

IoT Based Smart Solar Vacuum Cleaner Project

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Abstract:

IoT-based smart solar vacuum cleaner is a new sustainable solution for cleaning solar panels and optimizing energy consumption. As solar power continues to grow as a renewable energy source, solar panel maintenance and efficiency have become increasingly important. Dust, debris and other contaminants can accumulate on the solar panel, resulting in reduced efficiency and power. Traditional cleaning methods are expensive, time consuming and often impractical, especially for large solar installations. This research presents a new method for solar panel cleaning using a solar powered IoT vacuum.

The system consists of the following main components:

Solar Vacuum Cleaner Unit: This cleaning machine consists of a brush and a vacuum cleaner specially designed to gently remove dust and debris from the solar panel without damaging it. **Solar Panel Monitoring System:** Integrated sensors continuously monitor the cleanliness and functionality of solar panels. The data is sent to a central control center for analysis. **IoT Network:** Wireless communication connects solar vacuum cleaner an central control center for real-time data exchange and remote control. **Central Control Unit:** This unit acts as the brain of the body, processing information from monitoring sensors and making intelligent decisions. It uses machine learning algorithms to predict the optimal cleaning time for each panel. **Solar power and batteries:** Solar powered vacuum cleaners are solar powered and self powered. It is also equipped with a storage battery that guarantees uninterrupted operation even on cloudy days or at night.

INTRODUCTION:

Cleaning is an important business almost everywhere. This is sometimes easy, sometimes difficult. Sometimes we hire and pay people to clean sometimes we have to clean in areas where 's life is at risk, so we can't bring all to life. It takes more than one person to clear so we need some tools to do . As science progresses, robots appear, tab but in they were run by humans.We need more than technologies to avoid these manpower limitations. Automation solves this problem well. That's why we built the autonomous floor cleaning robot. Because the ultrasonic sensor acts as the eye of the robot, the ultrasonic sensor is the most important part of the autonomous floor cleaning robot. The ultrasonic

sensor can be used to turn the robot by detecting obstacles or walls. The measured distance is set by programming. In most cases, the robot hears the issue and returns. Cleaning is an important business everywhere. This is sometimes easy, sometimes difficult. Sometimes we have people clean and pay cash for reasons, sometimes we have to clean in areas where lives are at risk, so we can't change lives anywhere. There are few places with large areas to protect the because we need more than one person so we need to find a way to get the to fix these problems. Robots are appearing in science education, but are employed by teachers. We need more innovation to break the limitations of teachers. Computerization is an unusual solution to this problem. So we created a vacuum cleaner robot that works with IoT and Arduino programming. Today's families are getting smarter and more technological. one. Building robots at home provides help and creates more opportunities for humans. Home robots enter homes and the lives of people every day, but this is still a new and immature market.

MOBILE INDUSTRIAL ROBOTS:

Mobile industrial robots, also known as autonomous mobile robots (AMRs), are advanced robotic systems designed to automate material handling and transportation tasks within industrial environments. They are equipped with sensors, onboard computing capabilities, and sophisticated navigation systems that allow them to operate autonomously without the need for human intervention or infrastructure modifications.

Here are some key characteristics and features of mobile industrial robots:

1. **Navigation:** Mobile industrial robots use a combination of sensors, such as lasers, cameras, and lidar, to perceive their surroundings and navigate through the workspace. They can detect obstacles, map the environment, and plan optimal paths to reach their destinations.
2. **Autonomy:** These robots operate autonomously, meaning they can make decisions on their own and adapt to dynamic environments. They can handle tasks such as picking up and delivering items, transporting materials, and collaborating with humans or other robots.
3. **Flexibility:** Mobile industrial robots are highly versatile and can be easily deployed in various industrial settings, including warehouses, factories, fulfillment centers, and distribution centers. They can navigate around obstacles, move between different workstations, and work alongside human workers.
4. **Safety:** Safety is a crucial aspect of mobile industrial robots. They are equipped with built-in safety features, such as collision avoidance systems, emergency stop buttons, and sensors to detect and respond to human presence. These measures ensure the safety of both the robots and the humans working in their proximity.

EXISTING SYSTEM:

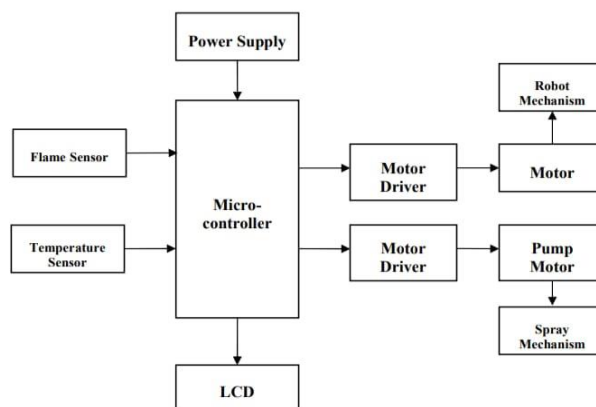
INTRODUCTION:

In the current system, an object search method based on global images based on contour elastic matching is proposed. This paper does many different tests. The authors concluded that dustmap shortens the cleanup time, as it reduces the time required to clean the same area multiple times. Interference in the chamber increases the time and energy consumed by the as the vacuum needs to be changed more frequently.

