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An IoT Enabled Framework For Smart Waste Management

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ABSTRACT

Waste management is a need for actions and activities to manage waste. It is one of the existing challenges and has become a critical issue due to rapid increase in population. Absence of efficient waste management has huge environmental impacts and can cause serious problems. So, appropriate waste management system is required. As technology has always helped people make life simpler. In this paper, an Internet of Things (IoT) framework for waste monitoring, collection and segregation has been proposed; an innovative way which improves the trash management system. At present in most of the public places proper disposal of trash is not done which led to overflow of dustbins. The traditional technique used to separate waste in India is through rag pickers it can adversely affect the health of individuals exposed to such waste and is time consuming. By using embedded system we can continuously monitor the amount of waste present in the dustbin and can segregate the waste. The sensor placed on the lid of the dustbin senses the amount of waste present in the dustbin on reaching the maximum capacity an instant message is sent to the trash management department. Open debris can be reported by uploading an image with location on the waste management portal or mobile application. This will also show the employees of trash department the amount of trash filled in these smart dustbins at different locations. By implementing this idea, instead of driving blindly, the garbage collector can optimize the collection schedule. Waste segregation takes place when the waste is collected and dumped into the truck .The waste can be segregated into different categories like metallic, dry and wet waste.

Keywords- IoT, embedded system

1. INTRODUCTION

According to the 2011 census, India's population is about 1.2 billion. The increase in the population of India poses a serious threat with regards to the utilization of natural resources and raw materials, availability of living space etc. Another serious peril that follows is the amount of waste generated by every individual per minute. India produces 62 million tons of waste, with an annual growth rate of 4 percent (PIB 2016), according to the Press Information Bureau. This is a mixed waste that contains recyclable as well as non-recyclable waste. The fundamental necessities of India have sometimes been overlooked, with megacities growing by 30.47% (Census 2011). Unfortunately, the Indian administration has ignored significant waste management public service while concentrating on facilities for the increasing population such as water, electricity and food. The inappropriate disposal of municipal waste has a severe and harmful effect on a broad spectrum of fields and our waste is both dangerous and non-hazardous.

Currently, we are not limited to manage waste due to our day-to-day activities. Garbage thrown in public places or streets creates a public health hazard. Water gets contaminated by the waste which is dumped near rivers, lakes and streams. Garbage burned in the open instead of properly disposed of creates air pollution and releases toxic gasses into the environment. Non- biodegradable waste which is thrown into open drains makes their way into the sewerage systems, which damages the infrastructure and clogs the pipelines. Even more dangerous is the dumping of untreated hospital and industrial waste, with the release of pathogens and toxic compounds posing a serious threat to human life as well as to plants and animals. Entire landscapes are ruined and unique habitats for flora and fauna are lost by dumping garbage in the countryside. In India it is widely seen, large amounts of solid waste stay uncollected along main highways, streets, vacant parcels of land, illegal dumps and downhill slopes. Though the country is in a stage of upgradation, there is yet another problem that has to be resolved is garbage. Images of the waste that is poured out of the containers due to overflow can be seen all around. This can be the cause of various diseases as a large number of mosquitoes and insects breed on it. This scenario requires an effective system capable of optimizing waste collection and separating waste.[1]

2. LITERATURE REVIEW

In the existing system, the collection of unseparated solid waste in residential, commercial, streets, parks, industrial facility and vacant areas is difficult and complex. Residents bring and deposit the waste in the community bins located at street corners. There are many drawbacks of the existing system. Waste at sources is not stored in a scientifically segregated way. Citizens should be taught the importance of waste management and stop littering waste on the streets. Municipal sanitation workers collect the discharged waste by road sweeping, drain collection etc. Street sweeping is not performed on a daily basis. There is generally no solid waste processing in the nation. Few towns have used aerobic or anaerobic composting systems to perform decentralized or centralized composting on a restricted scale. A few towns are practicing vermicomposting. Landfill gas with 50 to 60 percent methane by volume is released by landfill sites. Methane is 21 times more powerful than carbon dioxide provoking problems related to global warming. TERI estimated that approximately 7 million tons of methane was released into the air in 1997. Recycling could rise to 39 million tons by 2047 if composting does not try to decrease emissions.

