An-Najah National University

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Hardware Graduation Project

WasteCar

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Disclaimer Statement

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Abstract

This project is pivotal due to its potential to revolutionize waste management practices, addressing a critical issue faced by many communities. The importance of the project lies in its ability to save human resources, enhance efficiency, and contribute to cleaner and healthier spaces.

The WasteCar is a waste car that can be directed to move in different directions using a remote control. The remote control is programmed with specific buttons to manage the WasteCar's movements and operations. One button controls the arm of the WasteCar, allowing it to lower to the ground, pick up waste, and place it in the basket. Another button is programmed to empty the basket by tilting it backward three times to ensure all trash is expelled.

The main objectives of the project revolve around reducing the dependence on manual labor for waste collection, promoting sustainable practices through efficient waste handling, and adapting to different environments. The methodology employed in the application development process encompasses a thorough design phase, testing procedures, and continuous refinement to ensure the robot's reliability and effectiveness in diverse real-world scenarios.

Chapter 1: Introduction

1.1 Statement of the problem:

Typical waste management depends on manual labor, which is inefficient, often culminating in incongruent garbage collection and incorrect waste disposal. Such a strategy can lead to bins that overflow, environmental pollution as well as health risks among workers. Therefore, there is a requirement for the system that can ease up the process of waste collection, reduce human effort, and improve public areas' cleanliness and safety.

1.2 Project Objective:

This project aims to develop a remotely controlled rubbish vehicle referred to as WasteCar, which could make trash collection and disposal. Through enabling the car's movement and operations to be very accurate, WasteCar is meant to decrease the reliance on man power, improve waste handling efficiency, and enhance sustainable waste management patterns. The study seeks to ensure that the robot operates in diverse environments effectively hence contributing towards cleaner and healthier spaces.

1.3 Project Significance:

There is a strong potential for the WasteCar project to result in a transformative change in waste management with emphasis on community's critical challenges. The collection and disposal process can save human resources, cutting labor costs, as well as enabling waste handling to be more efficient and uniform. More than that, but this invention also promotes sustainable habits by providing appropriate garbage separation and timely eradication. Also, WasteCar adoption may reduce exposure to health problems related to hand collection of garbage and improve general safety of people.

1.4 Report Organization:

Chapter 1: Introduction to the problem, the objectives and significance.
Chapter 2 : Theoretical background and previous work.
Chapter 3 : Standards, constraints, tools and methods.
Chapter 4 : Results and analysis.
Chapter 5 : Discussion.
Chapter 6 : Conclusions and Recommendations.

Chapter 2: Theoretical Background and Previous Work

2.1 Theoretical Background:

The inspiration for the project has been taken from robotics. The robotic approach adopted in designing the WasteCar takes into account its movement and the manner in which its arm collects waste and empties it. These ideas are important when programming the remote control, making it easier for users to steer the car and operate its arm and basket. The goal of this initiative is to come up with a basic but efficient way of enhancing waste management processes through minimizing manual efforts needed during garbage disposal.

2.2 Previous Work:

We explored different ideas and examples we found on the internet and on other platforms that relate to our project. In this research we understood how trash cars and robots work. We saw some videos and read about different designs, which allowed us to kind of guess what our garbage truck should be like. This background research was crucial for us to come up with some features that needed to be added and some effective ways in which we could design our WasteCar.

Chapter 3: Literature Review

This area highlights the inefficiencies and labor-intensive of manual waste collecting methods, Inserting of robotics in this field has shown promising results and the studies showed the effectiveness of remote-controlled waste collecting systems. For example, this type of project has been used in canals and rivers in the USA, which have reduced the amount of toxins and lead to healthier immune systems.

It also utilizes remote control technology and the arm for precise and efficient waste collecting. But, challenges like design complexity and adaptability to different environments exist.

Our WasteCar project depends on these concepts by combining a remote-controlled waste car with a programmable arm and basket mechanism, aiming to simplify waste collection and disposal.

Chapter 4: Methodology

4.1: Overview

In this chapter we will explain what the hardware parts we used and for what purpose we used them for.

