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Traffic and Weather Monitoring System Using Wireless Sensor Networks

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Abstract: Extreme increment of Vehicular traffic around the world, especially in urban areas has led to many disastrous situations, managing such a massive amount of traffic is becoming difficult. To overcome this difficulty new traffic and weather forecast sensing devices based on wireless sensing technologies are to be designed. This technology can monitor traffic and weather parameters such as traffic flow, accidents, rainfall and humidity, smoke on road systems in real-time. User can access this data provided by the data collector devices using a android application.

Keywords: Traffic monitoring, WSN, Weather monitoring.

I. INTRODUCTION

Traffic congestion have various harmful effects such as air pollution which pose major concerns to the public. Congestion in urban areas has increased dramatically during the past 20 years. The number of hours lost each year by an average driver due to congestion has increased by 300 percent. A survey in the largest cities showed that, drivers spend the equivalent of almost eight work days each year stuck in traffic. One option is by increasing the capacity of the roadways which becomes expensive and, in some areas where land is scarce, is not an option. Improving the efficiency of the current transportation system through the implementation of advanced technologies may reduce effects of traffic congestion and decrease the accidents. Real-time traffic surveillance is one of the most important components of this approach.

A Traffic Management Scheme has been built by the police, to help people to get the latest information regarding traffic jam in different areas. In this paper, information about traffic and weather is collected in a database, so that the traffic information can be presented in mobile application of Android. Based on the rules, the information of traffic and weather can be extracted in the form of table which consist of origin, time, destination and traffic condition, weather condition.

The main objective of this project is to help people to get the news of traffic and weather from a reliable source with a very nice presentation on the android application by developing a system that can extract the information of traffic and weather. This process basically works by analysing a message, getting certain information regarding traffic and weather in a tabular format and use this information for android application which will give a note of condition in that area. Android OS is chosen because of increasing popularity of android phones in the world.

Traffic-monitoring can efficiently promote better urban planning and encourage better use of public transport. The investment in traffic-monitoring system will bring huge social and economic benefits by reducing congestion and pollution. Based on the wireless sensor network (WSN) technique, this paper investigates the problem of efficiently monitoring, collecting, and disseminating traffic information in an urban areas. We design the architecture of WSN-based traffic-monitoring system and specify the phases of the traffic information acquisition and delivery in the context of WSN environment. A routing algorithm is proposed for data delivery, in which multiple routing-related information are adopted for routing decision making.

II. RELATED WORK

Roads safety is one of the serious challenges that the humanity is facing now-a-days. In order to address this problem, advanced technologies are being implemented. Applications range from devices for vehicle detection, traffic control to hazard traffic identification.

A. Present work related to the project topic

The existing data acquisition technologies in transportation systems suffer from the following drawbacks:

(1)Technologies used : Zigbee technology is used for communication between the sensor and the server. The motive behind this approach was to reduce the number of accidents by flashing light on highways.
(2) High cost: The majority of technologies require expensive instruments, which inhibit cost effectiveness of large-scale and distributed traffic measurements.
(3) Maintenance: Most existing technologies need significant maintenance and calibration and are costly to install. Installation costs may include wiring of the instruments to power sources or the wiring required for communication.
(4) Scalability: The majority of existing technologies cannot be deployed on a large scale due to limitations such as installation cost, wiring, availability of energy sources, etc.

B. Proposed System

The main goal of this project was to develop an inexpensive and scalable wireless sensor network

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prototype, which encompasses a cost-effective architecture for real-time traffic measurement over distributed points on a transportation system. The sensors are capable of performing simple sensing operations such as traffic count measurement, weather condition detection.
The architecture has the following advantages over the existing methods:
(1)Energy efficiency: The sensors and measurement devices uses a minimal energy and uses low-power sensing, amplification, and communication technologies.
(2)Range of measurement: With the sensor networking, several types of traffic and weather measurements can be performed.
(3)Ease of installation: Compared to existing systems, the system requires minimum installation effort
(4)Endurance: Callibration of values have minimal error.
(5)Driver's safety**:** The main principle behind it is to provide information related to accidents and weather in order to reduce the accidents on roads which then lowers the number of deaths and injuries. It can also provide accident information to guide ambulances and fire trucks.
(6)Navigation Guidelines: Drivers can be guided to alternative routes in order to minimize cost and fuel consumption.

