web have been imagined similar thought with these insights about IoT and modern robotization idea. The fundamental idea of remote associated network from gadget to gadget and human inviting channel that is introduced as the term of IoT has been acknowledged steadily in social orders. The effect of it has been critical in our reality that it has canvassed all the areas in our day by day life. There are limitless IoT applications that can't be covered certainly. In the area of agribusiness, schooling, industry, business, mechanical, security and a lot more are straightforwardly related with IoT. The purpose for this blast is the brilliant and auto easy to

understand gadgets that are useful, tedious and riskless. The mechanical robotization idea a significant piece of IoT has been prospered because of this utilization and easy to understand idea. It has deducted our manual mechanical attempts to save time, less danger and robotized order. We don't have to pause or remain in our modern to work everything now daily as mechanical robotization framework is working easily with an easy to use manual idea. Such points of interest spurred on this proposition paper to consider outside work as opposed to considering mechanical variables. At this current stage, more force devouring idea are in exploration as this IoT and modern robotization diminishes quickly the wastage of energy so that individuals can take the best advantage of IoT and mechanical mechanization. In this way, the widen ideas of IoT and its mechanical robotization through these diaries, papers and web implanted our idea that can prompt work with such ideas.

2.3 Industrial Energy Management System

To get the more effective utilization aftereffect of IoT, we likewise need to think on the administration arrangement of IoT that are available in our modern and structures. These frameworks should be force proficient and customer compelling to improve yield as result. A few frameworks are being proposed regularly by specialists and understudies yet all the frameworks are in additional test for the most noteworthy decrease of intensity misfortune. Junyon Kim's "Stitches Industrial Energy Management System" paper imagined an overall programmed savvy mechanical picture before us that rundowns the essential parts for modern computerization framework [6]. Segments like LED, CCTV, speakers, IR Sensors, Ultrasonic sensors, PDAs and gadgets for systems administration among and outside mechanical have been utilized here to give an appropriate thought of a modern mechanization the executives framework. On our postulation paper, we were searching for the best idea to decrease energy the board wastage. Ravi Kodali et al., made an easy to use savvy modern robotization framework worked by microcontroller and portrayed it in their meeting paper "IoT Based Smart Security and Industrial Automation System" which was introduced on International Conference on Computing, Communication and Automation [7]. A microcontroller TI CC3200 platform works the all out security arrangement of a modern gets the order from PIR movement sensor by getting to organize through wifi. This straightforward plan can undoubtedly be sorted out and give representation of a basic circuit for our paper-based venture in proposition. Along these lines, an end can be acquired to make a basic plan for this venture that can be available, modest for everybody and further can be altered.

Modern energy the board framework configuration is significant first to instate and improve venture yield however the yield information should be more explicit and restrictive. For instance, in the event that we switch on a machine or gadget at on pinnacle hour, the force utilization and further electric bill will be expanded. In the event that it very well may be utilized at off pinnacle hour, at that point the tension on the heap will be diminished. Also, supply power from the network is all the more exorbitant in this age of sun based. However, it's tad exorbitant in the absolute first to develop a PV cell for a framework, it can undoubtedly be worked with an extremely low upkeep cost further on. Then again, the force from network supply is trustworthy on use as more utilization costs more bill. For these issues, it's in idea how to diminish the force misfortune or the effectiveness of the framework that individuals are on exploration. An IEEE paper "An Internet of Things Framework for Smart Energy in Buildings: Design, Prototypes and Experiments" composed by Jianli Pan and Jain demonstrated long term noticed information of energy transformation for various occasions at modern and authority structures in USA [8]. They noticed

the power devoured by individuals in two better places of business and modern of a specific zone. The perception came for two distinct occasions one for winter and another is for summer. Subsequent to breaking down all these utilization rates, they went to a proposal to utilize a substitute technique so the tension on inventory matrix limits and customers get advantage on use pay. This paper recommended a computerization framework like programmed turning on/off with the move of individuals in the room, manual activity by shopper subsequent to perusing the pinnacle hour rates and so on A brief on this paper zeroed in the objective on this undertaking to limit the energy misfortune with more suitable robotized highlights. It extended the work measures to chip away at with mechanization for energy saving.

2.4 Scheduling

Another IEEE paper on "Study on Smart Grid Technologies-Smart Metering, IoT and EMS" by Shobhit Jain et al., proposed a force planning based interfacing convention for modern apparatuses associated over Industrial Area Network (HAM) accepting ongoing power cost [9]. An Energy Management System (EMS) comprises of Smart Metering Architecture (SMA) or Advance Metering Infrastructure (AMI) which empowers two-way interchanges gives data to the shopper by estimating power utilization. It can give the data distantly utilizing IP based remote organization. All the numerical figurings and information handling are constrained by microcontroller so the sequential correspondence regulator should be viable with conventions like Zigbee, GSM, Wifi and so forth Zuang [10]. That likewise imagined the shrewd meter proficiency on this field. There are additionally a few diaries for the booking technique for brilliant modern and shrewd mechanical apparatuses like cooling, warming and so on However, a view on Zigbee, DLMS, DPWS, 6LowPan and other remote correspondence advancements were taken yet it didn't work in this undertaking as they are exorbitant and some are not accessible in the nation.

2.5 Supplied Power and Solar Power in Bangladesh

A significant IEEE paper that turned out generally for this extend and expand work standards is "An Optimized Stand Alone Green Hybrid Grid System for an Offshore Island, Saint Martin, Bangladesh" composed by Khandakar Haque et al., all things considered for an island of our nation and matches with the arrangement of our nation [11]. The paper enhanced the contrast between power supply and nearby planetary group energy the executives effectiveness as they deal with sun based electric arrangement of Saint Martin Island. The distinction effortlessly guaranteed an input on how the sun oriented board can be force and cost productive particularly for a non-industrial nation like our own. Thus, a view on the profundity of that venture paper prompted set up this proposal venture converging with PV sun based administration, power utilization and cost.

