Green & Smart Bin with Compactor and Waste Management: A Review

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Abstract— Paper and plastics are the major source of waste in commercial areas or inside industries. Because of low weight and large volume, it inhabits a large space of waste bin which is a reason to fill the bin earlier than it should be. It causes money and time wastage as well as pollution. It impacts the healthy environment of cities in the form of air pollution due to the large movement of the garbage collecting vehicles. In this paper, we proposed a plan to solve this problem by creating a smart bin by following the green technology (Solar power source). With the help of different sensors (ex. Level sensor, fire sensor, touch sensor, etc.), compactor and Infrared (IR) wireless connectivity with the control room. We will create a chain system of waste transportation. In the whole process, we will ensure the participation of citizens. The level sensor will detect the level of waste inside the bin. When a certain level of bin achieved then the compactor will activate and compress it to the possible depth. By this process, it increases the space (up to 70 percent) inside the bin so transportation activity decreases in the area which causes to decreases the pollution level. As India is ready to welcome the modern smart cities so it will play a vital role in solid waste management.

Keywords: Smart Bin, Wireless Connectivity, Sensors, Compactor

I. INTRODUCTION

IoT was introduced many years before. It solved many critical problems regarding waste collection. There are many research papers published related to waste management, control, and connectivity solution of bins. However, still human being is not stoppable to find a solution and every time improvement should be welcomed and we proposed a unique smart bin and waste management system. Generally, when we observe the nearby sites like malls and commercial areas in cities, the large number of plastics and paper waste. People throw the after use plastics and papers in the bin. N. Sharma Says "The improper disposal of municipal waste can generate a serious and dangerous impact on large areas. Garbage thrown in the road or in open spaces creates a public health hazard, while waste dumped near rivers, lakes, and streams contaminates the water supply [1]."

We are living in an era where industrial resolution is at its peak new technologies introduce time to time so the amount of waste generation also increasing. Inside the industries, there are many components that are imported from vendors and dealers, packed in the rappers which are either plastics or paper. When these components are used then no one care about that waste in form of plastics and paper. Due to the bulky property of plastics and papers, the bin filled much more quickly than it should be. Since the bins are filled quickly so waste management vehicles will come to pick it many times in a single day which may cause environmental problems.

A. Medvedev introduces Intelligent Transportation Systems (ITS) that enable new services within Smart Cities. Efficient Waste Collection is considered a fundamental service for Smart Cities. Internet of Things (IoT) can be applied both in ITS and Smart cities [2]. L.A. Guerrero aims to determine the stakeholders that have an interest in the waste management system of cities under study and the factors that influence the efficiency of the system in three continents [3]. E Al-Masri says that waste management systems can identify sources of defilements and remedy this by bringing mindfulness to the public or hand out fines to prevent defilements from occurring [4].

Mufeed Sharholy studies that about 90% of MSW is disposed of unscientifically in open dumps and landfills, creating problems for public health and the environment [5]. D. Hoornweg talks about the present situation, the volume of the generation of municipal solid waste is increasing at a very fast rate due to increase in population, industrialization, and change in habit and lifestyle of urban population [6]. Gulson soni makes a comprehensive survey of various proposed approaches for smart bin systems such as Smart Garbage monitoring system, Wisely waste segregation system, and Smart Waste Collection System. It proposes a framework for smart garbage Management System (GSM) that can be deployed in metro cities [7]. The waste collection process is a critical aspect of municipal corporations and service providers. The traditional way of manually tracking the wastes in bins is a complicated process and utilizes more human power, time and cost which is not compatible with present-day technologies.

II. PREVIOUS WORK

There are many papers published related to smart bin and waste management. M.R. Mustafa introduces a design and increases the smart green environment of trash monitoring system by measuring the garbage level in actual time and to alert the municipality whenever the bin is full [8]. V.K Kurre introduces a project in which they place a sensor (Infrared sensor/proximity sensor) under the dustbin. When the sensor signal reaches the threshold value, mail notification will be sent to the respective Municipal Corporation [9]. R.R. Sabat says that The main purpose of the smart eco bin is to instead of lobbing the waste material like cold drink bottles, plastic material and used papers here and there we can drop it in the eco bin device as the outcomes of that we will get a clean, green and healthy environment [10].

