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Smart Waste Segregation

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Abstract: *The waste is leading to a lot of environmental problems. The main reason for Increase in waste is increase in population. In most of the cases the waste segregation is unplanned. And the segregation of waste is very difficult to a human to manage. When the wastes are directly dumped to the landfills it will cause pollution, it will cause generation of leachates and fungus. The waste is segregated into main basic streams dry wastes, wet wastes, metal wastes. The main objectives are to reduce the occupational hazardous to the workers. To reduce the time of workers in segregation of waste which makes the work easy. In future the population increases, the villages changes into large cities. Such will need some more advanced services and requirement. The sustainability segregation of waste will provide the sustainability. This development also reduce the work of workers who work in segregating the waste. Paper, plastic, metal, non-metal, and uncategorizable wastes are among the categories into which it guarantees precise trash sorting.*

Keywords: Waste segregation, Atmega328p microcontroller

I. INTRODUCTION

Over the past 20 years, waste generation in large cities has increased dramatically. According to research done worldwide, it is anticipated that the yearly production of solid waste will reach around 3.40 billion tones by 2050 that would lead to an approximately cost of $635.5 billion in the management of municipal waste management[1].A Zigbee transceiver pair provides the wireless interface for the suggested system, which is a mobile unit whose motion is controlled by the user via a graphical user interface. When the waste is put onto the conveyor belt via a metal plate that is managed by servo motors, an ATmega328P microprocessor is utilized. The electromagnet mounted on the servo motor-controlled arm separates metallic wastes, and a flap-directed DC air blower removes the dry waste. When the conveyor is empty, the HC-SR-04 ultrasonic sensor is employed to save power[2].Waste can be disposed of properly and the Reuse, Reduce, and Reuse concept can be implemented by separating waste into moist, dry, and metallic categories recycle. It is possible to recycle the dry trash, decompose the wet waste to create manure for the plants, and recycle the metallic waste. As a result, the Automatic trash Segregator has numerous uses in trash management. The garbage is separated by the system into three distinct bins: moist, dry, and metallic. Various sensors are employed to identify the kind of garbage. To ensure that the bins don't overflow and are emptied on time, the amount of trash in them is constantly checked[3].The separating procedure will be facilitated by the use of a conveyor belt and a robotic arm. Additionally, additional sensors can be employed to separate trash that is biodegradable from that which is not. medical waste, plastics, recyclable waste, and e-waste[4].

A. Related Works

Numerous IoT-based smart technologies have been put out to address various issues with the waste management systems that are currently in place in smart cities. According to the literature, solid waste management is the smart city's most important problem. To address these problems, the researchers have used a variety of strategies, particularly in the area of solid waste management .Capacity, weight, temperature, humidity, and chemical sensors are employed into monitor and collect solid waste[1].A municipal solid waste management platform for recycling collection data using IT technology was presented by the author(s) in this study used a model that was created for processing, recycling, transportation, and garbage collecting. The findings in this study show that the system that was created aids municipal authorities in using the data generated at each step of waste collection and monitoring. Ultimately, the

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technique succeeded in offering a clever method of recycling garbage from collected materials[1].Utilizing Deep Learning Algorithms for Waste Segregation. The automatic waste classification method based on convolution neural networks is presented in this research. It divides the garbage into using image classification based on deep learning to distinguish between non-biodegradable and biodegradable categories. In order to learn data representations with abstraction of several levels, the Deep Learning concept enables "processing of numerous layers through the computational models." This is suitable for a significant amount of garbage. Using a webcam and the Python index package, the materials are classified in real time. The open source software libraries that are utilized include Spyder and Tensor Flow. The training procedure takes a lot of time. It significantly reduces the need for manual labor[3].

II. SYSTEM COMPONENTS

System Components

- **Atmega328:** The **ATmega328P** is an 8-bit microcontroller from Microchip Technology, based on the AVR architecture. It is widely used in embedded systems and Arduino platforms. It microcontroller plays a critical role in a **waste segregator model** by acting as the central processing unit that controls sensors, actuators, and other components.
- **Ultrasonic Sensors**: These sensors measure the distance of objects on the conveyor belt by emitting ultrasonic waves and detecting their reflections. This allows for precise detection of waste materials and triggers subsequent actions in the system.
- **Load Cell with HX711 Amplifier**: The load cell measures the weight of each waste item as it passes over the conveyor belt. The HX711 amplifier processes the load cell's output signal and sends it to the Arduino Nano for analysis. Accurate weight measurements are crucial for classifying waste into predefined categories.
- **Conveyer Belt For Segregation**: The belt is the system's moving component. The system consists of a minimum of two pulleys that guarantee the belt's circular motion as it revolves around them. When the pulleys are powered, the belt and the object on it advance. The driver pulley is the powered pulley, and the idler pulley is the unpowered pulley[3].
- **Servo Motor**: This device is used to divert garbage to the appropriate containers. "A rotary actuator or linear actuator that takes into account exact control of angular or linear position, velocity, and acceleration" is the definition of a servomotor. To get position feedback, a sensor is connected to an appropriate motor[3].
- **A moisture sensor** is used to determine whether the trash is dry or wet. After testing to determine the waste's moisture level, it is dumped in the proper trash[2].

