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Waste Segregator: Waste Management Prototype

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Abstract: ***Smart Waste Dustbins utilize IoT, AI, and computer vision for efficient waste management. They feature multiple compartments, sensors, and automatic lid mechanisms for real-time waste sorting. Computer vision and AI algorithms accurately identify and segregate waste. Smart Waste Dustbins monitor fill levels and offer a user-friendly interface for public engagement. Sensors include ultrasonic, moisture, and metal sensors for proximity, moisture analysis, and metal item segregation. Smart Waste Dustbins revolutionize waste management, enhancing efficiency in segregation, recycling, and collection processes, leading to reduced environmental impact and improved resource utilization for sustainable communities.***
Keywords: waste management, image processing, waste segregation, electronics, microcontroller.





I. INTRODUCTION

Manual waste sorting, while effective, is becoming inefficient due to increasing waste volumes and limited human resources. Source segregation, particularly into wet and dry streams, enhances recyclability and resource recovery. Wet waste, often converted into compost or biogas, can replace chemical fertilizers and serve as an energy source. Currently, there is no such system of segregation of dry, wet and metallic wastes at the household level. To address excessive trash, alternative methods like pre-shredding or sensor-based sorting are investigated. Sensor-based sorting offers a promising solution for large waste volumes. These bins utilize sensors to distinguish wet and dry waste based on moisture content, directing waste to appropriate containers for direct processing. By automating the sorting process, smart dustbins streamline waste management, promoting recycling and reducing reliance on manual sorting. Additionally, it reduces dependency on manual labour and optimizes the utilization of available resources, contributing to a more efficient and sustainable waste management system.

II. RELATED WORK

Amrutha Chandramohan et. al. states there is no such system for segregation of wastes into categories such as dry, wet and metallic wastes at the household level.

Nishigandha Kothari et. Al. used Ultrasonic Sensors are used to monitor the garbage collection. When the garbage reaches the sensor level an interrupt is sent to the microcontroller.

J.S. Bajaj et. al. says many upgrades can be done to the existing project. Some of which are listed below: Advanced processing techniques can be incorporated once the waste has been segregated, methods for individual material feeding for local use so that the segregation can be performed continuously once the waste is dumped, image sensing can be used to segregate materials through Image processing technology.

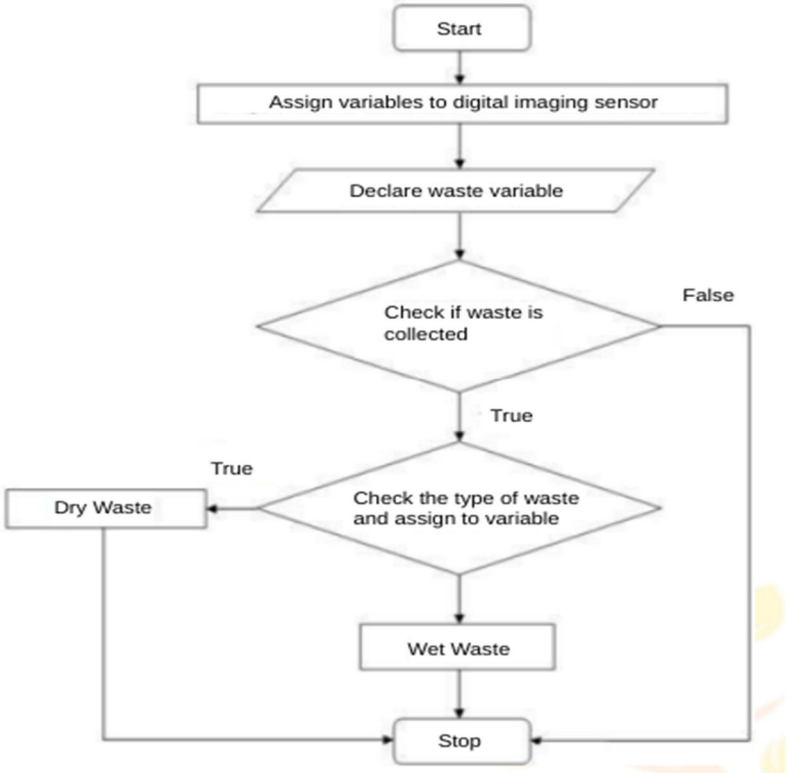
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Rashmi M. Kittali et. al. says that even PLC can be used for AWS. It has an advantage of reduced manpower, improved accuracy and speed of management of waste. It also avoids the risk of working in hazardous places

III. PROPOSED SYSTEM

The Waste Segregator System is driven by the ESP32 Module. All the components that are connected to ESP32 are programmed using the C language. The program is written in Embedded C language and it reads the input/output pins of the components. The conveyor belt system moves when it senses the garbage. The servo motors are present to deflect the wet, dry and metallic waste into the specific bins. The waste is detected by Digital Image sensors. The wet waste is examined with the help of dataset provided.
The measure of the dustbin level is calculated by the Ultrasonic sensor connected at the edge of the dustbin. When the dustbin is full, a message- BIN IS FULL is sent to the cleaning authorities. The message is sent using the GSM module that provides the communication between the bin and the authority. The location of the bin can also be sent. The location is known with the usage of GPS module that is connected to the system.

