IOT BASED ENGINE COOLING SYSTEM

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A GRADUATION EXERCISE SUBMITTED TO THE DEPARTMENT OF MECHANICAL ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF MECHANICAL ENGINEERING

**BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING
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II

CERTIFICATION OF APPROVAL

The thesis title "**IOT BASED ENGINE COOLING SYSTEM**" Submitted by Md. Tarequl Islam ID: BME 1902018281, Sohag Parvez ID: BME1902018284, Sumon Mia ID: BME1901017420, Sourav Das ID: BME2001020030 and Md Abdul Halim ID: BME2001020210 Session 2018-19 has been accepted as satisfactory partial fulfillment of the requirements for the degree of **Bachelor of Science in Mechanical Engineering** on 22 September 2023

Countersingned

....
Prof. Md. Mostofa Hossain
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DECLARATION

We, hereby, declare that work presented in this Thesis, is the outcome of the research work performed by us under the supervision of **Prof. Md. Mostofa Hossain, Head of the Department in Mechanical Engineering, Sonargaon University (SU).**

We also declare that no part of this thesis and there has been or is being submitted elsewhere for the award of any degree.

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ACKNOWLEDGEMENT

ABSTRACT

This work is primarily about the improvement of current engine home practices by using modern technologies for better weather. This work provides a model of a smart engine cooling system, which helps the people to carry out the work in a engine cooling automatically without the use of much manual inspection. IoT automation is the biggest invention of modern world, we can make life easier by using this system in our life. We have tried to incorporate the modern conveniences of a engine cooling system here. All the data in a display, and That data can be monitored from anywhere in the world through the Internet, using only one software. The above project circuit diagram is a mature circuit diagram that combines all instruments are given and details of all the instruments are given in the project book. As well as being able to monitor engine temperature, engine room cooling temperature and humidity. A fan will automatically turn on and off depending on the temperature. In addition, the water misting system can be turned on and off when additional cooling is needed via the Internet. Water can be supplied to the water block through a water motor which is connected to the engine. Separate water supply, mist supply and fan are make the cooling system through. We learned a lot by doing the project. Water cooler system are used in various industries, which will be useful in our real life ,we gained real knowledge through this project. Project is considered to be a success, even there no fabrication at this stage. Problem statements above will be addressed, the implementation phase pending to conclude the work Economic wise, and this project will be a success because components used are not expensive.

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LIST OF ABBREVIATIONS

SCADA	Supervisory Control and Data Acquisition
IoT	Internet of Things
IR	Infrared
ESP	Extra Sensory Perception
IDE	Integrated Development Environment

CHAPTER-01

INTRODUCTION

1.1 Introduction

Automotive designers strive to incorporate efficient components within aesthetically pleasing designs while maintaining a high degree of reliability. In addition, governmental regulations for fuel economy also have a strong influence in the design of automobiles. Aerodynamics, weight, and space saving features are also significant considerations in new automotive designs. While lower hood profiles, for better aerodynamic design, have reduced the available space for the cooling system the demand on the cooling system remains changed and in some instances, has increased. New technologies have increased the engine power output requiring more heat to be rejected via smaller heat exchangers such as the radiator and oil coolers. To meet these design requirements, an understanding and accurate prediction of the performance of the cooling system including the mutual interactions between components is essential.

In the development of cooling systems, airflow predictions are generally based on cooling system component flow resistance characteristics obtained from tests of individual or "isolated" components. The assumption is that the pressure drop or jump of the components when combined or "installed" in a complete cooling package is equivalent to the sum of the pressure drops of the isolated components. In the case of the air side-pressure drop, this assumption can lead to significant errors in calculations of the net flow resistance of the cooling package.

When cooling components are combined to form a cooling package, it can be expected that interactions between the components will modify their flow resistance characteristics. By mounting the complete cooling package on a flow stand and measuring the net pressure change across the package as function of flowrate, comparisons with the pressure drops of isolated components can be made to evaluate the magnitude of the interaction effects. The magnitude of the interactions is useful in evaluating overall cooling package flow resistance but does not provide information concerning individual component interactions and the actual flow resistance of individual components with in the cooling package.

Although engine technology by now was developed with sophisticated, but heat lost and efficiency lost during combustion in engine still become a challenging research theme for researchers all over the world. Fuel consumption is tidily related to the efficiency of the engine combustion activity. As we know, the internal combustion engine only converts

approximately one third or 30 percent of the fuel energy to mechanical work in make vehicle moving. This is the fact at the present and it is extremely difficult to improve this internal combustion engine. In this project, the most focusing is on the diesel engine cooling system, in which the diesel engine is operating at a high compression ratios as compared to gasoline engines. In order to ensure the life span of the engine, engine cooling system is necessitate to more efficiently. From the recent innovation and finding in nanotechnology which named water cooler system, improving the heat exchange system is possible with great potential in heat transfer enhancement from these cooler system.

1.2 Objective's of the Project

The main objective's of this project is to "**IoT Based Engine Cooling System''** Project for the main purpose is to create a smart system so that we can take many benefits from one project.

- To monitor and control engine cooling system by using internet.
- To build low cost IoT Based Monitoring System with web hosting facility.
- To use the data group we receive will be monitored from anywhere and can be viewed at the engine room.
- Reduce the frictional resistance of the engine to a minimum to ensure mechanical efficiency.
- Separate water supply, mist supply and fan are make the cooling system through.
- Serve as a cooling by picking.

1.3 Background of the Project

This work is primarily about the improvement of current engine home practices by using modern technologies for better weather. This work provides a model of a smart engine cooling system, which helps the people to carry out the work in a engine cooling automatically without the use of much manual inspection. IoT automation is the biggest invention of modern world, we can make life easier by using this system in our life. We have tried to incorporate the modern conveniences of a engine cooling system here. All the data in a display, and That data can be monitored from anywhere in the world through the Internet, using only one software. The above project circuit diagram is a mature circuit diagram that combines all instruments are given and details of all the instruments are given in the project

book. As well as being able to monitor engine temperature, engine room cooling temperature and humidity. A fan will automatically turn on and off depending on the temperature. In addition, the water misting system can be turned on and off when additional cooling is needed via the Internet. Water can be supplied to the water block through a water motor which is connected to the engine. Separate water supply, mist supply and fan are make the cooling system through.

1.4 IoT System

The Internet of Things (IOT) is a system of interrelated computing devices mechanical and digital machines object animals or people that are provided with unique identifiers (UIDs)and the ability to transfer data over a network with requiring human-to human or human –to-computer interaction. The define of the Internet of things has evolved due to the convergence of multiple technologies real- time analytics machine learning commodity sensor and embedded system.
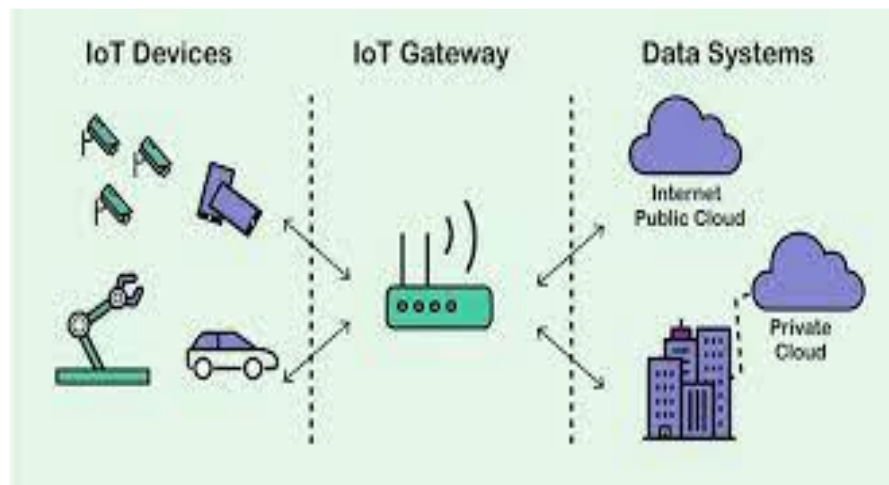
Fig-1.1: IOT System

Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of Things. In the consumer market, lot technology is most synonymous with products pertaining to the concept "**IoT Based Engine Cooling System**", covering devices and appliances (such as lighting fixtures, thermostats, home security systems and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as
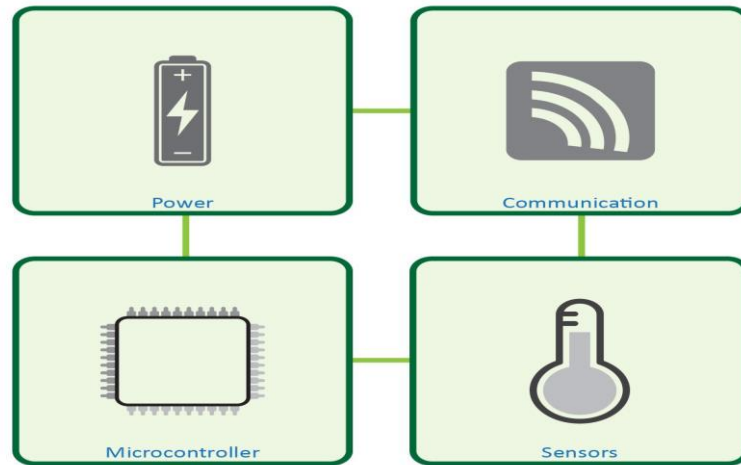
Fig-1.2: Block Diagram

Smart phones and smart speakers. There are a number of serious concerns about dangers in the growth of lot, especially in the areas of privacy and security, and consequently, industry and governmental moves to begin to address these.

1.5 Methodology

In recent years, existing solutions for cooling engine have been supplemented by a new product category, factory sealed water cooling loops. These systems, consisting of a water block with an integrated pump, a fan and a mist maker, perform well compared to the air cooling solutions but are effective than larger, custom built water cooling systems.

- Collection of data from books and internet.
- Collection of required components from local market and online shop.
- The concept of the design is based on using a microcontroller for processing.
- Designing a schematic for creating the circuit board.
- Programming for the microcontroller (Node MCU).
- Setting all the components in a PCB board, Car Chassis and soldering.
- Turn on the device experimental.

