Design And Implementation A Security System To Protect Children In The Car From Suffocation By Ventilation System And Utilize On Solar Energy

Project Team

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Abstract:

In this project, we will design a safety system to protect children from being suffocated inside vehicles through new ventilation system works on solar power; this system will be easy to install in almost all types of vehicles and to be used in different countries especially those with high temperature, the system also serves to cool the vehicle while it is parked under sunlight before driving.

This ventilation system consists of the following: solar system to serve as power source for the whole system, conditioning system which works on the same conditioning system of the vehicle with addition of a second electrical compressor works in parallel with the mechanical compressor, monitoring system to control the whole system; a microprocessor will be used to give the commands depending on sensors which will describe the physical status of the system inside the car, in other words; sensors represent the inputs of the system.

ملخص :

تصميم نظام أمني لحماية الأطفال في السيارة من الاختناق عن طريق نظام تهوية جديد يعمل على الطاقة الشمسية و هذا النظام مصمم ليكون سهل التركيب في جميع أنواع السيارات ، ويستخدم أيضا في جميع البلدان ،ولاسيما المناطق التي تكون فيها درجة الحرارة مرتفعة ويمكن الاستفادة من نفس النظام لتبريد السيارة في حال كانت متوقفة في أشعة الشمس بحيث توفر الجو المناسب قبل استخدامها بالإضافة لوضعية الأمان للأطفال.

ويتكون نظام التهوية الجديد من الأجزاء التالية من : النظام الشمسي ،الذي يمثل مصدر الطاقة لنظام كامل ونظام التبريد الذي يعمل على نفس دوره التبريد في السيارة ،ولكن مع إضافة ضاغط كهربائي ثاني بشكل متوازي مع الضاغط الميكانيكي ونظام مراقبة للسيطرة على النظام الكلي ،حيث يعمل المتحكم الدقيق لإعطاء الأوامر ،بالاعتماد على أجهزة الاستشعار التي تصف الحالة الفيزيائية للنظام داخل السيارة وبعبارة اخرى فان اجهزة الاستشعار تمثل مدخلات النظام.

الاهداء

نهدي مشروعنا هذا الى قدوتنا ومعلمنا وقائد امتنا محمد صلى الله عليه وسلم

الى من رعونا بنور قلبهم..وحمونا بحكمتهم..وقدموا لنا حنانهم وقلبهم..إلى من سقونا وأطعمونا وربونا وأدبونا..ومنحونا الحب والحنان.. الى من فرشوا طريقنا بالورود..ورافقونا في الصعود..إلى من فتحوا أمامنا أبواب التفوق والنهوض وكسر
قيود الظلام..إلى بسمة الأمل ونبع الحنان إلى من هم بلسم روحنا إلى ورود حياتنا إلى من رعونا بحنانهم..
اليكم والدينا..

إلى من يحملون في عيونهم ذكريات طفولتنا وشبابنا....إخوتنا وأخواتنا

إلى من ضحوا بحريتهم من أجل حرية غيرهم....الأسرى والمعتقلين

إلى من هم أكرم منا مكانة....شهداء فلسطين

إلى شمعة أحرقت نفسها لتضيء لمن هم حولها..اليك يا وردة فاح عبيرها وطاب شذاها..اليك يا وردة زاد بريقها ورونقها..ماذا بوسعنا أن نقول لقد هربت منا الكلمات وتشتت شمل العبارات..لا ندري أي الكلام يفيدك حقك..بل أي العبارات تليق بمقامك ..ندين الشكر الى مشرفنا المهندس مجدي زلوم الذي أنار لنا الطريق ولم يبخل علينا بتوجبهاته ونصائحه والى معلمينا الذين لم يبخلوا علينا بعلمهم والذي لولا جهودهم لما وصلنا لما نحن عليه الان كما

ونوجه شكر

لكل من ساهم بإنجاز عملنا هذا الذين لم يدخروا جهدا في تقديم المساعدة لنا من توفير المصادر والمراجع اللازمة وكل التقدير للذين منحونا كل التشجيع.

ولا ننسى أيضا أصدقائنا الذين وقفوا إلى جانبنا في السراء والضراء وخصوصا الذين كانوا اصدقاء أوفياء ولم يترددوا في
مد يد العون لنا سائلين المولى عز وجل بأن يجمعنا بهم في جنات الخلد مع الرسل والصديقين والشهداء والأبرار حيث لا يوجد فراق

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Chapter one

1. Introduction

1.1 Introduction

In the last time, there have been many cases of suffocation children in the cars in case of forgotten alone in the car, or exposure to heat stroke, as a result of high temperature as the sun's rays are bound to transform the car into a burning furnace room in a few minutes. Therefore, it was necessary to find a solution to solve the suffocation problems of children in the car, so by creating a new security electronic system.

The system works on most types of cars , which is necessary in every car, where it should be imposed on all family cars and school buses in the state, to prevent accidents resulting from forgetting children inside cars , and should be used in all countries, especially countries with high temperature in the summer or other seasons (desert areas).

This system uses different forms and function of sensors , we have carbon dioxide sensor that measure the ratio of carbon dioxide in the car and compare between this value and the specified value , if the measured value is more than the specified value the sensor gives a signal to the microcontroller which make the system work : i.e. the windows down by 3 cm to the bottom to enter the air into the car [1].

Also , we have temperature sensor , to measure the temperature in the car and compare it with the specified value , if it is increase , the temperature sensor gives a signal to the microcontroller which runs the air-conditioning system until the temperature reaches the desired value.

Techniques that we use in our project :

Solar system

Solar system used as a main source of energy , Where solar cells on the absorption of rays sun's, and convert them into electrical energy, then this energy is transmitted to a charge controller where it makes the purification and install the electric power generated into the solar cells are fixed and directed energy can be stored in the battery.

Accurate control system

Precise control system using Arduino , that receive the electrical signals from sensors that used in project , and send a command to run the system.

1.2 Aims of project

- Design safety system to save the life of children in case of leaving them alone inside vehicles and protecting them from the danger of getting suffocated.
- Adjusting temperature of vehicles parked under sunlight for long period so that the driver will be able to drive it when he comes.
- Using renewable and environment friendly power which is solar power in running the project.
- Applying the project in practice on any new car, not just designing or modeling.

1.3 Previous studies

Through our research on the internet and found some of the projects that are similar to the idea of our project is the most prominent.
Three engineers from the Faculty of Electrical Engineering project in one of the Arab universities and industry a simple model of the car and put a warning system so that it issue a loud sound or send a message on a mobile phone, but we did not find this project applied to the car [2].

1.4 Problem Definition

Since the development of the world and has become a means of transport of the necessities of life, which cannot be dispensed with where used by all members of society, whether they are young or old it must be that there will be some problems that will confront us in. It is the most prominent of these problems, but which is leaving the children alone in the car either are unbeatable a choking hazard or that are unbeatable for sunstroke.

This is why we decided to find a solution to this problem and that our project will be a work of rescue children trapped inside the car.

1.5 Suffocation Definition

Suffocation it the case of a severe shortage of extended oxygen accompanied by accumulation of carbon dioxide. An example of asphyxia is choking. Asphyxia causes generalized hypoxia, which affects primarily the tissues and organs. There are many circumstances that can induce asphyxia, all of which are characterized by an inability of an individual to acquire sufficient oxygen through breathing for an extended period of time. Asphyxia can cause coma or death.

1.6 Project Schedule

Table (1.1):Project plane

No. of week Task	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Identification of Project Idea															
Drafting a Preliminary Project Proposal															
Choice the appropriate car															
Choice of sensors required															
Choice the controller and related modules.															

Choice the appropriate solar system															
Choosing the right air conditioning system.															
Mounting and implementation the project.															
Testing and improving.															

1.7 Total Cost for the Project

Table (1.2): Total Cost

components	**Price (NIS)**	**Quantity**	**Total (NIS)**
Car	2000	1	2000
Solar system	1400	1	1400
Cooling compressor	300	1	300
Inverter	750	1	750
One way valve	120	2	240
Pressure pipe	50	2	100
Pipe Coupling	20	10	200
T-connector	10	2	20
Arduino	70	1	70
Relay (5-12)V	12	4	48
Relay (12)V	8	5	40
Relay (12 DC-220 AC)V	15	1	15
DHT11 sensor	30	1	30
BMP180 sensor	30	1	30
MG-811 sensor	250	1	250

LDR sensor	2	1	2
Limit switch	12	1	12
LCD	25	1	25
turning	500	1	500
Total cost			**6030**

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Chapter Two

2.Ventiletion and Heat Transfer

2.1: Heat Transfer

2.1.1: Convection

2.1.2: Radiation

2.2: Humidity

2.3: Vehicle Air Condition System

2.4: Design of the new air-conditioning system in the project

2.1 Heat Transfer

Heat is defined in physics as the transfer of thermal energy across a well-defined boundary around a thermodynamic system. The thermodynamic free energy is the amount of work that a thermodynamic system can perform. Enthalpy is a thermodynamic potential, designated by the letter "H", that is the sum of the internal energy of the system (U) plus the product of pressure (P) and volume (V). Joule is a unit to quantify energy, work, or the amount of heat [3].

Heat transfer is a process function (or path function), as opposed to functions of state, the amount of heat transferred in a thermodynamic process that changes the state of a system depends on how that process occurs, not only the net difference between the initial and final states of the process [3].

Heat Transfer Mechanisms:

Heat transfer mechanisms can be grouped into three broad categories,

Conduction ,Conviction and Radiation as shown in figure (2.1).

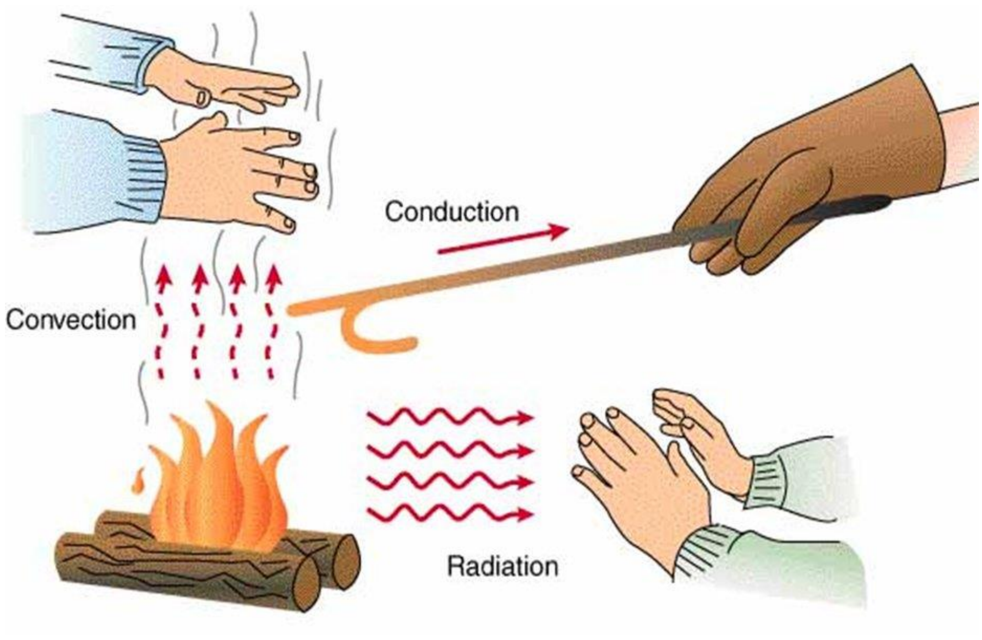


Figure 2.1:heat transfer mechanisms.