EXISTING SYSTEM:

The researchers used the design method as they intended to talk more with client software through meanwhile he will (partially) learn more in layout In summary, the developer prioritizes meeting the needs of the purchasing machine throughout the process. The first "customer rest" bulletin and improvement in that is, at the level of "build / update model" immediately after the needs of the buyers, especially as a finished product to complete the design and preparation special. from "research driver model" level to . We already have as a hobby, see what software the buyer needs, or whether the needs more than machine software, that's what was designed for, if less needed go to real .

EXISTING SYSTEM BLOCK DIAGRAM:



DISADVANTAGES:

- Existing system has some limitations due to atmospheric conditions.
- Also had limitation of high false alarm rate.
- System was installation of too many antennas;
- Continuous power was required to both WSN sensor setup and antennas.
- In addition to this climatic/seasonal changes can affect the system

PROPOSED SYSTEM:

INTRODUCTION:

Cleaning is important business almost everywhere. This is sometimes easy, sometimes difficult. Sometimes we have people do the cleaning of and pay for it, sometimes we have to clean in areas where the life of is in danger, so we can't give life to all.

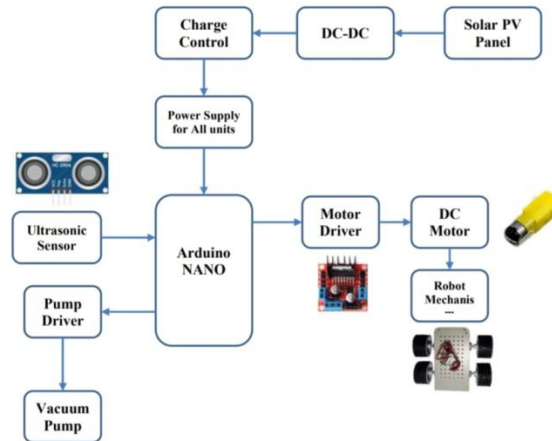
PROPOSED SYSTEM:

First check if it is in book mode. If so, check the keyboard. Controls whether a key is pressed on the keypad, for example left, right, or middle. If so, then the data of will appear on the LCD, so we use the mobile phone as a remote control to manually control the robot. Data is sent to bot . It then checks for any problems. If so, show the signal and tell robots to stop and return to manual mode. If there is no interference , the robot checks the received signal. If a data signal is received, starts decoding the data and displays it on the LCD.

If the data signal is not received, it returns and checks the data sent to.

- We created this project based on the installation of all parts of the robot on the robot and controller via wireless devices.
- If fire is detected, the thermal sensor sends a signal to the processor.
- Find the fire location according to the displayed directory

PROPOSED SYSTEM BLOCK DIAGRAM:



The concept uses physics and engineering electronics to produce the flame. It is important to understand that, according to the physics aspect of the sound wave, the sound wave pattern is known as the longitudinal pressure wave - this means that the waves move in a returning vibrational sound and they can confuse the wind. molecules move away from the fuel of the flame . Second, we assume that the physical aspect of the ideal gas law has an effect on the flame. The ideal gas law states that the time pressure volume of the gas is equal to n, the product of, and the constant R, the universal gas temperature time ($PV = nRT$). Therefore, when the pressure wave is directed to the surface of the flame, it lowers the pressure of the surface, which in turn lowers the temperature of the flame.

Ultrasonic sensors are used to detect obstacles in this system. The frequency of the sound wave emitted by the ultrasonic sensor is the ultrasonic spectrum (20KHZ), which the human ear cannot hear. The sound waves hit the barrier and returned to the detector. Ultrasonic sensors are used to detect objects/obstacles and move them in the robot direction. Blind calls the mobile phone number registered in the microcontroller with in an emergency using the GSM module. Robot movement will be controlled using GSM technology. And the uses ultrasonic obstacle avoidance to achieve this. Here is an Arduino Uno used as a microcontroller. The circuit consists of a GSM module, an ultrasonic sensor, two L293D driver ICs, two motors, a vacuum cleaner and an LCD screen. The ultrasonic sensor trigger and echo pins are respectively connected to the PWM on the Arduino. The virtual terminal represents the GSM module. RXD and TXD of GSM module are connected to TXD and RXD of Arduino. A motor driver IC (L293D) is used to drive the. The connection between the two motors is to drive the motor

- IN1 and IN2 of are connected to motor
- Connects to L293D engine. power 1, OUT3 and OUT4 are connected to motor
- LCD interface is LCD RS, E, D4-D7 connection.

ADVANTAGES:

- This technology is used to construct an efficient and intelligent dynamic evacuation path.
- Reduce casualties and economic losses.

