An IoT Based Waste Management System using Node MCU

Sri Harsha Molakalapalli, Vijayan Reddy Kamalapuram, R. Radha
Computer Science and Engineering, SRM Institute Of Science And Technology, Kattankulathur

Abstract— This paper presents a novel approach to provide illustrative model of the Waste Management systems using IoT. Waste Management System. India as the world's second populated country faces the undaunted task of building a creditable and sustainable Waste Systems that can operate on its own, with or less human intervention. Waste Segregation, Accumulation, and disposal of the same and disposal all forms the crux of the Waste Management System. Technology infusion into real world problems and solutions to the problems creates a sustainable system and that is being implemented in this paper

Index Terms— **IoT, NodeMCU, Waste Management, MQTT, Ultrasonic Sensor**[fig5]

I. INTRODUCTION

The quick development of human populace and the interminable quest for monetary improvement are making over-misuse of characteristic assets, causing fast, novel, and considerable changes to Earth's environments. The changing eco systems in return are subject to the wastes segregations. Industrial Wastes, Domestic Wastes, Plant and Animal Wastes and dumping causes a havoc in the social systems and may also have a considerable effect in the health sector. Thus, a Waste Management system that is sustainable, with or without human intervention is necessarily needed now. A Waste Management system with automatic segregation and an automated alert system has become an essential innovative strategy for the treatment of the wastes. This paper provides a concept to innovate and apply the Emerging trends of Internet of Things & Node MCU Controller to enable and create a IoT Enabled Waste Management System, deploying sensors and cloud interfaces so as to make the best use of predictive technology.

II. LITERATURE SURVEY

[1] Used raspberry pi which makes it expensive, [2] Used PIC microcontroller and GSM to find the location of the bin,[3] Android application used for communication, [4] There is no segregation of waste but it is cheap,[5] There is no segregation of waste and expensive compared to others, [6] Discusses various methods of implementation,[7] Used machine learning managing the garbage but not for segregation, [8] Used solar power cell instead of electric city which is cost effective,[9] Uses Arduino UNO to check the status of the garbage bin but no segregation of garbage implemented, [10] It does not segregate the garbage but it shows the status of the garbage bin. [11] There is no separation of waste and used Arduino UNO to monitor the garbage bin which

bit more expensive.[12] Uses GSM module to communicate and two Arduino bords are required which increases the cost, [13] Uses machine learning to process the data,[14] Uses simple and effective technology like Wi-Fi module and amplifier to monitor the garbage bin, [15] Uses garbage bin and Arduino as the IOT platform for garbage monitoring, [20] Uses Android application as communication platform to monitor the garbage bin.

III. EXISTING WORK AND SYSTEM

Waste management systems have been since long. Existing systems deploy a large amount of human intervention in Waste Management systems. Local Bins are placed at various points of the city, Manual labor checks the same at frequent intervals and checks the capacity of the bins, whether it has been filled to the maximum, empties the bin if filled and then makes a visit to the next bin and continues the process from the next bin. Each and every time the Manual Labor is required to visit and check the status of the bins. This is time consuming and tedious. Moreover, lack of orderly clearing of the wastes, informal segregation of the material wastes into organic or inorganic, wet or dry waste results in the dumping of all the wastes into the same process of treatment, which again results in material and monetary loss to the organizations or government. Moreover, in the existing system, there is a major setback, as there is no communication between the availability, filling of the bins or the location of the fully filled bin. Only limited visit can be planned to collect the material wastes in the city as per the existing number of collected images are in favorable for processing. Most of the wastes may not be viable for processing which again collected causes delay in response time and lack of best use of the manpower.

Non availability of the communication processing systems, Lack of Segregation systems to detect the category of the wastes and processing automation are a major setback to the existing waste management systems. Making this costly, time consuming manual analyzing process automated thus could dramatically reduce a large amount of human resource and quickly provide desired results. The system would gain more weightage if the same has a subsequent alert facility to alert the authorities.
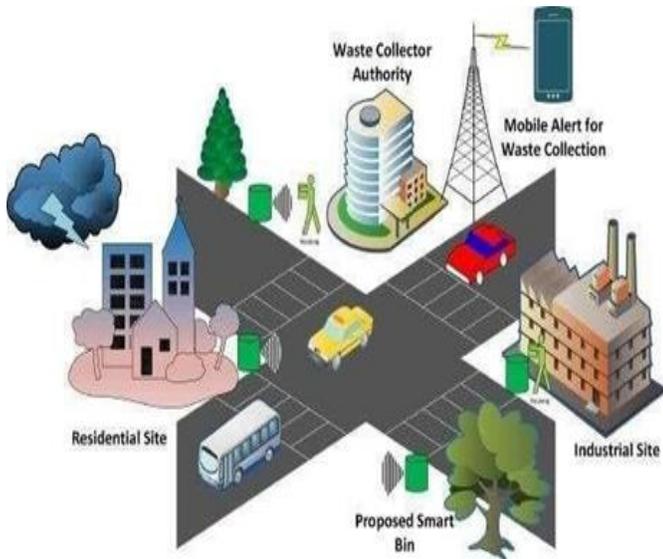
Fig 1. Illustration of the Proposed Management System

