سيارة كهربائية تعمل بالطاقة الهجينة
(الطاقة الشمسية وطاقة الرياح)

بحث من إعداد :
م. احمد علي سالم الختلان.
- حاصل على شهادة بكالوريوس وماجستير في الهندسة الكهربائية.
- موظف في الهيئة العامة للاستثمار.
- عضو جمعية المهندسين الكويتية.

ملخص:
تعتبر السيارة الهجينة نظاما مدمجا بين موردين للطاقة يوفران السيارة للعمل دون استخدام موارد الطاقة القديمة. علاوة على ذلك، يتكون نظام الطاقة الهجينة من ألواح الطاقة الشمسية الكهروضوئية وطاقة الرياح التي توفر الطاقة للبطاريات والتي تعطي الطاقة لأحمال التيار المستمر داخل السيارة.
السيارة الهجينة هي سيارة ذكية متاحة للتحكم دون واجهة بشرية داخل قيادة السيارة باستخدام نظام التحكم البعيد.

Solar and Wind Powered Hybrid Car

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Abstract

This thesis describes the hybrid robot system, which is run on the wind turbine, solar, and electrical energy. The Hybrid car is considered as a merged system between two resources of power that supply car for work without using old power resources. Moreover, the hybrid system is formed from solar energy photovoltaic and wind turbines that supply power for batteries, which is giving energy to DC loads inside the car. The hybrid car is a smart car that available to control without human interface inside car driving by using a far control system. This system will work his operation and make a decision depending on ATMEGA 328 microcontroller; also, it mainly used an RF receiver.

1. Introduction

A hybrid car uses two or more specific types of energy, such as private ignition engine to drive an electric motor that powers an electric motor, e.g., in diesel-electric tracks using diesel motor to drive an electric dynamo that powers an electric motor, and submersibles that use diesel when surfaced and batteries when submerged.

Other means to save energy include pressurized fluid in hydraulic hybrids.

The basic foundation with the hybrid car is that the various motors run better at various speeds; the electric motor is more powerful at producing torque, or turning power, and the ignition motor is improved for maintaining high speed (better than the typical electric motor).

Switching from one to the other at the proper time while speeding up yields a win-win in terms of energy productivity as such that translates into greater fuel efficiency, for example.

Hybrid power systems are one of the newest systems developed from renewable energy systems. It does not rely on a uniform energy system to feed loads.

It has become possible to rely on more than one system to feed loads of energy, which distinguishes the hybrid energy system from other renewable energy systems.

Moreover, it is known that each energy system has advantages and disadvantages that will be addressed within the reading.

However, hybrid systems can avoid the flaws of one system by compensating for another with the first

In this project, we use a hybrid system of renewable energy between the solar photovoltaic system and windmill and wind turbine system.

Those two systems are conveniently interconnected to feed the vehicle running on environmentally friendly electricity

There is no doubt that many cars today still rely on gasoline and gas as a source of energy to feed cars.

However, the future has become a new dependence on environmentally friendly energy, which does not adversely affect the health of living organisms and the atmosphere

On the other hand, many companies have gone on to produce many electric car systems such as Tesla, which specializes in designing clean electric cars instead of gasoline and gas.

1.1 Problem statement

With the recent increases in the price of gasoline, electric cars have become the essential vehicles in the equation to provide a solution to the problem of fuel prices besides gas cars, and they are cleaner cars in relation to the problem of emissions and global warming, which is 50% better for the environment.

Percent and electric car batteries produce less than half of the greenhouse gas emissions from gasoline-powered vehicles, and electric cars are now cleaner than ever. Driving electric vehicles leads to lower global warming emissions than gasoline.

Moreover, the car is fully electric without any other source of energy because they replaced the original engine, which is gasoline with a completely different engine, Basis.

And, the electric car depends on the charge of electricity stored in lithium batteries, batteries that are experiencing high price increases.

1.2 Project Idea

- To use solar and wind power to energize a vehicle.
- The system can harvest solar and wind energy and properly store it in the car battery
- The stored power will be used to drive the vehicle motors
- As a demo, the car will be controlled using radio frequency remote control.
- Also, a live video will be streamed from the vehicle to the user mobile phone application
- The power from the hybrid system will be monitored and displayed on an LCD inside the vehicle.

1.3 Motivation

The importance of a hybrid car is represented depending on renewable energy.

The intensive and costly use of conventional energy, which relies on “fossil fuels” of petroleum and its derivatives, coal and natural gas, has caused severe damage to humans, the environment and all living organisms, and has led to unprecedented environmental pollution, global warming, global warming, acid rain.

Many of the environmental disasters that started and do not know when to end in addition to health problems, which are difficult to enumerate, which led to the search for alternative sources of clean energy that achieve sustainable development and do not negatively affect human health and the environment and this is what is achieved The reliance on renewable sources of energy, which is generated naturally in a sustainable manner and without resulting in any harmful waste.

1.4 Contribution

The contributions of renewable energy to remote control in our time are key factors in the standard of the progress of society in terms of reducing the sources of energy polluting the environment and the technological advancement of human control.

Contributions of Renewable Energy the world of energy is equally pleased by recent developments. Renewable energy prices have fallen considerably over the past years, especially wind and solar energy.

It is expected to become the world's largest source of new power generation capacity - 700 GW in the next five years.

The IEA does not expect falling oil prices to affect renewable energy growth and expects the electricity sector to continue to lead the transformation of global energy.

The Agency also estimates that the proportion of electricity generation from modern renewable energy (including hydropower) will increase from 22 percent in 2013 to 26 percent in 2020.

Despite a significant reduction in the cost of solar and wind power over the past decade, radical innovations in energy storage should be introduced to increase supply uniformity, increase the efficiency of utility operation and improve the market structure to increase the spread of renewable energy in unified networks.

For more mature technologies such as geothermal and hydropower, there is a need to increase systematic and innovative approaches to ensure environmental and social sustainability. Despite its vast potential, hydropower remains mostly untapped in sub-Saharan Africa, South Asia, and other regions of the developing world where hydropower may be the most extensive available source of affordable renewable energy.

Dependence on smart remote control system: Intelligent systems work in one of the branches of artificial intelligence, Expert Systems, programs that simulate the human experience in a particular area of expertise, by collecting information and expertise from more than one expert in a specific field, which is created, to help transfer these experiences to other people, and to replace Human in some places.

Intelligent systems use real-time data as inputs from machines, people, video broadcasts, maps, news feeds, etc. They are connected to sensors that can distinguish and perceive, and thus be more productive: natural language, data mining, machine learning.

1.5 Block Diagrams

- **Remote unit block**

Figure 1.1 below shows the remote unit block, it consists of four push buttons to give the user the ability to choose one of the four directions, and the encoder will convert the data from parallel to serial and feed the data to the radio frequency transmitter.

The system operates on a single 9v battery with a voltage regulator to stabilize the voltage at 5volts.

