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SOLAR FLOOR CLEANER ROBOT USING IOT

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ABSTRACT
Cleaning is a crucial task in every setting. Depending on where you are, it might be easy or challenging at times. To lessen the impact of labor, we are assigning humans to certain cleaning tasks. Computerization is an excellent solution to this problem. As a result, we created a self-governing floor cleaning robot powered by the internet of things and Arduino programming. We created a little solar floor cleaner robot that can clean both dry and wet surfaces. Solar-powered floor cleaner robot that makes mopping outdoor areas, terraces, open eateries, vast campuses, and so on a breeze. The technology is designed to assist workers in cleaning big open spaces with minimal human effort and without the need to regularly charge the robot It can be employed at nuclear power plants when sending humans to clean is hazardous to their health due to toxic radiations.

Keywords: Solar panel, vacuum cleaner, IOT, sensors, Arduino

I.I INTRODUCTION
Cleaning is a crucial or fundamental necessity in the twenty- first century, particularly in residential settings, where the floor must be cleaned on a regular basis. Diverse methods are used to clean various types of surfaces, with the main goal being to avoid accidental fatalities and injuries caused by glides on floor surfaces, which are primarily caused by poor floor cleaning practises, beautify the floor, start by removing dust, food allergies, debris, and obstacles, prevent surface wear, make the spaces and atmosphere conducive, maintain constriction at an optimum level, and prevent slip [1]

The cleaning process is carried out using several procedures that might be of various types. Different kinds of floor areas necessitate different ways to get the desired outcome, which necessitates that the floor be clear of any liquids and debris during the cleaning procedure; otherwise, it may pose a hazard. On some floors, dust is utilised to absorb various liquids, so that there is no need to prevent them from spilling. Every day, the sawdust must be cleaned and refilled. This method is still employed in butcher shops, but it was formerly popular in pubs. In some places, tea leaves are even used to collect stains on carpets and to remove odours. Today, floor mops, vacuum cleaners, and automatic floor scrubbers can clean nearly everything in much less time than traditional means. It is one of the types of floor cleaners that can clean hard floors or carpets of type [2].

Robots are electromechanical devices used for various tasks and purposes in mechanized domestic work. The advent of robots has brought robotic devices into the consumer market. After iRobot, a number of similar devices were discovered from various manufacturers. The main goal was to create a cleaning device, but over time many improvements have been made to make it better and more efficient [3].

Robots are being integrated into task performance, increasingly replacing humans. In general, robotics can be divided into industrial robotics and service robotics. The International Federation of Robotics (IFR) defines service robots as robots that operate semi- autonomously or fully autonomously to perform tasks that benefit human health and equipment. do or do a job [4]

In this project, we used an IOT based solar floor cleaner. The usefulness of robotic cleaners are helping the people in floor cleaning requirements in hotels, homes, businesses, hospitals, and factories among other locations as recently gained significant attention in robotic research. Robotic cleaners are defined primarily by the cleaning skills they possess, such as floor mopping, dry vacuum cleaning, etc. There are benefits and drawbacks to each robotic floor cleaner's cleaning and operation system.[5]

In this project a solar floor cleaner prototype is designed, and this vacuum cleaner robot has features like a plucking the dirt particles, as well as cleaning the floor by spraying water. This work will significantly benefit the quality of human life. Cleaning is a necessary task in almost every location. This is both simple and challenging at times. We cannot always assign living things to every location since sometimes cleaning is necessary in places where the existence of living beings is dangerous, and we allot people for that purpose and pay them. We needed a method to address this issue because there are some locations that require more than one person to clean effectively. [6]

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II. OBJECTIVE

The objective of our project is to create an autonomous floor cleaning robot that can function in human-hazardous environments without the need for employees. To create an autonomous rover system using the internet of things and to construct a floor cleaning robot that does not require human intervention. It is mainly employed when there are few obstacles and a vast area has to be cleaned.

