An Efficient Healthcare Monitoring System in Vehicular Ad Hoc Networks

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ABSTRACT

The proper management of personal health information is important to the healthcare system. The major challenge for patients is collecting their health information in one location so that it will be accessible to them and to the providers with whom they wish to consult. These records are generally not exchanged and updated unless the sites are part of a network of providers that share common information systems. In recent years, there has been a tremendous increase in the utilization of wireless sensors in the medical field in order to monitor patient's health records in real time. A new trends in ad hoc network are Vehicular Ad Hoc Networks (VANETs) and Wireless sensor networks. In this paper, the VANET and Wireless Body Sensor Network (WBSN) technologies are shared together to form an efficient healthcare monitoring system. Particularly, medical assistant is not needed to monitor in the patient's home or hospital surroundings. As an alternative, patients are prepared with a smart phone and WBSN formed by body sensor nodes. By using the WBSN, the patient's Personal Health Information (PHI) is collected together. By using VANET technology ambulance and medical personnel will be sent to the patient's location. This approach will lessen the complexity and time taken for assistance

Keywords

Vehicular Ad Hoc Network, Personal Health Information, wireless body sensor network, GPS systems

1. INTRODUCTION

1.1 Vehicular Ad Hoc Network (VANET)

Retinal image Vehicular networks have acknowledged with rigorous research work in the modern years due to the wide variety of services they provide. Vehicular Ad Hoc Network consists of majority of the imperative elements of Intelligent Transportation System (ITS) in which vehicles are arranged with several short-range and medium-range wireless communications [1]. In VANET two kinds of communication are hypothetical, they are, Vehicle-to-Vehicle and Vehicle-to-road side units, where the road side units could be a cellular base station. Figure 1 clearly shows VANET communications in a road side.

Knowledge of the real-time location of nodes is an hypothesis made by the majority of the protocols, algorithms and the applications in VANETs [1]. This is a very sensible supposition, because GPS receivers can be installed easily in vehicles, a number of which already comes with the technology. VANET recommends several benefits to any size organizations. Concurrently such a network does certain false safety concern does not limit VANET's feasible as a production tool. Navigation and GPS systems can benefit, as they can be joined together with traffic reports to supply the rapidest route to work. Strong points of GPS are as follows.

- GPS works in all weather conditions.
- Relatively low costs compared with other navigation systems.
- Due to its low cost, it is moderately easy to incorporate into other technologies hence, the use of GPS is widely used in cell phones.
- 100% coverage on the planet.
- Accuracy can be different to several meters from millimeters depending on the technique that is used.

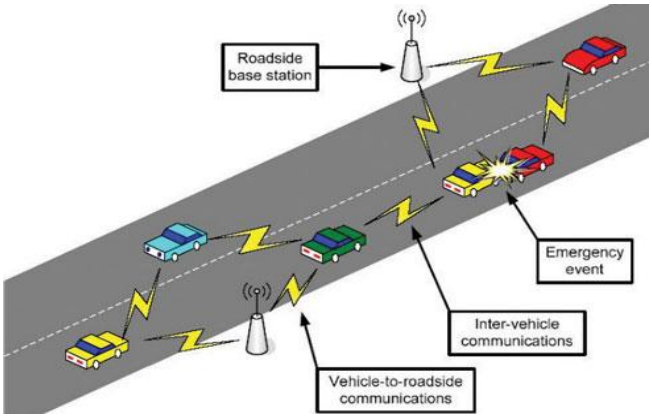

Fig 1: Vehicular Ad hoc Network

Most numbers of applications are imagined for these networks [2], some of which are previously possible in some designed vehicles.

- Security distance warning
- Vehicle collision warning
- Cooperative driving
- Cooperative cruise control
- Driver assistance

With these applications, also VANET technologies are also involved. The concept of VANET and GPS technologies are used in the place of finding the ambulances' geographical location for passing the personal Healthcare Information (PHI) to the ambulance [3].

1.2 Wireless Body Sensor Networks (WBSN)

A wireless sensor network (WSN) consists of spatially scattered independent sensors to monitor physical or environmental situation, such as sound, pressure, temperature etc. and pass their information all the way through the network to a major location.

Sensor networks consist of a numerous battery powered sensor nodes. These nodes jointly form a network and promote the information that is collected on a hop by hop source in order to reach the preferred destination.

For the purposes of collecting and analyzing the data from the sensor nodes, a base-station or data sink may be the destination. Though numerous protocols and algorithms has been proposed for traditional Wireless Ad-Hoc Networks (WAN) which are not fix to the limited characteristics and application necessities of sensor networks.

