

Design and Fabrication of IOT Based Solar power Vacuum cleaner Project Report

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Abstract— The renewable energy is very important for today's world as in near future the non-renewable sources that we are using are going to get exhausted. The solar operated vacuum cleaner is a step in saving these non renewable sources of energy. Today more than ever we see and feel the consequences of the climate change. From melting ice caps, to the rising sea levels, weather changes and temperature rises, there are more and more natural disasters that we learn about from the news. The technology that can help us to maintain our environmental climate and help in our daily lives. We offer solar powered vacuum cleaner as one possible solution that can slightly change our way of living for better. Solar vacuum cleaner can help us to reduce the pollution. to collect the sun rays, provide a better platform to collection of dust which is helps to environment.

Index Terms: Arduino, IoT, Solar power, Vacuum cleaner, Arduino uno, Infrared sensor, ultrasonic sensor, microcontroller.

INTRODUCTION

The Energy is one of the most vital needs for human survival on earth. We are dependent on one form of energy or the other for fulfilling our needs. One such form of energy is the energy from fossil fuels. We use energy for the sources for generating electricity, running automobiles etc. But the main disadvantages of these Fossil Fuels are that they are not environmentally friendly, and they are exhaustible. To deal with these problems of Fossil Fuels, we need to look at the renewable energy source of energy. About this idea we have designed dust collector that runs on solar energy [1]. In earlier days we used to the cleaning manually. In further days we use electrically operated vacuum cleaner, but this is restricted for residential & commercial applications only. For cleaning of bigger area, the diesel operated dust collectors are used, but unfortunately this more costly and they create pollution due to (diesel, petrol

etc.). This helps to increase global warming. To reduce this drawback, we use solar operated vacuum cleaner. We have pleasure in introducing our new project "SOLAR POWER VACUUM CLEANER", which is equipped by micro controller, motor driving mechanism and battery.[2] The power stored in the battery is used to drive the DC motor that causes the movement to Vehicle. The speed of rotation of DC motor i.e., velocity of VEHICLE is controlled by the microprocessor controller. This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation as shown in Figure 1. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased. There are numerous ways to conserve energy. The process of conserving energy is not only how but also on what to use for it. Solar energy is one alternative energy source, which can be converted to electricity using solar panels. Most solar panels use silicon to produce the panels. The cells that are contained in these solar panels are normally silicon. These individual cells are shrinking all the time and becoming cheaper to produce. Solar panels provide users with a source for their work. Applications of solar panels are presently economical where there is plenty of sunshine. Further solar panels help to reduce reliance on fossil fuels and other depleting resources used to generate electricity. Solar panel is a source of clean, cheap, and renewable energy for our homes. Using solar panels can influence the capacity of our home supplies. This method allows us to generate additional electricity, which fed into our current power systems, will have the effect of reducing consumption from the national grid, saving you money in the process [1]. The fabrication of a dual powered vacuum cleaner, in which we will have a suction pump run by a dc motor. The outlet of the

pump will be connected to a bin to hold the litter. The power to the dc motor will be provided by a battery, which will be charged by the solar panels mounted on top of the device. Provision is given to charge the battery in adverse conditions by electricity [1]. The complete unit will be mounted on a trolley for easy movement. By this technology, the use of engines run by fuel for the same purpose can be eliminated as fuel is one depleting source of energy and the price of fuel in the recent years is an increasing curve on the graph, which is still increasing further.



Figure1 conventional vacuum cleaner robot [3]

LITERATURE REVIEW

A vacuum cleaner is commonly referred to as a vacuum occasionally as a Hoover is a device that uses an air pump to create a partial vacuum to suck up dust and dirt, usually from floors. The dirt is collected by either a dust bag or a cyclone for later disposal. Vacuum cleaners, which are used in homes as well as in industry, exist in a variety of sizes and models: from small battery-operated hand-held devices to huge stationary industrial appliances that can handle several hundred liters of dust before being emptied. The first manually powered cleaner using vacuum principle was the "Whirlwind," invented in Chicago, USA in 1868 by IvesW. McGaffey [2]. As shown in Figure 2 accumulation of dust on the PV panel reduces its transmittance which results in the reduction of the power output, thus resulting in loss of power generation. This particular problem is also responsible for the short life span of many interplanetary exploration missions such as Mars Exploration Mission of Curiosity Rover as the power

