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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Garbage Monitoring and Controlling with Smart Segregation of Dry and Wet Waste

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DOI: https://doi.org/10.55248/gengpi.5.0124.0128

A B S T R A C T

Waste production has been rising as a result of urbanisation and population growth. The overflowing trash can in cities contributes to an unclean environment. It damages the environment as a result. "Garbage Monitoring and Segregation of Dry and Wet Waste" was created as a solution to lessen the ragpickers' workload. Humans separate the waste, which causes health issues for the employees. Dry and wet waste are the two categories into which the waste is divided under the proposed system. In addition to being economical, this system's development increases waste management's productivity. waste is separated inside the bins after being identified by the corresponding sensors.

I. Introduction

The management of waste is a crucial aspect of ensuring the sustainability of our planet. In many cities and towns around the world, waste management practices are still largely manual, leading to inefficiencies and environmental hazards. The need for a more efficient and sustainable waste management system has become more pressing, especially as the amount of waste generated continues to increase. The Waste Segregation System utilizes sensors and other advanced technologies to identify different types of waste and separate them into their respective categories. This system has numerous benefits, including reducing the amount of waste that ends up in landfills, increasing the amount of waste that can be recycled, reducing the need for manual labor, and improving the overall efficiency of waste management processes. The project has the potential to significantly improve waste management practices, reduce waste contamination, and promote sustainable waste disposal methods. It will also contribute to the development of smart city infrastructure, which leverages technology to optimize resource usage and reduce environmental impact. Additionally, garbage monitoring and control with smart segregation of dry and wet waste systems can help to minimize the environmental impact of waste disposal by ensuring that recyclable materials are properly sorted and recycled, and that non-recyclable waste is disposed of in the most appropriate manner. Moreover, it encourages people to be more conscious of their waste and to dispose of it properly, which can help to create a more sustainable future for all.

II. Objectives

- To understand various sensors and their functionality.
- To develop a waste monitoring and segregation system using Arduino.
- To fabricate a less complex automatic waste monitoring and segregation system.

III. Methodology

A. Block Diagram

Figure 1: Block Diagram

The system consists of a power supply, Arduino UNO, moisture sensor, IR sensor, ultrasonic sensor, servo motor, 16x2 LCD display, and buzzer. Garbage monitoring and segregation of dry and wet waste systems are driven by the microcontroller Arduino UNO. All the components that are connected to the Arduino UNO are programmed using the Arduino IDE. The program is written in the embedded C language, and it reads the input and output pins of the components. Firstly, the waste is being dumped in the bin, and the IR sensor senses the presence of waste. In the presence of waste, a moisture sensor checks whether the waste is dry or wet. Based on the output given by the moisture sensor, the waste is dumped in its respective slots by the servo motor. Ultrasonic sensors are present in each slot, which measure the level of the bin. If the bin is full, an ultrasonic sensor detects it, the LCD displays that the bin is full, and the buzzer buzzes.

IV. Hardware requirements

A. Arduino UNO

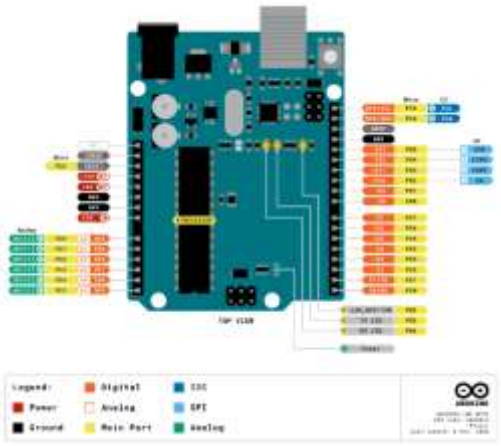

Figure 2: Arduino UNO

Six analogue input pins and fourteen digital pins for input or output on the Arduino boards are utilised to interface various circuits. Microcontrollers can be customised by using C++ and Embedded C programming codes. The Universal Serial Bus is used to programme Arduino boards nowadays (USB). It is the primary unit that controls.

B. Passive infrared sensor

Figure 3:Passive infrared sensor

An electronic device called a passive infrared sensor (PIR sensor) detects infrared (IR) light emitted by objects within its field of view. The majority of the time, PIR-based motion detectors use them. It is employed to find waste where it is.

C. Moisture Sensor

Figure 4:Moisture Sensor

It is used to identify if the garbage is wet or dry. The content of moisture in the waste is tested and accordingly, it is dropped in the appropriate dustbin. It measures the volumetric content of water inside the waste and gives us the moisture level as output. The module has both digital and analog outputs and a potentiometer to adjust the threshold level.

D. Ultrasonic Sensor

Figure 5:Ultrasonic Sensor

It is used to keep a check on the garbage level of the bin. The acoustic Ultrasonic sensor is divided into three categories:

1. Receivers
2. Transceivers
3. Transmitters

The transmitters radiate the ultrasound by converting electrical signals into ultrasound. It is then reflected by the obstacle and received by the receiver which converts the ultrasound into an electrical signal. The reflected signals are used to interpret the position of the garbage in the bin.

