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# A light Weight Secure Patient Monitoring System based on VANET

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## ABSTRACT

The innovation based universal patient monitoring is viewed as an optimal solution for dealing with the long-lasting infections and therapeutic crises to streamline the social economize the unwavering quality of end to end communication in the middle of patients and healthcare services in remote patient monitoring is the basic necessity in such system independent of time and area conditions. A new wireless patient monitoring service called System is proposed which utilizes the patient health information collected by the body sensors to securely transmit it to the healthcare services wireless via vehicular ad hoc network. The patient data gathered by body sensors are transmitted by the vehicle as XML information to the closest road side infrastructure for the health centers determination of the social insurance Center and the data is transmitted to the health centers for the appropriate service reply. The XML reliance tree is utilized for the viable transmission of patient and medicinal data in the vehicular ad hoc network. VANETs go about as the middleware stage for medicinal services determination between the patient and the healthcare services for the portable patients and vehicular users. In this way, the proposed System provides personalized healthcare services by employing the XML based dependency tree for information transmission.

**KEYWORDS:** VANETs; System; Patient Monitoring; XML

## 1. INTRODUCTION

As the cost of healthcare and populace of patients is developing in hospital and nursing homes, there is a prerequisite to build the nature of the health services gave. With late advances in remote communication advances, remote patient monitoring is considered as an imperative solution for steadily expanding rate of medicinal services and to minimize the social insurance cost in today's electronic world. The new worldview of patient monitoring utilizing Vehicular Adhoc network (VANETs) for enhancement of healthcare services has as of late been a famous standard for research in enormous applications. These days, the vehicles are somewhat getting to be "System on Wheels" with scaled down PCs introduced on vehicles. Vehicular Ad-Hoc Network, a rising system worldview is considered as a minimal effort solution for the issue of associating gadgets with each other to give the end to end network with therapeutic experts. The greater part of the patients is portable and the precise auspicious data will be served to them utilizing VANETs. Persistent monitoring incorporates the transmission of the crucial patient signs and side effects intermittently to the medicinal services experts utilizing remote systems. Along these lines, the patients in crisis or basic conditions can get the therapeutic master help immediately, immediately. VANETs are postponement Prejudiced systems and along these lines, can be best connected to such crisis circumstances where little defer can prompt loss of patient's life. The elderly populace generally experiences the issues like circulatory strain, diabetes, hypertension, heart assault, heart palpitations, growth and so on and along these lines, making the assignment of patient monitoring more troublesome with the increasing number of patients. Along these lines, the electronic health monitoring is the best optimal solution for manage the increasing interest of the patients The work has been done in patient monitoring which incorporates portable telemedicine [1] [2] [3] [4], home monitoring [5], Bluetooth-based system for digitized ECGs [6], remote telemetry system for EEG epilepsy [7], a healing center wide versatile monitoring system [8], and continuous home monitoring of patients [9]. Sensors utilized for getting the key indications of the patient incorporate remote sensors for health monitoring [10] [11], ring-based sensor [12], garments inserted transducers for ECG [13] and stress monitoring sensors [14]. Also, the few routes for enhancing the restorative choice making are incorporated into [15] [16] [17].The fundamental signs and flags of the patient incorporate heart rate, pulse rate, breathing problems, balance disorder, dizziness, body temperature, blood pressure (Fig. (1) Which are measured by the body sensors and transmitted as simple signs over the remote media. The changing estimations of any of these essential signs speak to the sign of one or additionally disturbing medicinal condition, which needs prompt consideration. For instance, if the beat rate is under 60, it demonstrates bradycardia and in the event that it crosses 100, it shows tachycardia. The body sensors are utilized to identify these conditions by contrasting the real measured worth and the predefined ostensible territory and create the ready sign if the quality does not exist in the reach. In the long haul restorative history, these gadgets contrast the qualities and the earlier values in the database and give the sign in like manner. The essential engineering of

