جامعة الأمير محمد بن فهد
PRINCE MOHAMMAD BIN FAHD UNIVERSITY

College of Engineering

Department of Mechanical Engineering

Controlling the Power of the Solar Car

Senior Design Project Report

Team (10)

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Abstract:

This project aims to control the power of the solar car that intends to produce such a solar car which not only helps in protecting the environment by saving the fuel but also is smart enough to take the burden of the maintenance of the car and staying safe and comfortable for the driver at the same time. The project is to design a smart solar car with monitoring system of its own installed and programmed in it. Arduino compatible controller will be used for this purpose which can be programmed easily and act as monitoring robot. This project is taken up in consideration of current scenario of oil reserves limitations as it is predicted by the experts that it will not last long and sadly our economy majorly depends on the oil which is point to ponder.

ACKNOWLEDGEMENT

First of all, we would mention that we are very thankful to Almighty Allah who has blessed us with wisdom, knowledge and courage to achieve what we had promised and provided us the opportunity to fulfill our ambition.

We are very grateful and would like to express our deepest gratitude to our project supervisor Chair of Mechanical Engineering Department, Dr. Faramarz Djavan Roodi for his help, guidance, his support, continuous encouragement and the confidence he has entrusted upon us. Along with him the constant encouragement and the motivation of our advisor Dr. Nassim Khaled which he inculcated during the course of our work helped us to look forward to the timely completion of our project with more enthusiasm and boost confidence within ourselves. We would also like to express our sincere thanks to all the faculty member of the department who have helped us at times and in many ways and made this whole effort demanding process pleasant.

In the last we would like to express our acknowledgement to our parents for their everlasting love, dreams and sacrifices they made throughout their lives to make us see this day. We cannot find the appropriate words which could properly describe our appreciation for their endless devotion, support and faith in our abilities in achieving our goal.

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Chapter 1: Introduction

1.1: Project Definition

This project controlling the power of the solar car intends to produce such a solar car which not only helps in protecting the environment by saving the fuel but also is smart enough to take the burden of the maintenance of the car and staying safe and comfortable for the driver at the same time. The project is to build a smart solar car or in other words a solar car with monitoring system of its own installed and programmed in it. For this purpose Arduino compatible controller will be used which can be programmed easily and act as monitoring robot. To make the solar car safe and smart we will be adding the 1). Motor controller to keep check of the power or voltages produced and utilized either from solar panel or from battery, 2). Cruise control to move at a constant speed resulting in less power intake, 3). Automated steering to maintain the direction of the car at constant speed with the help of front camera, 4). Temperature sensor to keep a check on the temperature of the engine. Many features according to the demand and requirement of the project can included or excluded in future during execution phase of the project.

1.2: Project Objectives

Our project is based on the following objectives:

- To build a solar car which can overcome the issue of unnecessary fuel consumption
- To build a solar car free of emission and cause no pollution
- To build an environment friendly solar car
- To build a smart solar car with vehicle monitoring system
- To build a solar car which is safe and comfortable for routine use
- To build a customized solar car which have its own controller and sensors programmed specifically for itself

1.3: Project Specifications

This project is part of university project solar car there have been different groups involved and each group is assigned with a different car part. So to be in accordance with that there are basic parameters to be kept in mind which are as follows.

Table# 1.3: Basic Parameters of Solar Car

CHARACTERISTICS	SPECIFICATIONS
Vehicle type	2 seat solar car
Drive form	Rear wheel drive
Brake system	Hydraulic brake system
Battery	16kWh
Maximum speed	80 km/h
Area Solar panel	$4m^2$
Weight of the car	400 kg approx.
Dimensions	5*2*1.5m

As this project intends to produce a modified solar car with commissioned controller which will make this solar car smart enough to monitor and act accordingly. With the help of this controller current is monitored and controlled to avoid any hazards and accidents. Following is the image and specifications of the controller that will be used:

Figure# 1.3: Controllino Mega

Table#1.3(a): Specification of Controller

Characteristics	Description
Output current	Max 30A
Relays	16x relay outputs @ 6A max
Digital Outputs	24 outputs (high side & half bridge @ 12V or 24V @ 2A max
Analog/Digital Inputs	16 Analog/Digital inputs & 5 digital inputs
Microcontroller	Clock Speed @ 16MHz, Arduino compatible
RTC	Real time clock integrated

1.4: Project Applications

The main application of this project are:

- Controlling system of solar car can be used in other solar powered applications with some modifications.
- Controlling system of solar car can be used in solar tracking panels with required alterations
- Smart solar cars can be used in world solar car race challenge
- Smart solar cars can be used domestically as regular cars
- Smart solar car controlling systems can be used to raise the awareness of environment friendly practices

Chapter 2: Literature Review

2.1: Project Background

Globally there has been a lot awareness programs and campaigns in different developed and developing countries on account of using fossil fuel and producing harmful effects to the environment. Countries are working on the plans to how to go green and become environment friendly. Saudi Arabia is also working in this regard as it has announced Saudi vision 2030 which states to transmit the dependency of the economy of kingdom from fossil fuel to the solar energy which fortunately is in abundance in this particular region. For this purpose ideas are floating to convert the conventional fuel consuming cars to solar powered cars which due to some reasons has not able to get mainstream attention yet no serious actions are taken to do so. It is the hour of need to become solar as soon as possible. This project is taken up in consideration of current scenario of oil reserves limitations as it is predicted by the experts that it will not last long and sadly our economy majorly depends on the oil which is point to ponder. This project not only strives to produce a solar car with smart controlling system but it also open ventures and venues for the industry to set up plants to manufacture customized control system for solar cars to make it more feasible and sustainable.

2.2: Previous Work

Solar cars is no new concept neither the control system as quite advanced motor controller and vehicle monitoring system have been introduced in market for hybrid or electric cars. A detailed research is done by Singh R, Kumar M and Shekhar C and results are presented in the study named Study of Solar Energy Operated Hybrid Mild Cars in 2012. According to them solar car or a hybrid of solar and electric car is the future of cars but their findings state that no doubts solar and hybrid solar energy and electric operated cars have been developed and are being in use and under research from last ten years yet solar car still have technical issues that why it is facing problems in being accepted as new future. They concluded that the requirement of a viable solar car is its small size and this small size in terms of height and length is the main reason of its rejection.

According to the students Ahmed S, Asrar S, Nahif R, Hossen B and Rubayet R of BRAC University Dhaka Bangladesh in 2014 electric vehicles are going to the next or future generation cars as everyone will turn to them due to fact that they are low cost and have less or no polluting effect on the surroundings. But they also state that the car developed by them was unable to be charged completely by only solar power it needed a push or a fraction of its charge

from the grid as well. It was there lacking point as it will lose its essence of pure naturally powered edge if required other external source to get power. They also suggest that air quality also affects the efficiency of the solar powered car as impure or dusty air will be stuck of the solar panel and in result will affect its performance and conversion rate. In this study the researchers also mentioned the limitations of their study is that controller used for solar charging is not equipped with maximum power point tracking due to which it consumes a significant amount of the charge obtained from the solar panels.

The above mentioned previously done work on the control system of solar car provides our team with an insight of constraints to be taken in consideration during parts selection and designing criteria which will be followed by the parameters we have to be habituated to.

2.3: Comparative Work

In order to set a benchmark for our project there is a need to do a lot of market and study research. To achieve our goal it is vital to keep our selves open to any changings and modifications needed or required aside from the designed once during the practical phase of the project to avoid any close ends and failure. There is always a need to expose ourselves in to the environment where we have to gather new knowledge, skills, expertise and crucial information which may lead us towards our goal. So we will keep all these previous researches in mind and will try to take their suggestions and recommendations under consideration to achieve positive and better results.

In previous researches we noticed that they did not use the customized control system due to which they had to face limitations and to avoid this we are using Controllino mega the controller which helps us to program the solar car as it is compatible with the Arduino. In this way we will be able to control the car from the internet also if we like to although up till now it is not considered. We will be using temperature sensors to keep a good check of engine which other researchers are missing in their experiments. We will try to take the help of our advisor wherever needed to attain positive and unique results.

Chapter 3: System Design

3.1: Design Constraints and Design Methodology

3.1.1: Geometrical Constraints

To make the controlling system of solar car more effective and there are some constraints which should be taken under consideration. First of all motor controllers were added to keep check of the power and to make the solar car safe and smart. Second main concern was that to maintain the direction of the solar car at constant speed we have to add automatic steering which was a challenge for us. Temperature sensors were also added in controlling system of solar car to keep check on the temperature of the engine.

3.1.2: Sustainability

While working on our project design, it was kept in mind that the design should be made in such a way that it will be able to function for life time. The protection of the system from overcharging and deep discharge from photovoltaic panel was given the importance of the battery in embedded system. Another major concern was the optimization of the Arduino board use. Instead of making different operating system we made a hub and all the operations were done there to avoid hazards.

