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IoT based Waste Management System and Attendance Monitoring of Workers for Smart City Development

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Abstract –*The moto of this paper is to develop an IOT based smart dustbin which can monitor garbage level through sensors and provide conditional data on an Android Application. This bin has an additional feature of attendance monitoring of workers. All the bins are placed at different locations in a region which are connected to a network. Each bin is capable of measuring the level of garbage and monitor the attendance. This information is sent to the cloud server. At server this information is processed and it is sent to the concern authorities to take efficient actions. Compare to conventional methods, the proposed method is different in terms of design applicable to all designs of bins and gives the best performance.*

Keywords: Internet of Things, Cloud Database, RFID, Node MCU ESP 8266, Waste Management.

1. INTRODUCTION

In the progress of smart cities development waste is increasing proportionally with the increase in population and industries in urban areas. The main problem here is to collect the waste in different areas like Residences, Public places, Industries, Markets. With the improper communication and information nearly 90% of total budget assigned is spent on waste collection and transportation [1]. Also, still the method of attendance monitoring of workers in done manually which is a time taking process for the concerned authority. In the survey we found that, each bin will be rechecked whether it is emptied or not. This is a kind of tedious work, which requires a vehicle and person to inspect all the bins in the city. To obtain these all problems, we need a smart system to monitor waste levels and monitor the attendance of workers. This system gives the entire information to the authorities by this we can easily handle manage the waste in a city [2].

The proposed method given in this paper is to measure the level of waste inside the bin and monitor the attendance of workers. Sensors and microcontroller unit are used to collect the conditional data which is to be stored in the cloud data base. From the database information is transferred to android application. This application is usable by general public, which will provide the levels of bins located around the house.

This kind of algorithm implementation monitors all the bins located in different locations and it give the conditional data of bin and provide easy attendance monitoring. Android application will send the notification on mobile.

1.1. Internet of Things

Internet of Things is simply establishing communication between various devices on a medium called Internet. It needs the support of microcontrollers and microprocessors such as (8086, AT mega 328, AVR) depending on the requirement. These will maintain the sensors through signal pins and requires the supporting software to programme them. Maintaining network over these electronic devices is the key role of IOT (Internet of Things).

Fig 1.1: Internet of Things.

1.2. Node MCU - ESP 8266

Node MCU is a micro controller unit where ESP8266EX is embedded with Ten silica L106. ESP8266EX is a self-contained Wi-Fi networking solution which is responsible for the establishment of network connectivity. It integrates the antenna, power amplifier, filters, power management modules, low noise receiver amplifier. Ten silica L106 is 32 -bit micro controller which supports clock speed up to 160MHz and RTOS is enabled.

Features of Node MCU contains is having external SPI flash to store the user programs. A memory of up to 16MB can be stored. Supports RAM up to 36kB. There

are up to 17 GPIO pins, can be assigned to various functions. These pins are multiplexed with various other functions like I2C, UART, PWM etc. Also supports, 802.11n (2.4GHz), Wi-Fi Direct support, MIMO 1x1 and 2x1, dual and single antenna Bluetooth [5].

Fig 1.2: Node MCU

1.3 Ultrasonic Sensor – HC-SR04

It is used in estimating the distance between source and target. Working frequency is 40KHz. A short 10uS pulse is applied to the trigger input to initiate ranging. Then the module will send 8 cycle burst of ultrasonic sound at 40KHz. When an object is encountered in the ranging, echo will be received. This will help to estimate the range through the time interval between trigger and echo signals. Thus, distance is calculated by formula,

*Distance = (Velocity of Sound * Time) / 2*

Consider the Velocity of sound 343 ms^{-1}.

Fig 1.3: Ultrasonic Sensor (HC-SR04).

1.4 RFID Module - MFRC522

MFRC is integrated circuitry used for contactless communication at 13.56MHz. This IC will read ISO/IEC 14443 A/MIFARE and NTAG. Its internal transmitter is able to drive a reader/writer antenna to communicate with cards and tags. The typical operating distance to read/write mode is up to 50mm. For this we use MFRC522 in read mode. A Timer is available to measure the time interval between two events.

