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IoT-Based Smart Waste Management System and Alert Generation System

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A B S T R A C T

The system suggested is a proposal put forth for the benefit of society's members, who suffer greatly from the constant presence of garbage cans close to their residences and the nauseating smell that results from the accumulated trash. Due to poor municipal administration, the trash can frequently remain full because there is no quick fix, forcing residents to make accommodations. We devised a smart waste management system to detect the amount of trash accumulated in the trash cans and alert the company when the can is full so that immediate action can be done to address the issue. The system uses servo motors, an Arduino UNO, and ultrasonic sensors as its IoT components. Keywords – Smart alert system, waste management, Internet of Things, Garbage Collection.

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1. Introduction: -

The key to a "Smart City" is the absolute necessity of the moment for a nation that is developing. The significant ecological elements that pose danger to this may include dangerous pollution and the ensuing consequences on human health, worrisome global warming, ozone layer depletion, etc. Municipal Solid Leftovers may be mostly to blame for environmental contamination. [1] For the removal of the produced municipal solid waste to be efficient and effective, proper maintenance becomes necessary. It is believed that the irregular elimination of garbage from the dustbin frequently causes the waste space to become overcrowded. This explanation puts forth an electronic monitoring system that incorporates web-based software, an embedded system, and RFID and IoT technology. [2] The planned technology would allow for effective monitoring of the waste collection status. This design specifies a method through which the garbage level is able to be checked often, preventing the unintentional overflow of the bin. Additionally, it provides a facility to notify the cleaning authority upon discovery of any spills. The ultrasonic sensor could sense or keep track of the dustbin's original level height as well as its current fill level.

The Arduino UNO is programmed so that when a certain degree of filling is detected, an information message asking for a clean-up is sent. One important factor to take into account while trying to improve the environment in metropolitan areas is solid waste management. With accelerated urbanization and a rising population, solid waste has become important and difficult. If waste is not managed and collected in a timely manner, the environment will become dirty and polluted. A better waste management strategy can contribute to a neighborhood's improvement and the general well-being of a community.

Many Internets of Things (IoT)-based waste management solutions are being used today to increase the efficiency of rubbish collection and ensure that it's safe for everyone who lives on this lovely planet. [3] , [4], [5]. When the trash can is filled to capacity, some IoT-based waste management solutions [6], [7], [8] send out a notification alert for prompt waste pickup. a system with the Internet of Things, that is affordable and can track regular rubbish Monitoring garbage bins, dynamic scheduling, and navigation of trash collection trucks are all made possible by an IoT-based solid waste management system in a smart city. [9], [10].

The state-of-the-art solution, for instance in terms of a self-powered solution, is brought together here after an assessment of existing IoT-enabled solutions in smart cities' waste management.

II. LITERATURE SURVEY: -

N. S. Kumar et al, [11] this paper propose a smart alert system for garbage clearance by giving an alert signal to the municipal web server for instant cleaning of a dustbin with proper verification based on the level of garbage filling. This process is aided by the ultrasonic sensor which is interfaced with Arduino UNO to check the level of garbage filled in the dustbin and sends the alert to the municipal web server once the garbage is filled. After cleaning the dustbin, the driver confirms the task of emptying the garbage with the aid of an RFID Tag. M. Furqan Durrani et al, [12] a central control unit and an electronic waste-detecting device make up the Automated Waste Controlling Management System.

A GSM module for transmitting the message with information about the waste bin being full or empty, a sensor with infrared wavelengths for monitoring waste levels, a GPS for position identification, an Arduino board with a microprocessor, and other components. The central control unit consists of a receiving device that uses the microcontroller on an Arduino Board to deliver messages to the computer software through a USB cable after receiving them from the waste-detecting device via a GSM Module. S. Balamurugan et al, [13] the authors of this work have created a low-cost, low-power waste management system that can be used in areas with weak economies. As opposed to daily collection, this technique enables us to pick up the garbage as and when the container is full or when the waste within is decomposing.

This was created utilizing an Arduino Uno development board, along with extra modules like a GSM module for message sending. Z. Hisham Che Soh et al, [14] in order to keep track of the waste at the chosen site of the garbage collection area, this article proposes a smart garbage pickup monitoring and alerting system based on the Internet of Things. To monitor the level of trash bin garbage, the system is developed employing an ultrasonic sensor that is coupled to an Arduino UNO. In this system, the Ubidots IoT Cloud will receive waste bin depth level data via an Internet connection and Arduino Ethernet Shield. Mohan et al, [15] with the use of IoT, this research suggests a smart waste collecting system. The municipality centre will receive information to help with the timely collection of rubbish.