2.1.1 Convection

Convective heat transfer, often referred to simply as convection, is the transfer of heat from one place to another by the movement of fluids and the ambient load is the contribution of the thermal load transferred to the cabin air due to temperature difference between the ambient and cabin air.

In the project there are two types of convection, Convection free and there is a result of exchange between the air inside the car and the outside air. convection forces as a result of such an influential external fan [3].

2.1.2 Radiation

Radiation heat transfer is an energy transport due to emission of electromagnetic waves or photons from a surface or volume. The radiation does not require a heat transfer medium, and can occur in a vacuum, in our project the heat is transfer from the sun to the car through the front and back windows [3].

2. 2 Humidity

Humidity is the amount of water vapor in the air. Water vapor is the gaseous state of water and is invisible. Humidity indicates the likelihood of precipitation, dew, or fog. Higher humidity reduces the effectiveness of sweating in cooling the body by reducing the rate of evaporation of moisture from the skin.

We can measure the humidity by three methods, absolute, relative and specific [4].

2.3 Vehicle Air Condition System

The Air Conditioning system has a high pressure side, and a low pressure side. The high pressure side is between the outlet side of the compressor and the inlet side of the expansion valve. The low pressure side is between the outlet side of the expansion valve, to the inlet side of the compressor.

- High pressure.

The cycle starts at the Compressor. The Compressor (which is driven by the engine via a drive belt) compresses the refrigerant gas, which causes the refrigerant gas to become high pressure and high temperature. As the refrigerant gas passes through the Condenser (Assisted by the cooling fan if needed), the refrigerant temperature drops which causes the refrigerant gas to condense into a cooler temprature liquid refrigerant. The liquid refrigerant then passes through the Receiver/Dryer which is basically a filter and moisture trap combined. The liquid refrigerant then reaches the Expansion valve which acts as a temperature controlled restriction, this is the end of the high pressure side as shown in figure (2.2).

Figure 2.2: Vehicle air condition system

- Low pressure.

As the refrigerant leaves the expansion valve, on it's ways to the Evaporater, it instantly drops in pressure and therefore temperature. The refrigerant is now a very low temperature vapour rather than a liquid or a gas. The Evaporator now becomes very cold and as the interior fan motor blows air accross it, cold air blows out of the vents. As the refrigerant travels through the Evaporator it absorbs the heat from the vehicle's interior and returns to compressor as a low pressure, low temperature gas where the cycle can start again [5]. Figure (2.3) shows how all the various parts of a car air conditioning works:

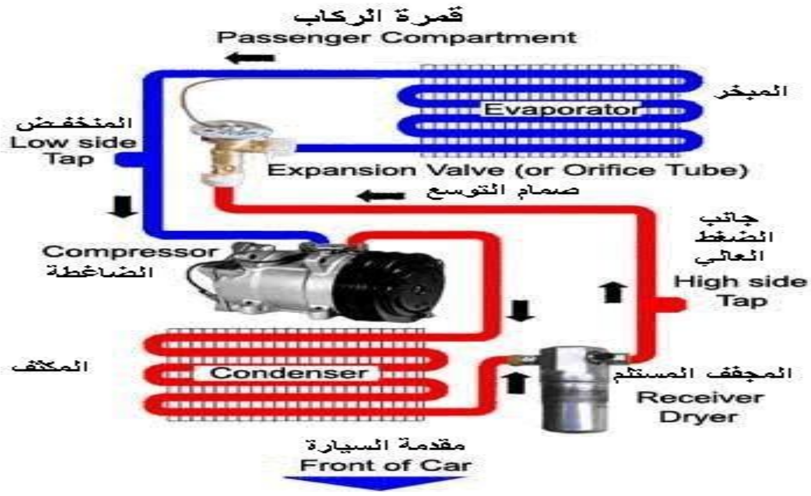


Figure 2.3 :Parts of a car air conditioning

Compressor:

The compressor as shown in figure (2.4) is the main component of the air conditioning system, powered by a drive belt connected to the crankshaft of the engine. When the air conditioning system is turned on, the compressor pumps refrigerant vapor under high pressure to the condenser [5].

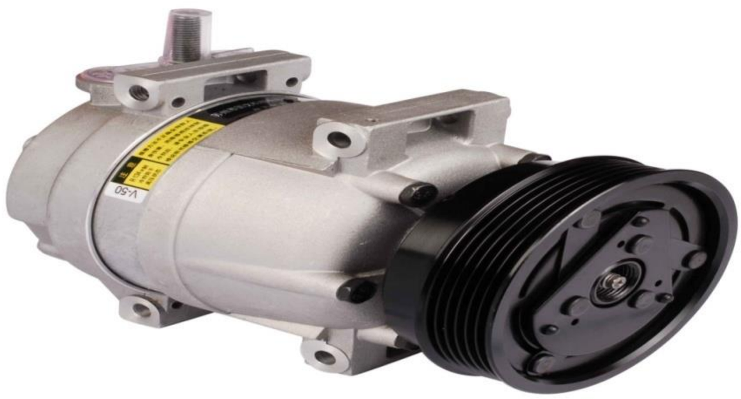


Figure 2.4 : mechanical Compressor

Condenser:

The condenser as shown in figure (2.5) used to change the high-pressure refrigerant vapor to a liquid. It is mounted in front of the engine's radiator, and it looks very similar to a radiator. The vapor is condensed to a liquid because of the high pressure that is driving it in, and this generates a great deal of heat. The heat is then in turn removed from the condenser by air flowing through the condenser on the outside [5].

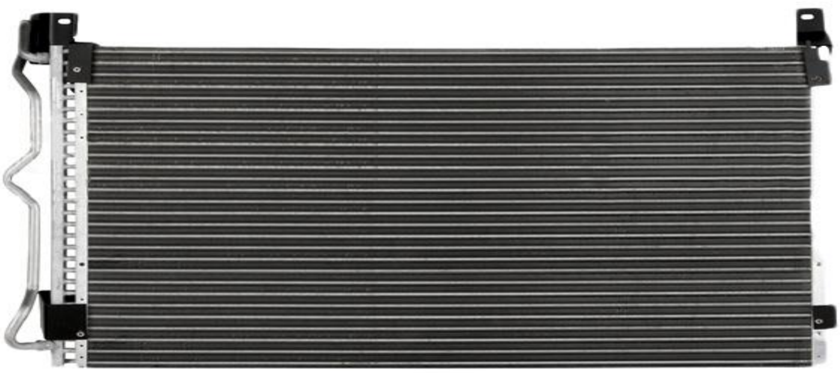


Figure 2.5: Condenser

Receiver valve:

The new liquid refrigerant moves to the receiver-dryer as shown in figure (2.6). This is a small reservoir vessel for the liquid refrigerant, and removes any moisture that may have leaked into the refrigerant. Moisture in the system causes havoc, with ice crystals causing blockages and mechanical damage [5]..

Figure 2.6: Receiver

Expansion valve:

The pressurized refrigerant flows from the receiver-drier to the expansion valve as shown in figure (2.7). The valve removes pressure from the liquid refrigerant so that it can expand and become refrigerant vapor in the evaporator [5]..

Figure 2.7: Expansion valve

Evaporator:

The evaporator as shown in figure (2.8) is another device that looks similar to a car radiator. It has tubes and fins , and is usually mounted inside the passenger compartment behind the fascia above the foot well. As the cold low-pressure refrigerant is passed into the evaporator, it vaporizes and absorbs heat from the air in the passenger compartment. The blower fan inside the passenger compartment pushes air over the outside of the evaporator, so cold air is circulated inside the car. On the 'air-side' of the evaporator, the moisture in the air is reduced, and the 'condensate' is collected and drained away.

Figure 2.8: Evaporator

2.4 Design of the new air-conditioning system in the project

In our project we used a new air compressor, works on air-conditioning system in the car, the new system, as same as old system. But it used a new air compressor as shown in figure (2.9) connected in parallel with the compressor in the old system as shown in figure (2.10), and it works when the car was stopped and it use the solar energy in its work.

Figure 2.9: DC Compressor

The advantage of this system ,it works on solar power and does not take from the car battery and high efficiency by theoretical calculations,and the disadvantage, it is need a long time to cool because the convection inside the car larger than the normal load of the compressor and it is need high cost.

The properties of new compressor is close to the properties of existing compressor in the car. It is possible in the future to replace the DC compressor with an another compressor, because of disadvantages of and also to the presence of the best compressor specifications.

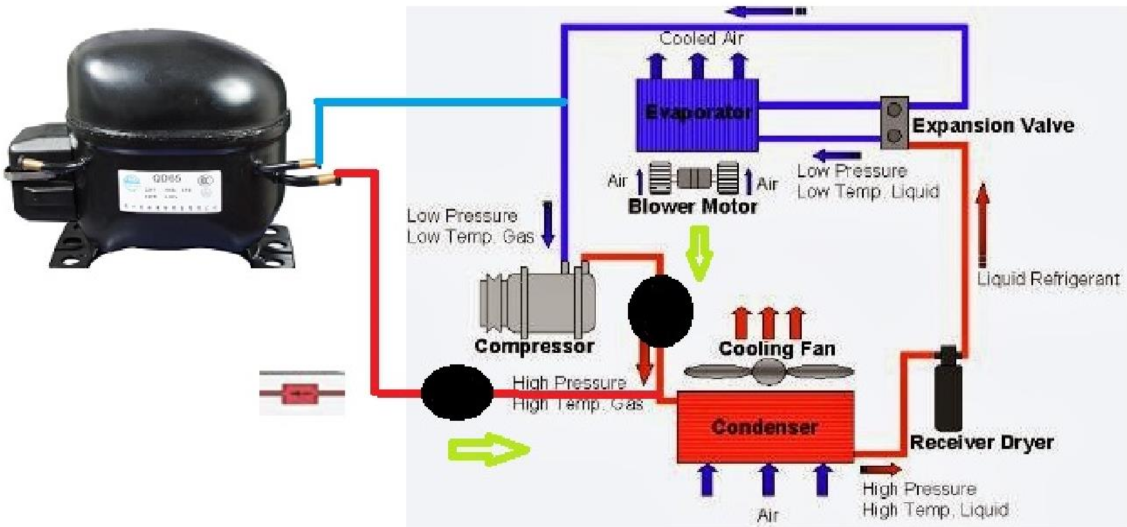


Figure 2.10: Compressor circuit in parallel.

Different types of thermal load experienced by the car, which in the equation (2.1)

$$\dot{Q}_{tot} = \dot{Q}_{dir} + \dot{Q}_{dif} + \dot{Q}_{ref} + \dot{Q}_{amb} + \dot{Q}_{exh} + \dot{Q}_{eng} + \dot{Q}_{ven} \quad (2.1)$$

All of the above $\dot{Q}$ values are thermal energies per unit time.

$\dot{Q}_{tot}$: Net overall thermal load encountered by the cabin.

$\dot{Q}_{dir}$, $\dot{Q}_{dif}$ ***and*** $\dot{Q}_{ref}$: Direct, Diffuse, and Reflected radiation loads, respectively.

$\dot{Q}_{amb}$: Ambient load.

