IoT Based Self Navigated Dustbin Dispensary System for Smart Cities

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***Abstract*- Population of the world is increasing day by day and the environment should be kept clean. Garbage overflow creates unhygienic environment and it creates bad smell. This will lead to illness and deadly diseases. To avoid such situations, it is required to implement a system that monitors and depart the garbage. This project purposes self navigated dustbins provided with sensors interfaced with PIC16F887 microcontroller for smart cities. Ultrasonic sensor is placed in the dustbin to monitor the garbage level and IR sensor are used to detect the obstacles while automatically navigating. When the level of the waste in the dustbin reaches the threshold limit, messages are sent to the concerned authority through GSM and also the dustbin will navigate automatically to certain distance and dispatch the wastes and it will come back to its position. This system not only saves time but also the man power.**

***Keywords*: Dispensary System, PIC16F887, IoT, GSM, Waste management.**

I. INTRODUCTION

Cities around the world are facing great challenges due to increasing urbanization and one of the major challenges is the rising amount of generated wastes. Public bins are filling up faster than ever and inevitably many of the bins end up overflowing before being collected, by the municipal authority. This causes not only cluttered streets and bad odors but also negative health and it has environmental impacts. The outcome of the overflowing garbage is air pollution, which has direct impact on humans by causing various respiratory diseases and other adverse health effects as contaminants are absorbed from lungs into other parts of the body. The wastes should be dispatched at the right time before it gets overflowed and for that steps must be taken accordingly. Managing the garbage is time consuming process and requires a lot of efforts. Due to insufficient time and efforts, we see overflowing bins. Here, in this system dustbin will be located at the streets and will be provided with ultrasonic sensor which keeps tracking of the level of waste and when it reaches the threshold limit, the dustbin will start to navigate automatically. In its way, it detects the presence of obstacle with the help of IR sensor. The status of the dustbin will be sent as messages to the concerned authority through GSM module. The dustbin will be programmed to move certain distance where the place of main dustbin is located. The dustbin will navigate automatically to that distance and dispatch the waste and it will return back to its position. So that concentration of collecting the waste can be done at the main dustbin.

II. LITERATURE SURVEY

[1], Maher arebey used RFID,GSM &GIS for solid waste monitoring and management and for tracking the vehicle position. however, this model is only used for monitoring and lacks in controlling of the solid waste.[2] M A Hannan proposed the concept of waste monitoring system integration based on “RFID, GPS & CAMERA” ,without any involvement of the truck driver. It consists of RFID tag mounted on the bin, FID reader as truck module, GPRS/GSM as web server, IS as map server, database server & control the station server.

[3-5],Dr.N.Sathish Kumar and S.Vinothkumar have developed a smart intelligent garbage alert system for garbage clearance by giving an alert to the municipal web server for instant cleaning of the dustbin and it is aided by ultrasonic sensor with ARDUINO UNO to check the level of the garbage filled and sends the status to the municipal web server and with the help of RFID tag the driver confirms the emptying of the garbage. The SMART E-DUSTBIN by Chinmay Kolhatkar,involved e-mail to notify about the garbage level, chip MCU ESP8266 platform to transmit the data wirelessly, the proximity sensor to detect the obstacle, ultrasonic sensor to detect the level and a led to display the situation of the dustbin. Recently,[6-8] Sangita S.Chaudhari presented a system which is equipped with low cost embedded device involving dynamic scheduling, routing and cloud based system for organizing waste management. Hitesh Poddar and pooja devi,presented an integrated platform for waste management where smart bins are equipped with a network of sensors and they transmit real time data indicating the fill percentage of the bin. The large amount of data collected can also be used to gain insights about the waste generated across the cities.

III. DISPENSARY SYSTEM

This proposed system of garbage management consists of a single bin instead of two bins. Implementation is done with the help of IoT concept. The Internet of Things (IoT) is a concept in which surrounding objects are connected through wired and wireless networks and without user intervention, the objects can communicate and exchange information.

In this system multiple dustbins are located throughout the city or the Campus, these dustbins are provided with a sensor which helps in tracking the level and a unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. When the level of the bin reaches the threshold limit, the device will transmit the reading along with the unique ID provided.

After that the dustbin will move for dispatch the excess waste to the particular navigated place .Once the bins are full then user will not be able to access the bins. The status of the bin is accessed by the concerned authorities from their place with the help of Internet and an immediate action will be taken to replace overflowing bins with the empty bins.

The Fig.1 shows the block diagram of dispensary system .In this, components used in the Smart Dustbin System are Power Supply, IR sensor, Motor, Using GSM Module. IR is connected in dustbin and it is used to detect the level of dustbin whether the dustbin is full or empty. Here we are using 4 different Ultrasonic sensors. The Working of Sensors can be explained with the following conditions.

