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Developing cooling system application for the immobile patients

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Abstract

There is an increase in the use of automated systems as technology moves forward towards the 21st century; people are trying to make use of their time the most with modern technology, with Microcontrollers becoming a necessity. Arduino, the popular portable microcontroller is one of the best currently in terms of making fast, efficient, automated devices that help in day-to-day life. This paper aims to present the ARDUINO-powered COOLING SYSTEMS, which can be applied in different areas including daily used objects. The use of this as COOLING will improve human life while educating people on the uses of microcontrollers. This book defines the Arduino microcontroller and the Arduino idea. Their methodology was to share microcontroller-based equipment and plan stages to share thoughts and advance development. To meet the wide group of onlookers, the document has been segmented to fulfill the need of everyone. The document contains numerous equipment guides to help the peruser ascertain all assortment of frameworks.

Keywords: ARDUINO; cooling system; Liquid Crystal Display (LCD); Microcontroller; sensor.

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1. Introduction

The venture Arduino cooling framework screens and controls the temperature in an environment. The framework is planned with Arduino (microcontroller) and Arduino is progressively being utilized to actualize power over frameworks (Ramírez, López, González & Mendoza, 2020). Since the framework is expected to control the cooling system, it is critical to comprehend Arduino-controlled frameworks (Asyiqin, Fadzly, & Amarul, 2019; Amin, Putra, Mulyadi & Desfiandra, 2019). These days with the progression of innovation especially in the field of microcontrollers, all exercises, particularly our everyday living has turned into a piece of data innovation, and we discover controllers in every single application. In this way, the pattern is coordinating toward small-scale controllers-based undertaking works.

Another design is to assemble a programmed framework utilizing a microcontroller and its interface with other devices. In the meantime, Arduino turns out to be progressively prevalent given its numerous favorable circumstances like straightforward programming and conservative size (Prabhu & Urban, 2020). It likewise underpins various gadgets, so we will likely accomplish the capacity to do programming and get thought regarding the Arduino framework.

In any sort of venture which requires a user, modified or exploratory field test, there are troubles experienced because of vulnerabilities and testing issues (Huber, Sloof, Van Praag & Parker, 2020). In this venture, we can say for each segment of the assignments, there were challenges that we experienced. Since we will be dealing with circuitry, arranging a circuit without testing if it works might be an issue. There are such a large number of types of automatic(self-operating) systems out there, some with various hardware structures, and choosing the one to take need a type of solid confidence that it will work. So, this research experienced preliminaries and mistakes until the correct circuit was found.

Considering how smart the bleeding edge improvement is affecting everything, adaptable or controlled frameworks are anticipating focal occupations in supporting individuals on the planet. These self-working frameworks can be evaluated down to fit into various regions to fit and work varying to look at. This obligation is valuable for security and observation if there should arise an occurrence of attack assignments or workers' blames and unfortunate behavior, where a human can neglect to be accessible or disregard the specific undertaking. Utilization of helpful or self-working frameworks sneaks in (Fadzly, Mardhiati, Foo, & Fakhira, 2019).

Specifically, where they can save and improve the situation without everyday checks, and for the benefit of both human beings and machines, self-working programs can be programmed with different methodologies that enable them to go into far reaches where it is perilous or un-appropriate for a human to work, especially because of working hours (Okorie, Ibraim, & Auwal, 2020). In cutting-edge life, asset abuse has expanded because of the expansion in populace on the planet thus the interest and use and shortage of power have made the charges high. Consequently this sort of self-working frameworks chip in sparing and improving the world by dispensing with the over-the-top utilization of vitality and of putting another person to staying, taking care of specific machines.

One other enormous obligation of this arrangement is in training understudies. This subject can assist them with understanding the chance of mechanical and electronic advances behind applying self-governance, how significant it is in various territories, and how to improve its presentation and help the individuals who are not in the field to comprehend robots on how they help us not to on an exceptionally essential level displace us. Acing the subject can credit understudies to business openings in the relating field of study. Since we are moving into a future where you will see self-working frameworks all over, this endeavor arrangement may help build up a couple of systems for different activities.

1.1.Purpose of study

The primary goal of this file is to show the temperature and when it goes to a specific utmost point, control it to bring it once again into the ideal dimension and lessen misuse of vitality and time. This helps individuals who are impaired and who are unfit to control the temperature encompassing their desires. It might likewise be utilized to screen changes in conditions sooner rather than later. It very well may be utilized in various enterprises and electronic gadgets.

2. Method

This study reports on an experiment that was taken. The process and the resources involved are outlined in the ensuing paragraphs. Any sort of task takes a course of occasions and work to get to its end.