2.6 Summary

In the wake of exploring all these and some more papers and diaries, the idea of mechanical robotization framework on IoT, its energy the board framework, booking energy the executives framework and some other computerization strategy to burn-through force in a successful manner are generally cleared. To build up a little task and paper for this proposition, those are sufficient to extend and fix vision at our work. Accordingly, the audit of these papers and diaries additionally point on the future works of the paper. A synopsis on these working papers and measures that coordinated with our task paper are in straightaway: -

Table 1: List of Review Papers

Topic	Paper Details	Reference no
Industrial Automation and IoT	Bharath,S., Pasha, M.Y., & Deepth, J.(2017, April). IoT-Industrial Automation. *International Journal of Computer Technology and Research, 5*, 4-6.	4
	Li, B., and Yu, J. (2011). Examination and application on the brilliant modern dependent on part advances and Internet of Things. Procedia Engineering, 15, 2087-2092.	5
Industrial Energy Management System	Kim, J. (2016). Sews (mechanical energy the executives framework) base on the IoT keen modern. Contemporary Engineering Sciences, 9(1), 21-28.	6
	Kodali, R. K., Jain, V., Bose, S., and Boppana, L. (2016, April). IoT based shrewd security and modern computerization framework. In 2016 worldwide gathering on figuring, correspondence and mechanization (ICCCA) (pp. 1286-1289). IEEE.	7
	Skillet, J., Jain, R., Paul, S., Vu, T., Saifullah, A., and Sha, M. (2015). A web of things system for savvy energy in structures: plans, model, and trials. IEEE Internet of Things Journal, 2(6), 527537.	8
Scheduling	Jain, S., Kumar, V., Paventhan, A., Chinnaiyan, V. K., Arnachalam, V., and Pradish, M. (2014, March). Review on shrewd framework advancements savvy metering, IoT and EMS. In 2014 IEEE Students' Conference on Electrical, Electronics and Computer science (pp. 1-6). IEEE	9

	Zhao, Z., Lee, W. C., Shin, Y., and Song, K. B. (2013). An ideal force booking strategy applied in modern energy the executives framework dependent on interest reaction. Etri Journal, 35(4), 677-686.	10
Power consumption System of our country	Haque, K. F., Saqib, N., and Rahman, M. S. (2019, March). An Optimized Stand-alone Green Hybrid Grid System for an Offshore Island, Saint Martin, Bangladesh. In 2019 International Conference on Energy and Power Engineering (ICEPE) (pp. 1-5). IEEE.2019.	11

CHAPTER 3 MODEL ARCHITECTURE 3.1 Automation and Features

The reason for this work is to build up a programmed framework which is flexible, practical, energy saving controller of modern apparatuses. The web application administers the framework for upkeep. Programmed controlling and distantly observing framework create our regular day to day existence more fulfilled and all the while save pointless scattering of electrical energy. For financial development of any nation power assumes extremely crucial job. Reformist nation like Bangladesh needs more adequacy of power. Due to having absence of regular assets and monetary exigency the up-degree and dispatch all the more new force plant principal concise edition. The purpose for rising energy cost is negative use of energy and ignorance of improvement of energy uses. The outcome results, the force plants don't give the interest of intensity inside the limit of intensity station. In spite of the fact that Bangladesh government constantly attempting to expand its ability by putting in new force plants and the in general settled power creation maintenance tumid 20,000MW (consolidating sun oriented force) in energy area. Another 2.4GW force plant which is known as "Rooppur Nuclear Power Plant" planned to go underway in 2023. Particularly the extensive force customers in Bangladesh are enterprises, private areas followed by business and farming areas. In spite of having the constraint of intensity age and expanded interest the careless utilization of substantial modern machines causes more effect on force matrix. On our regular routine, we generally rest the lights, fans and other electric family unit apparatuses on while it is no utilization or no one is in the loft. To be sure, some of the time we are in a rush or at some point our accident causes this wastage of energy. Whatever the condition is as a result the energy utilization necessity enhances. To synopses, dispense with this whole home issue this undertaking shows an exit from the present circumstance which save superfluous energy utilization by the

proficient utilization of mechanical useable gadgets and apparatuses. We have planned a 2200 sq.ft. model floor intend to finish our venture. Our venture credits are portraying roar.

3.2 Block Diagram

The figure shows the square graph of brilliant energy the board utilizing robotization arrangement of IOT. In this square outline all the machines are associated through the hand-off circuit to the regulator. Some essential burdens are overseen by a 12V SMPS power supply and now and again recommended apparatuses can be utilized through this force when basic pinnacle cost is high. This model is stimulated in two distinctive manner either 12V SMPS power supply or ordinary matrix. Above all the prime luxuries in this model framework is that it is associated with the web so the full framework would be controlled, observed and overseen from any spot of the world on the off chance that it is associated with web.

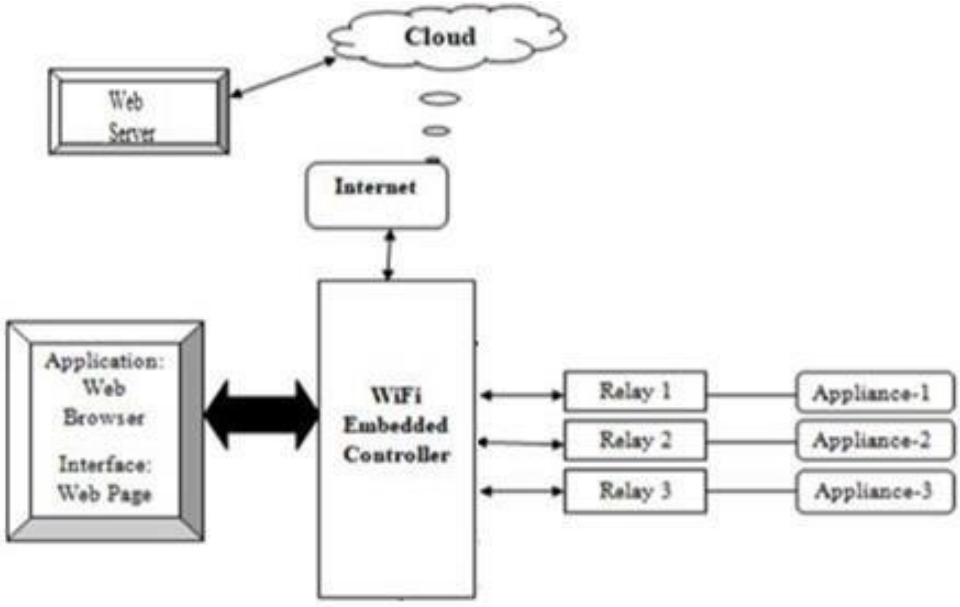

Figure 3.1: Block Diagram of HEMS using IOT

3.3 Prototype

The goal of this work is to build up a robotized energy saving savvy mechanical coordinated with IOT which implies on the shrewd world. IOT application gives the client to check the status of the relative multitude of apparatuses anyplace through web utilizing PC or telephone. In web application we can without much of a stretch control the machines. This task work is done on NodeMCU stage which speak with the worker by web correspondence.

3.4 Project Features

1. Lighting control
2. Exhaust fan control
3. Motor/Pump control

3.5 Lighting control

An industry has loads of lightings that is should be controlled. This is important to screen the lightings to bring down the energy utilization. In our undertaking, we've actualized the controlling capacity to control the lightings and furthermore at times we can likewise control the dimmable light's force. It will decrease the pointless light squanders and will save heaps of energy.

3.6 Exhaust fan control

A shrewd modern robotization has to realize the when the ventilation is required for a story. In an average modern working floor, there are a few fumes fans runs all at once. Occasion it needn't bother with that much ventilation. We can control each debilitate fan with our IOT framework. We can turn on any fan or different fans if necessary. We can likewise control the speed of the fan if necessary. Our application can control the speed of the fan if necessary.

