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Solar Powered Solid Waste Management using MANET and GIS

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Abstract- **As a developing nation and as the second most populous country in the world we in India face unique problems that require unique solutions. One such problem is waste management. In this project we propose a self sustaining maintenance free system that uses a combination of recent communication developments like MANET and solar power. MANET is used in this project as a communication back bone for the whole system for various reasons like low cost, easy to implement and flexible networks. MANETs [1] are self reconfiguring and self healing networks that have great reliability and very low power requirements. Hence these networks can work even with very low power and small solar panels that can be fitted on to the garbage bins itself. In this project each garbage bin is fitted with the AD Hoc transceiver [5] for communication, a sensor for monitoring the level of garbage in the bin and also the solar panel for powering the whole node. Each node is provided with a GPS location of the bin, using which a GIS system based on mapping applications like Google maps can be used to monitor the status of the bins.**

Keywords: MANET, GIS, GPS, Solid waste management, solar power.

I.INTRODUCTION

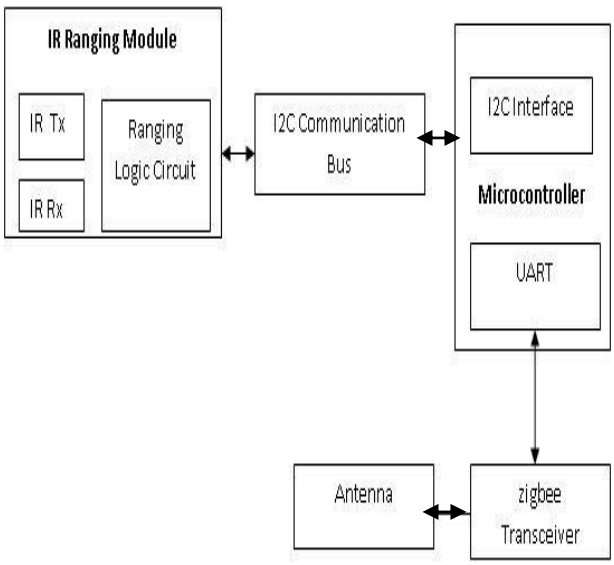
Over the last few years modern waste management has made great strides towards reducing the environmental impact and saving resources. Waste prevention measures and the development of advanced technologies for the recycling and disposal of waste have led to positive ecological effects. An approximation of the technological limits as well as increasingly more complicated logistics [4] due to separate collection have to be taken into consideration in the recycling of certain waste types. Ecological benefits of recycling could subsequently be reduced or eliminated under certain regional conditions.

In case of an ad Hoc network it is feasible to maintain dynamic routing tables that constantly need to reflect the changes in network topology. Therefore, data cannot be routed based on host addresses. Moreover, most applications are interested only in the data and not the host containing it. In such cases, application instances should be able to query for the data and get them even without knowing the source of the data. Routing should be done based purely on the data and the query. Such an approach to networking is called data centric. The objective of data centric networking [3] is to abstract the network as a database and support queries on top of it.

Thus different garbage bins in different locations within the city can form a dynamic multihop network that can provide the information to any local corporation office and at the same time to the head office as well. Hence if the local bodies are not performing the maintenance properly the head office will know the information almost instantaneously. Hence it can also act as an automatic double check on the part of the government authorities as well.

II.SYSTEM ARCHITECTURE

A.Manet garbage bin node



I. The microcontroller is the vital component in this section. Here we are using

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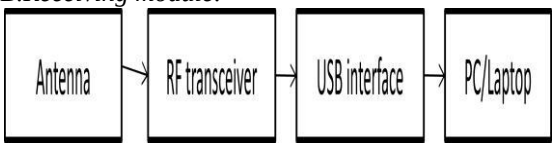
PIC18F45K22 microcontroller. The modules for the microcontroller are written in ICSP (In circuit serial programming). The microcontroller is capable of converting the electrical signal into digital signals with the help of inbuilt A/D converter. It is powered by using solar panel. It requires minimum of 3.3V as operating power. It is synchronized with zigbee transceiver with the help of UART bus .It is interfaced with an IR sensor and a zigbee transceiver. The IR sensor is used to sense the level of garbage level. In our project we are using IR proximity sensor because it is capable of sensing the level of the bin at any predefined height. The zigbee is used to transmit the processed results of the microprocessor to the main office. The zigbee is used in our project because it is capable of handling the communication between more than two nodes simultaneously. The power to the entire circuit because it is obtained from the solar panel setup.

B.Receiving module:



The antenna receives the signal from the garbage bin node and is processed in the zigbee transceiver section. Then the results are fed into the PC/Laptop using the interfacing component called USB Interface – FT231XS. This device acts as the buffer to synchronize the data transfer rate of zigbee transceiver with that of PC because in general, PC is having faster data transmission rate while the zigbee is having slower data transmission rate.

C.Description:

Whenever the garbage is full, the IR proximity sensor senses the pre defined garbage level [2] and converts the output into an electrical signal based on the light signal strength reflected by the sensor. The microcontroller processes the input from the sensor based on the coding fed to it from ICSP. It usually initiates communication if and only if the level of garbage has reached its threshold value [4]. Then the processed results are transferred to the zigbee transceiver using UART bus. The signals are received using the antenna placed in the corresponding nodes. The information is transmitted to the municipal office through least cost nodes. The municipal office officials then direct the garbage cleaners to clean the nodes.