$\dot{Q}_{exh}$ and $\dot{Q}_{eng}$: Exhaust and Engine loads due to the high temperature of the exhaust gases and the engine.

$\dot{Q}_{ven}$: load generated due to ventilation.

Some of the above loads pass across the vehicle body plates/parts, while others are independent of the surface elements of the cabin.

Figure(2.11): shows the various thermal load categories encountered in a typical vehicle cabin as in equation(2.1).

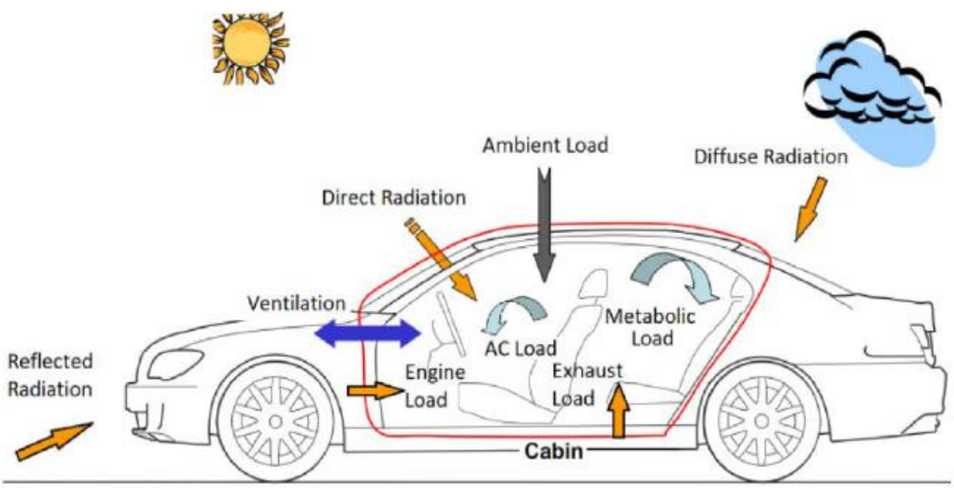


Figure 2.11: various thermal load categories encountered vehicle cabin.

Load calculations are performed at time steps during the period of interest, and after every time step, all the load components are algebraically summed up and the new cabin air temperature and surface element temperatures are calculated as in equation (2.2).

$$\Delta \boldsymbol{Ti} = \frac{\dot{Q}_{tot}}{\boldsymbol{m_a} * \boldsymbol{c_a} + \boldsymbol{DTM}} \Delta \boldsymbol{t} \qquad (2.2)$$

Ti: Temperatures.

$\dot{\boldsymbol{Q}}_{tot}$: Net overall thermal load encountered by the cabin.

DTM: Deep thermal masses.

$\boldsymbol{m_a}$: Cabin air mass.

$\boldsymbol{c_a}$: Air specific heat.

$$\Delta \boldsymbol{Ts} = \frac{\dot{\boldsymbol{Q}}\boldsymbol{s}}{\boldsymbol{MsCs}} \Delta \boldsymbol{t} \qquad (2.3)$$

$\boldsymbol{Ts}$: Element temperatures at the current time step.

$\dot{\boldsymbol{Q}}\boldsymbol{s}$: Net heat gain by a surface element consisting of the heat gain by radiation and the heat gain from ambient.

Ms and **Cs**: Mass and Specific heat of each of the surface elements.

t: is the time step.

- **Heat product from Radiation**

The heat gain due to solar radiation is a significant part of the cooling loads encountered in vehicles. According to ASHRAE [6], solar radiation heat load can be categorized into direct, diffuse, and reflected radiation loads. Direct radiation is that part of the incident solar radiation which directly strikes a surface of the vehicle body, which is calculated as in equation (2.4).

$$\dot{\boldsymbol{Q}}_{\boldsymbol{dir}} = \sum_{surfaces} S * \tau * \dot{\boldsymbol{I}}_{\boldsymbol{dir}} * \cos\theta \qquad (2.4)$$

$\dot{\boldsymbol{I}}_{\boldsymbol{dir}}$: Direct radiation heat gain per unit area.

θ: Angle between the surface normal and the position of sun in the sky.

$\boldsymbol{\tau}$: Surface element transmissivity.

S: Surface area.

$$\dot{I}_{dir} = \frac{A}{\exp\left(\frac{B}{\sin\beta}\right)} \tag{2.5}$$

where A and B are constants tabulated in ASHRAE Handbook of Fundamentals [6] for different months.

β is the altitude angle that is calculated based on position and time.

Diffuse radiation is the part of solar radiation which results from indirect radiation of daylight on the surface. During a cloudy day, most of the solar radiation is received from this diffuse radiation.

$$\dot{Q}_{dif} = \sum_{surfaces} S * \tau * \dot{I}_{dif} \tag{2.6}$$

Similarly, $\dot{I}_{dif}$ is the diffuse radiation heat gain per unit area which is calculated from:

$$\dot{I}_{dif} = C * \dot{I}_{dif} \frac{1+\cos\Sigma}{2} \tag{2.7}$$

∑: Surface tilt angle measured from the horizontal surface..

the values for *C* are tabulated in [6].

Reflected radiation refers to the part of radiation heat gain that is reflected from the ground and strikes the body surfaces of the vehicle.

$$\dot{Q}_{ref} = \sum_{surfaces} S * \tau * \dot{I}_{ref} \tag{2.8}$$

$\dot{I}_{ref}$: Reflected radiation heat gain per unit area, is calculated from:

$$\dot{I}_{ref} = (\dot{I}_{dir} + \dot{I}_{dif}) * \rho g \frac{1-\cos\Sigma}{2} \tag{2.9}$$

$\boldsymbol{\rho g}$:Ground reflectivity coefficient.

The net absorbed heat of each surface element due to radiation can thus be written as:

$$\dot{Q}_{s,Rad} = S\alpha\left(\dot{I}_{dir} * \cos\theta + \dot{I}_{dif} + \dot{I}_{ref}\right) \quad (2.10)$$

α :Surface absorptivity [6].

- **Heat product from Ambient**

The ambient load is the contribution of the thermal load transferred to the cabin air due to temperature difference between the ambient and cabin air. Exterior convection, conduction through body panels, and interior convection are involved in the total heat transfer between the ambient and the cabin.

$$\dot{Q}_{amb} = \sum_{surfaces} S * U * (T_s - T_i) \quad (2.11)$$

U :Overall heat transfer coefficient of the surface element.

T_s and T_i are the average surface temperature and average cabin temperature, respectively

$$U = \frac{1}{R} \quad (2.12)$$

Where $R = \frac{1}{h_\circ} + \frac{\lambda}{K} + \frac{1}{h_i}$

***R* :**Net thermal resistance for a unit surface area.

$h_\circ$ and h_i are the outside and inside convection coefficients.

k :Surface thermal conductivity.

λ :Thickness of the surface element

$$h = 0.6 + 6.6\sqrt[2]{V} \quad (2.13)$$

h :Convection heat transfer coefficient in W/m^2K and *V* is the vehicle speed in *m*/*s*.

$$\dot{Q}_{s.Amb} = S * U * (T_\circ - T_s) - S * U * (T_\circ - T_s) = S*U*(T_\circ - 2*T_s - T_i) \quad (2.14)$$

$T_\circ$, T_i, and T_s: Ambient, Cabin, and Surface average temperatures, respectively[6].

- **Heat product from Exhaust**

Conventional and hybrid electric vehicles have an Internal Combustion Engine (ICE) that creates exhaust gases. The Exhaust Gas Temperature (EGT) can reach as high as 1000 $°C$.[2] Because of the high temperature of the exhaust gas, some of its heat can be transferred to the cabin through the cabin floor. Considering S_{Exh} as the area of the bottom surface in contact with the exhaust pipe, the exhaust heat load entering the cabin can be written as

$$\dot{Q}_{Exh} = S_{Exh} * U * (T_{Exh} - T_i) \quad (2.15)$$

S_{Exh} :Surface area exposed to the exhaust pipe temperature.

T_{Exh} : Exhaust gas temperature [7].

T_{Exh}=0.138RPM -17

RPM :Engine speed in revolutions per minute.

- **Heat product from Engine**

Similar to the exhaust load above, the high temperature engine of a conventional or hybrid car can also contribute to the thermal gain of the cabin. Equation shows the formulation used for calculating the engine thermal load.

$$\dot{Q}_{Eng} = S_{Eng} * U * (T_{Eng} - T_i) \quad (2.16)$$

S_{Eng}*:* Surface area exposed to the engine temperature.

T_{Eng} *:*Engine temperature [7].

$T_{Eng} = -2x10^{-6}RPM^2 + 0.0355RPM + 77.5$

- **Ventilation**

Fresh air is allowed to enter the vehicle cabin to maintain the air quality for passengers. As the passengers breathe, the amount of CO_2 concentration linearly increases over time. Thus, a minimum flow of fresh air should be supplied into the cabin to maintain the passengers comfort. Arndt and Sauer [6] reported the minimum fresh air requirements for different numbers of passengers in a typical vehicle. For instance, a minimum of 13% fresh air is needed for a single passenger.

$$\dot{Q}_{Ven} = \dot{m}_{Ven}(e_{\circ} - e_{i}) \quad (2.17)$$

$\dot{m}_{Ven}$:Ventilation mass flow rate.

e_o and $_i$: Ambient and Cabin enthalpies, respectively.

e=1006T + (2.501x10^6 + 1770T)* X (2.18)

X is humidity ratio in gram of water per gram of dry air.

$$\mathbf{X = 0.62198 * \frac{\emptyset Ps}{100P - \emptyset Ps}}$$

Φ: Relative humidity, ***P*** : Air pressure, and ***Ps*** : Water saturation pressure at temperature ***T.***

This algorithm describes the system work will be translated into software codes in the next chapter as shown in figure (2.12).