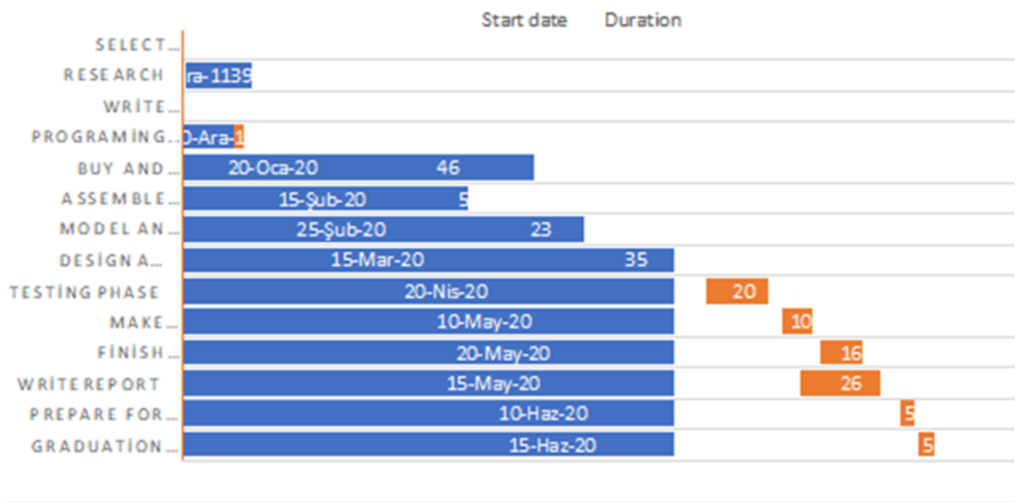
2.1.Procedure

2.1.1. Timeline of the study

The occasions and work are performed in various parts along a specific period. Figure 1 is the Gantt outline portrayal of the course of events of the undertaking project design. From the fourth of May to roughly the end of December, goals have been spread in the middle as indicated by the data on the graph. The graph shows that the first initial goal is the design selection and the task choice for each group member and took the least time length to finish i.e., two days. After that came one of the long span goals termed proposition composing and research arc 1 which took twenty-five and thirty days individually and respectively. The first research arc was for the most part connected with the design proposal yet some piece of it was connected to the listing of elements to build the robotic design with all things considered ten days to finish. What followed was the programming adapting of the first session in ten days. These ten-day programming arcs on the graph are one of the most important events of this design along with the second arc in the tenth place after ordering listed components, the beginning of report writing, the research arc number 2 then the potential time for the shipments to arrive. All these took a period of five, fifteen, twenty, and seven days respectively.

Figure 1

Layout of the timeline of the event for the Design



Above shows the expected timeline of the project in the form of a Gantt chart representation. Roughly estimated to reach completion in the course of six months ranging from December 2019 to July 2020. The initial step involves the selection of the project and the designated tasks on 5 December 2019 followed by a research phase when members of the group will study the main objectives and how to implement the project as a whole and the designated tasks. For the whole month of January, it was dedicated to the programming test of the code, finding the shortest and easiest program, choosing the best alternative, audio platform IDE, and respective components codes. After all the components are available then comes the task of assembling and modeling the system starting by sketching the flow chart which is the first objective of the project. The next 15 days involve the third objective which is for the component testing as many components.

After completion of this task, the study then moved on to the testing phase to improve efficiency and reduce errors from the 15th of May to the 1st of March. Then according to the results of our testing, the necessary modifications were made. With all these steps, the project will be very much near completion, and the whole of April to June will comprise of writing a report, preparation of the graduation presentation alongside the poster then followed the presentation itself thus concluding the timeline.

2.1.2. Budget

Materials are expected to make this venture a triumph. In light of that, there will be a rundown and the measure of monetary consumption for everything available.

Table 1

Materialistic elements and cost for the design

ITEM	EXPLANATION	UNIT (pcs)	UNIT COST ($/pcs)	AGGREGATE ($)
				shipping cost
Arduino-Uno R3	Microcontroller (Brain of the robot)	2	9,84	19,68
Liquid crystal display	1602d,16pin	1	5.99	3.20
Jumper Wires	200mm Male to female and male to male connection cables	40	0,11	4,40
Breadboard	MB102, 830-point unsoldered printed circuit board	2	2,03	4,09 + 0,29 shipping cost
Battery	AA rechargeable (lithium)	4	6,93	27,72
DC Fan	12v (power source) the cooling source	1	1,12	2,50
Resistors	control the flow of current to other components	3	0.10	-
TOTAL	Total cost of the components	66	Varies	123.34

Table 1 is the materials and cost price for the project. The table is showing the items required with a total of fifty-seven pieces and a total cost of sixty-four US dollars, fifty-three cents to be shared among five members. It will be twelve dollars and ninety-one cents per member. The current cost prices are from Gear best, Amazon, and Ali-express websites.

3. Results

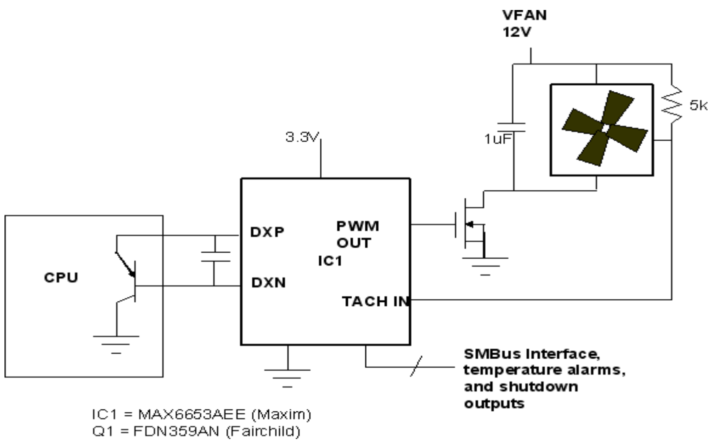
3.1. Findings from the Literature Review and Theories Used

As observed from the section title, it contains two segments which will be separated in a similar order, the initial segment is for dialogues relating to previous work that has been done identical to this design and the subsequent part has a plan on a similar subject to be finished by the end of the year 2019. In this file, everything is focused on and aligned with the use of microcontrollers. A microcontroller is a PC. All PCs - regardless of whether we are discussing an individual personal computer or a huge, centralized computer PC or a microcontroller - share a few things. Microcontrollers are "installed" inside some other gadget (frequently a shopper item) with the goal that they can control the highlights or activities of the item. Another name for a microcontroller, in this way, is the "inserted controller." Microcontrollers are regularly low-control gadgets.

A workstation is quite often connected to a divider attachment and might expend 50 watts of power. A battery-worked microcontroller may expend 50 milliwatts. A microcontroller has a committed information gadget and frequently (yet not generally) has a little LED or LCD show for yield. A microcontroller likewise takes contribution from the gadget it is controlling and controls the gadget by sending a sign to various segments in the gadget. For instance, the microcontroller inside a TV takes a contribution from the remote control and shows the yield on the TV screen.

