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Modeling and Fabrication of Smart Waste Segregation System Using IOT

Mr. Janardhana K[1] ,Swaroop B[2], R Vinay Kumar[3]

[1]Assistant Professor, Department of Mechanical Engineering, Sir MVIT, Bangalore, India
[2, 3] U G Scholar, Department of Mechanical Engineering, Sir MVIT, Bangalore, India

Abstract:

The growth of the human population and development of urban areas has led to the increase in the amount of waste generated, leading to pollution, disease, and unhygienic living conditions. To address this issue, an automated waste segregation system is introduced categorizing waste into dry, wet, and metallic groups enabled with IOT system that employs sensors installed in garbage bins to monitor waste levels and has been developed to inform collection service providers when the bins require emptying.Automatic door opening lid and methane gas indicator is also installed in the system for eco-friendly environment. The ultimate objective of this initiative is to create an inexpensive, user-friendly waste segregation system for households that categorizes waste and maintains disposal information on a server.

*Keywords:***Waste Segregation, Servo motor, sensors, microcontroller,IOT, Automated system**

1. INTRODUCTION

Due to increasing in the population of the world, waste disposal increases. Waste disposal is more time consuming and labor leading to a major issue in recent years. The most common method of waste disposal is unplanned and landfill disposal, this method has adverse effects on all living things. This method can lead to the formation of liquid leach ate and other fungi that contaminate surface and groundwater, and accelerate the development of harmful diseases that lead to the deterioration of the aesthetic values of the environment. In India, solid waste recycling is carried out by garbage collectors who play an important role in this process while garbage collectors are affected by many health problems like skin infections. Respiratory problems that depend on garbage collectors can be reduced if the garbage is automatically separated in the bin. Waste is sorted into primary main streams such as metal, dry and wet. This waste has been used for recycling. Although there are many industrial waste sorters out there, it is always best to sort waste at the source. The

advantage of this type of sorting is that there is no need to collect rags for waste sorting. Additionally, sorted waste can be sent directly to a recycling facility instead of sending it to a sorting facility and then to a recycling facility. Currently there is no such system for automatic waste separation into dry, wet, and metal waste. The main goal of this project is a compact, low-cost, and user-friendly waste sorting system for urban cities to improve the process of waste management.

2. REVIEW & RESEARCH

Forthelastfewyears,manyresearchersarefocusingonIoTbasedapplications,especially smart city

1. **Michael E., Otaru C. O., Liman A. D., Bomoi M. I., Awotoye B.** Design and Development of a Smart Waste Bin" The purpose of this paper is to develop a smart waste bin that detects the presence of man at a particular distance (1 meter for usage so as not to spill the dirt) and obeys voice command to open or close the lid
2. **B. Chowdhury and M. U. Chowdhury,** "RFID-based real-time smart waste management system," in this paper, some smart trash research consider "pay as you throw'" weight-based billing for residential collection, which could motivate residents to reduce their waste. It uses the load sensor.
3. **Dr. K. R. Nataraj and Meghana K. C**, "IOT Based Intelligent Bin for Smart Cities", The proposed system concentrates on eradicating the issue of ignorance of cleanliness which is spoiling our environment and then reduce it. The smart trash consists of two sensors namely IR and gas sensors. The IR sensor placed inside the trash to sense thetrash level and gas sensor that sense the toxic gases. Once the trash is filled, the alarm rings.
4. **V.Sowndharya, P.Savitha , S.Hebziba Jeba Rani** "Smart Waste Segregation and Monitoring System using IoT". This paper details that the amount of waste has been increasing due to the increase in human population and urbanization. In cities, the overflow bin creates an unhygienic environment. Thus degrades the environment, to overcome this situation "Automatic Waste Segregator" is developed to reduce to work for the ragpickers the wastes are segregated by the human beings which leads to health problems to the workers. The proposed system separates the waste into three categories namely wet, dry, and metallic waste. The waste is detected by the respective sensors and gets segregated inside the bins assigned to them the details of waste disposal is updated in the server regularly.
5. **Eunice David Likotiko, Devotha Nyambo, Joseph Mwangoka** "MULTI-AGENT BASED IOT SMART WASTE MONITORING AND

COLLECTION ARCHITECTURE". Managing Solid waste is one of the ultimate challenges in urban areas and is becoming a major issue due gradual increase in population. Appropriate sol waste management system is important f enhancing the environment and the well-being residents. In this work, Internet of Things(Io architecture for real time waste monitoring ar collection is proposed; can improve and optimi solid waste collection in a city. Platform of mul agentis used to simulate real time monitoring smart decisions on waste management.

