Automatic BinBot - Garbage Collecting System using IoT

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***Abstract*— The world today faces major garbage crisis-the product of rapid economic growth, poor urban planning, overcrowding, corrosive corruption and political dysfunction. The present tried and tested methods of garbage collection in residential areas have so far been done with Municipal solid waste workers (MSWWs). MSWWs universally expose too many work related health hazards and safety risks, notably allergic and other diseases of the respiratory system. Hence to overcome this major problem of waste collection, BinBot (Automatic Garbage Collecting robot) is developed. It facilitates the smarter way for garbage collection automatically from houses in the Residential areas and intimates the municipality about the BinBot status to collect the garbage when it is filled. This would be helpful for the "Swachh Bharat" (clean India) by 2019, India's real garbage challenge.**

Keywords – Arduino UNO, IoT Module, RFID, Ultrasonic Sensor, IR Sensor

I. INTRODUCTION

Garbage is the major problem not only in cities but also in rural areas of India. It is a major source of pollution. Indian cities alone generate more than 100 million tons of solid waste a year. In 2000, India's Supreme Court directed all Indian cities to implement a comprehensive waste-management programme that would include household collection of segregated waste, recycling and composting. These directions have simply been ignored. The ultimate need of the hour for a developing nation is the key for "Smart City". The influential ecological factor that poses to be a threat to this may include: hazardous pollution and its subsequent effects on health of humanity, alarming global warming and depletion of ozone layer etc. It is perceived that often the waste space gets too much occupied due to irregular removal of garbage occupancy in the dustbin and also for the regular removal of garbage from eery house daily. Even though there are many existing systems that solve cleaning and monitoring common dustbin but there is no proper method for the disposal of garbage at every house daily. When the human is not at home it is very difficult to dispose the household waste while the MSWW'S come to collect the waste. So this proposed system would facilitate disposal of waste at every house in the absence of human. This System consists of two bins that are home dustbin and the moving dustbin (BinBot). This smarter way of garbage collection facilitates the automatic garbage collection from
house by the BinBot (Moving dustbin) by moving in the predefined path and facilitate disposal using IoT. When robot read the RFID from RFID tag in dustbin at each resident it stop moving, collect the garbage and after collecting it proceed in further houses. The robot movement is controlled by programming the Controller. When the IR sensor encounters the obstacle, it stops moving wait until obstacle is removed then proceed its function. The garbage level is sensed by the ultrasonic sensor, on reaching maximum level it stops moving and using Internet of Things it intimate the municipality for collecting garbage.

II. METHODOLOGY

In this paper, the design of Automatic BinBot uses engineering method. In sequence, the method is identification of the needs required. Then these needs are analysed to get specific components. These components are later integrated to get the desired output.
The dustbind are categorized into two types

i) Home Dustbin
ii) Moving Dustbin

The operation of the robot can be classified into two main categories.

a) Garbage collection
b) Intimating disposal of garbage.

A. *Home Dustbin*

Home dustbin is for the people to throw their household wastes. Dustbin is interfaced with RFID and door opening mechanism. It is kept placed in a stand at certain height from the ground in front of every house. RFID enable interaction between home dustbin and moving dustbin. Ultra sonic sensor would indicate when waste in it reaches the maximum level. Door opening mechanism disposes the waste when it is interfaced with BinBot.The communication berween home dustbin and moving dustbin are also facilitated by the transmitter and receiver for effective respose.

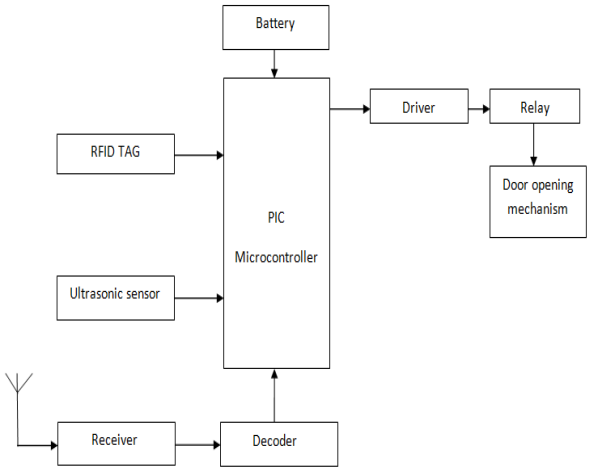

Fig 1: Block Diagram of Home Dustbin

B. *Moving Dustbin (BinBot)*

Moving dustbin contain Ultra sonic sensor, IR sensor, RFID reader, transmitter also interfaced with IoT module.