- Arduino Mega
- DC motors
- Wheels
- L298N Motor Driver Module
- Connecting wires
- Servo motors
- Remote control
- IR sensor
- Buzzer

- Leds
- On/Off button
- Power Bank
- Batteries

4.2: Description

In this section we will talk about the hardware components that we used:

1. Arduino Mega:

   It's an Arduino 2560 mega microcontroller ,can be used as an input or output, it contains 54 digital pins,15 PWM output , Reset button,16 analog pins and 4USARTS work on 16MHZ.
   We have used it in our project to connect tools with each other and make them work in an integrated process.

Figure 1: Arduino mega 2560

2. DC Motors:
   We used four dc motors to move the car forward ,backward ,left and right in order to reach the object.

Figure 2: DC motor

3. Wheels:
   The wheel is a mechanical part that provides movement for the project. It is connected to a dc motor. In our project we used four driving wheels.

Figure 3: Wheels

4. L298N Motor Driver Module:
   It consists of two DC motors that can be controlled concurrently by a dual H-Bridge motor driver. With a peak current of up to 2A, the module can operate DC motors whose voltages range from 5 to 35V.

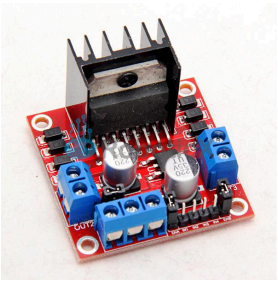

Figure 4: L298N Motor Driver Module

5. Wires:
   We used the wires to connect the components together.

Figure 5: Wires

6. Servo Motor:
   We used the servo motors to control the arm to pick up the object from the ground, and we used it to empty the basket.

Figure 6: Servo motor

7. Remote Control:
   We used it to control the project and we programmed different buttons that work as follows: we programmed buttons to control the movement of the car and also we programmed another two buttons for the arm and the basket.

Figure 7: Remote control

8. IR sensor:
   This sensor will receive the signal coming from the remote control and based on this signal an action will happen.

Figure 8: IR sensor

9. Buzzer:
   Indicate that the car is currently moving backward.

Figure 9: Buzzer

10. Led:
    It is a simple indication that the car is moving to the left or to the right.

Figure 10: Led

11. On/Off switch:
    Control the car movement so if it is off then the car can't move and vice versa.

Figure 11: On/Off switch

12. Power bank:
    The power bank provides the power to the arduino.

Figure 12: Powerbank

13. Batteries:

We used it to provide the power needed to the DC motors so the car can move.

Figure 13: Battery

4.3: Hardware Development

We started with creating the base design for the car then connect it with the wheels and the dc motors.

Figure 14: Car

4.4: Overall design

The final result for the project.

