Industrial Waste Management And Fire Detection Using ArduinoUNO

G Harikiran[1], B Govardhan[2], T Vishal[3] and Mr D Veeraswamy[4]

[1] Undergraduate Student, Institute of Aeronautical Engineering(Autonomous), JNTUH, Telangana - 500043

[2] Undergraduate Student, Institute of Aeronautical Engineering(Autonomous), JNTUH, Telangana - 500043

[3] Undergraduate Student, Institute of Aeronautical Engineering(Autonomous), JNTUH, Telangana - 500043

[4]Associate Professor, Institute of Aeronautical Engineering(Autonomous), JNTUH, Telangana - 500043

Abstract: - At present, people all over the world have come up with various systems using the Internet of Things (IoT) technology making human life smart. Since the mobile communication and the internet took a form that is accessible anywhere and at any time, there is a lot of latitude to manipulate the devices from remote locations. The solid waste management is one of the major concerns today worldwide because of the improper implementation of garbage removal from the villages, towns, and cities endangers the residents and it is the source for new diseases. Therefore with the concern of time, it is always important to incorporate some technology to resolve the issue of garbage management. In a conventional existing system, if monitoring and related activities and also garbage disposal are done by mankind, it becomes time-consuming, hence complementing the conventional approach with some aspects of IoT, then trashing of dirt bins will be manageable. some drawbacks are fire detection when fire occurs in dustbin. Why because it will imagine different ends and will imagine some other details which are also important like information needed about the exact starting point of the fire and information about the possibility to reach the building security office because we need to get in touch with a person who's main purpose there is to look after the place all the time. If there is a risk of fire accident how should we connect all security members to the system as to get a message when a fire has occurred out accidentially in order to cut down the time used in evacuation procedures? Once a security guard receives such a warning, within a few seconds,

everybody in the vicinity of the fire alarm will be a victim of the fire. And the same scenario will be repeated by all the security personnel at every point of the fire parameters.

Keywords: ***garbage, sensors, smart cities, and the internet of things (IoT).***

1. INTRODUCTION

The increased usage of packaged goods, textiles, paper, food, plastics, metals, glass, and other materials is the primary source of the alarming rise in the amount of industrial and household garbage produced daily; for this reason, waste management is an essential aspect of our lives. Wearables are anything that a person could utilize in their daily life. In this situation, many individuals are using their mobile phones to access the internet or even to read books or articles on their phones or laptops. IOT essentially refers to the collection or gathering of everything in our world in order to link everything to the internet. IOT is only a scarecrow used to promote the internet's reach and communication capabilities, which extend beyond smartphones and desktop computers to encompass a wide range of objects, environments, and even procedures. Then, anything that is connected is utilized to either transfer information or create a group of information, or it may be used for both activities. People and businesses are expected to gain greater visibility and control over 99 percent of environments and available objects that are currently disconnected from the internet thanks to the internet of things. IOT thus gives people and businesses the chance to connect with the outside world even more than before, which will result in increased levels of fulfilling work. In this system, IoT-edged nodes are embedded in the trash collectors or bins. These nodes collect data about the amount of waste that has accumulated in the bin and provide it to the workers. The conventional fire system is made up of various kinds of equipment, each of which plays a distinct part in identifying persons and wearing them Essential elements of industrial safety are fire detection systems, which are made to detect the early signs of smoke or fire and launch the proper action to stop loss and damage. These systems are made up of a variety of sensors and apparatuses that identify numerous fire indicators, including heat, flame, smoke, and gas. A timely and coordinated reaction to fire occurrences is provided by combining these sensors with alarm and suppression systems, greatly lowering the danger of catastrophic losses. This is not a novel idea; IOT-based dustbins have been used and tested extensively previously. Certain writers have also employed intelligent trash cans to monitor the degree of filling in real-time waste management systems. With this technology, the person in question may access information on all smart dustbins at any time and from any location, allowing them to make informed decisions. The efficient use of smart dustbins, cost reduction, and resource optimization were achieved by putting this suggested solution into practice. Indirectly, this approach decreased city traffic. In large cities, the garbage collection truck comes by twice or three times a day, depending on how many people live there. Every dust bin's status was updated by the system. A smart trash management system including an IR sensor, a microprocessor, and a Wi-Fi module has been presented. When the trash level reached its highest point, this method guaranteed that the dustbins would be cleaned promptly. Records were forwarded to higher authority if the trashcan wasn't cleaned within a certain amount of time, and they subsequently took the necessary measures against the contractor in question. Additionally, by keeping an eye out for bogus reports, this technology contributed to a decrease in corruption within the management system as a whole. In the end, it promoted societal cleanliness. Gradually, the dustbin with an integrated WiFi router was also introduced. There was a passive infrared sensor on the dustbin. The temporary connection code was intended to be displayed by the Wi-Fi router. The PIR sensor detected the trash that the user threw in the dustbin. An IR sensor and a GSM module are part of the current industrial waste management and fire detection system, which is based on Arduino technology. When a

