

SMART GARBAGE MONITORING AND MANAGEMENT SYSTEM USING K-NEAREST NEIGHBOURS ALGORITHM

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Abstract - Monitoring and managing of garbage bins regularly is the most necessary activity to be performed to keep our society clean. With this requirement, this paper focuses in an efficient monitoring and management system using a supervised machine-learning algorithm, K-Nearest Neighbours (KNN). The existing method using Top-k query algorithm is inefficient as the time taken to clear the waste is high. The distance travelled by the truck to clear the waste is longer and inefficient. The suggested algorithm makes the travelling of the truck to be efficient by concentrating on the level of filled garbage bin and the distance to travel to the bin to clear the trash. The ultrasonic sensor in the bin measures the filling level of garbage and sends the notification to the server using the LoRa interface. From the server the information of the bin will be connected to the truck driver using the app where the KNN algorithm is used to clear the bins. The suggested method can thus reduce the time taken to clear the trash and avoid unnecessary disrupts in garbage management.

Keywords- Smart bin, Waste Container, IOT, LORA

I. INTRODUCTION

Waste management or waste disposal are all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling. Waste can take any form that is solid, liquid, or gas and each have different methods of disposal and management [1].



Fig 1: Overall System view

Waste management normally deals with all types of waste whether it was created in forms that are industrial, biological, household, and special cases where it may pose a threat to human health. It is produced due to human activity such as when factories extract and process raw materials. Waste management is intended to reduce adverse effects of waste on health, environment or aesthetics. Waste management practices are not uniform among countries regions (urban or rural areas), and sectors. A large portion of waste management practices deal with municipal solid waste (MSW) which is waste that is created by household, industrial, and commercial activity [7].

This paper is structured as follows. Section II consists of literature survey, which explains the previous papers and its working prototype. Section III consists of methodology which explains the existing methods used. Section IV consists of proposed model to overcome the limitations of the existing methods. Section V consists of expected output and results. Section VI consists of the future scope and reference.

II. Literature Survey

In 2016, S.S. Navghane, designed a system in which the dustbins are interfaced with microcontroller based system having IR wireless systems along with central system showing current status of garbage, on mobile web browser

with html page by Wi-Fi. Hence, the status will be updated on to the html page. Major part of our project depends upon the working of the Wi-Fi module; essential for its implementation. The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision. The IR sensors will show us the various levels of garbage in the dustbins and the weight sensor is activated to send its output ahead when its threshold level is crossed. These details are further given of the microcontroller (ARM LPC2148) and the controller gives the details to the transmitter module (Wi-Fi module). At the receiver section, a mobile handset is needed to be connected to the Wi-Fi router so the details of the garbage bin is displayed onto the HTML page in the web browser of our mobile handset.

In 2015, Theodoros Anagnostopoulos, developed an IoT enabled system architecture to make the garbage collection to be efficient by proposing a Top-k query based dynamic scheduling model. This system consisted of an RFID tag, which is used to identify the bin, and contained a capacity-measuring sensor, which was used to measure the filling level or the volume of the bin. The data about the filled volume of garbage had been transmitted to the system architecture using an antenna. These data's were used to specify the number of full bins in order to initiate dynamic scheduling. A GPS had been incorporated in the truck to provide drivers instructions and real time routing directions. The bin, which had been filled first, will be first in the queue and then the next filled bins. The truck driver moves to clear the bins in the order of the queue resulting in an efficient and quick clearing of bins.

III. PROPOSED METHODOLOGY

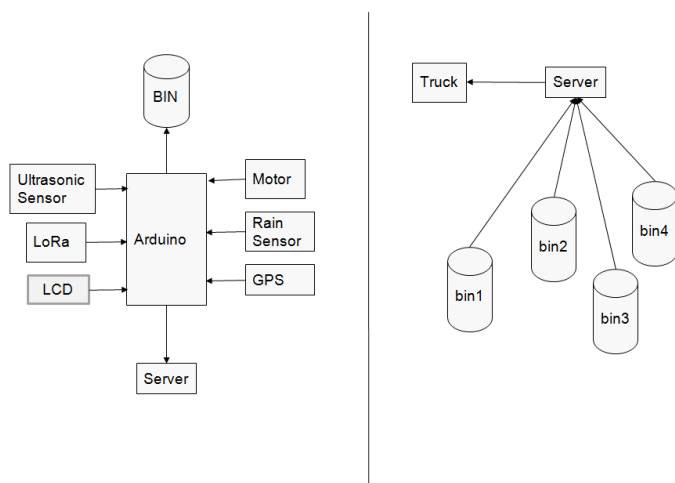


Fig 2: Proposed Model

Ultrasonic Sensor is installed at the top of Trash Can and will measure the distance of garbage from the top of Trash can and

we can set a threshold value according to the size of trashcan. If the distance is less than this threshold value, it indicates that the Trash can is full of garbage and we will display the message “Dustbin is Full” on the server and in the LCD. With the use of LoRa, a wireless is used to transfer data to the web server. The data from the server is updated in the application developed, which is used by the truck driver. Using the KNN algorithm, the distance from the truck to the bin will be calculated. From the information, shortest distance bins can be identified and cleared in an efficient manner.