III. EXISTING SYSTEM

Households are becoming sharper and automated. Home automation makes life easier and saves time. Domestic robots are used in many homes and daily lives as a replacement of man Power. There are various types of robots on market, but only a few can clean wet floors. The Wet Vac Robot is intended to make cleaning more convenient than using a hand sweeper. The main goal is to create a vacuum robot prototype with an Arduino Mega, an Arduino, and an Ultrasonic Sensor. This Robot Vacuum also satisfy various user-friendly requirements.

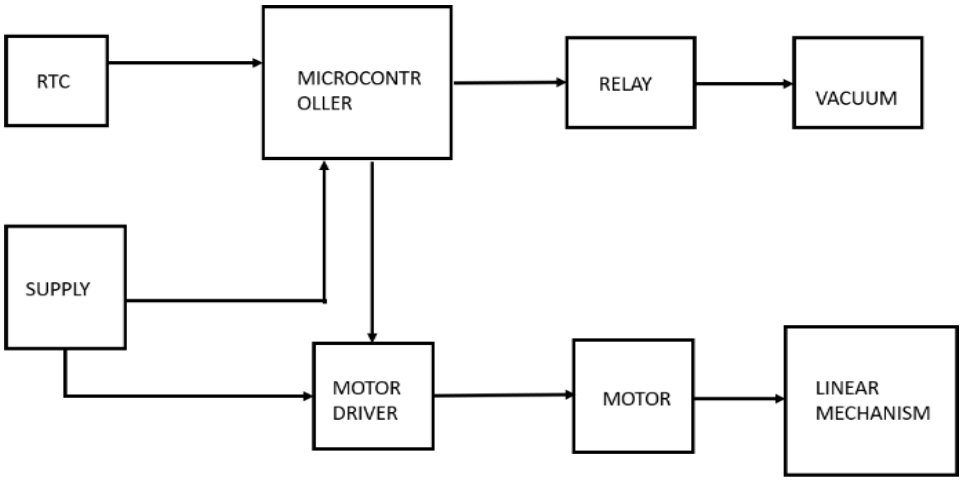

Fig. 1: Block diagram of existing vacuum cleaner

When power is supplied to the microcontroller the motor driver circuit drives the motor. The microcontroller instructs the motor to rotate in forward direction using a rack and pinion mechanism. The microcontroller is a timer-based device that is used to run cleaning cycles at specific intervals whenever needed. The dust accumulated on the panels at a particular place must be calculated before the system is installed, and the frequency of clean module will be programmed or altered based on the findings of the site inspection. Along with geographic location and season, the cleaning interval will change.

IV. PROPOSED SYSTEM

Nowadays households are becoming smarter with these types of automated robots. Which reduces time spend on house chores. Even though vacuum cleaners make the home cleaning process easier, they are noisy and bulky. To reduce these disadvantages, we have made a compact and efficient solar floor cleaner robot. It is equipped with vacuuming and cleaning technology which is controlled by Arduino microcontroller. The battery stores the power generated by the solar panel. The robot relies on a battery, which is continuously charged by a solar panel as it is depleted by the motors. When the battery is exposed to sunlight, it lasts longer. A vacuum cleaner is used in the system.

A 12V solar panel is connected to the battery and battery's electrical energy is used. The electrical switch board has 12V dc battery supply. The Battery is connected to the microcontroller. The primary power supply for vacuum cleaner is received from the electrical board. The DC motor is utilized to run the vacuum cleaner.

It helps to sucks the dirt via vacuum cleaner with the help of cooling fan and sweepers each given by 3V dc motor. The robot is covered by a battery which is rechargeable through 12V solar panel. The dc motor is used for rotating the mop for cleaning. The movement of the robot is carried by two high RPM dc motors. The uneven particles that accumulate on the floor surface is cleaned by the front cleaner machine. Water is cut off throughout for dry cleaning process. The entire operation is managed from a smartphone using Bluetooth technology.

In this case, Using GSM mobile telephone technology, a GSM module is used to provide wireless data is accessing to a network. mobile phones and other devices that are connected to networks use GSM modules. SIM cards link the gadget to the proper network. A servo motor is utilized to regulate the robot's position and speed.