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VANETs giving the social insurance services is appeared in Fig. 2 where the data with respect to the crisis ready or restorative condition recognized is transmitted to the therapeutic experts in the city by utilizing the vehicular impromptu system. The body sensors gather the data from the patient and transmit it to the locally available units of the vehicle. The locally available unit gathers the individual health data of the traveler and contrasts it and the predefined scope of these medicinal conditions. On the off chance that any of these crucial sign's worth does not exist in the set reach, then the crisis alarm is made which is transmitted to the locally available unit. The installed unit transmits the message to the system lastly the restorative expert gives the master guidance on the basic issue distinguished. In this way, the patient gets the restorative counsel in few moments, which if disregarded would have prompted lethal outcomes. In this paper, the medicinal services utilizing so as to check system for vehicular users is proposed the vehicular adhoc network for the transmission of the patient particular health information. The proposed scheme uses the XML based reliance tree development for the gathering and transmission of the patient particular information to the medicinal services suppliers by shaping the patient particular XML tree in which the health data of a specific vehicular client is put away. The Health suppliers analyze the indispensable signs and flags of the patient and send the data to the client as last XML tree work by the medicinal services focuses. The XML helps in quicker dispersal of information as XML tree.

### 1.1. Structure

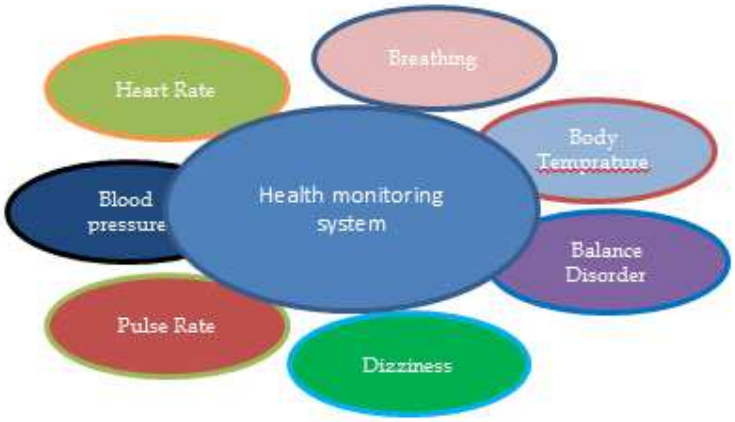



**Figure 1. The General Vital Signs and Signals of Patients**

### *1.2. Structure*

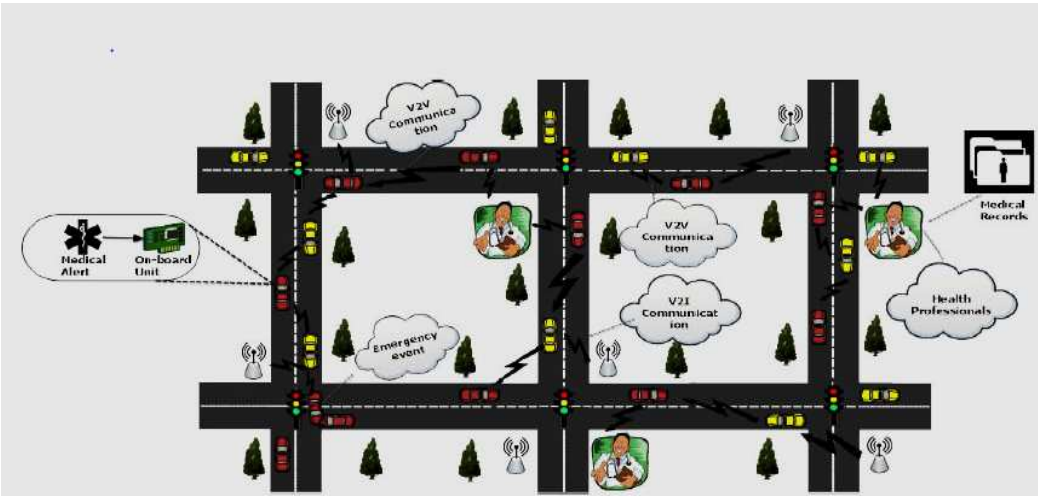



**Figure2. Patient Monitoring using Vehicular Ad-Hoc Networks**

## 2. RELATED WORK

As of late, an assortment of remote human services arrangements are being proposed for vehicular system applications for security change, for example, seeded cloud [18] and V-Cloud [19]. The proposed arrangements concentrate for the most part on long residency monitoring of health for vehicular users or might likewise consider on the ongoing crisis occasions in vehicular movement to stay away from any mishappening out and

