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Intelligent Trash Computation and Taxation System Using IoT

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ABSTRACT

Nowadays people are not only aware of the harmful effects of the waste they produce. Keeping the city clean is a must, and for that, we must keep our household clean. To keep our household clean, we must reduce the amount of waste we produce. Here we have developed a system that computes the amount of waste generated by each household. This information is sent to the authorities and stored in the database. Based on this accumulated amount of waste, the tax is calculated accordingly. If the weight of the waste increases, the tax will also increase. Likewise, if the weight of the waste is reduced, the tax is saved. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a web page. For this the system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with the garbage bin depth. The system makes use of AVR family microcontroller, LCD screen, Wi-Fi modem for sending data.

Keywords - AtMega328P microcontroller, Ultrasonic sensor, Weight sensor, Wi-Fi module, LCD display, Database, Taxation

I. INTRODUCTION

The Internet of Things is a new technology and has the potential to change human life globally in positive ways thanks to its diverse connectivity. Currently, IoT technology has been used in various fields, one of them being to solve the trash problem in the city environment. This IoT based system have a vital performance in improving living standards and human well-being by increasing energy efficiency. This system calculates the weightage of the trash generated by the user and then send this information to the authorities. For this, the system uses ultra-sonic sensors placed over the bins to detect the amount of trash weightage. In addition, we also have weight sensors attached below the trash bins. Thus the system sends over the internet the level to fill of the trash bins. The advantage of this combo sense is that the trash-lifting weight of the fill has reached to the limit of what the trash lifting vehicle can pick up, the vehicle can immediately have driven towards the bin for evacuation. The LCD screen is used to display the status of the level and weight of trash collected in the bin. Whereas a webpage is built to show the status to user to monitor. Based on trash weightage, tax is charged.

II. SYSTEM OVERVIEW

The intelligent trash computation and taxation system has been specifically designed to minimize the waste in our surroundings. This system calculates the weightage of the trash generated by the user and then send this information to the authorities. For this, the system uses ultra-sonic sensors placed over the bins to detect the amount of trash weightage. In addition, we also have weight sensors attached below the trash bins. Thus the system sends over the internet the level to fill of the trash bins.

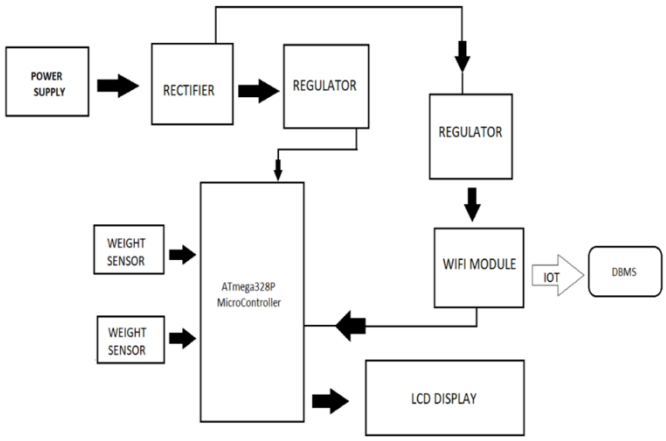


Figure 1. Block diagram of Intelligent trash computation and taxation system

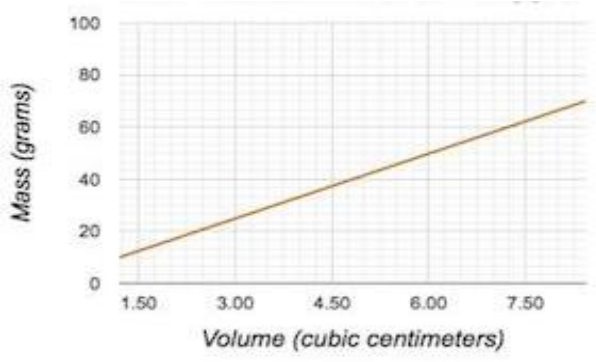


Figure 2. Mass-Volume relation

III. COMPONENTS REQUIRED

A. Arduino UNO

The ATmega328 Controller is an open-source controller board based on the Arduino.cc ATmega328 microchip controller. The board is equipped with sets of digital and analog input / output (I/O) pins that can be interfaced with different boards (shields) for expansion and other circuits. The board has 14 digital pins, 6 analog pins and is programmable via a type B USB cable with the Arduino IDE (Integrated Development Environment). It can be powered by a USB cable or by an external 9 Volt battery, but it accepts voltages between 7 and 20 volts. It's similar with Arduino Nano and Leonardo, too. Distributed under a Creative Common Attribution Share-Alike 2.5 license, the hardware reference design is available on the Arduino website. This microcontroller is supported with a full suite of program and system development tools including C compilers, macro assemblers and in-circuit emulators, etc.