3.7 Motor/Pump control

In occupants we as a rule face an exceptionally regular issue which is the accessibility of water and controlled water supply. Thus tenants use rooftop top tank to save water and for this they need water siphon which drives the water from cellar into the rooftop top tank and put away. By setting up a programmed water siphon that compress the deficiency of water issue and more changed other than water can be acclimated in more methodical manner. Keen water siphon is a completely practical and worked without anyone else in light of its man-made reasoning framework. By distinguishing the water level in the water tank, it runs a calculation whether it would turn ON/OFF without anyone else. As we as a whole realize that water siphon is very energy devouring, we found an answer for that. Prior to turning the siphon on; it first checks the storm cellar tank water level is sufficiently sufficient to siphon the water of that time contingent upon it takes choice. In the event that there isn't adequate water level on storm cellar tank it might consume the siphon. So on the off chance that we need to begin the siphon/engine, at that point we can essentially divert it on from our application or web interface from anyplace.

3.8 Protocols

3.5.1 Transmission Control Protocol (TCP)

Transmission control convention is a vehicle layer convention which is characterized for division and reassembly of information, multiplexing, association control, stream and mistake control of

information. In this layer information unit is known as portions. To control the progression of sections a port location and grouping number is appointed with the information unit.

3.5.2 Internet Protocol (IP)

Web Protocol is predefined rule and show which is utilized to administer the correspondence of advanced information between a gigantic quantities of gadgets associated through the web by doling out IP delivers to each and every one. This is Network layer convention and information unit at this layer is known as Packets. Thus, to trade bundles between precise sender and collector a one of a kind IP address is needed for each gadget which given by the network access suppliers (ISP) and represented by the Internet Engineering Task Force (IETF). An IP address is made by 32-digit long double number and written in four specked decimal documentations. For instance, here 192. 168. 12.1 every decimal is spoken to by 8 pieces.

3.5.3 MQTT

MQTT (Message Queue Telemetry Transport) is a convention utilized usually in IoT applications for distribute buy in informing. The reason for this convention is to move data between machines with confined organization transmission capacity and authority. For microcontroller ventures that send data over the web, it is enthusiastically suggested.

3.5.4 MQTT Working Process

It's a paired based convention which speaks with a worker called "dealer" to disperse messages to clients based on a particular "subject". At first distributer sends the agent data while supporters read the merchant's data. A common MQTT interface requires a host name, port, and distinguishing proof of the client, username and secret key.

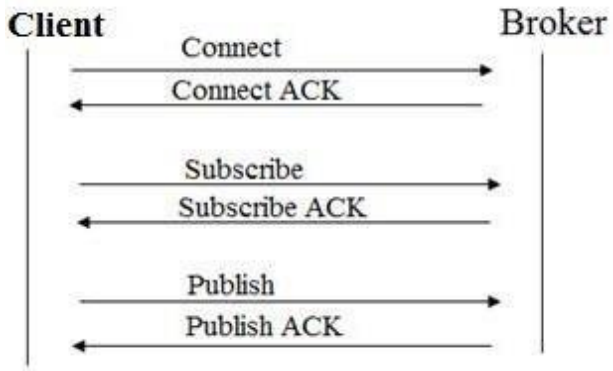

Table 2: Sample MQTT Control Message

Name	Value	Direction of the flow	Description
Reserved	0	Forbidden	Reserved

Connect	1	Client to the server	Client request to connect the server
Connack	2	Server to Client	Connect acknowledgment
Publish	3	Client to the server	Publish message

MQTT Packet Type

Control header	Packet length	Variable length header	Payload

3.5.4.1 MQTT Messages Type

- Connect: Waits to make a connection with the server and generates a connection between the nodes.
- Disconnect: Prepares for the MQTT client to complete any job they need to do and to disconnect the TCP / IP session.
- Publish: Arrives to the application thread promptly after the request is transferred to the MQTT customer.

MQTT is the best for IoT because with M2 M communication, neither HTTP nor Web socket have been intended specifically.

3.5.5 Hypertext Transfer Protocol (HTTP)

Hypertext Transfer convention is the arrangement of decides that is utilized for the translation between the web worker and the site page. This is a significant application layer convention which prepares for human to speak with the worker through the page. To show text, picture, sound and video information, various hyperlinks in a page from a far off worker HTTP convention is required.

3.9 Interface Working Procedure

In information advancement, the (UI) is everything arranged into an information contraption with which an individual may team up. This can consolidate grandstand screens and the presence of a work area. It is also the way through which a customer helps out a device on location.

Our interface is a site page. This site page comprises of HTML and CSS. Web worker is a spot which stores, techniques and passes website pages to Web clients. Web client is just a web program on our workstations and phones. The correspondence among client and worker happens using an uncommon show called Hypertext Transfer Protocol (HTTP). In this show, a client begins correspondence by making a sales for a specific site page using HTTP and the worker responds with the substance of that page or a misstep message if unsuitable to do all things considered (like prestigious 404 Error). Pages passed on by a worker are generally HTML reports. Maybe the best component ESP8266 gives is that it can't only interface with a current WiFi framework and go probably as a Web Server, anyway it can moreover set up its own special framework, empowering various devices to relate direct to it and access webpage pages. This is possible because ESP8266 can work in three extraordinary modes: Station mode, Soft

Access Point mode, and both meanwhile. This gives likelihood of structure work frameworks.

The ESP8266 that makes its own WiFi framework and goes probably as a middle (Just like WiFi switch) for in any event one station is called Access Point (AP). As opposed to WiFi switch, it doesn't have interface to a wired framework. Thusly, such strategy for movement is called Soft Access Point (sensitive AP). Furthermore, the most outrageous number of stations that can connect with it is confined to five. In AP mode ESP8266 makes another WiFi framework and sets SSID (Name of the framework) and IP address to it. With this IP address, it can pass on site pages to each related device under its own framework. At the point when you type a URL in a web program and hit ENTER, the program sends a HTTP interest (a.k.a. GET interest) to a web worker. It's work of web worker to manage this requesting by achieving something. You may have sorted out it now we will control things by getting to a specific URL. For example, expect we entered a URL like http://192.168.1.1/ledon in a program. The program by then sends a HTTP sales to ESP8266 to manage this requesting. Exactly when ESP8266 examines this requesting, it understands that customer needs to turn the LED ON. Thusly, it turns the LED ON and sends a powerful site page to a program demonstrating LED status: ON As straightforward as Pie!

For the progression of the Web application, as regards the client part, HTML propels were used. Data that counsel about the GPIO ports that are being utilized or the devices related with each room. For the execution of the Web application from the start all the status gets are crippled and are concealed dull. This exhibits the status of each device has not yet been gotten from the worker. At the point when the worker secures status data, the marker lights will change concealing and the contrasting status gets will be activated. In case for example a contraption is opened, by then the contrasting status catch will turn green and its operational OFF catch will be actuated. Then again, if a device is closed, by then the contrasting status catch will turn red and its operational ON catch will be impelled. The information about the status of each contraption is moved, continuously with the worker.

