Cloud-based Server Environment for Waste Management in Hospitals

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Abstract. One of the main factors causing illness epidemics, particularly in developing nations, has historically been overfilled dumpsters. Since the idea of Internet of Things (IoT) technology has come to pass, the area of medical research—along with its new technologies—is developing quickly. By controlling chronic disorders from one end and halting their spread on the other, IoT may play an important role inside the clinical sphere. Due to the presence of patients who are recovering, the risk posed by overflowing dumpsters within the hospital is rather substantial, and it contributes significantly to the preceding statement about pathogen transmission. Garbage must be removed from hospital grounds and rooms as soon as they fill up for this reason. To ensure that no bins overflow, manual bin monitoring needs to be done frequently. However, the frequent breaks could hurt the patients who are residents. As a result, our strategy ensures that dumpsters are only cleaned when necessary, lowering the number of workers needed. The proposed cloud-based waste management system in which the dumpsters are attached with sensors that can upload the cloud's status and notify users of their waste level status. The sensor measures the amount of dust in the garbage bin. The system consists of a cutting-edge RFID sensor-tag connected with an ultrasonic sensor as well as a cloud software platform that can manage the data gathered.

Keywords: Waste Management, Cloud server, RFID, Sensor-tag, Wi-Fi.

1 Introduction

Managing trash successfully without making the city dirty is a challenge that huge cities throughout the world are currently facing. Modern garbage management systems assign a huge number of staff to a specific number to dumpsters every day [1-3]. The system is therefore ineffective and unclean, with some bins overflowing and others being just half filled. Due to this difference in the city's density of population or some other random element, it is possible to determine which area needs immediate care. This section introduces a trash management system in which each trash is fitted with a control system that alerts the necessary staff when the dumpster fills to capacity [4-5].

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Additionally, this technique allows for the separation of dry and moist waste into two distinct containers. The problem of waste management is well handled by this technology. Many apartments and apartments have been built in the area that is currently quickly urbanizing [6-8]. This is due to a huge increase in the need for housing brought on by the number of people who have moved from rural to urban regions in quest of employment. To handle the city's growing population, the state has also erected new residential buildings [9]. The residents of the flat deal with a lot of problems. The treatment of solid waste is one of these. All units share a single garbage can, which tends to fill up quickly, in contrast to individual dwellings [10]. Figure 1 shows the general architectural solution for real-time garbage collecting and monitoring.

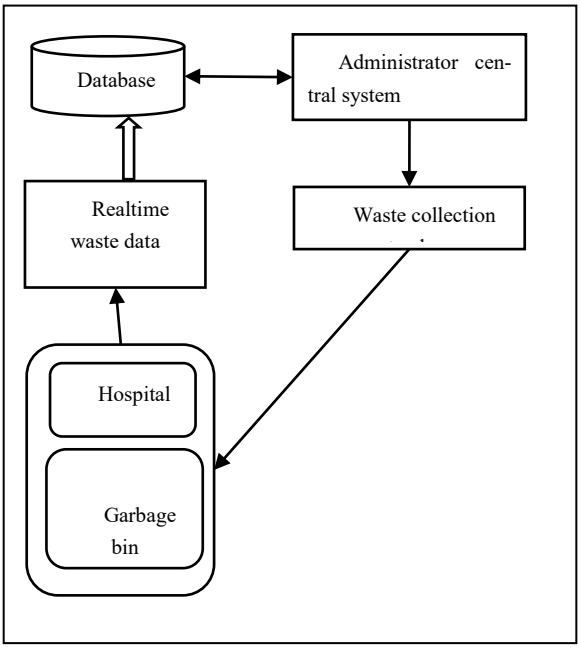

Fig. 1. Real-Time Garbage Collecting and Monitoring.

When considering how IoT could be used in smart buildings, waste management is regularly brought up. As the population continues to increase, more waste is created every day [11]. One of the primary problems, though, is that cities can't efficiently handle this waste. There are relatively few waste management techniques that don't need a lot of labor or human input. People are consequently compelled to live in unhealthy settings since some governments or organizations are unable to keep track of and control the everyday generation of waste in urban areas [12]. Keeping a tidy environment is important because of the implications it has on population lives and the image of the town.