An Arduino Uno microprocessor is connected to an ultrasound sensor, a weight sensor, and a MQ gas sensor to support this method. An alert is sent to the Municipality server when the values the sensors read cross a threshold. With the aid of this system, the garbage collection's progress may be monitored in real-time. M. R. M et al, [16] this paper provides information about the cleaning system to the assortment vehicle, saving time, money, and energy. As it destroys a flood of compartments, the suggested work is straightforward to employ. Given that the IoT helps keep the environment clean and the population healthy, it is important for vibrant urban areas. R. I. Rifat et al, [17] this study illustrates a strong design of the waste disposal infrastructure that guarantees proper waste storage for a constrained amount of time.

The suggested gadget was created using an Arduino Mega microcontroller, USR-C215 IoT WiFi, GPS, and GSM modules, as well as ultrasonic and infrared sensors. When waste is placed in the trashcan, if it fills to the top, an alarm will sound to notify those who collect that the garbage can is full, saving time and preventing spills. The primary goal of this article is to create a highly effective waste management system that is economical and will conveniently assemble the waste collection. T. Ji Sheng et al., [18] this study shows how a welldesigned waste disposal infrastructure may ensure proper waste storage for a set period of time. An Arduino Mega microcontroller, USR-C215 IoT wireless internet, GPS, and GSM modules, along with infrared and ultrasonic sensors, were used to build the recommended device.

To save time and avoid spillage, when the trash is put in the tactic if it fills the container's top, a sound will ring to alert individuals who collect when the disposal container is full.

The main objective of this essay is to develop an affordable, highly efficient system for handling waste that will easily assemble of waste. S. Madhunala et al, [19] the Big Bins and Small Bin are the two main subsystems that make up the proposed system. To gather the trash from Small Bins positioned in various areas, the Big Bin moves along a predetermined, regular path that is highlighted by a black line at regular intervals. The suggested system is an innovative method that may fully automate the process of waste collecting and disposal to ensure a clean environment. P. P. Rao et al, [20] the suggested neural network model had an accuracy of 80% in predicting garbage levels.

Results attest to the accuracy of the rubbish level forecast. Bar charts were also used to assess the data. Combining IoT along with deep learning has the potential to revolutionize technology and be used in trash management. In order to decrease waste bin overflow, local authorities may implement an effective garbage management system with the aid of forecasting and analysis of garbage levels.

III. METHODLOGY

This section will provide a quick summary of the project development and methods. This idea offered a mechanism to prevent waste from overflowing the trash can and send a reminder to the cleaner to collect the trash. The planned technology would allow for efficient monitoring of garbage collection status. This project identifies a method that would allow for routine garbage level monitoring in order to prevent bin overflow. The ultrasonic sensor could sense/monitor the dustbin's original level height and waste level as it was filling up. The Arduino UNO is programmed with such a way that when a certain amount of filling is detected, information is given to the user as a message asking them to clear the trash can.
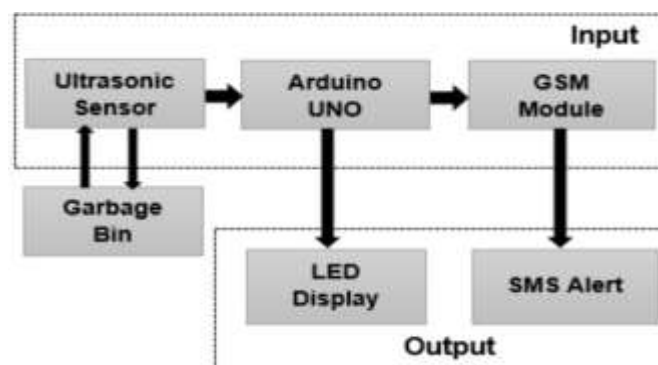
Figure 3.1 Block Diagram

Referring to the above diagram the module contains an Arduino UNO Microcontroller for the connectivity of all the sensors as the brain of this system. Other sensors like ultrasonic, servo motor, GSM, LED Display, and connecting wires are used here for making a smart dustbin.

Hardware Components:

- **Arduino UNO**:

Figure 3.2 Arduino UNO (Microcontroller)

A low-cost, adaptable, and simple-to-use programmable microcontroller board called Arduino UNO is available for use in a range of electronic applications. Relays, LEDs, servos, and motors can be controlled by this board as output devices, and it can communicate with other Arduino boards, Arduino shields, and Raspberry Pi boards.

- **Ultrasonic Sensor:**

Figure 3.3 Ultrasonic Sensor

An ultrasonic sensor is a device that uses ultrasonic sound waves to calculate the distance to an item. An ultrasonic sensor transmits and receives ultrasonic pulses using a transducer to determine the proximity of an item.

