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GSM POWERED SMART WASTE MANAGEMENT SYSTEM

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Abstract— The goal of this project is to create a waste management system that can monitor waste levels in real-time within a bin. The system is designed to operate on a local server without internet connectivity. An LCD will be utilized to exhibit the current garbage level in the bin, which will allow local staff to effortlessly monitor the waste levels. Moreover, a mobile app will be developed to remotely monitor waste levels over the Internet. Whenever the garbage in the bin surpasses a predetermined threshold, the system will send alerts to the management using GSM, preventing any overflow and promoting efficient waste management. To further improve the sustainability of the waste management process, the system will feature a mechanism to segregate wet and dry waste within the bin. This mechanism will aid in the efficient disposal and recycling of waste, resulting in a more environmentally friendly waste management system.

Keywords-GSM, segregator, real-time monitoring, webpage.

I. INTRODUCTION

In today's world, effective waste management is challenging to manage and dispose of waste safely and efficiently. The rise in population and urbanization has led to a significant surge in waste generation, making it increasingly challenging to manage and dispose of waste safely and efficiently. Fortunately, innovative solutions are emerging to tackle this issue, and one such solution is the GSM-powered smart waste management system. This technology enables sensors to monitor the waste levels in different types of garbage bins, including those in public areas, industries, and Wi-Fi-enabled campuses. With real-time monitoring, GSM alerts, and segregation this system enables efficient waste collection and disposal, promoting a cleaner and healthier environment. By 2030, many areas will be more developed and populated, which will lead to a rise in garbage generation. Therefore, using this paper's recommendations could help resolve this issue.

II. LITERATURE SURVEY

Bharadwaj B, Kumudha M, Gowri Chandra N, and Chaithra G [1] an approach for collecting dry and wet garbage separately was presented, with the dry trash gathered containers on the right sight of the conveyor belt. The device will use RF technology to deliver a signal to the microcontroller unit after receiving input from the dust collector via switches. To control waste, an IoT module is employed, and data is supplied to the agency and the common public. The waste collection schedule is displayed on the smartphone app as well as the vehicle's arrival date and time.

Smart Dustbins for Smart Cities" was published by Bikramjit Singh and Manpreet Kaur [2]. The Government of India introduced a smart city innovation, and to make these smart cities effective, the garbage collection system must improve. Every trashcan is fitted with a sensor that detects the level of filling and sends the data to a server.

Authors Prasun Chowdhury, Rittika Sen, Dhruba Ray, Purushottam Roy, and Souradeep Sarkar, [3] proposed a system called "Garbage Monitoring and Disposal System for Smart City Using IOT" which differentiate biodegradable and non-biodegradable waste by using ultrasonic sensor to measure the level of bin and MQ4 sensor to measure the odour level and the measured information will be sent to authorities using NodeMCU web server. The author also proposes SOS operation in the app, so that if the IOT system fails then an individual can send the message to the authorities.

III. PROPOSED SYSTEM

The proposed system aims to provide real-time monitoring of waste levels, segregation of wet and dry waste in a bin and sending alert messages when the bin is filled. It uses a variety of components, including ultrasonic sensors, a moisture sensor, an LCD, a servo motor, and a GSM module to achieve this goal. The system also includes a Node MCU, a web page to display real-time monitoring data locally (without the Internet), and an Android app for remote monitoring (through the Internet). The ultrasonic sensors detect the garbage level in the bin, while the moisture sensor determines whether the waste is wet or dry. Based on the waste type detected, the servo motor rotates the bin accordingly. The GSM module sends alerts to the management when garbage overflow occurs. This entire NodeMCU communicates via serial communication with STM 32 and gets the data from ultrasonic sensors. This system uses

Firebase to send data to the app, which displays real-time monitoring. Data Firebase is a cloud-based platform that provides a wide range of tools and services for developing and running mobile and web applications when garbage overflows a certain threshold level. Overall, the proposed system provides an effective solution for real-time monitoring of waste levels and segregation of wet and dry waste in a bin, with remote monitoring capabilities using an Android app.

