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GARBAGE SURVEILLANCE SYSTEM USING IoT

Siva Nandini B[1], Subhiksha R[2], Sanofar Shifa S[3], Sowmya S[4], Alisha M[5]

[1]*Assistant Professor, Department of Electronics and Communication Engineering,*
[2,3,4,5]*UG Student, Department of Electronics and Communication Engineering,*
National Engineering College, Kovilpatti, Tamil Nadu,

Abstract—India is turning into one big garbage dump. The garbage overflow creates an unsanitary environment which leads to spread of various diseases. To avoid such situations and maintain public cleanliness and health, IoT based garbage surveillance system is proposed. This paper proposes a garbage management system for garbage clearance and the presence of flammable substances by using sensor systems and a public web server. This process is done by interfacing the sensors with Arduino UNO and sends the message to the web server. The level of garbage is determined with the help of the ultrasonic sensor HC-SR04. The presence of smoke in the bin is detected using the smoke detector MQ-2. The system collects the status of the garbage bins and transmits the status data to concerned authority through GSM. For this, an ATmega-328 microcontroller is used. The real-time status about the garbage bin is given to the municipality so that they can take necessary actions immediately.

Keywords: IoT, Arduino UNO, Ultrasonic sensor, Smoke sensor, GSM, Atmega-328

I. INTRODUCTION

Nowadays most of the roadsides are polluted by the overflow of waste in the garbage bin. This not only pollutes the land but also pollute the environment. An indiscriminate discharge of waste, the absence of waste disposal and management systems and inefficient waste management policies have caused serious environmental problems and have incurred considerable costs for waste disposal. People are easily affected by many diseases due to the pollution caused by the overflow of the garbage bin. It creates an unhygienic condition for the people which lead to the spreading of deadly diseases. It is necessary to monitor the level of the garbage bin.

The traditional system has some major issues like the unhygienic environment and looks of the city. One of the most common problems in the overpopulated and residential urban areas are garbage bins overflowing on to the streets and footpaths causing environmental pollution and unhygienic living conditions in surroundings. This is mainly due to the routines for cleaning the dustbins by the government municipal corporation, without taking the waste disposal rate of the areas. There are some unwanted manual checks of garbage bin's level by municipal corporations which is less effective and time-consuming. Trucks are sent to empty the dustbins whether they are full or not. And the trucks need fuel which is costly. The bad smell is spread and may cause illness to living beings in the surroundings.

The restrictions of the existing system include time-consuming; trucks move around the city and empty the bin even if the bins are not empty. The bad odor due to the garbage causes the insanitary surroundings. So, it is necessary to build a system using the recent trends in technology to make the environment hygiene.

Various studies have been carried out to create a relation between human health and precarious waste. Certain actions are taken to improve the level of cleanliness in the country. People are getting more active in doing all the things possible to clean their surroundings. Proper methods of waste disposal have to be undertaken to ensure that it does not affect the environment around the area or cause health hazards to the people living there. This could help people in avoiding various problems. It is focused on providing better clean surrounding. In the proposed system the monitoring is done by using a technology called the Internet of Things (IoT). An IoT based garbage monitoring system monitors the garbage bins throughout the city and informs about the level of garbage to a person in the administrative department. In addition to it occurrence of smoke in the bin is also governed. All the information obtained from sensors are updated and conveyed to the authorities accurately to clear the garbage. The information can be transmitted through various technologies like GSM.

II. LITERATURE REVIEW

Sagnik Kanta, Srinjoy Jash, Himadri Nath Saha proposed Internet of Things based garbage monitoring system [8]. The level of the garbage bin is detected with the help of the ultrasonic sensor, and the wastes are differentiated with the help of a chemical sensor. The cameras are set on the bin location, and it continuously captures the image for garbage bins. Captured images are sent to the workstation using RFID, GPS, and GIS. The process starts by checking the garbage level (the bin is empty/not). Then it is connected through the chemical sensor to separate biodegradable and non-biodegradable waste. The separator part in the sensor separates the waste. The percentage level of garbage is viewed. If the percentage >50% the trucks are instructed to load the wastes. The communication is done through the GSM system. After loading and separating the wastes, the sensors are disconnected. To alert the trucks buzzer is used. The IOT system mainly uses Arduino ATmega2560 with an LCD or LED screen and a GSM modem. It is a cost and time efficient process.