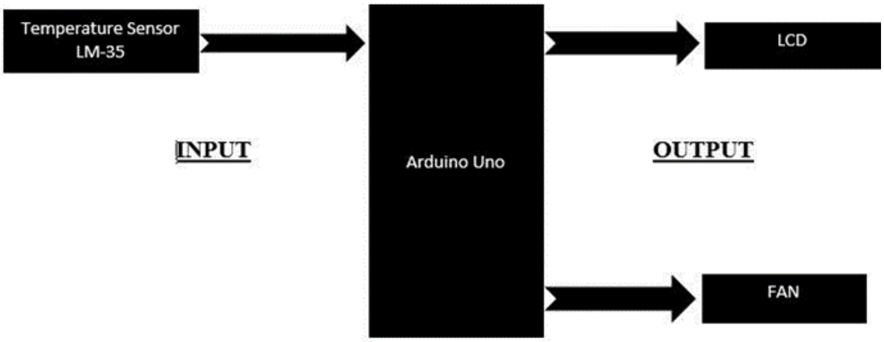
Figure 2

Circuit and gate pathways



3.2. Block diagram of the system

Figure 3
Block diagram of the system



In these circuits, the microcontroller is used to control the fan according to the temperature variation. The LM35 functions to measure the changes in temperature surrounding the area. All the operations are controlled by the Arduino to produce the output. The LCD, fans are the output where they are set with the pseudo-code.

There is a broad diversity of automatic cooling systems varying from different microcontrollers utilized, different circuitry design arrangements, and the materials used to construct the whole system. This current chapter will discuss the design of the cooling system. We will later bring up other alternatives for attaining the same design.

3.3. Components of the system

The following is a register of elements used to shape our robot;

3.3.1. Arduino Micro-processor

Needing something to control our framework and go about as the head or the thinking mind about our framework so any kind of chip would work. We can discover numerous kinds of smaller-scale processors like the Arduino Uno with its various adaptations and the Raspberry pi moreover. In my cooling framework I can, on the other hand, decide to utilize the Arduino Uno to control the fan and to deal with all capacities and occupations. The Arduino Uno is one of the littlest smaller-scale processors on the planet and its development is extremely muddled as there are introduced pins with a particular number and a particular number of pucks all dependent on the capacity the Arduino Uno is utilized for. There are a ton of capacities for the pins as there is a pin for power another for info and one for simple, reset, yield, etc. I additionally need a programing language to have the option to program my chip and as a PC engineer, we know an immense programming dialect however the most widely recognized language for us is the C language and with the assistance of the IDE programming application, I will amass the task. Programming in the Arduino Uno is finished unequivocally in the joined progression condition (IDE). Successfully programmable is the best good choice of the chip contrasted and different microchips.

Figure 3

Arduino Uno

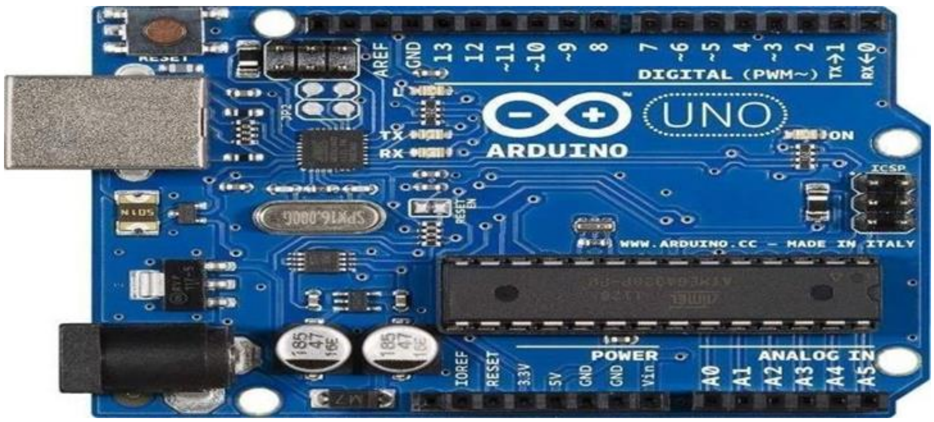


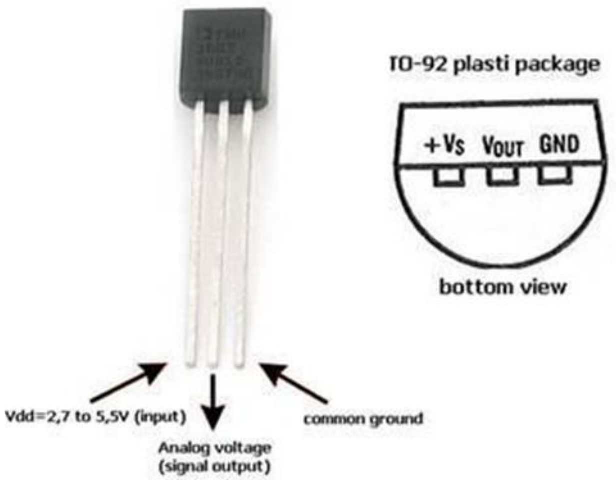
Figure 4 is the Arduino Uno installed in the project as the head, main controller.

3.3.2. Temperature Sensing Device

The Temperature Sensor LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full −55°C to 150°C temperature range

Figure 5

Temperature Sensing Device (LM35)



3.3.3. DC Fan (12V)

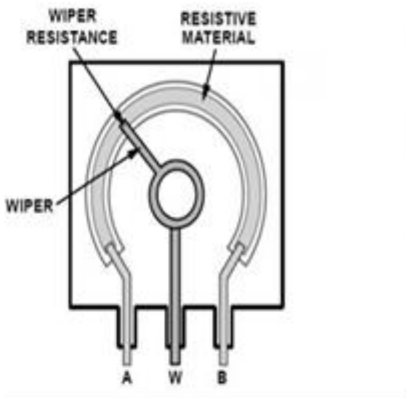
A fan is a powered machine used to create flow within a fluid, typically a gas such as air. A fan consists of a rotating arrangement of vanes or blades which act on the air. The rotating assembly of blades and hub is known as an impeller, rotor, or runner. Usually, it is contained within some form of housing or case (Saini & Dutta, 2020). This may direct the airflow or increase safety by preventing objects from contacting the fan blades. Most fans are powered by electric motors, but other sources of power may be used.