1. Dustbin full 90% (when all four level sensor gives output).
2. Dustbin is heavy when threshold level of dustbin is crossed (IR sensor gives output).

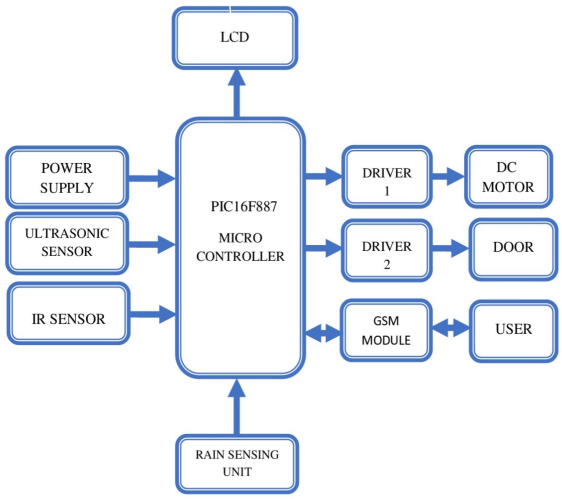

Fig.1.Block diagram of the proposed system

The coding for the proposed system is done with the software application called MPLAB IDE and the simulation is done with the proteus software.

- **MPLAB IDE**

MPLAB Integrated Development Environment (IDE) is a software program that runs on a PC (Wi to develop applications for Microchip microcontrollers and digital signal controllers. It is called an Integrated Development Environment because it provides a single integrated "environment" to develop code for embedded microcontrollers. MPLAB X IDE brings a host of features to enhance the debug experience during the design phase of the project.

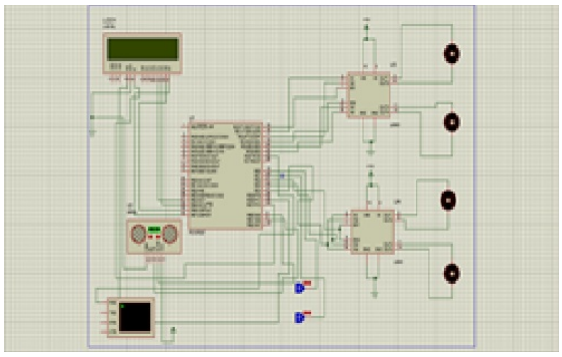

Fig.2.Simulation for the proposed system

IV. HARDWARE ANALYSIS

- *PIC16F887 Microcontroller*

PIC16F887 is a 40-pin and 8-bit CMOS PIC Microcontroller that comes with nanoWatt technology. Economical price and user-friendly architecture make this device easy to use and easy to configure.This PIC version, like other models in the PIC community, contains everything that is required to make an embedded system and drive automation.The PIC16F887 incorporates 256 bytes of EEPROM data memory, 368 bytes of RAM, and program memory of 8K.Apart from self-programming capability, it also contains 2 Comparators,10-bit Analog-to-Digital (A/D) converter with 14 channels,and capture, compare and PWM functions.

Fig.3.PIC16F887 Microcontroller chip

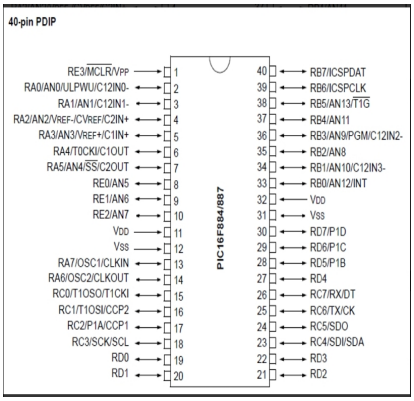

Fig.4 .Pin diagram of PIC16F887

The figure above shows the pin configuration of PIC16F887 Chip. This powerful yet easy-to-program CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 40- or 44-pin package. The PIC16F887 features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 14 channels of 10-bit Analog-to-Digital (A/D) converter.

- *LCD Display*

LCD Modules can present textual information to user. It s like a cheap monitor that you can hook in all of your gadgets.They come in various types. The most popular one is 16x2 LCD ModuleLCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.The LCD display is used for displaying the status of the dustbin.

