

Design and Implementation of a Wi-Fi Enabled Scrap Picking Robot with Integrated Vision and 3D Printed Gripper

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Abstract - Scrap handling in industrial and workshop environments is often associated with safety risks, inefficiency, and high manual effort. This paper presents the design and development of a Wi-Fi controlled scrap picking robot equipped with a 3D-printed gripper and an integrated vision system. The proposed system enables remote operation through a mobile device using wireless communication, allowing users to control the robot from a safe distance. A camera module is incorporated to provide real-time video streaming for accurate navigation and object handling. The gripper is fabricated using 3D printing technology with materials such as PLA (Polylactic Acid), ensuring lightweight, low-cost, and customizable design. The robot utilizes embedded systems and motor control mechanisms to perform efficient pick-and-place operations. Experimental results demonstrate that the system improves safety, reduces human effort, and enhances efficiency in scrap collection tasks. The proposed solution is cost-effective and suitable for small-scale industrial applications.

Key Words: Scrap Picking Robot, Wi-Fi Control, 3D Printing, PLA (Polylactic Acid), Embedded Systems, Automation, Vision System, Waste Management, Robotics, Remote Control

1. INTRODUCTION

Scrap collection in industries is usually done manually, which is time-consuming and unsafe for workers. Handling sharp and hazardous materials can cause injuries and health risks. To solve this problem, a Wi-Fi controlled scrap picking robot is developed. The robot can be operated using a mobile device and is equipped with a 3D-printed gripper to pick and place scrap materials. A camera is used for real-time monitoring, making the operation easy and accurate. Materials like PLA (Polylactic Acid) are used to make the gripper lightweight and low-cost. This project helps to reduce human effort and improve safety in scrap handling.

The proposed system aims to enhance safety, improve efficiency, and provide a low-cost automation solution for scrap collection in small-scale industries and workshops. This work demonstrates the effective integration of wireless communication, robotic control, and additive manufacturing in developing practical engineering solutions.

2. DESIGN AND IMPLEMENTATION

2.1 SYSTEM DESIGN:

The proposed scrap picking robot consists of mechanical, electrical, and control subsystems. The mechanical structure includes the robot chassis and a 3D-printed gripper designed to handle scrap materials. The electronic system includes a microcontroller, motor driver, Wi-Fi module, and camera module. The control system enables communication between the robot and a mobile device for remote operation.

2.2 HARDWARE IMPLEMENTATION:

The system is built using components such as NodeMCU (ESP8266), L298N motor driver, DC motors, relay module, and a camera module. The robot is powered using rechargeable batteries. The gripper is fabricated using 3D printing technology with materials like PLA (Polylactic Acid), making it lightweight and cost-effective.

2.3 SOFTWARE IMPLEMENTATION:

The software part involves programming the microcontroller to control the robot's movement and gripper operation. A mobile application is used to send commands via Wi-Fi. The camera module streams real-time video, helping the user to control the robot accurately.

2.4 WORKING PRINCIPLE:

When the system is powered on, the robot connects to a Wi-Fi network. The user sends control commands through a mobile device. Based on these commands, the motor driver controls the movement of the robot. The camera provides live video feedback. The gripper opens and closes to pick and place scrap materials as required.

2.5 RESULTS AND DISCUSSION:

The developed robot successfully performs movement in all directions and can pick and place scrap materials effectively. The Wi-Fi control system works reliably, and the camera provides clear real-time monitoring. The use of a 3D-printed gripper improves flexibility and reduces cost. Overall, the system demonstrates improved efficiency and safety compared to manual scrap handling.



Fig -1: Closed grip



Fig -2: Open grip



Fig -3: 360 Degree Rotation

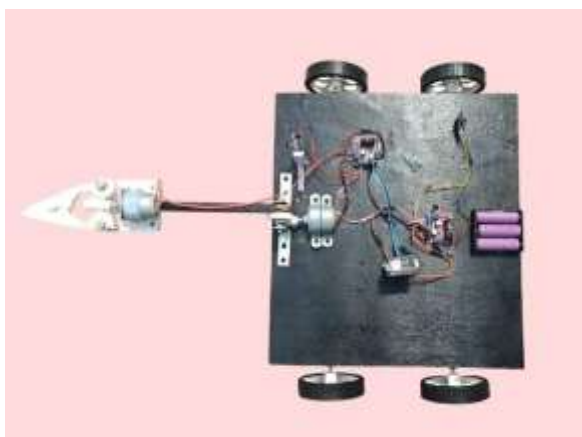


Fig - 4: Final Output

CONCLUSION

The Wi-Fi controlled scrap picking robot provides a simple and effective solution for scrap collection. It reduces human effort and improves safety in hazardous environments. The integration of wireless control, vision system, and 3D printing makes the system efficient and cost-effective.

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