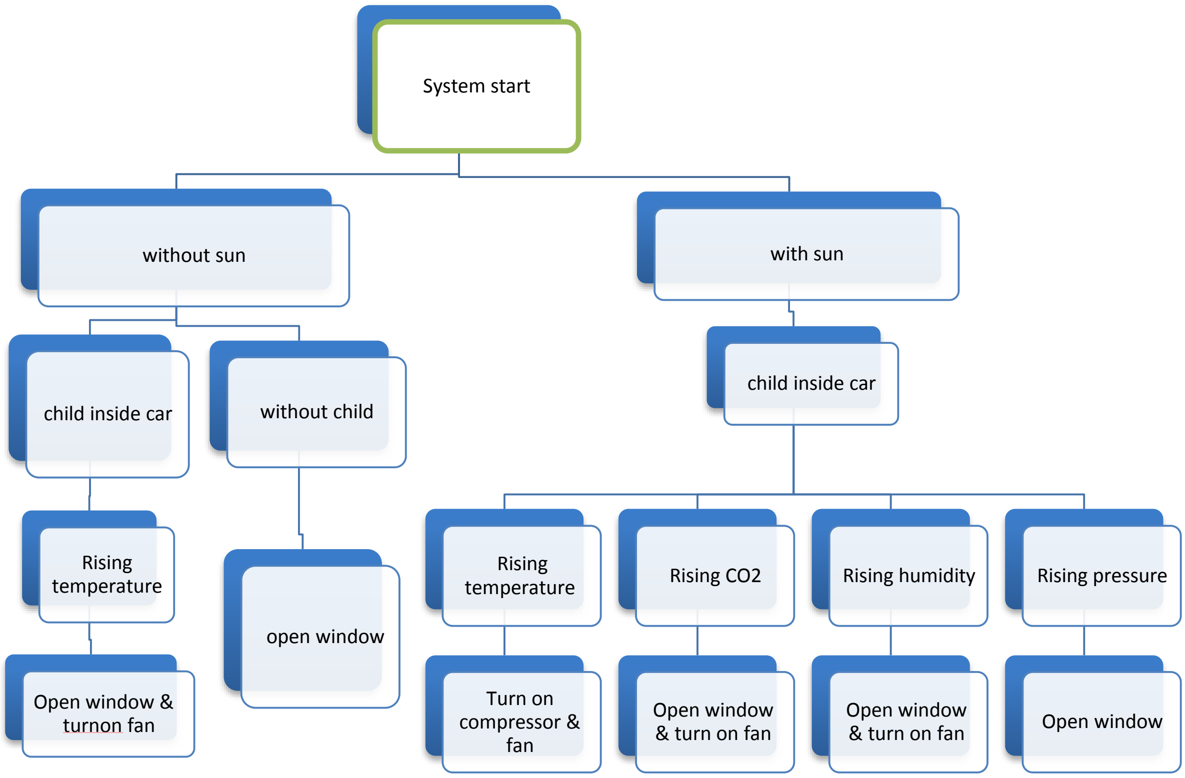


Figure 2.12: algorithm describes the system work

3

Chapter Three

3. Sensor And Solar System

3.1 Introduction

3.2: Definition of microcontroller (Arduino)

3.3: Definition of sensors and the sensors used in project

3.3.1: sensor of temperature

3.3.2: sensor of CO_2

3.3.3 : sensor of pressure

3.3.4 : LDR sensor

3.3.5 : limit switch

3.4 :solar system

3.4.1 : parts of the solar system

3.4.2: solar panels

3.1 Introduction

In this chapter we will learn about how the sensors that are found inside the car and from these sensors, sensor temperature, humidity sensor, probe the percentage of carbon dioxide and atmospheric pressure sensor and microcontroller.

The advantage of these sensors They give us an electrical signal that reflects the physical state inside the car, to the microcontroller (Arduino) and then give us the required output based on resulting from the sensors reading.

3.2 Definition of microcontroller (Arduino)

The Uno is a microcontroller board. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery as shown in figure (3.1) [10]

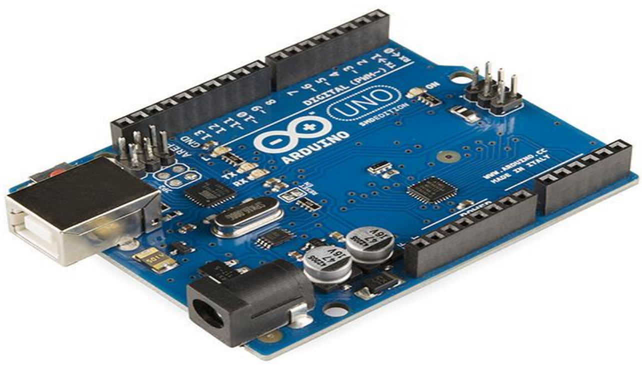


Figure 3.1: Arduino UNO.

3.3 Definition of sensors and the sensors used in project

A sensor is a device that produces a measurable response to a change in a physical condition, such as temperature or thermal conductivity, or to a change in chemical concentration. Sensors are particularly useful for making in-situ measurements such as in industrial process control.

3.3.1 sensor of temperature and humidity

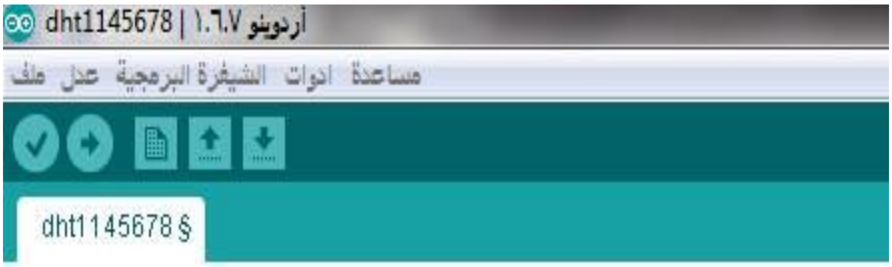
DHT11 digital temperature and humidity sensor is a composite Sensor contains a calibrated digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability. The sensor includes a resistive sense of wet components and an NTC temperature measurement devices, and connected with a high-performance 8-bit microcontroller [12].

Figure 3.2: DHT11 Digital Temperature and Humidity Sensor

Sensor temperature and humidity appropriate location it is the column located between the front door and the back door of the car as shown in figure (3.2) where it is far from the air stream outside of the cooling system when the system works and it's close to middle-region in the car, is not affected when you open the door of the car because it is disabled and works in the first place when the car is closed ,and code of Arduino shown in figure (3.3) and figure (3.4).

```
while( dht.readHumidity()> 50){
  digitalWrite(fan_cooling,LOW);
}
 digitalWrite(fan_cooling, HIGH);
```

Figure 3.3: code of Arduino of humidity.




```
    while(LDRValue  > light_sensitivity){

    while(digitalRead(limit_switch1) == LOW){
  digitalWrite(motor_window1, HIGH);
  digitalWrite(motor_window2, LOW);
}
digitalWrite(motor_window1, LOW);
  digitalWrite(motor_window2, LOW);

     while( dht.readTemperature()> 30){
       digitalWrite(fan_cooling, LOW);
       digitalWrite(compressor, LOW);
     }
     digitalWrite(fan_cooling, HIGH);
       digitalWrite(compressor, HIGH);
```

Figure 3.4: code of Arduino of Temperature.

3.3.2 Sensor of CO_2

This sensor module has an MG-811 on-board as the sensor component. There is an on-board signal conditioning circuit for amplifying output signal and an on-board heating circuit for heating the sensor. The MG-811 is highly sensitive to CO_2 and less sensitive to alcohol and CO_2. It could be used in air quality control, ferment process, in-door air monitoring application. The output voltage of the module falls as the concentration of the CO_2 increases [13] .

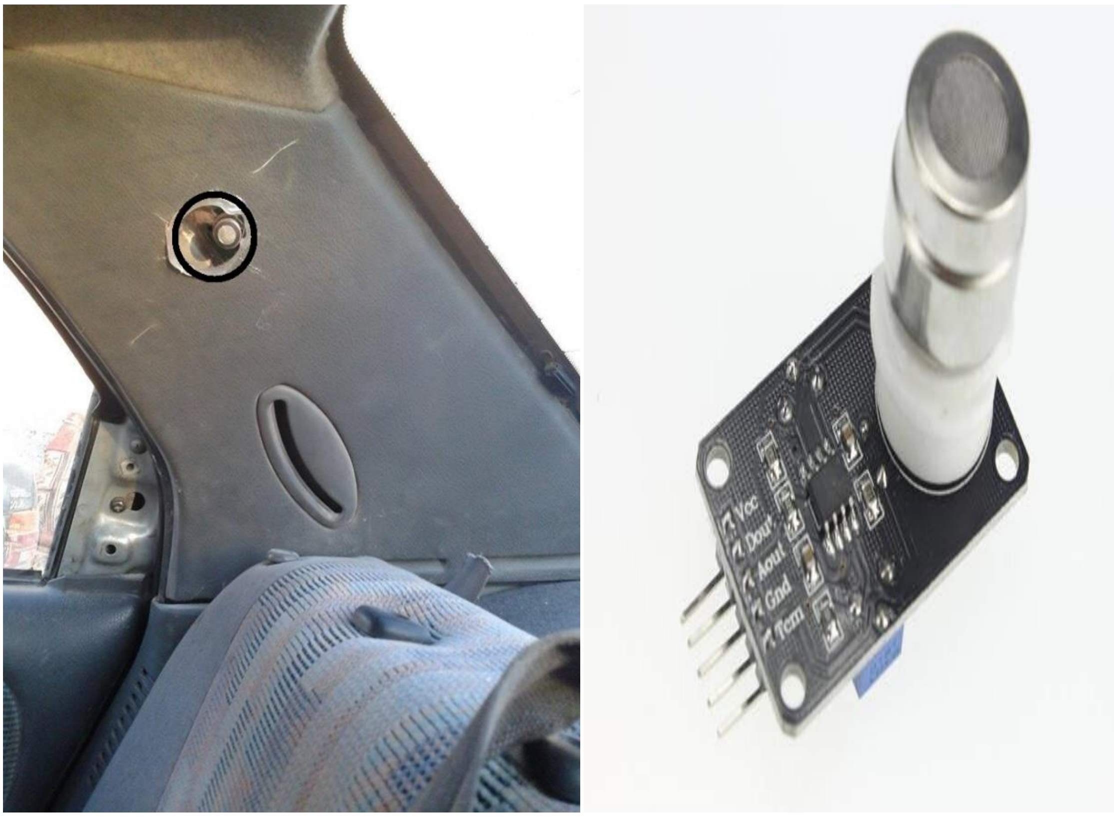


Figure 3.5: MG-811 Sensor connected and location

Its main function of MG-811 Sensor to knew there is someone inside the car or not and probe percentage of carbon dioxide, the right location is a column on the back of the car as shown in figure (3.5) in order to be away from the air resulting from the radiator fan or air because the CO_2 few and the piece will be a percentage of error in the reading and code CO_2 of Arduino shown in figure(3.6).


```
while(percentage > 2000){
  digitalWrite(fan_cooling, LOW);
digitalWrite(motor_window1, LOW);
digitalWrite(motor_window2, HIGH);}
while(digitalRead(limit_switch2) == HIGH){
  digitalWrite(motor_window1, LOW);
digitalWrite(motor_window2,LOW);

}
digitalWrite(fan_cooling, HIGH);


while(digitalRead(limit_switch1) == LOW){
  digitalWrite(motor_window1, HIGH);
  digitalWrite(motor_window2, LOW);
}
digitalWrite(motor_window1, LOW);
  digitalWrite(motor_window2, LOW);
```

Figure 3.6: code CO_2 of Arduino

3.3.3 Sensor of pressure

This pressure sensor module is used for measuring barometric pressure (weather) and altitude. It also have temperature sensor for temperature compensation of pressure measurements. It uses push sensor the BMP180. It offers a pressure measuring range of 300 to 1100 h Pa with relative pressure error to 0.12 h Pa (1m height) [14].

Figure 3.7: BMP180 Sensor and connected and location

Atmospheric pressure sensor is the appropriate location to him on the opposite site of the column sensor temperature and humidity as shown in figure (3.7) in order to be in the middle of the car and code of pressure of Arduino shown in figure (3.8).

