International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

IoT Based Solid Waste Management System

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***Abstract*—** An 8bit x-mega2560 controller with u-blox gps and a node mcu wifi with mqtt protocol is used for design of solid waste management system in metro. Existing system uses physical approach to verify the amount of the garbage collected in the bin if the bin is full and it will be emptied by the corporation have its limitation in regular check up routing the pick vehicles due to which wastage of fuel and un-cleanses is happening.

To overcome this issue a system is designed to provide the status of the bin filled level and also provides the information like temperature, humidity, with latitude and longitude of the bin position using u-blox gps to send the information to control centre cc2500 wireless unit is used an additional feature for distributing the messages for the multiple users published by authorised person for complete automation with information exchange will be given using Mqtt protocol.

Keyword MQTT, GPS, WI-FI, GSM

1. INTRODUCTION

In past few years solid waste generation is gradually increased at urban districts with the growing economic, level of industrialization and because of the change of open utilization propensities and local atmosphere conditions. Solid waste administration is one of the exorbitant urban administrations which require a large portion of metropolitan spending plans. The administration cost can be lessened by improving the waste gathering course, number and Area of receptacles and gathering recurrence. At exhibit, diverse sorts of data, correspondence and sensing technologies are accessible in the market that can help to get canister status data on ongoing from remote place. This continuous information enables the expert to design and advance squander accumulation courses that can decrease the voyaging separations of the waste accumulation vehicles. The accumulation of strong waste is one of the major challenges.

The increment in fuel costs, concernment about condition and wellbeing, rising operational expenses and the dynamic direction stack in the current years have caused the waste accumulation authorities to optimize their waste accumulation courses. The transportation of solid waste devours around 70 to 80% of all operational expenses in waste management.

Scheduling and processing are the complex sectors in automation. As soon as schedule is processed consistent monitoring in real time must be created for smart bins. Due to this, there is a chance of delay in processing time. And some information provided by users must be sent to the authorised receivers called as hosts without fail as shown in figure below1.1

Figure 1.1: Sharing information between dustbins user and central system

A master system with known communication channel includes gps, level sensor, and wireless. Central unit device must be connected to MODEM which must have Wi-Fi for linking and Internet for remote operation. After this, mqtt is used to establish connection between host and client using Amazon Web Server cloud is set by the user through the APP intended for real time monitoring. Every time central unit sends information to the cloud through modem. A subscription made by devices for the corresponding topics which will be received by the users.

1.1Related Work

This provides the various surveys done with the references for this project which is been designed by using various hardware components, software tools, new technologies, wired and wireless communication techniques and methodologies.

The following are the brief discussions of the papers referred to do this project are

1. This paper describes how information got through sensors is transmitted over the Internet to a server for storage and handling systems. It is utilized for checking the everyday determination of waste containers, in view of which the courses to pick a few of the waste receptacles from various areas are chosen. Consistently, the labourers get the refreshed advanced courses in their navigational gadgets.

The huge element of this framework is that it is intended to refresh from the past experience and choose on the day by day squander level status as well as the anticipate future state as for factors like movement blockage in a territory where the waste containers are set, fetched proficiency adjust, and different elements that is troublesome for people to watch and examine. In view of this chronicled information, the rate at which squander canisters gets filled is effortlessly dissected. Therefore, it can be anticipated before the flood of squanders happens in the waste canisters that are set in a particular area.

The framework configuration requires the sonar that can be utilized as a part of this model ought to give estimation from 2cm to 400cm with 3mm precision, which is sufficient for the waste bins, e.g., Ultrasonic Ranging Module (HC-SR04). The information gathered is sent to remote server by means of remote connection. WiFi is considered as a system get to information MySQL is utilized for store of all information gathered by the sensors and the trucks.

