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Design and Fabrication of Smart Waste Management System

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Abstract: The things of future are no longer smart phones or smart TVs they are smart cities.. A city can be characterized as 'smart' when interests in human, social capital, conventional, present day correspondence foundation, fuel, maintainable financial improvement and a high caliber of life, with a shrewd administration of characteristic assets, through participatory activity and engagement. But one of the major obstacles a country like India faces in achieving a smart city is the waste management system. The work aims to solve the above mentioned problem with the help of smart garbage bins which are used to keep track of the gardage filling levels. The bins have a GPS chip which enables us to locate the bin precisely. The garbage collection vehicles are retrofitted with GPS to know and keep track of the bins which are to be collected. The route to be taken by the trucks and the bins to be emptied is also automated using a routing algorithm. The filling level and also the trucks location and route can be monitored via a web application. The existing system relies heavily on manual labour and no route optimization technique is used while collecting the garbage bins. The quantity of gardage produced is not monitored or recorded. The utilization of wise waste compartments which identify the level of load and take into account an optimization of the collector trucks route. This can diminish the cost of waste gathering and enhance the nature of reusing..

Keywords: Embedded system, Hydrophobic Coating, GPS technology, SQL, Sharp IR sensor.

I. INRODUCTION

Waste management is every one of the exercises and activities required to oversee squander from its origin to its last disposal. This incorporates in addition to other things, accumulation, transport, treatment and disposal of waste together with checking and regulation. It also envelops the lawful and administrative system that identifies with waste management including direction on reusing and so forth. The term regularly identifies with a wide range of waste, regardless of whether created amid the extraction of raw materials, the preparing of raw materials into intermediate and final products, the utilization of definite items, or other human exercises, including city (private, institutional, business), horticultural, and social (medicinal services, family unit risky waste, sewage slime). Waste management is planned to decrease adverse effects of waste on wellbeing, nature or style. Waste management hones are not uniform among nations (developed and developing nations); locales (urban and rural area), and areas (residential and industrial). The Smart City is an idea that has been generally used to depict the umbrella of new patterns and objectives sought after to make urban communities more proficient. These goals are very diverse such as to make greener cities by energy savings or to improvement of people's quality of life. Regardless of the application area or goals, one of the key enablers for this evolution is digital data and ICT infrastructure, and specifically in relation to the topic of this work, GIS based tools are highlighted to play an important role in decision support and data analysis. Moreover, the development Internet of Things (IoT) and their applications have been acquiring relevance in Smart City solutions. In a nutshell, data gathered by sensors can be sent to remote servers where it is stored, processed and used for tracking, monitoring and ultimately making intelligent decisions for infrastructure or service management. When the deployment and use of sensors becomes massive, the data collected together with its processing and storage can be directly linked to Big Data. Big Data is widely recognized to open new business models and data in this context is often referred to as the new gold. In addition, Open Data is considered a promoter of Big Data technologies such as IoT, and consequently the integration of both as part of cyber physical systems enhances the potential of a large spectrum of innovative Smart City solutions. In relation to the application area of this work, waste collection systems and solutions have been a widely studied since they have direct impact on city management costs. However, these problems are very complex to solve due to its combinatorial nature. In addition, sensing systems for measuring waste level in containers have been proposed in studies. The Smart Waste Management essentially consists of 3 parts, sensing the level of the containers, locating the containers, generation of a routing algorithm for the collection of garbage from the various containers.Jose M. Gutierrez et al. / Procedia Computer Science 61 (2015) 120–127 Intelligence module has not been implemented yet, the can selection is expected to

be improved with the analysis of historical data (for example in terms of balanced cost-efficiency). Thus, there are good indications that when having a fully working system, an intelligent solution may outperform traditional strategies in both efficiency and costs.