3.1.3: Environmental Concern

This project controlling the power of the solar car intends to produce such a solar car which not only helps in protecting the environment by saving the fuel but also is smart enough to take the burden of the maintenance of the car and staying safe and comfortable for the driver at the same time.

3.1.4: Social Impact:

In 2020 we are facing so many problem on one hand we know that global warming is major concern of the world. The second most important is that we can see the world's energy resource depletion will be one of the major problems. This project aims to control the power of the solar car with Arduino which will make the solar car more reliable and functional. When

the car will work on solar there will be no consumption or we can say less consumption of patrol or diesel and emits no gas or emission. This will save the society from pollution.

3.1.5: Economic:

While we are working on the project controlling the power of the solar car, the one of the major constraints of the project is the financial concern. In this project we will make solar car which will consume no patrol. The shifting of car from fossil fuel towards solar energy will stop the degradation and depletion of oil reserves. It is economically suitable as it will reduce the use of oil resources as solar energy can be used to supplement other resources of energy.

3.1.6: Safety:

This project controlling the power of the solar car plans to produce such a solar car which is not only helping in protecting the environment by saving the fuel. This project also intend or is smart enough to take the burden of the maintenance of the car and staying safe and comfortable for the driver at the same time. The safety of the driver is our one of our major concern.

3.1.7: Ethics:

As this project intends to produce a modified solar car with commissioned controller which will make this solar car smart enough to monitor and act accordingly. With the help of this controller current is monitored and controlled to avoid any hazards and accidents. The project is to build a smart solar car or in other words a solar car with monitoring system of its own installed and programmed in it. For this purpose Arduino compatible controller will be used which can be programmed easily and act as monitoring robot.

3.2: Engineering Design Standards

For the project of Control System of Solar Car, the team has extensively considered the broad variety of materials to pick from in order to assign them for the project's design and has also took into consideration the restrictions and limitations of each material in terms of its special properties and its cost. However, the following selected materials are considered to be the first draft of selections due to the fact that the team is still working on the currently

unavailable materials in the Saudi market, the following selections might differ from the final product due to the constraint of unseen future.

Following table displays the engineering standards of the components used in the said project:

Table#3.2: Engineering standards

Components	Engineering
Solar panel	ASTM: E 2236
Relay	ASTM: A867
Jumper wire	ASTM: F2321
Thermocouple	ASTM: E2846
Temperature sensor	ASTM: F2362
LCD	ASTM:D4449
Current sensor	ASTM: E2338
Voltage sensor	ASTM: F1796
Diode	ASTM: 1n4001

3.3: Theory and Theoretical Calculations

As the said project is the very important aspect of the solar car as it encompasses all the control systems of the solar car. The control system of the solar car is designed in such a way that temperature, current and voltage sensor are added and attached to the Arduino mega to make it efficient and effective. Now the assessment of the performance of the prototype is based on the programming of the Arduino which is provide below.

3.3.1: Temperature sensor programming

```
const int sensor=A0; // Assigning analog pin A0 to variable 'sensor'

float tempc;  //variable to store temperature in degree Celsius

float vout;  //temporary variable to hold sensor reading

void setup()

{

pinMode(sensor,INPUT); // Configuring pin A0 as input

Serial.begin(9600);

}

void loop()

{

vout=analogRead(sensor);

vout=(vout*500)/1023;

tempc=vout; // Storing value in Degree Celsius

Serial.print("in DegreeC=");

Serial.print("\t\n");

Serial.print(tempc);

Serial.print("\t\n");

delay(1000); //Delay of 1 second for ease of viewing

}
```

3.3.2: Voltage sensor programming

```
Int offset =20;
Void setup()  {
  //
  Serial.begin(9600) ;
```

```
}
Void loop()  {
  Int volt = analogRead(AO) ;
  double voltage = map(volt,0,1023, 0, 2500) +
offset;
  voltage /=100;
  Serial.print(“Voltage: ”) ;
  Serial.print(voltage) ;
  Serial.printIn(“V”) ;
delay(500) ;
}
```

3.3.3: Current Sensor Programming

```
/*
Measuring Current Using ACS712
*/
const int analogIn = A0;
int mVperAmp = 185; // use 100 for 20A Module and 66 for 30A Module
int RawValue= 0;
int ACSoffset = 2500;
double Voltage = 0;
Double Amps = 0;

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

 RawValue = analogRead(analog In);
 Voltage = (RawValue / 1024.0) * 5000; // Gets you mV
 Amps = ((Voltage - ACSoffset) / mVperAmp);
```

```
 Serial.print("Raw Value = " ); // shows pre-scaled value
 Serial.print(RawValue);
 Serial.print("\t mV = "); // shows the voltage measured
 Serial.print(Voltage,3); // the '3' after voltage allows you to display 3 digits after decimal poin
t
 Serial.print("\t Amps = "); // shows the voltage measured
 Serial.println(Amps,3); // the '3' after voltage allows you to display 3 digits after decimal poin
t
 delay(2500);

}
```

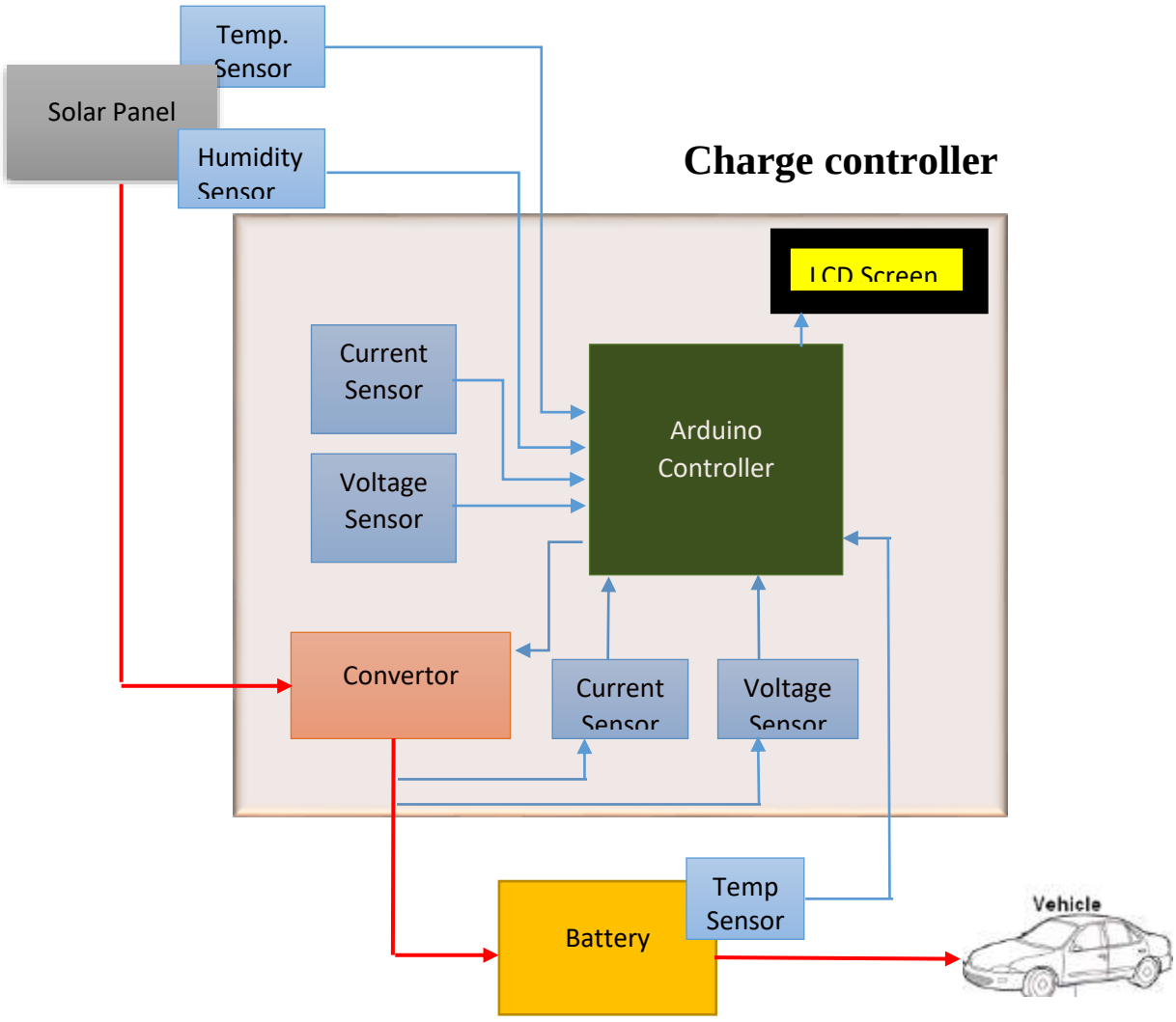
3.3.4: Humidity Sensor Programming

```
#include <dht.h>

#define dht_apin A0 // Analog Pin sensor is connected to

dht DHT;

void setup(){

  Serial.begin(9600);
  delay(500);//Delay to let system boot
  Serial.println("DHT11 Humidity & temperature Sensor\n\n");
  delay(1000);//Wait before accessing Sensor

}//end "setup()"

void loop(){
  //Start of Program

    DHT.read11(dht_apin);

    Serial.print("Current humidity = ");
```

```
    Serial.print(DHT.humidity);
    Serial.print("%  ");
    Serial.print("temperature = ");
    Serial.print(DHT.temperature);
    Serial.println("C  ");

    delay(5000);//Wait 5 seconds before accessing sensor again.

  //Fastest should be once every two seconds.

}// end loop(
```

