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Smart Solution For Smart Kolhapur Using Wireless Sensor Network for Smart Dumpster Management

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ABSTRACT

One of the challenges to innovate and create an IoT-enabled solution is in monitoring and management of the environment. Waste collection utilizing the Internet of Things (IOT) with the technology of smart wireless sensors will able to gather fill-level data from waste containers hence providing a waste monitoring solution that brings up savings in waste collection costs. One of the challenges to the local authority is how to monitor the works of contractor effective and efficiently in waste management. This paper will propose to the local authority the implementation of smart waste management to improve the city management and to provide better services to the public towards smart city applications.

Keywords-wireless sensor network, Arduino, Automation, Smart City ,Wi-Fi Model

I. INTRODUCTION

Wireless sensors are devices based on MEMS (Micro Electrical Mechanical Systems) with integrated sensing, digitizing, processing and communication capabilities. A set of wireless sensors can be configured as a WSN (Wireless Sensor Network) that can be deployed in numerous applications in healthcare, environment, defense and disaster management. Sensors have specific requirements to minimize the communication overhead and reduce the power consumption. The WSN runs its own routing and power conserving protocols and it can be configured in various topologies.

Smart cities are envisaged to harness the ICT (Information and Communication Technologies) to optimize the use of their assets including the traffic lights, roads, water supply and sewage system and solid waste collection and disposal system. The versatility of wireless sensors and their diverse usage makes them an integral part of the city's smart infrastructure.

In existing system the garbage bins are not cleaned at proper time intervals which results in overflowing of garbage resulting in hygiene problems, land pollution also it creates ugliness to that place. But in this system we propose deployment of smart dumpsters to optimize the route, fuel consumption and work hour for municipal staff tasked to collect and transport the solid waste in the city.

The proposed system is designed for finding optimized path and resources for solid waste collection in a smart city environment. We have worked to solve the problem of resource optimization for solid waste collection.

Each smart dumpster (with a HC-SR04 sensor) is modeled as an agent. Its behavior (low, high states) is modeled using a state machine. The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object.

II. LITERATURE REVIEW

2.1 Following is the present scenario

2.1.1. Collection of municipal solid wastes: In Kolhapur city, everyday 165 tons of solid waste is generated and all 165 tons are lifted every day. The dry and wet solid wastes are collected from individual houses and public dust-bins are transported to Kasaba Bawada Kolhapur where it is dumped at Zoom fertilizer project. The solid waste collection and transport is done as per timetable and collection route fixed by corporation.

The waste dumped at zoom project is processed to convert it into organic manure. The solid waste collection and transport work is done everyday day from morning 6 to 2 in the afternoon. The collect solid waste from houses from city areas with high pollution density carts with bells is deployed. Male worker are appointed for collection of waste from door to door. Road cleaning is done regularly in high density areas and as per necessity in extension area. Specific areas are assigned to sweeper. Similarly safety kits and long handle brooms, coconut sticks brooms, buckets will be given to all sweepers.

2.1.2. Segregation of municipal solid wastes: People and businessmen are motivated by public awareness programmers to segregate and store dry and wet solid wastes in separate bins at house level only. The dry and wet solid wastes collected by corporation are given to zoom fertilizer project. The wet solid wastes are processed to prepare organic manure. Plastic bags, bottles, scrape materials are separated from dry waste for recycling.

The earthworm compositing is planned to be implemented as scientific method of domestic solid waste disposal. Kolhapur corporation is trying to get people participation in segregation of wastes through publicity and public awareness campaigns with help of social organizations.

2.1.3. Transportation of municipal solid wastes: For transporting solid wastes, Kolhapur Corporation uses 22 vehicles like, dumpsters, placers, R.C. truck, and total containers are 1000. These vehicles of solid wastes transport are of closed type. Transport system is geared up to collect solid wastes daily from sensitive areas like, important places in the city, administrative offices, govt. hospitals, waste generating places etc. In order to or bad smell prevent falling of waste suitable arrangement is provided in the vehicles.

2.1.4. Processing of municipal solid wastes: The solid waste treatment plant to treat minimum 165 tons of solid generated per day in the Kolhapur city is established in an area of 38, 800sq.m.(4 hector.) on 30 year lease contract and zoom company treats the waste to produce compost. The information of waste collection collected by Sanitary Inspector. The wet solid waste is converted to organic manure and sold in the market.

