

Robotic Vacuum Cleaner Prototype Integrated with Arduino Uno

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DOI: <https://doi.org/10.30880/mari.2022.03.02.054>

Received 31 March 2022; Accepted 31 May 2022; Available online 28 July 2022

Abstract: Vacuum machine available nowadays it is also very unsuitable to take to a residential college because it is very large as equipment to clean the room. This is because the large size will make it difficult for a person to carry a vacuum to enter the room especially students who are staying upstairs. In addition, the vacuum nowadays will also cause anyone who uses it will need a lot of energy. It is because, during the use of the vacuum, we need to bring the machine together. After all, it has a pipe that connects to the garbage collection place inhaled. So high energy consumption is required while using the machine and will tire students to do the work. This project aims to test run the hardware (design of the vacuum cleaner) and software (Arduino Uno) to operate in the ideal working environment. The scope of the project should be given as a guide to ensure that the project does not deviate from the goals to be accomplished any time it is implemented. The Use of Wi-Fi and Bluetooth control that can be connected within 20 to 30 meters range only. A small prototype is built up to fabricate the design of the robotic vacuum cleaner that is ready for integration with Arduino Uno. The size of the prototype is built with dimensions 30 cm x 20 cm x 15 cm. We take this size because we don't want a larger size as it will occupy more space.

Keywords: Hardware(design), Arduino Uno, Wi-Fi and Bluetooth, SolidWorks

1. Introduction

A vacuum cleaner is a tool often used to easily clean dirty floors. In 1860, Daniel Hess was the first to invent a tool to easily clean floors called carpet sweepers to remove dust from carpets as shown in **Figure 1** [1]. However, this tool was not successfully commercialized. After that, many improvements have been made such as using a human-rotated fan. James Murray Spangler who is a cleaner in a supermarket has made an innovation that until now his equipment has been developed [2]. He has asthma problems which make it difficult for him to do cleaning work in the supermarket. He has designed the equipment using a fan in the beginning. After that, it improves by adding a pillowcase to collect the flying dust so that it can be collected.



Figure 1: The world's first vacuum cleaner by Daniel Hess

In recent years, robotic cleaners have taken major attention in robotics research due to their effectiveness in assisting humans in cleaning applications at homes, restaurants, offices, hospitals, and universities [3]. Robotic cleaners are distinguished from their cleaning expertise like floor mopping and dry vacuum cleaning. Some products are based on simple obstacle avoidance using infrared sensors. Each cleaning and operating mechanism of robotic floor cleaners has its advantages and disadvantages. For example, obstacle avoidance-based robots are relatively time-consuming and less energy efficient due to random cleaning but less costly [4-5]. The robotic vacuum cleaner is seen as more convenient than a regular vacuum cleaner because they can vacuum on their own.

2. Materials and Methods

2.1 Materials

As mentioned previously, this project focuses on the development of a robotic vacuum cleaner system that consists of an upgraded vacuum design that is integrated with a middleware developed using Arduino Uno. To fulfil the project objectives, the materials needed are as below:

- i. Arduino Uno
- ii. HC-5 Bluetooth Module
- iii. Motor Driver L298N
- iv. Ultrasonic Sensor HC-SR04
- v. Switch
- vi. Buzzer (5V DC)

- vii. 9V Battery
- viii. Plastic wheel
- ix. Plastic Corrugated board
- x. PVC Pipe

2.2 Methods

A methodology is a set of techniques for producing, improvising, or designing a project as shown in **Figure 2**. It is being utilized in the final semester to produce an original and creative project that meets the project's aims and standards. This is a critical component of the assignment since it allows the reader to assess the student's dependability and relevance. For example, researching the vacuum cleaner, analyzing the issues it faces and designing a robotic vacuum cleaner.

The investigation was carried out from the beginning of the analysis until the completion of the product. The issue statement should be reviewed and a list of project titles should be created initially when creating a project. Following the selection of an appropriate project title, information about the product was gathered to create a multifunction machine. Following that, goal to product development, the product design and analysis were completed. Following that, a project test run should be conducted to confirm that the machine is working. Following the successful test run, product finishing was performed to improve the machine's look. Finally, the final report was completed.