Figure 3 Arduino UNO

B. Ultrasonic sensor

The Ultrasonic sensor HC-SR04 uses sonar to measure distance to an item. This provides excellent non-contact range detection with high precision and an easy to use kit with reliable readings. It comes complete with module ultrasonic transmitter and receiver. The time between the signal being transmitted and received allows us to know the distance of an object.

Figure 4 Jumper wires

C. Weight Scale Sensor

A weight scale sensor is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. Its various types are hydraulic, pneumatic and stain gauge load cells. This load cell is capable to measure weight up to 5kg. The weight is measured in mille-volts and cannot be directly measured by a microcontroller.

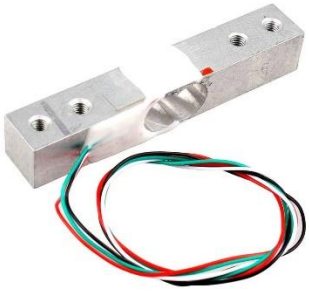


Figure 5 Soldering Iron and Lead

D. LED Display

A 16x2 LCD display is a basic 16 character by 2-line alphanumeric display. This display module uses a HD44780 parallel interface chipset. It requires minimum 6 general I/O ports to interface with the microcontroller. The LCD display works in 4-bit and 8-bit mode. There are many of them and can be recognized by the 16 pin interface. The LCDs have parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The process of controlling the display involves putting the display that forms an image desired to be displayed on the data registers.

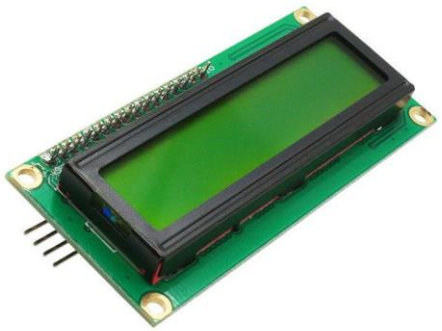


Figure 6 LCD Display

E. ESP 8266 Wi-Fi Module

An ESP 8266 Wi-Fi module is a remote serial wireless IoT board which is capable to handle all the necessary overhead for communicating with the network, such as TCP/IP stack and communicating with 802.11 networks. It is completely addressable over UART protocols. ESP 8266 serial Wi-Fi wireless transceiver module is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other applications specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area.

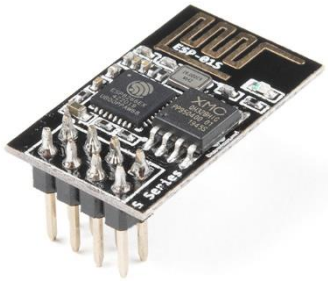


Figure 7 ESP 8266 WiFi module

F. Arduino Power Supply

The Arduino board comes with an AC socket that can be used to power the boards and to supply additional voltage if needed. A power supply adapter that provides from 7 to 12 V of DC is required. The adapter is plugged onto the wall socket and the other end goes directly onto the board's AC socket.

Figure 8 Arduino Power Supply

G. Arduino *IDE*

The Arduino Integrated Development Environment - or 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 hardware to upload programs and communicate with them. 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 righthand corner of the window displays the configured board and serial port.

Figure 9 Arduino IDE

H. HTML CSS

HTML (the Hypertext Markup Language) and CSS (Cascading Style Sheets) are two of the core technologies for building Web pages. HTML provides the structure of the page, CSS the (visual and aural) layout, for a variety of devices. Along with graphics and scripting, HTML and CSS are the basis of building Web pages and Web Applications.

CSS is the language for describing the presentation of Web pages, including colors, layout, and fonts. t allows one to adapt the presentation to different types of devices, such as large screens, small screens, or printers. CSS is independent of HTML and can be used with any XML-based markup language. The separation of HTML from CSS makes it easier to maintain sites, share style sheets across pages, and tailor pages to different environments. This is referred to as the separation of structure (or: content) from presentation.

