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Design of IoT Garbage Monitoring with Weight Sensing

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Abstract - *Keeping the city clean has been always an ongoing task which needs laborious efforts of people working on ground level emptying the garbage bins whenever they are full. The event of garbage bin getting full is not strictly dependent on a time pattern, instead it sometimes becomes rapidly full or sometimes requires more than normal time to become full. IOT Garbage Monitoring with Weight Sensing project is an innovative step towards making this process more smooths and efficient. 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. In addition, we also have weight sensors attached below the garbage bins. Thus the system sends over the internet the level of fill of the garbage bins as well as the weight of the fill of the garbage bins. The advantage of this combo sensing is that the garbage bin lifting weight can also be known by the authorities. If the garbage bin is not filled up, but still the weight of fill has reached the limit of what the garbage lifting vehicles can pick up, the vehicles can be immediately driven towards that bin for evacuation. The system makes use of AVR family microcontroller, LCD screen, Wi-fi modem for sending data and a buzzer.*

Key Words: **Wi-fi modem, Weight Cell, Ultrasonic Sensor, Atmega328, LCD Display, Solar Panel**

1. INTRODUCTION

IoT or the Internet of Things refers to a network of linked physical objects which can interact and share data among themselves without any human interference being desideratum. It has been formally defined as a "Information Society Infrastructure," because IoT sanctions us for collecting information from all kinds of media such as humans, animals, conveyances, kitchen appliances. Thus, by embedding them with electronic hardware such as sensors, software and networking equipment, any entity in the physical world that can be provided with an IP address to allow data transmission over a network can become part of the IoT framework. IoT is different from the Internet because it transcends Internet access by allowing everyday objects that use embedded circuits to interact and communicate with each other using the Internet infrastructure currently in use.

Since then the spectrum of IoT has expanded enormously as it currently consists of more than 12 billion connected devices and will rise to 50 billion by the end of 2020 according to the experts. Since the introduction of IoT it has helped both producers and customers. Manufacturers have gained insight into how their products are used and how they are performing in the real world by providing value-added services that enhance and extend the lifecycle of their products or services. On the other hand, consumers have the ability to integrate and control more than one device to deliver a more customized and improved user experience.

IoT weight-sensing garbage monitoring uses Atmega microcontroller with LCD display, rechargeable battery and solar panel. A 12V power supply is powered at the system. Similarly, it works with the combination of sensors, namely weight cell sensor and ultrasonic sensor, indicating their weight and different levels, respectively. The ultrasonic sensors will show us the various levels of garbage in the dustbins and also enable the weight sensors to send their output forward when they reach their threshold level. The microcontroller is further given these details, and the controller gives the transmitter module (Wi-fi module) the details. A mobile handset is required in the receiver section to be linked to the Wi-Fi router so that the garbage bin information will displayed in our mobile handset's web browser on the HTML tab.

1.1 Existing System

In the existing system, if the bin is empty, the garbage is collected on the daily regular basis by the municipal staff. As we see several times in the public places the garbage bins are full due to the regular rise in the waste. Because of this, the garbage is shrinking and producing the bad odor that tends to cause air pollution and spread disease. That can cause the damage to human health. Finding garbage bin location is also one of the tasks especially for new driver. GPS facility had been introduced to find the location and clean the dustbins to overcome the aforementioned problem. Disadvantages of the existing systems is i) It requires more human resource to run the system. ii) The system is totally manual. iii) High costs. iv) It spreads bad smell and may cause illness to human beings. v) Unhygienic Environment and look of the city.

1.2 Proposed System

The system proposed focuses on the process of waste collection. It reduces the consumption of time, and is an automated process. The bin 's status is continuously monitored, and the notification is sent via the android

application to the designated authority. The advantages of the proposed systems are i) Real time information of the dustbins. ii) Intelligent service management. iii) Improves the quality of the environment. iv) Cost management and the improvement of the capital.

2. HARDWARE

Atmega328 Controller, Load Cell, HX711 (Weighting Sensor Module), Wi-Fi Module (ESP8266), Ultrasonic Sensor, LCD, Solar Panel, Smart Phone.

2.1 Atmega 328 Controller

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. The ATmega328 comes pre-programmed with a boot loader that enables new code to be uploaded to it without using an external hardware programmer.

