PERFORMANCE IMPROVEMENT OF SOLAR POWERED ROBOTIC GARBAGE CLEANER FOR INDUSTRIAL APPLICATIONS

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ABSTRACT

Nowadays, robots are widely used in many industrial and household applications, and they have been found very successful in cleaning tasks. Keeping the current situation in concern; the design and fabrication of an improved automated wireless garbage cleaning robot have been proposed in this article. The proposed prototype robot can be used to clean public places, colleges, schools, coastal areas, and beaches which are found dumped with core various dirt, pollutants, toxic materials, debris, etc. Managing waste effectively and recycling efficiently, can move society one step forward. The waste is collected through conveyor blades and falls off through the perforated conveyor belt to the dustbin, the collected waste is then taken to the waste separation plant. The proposed robot is designed light-weight which helps in rapid movement, also equipped with sanitization equipment to keep the locality safe from the attack of an unknown virus. As the cleaning robot is automated it can be operated through remote/mobile/laptop with the help of a web server. Automation is achieved by Node MCU (multipoint control unit) and to make it more environment friendly, so has been operated with solar cells. Also, the proposed prototype has been found cost-effective as compared to similar existing machines in the market.

Keywords: cleaning robot, conveyor blades, ultrasonic light, dc motor, Node MCU, L293D, solar cell.

INTRODUCTION

Recent studies have shown that many types of garbage are usually floating in our society. Most of these garbage are man-made; like plastic, rubber, foam materials, and toxic materials, etc. In many high dense coastal areas, it can be easily found that whenever a wave crashes on beaches, each wave deposits plastic garbage and other toxic elements on the beaches [1]. This can also occur from disruption or damage to wastewater collection and treatment infrastructure or due to hurricanes or floods, illegal dumping, accidental oil spills, or solid waste trash left behind by people. This kind of garbage may not decompose for a very long duration and severely affect human health and may develop some chronic health issues in society. As coastal areas are the main attraction for visitors, there is a strong need for an efficient method to stop the increasingly negative impact of this trash debris on coastal ecosystems. To overcome this problem a high-performance "Remote Controlled Garbage Cleaning Robot" (RCGCR) has been proposed in this article. The design is finalized in such a way that it can work effectively in different-different locations like garden, beach, school, office, and in-home also with larger areas [2]. Also, the design of the proposed prototype is equipped with solar panel to conserve electricity and to make it environment friendly, especially for open locations.

[1] a lot of animals eat this garbage which was floating on-road and lost their life as plastic, rubber causes the intestinal problem.

[2] Cleanliness is vital and intuitive when it comes to public places because a huge number of people visit public places for different purposes every day. This includes children and senior citizens too, which further increases the risk of spreading diseases.

LITERATURE SURVEY

Technology is moving rapidly to improve the living standards of society and mechanized equipment is finding its better roles in day-to-day activities. Robots are found very suitable in garbage cleaning nowadays, and many works are still going on to make the garbage collection system more improved. Authors of **[3]** have proposed one such garbage cleaning mechanism in which the machines comprised a more or less standard form of track laying tractor or vehicle mounted with a conveyor belt having a plurality of rakes extending around the belt. One part of this belt being continuous rotate to engage the ground surface, with varying degrees of pressure around the conveyor belt, will effectively pick up bottles, paper of various sizes, and other compositions. It has been observed by the authors that the rakes carried by the conveyor belt must be of a width sufficient to clear the garbage spread on coastal areas and beaches. It has been found that a width of approximately 8 - feet is satisfactory in this respect. Also, the operator of the cleaning machine must necessarily be forwardly located thereon, ahead of the conveyor apparatus, so authors have formulated the transport superstructure in such a way "as to allow the chairman to control and control the vehicle while being found at the uncommon forward conclusion thereof" The machine is balanced to tow a box (squander collector) which gets the litter discharged by the transport belt and a fitting stripping gadget is given at the raise conclusion of the machine. The proposed model was found performing satisfactory and considered here as one of the base papers in the present article with some modifications in the existing structure **[3, 4].**

