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Optimizing Solar Panel Efficiency with Machine Learning-powered Cleaning Robots

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Abstract

Because of advancements in technology, scientists are focusing more on robots to make human existence better. IEEE Standard 1621, "IEEE Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments," is being used in this work to create a solar floor cleaning robot prototype through design and development. The subject robot can function in both autonomous and manual modes, in addition to other features including scheduling for a specific amount of time and a bagless dirt container with an automatic dirt disposal mechanism. The human lifestyle could be greatly improved by this work. Modern homes are becoming more intelligent and automated. People have more spare time and a more convenient existence thanks to home automation. Even though the market is still young and developing, domestic robots are becoming more common in homes and in people's daily lives. However, a surge is expected, and domestic robot usage is evolving.

Keywords: Motors, raspberry PI, bluetooth, ultrasonic sensors, robotic, floor cleaners, automated cleaners

INTRODUCTION

Because they are so good at helping people clean floors in homes, hotels, restaurants, workplaces, hospitals, workshops, warehouses, and other places, robotic cleaners have garnered a lot of attention in robotics research in recent years. Fundamentally, robotic vacuum cleaners are identified by their proficiency in cleaning tasks such as dry vacuuming and floor mopping. While some devices use laser mapping techniques, others rely on basic obstacle avoidance employing infrared sensors. Each robotic floor cleaner's cleaning and operation mechanism has pros and cons of its own. Robots that use laser mapping, for instance, are faster, less time-consuming, and energy-efficient but more expensive than obstacle-avoidance-based robots, which take longer to operate and use more energy since they need to clean up after themselves on a regular basis. In recent years, robotic cleaners have taken major attention in robotics research due to their effectiveness in assisting humans in floor cleaning application advantages and disadvantages. For example, robots utilizing laser mapping are relatively faster, less time consuming and energy efficient but costly, while obstacle avoidance based robots are relatively time consuming and less energy efficient due to random cleaning but less costly.

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While there are plenty of robotic hoover cleaners available, very few of them are capable of wet floor cleaning. This paper discusses the design of a solar floor cleaning robot for use in offices and homes, with each component according to IEEE standards. There are two modes of operation for the proposed concept. In one of the modes, the robot operates entirely on its own and makes decisions based on the inputs from tactile, ultrasonic, and infrared proximity sensors. These inputs are processed by an Arduino (mega) controller, which also uses the H-

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bridge driving circuitry to control two DC encoder motor actuators. When in manual mode, the robot may also be used to manually clean a designated section of a room by being controlled via Bluetooth from a laptop running Visual Studio, a Python programming language, and a Graphical User Interface (GUI).There are eight sections in this paper. In Section II, the IEEE standard used for this project is covered. Section III contains a thorough assessment of the robotic vacuum cleaner literature.