1.6 Motivation for Project

A poorly motivated team has been known to unravel even the best project plan. A good project manager needs to know how to harness the initial excitement that comes with starting a project and use it to maintain motivation – leading to success throughout the project's lifecycle. We now know that contemporary project managers need to be more than just

schedulers and contract managers. They need excellent skills in managing those complex human elements that have the potential to bring any project down.

1.7 Project Management

Management of any project can be briefly disintegrated into several phases. Our project has been decomposed into the following phases:

Experimentation: This phase involved discussions regarding necessary equipment regarding the project. The study of related already existing projects, gathering required theoretical learning. It also included figuring out the coding part, by developing simple algorithms and flowcharts to design the whole process.

ENVISIONED PHASE	• Information Gathering • Project Initiation
PLANNING PHASE	• Hardware & software estimation • Scheduling and distribution of task
MODELLING PHASE	• Analysis of project • Design and architechture of project
CONSTRUCTION PHASE	• Coding and hardware assembly • Testing and Debugging
DEPLYOMENT PHASE	• Delivery of project • Feedback
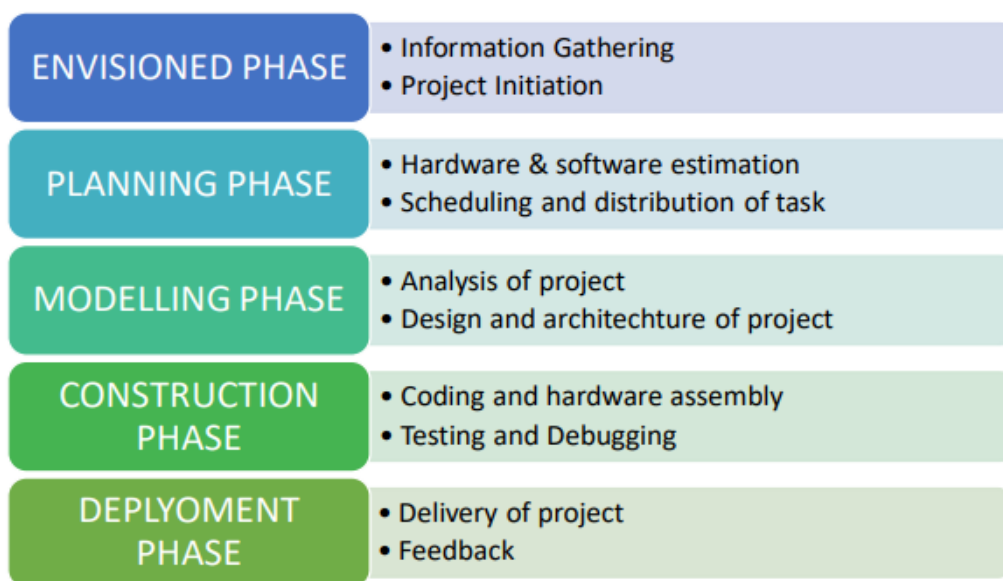
Fig-1.4: Project Management

Design: This phase was, designing layout of the application, and the necessary features to be included. This involved the complete hardware assembly and installing the Calibration for the Pixhawk Flight Controller. The power strip was designed to connect the home appliances that can be controlled via GPIO pins.

Development and Testing: This phase had the development of the application. The remote device was connected to the Pixhawk Flight Controller via wireless network and the whole prototype was tested for identification and removal of bugs.

Real world Testing: The prototype was ready to be tested into the real world and integrated with various real time electrical appliances.

CHAPTER-02

LITERATURE REVIEW

2.1 Introduction

While in automotive applications the cooling system is designed for the majority of operational conditions and coolant temperatures are managed the by actively controlling coolant flow and engine output in specific purpose applications, such as the case of locomotive engines, the trend is still to size the cooling package so that sufficient heat is rejected at extreme operating conditions (full engine power, high ambient temperature). Nevertheless, many of the technological practices matured in automotive thermal management are now being implemented in specific applications. Along with this, there is also an increasing demand to reduce product development times, to respond to market trends and to reduce investments. In this context, development engineers are encouraged to develop conceptual design strategies for the rapid assessment of the whole thermal management system at the component, system, and application levels, based on the use of CAE tools, in order to achieve design objectives and specifications for different system aspects. The models have to be kept simple, especially compared with state of the art radiator calculation methods, if acceptable calculation times are to be achieved. Separate water supply, mist supply and fan are make the cooling system through.

2.2 Temperature Control System

When the tempera inside the warehouse is lower than lower limit of the set value higher than the upper limit of the set value or higher than the upper limit of the set value the MCU will output the corresponding control signal to temperature and humidity control system and start the heating cooling or dehumidification circuit. When the temperature and humidity meet the requirement the temperature and humidity control system stop working the core work of temperature and humidity control system is to control the action of relays to achieve circuit switching part of the control circuit diagram is show in Figure.

2.3 Internet of Things (IOT) Basic Concept

The intercommunication between gadget or AI associated through the web with inserted innovation frameworks utilizing remote sensor actuators which is distantly controlled, screen and upgraded by the client for mechanization is alluded as internet of things IOT).Here the

expression "Things" signifiers actual gadgets for example, chips, cameras, sensor and other such gadgets. These actual gadgets are capable to impart gather data and trade information by interfacing an organization. The impotent innovation of these actual gadgets masks the trade of data each other conceivable. There is 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 a control the contraptions that the usually turn on and off very day. With a modern computerization structure, you can overs 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 than inquire. The creating proximity of the internet of things in person lives has made turn of event and progression in the clever mechanical space, empowering customer to relate their device through the web to their telephones and tablets, and improve then at any other time benefited for nuclear families. Also as house proprietor are changing their device to one central application device or focus thy further comprehend the value these modern robotization thing can bring to family. It is the network separated from the regular gadgets utilizing web for example, work is, PCs, smartphone, tablets and so on.
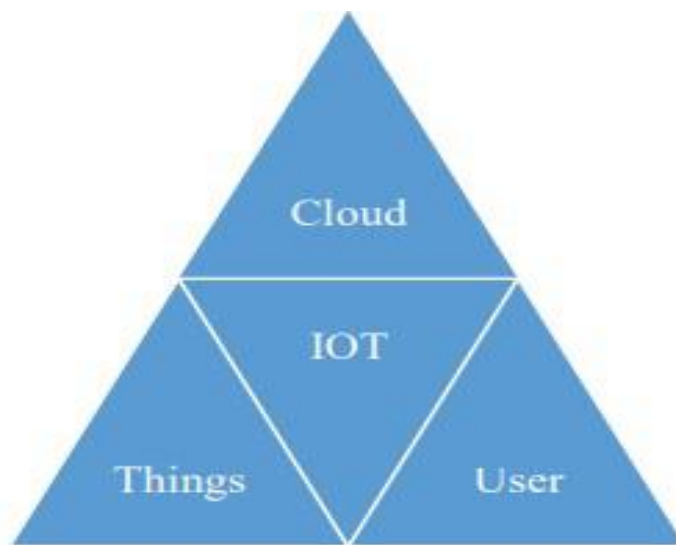
Fig-2.1: IoT Basic Concept

2.4 Literature Survey

Copper and brass were used in making radiator parts as they were good conductors of heat but were costly both as materials and for manufacturing. Ford company in 1983 tried to find different alternative material which will be used in radiators. After several experiments aluminium was selected for making radiator parts. The reason behind it was that it was lighter in weight, lower in cost, reliable and durable to its copper and brass counter parts. It was

selected where cooling requirements were moderate. It was used in making tubes, fins and header of the radiator. 3003 Al for tubes by extrusion process, hard 3003 Al for fins in flat plate design, 3005 Al for header of the radiator. Fin pitch was kept from 1.1mm to 2.2mm. The air side interface of this radiator joint was sealed with one part epoxy to prevent seepage and strengthen the header. The tank of the radiator was joint to the core by sandwiching a nitrile rubber gasket between header and tank. After the whole assembly, the radiator was tested and its calorimeter performance, durability, corrosion resistance and qualification with respect to vehicle was noted down. It was concluded from these experiments aluminium performed better in all the tests and was used in all automobiles manufactured by ford from that time. [1]

Corrosion Cracking Test: - Stress Corrosion is performed on CACTUS CB203 brass. In which slight corrosion was observed on the material in the form of graph. [2]

In year 1992 an experiment was performed to increase the thermal efficiency of radiator. It was done by using a converge shape at the starting of coolant flow which reduce the pressure of the tube in one size of tube made the coolant flow in smaller quantity from each tube. This helped the coolant to cool at faster rate increasing the thermal efficiency of tube. [3]

After a decade it was discovered that the airflow around the radiator had a huge part in cooling the system and the system was not optimize to use the air efficiently. Different tests were done on a vehicle with a radiator installed in it and all different measures that affects in cooling of the system were taken into account. Tests were done considering aerodynamic drag that acts on the vehicle and how it would influence the cooling airflow. Also, other test was done considering crosswind flowing through the vehicle when its in yaw or lifted. Different thermal rejection methods were tested to achieve a radiator which was thermally balanced and was efficient throughout the test. [4]

The high thermal conductivity graphite was less in weight and has density between 0.2 to 0.6m/cm^3 & bulk thermal conductivity is 187w/m^2.k due to the bulk thermal conductivity of graphite it will increase the cooling which will result in reduction of tubes required for cooling the system. Using graphite in the radiator assembly will reduce the overall weight, cost & volume of the radiator thereby improving fuel efficiency of the vehicle. [5]

The radiators required a higher heat flux. The carbon foam has higher heat transfer efficiency & better heat dissipation. Using carbon foam the material fins and tube had given great result in efficiency of cooling system. But the problem of carbon foam material was that it was not giving the required strength for the radiator and also there were bonding issue. To overcome this, carbon foam was coated with 2 different material made of Sic and metallization was done over it. This resulted increase in the strength and bonding of carbon foam material by

430% in which Sic coating gave increase 100% and metallization layer gave 330% improvement. [6]

The era of 2007 normal radiators were using parallel tubes which had aluminium fins attached to them. They were not giving the heat transfer coefficient to improve cooling. They designed some different fins which were made up of carbon foam which had porosity of 70%

thickness of 0.762mm and heat transfer coefficient 1000 w/m^2 k. This resulted in better heat dissipation which increased the cooling efficiency of radiator. [7]