C.Scope

- Traffic congestion problem may be solved by improving the efficiency of the current transportation system through the implementation of Sensor network technologies.
- Surveillance of Real-time traffic is one of the most important components of such an approach, and real-time travel information is useful for further advising systems.
- Emergency management agencies such as police, fire stations, and ambulance dispatchers may also benefit from real-time traffic information in routing their vehicles through the transportation network to save lives.

III. SYSTEM ARCHITECTURE

A. *System requirements*

In order to make a wireless sensor network suitable for traffic and weather monitoring, some requirements have to be met. In the following we give a brief overview of requirements that will be used to design the proposed architecture and choose the wireless protocol to use.

(1)Predictability: The system implements a WSN that allows its network environment to determine the conditions in that area from end-to-end.

(2)Performance: power consumption, jitter, throughput.

(3)Quality of Service: The WSN implements advanced mechanisms and a clear policy to ensure guaranteed performance. QoS will be ensured also when nodes number increase.

(4)Network Coverage: The WSN should be able to work in a harsh and dynamic environments taking into account factors like heavy traffic, high temperature, dust, vibrations, humidity, fog or heavy rain, etc.

(5)High density of nodes: Nodes density should be high.

(6)Communication reliability: The WSN shall provide high reliability in terms of communication between the services

(7)Fault tolerance: The sensors should provide valid information to the database server. In any fault situation it should avoid performance degradation. Error/Fault in any sensor shall be notified to the database so that actions could be taken to replace it.

(8)Mechanisms and support: The working conditions in traffic monitoring systems are not static it should work in any environment.

(9)Network ability to transmit data: WSNs should be able to transmit data to the server time to time.

B. *Safety Requirement :*

The server should always be confirmed to run properly and the data are saved to the database at consecutive intervals. Power is a significant feature and the power supply should be always taken care of. An Uninterrupted Power Supply is always recommended.

C. *System Features*

In summary each device includes the following components

(1) Sensing elements: The main sensing elements are IR sensor for traffic count measurement and weather sensors such as humidity and smoke sensor.

(2) Bluetooth Connection devices: This component includes a communication between road side Bluetooth device and HC05 Bluetooth.

General Android application provide their users with the power of getting information related to weather and traffic.

Flow can be expressed in form of 4 blocks as :

A.Hardware Block:

It consists of different sensors like temperature sensor (TDR), Rainfall and humidity sensor, Smoke sensor, IR sensor (For traffic density). These sensors are deployed on the road and connected to ADC ports of microcontroller device like the AVR microcontroller. This device collects data sensed by the sensors in real time and

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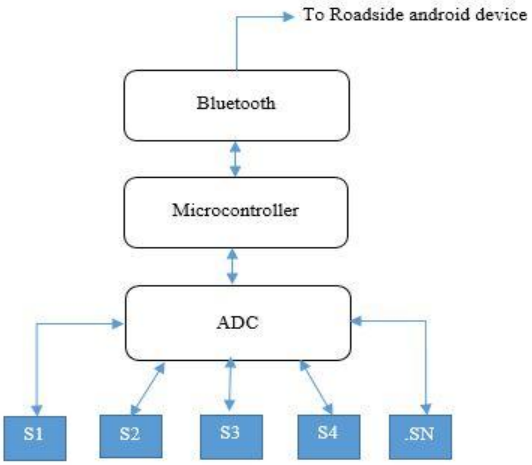
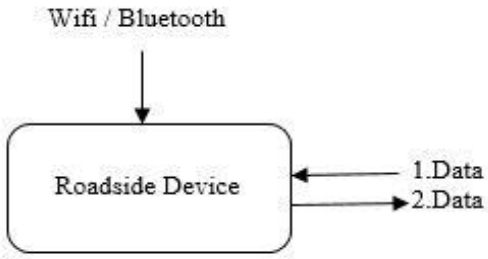
continuously transmits it to remote android device present on the roadside by Bluetooth connection.