2. This paper describes the usage of four Infrared Obstacle Line Sensors fitted on the upper edge of a dustbin the sensor framework can be introduced in both top based containers and without top canisters. The IR sensors are interfaced with a Raspberry Pi 2 board. The board is fitted with a Wi-Fi Card/GSM Module that is linked to Internet. At the point when the dustbin fills up, the board informs the framework. The framework is a Python based Web Application that handles all warnings from the receptacles and sets up their areas on a guide. The framework at that point plans the gathering design and gives an improved course. The accumulation times of different dustbins can be loaded into the Azure Machine Learning System to get future anticipated circumstances,

3. Implementation of hardware is discussed in this paper about the system design is made out of three section, for example, gateway, portal and control station The functions are to get the updated real time bin information, process the information and transmit the information to a server via the gateway. Process the data and transmit the data to a server through the gateway. Smart Bin An arrangement of detecting and correspondence innovations involves the brilliant container.

Among the sensors, some are appended with the drawback of the container cover and the other is at the base side of the container. The principal detecting components contains temperature, dampness, and accelerometer, ultrasound and hall sensors. Gateway is used to send the data about the bin status data based is used to parse and store the data this same data is sent to control centre through gprs network.

DBMS is used as a database in control station which is hosted by a server all the data are received through gate way about the bin status a web based user interface is used for user interaction to monitor these stored data can be used to improve the feed programs like data parsing programs, routing and scheduling process.

2. MOTIVATION

Waste management is the one of the biggest problem now a day's faced, which causes diseases and attract animals. So to overcome this problem an automation is needed which must inform the municipal cooperation to empty the bins to maintain the cleanliness of the city.

2.2 Problem Statement

Recent days in India multiple metro and other cities are enlisted under smart city project which uses different technologies to achieve. Smart cities include the building the infrastructure like road sewage system etc major problem almost the cities are facing is to manage the waste that are generated daily. Currently emptying of the bin is done by corporation vehicles they need to visit the bin every day in a specified route some time bin will be overflowing by the garbage which attracts dogs and cattle's these animals will make the garbage to spill on the road secondly people won't go near to bin to throw their waste due to overfilled bins currently there is no bin is monitored remotely so complete automation is needed to monitor the bins remotely by the concerned persons and can inform the collecting vehicle to empty the bin when its full by doing in these method fuel can be saved and spill over of waste can also be avoided.

2.3 Objective

The following are the goals of the work.

1. Design a unit of automatic sensing system with dedicated apparatus.
2. Extract the bin position using indoor supported ublox gps.
3. Send the information regarding bin to control centre using cc2500 wireless
4. To provide gateway on Mqtt protocol for secured communication with reserved Internet Protocol (IP).
5. Configuring the available my-mqtt app from play store for the project.

3. METHODOLOGY

System block diagram as shown in figure is divided into two blocks, first block consist of Ublox GPS to send latitude and longitude values, DHT11, carbon monoxide and IR sensor to provide levels of filled waste in the bin. Cc2500 is used to send temperature and humidity level status to the centralized unit. All these peripherals are monitored and controlled by Xmegs2560 8-bit microcontroller which has 256k byte ROM to store the program and 8k byte of RAM. These controllers can execute 16 million instructions for external oscillator.