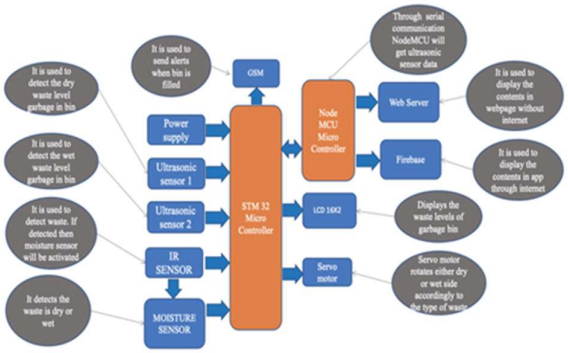

Fig.1: Block Diagram of Proposed System

Hardware Implementation is done using the below-mentioned components along with each of their functionalities.

Ultrasonic Sensor

An ultrasonic sensor is a device that emits ultrasonic waves of sound to get the distance of a target and converts the reflected sound waves into an electrical signal. Ultrasonic sensors have two main components: the transmitter (which emits the sound using a piezoelectric crystal) and the receiver (which detects the sound after it has travelled to and from the object). The bin utilizes ultrasonic sensors to detect and quantify the amount of waste it contains.

NodeMCU

The NodeMCU (Node Microcontroller Unit) is a small electronic module that can be programmed to perform a variety of tasks. It is based on the ESP8266 microcontroller and is compatible with the Arduino programming environment. The NodeMCU has built-in Wi-Fi capabilities, making it ideal for Internet of Things (IoT) applications.

STM 32

It is a small electronic module that can be programmed to perform various tasks. STM32 microcontrollers, developed by STMicroelectronics, are small, powerful chips based on the ARM Cortex-M architecture.

Programming is typically done using C/C++ with IDEs like STM32CubeIDE and is compatible with the Arduino programming environment. STM 32 microcontrollers are widely used in IoT, consumer electronics, and industrial automation.

LCD (I2C)

It is used to display dry and wet waste levels of contents.

Servo motor

A servo motor is a small device that can move in a specific direction or angle. It is a type of DC motor that can rotate to a specific angle with high precision and accuracy, making it ideal for applications that require precise control of movement. The servo motor is compact and

lightweight, making it easy to integrate into projects with limited space. It is used for segregation in this project.

IR Sensor

An infrared (IR) sensor is a type of electronic device that detects and measures infrared radiation emitted by objects. If an object is detected then a moisture sensor will be activated.

Moisture Sensor

A moisture sensor is a device used to measure the amount of moisture in a material or an environment. Moisture sensors measure changes in the electrical conductivity or capacitance of a material caused by moisture. In this project, we have used it to detect whether the waste is wet or dry.

GSM Module

A GSM module is a device that allows communication between electronic devices and the GSM mobile network. usually consists of a SIM card slot, an antenna and a set of electronics that allows communication with the mobile network. The GSM module enables remote communication using AT commands via UART. It can be used to send alert messages when the bin is filled.

Software Implementation includes the programming part done in Arduino IDE software by the following steps:

Step 1: Open Arduino IDE and click on File
and open a new sketch.

Step 2: After typing the code, save it.

Step 3: Select the board and verify the code.

Step 4: After completion of Compiling the sketch if no errors, then upload the code into the microcontroller board.

Fig.2: Arduino IDE

HTTP server

A web server is a computer program that stores, processes and delivers web pages to web clients, such as web browsers used on computers and phones. To communicate with a web server, web clients and servers use a protocol called Hypertext Transfer Protocol (HTTP). When a client wants to access a particular web page, it sends an HTTP request to the server. The server then responds by sending the requested web page or an error message if the page cannot be found. In Station (STA) mode, the ESP8266 (a low-cost Wi-Fi microchip) can connect to an existing Wi-Fi network created by a wireless router. When in STA mode, the ESP8266 obtains an IP address from the router, which enables it to set up a web server and serve web pages to all devices connected to the same Wi-Fi network.

