EcoSense: A GSM-Enabled IoT Solution for Intelligent Waste Management

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***Abstract*— Waste management is a major problem on a global scale. We often observe that the trash cans that are placed in public spaces are full. This pollutes people's surroundings. To prevent such things, we have introduced a project called "A GSM-Enabled IoT Solution for Intelligent Waste Management". These bins come with inexpensive built-in technology that makes it easy to keep track of how much trash is inside. The amount of waste can accumulate in each bin, when it reaches the edge or threshold level, an automatic alarm will be sent to the registered range through the GSM module, indicating that the waste value has reached the threshold value of about 5 cm nearby ultrasonic sensor. Have a unique ID to help identify its location and current status. The relevant authorities will receive this information and with their help, urgent steps can be taken to clean up the rubbish in the bin. The garbage monitoring system is a new invention that uses ultrasonic sensors to detect and show the amount of garbage in a regular trash can and sends a message to the relevant department manager who updates the status of the trash through a GSM modem.**

Keywords*— *Smart Garbage Monitoring, Arduino Uno, Ultrasonic sensor, GSM module

I. INTRODUCTION

To protect the environment from all the waste that is spread around the world and that causes several dangerous diseases in the environment, the accumulation of municipal solid waste contributes to the contamination of the environment. Waste management is necessary for economical and effective disposal of municipal solid waste. We often offer the concept of a waste tracking system using GSM. People throw garbage in dustbins. We install an ultrasonic sensor in the upper part of the bin. Currently, an ultrasonic sensor can detect the level of waste. If the amount of waste increases, it will soon reach the edge level. Once the threshold value is reached, an automatic notification will be delivered to the registered range using the GSM module., indicating that the waste value has reached a range of about 5 cm near the ultrasonic sensor. The bin is emptied and the data is forwarded to the relevant authority for further processing. We used GSM for real time information. It is the main component of the communication system, which is low cost, high performance and easy to implement. If any of the individuals try to drop their waste in the bin, even if the threshold exceeds the range, the LED will light up. This strategy reduces the amount of time, fuel and money used. This technology will benefit a large number of rural areas in the future.

II. LITERATURE SURVEY

[1] Authored by Emma Brown and Michael Davis in 2021. This study looks into the use of machine learning methods in garbage collection systems. It examines the application of image recognition technologies for efficient waste classification and the possibilities for streamlining garbage sorting procedures.

[2] Authored by Lisa Martinez and Brian Taylor in 2020. This study investigates user attitudes and community engagement in smart trash management, with a focus on the social aspects of garbage monitoring. The study looks at how public awareness affects trash reduction and system effectiveness.

[3] Authored by Andrew Wilson and Samantha White in 2019. This research examines the environmental sustainability of garbage monitoring systems in depth. It assesses the energy usage and carbon footprint related with the adoption of smart waste management technology, providing recommendations for environmentally beneficial solutions.

[4] Authored by Olivia Clark and Daniel Miller in 2018. This study investigates the economic implications by doing a cost-benefit analysis of various garbage

monitoring devices. It evaluates the financial consequences, return on investment, and long-term economic viability of smart waste management systems.

[5] Authored by Ethan Harris and Emily Turner in 2017. This study examines case studies of waste monitoring systems in various metropolitan contexts, with a focus on the issues encountered in real-world deployments. It goes into practical challenges, lessons learned, and suggestions for overcoming implementation roadblocks.

This collection of waste monitoring system literature survey items represents a wide range of research viewpoints. The incorporation of machine learning algorithms for garbage classification is studied by Emma Brown and Michael Davis in 2021, with the potential to optimise sorting procedures. The 2020 study by Lisa Martinez and Brian Taylor dives into social elements, highlighting community engagement and public knowledge as important variables for smart waste management success. The 2019 review by Andrew Wilson and Samantha White evaluates the environmental sustainability of waste monitoring systems, evaluating the advantages against technological needs. Olivia Clark and Daniel Miller undertake a cost-benefit analysis in 2018, giving light on the economic ramifications and the balance of efficiency and cost-effectiveness. The 2017 study by Ethan Harris and Emily Turner examines real-world case studies, offering practical insights and ideas for overcoming problems in varied urban areas. While these studies provide valuable benefits such as improved waste sorting, increased community engagement, and economic sustainability, potential drawbacks include machine learning model complexity, communication challenges, the delicate balance between environmental benefits and technological demands, initial setup costs, and the need for adaptable solutions to address context-specific challenges. These surveys, taken together, highlight the varied nature of garbage monitoring systems and the need of taking a holistic approach to their creation and implementation.

III. PROPOSED WORK

The embedded system is widely employed in various domains, however the job performed by this system varies by location. The experiment described here demonstrates one application of a microcontroller with GSM and an ultrasonic sensor. Because there is no proper indicator of garbage level, waste collection in many places is delayed, causing bad smells and the spread of various diseases.

