Automatic Waste Segregation

Conference Paper · June 2018

DOI: 10.1109/ICCONS.2018.8663148

6 authors, including:

Nimisha S Gupta
1 PUBLICATION **28** CITATIONS
SEE PROFILE

Deeepthi Vasudevan
1 PUBLICATION **28** CITATIONS
SEE PROFILE

Maya Kunnath
NSS College of Engineering
2 PUBLICATIONS **28** CITATIONS
SEE PROFILE

Nikhil Binoy C
14 PUBLICATIONS **58** CITATIONS
SEE PROFILE

Proceedings of the Second International Conference on Intelligent Computing and Control Systems (ICICCS 2018)
IEEE Xplore Compliant Part Number: CFP18K74-ART; ISBN:978-1-5386-2842-3

Automatic Waste Segregation

Nimisha S Gupta, Deepthi V, Mayakunnath, Rejeth Pal S, Badsha T S, Nikhil Binoy C
Instrumentation and Control Engineering
NSS College of Engineering
Palakkad, India.
nimisha.sreemadam@gmail.com, deepthivdevan@gmail.com, lachumaya38@gmail.com,
rejethpals@gmail.com, badshatpr@gmail.com, nikhilbinoy@gmail.com

***Abstract*— Dynamic increase in the amount of waste and despicable dumping of waste has become a matter of concern because of the threat it causes to the environment. There comes the pivotal role of an automated waste segregate which avoid this plight and also reduces the difficulty of recycling. The importance and the economic value of waste is realized only when it is segregated. Currently there is no such system for segregation of metal, dry and wet wastes. This project proposes a spot automatic waste segregation unit that effectively gives a solution to this problem. In order to segregate the metallic waste a parallel resonance impedance system is used, and for the separation of wet and dry waste capacitive sensors are used. The benefits of this work are, the waste has a higher potential for recovery and the occupational hazards of waste separating workers is also reduced.**

Keywords— Waste segregation, metal detection, capacitive sensing, IoT.

I. INTRODUCTION

Considering the hazards caused by the common method of waste disposal an automatic waste segregate is designed to overcome this. Here waste is pushed through a fold into the framework and for the recognition of waste, an IR sensor is utilized. As the IR sensor recognized waste, microcontroller turn the DC motor to ON state and the waste processed through the inductance coil and capacitive sensing module, and then the waste is classified to wet and dry based on relative permittivity of waste kept in a circular base driven by DC geared motors [1]. Introducing a solution for the segregation and collection of solid waste. Three types of waste, such as metal, glass and plastic are separated with the help of Arduino microcontroller [2]. The proposed system is a mobile unit whose motion is controlled by the user using the GUI and wireless interface is provided by a Zigbee transceiver pair. ATmega328P microcontroller is used, when the waste is dropped onto the conveyor belt by means of a metal plate controlled by servo motors. Metallic wastes are separated by the electromagnet attached to the servo motor controlled arm and the dry waste is blown off using a DC air blower directed by a flap. Ultrasonic sensor HC-SR-04 is used for power conservation when the conveyor is empty [3]. This method involves the usage of three sensors namely IR sensor, moisture sensor and gas sensor which are attached to bins kept in public places. The IR sensor detects the waste and sends information to PIC16F877A microcontroller. Similarly moisture sensor senses moisture in the bin when the wet waste is deposited and the gas sensor senses some unpleasant or toxic smell from the bin and sends information to the controller. The information is accepted using radio frequency (RF) receiver and the data is decoded by the decoder, and in the transmission side controller receives the information and transmits the data using the encoder and an RF transceiver, the data is displayed on LCD [4]. The 8051 microcontroller is used, the model consists of a stationary unit the waste is collected into a funnel shaped collector. Sensors are placed on this funnel [5]. This paper proposes an advanced trash collection system with smart bins having sensors and that alerts the authorized collector by sending messages for efficient trash collection in cities, IOT is acting as a back born technology for the efficient management of waste [6]. The system will receive the input through the dust collecting people through switches and sends back a signal to the microcontroller unit using RF technology and makes the H-bridge to rotate conveyor belt. When the belt starts rotating clockwise the dust bin's lid is automatically closed, simultaneously the waste is dumped into the underground garbage container [7]. A waste segregation system using a programmable logic controller is designed to separate the metal particles from the municipal waste. It contains a rotating conveyor belt, which starts rotating when the metal particle is detected. A robotic arm functions when metal is recognized and conveyor belt stops. The control signal is given to the robotic arm by the controller, to which the electromagnet is attached and the metallic wastes drop into a separate bin [8]. This paper shows how the Internet of Things integration with data access networks, Geographic Information Systems, combinatorial optimization and electronic engineering systems can contribute to improve the city's management system. Here presents a waste collection method based on providing intelligence to trash cans, by using an IoT prototype embedded with sensors [9]. The waste management as a set of services on top of an IoT infrastructure in a smart city. These services cover the waste collection planning and implementation, transport of waste to specific locations and recycling and preparation for reuse with the help of RFID, sensors and actuators. [10]. This work presented here gives a novel approach in handling and disposing of the daily solid wastes in an efficient method. The system consists of four main systems, namely smart trash system, local base station, smart vehicle system and smart monitoring and controlling hut. The proposed system would be able to automate the

