

Collection of Garbage using Internet of Things

N. Ganesh, R.C. Narayanan



Abstract: Due to rise in population, the waste disposed by human has become enormous. This paper deals with a real time practical application of designing and building a prototype for an automatic opening and closing of dustbin on the detection of the human intervention who wish to throw out their trash. In this system the level of garbage in the bin can be known by the use of sensors. Each dustbin has a unique ID. If the garbage in the bin reaches the threshold level, the garbage collectors are given information based on which they can collect the garbage. In case the dustbins reach threshold level, user will not be able to access the bin. In order to avoid the decaying smell around the bin the harmless chemical sprinklers are used. Further, the garbage is segregated into bio degradable and non-biodegradable wet and dry waste using a conveyor belt. Internally electric oven burns the dry waste and the ashes are used for certain applications such as in cleaning the pond and in preventing the growth of algae in the pond water. The wet wastes are made to decompose and it acts as a fertilizer to the fields. The plastic wastes collected are used in building plastic tar roads.

Index Terms: Internet of Things, Smart Dustbin, Garbage, Conveyor belt, Material handling, Arduino Uno, GPS, GSM, Ultrasonic sensors, Chemical sprinklers

I. INTRODUCTION

In today's scenario garbage overflow and collection of the same has been a major challenge and it results in stinky smell when crossing the bin and this results in air pollution. It creates unhygienic condition for the people and creates bad odour around the surrounding which leads in spreading of deadly diseases. To avoid this situation a Smart Garbage Collector using Internet of Things (IoT) is used. IoT is a concept in which surrounding objects are connected through wired or wireless networks without the intervention of user. IoT objects communicate and exchange information. The novel approach in collecting the garbage using IoT is dealt with. The second part of this paper examines the related literatures. The third part speaks about the research methodology adopted. The fourth part deals with the initial results and the respective findings. The fifth part gives conclusion and future work.

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II. LITERATURE STUDIES

Various ideas and concepts on the usage of smart dustbins were dealt with and such concepts were enhanced with the help of IoT. [1] used the weight sensor and IR sensors. Weight sensors are used to know the weight of the bin regularly and IR sensors to send status of the bin regularly. The level sensors are also considered as one of the criteria to determine the threshold levels. [2] gave an idea of using GSM as a module for communication (that is to send text message to the garbage collectors in the message format) instead of using the internet. Information about using GPS for the collectors to track the bins location is claimed [3]. In this the camera and the laser is used for the detection of the level, which is not reliable. [4] uses three different levels of threshold which means three ultrasonic sensors are used which may be costly. [16] shares the information about using the Liquid Crystal Displays (LCD). [16] speaks about the usage of LCD display in the garbage bin wherein the LCD is connected to a server and the status of the bin is known in advance. [17] deals with an idea of implementing smell sensors in the bins.

III. METHODOLOGY

As it is a new initiative to build a smart village, the proposed system consists of multiple dustbins that are placed at specific places of the Vellanoor village, Near Avadi, Chennai. These dustbins are provided with sensors. Each dustbin is given a unique ID. Ultrasonic sensors are used for automatic opening of the lid for a maximum span of 15 seconds and will get automatically closed, if not accessed for the said time frame or if 75% of the dustbin gets filled out. Level sensors and weight sensors are used to detect the level of the bin. Level sensor used here is ultrasonic sensors. Weight sensors are used to detect the weight of the bin. The level of bin can be tracked using these sensors. To avoid the decay smell, the smell sensors are used to detect the decay smell. Using the motor driven chemical sprinkler, a cost effective chemical like baking soda are sprinkled. GSM module is used to send information. The information sent will be in the format of text message. Such messages are intended to be sent to the garbage collectors when the garbage in the bin reaches the threshold level of 75% of the garbage collector, if filled. The garbage collected will be of both dry and wet waste. The dry and wet wastes are segregated using a conveyor belt. The wet waste materials are handled in a separate cabin available in the bin and it is used for application such as manure. The dry plastic waste material is handled separately and it can be mixed with tar for placing plastic roads. Once the threshold levels are reached, the user will not be able to access the bin and the lid will remain closed.

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The message sent contains unique ID, location of bin, level of bin and the amount of chemical such as baking soda available in the container. The Short Messaging Service (SMS) is sent at two levels - when the bin is 3/4th full and a remainder with complaint to the concerned higher authorities after 5hrs of the intimation. Liquid Crystal Display (LCD) is used to display status of the bin and a beep sound if garbage is not collected on time or if there is some malfunctioning.

