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Waste Management Through Smart Bin

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***Abstract*:- In this paper, we present the Waste Management through Smart bin system that looks for the amount of waste in the bin. Dustbin containers are used for collecting the household as well as human society waste from all around the world[1][2][9]. Our system is designed such that it continuously collects real-time data to maximize the operational time and deliver this data through a wireless mesh network. The Smart-bin system was tested in an outdoor environment. The collected data from the dustbin was applied with sense-making methods to obtain refined utilization of our smart bin. It also gives the daily seasonality information to the Municipal Corporation which enables them to make better & organized collection for recyclable, organic, and plastic waste. Human society disposes of a variety of waste materials daily and mainly this waste is categorized as dry waste, plastic waste, recyclable waste, sewage wastes, domestic wastes, etc. Our project focuses mainly on outdoor dustbins placed outside every corner of the street and societies that maintained by the Municipality. Household dustbins are used to collect wastes of a particular family, later that collected waste is disposed into the common dustbins of society. Since waste in roadside dustbins are not monitored and collected properly most of the times, hence our main motive is to efficiently organize and manage outdoor dustbins for a clean and hygienic environment**

Keywords - (US) Ultra - Sonic, (IR) Infra-red, (IOT) Internet Of Things, (Wi-Fi) Wireless Fidelity, (CP) Capacitive Proximity,(LCD)Liquid Crystalline Display,(VCC) Voltage Common Collector,(CH-PD) (DC)-Direct Current (AC)-Alternate Current

I. INTRODUCTION

Traditionally, litter bin's waste are collected at fixed intervals by the cleaning staff and the segregation of waste cannot be done properly. With the traditional method there were several drawbacks such as: **(1)** In a heavily populated region bins fill up

much faster rate. Fixed schedule of waste collection leads to overflow of waste. This creates hygiene risk and environment pollution. This happens because there is no flexible waste collection schedule in our current system.**(2)** There is a need for escalated collection intervals of waste in the special periods (i.e. festivals, weekends, holidays) since

there is an extra load on litter bins and they fill up very quickly. **(3)** Till now we are using Mechanical ways of segregating different kind of waste (i.e. dry, wet organic, plastic) **(4)** Usually the light weight waste at the top of dustbin flows out of it, which again creates a mess. This creates a challenge to maintain a clean and hygienic environment in the city. Several factors are involved in management of this waste such as collection authorities at different level, stakeholders, financial/economical, collection team & transport, etc. The work proposed in this paper illustrates how the Smart-bin solution empowers cleaning operators to detect cleanliness issues in real time. Thus, the system is able to help in increasing overall productivity, optimizing cost and contributing towards cleanliness of environment. Smart Bin are used for collecting garbage, and sense the waste level in the dustbin. These self sensible dustbins are equipped with variety of sensor such that it can send vigilance memorandum to the Corporation, so that the concerned authorities make the arrangements to coordinate the pickup of waste from the dustbin The aforementioned concept is achieved using real-time systems, & sensors, where data will be collected , then processed in real-time. the acquired information is used to extract related knowledge that becomes the key in tackling inefficiency and proper optimization of resources.

II. LITERATURE SURVEY

The implementation of smart garbage bin is an idiosyncratic idea. Our aim for designing smart garbage bin is achieved by using *IR* Sensor, *US* Sensor, Motor, *CP* Sensor, and *Wi-Fi* module for real time transferring of data. We reviewed and examined various papers which deals with the concept of smart bin. In our initial phases briefing us of different methods which were proposed for waste scraping and management in different research papers. Paper [1] put in the picture about the different methodologies and making advances towards basic nuances in *IoT* and describes the detailed functionality of *IoT*. This gives a general thought of building an application identified with data that executives over web. A review of the idea for joining client application with IOT [2] and manages nitty gritty portrayal about versatile examination and overseeing data from Sensor. It summed up the recent advancements by world foremost innovators in field of developing *IoT* Standards, big data management and versatile analytics, providing standards for open source platforms for developing *IoT* applications. To understand this vision of IoT we should guide one's consideration toward various difficulties in the area that we have sketched out in this paper. Tending to these noteworthy difficulties requires both global coordinated effort and high effect working-applications. Another procedure was presented in this paper and actualized for a dream of a Smart City with great waste administration accomplished through IoT [3], The dynamic planning idea required for the cleaning of dustbin occasionally and the Top-k query lead us to need-based cleaning of dustbins. City Garbage Collection Indicator utilizing RF (Zigbee) and GSM innovation [4]. In the proposed framework utilizes RFID to recognize a specific dustbin. It distinguishes the dustbin fillings utilizing US Sensors and utilization of GSM to caution the specialists.

