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Smart Waste Collection Monitoring and Alert System via IoT

Dr. Ravi Shankar Mishra¹, CH. Nikhil Kumar², K. Vinay³, L. Yashwanth Reddy⁴

¹Professor, ^{2,3,4}UG Student, Department of Electronics and Communication Engineering, Guru Nanak Institute of Technology, Ibrahimpatnam, Telangana, India.

Abstract: *Through the history, the significant amount of solid waste generated by humans was due to low population density and low levels of the exploitation of natural resources. Common waste produced during pre-modern times was mainly ashes and human biodegradable waste, which were released into the ground locally, with minimal environment impact. Tools made out of metal or woods were generally reused or passed down the generations and generations. However, in mid-19th century, due to cholera outbreaks and the emergence of a public health debate that the first legislation on this solid waste issue emerged. The Sanitary Condition of the Labouring Population in 1842 of the social reformer, Edwin Chadwick, in which he argued for the importance of adequate waste removal and management facilities to improve the health and wellbeing of the city's population was highly effective. Internet of Things (IOT) is playing an important role in many application fields such as home, industry, environment and health. This approach can be applied in the field of solid waste management. In this paper a new cost effective method is proposed to collect and monitor the waste collection process. Smart bins are placed in the urban are interfaced with arduino based system with ultrasonic sensors and IOT modules where the ultrasonic sensors detect the level of the smart bin and send the signal. The arduino receive the signal and pass the signal to the central system through internet. The data will be received, analysed and processed which displays the status of the garbage in the smart bin on the Dashboard. At the same time the main server system will give an indication to the nearest driver of the garbage collection truck as to which smart bin is completely filled and needed urgent attention. This indication will be given by a notification through an android application which is developed and installed in driver's smart phone. This application will send the vehicle's current location to the main server which is also displayed in the dashboard.*

Keywords: Dash board, IOT, Arduino, Ultra Sonic sensors, IOT module.

I. INTRODUCTION

Now a days, there are a number of techniques which are purposefully used and are being build up for well management of garbage or solid waste. The generation of waste is increasing by 1.3% per annum. The urban population which is increasing between 3 to 3.5% per annum generates waste around 5% annually [3]. With increase in population, the scenario of cleanliness with respect to garbage management is important. In the present day scenario, many times we see that the garbage bins placed at public places in the cities are overflowing due to increase in the waste every day. The overflow of garbage in public areas creates the unhygienic condition in the nearby surrounding and creates bad smell around the surroundings. It may provoke several serious deadly human diseases amongst the nearby people. It also degrades the valuation of the area. When the bin is filled with garbage it is not collected immediately because waste collection occurs in regular time interval mostly in mornings. Even though the bin is filled in the evening of the previous day, it is collected in the next day morning this is one of the major reason for the environmental pollution in urban areas. This approach often displays unacceptable result with overloaded bins. This has resulted in dissatisfaction of residential and ineffective usage of dustbins. In the Municipality of Athens [2], it has been estimated that the 60% to 80% of the total cost of waste collection, transportation and disposal is spent during collection. The amount of fund that is spent on treatment and disposal of waste is minimal and hence crude dumping of this waste is practiced in most of the cities [1]. Smart Dustbins can prevent the accumulation of the garbage along the roadside to a great extent thereby controlling the widespread of many diseases. It can prevent pollution and also prevent the consumption of the spread out garbage by the street animals [4].

The whole waste collection and transporting process must be observed by the authorised party in order to provide an effective service to the public. Most of the project have failed because inappropriate management and less involvement of the public. It is very important to authorized party to monitor the overall process and get the public involved in the project. There are no monitoring mechanism for the waste collection process the authorized person cannot be able to monitor the movement of the waste collection truck and no tracking mechanism for the waste collection truck. Real time information of the bins or current status of the bin must be displayed to the authorized person for the proper management purpose the existing systems doesn't have the facilities to display the current status of the bins. However, we have used IOT based Wi-Fi communication module in this project as the wireless communication media.

II. LITEARTURE SURVEY

This paper IOT Based Intelligent Garbage Monitoring system is a newfangled system which will keep the cities clean[5]. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a web page. This system uses two ultrasonic HC-SR04 sensors placed over the bins to track down the garbage level and correlate it with the garbage bins depth. The system makes use of 8051 microcontroller to control every process and Wi-Fi modem for sending data to server. Dustbins are provided with economical implanted components which helps in tracking the level of the garbage bins and an unparallel ID will be provided for every dustbin so that it is easy to find which garbage bin is full. When the level reaches the threshold limit, the device will transmit the level along with the unique ID provided. This data can be retrieved by the person who has authority to access the data from their place with the help of Internet and an immediate action can be made to empty the dustbins