- **Servo Motor:**

Figure 3.4 Servo Motor

The dustbin lid can be opened with the aid of a servo motor. With the help of this servo motor, the Arduino is programmed to automatically open the lid after detecting waste using an ultrasonic sensor.

- **LED Display:**

Figure 3.5 LED Display

Liquid crystal displays, or LCDs, are utilized in embedding system applications to display different system data and statuses. A 16-pin gadget called an LCD 16x2 has two rows with room for 16 characters apiece. You can use the LCD 16x2 in either 4-bit or 8-bit mode.

- **GSM Module:**

Figure 3.6 GSM Module

An Individualized Global System for Mobile Communications With the use of SMS and the GSM module, wireless radiation monitoring is possible. This module can send text SMS data to a host server after receiving serial messages from radiation monitoring equipment like survey meters and area monitors.

Working:

- The Arduino mega 2560 board, which is a microcontroller-based platform, is the foundation for the smart bin. It is interfaced with an ultrasonic sensor and a moisture sensor.

- At the top of the trash can is an ultrasonic sensor that will measure the bin's height. 20 cm is the threshold height.

- The Arduino will be configured such that a notification will be sent to the waste collector when the trashcan is filled.

- When the level of rubbish hits the threshold, an ultrasonic sensor will notify the appropriate authority and continue to do so until the trash is crushed.

- Anyone can reuse the trashcan after it has been crushed.

The LCD display is an output device connected to an Arduino Uno, and the ultrasonic sensor was a data input device in the block diagram that follows. In this case, an Arduino Uno will serve as a controller and send and receive data. The information is sent from the ultrasonic sensor to the Arduino Nano, which then receives it from the GPS and GSM systems and delivers it to the NMC.
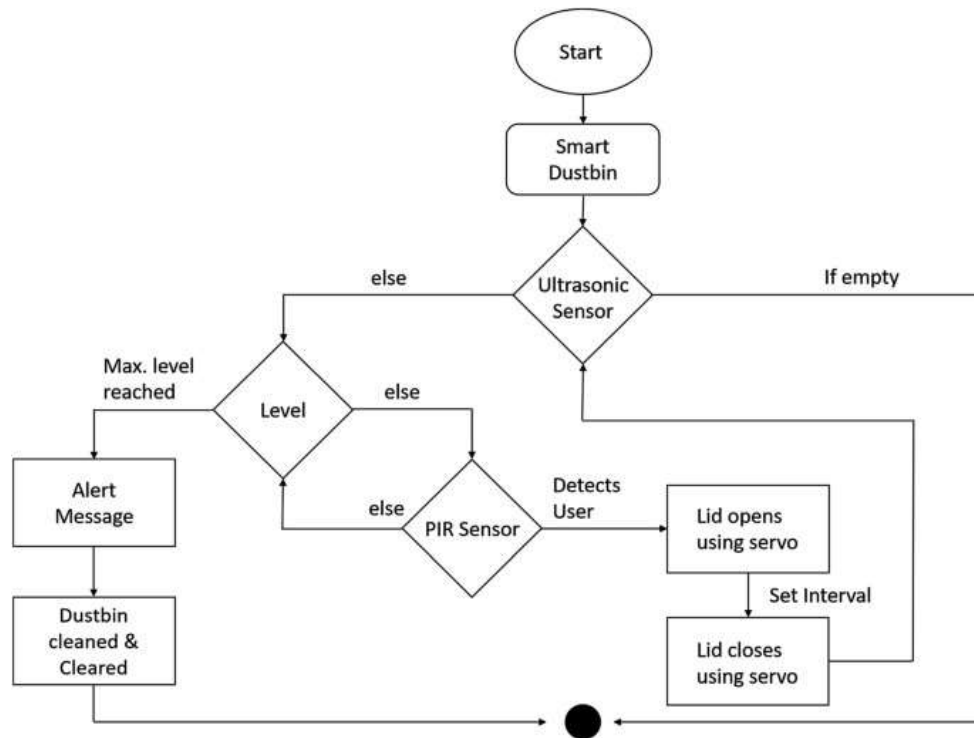
Figure 3.7 Proposed system Flow Diagram

IV. RESULTS

V. CONCLUSION

With the help of ultrasonic sensor systems and the Arduino Uno with Arduino Ethernet Shield technology, we suggest a fresh approach to improving waste collection's effectiveness. The proposed system makes it possible to efficiently control and prevent waste overflow. This will notify the authorized individual using a web portal, sending them an SMS. The current garbage collection infrastructure and management system are insufficient for the demands of the time.

Therefore, greater rubbish collection and transportation facilities need to be offered. The frequency of the waste collection vehicle's arrival is decreased because this technology alerts users when the trash can is totally full. Finally, this technique contributes to environmental preservation.

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