This piled-high waste presents a sanitary issue because it could transmit illnesses like cholera and dengue [13]. Additionally, it is a waste of petrol to drive across a

complex or region only to find some garbage cans to be empty. Furthermore, if there is too much trash for the truck to transport on rare occasions, problems could occur [14]. The idea came to us when observed that the waste truck used it to circulate the town twice daily to gather solid waste. This approach was quite detailed, but it wasn't very effective. Waste management firms have employed information technology to detect stolen or misplaced bins and reduce costs.

To cut expenses and boost efficiency, intelligent systems can be very helpful in giving information that has been processed intelligently and is individualized about clients, waste treatment administrators, and services [15]. It may be simpler to put these ideas into practice by utilizing mobile technologies, such as RFID, strain gauge sensors, and so forth. Modern mobile technology called RFID, commonly referred to as a "garbage tag," can rapidly and accurately identify the RFID tag on a waste bin.

2 Literature Review

Around the world, there has been extensive research on waste management. Technology has just lately started to be used for efficient trash monitoring and collection [7]. Mahajan and Chitose have suggested a Zig-Bee-based garbage bin monitoring system. Through a brief message service, the status of the trash can is relayed to the garbage collection truck's driver [16]. The sensors in the trash cans measure the volume of trash inside each container. Similar tactics are offered by Gupta and Kumar. Utilizing RFID and GSM technologies, they have been able to communicate garbage can status. Sensor technologies in the proposed model from Bohr detect the amount of trash in the bins and transmit that information to the approved central station via a GSM system [17]. A graphical user interface (GUI) has also been created to track the pertinent data regarding trash cans at various chosen locations. This will be more advantageous for the handling of rubbish collection. The idea of smart bins is given for managing and collecting waste across the entire city.

A sensor that is attached to the smart bins collects the data needed to determine the height of the bins. The data is then further examined and shown to demonstrate the actual garbage situation in the city [18]. With the mechanisms in place now, it is impossible to broadcast both the condition of trash cans and the computation of an ideal route. It is therefore necessary to create a system that would inform garbage collection truck drivers of the state of the garbage cans in real time as well as the best path to take to get to the cans [19]. IoT concepts an intelligent waste segregation and monitoring system Three different waste types—dry, moist, and metallic—are separated in this essay. To accomplish this, sensors are employed. In [20] described a "Smart dustbin management system." Dustbins in this instance have four-directional placement and are outfitted with affordable smart electronics. A "Smart Waste Management System" suggests that these devices can be watched over by system administrators and staff to stop rubbish from moving in an undesired way.

To gather information and keep tabs on the condition of the trash in the bins, smart sensors were integrated into this paper's traditional waste management system. While it is discussed, the server is processing the information. The [21] "Implementation of

IoT based Waste segregation and Collection system “They have considered three basic entities such as sensing nodes, cloud and mobile application [22]. The sensing nodes include ultrasonic sensor, moisture sensor and gas sensor. Ultrasonic sensor provides the value of the distance available in the bin. Advanced Suburb, Intelligent Environmental Services: Implications on Structural transformation makes the case for using artificial intelligence (AI) to address the issue of managing waste, including the application of artificial neural networks for appropriate waste characterization and recognition as well as other AI technologies. The technology required to achieve smart management are also briefly described. To satisfy the area of environmental safety, an in-depth study of each element is considered [23].

Created a smart waste monitoring system that uses SMS text messages to alert the proper authorities and measures the amount of garbage in real time. The system is made to keep an eye on the trash can and send out alerts when it senses that it is filled or about full to allow prompt bin pickup [24]. The system's value comes from its ongoing efforts to increase solid waste management effectiveness. However, one drawback is that it is challenging to discover and gather the bins promptly because the communication of the condition of the bins doesn't include the bin's coordinates or coordinates [25].

The Internet of Things-based smart system for waste management continuously monitors the amount of trash in the trash cans using sensor devices. When the system detects the waste level is above the trash cans using this way, it notifies the authorized individual through GSM/GPRS. The sensor and GSM/GPRS system are connected through a microprocessor, which also functions as the system's power source. Additionally, the relevant information relating to the various levels of garbage perceived in various places is screened and coordinated using an Android application [26]. With this approach, anyone can register as a user, not only the administrator. The technology does, however, allow access to those who didn’t intend to use it, and anybody can open an account.

