



Research Issues in Mobile Sensor Networks Applications and Survey of Key Factors

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Abstract: This paper aims at discussing various research issues of implementing the mobile gateway to integrate wireless sensor network (WSN) and other networks and another method of implementing mobile phones itself serve as sensor of wireless sensor network and various mobile sensor network based applications. In recent years, the deployment of wireless sensor networks are used in variety of fields such as medical, environmental and habitat monitoring factories, traffic control, structure monitoring, fire detection and infrastructure security etc. WSN consists of sensor nodes of low power, low data rate communication ability and low processing power. So there is a possibility of lose of data which are sensed by the sensors and also many difficulties to transmit the sensed data to other networks easily. Overcome this situation, a smart phone equipped with high processing power sensors are used as sensors in WSN or used as a gateway between WSN and other network and this functionality of integrating WSN and other networks through smart phone technology called mobile wireless sensor network(MSN) is used in many applications.

Keywords: Wireless sensor network, Blue tooth, Body area sensor network, Mobile sensor network, Wreck watch, web based architecture.

I. INTRODUCTION

Wireless Sensor network consists of a number of small or large sensing wireless devices called as sensor nodes densely deployed in various locations. These sensor nodes are vary in sizes and containing various sensing capability sensors such as a radio transceiver for generating radio waves, microcontroller which controls the monitoring and various communicating devices . These different types of sensor nodes perform different work in different fields efficiently. The entire network consisting of different types of sensors sense the physical and environmental conditions and communicate themselves to gather global information

Modern smart phones are equipped with a various range of internal sensors like accelerometer, camera, digital compass, magnetometer, gyroscope, GPS, Microphone, ambient, light, orientation sensor, geomagnetic sensor, etc. Using these sensing devices, smart phones have high features of complex sensing capabilities such as detecting user location, recording high quality audio, video etc. Smart phone are also having some interfaces for audio, video and data communication such as UMTS, Bluetooth(BT) and WIFI etc. Apart from these sensing devices and interfaces, smart phone are also equipped with programmable tools with different kinds of application that allow smart phones to communicate with sensing devices of wireless sensor network for gathering data from it. Smart phone combines

its own sensed data and the data collected form WSN and performs some processing if necessary. Then it transmits the combined data or processed data to other web applications which are used in various fields. Based on the above explanation, we suggest that mobile phones and wireless sensors can complement each other to perform collaborative sensing efficiently and effectively. The integration of wireless sensor network and smart phone combination is called mobile sensor network (MSN). This paper described detailed overview of the research issues in smart phone based sensor network (MSN) systems scenarios and also the various applications based on those scenarios.

II. RESEARCH ISSUES IN MOBILE SENSOR NETWORKS

Among the wide range of mobile sensor network applications, we select three representative research issues for mobile phone wireless sensor deployments: Research issues of msn in biological applications, Research issues of msn in environmental monitoring, Research issues of msn in traffic accident detection system. By these research issues, we explain the utilization of both wireless sensor network and mobile phones as sensing platforms. We provide examples for the research issues and explanation for the



utilization smart phones as sensors in mobile sensor networks.

A. Research issues of MSN in Biological Applications

Wireless sensor networks (WSNs), Body area sensor networks (BASN) and smart phones are combined together to monitor the patient along with the environmental information and sent this combined information to doctors or medical centers.

- (1) Deployed sensors of wireless sensor network sense the environmental information such as temperature pleasure, oxygen content, humidity and other air pollutants.
- (2) Monitored patient wears sensors on his body or specialized sensor can be implanted in his body to measure his vital signs such as blood pleasure, body temperature, body acceleration, heartbeat, blood pressure sand oxygen level in blood.
- (3) Mobile phone are commonly familiar to people, and hence it is carried by them wherever, they are going outside. This allows monitoring of the person in different environmental situation without limiting the mobility of the monitored people.