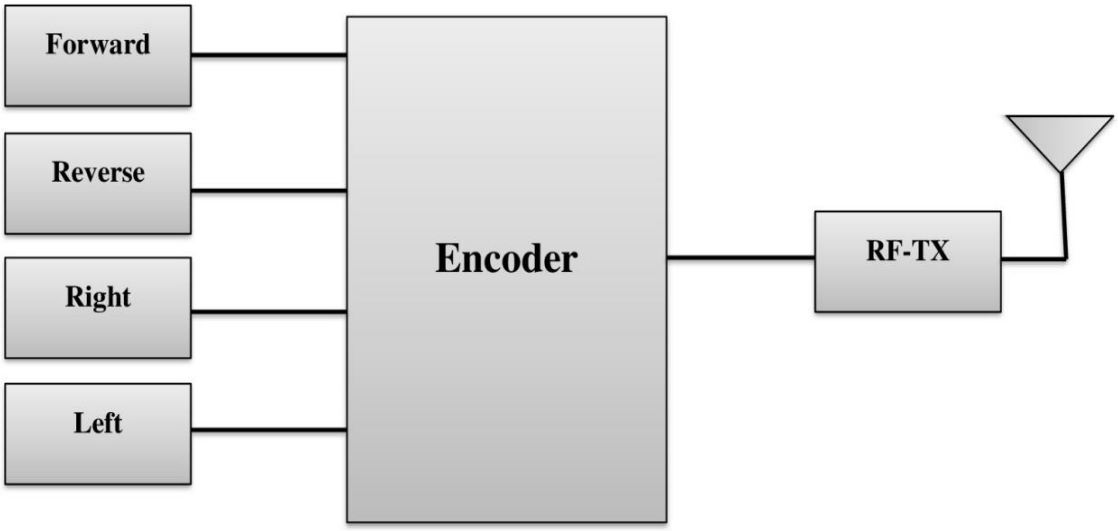

Figure 1.1: The robot unit block

- **Main block diagram**

Figure 1.2 below shows the main block diagram of the system

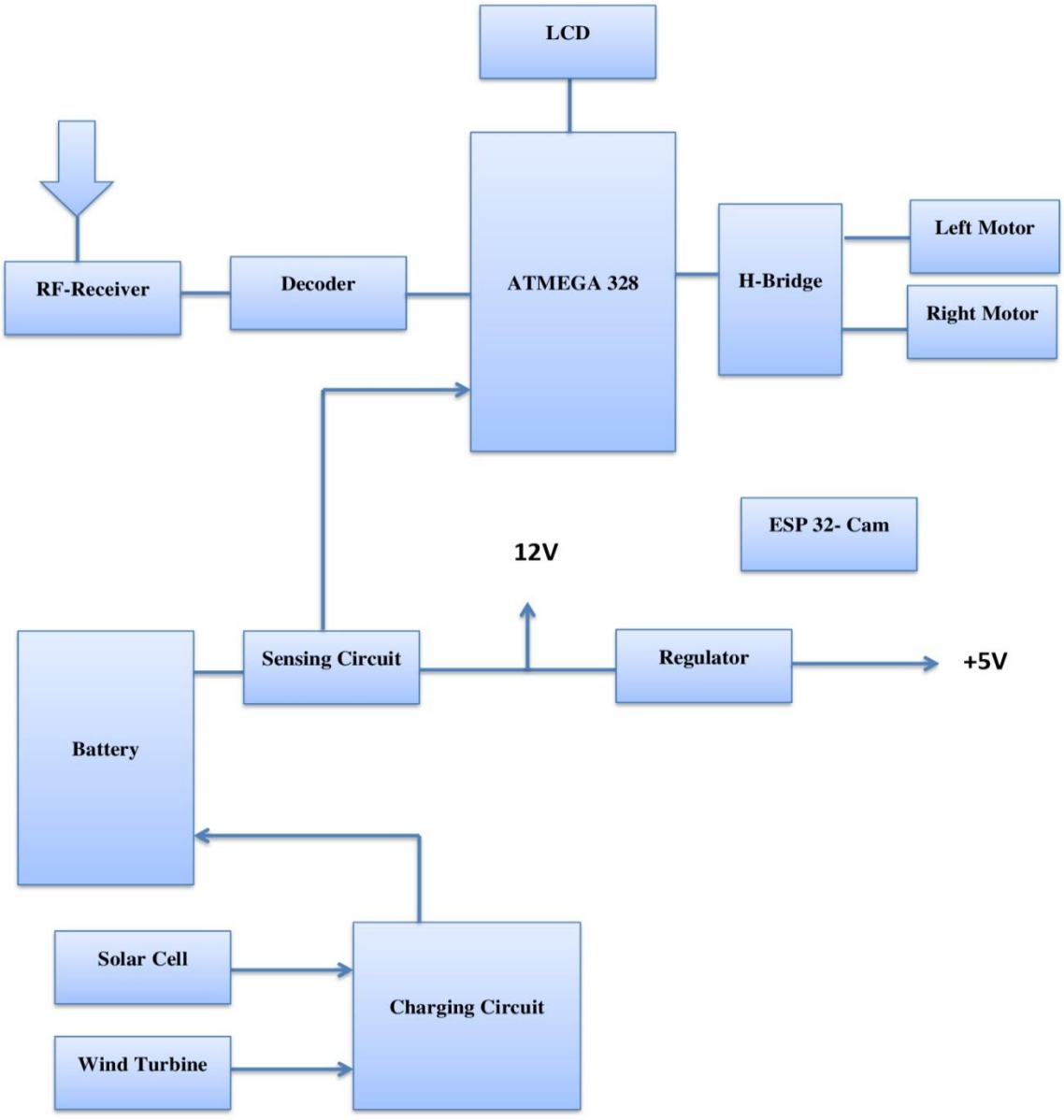

Figure 1.2: The main block diagram of the system

The Atmega is the heart of the system where all of the decisions will be taken; the controller will read the data from the decoder and give the appropriate command to the h-bridge to control the motors to rotate in the desired direction.

The battery will be charged using the charging circuit, which in turn will get the power from the solar and the wind; the charging circuit will stop charging the battery when it gets full of charge.

The battery is 12 volts, and most of the system operates on 5volts, so the voltage regulator is used to step down the voltage to 5 volts.

2. Literature review

The claim for gasoline in Canada, primarily by light-duty cars, stay to increase with economic rise and expansion.

Fossil fuel-driven cars are not only initiating financial strain due to fluctuating gas prices but are also violating the environment and posing health dangers to the community.

To promote public attention, this system reviews hybrid vehicle technology as a logical step towards continuous, robust, and environment-friendly transportation. It discusses the measures taken by the Canadian government to encourage hybrid car sales and to minimize fossil fuel dependency of the transportation sector.

With increasing realization towards economic and environmental involvement combine with fuel ignition in automobiles, the world is focusing on the development of sustainable technologies.

The transportation side is one of the highest consumers of fossil fuels and the largest giver of greenhouse gas (GHG) emissions in Canada with gasoline sales constituting 40% of the country's total giver natural gas sales this oil-reliant, particularly light-duty

Vehicles are responsible for a quarter of the total GHG discharge in the country and have become a source of economic stress with rising oil prices

Hybrid electric vehicles (HEVs) offer a fuel-efficient explanation that combines an electric motor-based drivetrain with the conventional internal combustion engine (ICE) to decrease fuel consumption and vehicle emissions.

These HEV benefits have prompted the automakers to improve hybrid vehicles, most of which are available in Canada today.