potential fire is detected, the GSM module helps with communication by sending SMS alerts to designated personnel. The IR sensor is in charge of detecting infrared radiation, which is typically emitted by a fire. The goal of this system is to offer an early warning system to stop incidents involving fire in industrial settings. The existing industrial waste management and fire detection system, which utilizes an IR sensor and GSM module, offers numerous major issues that limit its effectiveness and dependability.

2. METHODOLOGY

The Next-Gen Energy Management Approach for Ecofriendly IoT Networks focuses on creating a scalable, energy-efficient, and sustainable solution to address the challenges posed by the increasing deployment of IoT devices. As IoT networks expand in areas like smart homes, industries, agriculture, and healthcare, managing energy consumption effectively becomes critical to avoid unnecessary energy wastage and environmental impact.

This proposed system leverages:

This system aims to provide a comprehensive solution for industrial waste management and fire detection, incorporating advanced features and addressing potential challenges.

- The Arduino UNO, a microcontroller that acts as the system's brain by processing sensor input and managing outputs, is one of the main hardware elements of this setup.
- The level of the garbage is determined by measuring the distance to the waste surface using an ultrasonic sensor.
- When smoke or fire is present, a smoke sensor detects it
- Cellular connectivity is made possible by a GSM module, which enables the system to notify specified persons by SMS in the event of a fire.
- Lastly, when a fire is detected, a buzzer immediately emits an aural warning.

Algorithm:

Step 1: An industrial waste management and fire detection system that uses direct mobile phone communication rather than a cloud platform like Blynk is described in the flowchart.

Step 2: The system starts by initializing the hardware, which includes the Arduino, ultrasonic sensor, smoke sensor, GSM module, and buzzer.

Step 3: Next, it sets up the software, establishing communication protocols (like Bluetooth and Wi-Fi Direct) with the mobile phone application.

Step 4: The system then enters a continuous loop, where it uses the ultrasonic sensor to measure the waste level and determines the distance to the waste surface while continuously monitoring the smoke sensor's output to detect possible fire.

Step 5: The technology transmits the measured waste level data straight to the mobile application in the event that no fire is detected. On the other hand, the system notifies the mobile phone application of a fire and sounds an alarm by turning on the buzzer if a fire incident is detected. This loop never ends, guaranteeing ongoing waste level monitoring and fire detection.

Step 6: The flowchart highlights how the Arduino and smartphone may communicate directly, doing away with the requirement for an outside cloud platform.

Step 7: More control over communication protocols and data transfer is provided by this method, which may improve system security and lessen dependency on outside services.

