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IOT-BASED SMART BIN MANAGEMENT WITH LOCATION ALERT USING NODEMCU

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ABSTRACT
Garbage bins often go uncollected for extended periods, posing a significant risk to public health, particularly in the event of a Cholera outbreak, especially during the rainy season. This issue stems from the absence of a monitoring system that can track the levels of garbage and promptly alert the appropriate authorities. To mitigate this problem, this project proposes the development and implementation of an innovative Garbage and Waste Collection Bin Overflow Management System that leverages GPS and IoT technologies. This system aims to provide real-time information regarding the status of garbage bins, specifically when they reach full capacity, enabling prompt and effective action. The proposed system utilizes GPS and IoT technology to relay information to the designated truck driver responsible for garbage collection. Through IoT web notifications, the system notifies the driver of the exact location of the full bin that needs attention. Additionally, the system informs the Central Office that the notification has been successfully dispatched to the driver. This streamlined approach saves significant time by eliminating the need for manual checks on the garbage bin levels. Moreover, it prevents the overflow of garbage by ensuring timely collection. Consequently, the council can focus on collecting garbage only, when necessary, rather than following a routine that leads to the collection of even half-full bins.

Keywords:
NodeMCU, Smart bin, Internet of Things, GPS.

1. INTRODUCTION
We are living in an age where tasks and systems are fusing together with the power of IOT to have a more efficient system of working and to execute jobs quickly! With all the power at our finger tips this is what we have come up with. The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different systems, while providing data for millions of people to use and capitalize. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system. One of the main concerns with our environment has been solid waste management which impacts the health and environment of our society. The detection, monitoring and management of wastes is one of the primary problems of the present era. The traditional way of manually monitoring the wastes in waste bins is a cumbersome process and utilizes more human effort, time and cost which can easily be avoided with our present technologies. This is our solution, a method in which waste management is automated. This is our IoT Garbage Monitoring system, an innovative way that will help to keep the cities clean and healthy. Today main issue for pollution is Garbage Overflow. It creates unhygienic condition for the people and creates bad smell around the surroundings this leads in spreading some deadly diseases & human illness. To avoid all such situations we are going to implement a project called IoT Based waste management using smart dustbin. Implementation is done with the help of IoT concept.
The Internet of Things (IoT) is a concept in which surrounding objects are connected through wired and wireless networks without user intervention. Objects communicate and exchange information. In this system multiple dustbins are located throughout the city or the Campus, these dustbins are

provided with a sensor which helps in tracking the level and weight of the garbage bins and a unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. When the level and weight of the bin reaches the threshold limit, the device will transmit the reading along with the unique ID provided. In order to avoid the decaying smell around the bin harm-less chemical sprinkler is used which will sprinkle the chemical as soon as the smell sensors detect the decaying smell. Once the bins are full then user will not be able to access the bins. In such circumstances the bin displays the direction of the nearby bins on LCD display also generate the voice messages if the user place the waste on the floor. The status of the bin is accessed by the concerned authorities from their place with the help of Internet and an immediate action will be taken to replace overflowing bins with the empty bins.

In this project methodology model takes the fundamental process activities of Project Plan, specification, Analysis, Design, development, validation and evolution and represents them as separate process phases. Using a waterfall model as a project development methodology. Do to Specific system models, system architecture and detailed design of the project, to implementation process using Eclipse JUNO tool and aurdino tool with java language for developing the modules in windows platform. In the smart dustbin hardware contains motor-driver, 16*2 LCD Display, Aurdino UNO, Load cell, Playback IC, Speaker, IR Sensors, Smell Sensors , Bread Board, Power Supply and Raspberry pi. In the smart dustbin IR sensors will continuously monitor the status of the bin. If the bin reaches more than certain weight, the weight sensors will trigger the message to the concerned authority. Also when certain threshold level is reached, the level sensors will trigger the message to the concern authority. Here when the bin is filled it will give the user the details of the empty bins which are nearby with the help of LCD display, these dustbin will generate voice messages with the help of playback IC and speaker. In order to avoid the decaying smell produced inside the dustbin harm-less chemical sprinkler is used. By using motor driver (12v), chemical will be sprayed. Here the chemical used is Baking Soda, which will prevent decaying smell spreading around the dustbin.

