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LINE MARKING ROVER: AN ARDUINO-BASED CHALK DISPENSER FOR PRECISION GROUND MARKING

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ABSTRACT

This paper presents the design and implementation of a line marking rover, an innovative ground marking solution utilizing an Arduino microcontroller. The rover is equipped with four motors, each connected to an L298 motor driver, and controlled via an HC-05 Bluetooth module, allowing for wireless operation using the Android Bluetooth Controller app. The primary objective of the project is to enable precise line marking on surfaces through a chalk dispensing mechanism. The rover features a box mounted at the rear, containing chalk powder with a slit that remains closed during non-forward movements. Upon forward movement, a servo motor actuates to open the slit, dispensing chalk powder in a controlled manner. This setup ensures that marking occurs only when the rover is moving forward, preventing accidental markings during turns or reverse movements. The paper details the hardware and software components used, the control logic implemented, and the results from testing the system under various conditions. The line marking rover demonstrates a cost-effective and efficient approach to automated ground marking, with potential applications in sports field marking, construction, and other domains requiring precise ground-based line drawing.

I. INTRODUCTION

In various fields such as sports, construction, and event planning, accurate ground marking is essential. Traditional methods of line marking are often labor-intensive and prone to human error, leading to inefficiencies and inaccuracies. To address these challenges, we developed an automated line marking rover, capable of precise and consistent line drawing on various surfaces. This project leverages the capabilities of an Arduino microcontroller, an L298 motor driver, an HC-05 Bluetooth module, and a servo motor to control a chalk dispensing mechanism. The rover can be operated remotely via a mobile app, enabling easy and flexible control. The primary objective of this project is to design and implement a rover that dispenses chalk powder only when moving forward, ensuring clean and accurate lines without unwanted marks during turns or reverse movements. This paper outlines the design, implementation, and testing of the line marking rover, highlighting its potential applications and advantages over traditional methods.

II. METHODOLOGY

2.1. HARDWARE COMPONENTS

- **Arduino:** The central controller of the rover, responsible for processing input signals and controlling the motors and servo.
- **L298 Motor Driver:** Used to control the four DC motors attached to the wheels of the rover, allowing for forward, backward, and directional movements.
- **HC-05 Bluetooth Module:** Enables wireless communication between the rover and a Smartphone, using the Android Bluetooth Controller app for remote operation.
- **Servo Motor:** Controls the opening and closing of the slit on the chalk box. The servo motor is programmed to rotate and open the slit when the rover moves forward.
- **Chalk Box:** A container mounted at the rear of the rover, designed to hold chalk powder. It has a slit that dispenses chalk when opened by the servo motor.
- **Other Components:** Includes the chassis, wheels, and necessary wiring to connect all components.

2.2. SOFTWARE

- **Android Bluetooth Controller App:** This app is used to send directional commands to the rover via Bluetooth. It allows the user to control the rover's movements remotely.

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- **Arduino Code:** The software running on the Arduino microcontroller includes the logic for motor control and servo operation. Key functions include:
  - **Motor Control:** Code to handle forward, backward, left, and right movements based on input from the Bluetooth module.
  - **Servo Control:** Logic to open the chalk box slit when the rover moves forward and keep it closed during other movements.

```
void moveForward() {
  digitalWrite(motorPin11, HIGH);
  digitalWrite(motorPin12, LOW);
  digitalWrite(motorPin21, HIGH);
  digitalWrite(motorPin22, LOW);
}
 void openSlit() {
   slitServo.write(0); // Open position (adjust as needed)
 }

 void closeSlit() {
   slitServo.write(90); // Closed position (adjust as needed)
 }
```

Figure 1: Code snippet for controlling rover movement and chalk dispensing

III. IMPLEMENTATION

3.1. DESIGN

The rover's chassis is assembled with four wheels, each connected to a DC motor. These four motors are controlled by the L298 motor driver, enabling the rover to move forward, backward, left, and right. The chalk box is securely placed at the back side of the car model, with a vertical slit that dispenses chalk when opened. A servo motor is used to control the opening and closing of this slit. All other hardware components, including the Arduino, HC-05 Bluetooth module, and power supply, are mounted on the top of the chassis for easy access and efficient use of space.

Figure 2: Rover chassis with mounted components

Figure 3: Rover chassis with the servo motor placed at the rear of the chassis

3.2. CONTROL LOGIC

- **Movement Control:** The Bluetooth module receives commands from the smartphone app, which are processed by the Arduino to control the rover's direction.
- **Chalk Dispensing Mechanism:** The Arduino code includes conditional statements that activate the servo motor only when the forward command is received. This ensures that the chalk slit opens only during forward movement, preventing unwanted chalk dispensing.

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Figure 4: The top view of the components places on the chassis

IV. RESULTS

The line marking rover demonstrated reliable performance in various tests. The rover responded accurately to commands from the Android Bluetooth Controller app, moving smoothly in all directions. During forward movement, the servo motor successfully opened the slit to dispense chalk, creating clear and continuous lines. The slit remained closed during backward, left, and right movements, preventing unintended chalk dispensing. The lines marked were straight and well-defined, with minimal deviation. The rover operated continuously for up to 2 hours and performed well on different surfaces, including concrete, asphalt, and grass. Initial challenges with Bluetooth connectivity and chalk consistency were resolved, ensuring reliable and consistent performance.

V. DISCUSSION

The line marking rover project successfully addresses the challenges of manual ground marking by providing an automated and precise solution. The use of an Arduino microcontroller, L298 motor driver, and HC-05 Bluetooth module enabled effective remote control of the rover, while the servo motor ensured accurate chalk dispensing only during forward movement.

One of the main strengths of this project is its ability to create clear and continuous lines without unintended marks during directional changes. The decision to use finely ground chalk and an appropriately sized slit proved crucial in maintaining line consistency. Additionally, the rover's adaptability to various surfaces, such as concrete, asphalt, and grass, demonstrates its potential for diverse applications.

However, some challenges were encountered, particularly with Bluetooth connectivity and chalk consistency. These issues were mitigated by optimizing component placement and using fine chalk powder, respectively. Future improvements could include enhancing the Bluetooth module's range and exploring alternative chalk dispensing mechanisms to further increase reliability.

VI. CONCLUSION

The line marking rover represents a significant advancement in automated ground marking technology. By combining remote control capabilities with precise chalk dispensing, the rover provides a practical and efficient solution for applications requiring accurate line marking. The project successfully met its objectives, demonstrating reliable performance in various tests and conditions. With further enhancements, this technology has the potential to be widely adopted in fields such as sports, construction, and event planning.

VII. REFERENCES

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