However, consumer acceptance to hybrid vehicles remains low, mostly due to public unawareness of the work and reliability of HEV technology as well as the high initial cost of hybrid cars.

With the growth in the 21st Century, there has been raised in the usage of Oil and Gas leading to issues like Global Warming, climate change, shortage of crude oil, etc. Due to this reasoning, Automobile Companies have started doing exploration for making Hybrid Technology usable into daily life.

The paper starts from a terse history about Hybrid Technology and also some brief introduction to it. Paper will also discuss the technologies used in the making of Hybrid Cars such as "Hybrid Solar Vehicle," "Hybrid Electric Vehicle," and "Plug-In hybrid electric vehicles."

One of the front runners in the area of sustainable energy sources today is solar energy. Photovoltaic cells are used to convert solar energy into useful electrical energy.

The objective of this paper is to build up a powerful solar car for the daily office drivers of Dhaka city so that they can move a fixed area that they need to drive every day on an honest and economical car that essentially runs on free sustainable solar energy.

All calculations would be made, bearing in mind the maximum distance traveled by Dhaka office commuter i.e., from Uttara to Motijheel since overcoming this area would be the fundamental objective of the solar car to be built.

The paper clarifies how the charge achieved by an array of solar panels is received, and its flow in and out of a battery pack is to be controlled using a microcontroller-based charge controller to ensure efficient storing of charge in a battery pack.

The stored energy would be divulged to a DC motor, which would run the car. The design of a motor controller to control the car's speed and forward/reverse the direction of motion shown.

The mechanical construction from scratch of the chassis, along with all necessary mechanical systems, is illustrated. Finally, the wiring of the electrical system onto the mechanical body is demonstrated.

The idea of this project is to arrange a solar car that aims to begin the problems linked to infection and shortage of fuel.

A Smart vehicle is the one that takes all our anxiety on the preservation of the car while ensuring security and comfort for the driver and the travelers.

The vehicle monitoring system includes different sensors that sense the various vital parameters such as Engine temperature, Fuel level, and as we have improved it for a vehicle battery chamber temperature is also included.

In addition to this, accelerometers and speed sensors sense abnormal vibrations in vulnerable parts and over speeding.

These data, after being sensed, is stored in the cloud. This enables the monitoring of the vehicle's performance and driver's actions remotely.

The safety system includes sensing the speed of a vehicle approaching to perform safe cuts and lane change over.

This also includes sensing objects in the proximity of the vehicle, which helps in parking and driving in heavy traffic. An Emergency Shutdown System is designed to stop the car at the flick of a switch when it is out of control.

3. Technical Approach

In this section we will discuss the hardware implementation of our project with details.

3.1.1 ATMEGA 328 Microcontroller

The ATmega328 is an individual-chip microcontroller designed by Atmel in the megaAVR family.

It has an altered Harvard construction 8-bit RISC processor core.

As of 2013, the ATmega328 is generally used in many activities and self-governing schemes where an elementary, low-powered, low-price micro-controller is needed. Perhaps the most general implementation of this chip is on the popular Arduino development platform, namely the Arduino Uno and Arduino Nano models.

- **Specification**
    1. Program Memory Type: Flash
    2. Program Memory Size (KB): 32
    3. CPU Speed (MIPS/DMIPS): 20
    4. SRAM (KB): 2,048

5. Data EEPROM/HEF (bytes): 1024
6. Temperature Range (°C): -40 to 85
7. Operating Voltage Range (V): 1.8 to 5.5. [1]

Figure 3.1 below show the ATMEGA 328 Microcontroller

Figure 3.1: The ATMEGA 328 Microcontroller [1].

- **Microcontroller connection circuit**

Figure 3.2 below shows microcontroller connection circuit, the reset button is used to reset the controller in case of any error during the code execution, and the crystal will give the clock pulses to the CPU inside the controller.

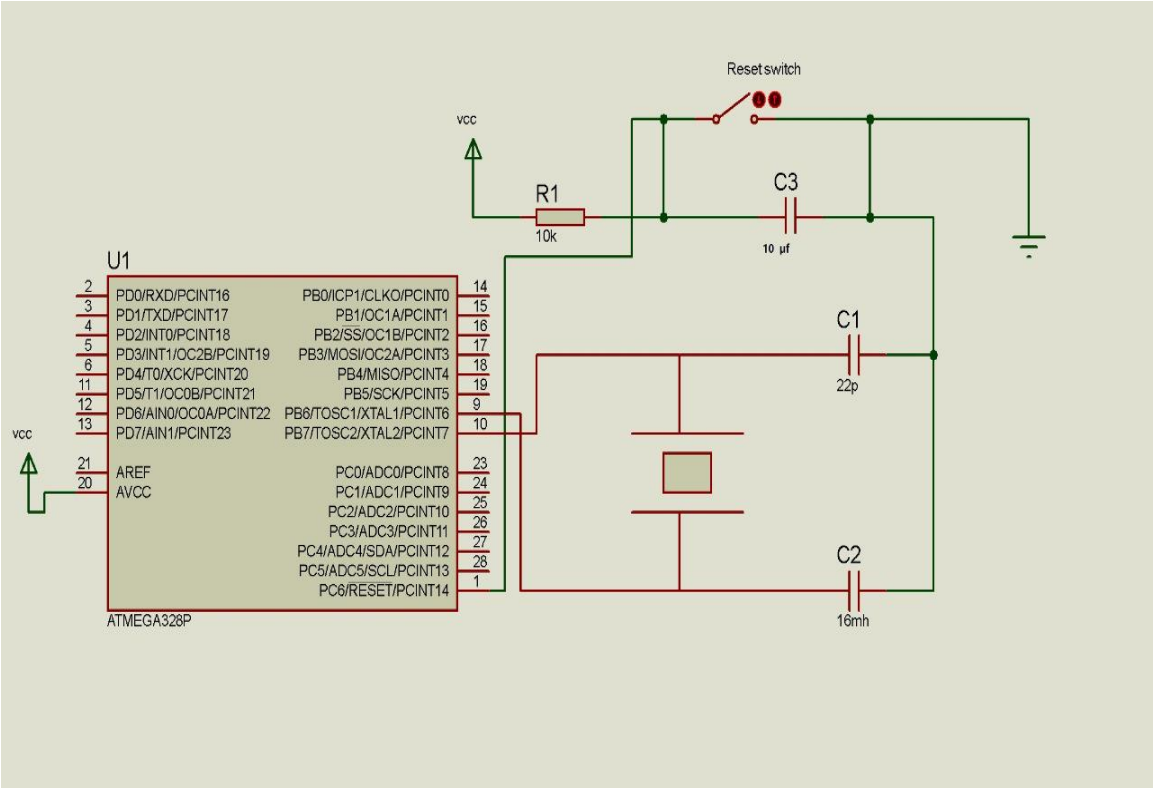

Figure 3.2: Microcontroller connection circuit

3.1.2 H-Bridge

An H bridge is an electronic circuit that shifts the polarity of a voltage practiced to a load. These circuits are often used in robotics and other applications to grant DC motors to race forwards or backwards.