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FA Graphical User Interface is proposed in [5], which can show the present status of the dustbins. No effective ready framework is available since it sends all the alarms to a similar individual

III. RESEARCH GAP

In traditional system all type of waste were collected in a single/split dustbin leading to a large portion of mixed unsorted plastic waste along with organic and inorganic waste. Since these waste gets mixed up , processing and segregation becomes difficult. Apart from that this system improves the percentage of segregated waste and also save time and money in terms of collection of waste from the dustbin. In our society, most of the dustbin get overfilled easily because of no proper management of waste and irregular cleaning of the dustbins. Proposed model not only eliminates these problem by sending alert to cleaning authority when dustbin is filled by 75% but also also provide individual user based data that restrict throw of waste after dustbin is filled by 90%.

IV. PROBLEM DEFINITION

With a proper user based data it would be easy to track down the kind of waste littered by individual or a society. In the described model we have utilized a sensor for downpour water. It detects water and naturally shuts the entryway if there arise an occurrence of any downpour.[9][11][13][14][15]

Domestic wastes are disposed by people in the roadside dustbins which leads to random filling of these public dustbins. Continuous human work force is required in monitoring of bins and control the overflow level of the dustbin. This is because sometimes in specific areas the dustbins fill up faster due to the various factors like festive season, overload, etc. People are forced to dispose their wastes outside the bin in case if the dustbins overflow. The situation gets worse in the monsoon when rain water enters the dustbin, leading to decomposition of waste by bacteria and insects releasing bad odor. So as to forestall this mayhem by forestalling flood of waste and to evade individuals disposing their wastes outside the container. Our proposed model of smart bin system, therefore have the potential of detecting overflow and wastes thrown around the bin. This is done with the help of a buzzer which beeps to make the people stop from disposing the wastes outside. With this it also alert the authorities regarding pickup of dustbin in case of overflow above 75 %. In addition, a water Sensor is available which recognizes water and consequently shuts the entryway in the event of downpour.

V. SENSOR DETAIL

A. *ULTRASONIC SENSOR*

The *US* sensors[7][8] sense the distance between the closing lid of the Smart Bin and the level of waste present in it . The continuous recorded data by the *US* sensors is sent to the *Wi-Fi* module through the Arduino Uno. real-time data from **Smart bin** *US* **sensor** transmitted through wireless module to a Smart Waste Management application platform. We are using *Wi-Fi* Module but it can be improvised more by using 2G and 3G telecommunication modules. The US sensor detects the distance between the waste level of the bin and the lid of the bin through a transmitter and receiver.

The below mentioned calculation demonstrates the conversion of distance to fill percentage used in the design:

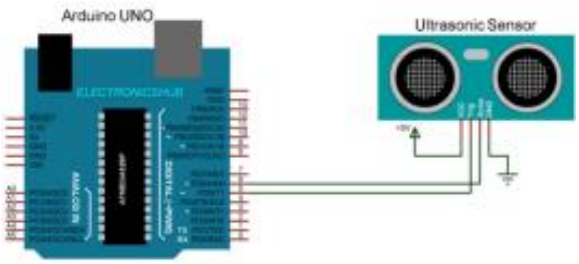
$$V_t = V_o + N^* T$$

Where, V_t is **velocity of sound** at **temperature.**
V_O is **velocity of sound** at 0^O **C**
T is the **Temperature.**
N is **rate of change of velocity** with per degree rise in Temperature.

Distance(d) = (V_t * Time) / 2

Where, **Time** is the ping time from sensor

Percentage Filled = 100 – (100/l) * d
Where, **l** is the **height of the Bin.**



Block Design

B. *Aurduino*

Arduino is an open-source project, PC gear and programming association, attempt, and customer bunch that plans and produce miniature regulator packs for building customized gadgets and savvy object that can distinguish and control inquiries in reality. Automation, for the entire system i.e the self functioning is achieved by using an *ARDUINO UNO* board. The board itself acts as the brain i.e the CPU(Central Processing Unit) to the entire apparatus. It controls the various interaction and synchronization of the sensors. A small device known as the *Wi-Fi / GSM* module is used along with the *Arduino Uno* board to provide an internet connectivity to the system and help in transmission of data in real time.**[17]**