LITERATURE SURVEY

Manual labor has been supplanted by robot technology, and many related robot appliances are currently in common usage. Manreet Kaur et al.'s system [1] is an example of the technology that recommended utilizing a robot to clean floors. This floor-cleaning robot can operate in both "Automatic" and "Manual" modes. All hardware and software processes are controlled by the ARM7 CPU. Their robot had sweeping and mopping capabilities. RF modules with a 50m range have been used for wireless communication between the robot and remote control (controlled in manual mode). Their robot is equipped with an infrared sensor to identify obstructions and a self-contained water spray pump. Four motors are in operation: two for the water pump, one for cleaning, and two for the wheels. In their paper [2], Frolizzi et al. discuss human-robot interaction in the home and include ethnographic research on real user experiences. We took an ecological approach to better understand how this technology may be applied in this context and determine how an autonomous mobile robot might "fit" into it. The introduction of technology is important in the first place; technology use becomes social in the second; and, last, homes and domestic service robots should ideally be able to coexist. These are our preliminary findings about the creation of these products. The research by Manya Jain et al. [3] enables efficient floor cleaning. Since the floor cleaner is combined with several devices, including DC motors, ultrasonic sensors, and others, it will be easy to use, save time, and function automatically to clean homes and businesses. With the help of a simple algorithm and program, the cleaner will be able to sweep large sections of the floor and fit into and out of tight corners. As the cleaner moves around the room, its integrated sweeper will be able to gather a large amount of dirt. Because it's out of sight, manual sweeping might not be as successful as it could be, but robotic floor cleaning makes it easy to do. The project of Ravikumar et al. aims to develop and implement a vacuum robot with two cleaning modes: manual and autonomous, with the latter accessible through a smartphone application [4]. Compared to manual vacuums, robotic vacuum cleaners are meant to make cleaning simpler. Their project's primary objective is to build and test a vacuum robot prototype that uses an Arduino Uno, sensors, a DC motor, a motor driver L298N, an ultrasonic sensor, and a vacuum suction unit to achieve the desired result. Vacuum Robot must adhere to several user-friendly specifications. A vacuum robot with two cleaning modes autonomous and manual that can be accessed by a phone application is developed and deployed by Rajeshwari et al. A robot vacuum cleaner is intended to make cleaning simpler than using a manual vacuum [5]. The hoover robot must have several user-friendly features that fulfill human needs and facilitate labor. Using suitable commercial software, Vaishnavi et al. modeled and analyzed the floor cleaning machine. The components of the floor cleaning machine were designed with the often-used materials in mind. The finite element study demonstrates that the stress level in the mobile floor cleaning machine is within the safe range [6]. The robot that was showcased by Daniel et al. [7] has a floor that is isolated from other picture elements, allowing smudges to only affect the floor and not cover other objects. This helps the models distinguish between filthy areas and image-based products, hence reducing the number of false positives. Furthermore, a relevant dataset from the Automation and Control Institute (ACIN) was found to have only incomplete labeling. This dataset was fully reannotated in order to correct some weak annotations from the original labels and triple the number of tagged photos. Additionally, their publication included instructions on how to produce synthetic data for YOLOv5 model training. When these models were evaluated on an actual dataset (ACIN), the top model obtained a mean average precision (mAP).

Proposed Model

For a better understanding of the suggested work, refer to the "Design and Implementation of Smart Floor Cleaning Robot using Android App" recommended model. The 12v DC motor, L293D IC, IR sensor, Bluetooth module, cleaning mechanism, and Arduino UNO are all shown in this block diagram.

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Both the and the relay get the power supply. When the user receives commands from the transmitter app, the relay functions as a switch to control the water pump. Three DC motors make up the robotic arm employed here [8–10]. The first DC motor moves the arm up and down, the second DC motor closes and opens the arm's teeth, and the third DC motor rotates the arm fully. Here, we're using L239D drivers to propel DC motors both forward and backward. Within a certain range, a mobile phone application is utilized to control the robot via a Bluetooth module as shown in Figure 1 and proposed system in Figure 2.