- **Description**

1. Wide Supply-Voltage Range: 4.5 V to 36 V
2. Separate Input-Logic Supply
3. Internal ESD Protection
4. High Noise-Immunity Inputs

5. Output Current 1 A Per Channel (600 mA for L293D)
6. Peak Output Current 2 A Per Channel (1.2 A for L293D)
7. Output Clamp Diodes for Inductive. [2]

Figure 3.3 below shows H Bridge

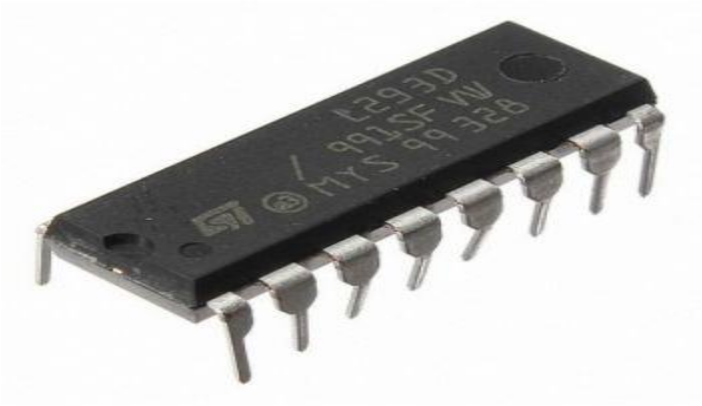

Figure 3.3: H Bridge [2].

3.1.3 12V DC Gear Motor

A Direct Current (DC) motor is revolving electrical equipment that modifies direct current, of electrical power, into mechanical energy.

An Inductor (coil) inside the DC motor bear a magnetic field that builds revolve motion as DC voltage is practiced to its terminal. Inside the motor is an iron shaft, wrapped in a coil of wire.

- **Description**
    1. work voltage : 3-12v
    2. output shaft : 4mm
    3. default 1 hair : 7 8 's reduction ratio motor

Figure 3.4 below shows the 12v DC gear motor

Figure 3.4: The 12v DC gear motor [13].

- **Motor drive circuit**

Figure 3.5 below shows the H-Bridge connection, there are four wires connecting the l293 to the controller, each two wires is controlling one motor, each has a capacitor connected in parallel to cancel the noise from the motor coil .

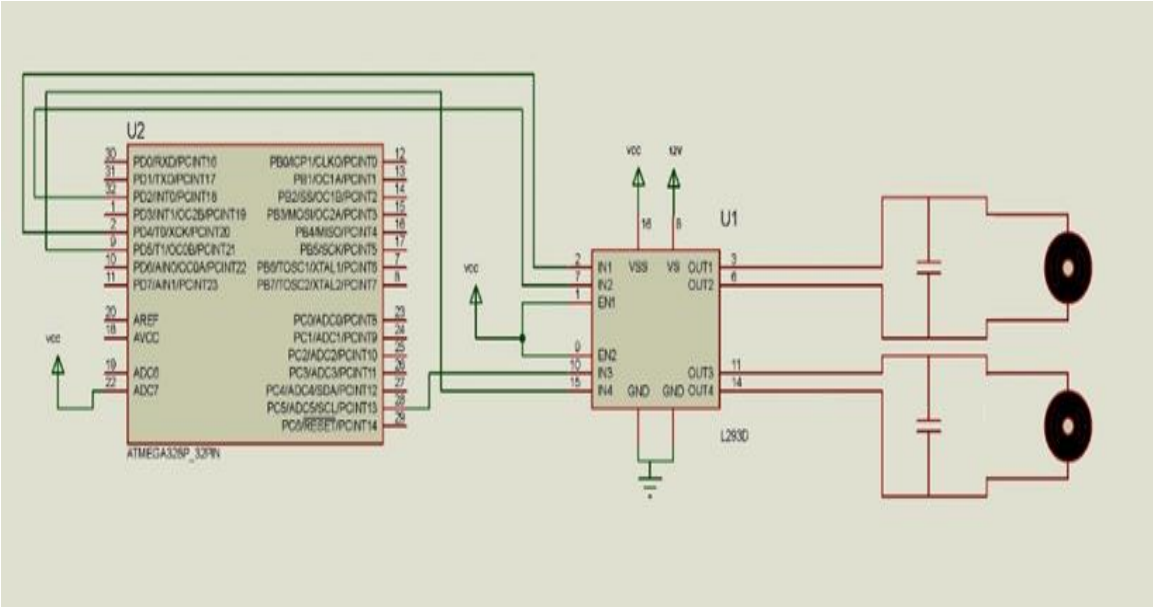

Figure 3.5: The H-Bridge connection

3.1.4 HT12D (Decoder)

The HT12D decoders are a set of CMOS LSIs for remote control scheme applications. They are coupled with Hole HT 12E sets of encoders.

For useful activity couple of encoder/decoder with the same number of addresses and information format should be chosen.

Figure 3.6 below shows the HT12D remote control (Decoder)

Figure 3.6: The HT12D (Decoder) [3].

3.1.5 HT12E (Encoder)

The HT12E encoders are a set of CMOS LSIs for remote control scheme applications. They are capable of encoding information which contain of N address bits and 12 N data bits. Each address/ information input can be set to one of the two logic cases.

The programmed addresses/information is transmitted together with the header bits via an RF or an infrared transmission intermediate upon receipt of a trigger signal.

Figure 3.7 below shows the HT12E (Encoder)

Figure 3.7: The HT12E (Encoder) [3].

3.1.6 (12) volt led acid battery

A lead acid battery is secondary cell, meaning that it is able to recharge. It contains of plates of lead and lead oxide in a sulfuric acid solution.

The lead (IV) oxide oxidizes the lead plate, making an electrical current.

- **Applications**
    1. Automotive and traction applications.
    2. Standby/Back-up/Emergency power for electrical installations.
    3. UPS (Uninterruptible Power Supplies).
    4. High current drain applications [4].

Figure 3.8 below shows type of 12V Lead Acid Battery

Figure 3.8: Type of 12V Lead Acid Battery. [5]

- **Measuring voltage circuit**

Figure 3.9 below shows the measuring voltage circuit, the input from the charging circuit can reach up to 13 volts and this voltage cannot be fed to the controller input.

For this a voltage divider is used to reduce the voltage and the controller can read the analog voltage safely.