Nesreen Alsbou set a goal to overcome all the difficulties in handling waste through designing a smart trash bin system that is not only cost-effective but also environmental friendly. The whole system operated by solar energy attached to the lid of the primary bin, thus making it an environmentally friendly system [11].

M. Kalpana proposed a System in which there are multiple dustbins placed in the city or the Sites, the

information of the trash bins and the area details are stored on the server. This information about the trash can be accessed by the concern specialists from office and immediate action can be complete to clean the dustbins [12]. Hitesh Poddar introduces an Assimilated Podium for Waste Management where smart bins are equipped with a network of sensors and they conduct tangible time data indicating the fill percentage of the bin. As per the status of bin route optimization can be performed which increases the efficiency of fuel and time [13]. S.R. JinoRamson creates wireless link class and the surface level attainment between the system reading and manual reading has been compared and studied. Based on the obtained results the identified system can be applied eminently for solid waste management [14].

The info related to the trash removal is sent to the respective area truck driver about the location of the field trash bin. If the trash can is not replaced at the right time, the microcontroller set at the trash can intimate the information to the central office once again. Due to the quick disposal system of bin, chances of disease can be minimized [15]. Theodoros proposes a top - k query-based dynamic scheduling system to address the challenges of near actual-time scheduling driven by sensor data streams. An Android app with a user-friendly GUI is introduced to the public and presented in order to provide feasibility and to evaluate a waste collection scenario using experimental data. Finally, the proposed models are evaluated on imaginary and real data of city waste. [16].

Shilan Abdullah Hassan tells about a smart solid waste control and collection system which sends a signal to the control center which will have the level of trash in the containers and through GSM/GPRS, a message will send to the mobile phone of the truck driver of which waste bin is full and need to be empty. The system consists of smart containers or smart bins, each bin or container installed with Arduino Uno, ultrasonic sensor and Radio Frequency, the transmitter on the top of the container. When the container is full of trash [17]

Many times, in our city we see that the garbage bins or dustbins placed at public places are overloaded to avoid all such situations implement a project called IoT Based Smart Garbage and Waste Collection bins [18].

III. PROPOSED WORK

After observing the current issues of solid waste management we proposed this paper to overcome these problems. It will be more advanced, smart and organized for previous works.
In this paper, we have worked on three module

1) Smart bin
2) Transportation system
3) Data management of waste

This Bin contains four sensors a) Level sensor b) Temperature sensor c) Touch sensor (condition-based) d) Weight sensor. We are inserting a touch sensor so that bin opening remains closed during the no-use condition. Since we are also installing a compactor and a solar panel on the top of the bin since its lid will not open so we insert the trash opening on the front side. The power requirement for all this process will be fulfilled by the solar system to reduce the pollution of the environment.

People will be connected with waste collection authorities with mobile app and websites where they have to register themselves as a customer. The information of all bin inserted in a specific zone will be distributed in two ways one with Central Data Base (CDB) and another with garbage collectors.

All data like Bin filling time, the mass of garbage, collection time, etc. will be recorded in the data center. For future plan and estimation, we could retrieve the data stored in the data center computers' memory.

The garbage truck will be guided and track by the data center so that it can work error-free.

We can also put some advertisements on the wall of the bin to encourage the people towards cleaning.

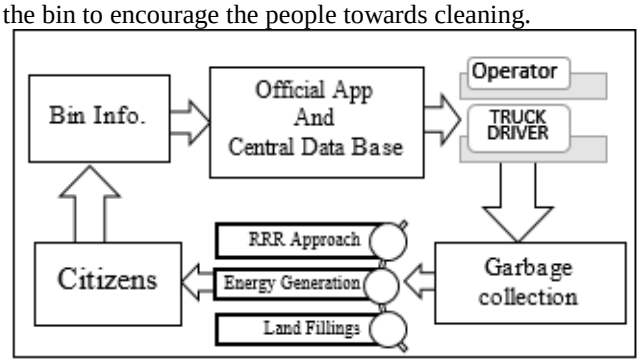


Fig. 1: block diagram for waste collection cycle

IV. ESSENTIAL COMPONENT AND WORKING

A. *Sensors*

There are four sensors used in this bin.