Figure 6
DC Fan (12V)

3.3.4. Potentiometer

The potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider.

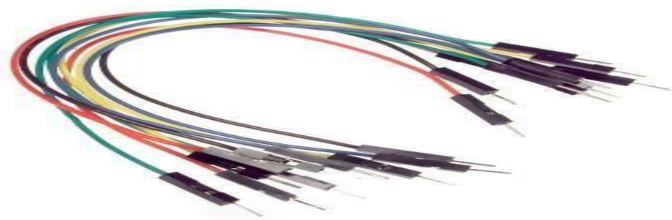
Figure 7
Potentiometer



3.3.5. Jumper wires

Figure 8 shows a bundle of small cables named jumper wires. They possess connector pins at every end, Figure 8: A bundle of jumper wires granting them to be used to interface two points to one another without binding. These types of wires are regularly utilized with other prototyping instruments such as breadboards to make them uncomplicated to alter a circuit as desired. Genuinely it is straightforward. Truth be told, it doesn't get Figure 8 shows a bundle of small cables named jumper wires. They possess connector pins at every end, granting them to be used to interface two points to one another without binding. These types of wires are regularly utilized with other prototyping instruments such as breadboards to make them uncomplicated to alter a circuit as desired. Genuinely it is straightforward. Truth be told, it doesn't get considerably more fundamental than jumper wires.

Figure 8
Jumper wires



3.3.6. LCD

An LCD is an electronic display module that uses liquid crystals to produce a visible image. The 16×2 LCD is a very basic module commonly used in DIYs and circuits. The 16×2 translates to a display of 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7-pixel matrix.

3.3.7. Batteries

We must have a source of voltage and electrical energy to be converted into mechanical energy to be used in the movement of the robot. Any two of the 9 volts batteries will be enough for our robot to work but we will bring two other batteries as a spare because the consumption of electrical power is high.

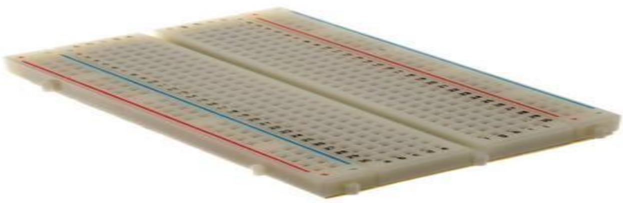
Figure 9
Batteries

3.3.8. Breadboard

Shows a breadboard which is a solderless platform for brief mock-up with hardware and experiment circuit sketches. Many electronic elements in electronic circuits are to be interconnected by embedding their leads or terminals into the holes and then after that make connections through wires were proper. The breadboard has portions of metal underneath the board and interfaces the gaps on the surface points of the board. The metal strips are spread out as demonstrated. Notice how the surface and bottom row lines of the holes are associated horizontally on a level plane and split at the centre as the rest of the gaps is associated vertically.

It is important to notice how all the holes in the chosen row line are associated together, and so do the gaps in the chosen column section. The group of connected openings is known as nodes. To interlink, the chosen row and column lines, node A and node B, a cable have to link from any gap in the row line to any gap in the column.

Figure 9
Breadboard



3.3.9. LED

LEDs. An LED is a small light (it stands for "light-emitting diode") that works with relatively little power.

Figure 10
LED

3.3.10. Resistors

When building your Arduino projects, you use resistors to limit the amount of current going to certain components in the circuit, such as LEDs and integrated circuits. To calculate the resistance, you should use a modified version of Ohm's Law.