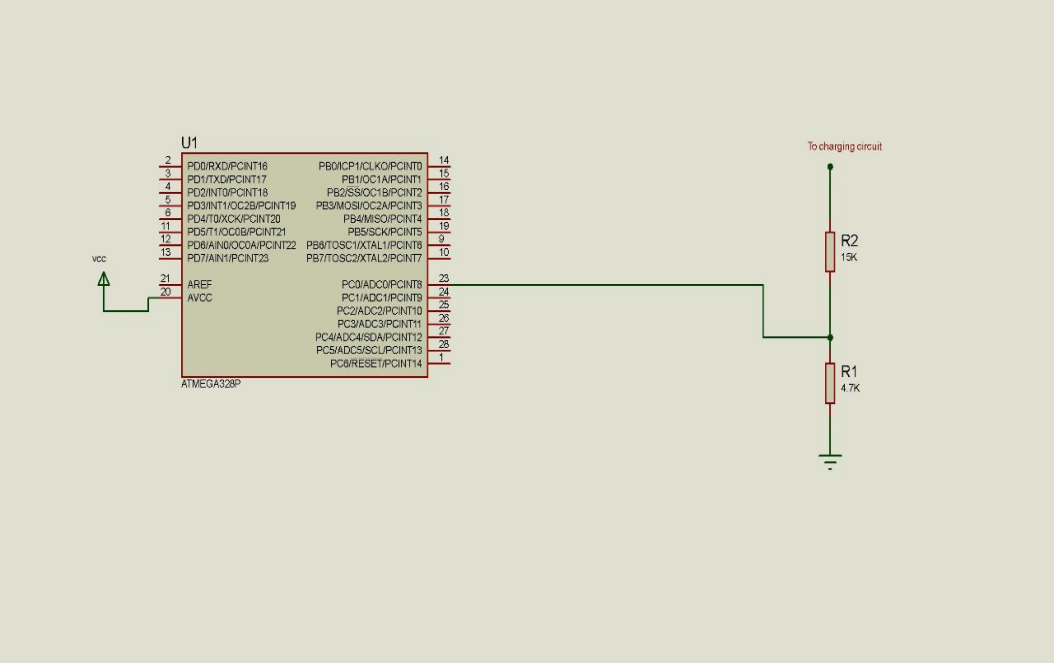

Figure 3.9: The measuring voltage circuit

- **Charging circuit**

Figure 3.10 below shows the charging circuit, the input from the wind turbine is first fed to full wave bridge rectifier because the output of the wind turbine is AC and must be converted to DC.

The output of the solar cell is connecting with the output of the wind turbine using a forward diode then those two inputs are fed to the controlling transistor.

The transistor will be controlled to start charging or stop charging using a voltage comparator.

This comparator is comparing the battery voltage with the input from the hybrid system and if the battery voltage is high then it will turn off the charging by turning of the transistor.

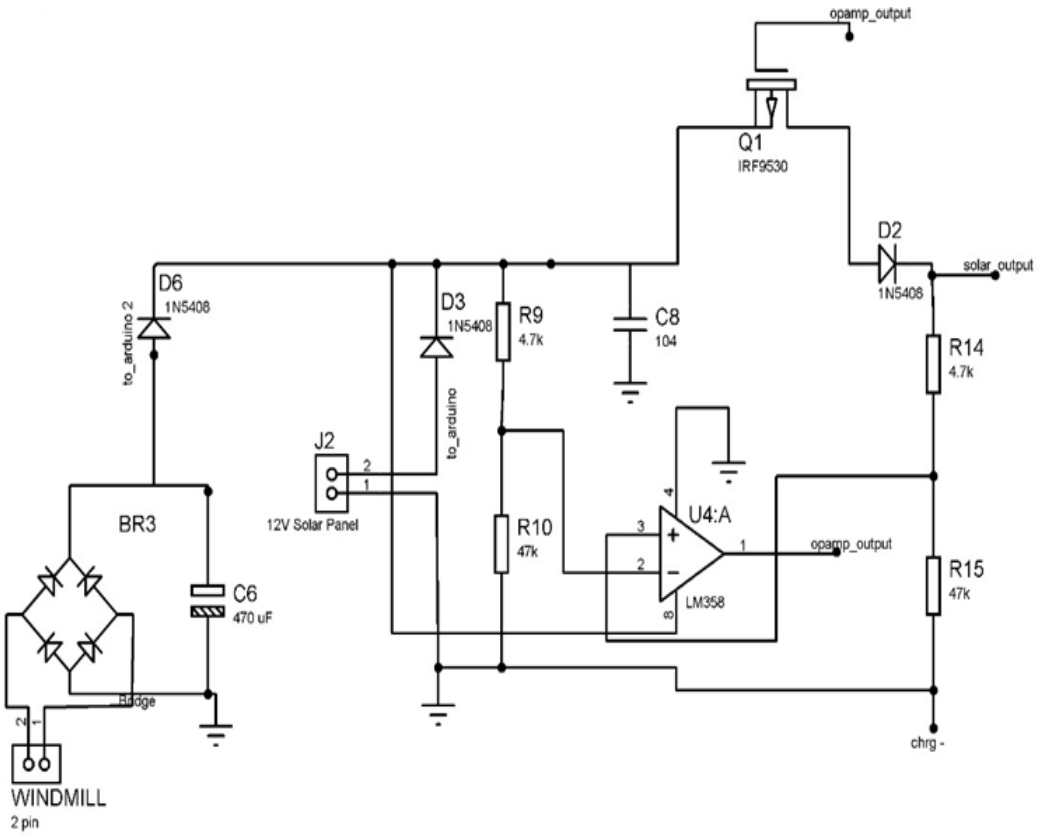

Figure 3.10: The charging circuit

- **Power supply circuit**

Figure 3.11 below shows the power supply circuit, since all of the components are operating on 5volts a voltage regulator must be used.

The output of battery is 12volts, a button is used to turn on/off the system then the input is fed to regulator (lm2576), the output is connected to a coil then to a capacitor.

On the 5volts output an indication led is connected to be turned on when the power is on.

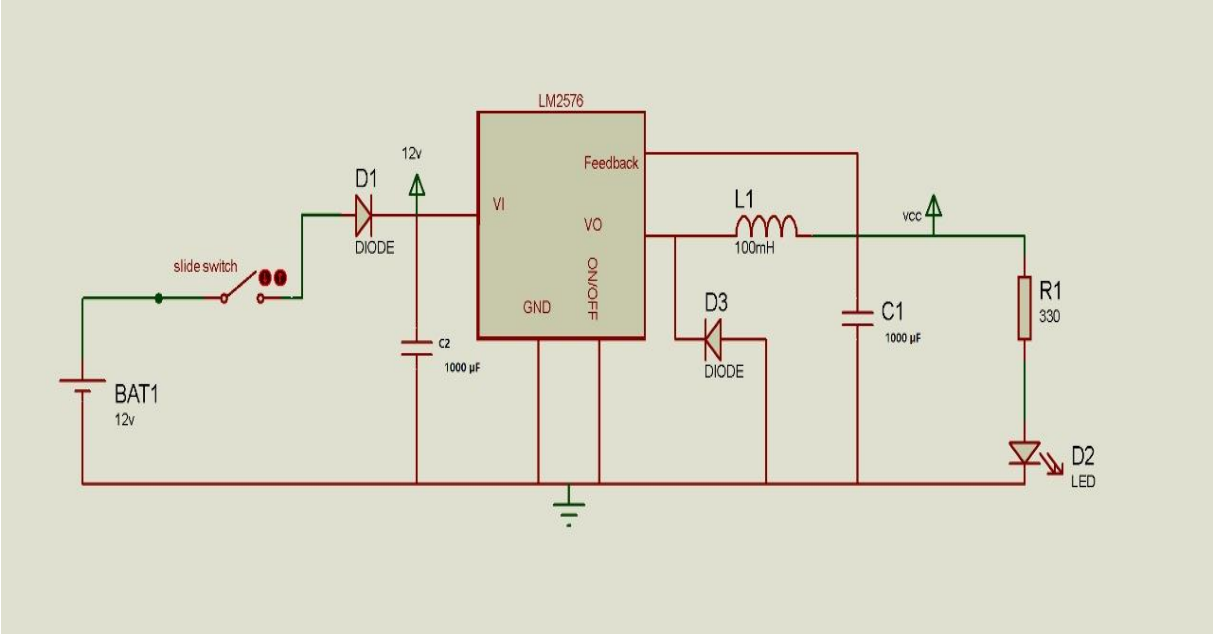

Figure 3.11: The power supply circuit

3.1.7 LCD 2*16 Display

A liquid-crystal display (LCD) is a tenement-panel display or other computerized modulated optical equipment that uses the light-modulating properties of liquid crystals. Liquid crystals do not emanate light straightly, rather than using a backlight or reflector to production photos in color or monochrome.