Himadri Nath Saha, Supratim Auddy, Subrata Pal, Shubham Kumar, Shivesh Pandey, Rakhee Singh, Amrendra Kumar Singh, Swarnadeep Banerjee, Debmalya Ghosh, Sanhita Saha presented waste management using internet of things [4]. IOT based smart solution to waste disposal is discussed in this paper. Integrated hardware and software solution optimizes waste collection and saves time. The bin is designed with a solar-powered waste compacting bin which monitors the level of garbage and automatically compact the waste so that it can hold up to 10 times of regular bins. It also sends the information wirelessly. The level of the containers is sensed by fixing pin fill level sensor powered by either battery or solar energy. The detected information is sent to the cloud server. The server notifies the users when collections are required and generates optimized routes for collection. This solution helps the users to need fewer trucks, less fuel and less time for the collection. And also it saves money and keeps streets clean.

Andrei Borozdukhin, Olga Dolinina, Vitally Pechenkin developed an approach to the Garbage collection in the Smart, clean city project [2]. It was developed to optimize garbage collection and manage the process of garbage collection. The main aim of the project is to indicate the level of garbage, to send the trucks to collect the filled containers and to develop an optimal route for the garbage collection. This system consists of software and special signaling equipment. The garbage containers are equipped with two way receiver-transmitter and sensors to determine the fullness of the container. The containers are fixed with a transmitter on the side wall of it. The level sensors are connected to the radio transmitter to transmit the level of containers to host the receiver-transmitter unit. A frequency controlled microcontroller is connected to the sensors to save energy. Information from the containers is transmitted using the GSM module. The client and server part of the system, process the information. The client part is responsible for route generation, warning about the state of containers and send information to the server periodically. The server part is responsible for information storage and further analysis.

Shubham Thakker, Narayana moorthi proposed a system for smart and wireless waste management [9]. Ultrasonic sensors are used to detect the level of the bin. A set of three ultrasonic sensors are placed at an angle of 120 degrees from each other so that the whole area of the bin is covered. Load cell will be placed at the bottom four corners of the bin. These are used as secondary sensors. If the ultrasonic sensors fail to give output, these can be used as a reference. A GSM module is used to communicate with the server room. When the bin is about to fill, with the help of a GSM module, a message signal will be sent. The microprocessor will allow the voltage to flow across sensors after a certain period. Once the waste materials are collected in one place, separation of plastic resins is started. By using Near Infrared (NIR) reflectance spectroscopy identification and separation of different types of plastic materials are done The NIR reflectance spectra covers a range of 700 to 2500nm. The advantage of this process over other process includes low energy expenditure and a higher level of efficiency.

Namakambo Muyunda, Muhammad Ibrahim presented arduino-based smart garbage monitoring system [7]. The sensor is to monitor the state of the garbage and route planning for the collection based on the selected fill level and priorities of each bin. The sensors used are a level sensor and a tilt sensor. The level sensor is used to check the fill level of the bin and tilt sensor is used to monitor if the bin is in an upright position. For communication, the Wi-Fi module is used. A real-time clock allows the battery life of the sensor node to be extended. The use of the real-time clock allows the data to be accurate, as the time of each reading is stored. The information is uploaded to the database. This allows the city authorities to have access to information that would otherwise be absent. A website developed allows the user to view information on the bins in a given area. The system will mitigate the risk of overfilled bins and unsanitary conditions that are caused by the lack of information that is present in the current collection process.

Vinoth Kumar S, T. Senthil Kumaran, A. Krishna Kumar and Mahantesh Mathapati proposed Smart Garbage Monitoring and Clearance System using the Internet of Things [12]. The level of waste in the dustbins is detected with the help of the Ultrasonic sensor. The force sensor is used to measure the weight of the dustbin. When the measured value of sensors exceeds a particular threshold value, then the red led becomes ON (i.e.it indicates dustbin is filled else green led is ON). GPS provides location information of where the dust bin is located and is communicated to the Android device through the GSM system. Android device will detect, in which area dustbin is situated, by comparing coordinates and updates the location and inform the respective vehicle to collect the waste. The microcontroller is used to interface the sensor system with the GSM system. This will help in managing the garbage collection efficiently.

III. PROPOSED SYSTEM

In the proposed system, the garbage bin is monitored based on two parameters. First, if the bin is full or if there is no more places for the garbage, ultrasonic sensor is used to identify and inform the authority who is responsible. Second, if there is any sudden fire smoke detector is used to detect the occurrence of smoke. The status of the bin is transmitted to the concerned authority through GSM modem. The status of the bin is viewed by the authorized person using webpage. The overall block diagram of the proposed system is as below in figure 1.