HTML:

HTML is a language for portraying the structure of Web pages. HTML represents Hyper Text Markup Language. Site pages comprise of markup labels and plain content.

CSS:

CSS speaks to Cascading Style Sheet. Falling formats are used to organize the plan of Web pages. They can be used to describe content styles, table sizes, and various pieces of Web pages that previously should be portrayed in a page's HTML. CSS helps Web engineers make a uniform investigate a couple of pages of a Web webpage.

CSS can be added to HTML components in 3 different ways:

- Inline - by utilizing the style quality in HTML components.
- Inward - by utilizing a <style> component in the <head> segment.
- Outer - by utilizing an outside CSS record.

In our page, we have catches to open or close primary entryway and it additionally show the condition of principle entryway. Moreover, it shows us the conditions of six AC burdens and it additionally has the catches to switch six burdens.

3.10 Schematic Simulation Diagram

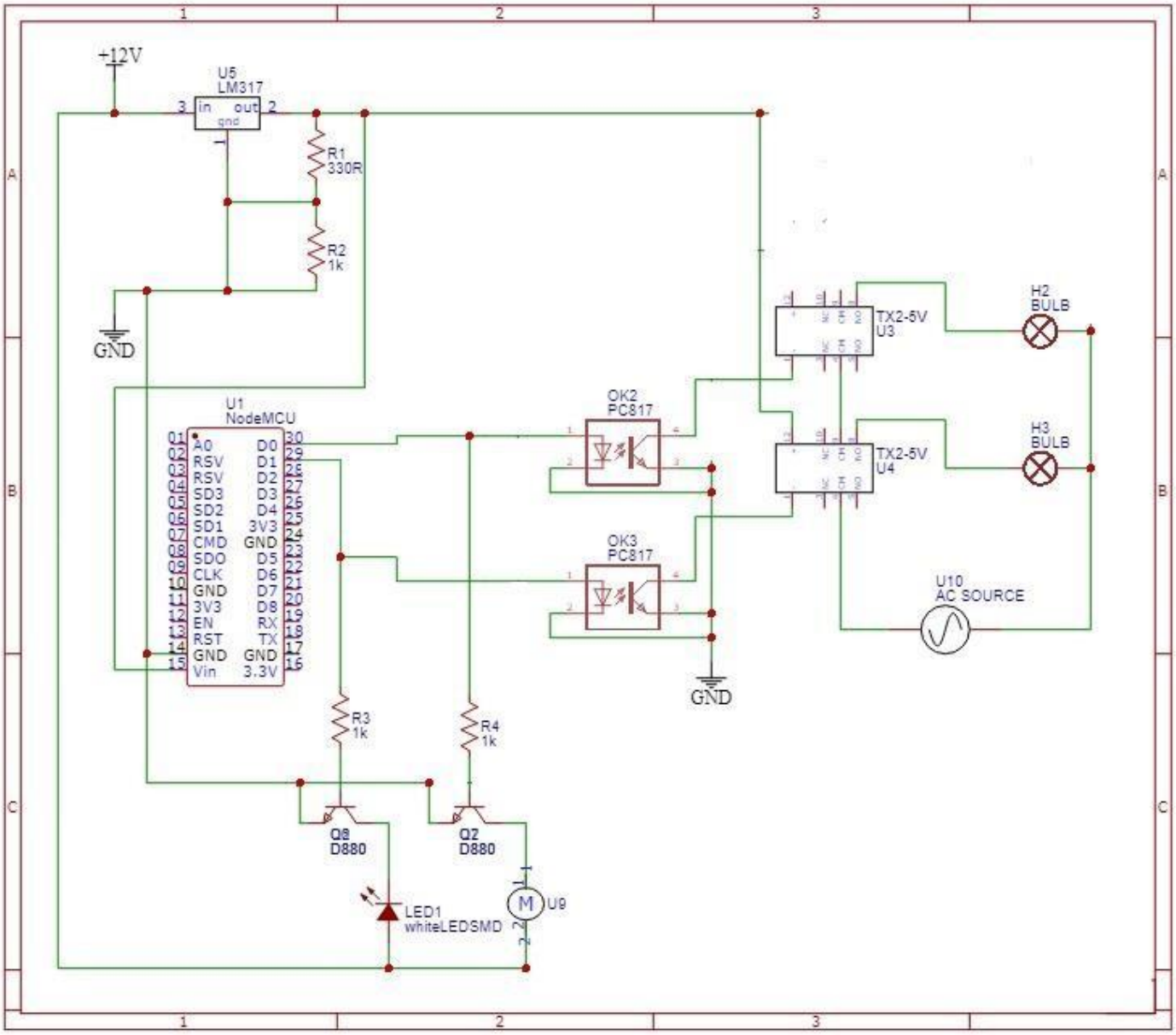

Figure 3.2: Circuit Diagram

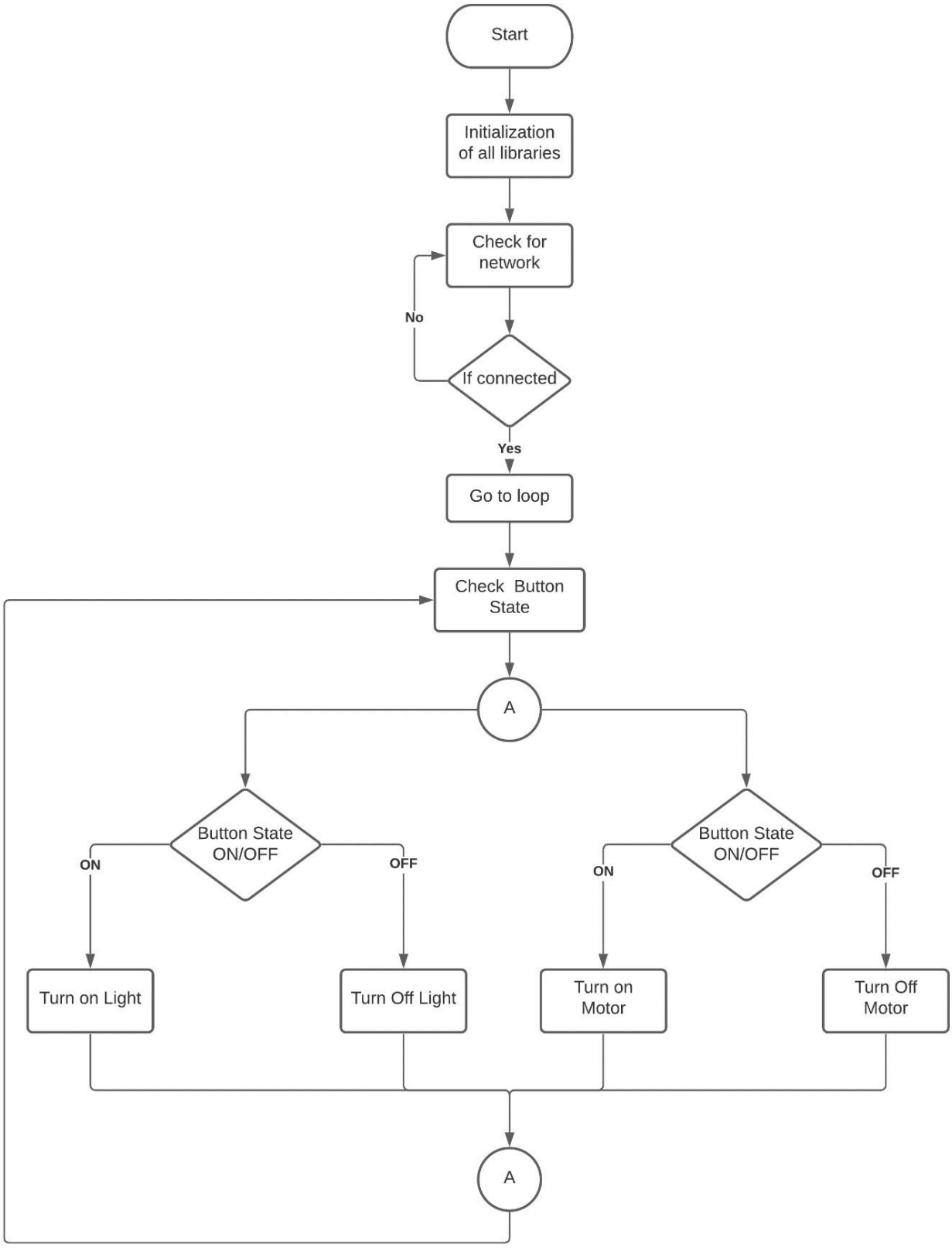

Figure 3.2: Flowchart

CHAPTER 4 HARDWARE AND SOFTWARE IOT Elements

4.1 Hardware Implementation

4.1.1 ESP 8266 NodeMCU

In our undertaking we utilize numerous gadgets like ESP 8266 NodeMCU module v3. The ESP8266 is the name of a miniature regulator organized by Espressif Systems. The ESP8266 itself is an autonomous Wi-Fi sorting out course of action offering as an expansion from existing more modest scope regulator to Wi-Fi and is in like manner fit for running free applications. This module goes with a characteristic USB connector and a rich course of action of stick outs. With a more modest scope USB interface, you can relate NodeMCU devkit to our PC and gleam it with no bother, much equivalent to Arduino. It is moreover speedily breadboard welcoming.