Combining the above said three features personal health monitoring is described in detail which is given below:

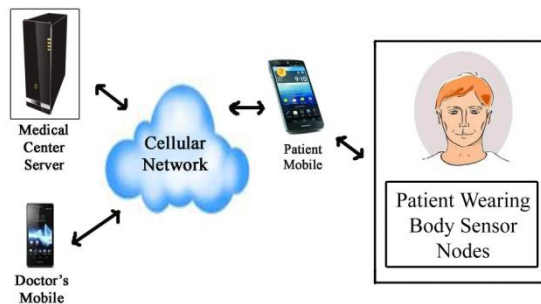


Figure 1: MSN in Patient Monitoring

- (a) Mobile phone collects the environmental information from WSN sensors such as peak flow meter, Pollution sensor etc which are interfaced to the mobile phone via a Bluetooth connection.
- (b) Body area network (ie) sensor nodes within the patient body records patient vital signs and these information are sensed by mobile phone sensor and recorded in the mobile phone.
- (c) Mobile phone couple the information collected by wireless sensor network and body area sensor network and perform any processing if needed.

- (d) Using the available network the mobile phone transfer the coupled information to the hospital or medical center for long term inspections and further future examination of the patient and also send to the doctor's mobile phone to get immediate suggestions and medicines in the case of emergency.

B. Research issues of MSN in Environmental Monitoring

In environmental monitoring, the fixed Wireless sensors/Actuator Networks are integrated with web based technologies through the mobile gateway and thus creating smart phone based mobile sensor networks which are used to measure the environmental parameters accurately and instantly which is shown in figure2.

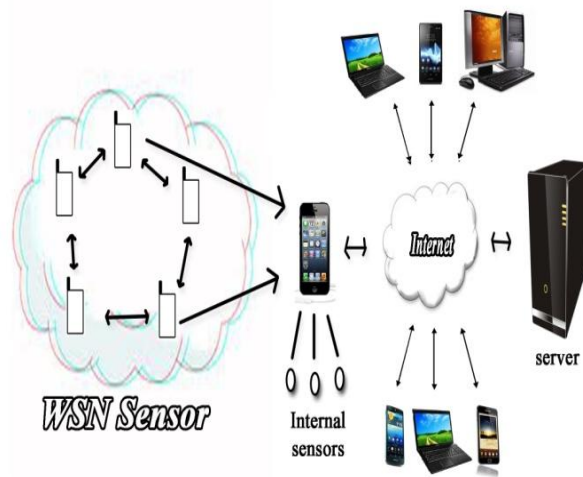


Figure 2: MSN in Environmental Monitoring

In environmental monitoring system, WSN consists of a number of sensors deployed in different environments. These sensors are programmed in different manner according to the respective applications. They have different sensing capabilities to monitor the environmental parameters such as temperature, pressure, humidity, air quality, the pollutants, the oxygen content, etc. They sense the environmental conditions and at the same time, they communicate themselves to share the collected information for the purpose of gathering the complete information about the environment and send the information to the base station or other network through normal gateway. Since the WSN sensors have small transmission range, they are not able to send the collected meta data to the external network easily. So, there is need for the implementation of mobile gateway to collect the meta data from WSN sensors and make the



meta data to well formulated data before sending to the external network.

Smart phones are equipped with powerful CPUs, different internal sensors and high range transmission tools using the internal sensors, smart phone sense some environmental parameters of the surroundings and also receive the environmental data collected by WSN sensor node through wireless transmission apparatus. Then smart phone combine its own sensed data of the surroundings and the received environmental data from deployed sensors of WSN and process the combined data and change it into complex meaningful information. After processing, the Smart phone acts as a sensor gateway and sends the processed information to the data server over the internet. Data Server the store the information in database which is accessed by authorized users.

C. Research issues of MSN in Traffic Accident Detection System

Usually Traffic accidents are detected by in-built automatic accident detection systems which are fixed vehicles. This facility is not available in most of the vehicles. To overcome this situation, we have provided an alternative system called smart phone sensor Network which combines the feature of advanced computational capabilities of smart phones such as iphones and Android phones, etc and web services such as face book, Google maps etc.

Android smart phones run wreck watch application helps the smart phone users to detect the car accidents in real time and hence the travelers can change their travelling route and avoid the traffic jam around the accidental area.



Figure 3: MSN in Accident Detection System

Wreck watch is divided into two main components.