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An ultrasonic sensor is placed which turns 180° for detecting the obstacles and subsequently help the robot navigate a buzzer on the controller indicates the functioning of the sensor The system components includes an Arduino UNO, a relay board, a motor driver, a gear motor, a dc motor, sensor, vacuum cleaner. These system components are controlled and monitored by the Arduino microcontroller.

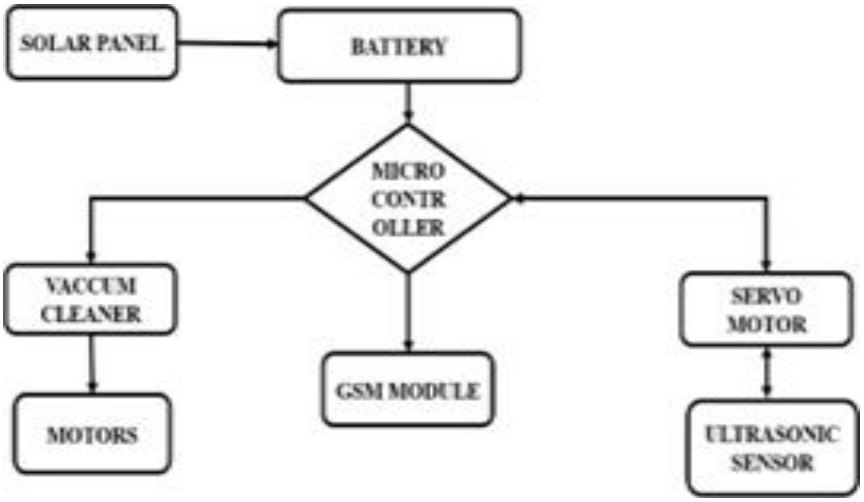

Fig 2: Block diagram of Solar floor cleaner

V. HARDWARE COMPONENTS

The components required for the proposed solar floor cleaner are

- Solar Panel
- BLDC Motor
- ESC
- Switch
- Sensor
- Servo Motor
- Gear Motor
- Battery
- Wires
- 3D Printing Filament
- Acrylic Sheet
- DC To DC Convertor
- Motor Driver
- Arduino UNO

I. Solar panel

Solar panels are made of smaller components known as solar cells. Silicon is the most often used material for solar cells. Solar panels use crystalline silicon placed between conductive layers to gather radiant energy from the sun, which is then turned into electrical energy. in the form of direct current (DC). The solar panel output interface is a PV connector mounted to the panel's rear. For rapid, weatherproof connections to the rest of the system, most photovoltaic modules' exterior connections employ MC4 connectors. Another possibility is to use a USB power interface. It also uses metal frameworks made comprised includes racking components, brackets, reflection forms, and valleys to maintain the structural element of the panel.

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Fig 3: Solar panel

II. BLDC motor

A brushless DC electric motor is one that is powered by a straight current voltage source and connected to the circuit electronically, as compared to brushes in ordinary DC motors (BLDC). Brushes are not used in brushless DC motors. In brushed motors, the coils on the rotor get current from the brushes through the commutator. Consequently, what is the process through which a brushless motor transfers current to the rotor coils? It does not happen because the loops are not located on the rotor. The coils are fixed rather than revolving on the stator, and the rotor is a magnetic material. There is no need for brushes or a BLDC commutator because the coils are stationary.

Many of the tasks that brushed DC motors used to carry out are now handled by brushless motors, Brushless motors cannot completely replace brushed motors in low-cost applications due to their greater cost and more demanding control methods. Brushless motors, on the other hand, have taken over a wide range of applications., particularly those involving CD/DVD players and computer hard drives. The only source of electricity for Brushless motors are used in tiny cooling fans in electrical equipment. They can be found in cordless power tools, where increased motor efficiency allows for greater use before the battery has to be recharged. Direct-drive turntables employ low-speed, low-power brushless motors for gramophone records.