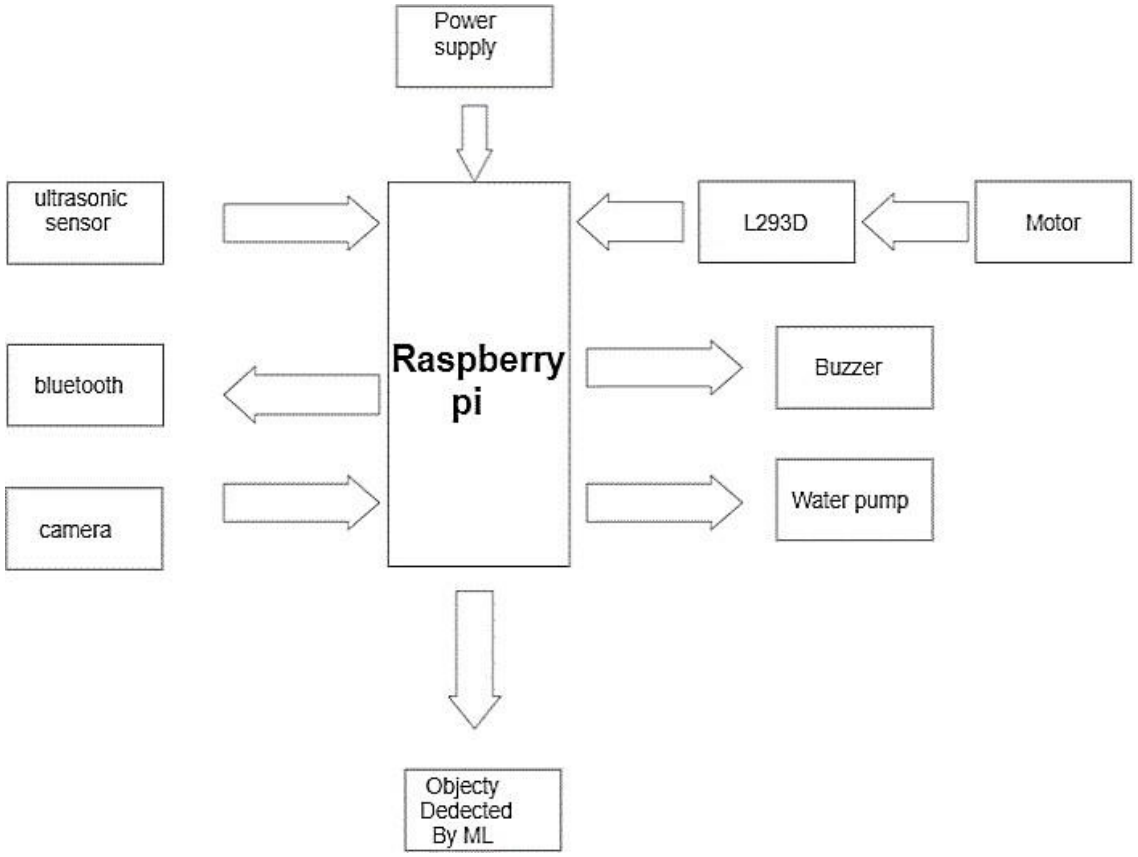

Figure 1. Block diagram of proposed system.

RASPBERRY PI 3B+

Broadcom Bcm2837B0, Cortex-A53 (Armv8) 64-Bit Soc @ 1.4Ghz

Bluetooth Low Energy V4.2 (Ble)

Extended 40-Pin Gpio Header, 2.4Ghz and 5Ghz Ieee 802.11.B/G/N/Ac Wireless Lan, 4.2, Ble 4X Usb 2.0 Ports

Power Supply Requirements - 5V/2.5A Dc Via Micro Usb Or GpioGraphics Card Interface:Integrated

Bluetooth Model HC05

Version 2.0 of Bluetooth together with EDR (Enhanced Data Rate) ISM band frequency: 2.4 GHz, GFSK (Gaussian Frequency Shift Keying) modulation, Class 2 transmit power (up to 4 dBm), Attenuation: -80 dBm usual, Range: in open air, about 10 meters (33 ft), Supported profiles include HID (Human Interface Device), SPP (Serial Port Profile), and others.

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Working voltage range: DC 3.3V to DC 5V, Operating current: under 50 milliamperes, Standby current: under 2.5 milliamperes. Less than 1 mA is the sleep current. Data can be seen on a PC serial terminal by sending it from a smartphone terminal to the HC-05 Bluetooth module and vice versa. A smartphone needs a Bluetooth terminal application in order to send and receive data while interacting with the HC-05 Bluetooth module. The corresponding app stores for Android and Windows provide Bluetooth terminal applications.

Ultrasonic Sensor -HC-SR04

The HC-SR04 ultrasonic distance sensor is this one. This affordable sensor has a range accuracy of up to 3mm and offers non-contact measurement functionality from 2cm to 400cm. An ultrasonic transmitter, a receiver, and a control circuit are included in every HC-SR04 module.

On the HC-SR04, there are just four pins that you need be concerned about: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). For your next range-finding project, you'll discover that setting up and using this sensor is quite simple!

Depending on the application, this sensor's extra control circuitry can stop "bouncy" data that is inconsistent.