solid waste monitoring and collection process[11]. It employs both collection and segregation of waste where collection part consists of specially designed baskets placed at the roadside in a fixed gap having air sensors, when your sensor senses basket fills and put down the waste to the sub conveyor. The segregation part contains sensors to separate into wet, dry and metallic[12]

A. Technical Background

It is a discrete state control system to prevent over dumping of waste in bins and to separate wastes automatically through conveyor belts. The filling level of each bin arranged at different positions, is detected using the IR sensor. Each bin will have separate sub conveyor belts and all these sub conveyor belts are connected to the main conveyor belt. The wastes from all sub conveyor belts will get collected in the main conveyor belt. The wastes from the main conveyor belt are given into dry, wet and metallic wastes. Internet of Things (IoT) used in this project is useful for counting the number of different types of wastes. Hence the quantity of each type of wastes is also noticed.

B. Proposed Solution

Many sub conveyors which protrude to a main conveyor. At the starting portion of each sub conveyor a trash bin is kept. Wastes are being dumped into the trash bins where infrared sensors are kept at the top level. Infrared sensor actually does the function of a human eye that enables the detection of waste. As a waste comes in the vicinity of the infrared sensor by the increased amount of wastes there occurs a decrease in the radiation received by the infrared receiver, which is transmitted by the infrared transmitter. This decrease in the radiation received by the infrared receiver helps in the detection of waste. Whenever a waste is detected in the sub conveyer's trash bin, it causes the trash bin to rotate thereby allowing waste to fall onto the sub conveyor. Then the sub conveyor moves and the waste reach the main conveyor. At the end of the main conveyor also an infrared sensor is kept in the waste detection. Then the segregated section begins. In the segregated section trash bins are kept where sensors which enables the separation of waste into metal, wet and dry. At first with the help of a contact type metal sensor the waste is classified to metal or non-metal. If metal the waste falls into the respective bin of the circular base kept at the bottom, which is rotated with the help of servo motor. If else the waste is classified into wet or dry with the help of capacitive proximity sensors. If waste is detected as wet it falls onto the respective bin at the circular base and if dry the waste falls into the respective bin of the circular base. An internet of things is incorporated for the purpose of counting and monitoring of the waste. The ESP8266 Wi-Fi module chip is connected. With the help of IOT the amount of waste that falls on dry metal and wet categories are obtained.

II. Implementation

Figure 2 shows a diagram of the process of automatic waste segregation. First of all, the IR sensor senses whether the waste bin is filled or not. If the bin is filled, then the IR sensor senses it and gives information to the PIC16F877A microcontroller. Then, according to the coded program in the microcontroller, after a delay of 5 seconds servo motor rotates the waste bin in 120° and hence allows the wastes to fall onto the sub conveyor. Sub conveyor starts to roll. Now the wastes are falling onto the main conveyor. Based on the time delay given in the microcontroller program, after some delay main conveyor starts to roll while sub conveyor stops it working.

Waste is falling upon the segregation bin, where metallic, dry and wet sensors are placed. Metallic inductive proximity sensor, moisture sensor is fixed and connected in the segregation bin. IR sensor is also fixed at the end section of main conveyor for the purpose of waste arrival detection, it causes the segregation bin to rotate in 120° according to the program. 3 Different collecting bins are connected upon the servo motor. The servo motor rotates in clockwise or counter clockwise directions based on the type of waste and waste falls on to the particular waste collecting bin.