In this article, Remote Controlled Garbage Cleaning Robot" (RCGCR) has been proposed which is solar powered also. The machine's main function and its direction function are powered by solar panels, which is a new & important feature compared to other machines in the market. Also, the proposed robot is designed light-weight which helps in rapid movement, also equipped with sanitizing equipment to keep the locality safe from the attack of an unknown virus. As the cleaning robot is automated it can be operated through remote/mobile/laptop with the help of a web server. Automation is achieved by Node MCU (multipoint control unit) and to make it more environment friendly, so has been operated with solar cells. Also, the proposed prototype has been found cost-effective as compared to similar existing machines in the market.

RCGCR MODEL DESIGN

The block diagram, various components, and constructional design aspects are described here. As an automated garbage cleaner robot, a robot requires a higher degree of structural robustness. To achieve this goal, the design of the body of the robot is made with a 3 mm-weight aluminum plate. Together with some metals used, grant the desired durability and endurance for a wide range of possible working environments and can sustain minor break downs. The designed automated robot has 4-wheels and is equipped with a conveyor belt mechanism with pedals attached to collect waste. It uses two high performances, economical electrical DC motors. One DC motor is used to drive the robot front and back as per the instruction given from the web server to Node MCU along with L293D. The web server is designed in such a way that the first control consists of directional push buttons used to transmit directional commands through remote, mobile/laptop. Another DC motor is used to drive the conveyor belt or chain and sprocket based. The lifter component comprises a chain sprocket course of action to drive the waste lifter and collection process.
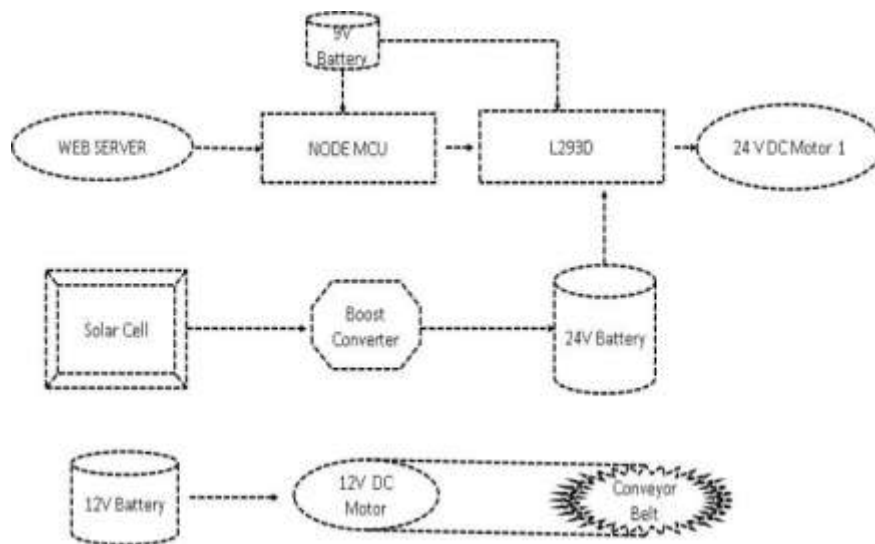
Figure 1: Block Diagram of Proposed RCGCR

Figure 2: FRONT VIEW
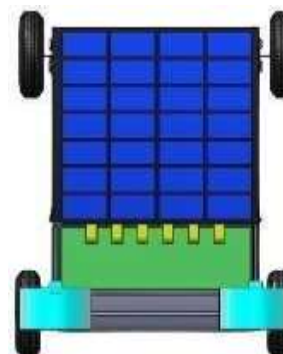

Figure 3: SIDE VIEW   Figure 4: TOP VIEW

The proposed automated robotics garbage cleaner separated in four units, mentioned below:

1. Main Unit: This unit consists of the automation part, which is controlled by the webserver. The main unit of the robot is built in such a way that we can add new useful features and also allow us to attach external actuators and sensors for sensing. First, the wheel configuration had to be chosen in such a way as desired tasks with a four-wheel differential drive that the robot could perform, a differential motor drive configuration in a web server to make it superior in terms of performance. Each pair of wheels is driven by an independent motor linked with a belt or chain and pulley-like system, and a lot of work of some sort, its mechanical simplicity and complexity **[5, 6].**.
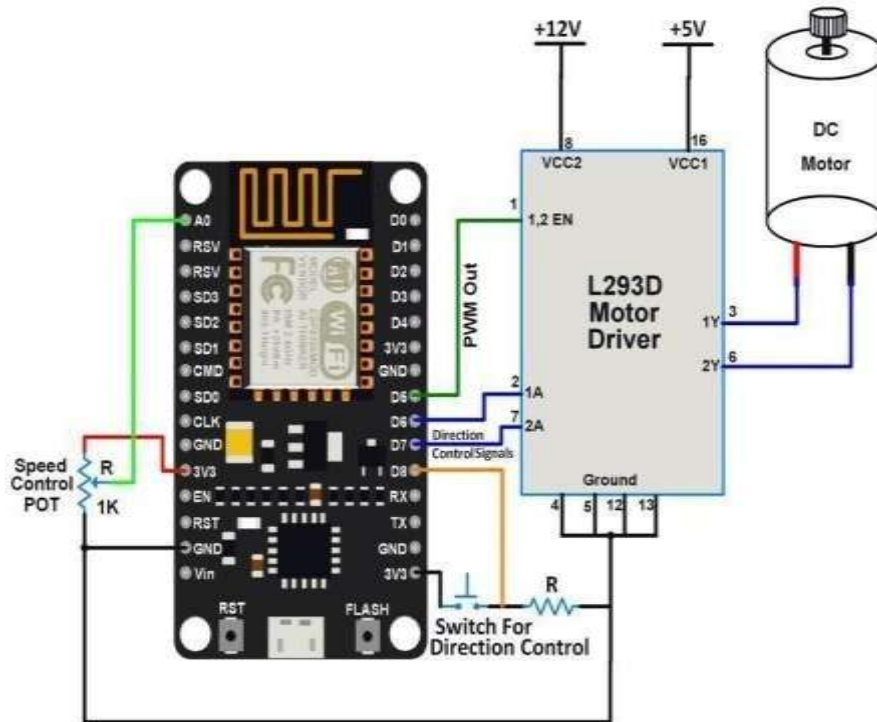

Figure 5: node mcu dc motor control

2. Collecting System Unit: A conveyor belt with blades is designed and attached to the robot enabling it to collect waste from the ground. The conveyor was designed in the shape of an excavator dumper, a well-known technique used in dump trucks to collect trash or waste. There are plenty of good gripping techniques for collecting, but the environment may pose different challenges, where the robot has to operate and collect even semi-buried waste in the soil **[7]**.

3. Solar Panel Unit: Solar India 5 W 12 V Polycrystalline Solar Panel SSI5W is extremely useful when it comes to reducing the electricity bill or the power usage. The polycrystalline sun-based boards are amazingly eco-friendly as no toxin is created whereas utilizing them. Sun-based India 5 W 12 V Polycrystalline Sun oriented Board SSI5W features a module voltage of 12 volts and expends almost 5W power.

Type of Product:	Polycrystalline Solar Panel
Rated Power Range:	1-30 W
Module Voltage:	12 V
Number of Cells:	36

