IOT BASED WASTE MANAGEMENT SYSTEM FOR SMART CITY

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Abstract - *In our day to day life, we see that the dustbins are placed at the public places overflowing due to increasing waste every day due to the increasing population, which affects the human life. To avoid such a situation it is necessary to manage the waste in a smart way by collecting the waste within time and trip planning in real time based on the status of the waste bin. In previous work the plan of the trip in an optimal path not much considered. In this paper, the collection of waste can be done in an optimized path so that the time and cost are reduced.*

Keywords: Ultrasonic Sensor, Genetic Algorithm (GA), Internet of Things (IoT), ATmega 16A Microcontroller, Optimized path

1. INTRODUCTION

The Internet of Things (IoT) is the connection of devices which connected to the network, transfer data and communicate with each other with or without user intervention. It's an ever-growing technology connecting sensors; objects extend to computing capability and also allowing devices to generate, exchange and data consumption.

The smart city includes the information and Communication Technology (ICT) and IoT technology to remain safe and to manage the city's asset. Urban development is the vision of a smart city. The smart city includes quality of life.

In recent years, there was a rapid growth in population which leads significantly on humanity, wildlife, and the environment. Hence a proper waste management system is necessary to avoid spreading some deadly diseases. In our system, smart binds are connected to the internet to get the real-time information of the smart dustbins and the trip management in cities is done so that cost and time are reduced with an optimized path for waste collection.

There are multiple dustbins are located in the city. These dustbins are interfaced with microcontroller based system with ultrasonic sensor, RF transmitter, and RF receiver. Where ultrasonic sensor which is placed on the top of the bin collects the data and transmits to server-side through RF transmitter shield. Based on the database for an optimized plan using a Genetic Algorithm. The data has been received, analysed and Processed in the cloud, which displays the status of garbage in the dustbin on the web browser.

2. LITERATURE SURVEY

Review of papers is carried out to know the background, current working procedure, and existing system flaws, where we can work out on unsolved problems. A variety of related papers have been reviewed and summarized as follows.

The author introduces technologies like the Global Position System, Radio Frequency Identification, General Packet Radio Service, Geographic Information System, and web camera are integrated devices [1]. RFID reader device in a truck will read both customers and also bin information. Efficient waste collection is achieved. Truck management is also done but is not an optimized way.

A writer of this paper introduces two models of routing they are dynamic and semi-static [2]. Further, accumulation of waste in the city is done by facilitating IoT a routing model dynamically is designed and in case of tragedy, it's robust. Research related to waste collection concentrates on routing and scheduling dynamic design. Though a lesser amount of research indicates gathering waste for smarter cities assistance.

The author explains that the sensor helps to know the level of garbage at a maximum level, Microcontroller acts have an interface between sensor and GSM system. [3]GUI is to monitor garbage information for different locations selected. If garbage is not collected when the maximum filled message reaches higher authority to take serious action which in turn will help to reduce the number of the trip for garbage collection and also can reduce expenditure. Collecting garbage is efficiently managed.

This work expresses to find the shortest route using route algorithm and predictions, which will reduce the workforce, reduce trucks number for cleaning, can save consumption of fuel by trucks and also can save tax payer's money. Smart bin application of model helps in managing the waste collection. [4]Sensors with network connected to bins generating large data through a cellular network. Further visualization and analyzation are done in real time to know the status of the city's waste all over.

Originator proposed a robust, dynamic routing algorithm for trucks when they are damaged and overloaded replacement is needed [5]. This gives a framework for two varieties of trucks for the collection of waste, the High Capacity Trucks (HCTs) and the Low Capacity Trucks (LCTs). By using trucks of big capacity can store large waste thus, reducing the cost of operational collection of waste is due to the reduction of trip plan to dumps.

Here author came up with a model of scheduling dynamically for query called top–k. Collection of solid waste is done by dynamic scheduling were each bin alerts when the capacity level reaches the top. [6]Further developed GUI user-friendly Android app and evaluated based on experimental of waste collection. Finally, real data and synthetically proposed models have evacuated from St. Petersburg municipality, Russia. Collection of data for trip cost is high.

The ZigBee, GSM (Global System for Mobile Communication) and ARM7 are used to form the Integrated system to monitor the waste bins remotely [7]. The sensors are placed in the common waste bins placed at the public areas. When the garbage reaches the level of the sensor, then that indication will be given to the Controller. The controller will give an indication to the driver of a garbage collection truck as to which garbage bin is completely filled and needs urgent attention. ARM 7 will give an indication by sending SMS using GSM technology.

3. PROPOSED METHODOLOGY

The waste management system basically consists of ATmega 16A microcontroller, HCSR04 ultrasonic sensor, RF CC2500 transceiver, remote server, LCD display, power supply circuit, and IoT as shown in figure1.

ATmega16A microcontroller is used in this monitoring system. To cheque the garbage levels a 16*2 LCD display is used. The HC-SR04 Ultrasonic sensors are used to detect the garbage level of dustbins in different regions. A power supply circuit is used for supplying power the circuit. The crystal oscillator is used for applying pulses to trigger the process of level detection in the system.