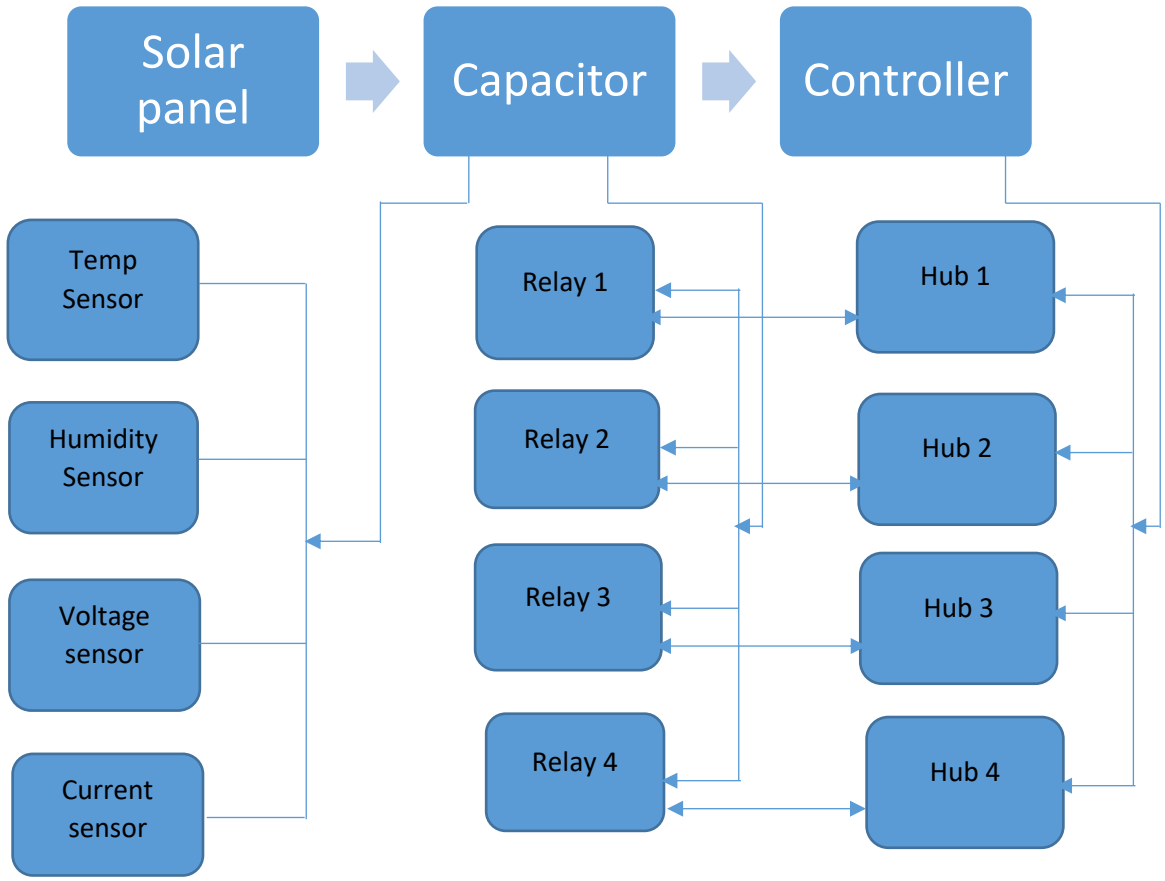
3.3.5: Block Diagrams

Following block diagrams show the connections and relation between the whole system the Arduino Controller, the sensors, LCD screen, solar panel and battery. This show what is connected to what and how controller receives the signals and how the data is displayed on the LCD by the Arduino.



Figure#3.3.5 : Block Diagram showing automatic control system of solar Car

Block diagram no 2:



Figure# 3.3.5(a): Block Diagram Displaying Relation of Controller

3.4: Product Subsystems and Selection of Components

The control system of solar car is quite complex system and it can get more and more complex if tend to add or interconnect all the controls of the car. So keeping the project workable we as a team decided to add only such controls which are practical and pragmatic. Following are the components we are working with although we haven't been able to get hold of all the required components according to the design but we are trying our best to have those remaining items as well which includes

- Small batteries
- Small motor
- Solar panel
- Diode

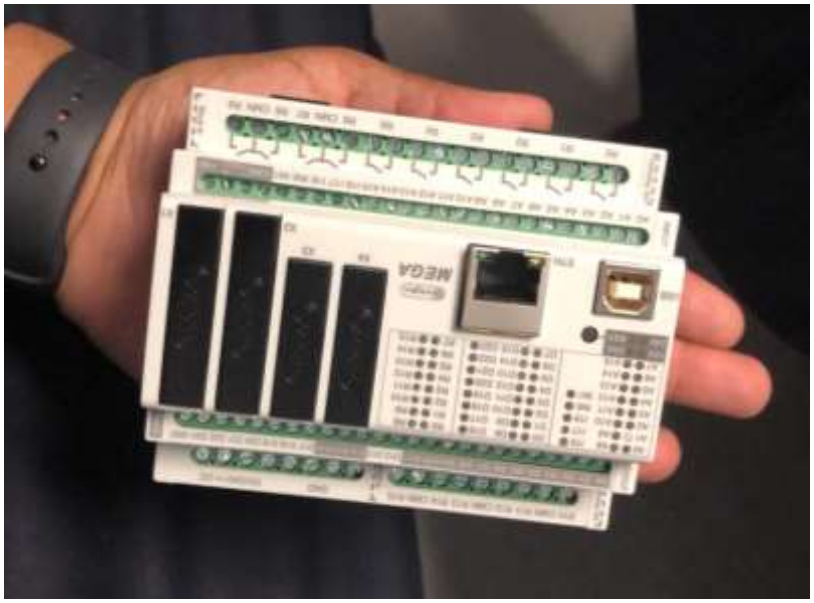
Following are the basic important components which as whole shape up the control system of the solar car

3.4.1: Arduino Mega

We are using Controllino Arduino Mega to code the controls of the solar car so that we can make sure that everything is under control like temperature, current or voltage. We want out solar to have the best vehicle monitoring system to ensure the safety and sustainability of the solar car. Following are the specification of the Arduino used in the project.

Table#3.4: Specification of the Arduino

Characteristics	Specification
Microcontroller	AT mega 2560
Operating voltage	5V
Input voltage	6-20V
Digital I/O Pins	54
Analog Input Pins	16
DC Current per I/O Pin	20mA
DC Current for 3.3V Pin	50mA+
Flash memory	256KB
SRAM	8 KB
Clock speed	16 MHz
LED built in	13
Length and width	101.52mm x 53.3 mm
Weight	37g

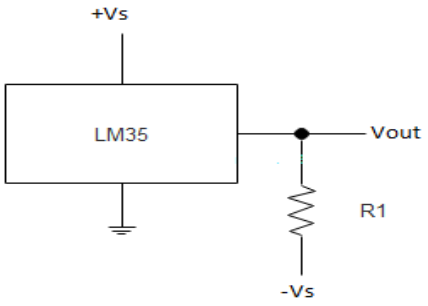


Figure#3.4: Arduino Mega

3.4.2: LM 35 Temperature Sensor

Another important device that should be used as safety measure in setups which may operates on extreme temperatures. Temperature sensor is gadget which is used to measure the temperature via electrical signal and in our case temperature sensor is attached to the Arduino and coding regarding sensor is also been done. So the ambient temperature is displayed on the LCD connected to the Arduino continuously.

Full Range Centigrade temperature Sensor



Choose $R_1 = -V_S/50\ \mu A$

V_{OUT} = 1500mV at 150 ºC

V_{OUT} = 250mV at 25 °C

V_{OUT} = -550mV at -55°C

Features of temperature sensor

- Calibrated directly in Celsius
- Linear + 10-Mv/C Scale Factor
- 0.5 C Ensured Accuracy at 25 C
- Rated for Full -55C to 150C Range
- Suitable for remote applications
- Low cost due to water level trimming
- Operates from 4V to 30V
- Less than 60Ua Current Drain
- Low self-heating 0.08C in still Air
- Non linearity only +_1/4C
- Low impedance output 0.1 Ω for 1-mA Load

3.4.3: Max 6675 Thermocouple

Thermocouples also perform the same action but they are more sensitive and acts differently than simple temperature sensors. Thermocouple constitutes of two unlike electrical conductors producing electrical voltage indirectly proportional to change the temperature. A thermocouple as a result of thermoelectric effect generates a temperature-dependent voltage that can be inferred to measure temperature. In the same manner thermocouple is also attached to the Arduino so its reading is also displayed on the LCD shows the temperature of the solar panel.