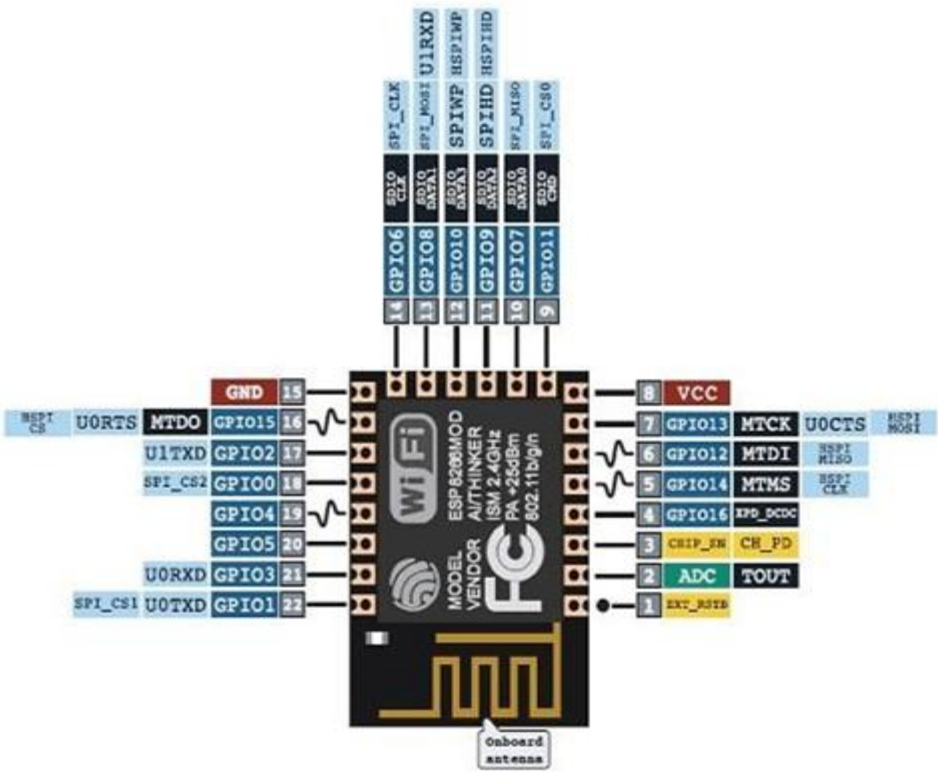
Figure 11
Resistors

3.4.Alternatives for The Parts

3.4.1. ESP8266MOD Node MCU Module (Wi-Fi)

Figure 12 is the Wi-Fi module termed ESP8266MOD. This specific Wi-fi module is a small chip used to connect the robot with other devices to be allowed to command the robot through a computer or a mobile phone using a certain wizard. Here we are going to use the ESP-8266-Wifi module. This type of Wi-Fi module is to be programmed before with AT command set which is a well-known software so it will be easy to connect with our Arduino. The ESP8266 is prepared to do either the job of facilitating in hosting an application or offloading all Wi-Fi organizing capacities from an additional application processor hence it can act as a micro-controller enabling it to be correlated with the sensors and other application explicit devices via its GPIOs with negligible improvement in advance and insignificant stacking during runtime. Its high level of on-chip joining considers negligible outside hardware, plus the front-end module is intended to involve an insignificant PCB region. The ESP8266 underpins APSD for VoIP applications and Bluetooth conjunction interfaces, it has a self-adjusted RF enabling it to work under every single working condition and requires no outside RF parts. There is a practically boundless wellspring of data accessible for the ESP8266. The use of WiFi modules is widely increasing recently and is included in a lot of electronic fields (McConville, Atchison, Roddy & Davis, 2019; Moreno, Morales, Ruız & Pérez, 2020).

Figure 12
ESP8266MOD Node MCU Module

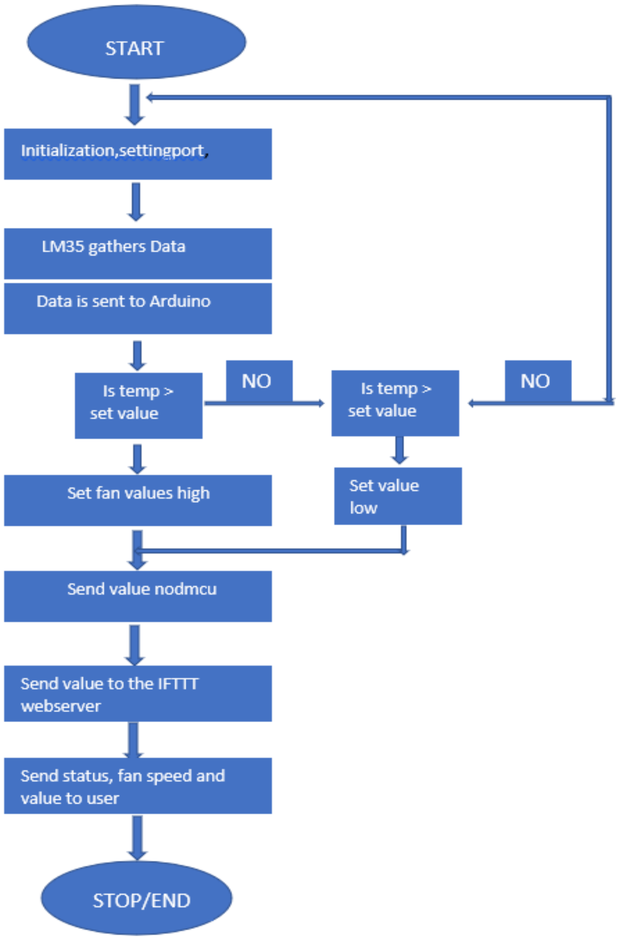


3.5.System Model /Architecture

The framework formation of the system created utilizing the temperature sensor is provided in Figure 13, the cooling system device compromises two methods of control, in particular, the client control and Automated control method for change of code and updates to suit the needs of a given platform.

Figure 13

Model of the system design



This design will deliver a sell-operating cooling system, that can work efficiently and fulfill users' needs within specific limits.

2. Results

This section is going to provide details of all the work that has been done leading to the final design. Since the main subject can be made in different ways, this splits through four different designs leading up to our final successfully working design (Appendix A.1). The mechanical design is the first step of the project.

Figure 14

The connections and the Design

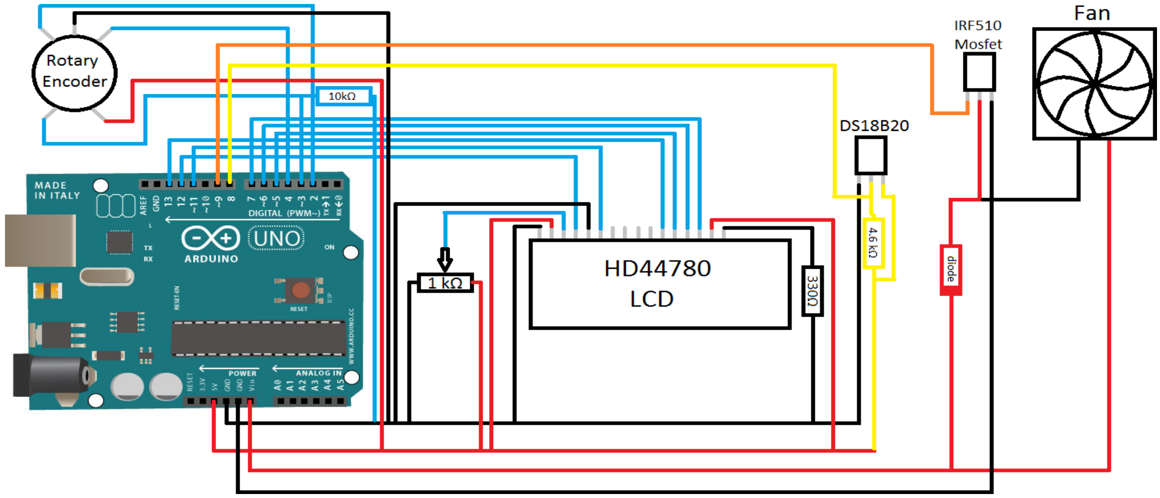


Figure 14 shows the method of connecting the dc motors to the motor shield (L294D specifically) to the Arduino and the wheels used in the robot movement. This design can take in up to twelve volts and has a local voltage controller aboard which yields five volts, the ideal sum for fuelling our Arduino. One can connect everything as indicated in Figure 4.1 above. Nevertheless, with four engine motors, we can at present get this design to turn toward any path by causing the two sides to go in inverse ways. The red and black wires are for power with the red ones taking current from the positive terminal of the battery whilst the black wires are grounded with the negative terminal. Therefore, power is supplied to the Arduino module, all the DC motors, and the L293d shield.