Body Area Network (BAN) [4] [5] [6], is related to Wireless Body Area Network (WBAN) is a application of wireless network of wearable computing devices. Generally, the network consists of several miniaturized Body Sensor Units (BSUs) jointly with a single body central unit (BCU). Wireless personal area network (WPAN) technologies are used to put into practice of communications nearer, around and on the human body. Afterward, the term "BAN" refer to systems where communication is on, in and within the direct closeness of a human body. A WBAN system is able to make use of WPAN wireless technologies as gateways to reach longer range. Figure 2 represents the design of Body Sensor Network [7][8][9] in a human body.

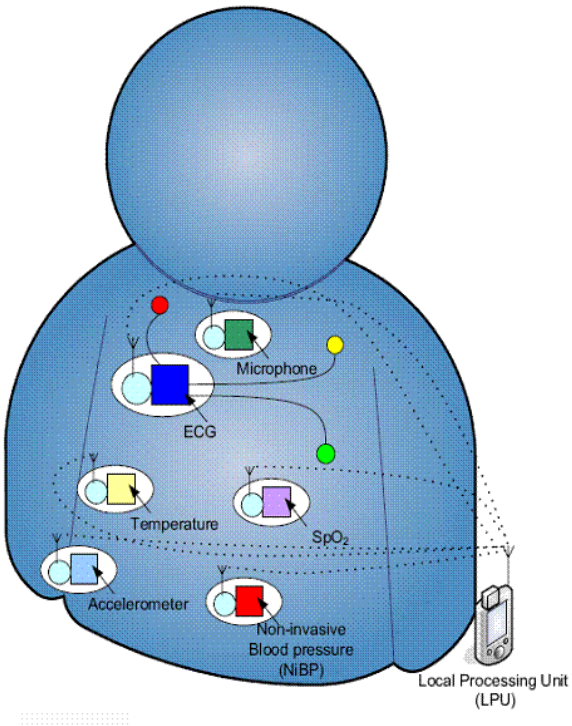

Fig 2: Wireless Body Sensor Networks (WBSN)

In this paper, VANET and WBSN are together utilized to monitor patients' healthcare information. This paper focuses on monitoring the Personal Healthcare Information (PHI) through the utilization of VANET and WBSN.

2. RELATED WORKS

Vehicle communications has become an attractive area of research in various industrial applications and the Intelligent Transport System (ITS). Behin Alipour [10] reviewed existing ITS techniques and discussed on enhancements and minimized restrictions of those existing techniques. Behin Alipour presented a new hybrid system that enhances the current systems through Grid knowledge.

The novel health monitoring system has been advanced in recent years in which the health parameters are automatically observed at home without affecting the daily activities. Dae-Seok et al [11] system is a network that aids a number of wearable sensors and contains on-board computing abilities for individual event detection, alerts, and communications with a number of medical informatics services. The main aim of this approach is to offer continuous observation for elderly patients under drug therapy after infarction, data collection in certain scenarios, and remote consultation for elderly people.

Applications of Wireless sensor network in healthcare leads to an area called Body Area Network (BAN) or Body sensor Networks. In recent years, Wireless Body Area Network has become emerging technology for providing this health facility to the required people. Balakrishna et al [12] presented an overview of wireless body area networks and novel ideas to enhance healthcare systems in India with the help of telecommunication and information technology.

The major challenge in the health care monitoring service is to offer efficient services to large number of people with limited resources. Wireless patient monitoring system has the ability to support these multiple requirements. But, the reliability of existing monitoring systems do not offer significant performance due to the unpredictable and spotty coverage of wireless networks. Ad hoc wireless networks can be used among mobile and wearable patient-monitoring devices for enhancing the coverage of patient monitoring when infrastructure-oriented networks are not accessible. Varshney and Sneha [13] offer support for reliable wireless patient monitoring through the utilization of number of protocols for power management of devices, assisted power control, and sleep strategy.

A constant and reliable monitoring of physiological signals has become an essential factor for many diseases. It is vital to provide a platform that facilitates the constant collection of physiological data even when the patient is not inside of the coverage area. The information must be quickly" transported" to the designated medical team. Hyduke Noshadi et al [14] presented an evaluation of of the VANET as a technique of collecting patient pre-recorded physiological data and at the same time reconfiguring patient medical wearable body vests to select the data specifically requested by the physicians. Another important use of vehicular collection of medical data from body vests is prompted by the need to correlate pedestrian reaction to vehicular traffic hazards such as chemical and noise pollution and traffic congestion. The vehicles collect noise, chemical and traffic samples and can directly correlate with the "stress level" of volunteers.