LCDs are applicable to present arbitrary photos or fixed photos with low message content, which can be visible or non-shown, such as preset words, digits, and seven-segment displays, as in a digital clock.

- **Features**
  1. Operating Voltage is 4.7V to 5.3V.
  2. Current consumption is 1mA without backlight.
  3. Alphanumeric LCD display module, meaning can display alphabets and numbers.
  4. Consists of two rows and each row can print 16 characters.
  5. Each character is built by a 5×8 pixel box.
  6. Can work on both 8-bit and 4-bit mode.[6]

Figure 3.12 below shows LCD 2*16 Display

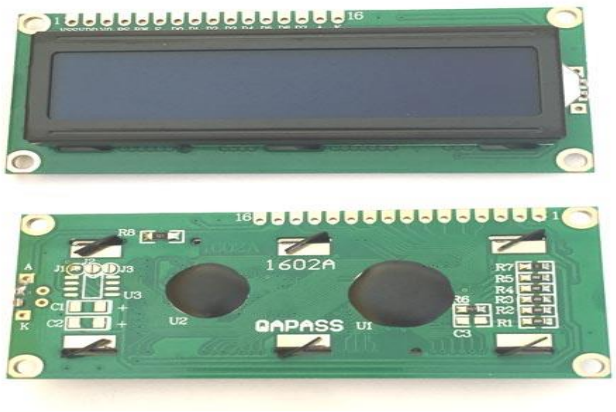

Figure 3.12: LCD 2*16 Display [6].

- **LCD Connection**

Figure 3.13 below shows the LCD connection, the connection between the controller and the LCD is consisting of four data pins, and two pins for the control.

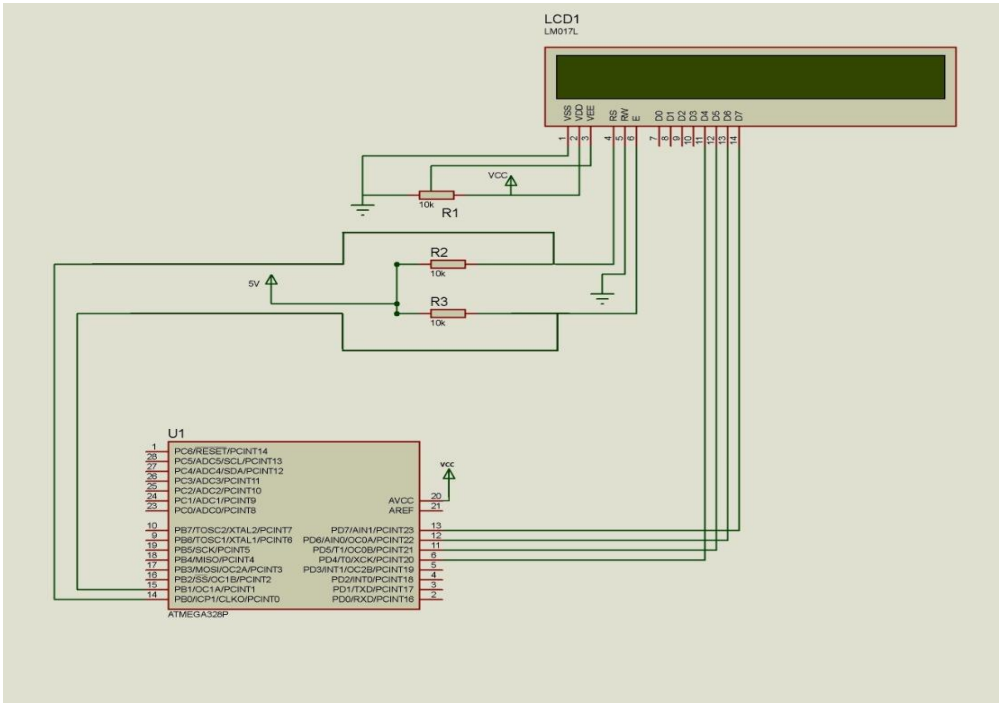

Figure 3.13: The LCD connection

3.1.8 Solar cell

Solar cells Photovoltaic cells or photovoltaic cells are a device and a device in the form of paved cells next to each other that convert sunlight to electricity by exploiting the photovoltaic effect, and have been using solar cells for decades, since they have been working since 1996

In addition; it supplies electricity to the International Space Station (ISS). Currently, Spain has the largest solar power plant with a capacity of about 23 MW, and plans to build Spain's largest power plant.

- **Features**
  1. Rated power: 5w
  2. Open circuit voltage: 21.5 v.
  3. Short circuit current: 0.310 A.
  4. Voltage at maximum power: 17.17v.
  5. Current at maximum power: 0.28A

Figure 3.14 below shows the solar cell

Figure 3.14: The solar cell [7].

The solar cells, which are placed directly under the sun, absorb these rays and convert these rays to electrical energy for human use in many purposes and fields, and thus serve as an alternative to the rays of the usual generators, when the sun shines.

which contains very large energy, Here, solar panels attract this energy, which contains many solar cells arrayed next to each other, and these solar cells are composed of semiconducting materials (often silicon), and these cells receive solar energy and start movement.

The electrons form an electric field and electrons are released from semiconductor or silicon.

- **Features**

1. Power : 5watt
2. Voltage : 21.5 volts
3. Short circuit current:300ma
4. Voltage at maximum power: 17.7v
5. Current at maximum power: 280ma

- **Characteristic equation**

From the equivalent circuit it is evident that the current produced by the solar cell is equal to that produced by the current source, minus that which flows through the diode, minus that which flows through the shunt resistor:

$I=I_L-I_D-I_{SH}$

Where

I = output current (ampere)

IL = photo generated current (ampere)

ID = diode current (ampere)

ISH = shunt current (ampere).

The current through these elements is governed by the voltage across them:

$V_j=V+IR_S$

Where

Vj = voltage across both diode and resistor RSH (volt)

V = voltage across the output terminals (volt)

I = output current (ampere)

RS = series resistance (Ω).

3.1.9 Wind Turbine

Wind turbines represents in our hybrid car that devices converts wind energy into a curved motion, and then provide either a generator, developed this idea where the air turbines are widely manufactured and different types of vertical and horizontal axis turbines.

This mechanical force can be used for specific tasks (such as grinding grain or pumping water) or can the generator can convert this mechanical energy into electricity.