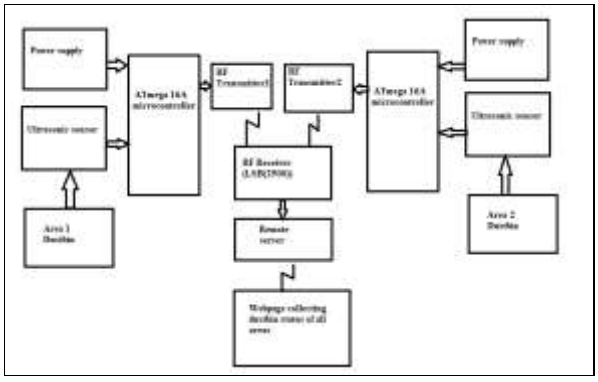

Figure1: A block diagram of a smart waste management system

The presented system uses ultrasonic sensors placed over the dustbins to detect the garbage level and compare it with the garbage bins depth i.e. the percentage of waste in the bins. A level is a monitor via the web page.

The figure2shows the interfacing of components like sensors, LCD, etc. to themATmega16A microcontroller. Port A pins 0 and 1 are interfaced with the ultrasonic. For displaying data Port C pins 0 to 7 are interfaced with the 16*2 LCD. Pin 1 of Port D is connected to the reset circuit. Pins 5, 6 and 7 of Port D are interfaced for controlling contrast and brightness of 16*2 LCD display. Also, a crystal oscillator circuit is connected to ATmega16A microcontroller to generate and provide oscillator frequency to the system.

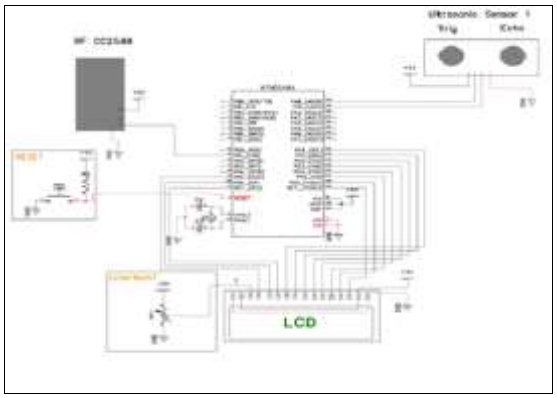

Figure2: Circuit diagram

Each component is connected to Vcc (+5V) i.e. power supply and ground. RF module is connected to port D pin. The basic step of designing any system is to design the systems power supply. The steps involved in the designing of the power are as follows, the first is to determine the total current that the system sinks from the supply. The second step is to determine the voltage rating required for the different components in the circuit of the system.

A system monitors the garbage bins. For detecting the garbage level and compare it with the garbage bins depth. The system informs about the level of garbage collected in the garbage bins using the internet of things. In this system, the information of all smart dustbins can be accessed from anywhere and anytime by the authenticated person and an authenticated person can take a decision accordingly. By reducing unnecessary rounds for garbage collection this system indirectly reduces traffic in the city and saves the time and extra efforts.

In urban cities, the garbage collection vehicle visit a particular area's every day twice or thrice depends on the population of the particular area and sometimes these dustbins may not be full. This system will inform the status of each and every dustbin in real time located throughout the city so that the concerned authority can dispatch the garbage collection vehicle only when the dustbin level is completely full or is about to full.

The traditional garbage collection system is changed into a smart and intelligent system for the smart city. The integrated IoT system is very useful to monitor the garbage levels in dustbins in cities from a distance without any physical contact. This system reduces cost and saves huge time. This system also reduces human efforts and it is a user-friendly system.

3.1 Genetic Algorithm:

Genetic algorithm (GA) is a programming technique that uses the biological spectrum for solving the problem. The genetic algorithm selects a group of elements with similar or dissimilar characteristics over a population in which every element plays an integral part in deciding the optimum solution from a bunch of selected group. Using crossover and mutation, new offspring are generated, and only those offspring that are the best to fit stay, while others are discarded. This process of survival of the fittest goes on until the optimum solution is obtained. The lesser the selection gets; the more the optimum solution is obtained. The accuracy of the solution also depends on the selection of population, achieved target, an element selected for the process.

3.2 Optimization:

Optimization relates to the optimum solution to a problem. When a model is proposed, cost and profit value analysis is a selected parameter for decision-making. Proposed cost should be less and profit should be more, in other words, for minimum input, the maximum output should be achieved; the process of attaining the selected parameters at a minimum rate is optimization. Optimization uses the theory of ordinary differential equations and methods involved in solving iterations. The main objective is to develop objective function based on a defined set of criteria F = {f1, f2… fn}.

Algorithm for calculating Optimized path using Genetic Algorithm:

Step.1- the Original population is created randomly for Separate string for the TSP problem that has been given

And the representation of the matrix is created between two Cities along with a cost of the path.

Step.2- Every chromosome in population is assigned with the fitness using criteria to measure fitness

F(x) =1/x where the total cost is represented by x

If the value of the threshold is nearer to String value then it depends on selection guidelines.

Step.3- Select two chromosomes from existing parent Population can generate latest off-spring inhabitants by Effect of crossover mechanism.

Step.4- Transform the resulting off-springs if it's Essential.

Step.5- Until we obtain optimal solution iterates step 3 and step 4.

4. CONCLUSION

Based on the previous work smart waste collection has certain issues keeping this in mind smart bin involving multiple technologies like ultrasonic sensor, IoT and microcontroller are used to measure the level of waste. An ultrasonic sensor is used to find the status of a bin with a measure of eco back distance. Path optimization is done using genetic algorithm through this cost and times are reduced as compared with the previous work. By the effective usage of smart dustbins can the resource is optimized. This system reduces the traffic in the smart city, so that environment will be cleaned.

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