SYSTEM REQUIREMENTS:

HARDWARE REQUIREMENT:

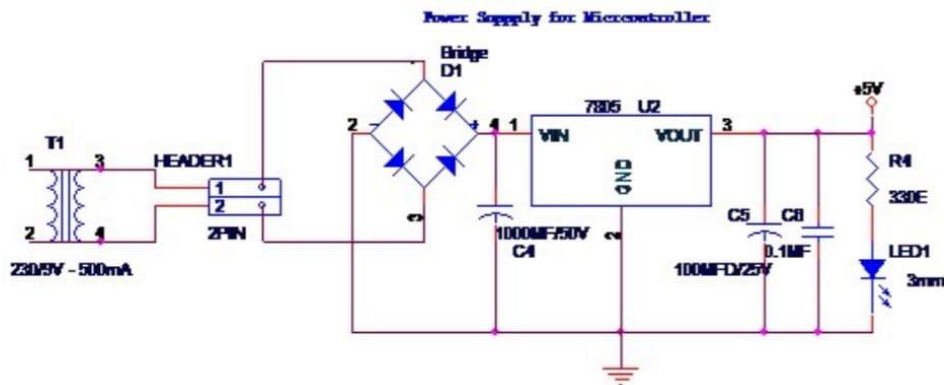
- Arduino NANO
- Ultrasonic Sensor
- Vacuum Pump
- Solar Panel
- Battery
- Robot Mechanism

SOFTWARE REQUIREMENTS:

- Arduino IDE

POWER SUPPLY:

A Power Supply Unit (sometimes called a Power Supply Unit or PSU) is a device or system that supplies electrical power or other power to the Load output or load bank products. The term is usually used for electrical equipment is rarely used for mechanical equipment and rarely for other equipment.



Block diagram of power supply

This circuit is a small +5V power supply which is useful when doing digital experiments with the. Small, inexpensive wall transformers with to change output voltages can be purchased from all electronics stores and supermarkets. Transformers are simple, but often have poor regulation, making them of little use in electrical testers unless a good control of the accomplishes anything. The answer to question is below.

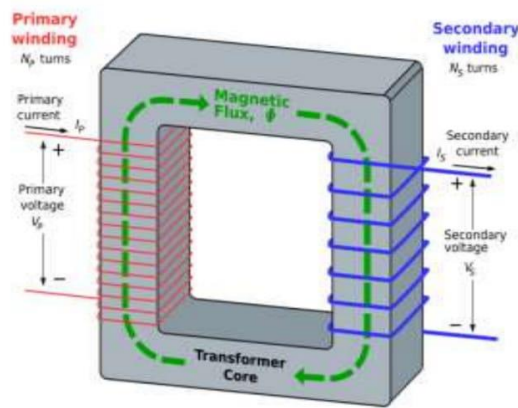
TRANSFORMER:

A transformer is a device that converts electricity from one circuit to another through inductive coupling. A change in current in the primary circuit (primary) causes the magnetic field to change; in turn, this magnetic field causes a change in voltage in the secondary circuit (secondary). When a load is added to the second circuit, current will flow in the transformer so changes energy from one circuit to another.

The second induced voltage V_S is measured from the first V_P , which is equal to the ratio of the number of turns in different windings:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

With the right choice, the transformer will allow to increase the AC voltage by making N_S greater than N_P , or to lower by making it smaller. Transformers are some of the most efficient electrical "machines", some large units are capable of converting 99.75% of input power into output. Transformers come in a variety of transformers hidden in stage microphones to huge gigaamp-rated units used to cut parts of the national grid. Although there are many models designed for specific home and business tasks, they all work on the same principle.



An ideal step-down transformer

A simple ideal step-down transformer design is shown in figure above. Now create a magnetic field in the first step. primary and secondary coils are wound on iron core with high permeability, such as iron core; this ensures that most of the magnetic field is generated by the primary current in the wire and goes through the secondary coil. like the first coil.

RECTIFIER:

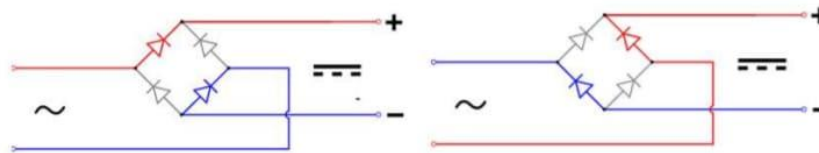
A rectifier is an electrical device that converts alternating current (AC) to direct current (DC) that flows in only one direction. This process is called correction. The rectifier is used as a component of electronic equipment and a receiver of the radio signal. There are three rectifiers. Half wave rectifiers, full wave rectifiers and bridge rectifiers.

Bridge Rectifier:

A diode bridge is an arrangement of four (or more) diodes in a bridge circuit configuration that provides an output in the same polarity and an input in both polarities. In its most common application, the is known as a bridge rectifier as it converts a direct current (AC) input to a direct current (DC) output. The bridge from a 2-wire AC input to a 3-wire input with a central tapped secondary winding transformer. The basic feature of the diode bridge is that whatever the polarity of the input to the is, the polarity of the output is the same.

