Smart Dustbin using Compression Technique

Adarsh Vijayakumar[1], Joyal T John[2], Julie Elis Lagy[3], Vaishnavi R Nair[4], Manju Ann Mathews[5] (Asst. Prof)

[1-5]*Department of Electrical and Electronics Engineering, A.P.J Abdul Kalam Technological University, Trivandrum, Kerala, India*

Abstract - *Waste management is one of the primary problems that the world faces irrespective of the case of a developed or developing country. The key issue in waste management is that the garbage bin at public places gets overflowed well in advance before the commencement of the next cleaning process. It in turn leads to various hazards such as bad odour & ugliness to that place which may be the root cause for the spread of various diseases. To avoid all such hazardous scenarios and maintain public cleanliness and health this work is focused on a smart garbage system.*

The main theme of the work is to develop a smart intelligent garbage alert system and compacting the trash for proper garbage management. With the help of microcontrollers, sensors and compaction mechanisms, the size of trash is reduced so that in small spaces more trash can be stored. Again, this compacted trash can be compact again and the space used to store the trash can be made free. The sensors are interfaced with a microcontroller to check the level of garbage filled in the dustbin and send an alert to the municipal web server when the garbage is filled. After cleaning the dustbin, an alert is sent to the municipal web server that the dustbin is cleared. The real-time status of how waste collection is being done could be monitored and followed up by the municipality authority with the aid of this system.

1. INTRODUCTION

In metropolitan areas, waste management is one of the challenging tasks for majority of the countries; therefore there is need for a well-organized waste clearance system is mandatory by keeping a green environment. The key issue in waste management is that the garbage bin at public places gets overflowed well in advance before the commencement of the next cleaning process. The main theme of the work is to develop a smart intelligent garbage alert system and compacting the trash for proper garbage management. The main motivation behind this project is what we see in our locality on a daily basis. Trash is dumped in every nook and corner of the city. According to a recent survey, around 3,176 tonnes of waste is being generated per day and only less than 25% is being properly disposed of and treated. In addition to the various types of wastes, there are pollutant discharges that affect the environmental cleanliness and aesthetics of Kerala. This affects both the physical well-being and the mental well-being of the people. The main problems our present day society faces are lack of proper waste disposal management which leads to a condition of over littering among the citizens and the lack of proper maintenance and regular follow ups from the authorities. This results in the constant trash overflow and also serious health conditions in both animals and human beings.

2. WASTE COLLECTION METHOD

Waste collection, storage and transport are the inevitable factors of any Solid Waste Management (SWM) system. Waste collection is the responsibility of the municipal corporations in India. Separate bins are provided for the collection of biodegradable and inert waste. But the waste is often dumped together making it difficult for segregation. This dumped waste is subjected to open burning which is a common practice. Improvements to waste collection and transport infrastructure will create more jobs, improve the aesthetics and in turn increase tourism. According to the records local bodies spend around Rs. 500-1000 per tonne on SWM with 70% of this amount spent on collection and about 20% on transport.

2.1 Waste Disposal Methods

Waste disposal is a crucial step in the SWM system. There arises the need to develop facilities and treatment centers to treat and dispose of the waste in a hygienic and in an eco-friendly manner. It is estimated that India generates about 62 tonnes of waste. More than 90% of the waste is left unattended and in an unsatisfactory manner in our society. Properly engineered waste disposal protects public health and preserves key environmental resources such as ground water ,air quality etc.

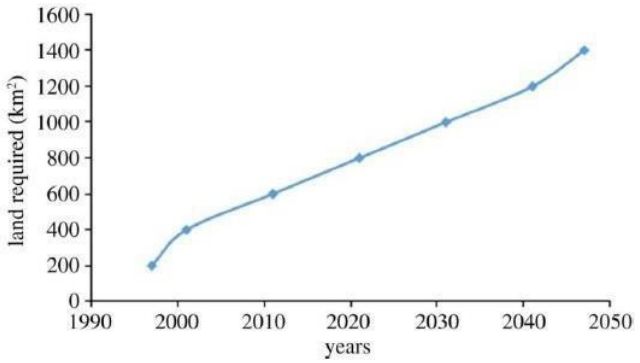

Chart -1: Land required for landfill in following years

2.1 Impact of Waste Dumping

Waste dumps have adverse impacts on the public and environmental health. Table-1 illustrates the waste generation scenario in India up to 2041. Due to this dumping methane is released from decomposition of the biodegradable waste under anaerobic conditions leads to pungent odour and rise of air borne diseases. The garbage is left scattered along the roadsides and causes an unhygienic situation to the nearby dwellers. The waste that is being dumped in the water bodies damages the availability of pure drinking water. This can affect both the aesthetics and scope for tourism in India.