1) *Level Sensor*

The three-level sensor is inserted at the bottom medium and top level. These sensors sense the garbage level and share info with the compactor module. On the front side, there is a digital display that will show the fill level.

Ultrasonic level sensors are used to detect the levels of sticky liquid substances and bulkiness materials as well. They are worked by producing audio waves at the range of frequency from 20 to 200 kHz.

2) *Temperature Sensor*

It will be inserted inside the bin when it feels temperature greater than a certain temperature then it will pass the information to the central database and start the alarm.

3) *Touch Sensor*

Low power consumption Power supply for 2 ~ 5 V DC. It is used in the bin to open the mouth shutter of the bin. The open mouth of bin may harm people because compactor is used in this bin. It helps the bin mouth to remain closed during no use condition. If we touch it will automatically be opened.

4) *Weight Sensor*

This sensor measures the weight and sends the data to the central database. This sensor is only used to record the data amount of trash collecting in a day or month basis.

5) *Wi-Fi Module*

Wi-Fi Module: 802.11b/g/n protocol, Wi-Fi Direct (P2P), soft-AP, Integrated TCP/IP protocol stack. Wi-Fi Module helps us to send the details of the dustbin at the receiver side [18].

B. Compactor

The compactor is used to regain the imaginary volume occupied by the plastics and paper trash. When the controller receives the information from the level sensor then it will start and compress the trash at the lowest level. By this process, it will create up to 75% space.

It will help to reduce the amount of waste transportation inside the city and industrial areas which tends to reduce the environment pollution by less movement of garbage trucks

We also care about the safety of workers for this compactor movement will be controlled by a hand detection safety sensor. As well as it detects the hand in the path of the compactor, the compactor will stop & return back to the initial position.

C. Solar Panel

The solar panel will be inserted on the top and the battery back-up will be at the bottom of the bin so that the no extra equipment required. A solar panel helps to make the system green and to reduce pollution. It provides the power to the sensors, compactor and communication module. The compactor is the major power consumption device in this system.

100W 12V solar panel is enough to provide the required power and also it is cost-effective. Dimension (Approx.) 666 (W) x 1006(H) x 35(T) mm

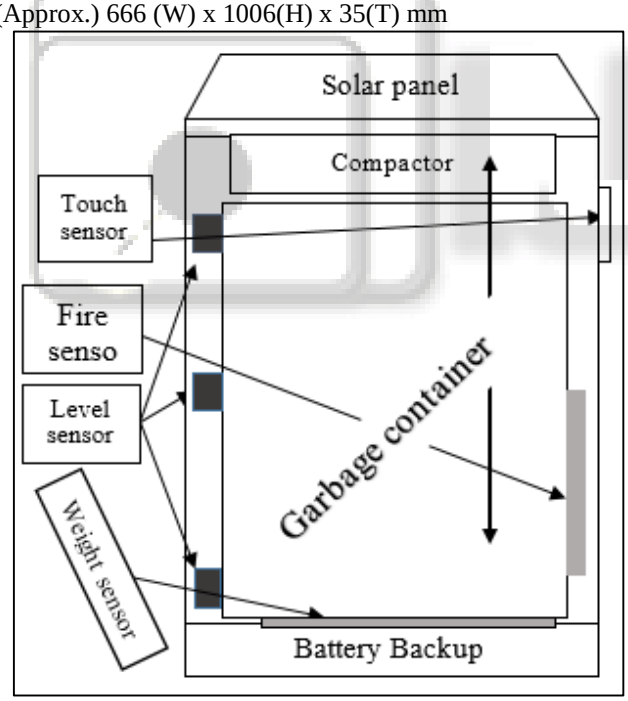
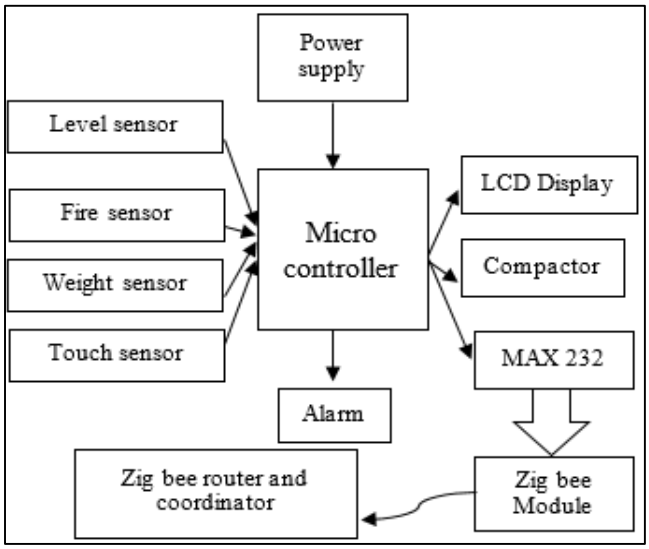