3 Proposed System

This study seeks to set up a cloud-based server environment for hospital waste management using IoT technologies. The main goal is to use IoT devices to control and monitor garbage disposal. As a result, hospital waste management processes will be more effective and efficient. The paper's objective is to develop a unified system that can track trash production and disposal, improve waste collection and disposal schedules, lessen waste accumulation, and lessen the environmental effect of garbage disposal. The overall objective is to create a waste management system that is cost-effective, long-lasting, and capable of meeting hospital needs while also reducing environmental impact.

The proposed model is cloud-based waste management. The continuous garbage collection process is what the suggested waste management system intends to control. The amount of municipal rubbish created by everyone can be calculated using a specifically developed RFID tag with ultrasonic sensor capabilities. A sensor on the

RFID tag fastened to the garbage can allows it to detect garbage within. To use an ultrasonic sensor at the bottom of the bin, the sensor tag can identify waste, which is a crucial feature.

This system directly receives information about the amount of trash in the bin from an ultrasonic sensor. RFID readers oversee gathering tag readings and transmitting them to a cloud server. The wifi module is used by the RFID reader to communicate to the cloud server. The waste bin status is sent to a central cloud server using microcontroller and RFID-based circuitry.

To determine the exact level of waste fill, the system will employ an ultrasonic distance measurement sensor. In this instance, an ultrasonic sensor is mounted on top of the garbage can and produces ultrasonic waves at a frequency of 50 KHz (far above human hearing range). The waves strike the garbage and bounce back to the sensor. The amount of garbage in a container is determined by the amount of time between emitting and receiving it. This module will continuously update the web server with real-time status information from all the waste bins. Figure 2 shows the proposed model.

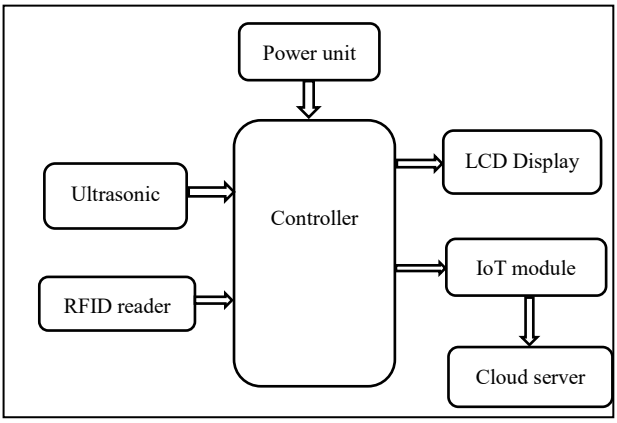

Fig. 2. Proposed Model.

These are components used in cloud-based server environment for waste management in hospitals.

1. Node MCU ESP8266
2. Ultrasonic sensor
3. RFID Reader
4. LCD display

Mostly on ESP8266 in Figure 3 shows Wi-Fi SoC, created by Espress if Systems, runs Node MCU, an open-source development environment. It is suitable for Smart

applications because it features an integrated Wi-Fi module. The system uses Node MCU because of this.

Fig. 3. Node MCU ESP8266

As soon as a launch of an ultrasonic wave occurred, an ultrasonic transmitter in Figure 4 started to produce waves in that direction. When the airborne ultrasonic wave came across obstacles, it turned around right away. Time would come to an end when the ultrasonic receiver finally picked up the reflected wave. Calculated is the sensor's separation from the targeted item. It provides exceptional non-contact range detection with dependable readings and great accuracy in an approachable design. Whether there is lighting or darkness nearby, it is ineffective. The sensor receives a voltage level of 5 VDC. Digital input for the controller is provided by the two trig & echo pins also on sensor.

Fig. 4. Ultrasonic Sensor

The device used to gather information from an RFID tag, which is used to track specific products, is called a Radio Recurrence ID Per user (RFID per user), as shown in Figure 5. Using radio frequency waves, information is transmitted from of the tag to a reader. The RFID tag needs to be close enough to an RFID reader to be read. Even when a single product is surrounded by several other products, RFID technology enables speedy scanning of many goods and rapid identification of that one product.