The quantity of each type of wastes such as metal wastes, dry wastes or wet wastes could monitor. The ESP8266 Wi-Fi chip is programmed and connected. IoT module is used to monitor the waste and the information will be sent to the user's mobile phone. The mobile app shows the collection of each type of wastes on the bins.

A. Metal detection system

This sensor is a non-contact electronic sensor that is utilized to identify positions of any metal things. It induces current when metal is close to it. The sensor does not indicate the presence of an object if it is not metal. The sensor incorporates an electromagnetic coil which is used to recognize the presence of a conductive metal thing. When an alternating current is passed through a coil it creates a magnetic field. When a metallic object is introduced in the region of the coil, eddy currents are induced on its surface area. These eddy currents are a function of the size, distance, surface area and composition of the target. This generates a magnetic field which opposes the actual Magnetic field which is generated by the coil. The inductive coupling between the object and the coil creates a mutual inductive effect on the coil which reduces the parallel resonant impedance of the circuit which in turn is reflected by a rise in the proximity count value. Magnetic fields do not affect the metal detection system. It can detect any conducting material irrespective of its magnetic nature. As the target nearer to the sensor the eddy current increase, increasing the load on the oscillator and further reducing the amplitude of the field. The trigger circuit monitors the oscillator's amplitude and at a

predetermined level switch the output state of the sensor from its normal original condition.

B. Capacitive sensing module

The way used for segregation of waste is the relative dielectric constant. Once a dielectric is present between the plates of the capacitor the capacitance rises. Wet waste has more relative dielectric constant than that of dry waste because of the wet content present in the waste. If the change in the capacitance count is greater than the threshold, then the type of waste is inferred as wet waste else it is dry waste.

C. Internet of Things

The amount of each type of wastes such as metal wastes, dry wastes or wet wastes could monitor. Here IoT module is used to monitor the waste and the information will be sent to the user's mobile phone. The mobile app shows the collection of each type of wastes on the bins.

D. IR Transmitter

Infrared Transmitter is a light emitting diode (LED) which produces and emits infrared radiations. Hence, they are called IR LED's. Even though an IR LED looks like a normal LED, the radiation produced by it is invisible to the human eye.

E. IR Receiver

Infrared receivers are also called as infrared sensors as they recognize the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors.

Figure 1 Automatic waste segregation process diagram

III. EXPLANATION

IR sensor senses whether the waste bin is filled or not. If the bin is filled, then the IR sensor senses it and gives information to the PIC16F877A microcontroller. Then, according to the coded program in the microcontroller, after a delay of 5 seconds servo motor rotates the waste bin in 120° and hence allows the wastes to fall onto the subconveyor. Subconveyor starts to roll. Now the wastes are falling onto the main conveyor. Based on the time delay given in the microcontroller program, after some delay main conveyor starts to roll while sub conveyor stops it working.

Waste is falling upon the segregation bin, where metallic, dry and wet sensors are placed. Metallic inductive proximity sensor, moisture sensor is fixed and connected in the segregation bin. IR sensor is also fixed at the end section of main conveyor for the purpose of waste arrival detection, it causes the segregation bin to rotate in 120° according to the program. 3 Different collecting bins are connected upon the servo motor. The servo motor rotates in clockwise or counter clockwise directions based on the type of waste and waste falls on to the particular waste collecting bin. Namely metal, wet, dry waste bins are placed. If a metal waste is detected it falls upon metal bin. If a wet waste is detected it falls upon wet bin and if the dry waste is detected it falls upon dry bin.

