Vertical Waste Segregator for Households

Nayan Rajesh Wayangankar, Beena .R. Ballal, Raghav Papnai, Tejal Sushir, Akshada Tupe
Electronics and Telecommunication Engineering, Vidyalankar Institute of Technology, Mumbai, Maharashtra, India

Abstract- **In today's modern age, it is very difficult to separate waste manually at household level due to the time crunch and busy schedule of people living in metropolitan regions. Also if the waste is separated manually, it may lead to spread of various harmful diseases. Hence to overcome this issue, we have put forth a solution. In our model, we are separating dry, wet and metallic waste by using inductive and capacitive proximity sensor.**

Index Terms- **Inductive Proximity Sensor, Capacitive Proximity Sensor, Segregation.**

I. INTRODUCTION

In current scenario the disposal of waste is a big concern for our society. This huge amount of waste is disposed by methods which have dreadful effects on nature. Without giving a thought, waste is dumped into various landfill sites. This method of dumping waste has detrimental effects on all living beings. To counteract this adversity, we have designed a system which separates three types of waste which are dry, wet and metallic. These wastes are then separated and collected into their respective bins. After the segregation is done, the respective authorities can dump the dry waste, use the wet waste for making compost and the metallic waste can be recycled.

Keeping in account the space constraints of the houses in metropolitan regions, we have preferred to implement a vertical model instead of a horizontal one.

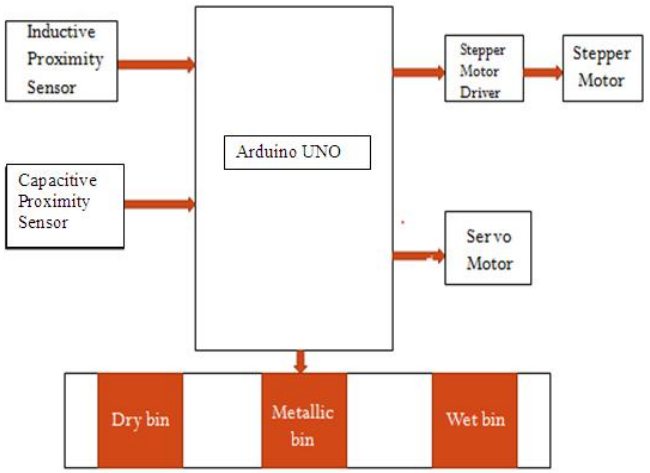


Figure1: Block Diagram

The upper part of our model consists of a vertical hollow tube in which two slots are made. In these slots flaps are inserted at a certain inclined angle. Above the upper flap two inductive proximity sensors are placed and above the lower flap a pair of capacitive sensor is placed. Each flap is controlled using a servo motor. This hollow cavity is connected to the lower part of our model using a pair of wheels which are controlled using stepper motor. In the lower part, three bins are placed where different types of waste are collected. A door mechanism is incorporated to remove the bins once they are filled. At the bottom of this section wheels are attached so that the model can be made to move as per one's convenience.

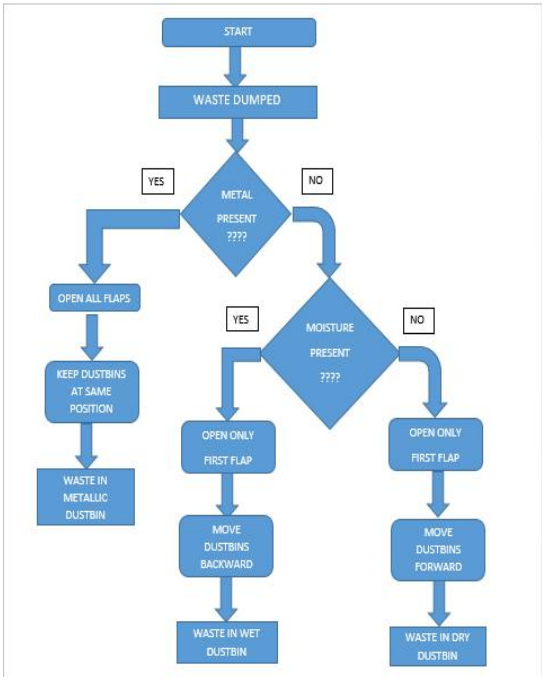
Initially, when waste is dumped into the vertical hollow tube, it will fall on the first flap. The flaps are wrapped using aluminium foil which helps in improving the accuracy of detection of various waste materials. Here the inductive proximity sensor will detect if the waste is metallic or not. If the waste is metallic the tube would remain in its position and both the flaps would be opened. The waste would be dumped in the assigned bin. Now, if the waste is not metallic, only the first flap would be opened. At the second flap the capacitive proximity sensor will check if the waste is dry or wet. The capacitive sensor can detect a wide range of materials. A minimum threshold is set to detect only wet waste. If wet waste is detected the hollow tube will move forward above the appropriate bin and the second flap would be opened. Once the waste is dumped the flaps would move back to their respective position and the tube would also move back to its initial position. If wet waste is not detected the hollow tube will move backward above the bin allocated for dry waste. Now, again the second flap would be opened and the waste would be deposited in its bin. As before the tube would move back to its original position.