The idea of smart garbage bins and systems have been in discussion for quite a long time. The technologies used at disposal to develop this smart system have also evolved, Internet of Things (IoT). Each idea seems to be similar but is slightly different at its core and our proposed work is no exception from the same. After the IoT field, finding its hold in our lives, this is our original plan for designing a smart garbage collection system which has provision for citizen participation and analysis of data for better decision making. At hardware level, the smart system is a garbage bin with IR sensor, a micro-controller and Wi-Fi module for transmission of data. The worldwide implementation of Internet of Things is possible with a Cloud centric vision. This work exploits the future possibilities, key technologies and application that are likely to drive IoT research. But a strong foundation to our work is provided, where the basics and applications of NodeMCUboard is explained .

2. LITERATURE SURVEY

The idea of smart garbage bins and systems have been in discussion for quite a long time. The technologies used at disposal to develop this smart system have also evolved, Internet of Things (IoT). Each idea seems to be similar but is slightly different at its core and our proposed work is no exception from the same. After the IoT field, finding its hold in our lives, this is our original plan for designing a smart garbage collection system which has provision for citizen participation and analysis of data for better decision making. At hardware level, the smart system is a garbage bin with IR sensor, a micro-controller and Wi-Fi module for transmission of data. The worldwide implementation of Internet of Things is possible with a Cloud centric vision. This work exploits the future possibilities, key technologies and application that are likely to drive IoT research. But a strong foundation to our work is provided, where the basics and applications of NodeMCUboard is explained . It is quite interesting as it implements a GAYT (Get As You Throw) system concept as a way to encourage recycling among

citizens. As we would discuss further, the citizen participation part of our system is quite influenced by their work Solid waste management (SWM) is the process of collecting, handling, and disposing of no longer in use solid objects that are discarded[1].

In today's world, typical solid waste management includes large outdoor waste bins, waste pickup trucks, and scheduled pickup routine by the related party. Manaf et al. [2] explain that solid waste is categorized into three categories, each is handled by different authorities. the categories of solid waste and the related party that's responsible for handling the waste. In London, solid waste collection is carried out based on selective collection requirements. Different color of garbage bags and/or garbage bins are used for different categories of solid waste. The examples of this color categorization are the yellow container for hospital waste, the red container for toxic waste and black container for household waste [3]. Pardini et al.[4] On the other hand, smart solid waste management system (SSWMS) is a smart system that links smart waste bins (as smart objects) to web-based and/or mobile-based application through cloud servers using Internet-of-Things (IoT) technologies [12]. IoT allows traditional, physical objects to communicate among each other by transforming them into "smart objects" using several essential technologies such as embedded devices, sensor networks, and Internet protocols [13].

The overall concept of IoT is depicted in Figure 1 which shows an example of domains suitable for IoT services. In a SSWMS, the smart waste bins are integrated with several sensors (e.g., proximity sensor, weight sensor, temperature sensor, etc.). Example of working smart waste bin is produced by ZAN Compute Inc. called Smart Garbage Bin, as patented by Shahabdeen[14]. These sensors then collect related real-time data regarding the solid waste inside the bin before the microcontroller embedded on each bin transfer the data to Cloud servers. Next, the Cloud servers communicate with specially developed mobile-based and/or web-based applications for monitoring and management purposes. This SSWMS is important as its efficiency is proven to be better than the traditional waste management procedures. The aim of this system is to assist the waste management team to carry out their work more efficient in terms of (but not limited to) monitoring, scheduling and cutting operational cost. For example, the implementation of Bigbelly Solar Waste &Recycling System (BSWRS) in smart cities such as Hamburg and New York City has managed to help these cities reducing their number of waste pickups up to 80% while also reducing the waste collection costs around 75% [15].There is no universal solution on how SSWMS should be planned and implemented as it is a complex task. Therefore, several factors and aspects need to be considered and analyzed. IoT is an integral part of any development and implementation of SSWMS. According to Dorsemaine et al.,[16]Internet-of-Things (IoT) is a group of infrastructures interconnecting linked objects and permitting their management, data mining and access to the information they generate.