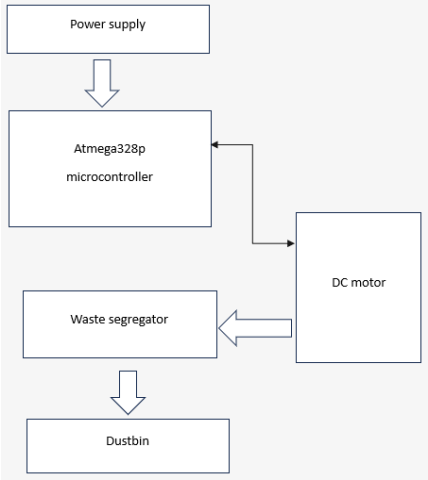

Fig. 1. Block diagram

- **Proximity sensor:** This device uses proximity to detect the presence of things without making physical touch. By "emitting electromagnetic field or electromagnetic radiation and observing the changes in the field or return signal," it is able to detect objects. The metallic waste is identified using an inductive proximity

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sensor. Paper and plastic can be distinguished using a capacitive proximity sensor. Additionally, it distinguishes between them because the permittivity values of plastic and paper differ[3].

III. WORKING PRINCIPLE

The Atmega mic powers the Automatic Waste Segregator System. Every component attached to the Atmega328 is configured using the Arduino IDE. The application reads the components' input/output pins and is developed in the Embedded C programming language. When the conveyor belt system detects trash, it moves. The purpose of the servo motors is to divert the metallic, dry, and moist waste into the appropriate containers. Inductive proximity sensors are used to identify the metallic waste. A moisture sensor is used to check the wet waste. The ultrasonic sensor attached to the dustbin's edge determines the level of the trash can. The proposed system is designed to automate waste segregation using a series of hardware components and programmed logic. Below are the detailed steps for implementation[5].

System setup: Assemble the conveyor belt mechanism driven by DC motors, ensuring it is robust enough to handle waste materials of various sizes and weights. Mount the ultrasonic sensors above the conveyor belt to detect incoming waste. Install the load cell beneath the conveyor belt to measure the weight of waste items as they pass over it. Attach the electromagnet to a servo motor for metallic waste segregation, ensuring precise movement and placement. Connect all components to the Atmega328p through appropriate interfaces, such as the HX711 load cell amplifier and the L298N motor driver[5].

Atmega code Writing: Write code to read inputs from the ultrasonic sensors and process these inputs to classify the waste. Program the Atmega to control the motor driver for operating the conveyor belt and sorting mechanisms. Implement logic to activate the electromagnet for metallic waste when detected by the system[5].

Operational Workflow: Waste materials are placed on the conveyor belt, which transports them to the detection zone. The ultrasonic sensor identifies the presence of an item and signals the Arduino Nano. The load cell measures the weight of the item, and this data is used to classify it into categories such as biodegradable, non-recyclable, or recyclable. For metallic objects, the electromagnet is activated, and the servo motor positions the electromagnet to lift and drop the item into the appropriate bin. Non-metallic items are directed to designated bins based on their classification, controlled by the motor driver and DC motors[5].

Calibration: Test the system with various types of waste to ensure accurate detection, classification, and sorting. Calibrate the load cell and ultrasonic sensors to improve accuracy. Adjust the motor speeds and electromagnet power for optimal performance[5].

IV. APPLICATIONS

- Improved Waste Management. Automatically separates recyclables, organic garbage, and non-recyclables. Reduces contamination in recycling streams, hence increasing the grade of recycled materials. Reduces the amount of waste that ends up in landfills.
- Environmental benefits Reduces pollution by ensuring that hazardous trash is adequately sorted and processed. Increases composting efficiency by separating biodegradable elements for organic waste recycling. Encourages the circular economy by recovering more reusable resources.
- Cost Reduction Saves money on waste processing by lowering manual labor and sorting costs. Reduces transportation expenses by properly compacting segregated garbage. Reduces landfill fees due to lower volumes of non-recyclable garbage.
- Energy Recovery. Separates items suitable for energy recovery operations such as incineration and biogas generation. Improves efficiency in waste-to-energy plants by assuring feedstock quality.

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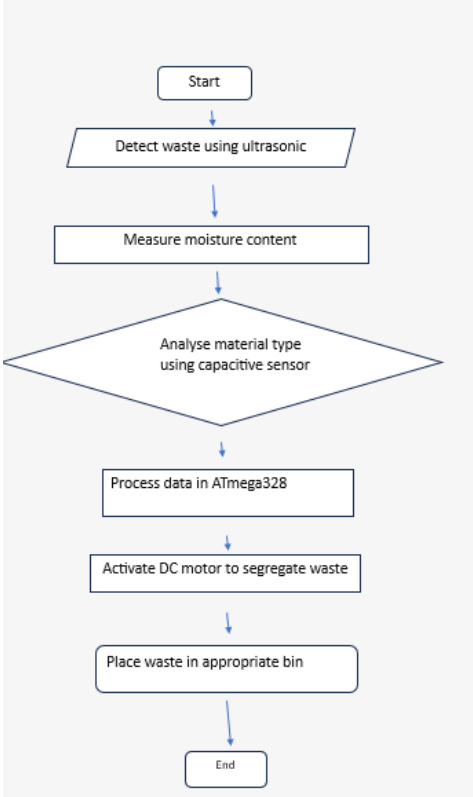

Fig. 2. Flowchart

V. CONCLUSION

This study offers a clever method for gathering waste in a smart city. A sensing prototype that gauges the amount of waste in bins .Everything that must be done to manage garbage from its creation to its ultimate disposal is referred to as waste management. The system that separates the garbage is part of the design of this project. The conveyor belt collects garbage and delivers it to the segregation section . India, a developing nation with the second-largest population in the world, produces a lot of rubbish every day. Implementation of this system at a local level like societies, educational institutes, etc. can reduce the burden on the local authorities. The automatic waste segregator is one small step towards building an efficient and economic waste collection system with a minimum amount of human intervention and also no hazard to human life. Using a conveyor belt makes the system far more accurate, cost-effective and also easier to install and use at a domestic level. Segregating all these wastes at a domestic level will also be time-saving.

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