II. ALGORITHM

- Waste is dumped into the hollow tube.
- Detection of waste is carried out to determine if the waste is metallic or not.
- If metallic, the waste is dumped in the appropriate bin.
- If the waste is not metallic, only the first flap will be opened.
- Detection of dry and wet waste is carried out.
- If the waste is dry the hollow tube moves backward and waste is dumped .

- If the waste is wet the hollow tube moves forward and waste is dumped.
- After the waste is dumped, the hollow tube returns to its initial position

III. FLOWCHART



IV. INDUCTIVE PROXIMITY SENSOR

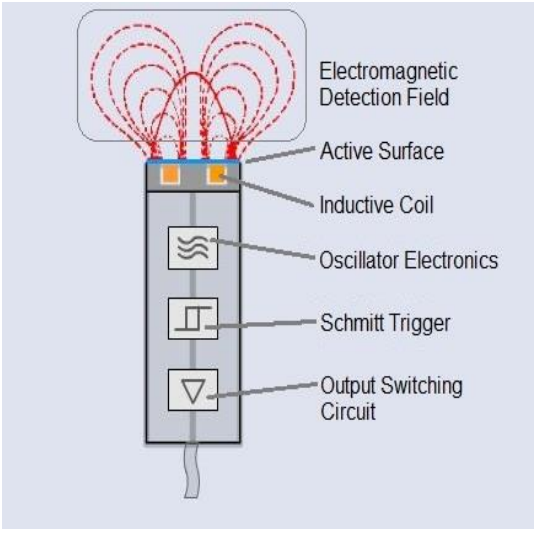


Figure 3: Inductive proximity sensor

One of the main applications of inductive proximity sensor is detection of metallic objects without contact. The working of the sensor is dependent on a coil and an oscillator. The coil and oscillator are responsible for generation of an electromagnetic field in the vicinity of the sensing area. Once a metallic object comes near this surface, there is a change in the oscillations of the electromagnetic field. The increase or decrease in the amplitude levels of the oscillation is detected by the threshold circuit. This change in the amplitude modifies the output of the sensor. The working range of the sensor depends on the cross section and shape of the contactor.

Sensitivity of sensor varies when it comes in contact with different metals and depends on the distance from the sensing contactor (d). The Following table shows operating range for different metals.

Metal	Operating range
Iron	1xd
Aluminum	0.4xd
Copper	0.4xd
Brass-Bronze	0.5xd
Stainless Steel	0.9xd