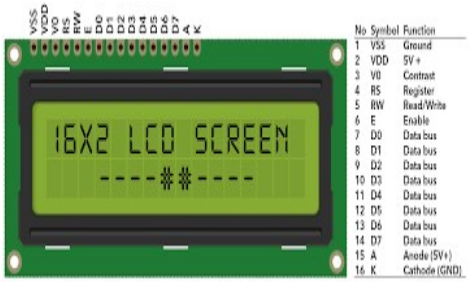

Fig.5. 16×2LCD Display

- *DC Motor*

In any electric motor, operation is based on simple electromagnetism. A current carrying conductor generates a magnerticfield ,when it is placed in external magnetic field, it will experience a force proportional to the current in the conductor and to

Fig.6.DC Motor

the strength of the external magnetic field. Like polarities repel each other and unlike polarities attract each other. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current carrying conductor and an external magnetic field to generate rotational motion. Here DC motor is used to open and close the top door of the dustbin when the level of waste is filled, to open and close the side door of the dustbin to dispatch the wastes and to move the dustbin automatically to certain distance.

- *Battery*

An electric battery is a device consisting of oneor more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work.

Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to additionally include devices composed of a single cell.

Fig .7.Battery

- *IR Sensor Module*

The basic concept of IR(infrared) obstacle detection is to transmit the IR signal(radiation) in a direction and a signal is received at the IR receiver when the IR radiation bounces back from a surface of the object. The IR obstacle sensor is used to used to detect the presence of obstacle in its way while it is moving in its path to certain distance.

Fig .8.IR Sensor Module

- *Rain Sensing Unit*

The rain sensor module is easy tool for rainfall detection. It can be used as a switch when raindrop falls through the rain board. This module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer. The analog output is used in the detection of drops. It works in 5v power supply. By using rain sensing module when rain drops falls on the board, the top door of the bin closes automatically

Fig. 9.Rain Sensing Unit

- *Ultrasonic Sensor*

Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic sensors measure the distance to the target by measuring the time between the emission and reception. An optical sensor has transmitter and receiver, whereas an ultrasonic sensor uses a single ultrasonic element for both emission and reception. In a reflective model ultrasonic sensor, a single oscillator emits and receives ultrasonic waves alternately. This enables miniaturization of the sensor head.

The distance can be calculated with the following formula:

Distance L = 1/2 × T × C where L is the distance, T is the time between the emission and reception, and C is the sonic speed. (The value is multiplied by 1/2 because T is the time for go-and-return distance.).

Fig .10.Ultrasonic Sensor

- *L293D*

L293D is a typical motor driver or motor drier IC which allows DC motor to drive on either direction.L293D is a 16 pin IC which can control a set of two DC motors simultaneously in any direction. The operating voltage is of 12V. The power supply is provided externally by the battery.

Fig .11.L293D(Driver Circuit)

- *GSM Module :*

GSM (Global System for Mobile communication is a digital mobile network that is widely used by mobile phone users in Europe and other parts of the world.GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technology. It is used to sent the status of the dustbin to the authority.

Fig 12. GSM Module

IV. RESULTS AND DISCUSSION

All the hardware modules are implemented in real life dustbins as shown in Fig.13 that demonstrates the garbage level. As the ultrasonic sensor measured a distance greater than20 cm it gives the signal to PIC Controller and finally PIC instructs the DC motor to close the lid of the dustbin. Therefore the automatic closing of lid helps to reduce the garbage overflow and spreading of diseases . After reaching a threshold level the following message is sent to the corresponding authority. GSM Module plays a key role in sending the message .As the ultrasonic sensor measured a distance greater than 20 cm indicating filled up fully, the DC motor closes the lid of bin and a message is conveyed. Now the dustbin will completely close and will not open until the bin is cleared. The dustbin is programmed to move a certain distance, where the place of main dustbin is located. As soon as the messages reaches the corresponding authority, the dustbin will navigate automatically to certain distance and dispatch the wastes and it will come back to its position.

Apart from that additional rain circuit is also

included in this present model which senses rain and immediately closes the top door to avoid contamination of wastes. The IR sensors are placed infront of the bins to detect the presence of obstacles. If it detects any obstacle over its path it waits there until the obstacle gets cleared. Then it moves forward. Now the PIC instructs the DC motor to open the side door to dispatch the wastes. After few seconds the side door gets closed and top door gets opened .finally the dustbin returns back

Fig 13.Smart Dustbin

to its original position. Therefore it is evident from the above results that the present concept of self navigated dustbin dispensary system is verified and also follows the proposed algorithm. Further the present model also demonstrates that along with intimation to the corresponding authority, it also provides additional facilities to dispatch the wastes. If the only message is sent, the authority should immediately come and collect the waste. But it is not a good idea. So the present model offers an advantage of automatic dispensary system. Fuel efficiency will be a concern in our model and the bin will provide authority more time to pick the waste. This system not only saves time but also the manpower.

V. CONCLUSION

The proposed waste management strategy effectively uses technology to develop a much smarter bin than the existing one. The garbage bins located throughout the city is proposed with features like resource optimization, cost reduction and as well time management which in turn saves the manpower.

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