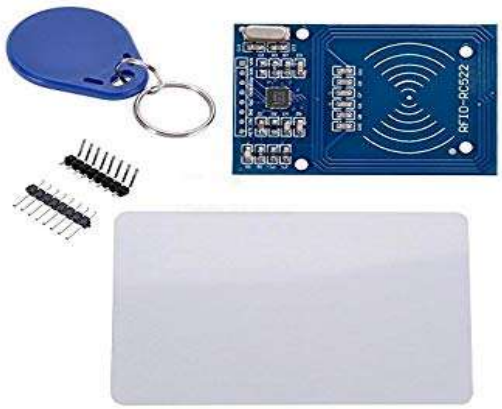

Fig 1.4: RFID Module Kit (MFRC522, Card, Tag).

1.5. Cloud Database

Database the place where we store the data collected by sensors. Cloud database is the service available on cloud platform. In this paper we used Google Firebase to store and access the data. The conditional data of each bin is stored and transferred to the linked android application. Each bin has a unique ID to store its data. For the attendance monitoring a table of employee ID is created, which will store the statistical attendance report every worker concerned to that authority.

The data in this base is transferred to android app, which will be easy access to view [4].

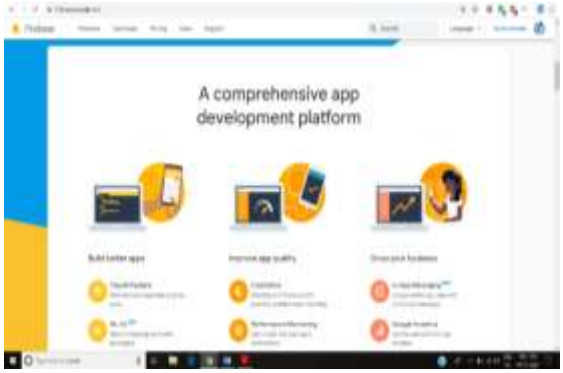

Fig. 1.5: Google Firebase.

2. THE PROPOSED MODEL

The explanation of proposed working model

2.1 Cloud server

Data base the place where we store the data collected from micro controller. It, can be accessed when it is required using mobile application.

2.2 Mobile application

This application will be installed by the municipality, so that the authority can know the level of garbage and also attendance of the workers through this application.

2.3 Garbage level sensor

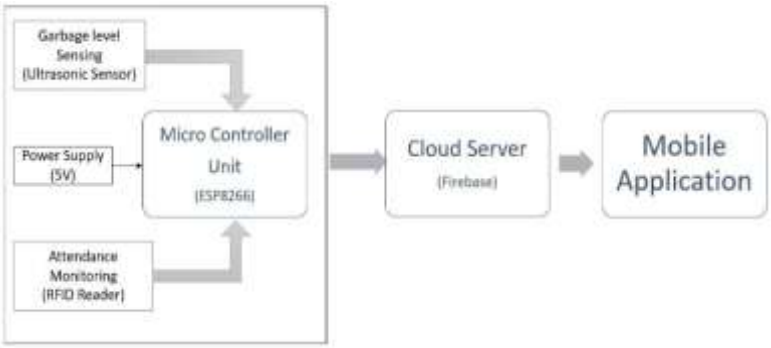

Fig. 2.1: Block Diagram.

2.4 Garbage level sensor

Ultrasonic sensor measures the depth of the bin. And by adding the garbage to the bin the depth gradually decreases, both the measurements will be subtracted and this give the level of garbage present in it. This information is sent to the micro controller.

2.5 Attendance monitoring

RFID Reader is setup on the dustbin, this provide the attendance to the worker when the RFID is read by the RFID reader. It gives the information that worker cleaned the dustbin or not.

2.6 Micro Controller (ESP8266)

Micro controller is provided with both the data from ultrasonic sensor and RFID Reader. It sends the complete information to the firebase.

