International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

A Design of Robotic Bord Cleaner by Using Arduino Microcontroller

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Submitted: 11/11/2022 **Revised:** 17/01/2023 **Accepted:** 09/02/2023

Abstract: A tool that is utilised at several institutions all around the world is the whiteboard. Erasing the ink from the board, however, may be time-consuming and distracting. Modern houses with more automation are more convenient and need less time to clean. Despite the fact that robotic cleaners have made housecleaning simpler, most of them are too loud and huge to be used regularly. Therefore, to address these shortcomings, advancements in robotic cleaning technology are a sine qua non. Here, we discuss the creation of a portable and effective robotic cleaning robot for possible application in homes and offices. The developed robot is shaped like a disc, is furnished with cleaning tools, and is managed by an Arduino mega microcontroller. Two sweepers that are each driven by a 6 V DC motor and a retractable dustbin with an attached cooling fan assist it gather dirt. Two motor the robot's front caster wheel, which also controls turning, provide propulsion. To help the robot navigate, four ultrasonic sensors that are 90 degrees apart from one another detect obstacles. The robot is powered by five batteries. It is a trashcan made of cardboard with a little blower that weighs around 2 kg. In this instance, we used an automated roller-based cleaning to reduce the amount of dust in the sweeper. The voltage was quite low. When fully charged, a battery can efficiently clean the floor for two hours while running constantly.When the ultrasonic sensor reads a distance of less than 25 cm, the sensor's distance number is set. When trying the ultrasonic sensor distance value, different situations were found. The road floor cleaning robot prototype's condition may be acquired at a distance more than 25 cm, however at a distance less than 25 cm, the condition of the robot prototype has ceased. With this feature, the device may be used both at home and at the office, making cleaning a completely autonomous activity.

Keyword: *Robotic cleaners, DC voltage, blower, ultrasonic sensors, Arduino mega microcontroller.*

1. Introduction

Cleaning the floors is a very common job that is often seen as nasty, hard, boring [1]. Most of the time, detergents are hired to do the job instead of the people who live in the house. Because this was a bothersome job that had to be done often, a hoover cleaner was made to help people with it [2]. A hoover cleaner is an electrical machine that is often used to clean floors, furniture, rugs and carpets by sucking them up. Inside the device is an electric motor that turns a fan. The fan creates a partial vacuum, which makes outside air rush into the empty space [3]. This pushes any dirt or dust near the sprayer into a bag confidential the machine or on the outside.The cleaner would need sensors to detect the boundaries and dimensions of the whiteboard. These sensors could include optical sensors, cameras, or ultrasonic sensors to determine the position and size of the board accurately.It's worth mentioning that the design and functionality of an actual automatic whiteboard cleaner might vary, and advancements in technology could have resulted in new innovations since my knowledge cutoff. If you're interested in purchasing such a device, I recommend checking with office supply retailers or conducting an online search for the most up-to-date options available [4].

Erasing Mechanism: The erasing mechanism could consist of a soft material or a set of eraser pads attached to the robotic arm. This material would make contact with the whiteboard surface and remove the markings through a combination of gentle pressure and motion. Even though the hoover cleaners we have now work well, they are pretty big and need a lot of work to make them work right. Daniel Hess of Iowa made the first known cleaner in 1860, and Ives W. McGaffey of Chicago made the first known cleaner in 1868 [5]. The first one had a blower that created suction and a spinning brush that picked up dust. The second one had a belt that was driven by a hand-cranked fan, which made it hard to use. In the late and early sweepers with less power were made that were more efficient. iRoomba, Neato, and bObsweep are some well-known names [6 and 7]. Depending on the purpose of the design, robotic hoover cleaners can be used [8]. But most cheap cleaners need a better formula for cleaning patterns to work well, and smart cleaners are expensive and therefore out of reach for most homes. When making the robot hoover cleaner

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explained in this paper, these problems were carefully thought through [9].