IV. PROPOSEDSYSTEM

The proposed system detects the waste on board and classifies them based on the moisture content as dry or wet waste. It is then being placed in the appropriate bins and the levels of the bins are continuously monitored. In case the level on the bins exceeds 80 or 90% fill stage, there is an automatic notification sent to the civil authorities, intimating that the bin would be 100% filled soon, thus enabling the possibilities of them clearing the bin asap. The whole process is completely automated and the data is stored on the cloud, so as to avoid delay in time and involvement of humanlabor. The Proposed system constitutes the NodeMCU[fig6] Controller, Ultrasonic Sensor[fig5], IR Sensor, Moisture Sensor and deploys MQTT Protocol for sending alert to the authorities. Prior to initializing the Data Sending Process, a Segregation setup in used to detect the wet and dry wastes and classify them and sort them accordingly.

The system comprises of three sections viz a viz , Waste Segregation System , Cloud Server System, and the Data Process System.

A. WASTE SEGREGATION SYSTEM

Waste Segregation systems forms the crux of the IoT Enabled on Waste Management System. This is the first step towards the Waste Segregation System. Classification of Waste as Wet or Dry is performed in this system process. This deploys Moisture Sensor and IR Sensor.

High Value in IR Sensor depicts the closed control of the circuit and hence the line of control loop is passed on to the Moisture Sensor. Detection of Value 1 or High in Moisture sensor depicts

that the Waste on the board is a WET Waste. This fact is justified using simple physics application as the liquids conducts electro pulse within them. Once the waste is classified as WET Waste, a simple DC Motor is deployed to place the waste in BIN 1 or in BIN 2. This section of the implementation consists of IR Sensor, Moisture Sensor, and a DC Motor.
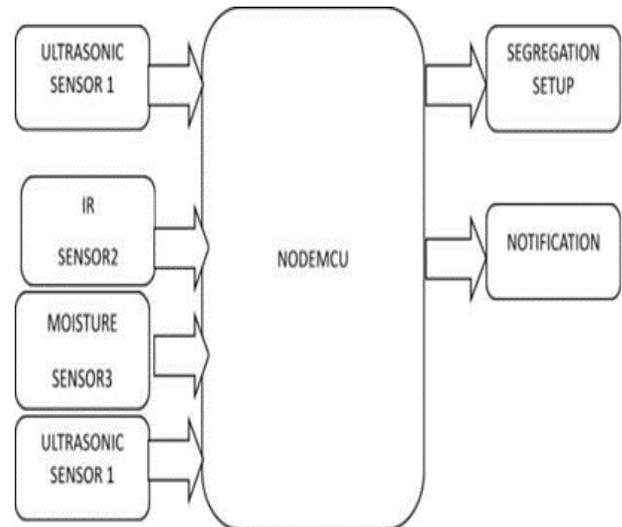
Fig 2. Block Diagram of the Proposed Waste System
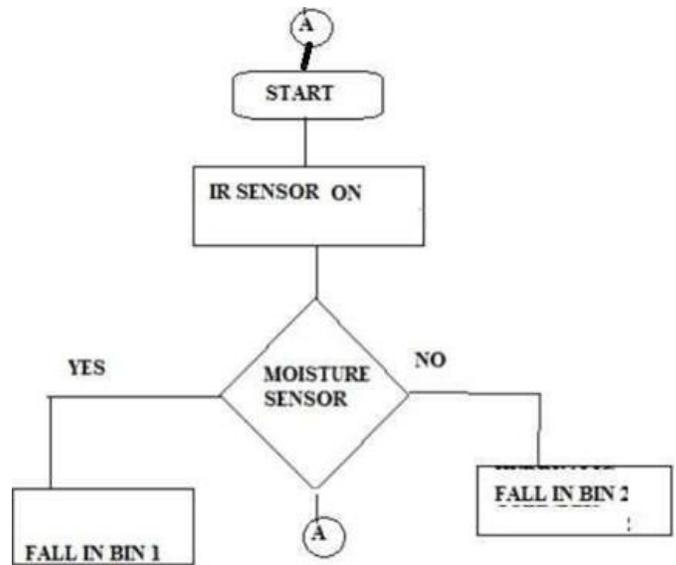
Fig 3. Process flow diagram of the Waste Segregation System