V. CAPACITIVE PROXIMITY SENSOR

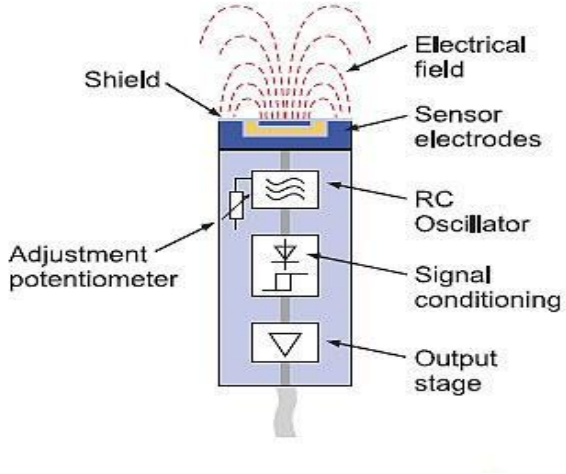


Figure 4: Capacitive Proximity Sensor

The capacitive proximity sensor is used to sense a wide variety of materials which include non-metallic and damp objects. Capacitive proximity sensor measures the change in capacitance between the sensor and the object which is being detected. When an object comes in proximity of the sensor, oscillations are generated. The change in amplitude levels of the oscillations are detected by the threshold circuit which drives the amplifier connected to an external load. This external load is driven by the amplifier. A screw is situated on the rear side of the sensor which helps in adjusting the operating range.

Sensitivity of sensor varies when it comes in contact with different objects and depends on the distance from the sensing

contactor (d). The Following table shows operating range for different metals.

Materials	Operating range
Metal	~1xd
Water	~1xd
Plastic	~0.5xd
Glass	~0.5xd
Wood	~0.4xd

VI. IMPLEMENTATION

A. Upper Assembly

The upper assembly is a vertical hollow tube which is made up of acrylic sheets. The vertical tube has a dimension of 51.2cm*10cm. This vertical tube has two slots for the two motors which would be controlling the flaps. These slots have a dimension of 5.9cm*2.8cm. the flaps used here have a dimension of 8.3cm*9cm. For easy insertion and removal of flaps, one of the four walls of the tube is connected to hinges for the wall to act as a door. The dimensions of this tube is deliberately kept moderate as our model is proposed for household applications. Two holes are made above each flap on one of the walls. These holes are made in order to hold the inductive and capacitive proximity sensors. This vertical tube is been made movable by attaching four wheels at the rear end of the tube. These wheels are connected to the tube with the help of two horizontal rods. These wheels will be controlled with the help of DC motors.

Figure 5: Upper Assembly

B. Lower Assembly

The lower assembly is a cubical hollow box of dimensions 90cm*20.5cm*25cm. On the top part of the lower assembly, at the center rectangular slit is made with the dimensions of 60cm*6.5cm so that the waste can pass through the slit to the respective bins. On the roof of this lower assembly, two rods are placed for the movement of the wheels. Inside the hollow space, three bins are placed for collecting three different types of wastes. On one of the walls of this box, hinges are used so that it can opened and closed. From this opening the bins can be removed for the dumping of waste. Four wheels are attached to the lower part of this assembly so as to provide movement to the entire model.

Figure 6: Lower Assembly

C. Final assembly

The upper and lower assembly are connected to each other to form a whole unit. The upper assembly moves on the lower assembly with the help of rod and wheel mechanism. Depending on the type of waste the vertical hollow tube moves either in the forward or the backward direction.

Figure 7: Final Assembly

VII. CONCLUSION

This project will help in effortless collection and separation of waste. It will primarily be used in households, offices, schools and college classrooms, but with certain modifications it can be used in hospitals, airports etc.

REFERENCES

[1]. https://youtu.be/stejKa03tdw
[2]. S. Yamazaki, and H. Nakane, "Basic analysis of a metal detector," IEEE Trans. Instrum. Meas., vol. 51, pp. 810-814, Aug. 2002. (Pubitemid 35369701)
[3]. S. Fericean, M. Friedrich, E. Gass, "Inductive Sensor Responsive to the Distance to a Conductive or Magnetisable Object", 1996.
[4]. D. Goeger, M. Blankertz, H. Woern, "A tactile proximity sensor", IEEE Sensors, pp. 589-594, 2010.
[5]. B. George, H. Zangl, T. Bretterklieber, G. Brasseur, "A combined inductive-capacitive proximity sensor for seat occupancy detection", IEEE Trans. on Instrumentation and Measurement, vol. 59, pp. 1463-1470, 2010.
[6]. http://www.alselectro.com/proximity-sensor.html
[7]. http://www.emergingtechs.org/p/blog-page_57.html
[8]. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=735332
[9]. Reshmi Waikhom, Sundaram RamKumar, M. Rajeev Kumar, "Sensor Unit for Waste Management", A Better Method International
[10]. Mahmudul Hasan Russel, Mehdi Hasan Chowdhury, Md. Shekh Nairn
[11]. Uddin, Ashif Newaz, Md. Mehdi Masud Talukder, "Development of Automatic Smart Waste Sorter Machine", International Conference on
[12]. Mechanical Industrial and Materials Engineering 2013 (ICMIME2013), 1–3 November, 2013
[13]. Amrutha Chandramohan, Joyal Mendonca, Nikhil Ravi Shankar, Nikhil U Baheti, Nitin Kumar Krishnan, M S Suma, "Rashtreeya