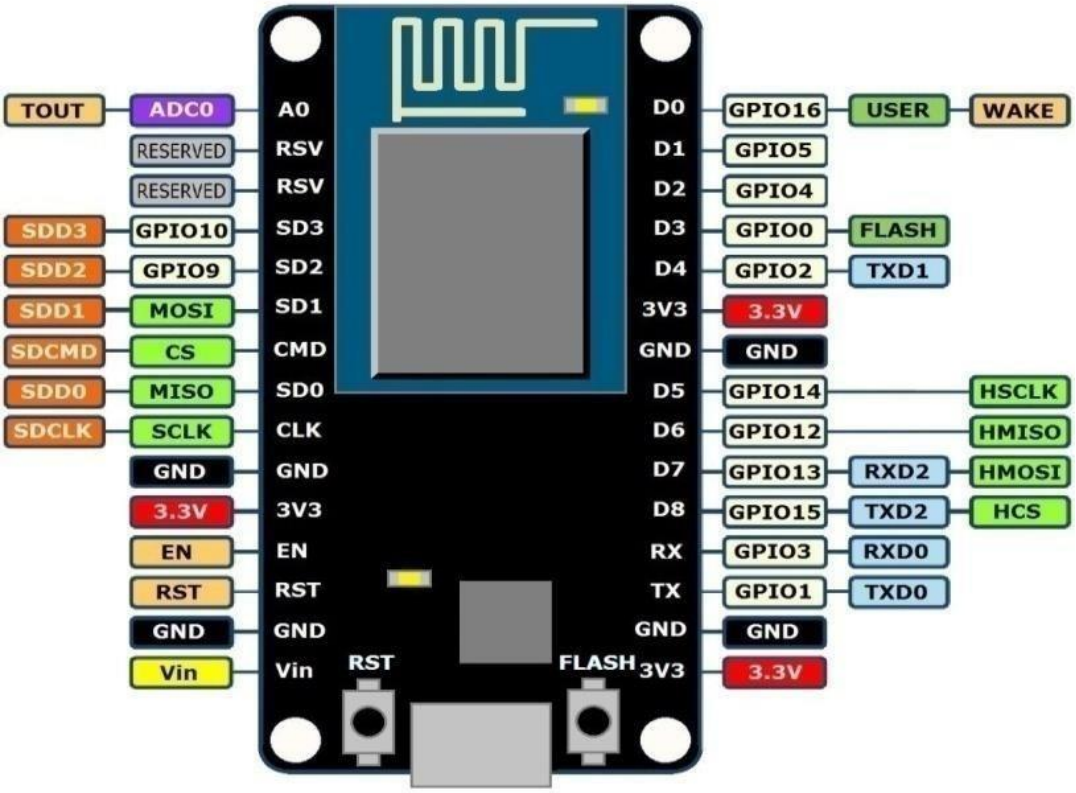

Figure 0.1: ESP8266 Node MCU

Specification:

• Voltage: 3.3V.

• Wi-Fi Direct (P2P), delicate AP.

• Current utilization: 10uA~170mA.

• Flash memory connectable: 16MB max (512K typical).

• Integrated TCP/IP convention stack.

• Processor: Ten silicaL106 32-digit.

• Processor speed: 80~160MHz.

• RAM: 32K + 80K.

• GPIOs: 17 (multiplexed with different capacities).

• Analogue to Digital: 1 contribution with 1024 stage goal.

• +19.5dBm yield power in 802.11b mode

• 802.11 uphold: b/g/n.

• Maximum simultaneous TCP associations: 5.

4.1.2 Motor

In This project we've also used DC motor. It is small size motor and very suitable to control.

Figure 0.2: DC Motor

A DC engine is any of a class of rotating electrical engines that converts direct flow electrical energy into mechanical energy. The most widely recognized sorts depend on the powers delivered by attractive fields. Essentially a wide range of DC engines have some interior system, either electromechanical or electronic, to occasionally alter the course of current in piece of the engine.

DC engines were the principal type of engine broadly utilized, as they could be fueled from existing direct-current lighting power conveyance frameworks. A DC engine's speed can be controlled over a wide reach, utilizing either a variable inventory voltage or by changing the strength of current in its field windings. Little DC engines are utilized in instruments, toys, and machines. The general engine can work on direct current however is a lightweight brushed engine utilized for convenient force instruments and machines. Bigger DC engines are presently utilized in impetus of electric

vehicles, lift and raises, and in drives for steel moving factories. The coming of intensity hardware has made supplanting of DC engines with AC engines conceivable in numerous applications.