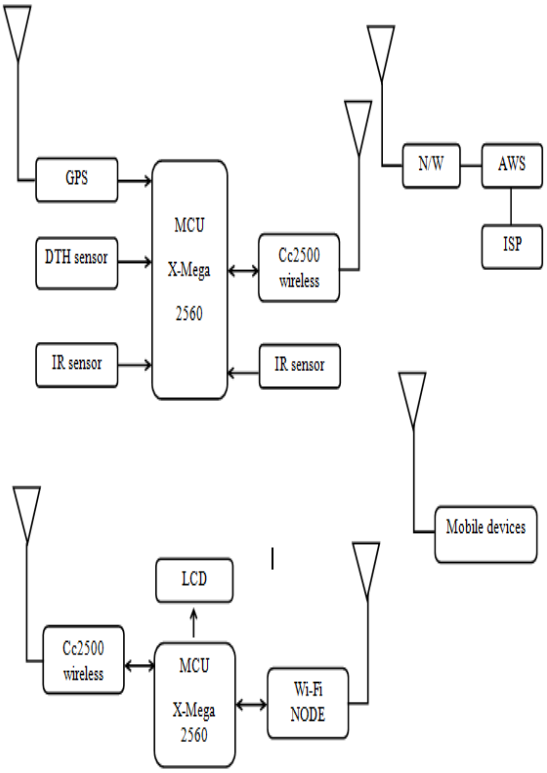

Figure 2.1: Solid Waste Management System Block Diagram

Second block considered as centralized block which received data from bin block and display it on LCD like temperature and humidity sensor status and latitude and longitude of the bin. The same information is passed to nodeMCU Wi-Fi which in turn sends the data to the cloud server using MQTT protocol. User can access the information using ready app using Google play store called as MY MQTT. User need to provide specific IP with port addresses for server connection. Once the messages sent by the unit by entering receive latitude and longitude in Google app, user can view the exact position of the bin in maps.

3.1 Design Requirements

The hardware components required for analysis and alerting for remote application are as follows.

1. Microcontroller-XMega2560
2. U-bloxgps
3. WiFi nodemcu
4. LCD Display 16*2
5. Ir sensor
6. DHT11 sensor
7. Cc2500 wireless

3.2Flowchart

Task 1: This is called as initialization task as it perform of various ports and communication channels with enabling the concurrent task used by the multiple devices.

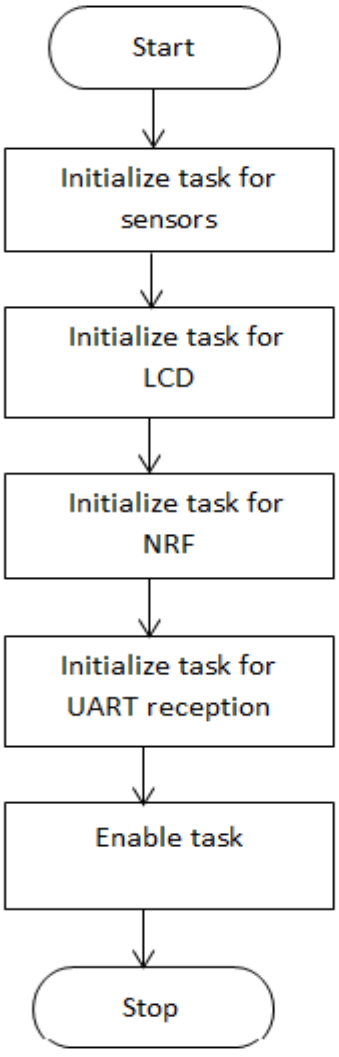

Figure 3.1: Initialization Task

Task 2: In this task GPS reception for latitude and longitude is performing. This task receive 200 bytes information every second and checks for specific detail called GPGGA. Once this task is identify latitude and longitude coordinate will be read of the corresponding locations.