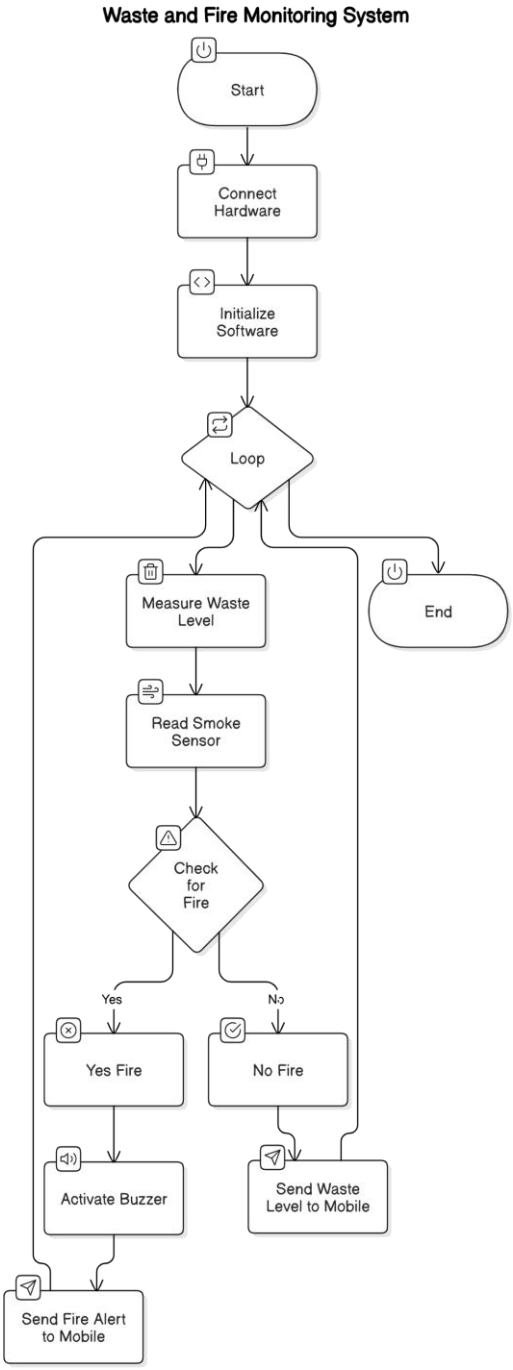

Figure 1. Flow Chart Of Prototype

The functioning of the suggested smart garbage monitoring with fire detector system is explained in depth in this part, along with each block's components. The following describes the function of the hardware parts that are used and how they are integrated with the cloud and Android application platforms to manage the overall operation of the suggested system.

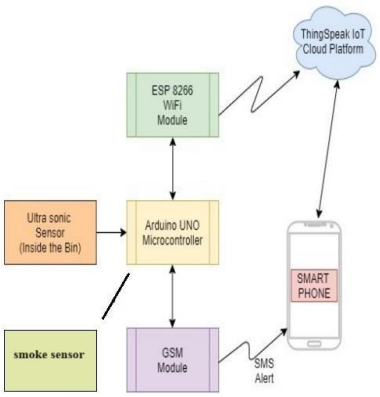

Figure 2. Block diagram of device prototype

The ultrasonic sensor and microprocessor are integrated into the smart trash can. The GSM and Wi-Fi modules are also connected to the microcontroller. The microcontroller's processed data is delivered to the Thing Speak cloud platform, where it is visually displayed. Using a smartphone, the Android application provides access to the same data. The block diagram shown in figure:1above covers the entire process.

3. IMPLEMENTATION

3.1 Hardware Implementation

The Arduino UNO, a microcontroller that acts as the system's brain by processing sensor input and managing outputs, is one of the main hardware elements of this setup. The level of the garbage is determined by measuring the distance to the waste surface using an ultrasonic sensor. When smoke or fire is present, a smoke sensor detects it. Cellular connectivity is made possible by a GSM module, which enables the system to notify specified persons by SMS in the event of a fire. Lastly, when a fire is detected, a buzzer immediately emits an aural warning.

