INTELLIGENT BUS LOCATOR AND POLLUTION MONITORING SYSTEM IN WIRELESS SENSOR NETWORKS

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Abstract

Sensor networks are currently an active research area mainly due to the potential of their applications. In this paper we discuss the use of wireless sensor networks for Intelligent Bus Location and Pollution Monitoring System. With fast growing industries, the problem of pollution is becoming more a matter of concern for the health of the population. We proposed an innovative system named IBLPS to locate buses and in addition to that monitor pollution in and around the city. Wireless Transceivers are used by the system to detect the location of buses and gas sensors such as Carbon dioxide sensor, Carbon monoxide sensor etc. are used to monitor pollution around the area. All the data gathered are stored and analyzed with special Non Duplicate Data Acquisitions algorithm for elimination of duplicate data.

Keywords-Bus Locator, IBLPS, Sensor Networks, Pollution Monitoring, Non Duplicate Data Acquisition.

I. INTRODUCTION

Sensor networks are dense wireless networks of small, low cost sensors, which collect and store environmental data. Wireless sensor networks facilitate monitoring and controlling and physical environments from remote locations with better accuracy. They have applications in a variety of fields such as environmental monitoring, indoor climatic control, surveillance, structural monitoring and medical applications as well. In this paper we proposed Intelligent Bus Locator and Pollution Monitoring System (IBLPS). Even with the development of city, there are people who are either innocent or new comers to the city. People get messed up not knowing the bus stops, getting cheated by trespassers and many of these happen day by day. To help them IBLPS helps them to notify them the locations while they travel in bus. With the increasing traffic everyday pollution has considerably increased over the last few years. Development of a city cannot hinder by restricting the industrialization. But still they degrade the Environment and hence monitoring of pollution is a must need. Traditionally pollution is monitored by collecting data by sending personals to various parts of the city and this way is very much time consuming, at times defective and expensive too. The use of IBLPS helps people locate themselves even in remote areas and be aware. Not only it, it also monitors pollution day by day and in a less complex manner.

II. REQUIREMENTS

1. Implement transceivers (nodes) at the point of interests.
2. Implement transceivers in buses.
3. LED display to display location detail in the bus.
4. Arduino (Open Source Hardware) clubbed with sensors (Carbon dioxide, Carbon monoxide, etc.)
5. Collect pollution readings from a region of interest.

6. Collect data from nodes and transmit them to common gateway.
7. Implement Non Duplicate Data Acquisition Algorithm to avoid data redundancy.
8. Use data to plot graphs and gather statistical details about the pollution of the area.
9. Report generation.

III APPLICATION OF WIRELESS SENSOR NETWORKS

Sensor networks is an active field of research due to its emerging importance in many applications including environment and habitat monitoring, health care applications, military applications etc. However, sensor networks are now used in many civilian applications as well for commercial and industrial use. Some of the applications are

3.1 Fire and Flood Detection

Large number of environmental applications makes use of sensor networks. These are deployed in forests to detect the origin of forest fires. Weather sensors are used in flood detection system to detect, predict and hence prevent floods. Sensor nodes are deployed in the environment for monitoring biodiversity.

3.2 Bio complexity Mapping and Precision Agriculture

Wireless sensor networks can be used to control the environment which involves monitoring air, soil and water. Sensors are deployed throughout the field and these sensors form a network that communicate with each other to finally reach some processing center which analyze the data sent and then accordingly adjust the environment conditions. For example if the soil is too dry.

3.3 Habitat Monitoring

Concerns associated with the impacts of human presence in monitoring plants and animals in field conditions have to a large extent been overcome by sensor networks.This represents a substantially more economical method for conducting studies than traditional personnel rich statistics.

IV PROPOSED IDEA (IBLPS)

4.1 Bus Locator

Bus locator system forms the base platform for the effective and cost efficient sensing of the location of the bus. The ultimate aim of the bus locator system is to locate the present location of the bus with the help of transceivers.