The interconnection between objects is realized by having an Internet connection and/or cloud server as its gateway. To understand the IoT concept further, it is divided into six components as shown in Table 3[13]. Table 3: Components of IoT Component Examples IoT Identification Object ID, object's address IoT Sensing Smart actuators, sensors, wearable sensing devices IoT Communication 6LOWPAN IoT Computation Fog Computing IoT Semantics Extraction of knowledge wisely by different systems IoT Services Identity-related services, collaborative-aware services, ubiquitous services, information aggregation services SSWMS is one of many services that any Smart City can implement in order to provide an environment that is more sustainable. According to Priano& Guerra[17], Smart City can be defined as a future-looking and well performing city based six characteristics (i.e., Smart Economy, Smart People, Smart Living, Smart Governance, Smart Mobility and Smart Environment), built on the abilities combination and activities of independent, self-decisive and conscious citizens.Several SLRs can be found regarding IoT and Smart City which are both highly related to SSWMS as mentioned earlier in this paper.

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These SLR investigates on issues regarding IoT and/or Smart City but with different focuses. In [18], a SLR has been carried out to find out potential indicators in implementing Smart City. In the SLR, the author manages to list out twelve main indicators that can be used as the main factors in making the decision regarding Smart City Development which includes environmental sustainability. Next, Trindade et al. [19] discuss environmental sustainability and smart city concept. The SLR focuses on theoretical basis concepts of both sustainability and smart city, their relationships, issues, proposed works and strength and weaknesses of related works. Besides, Mijac et al. [20] conducted an investigation on proposed Smart City services driven by IoT by using SLR. The SLR gathered literature regarding applications of IoT in the development of Smart City services before dividing them into categories of proposed or described services.

One of the dominant categories of Smart City services driven by IoT that the SLR recognized is waste management. Therefore, this paper aims to gather information regarding proposed and existing solutions of SSWMS.

3. PROPOSED SYSTEM

Whenever the garbage is full information can be send to the concerned authority to clean the bin. IOT is used in the project as a communication back bone for the whole system for various reasons like low cost, easy to implement and less signal deterioration. This project uses the ultrasonic sensor module, IOT Modem, the NODEMCU Microcontroller and Liquid Crystal Display (LCD). Without a smart waste management system, any smart city is incomplete. In the proposed system, the level of waste material in the garbage bin has been detected with the help of ultrasonic sensor and it will continuously communicate to the authorized control room through IOT module. Microcontroller is used to interface the sensor system with IOT system. A GUI is also developed to supervise the desired formation related to the garbage for various selected locations.

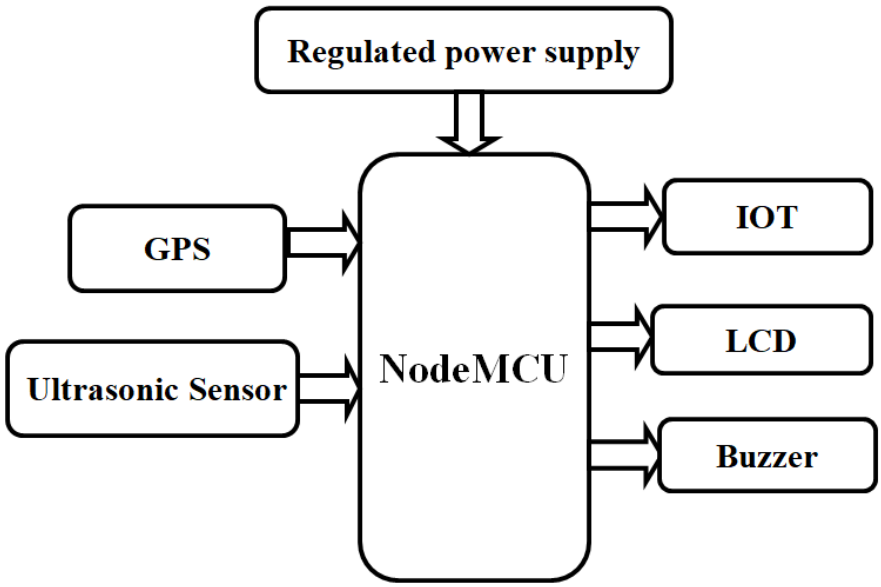

Fig. 1: Block diagram of proposed system.

