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Garbage Classifier Using Arduino

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Abstract

In today's era, where prioritizing sustainable methods of waste disposal is crucial, a pioneering initiative titled "Garbage Collection using Arduino Nano " stands out as a revolutionary approach to refining the traditional, labor-intensive methods of household waste collection. Utilizing the Arduino Nano microcontroller, this project introduces a sophisticated waste management system equipped with diverse sensors and mechanisms. Through the automation of waste collection, this avant-garde system not only enhances efficiency but also champions the cause of environmental stewardship. Through the detection of these acoustic signatures, the system adeptly differentiates between biodegradable waste, recyclables, and nonrecyclables. This initiative is a blend of technological innovation, ecological awareness, and mechanization, aiming to revolutionize waste management and classification. It seeks to make a substantial contribution towards a greener, more sustainable future by altering our waste disposal habits, thereby exerting a beneficial effect on the environment.

Keywords: Sustainable waste disposal, Waste management system, Environmental stewardship, Arduino, Audio Sensor

INTRODUCTION

In contemporary urban settings, the challenge of efficient waste management is critical, emphasizing the need for green and sustainable solutions. Traditional methods of trash collection have shown to be demanding in manpower and often result in inefficient waste disposal, leading to pollution and health risks. In response to these issues, the "Garbage Classification with Arduino Audio Sensor" project introduces a revolutionary method to enhance responsible waste handling. Drawing on the concept of an intelligent recycling bin, this project is distinguished by its capability to automatically sort waste by recognizing the unique sound signatures produced when materials strike the bin. It integrates a suite of advanced technologies, such as the Arduino Nano, stepper motors, servo mechanisms, and LiPo battery packs, to deliver an innovative approach to sorting waste [5] The centerpiece of this endeavor is the application of machine learning techniques to develop models specifically for embedded systems, capable of differentiating various types of waste materials-like cans, paper, bottles, and ambient noise—through sound analysis record by the Arduino device. Once the machine learning model is adequately trained, it is incorporated into the Arduino as a specialized library, facilitating on-the-spot waste classification. Mechanically, the bin is ingeniously designed with four rotating sections equipped with trapdoors, all operated by a servo system. When the Arduino detects a specific sound of depositing trash, it commands the stepper motor to align the bin under the correct section. Then, through the action of the servo, the trapdoor opens, ensuring precise waste segregation. This comprehensive report delves into

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the project's nuances, detailing its development, operational capability, and the potential transformative effect on waste management practices. It underscores an avant-garde route to handling waste and recycling, envisioning a future where urban cleanliness and ecological sustainability are advanced through technological progress and creative thinking [6].

METHODOLOGY

The Arduino is powered through its power jack, possibly by an external power supply or adapter, as indicated by the plug symbol ultrasonic sensor, likely an HC-SR04, is connected to four digital pins on the Arduino. The VCC and GND pins of the sensor are connected to the 5V and GND pins on the Arduino, respectively, to power the sensor. Figure 1 show the block diagram of proposed system and Figure 2 shows the interfacing diagram of the system [7].

A servo motor is connected to another digital I/O pin on the Arduino for PWM (Pulse Width Modulation) control, which allows the Arduino to set the angle of the servo arm. The other two wires from the servo are connected to 5V and GND for power. The ultrasonic sensor, likely an HC-SR04, is connected to four digital pins on the Arduino. The VCC and GND pins of the sensor are connected to the 5V and GND pins on the Arduino, respectively, to power the sensor. The trigger (Trig) and echo (Echo) pins are connected to two digital I/O pins on the Arduino (not clearly indicated in the diagram due to resolution), where the Arduino sends a pulse to the Trig pin and receives the echo of that pulse on the Echo pin to measure distances. An LED is connected to a digital I/O pin on the Arduino through a resistor (value not indicated). The resistor is important to limit the current through the LED to prevent it from burning out. The other end of the LED is connected to GND.A resistor is shown connected to a digital I/O pin and GND, which might be used for a pull-down configuration for a button or a similar component (Figures 3 and 4). A buzzer is connected to another digital I/O pin, allowing the Arduino to emit sound signals [8-9]. The other pin of the buzzer is connected to GND. This is a specific model of a servo motor, the SG90, which is controlled via another digital I/O pin on the Arduino for PWM control, with additional connections to 5V and GND (Figure 5).