Max 6675 K- type thermocouple temperature sensor converter resolves temperatures to 0.25C, allows readings as high as+ 1024°C. Following are the specification of the Max 6675 thermocouple.

- Working voltage: DC 5V
- Operating current: 50mA
- Temperature range: 0°C - 1024°C
- The temperature measurement accuracy: +/-1.5°C
- The temperature resolution: 0.25°C
- The output mode: SPI digital signal

Figure#3.4(a): Thermocouple

3.4.4: ACS 712 Current Sensor

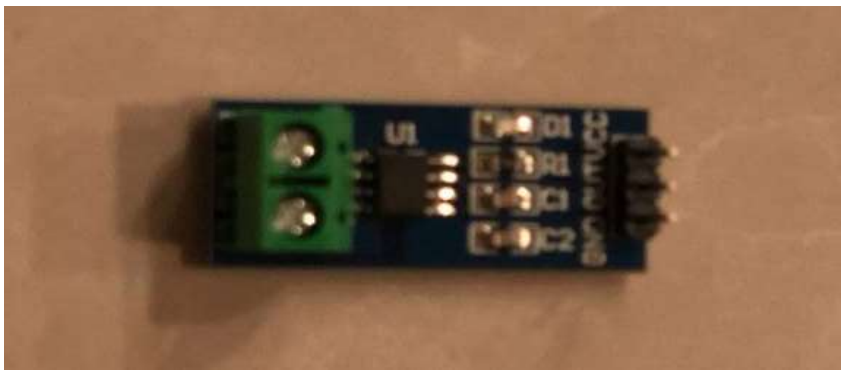
A current sensor is a device used to detect and convert the current to an easily measured output voltage, which is proportional to the current through the measured path. When a current flows through a wire or in a circuit, voltage drop occurs. Also, a magnetic field is generated surrounding the current carrying conductor. Arduino is programmed with the coding of current sensor as well.

Specifications

- Measures both AC and DC current
- Available as 5A, 20A and 30A module
- Provides isolation from the load easy to integrate MCU, since its outputs analog voltage.

Table#3.4(a): Electrical Specification

Module	5A	20A	30A
Electrical specification	185mV/Amp	100mV/Amp	66mV/Amp



Figure#3.4(b): Current sensor

3.4.5: Voltage sensor

Table#3.4(b): Specification of voltage sensor

Characteristics	Description
Voltage input range	0-25V DC for 5V
Voltage input range	0-16.5V DC for 3.3V
Voltage analog resolution	0.00489V
Operating Voltage Output	3.3V-5V

Figure#3.4(c): Voltage sensor

3.4.6: LCD

LCD used in this project is of display 4 x 20 which means that LCD has 4 lines and can display 20 characters per line. So it can display up to 80 characters at a time. LCD is connected to the Arduino Mega so that it can display the reading on the LCD as programmed. Following are the electrical and mechanical characteristics of the LCD.

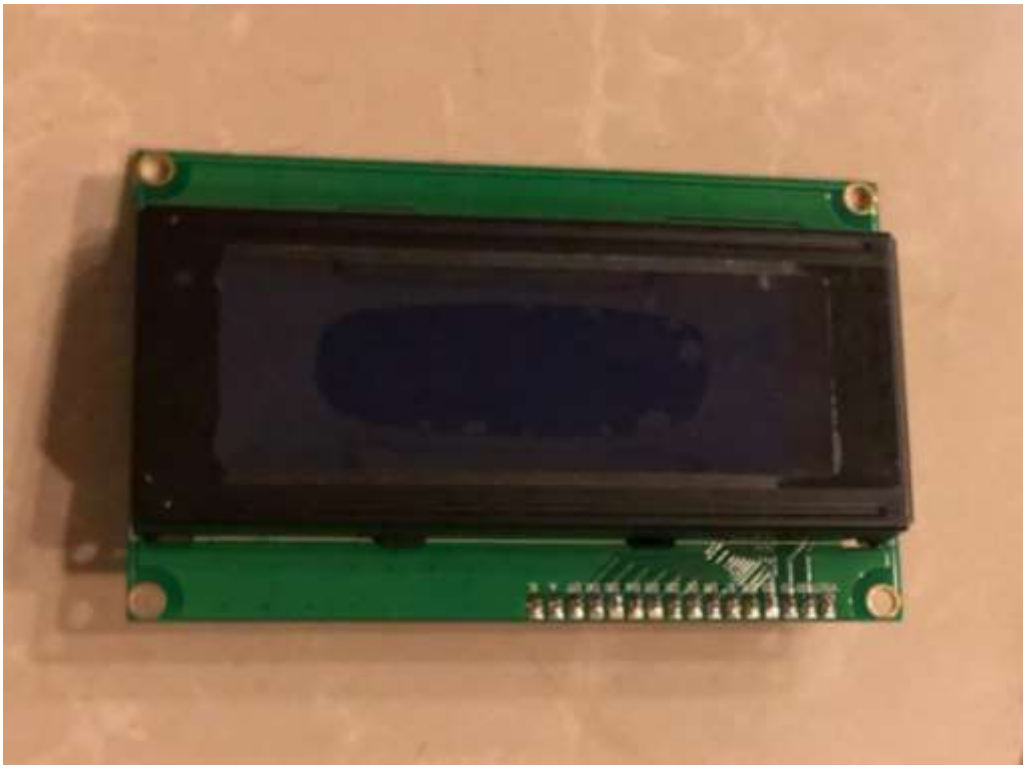
Table#3.4(c): Electrical characteristics of LCD

Item	Symbol	Condition	Min	Type	Max	Unit
Supply voltage for LCD	VDD-VO	Ta=0C Ta =25C Ta = 50C		4.5		V
Input high voltage	VIH		2.2		VDD	V
Input low voltage	VIL		0.3		0.6	V
Output High Voltage	VOL		2.4			V
Output Low Voltage	VOL				0.4	V
Supply Current	IDD	VDD=5V		2.5	4.0	Ma

Table#3.4(d): Mechanical characteristics of LCD

Item	Dimensions	Unit
LCD size	98 x 60	mm
Viewing Area	77 x 25	mm
Dot Size	0.55 x 0.55	mm
Dot Pitch	0.60 x 0.60	mm
Character size	2.95 x 4.75	mm
Character pitch	3.55 x 5.35	mm
LCD Thickness	8.8	mm