3. ANALYSIS

The increase in the growth of the population has led to depletion of the natural resources. The quantity of waste generated depends on living standards, type of commercial activities, season, eating habits etc. The per capita generation of municipal solid waste in India varies from about 0.17 kg per individual per day in small towns to about 0.62 kg per individual per day in towns. The data for Municipal Solid Waste generation in different states indicates high waste generation in Maharashtra, Uttar Pradesh, Tamil Nadu, West Bengal, Andhra Pradesh, Kerala and Madhya Pradesh, Rajasthan, Gujarat, Karnataka and Mizoram. In some states like Assam, Arunachal Pradesh, Jammu and Kashmir, Bihar, Jharkhand, Chhattisgarh, Tripura, Nagaland and Manipur, Orissa, Goa, Meghalaya less amount of waste is generated.

In India, street littering and waste is a major issue which has severe impacts on public health. Waste dumps have serious consequences for public health and the environment. Methane is produced from the decomposition of biodegradable waste in open dumps under anaerobic conditions, causing fires and explosions to contribute significantly to global warming. Issues are also associated with odor and leachate migration to receive waters especially during the summer when average temperatures in India may exceed 45 ° C; odor is a severe issue. Waste burned at dump sites releases fine particles that can trigger respiratory and smog disease. Tires placed in dumps accumulate water, enabling the breeding of mosquitoes, which raises the danger of illnesses like dengue. Municipal solid waste and tires open combustion emits 22,000 tons of pollutants into the atmosphere around Mumbai each year. The various impacts of poor waste management on public health are increased incidences of nose and throat infections, bacterial infections, breathing difficulties, inflammation, reduced immunity, anemia, asthma, allergies and other infections.

In order to achieve effective economic growth there is a need for developing high-quality infrastructure which protects the environment as well as meets the needs of people. The transmission from waste to resources can be achieved when there is an investment in solid waste management as this depends on set of actions to maximize the recovery of recyclable materials and develop markets. Improvements in India's waste collection and transport infrastructure will generate employment, boost tourism, and enhance public health. Disposal of solid waste is at a critical development stage in India.

There is a need to develop facilities for treating and disposing increasing amount of wastes. More than 90% of the waste is believed to be dumped in India in an unsatisfactory manner. India presently relies on inadequate infrastructure for waste, the informal sector and waste dumping. There is usually a lack of community accountability for waste and there are significant problems linked to government involvement in waste management.

The key to creating adequate and sustainable waste management systems is to raise awareness of the community and alter people's attitude towards waste. Sustainable and economically viable waste management must guarantee maximum waste resource extraction in combination with waste-to-energy equipment and secure waste disposal through the growth of the engineered landfill. India is facing issues linked to the choice of waste technology, waste policy and the accessibility of adequately qualified individuals in waste management. As long as these basic conditions are met, India will continue to suffer from bad waste management.[2]

4. DESIGN

The components used in this project for monitoring waste are ultrasonic sensor, GPS, GSM, Arduino UNO and Node MCU. Sensors, GSM, GPS are programmed using Arduino and Node MCU microcontroller. The ultrasonic sensor placed on the lid of the dustbin is used to detect the level of the dustbin. This level can be measured in centimeters. The processor processes the data from the dustbin and sends it to the

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cloud and displays the level using user interface like website and mobile application. GPS is used to detect the exact location of the dustbin and display it on the user interface. If the level of garbage is more than 80% then it sends a message to trash management department using GSM.

In certain areas there is no proper dustbin or container; garbage is just littered anywhere. In this scenario, any citizen can click a picture of debris and upload it on the website or mobile application with appropriate location and description. Thus the trash management department will be notified and take appropriate actions to collect the waste resulting in a clean surroundings.

The board of Arduino UNO includes a collection of digital and analog I / O data pins that interface the board with other electronic components. Arduino Uno has 6 analog pins and 14 digital pins. IR Sensor is equipped with a transmitter and receiver. When powered, the IR transmitter begins to transmit ongoing IR waves, if an obstacle is positioned in the path of these waves; they are reflected from the barrier and obtained by the receiver. Metal Sensor an Inductive Proximity Sensor is a non-contact electronic proximity sensor. It is used for metal detection. This sensor's sensing range relies entirely on the metal being detected. Moisture sensor is used in a specified material to assess the moisture content. By using certain characteristics such as electrical resistance, these sensors indirectly use the volumetric water content. DC Motor stands for the direct current motor. It is an electrical machine .It transforms electrical energy of direct current into mechanical energy. Most of the DC motor types have an internal mechanism to reverse the current flow direction in part of the motor. Liquid Crystal Display is a flat panel display using liquid crystal properties. LCD displays are not directly emitting light. They use a backlight to develop images in single color. Motor Driver Circuit, L293D is a motor driver circuit .It is connected with a motor when the required current for a motor is more than what is specified. Thus, motor drivers act as a current amplifier. Arduino IDE (Integrated Development Environment) is a software platform. It allows a user to program Arduino or any of the ATmega family controllers. This IDE connects to the Arduino and hardware to upload programs and communicate with them.[3]