The current robot hoover cleaner was made from old computer parts, ultrasonic sensors, and an Arduino mega2560 processor. This made it fairly inexpensive. It moves through rooms by following a path, and two spinning sweepers next to each other help it clean better. The form of the disc was carefully thought about when the sweepers were made, and its usefulness was also looked at [10].

2. Literature Survey

Asafa et al. [11] have made a robot that can hoover and clean and is driven by an Arduino giant microcontroller. It picks up trash with a bucket that pulls out and has a cooling fan on top. It also has two sweepers that are each powered by a 3 V DC motor. The robot moves around with the help of two rear wheels driven by a motor shield and a front caster wheel that also panels how it turns. Four sound sensors at 90° angles from each other find objects and help the robot move around. The robot is driven by three 28.8 V DC batteries that can be charged by an AC-DC charger built into the robot. It is 12 cm wide and 9 cm tall, which makes it easy to move around. It weighs about 1.5 kg because it has a light battery, a trashcan made of cardboard, and a small fan. The total amount of electricity used is about 1,102 mA. When fully charged, a 2200 mAh battery works for two hours straight and cleans the floor well. With this feature, the gadget can be used in both the office and at home, making cleaning a completely hands-off job.

The design used by Juang et al. [12] is made up of two DC computer board. A single-axis gyroscope and a two-axis accelerometer are used to figure out the robot's attitude. A complementary filter is also used to make up for when the gyro moves. Experiments are done to figure out the electrical and kinematic factors, and PID and LQR-based PI-PD control methods are done on the motion. Experiments show that PI-PD control can be used to get a robot to self-balance in a position close to standing up straight.

Goon et al. [13] said that a Bluetooth phone can be used to turn on or off an automatic floor cleaner. The Bluetooth linking method has an easy-to-use interface and works with apps from other companies. A microprocessor called Arduino, an ultrasonic sensor, two PC fans, four DC motors, two discs, LEDs, and a Bluetooth module are used to build this project. This polisher robot floor cleaner is small, made from 3R materials, and good for the environment.

Ronnaronglit N et al., [14] Emerging the Robots can be used to work instead of people, especially since it's not necessary to have a boss to direct the work and there's less risk of damage from moving a robot. But Solar Frames Connected Robot still has flaws that make it hard to move and limit the size of the solar panels. This study's goal is to create and improve Solar Panel Cleaning Robots by looking at how they move and how well they work in Thailand. Using a gear motor and an ARDUINO microprocessor, we made a wireless joystick and a sensor sonar. A spinning brush and a spray of water will be used by the robot to clean a solar cell. Based on the research, Solar Panel Cleaning Robots can move on surfaces between 0 and 30 degrees Celsius and use a rotating brush to clean up to 80% of the solar panels.

Gopalakrishnan et al. [15] used a project that will have a few efforts that are good for clients. This paper is a plan for making a better platform that can be programmed. At the moment, there is a lot of focus on the area of mechanical knowledge in order to make human work easier. The main goal of this study is to make a cleaner that can be fully designed to clean dry, wet, and with UV light. There are now a lot of cleaners on the market that only do a few things. Arduino is used in the model because it is cheap and easy to use. The suggested cleaning robot will be a part of making life easier by fixing problems with current floor cleaning methods.

3. Proposed Methodology

A short description of the different parts of the model and how they help the process of automatization. We have an idea for a very effective whiteboard cleaner robot that only erases traces of lines by following the trails.

