International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

SMART WASTE MANAGEMENT SYSTEM

Shraddha Golande[1], Kaushal Purohit[2], Aalok Marathe[3], Anuja Ghotekar[4], Ms. Sonam Borhade[5]

[1,2,3,4] B.Tech student, Computer Science, Sinhgad Institute of Technology and Science , Pune, India
[5]B.Tech Professor, Computer Science, Sinhgad Institute of Technology and Science , Pune, India

---

Abstract - *Current waste management systems are inefficient and costly. Electronic sensors can be used to efficiently manage the waste and significantly reduce the cost of man labor. In this project raspberry Pi is used along with servo motors and conveyor belt. TensorFlow is used to build the waste object detection model. Waste will be carried by the conveyor belt and servo motors will turn the flaps in order to segregate the waste into solid and wet waste.*

***Key Words*: Object detection, waste management system, TensorFlo*w**

1. INTRODUCTION

2.01 billion tons of municipal waste is being generated worldwide every year. It is projected to increase at least by 70% to reach 3.4 billion tons by 2050 due to rapid urbanization, population growth and economic development unless urgent measures are not taken. Segregation at the source level is critical to its recycling and disposal. Lack of segregation, collection and transportation of unsegregated mixed waste being dumped in the landfills has an impact on the environment. During such times reducing man labor and automating the tasks of segregation and collection to increase the efficiency can be helpful and this project helps in achieving the same. It helps in reducing the labor cost as well as helps in segregating the waste in the form of solid and wet waste.

1.1 INTERNET OF THINGS

The Internet of Things helps in acknowledging the objects in the real world with the help of cameras, sensors and various softwares who have the ability to process it over the internet or other networks used in communication.

Advancements in the field of Internet of Things have made it possible to improve the existing waste management system. Implementation of the sensors in the waste bin along with Internet of Things connectivity allows for the real-time monitoring of the waste being collected, which is absent in the existing waste management system. Data such as the type of waste, and any necessary data can be collected from the sensors. This data can then be uploaded to the cloud for storage and processing. The processed data can then be used to study and assess the limitations of the existing waste management system and hence improve the system's efficiency as a whole. The Internet of Things application in the waste bin is one step towards a smart city. With the help of Internet of Things, the workers can get to know the actual fill level of each compartment of the segregated waste, which will further help them in the management phase and also cut the management costs considerably. The waste can also be segregated in solid and wet waste. With the help of Internet of Things one can also record the number of times the bin has been emptied.

2. Requirements

Following are the requirements for the smart waste management system.

- Raspberry Pi 4B (4GB ram or more)
- Moisture sensor
- Servo motors
- Conveyor belt
- Pi camera (5MP or more)

3. METHODOLOGY

3.1 IMPLEMENTATION

The camera module is connected to Raspberry Pi to capture the waste image for the purpose of object detection and identification. Waste is dumped on the conveyor belt and the raspberry pi detects it. After this the waste will come in front of the moisture detector and then the detector will check whether there is moisture present or not. After the waste is detected, we will carry out classification with the help of SVM (Support Vector Machine) algorithm. And then after applying CNN (Convolution neural network) model we can detect the waste and determine whether it is solid or wet waste. Waste detected is added to the database by calling the api. Then the flaps will turn accordingly to dump the waste in the specified bin. If there is moisture present in the waste ,then that particular waste will be dropped off at the wet waste compartment. Speed of the conveyor is to be considered with reference to the time required by the object detection model to identify the waste.