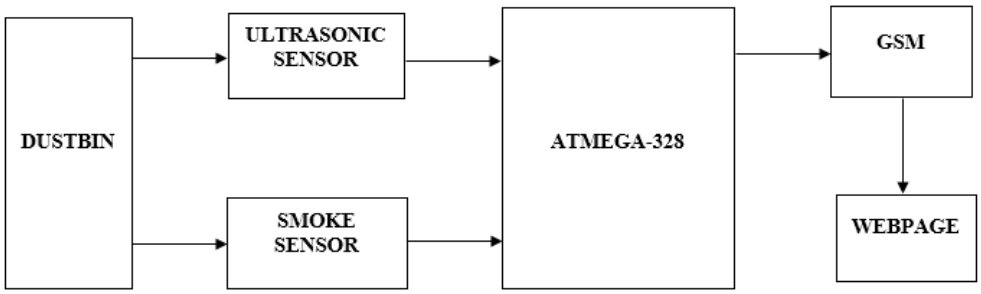

Fig 1: Block Diagram of the Garbage Surveillance System using IoT

Ultrasonic sensor and the smoke sensor is fixed on the top of the garbage bin.The level of garbage is sensed using ultrasonic sensor (HC-SR04). It consist of ultrasonic transmitter, receiver and control circuit. The principle beyond the sensor is sound-wave reflection. The sensor uses a single ultrasonic element for both emission and reception which emit short, high-frequency sound pulses at regular intervals. These are propagated in the air at the velocity of sound. Based on the time-span between signal emission and receiving echo the distance to the target is calculated when they strike the garbage. Thus the level of garbage was determined by measuring the time of flight. The Trigger pin of the sensor is used to send the signal, and the echo pin is used to listen to the reflected signal. The ultrasonic sensor is interfaced with the arduino UNO using its analog input pin.

Fig 2: Ultrasonic Sensor

Smoke Sensor (MQ2) is used for detecting flame due to the occurrence of fire in the garbage. It is sensitive to flammable gas and smoke. When the smoke comes in contact with the sensor it leads to the change of resistance of sensing element. The concentration of smoke is detected by a simple voltage divider network. While measuring the amount of smoke in ppm the analog pin is used. The analog pin is also TTL driven and works on 5V and hence it is compatible with arduino UNO.

Fig 3: Smoke Sensor

Arduino UNO is a microcontroller board which is based on ATmega 328P. It contains everything needed to support the microcontroller, simply connected it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started. The UNO varies from all existing boards, since it does not use the FTDI USB-to-serial driver chip. The UNO was the latest in a series of USB Arduino boards and the reference model for the Arduino platform. The ultrasonic sensor and smoke sensor are interfaced with Arduino UNO by the analog input pins. The status of the garbage bin obtained from the ultrasonic sensor and smoke sensor is displayed in LCD which is kept beside the garbage bin.

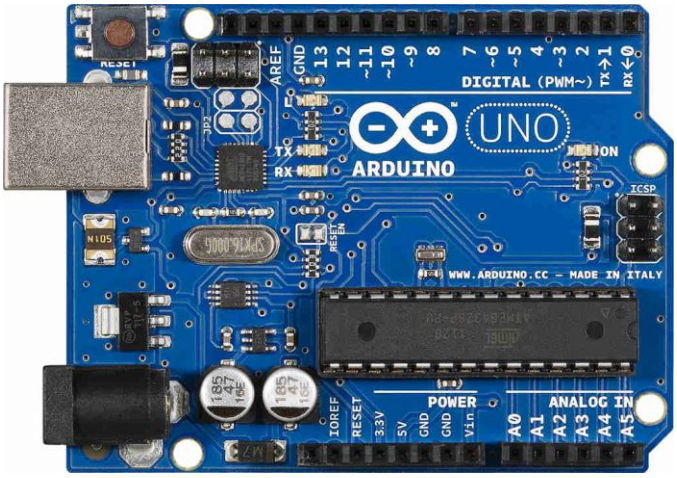

Fig 4: Arduino UNO

The GSM modem is a device, which accepts a SIM card and operates on a subscriber's mobile number over a network. GSM Modem connected with different types of output taken from the board – say TTL Output (for Arduino).GSM system is developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its particular time slot. It is interfaced with the arduino board using data pins 4 to 7. The information determined about the level and smoke content in the bin is transmitted through the GSM modem to municipal webpage. The status displayed in the webpage is viewed by concerned municipal authority. If the sensed garbage level is greater than 75% or if there is any occurrence of smoke, the information is given to the truck driver for waste collection in the particular bin. This minimizes unnecessary visit of truck for garbage collection and keeps the environment clean.