4. UV Sanitization Unit: UV light is one kind of electromagnetic radiation that works out easily from the sun and can likewise be made falsely with specific bulbs. There are three sorts of UV radiation—UV-A, UV-B, and UV-C—none of which can be seen with the unaided eye. Of the three, UV-C has the littlest frequencies (180-280nm) and is the one needed for UV sanitization.
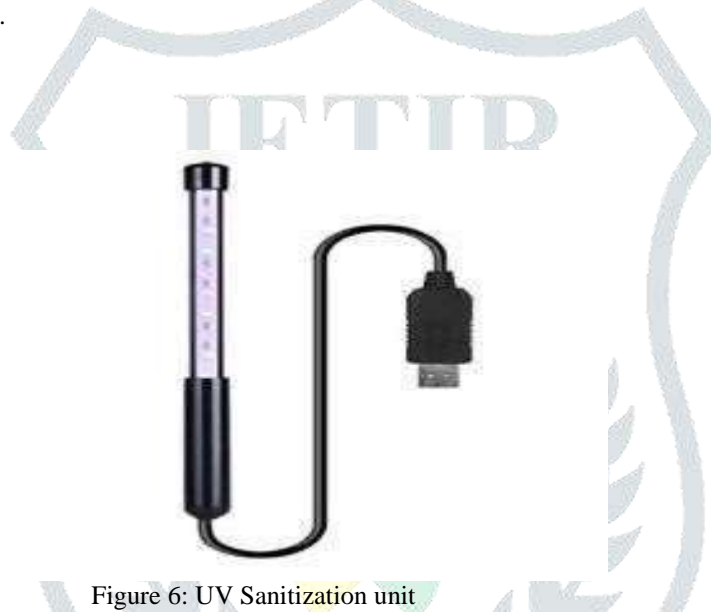

Figure 6: UV Sanitization unit

Node MCU - NodeMCU is AN ASCII text file Lua primarily {based} computer code and development board specially targeted for IoT based Applications. It includes computer code that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware that is predicated on the ESP-12 module.

L293D - The L293D may be a well-known 16-Pin Motor Driver IC. As the title recommends it is basically utilized to drive motors. A single L293D IC is competent in running two DC motors at the same time; too the heading of these two motors can be controlled freely.

Web server and Web Browser - Web Browser may be a program which is utilized to browse and show pages accessible over the internet through a web server may be a program which gives these reports when asked by web browsers. ... Web browser sends an HTTP Ask and gets an HTTP Reaction. The net server gets HTTP Ask and sends an HTTP Response.

RESULT

The prototype robot was tested in an open location (university campus). Garbage's like water and juice bottles, plastic cans, plastic covers, and other similar waste materials were collected by blades attached to the conveyor belt **[8]**. The conveyor starts rotating once the motor is switched on. The wastage material is collected by blades sent to a dust bin arranged back of the robot body. Once the dust bin is full, the dust bin is removed and replaced. During the observations, some good features were noted and mentioned here:

- Versatility: the proposed RCGCR model is versatile, as it was found that it can collect and remove garbage's of different varieties.
- Also, the proposed model can clean surroundings by effective sanitizing.
- Light-weight and dynamic due to inbuilt motors with high torque-weight ratio.
- Economical operation and high durability
- Low Installation cost
- Easy Control

CONCLUSION

The proposed robot (RCGCR) helps to clean and sanitize public places. The robot can be operated by one man that may reduce labor costs and keep humans safe from the high-risk viruses. Effective performance, economical and can be used in programs like Swachh Bharat. An automatic garbage cleaning robot is an example of innovation that can boost various new technologies in managing waste and ensure effective recycling methods.

FUTURE WORK

The automated garbage cleaning robot with simple design helps the garbage grinder which will be helpful for the disposal of the garbage simultaneously. The grinder converts waste into small pieces, that pieces will be disposed of using a chemical which is used as fertilizer or may send it to recycle plants, and collected waste pieces are to be mold into different shapes for different use **[5, 10]**. The robot was fabricated with local materials and local production metals such as aluminum, lightweight metals, and simple structural design, a further improvement can be done here.

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Puchakayala Shashivardhan 4th-year B. Tech Electronic and Communication Engineering student from Lovely Professional University had hands-on experience in PCB fabrication and designing. Good exposure about embedded system design and worked on different university level IOT. Apart from hardware projects he was also engaged in project development on C, C++, JAVA, Embedded C,DBMS. Now engaged automated robotic cleaner.

