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IoT Based Smart Waste Management System

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ABSTRACT

The issue of overflowing garbage bins and manholes has become common in many urban areas in India, the delay in cleaning them by sanitary workers being major reason. The manholes overflow due to reduction in flow capacity in them, which occurs mainly because of siltation. This causes environmental pollution, which results into health hazards. A smarter solution to this problem needs to be discovered. The integration of computing, sensing and communication devices can be used for effective waste management. This paper describes a smarter way to monitor fill level of garbage bins as well as manholes, using sensors and informing municipal authorities in time, to prevent them from overflowing. The sanitary workers can locate bins and manholes which have reached their limit, using android app. The proposed system can be mounted below their lids for evaluation.

Keywords: IoT, Smart City, Waste Management System, Smart Garbage Bin

1. INTRODUCTION

In many urban areas in India, there is problem of health hazards due to improper waste management system. As per [1] in September 2016, in city of Noida, during outbreak of chikungunya and dengue, RWAs in sectors 40 and 19 alleged that Noida authority's apathy towards overflowing garbage and blocked drains in the area is creating a major health hazard for residents. The sights of garbage strewn across roads and choking drains are common in both sectors. The RWA executive member claimed that the quantity of silt taken out from a drain was a proof of drains not being cleaned for a long period. In July 2016, in Nagpur city, the news of sewage flowing on main streets of upscale localities like Ravi Nagar and Bharat Nagar, posed serious health hazards to residents. A resident of Vashishtha Apartments claimed that a youngster died of dengue a year before. The residents said that the problem has existed for past 20 years. The main motive of this project is to prevent such situations mentioned above. The idea of making India a cleaner place to live forms the basis. The concentration is on urban cities specifically, as huge amount of waste needs to be managed in highly populated cities. The project will make existing waste management system better by informing municipal authorities in time about required cleanup. In smart cities, with amenities evolving and becoming better and smarter, there is a need to make waste management smarter, as it is an important part of infrastructure. The availability of Wi-Fi in smart cities is obvious. The system uses Wi-Fi for connectivity with municipal authorities. The system continuously monitors fill levels in bins and manholes and if there is rise above a threshold, it updates the status of bins and manholes and locations of them are sent to municipal authorities through web application. Then authorities can assign sanitary workers particular areas according to status updated and workers will be able to locate them through an android application.

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2. LITERATURE SURVEY

Numerous studies have led to actualize the idea of IoT to make the urban areas, more intelligent with the usage of sensors which creates vast measure of information. Some of these are looked into as under:

A system based on Smart M3 platform [2], through which sharing of data be-tween devices, for highly dynamic and heterogeneous environments of smart city, is discussed. Multi-layer waste management system architecture for design of a RFID; sensor based real-time automatic Waste Identity, Weight and Stolen Bins Identification System (WIWSBIS) [3]. Smart waste-bin system, which was a part of Dynacargo project in Germany in 2015 [4]. The proposed architecture mainly exploits RFID communication to reduce costs, and support scaling at urban level. The Smart bin system represented in [5] incorporates mesh network and duty cycle features, to identify whether extra litter bins are needed or there is need to relocate existing litter bins to other places. The system enables cleaning operators to better plan their cleaning schedules and routes. The Gully pot monitoring system represented in [6] able to transfer and process data effectively and it also gives solution to monitor sewer information. This paper gives cost effective solution be-cause of variety of sensors. The sensor based sewer monitoring system [7], which was the part of Sense Smart City. The proposed architecture mainly focuses on monitoring of natural variation of the sewer. Changes in climates affect storm drainage system [8] specify the problems in modification of existing drainage infrastructure. A system is presented in [9] for smart city framework for solid waste collection. RFID communication is exploited in the system architecture. Ultrasonic sensors have been used for fill level detection of bins. The system has been implemented and verification provides promising results

3. PROPOSED SYSTEM

3.1. System Architecture

The system mainly consists of Arduino Uno R3 microcontroller, ultrasonic sensors, GPS module, Wi-Fi module, and batteries. The system is based on periodic monitoring of fill levels in garbage bins and manholes. To reduce power consumption, periodic monitoring is preferred over continuous. Highly durable batteries provide power to the system. Figures below give an architectural overview of proposed system.