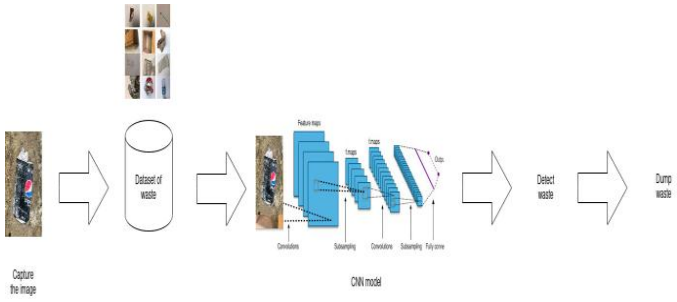

Fig-1:System Architecture

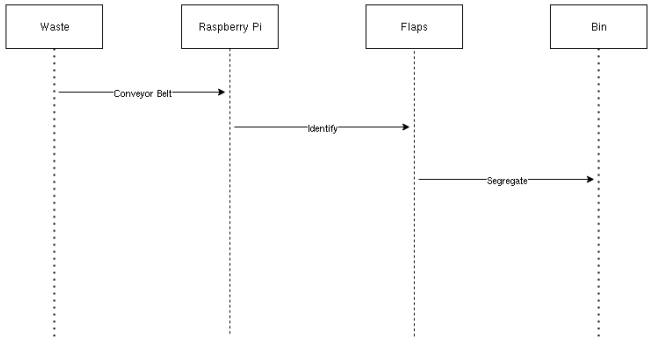

Fig-2:Sequence Diagram

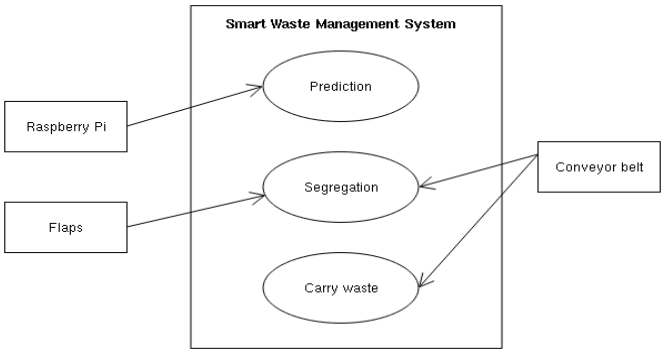

Fig-3: Use Case Diagram

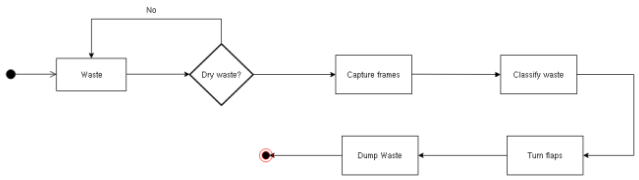

Fig-4:System Architecture

Algorithm

1: Drop waste

2: Move the conveyor belt

3: Capture frames using Pi Camera

4: Raspberry Pi performs waste image classification using the CNN model

```
if waste = paper then
  Open paper compartment's ;
elseif waste = metal then
  Open metal compartment's ;
elseif waste = plastic then
  Open plastic compartment's ;
else
  Open Wet waste compartment ;
```

5: Dump waste in the compartment.

3.2 DATASET

Dataset Contains 'cardboard', 'compost', 'glass', 'metal', 'paper', 'plastic', 'trash' and 'wet waste' total 8 different types of waste materials which are used for recycling, and contain 2187 images belonging to 8 classes. Accuracy can be improved by adding more images into the dataset.

Fig 5:Waste Dataset

4. CONCLUSIONS

During such times when waste management has become a concern to the world an efficient model is required to overcome the problems being faced. This project will help to increase the efficiency of the current waste management system significantly and also help in proper segregation of wet and solid waste. This project will also help in cutting the labor costs and also in the management process.

5. ACKNOWLEDGEMENT

We would like to thank our Principal Dr. S. D. Markande, Head of the Department Dr.Geeta S. Navale, our project Coordinator Mrs. B. D. Shendkar, our guide Ms. Sonam Borhade for their valuable advice and technical assistance.

REFERENCES

[1] M. Shahidul Islam, M. T. Islam, A. F. Almutairi, G. K. Beng, N. Misran, and N. Amin, "Monitoring of the human body signal through the Internet of Things (IoT) based LoRa wireless network system," Appl. Sci., vol. 9, no. 9, p. 1884, May 2019.

[2] M. A. Abu, N. H. Indra, A. H. A. Rahman, N. A. Sapiee, and I. Ahmad, "A study on image classification based on deep learning and tensorflow," Int. J. Eng. Res. Technol., vol. 12, pp. 563–569, Oct. 2019.

[3] N. Misran, M. S. Islam, G. K. Beng, N. Amin, and M. T. Islam, "IoT based health monitoring system with LoRa communication technology,"in Proc. Int. Conf. Electr. Eng. Informat. (ICEEI), Bandung, IN, USA, 2019, pp. 514–517.

[4]K. Kumar and S. Kumar, "Energy efficient link stable routing in Internet of Things," *International Journal of Information Technology*, vol. 10, no. 4, pp. 465–479, 2018.

[5] A. Meijer and M.P.R.Bol´ıvar, "Governing The Smartcity:A Review Of The literature on smart urban governance," Int. Rev. Adm. Sci., vol. 82, no. 2, pp. 392–408, 2016.

[6] A. Zanella, N. Bui, A. Castellani, L. Vangelista, and M. Zorzi, "Internet of Things for smart cities,' 'IEEE Internet Things J.,vol.1,no.1, pp. 22–32, Feb. 2014.

[7] O. Vermesan, P. Friess, P. Guillemin et al., "Internet of things strategic research roadmap," *Internet of Things-Global Technological and Societal Trends*, vol. 1, pp. 9–52, 2011.

[8] L. Atzori, A. Iera, and G. Morabito, "The Internet of Things: A survey," Comput. Netw., vol. 54, no. 15, pp. 2787–2805, Oct. 2010.

[9] M.O.Saeed,M.N.Hassan, and M.A.Mujeebu,"Assessment Of Municipal solid waste generation and recyclable materials potential in kuala lumpur, malaysia," Waste Manage., vol. 29, no. 7, pp. 2209–2213, Jul. 2009.

BIOGRAPHIES

Shraddha Golande is currently a final year B.student of savitribai phule pune University.
Kaushal Purohit is currently a final year B.student of savitribai phule pune University.
Aalok Marathe is currently a final year B.student of savitribai phule pune University.
Anuja Ghotkar is currently a final year B.student of savitribai phule pune University
Ms. Sonam Borhade is currently working as a Professor in Sinhgad Institute of Technology and Science, Narhe