A. Visualisation



B. Working

1) The Waste Segregator consists of three cylindrical waste collectors attached to a spinning wheel along with a image processing hardware. The Image Processing Software first compares the data received by scanning the collected waste at first step.
2) The data received is compared with a dataset of waste products fed through software, the compared results is then transferred to microcontroller to trigger the spinning wheel mechanism.
3) The spinning wheel is controlled by a motor through a motor driver, appropriate cylinder is placed beneath the collect waste to filter it accordingly ex. Dry, wet, electronics, etc. The collected waste can be later removed and packed accordingly.
4) The device made during this project is home prototype, can be modified according industrial application like larger unit additional facilities like decomposition and conversion of waste to energy.
5) The digital image processor can also be modified to high efficiency spectrum which can segregate waste more precisely for industrial purposes.

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IV. CONCLUSIONS

This project proposes an Waste Segregator which is a cheap, easy to use solution for a segregation system for household, so that it can be sent directly for results show that the segregation of waste into metallic, wet and dry waste has been successfully processing. Experimental implemented using the Waste Segregation. With the future scope the bins can be made solar powered with better segregation techniques like digital image processing and the waste collected in the bins can be made compact to increase the storage capacity. We analyzed the solutions currently available for the implementation of IoT and segregate the wet, dry and metallic waste. The model developed in this paper is efficient and durable since it requires less power and equipment for its operation. The model segregates wet, dry and metallic waste. This efficiently reduces man power, wastage of time and is very convenient to use.With the future scope the bins can be made solar powered with better segregation techniques like digital image processing and the waste collected in the bins can be made compact to increase the storage capacity.

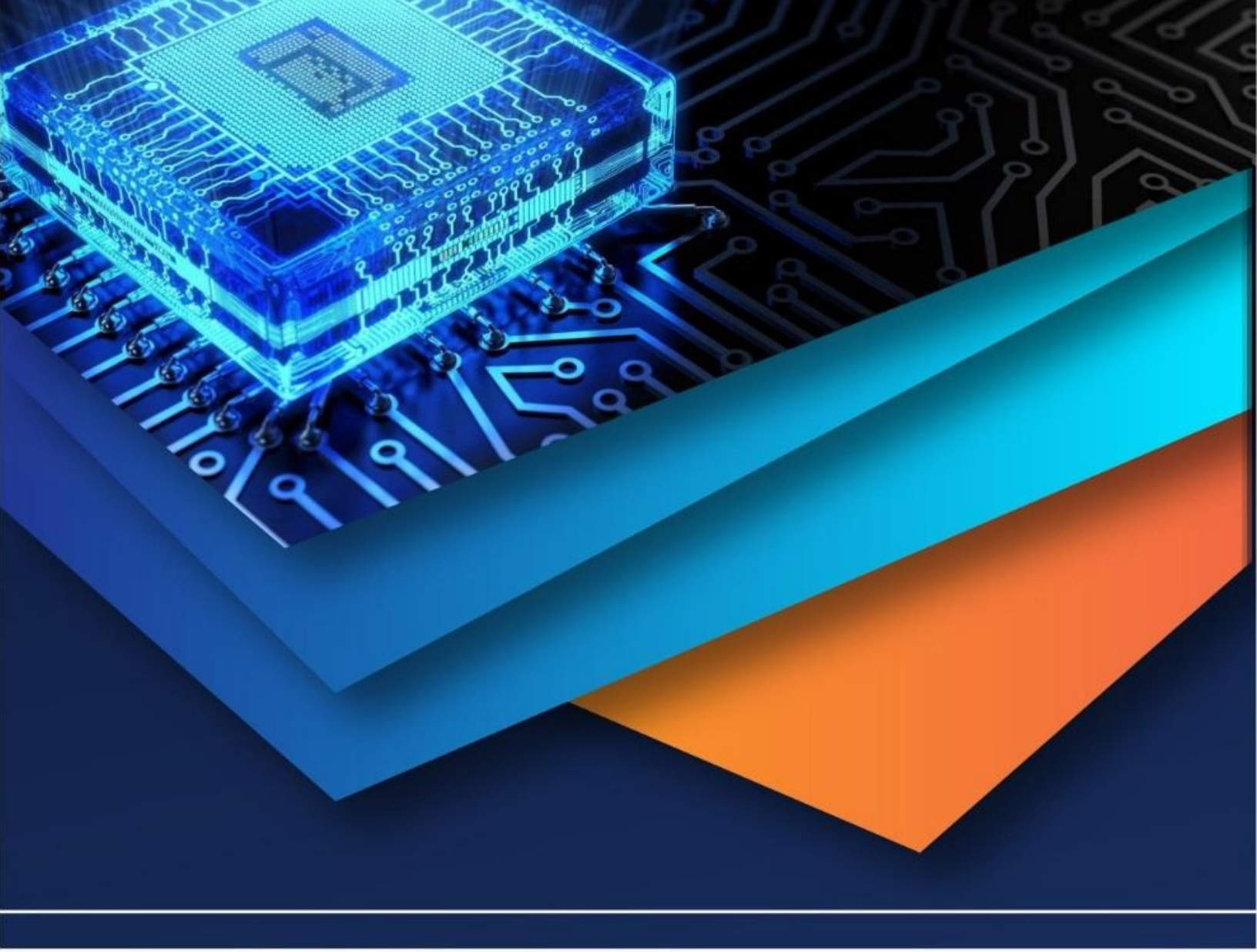
V. FUTURE SCOPE

1) This type of product can be used in housing societies, offices etc. Since it is cost effective, it can be implemented on a large scale as well, with some modifications.
2) Using a robotic arm along with a conveyor belt will make the process of segregation easier.
3) Also more sensors can be used to segregate biodegradable and non-bio-degradable waste, plastics, recyclable waste, e-waste and medical waste.
4) The project can further be implemented in industries on a larger scale in order to make the correct choices for disposal of hazardous wastes.

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