IV. RESULTS AND DISCUSSIONS

The hardware implementation of the garbage surveillance system is given in figure 5. A 12V power supply is used. Arduino UNO acts as an interface between sensors - ultrasonic sensor HC-SR04, smoke sensor MQ-2 and GSM SIM 900. LCD is used to display the status information.

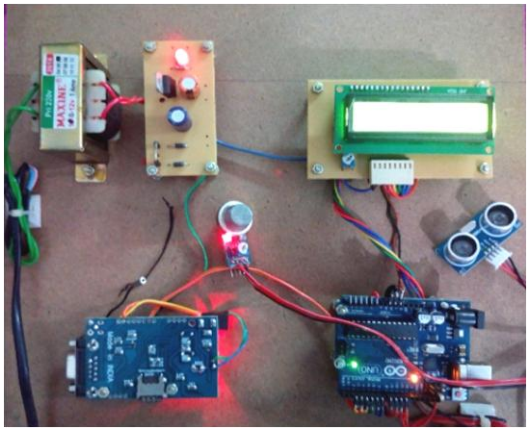

Fig 5: Hardware implementation of Garbage Surveillance System

The status information is viewed by the authorized person by using the webpage as given below in figure 6 and 7. The webage is refreshed every 2 minutes.

Case1: Figure 6 indicates the level of garbage as 30% and smoke level as low. This is a normal condition where there is no need for the authorities to empty the bin.

Fig 6: Webpage Displaying Status Data - normal condition

5Case2: Figure 7 indicates the level of garbage as 100% and smoke level as high. This is a critical condition where the authorities must empty the bin. So the information is given to the truck driver to collect the waste from the specified bin. Similarly each and every bin of the city can be monitored using the same process.

LCD display is also used to show the status of the bin. Figure 8 and 9 show the information displayed in LCD.

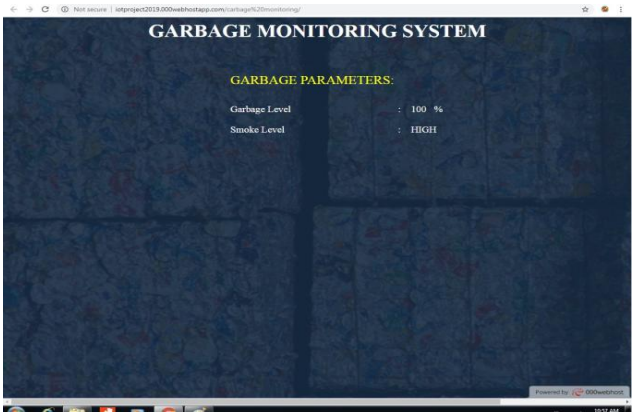

Fig 7: Webpage Displaying Status Data - critical condition

Case1: Figure 8 indicates the level of garbage as 92% and smoke level as low. This is a condition which could go to a critical stage at any time.

Fig 8: LCD displaying Status Data

Case2: Figure 9 indicates the level of garbage as 100% and smoke level as high. This is also a critical condition, and the authorities must take immediate steps.

Fig 9: LCD displaying Status Data - critical condition

IV. CONCLUSION

One of the most common issues in the over populated and residential urban areas are garbage bins overflowing on to the streets and footpaths causing environmental pollution and unhygienic living conditions in surroundings. Garbage overflow is a major challenging one. The garbage surveillance system based on the technology of wireless sensor embedded controller and Internet of Things is used to monitor and take necessary actions accordingly. Ultrasonic sensor and smoke sensor are used for sensing the garbage level and flame detection. The status information of the bin is sent to the concerned municipal authorities through GSM. The webpage is used by the authorities to view the status and necessary actions are taken. It helps to maintain cleanliness in the society. This system makes the garbage collection more efficient. The system may be updated in future with a compactor for compressing the waste in the bin when it goes above the threshold level. Further sprinkler can be used to extinguish fire caused in the waste.

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