Fig 4: BLDC Motor

III. ESC

ESC means electronic speed control and it is an electronic circuit, it is mainly used to change the speed of the motors Traditional BLDC 30amp ESC Quadcopters and multi-rotor aircraft are designed exclusively for the Electronic Speed Controller (ESC) with Connector. It offers faster and better motor speed control, improving flight performance. The speed of an current motor iscontrolled and regulated by electrical circuit known as electrical speed regulation (ESC). It also has active braking or motor reversing capabilities. In radio-controlled versions powered by electricity, tiny electronic speed controls are employed. Full-size electric cars also incorporate speed-control mechanisms for the driving motors).

The majority of ESCs are used in mass-produced electric automobiles can reverse the motor's direction of rotation. The motor merely operates in the opposite way to for the automobile to move in reverse, even if the vehicle only has one gear ratio. Others operate to reverse direction, run the motor in the same way every time and use a standard manual or automatic gearbox.

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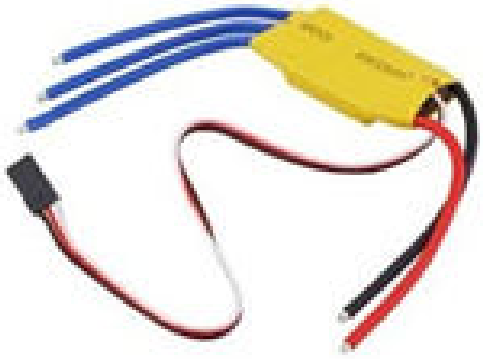

Fig 5: ESC

IV. Switch

A switch is an electronic signal that may split or join a conducting path, either stopping or switching the passage of electricity from one conductor to other. The most common form of a switch is an electro mechanical switches, which consists of one or more sets of movable electrical contacts connected to external circuits. When two contacts are in touch, the current and can flow; when the contacts are separate, current cannot flow. Switch contacts can be operated simultaneously, sequentially, or alternatively, and many set of contact can be controlled by the same knob or an actuator. A switch, similar to a thermostat, can detect the position of the machine part, fluid pressure, stress, or temperature, or it can be triggered manually, similar to a light switch or a button in the keyboard.

It is the simplest type of switch, with two contacts linked to an external circuit and contacting to construct the circuit and separating it to open (broke) the circuit. Metal interactions are quite common. The contact material was chosen because of its corrosion resistance since the majority of metals develop Insulating oxides that prevent the switch from functioning. Contact substances are also selected for their electrical conductivity, mechanical strength, hardness (abrasion resistance), low toxicity, and low cost. The growth of Contact pressure, surface roughness, and oxide coatings on the contact surface all have an impact on a mechanical switch's contact resistance and wetting current. Noble metals are occasionally used to plate connections due to their greater conductivity and corrosion resistance. They might be made to brush against each other to eliminate pollutants.

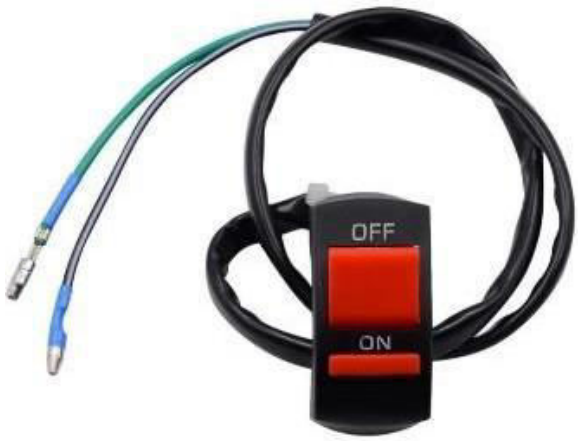

Fig 6: Switch

V. Ultrasonic sensor

Ultrasonic sensors employ ultrasonic sound waves to detect or determine the distance between two objects. An ultrasonic sensor emits and receives ultrasonic pulses from the transducer to determine the object's proximity. They are most commonly used in tandem with proximity sensors. They are used in automobile technology for self-parking and anti-collision protection. They are employed in robotic obstacle detection systems as well as industrial processes. Devices that create or detect ultrasound energy are known as ultrasonic transducers and ultrasonic sensors. They are classified into three types: transceivers, collectors, and transmitters. Transceivers can both transmit and receive ultrasonic, whereas transmitters turn electrical impulses into ultrasound and receivers accept them.