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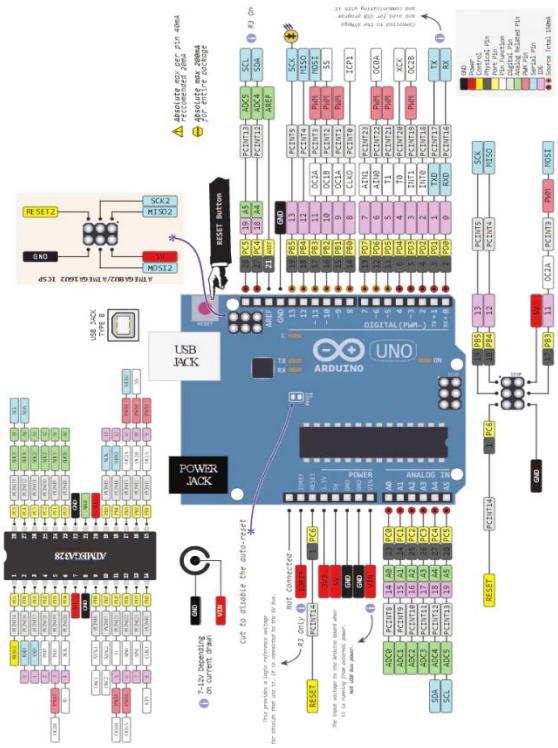


C. *ESP8266(Wi-Fi module)*

Wi-Fi or Internet access will be given to our projects by ESP8266,which is knows as *Wi-Fi* module . It is a very cost efficient device but it will expand the capabilities of our projects making it very powerful. *Wi-Fi* module can communicate with any kind of micro-controller and helps us in making the projects wireless for remote access & arduino is among the most leading transmitting devices in the IOT platform. Arduino runs on a power supply of 3.3V and it will get damaged if 5V is supplied. The *Wi-Fi* module ESP8266 has 8 pins; to enable the *Wi-Fi* in Arduino UNO,

Figure 1

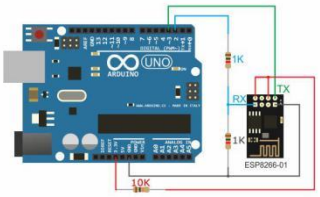
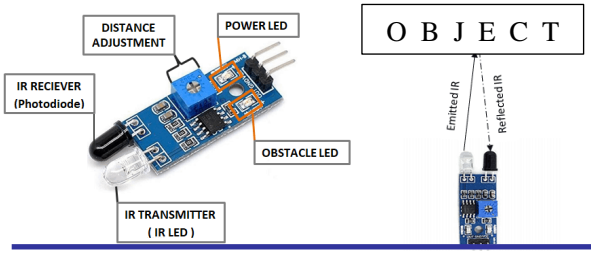


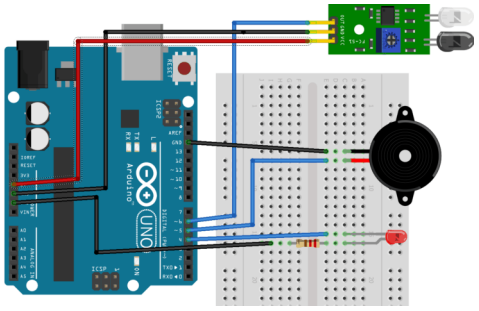
Figure 2

the *VCC* and *CH-PD* will be connected to the 3.3V . The TX and RX pins of ESP8266 will be responsible for the communication of ESP8266 with the Arduino. We have to make a voltage divider since the RX pin works on 3.3V .The above mentioned figure shows the WiFi module and its Schematic Connection with Arduino

D. *Infrared Sensor*

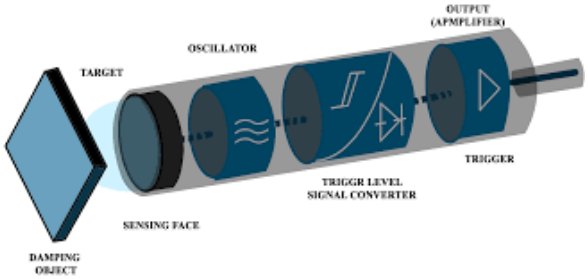


Infra-red sensor is used basically for two tasks, firstly it is used to detect any wastes that is disposed around the dustbin and secondly to detect the presence of user around the bin. If an object is near the range of the bin, the infra-red sensor detects it and triggers i.e switches ON the buzzer. In other scenario it helps us in detecting the user at time they are nearby and want to throw waste**[16]**.The below mentioned figure shows the detailed descriptive image of *IR* sensor, its working in terms of detection of object, & how its is connected to an Arduino Board.