Basic operation:

In the figure below, when the input connected to the left side of diamond is positive and the input connected to the right side is negative, current flows from the supply using the upper part as the red (good) path on the right. Take exit and take the blue (negative) road back to the lower transport area.



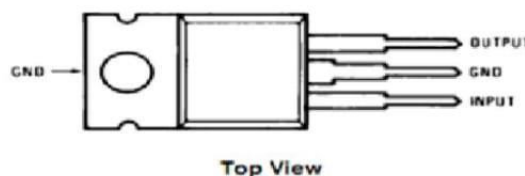
Current flow of bridge rectifier

When the left corner connected input is negative and the right connected input is positive, current flows from the low voltage terminal along the right side red (good) path to the output and back to the upper power. take the blue (negative) route to the terminal at. In all cases, the upper right output is positive and the right output is negative. Since this is true regardless of whether the input is AC or DC, instead of the producing only DC from the AC input, this circuit also gives the what is sometimes referred to as "reverse polarity protection". That is, when the battery returns toor the leads (wires) of the DC power supply return to , it allows DC power tools to work properly and protects the device from damage caused by reverse polarity.

IC Voltage Regulators:

Voltage regulators include a commonly used class of ICs. Regulator IC Unit includes power supply, comparator, controller, and overload protection in a single IC. While the internal structure of the IC is slightly different from the different voltage regulators described, the external operation of the is the same. IC unit provides regulation of constant positive voltage, constant negative voltage or adjustable set voltage. The power supply can be produced using a transformer connected to the AC power line to step up the AC voltage to the desired level, then adjust the AC voltage, filter the with capacitors and RC filters if necessary, and finally control the DC voltage . Using IC voltage regulator. The voltage regulator can select an operating current from hundreds of milliamps to tens of amps, corresponding to a power rating of from milliwatts to tens of watts.

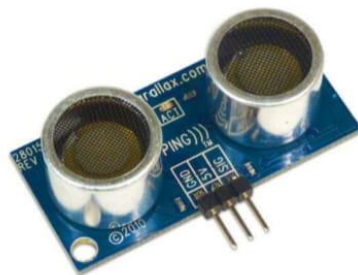
Three-Terminal Voltage Regulators:



Basic connection of a three-prong regulator IC to a load. The Constant Voltage Regulator has a constant DC input voltage (V_i) applied to an input terminal , controlling the output DC voltage (V_o) from the second terminal and the third of the to ground. For an optional controller, IC device specification specifies a range within which the input voltage can vary, and provides a fixed output voltage over a range of input currents. The specification also specifies the amount of output voltage change due to

changes in load current (load regulation) or input voltage (line regulation). 78 Series Voltage Regulators provide stable voltage regulation from 5 to 24 V. The schematic shows how the IC is connected to the +5V DC output of the unit of the 7805 to provide voltage control. The unregulated input voltage V is filtered by the capacitor C1 and is connected to the IN terminal of the IC. The IC's OUT terminal provides a regulated + 12V voltage filtered (for noise only) by capacitor C2. Third IC terminal grounded (GND). When the input voltage can vary within some range of output voltage, and the output load can vary within some range, the output voltage remains constant within the voltage change limit. These parameters are specified in the manufacturer's specification sheet.

ULTRASONIC SENSOR:



Ultrasonic sensors

Ultrasonic sensors are based on measuring equipment of sound parameters with frequencies above the human audible range. They follow three physical principles: time of flight, Doppler effect, and sound wave attenuation. The Ultrasonic Sensors do not interfere as they do not need physical contact with their targets and can detect some clear or bright targets that would otherwise interact with the for some that don't look like sensors. On the other hand, its measurements are sensitive to temperature and target. ultrasonic sensor "According to the measurement of the acoustic energy of at frequencies above the human audible range", (40 kHz 1), respectively.

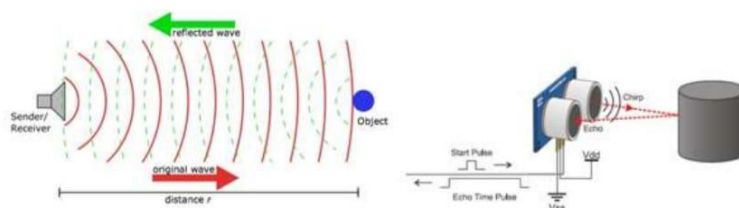
They usually work by generating reverb pulses and then taking and measuring the characteristics of the reverb pulses. The can measure three different echo pulses received for different targets.

Modes of Operation:

Reflection Mode:

The pulse bounces off a target and returns to the receiver after a time interval t. The receiver records the length of this time interval, and calculates the distance travelled r based on the speed of sound c.

$$r = c * t^2$$



Working model

Often, separate transmit and receive transducers are placed side by side in a room. (PING) Range Finder, Omega flowmeter and Migatron high precision sensor below are all design. then the distance from the

sensor to the target will be twice the distance. With proper coordination, a switch can be used to send pulses and receive echoes. Note that it takes time for the transducer to change the die, making it difficult to measure closely.