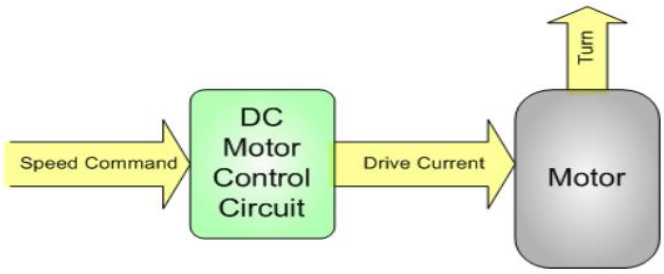

Figure 1: Schematic Character Over the Open Loop Speed Scheme for the Continuous Motor

Our method is different because it uses a smart robotic car that traces lines and only erases those lines. It can be used to clean part or all of a whiteboard. When we only need to clean a few lines, it only erases the ones that are linked and leaves the rest. The robot is a small vehicle with wheels and a sensor-based circuit. The sensor circuit uses infrared sensing to find lines, and the robot will only rub against linked lines when it is set on them. A microprocessor chip from the 8051 family is used in the robotic system to do this. The processor gets the information from the sensors and keeps the motors running so that the desired cleaning is done. Also, a radio frequency (RF) remote lets the robotic car be controlled by hand and switched on and off wirelessly as needed. So, the system makes a whiteboard rubber robot that is cleverly automatic..

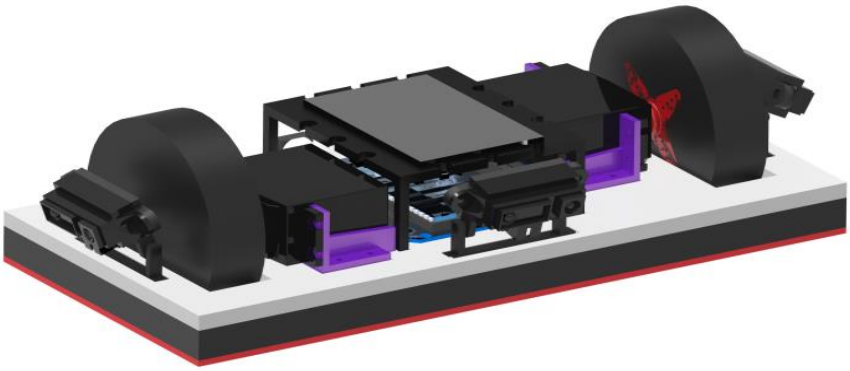

Figure 2: Render of the Final Demonstrator

Figure 3: A Opinion Over the Bottom Plate Positions

When the rubber was first tried out with all of the parts that came with the tester, it didn't move. The wheels weren't touching the ground. The bottom plate, whose job was to make the frame stronger, had to be taken off. Even though the wheels now started to move, the ink on the surface did not come off. Then, different methods were tried, and one of them was to use more magnets. But in the end, one answer was to wrap rubber bands around the wheels to make them move more slowly. Again, the number of rubber bands was figured out by

changing the number between each test run until the wheels had a good grip on the ground and didn't slip..

4. Arduino Micro Controller

The Arduino microcontroller is an open-source electronics platform widely used for creating interactive components that provide a user-friendly environment for prototyping and developing various electronic devices.

The Arduino platform's accessibility, extensive documentation, and large community support make it an excellent choice for both beginners and experienced electronics enthusiasts.

However, in this system we have used Arduino Mega microcontroller. It is an upgraded version of the Arduino Uno with expanded capabilities, increased memory, and additional input/output (I/O) pins. The Arduino Mega is often preferred for projects that require more processing power, memory, and a greater number of I/O pins.

4.1 Hardware:

The Arduino board is the chief hardware component of the Arduino platform. It features a microcontroller chip, input/output (I/O) pins, power connectors, and other necessary components. There are different types of Arduino boards available, such as Arduino Uno, Arduino Nano, Arduino Mega, etc., each with its own specifications and capabilities.

The microcontroller chip on the Arduino board is typically an Atmel AVR series chip, which is programmed using the Arduino software. The board also includes digital input/output pins (GPIO) and analog input pins, allowing you to connect various sensors, actuators, displays, and other electronic components to interact with the physical world.