3.1.1 Microcontroller block:

The project's Arduino UNO microcontroller may read inputs from hardware devices, or sensors; The Arduino Uno, an ATmega328 embedded microcontroller microprocessor, is used in many Internet of Things applications. It features a reset button, six digital GPIO (general input/output) pins, six of which are utilized for PWM outputs, and an inbuilt resonator running at 16 MHz. It also features a power button, an In- Circuit System Programming (ICSP) header, a USB port, and a power port. Figure 2 shows the Arduino UNO schematic

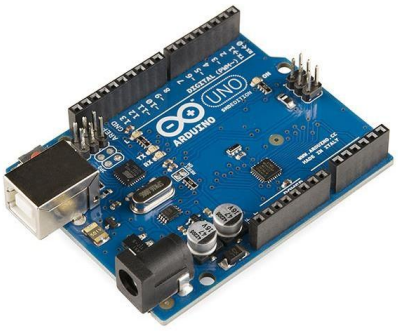

Figure 3. Arduino UNO

3.1.2 GSM Module:

For many Internet of Things applications that require mobile communication features, the Global System for Mobile Communication (GSM) is extensively utilized A popular, small, and reasonably priced option for mobile connectivity in embedded and Internet of Things applications is the SIM900A GSM module. With data speeds of up to 85.6 kbps, it enables devices to send SMS, make voice calls, and connect to the internet via GPRS while operating on the 900/1800 MHz GSM bands. An external power source of 5V is frequently required to manage peak GSM activity, which can take up to 1A of electricity. The module is extremely energy-efficient and runs at a voltage range of 3.4–4.4V. UART (serial communication) at 9600 bps is used to communicate with microcontrollers like the Arduino and Raspberry Pi. Furthermore, the SIM900A is perfect for remote monitoring, control, and data logging projects since it features an integrated TCP/IP stack that supports internet protocols like HTTP and FTP for lightweight internet applications. In Figure, the GSM module is seen.

Figure 4. GSM Module

3.1.3 Infrared sensor:

Infrared sensors (IR sensors) are radiation- sensitive optoelectronic components with spectral sensitivity in the 780 nm to 50 µm infrared wavelength range. These days, infrared sensors are commonly used in motion detectors, which are used in building services to activate lights or in alarm systems to detect intruders. Within a preset angle range, the sensor elements detect heat radiation (infrared radiation) that changes with time and location due to human movement.

Figure 5. IR Sensor

3.1.4 MQ2 Smoke sensor:

The MQ2 sensor is one of the most often used models in the MQ sensor line. It is known as a MOS (Metal Oxide Semiconductor) sensor. Metal oxide sensors are also referred to as chemiresistors since the fundamental principle of sensing is the change in resistance of the sensing material upon exposure to gas. The MQ2 gas sensor operates on 5V DC and consumes roughly 800mW of power. It can identify quantities of LPG, smoke, alcohol, propane, hydrogen, methane, and carbon monoxide between 200 and 10,000 parts per million. Many gases can be detected by the MQ2 gas sensor, however it cannot distinguish between them. This is the norm for the majority of gas sensors. As a result, it functions best for detecting changes in a known gas density rather than determining which gas density is changing. It can detect levels of 200–10,000 parts per million of alcohol, smoke, propane, hydrogen, methane, and carbon monoxide.

Figure 6. IR Sensor

3.2 Software Implementation

In order to continually check trash levels, detect fire, and send data to a mobile phone, the Arduino code for this project entails designating pins for sensors, starting communication, and putting in place a loop. Within the loop, the Arduino uses an ultrasonic sensor to measure the waste level, reads the data from the smoke sensor, and then uses the chosen communication mechanism (e.g., Bluetooth, GSM) to send the waste level and smoke sensor value to the mobile phone. The code sets off a fire alarm by turning on the buzzer and sending a "FIRE ALERT!" message to the mobile device if the smoke sensor reading over a certain threshold. In addition to providing useful real-time data on waste levels, our continuous monitoring and alarm system guarantees prompt reactions to possible fire dangers.