output from their solar panel reduces over time because of the accumulation of dust. At a point of time density of dust increases to level where power output declines to the extent which is not able to support its vital functions. Further this problem has also resulted in huge losses for the solar power plant operators which suffer from reduced power output because of frequent dust storms. Most widely used method of cleaning is through the manual labor. Apart from being time taking and cumbersome, there is also a risk of damage by the unskilled labor which is involved in this method [4].The purpose of this project is to develop a semi-automatic self-cleaning mechanism for cleaning so that the process can become more reliable and faster, thus increasing the power output of the solar power plant.



Figure 2 Image of first vacuum cleaner [3]

SCOPE OF PROJECT

Can make it more effective using lithium ion battery for more life because over cost may increase double than the initial budget In today's world people looking for more innovative without the manual work, were automation plays an important role to adapt in today's life. using controller board and embedded c programming can be implemented in this system, Solar capacity can be increased for max efficiency This system can be manufactures using plastic for lesser weight Atmospheric dust and dust deposition on solar PV both reduce efficiency of solar panel. Experimentally it is seen that efficiency of the solar panel decreases by 30-40% for indoor set up with constant illumination whereas there is loss of 4-5% for outdoor set up with natural lightening condition Most of the cleaning system require human

interface to clean efficiently. Functionality – the function of a vacuum cleaner is to “remove soiled material (dust, fiber, threads) from a surface to be cleaned by an airflow created by a vacuum developed within the unit by an electrically powered vacuum generator or fan”. End use (domestic / commercial) – this study focuses on products designed for domestic/household use and similar usage by laymen in a commercial or in situational environment such as shops, hospitals, offices and hotels, for removal of settled dust on carpets and dry hard floors. Because of their specialist application, it is not sensible to include industrial vacuum cleaners used, for example, on construction sites or in factories. Availability of test standards – For example, the definition according to Standard 60335 is “This International Standard deal with the safety of electrical appliances for households and similar purposes, their rated voltage being not more than 250 V for single-phase appliances and 480 V for other appliances. Appliances not intended for normal household use, but which may be a source of danger to the public[6].

Design and fabrication

The Internet of Things, or IoT, refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data. Thanks to the arrival of super-cheap computer chips and the ubiquity of wireless networks, it's possible to turn anything, from something as small as to something as big as airplane, into a part of the IoT. Connecting all these different objects and adding sensors to them adds a level of digital intelligence to devices that would be otherwise dumb, enabling them to communicate real-time data without involving a human being. The Internet of Things is making the fabric of the world around us smarter and more responsive, merging the digital and physical universes [10].

Arduino is an open source electronics creation platform, which is based on free, flexible and easy to use hardware and software for creators and developers. This platform allows you to create different types of single-board microcomputers to which the community of creators can give different types of use [7]. In order to understand this concept, first you need to know about free hardware and free software concepts. Free hardware are devices whose specifications and diagrams are publicly accessible,

so anyone can replicate them. This means that Arduino offers the base so that any other person or company can create their own boards, being able to be different from each other but equally functional when starting from the same base[7]. Arduino can be used to create standalone elements, connecting to devices, and interacting with both hardware and software. It helps us both to control an element, for example a motor that raises or lowers a blind based on the existing light in a room, thanks to a light sensor connected to the Arduino, or to read the information from a source, such as It can be a keyboard or a web page, and convert the information into an action such as turning on a light and writing what you type on a display. With Arduino it is possible to automate anything to make autonomous agents (if you want, we can call them Robots). To control lights and devices, or anything else you can think of, you can go for an Arduino-based solution, especially in developments of devices connected to the Internet. Arduino is a technology that has a fast learning curve with basic knowledge of programming and electronics, which allows developing projects in the field of Smart Cities, the Internet of Things, wearable devices, health, leisure, education, robotics [7].