4.2 IR-sensor

An IR sensor is made up of two main parts: a projector and a receiver that are close to each other. By having an infrared generator and detector send out IR light and wait for the light to come back, the IR detectors can figure out how far away an item is..

$$Distance = Time * Speed$$

where the speed is assumed to be the speed of light

5. Robot Navigation

Most hoover robot navigation systems are set up arbitrarily to avoid common obstacles. Our device's navigation system, on the other hand, is set up in a simple process to avoid obstacles, even in a home where the obstacles are always changing, like in a store. The robot doesn't just remember this routine; it keeps track of what's going on around it and makes decisions based on the pattern. The system is made to work quickly and well. This is clear from what the robot does when it is put in the middle of the room. When this happens, all cleaning stops until the robot can find its way back to where it started.

Fig. 4 is a flow chart of how the created robot will move around. Once the robot is turned on, it looks around to see what's going on and decides which way to go. This is done by checking how far away the left or right sensor is from the nearest obstacle. The side with the farther away object is the one that gets to go where it needs to go. After that, the robot checks to see if it is near a corner of the room. With the back sensor, an estimate is made of how far away the object or turn is. The robot then moves is less than the safe distance, safe D, which is set to 15 cm. The Arduino motor driver that can put on an engine stop.

6. Result and Discussion

In this automatic board cleaner system, we used different electrical and mechanic component to drive the cleaner. The Ultrasonic Sensor works as a distance sensor and is linked to the Arduino Microcontroller so that the distance can stop the robot. The Servo works with the Arduino Microcontroller as a motion driver to help move the ultrasonic sensor..

Table 1: Mechanical and Electric Components

Components	Range
microfiber	1kg
Arduino Uno	5 Volts
Sensors	Ultrasonic Sensor
LED indicators	5 Volts
sweaper	400 Gram
Iron peices	2kg

To build an automatic whiteboard cleaner, you would need various components to construct the mechanism and control system. Here are some key components you might consider using:

Arduino Mega or Arduino Uno: An Arduino board can serve as the brain of the automatic cleaner, providing control and coordination for the different components.

Stepper Motors or Servo Motors: Stepper motors or servo motors can be used to drive the movement of the cleaning mechanism along the whiteboard surface. They offer precise control and positioning capabilities.

Motor Drivers: Motor drivers are electronic modules that interface between the Arduino and the stepper or servo motors, allowing you to control their speed, direction, and movement. Popular motor driver options include the L293D or the DRV8825.

Cleaning Mechanism: The cleaning mechanism can consist of a soft material, such as a microfiber cloth or foam, attached to a robotic arm or mechanical structure. It should be designed to make contact with the whiteboard surface and remove the markings effectively.

Sensors: Sensors are necessary to detect the boundaries and dimensions of the whiteboard. You could use proximity sensors, ultrasonic sensors, or optical sensors to determine the position and size of the board accurately.

Power Supply: Depending on the specific requirements of your components, you would need a suitable power supply to provide electrical power to the Arduino board, motors, and other electronic components. This could be a battery pack or a regulated power supply.

Control Interface: You might consider incorporating a control interface, such as a keypad or buttons, to allow users to start, stop, and program the cleaning operation.

Mounting Hardware and Structure: You will need appropriate mounting hardware and structural components to assemble and position the cleaning mechanism securely on the whiteboard.

Optional: Additional components such as LED indicators, switches, or a display module can be added to enhance the functionality and user experience of the automatic whiteboard cleaner.

It's important to note that building an automatic whiteboard cleaner involves a fair amount of mechanical and electrical engineering skills. You may need to design and fabricate custom parts to suit your specific requirements. Additionally, safety precautions should be taken into account when working with moving parts and electrical systems

Parameters

In this section different parameters are evaluated to described the evaluation of model performance.