3.2.1 Arduino IDE:

The software for this industrial waste management and fire detection system is developed and implemented in large part using the Arduino UNO IDE. First of all, the Arduino code may be written and edited in an easy-to-use environment thanks to the IDE. This comprises functions that greatly improve the development process and lower the possibility of errors, such as syntax highlighting, code completion, and error checking. Second, the IDE makes it easier to compile the code and upload it to the Arduino UNO board. After converting the code into machine code that the Arduino can comprehend, it uploads the code to the memory of the board so that it may run. Additionally, developers can communicate with the Arduino, view real-time sensor data, and debug code using the serial monitor that the IDE offers. This is very helpful for identifying problems, monitoring system activity, and optimizing system performance. The main development

and programming tool for this project is essentially the Arduino UNO IDE, which makes it possible to create, test, and implement the software that governs the system's functionality and powers its essential functions.

Figure 7. Software Implementation Using Arduino IDE

3. RESULTS AND DISCUSSIONS

The project's outcomes show how to successfully use an Arduino UNO to construct a system for industrial waste management and fire detection. The green LED will light up when the system is powered on, signaling that everything is operating normally. The red LED will illuminate and the green LED will switch off to indicate a high waste level if the IR sensor detects one. Using the GSM module, an SMS warning with the subject line "Warning: High waste level detected!" will be sent simultaneously to the designated phone number. The buzzer will sound a warning if the smoke sensor detects smoke, which is indicated by an analog value greater than the 300 threshold. Additionally, the designated phone number will receive an SMS warning with the phrase "Warning: Smoke detected! "The red LED will come on and the green LED will turn off simultaneously if both circumstances

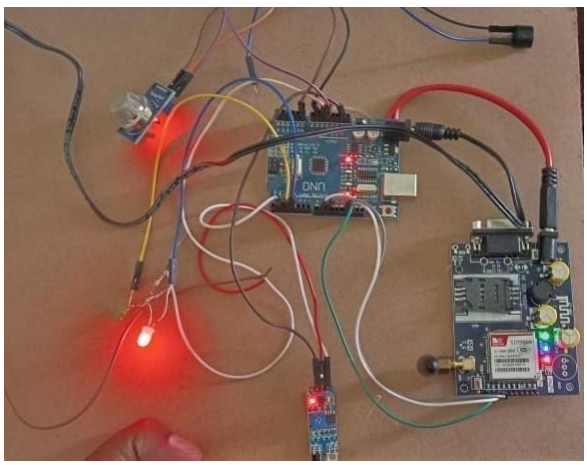

Figure 8. Result

The system uses a smoke sensor to identify fire incidents and an ultrasonic sensor to efficiently monitor waste levels. A mobile phone receives real-time information on trash levels and fire alarms using the chosen communication mode (e.g., Bluetooth, GSM). This

makes it possible to intervene promptly and take the proper action, like planning the evacuation of waste or starting fire suppression procedures.
Accuracy of Ultrasonic Sensor: Variations in temperature, humidity, and the presence of dust or debris can all interfere with ultrasonic waves, making distance measurements less accurate.
Environmental Influences: The accuracy of the ultrasonic sensor can be greatly impacted by outside variables. For example, variations in humidity and temperature can modify the speed of sound, resulting in erroneous distance measurements.
Calibration: To reduce the effects of these environmental influences and guarantee precise distance measurements, the ultrasonic sensor must be calibrated on a regular basis.
False Alarms: A number of things, including dust, smoke from other sources, and even variations in the surrounding light, can cause false alarms. For this system to function over the long term, power consumption must be kept to a minimum, particularly in situations when external power sources may be scarce. There are several ways to accomplish this. The total power demand is greatly decreased by using low-power components like low-power sensors and microcontrollers (such as the ATmega328P in the Arduino UNO).

4. CHALLENGES AND FUTURE SCOPE

4.1 Sensor Accuracy and Environmental Influences:

The accuracy of the ultrasonic sensor in detecting distances can be greatly impacted by variables such as temperature, humidity, and the presence of dust or debris. These environmental elements have the potential to disrupt ultrasonic wave propagation, resulting in imprecise distance measurements and, ultimately, imprecise waste level assessments. The smoke sensor's ability to identify particular forms of smoke while reducing false alarms caused by dust, steam, or other environmental influences is crucial to the accuracy of fire detection.