After several years an experiment was done which tested the radiator design with practical scenarios. The heat transfer rate of radiator was cross verified, internal flow of water through radiator tubes whichwas depended on area of tube, velocity of water flowing from the tubes Reynold's number of water. Also, with these external flow of air over tubes and fins of the radiator, air Reynold's number, fin's dimension and its efficiency and effectiveness by NTU method. [8]

In the year 2009 using the side pod for improving the efficiency of radiator an fsae team used aerodynamic consideration in which they used converging and diverging roles. The Design were tested on Ansys CFD Simulation. From the results they concluded that using an aerodynamically shape side pod was directing the air on face of the radiator which increased the cooling rate of the radiator and the issue of overheating was overcome. [9]

After a year a new material was discovered as carbon foam it was tested for material of fins. During research of the material it was discovered that it has extremely high thermal conductivity and had an open cell structure which will helpto make a radiator efficient from a huge margin. The researcher also found out that they can improve the rate of heat dissipation through radiator by lowering the coolant inlet temperature and decreasing the air side resistance. After all the testings they observed that carbon foam's heat transfer coefficient was 40% greater than aluminium and it was 28% lighter in weight than aluminum. [10]

In year 2015 to reduce the size of radiator and also not come across overheating issues, the inlet port of radiator was provided with sensor attach to it. Same sensor was attach in the outlet port. Both sensor were connected to the ECU and were monitored continuously. Also with these the coolant tank was brought closer to inlet port which made sure the flow of water was continuous without any lag; by doing this the overheating of engine was reduced by a huge margin. This resulted in reduction of the size of cooling system. The cooling

system overall weight was reduced by 45% from its previous results. This not only reduce weight of the vehicle but also power loss done by radiator that was generated by the engine was reduced by huge margin. Also fuel efficiency was increased. [11]

An experiment was performed in 2016 using Nano-fluid materials in the coolant (silicon oxide, alumina, titanium). They achieved these by putting solid composite materials ranging from 1nm -100nm in size were mixed with the base fluid (used as coolants and include water, ethylene glycol, engine oil, etc.). During testing it was seen that the mixture of these resulted in giving better thermal properties than conventional fluids. Also due to this there was possibility in reduction of radiator size, reducing its weight and with that less fuel consumption was achieved. The mixture of fluid and solid particles can be done by two methods, first is one step method in which synthesis of nanofluid was done, other method was called two step methods in which particles were directly mixed with base fluids. It was concluded that the density, viscosity and thermal conductivity of nanofluid will increase with increase in volume concentration of particles in fluid. [12]

He also considers different ways and methods in ifferent scenarios in which the first approach was by theoretical and numerical. From this calculation the size of tube and thickness of fin of radiator was determined. This calculation was then converted into a CAD model and it was simulated on 1-D simulation software. From the results he found out that overall radiator efficiency was improved. [13]

In year 2016 the different assembly of tubes in the radiator were tested on software and calculation basis different setups of tube were considered like parallel flow, cross flow, flat tube, helical tube structure, dual pass flow in which they found out that parallel flow setup was not providing better result in cooling the system but also the material required to build the assembly was less hence overall cost was reduced. [14]

2.5 Time Plan

The following tables define the main tasks in the project introduction and project itself.

T1	Project Definition	1 Week
T2	Collecting data	11 Weeks
T3	Analysis	7 Weeks
T4	Theoretical calculation	4 Weeks
T5	Documentation	10 Weeks
T6	Prepare for presentation	2 Weeks

Table- 01: Time Scheduled Table for Project Introduction

The time of the project introduction is scheduled over 16 weeks, table 2 shows how the work was scheduled over this time:

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T1	■															
T2		■	■	■	■	■	■	■	■	■	■	■				
T3				■	■	■	■	■	■	■						
T4						■	■	■	■							
T5					■	■	■	■	■	■	■	■	■	■		
T6															■	■

Table-02: Time Plan Table for Project Introduction

The following table defines the main tasks in the project:

T1	Collecting data	3 Week
T2	Implementation	10 Weeks
T3	Analysis	5 Weeks
T4	Building and testing the system	8 Weeks
T5	Documentation	10 Weeks
T6	Prepare for presentation	2 Weeks

Table-03: Time Scheduled Table for Project

The time of the project is scheduled over 16 weeks, table 4 shows how the work was scheduled over this time:

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T1	■	■	■													
T2				■	■	■	■	■	■	■	■	■				
T3				■	■	■	■									
T4							■	■	■	■	■	■	■	■		
T5					■	■	■	■	■	■	■	■	■	■		
T6															■	■

Table-04: Time Plan Table for Project

CHAPTER-03

EXPERIMENTAL DESIGN

3.1 Introduction

Managed areas for the production of are Engine Cooling System. Because current Engine Cooling System restrict themselves, they are not automatically controlled and have to be manually operated with various documents. The system suggested must be monitored and controlled continuously to ensure optimal growth of system, temperature and humidity. In this paper we will see how an Engine Cooling System was designed, developed and how it was made efficient for Engine Cooling System in all condition. Separate water supply, mist supply and fan are make the cooling system through.

3.2 Required Components

- Node MCU.
- Buck Module.
- SMPS.
- LCD Display.
- DHT-11 Sensor.
- Relay Module.
- Mist Maker.
- DS18B20 Sensor.
- Pump Motor.

3.2.1 Required Software

- Arduino IDE.
- Proteus 8.13.
- United Diagram.
- Blynk IoT.

3.3 Node MCU

Node MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which is based on the ESP-12 module. The term "Node MCU" by default refers to the firmware rather than the development kits. The

firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espress if Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. NodeMCU was created shortly after the ESP8266 came out. On December 30, 2013, Espress if Systems began production of the ESP8266.The ESP8266 is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core,[citation needed] widely used in IoT applications (see related projects). Node MCU started on 13 Oct 2014, when Hong committed the first file of nodemcu-firmware to GitHub. Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9.
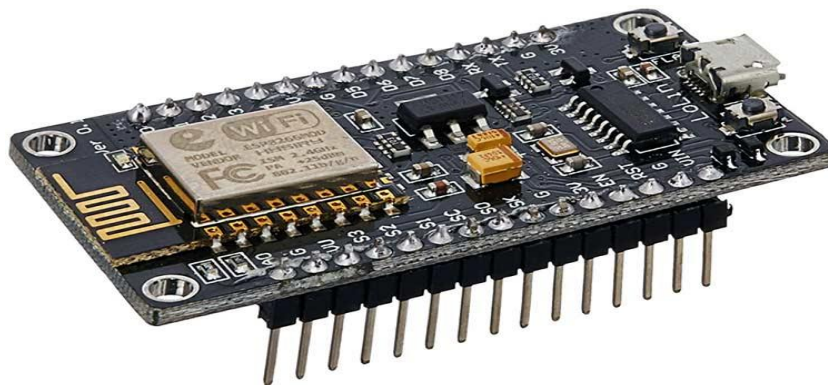

Fig-3.1: Node MCU

3.3.1 Technical Specifications

- Transfer rate: 110-460800bps
- Support UART / GPIO data communication interface
- Support Smart Link Smart Networking
- Working temperature: -40°C ~ + 125°C
- Drive Type: Dual high-power H-bridge
- Don't need to download resetting
- A great set of tools to develop ESP8266
- Flash size: 4MByte
- Lowest cost WI-FI
- Power input: 4.5V ~ 9V (10VMAX), USB-powered

3.4 Buck Module

The LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with

excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixed frequency oscillator. The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators. Available in a standard 7-pin TO-220 package with several different lead bend options, and a 7-pin TO-263 surface mount package.

Fig-3.2: LM2596 Voltage Converter

3.5 SMPS

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently.

Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power, see AC adapter) to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. The switched-mode power supply's higher electrical efficiency is an important advantage.

Switched-mode power supplies can also be substantially smaller and lighter than a linear supply because the transformer can be much smaller. This is because it operates at a high switching frequency which ranges from several hundred kHz to several MHz in contrast to the 50 or 60 Hz mains frequency. Despite the reduced transformer size, the power supply

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topology and the requirement for electromagnetic interference (EMI) suppression in commercial designs result in a usually much greater component count and corresponding circuit complexity.

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight is required. They are, however, more complicated; switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.

Fig-3.3: Switched Mode Power

3.5.1 Technical Specifications:

- Input Voltage: AC 85-265V
- Output Voltage: DC 12V
- Current: 10A
- Size:128mm*98mm*40mm
- Shell Material: Metal case / Aluminum base
- Protection: Shortage Protection, Overload Protection, Over Voltage Protection
- Widely used in Industrial automation, LED display, communications, etc.
- Safety Compliance: CCC/ FCC / CE
- Working Temperature: 0~40℃
- Storage Temperature: -20~60℃
- Ambient Humidity: 0~95% Non-Condensation

3.6 LCD Display

A Liquid crystal display (LCD) is a flat display that uses the light modulating properties of liquid display. They are common in consumer devices such as video players, gaming devices,

clocks, telephones, computers, calculators etc. A (20×4) LCD panel consists of 20 columns and 4 rows. It can show upto 16 characters in 2 lines.