4.1.1 Implementation

The transceivers are installed at all bus stations (stops), each and every bus. These are pre-fed with name of the bus stop where they are being installed. The transceiver at bus stop is controlled with the help of a power controller and an actuator. Actuator just activates ordeactivates the transceiver depending upon the availability of data from the bus's transceiver. This manages power efficiently for the transceivers. The transceivers are controlled with power controller. The power is managed with the help of the following algorithm.

```
while(bus_transceiver_data!=0)

{

if(route_id==transceiver_route_id)

{

        Initiate Actuator;

        Power Controller turns on Transceiver
        at bus stop;

        Acknowledgment sent;

}

}
```

Figure1: Algorithm for Transceiver-Transceiver

Each bus has its own BUS_ID and ROUTE_ID. The stop list for the corresponding route id is read from the text record file. Thus the current stop information and the next stop information can be read from the text record file and then made to display in the LED board by means of Transmitter installed in bus.
The transmitted in the bus is powered with bus's connection. Also the bus's current place information is then fed to the Arduino chip installed to calculate the various pollution levels at the place. Backend database is made with BUS_ID, ROUTE_ID and the sensor information got from the Arduino chip. This is then sent to the transceiver via wifi or zig bee using remote data transformation and its changes are made to database accordingly and the duplicate data are eliminated. This clearly then processes and the BUS_ID and ROUTE_ID are transferred accordingly and a real time access is granted accordingly based on the data reception.

```
while(transceiver_arduino_data!=0)

{

Initiate sensors;

Sensor levels of various pollutions
calculated;

Data stored in text record file;

}
```

Figure2. Algorithm for Transceiver-ArduinoTransmission

4.2 Pollution Monitoring

The proposed IBLPS system comprises of a single Arduino chip which is placed in every bus and a transceiver placed both at bus and at bus stops to send/receive data/acknowledgement about the name of the place. The collected sensor details are stored temporarily in Arduino chip which then is allowed to reach a server for data analysis and processing later.

4.2.1 ARDUINO

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software running on a computer
(e.g. Flash, Processing). The boards can be built by hand or purchased preassembled; the software can be downloaded for free. The hardware reference designs (CAD files) are available under an open-source license; we are free to adapt them to your needs.

4.2.1 Sensors

The most common principles for CO2 sensors are infrared gas sensors (NDIR) and chemical gas sensors. Measuring carbon dioxide is important in monitoring indoor air quality and many industrial processes.

The information from the satellite is updated every minute in the server and stored in the database. The information can then be accessed by all using an interface website. The IBLPS server processes the received data to store in database from which a user Interface is made which is a website where there is student login and normal user login. The web portal can be assigned for education purposes and

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normal user login for monitoring by pollution control board.

4.2.2 Architecture of IBLPS

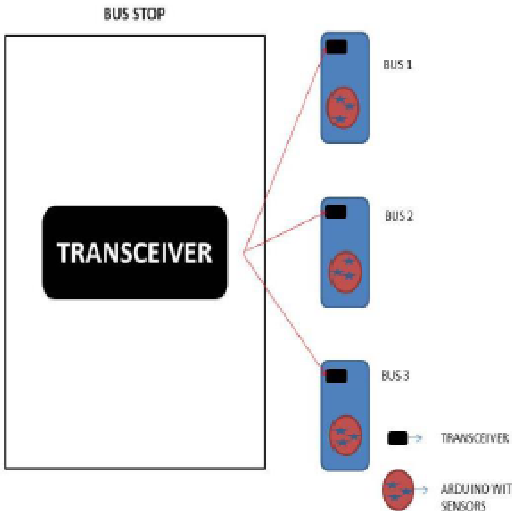

Figure 3: Architecture of IBLPS

Here is a brief description of each component of IBLPS

Transceiver (AT BUS STOP): Sends information about the stop where it is located and receives Acknowledgement about the transmission of information to transceiver placed in bus. (For Unique BUS_ID).