II. METHODOLOGY

The objective of this work is designing a "Smart Waste Management System". The work consists of microcontroller, GPS/GPRS module, IR sensor and power source. Using the IR sensor, we can detect the level of filling in the garbage bin. When the level of filling is stored on the microcontroller, it can be transferred to a web server via a GPRS module. The location of the bin is detected by using GPS module. This is also sent to the server via a GPRS module. All these components are interfaced to the microcontroller ATMEGA2560.

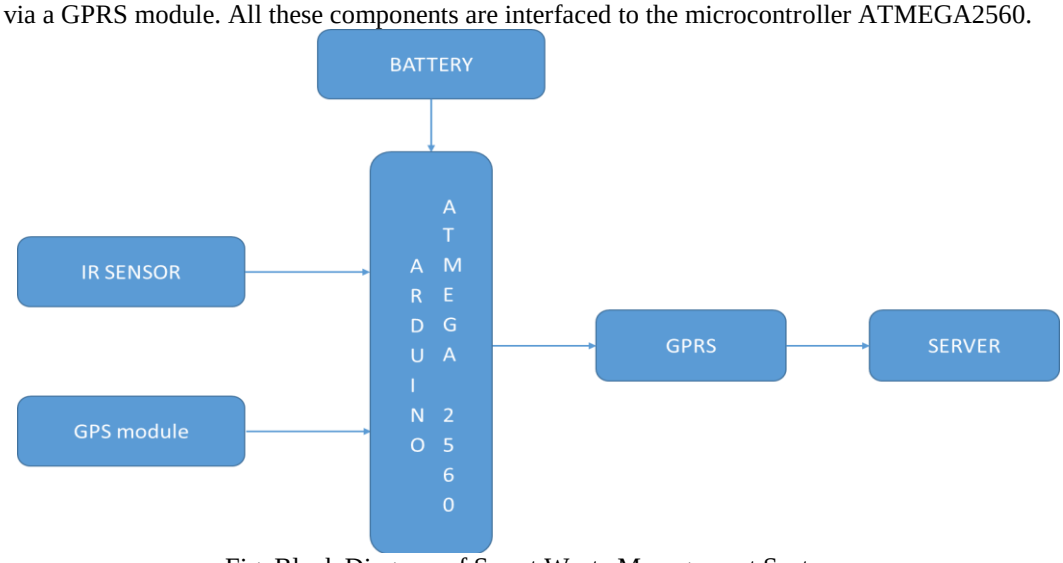

Fig: Block Diagram of Smart Waste Management System

III. STEP BY STEP PROCEDURE

1. The work is designed for waste management system with level detection that uses an IR sensor
2. It detects the level of filling in the garbage bin in real time.
3. IR sensor, GPRS/GPS module and microcontroller are the main components of the project.
4. The IR sensor detects the level of the garbage in the bin.
5. GPS module is used for detecting the location of the bun.
6. ATMEGA 2560 microcontroller is the heart of the circuit as it controls all the functions.
7. A battery is provided to provide power supply to the circuit.
8. All the components are working properly, the garbage bin filling level has been successfully obtained from the IR sensor and this data has been sent to the server via the SIM808 GPRS/GPS module.

IV. COMPONENTS

The project has the following components:

- SIM808 GPRS/GPS module
- Arduino (atmega) 2560
- Sharp IR sensor
- Garbage bin
- Web Server
- Battery

SIM808 GPRS/GPS MODULE

SIM808 module is a complete Quad-Band GSM/GPRS module which combines GPS technology for satellite navigation. The compact design which integrated GPRS and GPS in a SMT package will significantly save both time and costs for customers to develop GPS enabled applications. Featuring an industry-standard interface and GPS function, it allows variable assets to be tracked seamlessly at any location and anytime with signal coverage.

ARDUINO (ATMEGA 2560)

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/ output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

SHARP IR SENSOR

The Sharp distance sensors are a popular choice for many projects that require accurate distance measurements. This IR sensor is more economical than sonar rangefinders, yet it provides much better performance than other IR alternatives. Interfacing to most microcontrollers is straightforward: the single analog output can be connected to an analog-to-digital converter for taking distance measurements, or the output can be connected to a comparator for threshold detection. The detection range of this version is approximately 10 cm to 80 cm.