Direct Measurement Mode:

In this mode of operation, the transmitter and receiver are two separate units moving towards each other. For example, the receiver may be fixed to a moving destination to a fixed delivery location, and vice versa. They may use multiple emitters to increase the direction of the propagating pulses. Lima et al. Several ultrasonic transmitters are placed on the Performer, whose signals are received by several receivers in the Performance area, allowing a computer program to triangulate the Performer's position.

SOFTWARE DESCRIPTION:

Arduino is open source, electronics based, easy to use hardware and software. Arduino boards can read the input - light from the sensor, finger on the button, or Twitter message - and convert that to an output - activate the motor, turn on the LED, post something online. You can tell your board what to do by sending instructions to the microcontroller on the board. For you can use Arduino programming language (wiring based) and follow Arduino software (IDE). The Arduino has been at the center of thousands of projects over the years, from everyday tools to complex research tools. A global community of creators - students, amateurs, artists, professionals and professionals - gathered around the open platform and contributing an incredible useful information whose contributions should be valued can be of great help to novices and novices alike. experts liked it. The Arduino was born by the Ivrea Interaction Design Institute as a simple tool for rapid design, for students without electronics and programming background. Once the Arduino board reached the wider community, it began evolving to meet new needs and challenges, differentiating its use from the as a simple 8-bit board for use in IoT applications, wearables, 3D printing, and embedded environment. . All Arduino boards are fully open source and the allows users to create their own boards and ultimately adapt them to their specific needs . The software is also open source and continues to grow with the participation of users worldwide.

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The cheapest version of the Arduino module can be assembled by hand even before the Arduino module comes in for less than \$50.

Cross-platform - Arduino software (IDE) runs on Windows, Macintosh OSX and Linux operating systems. Most microcontroller systems are, Windows only.

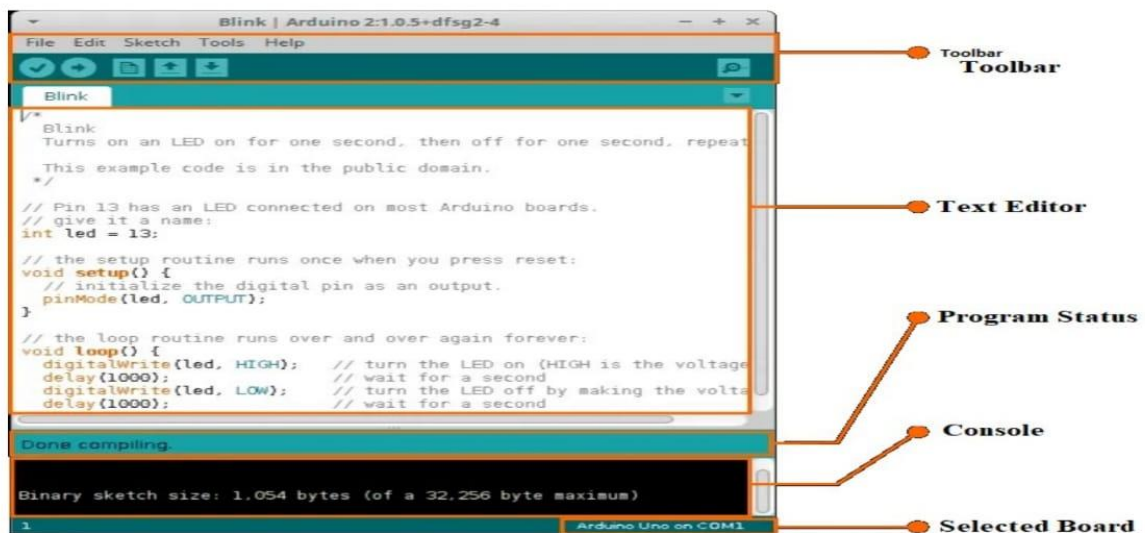
Simple, clear programming environment - The Arduino Software (IDE) is easy for beginners, but flexible enough for advanced users to take advantage of the. It is as easy for teachers as the operating environment, so students learning in the environment will know how the Arduino IDE works.

Open source and extensible software - Arduino software released as an open source tool that can be extended by experienced programmers. The language can be extended with the C++ library, and anyone who wants to understand the content of can switch from Arduino to the AVR C programming language on which it is based. Similarly, you can add AVR-C code directly to your Arduino program if you want.

Open source and extensible hardware - The plans for the Arduino board have been released under the Creative Commons license, so programmers familiar with the can make, expand and develop their own version of the module. Even users unfamiliar with the can create a breadboard model of the to see how it works and save money.