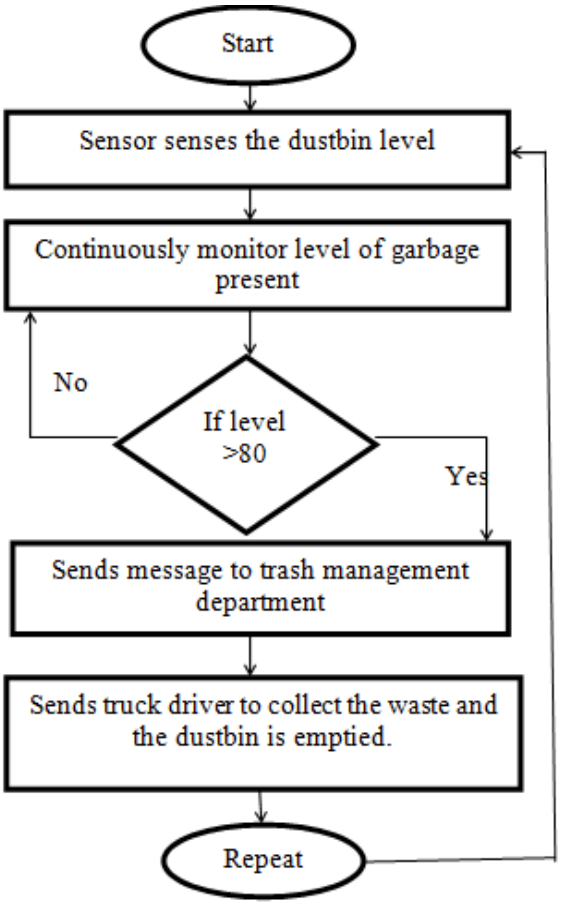

Fig 1: Flowchart for waste collection

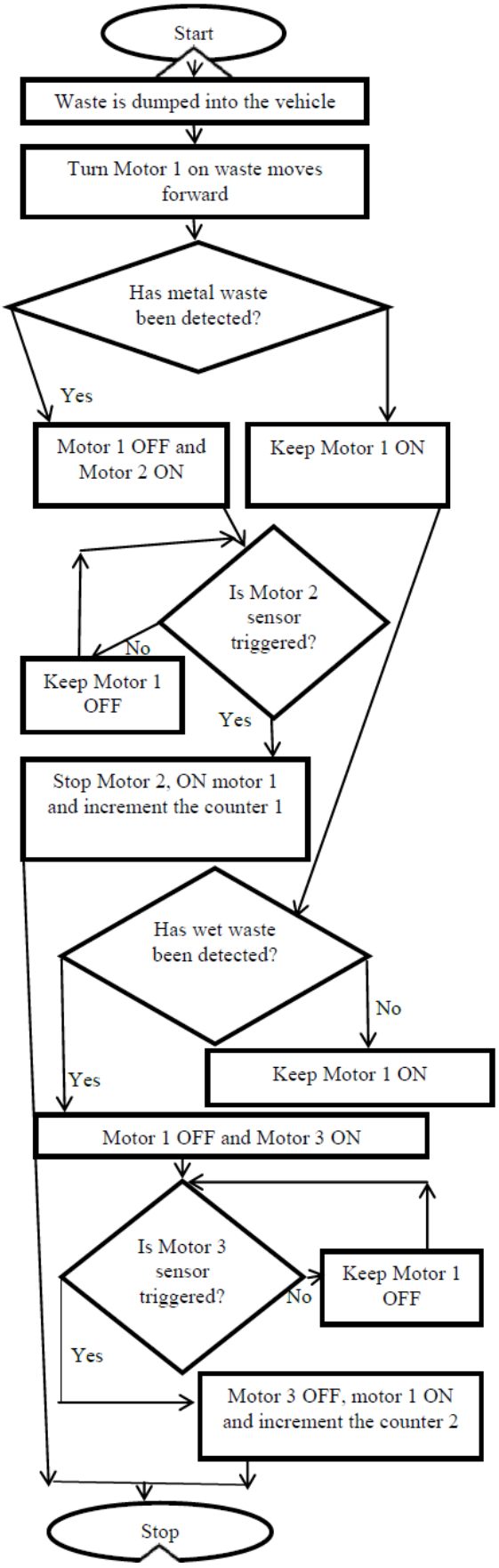

Fig 2: *Flowchart for waste segregation*

Separation plays a crucial role in the complete management of waste. Studies reveal that majority of the population living in both urban and rural areas do not segregate waste as they find it inconvenient. After collecting the garbage, it is usually dumped into the truck. Segregation can be performed at this stage in the truck. To implement this system we require Arduino UNO, IR Sensor, Metal sensor, Moisture sensor, DC Motor, Liquid Crystal Display, Motor Driver Circuit, and Arduino IDE.