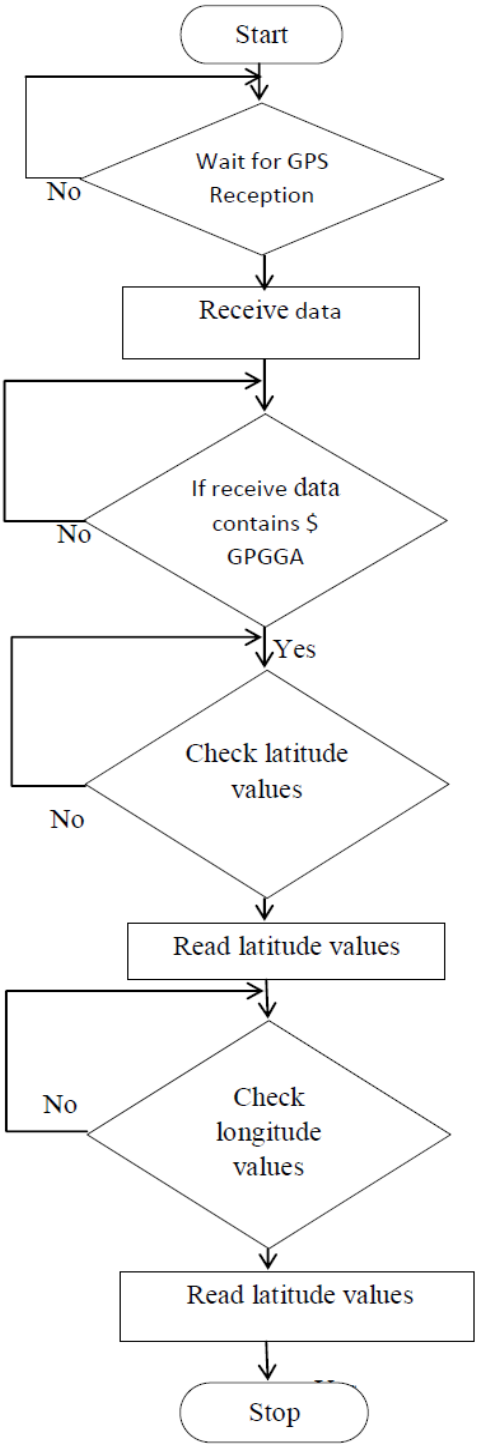

Figure 3.2: gps processing

Task 3: This task scans multiple sensors like level, co, humidity and temperature etc. carbon monoxide and level sensors are of digital type DHT level is the combination of humidity and temperature which sends the information inform of packets which consist of temperature, humidity and CRC. This same information is send to the station.

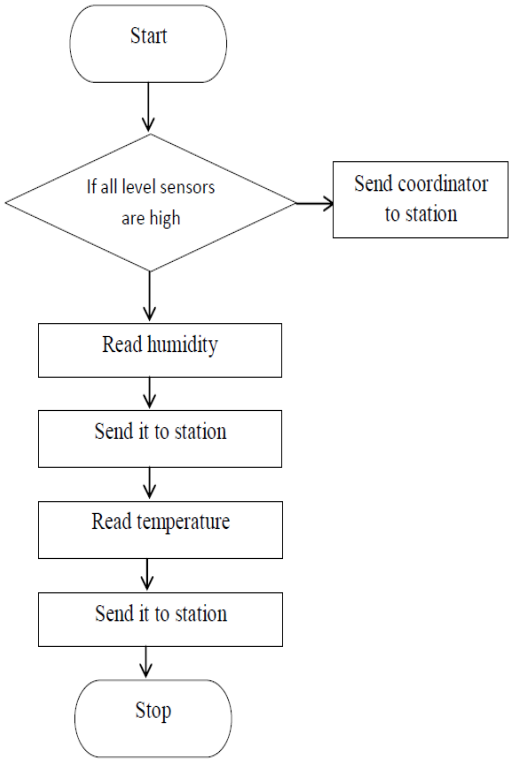

Figure 3.3: Sensor scan

Task 4: Wi-Fi and NRF communication devices are enabled by using specific protocol by using UART and SPI is performed once it is enabled any incoming signal can be received.

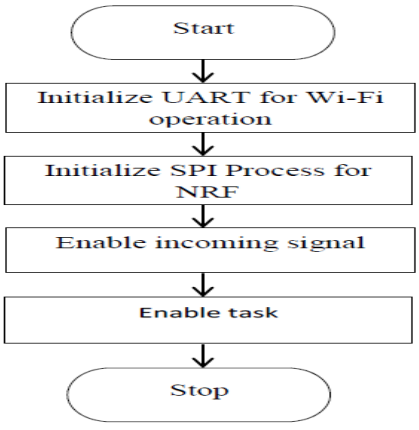

Figure 3.4: communication link

My mqtt user app: This is a station monitoring task where specific app called MQTT lens is used for viewing log of different sensor which is done by using a received IP and corresponding port address with hot spot connection once it is successfully done process will be link to Amazon web service for client access.