One can want to have a look on these similar products:

1. LCD Display (20×4) with Header soldered

2. LCD display module (20×4)

3. LCD display module advanced (20×4)

4. 3 wire LCD module (20×4)

5. I2C LCD Display (20×4)

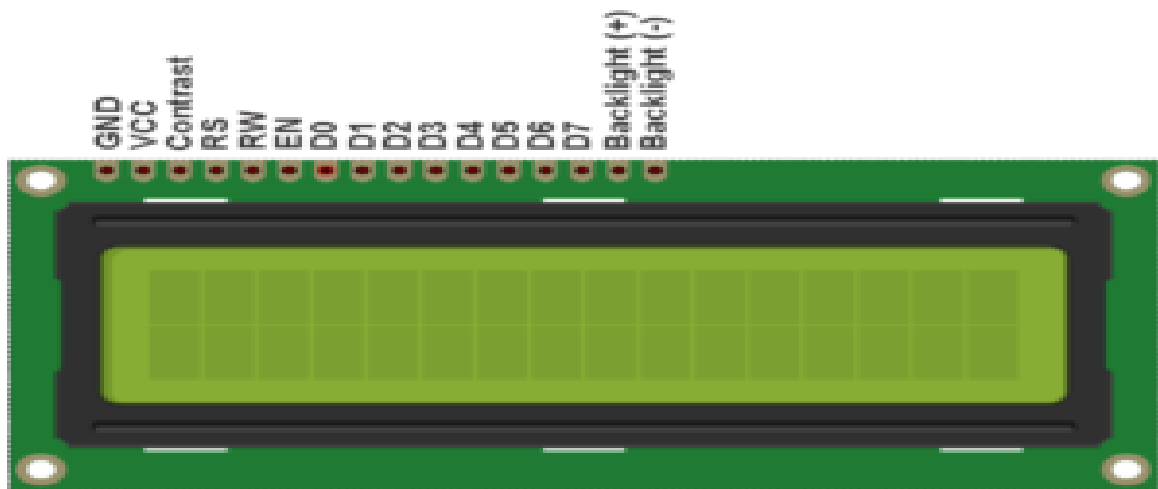6. Arduino LCD keypad shield

7. LCD Display (20×4)

Fig-3.4: LCD Display

Pin	Function
VSS	connected to ground
VDD	connected to a +5V power supply
VO	to adjust the contrast
RS	A register select pin that controls where in the LCD's memory you are writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.
R/W	A Read/Write pin to select between reading and writing mode
E	An enabling pin that reads the information when High level (1) is received. The instructions are run when the signal changes from High level to Low level.
D0-D7	to read and write data
A	Pins that control the LCD backlight. Connect A to 3.3v.
K	Pins that control the LCD backlight. Connect K to GND.

Table 05: LCD Display Outline

3.7 DHT-11 Sensor

The DHT11 Humidity & Temperature Sensor Module is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and outputs a digital signal on the data pin (no analog input pins needed). Its

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very simple to use, and libraries and sample codes are available for controller. This DHT11 Humidity & Temperature Sensor Module makes is easy to connect to microcontroller as it includes the pull-up resistor required to use the sensor. Only three connections are required to be made to use the sensor – Vcc, Gnd, and Output. We have also included the required to connect the DHT11 to a microcontroller.
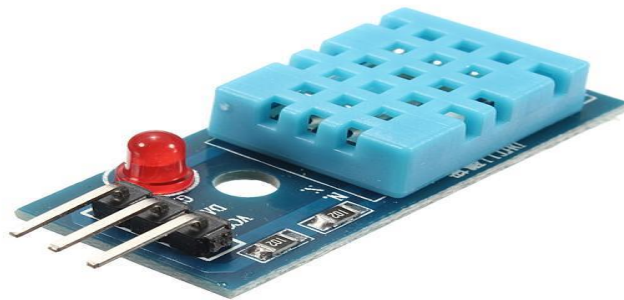

Fig-3.5: DHT-11 Sensor

3.7.1 Technical Specifications

- Input Supply Voltage (VDC): 3.3 ~ 5.
- Supply Current (mA): measurement 0.3mA standby 60μA.
- Temperature measurement range: 0~50 degrees.
- Temperature measurement error: ±2 degrees.
- Humidity measurement range: 20%~95%RH.
- Humidity measurement error: ±5%RH.

3.8 Relay Module

A relay is an electrically operated device. It has a control system and (also called input circuit or input contactor) and controlled system (also called output circuit or output cont. actor). It is frequently used in automatic control circuit. To put it simply, it is an automatic switch to controlling a high-current circuit with a low-current signal.

Fig-3.6: Relay Module

The advantages of a relay lie in its lower inertia of the moving, stability, long-term reliability and small volume. It is widely adopted in devices of power protection, automation technology, sport, remote control, reconnaissance and communication, as well as in devices of electro mechanics and power electronics. Generally speaking, a relay contains an induction part which can reflect input variable like current, voltage, power, resistance, frequency, temperature, pressure, speed and light etc. It also contains an actuator module (output) which can energize or de-energize the connection of controlled circuit. There is an intermediary part between input part and output part that is used to coupling and isolate input current, as well as actuate the output. When the rated value of input (voltage, current and temperature etc.) is above the critical value, the controlled output circuit of relay will be energized or de-energized.

NB: input into a relay can be divided into two categories: electrical quantities (including current, voltage, frequency, power etc.) and non- electrical quantities (including temperature, pressure, speed, etc.)

3.8.1 Features

The features of 1-Channel Relay module are as follow:

- Good in safety. In power system and high voltage system, the lower current can control the higher one.
- 1-channel high voltage system output, meeting the needs of single channel control.
- Wide range of controllable voltage.
- Being able to control high load current, which can reach 240V, 10A
- With a normally-open (NO) contact and a normally-closed (NC) contacts

3.8.2 Interface Specifications

We can do further development with the development tool you like as well as test it in the way of testing firmware. Firmware test: after the connection as in picture1-4, pay attention to the blink of LED, listen to the flicker of relay when it is working.

Software test code:

```
void setup () {
 pin Mode (7, OUTPUT);
 }
 void loop () {
pin Mode (7, OUTPUT);
delay (2000);
digital Write (7, LOW);
delay (2000);
 }
```
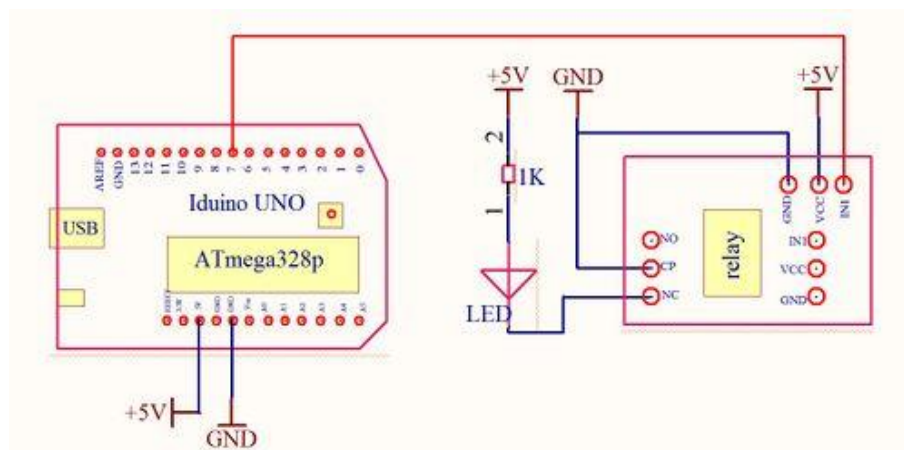

Fig-3.7: Sematic of Relay Module

The output contacts of a relay (including NO, NC, and the common port) works as a SPDT – Single Pole Double Throw switch. Its operating principle is as follow: VCC----5V, GND----for ground

IN1 connects to the control valve which output 3V-5V

Output contacts: connect to applications

Interface Connecting and Setting: Arduino board (any versions), wires, LED, 5v power supply. Software resource: Arduino IDE the one-channel relay can be programmed to realize the open and close automatically. NB: customers can use any software or firmware to control the module as long as the IN1 of which can input a voltage of 3V-5V.
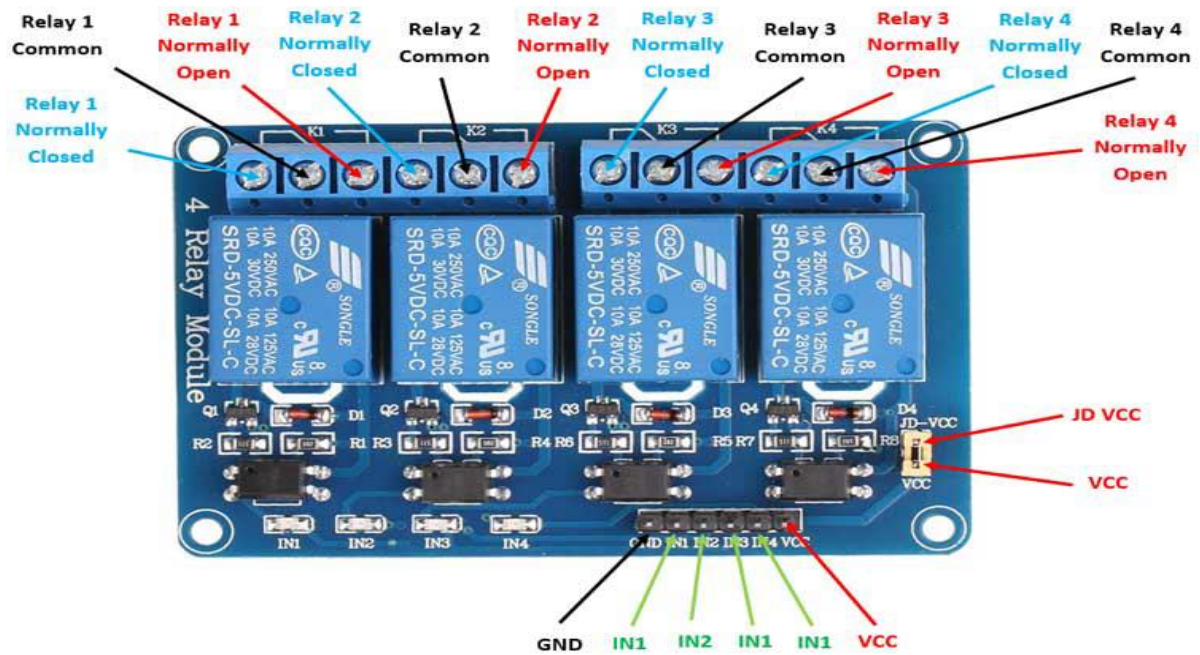
Fig-3.8: Pin out of Relay Module

3.9 Mist Maker

Mist is a phenomenon caused by small droplets of water suspended in the cold air, usually by condensation. Physically, it is an example of a dispersion. It is most commonly seen where water vapor in warm, moist air meets sudden cooling, such as in exhaled air in the winter, or when throwing water onto the hot stove of a sauna. It can be created artificially with aerosol canisters if the humidity and temperature conditions are right. It can also occur as part of natural weather, when humid air cools rapidly, notably when the air comes into contact with surfaces that are much cooler than the air (e.g. Mountains). The formation of mist, as of other suspensions, is greatly aided by the presence of nucleation sites on which the suspended water phase can congeal. Thus, even such unusual sources of nucleation as small particulates from volcanic eruptions, releases of strongly polar gases, and even the magnetosphere ions associated with polar lights can in right conditions trigger condensation and the formation of mist. Mist is commonly confused with fog, which resembles a stratus cloud lying at ground level. These two phenomena differ, but share some commonalities; similar processes form both fog and mist. Fog is denser, opaquer, and generally lasts a longer time, while mist is thinner and more transparent.