A. Arduino UNO

The Arduino UNO is an open-source microcontroller board based on the [Microchip ATmega328P](#) microcontroller and developed by [Arduino.cc](#). The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the [Arduino IDE](#) (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.

B. Moisture Sensor:

The sensor measures the dielectric constant of the soil in order to find its volumetric water content (VWC). It obtains volumetric water content by measuring the dielectric constant of the media through the utilization of capacitance/frequency domain technology. Since the dielectric constant of water is much higher than that of air or soil minerals, the dielectric constant of the soil is a sensitive measure of volumetric water content. The sensor has a low power requirement and very high resolution. This gives the ability to make many measurements (i.e. hourly) over a long period with minimal battery usage. In addition, the sensors incorporate a high frequency oscillation, which allows the sensor to accurately measure soil moisture in any soil with minimal salinity and textural effects. An on-board voltage regulator allows factory calibrations to be used with any excitation voltage above 3V.

C. Ultrasonic sensor:

Ultrasonic sensors use sound to determine the distance between the sensor and the closest object in its path. Ultrasonic sensors are essentially sound sensors, but they operate at a frequency above human hearing. The sensor sends out a sound wave at a specific frequency. It then listens for that specific sound wave to bounce off an object and come back. The sensor keeps track of the time between sending the sound wave and the sound wave returning.

D. LoRa:

The term LoRa stands for Long Range. It is a wireless Radio frequency technology introduced by a company called

Semtech. This LoRa technology can be used to transmit bi-directional information to long distance without consuming much power. This property can be used by remote sensors, which have to transmit its data by just operating on a small battery. The LoRa module consists of 16 pins with 8 pins on each side. Out of these 16 pins, GPIO pins ranging from DIO0 to DIO5 use six and Ground pins use four. The module operates in 3.3V and hence the 3.3V pin on LoRa is connected to the 3.3v pin on the Arduino UNO board.

E. KNN algorithm:

The K-nearest-neighbor (KNN) algorithm measures the distance between a query scenario and a set of scenarios in the data set. We can compute the distance between two scenarios using some distance function $d(x,y)$, where x,y are scenarios composed of N features, such that $x = \{ x_1, \dots, x_N \}$, $y = \{ y_1, \dots, y_N \}$

Euclidean distance measuring:

$$d_{E(X,Y)} = \sqrt{x^2 - y^2}$$

F. MySQL:

MySQL, the most popular Open Source SQL database management system, is developed, distributed, and supported by MySQL AB. MySQL AB is a commercial company, founded in 1995 by the MySQL developers. A second-generation Open Source company unites Open Source values and methodology with a successful business model. A database is a structured collection of data. It may be anything from a simple shopping list to a picture gallery or the vast amounts of information in a corporate network. To add, access, and process data stored in a computer database, you need a database management system such as MySQL Server. Since computers are very good at handling large amounts of data, database management systems play a central role in computing, as standalone utilities, or as parts of other applications.

IV. Expected result and output:



Fig 3: When bin is empty



Fig 4: When bin is almost filled with threshold

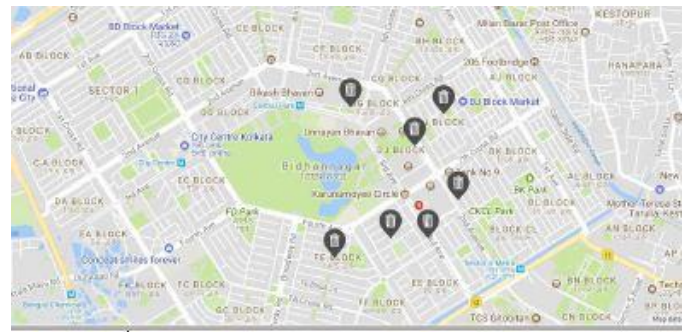


Fig 5: Location of bins showcased in the app

V. Future Scope

This project can be further developed using various sensors for monitoring other parameters of the bin. The major issue to be faced is the positioning of hardware. In practical implementation, various possible changes can be made to enhance the work. In addition, the process is a supervised one. The decision to choose the shortest distance is in the hands of the truck drivers. It would be more effective if it were made to be an unsupervised process using artificial intelligence.

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