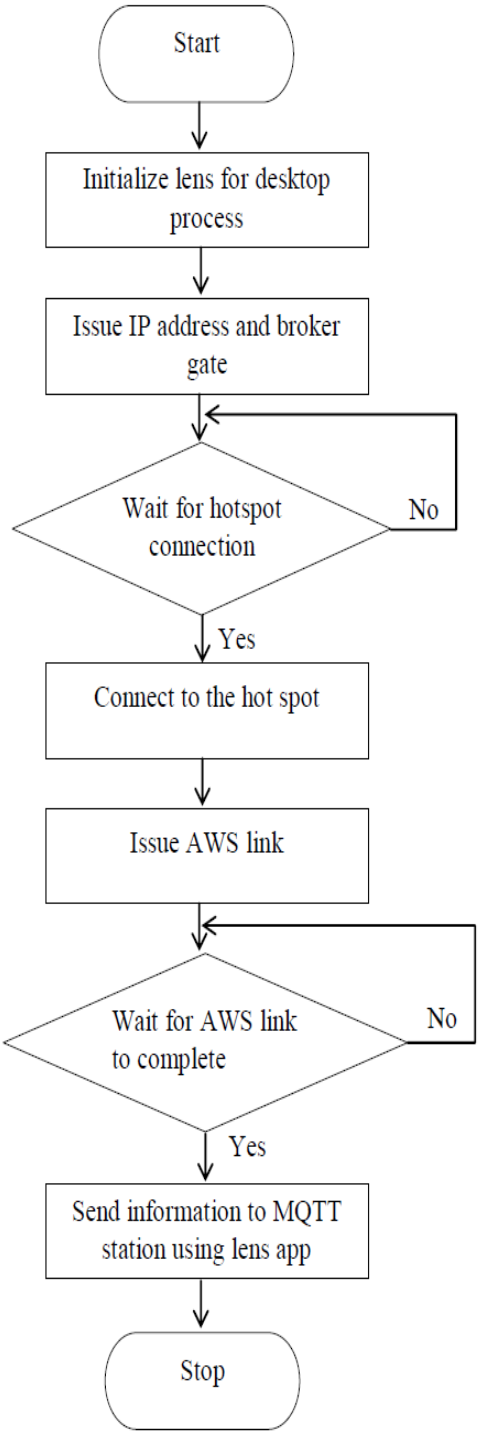

Figure 3.5: MQTT Broker

4 RESULTS

Figure 4.1 shows the overall system with peripherals interfaced to carry out specific operation. Automation is done to send information in the format of topic to an mqtt application developed for pickup truck driver's pdo to monitor the status of the bin. This is done by automatically subscribing and publishing for the corresponding topics. This module is connected with gps system to provide the exact location of the bin. Message queuing and telemetry transporting protocol is used between central station and users.

Figure 4.1 shows the position of the bin in Google map by entering the latitude and longitude co-ordinates

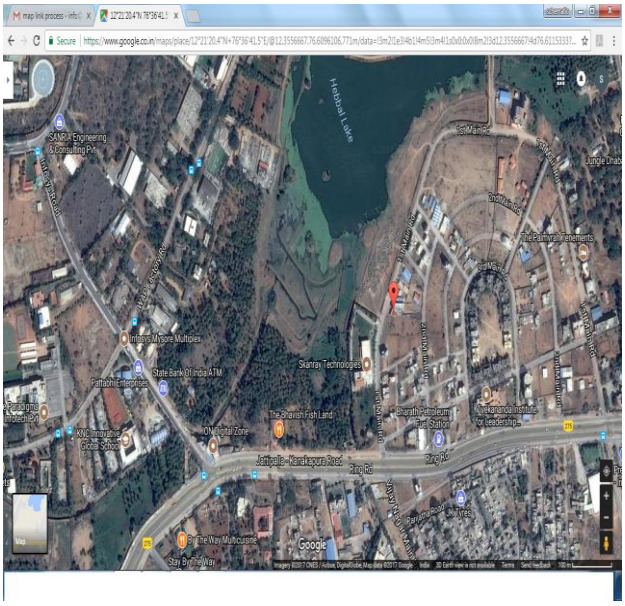

Figure 4.1: bin position display on Google map

Figure 4.2 shows the information displayed on my Mqtt app on user mobile to link with the cloud user need to provide the cloud address and accesses port link.

Figure 4.2: cloud address and port number for remote connection

Figure 4.3 shows the information displayed on dashboard of the app updated information about the fill status of the bin.