1. Wreck watch client

2. Wreck watch server.

Wreck watch Android client detects car accident by the data received from internal sensors of smart phone such as GPS receiver and accelerometers and hardware such as camera, microphone, speaker phone, etc. Accelerometer measures the vibrations, microphone records sounds and camera takes the accidental photos. Apart from these sensors, interfaces and hardware, android phones have different android application activities. Using these application activities, wreck watch Android client test the received accidental data and post them to wreck watch server via HTTP post. As soon as wreck watch server receives the accidental information, it immediately post them to web services such as AmasonS2, XML / Json and Google map from which the first responder receives the accidental information. The accidental information are also uploaded in appropriate servers that are received by the family members. The travelers around the accidental area also receive the accidental information and thus preventing the traffic jam.

III. KEY FACTORS FOR THE IMPLEMENTATION OF MOBILE PHONES IN WSN

In this section, we discuss the technical factors for using mobile phones as sensors instead of deploying sensors in WSN and mobile gateway between WSN and external networks.

I. TECHNICAL FACTOR

We compare smart phone and WSN wireless devices based on their processors, storage devices, energy resources, sensors, OS and other capabilities.

(a) Processors, Storage devices and Energy resources of Smart phones

In terms of processing and storage, the mobile phones are more resourceful in comparison with WSN wireless devices. Mobile phones are equipped with powerful processors and a considerable amount of memory space. WSN sensor nodes have less power CPU and smart phone sensors have powerful CPUs. WSN sensors have memory ranging from 1MB to 8MB and those of smart phones have nearly 16GB. Energy resources are also very low in WSN sensor node and because of this reason, these sensor nodes often cycle to sleep to recover energy. According to user requirements, powerful batteries can be used in smart phones.

(b) Embedded Sensors of Mobile phones

The sensor nodes of WSN capture only primitive data types. But, the mobile phone sensors collect complex data types, such as audio, video and pictures and photos. When compared to WSN sensors, mobile phones can provide rich information about their environment using the advanced sensors. Most of the WSN sensors have only humidity sensors, temperature sensors, light sensors and proximity sensors alone. But smart phones are equipped with more advanced sensors. If we require some extra types of sensors which is not available in smart phone, we can easily attach the required sensors in smart phone via Bluetooth. But in the deployed sensor, it is not easily possible. Furthermore, mobile phones also contain positioning systems such as GPS, Wi-Fi, digital compass, and cellular triangulation, which perform automatic annotation of the sensor readings in the locations where the smart phone resides.

(c) Wireless Technologies

WSN sensor supports the wireless technology of IEEE802.15.4 only. But smart phones support the variety of the wireless technologies such as IEEE 802.15.4, Bluetooth, GSM/CDMA IEEE 802.11. Bluetooth standard is very useful to interface with external sensors. Using different communication standards in smart phones, we can easily communicate with external networks and communicate with other smart phones and widely deployed sensor nodes of WSN.

II. Human Factor

Since larger number of sensor is widely deployed in different places, it is difficult for the wireless sensor network designers to manage the sensor nodes. Often a number of sensor nodes become faulty. So it is necessary for the network developers to attend the faulty node for the purpose of repairing them. But the smart phone users themselves recover the faults whenever they occur and also they install new applications such as operating system, interfaces whatever needed. Intermediate persons or network developer are not needed in the maintenance of smart phone sensors. Today, smart phones become very popular and are accepted by most of the population worldwide. This large acceptance proved that its coverage and mobility. The smart phone users commonly carrying their phones wherever they are going. This proves the easiest dynamic communication among the population.

CONCLUSION

In this paper, We have presented various applications based on the smart phone feature of its larger number of embedded sensors, wireless standards, and interfaces. Using mobile gateway and mobile sensor networks, an application designer develop new applications and implement them based on web based wireless sensor network architectures. We have also discussed the mobile

gateway concept for metadata retrieval of sensor nodes of WSN, its enrichment with smart phone information and sending combined information to the server side which is used by web applications. Data from many smart phones can be also combined and in conjunction with web services to create powerful real time applications and share this applications with multiuser through distribution networks. Implementing smart phone based sensor networks become familiar in recent years due to increasing number of smart phones and increasing sensing capabilities, different types of hardware, standards and interfaces equipped in smart phones.

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