Table -1: Waste generation in India

year	population ($x10^6$)	per capita generation (kg per day)	total waste generation (x 10^3 Tonnes per year)
2001	197.3	0.439	31.63
2011	260.1	0.498	47.30
2021	342.8	0.569	71.15
2031	451.8	0.649	107.01
2036	518.6	0.693	131.24
2041	595.4	0.741	160.96

3. DESIGN OF COMPRESSION SYSTEM

The compression system which is the main part of Smart dustbin is connected inside the outer dustbin. The inner dustbin can be taken out for emptying trash or can be replaced with another one. The compression system will be placed just above the inner dustbin when kept inside the cavity of the outer box and it will compress the trash inside the inner dustbin. The compression system is made up of a scissor mechanism which expands and compression of trash takes place. It compresses the waste when it expands as shown in Fig 1. The reasons for selecting this mechanism are that it is easily customized, compact size, ease of use and it is economical.

Fig -1: CAD drawing of compression mechanism

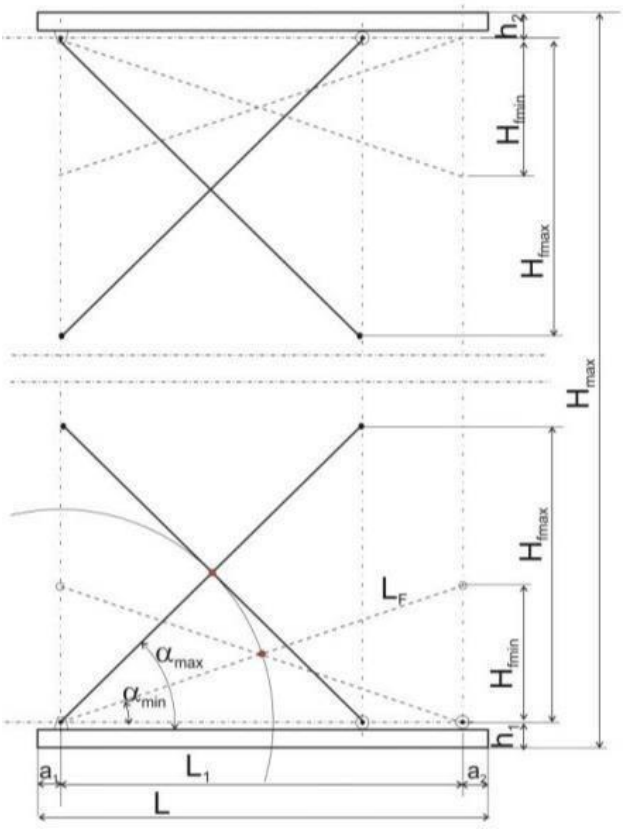

Fig -2: Design criteria for scissor mechanism

$$l_1 = \frac{L-(a_1+a_2)}{2\cos(\alpha_{min})} = 18\ cm \quad (1)$$

$$n = \frac{H_{max}-(h_1+h_2)}{2.l.\sin(\alpha_{max})} = 3\ cm \quad (2)$$

$$H_{max} = h_1 + h_2 + 2N.l.\sin(\alpha_{max}) = 47\ cm \quad (3)$$

$$H_{min} = h_1 + h_2 + 2.N.l.\sin(\alpha_{min}) = 9.4\ cm \quad (4)$$

Here l_1 is the actual length of the scissor and it is rounded to the value , $L$is the Platform length, the minimum/ maximum (folded/open scissors) angle, α_{min}; α_{max} [°] and cotes a_1, a_2, h_1, h_2. n is the number of scissor needed, H_{max} is the maximum height and H_{min} is the minimum height.

4. METHODOLOGY

This explains the procedure of how the system is being operated. The block diagram of the complete system is shown in Fig 5. Two basic implementations are done in this:

1. Compaction of the waste using a compressing system
2. Sending instantaneous messages to the authorities to inform the real time status and the location of the dustbin.

An application called Blynk, to display real time values of the fill status along with the location of the dustbin and alerting

any sort of fire outbreak in the bin, in mobile phones is also defined here.

Proteus is used to develop the circuit diagram and also simulate the project. SolidWorks is used to design our compression system.