The conveyor belt starts moving once the waste enters the conveyor belt and the sensors are switched on. Arduino UNO receives input from the metal sensor, moisture sensor, and the motor sensors used to set up the segregators. Finally, we separate the waste into various bins. In the proposed system, M1 is motor driving the conveyor belt, M2 is motor driving the segregator to put metal waste into the bin, M3 is motor driving the segregator to put wet waste into the bin.

When the waste enters the conveyor belt from the inlet, the motor is turned on and the conveyor belt starts moving. All the motors, sensors and the microcontroller, are turned on. Proximity sensor is used to sense the waste, detect if it is a metal or no. If the waste is found to be metal waste then M1 is turned off and M2 is turned on and the waste is pushed into the metal waste bin. The counter 1 is also increased (keeps a count of a number of metal wastes dumped). If the waste is non-metallic, M1 will be left on when it comes into touch with the moisture sensor that decides whether the waste is a wet waste or a dry waste by detecting the waste's moisture content. If there is some moisture in the waste material, it will be identified as wet waste and M1 is switched off and M3 is switched on and the waste is driven into the wet waste bin. Also, the counter 2 is incremented (keeps a count of the number of dumped wet waste). If a wet waste M1 is not kept on, the waste will be dropped into the dry waste bin at the end of the conveyor belt. The waste is finally separated by falling into the corresponding bins and completing the segregation process.[4]

5. CONCLUSION AND FUTURE WORK

At present, waste is a major problem faced by the society. In this paper, we have presented a framework for smart waste management. With the help of IoT waste collection and segregation has moved to the next level. Smart waste management is a move towards automating manual waste collection and detection in nature. It is efficient, automatic segregation and information about garbage level in the smart dustbin is a time saving process than the currently employing method in which concerned municipal employee has to check for the filled waste bins manually across different areas/streets for checking regularly whether the waste bin is filled or not. Total number of trips carried out by garbage collection vehicles will decrease. Thus the overall expenses related to collection of garbage will be reduced. It will prevent the overflow of dustbin and help in keeping the environment clean and neat. It will reduce the wastage of cost, energy and time of the people and help in reducing the occurrence of any disease. The collection and segregation of trash is therefore made more effective.

The scope for future work is that this system can be implemented with the time stamp where the real-time clock will show the person who is concerned the time when the dustbin is full and when the garbage was last collected. This proposed system can be implemented on a large scale as well with some modifications. The process of separation can become simpler by using a robotic arm along with a conveyor belt and more sensors could be used to segregate biodegradable and non-bio-degradable waste, plastics, recyclable waste, e-waste and medical waste [5]

6. REFERENCES

[1] Himadri Nath Saha, Supratim Auddy, Subrata Pal, Shubham Kumar, Shivesh Pandey, Rakhee Singh, Amrendra Kumar Singh, Swarnadeep Banerjee, Debmalya Ghosh, Sanhita Saha,"978-1-5386-2215-5/17/$31.00 ©2017 IEEE Waste Management using Internet of Things (IoT)", Industrial Automation and Electromechanical Engineering Conference (IEMECON), 2017 8th Annual, At Bangkok, Thailand.

[2] Sunil Kumar , Stephen R. Smith , Geoff Fowler , Costas Velis , S. Jyoti Kumar , Shashi Arya , Rena , Rakesh Kumar and Christopher Cheeseman,"Challenges and opportunities associated with waste management in India",published on 22nd March 2017.

[3] Shobana G, Sureshkumar R,"AUTOMATED GARBAGE COLLECTION USING GPS AND GSM ",International Journal of Pure and Applied Mathematics Volume 118 No. 20 2018, 751-755 ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version).

[4] Arunkumar Balakrishnan Iyer ,"Arduino Based Automated Waste Segregator Final Year Project",October 20,2018.

[5] Kesthara .V, Nissar Khan, Praveen .S.P, Mahesha .C, Murali .N,"Sensor Based Smart Dustbin for Waste Segregation and Status Alert",International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS) Volume VII, Issue IV, April 2018 | ISSN 2278-2540