In Figure 1 (a), the Bluetooth module connections to the Arduino are shown. In any kind of Arduino project which utilizes this kind of module, these connections (Arduino to Bluetooth module) never change. The GND and VCC pins on the module are always connected to the GND pin and 5 Volts pin respectively on the Arduino. The TX and RX pins on the Arduino are connected to the RX and TX pins respectively on the module. Figure 4.1 (b) is the Arduino to Ultrasonic connections. In this case, the Trig and Echo pins of the sensor are connected to the Analogue pin zero (A0) and Analogue pin one

A1 respectively on the Arduino. Just like the Bluetooth module, the sensor's power pins (VCC and GND) are to be linked to the 5 Volts pin and GND pin on the microcontroller. The servo motor is additionally utilized in this design. The sensor is mounted on the servo and by turning the motor to various turns, we will get the readings from the ultrasonic sensor in that direction of turns. This will assist the operator with detecting the definite pathway to explore.

The design is set to operate in two modes, the Bluetooth-controlled mode (or manual control) and the Automated mode (capable of obstacle hindrance innovation). On the same robotic body is a phone in camera mode with its interface being screened on a personal computer or laptop. There will be an external radar that will help to map the environment of our robot car. Our robotic vehicle is comprised of an Arduino Uno, Arduino motor L293D shield, Bluetooth module, 9 Volts or 12 Volts battery (preferably rechargeable), Direct Current motors, Ultrasonic sensor HC-SR04, HC-06 Ultrasonic Sensor working standard, and an on-board camera.

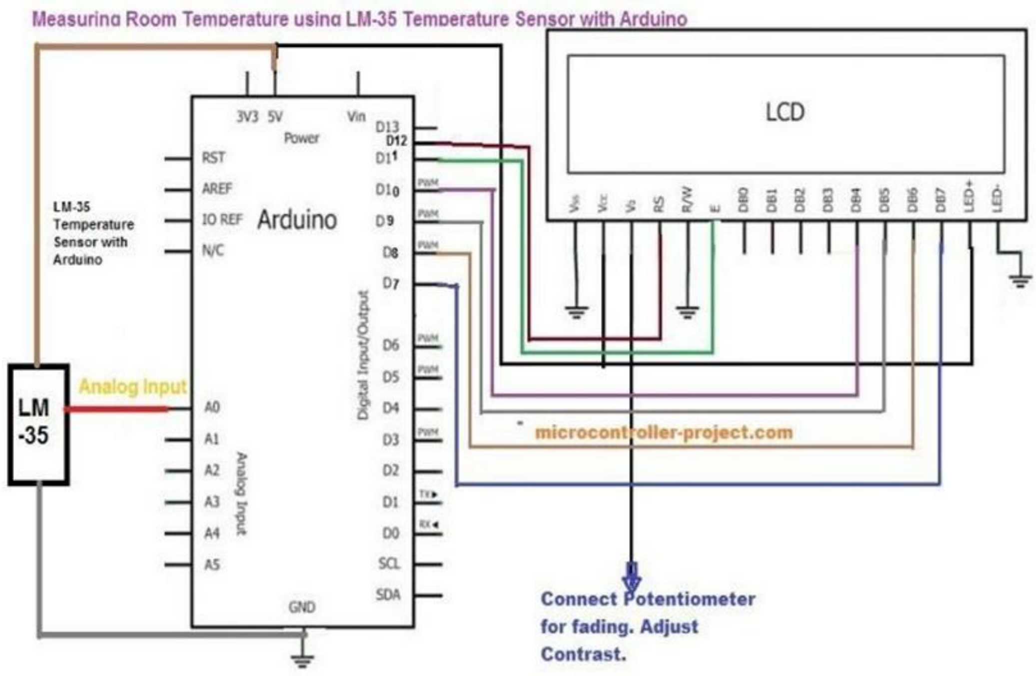
Temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal, which is applied to the ATmega328 microcontroller of the Arduino UNO Board. The analog value is converted into a digital value. Thus, the sensed values of the temperature and speed of the fan are displayed on the LCD. When the temperature exceeds 30°C the fan starts rotating. A low-frequency pulse-width modulation (PWM) signal, whose duty cycle is varied to adjust the fan's speed is used. An inexpensive, single, small pass transistor-like 2N222 or BD139 can be used here. It is efficient because the pass transistor is used as a switch.

2.1.Code/Program

The code for our radar system will be in A.2. As for the two-mode controlling code, the code and explanations will be in A.3. However, Figure .3 is the flowchart of the algorithm for the Arduino Bluetooth RC Car application. The complete circuit was assembled and tested on several occasions with the use of several different codes. The major goal of this project was to design and implement an auto cooling system. The complete project as said earlier was tested and the result was specified although every system at one point or the other needs improvement or upgrade for better performance.

Figure 15

The connections and the Design



To test the work that was done some data sets are required to test the algorithms and code used. The data set used made me reach a good conclusion about the performance of the codes and algorithms used. The data sets used in this project were one for creating a very simple perfuming cooling system. For me to be able to get a temperature sensor model that's effective I had to research and watch test videos as I could from different people could see different versions with different performance and results. The dataset was then partitioned into testing data and results, and the model was created based on the collected information.