2.2 Load Cell

A load cell is defined as a "weight measuring system needed for electronic scales that display weights in Figure its." However, load cell is not limited to weight measurement in electronic scales. Load cell is a passive transducer or sensor translating the force exerted into electrical signals. They are also called "load transducers". The only load cells that predominate, however, are the load cells based on strain gages. The reason why strain gage-based load cells are broadly adopted is their characteristics:- Small size compared to other load-cell types. Long operating life due to lack of moving parts or other friction-causing components. Ease in production due to small number of components.

2.3 HX711 (Weighthing Sensor Module)

Weight Sensor Module is based on HX711, which is a 24-bit analog-to - digital precision converter designed to interface directly with a bridge sensor for weight scale and industrial control applications. HX711 not only has a few simple functions compared to other chips, it also includes high integration, rapid response, immunity and other features. The lower chip ds the electronic scale costs, while improving performance and reliability at the same time.

2.4 Wi-Fi Module (ESP8266)

The ESP8266 Wi-Fi Module is a self-contained SOC with built-in TCP / IP protocol stack that can provide connectivity to your Wi-Fi network to any microcontroller. The ESP8266 will host an application or discharge all Wi-Fi networking functions from another device processor. The ESP8266 Wi-Fi module is a low cost component with which manufacturers make module microcontroller wirelessly networkable. Wi-Fi module ESP 8266 is a system-on-a-chip with 2.4GHz range capabilities. It uses a RISC CPU of 32 bit, running at 80MHz. It is based on the TCP / IP (Transfer control protocol). This is the most critical component in the system because it conducts the IOT operation. It has ROM booting 64 kb, RAM instruction 64 kb, RAM data 96 kb. Wi-Fi device performs IOT operation by sending data from an energy meter to a website that can be accessed via IP address. The TX, RX pins link with the Arduino microcontroller's 7 and 8 pins.

2.5 Ultrasonic Sensor

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.

2.6 Liquid Crystal Display (LCD)

The word LCD stands for liquid crystal display. It is one type of electronic display module used in a wide range of applications such as various circuits & devices such as cell phones, calculators, computers, television sets, etc. Such displays are chosen for light-emitting diodes and seven segments in multi-segment configurations. The main benefits of using this module are inexpensive; simply programmable, animations, and the display of custom characters, special and even animations, etc., is not limited. A 16 LCD has two registers like the register of data and the register of commands. The RS (register select) is primarily used to switch between registers. When the set of the register is '0' it is known as the register of commands. Similarly, it is known as the data register when the register set is '1.'

2.7 Solar Panel

Solar panel is of 6V, 5W rating. Which is capable to recharge 3.7V battery.

3. BLOCK DIAGRAM

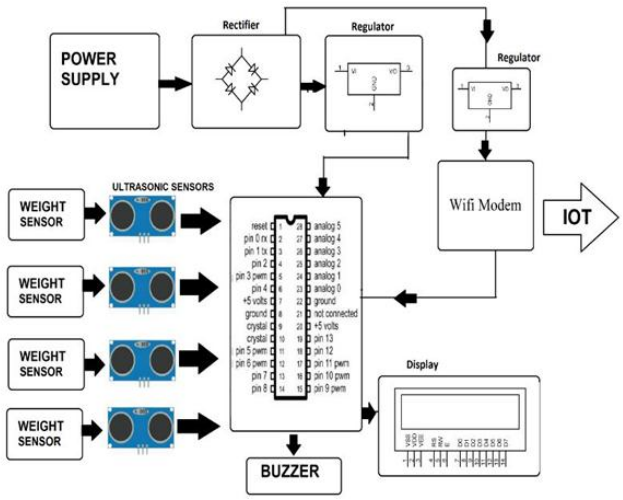

Fig -1: Block Diagram

4. FLOW CHART

Flow chart which will indicate the actual flow of the proposed system to obtain the appropriate result.