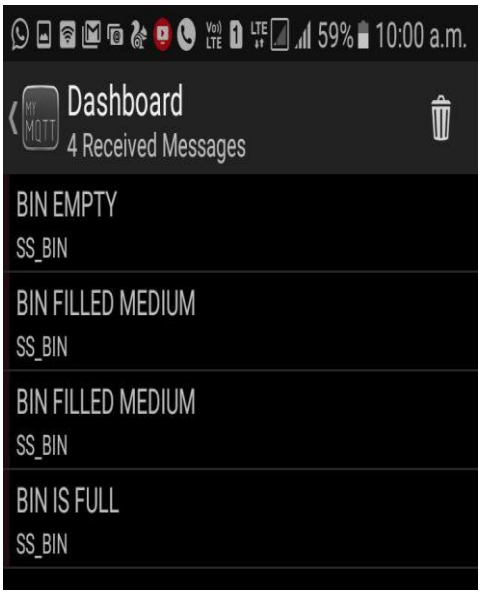

Figure 4.3: bin status for the subscribed topic SS_BIN

Figure 4.4 shows the information displayed on dashboard of the app updated information about temperature and humidity.

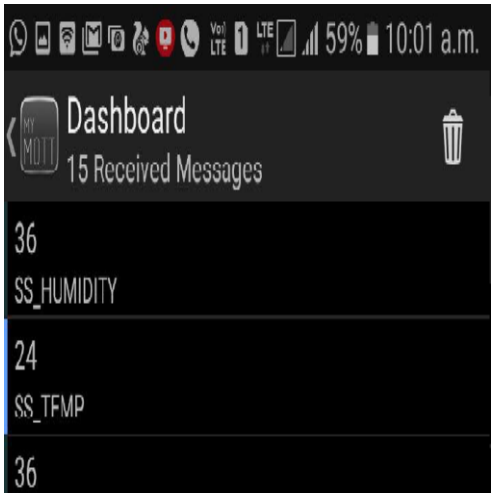

Figure 4.4: environment status for subscribed topic SS_TEMP, HUMIDITY

Figure 4.5 shows the information displayed on dashboard of the app updated information about the bin position obtained through gps.

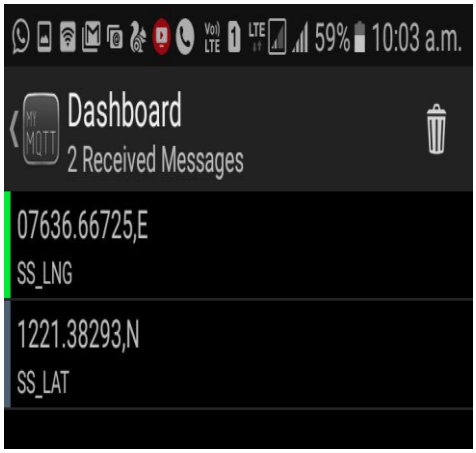

Figure 4.5: position status for subscribed topic SS_LAT, LNG

5.CONCLUSIONS

This advanced embedded system provides bin information for the corresponding locations by taking the requirements of complex design need with minimised essentials for analysing in different places for restorative needs.

This system checks corresponding intended information from different sensors to help oversee about the bin status. The proposed research enhances the smart waste management and minimal exposure to pollution. In crisis the framework cautions the personal to oversee about the dangerous levels and conditions for furthermore. It alerts to the corresponding personal in the event that he/she is checking for furthermore to

make by implementing the designed work. The fundamental estimation of the exactness is inside permissible ±2% error depending on the computations, the solitary results with percentage of error gives a clear picture that the proposed system performs better and consumes minimal latency to quantify the key hazards.

This executed innovation is in its better way with existing identification process followed by continuous streaming data using mqtt protocol. The modules used in this design are minimal in cost, flexible and rugged.

A list of future works which can be performed on this waste management system is listed as follows:

- To interface the vehicles with appliances to provide shortest path for extraction of garbage
- To measure gaseous pollutants like CO, etc and based on these data with moisture contents in air
- With furthermore sensors interface multiple nodes as such with keeping a server development for central station.

6 ACKNOWLEDGMENTS

Our thanks to Mr. Harish S V who has guided us throughout the project.

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