3. LOCATION-AWARE VANET

The majority of the VANET applications believe about the ease of use of abrupt updated position information is explained in [2]. However, they differ with localization accuracy is necessary in sequence to be capable to function properly. For example, some applications can work with incorrect localization data in which the calculated positions have errors from 10 to 20 or 30 m, while other applications, particularly critical safety applications, need more accurate and consistent localization systems with sub-meter precision. In this section, the VANET applications are divided into three main groups according to their localization requirements and show how position information is used by these protocols and algorithms.

3.1 Inaccurate Localization Application

Few VANET applications does not need any localization to function, some of them have a advantage of localization and

prove improved performance when the positional information of vehicles is presented [2]. The majorities of these applications are associated to vehicle communication, which includes vehicle-to-vehicle (V2V) and vehicle-to-roadside (V2R) communication and afford services such as the data dissemination of accidents, information routing, and road congestion and so on [15].

3.2 High-accurate Localization Applications

Most of these applications are serious applications such as Vehicle Collision Warning Systems (CWS) and other driver aid applications [2]. In driver support applications, VANET resources are mainly used to improve the driver's observation and information of the road and the environment.

In these applications, the driver is knowledgeable about the nearby environment in order to get better safety, and in case of emergency, the vehicle can carry out various automatic procedures. These are the most attractive applications for VANETs, and as dealing with site information consistency and accuracy are vital. Accurate positioning make certain localization with a meter or sub-meter precision in order to calculate accurately the distances between one vehicle to another vehicle, at the same time as a reliable localization will make sure that the updated information will always be accessible.

4. PROPOSED METHODOLOGY

In this paper, to monitor the patients health care continuously and to collect the patients Personal Health Information (PHI), a VANET and WBSN based healthcare monitoring system is proposed. The WBSN network is used to collect the information about the patients information and the VANET topology helps to alret the ambulance and the medical professional to sent to the patients location. Figure 3 shows a general idea of VANET and WBSN based health care center.

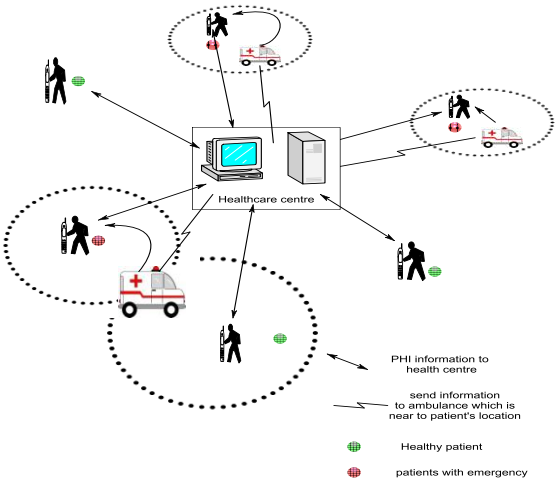

Fig 3: Overview of proposed System

4.1 Proposed Healthcare Centre through VANET and WSBN

Medical users can walk outside and receive the high-quality healthcare monitoring from medical staff in the health care center. All the portable medical user's personal health information (PHI) like blood sugar level, heartbeat, blood pressure and others can be gathered by the Body sensor networks and then they are get by Smartphone through Bluetooth.

The Smartphone is used to send PHI data to the Medical staffs at the health care center can constantly check the patients' health conditions and immediately react to patients' emergency situations and save their life by dispatching ambulance and doctor to a patient's location in a timely fashion. This is possible based on these collected PHI data. VANET can be used in the health center in order to dispatch ambulance to the patient's location.

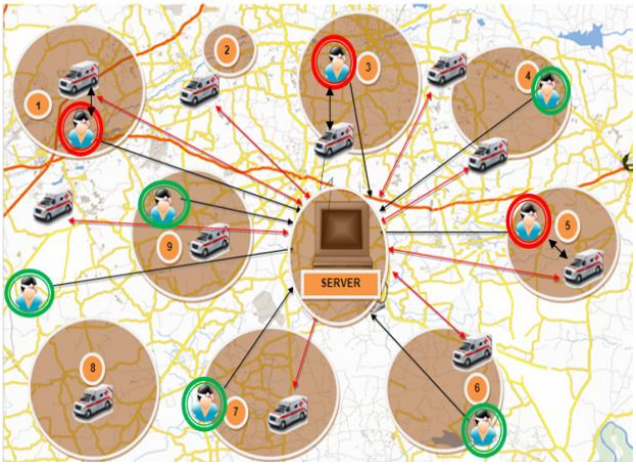

Fig 4: VANET Based Healthcare Centre

Fig 4 represents the general idea of the proposed VANET based health care center system. In the figure, red color circled patients represents the patients in the emergency condition. Green color circled patients' represents patients with normal health condition. The red circled patients are in need of medical authentication. This proposed approach would aid medical services to those patients in time.