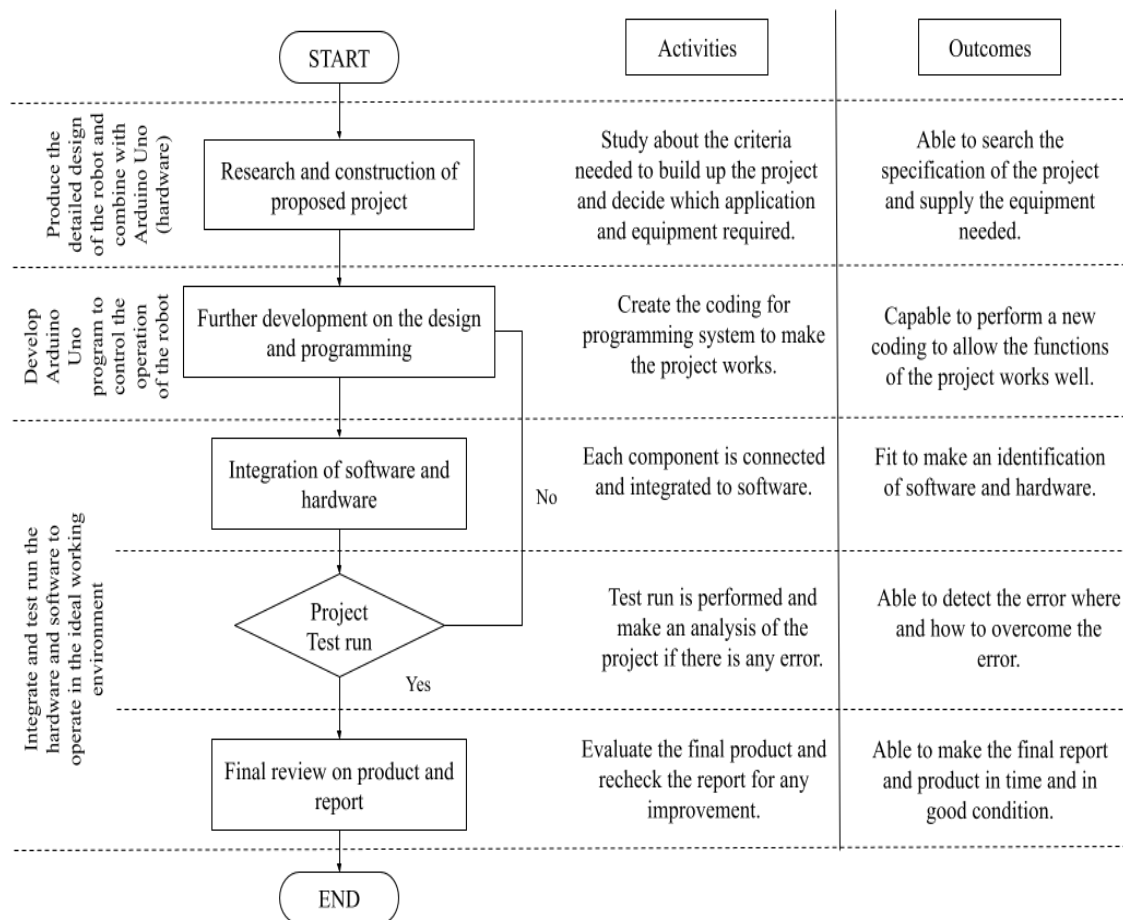


Figure 2: Methodology flowchart

2.3 Design Process (Conceptual)

During the first stage of the design process, the idea was to make an ideal vacuum which is a robotic vacuum. The design must be small, suitable for any type of skin, less energy use and we only focus on family members because this vacuum is useful for them. Then, we sketch the design with SolidWorks 2020 and try to make innovation from another vacuum product. So, we only use recycled materials such as boards, bottles and tires from a toy cars. The concept chosen has some significant characteristics after going through the necessary processes.

2.4 Component Breakdown list

The components breakdown list is shown in **Figure 3** and it is divided into two main categories: i. Electrical System and ii. Recycle Items.