Working

There are 5 modules one is regulated power supply in this adaptor converts 230 volts of AC TO 12 voltage DC by the capacitor we can reduce the noise and the voltage regulator converts the 12v of DC to 5v DC.

The 5v DC power is supplied to NodeMCU, Ultrasonic sensor, GPS module and IOT module. Input of the project is GPS module (NEO-6M) it collects the data directly from the satellite and it stores in NodeMCU control. And second input is ultrasonic sensor(HC-SR04) used to measure the dust level. Output of this project is 16 by 2 LCD which is used to display the output. And buzzer gives the alert when the bin reaches the maximum level. IOT module(ESP 8266) which is used to post the data to the user. To post the data to server we need internet through mobile by the hotspot. After connecting to the WIFI the data is posted to the web server. In the web server garbage level location and date and time is displayed. So that we can track the location.

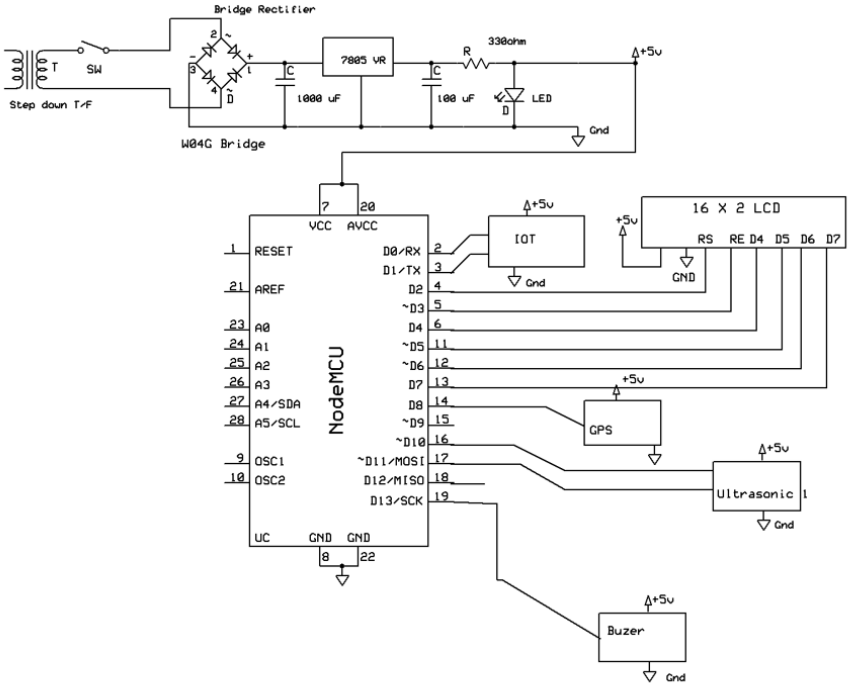

Fig. 2: Schematic diagram.

4. CONCLUSION

We designed and implemented IoT smart garbage collector using NodeMCU, Ultrasonic sensor, GPS module and IOT module. The system is able to monitor the garbage level in the bin, avoid the overflow of garbage by notifying the collector via an IOT SMS and give the precise location. The system provides an efficient and effective way of garbage collection. When the bin reaches the maximum level. IOT module (ESP 8266) which is used to post the data to the user. To post the data to server we need internet through mobile by the hotspot. After connecting to the WIFI the data is posted to the web server. In the web server garbage level location and date and time is displayed. So that we can track the location. We executed required outcomes successfully.

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