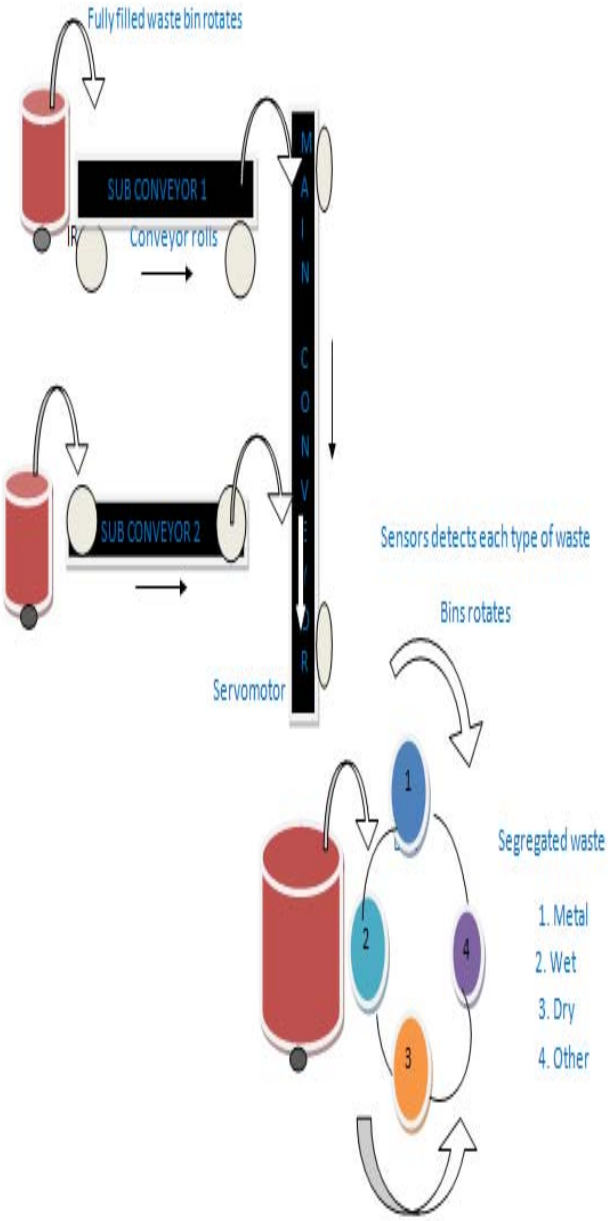

Fig. 1. Automatic waste segregation process diagram

The quantity of each type of wastes such as metal wastes, dry wastes or wet wastes could monitor. The ESP8266 Wi-Fi chip is programmed and connected. IoT module is used to monitor the waste and the information will be sent to the user's mobile phone. The mobile app shows the collection of each type of

wastes on the bins. Figure 2 shows a block diagram of automatic waste segregation.

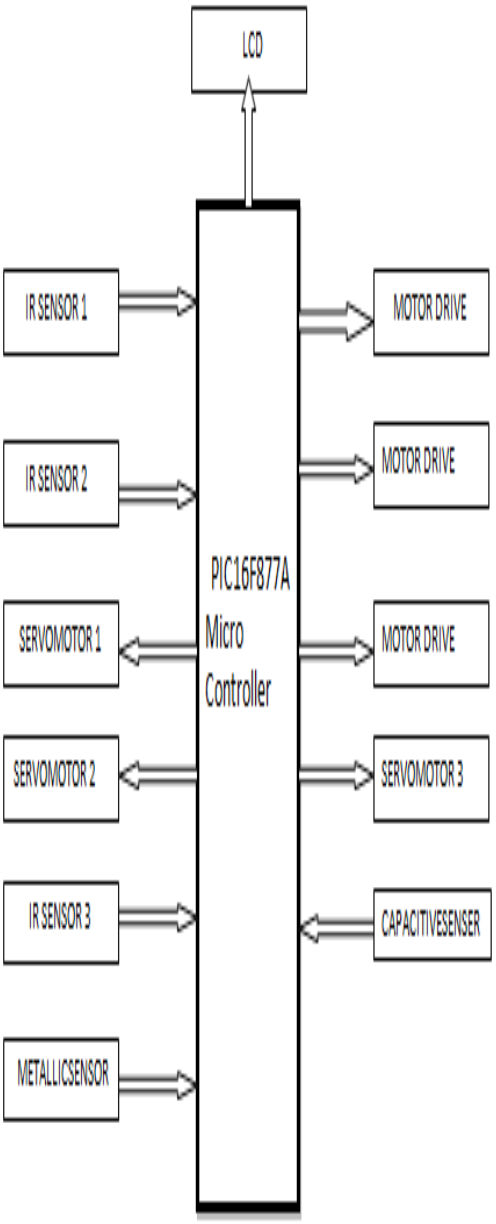

Fig. 2. Block diagram

IV. RESULT AND OBSERVATIONS

Based on some experiments paper, dry cloth, wood pieces, plastic wastes, cardboard pieces etc. is detected as dry waste. Banana peel, wet cloth, lemon, etc. is detected as wet waste. Keys, tin lid, aluminium sheet pieces, etc. are detected as metallic waste. An internet of things helped to count and monitor the type of waste and its quantity in mobile phone. Used a mobile app named "Fing", which is connected to the ESP8266 Wi-Fi module. Figure 3 shows the project structure.