6. **Sagar Kumar Pandey, Shivam Kuma Yadav, Sharmistha Su Ajeet Tyagi, Saga Mishra, Harpreet Kaur Channi.** "Design and Fabrication of Smart –Edustbin". imperative need of a smart lifestyle begins w cleanliness. The main difficulty in managing current waste system in most of the Indian ci is the unhealthy status of dustbins. In this w they have tried to emphasize trivial and v component of the urban waste management system, i.e. by using the IOT protocol for transmitting the dustbin wirelessly, that generate email to notify to the concerned authorityregarding the fill level of garbage and need to be replaced. The ultrasonic sensor will show the level of garbage filled in dustbin, whereas the proximity sensors will detect the obstacle present in front of dustbin to avoid collision. LCD interfacing has been done to show the current situation of dustbin.

7. **Vishesh Kumar Kurre,** "Smart Garbage Collection Bin Overflows Indicator using IOT",[8] in this paper a sensor (Infrared sensor/proximity sensor) is placed in dustbin. A mail notification (like email, twitter, WhatsApp message) will be sent to the respective Municipal / Government authority person. The density of the Dustbin through the internet on a Dashboard is observed, this is a GUI (Graphical User Interface) dashboard, the responsible person will easily check the present condition of the dustbin. The respective person will organize the collection vehicle to collect the full garbage bins or dustbins.

8. **S.S.Navghane, M.S.Killedar, Dr.V.M.Rohokale,** "IoT Based Smart Garbage and WasteCollection Bin",[6] After the IoT field finding its grip in our lives. This is an original plan for designing a smart garbage bin with a weight sensor, IR sensor and module of Wi-Fi for data transmission. This system convinces the dustbin cleaning when the garbage level reaches its maximum.

3. METHODOLOGY

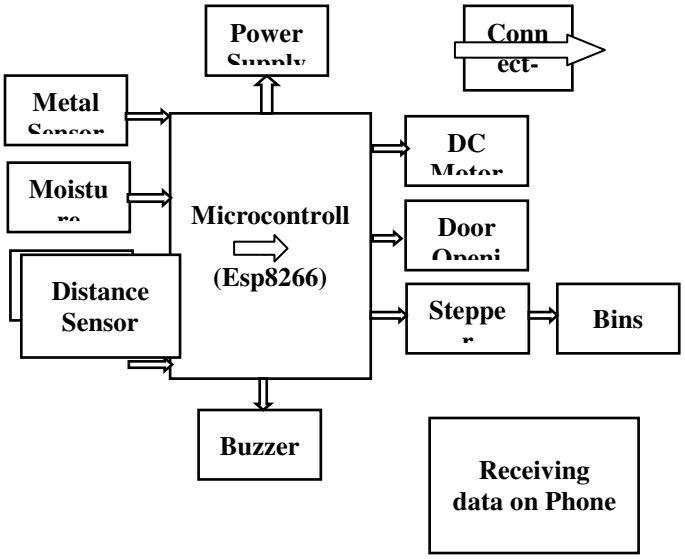

Fig1(a): Baisc Block diagram of smart waste segreagtion system

Model Working: When a person approaches the container, the door opens automatically via an ultrasonic sensor. When trash is thrown into the smart bin, infrared sensor detects the trash and activates the microcontroller. Basically, an infrared sensor is used to detect certain features in the environment by emitting and/or detecting infrared radiation. The microcontroller then starts the DC motor used to spin the drum. All data is received to the Smartphone via IoT. A DC motor contains a live armature connected to the supply end via commutator segments and brushes located at the north-south poles of a DC or electromagnet. When litter is thrown into the Smart Bin, it falls onto a drum to which various sensors are attached to identify the type of litter. The first sensor is a metal sensor that emits an electromagnetic field. Every metallic object in the electromagnetic field becomes charged and emits its own electromagnetic radiation. The sensor coil receives the returned field and alerts the user by generating a targeted response. Another connected sensor is a moisture sensor that capacitively measures the dielectric constant of the surrounding medium. Wet waste has a high relative dielectric constant than dry waste due to the presence of moisture, oil, and grease. By this