III. OVERALL ARCHITECTURE:

In our project the whole system is arranged in the hierarchical basis. The first stage comprises of the garbage nodes. It consists of IR sensor to check the garbage level. It is communicating using short range bandwidth like zigbee. The frequency bands used in this project are unlicensed and hence it provides ease of access by all the nodes in the network. The second stage is composed of decision support system that provides effective routing techniques to route information packet to the server. In this stage we are using GSM/GPS in order to find the node in the network. The final/third stage consists of server i.e., PC in the municipal office. The visual studio in the server provides various information about the status of the bins in that network.

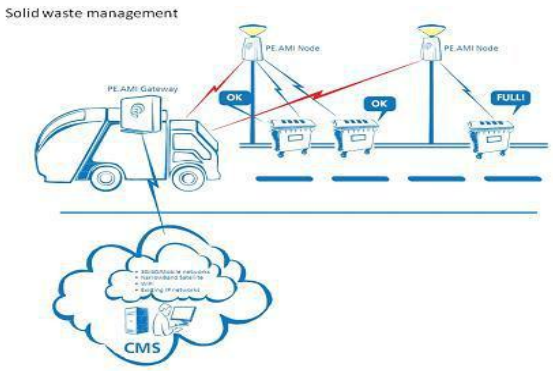


Fig.1 Solid Waste Management System

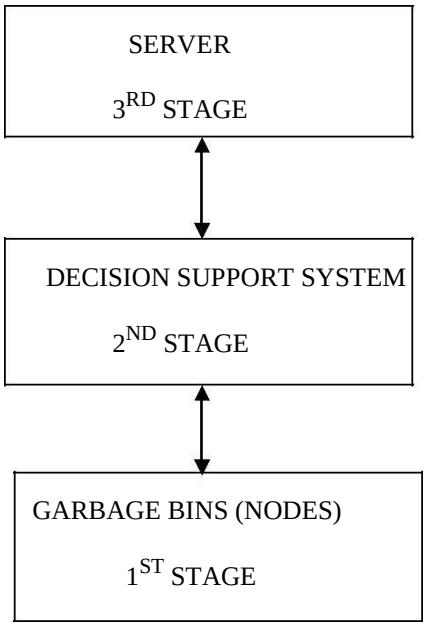


Fig.2 Architecture of the network

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IV.DYNAMIC SOURCE ROUTING:

In our proposal we use the *dynamic source routing* technique for data transfer between the nodes and the municipal office. It describes the design and performance of a routing protocol for ad hoc networks that instead uses *dynamic source routing* of packets between hosts that want to communicate. Source routing is a routing technique in which the sender of a packet determines the complete sequence of nodes through which to forward the packet; the sender explicitly lists this route in the packet's header, identifying each forwarding "hop" by the address of the next node to which to transmit the packet on its way to the destination host. Source routing has been used in a number of contexts for routing in wired networks, using either statically defined or dynamically constructed.

The protocol presented here is explicitly designed for use in the wireless environment of an ad hoc network. There are no periodic router advertisements in the protocol. Instead, when a host needs a route to another host, it dynamically determines one based on cached information and on the results of a *route discovery* protocol. We believe our dynamic source routing protocol offers a number of potential advantages over conventional routing protocols such as distance vector in an ad hoc network. First, unlike conventional routing protocols, our protocol uses no periodic routing advertisement messages, thereby reducing network bandwidth overhead, particularly during periods when little or no significant host movement is taking place.

Finally, conventional routing protocols are not designed for the type of dynamic topology changes that may be present in ad hoc networks. In conventional networks, links between routers occasionally go down or come up, and sometimes the cost of a link may change due to congestion, but routers do not generally move around dynamically. In an environment with mobile hosts as routers, though, convergence to new, stable routes after such dynamic changes in network topology may be slow, particularly with distance vector algorithms. Our dynamic source routing [5] protocol is able to adapt quickly to changes such as host movement, yet requires no routing protocol overhead during periods in which such changes do not occur.

IV.COMPONENTS USED:

HARDWARE COMPONENTS:
Microcontroller – PIC18F45K22 I/P
Ultrasonic Ranging Module – Daventech SRF 02
Wireless Transceiver – RF / Zigbee
Solar panel – 5W
Voltage Regulator – LM1117 Super
capacitors
USB Interface – FT231XS

SOFTWARE TOOLS:
Google Maps
Visual Studio
Orcad for Circuit Design Eagle
for PCB design
Comtest for network communication testing

CONCLUSION:

A mobile adhoc network has been used to control the filling of the bin collecting data from embedded sensors. Through long-range communication modules all data are sent to a remote server using zigbee, where operator controls the state of the whole system. The edge routers allow nodes interfacing with an access gateway to Internet.

Several efforts for the whole system optimization have been made. These include:
The increasing of sensor node's battery life-time by using solar power, in order to reduce maintenance;
Improved GUI adaptation to the local administrations needs;

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