Figure 11 HTML CSS

I. MySQL

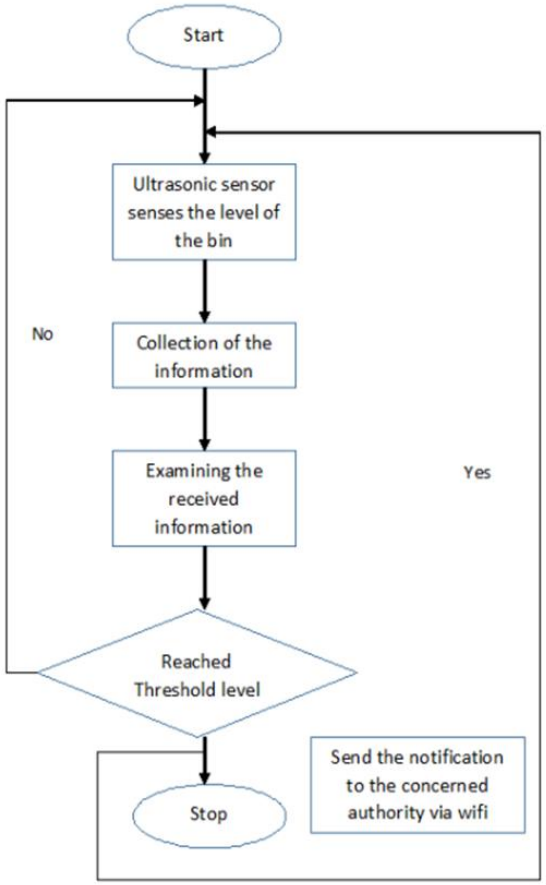
MySQL is a relational database management system based on the Structured Query Language, which is the popular language for accessing and managing the records in the database. MySQL is open-source and supported by Oracle. A database is an application that stores an organized collection of records. It can be accessed and managed by the user very easily. The SQL part of "MySQL" stands for "Structured Query

Language". SQL is the most common standardized language used to access databases. Depending on your programming environment, you might enter SQL directly (for example, to generate reports), embed SQL statements into code written in another language, or use a language-specific API that hides the SQL syntax. SQL is defined by the ANSI/ISO SQL Standard.

Figure 12 NRF24L01 Module

IV. SYSTEM DESIGN

This project IOT Garbage Monitoring system is a very innovative system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a web page. For this the system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with the garbage bins depth. The system makes use of AVR family microcontroller, LCD screen, Wifi modem for sending data and a buzzer. The system is powered by a 12V transformer. The LCD screen is used to display the status of the level of garbage collected in the bins. Whereas a web page is built to show the status to the user monitoring it. The web page gives a graphical view of the garbage bins and highlights the garbage collected in color in order to show the level of garbage collected. The LCD screen shows the status of the garbage level. The system puts on the buzzer when the level of garbage collected crosses the set limit. The wifi module is attached to the pre-program SSID and to the PASSWORD at device initialization. The user must set the SSID and PASSWORD to either router or mobile hotspot. During the wifi connection, the system also calculates the garbage bin height and record all the bins height. After that the system starts monitoring all the garbage levels. Also for better performance the wifi connection is established over and over again for each time of garbage monitoring. All the monitoring data is sent over the website so that the person concerned or the municipal officer can see the level of garbage from anywhere. The machine automatically plays the buzzer when each garbage bin is full and turns the led on and it constantly sounds the buzzer until the garbage level goes down.



V. RESULT

After observing the user's need to have a smart trash that can monitor the condition of the waste, the researchers designed a smart trash can using 2 sensors to detect the weight and height of the garbage. A smart trash bin with Ultrasonic Sensor. Garbage that enters the trash can will be detected through two sensors, namely the height sensor and the weight sensor. The

height sensor will detect how high the trash is in the trash can. The weight sensor will detect how much trash weighs in the bin. The data that has been read by each sensor will be sent to the MCU node then the MCU node will send the data to the database server via the internet network. Trash condition is said to be full if it has reached a maximum height of 40 cm and a weight of 20 kg and is displayed on a web application.

VI. ADVANTAGES

- Very simple circuit
- The HCSR04 sensor is very rugged
- Helps monitor garbage levels and uses small amount of electricity
- Ultimately helps in better palnning of garbage management.

VII. CONCLUSION AND FUTURE SCOPE

This paper helps in implementing a small smart management system using weight sensor, weight sensor , microcontroller and wifi module. This system ensures dustbin will be cleaned soon when the level of garbage reaches to its maximum. If the dustbin is not cleared in a reasonable period, the record shall be submitted to the higher authorities which may take appropriate actions against the concerned. This program also helps track the false report and therefore eliminate corruption in the overall system of management. This reduces the total number of garbage collection vehicle trips and thus reduces the overall costs associated with the garbage collection.

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