Table 2: Performance Analysis of Proposed Model

Dust level	Speed	Power consumption
Very low	55seconds	5days

The performance of an automatic board cleaner can vary depending on several factors, including the design, components used, and the specific cleaning mechanism employed. Here are some key aspects that can affect the performance of an automatic board cleaner:

Table 3. Testing of Ultrasonic Sensor

Distance	Barrier	Condition	Validation
>25 CM	Nothing	The prototype of a street floor cleaning robot	Victory
<25 CM	Front	The turns left or right	Victory
<25 CM	Front and Left	The turns righ	Victory
< 15 CM	Front, Left	The	Victory

	and Righ	turned backward	

According to the findings of the research, planning, and execution that have already taken place. Create a floor cleaning robot prototype that uses an ultrasonic sensor to determine its distance from obstacles and an Arduino Uno microcontroller as a data processor so that it may move in the direction free of obstructions. In order for the ultrasonic sensor's distance value to be established, the distance must be less than 25 cm. It was found in a variety of conditions when testing the distance value of the ultrasonic sensor.

Cleaning Efficiency: The primary measure of performance is the cleaner's ability to effectively remove markings from the whiteboard. Factors that can impact cleaning efficiency include the type and quality of the cleaning material (e.g., microfiber cloth, eraser pads), the pressure applied to the board, and the cleaning mechanism's motion.

Coverage and Accuracy: The cleaner should cover the entire whiteboard surface and accurately navigate its boundaries. The movement system, whether robotic or mechanical, should provide smooth and precise control to ensure complete coverage without missing any areas or leaving residues behind.

Speed and Time Efficiency: The speed at which the cleaner operates can impact its overall performance. A faster cleaning process reduces the time required to clean the board, which can be particularly important in time-sensitive environments. However, the speed should not compromise the cleaning quality.

User-Friendliness: The ease of use and user-friendliness of the automatic board cleaner contribute to its performance. The control interface should be intuitive and straightforward, allowing users to start, stop, and program the cleaner easily.

Noise Level: The noise generated by the cleaner's operation can affect its performance in certain settings, such as classrooms or quiet environments. Quieter operation is generally preferred to minimize disturbances.

Maintenance and Durability: The cleaner's reliability, durability, and maintenance requirements are crucial for long-term performance. It should be designed to withstand continuous operation, have replaceable or easily cleanable components (e.g., cleaning material), and require minimal maintenance to ensure consistent performance over time.

Safety: Safety features and precautions should be incorporated into the design to prevent any potential hazards or accidents during operation. These may include mechanisms to detect obstacles or humans and automatically stop the cleaner if necessary.

It's worth noting that the performance of an automatic board cleaner can vary between different models and manufacturers. If you are considering purchasing an automatic board cleaner, it's advisable to research and read reviews to gain insights into the performance and reliability of specific products before making a decision.

7. Conclusion

Most of the students have been sitting in the lecture hall and watching the teacher erase the ink on the board by running back and forth with a whiteboard rubber. Imagine how this tool would help in the long run if the teacher didn't have to spend time doing easy things like cleaning the whiteboard and could instead spend that time answering students' questions. The way to make that happen is to organise the process of deleting. The robot that was made is in the shape of a disc and has cleaning tools. It is controlled by an Arduino giant processor. Two sweepers that are each driven by a 6 V DC motor and a retractable dustbin with an attached cooling fan assist it gather dirt. Two motor shield-controlled rear wheels and the robot's front caster wheel, which also controls turning, provide propulsion. To help the robot navigate, four ultrasonic sensors that are 90 degrees apart from one another detect obstacles. The robot is powered by five batteries. It is a trashcan made of cardboard with a little blower that weighs around 2 kg. In this instance, we used an automated roller-based cleaning to reduce the amount of dust in the sweeper. The voltage was quite low. When fully charged, a battery can efficiently clean the floor for two hours while running constantly. With this feature, the device may be used both at home and at the office, making cleaning a completely autonomous activity.in this methodology we used double roller at the sweeper to reduce the dust.Sweeping is a task that may be automated to save workers time and energy. The current crop of electrically powered sweepers is cumbersome to use in crowded areas because of their enormous footprint. The equipment needs to be portable, therefore a small footprint is essential. The cylindrical brush and the two side brushes make up the robotic sweeper.

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