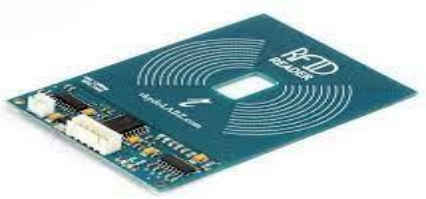

Fig. 5. RFID READER-RS232

The device used to display the information is a liquid crystal display, Figure 6. It serves as the screen for TVs, monitors, and portable electronics.

Fig. 6. LCD

The waves hit the trash and return to the sensor after impact. The duration of time between emitting and receiving garbage affects how much is in a container. The web server will be updated on a constant basis with status data from every trash can by this module. Finally, after carrying out all necessary steps in Figure 7, the system was able to put our idea on the Virtual System for cloud-based waste management. Beginning with option start, the paper's smart system for waste management flows.

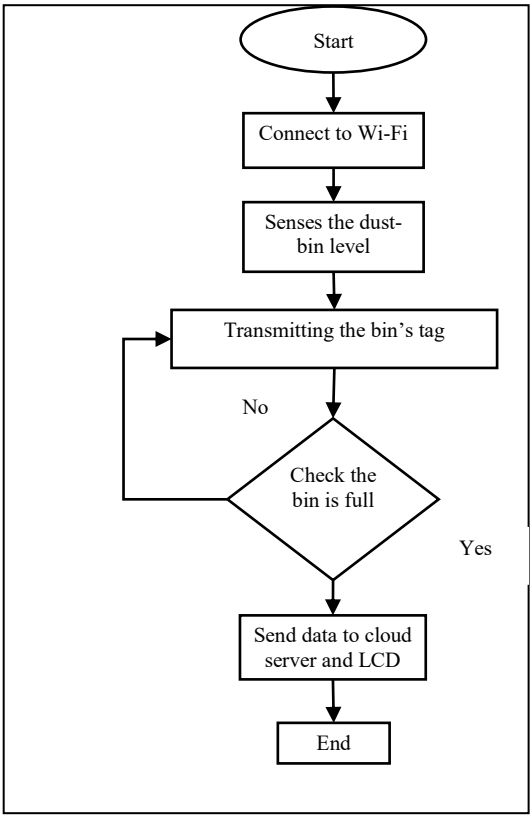

Fig. 7. LCD

To ensure that the relevant authority can quickly clean the dustbin, ultrasonic sensors are used to detect the level of garbage in the bins. When the level of garbage reaches a certain threshold, a message is sent to the relevant authority via Wi-Fi module. Until the garbage bin is not cleaned, the process is repeated. Our approach ensures that dumpsters are only cleaned when required, hence reducing the number of people required. The solution that was designed has sensors linked to the dumpsters that can upload data to the cloud and alert users to their garbage level status. The sensor calculates how much dust is present in the trash can. The system is made up of an ultrasonic sensor, a cutting-edge RFID sensor-tag, and a cloud software platform that can manage the data collected.

4 Results And Discussion

We've created a virtualized environmental administration platform for healthcare that will feature a garbage can fitted with an ultra - sonic sensor to gauge how much trash is contained inside and an Identification ID to collect data in real time. Using the internet, these two parts will be transmitted to the cloud, and they will be examined to create a wireless transmission application page. All the components use the ESP8266 Node MCU as an interface. The Arduino IDE platform has run some code. Figure 8 shows the Hardware Implementation.

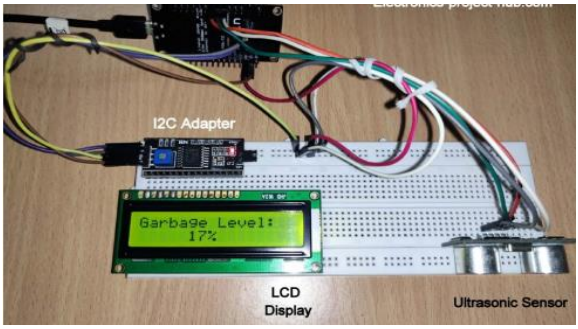

Fig. 8. Hardware Implementation

Using sensor that collect data from sensors and are controlled by a Node MCU esp8266 controller, such as ultrasonic sensor. The system can continuously track a garbage bin level and, in the event of sending data transmitting to the designated Wi-Fi module through cloud server. The hardware is put into use after the output is examined.