4.2 Communication Reliability and Robustness:

Unreliable data transfer and possible communication failures might result from the selected communication technology (such as Bluetooth or Wi-Fi) being vulnerable to interference from other devices or environmental conditions. The intensity of the communication signal may weaken in industrial settings with physical barriers or electromagnetic interference, affecting the dependability of data transfer. Inaccurate measurements and maybe missed fire alerts could result from data loss or corruption that happens during transmission.

4.3 Power Consumption and Energy Efficiency:

When sensors are used continuously, power can be greatly depleted, particularly in systems that run on batteries. Bluetooth and Wi-Fi are two examples of wireless communication techniques that can use a lot of power, which can shorten the system's lifespan. Changes in temperature can have an impact on how much power electronic components use, which may have an effect on battery life and system performance.

4.4 System Integration and Compatibility:

The system may need to be significantly modified or adapted in order to integrate with current industrial control systems or safety regulations, which could increase complexity and cost. Unexpected behavior and performance deterioration might result from incompatibilities between various hardware and software components in the system.

4.5 Maintenance and Calibration:

To preserve accuracy and avoid reading drift over time, it is essential to regularly calibrate sensors, especially the ultrasonic and smoke sensors. To guarantee

optimum system performance and longevity, routine maintenance is necessary. This includes cleaning sensors, inspecting connections, and upgrading software.

5. CONCLUSION

This study examines how we use and develop Internet of Things-connected devices. Technology increasingly dominates people's lives and the planet; we utilize it in every part of our daily life, and it is rapidly evolving for the benefit of society. Buildings and woodlands alike can benefit from the use of an advanced fire detection system. The specific subject of this study is the Middle East College, or as we might say, government buildings and other areas. taking part in and helping to maintain the evacuation. But it also serves to direct dangerous people to the nearest available exit, emphasizing how important it is for every building to have an IOT-enabled smart fire detection and waste management system.

REFERENCES

[1] *P. Suresh, Vijay. Daniel, R.H. Aswathy, Dr. V. Parthasarathy, "A State-of-the-Art review on Internet of Things" International Conference on Science Engineering and Management Research (ICSEMR),IEEE,19 February 2015.*

[2] *Parkash, Prabu V "IoT Based Waste Management for Smart City" International Journal of Innovative Research in Computer and Communication Engineering, Vol. 4, Issue 2, DOI: 10.15680/IJIRCCE.2016. 0402029, February 2016.*

[3] *Evaluation on the Performance of Urban Domestic Sewage Treatment Plants in China - 2011Dongmei Han; Guojun Song.*

[4] *Teemu Nuortioa, Jari Kyto¨jokib, Harri Niskaa,Olli Bra¨ysyb "Improved route planning and scheduling of waste collection and transport", Expert Systems with Applications 30 (2006) 223– 232, Elsevier.*

[5] *M. Arebey, M. Hannan, H. Basri, and H. Abdullah, "Solid waste monitoring and management using RFID, GIS and GSM", The IEEE Student Conference on Research and Development (SCOReD), 16-18 November 2009,*

[6] *M. Hannan, M. Arebey, R. A. Begum, and H. Basri, "Radio Frequency Identification (RFID) and communication technologies for solid waste bin and truck monitoring system", Waste Management, Vol. 31, pp. 2406-2413, 2011.*

[7] *S. Longhi, D. Marzioni, E. Alidori, G. Di Buo, M. Prist, M. Grisostomi, et al., "Solid Waste Management Architecture Using Wireless Sensor Network Technology", The 5th International Conference on New Technologies, Mobility and Security (NTMS), 7-10 May 2012, Istanbul, pp. 1 5, 2012. 147.*

[8] *Waikhom Reshmi, RamKumar Sundaram, M. Rajeev Kumar, "Sensor Unit for Waste Management: A Better Method,", International conference on Science, Engineering Management Research, ©2014 IEEE*