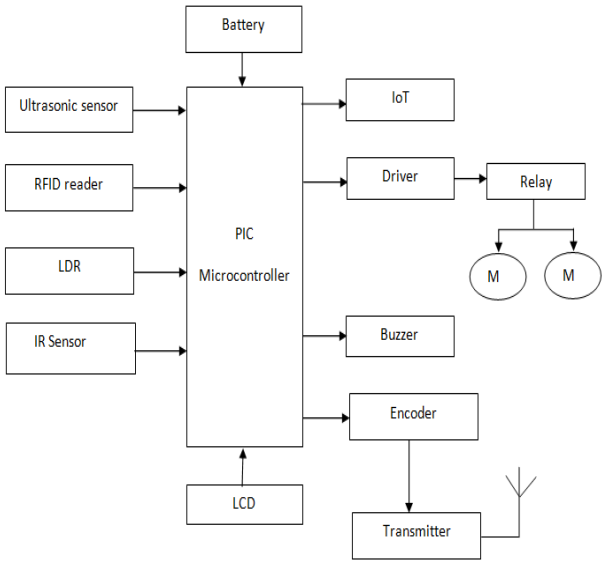

Fig 2: Block Diagram of Moving Dustbin (Bin Bot)

III. WORKING PRINCIPLE

Moving dustbin (BinBot) move along the defined path at the corner of the street (by line following mechanism). When BinBot comes closer to the home dustbin RFID reader reads the data from the RFID and stop moving then Bin Bot transmit data to home dustbin through the transmitter. After receiving the data about the arrival of BinBot it enable the door opening mechanism to dispose the waste to Bin Bot. After waiting for some time BinBot starts moving and continue this process at every house.

When BinBot comes in contact with any obstacle it detects it with IR sensor it stops moving and wait until the path is cleared. Garbage level in the BinBot is sensed by Ultrasonic sensor. If the garbage in BinBot attains the maximum level it stop moving and intimate municipality to collect the garbage. Also the BinBot status is sent through IoT for collecting garbage by municipality workers.

IV. HARDWARE USED

A. *MICROCONTROLLER*

PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in PIC 16877 is flash technology, so that data is retained even when the power is switched off. Easy programming and erasing are other features of PIC 16F877. PIC16F877A microcontroller is used in the project.

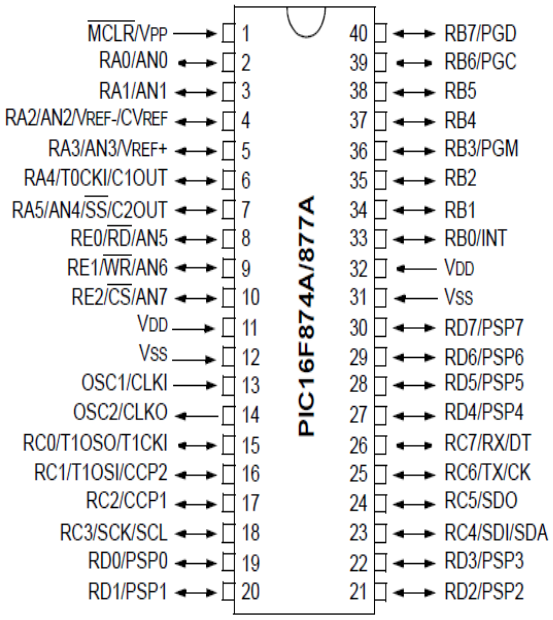

Fig 3: Pin Diagram of PIC16F874A

B. IR SENSOR

IR TRANSMITTER:

An IR LED' also known as IR transmitter, is a special purpose LED that transmits infrared ray in the range of 760nm wavelength.

Fig 4: IR LED

An IR LED' also known as IR transmitter, is a special purpose LED that transmits infrared ray in the range of 760nm wavelength. Such LEDs are usually made of gallium arsenide. The appearance is same as a common LED. Since the human eye cannot see the infrared radiations, it is not possible for a person to identify whether the IR LED is working or not, unlike a common LED.

IR RECEVIER:

An IR led is operated in forward bias just like any ordinary led. When it is in reversed biased condition if there is no light falling on the diode it will decreased and TX. The basic sensor circuit will be as follows

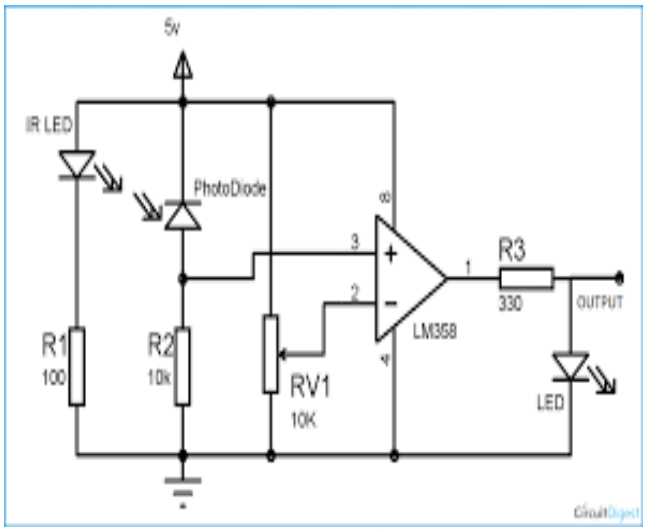

Fig 5: Circuit diagram of IR receiver

When the sensor is placed in front of a white surface the light emitted from led gets reflected on to diode so the photodiode act as a short circuit. So the voltage at the output will be almost equal to 0v in case of black body or space then no light falls on the diode so it will act like an open circuit. So voltage at output will be almost equal to 5v.