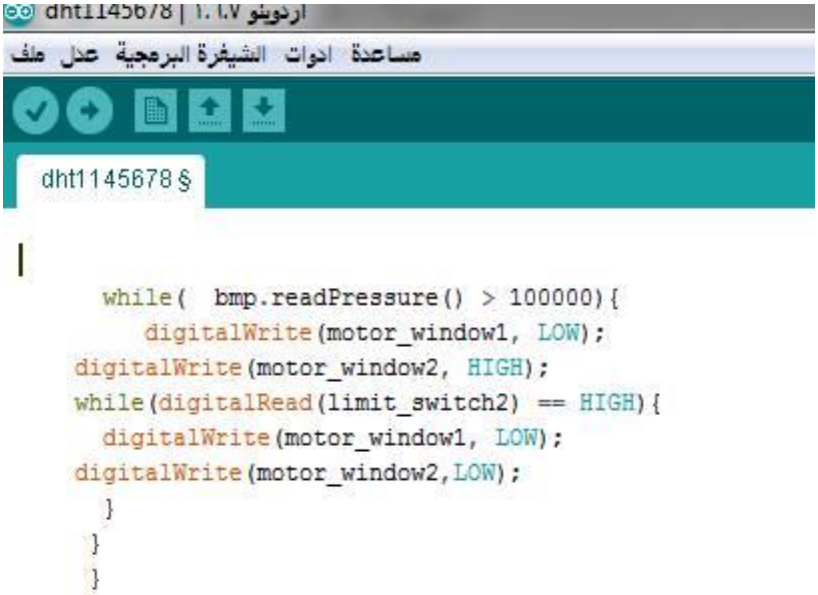


Figure 3.8: code pressure of Arduino

3.3.4 LDR Sensor

A photo resistor (or light dependent resistor, LDR, or photocell) is a light-controlled variable resistor as shown in figure (3.9). The resistance of a photo resistor decreases with increasing incident light intensity ; in other words, it exhibits photoconductivity. A photo resistor can be applied in light sensitive detector circuits, and light and dark activated switching circuits it was installed above the roof of the car and code of LDR of Arduino shown in figure(3.10) and (3.11).

Figure 3.9: LDR sensor

```
while(digitalRead(limit_switch1) == LOW){
  digitalWrite(motor_window1, HIGH);
  digitalWrite(motor_window2, LOW);
}
digitalWrite(motor_window1, LOW);
  digitalWrite(motor_window2, LOW);

 LDRValue = analogRead(LDR);      //reads the ldr's value through LDR

    delay(50);

while(LDRValue  < light_sensitivity){

   while (percentage > 2000){
    digitalWrite(fan_cooling, LOW);
    digitalWrite(motor_window1, LOW);
    digitalWrite(motor_window2, HIGH);
    while(digitalRead(limit_switch2) == HIGH){
      digitalWrite(motor_window1, LOW);
    digitalWrite(motor_window2,LOW);
    }
}
digitalWrite(fan_cooling, HIGH);
}
```

Figure 3.10 : code 1 of Arduino of LDR

```
      while(LDRValue  > light_sensitivity){

      while(digitalRead(limit_switch1) == LOW){
  digitalWrite(motor_window1, HIGH);
  digitalWrite(motor_window2, LOW);
}
digitalWrite(motor_window1, LOW);
  digitalWrite(motor_window2, LOW);

       while( dht.readTemperature()> 30){
         digitalWrite(fan_cooling, LOW);
         digitalWrite(compressor, LOW);
       }
       digitalWrite(fan_cooling, HIGH);
         digitalWrite(compressor, HIGH);

      while( dht.readHumidity()> 50){
        digitalWrite(fan_cooling,LOW);
      }
       digitalWrite(fan_cooling, HIGH);


while(digitalRead(limit_switch1) == LOW){
  digitalWrite(motor_window1, HIGH);
  digitalWrite(motor_window2, LOW);
}
digitalWrite(motor_window1, LOW);
```

Figure 3.11: code 2 of Arduino of LDR

3.3.5 limit switch

Limit switch is a switch operated by the motion of a machine part or presence of an object. They are used for control of a machine. In this project there is 2 limit switches, 1 to check closed window and the other one is to check the window opened 3 cm . The limit switches used in this project as shown in figure (3.12).

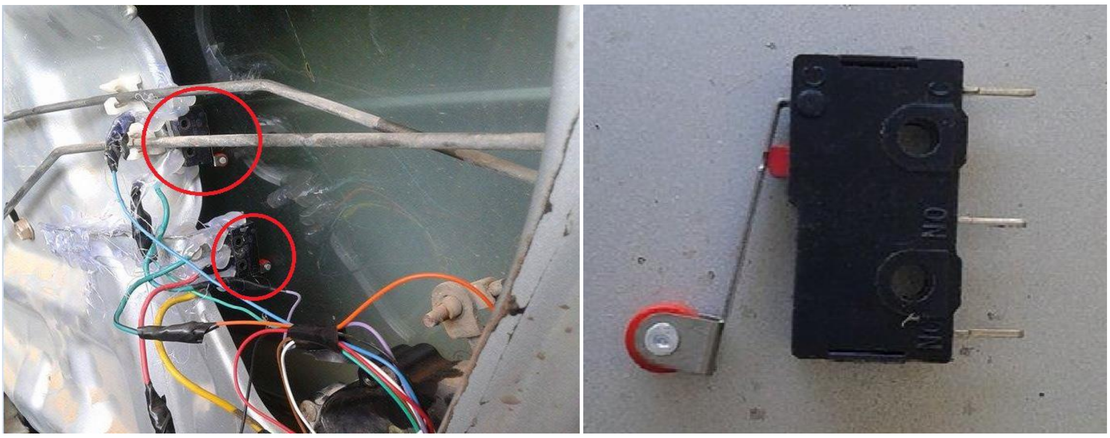


Figure 3.12: limit switch and install location.

3.4 solar system

Will be achieved how to use solar system in the project to supply power to the car battery and learn about how the solar system represent power source in the system.

We choose the solar system in our project because its properties such as clean energy source, renewable and sustainable, power remote area, can be installed on rooftop, low maintenance and silent source(does not make noise) [8].

3.4.1 Parts of the solar system

Solar system consist of many parts as shown in figure (3.13), that work together to convert the sun light to electrical power.

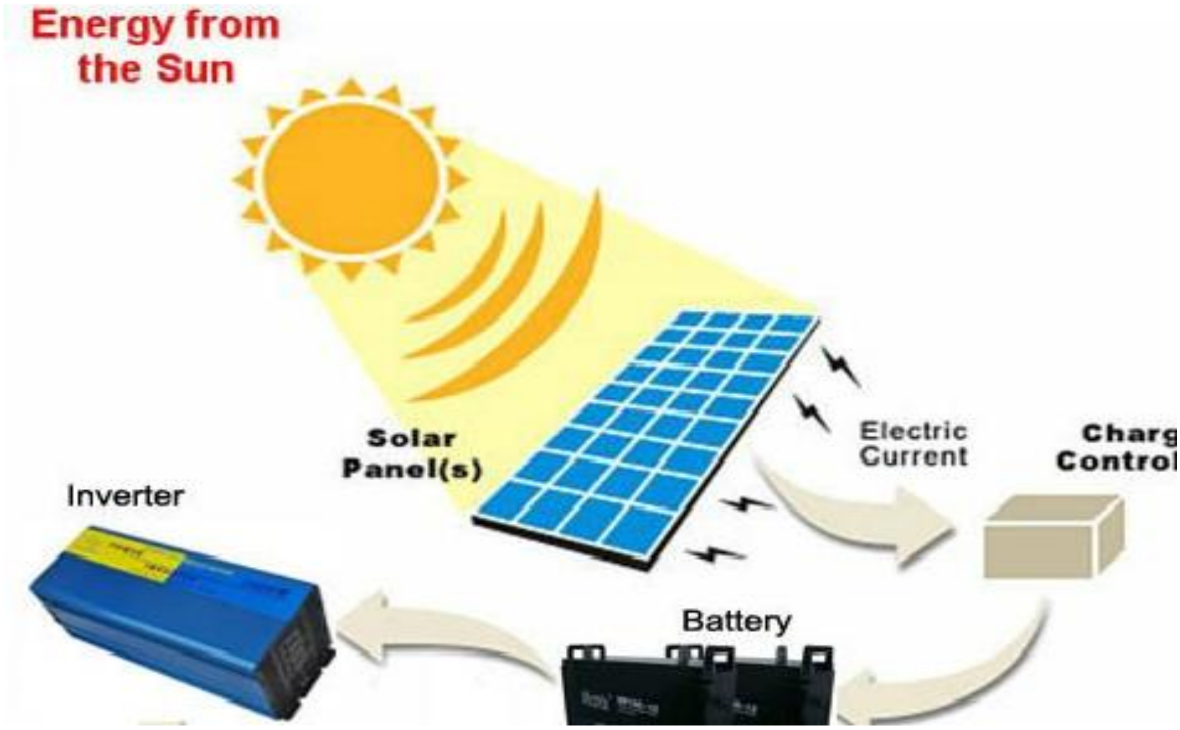


Figure 3.13: Parts of solar system.

3.4.2 Solar panels

The solar panels as shown in figure (3.14) are used to collect sunlight and convert it to electrical energy, by using semiconductors, the current which comes from this process depends on the time of the brightness of the sun and the intensity of the sun's rays, as well as the efficiency of the photovoltaic cell itself in converting solar energy into electrical energy, the panels area which used in the project is (1*160)m^2 [8].

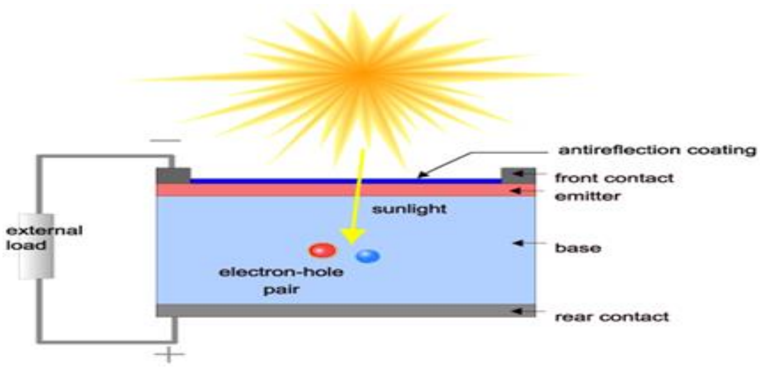


Figure 3.14: The schematic symbol of a solar cell.

To understand the electronic behavior of a solar cell, it is useful to create a model which is electrically equivalent, and is based on discrete electrical components whose behavior is well known. An ideal solar cell may be modeled by a current source in parallel with a diode; in practice no solar cell is ideal, so a shunt resistance and a series resistance component are added to the model. The resulting equivalent circuit of a solar cell is shown .

3.4.3 Charge controller:

A charge controller as shown in figure (3.15), charge regulator or battery regulator limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. It may also prevent completely draining ("deep discharging") a battery, or perform controlled discharges, depending on the battery technology, to protect battery life. The terms "charge controller" or "charge regulator" may refer to either a stand-alone device, or to control circuitry integrated within a battery pack, battery-powered device, or battery charger [8].

Figure 3.15: Charge controller

4

Chapter Four

4. The Project Design

4.1: How the System Work

4.1.1: The problem of high temperature inside the car

4.1.21: The problem of high humidity inside the car

4.1.3: The problem of rising carbon dioxide inside the car

4.1.4: The problem of high pressure inside the car

4.2: Electrical Design

4.3: Mechanical Design

4.4: The system works inside the car conditions

4.1 How The System Work

How to get Data from the car ?