3. Discussion

During the testing of the models about 50 / 50 percent chance, I would attain good and bad results based on different setups and codes. The researchers tried at first to see the results of the code and came up with a decent accuracy of about 0.5. After running the model again and changing some of the parameters and codes testing accuracy of about 76% was archived.

Advantages of the system include the following:

- Self-operating system once set up does not need a person to monitor it every time
- Saves electricity by switching off when the temperature reaches the desired range and also slows down the fan speed when the temperature goes down.
- It can be applied to suit different occasions, houses offices, labs, cars, and more.
- It helps elderly and disabled people, so they do not have to move around trying to switch on the cooler when the heat goes high.
- Easily implemented, can be designed by one person, less codding.
- Easy to install, does not need many people for installation
- Easy to debug when it is malfunctioning
- Easy to upgrade to suit different cases
- Cheap, the parts are easy to find and work with (buy)
- Improves the quality of air in rooms, e.g when the temperature goes up and you are sleeping, it can automatically switch on and switch off the handle the situation
- You can rely on it when you are away from home or at work

In light of explored consider the connection of home, robotization systems are displayed. Microcontroller, UI, a correspondence interface, and their display factor are being taken a gander at. There are different do-it-without anybody's assistance (DIY) stages available that grant to make Home Automation structure quickly and viable with insignificant exertion and tip-top. For instance, Raspberry Pi, Arduino, diverse microcontrollers, etc. This review cleared up different home computerization structures, for instance, Electronic, email-based, Bluetooth-based, adaptable-based, SMS-based, ZigBee-based, Dual Tone Multi Frequency-based, cloud-based and Internet-based. Later on, home, automation will continuously be sharp and snappy. The enormous scale condition is contacted, for instance, schools, working environments, handling plants, etc. The new system is very cheap since the components chosen and used are very affordable, we could have used the TMP36 sensor or the DHT sensor but LM35 is at least 0.25 degrees Celsius accurate, and this is ideal for a project like this. However, it takes time for it to cool down and measure the changing temperatures around it.

There are various approaches to developing an automatic system as there are many controllers out there nowadays. One can use raspberry pi and other controllers with or without a Wi-Fi connection, Wi-Fi connection for interface and notifications and easy control (Bhatnagar, Kumar, Rawat & Choudhury, 2018; Chin et al., 2019; Sawatrukkul & Thongchaisuratkrul, 2019; Bhor, Pawar & Das, 2020). The study was tried with raspberry pi, it did not work well due to different parts and the simplicity of the project goal, and the accessories were expensive. The other problem was the choice of selecting the sensor, mainly the temperature sensor, because the sensor should give and read an almost accurate temperature for the project to run to specifications. The problem faced here is that first a sensor was used which read the temperature correct but when it was time to cool down and read the current temperature it gave out wrong values. Another sensor, the LM35 sensor was used, which did pretty well in handling these temperatures.

Other problems were to make the device wirelessly connected so user or users can operate and use the system to adjust to their wants, but this failed as the ESP8266 WIFI module the researcher wanted to use is a microcontroller on its own and merged it to the whole project made the whole project complex whereas, it is supposed to be simple. One of the big problems was buying all the accessories for the project, most of them got damaged, and the researcher had to work with what was available as they couldn't get a replacement due to the great pandemic of 2020.

4. Conclusion

The new proposed system is very cheap since the components chosen and used are very affordable, we could have used the TMP36 sensor or the DHT sensor but LM35 is at least 0.25 degrees Celsius accurate, and this is ideal for a project like this. However, it takes time for it to cool down and measure the changing temperatures around it. I used two boards, Arduino Uno as the microcontroller and nod cu as the WIFI module, I could have used the nod cu as the microcontroller, but the Uno can connect the LCD to the Digital Write pins easily.

The system was a success, the challenges we face were converting the temperature voltage values into the temperature, we were using a multiplying factor but once the temperature goes up it escalate higher but by the use of a temperature map function, we made it possible. The system was a success, it worked well. The challenges faced were gathering the parts and also replacing faulty ones as there was a lockdown due to the pandemic. Another problem was converting the temperature voltage values into the temperature values, I was using a multiplying factor was once the temperature goes up it escalates higher but the use of a temperature map function resolved the issue.

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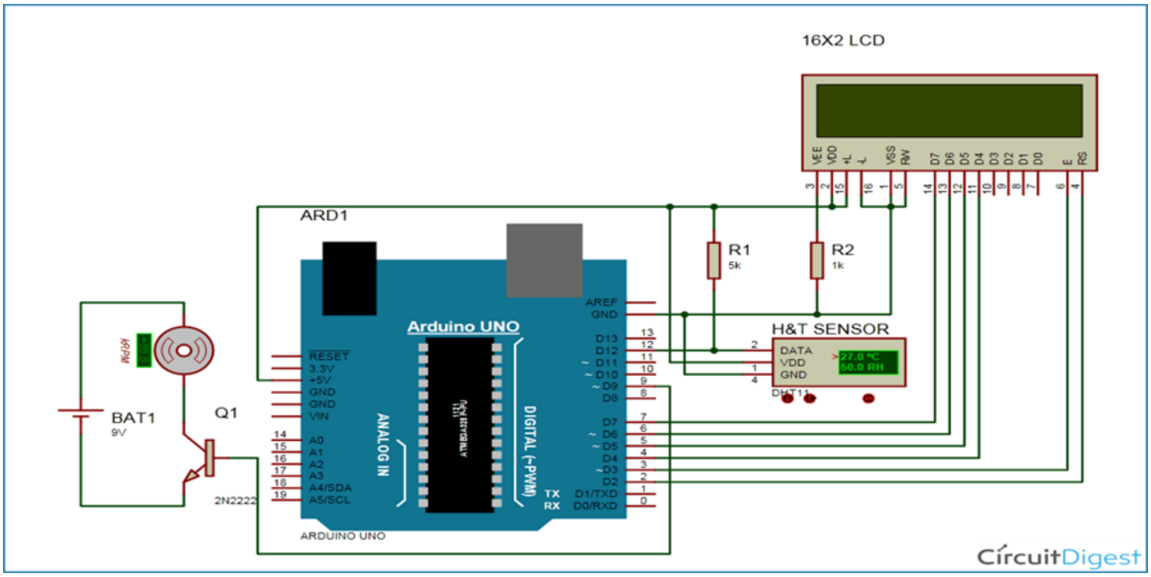
APPENDICES

A.1 FIRST FAILED DESIGN AND ITS SOURCE CODE

Our first attempt to make the robot had the following scheme in figure 4.1.