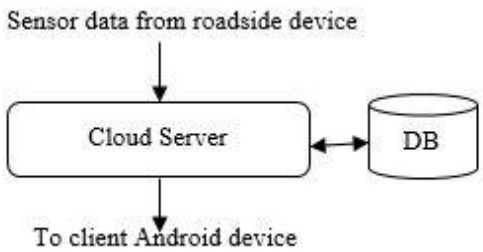
B.Road-side Devices:

The real-time traffic and weather information is sensed and collected in this phase. The transmitted data is collected by this device via Bluetooth or wifi network and it is updated into the cloud server database. Internet is required to constantly upload the data in the database. A simple device that consist of Bluetooth and internet facility can be used.



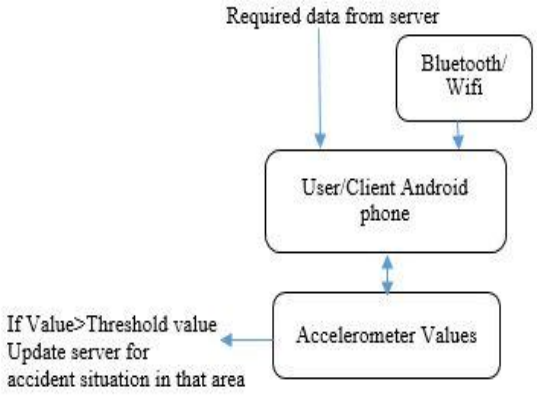
C.Server Database:

All the information collected by the sensors is updated in the database in sequential manner. Also it keeps a record of the users using the application to access the data in a particular area. It works as a Middleware by collecting data from sensors and providing it to the users. Apart from sensor data it also collects accident information from its client.



D.Handheld Android Device:

This device consist of a application which provides traffic and weather information to the user. It fetches only the required data from the database and presents it to the user. Also a accident detection system is introduced in this application using the device accelerometer. Jerk and variations in the values are considered for detection of accident situations. If accident is detected in a particular region, it gets updated in the server database.



IV. MATHEMATICAL MODEL

Set Theory:

Let S (be a main set of) ≡ {USER,SEN,B,A1,SENDB,A2}
Where ,
USER: is the a set of users of the system who will be requesting for data using android app, that will be generated by the sensors. Here (user1, user2, user3,…) Є USER.

SEN: is the set of sensors connected to Analog to Digital converter on each microprocessor board. Sensors used in implementation are:
-IR sensor
-Humidity sensor
-Smoke sensor
-Rainfall sensor
-Temperature sensor
Here (s1, s2, s3, s4, s5) Є SEN.

B: is a set of Bluetooth devices deployed in different areas. Here (b1, b2, b3,…) Є B.

A1: is a Android device considered to be a base station for remotely located WSN devices. Here (ad1, ad2, ad3,….) ЄA1.

SENDB: is the server database of the system. The server is responsible for registering, authenticating and providing associations to the end user. It provides
-User info

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-Area info
-Sensor data

A2: is a set of android devices responsible for gathering information from the server and providing it on the app also it gives reporting of accident situation. Here (a21, a22, a23,….)€A2.

Functionalities:

S = Read Sensors (s1, s2, s3, s4, s5);
SensorDB = Fetch All Sensor Data (Hardware, Server info, Bluetooth id, Sensed data);
SENDB = Upload Values (SensorDB, Area, Phone id);
A2 = Access Accelerometer and GPS (A2, GPS, Accelerometer);
SDB' = Upload Parameters (Server, A2);
SDBT = RegisterUser(uid, password, fullname, address, country, contact, email);
password = SHA1(input_password);
U = AuthenticateUser (uid, password, SDBT);

V. CONCLUSION

Using different sensors, information of traffic and weather in that area is extracted, and this information is used to present it in a view in the Android-based mobile application. The result of our project will show that the information extraction system will work well to extract traffic information and weather information from sensors, and the Android-based mobile application work well to display the information. The database of place and its coordinate are to be updated on regular intervals. Future work of our project are integrating the whole system with the profile based mobile application, new feature of the Android mobile application with GPS and mapping system and new source of traffic which means larger scope of information.

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