GARBAGE BIN

The bin has been fabricated using Stainless Steel so as to prevent corrosion due to the wastes. Stainless steel also has a longer life span as compared to other materials in a cost-cutting manner. The dimensions of the bin are 30cm*30cm*30cm. Top of the bin can be opened and is attached by using hinges.

WEB SERVER

A Web Server has been configured to collect the data being sent from the garbage bins via the SIM module.

PROTOTYPE

Fig : Prototype of Smart Waste Management System

CIRCUIT DIAGRAM

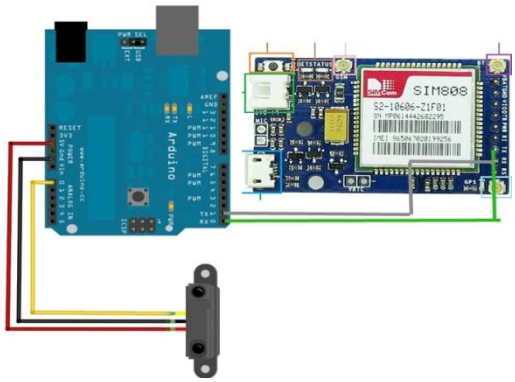

Fig: Circuit diagram of the prototype

V. SOFTWARE USED

The following softwares have been used for the completion of this work.

- Arduino IDE
- SQL
- JavaScript
- XAMPP

SOFTWARE CODE

```
<?php
        include("connect.php");
                $link=Connection();
                $result=mysql_query("SELECT * FROM `tempLog` ORDER BY `timeStamp` DESC",$link);
?>
<html>
        <head>
```

```
                <title>Sensor Data</title>
                <meta http-equiv="refresh" content="30">
        </head>
<body>
                <h1>POSITION / Depth Sensor Readings</h1>
                        <table border="1" cellspacing="1" cellpadding="1">
                                <tr>
                                        <td> Timestamp </td>
                                        <td> POSITION 1 </td>
                                        <td> depth 1 </td>
                                </tr>
        <?php
                                 if($result!==FALSE)
                        {
                                 while($row = mysql_fetch_array($result)) {
                                printf("<tr><td>  %s </td><td>  %s  </td><td>
                                 %s  </td></tr>",
                                 $row["timeStamp"], $row["position"], $row["depth"]);
                          }
                        mysql_free_result($result);
                        mysql_close();
                 }
        ?>
                </table>
        </body>
</html>
```

VI. TESTING

Software testing is a process of executing a program or application with the intent of finding the software bugs. It can also be stated as the process of validating and verifying that a software program or application or product meets the business and technical requirements that guided its design and development.

VII. RESULTS AND DISCUSSION

The tested code is dumped into the microcontroller, the garbage bin and the sim808 module, IR sensor are found to be working properly under ordinary conditions. The level of filling of the garbage bin is collected and stored in the database configured using XAMPP. The location of the garbage bins is also stored in the server. The data is now used to generate a mapping route for the collection of garbage from the bins whose level of filling is greater than the set point.Over the current waste management system this project is more efficient, reliable and safe, technically advanced, cost effective in maintenance, greater citizen satisfaction, and reduced manual labor.

VIII. CONCLUSION

The design and fabrication of smart waste management system prototype has been successfully achieved. For the demonstration purpose a prototype has been developed and the results are found to be satisfactory. In this project we have demonstrated the automatic detection of filling level of garbage bins. It primarily helps to reduce human effort and helps in achieving the goal of a smart city.

Integrated features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Also, utilizing exceptionally progressed IC‟s with the assistance of developing advancements, the undertaking has been effectively executed. Thus the work has been successfully designed and tested.

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