Power Controller: Each bus stop's transceiver (node) will be turned on when we called it. As for power saving modes, this will depend on the transceiver of the bus.

Communicator: This is implemented by transceivers. Inter-Process Communication is usually done using sockets so we expect the Arduino to provide us with sockets as well as methods such as "send" and "receive".

Data Collector: Gets a list of nodes from which it has to collect readings, then the messages to inform them and finally receives the required values.

Aggregator: Implements Non Duplicate Data Acquisition Algorithm (discussed later) to store values.

Connection Initiator: The Arduino DriverManager allows for a method of open a connection by setting it a name, username and password as parameters. It will return reference to the connection.

Connection Destructor: Connection Object is destructed after the data transmission is over. Therefore, this component just has to call this method and hence frees associated memory as well as save the state for later.

4.2.3 Deployment Strategy

We first partition the region into our area of interest as several smaller areas for better management of huge amount of data that will be collected by various buses and for better coordination of all the components involved. We deploy cluster head at a common place where all the buses can transmit data to a common server over a wireless LAN network (WIFI). We then randomly deploy the transceivers in various places of our interest and feed the data into the file list and route list of each bus. The common server will collect results from the sinks and statistically analyze and project the various pollution levels at various places at the end of the day.

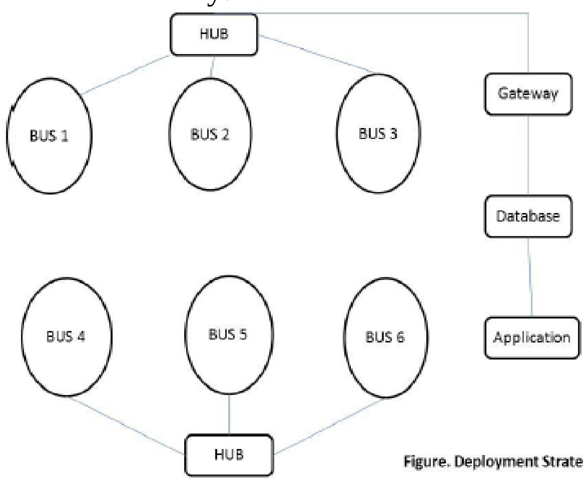

Figure 4: Deployment Strategy

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V DATA ACQUISITION ALGORITHM

For data acquisition we use duplicate elimination, since there will be large amount of location records and others logs are generated. To eliminate the redundancy, we employ duplicate elimination algorithm based on the timestamp of data which we process.

5.1 Duplicate Elimination

In IBLPS a node's data consists of two set of data: the data, which is the name of the place sent by the Transceiver, and a route id which identifies the node uniquely. The data created by the sensors connected with Arduino is stored along with the name of the place and timestamp. The collected details are stored in the list and check for the occurrence of data with the same id and same timestamp and thereby detecting the presence of duplicate packets. It then keeps only one instance of them.

VI CONCLUSION

As discussed in this paper, recent technological developments in the miniaturization of electronics and wireless communication technology have led to the emergence of Environmental Sensor Networks (ESN). These will greatly enhance monitoring of the natural environment and in some cases open up new techniques for taking measurements or allow previously impossible deployments of sensors. IBLPS is an example of such ESN. IBLPS will be very beneficial for monitoring different high risk regions of the region and in a wide range as a country. It will day by day information about the pollution level of a particular region of a country as well as provide alerts in cases of drastic change in quality of air. This information can then be used by the authorities to take prompt actions such as evacuation of people or sending emergency response team.

The major motivation behind our study and the development of the system is to help the government to device an indexing system to categorize air pollution in and around Tamil Nadu. IBLPS highly reduces the amount of data by Non Duplicate Data Acquisition System, thus reducing the transmission energy required and at the same time representing the original values accurately.

Strength of IBLPS is the high quality of result it produces. The collected readings are stored in the database and these can be accessed individually in a table or summarized area wise graph. Thus IBLPS is very flexible, very easy and yet powerful due to its ability to provide highly summarized and analyzed results at the level of sensors.

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