Vidyalaya College of Engineering (R.V.C.E.)", Automated Waste Segregator.
[14]. M. K. V, J, M. Bipin Nair, R, M. Pushpa, B., "E-Waste Management", International Journal of Commerce Management and Technology, vol. 2, no. 1, pp. 109-120, January 2014.http://www.kscst.iisc.ernet.in/spp/40_series/SPP40S/01_Seminar%20 Projects/088_40S_BE_0621.pdf
[15]. M. K. Pushpa, Aayushi Gupta, Shariq Mohammed Shaikh, Stuti Jha, V. Suchitra, "Microcontroller Based Automatic Waste Segregator", International journal of Innovative research in Electrical Electronics Instrumentation and Control Engineering, vol. 3, no. 5, May 2015. http://www.automationmedia.com/Port1050/SiemensFreeCourses/snrs _4.pdf
[16]. R. E Marshall, K Farahbakhsh, "Systems approaches to integrated solid waste management in developing countries", Waste Management, vol. 33, no. 4, pp. 988-1003 , April 2013.
[17]. D. K. J. G. A. G. V. A. Papalambrou, "A Versatile Scalable Smart Waste-bin System based on Resource-limited Embedded Devices", Emerging Technologies & Factory Automation (ETFA) 2015 IEEE 20th Conference on, 2015.
[18]. http://www.alselectro.com/proximity-sensor.html
[19]. https://www.youtube.com/watch?v=K7xoV9EhYDg
[20]. https://www.youtube.com/watch?v=-j8uhnf9MCo
[21]. https://www.youtube.com/watch?v=59WlVeYAXxY
[22]. https://www.instructables.com/id/Arduino-Servo-Motors/
[23]. https://www.allaboutcircuits.com/projects/servo-motor-control-with-an-arduino/
[24]. L.A. Guerrero G Ger, H William, "Solid waste management challenges For cities in developing countries", Waste Management, vol. 33, no.1, pp. 220-232, January 2013.
[25]. Y. S. L. W. L. Y.Fachmin Folianto, "Smartbin: Smart Waste Management System", 2015 IEEE Tenth International Conference on Intelligent Sensors Sensor Networks and Information Processing (ISSNIP), 2015.
[26]. L.Michelson, "Greater precision for noncontact sensors", Mach Des., pp. 117-121, Dec. 1979.
[27]. L.A. Guerrero, G Ger, H William, "Solid waste management challenges for cities in developing countries", Waste Management, vol. 33, no. 1, pp. 220-232, January 2013.
[28]. Y. S. L. W. L. Y. Fachmin Folianto, "Smartbin: Smart Waste Management System", 2015 IEEE Tenth International Conference on Intelligent Sensors Sensor Networks and Information Processing (ISSNIP), 2015.
[29]. M. K. Pushpa, Aayushi Gupta, Shariq Mohammed Shaikh, Stuti Jha, V. Suchitra, "Microcontroller Based Automatic Waste Segregator", International journal of innovative research in Electrical Electronics Instrumentation and Control Engineering, vol. 3, no. 5, May 2015.
[30]. http://www.automationmedia.com/Port1050/SiemensFreeCourses/snrs_4.pdf
[31]. http://www.alselectro.com/proximity-sensor.html
[32]. http://www.emergingtechs.org/p/blog-page_57.html