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IOT Based Smart Dustbin

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ABSTRACT: Every person in this world throws waste in the form of plastics, wet waste, dry waste and etc. Also, every person looks for a place or a plastic container to dispose that waste, that plastic container is the Dustbin which they look for. Dustbin is a plastic container where everyone can dispose their waste. Dustbin is used as a storage place to dispose waste, but we cannot estimate the exact amount of waste disposed by a society, and the dustbin cannot take more waste as the space should be available in it to take more. We need to know the level of waste in the dustbin and based on that we can intimate people to use the dustbin or not. In this Smart Dustbin project, we have designed a prototype where the lid of the dustbin is opened, on detection of human hand and waste, and the level of waste available inside the dustbin is sent as notification in the form of LED. The main components we used in making this prototype are Arduino, NODEMCU, Servo Motor and Ultrasonic Sensors. The software component is the application named as Blynk which is used to get notification. This dustbin can be a start to Smart Waste Management System where the officials can clean or empty the dustbin which depends on the notification received by them and not waiting for a call from a person of a society who informs the garbage trucks to come and take the waste from them.

KEYWORDS: Dustbin, Smart Dustbin, Arduino, NODEMCU, Ultrasonic Sensor, ThingSpeak, Smart Waste Management System.

I. INTRODUCTION

Dustbin is the storage container used for disposing waste by each and every person in the world. The main thing they look in their surroundings for disposing waste is the Dustbin. Smart Dustbin is just a normal bin where everyone can dispose waste but integration of some hardware components is done for more efficient use of it. Smart Dustbin is integrated with some hardware components such as Arduino, NODEMCU, Servo Motor, Ultrasonic sensors. These components help in opening the lid, on detection of human hand and waste and also sending the notification in the form of LED. The code required to perform the above-mentioned operation is dumped in Arduino and NODEMCU.

II. LITERATURESURVEY

First is the traditional method or the normal use of Dustbin in our daily life. Each and every person in the world disposes the waste in the dustbin and if the dustbin becomes full, he empties the waste inside the bin and again uses the same Dustbin. This is the basic use of a normal dustbin where no components are used, no coding is done and where everything is manual i.e. everything is done by hand. No batteries, no electronic components such as Arduino, NODEMCU are used. Only way of disposal is open the lid of the dustbin and dispose the waste in it and clean or empty it when it becomes full. When the same thing is applied in a neighbourhood or in a colony, the waste becomes more to dispose and if the dustbin is full people start throwing the waste around the dustbin which leads to different diseases. The official who should empty the bin will be irregular in emptying the bin and the waste will be lying in that street for weeks causing unhealthy environment and leading to various diseases. The maintenance of the bin is also not proper where the lid is broken which leads in the overflowing of the waste from the bin. The advantages of using this method of disposal is the waste will be disposed in the bin and emptying the bin is easy as there are no electronic components used. In this method a plastic container storage bin will be present for disposal of waste but this method leads to various disadvantages than being advantageous. The various disadvantages are If the maintenance of the bin is not proper then the bin gets a stinky smell. If the bin is not emptied immediately after it gets full then various flies, mosquitoes and other insects will be around it which leads to a cause of various diseases. If the bin does not have a lid then the waste is overflowed out of the bin causing damage to the environment.

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Fig 2.1 *Traditional Bin*

The second method is the use of dustbin with different segregations like green and blue bins which are placed together or the dustbin where only recyclable waste should be disposed. This method also has the same advantages and disadvantages as mentioned above because this method also does not use any hardware components or any electronic items like the above method. Only the bins are segregated in many types indicating which waste should be disposed in a particular bin.

Fig 2.2 *Different types of Bin*

Fig 2.3 *Different types of bins for different waste materials*

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The third method is the Smart Dustbin which uses electronic components like Arduino, Servo Motor, Ultrasonic Sensor and GSM module. In this the code for opening the dustbins lid and sending notifications to a mobile by using GSM module is interfaced in Arduino and the GSM module. This smart dustbin is an effective and efficient one when compared with the above dustbins. This smart dustbin works in the following manner: The ultrasonic sensor is present at the front side of the dustbin and this sensor is linked to the lid of the dustbin and the ultrasonic sensor to Arduino. The ultrasonic sensor detects human hand and waste when the hand and the waste are placed in front of that sensor and the lid of that dustbin opens and the waste is put into it. There is another ultrasonic sensor present inside the dustbin where the height of the waste inside the dustbin is measured and this distance is sent as the notification using GSM module to a mobile phone indicating that the dustbin is full or not. The advantages in this method are as follows: The waste is stored in a dustbin. Various electronic components are used in this making this dustbin as Smart Dustbin. This dustbin automatically opens the lid of the dustbin upon detection of human hand and waste without being able to touch the dustbin which is very hygienic. This dustbin also sends notifications to the mobile which tells us whether the dustbin is full or not. Considering the advantages and being more efficient than the above two methods this dustbin also has some disadvantages. The disadvantages in this method are as follows: The mobile should have a good signal of a carrier to receive notifications very fast, if the mobile is not reachable or a good signal is not available then notifications sent will not be received and the dustbin will not be cleaned or emptied. Multiple users share the same bandwidth; with enough users the transmission can encounter interference. The radiation is considered to be more harmful than Wi-Fi's radiation.