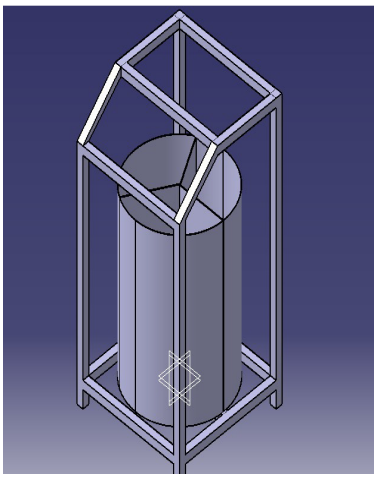

Fig1(b):3D CAD Model by using catia tool

we came to know the waste is wet or dry. Depending on the waste detected, the container is selected via a stepping motor. The stepper motor has a rotor with permanent magnets mounted on it, while the stator has at least two windings. When the rotor magnet is aligned with the stator winding, the other winding is energized. The two windings are switched on and off alternately. This locks the motor in the desired position. The buzzer signals the detection of waste by one of the sensors. Separate drivers are utilized for both the DC motor and the stepper motor to increase the voltage level as the microcontroller output is 5V and the motors require

12V.Initializing all modules ensures that dynamic changes in the environment do not affect detection.

4. HARDWARE DESCRIPTION

Microcontroller: The ESP8266 is a tiny microchip that facilitates wireless connectivity for other devices, enabling them to exchange data over the internet. It can be integrated with additional chips to acquire and analyze data from sensors, fostering communication between interconnected devices. Additionally, it can operate independently as a self-contained unit for accessing web pages and executing diverse applications. Equipped with a robust processor and generous memory capacity, it accommodates multiple forms of connections including SPI, IC, and UART. Moreover, it incorporates an embedded Wi-Fi antenna, affording the ability to access protected networks.

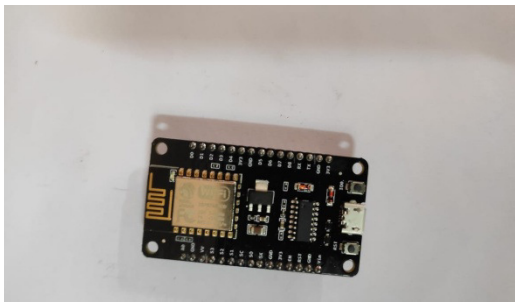

Fig.2ESP8266 Microcontroller

Micro servo: The SG90 Micro Servo Motor is a small and affordable motor that is popular among hobbyists who work on model making and robotics projects. It has a compact size and lightweight design, making it ideal for small robots. With a torque rating of 1.8 kg/cm, it is powerful enough for most small projects. The motor also has precise control and positioning capabilities due to its narrow dead-band width of only 1 µs. It operates on 4.8V and can function within a temperature range of 0ºC to 55ºC.

Fig.3 Micro Servo SG90

DCmotor : This component is an electrical device that typically operates based on the magnetic fields it produces, and it has an internal mechanism to periodically switch the direction of the current flow within the motor. The fundamental design of a DC motor consisting of a current-carrying armature that is linked to a power source, a commutator, and brushes. The rotating magnetic field generated by the coils interacts with the magnetic fields of the immobile section of the motor, generating a force that rotates the armature. The velocity of a DC motor can be modified by altering the voltage applied to the armature or by using power electronics systems to change the voltage.

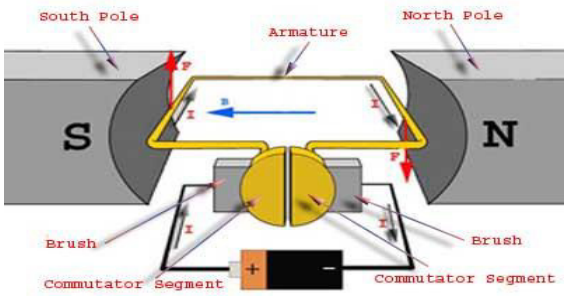

Fig .4DC motor

Stepper motor : This component is an electrical machine that moves in precise, fixed steps rather than rotating continuously. It can be controlled with a train of input pulses that rotate the motor shaft through a fixed angle. The motor consists of several toothed electromagnets arranged around a central gear-shaped iron piece. By energizing these electromagnets in a particular sequence, the motor shaft can be rotated in precise steps. The motor can be instructed to move and remain at one of these steps without requiring a feedback sensor.