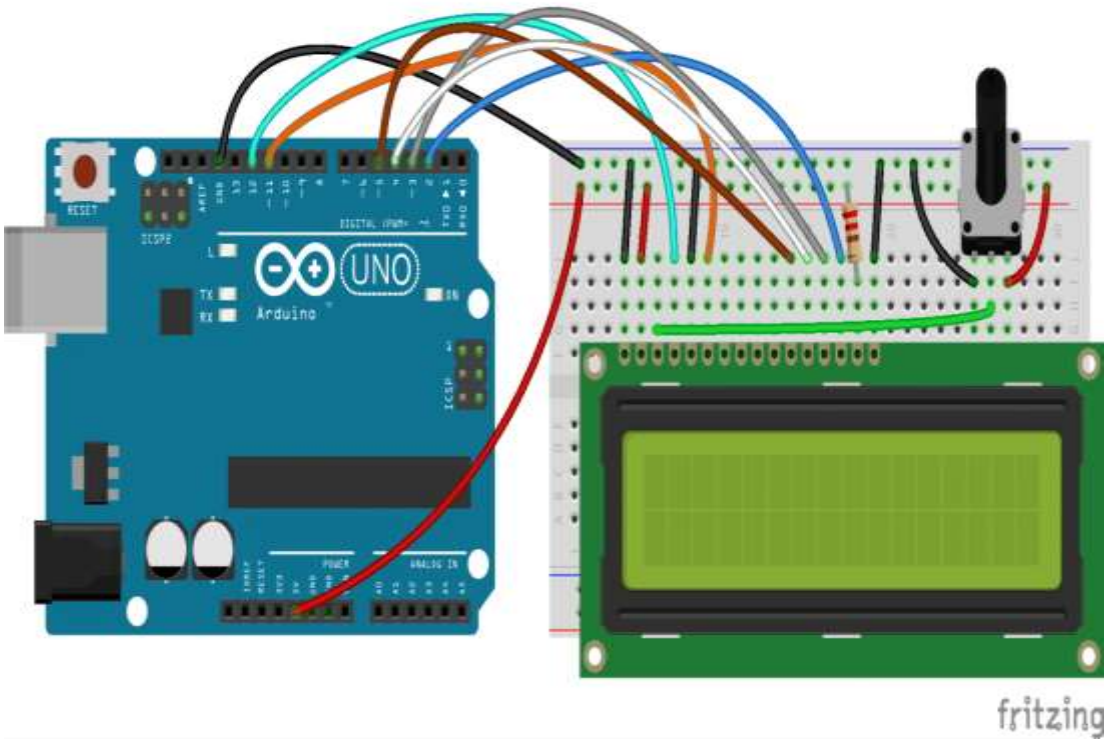
Figure#3.4(d):Backview of LCD



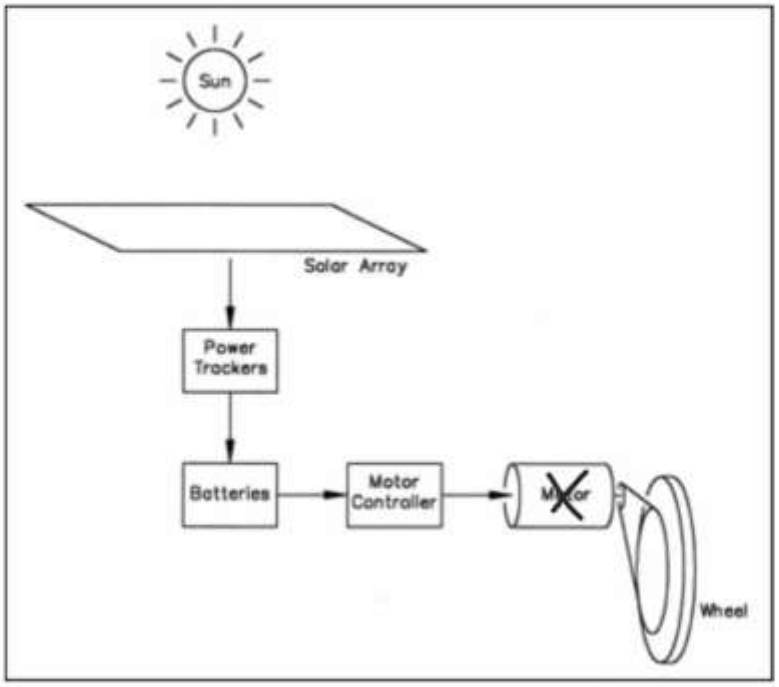
Figure#3.4(e): Front view of LCD

3.5: Manufacturing and Assembly (Implementation)

Control system of solar car is very important part of the car as it ensures the safety and sustainability of the solar car. The said project components were easily available in the market so that there was no need of getting anything manufactured on order. The components are very simple but what matters is the assembling of these components and connecting and attaching each part in such a manner that it is durable and long lasting. At the execution stage we attached all the sensors or to the solar system of the car and to the Arduino as well so that the readings of temperature, current and voltage are always in front of the eyes to avoid any technical or electrical shortage or accident. So this purpose the Arduino is programmed with the coding of temperature sensor, current sensor and the voltage sensor. Arduino transfers the electrical readings to the LCD and are digitalized and visual of the reading is available on the LCD screen. As the project develops and more ideas are considered team is open to make any changes to the prototype.