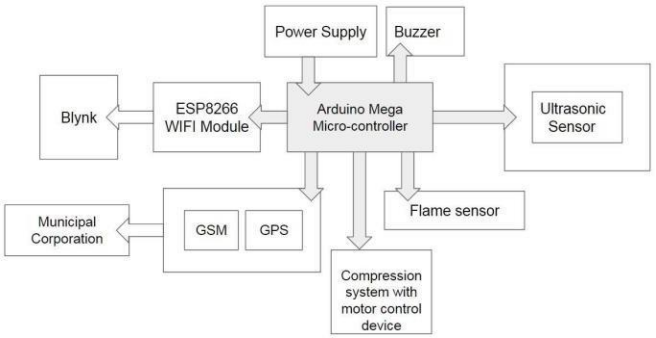

Fig -3: Block diagram of the system

5. FLOWCHART

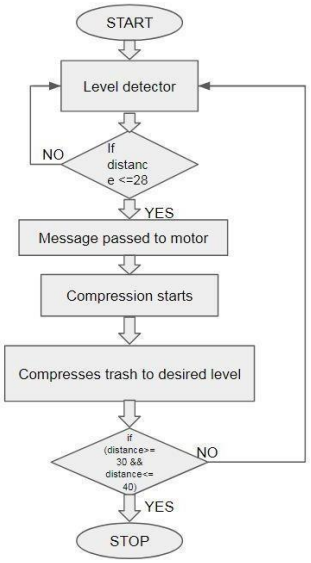

Fig -4: Algorithm for monitoring Compression System

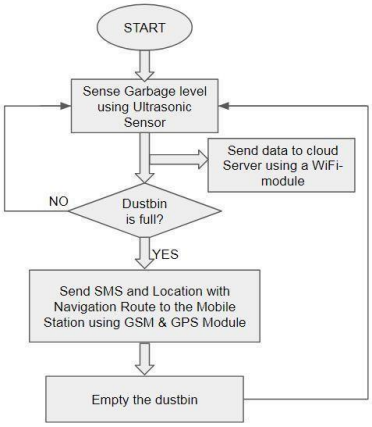

Fig -5: Algorithm for Alert System and Data Collection System

6. HARDWARE IMPLEMENTATION

This chapter discusses the prototype of the system that can be implemented in residential areas to obtain the real time values of compressed level and the fill status of the dustbin. The dustbin has two parts: an inner dustbin and outer box. The compression system is installed in the outer box. The ultrasonic sensor is placed in the sides of the dustbin to detect the level of the trash and the laser is placed on the compression system to detect the distance between the sensor and the trash. The signals from these sensors initiate the process of compression. The compression system is driven using a window motor which is able to drive this system. This compression process is initiated when the level of the dustbin is greater than 28cm. The process continues till the level of the trash becomes greater than or equal to 40cm. If the distance is less than 40cm and then the process is again into consideration. There is a laser time range sensing module to measure the distance vertically to make the process of compression more precise. The hardware is powered with the help of 12V power supply. Another ultrasonic sensor is placed for hand detection so that no one is harmed during the compression process. The hardware components are placed above the compression system in a compartment in the top part of the outer box. An IR flame sensor is also placed in order to detect the presence of any fire outbreaks. When there is an outbreak of fire the authorities are informed instantaneously and at the same time the buzzer turns on alerting the residents about the situation. As the outer box and the compression system is made of mild steel, the dustbin is not prone to being damaged. When the dustbin is filled and verified using both the sensors, the message is passed to the authorities along with the longitudinal and latitudinal position of the dustbin using the GPS and GSM module. Following that the authorities can collect the waste and do that well in advance of the commencement of the next cycle. The information is also stored in the Blynk app and also recorded for future references by the authorities using the inbuilt Wi-Fi module in the Arduino mega Atmega2560.

Fig -6: Hardware implementation

7. RESULTS AND DISCUSSION

The scissor mechanism of the compression system is done. The compression system to compress the waste inside the

dustbin and the real time location along with the fill statusof the dustbin is sent to the authorities is analyzed using sensors and correspondingly the information is sent using the GPS and GSM module. The message is being received using the Blynk app. The software part for the entire system is simulated in Proteus 8 Professional as indicated in Fig 7.