2.1.5. Disposal of municipal solid wastes: Fertilizer project is being implemented through privatization through stages (D.O.T.). The 16.76 hectares of land at post Halsavade, Section No.573/A for necessary infrastructure development works to enable long time dumping and disposal of solid waste is in progress.

2.1.6. Bio medical wastes: There is a legal binding of scientific disposal of biomedical waste as per prevailing rules of govt. of India. Hence, Kolhapur Corporation has erected a treatment plant at Kasaba Bawada Kolhapur drainage plant through a private company, Das Enterprises.

The company collects and transports the biomedical wastes from corporation and private hospitals through closed vehicles and treats and disposes the waste scientifically at the treatment plant site. This Das enterprises company works under directions of Kolhapur Corporation and has control over it.

III. SYSTEM ARCHITECTURE

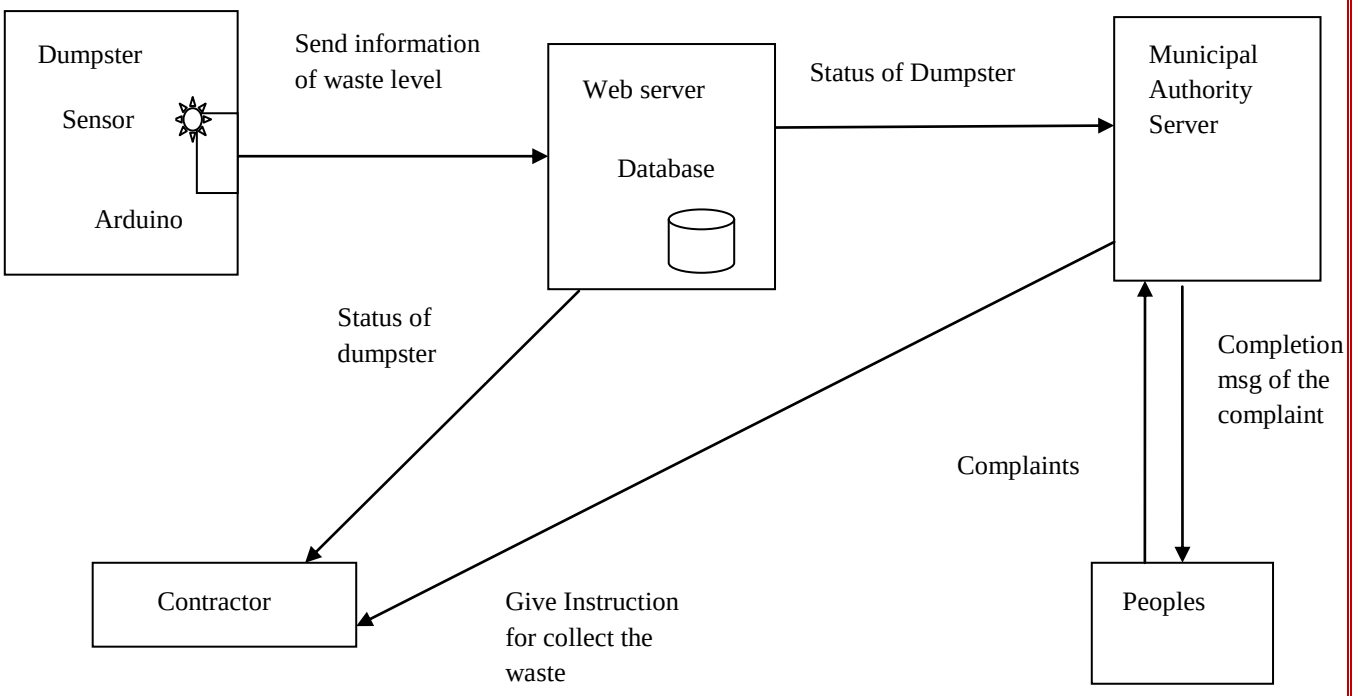

Fig 1. System Architecture.

As shown in above figure each smart dumpster equipped with a HC-SR04 sensor. Its behavior (low, high states) is modeled using a state machine. The HC-SR04 ultrasonic sensor used to determine distance to an object.
The sensor can detect several waste levels as experimentally verified in this we have considered only low and high levels. The change of states is simulated using random number generator. These FSMs (Finite State Machines) communicate with a control station (agent) through events (message passing). The control station communicates with trucks (agents) that react to the events.