C. ULTRASONIC SENSOR

Fig 6: Ultrasonic Sensor

WORKING PRINCIPLE:

Ultrasonic ranging module offers a 2cm - 400cm non-contact measurement function, the ranging accuracy could reach up to 3mm. The building modules includes ultrasonic transmitters, receiver and control circuit.
The basic principle:

(1) Making use of IO trigger for at least 10us high level signal

(2) The Unit inevitably sends eight 40 kHz and detects whether there is any pulse signal back.

(3) If any of a signal is received back in a high level, time of high output IO duration is the time from sending ultrasonic signal and receiving it back.

Test distance = (high level time× velocity of sound (340M/S) / 2

OPERATION:

Here electrical energy is transformed into sound to send the pulse. The sound that is received back is converted into electricity. Thus the time lag between the sent and received sound signal is used to estimate the distance to the object. Spacing between sensors is dogged by their beam angles. The sensors must be spaced so that they do not interfere with each other. This interference is sometimes referred to as "crosstalk". The target should be mounted perpendicular to the axis of the sensor.

D. LDR SENSOR

Light dependent resistors (LDRs) are light sensitive often used in circuits to detect the presence or level of light. They can also be described as photo resistor, photo cell or photoconductor. They provide large change in resistance for changes in light level. LDR resistance values can be several mega ohms in darkness and it fall to few hundred ohms in bright light.

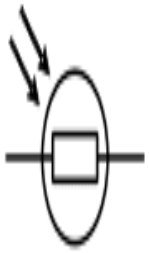

Fig 7: Symbol of LDR

Many semiconductor materials are used, but popular material for these photo resistors is Cadmium sulphide (CdS).

E. RADIO FREQUENCY IDENTIFICATION

RFID is an ellipsis for radio frequency identification. In brief RF stands for "radiofrequency" and ID owes to "identifier"; which allows an item, for instance a library book, to be identified, accessed, stored, reprogrammed and communicated by the aid of radio waves. Radio Frequency Identification (RFID) is a generic term that refers to the non-contacting technologies that makes use of radio waves to spontaneously identify people or objects. Several methods of identification are available, but the most common technique is to store an identical serial number that recognizes a person or object on a microchip that is committed to an antenna. The combination of antenna and microchip are combinely referred to as "RFID transponder" or "RFID tag" and it work in combination with the "RFID reader". An RFID system comprises of a reader and one or multiple tags. The radio frequency (RF) energy is transmitted with the aid of Reader's Antenna. The tag will then modulate the electromagnetic waves generated by the reader will be then modulated by the tag in order revert back to compiled data to the reader. The modulated waves that have got converted into a digital data will be received by the reader.

RFID TAG:

RFID tag is a tiny device that stores and forwards the data to RFID reader. They are characterized in two types – active tag and passive tag. Active tags are contains an inherent internal battery and do not demands power from the reader. Stereotypically active tags have a longer distance range than passive tags. Passive tags are slighter and lighter in dimensions than that of the active tags. They do not contain an inbuilt battery and thus they look upon RFID reader for its operating power and undoubtedly have a lower range limited up to few meters.

RFID READER:

The radio frequency gets transmitted by the reader when powered ON. When the tag is positioned close to the reader, the RFID tag will collect the radio frequency via the antenna placed inside the tag exclusively. The radio frequency received will be converted into electrical power that is enough for the tag to transmit the data back to the RFID reader. In addition to this, the reader will transmit the tag ID to the external device by a serial communication. A wide range of reader modules are readily available now. The most communal and easy way to use reader is EM-18.This module read the RFID passive tag and shifts the tag ID to the Arduino microcontroller.

F. IoT MODULE -ESP826612E

ESP-12E WiFi module is developed by Ai-thinker Team. core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry -leading ultra low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller. ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement

V. SYSTEM WORKING PROCEDURE

1. Home dustbin is placed in front of every house
2. BinBot moves along the line on the street corner
3. If BinBot comes closer to home dustbin, RFID reader read RFID and start communicating with the help of transmitter and receiver
4. Then home dustbin open the door at the bottom to put the waste into the BinBot
5. After collecting waste BinBot moves along the line and collect from all the house
6. When met with any obstacle, it stop moving and proceed after the removal of obstacle
7. Ultrasonic sensor monitor the level of garbage in BinBot and intimate municipality after reaching maximum level through IoT

VI. RESULT

The proposed system collect garbage in ana effective manner without human interruption. It also facilitates the disposal of collected garbage efficiently using the recent technology IoT

VII. CONCLUSION

This paper gives basic idea about efficient garbage collecting in every house by reducing the workload of municipality workers and enhanced the monitoring system by using the technology of IoT. The Garbage pickup work is physically demanding and when delayed it exposes workers too many occupational hazards. This system eliminates the health hazards of MSW'S while collecting garbage manually. Thus this system comes in handy as an admirable solution in environmental maintenance. In addition to this it also aids to diminish the need for high human intervention in garbage maintenance of the municipality and pollution monitoring system

VIII. REFERENCE

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