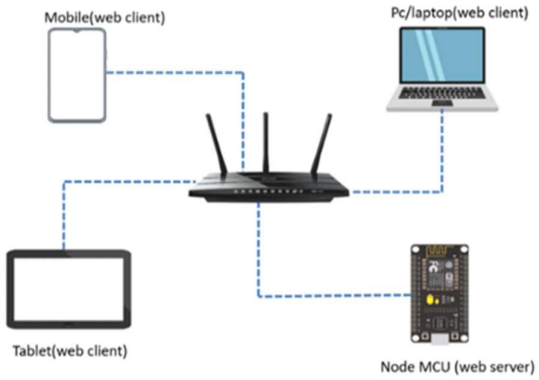

Fig.3: HTTP Web Server

Real-Time monitoring through a mobile application

This real-time monitoring application combines the components of a sensor, NodeMCU, Wi-Fi router and Firebase to provide continuous information on sensor data.

The sensor collects data and sends it to the NodeMCU, microcontroller which, is connected to the Wi-Fi

Fig.4: Real-Time Monitoring through App

router. The router then transmits the data to the Firebase. Firebase is an advanced cloud-based platform It streamlines the development of mobile and web applications, with a strong focus on delivering outstanding user experiences. This data is then accessible to a mobile application that is connected to a Firebase. The mobile application users monitor the sensor data in real time, giving a way to analyze the information provided by the sensor. Overall this type of application is useful for real-time monitoring of data and can be applied to a variety of applications where sensor data needs to be collected and analyzed in the real-time application.

IV. RESULTS

The waste management system proposed in this project aims to create an efficient and sustainable waste management process. The system utilizes various components, such as an LCD, a mobile app, GSM, and a mechanism for segregating wet and dry waste. The system can operate locally without internet connectivity, making it suitable for use in areas with limited internet access. The system's LCD provides real-time monitoring of waste levels, allowing local staff to keep track of the garbage level in the bin easily. The mobile app developed for the system provides remote monitoring capabilities,

allowing management to monitor the waste levels from anywhere with internet connectivity. The message alert will send to management through GSM when the garbage level in the bin

leads to a certain threshold level. This feature contributes to creating a more sustainable waste management system that is environmentally friendly.

Fig.5.1: Real-time monitoring through local area network in a webpage (without internet)

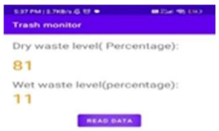

Fig.5.2 Real-time monitoring through a mobile application (with the internet)

Fig.5.3: Displaying the wet and dry waste levels in LCD

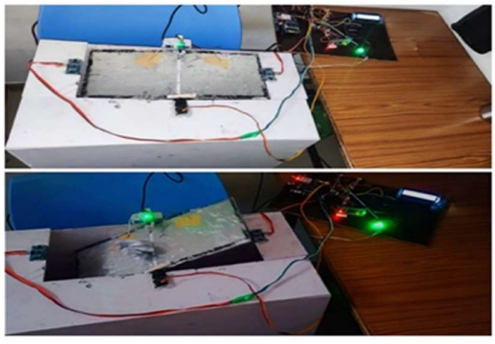

Fig.5.4: segregating the wet and dry waste

Fig.5.5: Alert messages when the bin is filled

V. CONCLUSION

The proposed waste management system is designed to monitor waste levels in real time using ultrasonic sensors, without the need for an internet connection. The system includes an LCD to show the current garbage level within the bin, while a mobile app enables remote monitoring of waste levels over the internet. The system will send alerts to the management using GSM whenever the garbage in the bin reaches a certain threshold, preventing any overflow and promoting efficient waste management. Moreover, the system features a mechanism to segregate wet and dry waste in the bin, improving the efficiency of waste disposal and promoting environmental sustainability. Overall, this system provides an effective solution for monitoring waste levels and managing waste efficiently, contributing to a cleaner and healthier environment.

VI. FUTURE SCOPE

The scope of future work is that this system can be implemented by incorporating harmful gaseous detection capabilities. By integrating gas sensors into the system, it becomes possible to detect and monitor harmful gases emitted from waste, such as methane or volatile organic compounds (VOCs). This enhancement can help identify potential health and environmental risks, allowing for timely actions to mitigate any harmful effects. Additionally, the collected data on gaseous emissions can contribute to better waste management strategies and decision-making processes aimed at reducing pollution and ensuring the safety of waste-handling operations.

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