The working of this system

1. Contractor sign into smart waste mobile application to view collection schedule before start the garbage collection.
2. When the dumpster is full the send information to the server automatically.
3. If the garbage is not collected people can log complaint using smart complaint mobile application.
4. Both information from sensor and complaint from citizen are send via wireless or mobile network connection.
5. In web server, the information and complaint is process and send to contractor and municipal authority as notification.
6. Municipal authority receives the notification, reply to the citizen complaint and monitors the contractor for any further action.
7. Contractor receives the notification, get the location of the dumpster and the navigate to the location to collect the garbage.

IV. IMPLEMENTATION

4.1 Web Server

Each smart dumpster equipped with a HC-SR04 sensor. The web server and router are responsible for collecting and analyzing the information of service provisioning. Web server contains database for maintaining the status of the each dumpster.

4.2 Tracker

Smart dumpsters equipped with waste level sensors. These sensors can read the level of waste as being low, medium or high. The HC-SR04 ultrasonic sensor uses to determine distance to an object. Arduino is the heart of this project. An Arduino is a microcontroller board that supports rapid prototyping. This board is task-specific and can carry out bit-wise manipulation. Thus, such a board is good for processing sensor output, Analog-to-Digital conversion (ADC) and Pulse-Width Modulation (PWM). Arduino Uno can be safely turned on and off at any time so there is no need to unplug or shut it down properly. Arduino studio is used to upload the programs on the arduino board and execute it.

4.3 Notification

Whenever a dumpster is FULL, it will send a “Request” to the municipal authority server in the form of a message. The request will contain the dumpster’s ID and the timestamp when the request is generated. The municipal authority server will queue these requests in the order of occurrence on the route.

In this way only those dumpsters will be added in the task list which are full. If the garbage is not collected, citizen can log complaint using smart complaint mobile application. Both information from the sensor and complaint from citizen are send via wireless or android application.

4.4 Complaint Management

If the garbage is not collected, citizen can log complaint using smart complaint mobile application. Both information from the sensor and complaint from citizen are send via wireless or android application.

Municipal authority received the notification reply to the citizen complaint and monitors the contractor for any further action.

V. RESULT

5.1 Login Module Of Dumpster Tracking

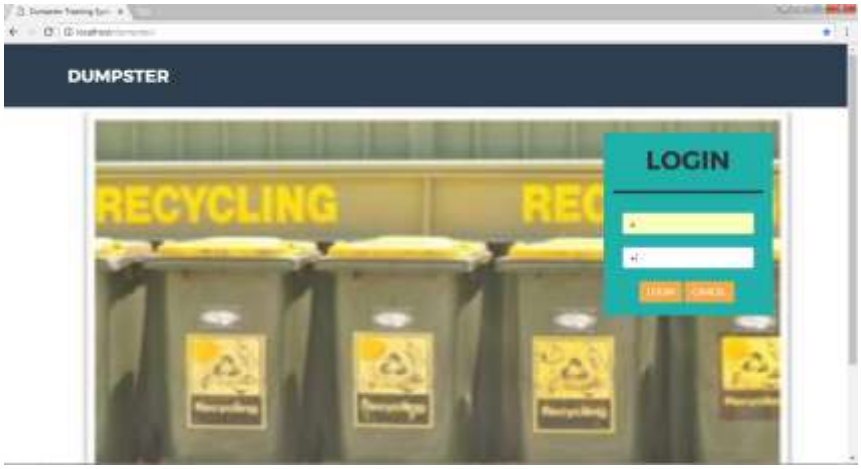

Fig.2 Dumpster Tracking.

As shown in fig 2. The user can login by using user name and password credentials. All the records are saved in the database at the backend.