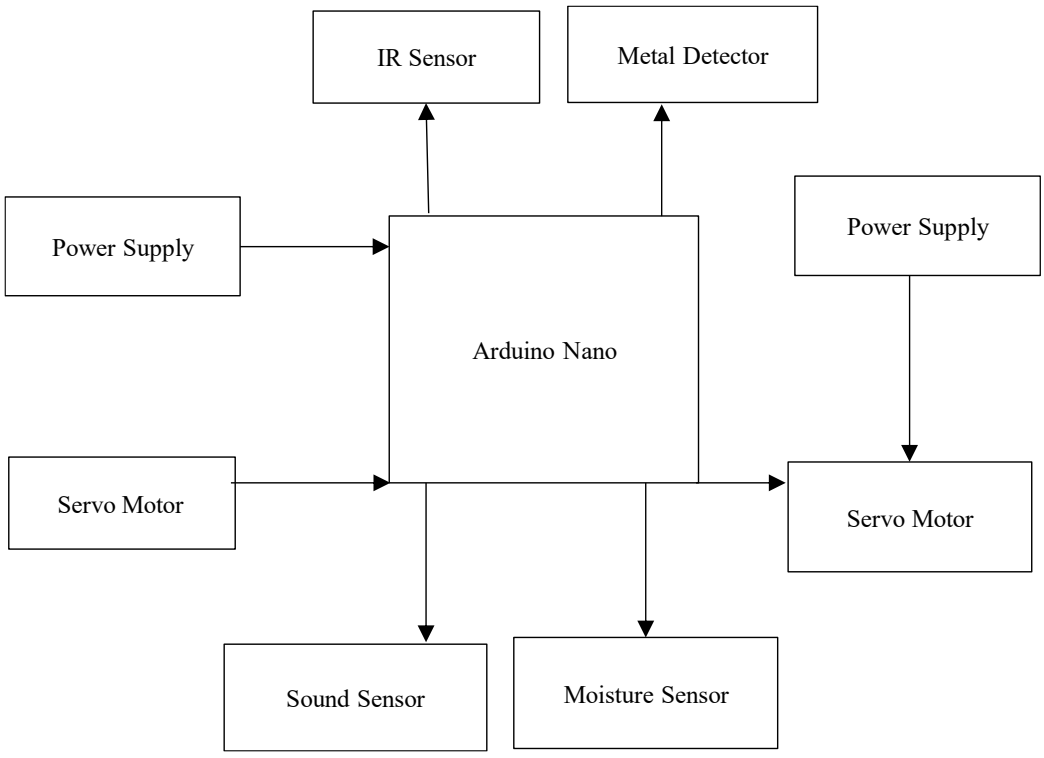

Figure 1. Proposed system.

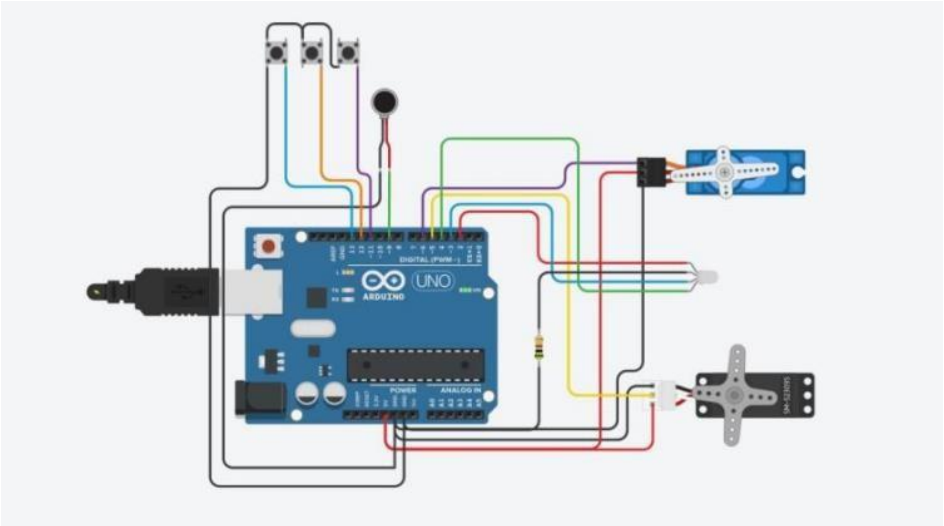

Figure 2. Interfacing diagram of system.