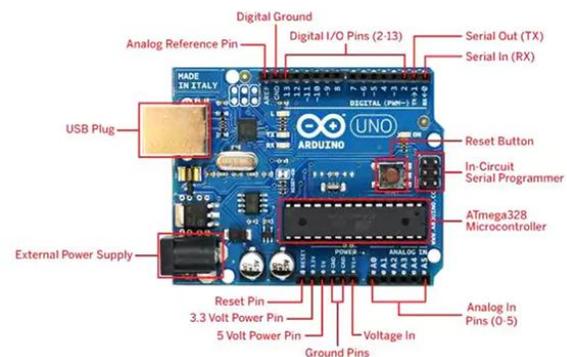


Figure3 detailed explained pins and circuit diagram of Arduino uno [7]

There are a lot of sensors available in the market each having its own usage. Every robot gets input via a sensor, they act as the sensory organs for the robot. In our case our robot should be able to detect obstacles and avoid them.

a) Infrared sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some

form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations [8]. The emitter is simply an IR LED and the detector is simply an IR photodiode. Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received [8]. There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength used as infrared sources [8].



Figure 4 Infrared (IR) sensor diagram with Pins and Emitter and transmitter part [8]

b) Ultrasonic Sensor An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound wave. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns. Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. uses a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse [9]. consists of two circular eyes out of which one is used to transmit the US signal and the other to receive the US rays. The time taken by the rays to get transmitted and received back is calculated by the microcontroller.

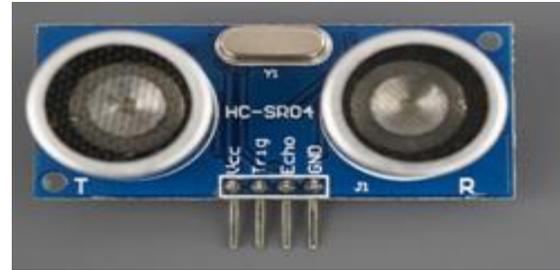


Figure5 ultrasonic sensor with pins and transmitters

DESIGN

1) The Robotic Vacuum Cleaner

The dust accumulated on solar panels forms a sticky layer which can not be cleaned directly by using portable vacuum cleaners. Hence a two-stage cleaning process is implemented.

Stage 1: A rolling brush is fixed on the robot such that it agitates and pushes the dust towards the vacuum cleaner.

Stage 2: The vacuum motor is used to create enough suction to collect the dust scattered on the solar panel. The presence of a sticky layer of dust on a smooth inclined surface adds to the problem of slipping. Therefore, to have better traction gripper wheels are used to traverse the solar panels. The robot is controlled using the MSP430G2553 microcontroller. It acts as the master control element of the robot. The robot is designed to minimize the total load in order to achieve higher efficiency and longer battery life.

2) The Docking Station

The docking station is setup at the beginning of the solar panels. It comprises of a base and two Aluminum strips mounted on it acting as the positive and negative terminals. The circular design ensures that the robot can charge itself at any orientation till it contacts the charging strips. If the battery voltage falls below a threshold, the robot returns to the docking station to charge itself. During the charging process, if the battery voltage exceeds the reference limit, the charging circuit disconnects itself from the battery. When charging is complete, it starts the cleaning the panels again if required.

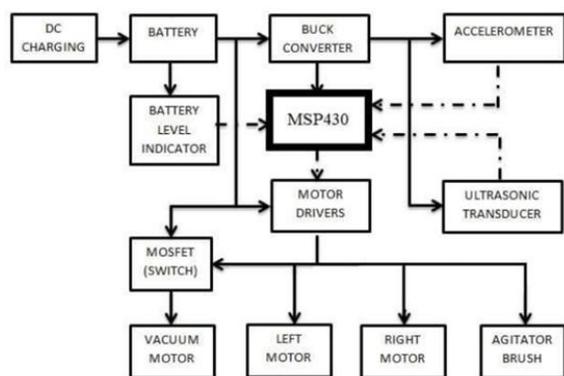


Figure 6 Block diagram of solar powered vacuum cleaner

CONCLUSION

Solar powered vacuum cleaner project has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, computing and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries. The solar vacuum cleaner will be working with satisfactory conditions. We can understand the difficulties in maintaining the quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work. Automation is a technology concerned with his application of mechanical, electronic and computer-based systems to operate and control production. This project may be developed with the full utilization machines, and materials and money. Also, we have followed thoroughly the study of time motion and made our project economical and efficient with the available resources. This system was Designed, fabricated successfully and tested. It works Satisfactorily. We hope that this will be done among the most versatile and interchangeable one even in future.

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