4.1.3 Relay

Hand-off is an electromagnetic device which is used to isolate two circuits electrically and interface them appealingly. They are significant contraptions and empower one circuit to switch another while they are absolutely discrete. They are much of the time used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at especially high voltage. For example, a hand-off can make a 5V DC battery circuit to switch a 220V AC mains circuit. Thusly a little sensor circuit can drive, say, a fan or an electric bulb.

A hand-off switch can be apportioned into two areas: info and yield. The info segment has a curl which produces attractive field when a little voltage from an electronic circuit is associated with it. This voltage is known as the working voltage. By and large used exchanges are available in different plan of working voltages like 6V, 9V, 12V, 24V, etc. The yield area involves contactors which interface or segregate decisively. In a basic hand-off there are three contactors: typically open (NO), regularly close (NC) and ordinary (COM). At no information express, the COM is related with NC. Right when the working voltage is associated the hand-off curl gets engaged and the COM changes contact to NO. Diverse transfer courses of action are available like SPST, SPDT, DPDT, etc, which have particular number of changeover contacts.

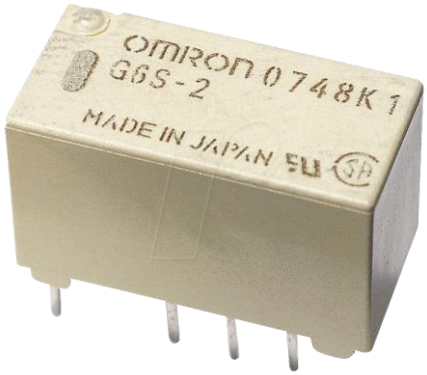

Figure 0.3: Relay

4.1.4 Transistor

A semiconductor is a semiconductor gadget used to intensify or switch electronic signs and electrical force. It is made out of semiconductor material typically with at any rate three terminals for association with an outer circuit. A voltage or current applied to one sets of the semiconductor's terminals controls the current through another pair of terminals. Since the controlled (yield) force can be higher than the controlling (input) power, a semiconductor can enhance a sign. Today, a few

semiconductors are bundled exclusively, however a lot more are discovered installed in incorporated circuits.

Austro-Hungarian physicist Julius Edgar Lilienfeld proposed the idea of a field-impact semiconductor in 1926, yet it was impractical to really build a working gadget at that time.[1] The main working gadget to be fabricated was a point-contact semiconductor developed in 1947 by American physicists John Bardeen and Walter Brattain while working under William Shockley at Bell Labs. The three shared the 1956 Nobel Prize in Physics for their achievement.[2] The most generally utilized semiconductor is the MOSFET (metal–oxide–semiconductor field-impact semiconductor), otherwise called the MOS semiconductor, which was concocted by Mohamed Atalla with Dawon Kahng at Bell Labs in 1959.[3][4][5] The MOSFET was the primary genuinely minimal semiconductor that could be scaled down and mass-delivered for a wide scope of uses.[6]

Semiconductors altered the field of hardware, and made ready for more modest and less expensive radios, mini-computers, and PCs, in addition to other things. The principal semiconductor and the MOSFET are on the rundown of IEEE achievements in electronics.[7][8] The MOSFET is the key structure square of present day electronic gadgets, and is omnipresent in current electronic systems.[9] An expected complete of 13 sextillion MOSFETs have been produced somewhere in the range of 1960 and 2018 (at any rate 99.9% of all semiconductors), making the MOSFET the most generally made gadget in history.[10]

Most semiconductors are produced using exceptionally unadulterated silicon, and some from germanium, yet certain other semiconductor materials are some of the time utilized. A semiconductor may have just a single sort of charge transporter, in a field-impact semiconductor, or may have two sorts of charge transporters in bipolar intersection semiconductor gadgets.

Contrasted and the vacuum tube, semiconductors are for the most part more modest, and require less capacity to work. Certain vacuum tubes have favorable circumstances over semiconductors at extremely high working frequencies or high working voltages. Numerous sorts of semiconductors are made to normalized details by various producers.

Figure 0.4: D880 Transistor

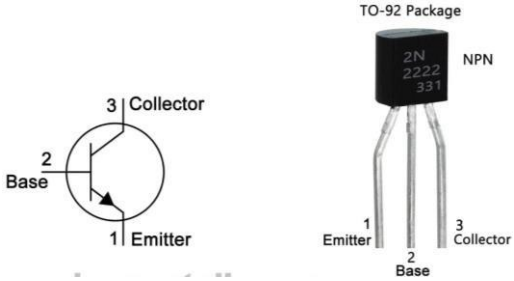

Figure 0.5: 2N2222 Transistor

4.1.5 Switched-mode power supply

An exchanged mode power supply (exchanging mode power supply, switch-mode power supply, exchanged force supply, SMPS, or switcher) is an electronic force supply that consolidates a changing controller to change over electrical force effectively. Like other force supplies, a SMPS moves power from a DC or AC source (frequently mains capacity) to DC loads, for example, a PC, while changing over voltage and current qualities. Dissimilar to a straight force supply, the pass semiconductor of an exchanging mode supply ceaselessly switches between low-scattering, all out and full-off states, and invests almost no time in the high dispersal advances, which limits squandered energy. A theoretical ideal exchanged mode power supply disseminates no force. Voltage guideline is accomplished by fluctuating the proportion of on-to-off time (otherwise called obligation cycles). Interestingly, a direct force supply manages the yield voltage by consistently scattering power in the pass semiconductor. This more powerful transformation productivity is a significant favorable position of an exchanged mode power supply. Exchanged mode power supplies may likewise be generously more modest and lighter than a straight stockpile because of the more modest transformer size and weight.

Exchanging controllers are utilized as substitutes for straight controllers when higher effectiveness, more modest size or lighter loads are required. They are, notwithstanding, more convoluted; their exchanging flows can cause electrical commotion issues if not deliberately stifled, and straightforward plans may have a helpless force factor.

Figure 0.6: SMPS Power Supply

4.2 Software

4.2.1 Arduino IDE for Controller and ESP Programming

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a substance chief for creating code, a message district, a substance comfort, a toolbar with catches for ordinary limits and a movement of menus. It partners with the Arduino and Genuine hardware to move programs and talk with them.

Tasks created using Arduino Software (IDE) is called plots. These portrayals are written in the word processor and are saved with the record growth. The article administrator has features for cutting/sticking and for looking/replacing content. The message an area gives analysis while saving and conveying and besides shows botches. The solace shows content yield by the Arduino Software (IDE), including absolute slip-up messages and other information. The base right-hand corner of the window shows the planned board and consecutive port. The toolbar gets empower you to affirm and move programs, make, open, and extra depicts, and open the successive screen.

CHAPTER 5
RESULTS AND DISCUSSIONS

5.1 Introduction

This chapter will present all the results and relevant discussions.