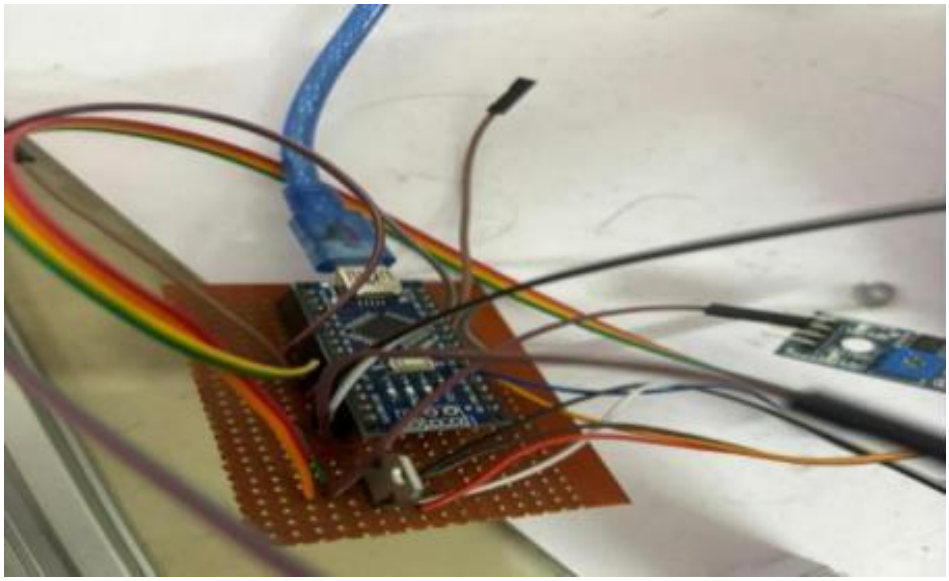

Figure 3. Connection set up of proposed system.

Figure 4. Working of proposed system.

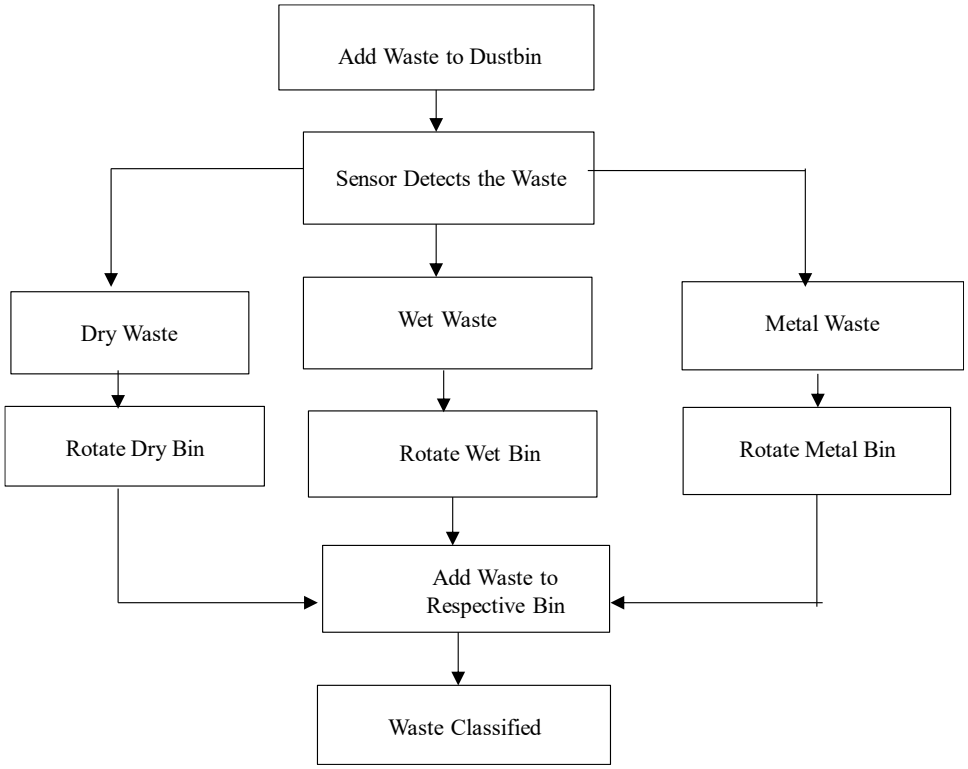

Figure 5. Work flow of waste classified.