III. PROPOSED SYSTEM

The proposed method for this smart dustbin is use of Wi-Fi module which is more beneficious than using GSM module. The hardware components used in this method are Arduino UNO, NODEMCU, Ultrasonic sensor, Servo Motor. Now we are going to see each and every hardware component in detail. Arduino UNO: It is a microcontroller board which has fourteen digital input/output pins, six analog inputs, USB connection, power jack, 16MHz quartz crystal, ICSP header, and a reset button. The components such as Servo Motor and Ultrasonic Sensor are connected to this board and the first part code is dumped into this board. After the dumping of the code, the sensors start working according to the code written. When the sensors do not work as expected then the reset button should be pressed so that the code and the microcontroller restart and the sensors start working. This UNO board and 1.0 version of Arduino IDE are the reference versions of Arduino. UNO means one in Italian which denotes the version of the device.

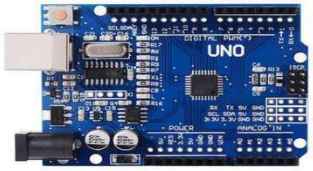

Fig 3.1*Microcontroller Arduino UNO board*

NodeMCU is an open source IoT platform. This is used for making the things work using Wi-Fi. This board includes firmware which runs on ESP8266 Wi-Fi SoC Express Systems and the hardware is based on ESP-12 module. The second ultrasonic sensor is connected to this board and the second part code is dumped into this board. Before dumping the code, in the Arduino IDE the correct board should be selected. This uses many open source projects such as lua-cjson and SPIFFS.

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Fig 3.2 *NODE MCU board*

Ultrasonic Sensor is an instrument which measures the distance to the waste using ultrasonic sound waves. It has a transducer that helps to send and receive ultrasonic pulses based on the object's proximity. It detects the objects and the waste materials.

Fig 3.3 *Ultrasonic Sensor*

The software requirements for this project are Arduino IDE andThingSpeak. Arduino IDE: The Arduino Integrated Development Environment is a cross platform application that is used to upload programs into Arduino Compatible boards. The Arduino IDE supports C and C++ using special rules of code structuring. The Arduino IDE employs the program AVRDUDE to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino Board by a loader program in the board's firmware. This IDE when selected opens a default sketch file where the part of the code is divided into two parts the void setup ( ) and the void loop ( ). Above these two statements the header files and the variable declarations should be done so that the actual code logic and be mentioned in those methods. The setup method has the different variables that are needed to perform the specific operation and the loop method consists the actual logic code. After the code has been written it should be verified and should be compatible to the board that the code needs to be uploaded.

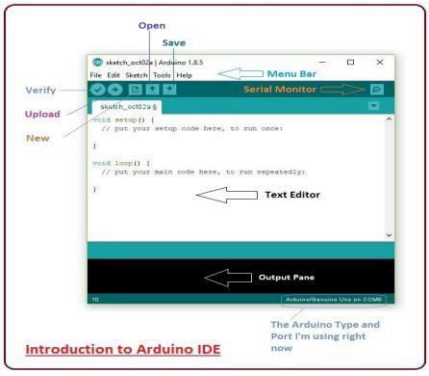

Fig 3.4 *Arduino IDE*

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ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to ThingSpeak from your devices, create instant visualization of live data, and send alerts.