III. IMPLEMENTATION

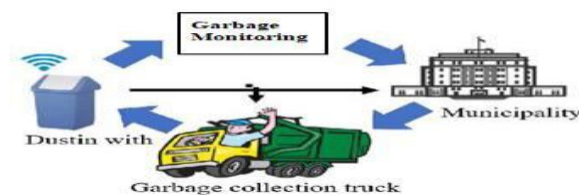


Figure: Actual Implementation

In Smart waste collection monitoring and alert system via iot we are going to monitor the dustbin in real time and update the status of the dustbin. It will inform the status of each and every dustbin so that concerned authority can send the garbage collection vehicle. Ultra sonic sensor is used to monitor the level of garbage level. IR sensor is used to monitor the nearby persons and automatically drivers the motor to open the lid of the dustbin. The information of the location of dustbin is been read by the controller along with the dustbin data are uploaded to the cloud using IOT. These helps for clearing the wastage from dustbin.

IV. SYSTEM DESIGN

A. Arduino Uno

Arduino is an open-source platform used for constructing and programing of electronics. It can receive and send information to most devices, and even through the internet to command the specific electronic device. it uses a hardware called arduino Uno circuit board and software programme(Simplified C++) to programme the board. In these modern day, Arduino are used a lot in microcontroller programing among other things due to its user friendly or easy to use setting, like any microcontroller an arduino is a circuit board with chip that can be programmed to do numerous number of tasks, it sends information from the computer programme to the Arduino microcontroller and finally to the specific circuit or machine with multiple circuits in order to execute the specific command.



Figure 2: Arduino Uno

V. METHODOLOGY

A. Hardware and Software implementation

To make the desired system function we designed a block diagram that functions as per the desired functionality as shown below.

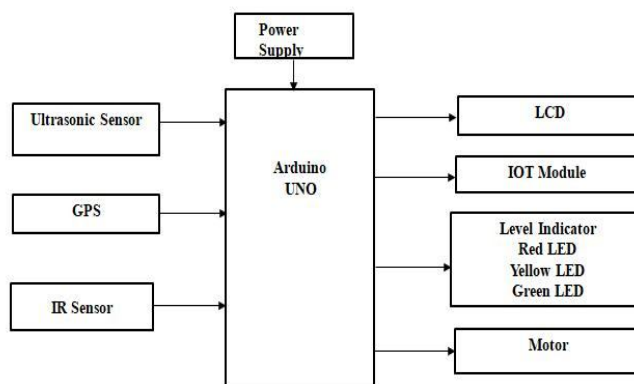
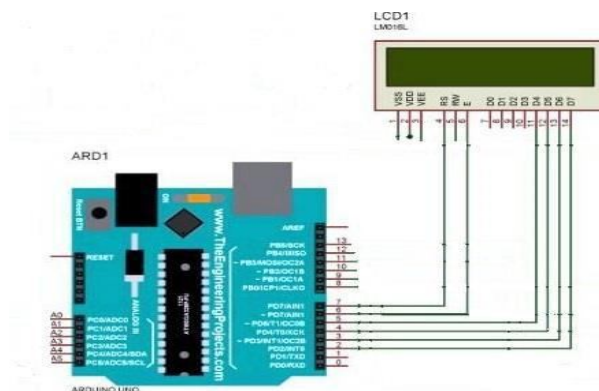


Figure: Block Diagram of System

The system is implemented using an ultrasonic sensor which is connected to Arduino UNO as to monitor waste bin garbage level. In this system, waste bin depth level and the location of the dust bin will be sent via Arduino with an Internet connection to the Ubidots IOT Cloud. The Ubidots store the collected waste bin level data into IOT database and display the waste bin depth level on online dashboard for real-time visualization. The Ubidots Event manager invoke a notification alert to garbage collector mobile phone via a SMS when the waste bin is nearly filled for immediate waste collection. Therefore, the waste collection became more effective and systematic.

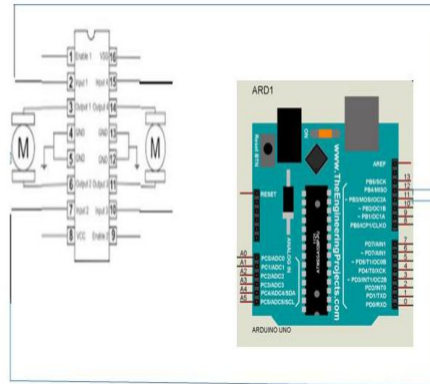
B. Software Implementation

- 1) *The Arduino Integrated Development Environment:* Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.
- 2) *Writing Sketches:* Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.
- 3) *Interfacing of LCD Arduino*



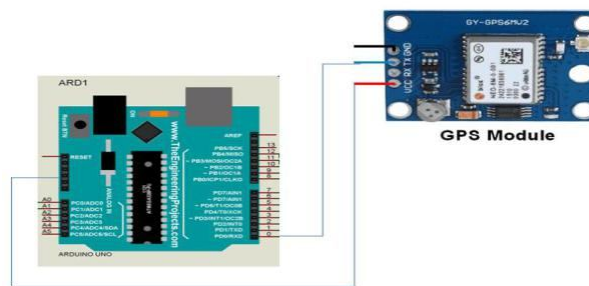
The figure shows the interfacing of LCD with Arduino. Here the Rs, E and Data pins of LCD is connected to digital pins of Arduino. LCD display is connected to Arduino to display the status of the dustbin.