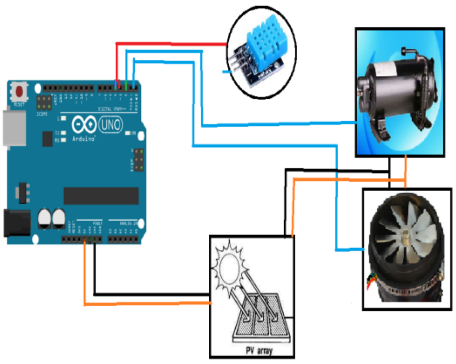
Inside the car are monitoring the situation through sensors placed inside the car, to measure humidity, temperature, pressure and carbon dioxide ratio. Data is sent to the microcontroller to perform multiple operations corresponding to the Data from sensors . Result solve in many problems such as high temperature, high humidity, high carbon dioxide and high pressure .

4.1.1 The problem of high temperature inside the car

The temperature reading through Sensor temperature and humidity THD11, Description was illustrated by section (3.3.1).

And send Analog data to microcontroller, These data expressed the physical case of the system. Where microcontrollers are check the physical situation inside the vehicle and take the decision based on the value of the data and then send command to the fan and DC compressor to work as shown in figure (4.1a).

the solar cells represent energy source of system and then do the work to reduce the temperature to the desired limit of (22-25) ° C as shown in figure (4.1b) [1] .



(a) (b)

Figure 4.1a: Child in a car which is closed

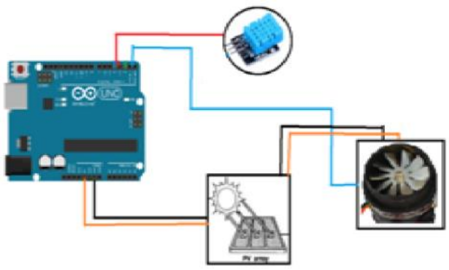
Figure 4.1b: Connecting the fan and compressor with Arduino

4.1.2 The problem of high humidity inside the car

The humidity reading through Sensor temperature and humidity THD11, Description was illustrated by section (3.3.1).

And send Analog data to microcontroller, These data expressed the physical case of the system. Where microcontrollers are check the physical situation inside the vehicle and take the decision based on the value of the data and then send command to the fan and the car windows motor to open the windows the amount of 3 cm and is running the fan as shown in figure (4.2b) until the humidity drops to the required limit is 60%.[4]

the solar cells represent energy source of system and then do the work to reduce the humidity to the desired limit as shown in figure (4.2a).



(a) (b)

Figure 4.2a: Increase humidity inside the car

Figure 4.2b: Connecting the fan and compressor with Arduino

4.1.3 The problem of rising carbon dioxide inside the car

The carbon dioxide ratio reading through carbon dioxide Sensor MG-811, Description was illustrated by section (3.3.2).

And send Analog data to microcontroller, These data expressed the physical case of the system. Where microcontrollers are check the physical situation inside the vehicle and take the decision based on the value of the data and then send command to the fan and the car windows motor to open the windows the amount of 2 cm and is running the fan as shown in figure (4.3) until the carbon dioxide ratio drops to the required limit is 0.040%[13]

the solar cells represent energy source of system and then do the work to reduce the carbon dioxide ratio to the desired limit.

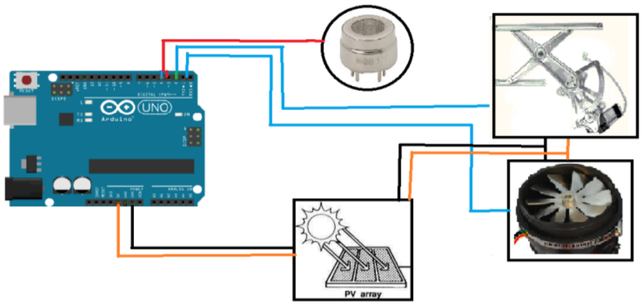


Figure 4.3: Connecting the fan,CO_2 sensor and the window motor with Arduino

4.1.4 The problem of high pressure inside the car

The air pressure reading through Sensor atmospheric pressure BMP180, Description was illustrated by section (3.3.3).

And send Analog data to microcontroller, These data expressed the physical case of the system. Where microcontrollers are check the physical situation inside the vehicle and take the decision based on the value of the data and then send command to the car window motors to open the windows the amount of 3 cm as shown in figure (4.4) until the atmospheric pressure inside the car becomes the same external pressure which is 899 mbar.[14]

the solar cells represent energy source of system and then do the work to reduce the atmospheric pressure ratio to the desired limit.

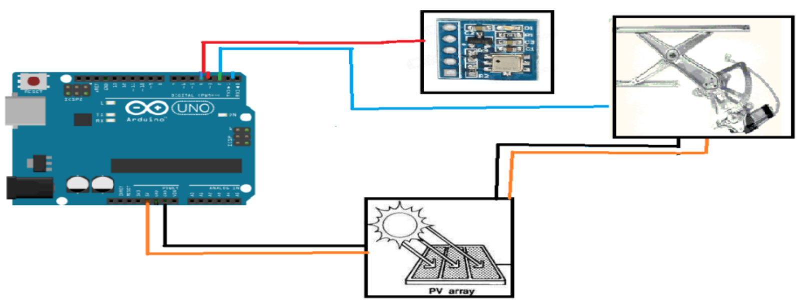


Figure 4.4: Connecting the pressure sensor and the window motor with Arduino

4.1.4 The problem of absence of sun

To know the presence of the sun or not (Do it mean the car parked in the sun or parked in a shady place), Installed LDR sensor, which is a sensor that measures the intensity of light. If it is high within the range of a given system is fully functional, but if the intensity of a few lighting is sufficient to open the net because the car is not exposed to sunlight directly as like car parked in the shade as shown in figure (4.5) , and also even provide electricity because the solar cell to be less effective in the absence of the sun.

Figure 4.5: A car parked in the shade

4.2 Electrical Design

Electrical design in this project was on several sequential stages:

- **The solar system:** that has been explaining the details of its components in section(3.4) So that the solar cell is fueling the car battery through the charging Controller.

- **The battery:** that has been used is the same a car battery and a capacity of 70 A , 12 V and feeds into the whole system as shown in figure (4.6).

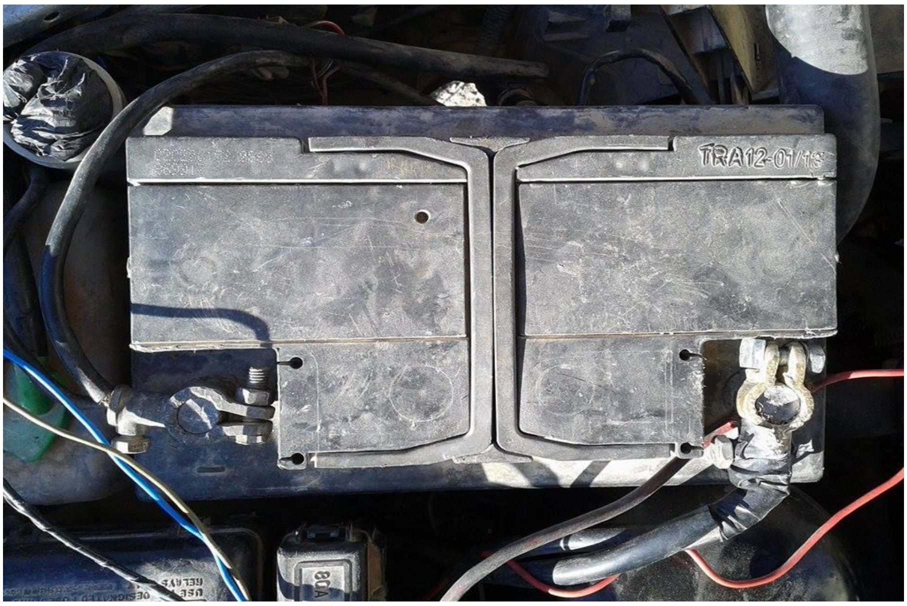


Figure 4.6: Battery of car

- **Refrigeration compressor:** that require electrical source AC 220 V, and battery-powered electric source But the battery 12-volt DC so use inverter to convert electricity from 12 **volts to 220 volts** as shown in figure (4.7) **.**

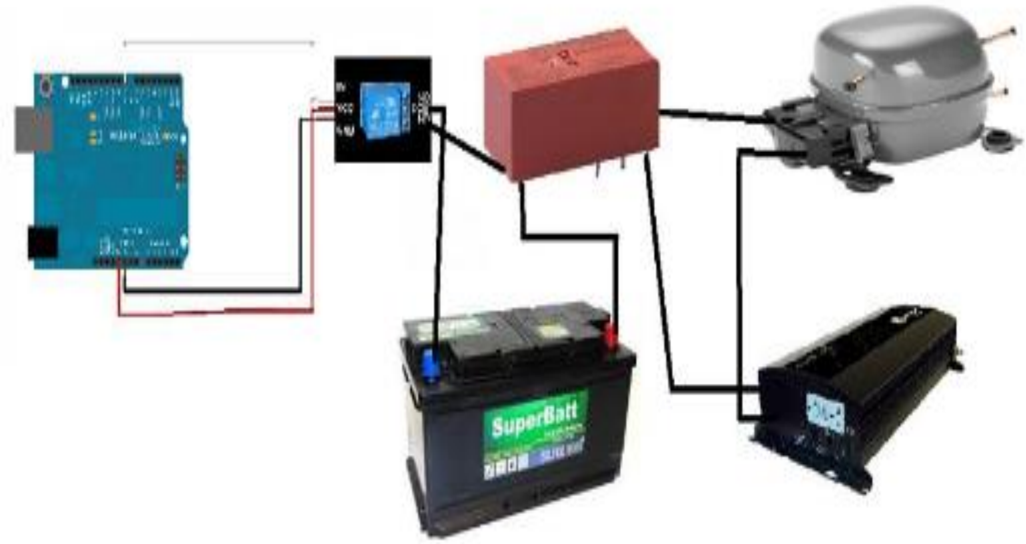


Figure 4.7:Refrigeration compressor connection

- **Fan conditioner:** So it was taken electrical lines to run the fan in case the car was turned off as he used the relay bear high current up to 20 A as shown in figure (4.8).

Figure 4.8:Fan conditioner

- **Motor the back window:** Where it was put two limit switch that explained in section (4.3.5) the first to know the window closed and the second to know that the window is open the amount of 3 cm, and to control in opening and closing the window through Arduino used many of the relay will be explained in the next point as shown in figure (4.9).

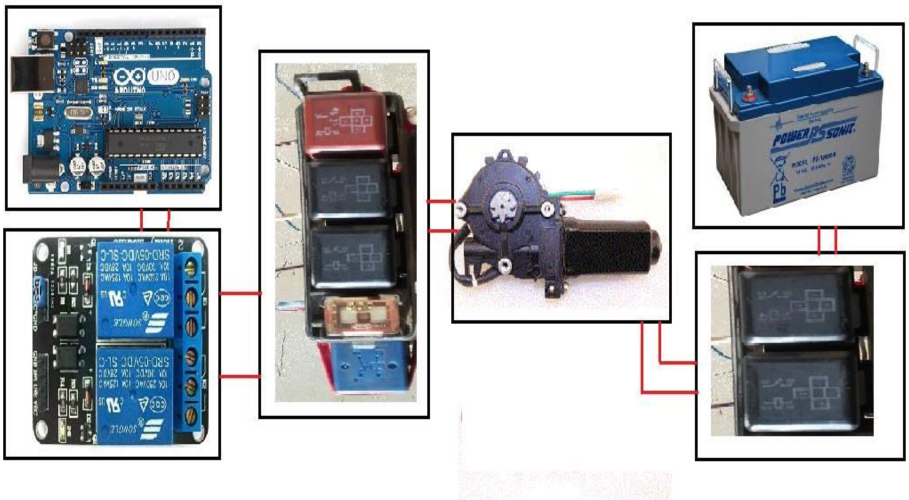


Figure 4.9: Motor the back window

- **Relays:** The relay used in the system , Are three types:

  1- Relay works on 5 volts - 12 volts as shown in figure (4.10) ,use of which four pieces so that they take the signal from the Arduino to reach 12 volts to the last relay.