E. Servo Motor

Figure 6:Servo Motor

A servomotor is defined by a rotary actuator or linear actuator that considers exact control of angular or linear position, velocity, and acceleration. MG995 Metal Gear Servo Motor is a high-speed standard servo motor that can rotate approximately 180 degrees (60 in each direction). It is used to deflect the waste to the respective bins.

F. 16X2 LCD Display

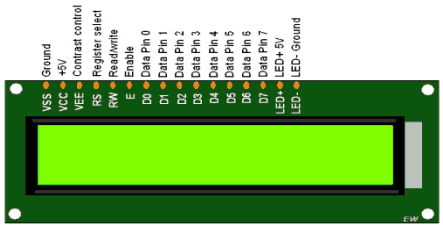

Figure 7:16X2 LCD Display

An LCD (Liquid Crystal Display) considerably basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in a 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display can display 224 different characters and symbols. This LCD has two registers, namely, Command and Data. Used to show the level of waste in the bin and indicate when the bin is full.

G. Buzzer

Figure 8:Buzzer

The passive buzzer is an electromagnetic speaker used to generate sound signals of different frequencies when the bin is full. The active buzzer is the simplest module to produce a sound of about 2 kHz.

H. 10K Potentiometer

Figure 9: 10K Potentiometer

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. It is often used to regulate the current flow either by adding or subtracting resistance from the circuit. Potentiometers consist of a resistive element, a sliding contact (wiper) that moves along the element, making good electrical contact with one part of it, electrical terminals at each end of the element, a mechanism that moves the wiper from one end to the other, and a housing containing the element and wiper. It is used to control the contrast of 16x2 LCD display.

I. 4 x AA Battery Holder Case

Figure 10:4 x AA Battery Holder Case

A 4 x AA Battery Holder case is suitable for 4 x AA batteries with a spring clip design, it powers the unit with AA batteries.

V. Wiring diagram and Description

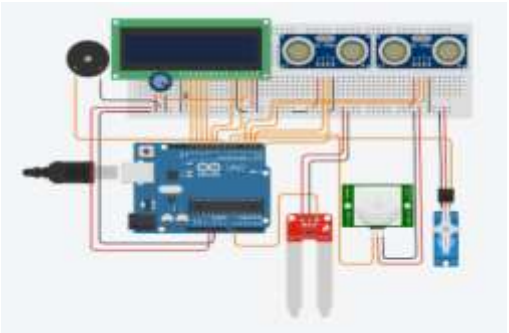

Figure 11: Wiring Diagram

A PIR sensor consists of 3 pins D0, VCC, and ground, the D0 pin is connected to pin 6 of Arduino Uno. The moisture sensor consists of 4 pins A0, D0, VCC, and ground, the A0 is connected to the analog A0 pin of Arduino Uno. Two ultrasonic sensors consist of 4 pins Tx (trigger pin), Rx (Echo pin),

VCC, and ground. TX (trigger pin) and RX (echo pin) of the sensor is given as input pin 0, 2 and 1, 3 of Arduino, respectively. The servo motor consists of 3 pins control (PWM), VCC, and ground, The Control (PWM) pin is connected to PWM pin 5 of Arduino Uno. 16X2 LCD display is used to display the output from the Arduino Uno connected to pins 8(RS), 9(Enable),10(D4),11(D5),12(D6),13(D7), and contrast pin is connected to 10K Potentiometer. The Buzzer is an output source, one of its terminals is connected to the ground, and the other terminal to digital pin 7 of Arduino Uno. When the pin 7 is high the buzzer buzzes.

VI. Software requirement

A. Arduino IDE

Figure 12:Arduino IDE

- A cross-platform application comprising functions that are coded in Embedded C and C++.
- In this system, the program is written in Embedded C for the working of the hardware components.
- The program code written on Arduino IDE was then fed to the Arduino for the working of the whole system.

B. Libraries used.

1. *Servo.h: Allows Arduino boards to control a variety of servo motors. This library can control a great number of servos. It makes careful use of timers: the library can control 12 servos using only 1 timer.*
2. *LiquidCrystal.h: Allows communication with alphanumerical liquid crystal displays (LCDs). This library allows an Arduino/Genuino board to control LiquidCrystal displays (LCDs) based on the Hitachi HD44780 (or a compatible) chipset, which is found on most text-based LCDs. The library works within either 4- or 8-bit mode (i.e., using 4 or 8 data lines in addition to the rs, enable, and, optionally, the rw control lines).*
3. *Ultrasonic.h: Minimalist library for ultrasound module to ArduinoWork with ultrasound module in a simple and light way. Compatible with the modules HC-SR04, Ping))) and Seeed Studio sensor. This library aims to resource efficiency and to simplify access to data.*