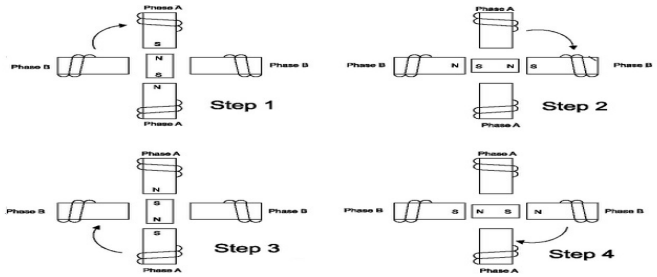

Fig .5 Stepper motor

Relay module :A power relay is an electronic gadget that functions as a switch and can be managed by a micro controller. It contains an electromagnet that pulls a mobile iron armature to either open or close an electrical circuit. When the relay is not energized, one group of contacts is shut while the other is open. When the electromagnet is stimulated, the contacts switch, and the reverse group of contacts close. When the signal is deactivated, the armature returns to its initial position. The majority of power relays operate speedily.

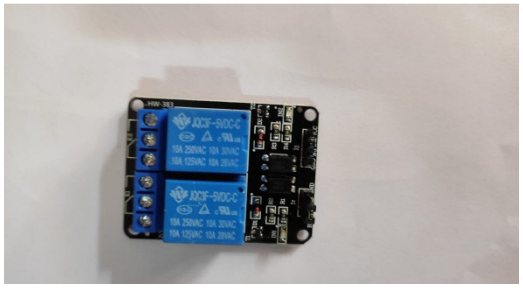

Fig.6.Relay Module

Metal sensor :A metal sensor is an instrument capable of detecting hard-to-see objects, including small or thin parts, wires, and reflective metals. It comes in several varieties to suit specific needs and installation requirements, with options for normally closed or normally open functions, NPN or PNP switching outputs, and cable or plug connections. The metal sensor has an IP66 rating, meaning it can withstand exposure to dust and water.

Fig.7. Metal Sensor

Moisture sensor :A device known as the moisture sensor module is used for detecting soil moisture. This tool measures the water content in the soil and provides moisture level as output, with both digital and analog outputs, and a potentiometer to adjust the threshold level. The module operates within a voltage range of 3.3V to 5V DC and consumes 15mA current. It generates a digital signal between 0V to 5V with an adjustable trigger level and an analog signal ranging from 0V to 5V, which is based on infrared radiation resulting from a fire flame falling on the sensor. In addition, it includes LEDs to indicate output and power and a small-sized PCB of 3.2cm x 1.4cm. The design is based on the LM393, making it convenient to use with microcontrollers or even with standard digital/analog ICs. The moisture sensor module is cheap, small, and widely accessible.

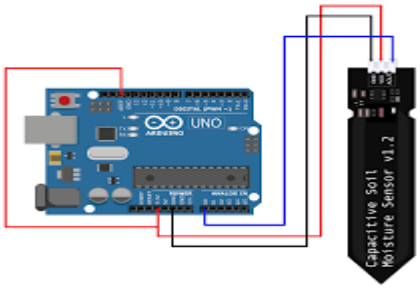

Fig.8. Moisture Sensor

5. RESULTS

The smart- waste dustbin systematically segregates the waste into wet, dry, and metallic waste respectively using various sensors. By using Blynk App software, the waste type is displayed in it. The methane gas detection message is also observed in the application. The microcontroller is programmed according to various conditions for dry, wet, and metallic waste using Arduino IDE software. This system successfully gives the output expected.

6. CONCLUSION

1. Waste Segregation using smart dustbin has been successfully proposed for waste segregation into wet, dry, and metallicwaste at root source.
2. To meet people's luxury needs, saves time in this busy world, and provide the right service for everyone without delay was the main problem and to encounter that problem,this type of segregation system is the solution.
3. This system successfully implementsthis intelligent electronic waste can be used public places, educational institutions, corporate worlds, offices, and many other places that the user serves in a friendly way and help keep the placeclean and tidy.
4. Probably the greatest benefit of arecycling bin smartly is the security it offers. This device thoroughly separates the three types of waste, not only increasing the economic value of the waste, but also providing a healthy and beautiful environment at a lower cost.

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