- **Features**
  1. Output voltage: DC 0.1v - 18v.
  2. Output current: 0.01 - 0.3A.
  3. Rated speed: 200 - 6000 rev/min.
  4. Total Size: about 200 x 190 x 130mm/7.87 x 7.48 x 5.12 inch.
  5. Motor diameter: 24.5mm/0.96 inch.
  6. Motor height: 34.2mm/1.35 inch.
  7. Motor shaft diameter: 2mm/0.079 inch.
  8. Motor shaft length: 13.5mm/0.53 inch.
  9. Blade diameter: 60mm/2.36 inch.[8]

Figure 3.15 below shows the micro wind turbines generator small DC motor

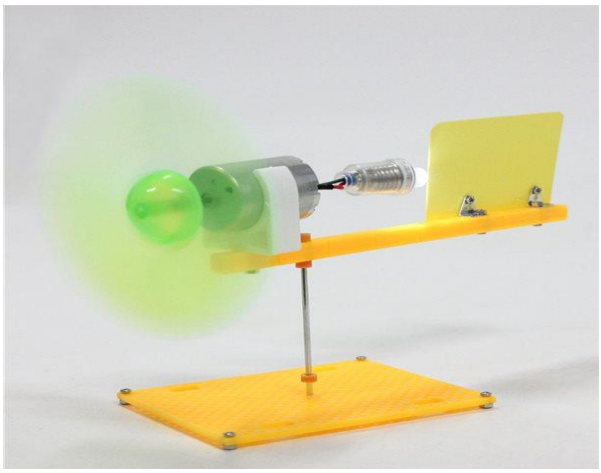

Figure 3.15: The micro wind turbines generator small DC motor [8].

3.1.10 433MHZ RF Transmitter

The 433MHz wireless module is one of the low-cost and simple to use modules for all wireless designs. These modules can be used only in combination and only simplex transmission is possible.

Meaning the transmitter can only transmit information and the receiver can only receive it, so you can only send data from point A to B and not from B to A.

The module could cover a minimum of 3 meters and with proper antenna a power supplies it can reach up to 100 meters theoretically.

But practically we can comparatively get about 30-35 meters in a normal test conditions.

- **Specifications**
    1. Transmitter Operating Voltage: +5V only.
    2. Transmitter Operating current: 9mA to 40Ma.
    3. Operating frequency: 433 MHZ.
    4. Transmission Distance: 3 meters (without antenna) to 100 meters (maximum) [10]

Figure 3.16 below shows the 433MHZ RF transmitter

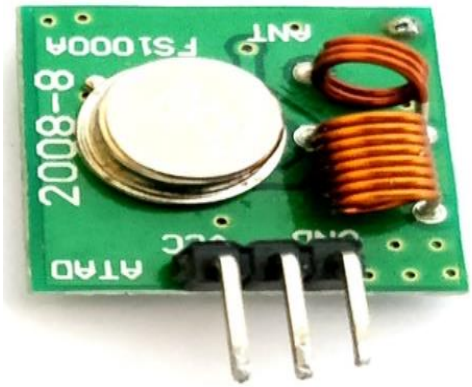

Figure 3.16: The 433MHZ RF transmitter [10].

3.1.11 RF receiver

It is a small ready-made electronic circuit that allows you to communicate and transmit information wirelessly using radio frequency waves.

It consists of two parts:

1. TX – Transmitter.
2. RX - the receiver.

- **Features**
  1- Receiver Operating Voltage: 3V to 12V.
  2- Receiver Operating current: 5.5 mA.
  3- Operating frequency: 433 MHZ.
  4- Data Transmission speed: 10Kbps [12]

Figure 3.17 below shows the RF receiver

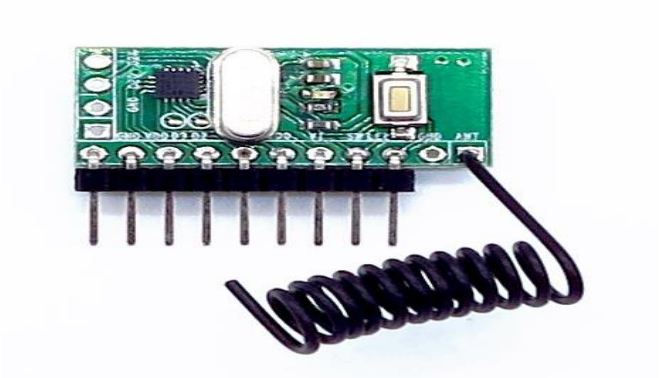

Figure 3.17: The RF receiver [11].

- **Radio frequency receiving circuit**

  Figure3.18 below shows the radio frequency receiving circuit, the output from receiver is fed to the decoder, then the decoder will change the data from serial to parallel and fed the output to the controller,