ARDUINO SOFTWARE (IDE):

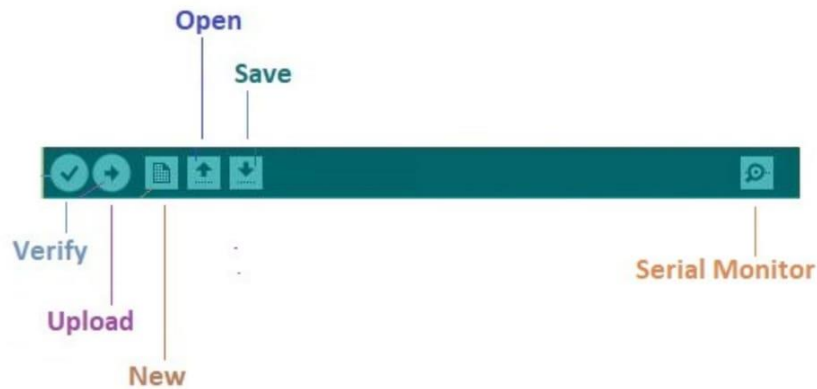
The Arduino Integrated Development Environment - or Arduino Software (IDE) - includes a text box for writing code, a text field, a text console, a toolbar with buttons for actions, and more menu items. It connects to the Arduino hardware to upload programs and communicate with them.



Writing Sketches:

Programs written using Arduino software (IDE) are called sketches. sketches are written as text and saved with the .ino file extension. Editor has text cut/paste and search/replace features. When saving and exporting, the message field has comments and an error will occur. The console displays the output of the Arduino software (IDE), including the completion error message and other information. The lower corner of the window shows the board configuration and serial port. Toolbar button allows you to define and load programs, create, open and save drawings, and open monitors.

- **Verify** Checks your code for errors compiling it.
- **Upload** Write your code and upload it to the installer board. See the download below for details. NOTE: If you are using an external programmer on the board, you can press and hold the "shift" key on the computer while using this symbol. The text will change to "Install using Programmer".
- **New** Creates a new sketch.
- **Open** Put a menu on each drawing in Sketchbook. When is clicked, it opens in the current window and its contents are saved.
- **Save** Saves your sketch.
- **Serial Monitor** Opens the serial monitor.



Arduino IDE Tool Icon

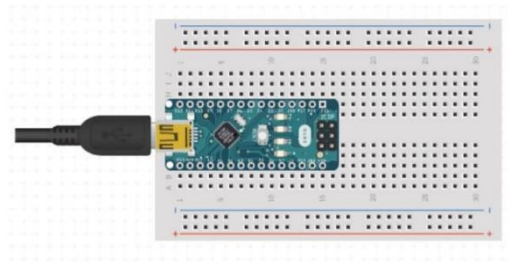
Additional commands can be found in five menus: File, Edit, Sketch, Tools, Help. The menu is contextual, meaning only items related to the task in progress are displayed.

Boards:

The clipboard chooses to do two things: set the parameters used when compiling and uploading the sketch (like CPU speed and baud rate); and lists the file and fuse settings used by the burn bootloader command. The contents of some boards differ only in the latter, so even if you successfully installed with custom options, you still need to check before writing the bootloader. The Arduino software (IDE) includes built-in support for the boards listed below, all based on the AVR core.

Started with the Arduino:

Arduino Nano is a small, complete, breadboard friendly board based on the ATmega328P. It has the same connections and features as the UNO board in a smaller form factor.



Arduino NANO Interface

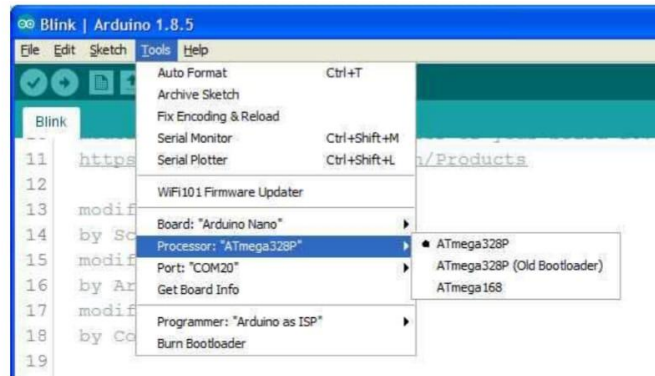
The Arduino Nano is programmed using the Arduino Software (IDE), our Integrated Development Environment for all our boards and can run the online and offline. For more information on how to get started with the Arduino software, visit the Getting Started page.

Open your first sketch:

Open the LED blink example sketch: File > Examples > 01.Basics > Blink. Select Tools > Board > Arduino AVR Boards > Arduino Nano.