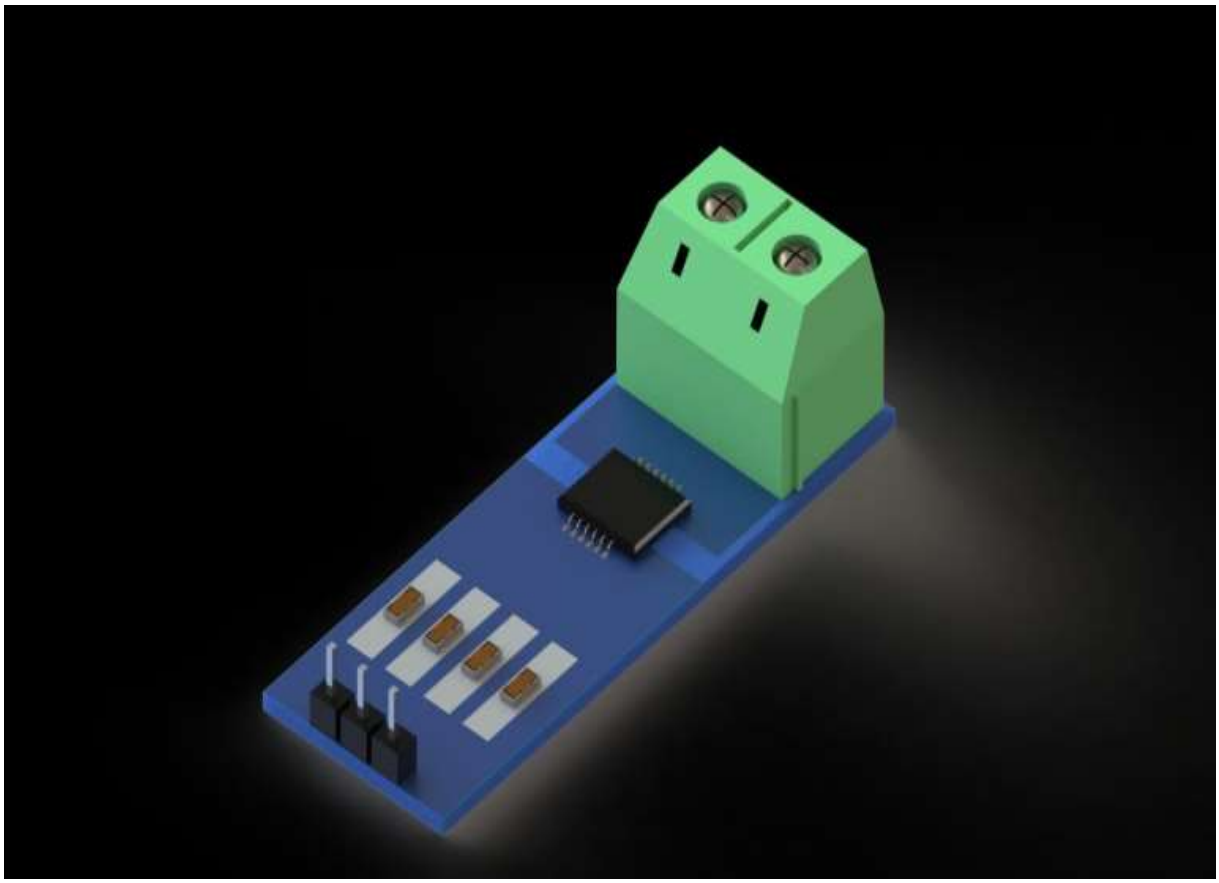


Figure#3.5: Image of Arduino and LCD connected to each other

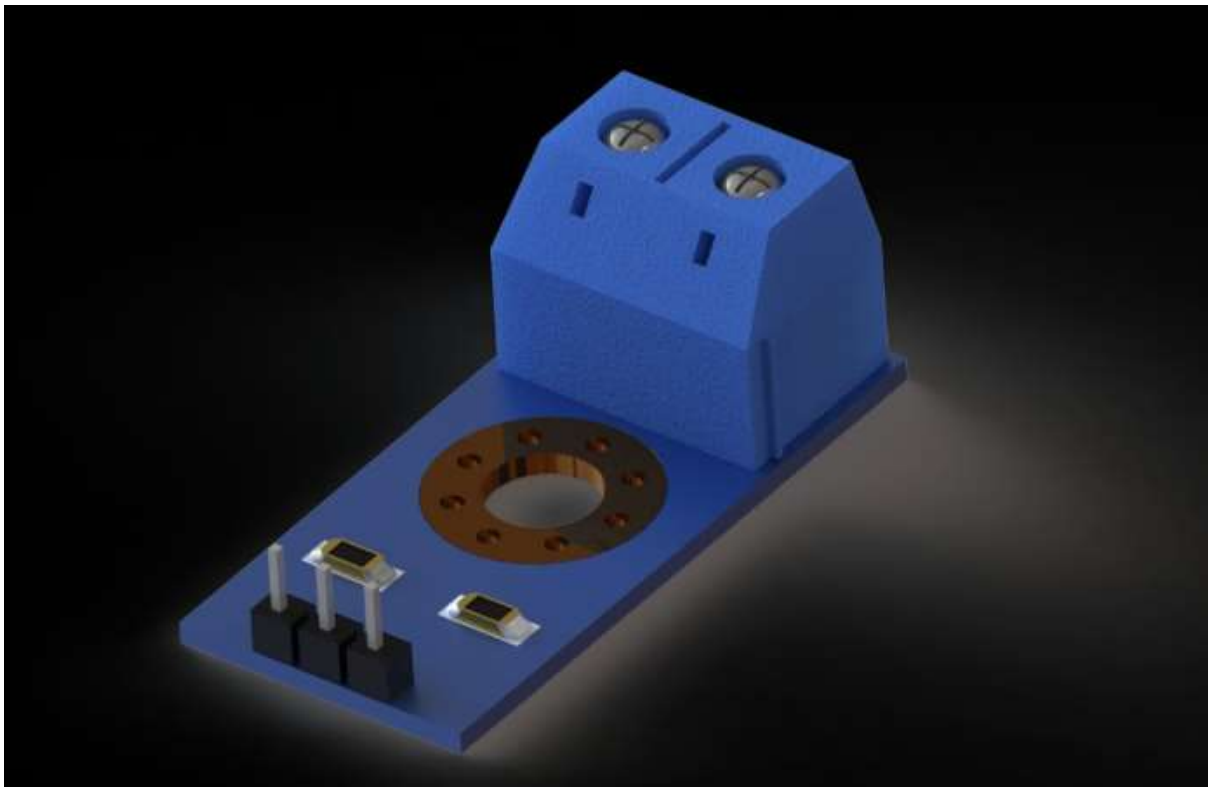


Figure#3.5(a): Sample diagram of the concept of the project

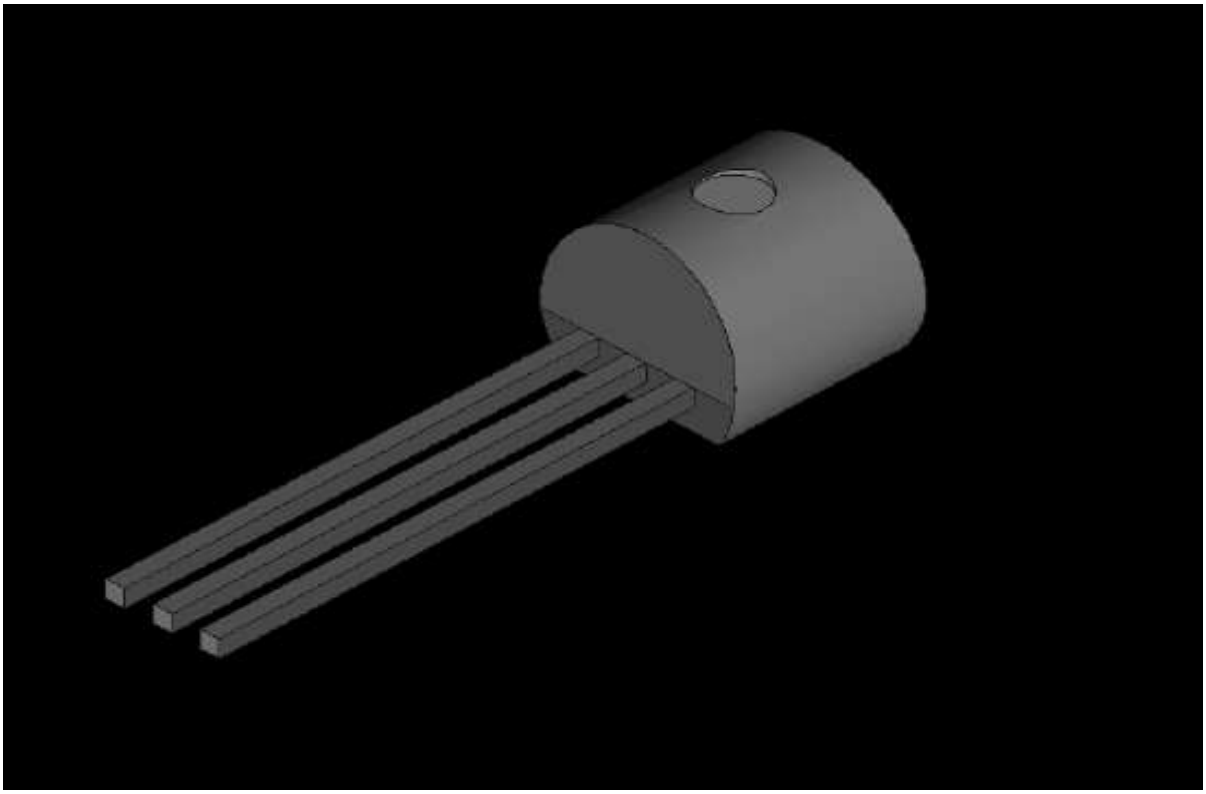
3.6: Cad Models



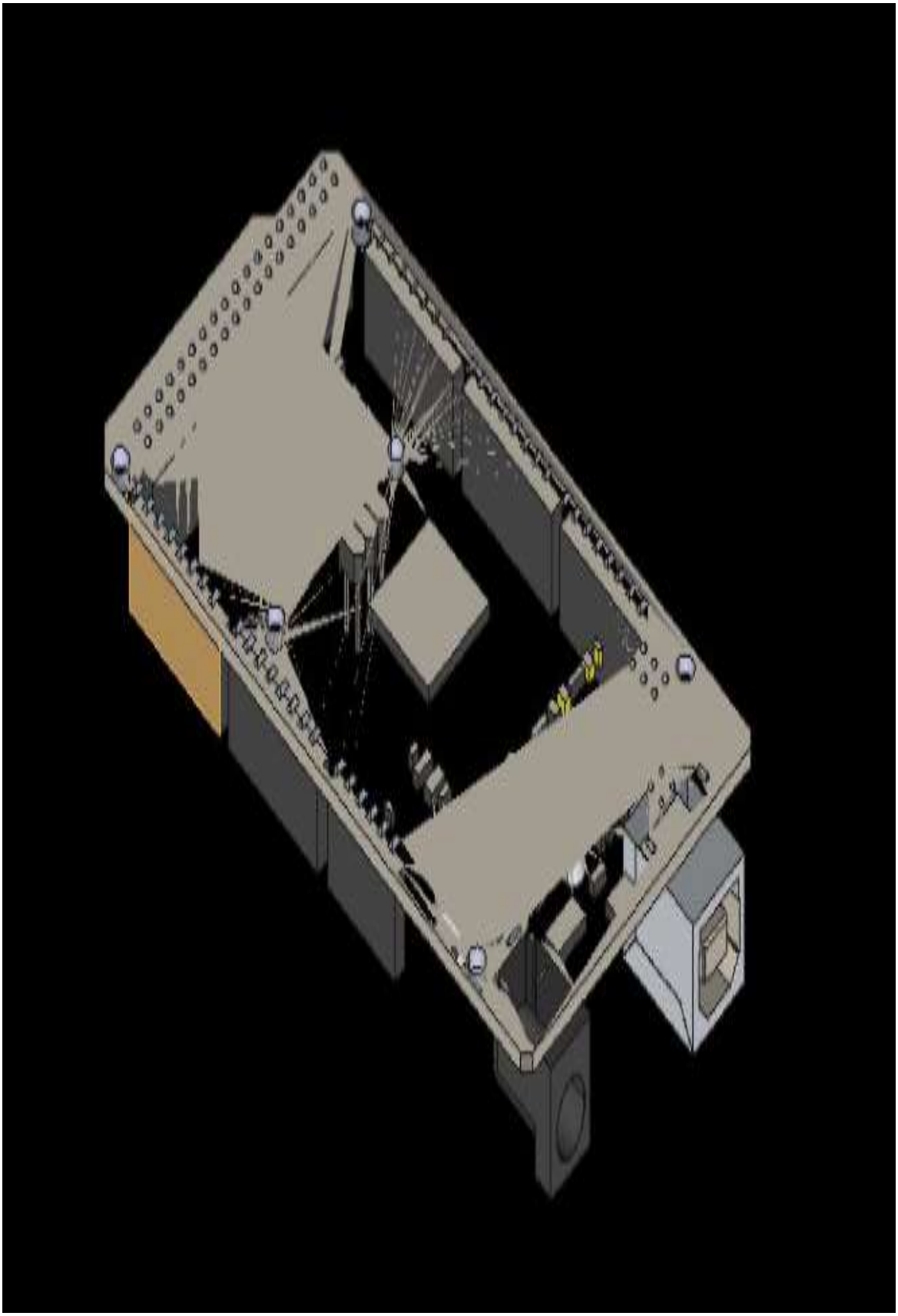
Figure# 3.6: CAD Model of Current Sensor