Fig-3.9: Mist Maker

3.9.1 Technical Specification

- Material: ABS Plastic Shell
- LED Light Color: Red, Yellow, Blue (Multi-color Changing Light)
- Plug Type: Asian Plug
- Power: 700MA/24V
- Adapter Voltage: 110~240V
- Atomizing Amount: 500ml/h (+-20%)
- Operating Temperature: +5°C~-45°C
- Suitable Water Depth: 4~6cm/1.57~2.36in
- Mist Maker Size (Diam* H): Approx. 4.6 *2.5cm/1.81*0.98in
- Atomizing Slice Diameter: Approx. 2cm/0.79in
- Atomizing Head: Approx. 1.5cm/0.59in
- Line Length: Approx. 1.4m/55.1in
- Weight: Approx. 203g

3.10 DS18B20 Sensor

The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply. Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area. Applications that can benefit from

this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.

Fig- 3.10: Temperature Sensor

3.10.1 Benefit and Features

- Reduce Component Count with Integrated Temperature Sensor and EEPROM.
- Measures Temperatures from -55°C to +125°C (-67°F to +257°F).
- ±0.5°C Accuracy from -10°C to +85°C.
- Programmable Resolution from 9 Bits to 12 Bits.
- No External Components Required.
- Parasitic Power Mode Requires Only 2 Pins for Operation (DQ and GND).
- Simplifies Distributed Temperature-Sensing Applications with Multidrop Capability.
- Each Device Has a Unique 64-Bit Serial Code Stored in On-Board ROM.
- Flexible User-Definable Nonvolatile (NV) Alarm Settings with Alarm Search Command Identifies Devices with Temperatures Outside Programmed Limits.
- Available in 8-Pin SO (150 mils), 8-Pin μSOP, and 3-Pin TO-92 Packages.

3.10.2 Applications

- Thermostatic Controls.
- Industrial Systems.
- Consumer Products.
- Thermometers.
- Thermally Sensitive Systems.

3.11 Pump Motor

DC 5V Pump Mini water pump For Fountain Garden Mini water circulation System.

3.11.1 Specifications

- DC Voltage:2.5-6V.
- Maximum lift:40-110cm / 15.75"-43.4".
- Flow rate:80-120L/H.
- Outside diameter of water outlet: 7.45mm / 0.3" (our 7mm inner diameter tube is ok for this pump).
- Inside diameter of water outlet: 4.7mm / 0.18".
- Diameter: Approx. 24mm / 0.95".
- Length: Approx. 45mm / 1.8".
- Height: Approx. 33mm / 1.30".
- Material: Engineering plastic.
- Driving mode: brushless dc design, magnetic driving.

Fig-3.11: Pump Motor

3.12 Description of the Software

3.12.1 Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension.ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Fig-3.12: Arduino IDE

3.12.2 Proteus Professional

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. It was developed in Yorkshire, England by Lab center Electronics Ltd and is available in English, French, Spanish and Chinese languages.

The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990, with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and microcontroller simulation then arrived in Proteus in 1998. Shape based auto routing was added in 2002 and 2006 saw another major product update with 3D Board Visualisation. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Support for high speed design was added in 2017. Feature led product releases are typically biannual, while maintenance based service packs are released as it is required.
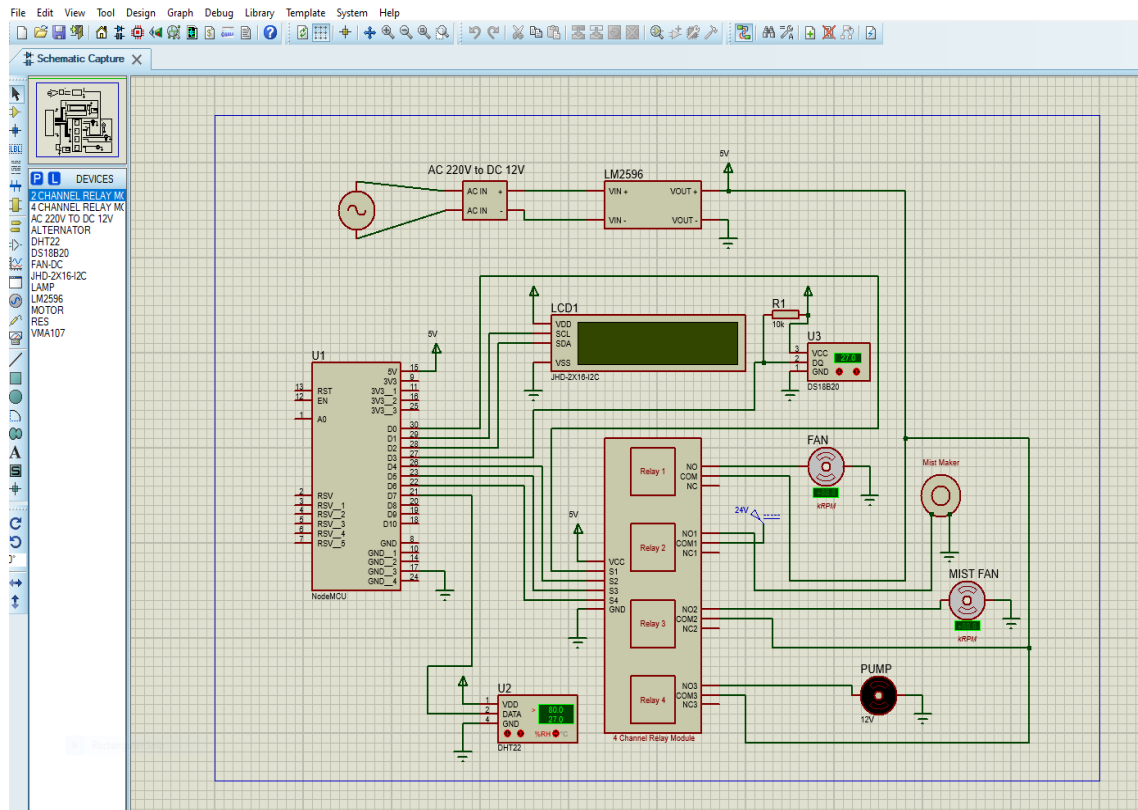
Fig-3.13: Proteus 8.13

3.12.3 United Diagram

The Unified Modeling Language (UML) is a general-purpose, developmental modeling language in the field of software engineering that is intended to provide a standard way to visualize the design of a system.

The creation of UML was originally motivated by the desire to standardize the disparate notational systems and approaches to software design. It was developed at Rational Software in 1994–1995, with further development led by them through 1996.

In 1997, UML was adopted as a standard by the Object Management Group (OMG), and has been managed by this organization ever since. In 2005, UML was also published by the International Organization for Standardization (ISO) as an approved ISO standard. Since then the standard has been periodically revised to cover the latest revision of UML.[3] In software engineering, most practitioners do not use UML, but instead produce informal hand drawn diagrams; these diagrams, however, often include elements from UML.
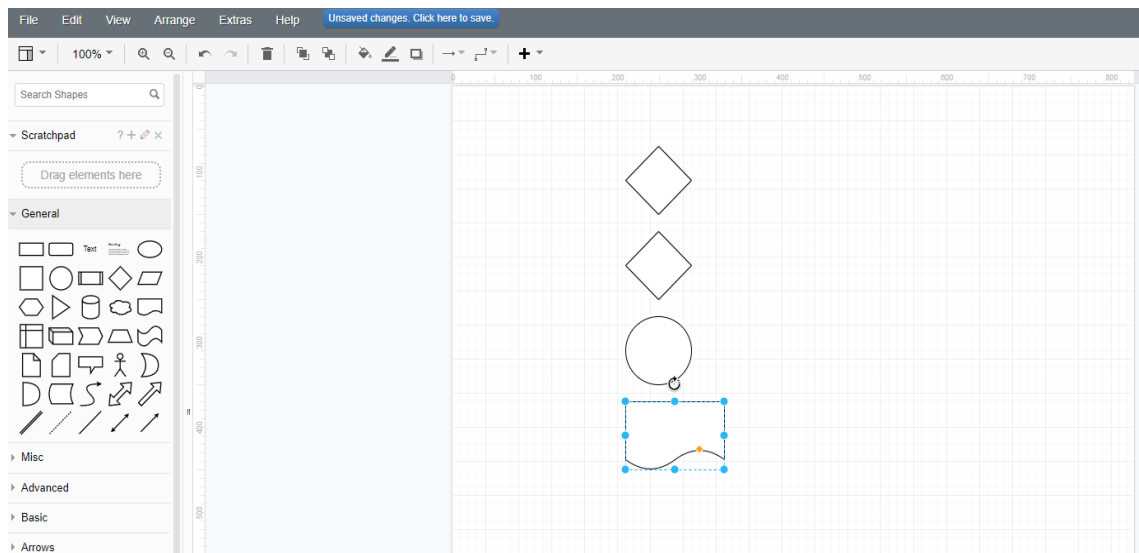
Fig-3.14: United Diagram

3.12.4 Blynk IoT

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and Node MCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets.

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform:

Blynk App: – It allows you to create amazing interfaces for your projects using various widgets which are provided.

Blynk Server: – It is responsible for all the communications between the smartphone and hardware.

You can use the Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

Blynk Libraries: – It enables communication, for all the popular hardware platforms, with the server and process all the incoming and outcoming commands.