Ultrasonic sensors are used to gauge the amount of trash in the dustbins so that the appropriate authority may swiftly clean them. When the garbage level reaches a predetermined level, a message is transmitted through Wi-Fi module to the appropriate

authority. The procedure is repeated until the trash can is cleaned. Figure 9 shows the garbage level in server with the time factor.

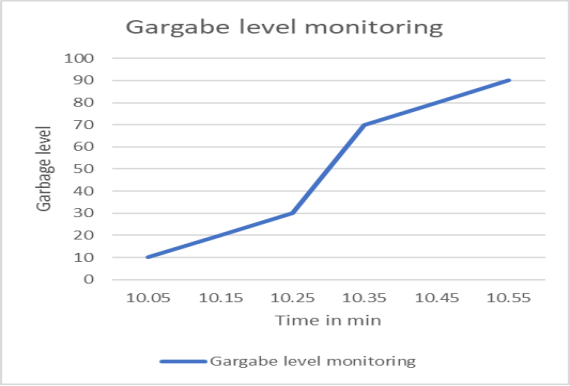

Fig. 9. Garbage Level Monitoring in Web Server

As transmitted to the cloud server in Figure 10, the waste levels in both bins are represented graphically in the image above. With the RFID ID's username and password, anyone can visit this page.

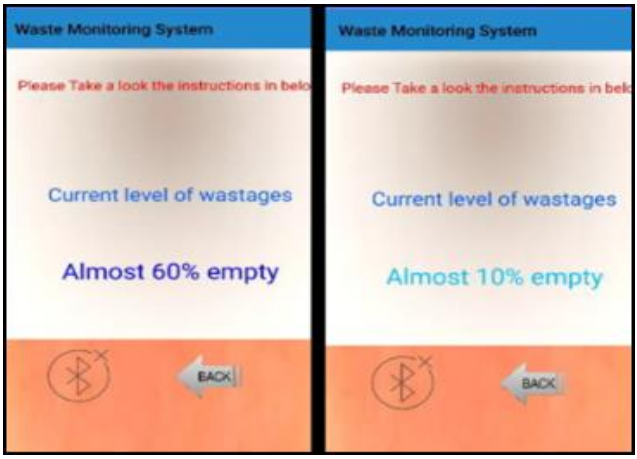

Fig. 10. Webpage of the Waste Management System

Figure 10 show the webpage of the waste management system. Using a smart phone, the system's cloud-based waste management is carried out. The sensors are used to record the garbage bin detection or not. A processing unit called a Node MCU esp8266 subsequently processes the acquired data. The processed data is subsequently sent through a wireless network. This article describes the hardware and software

designs for the accident detection alerting system. The mechanical, architectural, electrical, and electronic circuitry are all covered in the hardware section. A controller and smart phone application are programmed utilizing a transmission unit like Wi-Fi in the software component.

5 Conclusion

One of the most crucial systems, the waste management system aids in the process of environmental cleanliness and lessens the challenges associated with cleaning operations, where so many places aim to implement the hospital idea and offer more efficient services. The paper's goal is to allow real-time access to information regarding the trash can. This IOT-based waste management system has introduced real-time waste management utilizing smart trash cans that can detect when they are full or not by monitoring their fill level. The innovative cloud-based garbage collection system for hospitals aids the various stakeholders involved in this field. The management of garbage in hospitals is greatly improved by this work. The city is always kept clean without any overflow dumpsters utilizing a priority system in place of the traditional periodic collection techniques. To ensure that all the many components operate together for a seamless operation of the entire system, it has been properly tested and confirmed. Our model was created with low-cost, high-accuracy sensors, a cloud database to obtain data with high accuracy, and a NODE MCU board to provide a constant connection to the internet to the system so that the system could update the data in the cloud database. An Android app will then provide information about each bin in the cloud database.

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