B. DATA PROCESSING SYSTEM

Phase II of the proposed Smart Waste Management system is

the Data Processing system. Data from the bins are monitored continuously and the should the level exceed the threshold level; it is then activating the alert system through the cloud.
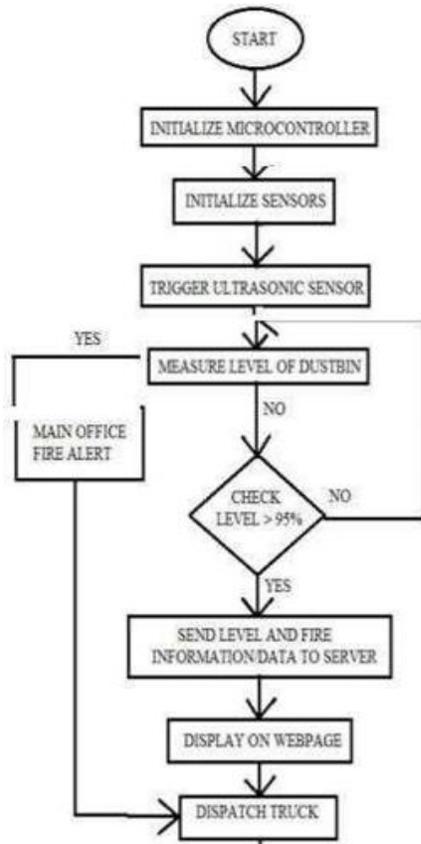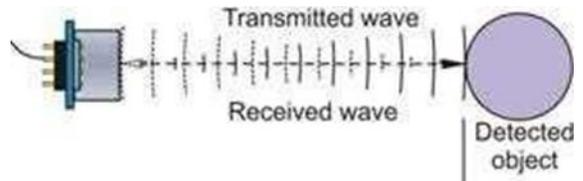
Fig 4. Process flow diagram of the Proposed Data Processing System

The level monitoring of the bins is done by the Ultrasonic Sensor[fig5]. Ultrasonic Sensors[fig5] are placed at preferable proximity on the bins. The ultrasonic sensor[fig5] get HIGH when the Waste Accumulated in the bin gets filled by 90% (as in our implementation) and can be changed as the civic authorities. When HIGH, the sensor

Fig. 5

C. CLOUD & MESSAGE ALERT SYSTEM

The cloud used in this system is the Cayenne cloud. Cayenne cloud is deployed to The Message alert system forms the subset of the Alarm system. This is achieved via the MQTT Protocol. Abbreviated for the Message Queuing Telemetry Transport Protocol, this MQTT is one of the most commonly used protocols concerning IoT. MQTT enables resource constrained IoT devices to send, or publish, information about a given topic to a server that functions as an MQTT message broker.

Continuous Data is being monitored and stored in the Cayenne cloud. Data of the bins can be monitored on daily basis, real time and also the same can be downloaded at any time for any analysis purpose.

V. HARDWARE DESCRIPTION

NodeMCU[fig6] is the base controller of the system. NodeMCU[fig6] is handy and comes in with several extendable pins to enhance and illustrate the operational Internet of Things. This can sometimes prove to be an upgraded extension of the Arduino Controller, except for the extended Inbuilt Wi-Fi Programmable features that can be used to send alert messages to the authorities via Wi-Fi also. That can also be considered as the future enhancement of the proposed project.

Fig. 6

A. SENSOR POSITIONING & CIRCUIT DIAGRAM

The IR Sensor is mounted on a place which is predominantly nearer in proximity to the board on which the waste is

placed. This will be handy in assessing accurate results. The circuit diagram[fig7] below is the replica of the proposed system . The same circuit has to be put in the Bins.

Fig 7. Circuit Diagram of the Hardware System

VI. RESULTS

Result implementation of this project can be enormously handy. Multiple Waste can be segregated and tested. Alert systems can be activated once the bin in 90% occupied. Systems work effectively and is subject to coherent weather conditions and functions perfect and the objective of the implementation is achieved.

Results of the same while receiving messages will be of the following format

Fig 8. Cayenne Cloud Result

VII. FUTURE SCOPE

The same implementation was tested in NodeMCU[fig6] and worked perfect, but Raspberry Pi can also be used for the same application, because of its vast image processing libraries. Moreover, optional Memory to store all the captured videos / images in the Raspberry Pi is higher compared to other controllers.

Data from the cloud can be retrieved anytime during the operational of the system . This data can then be used to predict and caliber systems that fuel various machine learning algorithms and predict the usage of the bins at a given date and time . This will be useful for the civic authorities in prediction of the bins and will facilitate the vehicular transport for clearing of the same , well in advance.

VIII. CONCLUSION

The traditional garbage collection system is changed into a smart and intelligent system. The IoT based waste management system is very useful to remotely monitor the garbage levels in dustbins in various places. This system reduces cost and saves time. This system alsoreduceshuman efforts and is user- friendly system.

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