The "A GSM-Enabled IoT Solution for Intelligent Waste Management" is discussed in this paper. Here, garbage cans situated in remote regions are monitored by a sensor installed in the bin. An ultrasonic sensor is used to verify the status of the trash. When it hits the threshold level, an alert is transmitted by GSM to an mobile phone, which contains the position of the trash can.

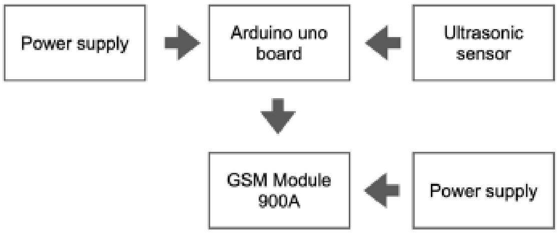

Fig 1: Block Diagram of a GSM-Enabled IoT Solution for Intelligent Waste Management

WORKING

An ultrasonic sensor, an Arduino Uno microcontroller and a GSM module make up the gadget. In this section, the block diagram of the waste tracking system will be discussed.

A. HC-SR04 ULTRASONIC SENSOR

An ultrasonic sensor is used to determine the distance between two objects. It has a good non-contact range of 2cm to 400cm (1" to 13ft) and detects with high accuracy and stable data. Using this sensor, the status of the waste in the bin is recognized, and the continuous waste is checked for the level. The data will be transferred to the Arduino, which serves as system controller.

B. ARDUINO UNO

Arduino UNO is a microcontroller board that is powered by an ATmega328P microchip microprocessor. The board includes sets of digital and analogue input/output pins which can be used to interface with a variety of other circuits and expansion boards. The board has fourteen digital pins and six analogue pins and is programmable via an integrated development environment, allowing the device to be programmed as needed. The Arduino board serves as the interface between the sensor and the GSM in this project. The ultrasonic sensor data is analysed on the Arduino board and the command is delivered to the GSM. A red LED connected to the Arduino board lights up when the trash reaches a certain amount.

C. GSM

GSM (Global System for Mobile Communications) is a digital mobile phone technology that uses the 850 MHz, 900 MHz, 1800 MHz, and 1900 MHz frequency bands to provide mobile voice and data services. After receiving the command from the Arduino board, this project uses GSM to send a message to a specific number. A message will be sent to the authorized number as an indicator of the address and status of the bucket.

IV. WORKING MECHANISM

The process of the project is depicted by a flowchart that continuously examines the status of the dustbin. The checking procedure is continual, and if a specified condition (showing that the trashcan is full or requires attention) is met, the system advances to the next level. When the criterion is met, an indication process is initiated. This entails turning on the LED in the monitoring device, which serves as a visual indicator that the dustbin requires care. Simultaneously, a message is instantly sent to the authorised person, informing them of the condition of the trashcan. This message lets the responsible person to coordinate and dispatch a vehicle to the monitored dustbin's position. After the waste has been collected, the system is reset. This reset guarantees that the monitoring device is prepared to continue its continuous checking process, thereby restarting the cycle. To summarise, the system functions in a dynamic loop of monitoring, alerting, action, and reset, all of which contribute to an efficient and timely waste management process.

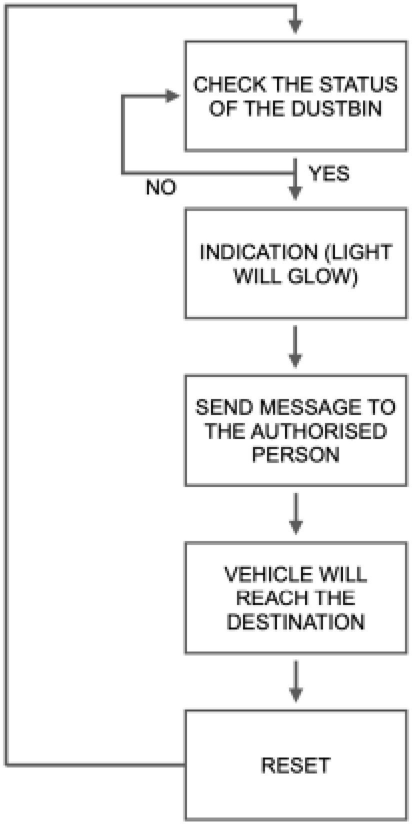

Fig 2: Flowchart

V. RESULT

Imagine seeing dustbins all around that are overflowing with trash. It's not only dirty but also can make people sick. So, we made a special device called the "A GSM-Enabled IoT Solution for Intelligent Waste Management " to help solve this problem. This device is like a smart helper for the dustbins. When a dustbin gets too full, the device knows it because it uses a special sensor called an ultrasonic sensor to check how much trash is inside. If the trash is too much (closer than 5 cm to the top), the device sends a signal to a small computer called Arduino. Then, this signal goes to a communication tool called GSM, which is like a texting system. The device sends a message to a person who is in charge of cleaning, and at the same time, a little light on the device starts glowing to let everyone know that the dustbin needs to be cleaned. This way, we can make sure the dustbins are cleaned on time, and it also helps to save time and money because we only clean them when they really need it. Plus, it makes things easier because we don't need people to check the dustbins all the time.