III. DETAILED EXPLAINATION OF PROPOSED METHOD

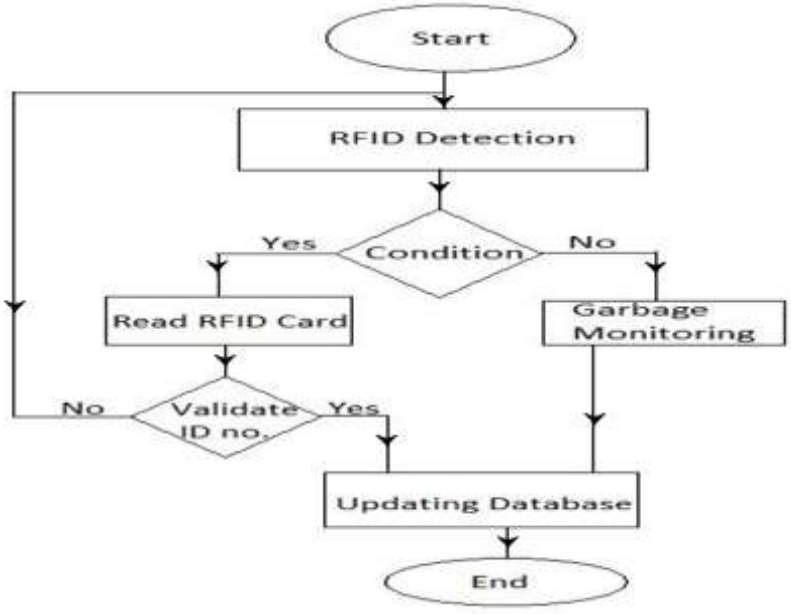

Fig 3: Flow chart.

Firstly, it detects RFID card, if there is any interrupt it goes to the garbage monitoring and update the data to database. If there is no interrupt then it reads the RFID card, if ID is not recognised then it goes back to initial stage, if it is detected then it allows the worker to collect the garbage and it updates the database [3].

3.1 RFID Detection

If there is any interrupt it goes to the garbage monitoring and update database. If there is no interrupt it reads the RFID card.

3.2 Read RFID Card

Here it checks the whether the id card is valid or not. If it is invalid it goes back to RFID.

4. RESULTS AND DISCUSSIONS

Proposed system as follows:

Fig 4.1: Arrangement of device to monitor garbage level.

The above fig. 4.1 represents the arrangement of device to monitor the garbage level for any type of design [8].

Fig 4.2: RFID Reading for Attendance Monitoring

In the above fig. 4.2 shows the arrangement of RFID reading for attendance monitoring to the dustbin. So that we can know attendance of worker and to know whether the bin is cleaned or not [10].

Fig 4.3: Data in cloud database.

The above fig. 4.3 represent the data in cloud database, in this we have shown the distance and directions of the dustbins. To represent the workers, we have given RFID numbers.

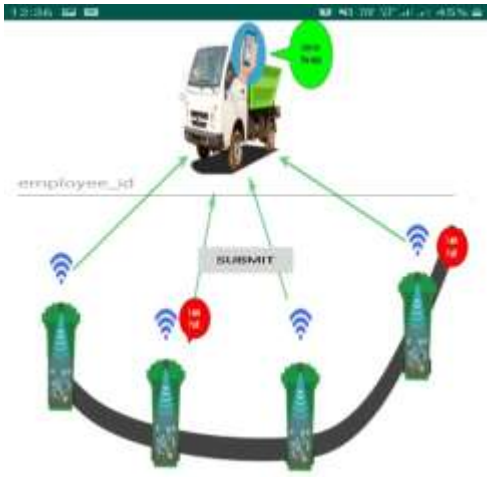

Fig. 4.4: Application Login

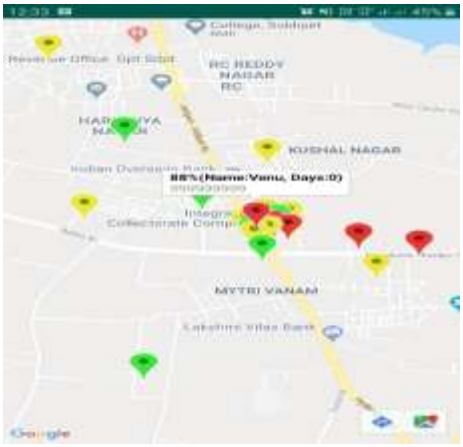

Fig. 4.5: Data on application

From the above fig. 4.4, fig.4.5 it shows the process of login to the application [9]. The registered people can know the data through this application.

5. FUTURE ENHANCEMENTS

Future enhancement includes-

- Android app will get access to all dustbins.
- Providing uninterrupted internet service.
- Tracing the location of bin.
- Improving graphical interface of application.
- Improving power efficiency.

6. CONCLUSION

The proposed method works efficiently in solid waste monitoring and workers attendance monitoring. And provides real-time data with in time on web portal and android application. By this system the conditional data of dustbin and statistical report of workers attendance can be easily monitored from anywhere. This system reduces the repetitive and unwanted works during the cleaning process. It mainly ensures that no over flow of dustbins. Our method of design is low cost and high accuracy sensors, efficient cloud data base is to access data with no delay.

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