VII. Flowchart

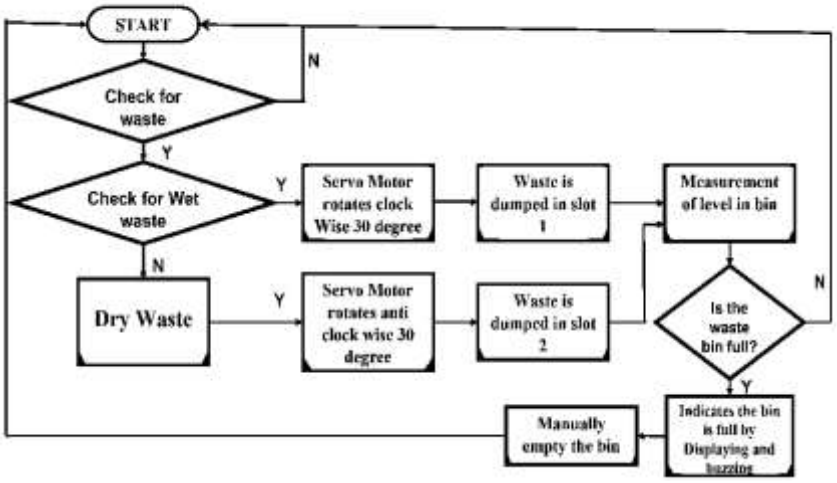

Figure 13: Flow Chart

VIII. Result and discussion

A. Final Output

1. Dry Waste Segregation

Figure 14: Dry Waste Segregation

Dry waste segregation is the process of separating waste materials that do not decompose or decay easily from other types of waste. This type of waste includes materials such as plastics, metals, glass, and paper, among others. The goal of dry waste segregation is to reduce the amount of waste that ends up in landfills and promote recycling, reuse, and proper disposal.

2. Wet Waste Segregation

Figure 15: Wet Waste Segregation

Wet waste segregation is the process of separating biodegradable waste materials such as food scraps, and yard waste. This segregation helps in the efficient processing of waste as wet waste can be composted or converted into biogas.

IX. Applications

- Residential: These systems can be used in residential areas to help residents sort their waste into different categories.
- Commercial: These systems can be used in commercial areas, such as restaurants, hotels, and offices to help businesses sort their waste.
- Industrial: These systems can be used in industrial areas, such as factories and warehouses to help businesses sort their waste.
- Municipal: These systems can be used by municipalities to help manage waste collection and disposal.

X. Advantages

- Reduces the amount of waste sent to landfills: By segregating waste, it can be recycled or composted which reduces the amount of waste that ends up in landfills.

- Reduces the amount of pollution from waste: When waste is not effectively managed, it can pollute the air, water, and soil. By segregating waste and recycling or composting it the amount of pollution from waste can be reduced.
- Improves public health: By reducing the amount of waste that ends up in landfills, the risk of disease from contaminated waste can be reduced.
- Creates jobs: The implementation of these systems can create jobs in the waste management industry.

XI. Limitations

- Sensor accuracy: The accuracy of the sensors used to detect the type of waste can be affected by factors such as the moisture content of the waste, the size of the waste, and the ambient temperature. This can lead to false positives or negatives, which can impact the efficiency of the system.
- Cost: The cost of the sensors, Arduino Uno board, and other components can be a barrier to the widespread adoption of this technology.
- Complexity: The system can be complex to set up and maintain, which may require specialized skills.
- Interference: The system can be susceptible to interference from other electronic devices, which can lead to false alarms or malfunctions.
- Waste type: The system may not be able to segregate all types of waste, such as hazardous waste or medical waste.
- User behavior: The system relies on users to correctly segregate their waste, which may not always happen.

XII. Conclusion

Implementation of this system at a local level like societies, educational institutes, etc. can reduce the burden on the local authorities. The waste segregator is one small step towards building an efficient and economic waste collection system with a minimum amount of human intervention and no hazard to human life. Segregating all these wastes at a domestic level will also be timesaving. While implementing our system we came across many problems like the accuracy of the moisture sensor, adjusting the range of PIR sensors, and some more, but using some modifications we tried the make the system as reliable as possible but not completely perfect. The garbage monitoring and controlling with smart segregation of dry and wet waste system using Arduino Uno is a promising new technology that has the potential to make a significant impact on waste management in urban areas.

XII. Future scope

- Improved sensor accuracy: The accuracy of the sensors used to detect the type of waste is likely to improve as new technologies are developed. This will reduce the number of false positives and negatives, which will improve the efficiency of the system.
- Reduced cost: The cost of the sensors, Arduino Uno board, and other components is likely to decrease as the technology becomes more widespread. This will make the system more affordable for cities and other organizations.
- Simplified setup and maintenance: The system is likely to become easier to set up and maintain as the technology matures. This will make it more accessible to a wider range of users.
- Reduced interference: The system is likely to become less susceptible to interference from other electronic devices as the technology is improved. This will reduce the number of false alarms and malfunctions.
- Expanded waste type: The system is likely to be able to segregate a wider range of waste types as the technology develops. This will make it more useful for cities and other organizations that need to manage a variety of waste streams.
- Improved user behaviour: As people become more aware of the importance of waste segregation, they are more likely to correctly segregate their waste. This will improve the efficiency of the system and reduce the amount of waste that is sent to landfills.

XIII. References

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