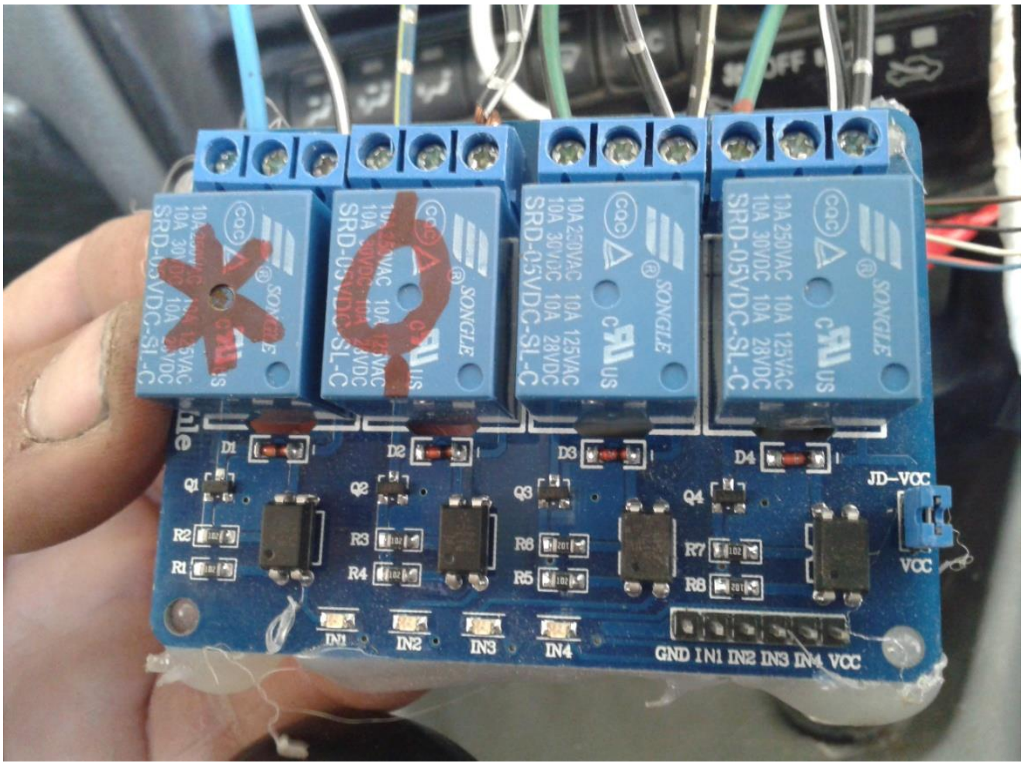


Figure 4.10: relay 5v to 12v dc

  2- Relay 12 volts with High A as shown in figure (4.11) and runs on 12 volts, use 8 pieces of relays, so that (1) normally open (NO) delivers power to the Arduino when the car stopped working, (1) is connected with the fan air conditioning and (4) are connected with the window back working as H- bridge. (2) to separate the current of the motor system when the current is controlled in the windows through the system to prevent any Short Circuit, which takes the signal from the relay is connected to the Arduino and the other takes signal from the the same system.

Figure 4.11: relay 12v to 12v dc

3- relay 12 volts - 220 volts AC as shown in figure (4.12) , used one to control the operation of the compressor and takes the signal from the relay Arduino.

Figure 4.12: relay 12v dc to 220v ac

- **Sensor and electronic system:** has been explained in chapter 3.

Figure (4.13) shows the entire electrical installation (solar system, electronic system, cooling the compressor, fan motor and the window air conditioner) and exposure values on the LCD screen

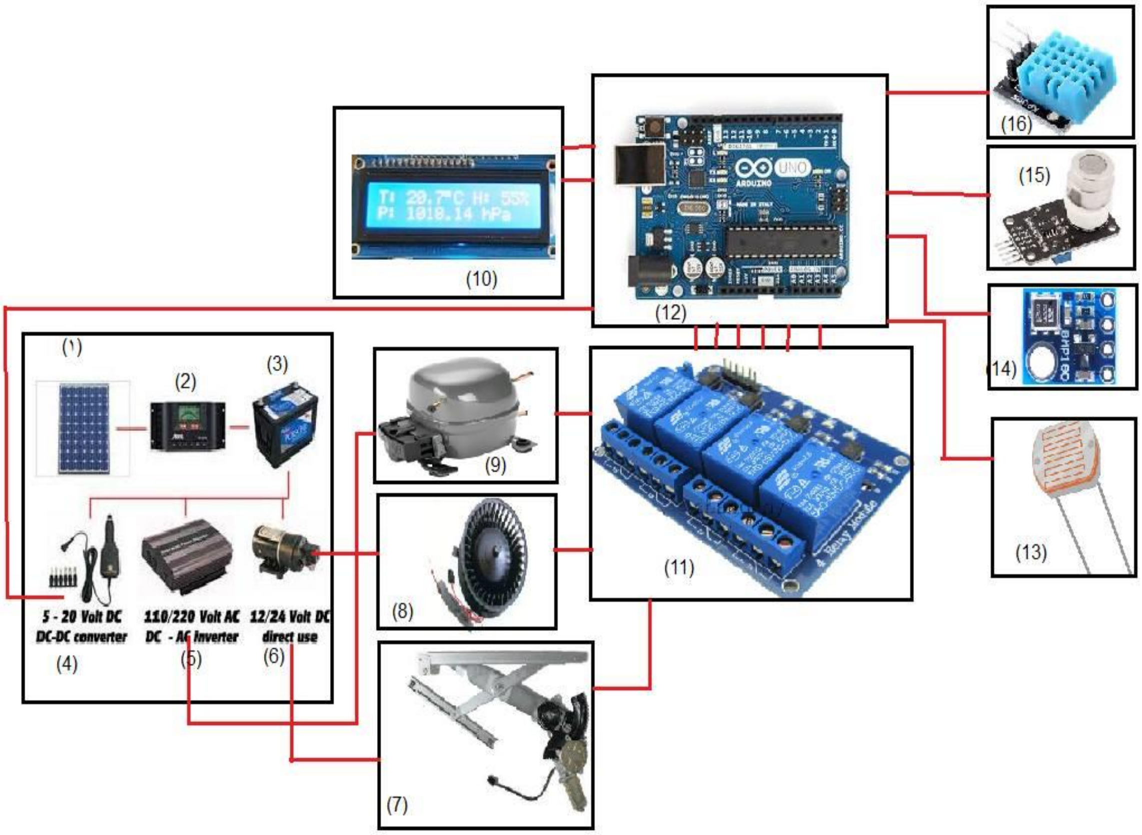


Figure 4.13: Electric Diagram.

4.3 Mechanical Design

This design aims to build conditioning system in the car in case the car stopped running, It is the addition of (electric compressor, pressure pipes, one direction valves , pipe coupling) and in addition to the same condition circuit in the car , which are described in the section (2.4).

- **Compressor Cooling**: (THG1352YKS) has power quarter horse (1/4 hp) runs on AC 220V, compresses gas cooling R134a, its connected in parallel with the mechanical compressor in the car , Has been installed base In Space exists near the car battery, and then took the two lines drag and pressure by the pressure pipeline as shown in figure (4.14).

Figure 4.14: Compressor Cooling with pipe connector.

- **Pressure Pipes:**

  Used for connection between the refrigerant compressor and cooling circuit of the vehicle bear a pressure of 270 bar As the highest value to the existing pressure up to 17 bar, use this type of pipe (SAE 100R2AT) because they are available in the market and bear the high temperatures as shown in figure (4.15).

Figure 4.15: Pressure Pipes

- **Pipe Coupling:** Used for connection between the pressure tube and the metal part in a cycle condition and installed by hydraulic piston so as to facilitate disassembly and installation of mechanical parts as shown in figure (4.16).

Figure 4.16: Pipe Coupling

- **One-Way Valves:** This valve is used to prevent go the pressure of the first compressor to the second compressor or contrary to withstand reverse pressure by 60 bar and a temperature (-32_140 C^{o}) as shown in figure (4.17), used two valve until the process is done properly, and was placed in a place of high pressure were connected using welding copper in side and pressure pipes from the other side.

Figure 4.17: One-Way Valves

- **T-Connector**: It was used (two T- connector) the first placed on drag line and second placed on pressure line that has been connected with the parties to the valves as shown in figure (4.18).

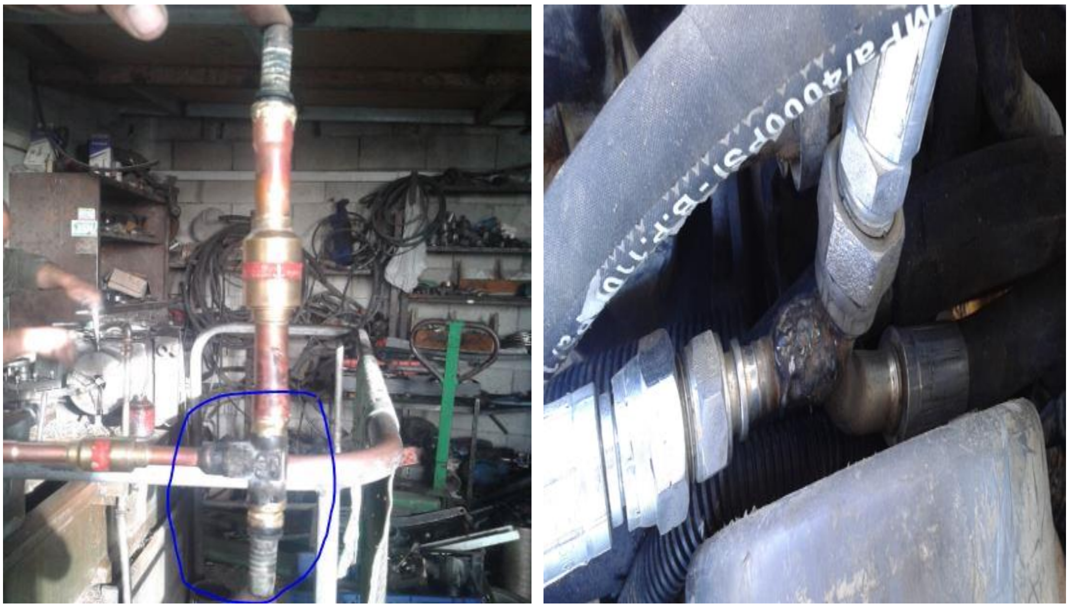


Figure 4.18: two T-Connector

4.4 The system works inside the car conditions

Conditions must be achieved Until the system runs inside the car:

- first condition the car engine's is turned off until the system turned on.
- Second condition the car to be closed Automatic where the windows fully closed.
- Third condition The car parked in the sun because System is designed working on solar energy.