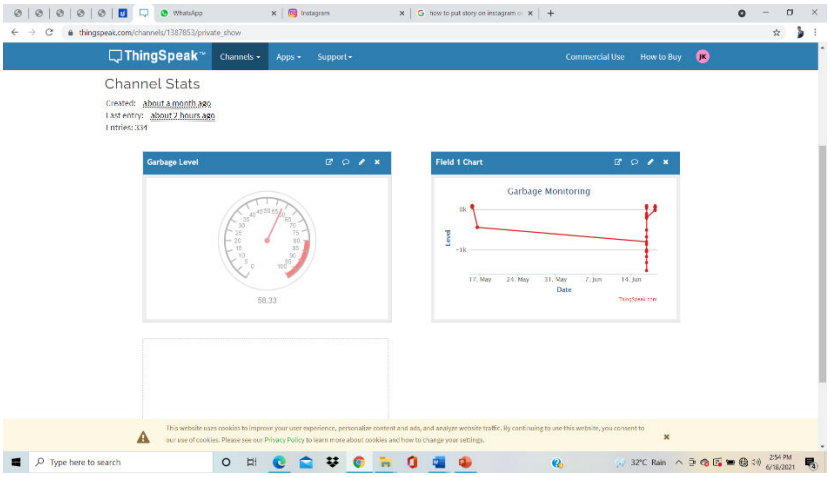

Fig 3.5*ThinkSpeak Application*

The prototype is constructed as follows: Taking a plastic container or a dustbin, placing an ultrasonic sensor at the front part of the dustbin. Another ultrasonic sensor is placed inside the dustbin. The code indicates the notification part which is received on the mobile using theThingSpeak. The first part is constructed as follows: The ultrasonic sensor placed at the front part has four pins named Vcc, GND, ECHO and TRIG. The pin TRIG, pin ECHO is connected to digital pin numbers two and three on the Arduino Board.TheVcc of ultrasonic sensor is connected to 5V of Arduino board. The GND pins are connected to ground on the Arduino board. After the connections are made, the Arduino is connected to the system and using the Arduino IDE the code is dumped inside the Arduino. This ends the connection and code dump for the first part. The second part is constructed as follows: The ultrasonic sensor which is placed inside the dustbin also has the same four pins named Vcc, GND, ECHO and TRIG. In the Arduino IDE the board has to be changed from Arduino UNO to NodeMCU, if the board is not available in the list then we need to install the board from the Boards Manager. In this part the TRIG and ECHO pins of ultrasonic sensor is connected to digital pins D5 and D6 of NodeMCU. The $V_{cc}$is connected to V_{in} of NodeMCU and GND to ground of NodeMCU. This is the connection that is required and now the code should be dumped into NodeMCU. This ends the connection and code dump for the second part.

Fig 3.6 *Construction of front part of dustbin*

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Fig 3.7 *Another ultrasonic Sensors for detecting level of waste inside the dustbin*

4WORKING

The waste is first placed in front of the ultrasonic sensor. The sensor detects the waste and makes the lid of the dustbin to open and the waste is disposed inside the dustbin. This process repeats and goes on like a cycle.

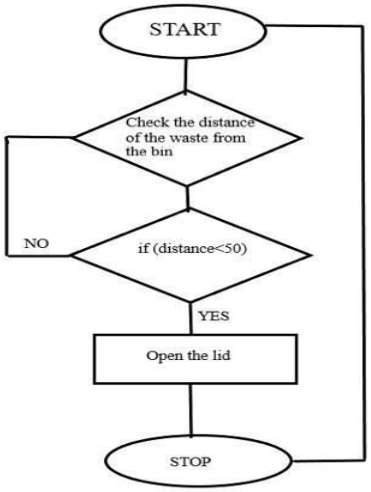

Fig 4.1 *The cycle of the first part of dustbin*

Now the waste is collected inside the bin. The NodeMCU is connected to a Wi-Fi hotspot or a connection that is known by giving its SSID and PASSWORD which are required to connect to a particular network connection. The ultrasonic sensor detects the level of distance of waste inside the bin and is indicated through LED's in the Blynk app. There will be three widgets, each representing a LED. There are three colors: Green LED, This LED indicates that the waste level is very low inside the bin and more waste can be added inside the dustbin. Orange LED, This LED indicates that the waste is half-filled inside the dustbin and more waste can be added into it. Red LED, This LED indicates that the dustbin is full and the waste inside the dustbin need to be emptied. The LED indication happens in real time and also very fast.

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V. ANALYSIS

After observing the working of the prototype, the analysis or the outputs that can be seen are as follows

Fig 5.1 *The notification is indicated by Green LED*

In the fig 5.1 the notification is shown as Green LED, this indicates the dustbin is empty or contains low level of waste and more waste can be added inside it. This LED will remain as it is when the level of the waste increases.

Fig 5.2 *The notification is indicated by Red LED.*

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In the fig 5.2 the notification is shown as Red LEDs are glowing where this indicates that the dustbin is full and the waste from the dustbin is needed to be emptied from it and no more waste can be added inside the dustbin. Red LED will be glowed because the rise of the waste has increased and the distance is also very less between the ultrasonic sensor and the waste. The main advantage of using this method of implementation is the radiation caused by Wi-Fi is very less and particular carrier signal is not required to get notifications. By maintaining the same SSID and Password of Wi-Fi connection between Mobile and NodeMCU board we get the real time notifications

VI. FUTURE ENHANCEMENT

The above method is just a stepping stone for implantation of IOT. There can be many enhancements done for this prototype which can be a revolutionary change in maintaining our environment clean and healthy. The few enhancements can be done are: The implementation of more collective bins placed side by side where it automatically detects the type and waste and places in the correct bin color which is assigned for that type. These dustbins can be placed with a GPS tracker where the dustbins in a particular locality can be located easily and the waste can be emptied. This method can lead to Smart Waste Monitoring System.

Fig 6.1 *Concept of Smart Waste Monitoring System*

VII. CONCLUSION

IOT based Dustbins help the people to manage the waste easily and help them reduce the work of calling or waiting for the specific person to make the area clean and makes a heathier environment to live. They won't be any kind of diseases and the people will be fit and are not prone to diseases caused by these waste materials. The mission Swachh Bharat can also be implemented easily. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. It will take power supply with the help of Battery. If the dustbin is not cleaned in specific time, then the record is sent to the Sweeper or higher authority who can take appropriate action against the concerned contractor. It ultimately helps in keeping the surrounding clean and the waste management can be much easier.

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