5.2 Final Result

Here’s our final assembled project.

Figure 5.2.1: Project Image 1

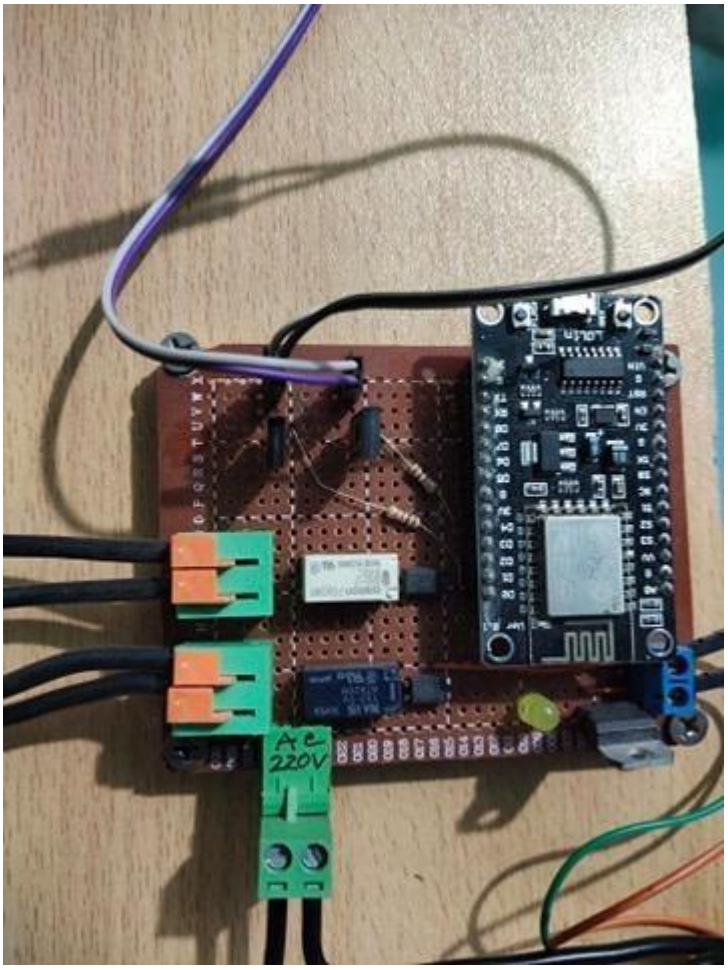

Figure 5.2.2: Project Image 2

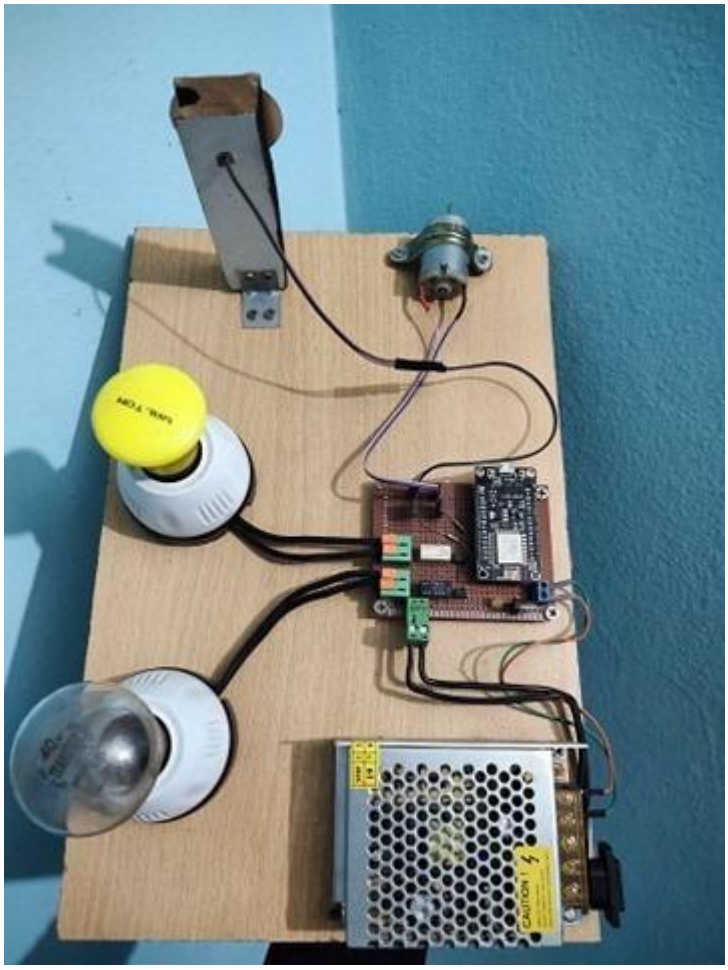

Figure 5.2.3: Project Image 3

5.3 Summary

In this chapter has discussed the result and discussion. With this project, we are successful to demonstrate with regarding the objectives of the project. At last, completing this chapter the project is ready to use. We've briefly discussed and shown the result of our experiment.

CHAPTER 6 CONCLUSION 6.1 Summary

This venture portrays the mechanical energy the executives by utilizing methodical uses of modern apparatuses in a keen industry. It is a novel proposed model which we actualized at least cost framework to decide a valid keen modern by utilizing its clever administration of mechanical apparatuses in productive way. Mechanical automation structure incorporates a ton of framework and assorted innovation.

Mechanical customization development hopes to diminish your concern by ensuring your home is secure despite when you are far away. It is furthermore proposed to reduce the proportion of effort you put every day into running your family so you can focus more on yourself and the general inside it. Imagine if your modern could normally put aside set aside you money, time and effort.

With an enormous number of these adequately settled and successfully improving systems, these yearnings are possible.

We achieved this venture into two stages through the use sun oriented force alongside lattice line in capable manner and an easy to use devoted credible page to screen and work the device that will make occupied life more lovely and bother free.

The main objective of this task is to utilize modern energy in effective structure by subsiding superfluous energy waste, cash and improve an easy to understand mechanical machine the board. The productivity of cost the board framework in this undertaking sub-par enough contrasted with some other programmed strategy accessible in market. Moreover, we likewise actualize an alternate kind of apparatuses in this circuit. It will assist with working family unit easily.

They need a system that is solid and continues running as one unit that issues bearings that are adroit and proper for the mechanical proprietor a lifestyle without them saying it. Whether or not through one-time programming or by sorting out some way to look at development and follow up all alone, these ventures are worked considering the customer. Sharp modern systems will simply continue to create and end up being additionally evolved. Various gadgets and systems are proposed to one or the other blend in with the climate or even stand apart as a declaration piece. In this way, while astute mechanical systems may put aside some push to grasp and pro, they will, and as of now may be, making life more straightforward.

6.2 Limitations

The primary restriction of this venture is control stacks carefully. Means we can either kill a heap on or. We can't shift the yield of regulator to control any gadget like engine speed, light force and so on Additionally as of now we can just control stacks locally. We can't control the heap over web yet. For this, we need to introduce a worker on a paid facilitating space and arrangement an information base on there to send and get order information and control the heaps as indicated by those order information.