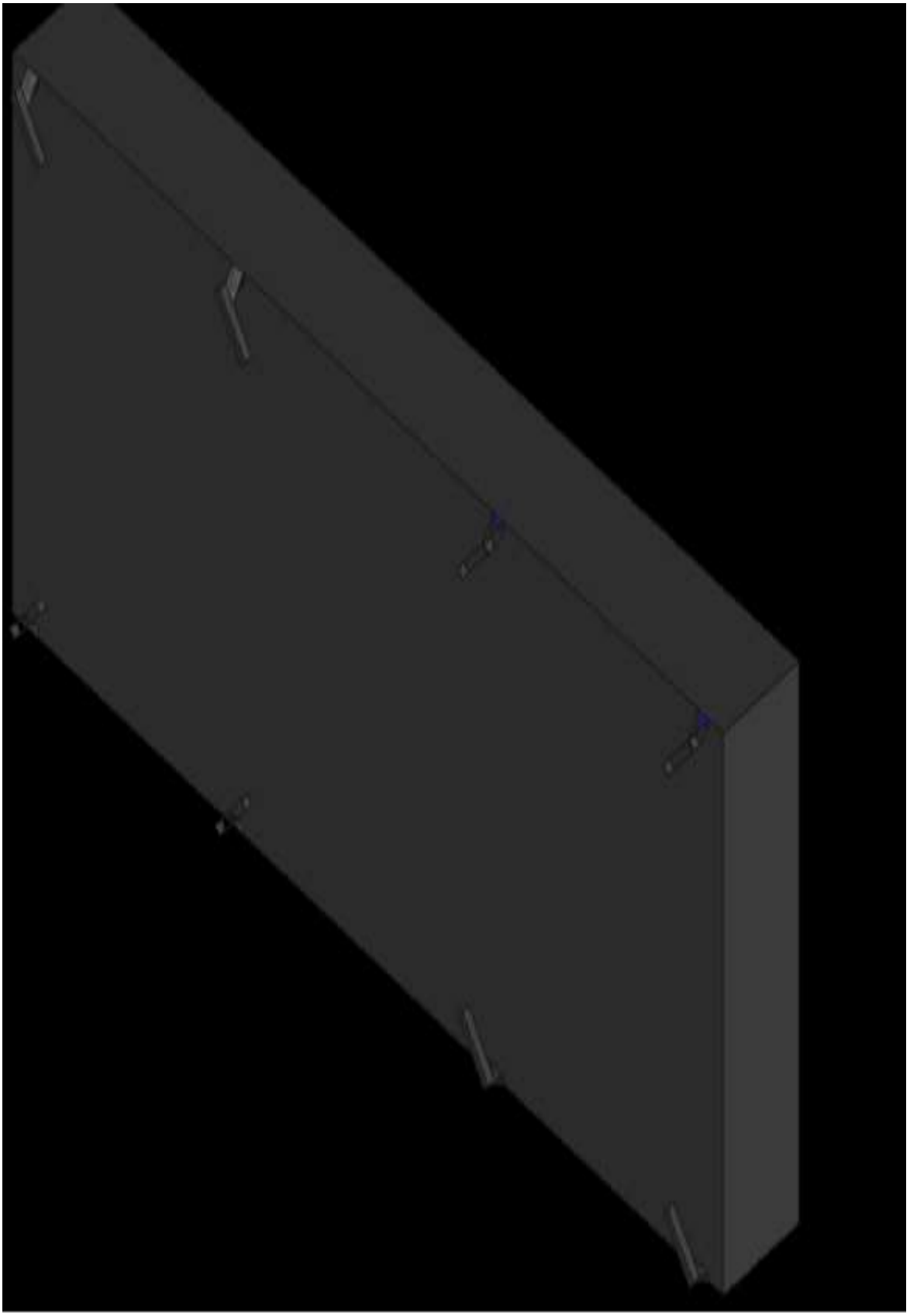
Figure# 3.6(a): CAD Model Voltage Sensor



Figure# 3.6(b): CAD Model LM35 Sensor



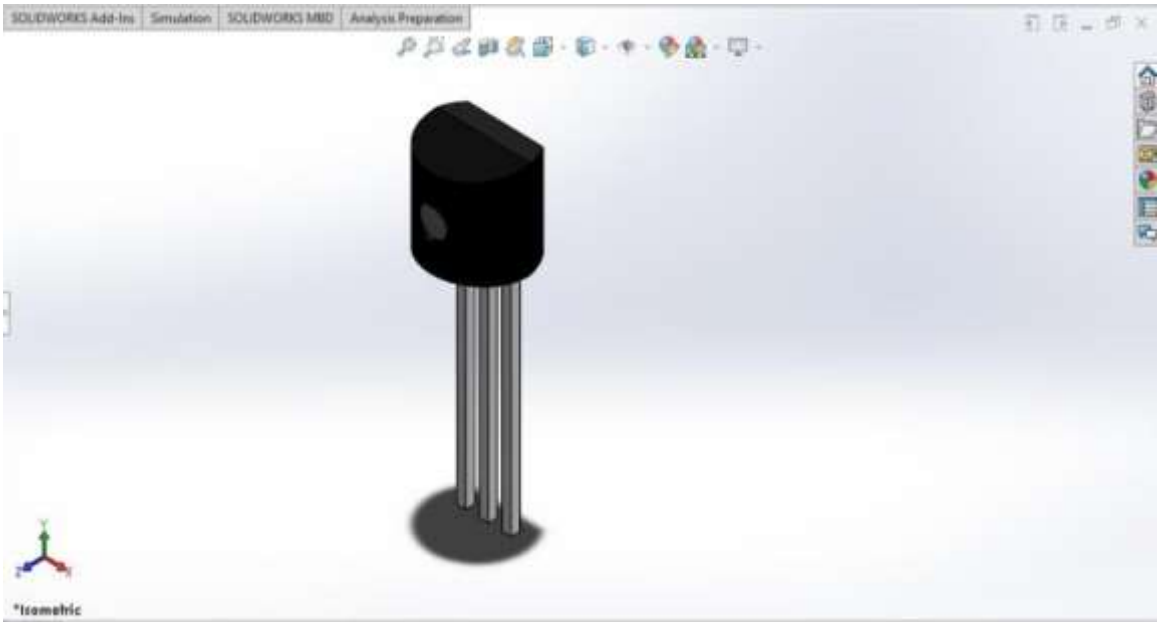
Figure# 3.6(c): CAD Model of Arduino Mega Controller



Figure# 3.6(d): CAD Model showing LCD

3.7: Solid Works

Figure# 3.7: Solid Works display of LCD



Figure# 3.7(a): Solid Works display of temperature sensor

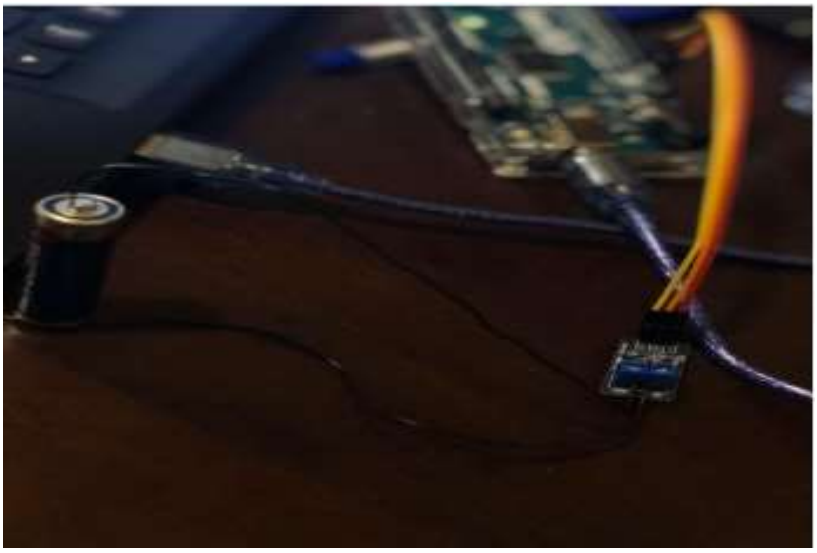
Figure# 3.7(b): Solid Works display of Arduino Mega

Chapter 4: System Testing and Analysis

Designing of the control system followed by the assembling of the prototype is not productive or constructive until and unless tests and experiments are run to make sure that the prototype is delivering its objectives and its meets it's set goals. For this purpose initially we were supposed to attach the control system to the solar car but due to the current scenario of coronavirus pandemic all activities of life were made static by implementing curfew in Saudi Arabia to practice social distancing to Covid-19. Due to this unseen factor we were unable to execute as planned earlier so we had to improvise and perform the test and not leave the work incomplete. To complete the project we decided to test the system with help of different power source like a regular battery of 1.5 power. Following are the tests performed.

4.1: Voltage Sensor Testing

First test we performed on the prototype was to test the voltage sensor along with the programming of the Arduino Controller. For testing purpose the voltage sensor was attached to battery of 1.5 power as well as to the Arduino controller and the controller was connected to the laptop to make proper notes of all the data received via Arduino. The voltage generated was sensed buy the voltage sensor and was signaled to the Arduino controller and controller is already programmed what to signal and what to filter. Once the connection is established and secured properly to avoid any disconnection during the testing phase. The following figure 4.1 shows the how the setup looks once the connection is made.



Figure# 4.1: Setup for Voltage Sensor Testing

Once the connection was established and the power was provided with the help of the battery the voltage sensor start sensing the voltage and the Arduino controller connected to the sensor received the signals and transferred the voltage signals received to the laptop in digital data as programmed. Following table shows the date generated by the controller on the laptop.