The front end consists of an android application and web applications that give a route to manholes or bin that have reached their cleanup limit. The Wi-Fi router that will be present at short distances considering a smart city will do the part of handling communication between main servers and the system. The system

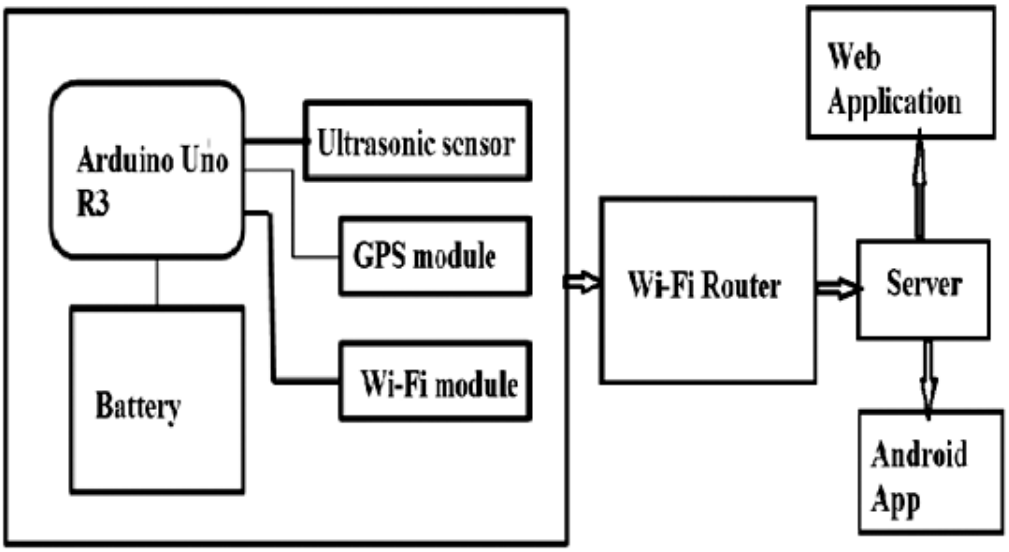

Figure 1: Simple Working of Universal Module

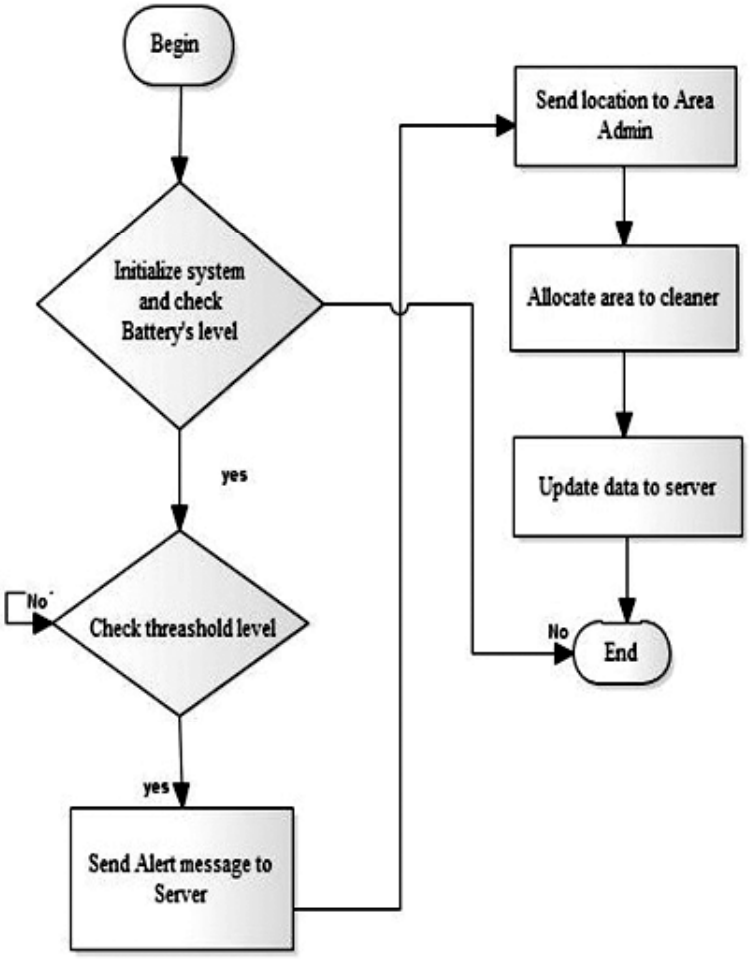

Figure 2: Flowchart of Universal Module

consists of Wi-Fi module for this purpose. The GPS module is used to provide the location of bins or manholes that have reached their threshold. The purpose of architecture is to provide data collected by the sensor to management body through a visual system that shows a graph that will predict how much time approximately would be taken by bin or manhole to overflow. The threshold once crossed, data is then sent to the administration. This will give authorities a hint so that there is timely cleaning of waste. The system will prevent authorities as well as society from efforts required and filthy conditions faced when there is overflow of bins and manhole.