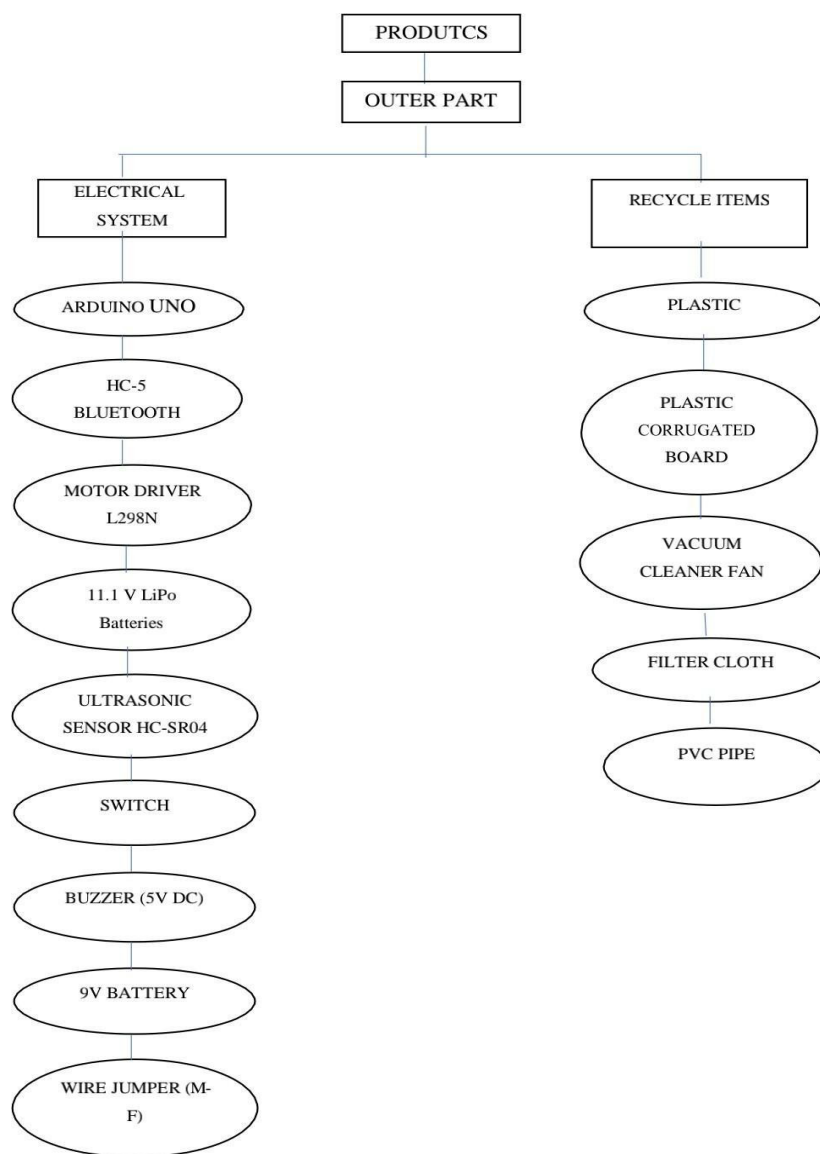


Figure 3: Components breakdown list

3. Results and Discussion

3.1 Result

The product assembly in Solidworks environment is available in **Figure 4** and the exploded view of the prototype is shown in **Figure 5**. Both figures show the outcome of this project.