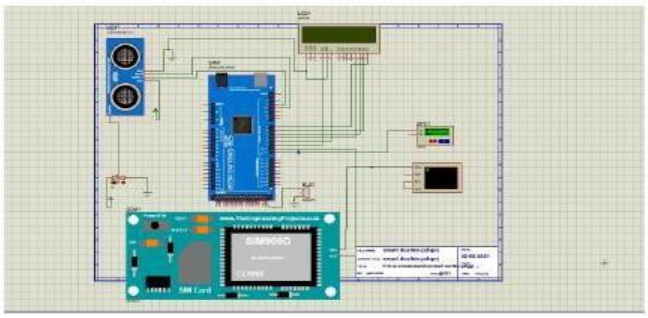

Fig -7: Circuit Diagram

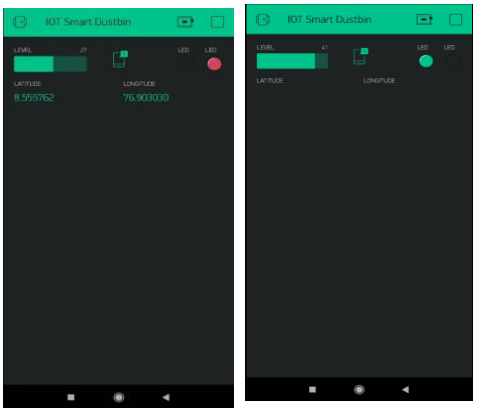

Fig -8: Compression System output
(a) Full state (b) Dustbin

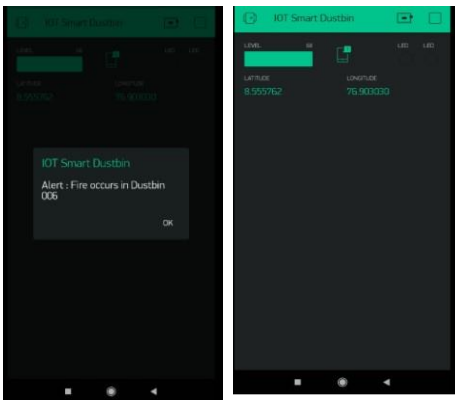

Fig -9: Fire Outbreak Alert Fig 12: GPS Output

8. CONCLUSIONS

According to a recent survey, around 3,176 tons of waste is being generated per day and only less than 25% is being properly disposed and treated. In addition to the various types of wastes, there are pollutant discharges that affect the environmental cleanliness and aesthetics of Kerala, in turn,reducing the assimilate capacity of environment. This adversely affects the health, tourism and ecosystem. The compression system using scissor mechanism was completed. The communication system using Blynk app has been done tested and verified. Fire sensor and level detection which is used to know the fill status has been successfully tested. This work focuses on effective waste management using compaction technique and trash overflow in our localities. This also ensures proper management andmonitoring bythe authorities. By implementing this project there will be awareness in making a healthy city with smart inventions. This work can also be used in association with Suchitwa Mission and Swachh Bharat Abhiyan initiated by Government of Kerala and India respectively. This system iseliminating the present day status about the dustbins whichare the most of the time lying in a wretched condition concerning about the filled garbage without being clean.

REFERENCES

[1] S.S.Navghane, M.S.Killedar, Dr.V.M.Rohokale, “IoT Based Smart Garbage and Waste Collection Bin”, 1 SKN-SITS, Dept. of E&TC, Lonavala, vol.5, Issue 5, ISSN: 2278-909X, May 2016.

[2] Dr.N.Sathish Kumar,B Vijayalakshmi,R Jennifer Prarthana,A Shankar, “IoTBased Smart Garbage Alert System Using Arduino UNO”, 2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM), August 2017. pp.184-189

[3] Minthu Ram Chiary, Sripathi SaiCharan, Abdul Rashath .R, Dhikhi.T, “Dustbin Management System Using Iot”, International Journal of Pure and Applied Mathematics, vol.115, no.8, 463-468 ISSN: 1311-8080, 2017.

[4] Cornel Ciupan, Emilia Ciupan, and Emanuela Pop ”Algorithm for designing a hydraulic scissor lifting platform” MATEC Web of Conferences 299,03012 (2019), MTeM 2019.

[5] Bekir Cirak “Dynamic Analysis of The Hydraulic Scissors Lift Mechanism” International Journal of Science and Research (IJSR) ISSN: 2319-7064 ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

[6] Ruhin Mary Saji,Drishya Gopakumar,Harish Kumar S, K N Mohammed Sayed,Lakshmi S, “A Survey On Smart Garbage Management In Cities UsingIoT”, International Journal Of Engineering And Computer Science ISSN, vol.5, no. 2319-7242,pp.18749-18754, 2016

[7] Rishabh Kumar Singhvi, Roshan Lal Lohar, Ashok Kumar, Ranjeet Sharma, Lakhan Dev Sharma, Ritesh Kumar Saraswat, "IoT BasedSmart Waste Management System: India prospective", Internet of Things: Smart Innovation and Usages 2019 4th International Conference on, pp. 1-6, 2019

[8] C. Kolhatkar, B. Joshi, P. Choudhari and D. Bhuva, "Smart E-dustbin," 2018 International Conference on Smart City and Emerging Technology (ICSCET), 2018, pp. 1-3, doi: 10.1109/ICSCET.2018.8537245