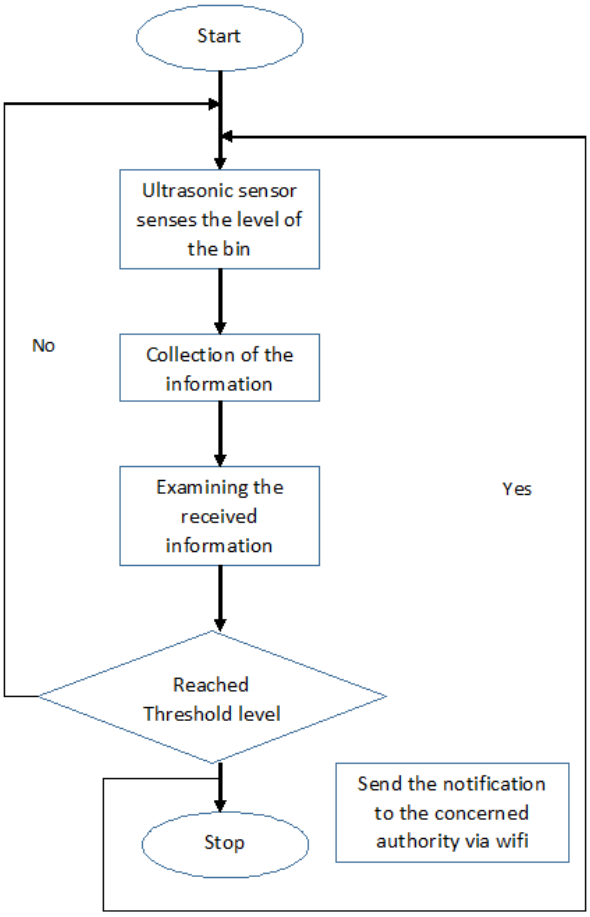

Fig -2: Flow Chart

5. IMPLEMENTATION

IoT garbage monitoring with weight sensing is very simple and real time. The project consist of:-

- **i)** Atmega328 microcontroller-based device which monitors the garbage continuously.
- **ii)** Ultrasonic sensors which track the level of the garbage. Four sensors are used to monitor four garbage bins.
- **iii)** A Weighting sensor module that is used to calculate garbage bin weight.
- **iv)** LCD screen for garbage level display.
- **v)** Wifi module for uploading all data to the website.

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.

6. TEST CASES AND RESULTS

1) Dustbin when empty – 0% (when output is given by the 1st stage IR Sensor)
2) Dustbin half – 50% (when IR sensor gives output on 1st and 2nd level)
3) Full dustbin – 90% (when all three level sensors give output)
4) Dustbin is heavy-when the dustbin 's threshold weight is crossed (weight sensor gives output)

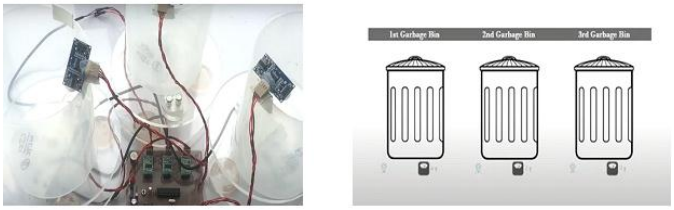

Fig -3: Dustbin When Empty

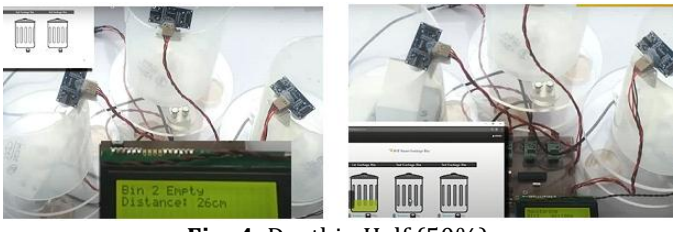

Fig -4: Dustbin Half (50%)

Fig -4: Dustbin Full (90%)

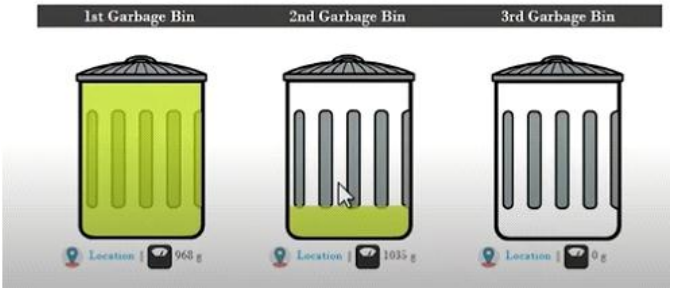

Fig -5: Dustbin is Heavy

7. CONCLUSION

This project work is implementing a smart garbage management system using Ultrasonic Sensor, Weight Sensor, Microcontroller, and Wi-Fi. This system ensures dustbins will be cleaned soon when the level of garbage reaches its maximum. If the dustbin is not cleaned in a reasonable period, the record shall be submitted to the higher authority which may take appropriate action against the contractor concerned. This program also helps track the false reports and therefore can 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. n the end, it helps to preserve cleanliness in society. The smart garbage management system therefore allows collection of the garbage more efficient.

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