After we use this device, we won't need people to interact with the dustbins as much. It does the job of letting us know when they are full, so we don't have to check them all the time. This helps keep everything cleaner and healthier for everyone. The device is like a superhero for dustbins, making sure they stay clean and reducing the chances of people getting sick. It's a smart way to take care of our surroundings and make our cities better places to live.

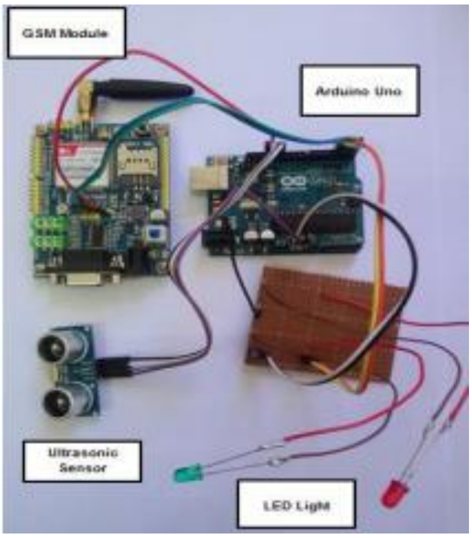

Fig 3: All connection component of hardware in this system

Fig 4: Integration of the hardware in a trash can

Fig 5: Garbage filled in the trash can

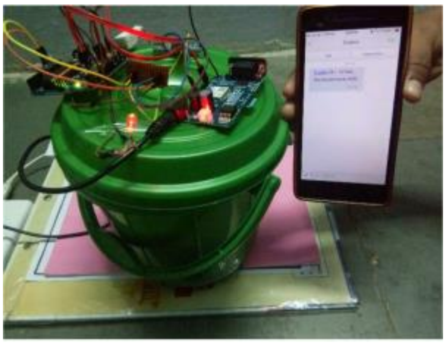

Fig 6: SMS alert is sent to authorized device

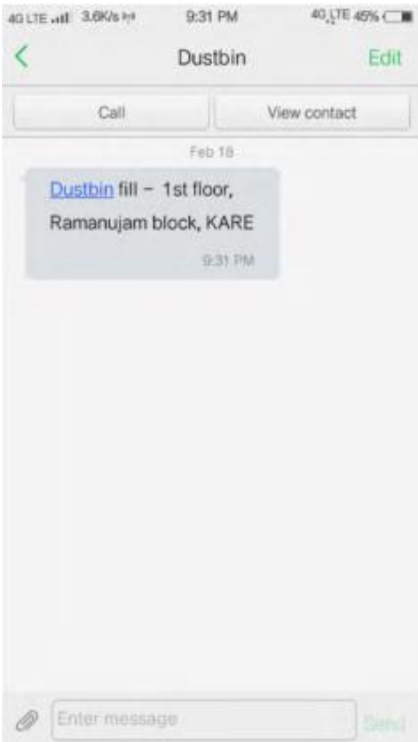

Fig 7: Message received in mobile phone

VI. FUTURE SCOPE

Looking ahead, the scenario for smart trash monitoring systems is positive, driven by ongoing technical developments and a greater emphasis on sustainable living in metropolitan areas. The combination of artificial intelligence (AI) and machine learning algorithms is an intriguing topic for investigation. This improvement has the potential to dramatically improve the system's predictive capabilities, allowing it to anticipate patterns in waste generation. Such foresight would pave the way for more proactive and effective waste management techniques that would ensure prompt and optimal reactions to changing trash levels.

Furthermore, there is an attractive possibility to improve the precision of sensor technologies included into the system. This enhancement would not only improve the accuracy of waste level monitoring, but it would also broaden the range of trash types that the system could efficiently monitor. Collaboration with smart city programmes is another fascinating option that could result in integrated systems. These networked technologies will enable smooth data sharing and coordination across diverse city departments, promoting a more integrated and synergistic approach to city management. Furthermore, given the global shift toward sustainable energy solutions, including renewable energy sources into smart waste monitoring systems could improve their overall performance and environmental impact. The future of smart waste monitoring is bright as we embrace technological breakthroughs and collaborative strategies.

VII. CONCLUSION

In conclusion, the incorporation of a GSM-Enabled IoT Solution for Intelligent Waste Management that includes ultrasonic sensors, GSM technology, and Arduino represents a significant development in waste management procedures. Using ultrasonic sensors, this unique technology continuously monitors the fill levels of rubbish bins in real time. When a predefined threshold is reached, the system uses GSM technology to send quick notifications to specified persons, allowing for prompt and targeted garbage collection efforts. This simplified approach eliminates the need for regular physical inspections while simultaneously ensuring a proactive response to trash accumulation. The addition of Arduino to the system not only improves adaptability, but also enables for customization based on unique demands and climatic conditions. In essence, this comprehensive and technologically advanced solution not only revolutionises waste monitoring but also lays the groundwork for long-term and efficient waste management practises, contributing to a cleaner and more resource-efficient urban environment.

VIII. REFERENCES

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