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Fig 7: Ultrasonic sensor

VI. Servo motor

The solar array is aligned using a servo motor to receive the lightest. A digital compass is used to determine the mechanism's location. Once the mechanism is out of position, two modified DC servo motors can move it back to the starting position. The motor utilized in servo systems is a servo motor. A control system that follows instructions is referred to as a servo system. The system's real state and the corresponding state of the instructions can be compared, and the comparison's outcome can be used to guide subsequent control. Direct current (brush and brushless) and alternating current (AC) motors are both types of servo motors (synchronous and asynchronous). A servo mechanism is made up of three parts: a motor, a feedback mechanism, and control electronics. A servo motor is one of these components. Any size AC or DC motor, brushless or with brushes, rotary or linear, for example, can be used. A voltmeter, Room device, tachometer, resolver, encoder, direct transducer, or any other acceptable sensor might be used as the feedback device. The servo system is completed by the control electronics, which power the motor and compare feedback data. order references to guarantee the servo motor is responding to commands. Simple DC motors used during hobby applications (such as updated airplanes) to massive brushless motors controlled by complicated gesture controls used in multi-axis machining machines are examples of servo motor uses.

Fig 8: Servo motor

VII. Gear motor

A gearmotor, also known as a geared motor, is a less electric motor that has an attached gearhead that is integrally (and permanently) connected to the motor. The end shield on the motor's drive end is made to serve two purposes. A gear motor is a device whose mechanism controls the motor's speed, forcing it to operate at a certain rate. Because the gearhead acts as a torque converter, geared motors may create significant torque at low speeds, allowing small motors to achieve higher speeds. A gear motor, also called as a gear reducer, combines a frequency reducer with an engine that ordinarily acts as a gearbox to reduce speed while increasing motor design.

A Gear motor essentially consists of an electrical motor, either AC or DC, and a gear reducer. One unit contains both the gear and the motors. At low speed or horsepower, a gearmotor creates a lot of torque. Stall-speed torque and standard speed are properties of these motors. To decrease speed so that greater torque is available, these motors need gears, which are often put together as a gearbox. The most common uses for gearmotors involve moving big things with a lot of force.

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Fig 9: Gear motor

VIII. Battery

These lithium-ion batteries are used in robotics or for hobbies. Compare to Ni-Cd, Ni-MH, and lead acid batteries, very tiny and light. extremely long lifespan without reducing charging capacity. ICR 18650 2000mAh 20C Lithium-Ion batteries of the highest caliber are used in this battery pack, together with a BMS circuit. The battery pack has an internal charge protection circuit, it may be charged directly using a DC power adapter without the need for specialized battery chargers or having to worry about overcharging. The buildup of electrons at the anode might originate from chemical processes that occur inside the battery. As a result, the anode and cathode have an electrical differential, which may cause an uneven buildup of electrons. Electrons want to reorganize themselves in order to eliminating this discrepancy. They can, however, take a certain course. Electrons are attracted to one another because they repel one another.

Whenever you recharge the battery, you use another power source, such as to switch the flow of electrons. The anode and cathode are returned to their initial states and are once more capable of producing full power as the electrochemical processes are reversed.

Fig 10: Battery

IX.Wires

Drawing the metal through a hole in a draw plate is the most popular method for making wire. When expressed as a gauge number, wire gauge are readily available in a variety of standard sizes. Wires are carried by mechanical loads, most typically in the shape of wire rope. In the context of energy and telecommunications transfers, a "wire" may refer to an electric wire. This cable might have a "solid core" made of a single wire or multiple strands woven together, and it could be stranded or braided.

Wire is mainly utilized. Important developed spring to a vital automatic or industry made components use carbon or stainless spring steel wire extensively. Large quantities of wire are used as feedstock in the production of pins and hairpins, needle and fishhook products, nails, pegs, and rivets, as well as carding equipment.