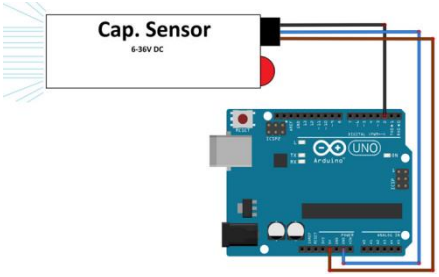


E. *Capacitive Proximity Sensor*

There are two types of Capacitive proximity sensors. The one used in our prototype produces electrostatic field unlike the inductive ones. This helps in recognition of metals as well as nonmetallic materials. [12]For eg. glass, paper, and



wood. The mechanism is dependent on the dielectric constant of the object. Therefore, materials with larger dielectric constants are easier to detect than the material with lower dielectric constants. The sensors generate an electrostatic field and their sensing surface is formed of two metal electrodes of an unwound capacitor. The shown figure shows the connection of Capacitive Proximity sensor to an Arduino Board



F. *Servo Motor*

A servomotor (or servo motor) is a simple electric motor. It is controlled with the help of servomechanism. In a DC Servo Motor controlled device is associated with a servomechanism with a DC supply . If AC operates the controlled motor, it is known as a AC Servo Motor. A servo motor is a self-contained electrical device, that rotate parts of a machine with high efficiency and with great precision. It operates on a 4.8*V* to 7.2*V* with a rotation of 0º to 180º. In

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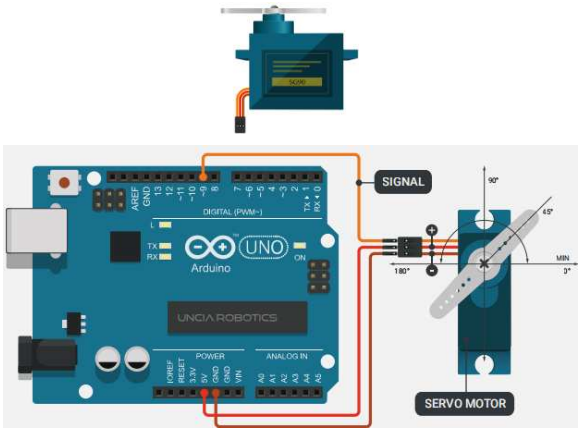
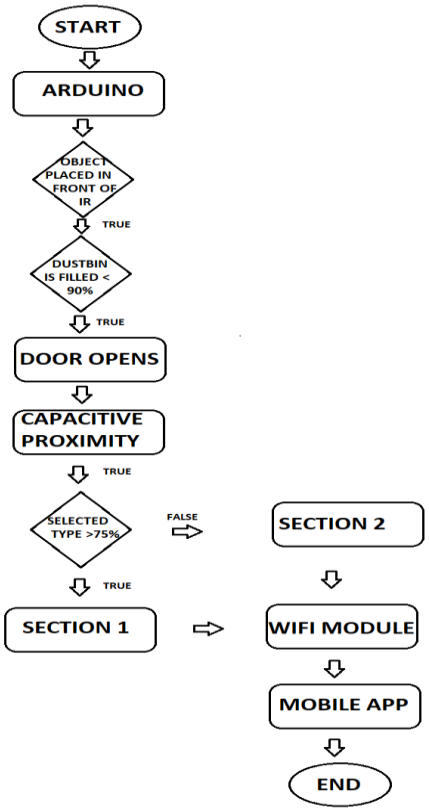
Vol. 9 Issue 09, September-2020

our proposed design we have used servo motors for two things. First to open the lid of the dustbin in case a user approaches the dustbin and is triggered by an IR sensor. The second use of servo motor is to open the sub containers in the dustbin as per the kind of object that is placed in it. Its high precision helps us to prevent an open container in case of rain. Shown below is the servo motor SG90 that is used in our project and its connection to Arduino board.



G. Real Time Analysis

The main idea of our smart bin lies on the fact that we can continuously monitor data in real time from each and every container. This gives us a broader picture on how to mange the routine pickup of garbage from the bin making it more efficient and cost effective. Each and every sensor continuously transmit data through Arduino Board which is then received at our *Wi-Fi* module which sends data directly to our waste management app. The algorithm shown below shows the complete mechanism of our smart bin in real time.