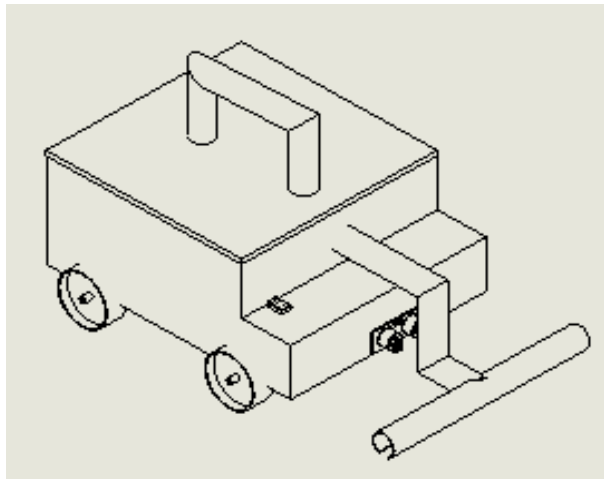


Figure 4: Assemble Product

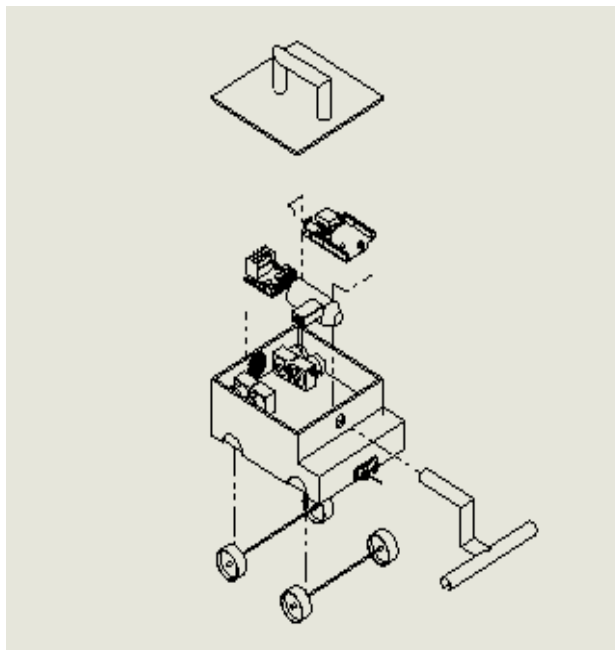


Figure 5: Exploded View

3.2 Discussion

Hardware and Software Integration

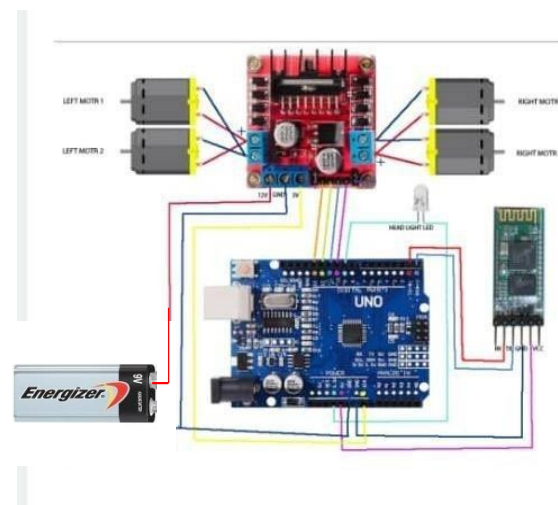


Figure 6: Motor DC, Motor Driver L298N, HC-5 Bluetooth Module and 9VBattery's Connection to Arduino Uno [6]

Figure 6 shows the ultrasonic sensor wired to the Arduino Uno as it will be sending ultrasound as a signal to the Arduino as it may bounce to or about to hit an obstacle from a distance. The power supply which is a 9V battery is used to support the function of each component in the circuit. It has to be connected to each component so that all components will move to do their functionality. After that, the DC Motor will receive a command from ArduinoUno to start rotating according to its command which direction to go [6-7].

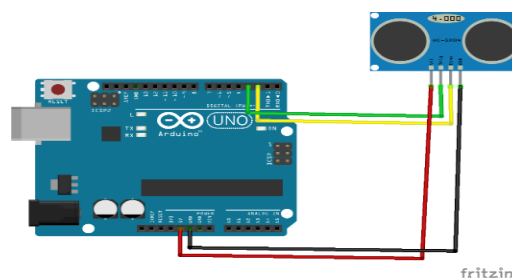


Figure 7: Connection of Ultrasonic sensor HC-SR04 with Arduino Uno

Figure 7 shows the connection of ultrasonic sensor HC-SR04 with Arduino Uno and with a range of 2 to 400 cm, the HC-SR04 is low-cost and use the ultrasonic distance sensor. Obstacle-avoidance robots and automation projects frequently employ it. Ultrasonic sensors work by producing sound waves that are too high in frequency for humans to hear [8]. These sound waves travel at the speed of sound across the air. If an object is in front of the sensor, the sound waves are reflected, and the ultrasonic sensor's receiver detects them [9]. Two silver cylinders (ultrasonic transducers) may be found on the front of the HC-SR04 sensor; one is the transmitter of sound waves, while the other is the receiver [10]. Set the Trig pin high for at least 10 seconds to allow the sensor to emit a sonic burst. The sensor then generates a 40 kHz 8-cycle burst of ultrasound. This sonic burst travels at the speed of sound bounces off the sensor's receiver and is received. The Echo pin then outputs the time in microseconds that the sound waves had to reach. The pins of an Arduino can generate and measure a 10-microsecond pulse. As a result, we can retrieve the distance from the ultrasonic sensor by connecting two Arduino pins: one to the trig pin to generate a 10- second pulse to the sensor's trig pin and the other to the ECHO PIN to measure the sensor's pulse [11].

4. Conclusion

The project, we produce is especially suitable for every user with this Robotic Vacuum Cleaner. We have used Ultrasonic Sensor HCSR04 and Arduino Uno in the success of this project. By using this item, we can study how to perform a coding that works to make this Robotic Vacuum Cleaner so it can be used properly. This is because it detects the area that has not yet been cleaned and can avoid any obstacles when used. Additionally, we have also been able to learn how to use SolidWorks well when we successfully make details of the design on each component of the Robotic Vacuum Cleaner. With a cost not exceeding RM100 has made it very reasonable to anyone who wants to buy it. With this, the existence of this Robotic Vacuum Cleaner will be able to make the entire people take care of the environment well especially hygiene in the house where we live.

Acknowledgement

The authors acknowledge sincerely the Department of Mechanical Engineering, Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia for their support.

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