The process that occurs when someone presses the Button in the Blynk application is that the data will move to Blynk Cloud, where data magically finds its way to the hardware that has been installed. It works in the opposite direction and everything happens in a blink of an eye are shown in Figure.
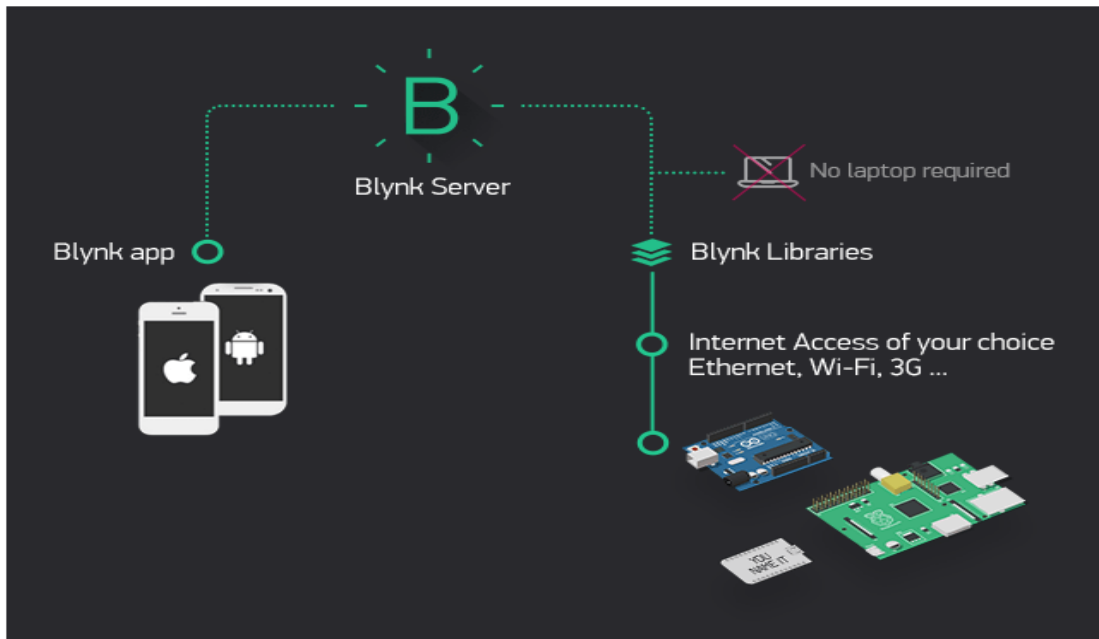
Fig-3.15: Blynk Apps

3.13 Block Diagram of This Project

The System can check for evident conditions, such as DHT-11 sensor, DS18B20 sensor, LCD Display, Relay Module etc. With Node MCU ESP8266, all data from the environment parameters are sent to the Node MCU. If a parameter exceeds the limit set, the associated actuator is switched on. If the Earth parameter does not meet the required value, the microcontroller turns on the system. A mobile phone and desktop allows the user to display and monitor parameters.
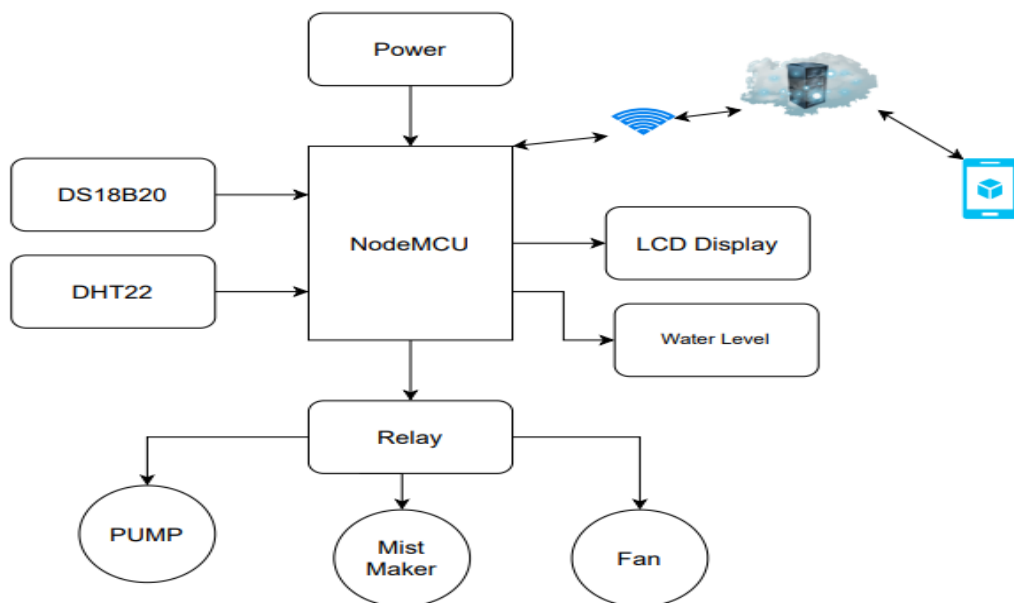

Fig-3.16: Block Diagram

3.14 Project Flow Chart

In any programming related project there is a part named "flowchart" is must. As per rules we made our project flowchart then wrote our proposed project program. There are several parts of our project thus many flowcharts we made.
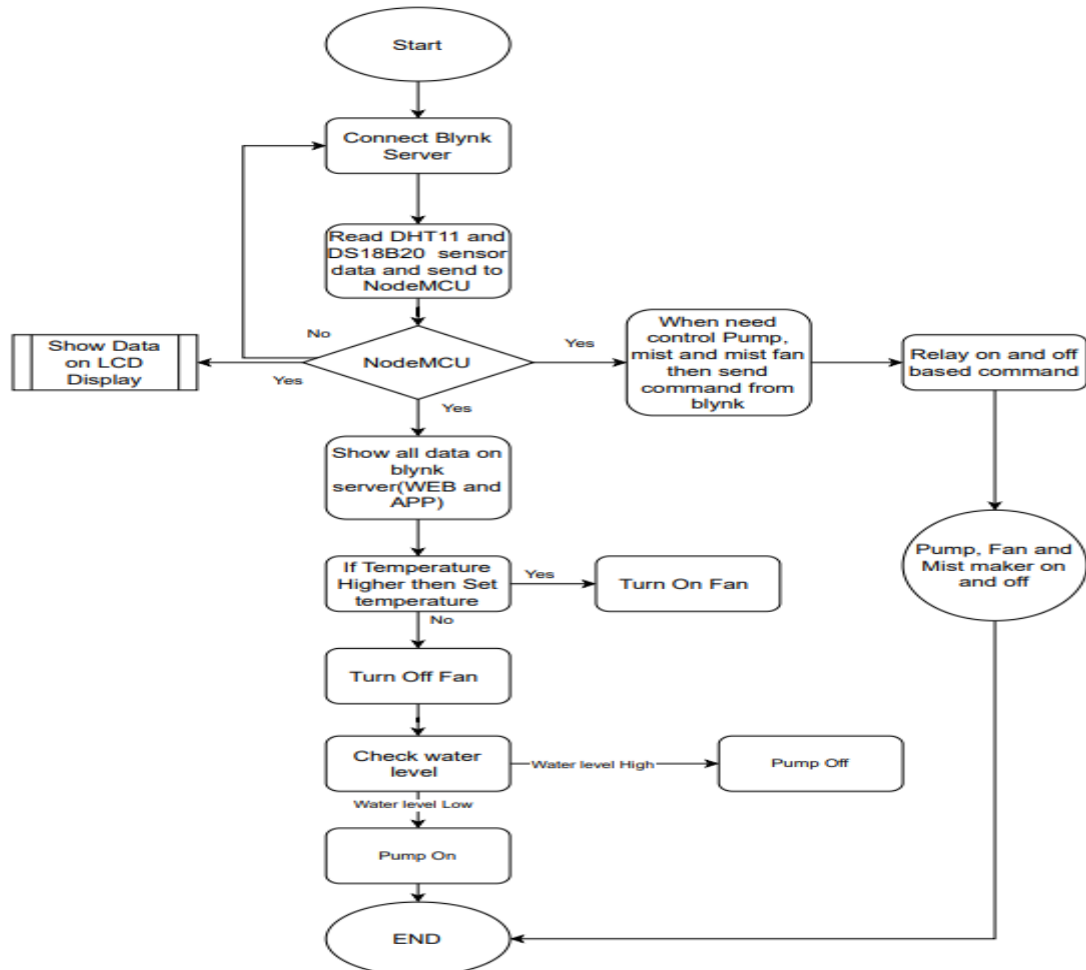

Fig-3.17: Project Flow Chart

3.15 Software Design

The software that is used to program the microcontroller is open-source-software and can be downloaded for free on www.arduino.cc. With this "Arduino software" we can write little programs with the microcontroller. These programs are called "Sketch". In the end the sketches are transferred to the microcontroller by USB cable. More on that later on the subject "programming".

Installation Now one after another the Arduino software and the USB driver for the board have to be installed.

Installation and setup of the Arduino software

1. We have downloaded the Arduino software from www.arduino.cc and installed it on the computer (This was NOT connected to the PC). After that we opened the software file and installed the program named arduino.exe.

Two set ups on the program are important and should be considered.

a) The board that we want to connect has to be selected on the arduino software. The "Arduino Uno" is here known as "Arduino / Genuino Uno".

b) We have to choose the right "Serial-Port", to let the Computer know to which port the board has been connected. That is only possible if the USB driver has been installed correctly. It can be checked this way:

At the moment the Arduino wasn't connected to the PC. If we now choose "Port", under the field "Tool", we will already see one or more ports here (COM1/ COM2/ COM3…). The quantity of the shown ports doesn't depend on the quantity of the USB ports on the computer. When the board gets connected to the computer, we will find one more port.
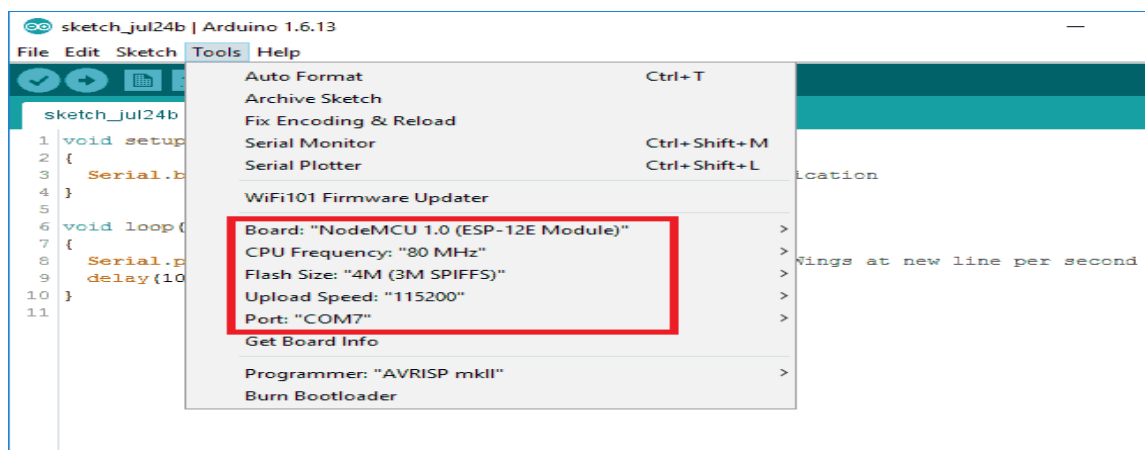

Fig- 3.18: Program Installation Process

3.16 Programming

C (pronounced like the letter c) is a general-purpose computer programming language. It was created in the 1970s by Dennis Ritchie, and remains very widely used and influential. By design, C's features cleanly reflect the capabilities of the targeted CPUs. It has found lasting use in operating systems, device drivers, protocol stacks, though decreasingly for application software. C is commonly used on computer architectures that range from the largest supercomputers to the smallest microcontrollers and embedded systems.