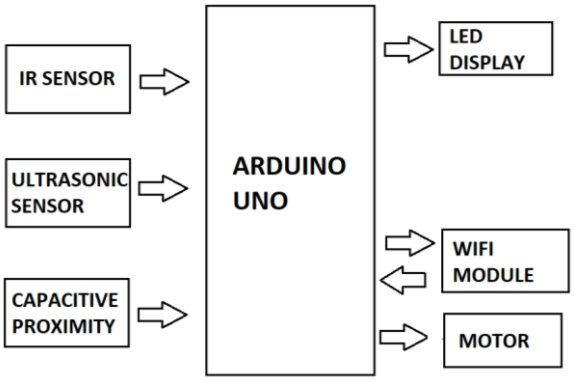


VI. WORKING MODEL

With the use of Arduino board and the sensors we automate the function of normal bin making it a smart bin. The *IR* Sensor helps in identification of any user near by and opens the lid of the bin. It also detects if the user has thrown any waste nearby and in that case it triggers the buzzer. When the user places the waste in the bin, with the help of Capacitive proximity sensor the smart bin is able to identify the type of object placed in the bin i.e plastic paper glass etc. The *Wi-Fi* module triggered from the Arduino board and send the real time data to Mobile apps analyzing the amount of waste that is placed in the bin by a particular use. With the help of the other ultrasonic sensor and IR sensor the amount of waste level in the bin is calculated. As soon as it reaches a particular level set by the governing authorities it send notification to the Municipal Corporation for immediate cleaning of bin.

The display unit on the Bin indicates the fill percent of the bin and in case if the user drops any waste around the bin the ultrasonic sensor identifies it and triggers the buzzer enabling user to pick up the waste around it making a clean environment. The rain sensor later in monsoon and in the high rainfall region gets triggered when the rain falls on the bin and closes the lid of the bin tightly restricting any foul smell or hazard inside the bin.

VII. PROPOSED ARCHITECTURE



VIII. SCOPE & MOTIVATION

A. Scope- Benefits To Society

The designed model of the smart bin is capable of identifying the status of the amount of waste and regulates the collection schedule with the concerned authorities which results in a reduction of cost and time to manage the waste. With access to an Internet Connection, real-time data from the smart bin which gives the measure of the amount of waste can be accessed at any point in time. This data gives an advantage to authorities, by enabling them to schedule the waste collection when it is needed making it a more optimized, resourceful and cost-efficient method of waste management

B. Motivation-

Cleanliness and hygiene are one of the most important things cherished by all human beings in the

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society[10]. In order to have a clean environment , we must reduce the improper waste disposal methods in unclean places and make them tidy and neat by proper waste management. Dustbins are often very unhygienic & filthy since it is filled with wastes of different kind and it spreads foul smell around it because of open containers. Our motivation for the project came from the fact that we should design a dustbin which maintains a fresh and untarnished environment around it. Later we should also reduce the huge cost and resources that is required to pick up the useless waste. This also helps in protecting the composure and serenity of the environment by making a healthy and happy surrounding. This project could help in those areas with high population density and areas with limited resource of garbage collection. Also with the proper segregation we have a better idea towards a proper management of plastic which is the biggest evil of mother earth

IX. CONCLUSION

Innovative progressions have influenced individuals in pretty much every part of their lives may it positive or negative.We have made some amazing progress in improving the day to day environments in our general public. As time passes, increasingly more accentuation is being given to business related to the correct administration of waste since it involves 2.01 Billion tones of waste created yearly. In the development of smart cities like Tesla Town by Elon Musk, the main focus is on the fact of conserving resources and utilitarian of renewable resources of energy producing minimum waste. This could set an example that could be demonstrated throughout the world. Moreover, population explosion and increased urbanization in city as well as country side has resulted in ever increasing levels of waste generation. An average person in the world produces 0.56~0.74 kg of waste. The customary waste administration plans are not proficient enough to deal with such a lot of waste. They are not under any condition in accordance with how the waste administration plan of a Smart city ought to be. The time and the utilization of innovation is made in this segment to make squander the board plans deserving of a smart city and productive enough to deal with the ever-expanding levels of waste. The waste management strategy proposed in the paper effectively uses IOT technology to develop a strategy much swift and far more systematized than the existing one. This paper would not just give a superior methodology towards squander the board yet in addition fill in as a support to other people, to additionally investigate this part and grow more hearty, financially feasible, and deliberate techniques later on with the guide of innovation. This, thusly, would make the urban areas cleaner, and the world a more healthier spot to live in. A prototype of the proposed design of the Smart Bin container required for the recommended elective for squander the executives methodology was actualized effectively. With appropriate commitment and support from the compelling individuals in the field, it is exceptionally conceivable to-form this model into a fully functional model.

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