Vivek Singh 4th-year B. Tech Electronic and Communication Engineering student from Lovely Professional University had hands-on experience about robotics and embedded system design projects. Apart from hardware projects he also engaged in project development on electronics, automation, and python. currently active in robotics projects.

Annexure

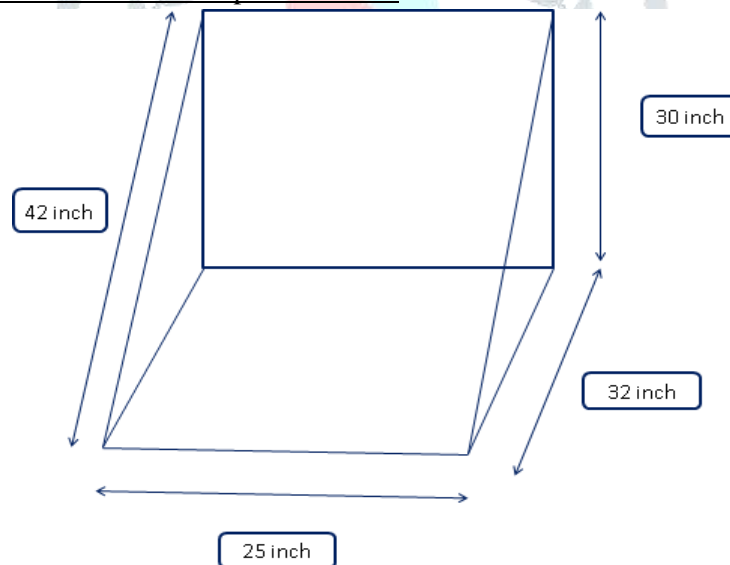[A] Dimensions of Mechanical Frame of Proposed Model :

Figure 7: Structure Dimension

Length (inch)	Breath (inch)	Height (inch)	Hypotenuse (inch)
25	32	30	42

[B] <u>**Node MCU With Motor Control**</u>

ESP8266 is connected to the Wi-Fi router using an SSID and password of the Wi-Fi router which is pre- programmed to Node MCU **[9]**. Creating an HTML web page that can be accessed by the operator (using a smartphone or a laptop). After the connection is established with Node MCU with Wi-Fi, an IP address will be displayed on the serial monitor of Arduino IDE as shown below. The operator of the robot then needs to put the same IP address on the web browser mobile or laptop to obtain a web page.

Figure 8: Web Server Control

As a customized button can be added into the Node MCU code to know the status of the robot displayed on the web page, the operator can operate the robot as shown in the direction web page. The status is updated automatically depending on the command. This motor will be capable of moving it either forward or backward.
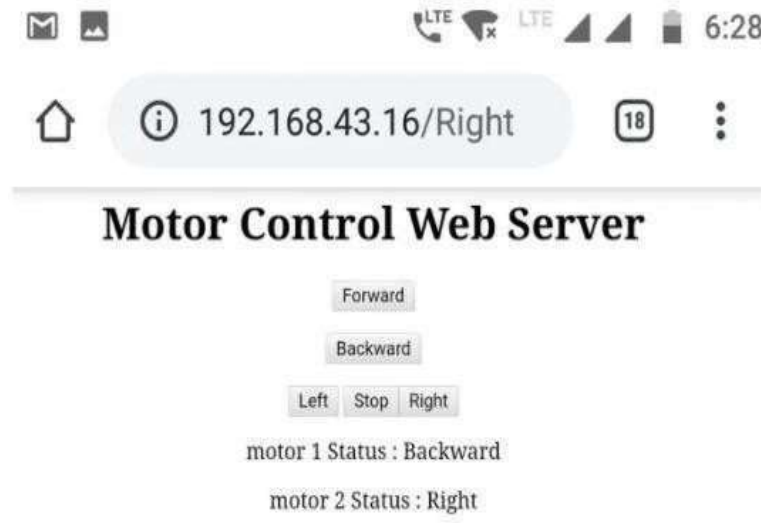
Figure 9: Web Server Control