A successor to the programming language B, C was originally developed at Bell Labs by Ritchie between 1972 and 1973 to construct utilities running on Unix. It was applied to re-implementing the kernel of the Unix operating system. During the 1980s, C gradually gained

popularity. It has become one of the most widely used programming languages, with C compilers available for practically all modern computer architectures and operating systems. C has been standardized by ANSI since 1989 (ANSI C) and by the International Organization for Standardization (ISO).

C is an imperative procedural language, supporting structured programming, lexical variable scope and recursion, with a static type system. It was designed to be compiled to provide low-level access to memory and language constructs that map efficiently to machine instructions, all with minimal runtime support. Despite its low-level capabilities, the language was designed to encourage cross-platform programming. A standards-compliant C program written with portability in mind can be compiled for a wide variety of computer platforms and operating systems with few changes to its source code.

Since 2000, C has consistently ranked among the top two languages in the TIOBE index, a measure of the popularity of programming languages.

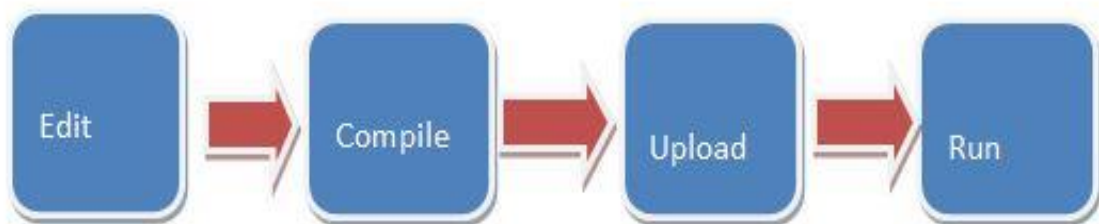The development cycle is divided into 4 phases:

Fig-3.19: Flowchart of the Compiling Process

Compile: Compile means to translate the sketch into machine language, also known as object.

Code Run: Arduino sketch is executed as soon as terminates the step of uploading on the board.

CHAPTER-04

RESULTS AND DISCUSSION

4.1 Introduction

Before 1983 automobile's radiator were made of using copper and brass. In 1983 ford company discovered that aluminium was a better material for transferring heat away from the engine and was lighter than copper and brass and was lower in cost, reliable than copper and brass. 3003 Al was used for making walls (tubes), fins with hard 3003 Al, header with 3005 Al. different testings like calorimeter, extreme durability, corrosion, qualification for vehicles. In 1986 researches were done in which they found out that corrosion resistant material was better for automobile radiator tubes and it is beneficial for effective cooling. From various materials brass was fulfilling the requirement. In the year 1992 author Ralph L. Offer mechanical and thermal design advantages for copper-brass radiators. This core design provides good heat conduction in full fin depth. This was done by changing shape of tube and also introduced two in size of one tube. In 1993 tests were done on airflow passing around the radiator which makes sure that the radiator runs at its optimum condition. An automobile with a radiator installed in it was tested in a lab on practical and software basis. All the scenarios which the radiator will come across were tested (aerodynamic drag, crosswind flowing from the radiator, etc.). How air was acting around the radiator and helping the radiator to cool down the engine and all things were noted. In this paper the author used different method for optimizing radiator size from calculation they used e-NTU method to achieve the desired radiator specification. In year 2009 am SAE team from Sweden Made a FSAE car in which they were radiators cooling was improved by having overheating issue. To overcome these issue; they implemented the side pods which were improving the radiators assembly by using aerodynamic of the car. In 2012 a detailed testing was done on the radiator and was cross-verified with theoretical calculations which were used to design them. The formulae derived for making the radiator were checked in practical life. In 2013 radiator were tested on their heat dissipating factor by using different materials for fin. Materials like brass, copper, aluminium and a new material carbon foam. They were tested in different scenarios and in those experiments, it was found that carbon foam was performing better in most of the experiments and was 40% better than aluminum and was giving better heat dissipation from the radiator. Up to year 2015 the radiator that were manufactured were bigger in size due to which carrying them with the vehicle had huge load on the engine. To overcome this and

reduce the size of the radiator different ways were taken into consideration and size both radiators was achieved. In 2016 nano-fluids were discovered and a test was performed using them as a substitute in the coolant used in automobiles. It was found that by using them in the coolant, better thermal properties were achieved then the conventional fluids used in those days. Also, in the year 2016 an experiment was done in which they used different types, shapes and flow of the tube in the tube in the assembly of radiator. They found different result in each case. The result was compared and a better tube assembly was selected.

We have tried to incorporate the modern conveniences of a engine cooling system here. All the data in a display, and That data can be monitored from anywhere in the world through the Internet, using only one software. The above project circuit diagram is a mature circuit diagram that combines all instruments are given and details of all the instruments are given in the project book. Separate water supply, mist supply and fan are make the cooling system through.
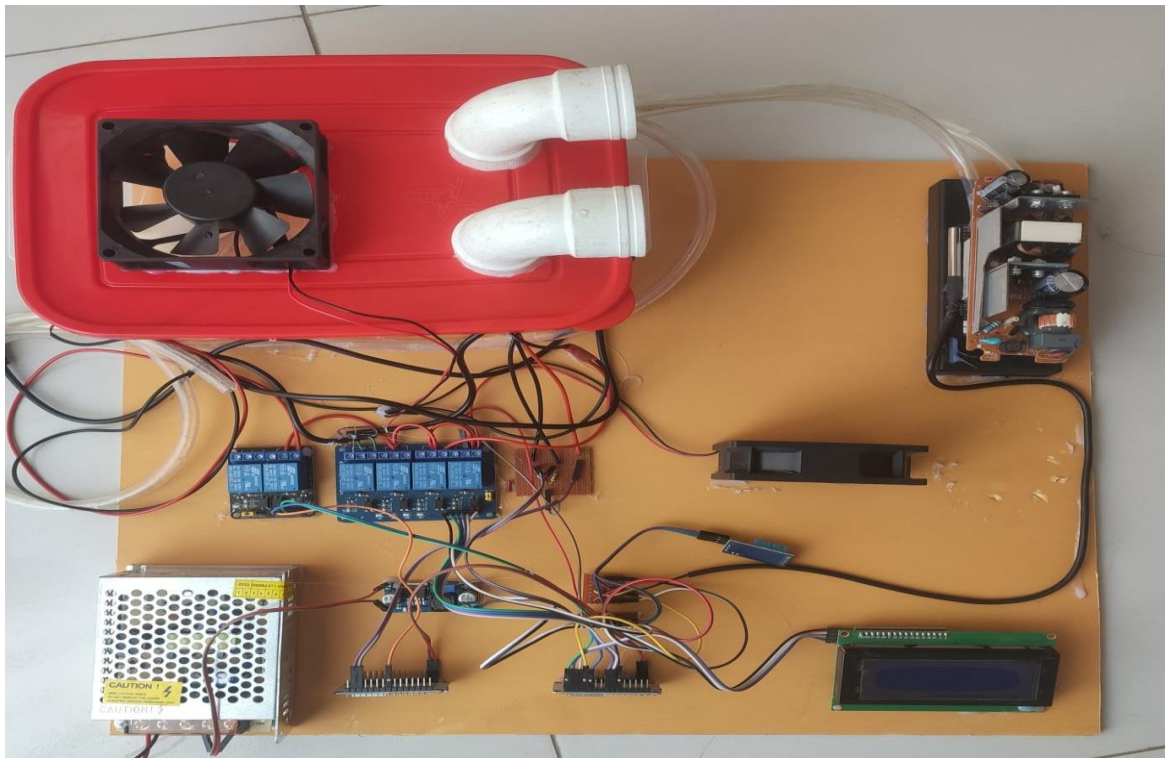