3.2. Algorithm

Step 1: Start

Step 2: Check whether lid is closed and module has sufficient battery also checks that all components of system are working correctly or not

Step 3: If any component not working or battery is less or lid is not closed then it will send notification

Step 4: If everything correct then SGB will be online to server else it'll be offline

Step 5: Module will start ultrasonic sensor to check fill levels of bin or manhole

Step 6: Values of ultrasonic sensor is used to calculate how much bin or manhole is filled with the help of distance formula: Distance=Speed*Time

Step 7: Module then sends fill level to server after every 1 minute

Step 8: Go to Step 6

Step 9: End

4. IMPLEMENTATION

When there is a rise in the level of sewage or storm water in manholes and if the level crosses a particular threshold, then ultrasonic sensor which is continuously sensing water level, records above a threshold level and universal module updates database and sends the notification to a server using Wi-Fi module. The GPS module is used to send the coordinates of the manhole. The area supervisor will analyze the statistics and allocate the manhole to sewer cleaner. The municipal sewer cleaners will be notified about the blocked manhole details (i.e. location, statistics, directed route) when they log into the Android application. The sewer cleaner will follow the directed route towards the manhole and will pump out silt and update the status to database that the blockage is removed. The batteries used will be lithium polymer ones. The complete module is placed inside a robust and waterproof IP67 rated case to protect it against sewage water and other waste. For better wireless connectivity and GPS monitoring, manhole lid will have a small hole through which antennas and magnetic charging port will be drawn upward to the lid surface. They are covered with IP67 rated material. The system proposed can be used in garbage bin also, there are two parameters that change, one is there will be a change in the threshold to be set. The threshold for garbage bin will be different than that of manhole due to variation in their heights. Other being that monitoring starts for bin only when a lid is closed, to get accurate fill levels. If garbage is still being dumped in a bin, a false alert can be sent that its level has increased above the threshold, without this constraint.

5. FUTURE WORK AND CONCLUSION

With the Increase in urbanization and need of healthy environment, the scope of improvement in waste management systems in our country is immense. A lot of improvement could be done to our current system. Majorly we can increase the robustness and durability of our system by using advanced polymers and resins. The lifespan of battery could be extended by using renewable energy as well as solar energy. The scope of a universal module could be increased from urban sector to industrial sector. Segregation could be done for metals, plastics, glass and electronic waste so that it could not harm animals who feed themselves

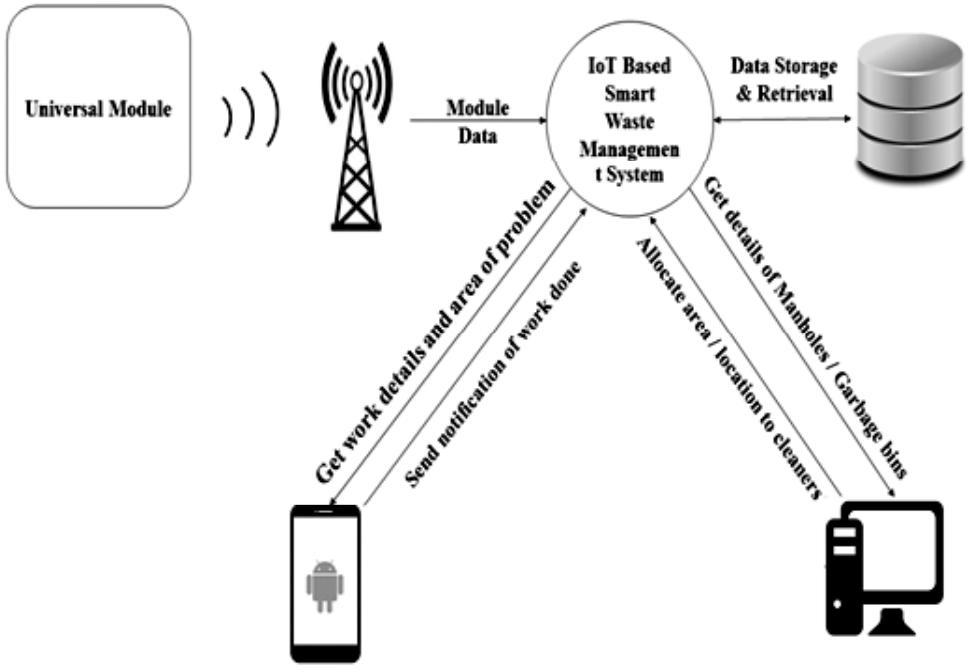

Figure 3:

on waste. Enhancing our system scope, recycling could be accomplished. The materials to be recycled could be picked up from curbside then stored, cleaned and reprocessed into refurbished materials. This paper presents the universal module for smart waste management. The expenditure involved in the modification of infrastructure of existing systems (mainly manholes) can be avoided by fitting this module into bins and manholes. Sanitary workers get locations of bins or manholes which are needed to be cleaned and also route is shown through android app. This will help them to plan their schedule and save fuel and time. The fill-level statistics of bins will help authorities with an estimate of required bins in particular area.

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