Fig. 2: Block diagram of smart bin components

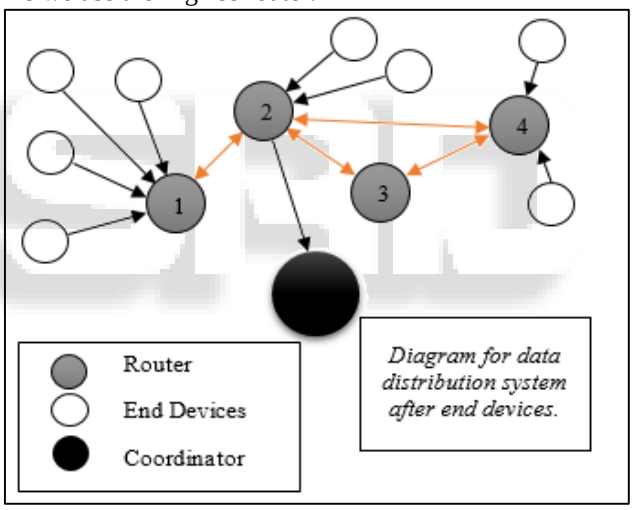
D. Communication Module

Sensors will be inserted between the outer cover and the main container. When these sensors sense any incident related to their working then it sends the information to the microcontroller where these data will manipulate according to their requirement.



The compactor will work on a feedback sensor that helps to stop the compactor when any hand movement in the path is observed then MC will suddenly stop the compactor and send it back.

ZigBee end device will be in sleep mode during no information transfer mode. To increase the working range of bins we use the ZigBee router.



As we will have wireless connectivity throughout the area. To engage more with people we will divide the whole city into different zones and create a unique WhatsApp group for each area. As we have manpower available so we can utilize it in different ways. What public has to do is that they have to register themselves online portal where they have to select the type and amount of waste (solid waste or wet waste) and now they have to send their location on respective WhatsApp group. As the massage will be posted on group the waste-collecting vehicle will approach their home and pick the waste for this process they have to pay some amount of money. Every house or flat profile will be created to maintain online waste information. People can see their status of waste. By this process, we will generate Door-to-Door waste collection

V. CONCLUSION

Due to industrialization and urbanization, the ways of waste generation by people and industries increases day-by-day. If

we talk about smart cities then we must have a smart management system to tackle problems. In this paper, we have tried to cover the solution related to waste collection, Waste management and solve the problem of large area connectivity. By following this process, we can reduce the human effort with bin and reduces the volume of waste up-to 70 percent by the compacting process. It ensures the less movement of garbage vehicles inside the city and industrial areas which help to decrease the air pollution. This well-designed communication system will help to achieve the waste collection, management and disposal. Also, with the help of recorded data, we can estimate future planning. The recorded like weight, Timing of bin fill, etc. will help us to make a special plan (like new bin installation, No. of vehicles) for a specific region where large waste is generated.

VI. FUTURE ENHANCEMENT

As now, we have a well-designed communication system to connect the whole city. By using the same communication line we can install the Flow sensor nearby drainage and connect with a bin communication line. It will help to decrease the investment of a new communication line. We can use blockchain technology to enhance the participation of people. A blockchain will help to reduce the cost of waste collection.

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