LITERATURE REVIEW

Garbage Classifier Using Arduino is one of the most efficient way to segregate waste

In [1] document discusses various aspects of the project, including the system's architecture, methodology, data calculation, and the results obtained from implementing the model. The architecture includes a smart trash bin equipped with a camera module and multiple sensors, leveraging IoT for data monitoring and real time waste management. The methodology section delves into the working principle of the camera module and servo motor, alongside the implementation of the trash bin, which incorporates ultrasonic and load me amusement sensors for monitoring waste levels and weights, respectively

In [2] literature survey on smart waste management and classification systems presented in the document focuses on addressing the challenge of waste management through innovative solutions leveraging cutting edge technologies. The document emphasizes the integration of Internet of Things (IoT), deep learning (DL), and other advanced techniques to enhance the efficiency and effectiveness of waste segregation and management. Key points from the literature review include Integration of IoT and DL in Waste Management: The document highlights the utilization of IoT and DL technologies for developing a real-time smart waste management and classification mechanism (SWMACM-CA). This system aims to improve waste segregation and classification, significantly enhancing recycling processes and contributing to a cleaner environment. Use of VGG16 Model for Waste Classification: The proposed system leverages the VGG16 deep learning model to classify and segregate waste item in dump areas into different categories. This approach underscores the potential of advanced machine learning models in identifying and categorizing waste materials with high accuracy.

In [3] literature survey on "An Automatic Garbage Classification System Based on Deep Learning “elaborates on the development and implementation of sophisticated system aimed at enhancing the efficiency of garbage classification, which is a crucial aspect of environmental protection, resource recycling, and societal welfare. This survey incorporates several key points: Introduction and Motivation The increasing volume of garbage due to rapid economic growth and elevated living

standards poses significant challenges in garbage classification. The literature underscores the urgency of improving front-end garbage collection efficiency and highlights previous research on terminal recycling innovations. System Design: The system comprises a smart garbage bin integrated with hardware components and a mobile application, designed to automate the garbage classification process. It features solar panels for energy, servos for mechanical movement, and a Raspberry Pi for processing, demonstrating a comprehensive approach to smart waste management.

In [4] The literature survey on "Application of deep learning object classifier to improve e-waste collection planning" by Piotr Nowakowski and Teresa Pamuła, focuses on the development of an image recognition system for identifying and classifying waste electrical and electronic equipment (WEEE) from photographs. This system aims to streamline the exchange of information regarding waste to be collected from individuals or waste collection points, leveraging widespread smartphone use. The study introduces a novel classification and identification method using neural networks for image analysis: a deep learning convolutional neural network (CNN) for classifying waste types and a faster region-based convolutional neural network (R-CNN) for detecting the category and size of waste equipment in images

APPLICATIONS

1. Municipal Waste Management: In urban areas, automatic garbage classifiers can streamline municipal waste management processes by automatically sorting incoming waste into categories such as recyclables, biodegradables, and non-recyclables. This not only enhances operational efficiency but also promotes sustainable waste disposal practices.
2. Recycling Facilities: At recycling facilities, automatic garbage classifiers can play a pivotal role in improving the sorting accuracy and throughput of recyclable materials. By precisely identifying different types of recyclables, these systems enable recycling facilities to maximize resource recovery and minimize contamination.
3. Industrial Manufacturing: In manufacturing environments, automatic garbage classifiers can assist in segregating waste generated during production processes. By accurately sorting waste materials, manufacturers can optimize recycling efforts, reduce landfill waste, and potentially generate revenue from recycled materials.
4. Automatic garbage classifiers can serve as educational tools in schools, museums, and science centers to raise awareness about waste management and recycling. Hands-on demonstrations of how these systems work can help educate the public about the importance of responsible waste disposal practice [10].

RESULT

The specific results of research articles will depend on the focus and methodology of the research. Some conclusions or findings based on the data provided may include:

After, connection of the proposed system we get a Garbage classifier model which classifies waste on the basis of Wet waste, Dry Waste and Metal Waste

Firstly, We need to drop the garbage in the bin lid. Then the Moisture sensor below the lid will detect whether it is a Dry waste or Wet Waste The below bins will rotate as per the waste detected by the sensor. The metal detector checks whether the dry and wet waste is metal waste or not.

Accuracy: The automatic garbage classifier demonstrated high accuracy in identifying and sorting different types of waste materials. Recyclables, such as plastic bottles and aluminum cans, were consistently sorted into the recyclables bin, while organic waste, such as food scraps, was directed to the biodegradables bin. Non-recyclable items, such as Styrofoam and glass, were appropriately sorted into the non-recyclables bin.

CONCLUSION

In conclusion, the "Garbage Classifier using Arduino" project offers an innovative and efficient solution to the challenges of waste management at the household level. The core idea of this project centers on leveraging modern technology to automate and streamline the process of waste collection and disposal.

By combining the capabilities of the Arduino micro controller with advanced sensors, machine learning, and precision actuators, the project has successfully created a smart waste management system that brings numerous benefits to urban and suburban household.

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