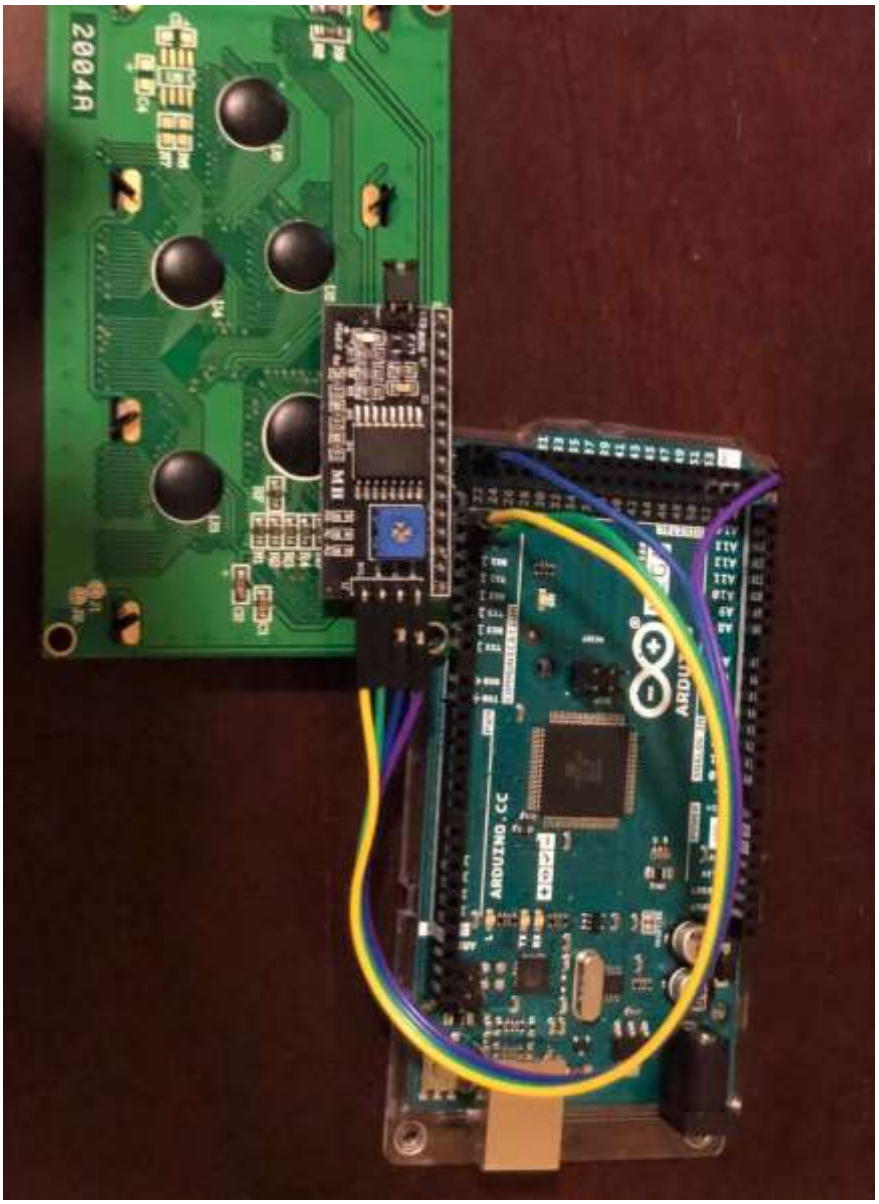
Table# 4.1: Voltage Readings

Sr. No	Battery Connected	Voltage sensed
1.	1.5	0.37 V
2.	1.5	1.76 V
3	1.5	1.76 V
4.	1.5	1.73 V
5.	1.5	1.73 V
6.	1.5	1.76 V
7.	1.5	1.73 V
8.	1.5	1.76 V
9.	1.5	1.76 V
10	1.5	1.76 V

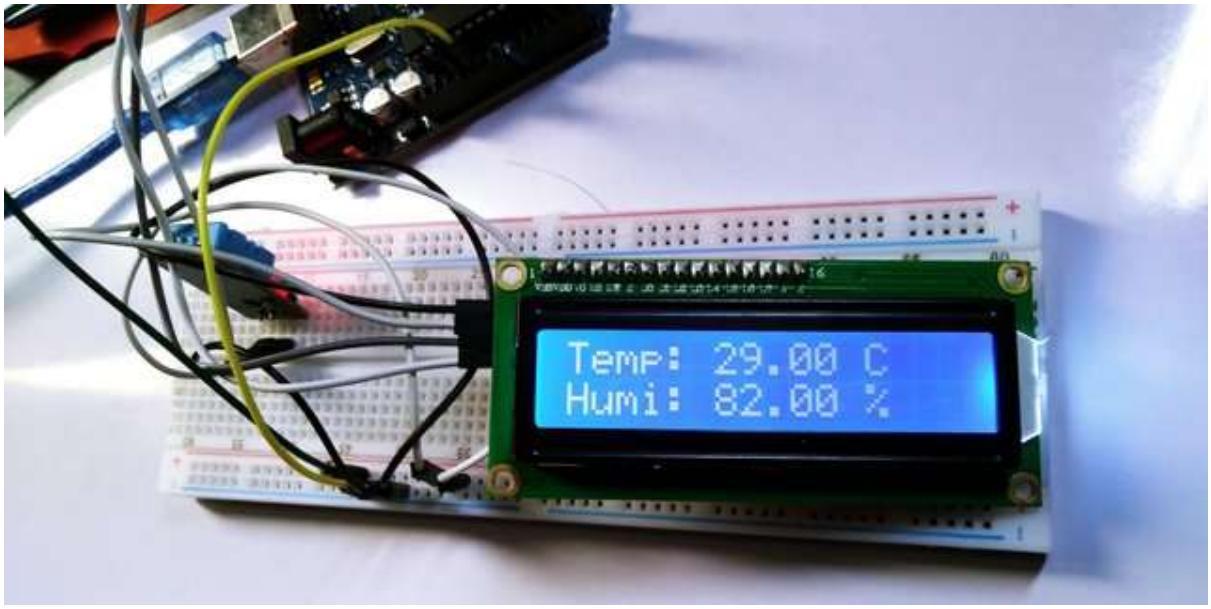
4.2 Temperature and Humidity Test

The project focuses on the automatic control system of the solar car which makes it very essential to perform and run tests to make sure there is no loop hole in the system. The next test we performed was encompassing many aspects of the prototype as it covers the testing of the LCD screen, temperature sensor, humidity sensor and the Arduino controller. In this setup we connected the temperature and humidity both sensors to the setup and Arduino controller was connected to sensors and to the LCD as well to see if the display was working finely. As the one of the temperature sensor will be detecting temperature of the solar panel so we provided the heat to the setup artificially by attaching the temperature to the laptop

processor to test if the temperature sensor was sensing any heat. Humidity sensor was also attached to the laptop processor. Once the setup was completed we run the test and were successful in getting the reading on the LCD screen which are showed in the figure 4.2.



Figure# 4.2: Arduino connected to LCD



Figure# 4.2: test Results of Sensors and LCD

Chapter 5: Conclusion & Future Recommendations

5.1: Conclusion

The main aim of the project was to build a solar car which can overcome the issue of unnecessary fuel consumption and to design an environment friendly solar car with vehicle monitoring system. The most important is that to build a customized solar car which has its own controller and sensors programmed specifically for it. As this project intends to produce a modified solar car with commissioned controller which will make this solar car smart enough to monitor and act accordingly and with the help of this controller current is monitored and controlled to avoid any hazards and accidents.

There have been a lot awareness programs and campaigns globally in different developed and developing countries on account of using fossil fuel and producing harmful effects to the environment. Saudi Arabia is also working in this regard as it has announced Saudi vision 2030 which states to transmit the dependency of the economy of kingdom from fossil fuel to the solar energy which fortunately is in abundance in this particular region. For this purpose ideas are floating to convert the conventional fuel consuming cars to solar powered cars and our project is totally based on this vision. But due to corona pandemic we were unable to execute our design. Our work and project is totally based on theoretical work. The control system of solar car is quite complex system and it can get more and more complex if tend to add or interconnect all the controls of the car. So keeping the project workable our team decided to add only such controls which are practical and pragmatic. Small batteries, small motor, solar panel and diode are the components we worked with although we haven't been able to get hold of all the required components according to the design but we tried our best to have those remaining items as well.

5.2: Future Recommendations

This project not only strives to produce a solar car with smart controlling system but it also open ventures and venues for the industry to set up plants to manufacture customized control system for solar cars to make it more feasible and sustainable. The design that we planned was exceptionally well but due to corona pandemic we were unable to execute our plan. If we got chance to execute our design we would definitely get exactly what we hoped

for and would surely achieve Saudi vision 2030. Corona pandemic is the reason we do not get the opportunity to execute our design. Due to lockdown it was not easy to for our team mates to get together at same place and work on our design. The markets were closed so it was difficult to buy the required items and to make this project successful our required item should be according to the design. Our team also tried to buy online items but the items were not accurate. Our team was keen to open ourselves to further research and study and make any amendments in the designing of the braking system of the solar car if required to attain better results.

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