It is noted that when the change in the percentage of carbon dioxide inside the car, then the system knows that there is someone inside the car and then it is taking procedures that are explained previously such as monitoring temperature, humidity, pressure, and the percentage of carbon dioxide.

5

Chapter Five

5. Mathematical calculations

5.1 Load Calculation Procedure Inside the car

Values for the car from table (5.1) and table (5.2) :

Table 5.1: Specifications for the first simulated driving condition.

Specification	value
Month	july
Time	13:00 to 16:00
location	hebron
Driver height, weight	1.7m ,70kg
Passenger height, weight	1.6m, 55kg
Ventilation flow	$0.1m^3/sec$
Ground reflectivity	0.02
Ambient temperature	35 C
Initial cabin temperature	80 C
Ambient relative humidity	70%
Cabin relative humidity	50%
Comfort temperature	23 C
Pull down time	10min(600 sec)
Deep thermal mass	5600 J/K

Cabin Geometry:

In order to perform the energy simulations of the present model, the geometry of the cabin as shown in figure (5.1) should be known. Often the compartment geometry is available in a 3Dmodelingsoftware.

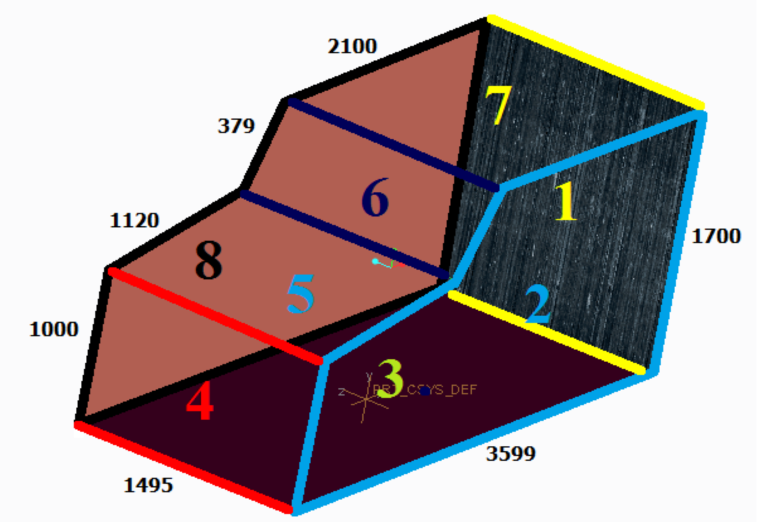


Figure 5.1 **:** Cabin Geometry

Table 5.2 : Material properties

property	glass	Vehicle body
Conductivity (W/mk)	1.02	0.2
Density (kg/m^3)	2500	1500
transmissivity	0.5	0
absorptivity	0.3	0.4
Specific heat (J/kgk)	840	1000
Thickness(mm)	3	10

First lets defining the **Pull Down Time** :

Pull-down time is defined as the time required for the cabin temperature to reach the comfort temperature within 1 *K*.

Pull down time = 10 min (600 sec) .... (given)

Case A : During the pull down time (within first 10 minits)

(1) Heat product from Radiation

(a) Direct Radiation:

$$\dot{Q}_{dir} = \sum_{surfaces} S * \tau * \dot{I}_{dir} * \cos\theta$$

=1000 W

(b) Diffuse Radiation:

$$\dot{Q}_{dif} = \sum_{surfaces} S * \tau * \dot{I}_{dif}$$

= 190 W

(c) Reflected radiation:

$$\dot{Q}_{ref} = \sum_{surfaces} S * \tau * \dot{I}_{ref}$$

=0 W

(2) Heat product from Ambient

$$\dot{Q}_{amb} = \sum_{surfaces} S * U * (T_s - T_i)$$

= - 200 W

(3) **Heat product from Exhaust**

$$\dot{Q}_{Exh} = S_{Exh} * U * (T_{Exh} - T_i)$$

= 0 W

(4) Heat product from Engine

$$\dot{Q}_{Eng} = S_{Eng} * U * (T_{Eng} - T_i)$$

= 0 W

(5) Ventilation

$$\dot{Q}_{Ven} = \dot{m}_{Ven}(e_{\circ} - e_{\mathrm{i}})$$

= - 1000 W

TOTAL LOAD :

$$\dot{Q}_{tot} = \dot{Q}_{dir} + \dot{Q}_{dif} + \dot{Q}_{ref} + \dot{Q}_{amb} + \dot{Q}_{exh} + \dot{Q}_{eng} + \dot{Q}_{ven}$$

= 1000 + 190 + 0+200 + 0 + 0 +0

= 1390 W (Since cooling is done in summer , this load is negative.)

These accounts were taken from the site ready [6] [7] because they require large equations solved on a special program to this topic

5.2 Mathematical calculations of the AC compressor cooling:

The **Reciprocating AC Compressor** needs to 220 volt and 186.5 watt, the voltage source in the system is a DC source ,so we need to to an adapter to convert the voltage from 12 volt DC voltage to 220 volt AC voltage. The compressor cooling specifications that are used in Table (5.3)

The converted current = capacity / 220 volt.

we must pay attention to start current in order to protect the adapter.

Table 5.3: Basic Specifications AC Compressor

		Refrigeration Capacity			Input Power	Efficiency			EVAP TEMP	COND TEMP	AMBIENT TEMP	RETURN GAS	LIQUID TEMP
Condition	Test Voltage	Btu/h	kcal/h	W	W	Btu/Wh	kcal/Wh	W/W					
CECOMAF	220V ~ 50HZ	335	84	98	99	3.38	.85	.99	-23°C (-10°F)	55°C (131°F)	32°C (90°F)	32°C (90°F)	55°C (131°F)
ASHRAE	220V ~ 50HZ	460	116	135	108	4.26	1.07	1.25	-23°C (-10°F)	54°C (130°F)	32°C (90°F)	32°C (90°F)	32°C (90°F)

5.3 Mathematical calculations Solar Cells:

The solar cell is the main source of the electricity , where is providing the power for the vehicle battery by charge controller which organize the process of charging the battery, it provide an electric current **Isc =8.3 A ,and 240 watt** at an appropriate situation at a temperature and sun light on two occasions The Solar Cells specifications that are used in Table (5.4) and diminution in Table (5.5) .

The large amount of the energy used in cooling the vehicle, so we need a large amount of energy, in order to get this energy ,the solar cell must be on the upper surface of the car, in order to be exposed to the sunlight and absorb a large amount of sunlight then convert it to electric power.

The battery that used in the project is the same battery in the car ,its current is 70 A ,and its voltage is 12.

Table 5.4: DC Electrical Characteristics

STC Power Rating	235W
PTC Power Rating	206.3W 1
STC Power per unit of area	13.2W/ft2 (142.3W/m2)
Peak Efficiency	14.23%
Power Tolerances	-3%/+3%
Number of Cells	60
Nominal Voltage	not applicable
Imp	7.81A
Vmp	30.1V
Isc	8.44A
Voc	36.8V
NOCT	45°C
Temp. Coefficient of Power	-0.45%/K
Temp. Coefficient of Voltage	0.118-V/K
Series Fuse Rating	15A
Maximum System Voltage	600V

Table 5.5: Mechanical Characteristics

Type Polycrystalline	Silicon
Output Terminal Type	Multicontact Connector Type 4
Frame Color	Clear
Length	65in (1,652mm)
Width	39.4in (1,000mm)
Depth	2in (50mm)
Weight	48.5lb (22kg)
Installation	Method Rack-Mounted

5.4 Mathematical calculations battery:

The battery that used in the project is the same battery in the car ,its current is 70 A ,and its voltage is 12, 40% for capacity to running the car equal 28A as shown in figure (5.2).

- **Charging The Battery**

Charging Time=Charge Capacity/rate of charge.

42/8.3 =5 hour

The charge capacity of the battery=70 A, and the charge rate=8.3 A, charging time =**8.3 hour** if the battery is completely empty.

The minimum charge capacity of the battery needed to make the vehicle run is 40% of its capacity, that is mean the completely charging of the battery need to 42 A and **5 hours** charge time ,in order to make the system run.

- **Discharging The Battery**

The load that is on the battery in the system is a cooling fan has 72 watt , compressor cooling has 186.5 watt , conditioning fan has 120 watt and the motor which open the window has 36 watt (this motor works a short time).

Types of load in the project:

power of conditioning fan = V * I= 12*10 = 120 watt

power of cooling fan = V * I= 12*6 = 72 watt

power of compressor = V * I= 220*0.84 = 186.5 watt

power of window motor = V * I= 12*3 = 36 watt

Total Load = 72+186.5+36+120

Total Load = 414.5 watt.

charge capacity = 70-28 = 42 A

rate of discharge = 414.5/12 = 34.5 A

Discharging Time = charge capacity/rate of discharge.

= 42\34.5 = 1.2 hour = 73.2Minute

Voltage	State of Charge
12.6+	100%
12.5	90%
12.42	80%
12.32	70%
12.20	60%
12.06	50%
11.9	40%
11.75	30%
11.58	20%
11.31	10%
10.5	0%

Figure 5.2**:** 12-v battatry state of charge

6

Chapter Six

6. Testing And Evaluating

6.1: Introduction

6.2 :Experimental Result

6.3 :Recommendations

6.4 :Future work

6.1 Introduction

This chapter provides experimental result and some recommendations from the work learn for this project. In this chapter we are listing some goals hope to be accomplished or at least under attention.

6.2 Experimental Result

We made some experiments on parts of our project and these are some of results:

- Compressor currently used is 220 volts AC with the knowledge that he had planned to use the compressor with a 12-volt DC Specifications less energy and small size. For the following reasons Lower cost , available in the market and higher efficiency but must use an inverter.
- Compressor user 1/4 hp 220-volt AC needed 10 minutes to reduce the temperature of (30 to 26) degrees Celsius with the knowledge needed to run the fan cooling even gives these results.
- The start current of the compressor 3.5 A at the first operation, therefore, use 750-watt inverter, but when you turn it on again needed a 5.5 A ,because there is pressure on the compressor, leading to damage Inverter so requires the use of 1K watts instead of 750 Watt.
- Less current is required to run the car is 40% of the battery capacity represents 28 A of battery capacity, so as to allow the use of 42 A of the system, and this current operating system 1 hour a maximum if the battery is full.
- Solar system feeds the 8.3 amp battery, take the time to charge the battery if the 40% of the capacity of 5 hours.

6.3 Recommendations

- The main problem faced during implementing in the project was use of copper pipes were conduction welding because welding is considered a weak point of the pressure and when they were testing for leaks where it is difficult to control them show for it was the use of pressure pipes to avoid this problem.
- Short Circuit occurrence when the control windows by Arduino because the power system is separated from the car, was this problem by using two relay take signal

from running the car to disconnect the power current and used four relays as H-Bridge to control the opening and closing windows.

- Difficulty of overcoming the start current which required inverter has a high power, leading to increased costs.

6.4 Future work

- Get the compressor 12-volt high-capacity even dispense with the inverter and give the proper air-conditioning.
- Automotive design to be installed on this system so that the cabin roof of a solar system for easy system installation and be appropriately beauty hand.
- Project development work electronic scheduling to adapt the car before the ride so that they are appropriate for employees and linking it with the smart phone.

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