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Fig 11: Wires

X. 3D Filament

The polymers feed for fusion deposition modelling 3D printers is 3D printing filament. There are numerous varieties of filament available, each with its own set of benefits. its unique set of features. Filament is available in a variety of diameters, the most common of which are 1.75 mm and 2.85 mm, the latter of which is commonly not to be This is sometimes mistaken with the less common 3 mm. A filament is a long, thin plastic thread that is looped around a reel. The thermoplastic supply for fused laminate model 3D printers is 3D printing filament. There are many filament types with varying characteristics. Fused Filament Fabrication (FFF) or fused deposition modelling are two terms used to describe the plastic filament printing process (FDM). FFF is the one that gained popularity. Even now, the names are still used interchangeably, with the exception of some manufacturer brochures.

Fig 12: 3D Filament

XI. Acrylic sheet

Acrylic is most frequently offered for sale as sheets in a range of thicknesses, but it can also be available in other shapes, like rods or tubes, and in different finishes, including frosted, mirrored, or non-glare. In addition to coming in a variety of sizes and shapes, acrylic may also be colored and shaped to match certain needs. Transparent thermoplastic homopolymer acrylic is most frequently referred to as plexiglass. The substance can be used as an impact- resistant substitute for glass, just like polycarbonate (particularly when the high impact strength of PC is not required). It was created for the first time in 1928 and released on the market by Rohm and Haas Company five years later. It is typically regarded as one of the clearest polymers available. During World War II, it was utilised for periscopes on submarines and for windows, turrets, and canopies on aeroplanes.

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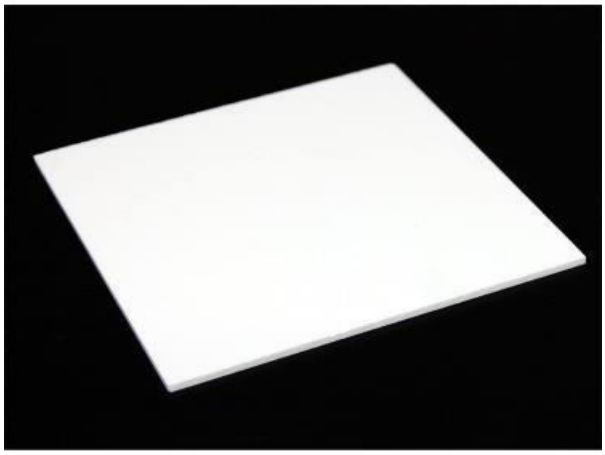

Fig 13: Acrylic sheet

XII. DC to DC converter

A dc power (DC) conversion is a circuitry or mechanical device that modifies a current (DC) source's reference voltage. It is a particular sort of power converter. Power levels range from very low (small batteries) to very large (high-voltage power transmission) are frequently utilized to efficiently deliver a regulated voltage from the source that may or may be appropriately controlled to a demand that may or may not be constant. DC-DC converters are briefly presented in this work, common examples are illustrated, and key datasheet characteristics and applications are examined.

High-frequency power converter circuits that use inductors, transformer, and capacitors to avoid switching noise and provide regulated DC voltages are known as DC-DC converters. Even with changing voltage input and output currents, closed feedback loops ensure constant voltage output. With 90% efficiency, they are often more efficient and shorter than linear regulators. Its drawbacks include complexity and loudness.

Fig 14: DC to DC converter

XIII. Motor drive

The motor drivers are the interface between the control circuitry and the motors. Although The controller circuit uses low current signals, but the motor demands a large current. As a result, servomotors transform low-current command signals into high- current command signals. greater signals capable of controlling motors. An electronic device so called as a motor Aids in the conversion of electrical energy into mechanical energy. Consequently, a motor driver enables you to carry out automatic tasks utilizing electricity. Electric motors come in a variety of varieties. These kinds include stepper motors, servo motors, and DC motors. These motors differ from one another in terms of their functioning theories and traits. It is crucial to pick the right kind of motor driver because it enables your engine to function effectively with the microcontroller of your choice. ICs are now the most common motor drivers available on the market Because there are numerous driving motors, each has distinct characteristics. A H bridge circuit connects the motor controller to these motor driver ICs.