L293D Motor Driver IC

A motor driver integrated circuit (L293D) enables a DC motor to run in either direction. With its sixteen pins, the L293D motor driver IC may simultaneously operate two DC motors in any direction. It is predicated on the H-bridge idea. The H-bridge will control which way current or voltage flows. A robot vacuum cleaner is an autonomous vacuum cleaner that cleans the floor on its own without assistance and has self-drive mode. In order to clean, this robot vacuum cleaner has surveillance cameras, mopping, UV sterilization, and spinning brushes. Some disadvantages of this vacuum cleaner were that it stopped closer to walls and other objects and collided with impediments. It left certain parts of the room dirty because it was unable to reach all the corners and edges. To collect dust, an automatic floor cleaner robot is equipped with brushes on its sides. This robot has a suction mechanism that collects dust while it moves freely around the room and uses ultrasonic sensors to avoid obstructions and change direction. The sweeping brush underneath the roomba vacuum cleaner robot, which is positioned at a 27-degree angle, removes debris and dust from corners and edges. Its strong motorized suction mechanism draws dirt into the filtered dust bin. Modern homes are becoming more intelligent and automated. People have more spare time and a more convenient existence thanks to home automation. Even though the market is still young and developing, domestic robots are becoming more common in homes and in people's daily lives. However, a surge is expected, and domestic robot usage is evolving. While there are plenty of robotic hoover cleaners available, very few of them are capable of wet floor cleaning.

Advantages

There are health benefits to using a robot. The ability of a robotic vacuum to recognize boundaries is good. utilizing machine learning and sensors Additionally, it can detect barriers and stairs, and it will automatically reverse course when it encounters one. Using a robot to assist you will save a ton of time.

CONCLUSION

This study shows that using a wireless robotic system, a robot can perform the floor cleaning task more quickly and easily. The personnel cost and time are decreased by this suggested robot. Robots had some limitations in earlier research papers on robotic vacuum cleaners and automatic floor cleaners. For example, the robot in the vacuum cleaner was unable to reach small spaces and left them dirty. The robot in the automatic floor cleaner was able to collect dust, but it was unable to clean wet floors. This study work has overcome these two shortcomings.

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Future Scope

It can be made a little more user-friendly by creating an Android and Windows app, as it contains a scheduling component that can only be used with a computer. It can also be utilized in industries where using a vacuum cleaner to clean with human assistance is hazardous.

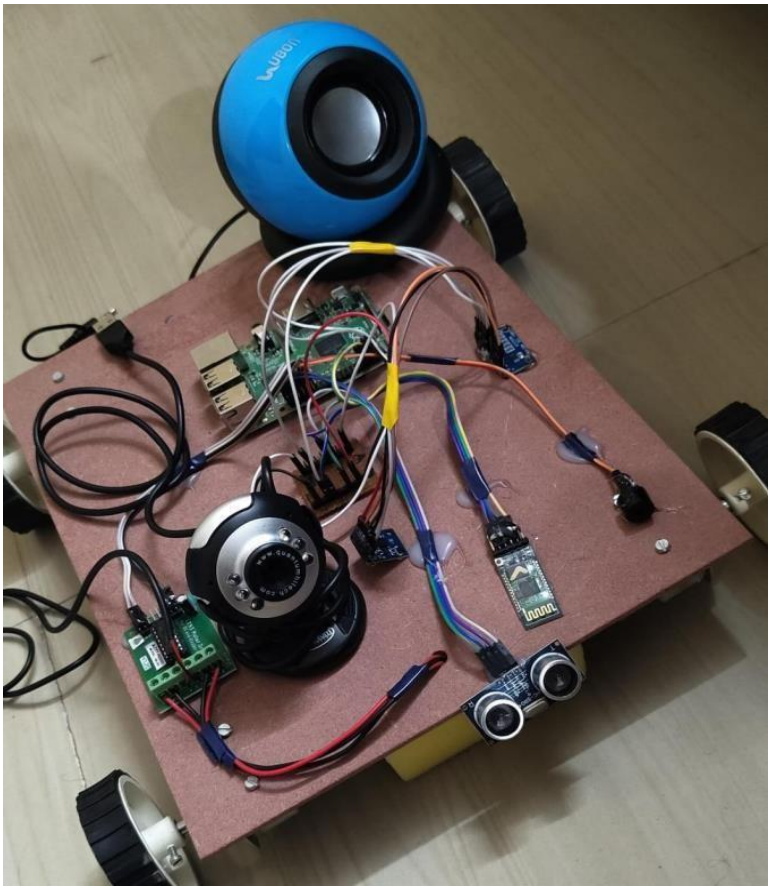

Figure 2. Result of the prototype attached.

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