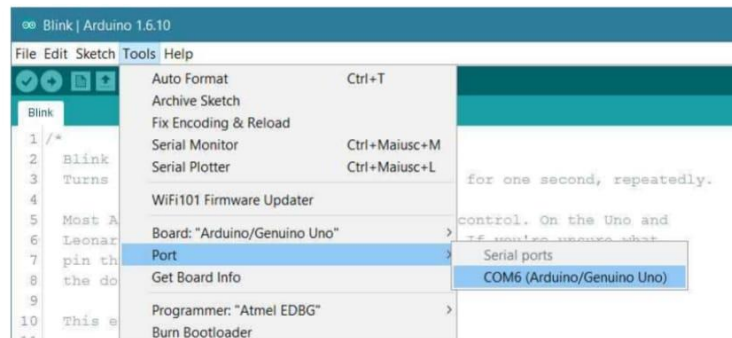
Note: We updated the nano board with a brand new bootloader. The motherboards we've sold since January 2018 have the new bootloader, while the boards produced before that date have the old bootloader. First, check Tools > Board > Board Manager to see if Arduino AVR Boards 1.16.21 or is

installed. Next, you need to select Tools>Processor>ATmega328P in to work on the new Arduino NANO board. To work on legacy board you need to select Tools > System > ATmega328P (Legacy Bootloader). If you encounter error during installation or are unsure of which bootloader you are using, try everything from the Tools > Processor menu until your board is programmed.



Picture of select the NANO Processor Type

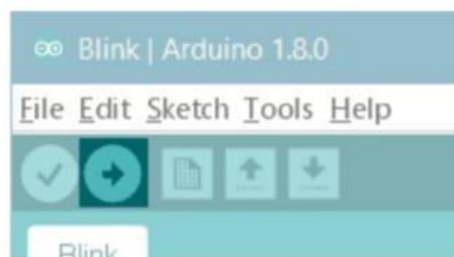
Select the Serial Port tool from the Serial Port Tools menu. This is probably COM3 or later (COM1 and COM2 are usually reserved for hardware serial ports). You can cut the board and reopen menu to find out; the missing input must be Arduino board. Reconnect board and select serial port.



Picture of Select Board Type

Upload and Run your first Sketch:

To upload the sketch to the Arduino Nano, click the Upload button in the upper left to load and run the sketch on your board:



Picture of upload to Nano

Wait a few seconds - you should see the RX and TX LEDs on the board blink. If the installation is complete, the message "Installation complete" is displayed. will appear in the status bar.

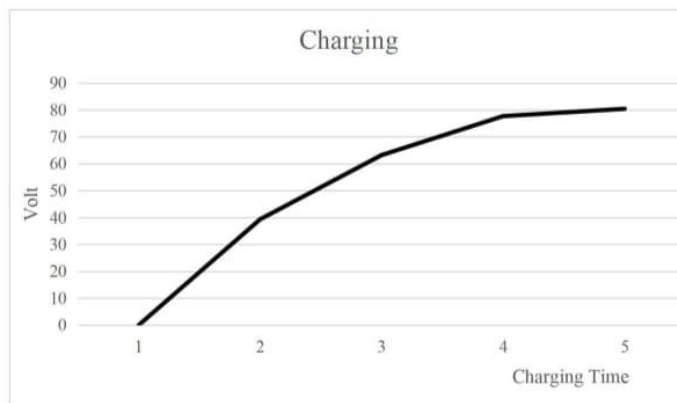
RESULT AND DISCUSSION:

First check if it is in book mode. If so, check the keyboard. Controls whether a key is pressed on the keypad, for example left, right, or middle. If yes, information is displayed on the LCD accordingly. Our phone number is and it is used to manually control the robot remotely. The information is sent to the robot. will then check to see if any problems are found. If yes, show the signal and tell the robot to stop and return to manual mode. If there is no interference, the robot checks the received data signal. If a data signal is received, starts decoding the data and displays it on the LCD. If the data signal is not received, it returns and checks the sent data.

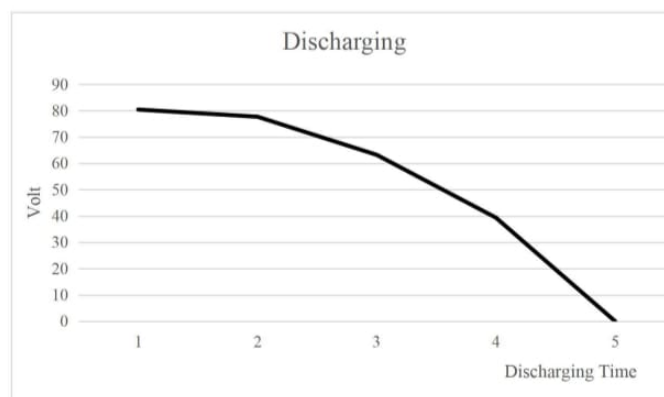
- Battery Capacity - 12V -10 Ah
- Panel Capacity 9V- 7 Watts
- Vacuum Suction Force - 3500 PA
- Suction Patricel Size and Weight- 80-100gsm

BATTERY CHARGING TIME:

- Through Panel - 4 hrs
- Through DC Supply - 2hrs



Charging



Discharging

The frequency of the sound wave emitted by the ultrasonic sensor is in the ultrasonic frequency spectrum (20KHZ), which the human ear cannot hear. The sound wave hit the barrier and returned to the detector. Ultrasonic sensors are used to detect objects/obstacles and move the robot's direction. Blinds

uses the GSM module to call the mobile phone number registered in the microcontroller in an emergency and calls. The movement of the robot will be controlled using GSM technology. And the uses ultrasonic obstacle avoidance to achieve this.