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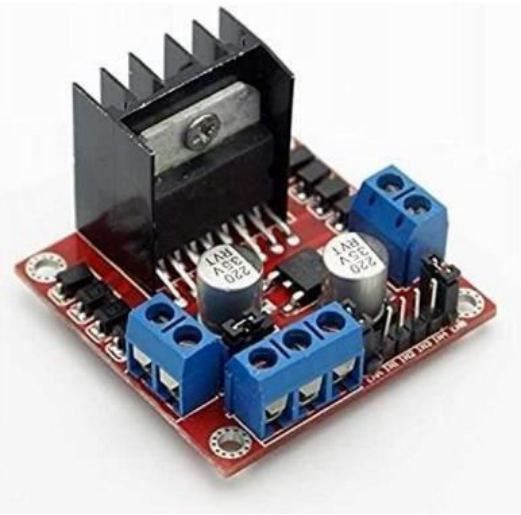

Fig 15: Motor drive

IX. Microcontroller

The Arduino UNO is the most basic Arduino board. The Italian word for "one" is UNO. The initial Arduino programming version was called as UNO. It was also first USB board made available by Arduino. It is regarded as a robust board that may be utilized for a variety of tasks. The Arduino Uno microcontroller board was created by Arduino.cc.

The Arduino UNO is powered by the ATmega328P microprocessor. It is easy to use in compared to other devices, such as the Arduino Microcontroller. The board's components include electronic and mechanical I/O pins, firewalls, and other devices. The Arduino UNO contains six analogue input pins, 14 data pins, a USB connection, a voltage connector, and an ICSP header (In- Circuit Serial Programming). It is created using the IDE (Integrated Development Environment). It is compatible with both on- and off- line devices. The IDE is the same for all Arduino boards.

Fig 16: Microcontroller

VI. SOFTWARE REQUIRED

Arduino IDE

The Arduino Software (IDE), our Integrated Development Environment (IDE), is used to programme an Arduino UNO, which is shared by all of our boards and works both online and offline.

The Arduino Programming (IDE), also known as the Development Environment ide (IDE), is a code editor that includes a message area, a textual terminal, a sidebar with basic buttons, and a menu system. It communicates with the Arduino platform and allows you to upload software to it. The Arduino IDE is free open- source software that lets you create and find the attached to Arduino boards. The IDE programme is compatible with a variety of computer platforms, including Pc, Mac OS X and Linux. C and C++ programming languages will be supported. The Integrated Design Environment is referred to in this remark.

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Fig 17: Arduino IDE

VII. RESULT

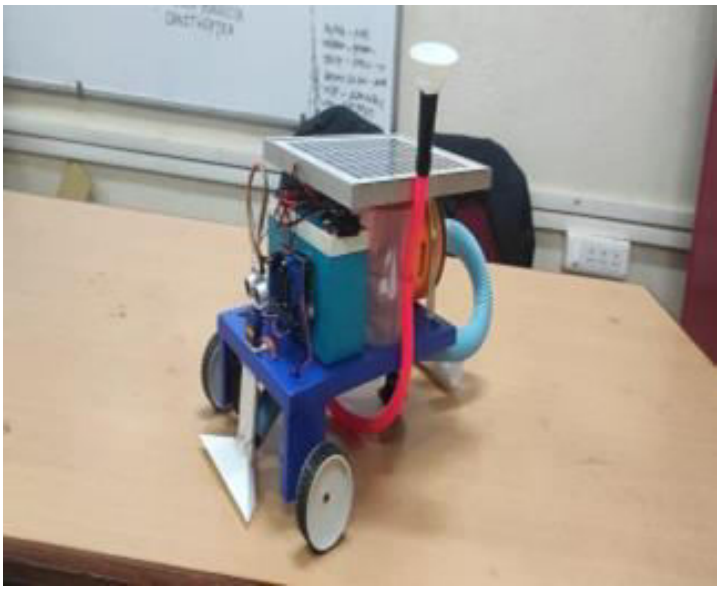

Fig 18: Prototype model of solar floor cleaner robot (side view)