5.2 Add Dumpster

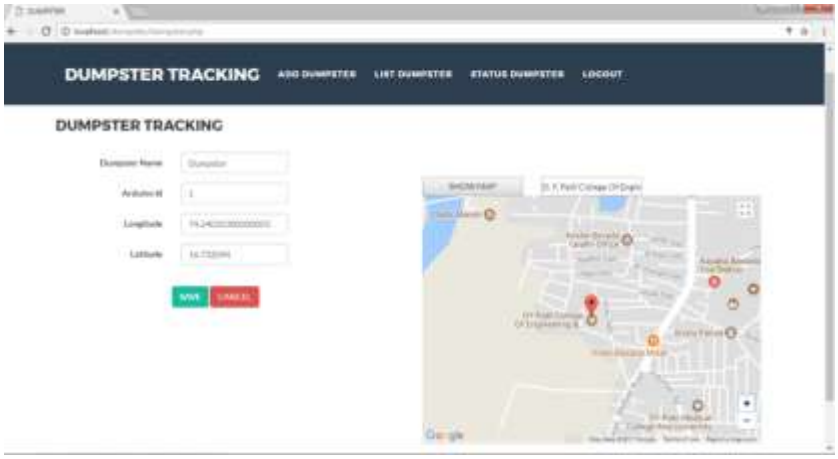

Fig. 3 Add Dumpster.

Fig. 3 shows the mechanism of adding the dumpster at serve side. All the information such as name and arduino id about dumpster is saved at server side. Arduino id is used for unique identification of dumpster. The dumpster can also be located using the Google Map.

5.3 List of Dumpster

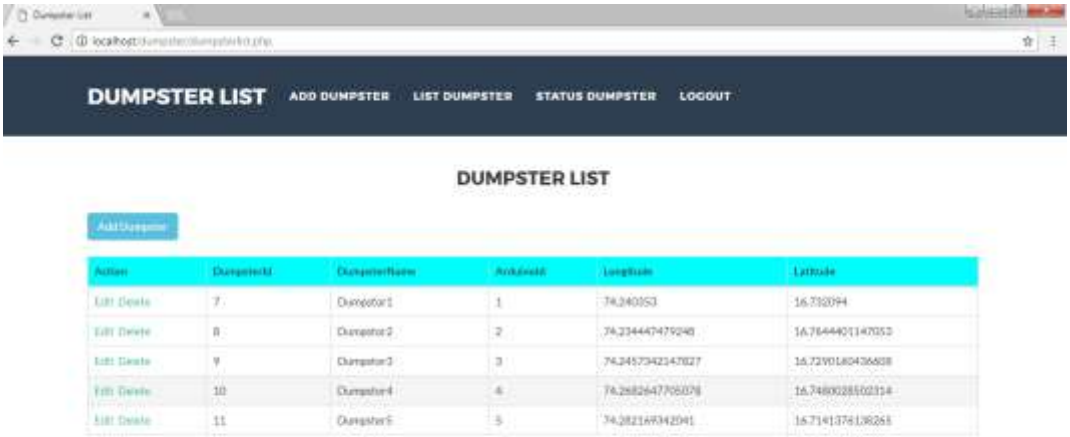

Fig.4 List Of Dumpster.

Fig. 4 depicts the list of the dumpster that are in use. Its saves the arduino id, dumpster id, dumpster name, and longitude and latitude. Latitude shown as a horizontal line is the angular distance, in degrees, minutes, and seconds of appoint North or South of the equator. Longitude shown as a vertical line is the angular distance, in degrees, minutes and seconds of a point East or West of the prime Meridian.

5.4 Clean Environment Mobile App

Fig.5 Login Page .

As shown in fig. 5 the user/authority can login by sing the credentials. After successful login the user can access its own account and proceed with its work.

VI. CONCLUSION

In this system present our approach to optimize the resources of smart city and reduce expenses on the solid waste collection operation. We have proposed an agent based approach in which the dumpsters communicate with the municipal authority server and the trucks through a wireless sensor network to inform the truck about the level of waste accumulated prior to start of the collection trip. This information is obtained through HC-SR04 ultrasonic sensors that are installed in the dumpsters scattered around the city.

Initial experiments with HC-SR04 sensors have yielded good results where the sensor is able to measure the level of waste at three different levels and the results are communicated back to the computer. The information about the level to which the dumpsters are full can be used to plan the route of the truck optimally and it can result in substantial savings. Results of simulating a set of dumpsters served by a single truck show that the total length of the trip can be reduced substantially if the fill level is known in advance.

Nevertheless, the proposed SWMS requires more maintenance cost than the existing system. There is a need to make it a sustainable which is the development cost is acceptable to implement in local authority. The most important issue is how to deliver to local authority with competitive price and less maintenance cost. With the current system, the implementation only limited for apartment and condominium which the sensor device put on top of the big garbage bin inside of apartment waste chamber. In the future, small IoT gadget for waste monitoring can be develop and put inside the waste chamber in front of each terrace house and bungalow to widening the implementation to the citizen.

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