CONCLUSION:

The Solar Panel Maintenance System project aims to bring better solutions to sustain solar power. The main task is to create a machine that can clean the solar panel with the appropriate control. This project has to learn design control, python coding to build and interacts with electronic equipment. Use the boards to learn how to design the circuit, the hardware blocks, relays and mechanics are all new. says so, the project completes the plan established by the administrative management and mechanism. The DC motor is controlled by relays and drivers, and the does the speed and control. In addition, control rules for DC motor and pump were written and entered into the system. Overall, the design and improvisation of the sonic fire extinguisher is complete. All extinguishers must be made for the to function properly. The sonic fire extinguisher with these modifications will complement the new safety and firefighting and rescue. According to the test of, it is seen that the sound wave can extinguish the flame.

PROGRAM:

```
//Header File
#include<Wire.h>
#include <SoftwareSerial.h>
SoftwareSerial myStream(2, 3); //pins for Rx and Tx respectively
//Temperature Sensor Define I/O
const int analogtemp = A2; // This is the analog pin which is measuring the input
voltage from the LM35 temperature sensor
double temp=0, Vin=0, samples[250];
unsigned int j=0;
const double Vref=1100.0;
//Define I/O
int gasPin = A3; // Gas Input Pin
float sen_vol = 0;
float sen_val = 0;
//L293D
//Left Motor A
const int L1 = 2; // Pin 14 of L293
const int L2 = 3; // Pin 10 of L293
//Right Motor B
const int R1 = 4; // Pin 7 of L293
const int R2 = 5; // Pin 2 of L293
nt incomingByte = 0;
// Ultrasonic pins numbers
const int trigPin = A0;
const int echoPin = A1;
// defines variables
```

```
long duration;
int distanceCm;
int fir = A2;
int fire= 0;
int sp = 0;
int spk = 9;
//Main program
void setup()
{
//Sensor Input
pinMode(fir, INPUT);
pinMode(spk, OUTPUT);
//L293D Output
pinMode(L1, OUTPUT);
pinMode(L2, OUTPUT);
pinMode(R1, OUTPUT);
pinMode(R2, OUTPUT);
//Ultrasonic Pin
pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
pinMode(echoPin, INPUT); // Sets the echoPin as an Input
Serial.begin(9600);
delay(1000);
}
//Loop program
void loop()
{
//Ultrasonic Sensor
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distanceCm= duration*0.034/2;
//distanceInch = duration*0.0133/2;
fire = digitalRead(fir);
if(distanceCm < 8)
{
digitalWrite(L1, LOW); // control for stop
digitalWrite(L2, LOW);
digitalWrite(R1, LOW);
digitalWrite(R2, LOW);
Serial.println("OB Stop\n");
```

```
}
serialmotor();
if(sp ==1){
while(1){
digitalWrite(spk , HIGH);
delay(50);
digitalWrite(spk , LOW);
delay(50);
serialmotor();
if(sp == 0){
digitalWrite(spk , LOW);
return;
}
}
}
else{
digitalWrite(spk, LOW);
}
Serial.println();
delay(500);
}
void serialmotor()
{
if (Serial.available() > 0)
{
incomingByte = Serial.read();
}
switch(incomingByte)
{
case '1':
digitalWrite(L1, LOW); // control for stop
digitalWrite(L2, LOW);
digitalWrite(R1, LOW);
digitalWrite(R2, LOW);
Serial.println("Stop\n");
incomingByte='*';
break;
case '4':
digitalWrite(L1, HIGH); // control for right
digitalWrite(L2, LOW);
digitalWrite(R1, HIGH);
digitalWrite(R2, LOW);
Serial.println("Right\n");
```



```
incomingByte='*';
break;
case '3':
digitalWrite(L1, LOW); // control for left
digitalWrite(L2, HIGH);
digitalWrite(R1, LOW);
digitalWrite(R2, HIGH);
Serial.println("Left\n");
incomingByte='*';
break;
case '2':
digitalWrite(L1, HIGH); // control for forward
digitalWrite(L2, LOW);
digitalWrite(R1, LOW);
digitalWrite(R2, HIGH);
Serial.println("Back\n");
incomingByte='*';
break;
case '5':
digitalWrite(L1, LOW); // control for backward
digitalWrite(L2, HIGH);
digitalWrite(R1, HIGH);
digitalWrite(R2, LOW);
Serial.println("Forward\n");
incomingByte='*';
break;
case '6':
sp = 1;
Serial.println("S ON\n");
incomingByte='*';
break;
case '7':
sp = 0;
Serial.println("S OFF\n");
incomingByte='*';
break;
}
}
```

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