4.2 Personal Healthcare Information (PHI)

Health care system is the group of institutions; people and property deal out with health care services to meet the needs of the health of desired populations. The rescue of recent health care depends on the group of trained professionals and paraprofessionals approaching jointly as inter penalizing teams. This includes professionals in nursing, medicine, dentistry and associated health and many others such as community health workers, public health practitioners and assistive personnel, who methodically supply personal and population-based precautionary, remedial and rehabilitative care services. There are two types of patients' health care.

- Primary care
- Secondary care

The Primary care is the word for the health care services which play an important role in the local group of people. It presents the work to the health care professionals who act as a first point of discussion for all patients in the system of health care. The Secondary care is the health care services given by medical specialists and other health professionals who usually not having primary contact through long-suffering peoples like urologists, cardiologists and dermatologists.

The health care system will maintain all the system PHI in the main system of the healthcare center [16]. Personal Healthcare Information is also known as protected health information is any information about health status, provision of health care, or for health care that can be linked to a definite individual. This is understood widely and comprises any part of a patient's medical record or payment history. PHI consists of subsequent information about the patients.

- Names
- Geographical position of the patient.
- Patient mobile numbers
- Medical record numbers
- Health plan beneficiary numbers
- Biometric identifiers (i.e. Fingerprints and Retinal scan)
- Full face photos and comparing images of the patient
- Distinctive identification number, characteristic or code.

By examining PHI information the medical supporter in the Health care center can be acquainted with the location of the patient. So the medical assistants then assess the current PHI information with the PHI of the normal person. If the patient is in the emergency condition the medical assistant will send an ambulance to the patients place.

4.3 GPS-based Vehicular Networks in Ambulances

Ambulances added advantages from Global Positioning System (GPS) in both Offline and Online Mode. These systems receive the satellite signals and calculate approximately the location of the Ambulance. An MMC Card is necessary for each and every ambulance to save the data in an offline mode. But in the online mode, a GMS is browbeaten to send the data to the healthcare system in a report format.

The Personal Healthcare information data is built up on the MMC Card can be recovered through complicated software system. In the online mode, an industrial mobile hardware is used for data interpretation. The main advantages are as follows,

- Patients are not being there in the health care center.
- Based on the collected Personal Healthcare Information data, medical professionals at healthcare center can constantly monitor medical users health conditions.
- Immediately react to users' life-threatening situations and save their lives by dispatching ambulance and medical personnel to an emergency location in an appropriate manner.

The collected physical location of the ambulance will be sent to the health care center. The complete details of the ambulances like driver identification number, driver name, and current position of the each ambulance are updated in the main system of the healthcare center [17]. The message of patients' PHI will be sent to the ambulance based on the following criteria,

- The ambulance which is near to the patients' location.
- The ambulance which was free at the time of emergency

5. EXPERIMENTAL RESULTS

The experiments are carried out to evaluate the performance of proposed network structure. The parameters taken to evaluate the proposed approach are monitoring and collection of PHI information.

The number of patient's information over is collected in bytes for the desired number of data reporting into mobility speeds for the two techniques is given in Figure 5. It may be observed that the proposed network is more reliable with efficient monitoring and increase in collection of patient's data over period of time. The better performance of the proposed VANET and WBSN based approach is evident when considering the average monitoring and collection of patient's Personal Health Information (PHI).

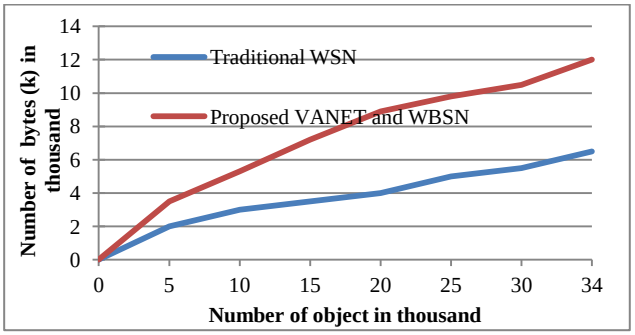

Fig 5: Communication Cost

6. CONCLUSION AND FUTURE ENHANCEMENT

In this paper represents the new application VANET and WSBN based modern health care system. In this modern health care system, the WSBN is used to collect patients' Personal Healthcare Information (PHI) and this information is continuously monitored in the Healthcare center. Based on PHI, the medical professional can recognize the condition of the patient. In case of any emergency situations, the information will be forwarded to the ambulance based on the above mentioned constraints. So the patient can get complete medical care and monitoring of their health condition from the place where ever he or she is present.

The future work of this approach would be to extend this PHI system with more security and trustworthiness. This future extension would avoid hackers from hacking the PHI. In recent years, cryptosystems is observed to offer better security in VANETs. Thus, a suitable cryptosystem should be integrated with the present one for better security.

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