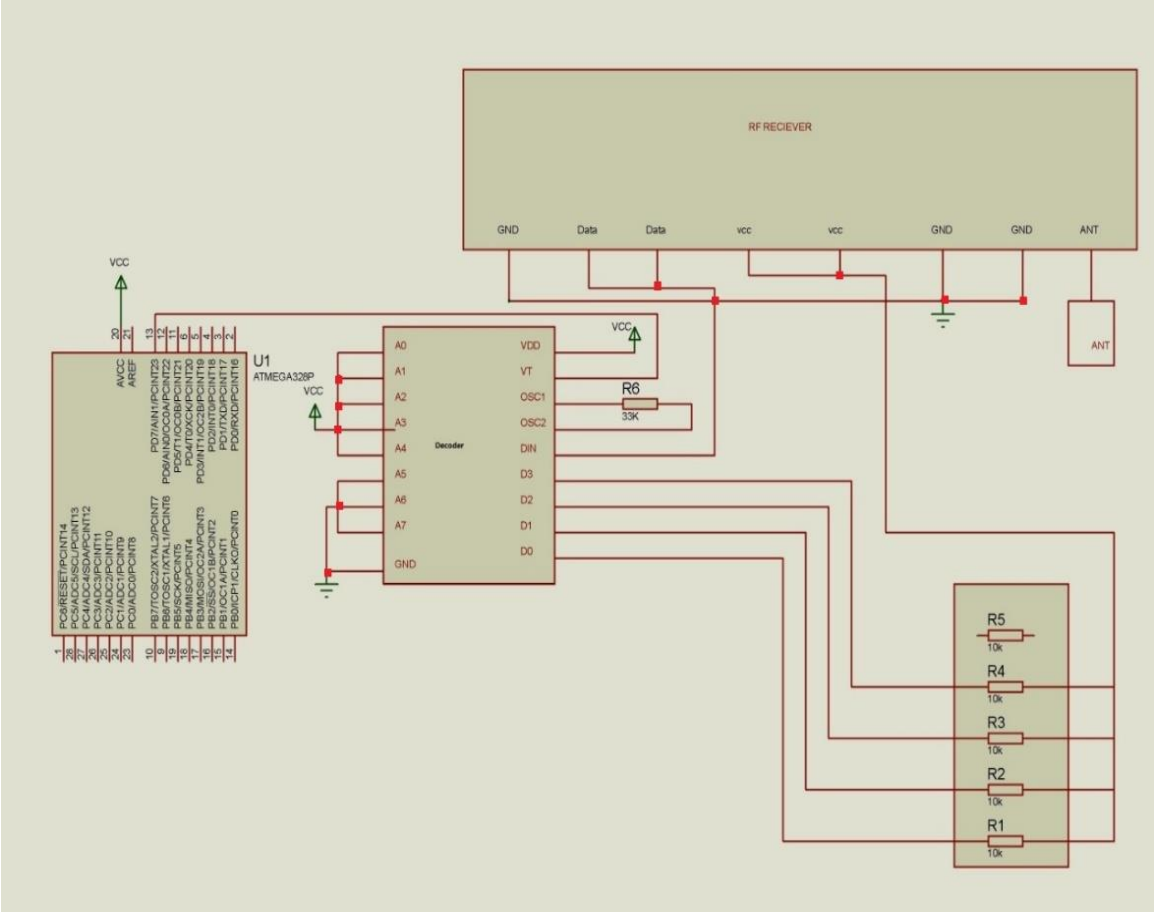

Figure 3.18: The radio frequency receiving circuit

3.1.12 ESP32 Cam

ESP32-CAM is a very slight camera piece with the ESP32-S chip. Besides the OV2640 camera, and several GPIOs to attach pieces, it also features a micro SD card slot that can be useful to store photos taken with the camera or to store files to serve to clients.

- **Features**

  1. The smallest 802.11b/g/n Wi-Fi BT SoC module
  2. Low power 32-bit CPU,can also serve the application processor
  3. Up to 160MHz clock speed, summary computing power up to 600 DMIPS

4. Built-in 520 KB SRAM, external 4MPSRAM
5. Supports UART/SPI/I2C/PWM/ADC/DAC
6. Support OV2640 and OV7670 cameras, built-in flash lamp
7. Support image WiFI upload.[12]

Figure 3.19 below shows the ESP32 Cam

Figure 3.19: The ESP32 Cam [12].

3.2 Engineering Standards and Constraints

3.2.1 Environmental Consideration

The proposed system works on turbine and solar electric energy, so its cant effect on the environment since there is no fuel burning in the proposed system

3.2.2 Economic consideration

the total cost of the system is about 140$, this is for the made model but in real life the cost of the electric car is almost the same price for the gas engine car but the running cost of electric cars is much less than other types

3.2.3 Manufacturability

The components which used in this proposed project are easy to use and accessible from a lot of market.

3.2.4 Health and safety Consideration

The proposed system can't harm the human or animals, it safe to use.

3.2.5 Political Consideration

No direct political effect due to the proposed system, but when replacing the fuel engine cars with electric vehicles the country demand of fuel will be reduced and it will be more dependent from other countries.

4. Analysis

A schedule for Arduino hardware may be recorded in any compute language with connoisseur that produces binary machine code for the function processor.

Atmel afford an improvement environment for their 8-bit AVR and 32-bit ARM Cortex-M based microcontrollers: AVR Studio (earlier) and Atmel Studio (modern).

- **IDE**

The Arduino integrated development environment (IDE) is a cross-platform operation that is reported in the programming language Java.

It originated from the IDE for the languages Processing and Wiring. It introduces a code editor with characters such as text cutting and pasting, searching and replacing text, automated indenting, brace identical, and syntax highlighting, and affords uncomplicated one-click structure to organize and upload programs to an Arduino board.

It also consist of a message area, a text console, a toolbar with buttons for common operates and a hierarchy of operation menus. The origin code for the IDE is discharged under the GNU General Public License, version 2.

The Arduino IDE supports the languages C and C using exclusive rules of code structuring.

User-written code only requires two basic functions, for starting the sketch and the main program loop, that are edited and related with a program stub main () into an executable cyclic executive program with the GNU toolchain, also holed with the IDE transportation.

- **Sketch**

A sketch is a program written with the Arduino IDE. Sketches are released on the improvement computer as text files with the file extension .ino. Arduino Software (IDE) pre-1.0 saved sketches with the extension .pde.

Figure 4.1 below shows screenshot of the Arduino IDE

Figure 4.1: Screenshot of the Arduino IDE [14].

5.1 Conclusion

- Hybrid system is formed from solar energy photovoltaic and wind turbines that supply power for batteries which is giving energy to DC loads inside car.
- Hybrid car is smart car that available to control without human interface inside car driving by using far control system.
- It has become possible to rely on more than one system to feed the loads of energy, which distinguishes the hybrid energy system from other renewable energy systems.

- **References**

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[11]: https://www.itead.cc/rf-receiver-module-433mhz.html

[12]: https://randomnerdtutorials.com/esp32-cam-video-streaming-face-recognition-arduino-ide/

[13]: https://www.dx.com/p/12v-220rpm-dc-gear-motor-with-hall-encoder-silver-multi-colored-2072067.html#.XcMEljMzbIU

[14]: https://randomnerdtutorials.com/how-to-install-esp8266-board-arduino-ide/

[15]: https://mikroelectron.com/Product/Push-Button-Switch/

- **Appendix Code**

```
//RF Hybrid Robot

int sw1 =2;

int sw2 =3;

int sw3 =4;

int sw4 =5;

int out1=8;

int out2=9;

int out3=10;

int out4=11;

Void setup ()

{

  pinMode(sw1,INPUT);

  pinMode(sw2,INPUT);

  pinMode(sw3,INPUT);

  pinMode(sw4,INPUT);

  pinMode(out1,OUTPUT);

  pinMode(out2,OUTPUT);

  pinMode(out3,OUTPUT);

  pinMode(out4,OUTPUT);

}

void loop()

{

  If ((digitalRead(sw1)==LOW) && (digitalRead(sw2)==HIGH) &&
(digitalRead(sw3)==HIGH) && (digitalRead(sw4)==HIGH))
```

```
  {
   fwd();
  }
  else if ((digitalRead(sw1)==HIGH) && (digitalRead(sw2)==LOW) &&
(digitalRead(sw3)==HIGH) && (digitalRead(sw4)==HIGH))
  {
   bwk();
  }
  else if ((digitalRead(sw1)==HIGH) && (digitalRead(sw2)==HIGH) &&
(digitalRead(sw3)==LOW) && (digitalRead(sw4)==HIGH))
  {
   lft();
  }
  Else if ((digitalRead(sw1)==HIGH) && (digitalRead(sw2)==HIGH) &&
(digitalRead(sw3)==HIGH) && (digitalRead(sw4)==LOW))
  {
   rgt();
  }
  else
  {  digitalWrite(out1,LOW);
    digitalWrite(out2,LOW);
    digitalWrite(out3,LOW);
    digitalWrite(out4,LOW);
  }
}
void fwd()
```

```
{  digitalWrite(out1,HIGH);
   digitalWrite(out2,LOW);
   digitalWrite(out3,HIGH);
   digitalWrite(out4,LOW);
}
void bwk()
{   digitalWrite(out1,LOW);
    digitalWrite(out2,HIGH);
    digitalWrite(out3,LOW);
    digitalWrite(out4,HIGH);
}
void lft()
{   digitalWrite(out1,LOW);
    digitalWrite(out2,HIGH);
    digitalWrite(out3,HIGH);
    digitalWrite(out4,LOW);
}

Void rgt()
{   digitalWrite(out1,HIGH);
    digitalWrite(out2,LOW);
    digitalWrite(out3,LOW);
    digitalWrite(out4,HIGH);
}
```