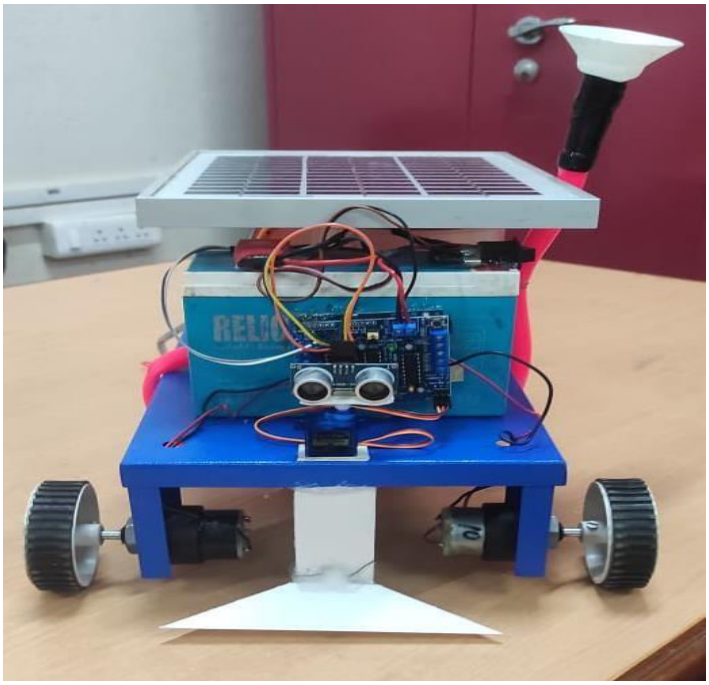

Fig 19: Prototype model of solar floor cleaner robot (front view)

The goal of this project is to develop and build a vacuum cleaner that operates on solar energy, is controlled by a smartphone app, and cleans using machine learning algorithms. This intelligent vacuum cleaner cleans both dry and wet floors. Its primary goal is to keep your surroundings clean without the need of human labour.

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VIII. ADVANTAGES

- Dust collection using a vacuum cleaner
- Wet cleaning water tank and brush
- Solar power source for extended battery life
- Operation via Remote Control
- Create a transportable cleaning device that is quick and simple to use.
- Minimize the work put forward by others.
- Shorten the time.
- A cost-saving measure
- Help stop slip-and-fall accidents from hurting people.
- Accidental injuries resulting from trips and slips on flat surfaces are a major contributor to fatality or harm. Accidents often occur as a result of poor floor cleaning techniques.

IX. DISADVANTAGES

- Robotic floor cleaners are labour - saving machines, but they are unable to work independently.
- An operator should still replace the cleaning fluids and make sure to empty the dirty water container on mopping robots.
- The worker is the responsible for emptying the dustbins of vacuum cleaning robots. Someone should educate the bot the floor plan.
- Usually, this makes involvement an operator for guiding the machine around the facility. Once the floor plan is learned, the robot is able to travel independently.

X. APPLICATIONS

- Nuclear power plants and industries.
- Hospitals: Both wet and dry cleaning of floors in hospitals is done with the use of floor cleaning machines. to obtain a sanitary surface.
- Colleges: It is mostly used to remove dust that has accumulated on the surface there.
- Train station: The platform at the train station is used year-round.
- Shopping Centres & Movie theatres
- To maintain the desired cleaning surface finish in computer centres.

XI. CONCLUSION

There are several varieties of robots on the market. However, they do not offer both dry and wet cleaning services. Our Robot's major function is to efficiently clean the floors. It can clean both dry and damp surfaces. The robot can identify surrounding impediments using an ultrasonic sensor, and we can programme the robot to clean the floor for a specific amount of time. The utilisation of this Robot not only saves money, but it also saves time. Reduced human effort implies more frequent floor cleaning, which improves overall cleanliness and promotes healthy living. These robots can be utilised at nuclear power plants, schools, hospitals, and colleges, among other places. Small increments in technology improvement like this would have a greater impact in the long term, making India more competitive.

XII. FUTURE SCOPE

In this project, we can connect the camcorder and use a wireless controller like a joystick and increase the speed control it and to manage the vacuum cleaner from a distance and monitor the operation without having to visit the cleaning location.

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