4) *Interfacing of L293D Arduino*



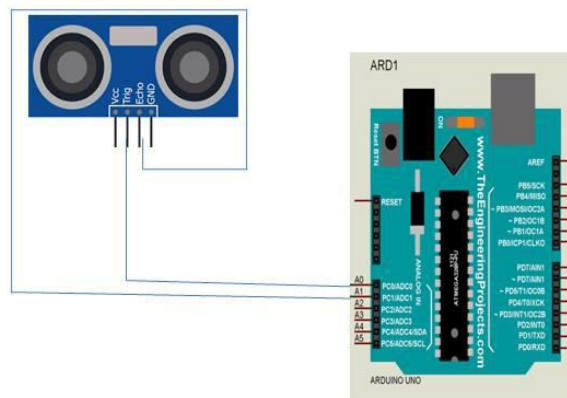
The figure shows the interfacing of L293D with Arduino. Here the input pins of IC is connected to the digital pins of Arduino. Also the output pins of the IC are connected to motor drivers.

5) *Interfacing of GPS Arduino*



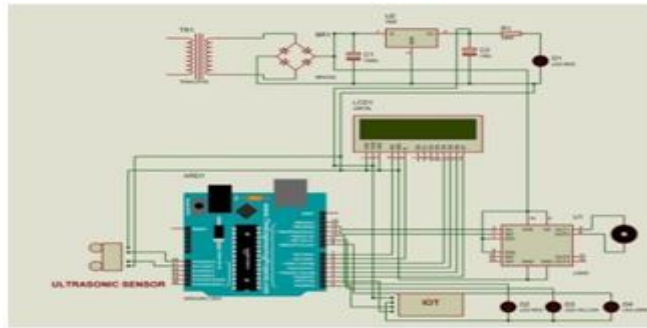
The figure 4.3 shows the interfacing of GPS with Arduino. Here the TX pin of GPS is connected to RX pin of Arduino and antenna is connected to the GPS Module. Also VCC pin of GPS is connected to 12v of supply.

6) *Interfacing of ultrasonic sensor Arduino*



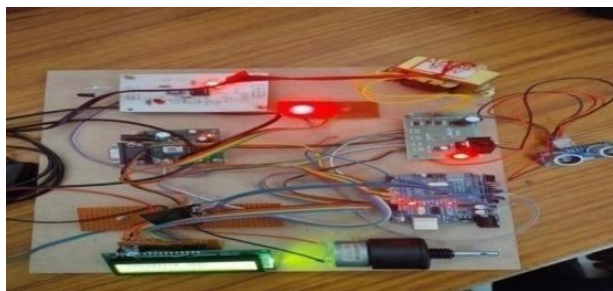
The figure shows the interfacing of Ultrasonic Sensor with Arduino. Here the Echo and Trigger pins of Ultrasonic Sensor is connected to A1 and A0 pins of Arduino. Ultrasonic Sensor emit short high frequency sound pulses at regular intervals, if they strike an object, then they reflected back as echo signals to the sensor which then it self computes the distance to the target based on the time span between emitting the signal and receiving echo.

7) *Circuit Diagram*



Observing the above figure 230 volt is supplied to the system by connecting it to the Arduino through bridge rectifier and voltage regulator decreasing its voltage to Arduino Operating voltage 5V. LCD display is connected to Arduino to display the status of the dustbin and warnings. Ultrasonic sensor is connected to the Arduino as to monitor garbage level. GPS is connected to the Arduino to track the dustbin. IOT is connected to UNO and it alerts garbage collector by sending the status of bin and location when the waste bin is nearly filled for immediate waste collection.

VI. RESULT



The above figure shows the connections of the Arduino based Smart waste collection monitoring and alert system. A 230v ac is connected as power supply. The dc motor is connected to their respective motor driver to open the lid.



Figure Data reception from the GPS module



Figure GPS coordinates displaying on the LCD

The above figures represents the data reception from the GPS module. The accurate location coordinates are obtained from the GPS receiver connected to the GPS module.



VII. CONCLUSION

An efficient, cost effective waste management and monitoring system is introduced in this. This system provide mechanism to display filled level of dustbin, sending notification to driver, finding shortest route to reach the destination, and display the current location of dustbins. The latitude and longitude of the each and every dustbin is informed to concerned authority and the current location shared with the waste collection trucks it will avoid unnecessary slow in waste collection process. Main objectives of this system can be achieved by implementing this system. There are more benefits such as it reduces the traffic in the city indirectly because in major cities the garbage collection vehicle visit the area's everyday twice or thrice depends on the population of the particular area.

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