Figure A.1

The connection chart of the chosen alternative



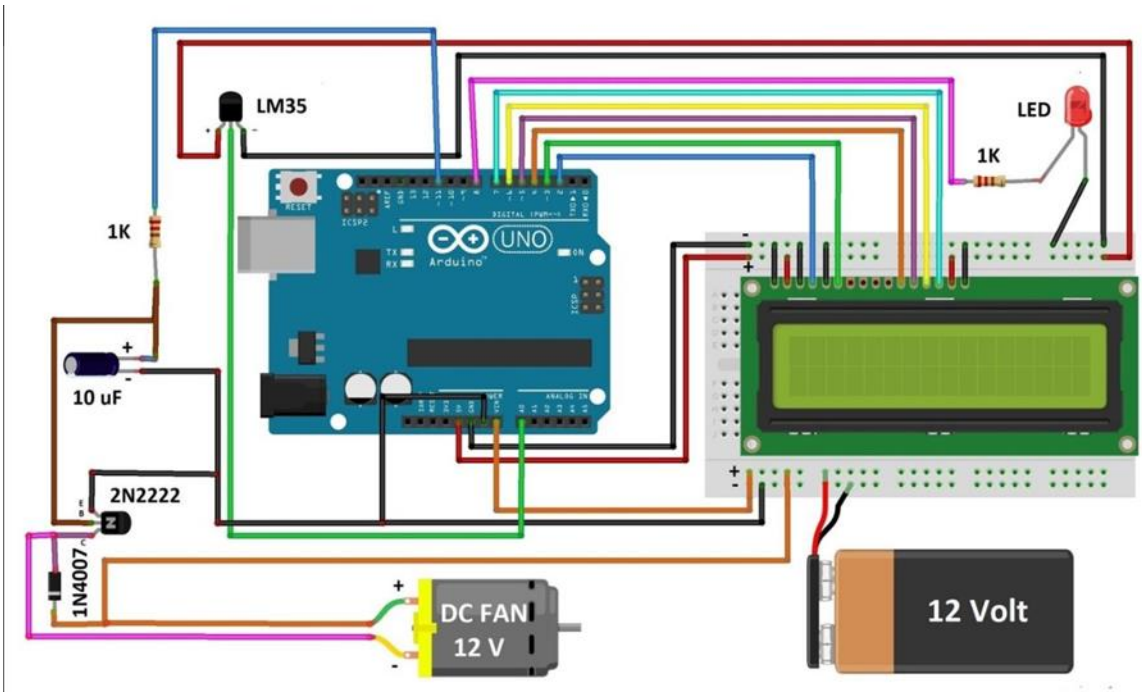
SOURCE CODE

```
#include
//source:     https://www.electroschematics.com/9540/arduino-fan-sp    eed-
controlled-temperature/
LiquidCrystal lcd(7,6,5,4,3,2);

int tempPin = A1;       // the output pin of LM35
int fan = 11;int        // the pin where fan is
led   =   8;   int      // led pin
temp;

int tempMin = 30;       // the temperature to start the fan
int tempMax = 70;00%    // the maximum temperature when fan is at 1
int fanSpeed;
int fanLCD;



void setup() {
  pinMode(fan, OUTPUT);
```

A.1.1 Set Up and The Code

Figure A.1.2

The picture of our design



A.2 ARDUINO CODE FULL CODE

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(2,3,4,5,6,7);
int tempPin = A0; // the output pin of LM35
int fan = 11; // the pin where fan is
int led = 8; // led pin
int temp;
int tempMin = 30; // the temperature to start the fan 0%
int tempMax = 60; // the maximum temperature when fan is at 100%
int fanSpeed;
```

```
int fanLCD;

void setup() {
pinMode(fan, OUTPUT);
pinMode(led, OUTPUT);
pinMode(tempPin, INPUT);
lcd.begin(16,2);
Serial.begin(9600);
}

void loop()
{
temp = readTemp(); // get the temperature
Serial.print( temp );
if(temp < tempMin) // if temp is lower than minimum temp
{
fanSpeed = 0; // fan is not spinning
analogWrite(fan, fanSpeed);
fanLCD=0;
digitalWrite(fan, LOW);
}
if((temp >= tempMin) && (temp <= tempMax)) // if temperature is higher than minimum temp
{
fanSpeed = temp;//map(temp, tempMin, tempMax, 0, 100); // the actual speed of fan//map(temp,
tempMin, tempMax, 32, 255);
fanSpeed=1.5*fanSpeed;
fanLCD = map(temp, tempMin, tempMax, 0, 100); // speed of fan to display on LCD100
analogWrite(fan, fanSpeed); // spin the fan at the fanSpeed speed
}

if(temp > tempMax) // if temp is higher than tempMax
{
digitalWrite(led, HIGH); // turn on led
}
else // else turn of led
{
digitalWrite(led, LOW);
}

lcd.print("TEMP: ");
lcd.print(temp); // display the temperature
lcd.print("C ");
lcd.setCursor(0,1); // move cursor to next line
lcd.print("FANS: ");
lcd.print(fanLCD); // display the fan speed
lcd.print("%");
delay(200);
lcd.clear();
}

int readTemp() { // get the temperature and convert it to celsius
temp = analogRead(tempPin);
return temp * 0.48828125;
}
```