6.3 Future Research

As the development for smart industrials continues propelling, the extent of limits is simply going to develop. At the present time, modern customization is continuing to advance. In future things have taken normal resources and changed them into mechanized devices, to get information about

your own use inclinations and conform to them. Industrials of things to come may very well go with clever mechanical features worked in, considering the rate at which these advances are being framed and joined into our ordinary everyday presences. Nonetheless, a couple of individuals may have to build up and additionally re-try mechanical automation contraptions without help from anyone else.

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APPENDIX Code

```
/*static const uint8_t D0   = 16;
static const uint8_t D1   = 5; static
const uint8_t D2   = 4; static const
uint8_t D3   = 0; static const
uint8_t D4   = 2; static const
uint8_t D5   = 14; static const
uint8_t D6   = 12; static const
uint8_t D7   = 13; static const
uint8_t D8   = 15; static const
uint8_t D9   = 3; static const
uint8_t D10  = 1;
*/
const int relayCount = 2; //total number of relays int
relayPin[relayCount] = {16, 5}; //
int relayState[relayCount] = {0, 0}; //initial state . 1 OFF, 0 ON String
buttonTitle1[relayCount] = {"Light ON", "Motor ON"};
String buttonTitle2[relayCount] = {"Light OFF", "Motor OFF"};
String argId[relayCount] = {"r1", "r2"};


#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266WebServer.h>
#include <ESP8266mDNS.h>
```

```
#ifndef STASSID

#define STASSID "Router"

#define STAPSK  "IIMS1234"

#endif


const char *ssid = STASSID; const

char *password = STAPSK;


ESP8266WebServer server(80);


void handleRoot() {

  //Robojax.com ESP8266 Relay Control

  String HTML = "<!DOCTYPE html>\

  <html>\

  <head>\

  \t\n<title>Industrial Load Control via IOT System</title>\

  \t\n<meta name=\"viewport\" content=\"width=device-width, initial-scale=1\">\

  \n<style>\

 \nhtml,body{\t\nwidth:100%\;\nheight:100%\;\nmargin:0}\n*{box-
sizing:borderbox}\n.colorAll{\n\tbackground-
color:#90ee90}\n.colorBtn{\n\tbackgroundcolor:#add8e6}\n.angleButtdon,a{\n\tfont-
size:30px\;\nborder:1px solid
#ccc\;\ndisplay:table-caption\;\npadding:7px
10px\;\ntextdecoration:none\;\ncursor:pointer\;\npadding:5px 6px 7px
10px}a{\n\tdisplay:block}\n.btn{\n\tmargin:5px\;\nborder:none\;\ndisplay:inlineblock\;\nvert
ical-align:middle\;\ntext-align:center\;\nwhite-space:nowrap}\n";


  HTML += "</style>\n\n</head>\n\n<body>\n<h1>Industrial Load Control via IOT
System</h1>\n";

  HTML += "</style>\n\n</head>\n\n<body>\n<h2>Prepared By: Rifat Ahmed</h2>\n"; HTML +=
  "</style>\n\n</head>\n\n<body>\n<h2>Daffodil Internatinal University</h2>\n";
```

```
  for (int i = 0; i < relayCount; i++) {
if (relayState[i]) {
    HTML += "\t<div class=\"btn\">\n\t\t<a class=\"angleButton\" style=\"backgroundcolor:#90ee90\"  href=\"/relay?";
    HTML += argId[i];
    HTML += "=on\">";
    HTML += buttonTitle1[i]; //Light ON title
   } else {
    HTML += "\t<div class=\"btn\">\n\t\t<a class=\"angleButton \" style=\"backgroundcolor:#f56464\"  href=\"/relay?";
    HTML += argId[i];
    HTML += "=off\">";
    HTML += buttonTitle2[i]; //Light OFF title
   }
   HTML += "</a>\t\n\t</div>\n\n";
  }


  HTML += "\t\n</body>\n</html>\n";
server.send(200, "text/html", HTML);
}//handleRoot()

void handleNotFound() {
  //Robojax.com ESP8266 Relay Control
  String message = "File Not Found\n\n";
  message += "URI: ";
```

```
 message += server.uri();
message += "\nMethod: ";
 message += (server.method() == HTTP_GET) ? "GET" : "POST";
message += "\nArguments: ";  message += server.args();  message
+= "\n";

 for (uint8_t i = 0; i < server.args(); i++) {
  message += " " + server.argName(i) + ": " + server.arg(i) + "\n";
 }

 server.send(404, "text/plain", message);
 //Robojax.com ESP8266 Relay Control
}//end of handleNotFound()

void setup(void) {
 //Robojax.com ESP8266 Relay Control

 for (int i = 0; i < relayCount; i++) {
  pinMode(relayPin[i], OUTPUT);// define a pin as output for relay  digitalWrite(relayPin[i],
relayState[i]);//initial state either ON or OFF
 }
 pinMode (4, OUTPUT);
digitalWrite(4, LOW);

 Serial.begin(115200);//initialize the serial monitor
 Serial.println("IoT based Industrial Machine Control System");
```

```
  //Relay control ON OFF by Robojax.com

  WiFi.mode(WIFI_STA);
  WiFi.begin(ssid, password);
  Serial.println("");
  Serial.print("Connecting to the internet");

  // Wait for connection
  while (WiFi.status() != WL_CONNECTED) {
digitalWrite(4, HIGH);     delay(100);
digitalWrite(4, LOW);     delay(500);
    Serial.print(".");
  }

  Serial.println("");
  Serial.print("Connected to ");
  Serial.println(ssid);
  Serial.print("IP address: http://");
  Serial.println(WiFi.localIP());

  //multicast DNS //Robojax.com ESP8266 Relay Control if
  (MDNS.begin("newtonodemcu")) {
  Serial.println("MDNS responder started");
  Serial.println("access via http://newtonodemcu");
  digitalWrite(4, HIGH);
  }
```

```
  server.on("/", handleRoot);
server.on("/relay", HTTP_GET, relayControl);
server.onNotFound(handleNotFound);
server.begin();
  Serial.println("HTTP server started");

}//end of setup

void                loop(void)                {
server.handleClient();
  MDNS.update();

  for (int i = 0; i < relayCount; i++) {
if (relayState[i] == 1)
    {
      digitalWrite(relayPin[i], HIGH);
    } else {
      digitalWrite(relayPin[i], LOW);
    }
  }

  delay(100);
}//end of loop

// relayControl() void
relayControl() {
```

```
  for (int i = 0; i < relayCount; i++) {
if (server.arg(argId[i]) == "on")
    {
      relayState[i] = 0;// set state of relay to ON
} else if (server.arg(argId[i]) == "off") {
relayState[i] = 1;  // set state of relay to OFF
    }
  }

  handleRoot();
}//relayControl() end
```