Fig. 3. Project structure

V. FUTURE SCOPE

The waste materials can be segregated into biodegradable, non-bio degradable and metals by using more sensors. The discarded things can be processed to extract or recover materials in an effective way and resources or convert them to energy as usable heat, electricity, or fuels. The large scale introduction of automatic waste management in villages, platforms, hospitals, industries, etc. Real time monitoring and controlling of waste management by using IoT. A prediction system by analyzing the given data's to predict the variation in the amount of waste and to adjust the timing of management.

VI. CONCLUSION

Waste management is all those activities, actions and works required to manage waste from its production to its final disposal. This project is designed such a way that a system which collects from different positions and segregates the wastes. As the bin fills IR sensor senses the level and bin rotates into conveyor waste is collected from different locations and reached to the segregation part through the main conveyor belt. The timing and movement of the conveyor belt are controlled by the peripheral interface controller (PIC microcontroller). As the name suggests automatic waste segregation segregates the waste into three major classes: dry, wet, metallic by using different types of sensors. An

internet of things incorporated in this project counted and monitored the waste.

References

[1] Amrutha Chandramohan, Joyal Mendonca, Nikhil Ravi Shankar & Nikhil U. Baheti,"*Automated Waste Segregator*", Texas Instruments India Educator's Conference, 2014,IEEE publication.pp. 1-6.

[2]"Muhammed Rafeeq, Ateequ Rahman,Mikdad, SanjarAlam. *"Automation of Plastic, Metal and Glass Waste materials Segregation Using Aurdino in Scrap Industry"*IEEE publication, pp.1-5

[3] Narendan Sivakumar, Adithyan Raj Kunwar, Sandeep Kumar Patel, Santhosh Kumar,Pushpa Mala S, "*Design and Development of an Automatic Clustered Assorted Trash Segregation System*,"IEEE International conference on Recent Trends In Electronics Information Communication Technology,May 20-21,2016 ,pp.1-5

[4] Priya B K,T Lavanya,V samyukta Reddy,Yarlagadda Pravallika, "*Bin That Think's*", The International Journal Of Science And Technoledge,pp.1-6

[5] M.K Pushpa, Aayushi Gupta, Shariq Mohammed Shaikh, Stuti Jha, Suchithra V, *"Microcontroller Based Automatic Waste Segregator*", International Journal of Innovative Research in Electrical,Electronics,Instrumentation and control engineering,Volume 3,2015

[6] S.M Dudhal,B.S Jonwal,Prof. H.P Chaudhari, "*Waste Segregation Using Programmable Logic Controller",* International Journal for Technological Research in Engineering ,Volume 1,2016

[7]Dr.N.Sathish Kumar,B.Vijayalakshmi,R.Jenifer Prarthana,A.Shankar, *"IOT Based Garbage alert system using Arduino UNO"*,2016 IEEE Region 10 Conference(TENCON)

[8] S.M Dudhal,B.S Jonwal,Prof. H.P Chaudhari, "*Waste Segregation Using Programmable Logic Controller",* International Journal for Technological Research in Engineering ,Volume 1,2016

[9]Jose M Gutierrez,Michael Jensen,Morten Henius,Tahir Riaz, *"Smart Waste Collection System Based on Location Intelligence",*Conference Organized by Missouri University of Science and Technology 2015

[10]Theodros Anagnostopoulos,Member of IEEE,Arkady Zaslavsky,Senior member IEEE, *"Challenges and Opportunities of Waste Management in IOT enabled Smart Cities:A Survey*",IEEE Transactions on Sustainable Computing

[11]Adil Bashir,Shoaib Amin Banday,Ab.Rouf Khan,Mohammed Shafi, *"Concept,Design and Implementation of Autmatic Waste Management System",*International Journal on Recent and Innovation Trends in Computing and Communication ISSN 2321-8169,Volume:1 Issue:7

[12]Adhrisya,Aiswarya,Ambili,Veena Mohan,Jancy, *"Centralized Waste Segregation System"*,IJSRD Volume 4,Issue 01,2016