With the help of IoT, a smart dustbin is created which reduces the pollution caused due to the overflow of the dustbin. Ultrasonic sensors are used to detect objects (in this case Human). Ultrasonic sensors measure the distance to or the presence of a target object by sending a sound pulse, above the range of human hearing, towards the target and then measuring the time it takes the sound echo return. Knowing the speed of sound, the sensor determines the distance of the target. When the user who wants to throw garbage into the places the hand near to the sensor (within 10centimeter) the lid of the bin opens automatically. After the user throws the garbage into the bin, the bin automatically closes within 15seconds. If the lid gets open more than the prescribed time limit, there is a chance of crow or other animals to get into it or breeding of mosquitoes can occur. Further, if the bin becomes full, due to the availability of sensors, the lid remains closed and makes the user to move to the next bin. The current scenario is known whenever garbage bins are crossed a foul smell is experienced. To avoid this smell sprinklers is used. When the smell sensors detect the decaying foul smell the chemical sprinklers sprays a chemical (like baking soda, coffee beans and lemon) to avoid the foul smell. Baking soda is helpful in removing many of household odours. It is of low cost and is easily available. Baking soda does not produce any odour, it just absorbs the odour. It does not have adverse affect on human. Though there will be no direct contact of human with the chemical. The next concept used is in setting of the threshold levels. Ultrasonic sensors are used as the level sensors. Weight sensors are used to determine the weight of the bin. When the garbage in the bin reaches 3/4th level, the information is send to the garbage collectors to replace the bin on time. The access is cut at the 3/4th level to avoid the damage of the kit, which is located at the inner side of the lid. The access o the bin is stopped by breaking the circuit. It is designed in such a way that if the garbage collectors did not replace the bins within the stipulated time frame, a warning message along with complaint will be sent to the higher authority. A text message is sent using GSM (Global System for Mobile). The message sent contains the Unique ID of the bin so that it is easy to identify the location of the bin and the amount of Chemical Sprinklers available in the bin will be shared. GSM is a digital mobile telephony system. GSM uses a variation of time division multiple access (TDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. There is a LCD placed in the server room where the status of the bin is displayed. When the garbage is not collected on time or if there is some malfunctioning (i.e. if the sensors are disturbed. Or due to various reasons the lid is not able to close or open. Or if there some breakage of bin)in the bin there will be a beep sound along with display on LCD so that required action can be taken and repair the machine.

The kit used is arduino kit which is an open source electronics platform based on easy to use hardware and software. Arduino boards are capable to read inputs. Fig.1

displays the work flow of the entire Smart Garbage Collector process.

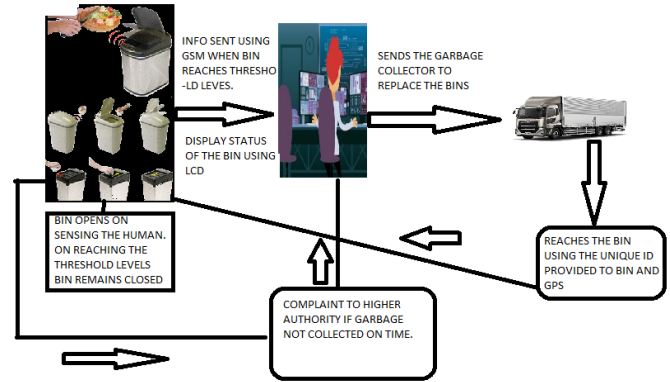


Fig. 1 Architecture of the work flow

If the bin reaches the threshold level, the information is sent (in message format) to the higher authorities through GSM. The authorities send the garbage collectors to replace the bins. The garbage collector with help of the Global Positioning Satellite (GPS) reaches the bin. If the garbage is not collected within stipulated time complaint is sent to the higher authorities so that they can take required action.

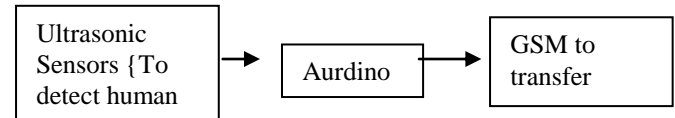


Fig. 2 The Process flow

Fig. 2 explains the process flow of transferring the messages from ultra sonic sensors to the aurdino and the message is passed through GSM. The status of the bin can be viewed or displayed using LCD displays.

IV. RESULTS AND DISCUSSION

The pollution caused due to the overflow of dustbin is reduced. Due to the dustbin lid being closed when not in use there is no breeding of mosquitoes or any insects therefore no spread of diseases. There are also some loop holds in this project. The Ultrasonic sensors may detect objects other than human to avoid the system like image processing can be implemented. Both level and weight sensors are used. If only the level sensors are used as stated in [9][3]. It may be assumed that the level threshold is reached and the bin may remain close. Similarly if only the weight sensors are used as in [1] Other in a heavy object falls into it the bin may remain closed assuming that threshold level is reached. To avoid this situation in our project we have considered both level and weight sensors. [4] shows the usage of ultrasonic sensors. This is a costlier thing to do. Among the three levels, one of the levels is, completely full. This is may cause damage to the kit therefore it is not advisable. In this paper the threshold level used is 3/4th so that there is a gap between the garbage and the kit which is placed in the inner side of the lid. And only one level sensor is used. The ultrasonic sensors are used instead of Passive Infrared Sensor (PIR). [6][11] since ultrasonic sensors are used to detect the objects at a particular specified distance. The arduino kit is used instead of raspberry pi as used in [7][13].

Arduino is a microcontroller it is good at performing repeated task. It is good at using system with many sensors. It is useful to get real time application with low power constrains.

V. CONCLUSION

Using this smart dustbin the pollution due to overflow is reduced to an extent. 100% can be achieved with the cooperation of human beings. Segregation of waste can be done within the dustbin at the source level. The garbage can is segregated into wet, dry, and metallic waste using electronic conveyor belt and wet sensors. The burning of non-biodegradable waste (like sanitary napkins, few plastics) within the garbage bin can also be implemented.

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