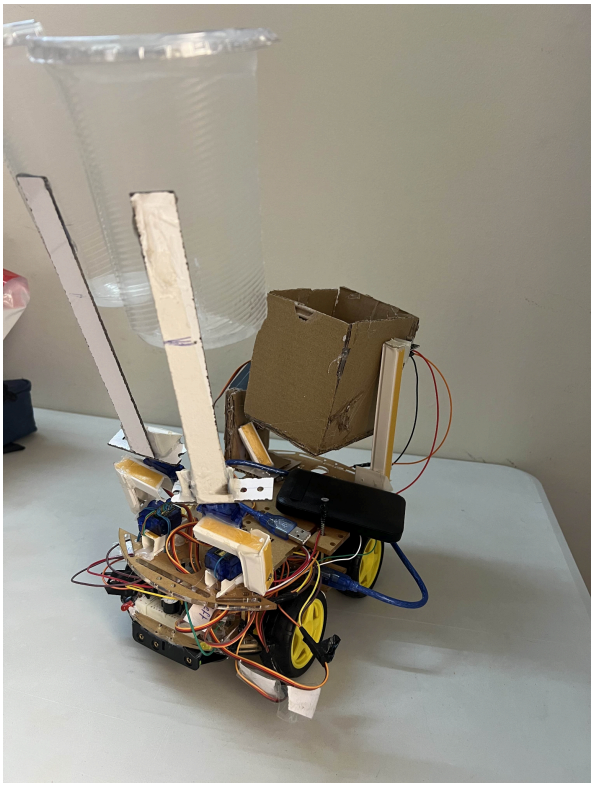

Figure 15: Final result 1

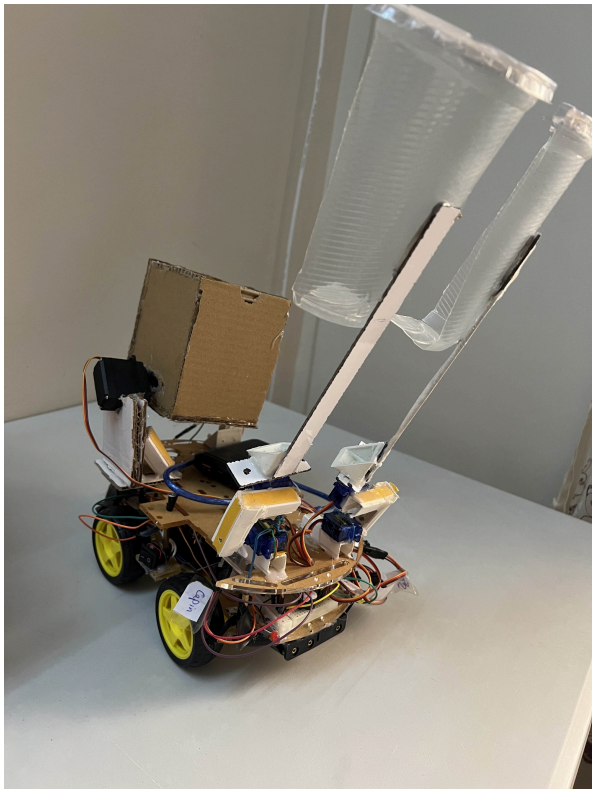

Figure 16: Final result 2

Chapter 5: Discussion

TASH CAR is a project that has provided the basic needs required for trash collecting subject, and will provide the user with a good experience.

In general, we didn't cover the whole concept of it. There are some details that will make a difference in the trash collecting process and the experience of the user like automated mode, mobile application to control the car from the mobile and the trash segregation in the basket.

Chapter 6: Conclusion and Recommendation

6.1 Conclusion:

WasteCar is a car that collects the ordinary waste, to leverage it by reducing time, cost and increasing the comfort of people.

We've gained experience and learned how to control objectives like arm and wheels using arduino using C++ language that will assist us in the future, either to upgrade our project or to work on other projects.

6.2 Future Work and Recommendation:

In the future work we will add some features that will make the using of the car more useful and benefit and this is some of the features that we are planning to add in the future:

- Automated mode so the car can move without any control of the user and collect the waste.
- Mobile application so the user can control the car even if there is an obstacle between the car and the user.
- Knowing the battery percentage helps us determine how long the car can run.

Chapter 7: References

1. Arduino Tutorial .URL: https://www.arduino.cc/en/Tutorial/HomePage

2. Dual H-Bridge Datasheet.URL: https://www.sparkfun.com/datasheets/Robotics/L298_H_Bridge.pdf

3. Dc motor Datasheet: https://category.alldatasheet.com/index.jsp?semiconductor=DCMotor

4. Remote control: https://projecthub.arduino.cc/lee_curiosity/a-beginners-guide-controlling-an-arduino-car-with-a-remote-5d4418

5. Servo motor: https://projecthub.arduino.cc/bruno_opaiva/controling-servo-motors-with-buttons-and-arduino-bcb3b6

6. A. Akib et al., "Unmanned Floating Waste Collecting Robot," TENCON 2019 - 2019 IEEE Region 10 Conference (TENCON), Kochi, India, 2019, pp. 2645-2650, doi: 10.1109/TENCON.2019.8929537. keywords: {Robot sensing systems;Belts;DC motors;Prototypes;Propellers;Water pollution;floating waste;remote controlled;motor control;aquatic animals;water pollution},