Fig-4.1: Project Picture

4.2 Circuit Diagram

For our project we have created the circuit in proteus software. Special attraction in our project is monitoring and controlling system through internet. We can monitor the engine system. In the project we used adapter as power supply. Confirmed the supply system through an adapter, which is mentioned in the circuit. Here we have switched on and off the automatic

cooling fan through the relay module. We have done data monitoring from LCD display. We used DHT-11 sensor for engine room weather monitoring. Each of our devices is connected to the programming microcontroller Node MCU. Automatic pump motor and mist maker will be started through the relay by taking the command from the internet. We can monitor the data from the display and through the Internet.
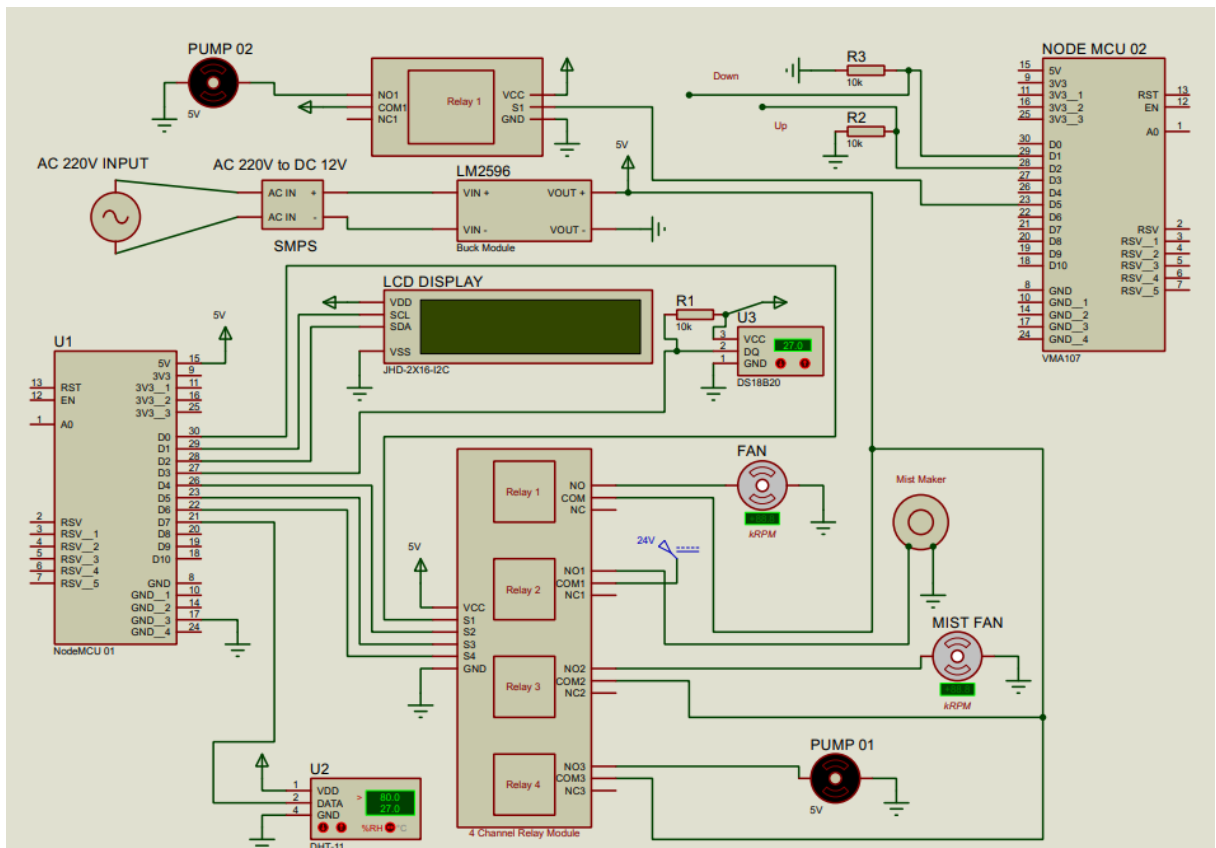

Fig-4.2: Circuit Diagram

4.3 Data Output

We have planned this System to track and monitor engine environmental parameters. The result was focused on the efficient control of the engine cooling by automated means. In this project, the engine cooling environment not only can be monitored in real-time, but also it can adjust the environment conditions: temperature at a suitable level automatically and continually. If the temperature is higher than the pre set temperature is outside the threshold, the fan would turn on, otherwise, the fan. Users can remotely access the monitoring data by phone or webpage through the network wherever the users are. The proposed architecture of the smart engine cooling system is illustrated.

All the data in a display, and That data can be monitored from anywhere in the world through the Internet, using only one software. The above project circuit diagram is a mature circuit

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diagram that combines all instruments are given and details of all the instruments are given in the project book. As well as being able to monitor engine temperature, engine room cooling temperature and humidity. A fan will automatically turn on and off depending on the temperature. In addition, the water misting system can be turned on and off when additional cooling is needed via the Internet. Water can be supplied to the water block through a water motor which is connected to the engine. Separate water supply, mist supply and fan are make the cooling system through.
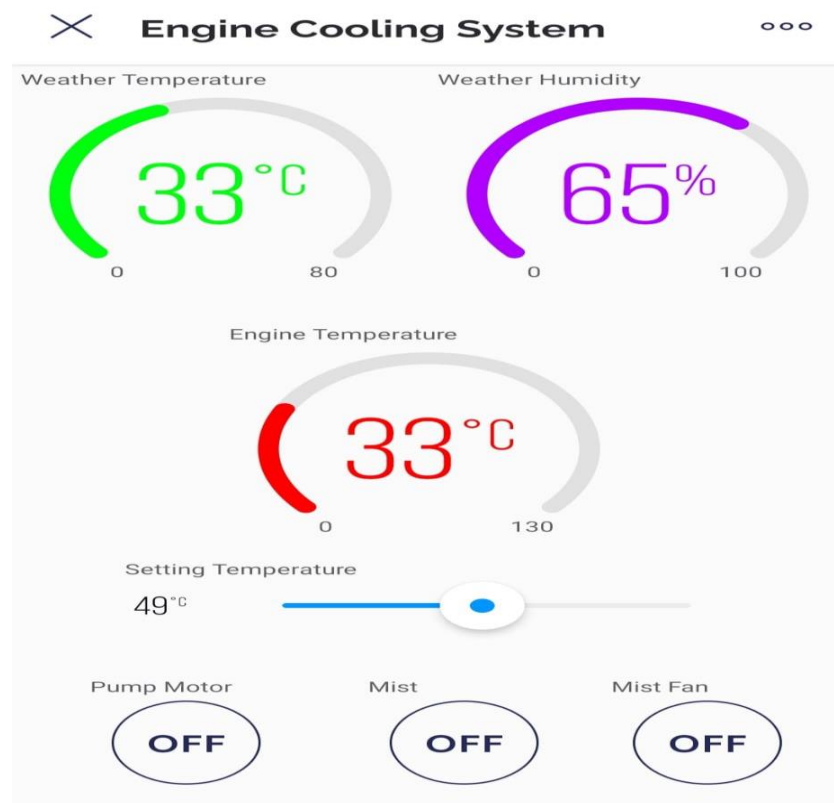

Fig-4.3: Experimental Results

CHAPTER-05

CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

After study literature review based observe diverse studies have been studied to have the right scope and knowledge of working with radiator machine. Radiator is cooling device used exactly for the cooling of heat produced for the duration of the functioning of engine. In this research paper, the overview study on car radiator is done. By using considering the factors which impacts the engine cooling gadget, the layout parameters of radiator are studied. The cooling device of an car performs a vital role in its performance, includes fundamental elements, diagnosed as mist and fan. Improving thermal efficiency of engine leads to increase the engine's overall performance, decline the gas consumption.

5.2 Advantage

There are certainly many advantages of our project and some of the major ones have been given below:

- Tool and maintenance costs are low.
- Relatively low investment required .
- Protect equipment.
- Enhance temperature control .
- Improve the lifespan efficiency and reliability of machinery.
- Reduce the downtime and associated with maintenance and repair.
- It could be configure it anytime we like.
- It could be connect to any network.

5.3 Application

- Engine.
- Motor.
- Industry.

5.4 Future Scope

Many features can be added to our project in future to get better output. Below are some of the features in the project:

- More research is needed on the project.
- Efficiency needs to be increased.
- This will allow the use of advanced sensors.

5.5 Conclusion

We learned a lot by doing the above project. Water cooler system are used in various industries, which will be useful in our real life ,we gained real knowledge through this project. Project is considered to be a success, even there no fabrication at this stage. Problem statements above will be addressed, the implementation phase pending to conclude the work Economic wise, and this project will be a success because components used are not expensive.

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Appendix:

Program for Node MCU:

```
#define BLYNK_PRINT Serial

/* Fill-in your Template ID (only if using Blynk.Cloud) */
#define BLYNK_TEMPLATE_ID "TMPL-y1NXAWJ"
#define BLYNK_DEVICE_NAME "temperature and Humidity Project"
//#define BLYNK_AUTH_TOKEN "12mWdgR9fsnl3_qq0bUQOW0tfJuC5Du6"

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include "DHT.h"
#include <LiquidCrystal_I2C.h>
#include <OneWire.h>
#include <DallasTemperature.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

#define DHTPIN D7      // what digital pin we're connected to
#define DHTTYPE DHT11   // DHT 11
DHT dht(DHTPIN, DHTTYPE);

// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = "12mWdgR9fsnl3_qq0bUQOW0tfJuC5Du6";

// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "student";
char pass[] = "iotstudent";
```

```
//int buzzer = D5;

int load1;
int relay = D0;

int load2;
int relay1 = D4;

int load3;
int relay2 = D5;

int load4;
int relay3 = D6;

void setup()
{
  // Debug console
  Serial.begin(9600);
  //  pinMode(buzzer, OUTPUT);

  pinMode(relay, OUTPUT);
  pinMode(relay1, OUTPUT);
  pinMode(relay2, OUTPUT);
  pinMode(relay3, OUTPUT)

  digitalWrite(relay, HIGH);
  digitalWrite(relay1, HIGH);
  digitalWrite(relay2, HIGH);
  digitalWrite(relay3, HIGH);

  lcd.init();
  lcd.backlight();

  Blynk.begin(ssid, pass);
```

```
}

BLYNK_WRITE(V2) // V0 is the number of Virtual Pin
{

 if (load1 == 0)
 {
  digitalWrite(relay, HIGH);
 }
 if (load1 == 1)
 {
  digitalWrite(relay, LOW);
 }
}

BLYNK_WRITE(V3) // V0 is the number of Virtual Pin
{

 if (load2 == 0)
 {
  digitalWrite(relay1, HIGH);
 }
 if (load2 == 1)
 {
  digitalWrite(relay1, LOW);
 }
}

void loop()
{

 float h = readHumidity();
 float t = readTemperature();

 Blynk.virtualWrite(V0, t);
```

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```
Blynk.virtualWrite(V1, h);

// Serial.println(t);
// Serial.println(h);

delay(1000);
lcd.clear();
lcd.setCursor(0, 1);
lcd.print("Temperature:");
// lcd.setCursor(6, 1);
lcd.print(temp);
lcd.print("C");

lcd.setCursor(0, 2);
lcd.print("Humidity:");
// lcd.setCursor(6, 3);
lcd.print(h);
lcd.print("%");

}
```