about [20]. In numerous examination works, it has been recognized that the driver conduct and driving conditions are likewise in charge of the powerful health contemplations in vehicular impromptu systems. Thusly, remote patient monitoring is vital for vehicular users as it gives the extra advantage to both the drivers and therapeutic experts. The essential configuration standards and the confirmation forms for the remote patient monitoring are portrayed in [21] where timestamp based validation convention was given for remote patient monitoring. The protection of the health data of the patient was additionally presented by characterizing the diverse parts to the information requesters and allocating them the entrance benefits appropriately. Another remote patient monitoring system was outlined by Niyato et al. [22] where heterogeneous remote innovations were incorporated to gather and transmit the patient bio signals gathered by sensors to the medicinal services focuses intermittently. Hu et al. [23] proposed a portable social insurance stage called Health Drive which utilizes a multi-level design to gather and decipher the detecting information from the vehicular environment to give the customized health services to the drivers. The three level engineering comprises of system level to bolster communication, cell phone level to store and decipher patient social insurance information and cloud level which works in parallel with cell phone level to total the medicinal services information. Lin et al. [24] proposed a security saving instrument for e health services against the worldwide foe in the system to address the patient protection issues by accomplishing both substance arranged protection and relevant protection. A security saving system for versatile medicinal services crisis was given by Lu et al. [25] where the asset use of PDAs was done to prepare the individual health data of the patients effectively amid medicinal services crisis. To guarantee client driven security in portable social insurance services, characteristic based access control system and scalar item calculation strategy was utilized. In this way, the restorative client can choose the interest of the users to help with artful processing for calculation of its own health information. Masi et al. [26] gave a compelling communication convention to trade the portable patient data among the separated health focuses and facilities where system association is not accessible, for example, in rustic zones. A danger model is additionally characterized in which it is demonstrated that the client cannot harm the patient particular information by performing any assault in this model. The open doors and difficulties for omnipresent registering are examined by Sneha at al. [27] by giving the system, included parameters, choice conventions and innovations empowered and an applied model of pervasive patient monitoring is created. The creators proposed a system for patient utilizing so as to check versatile adhoc network [28] to guarantee the end to end Network. It proposes the force service conventions to empower the low power persistent monitoring gadgets for expanding communication dependability and system to utilize the perplexing choice rationale to use the versatile impromptu systems for patient monitoring. Doorenbos et al. [29] gave an activity by giving so as to improve human services system of rustic regions them proficient medicinal services training. It teaches the provincial social insurance suppliers about the late advances in restorative innovations and the adjustments in pharmaceuticals to give quality medicinal services. Another social insurance scheme called Rcare [30] was proposed which used the vehicular impromptu systems for gathering and transmitting the patient particular data from rustic regions for giving availability to provincial ranges. Along these lines, the vehicles in VANETs are utilized as transporter supplier to forward the patient health data to the health service suppliers situated in the city to get the auspicious guidance from the top health experts and lessening the general health cost. All the proposed works used the remote innovations for the auspicious and proficient transmission of the patient particular health data of the portable patients to the health suppliers. The proposed model in this paper uses the vehicular adhoc network for the transmission of health data of the vehicular users as XML reliance tree to the closest crisis health suppliers.

## III. SYSTEM MODEL

The solid end to end network and the disconnected from the net monitoring of patients by transmission of crisis cautions is an urgent necessity in remote patient monitoring system. The communication dependability in ehealth System is upgraded by vehicular adhoc network by transmitting a crisis occasion of the patient from the vehicle to the closest roadside foundation unit lastly to the human services focuses close-by. In the proposed scheme, the body territory systems are coordinated with VANETs to give the communitarian stage to giving the ehealth services to the vehicular users and in addition portable patients. The Fig. 3 portrays the situation of mix of Body Region System Reject) with VANETs to give the therapeutic services in a split second to the patients.

### *1.3. Structure*

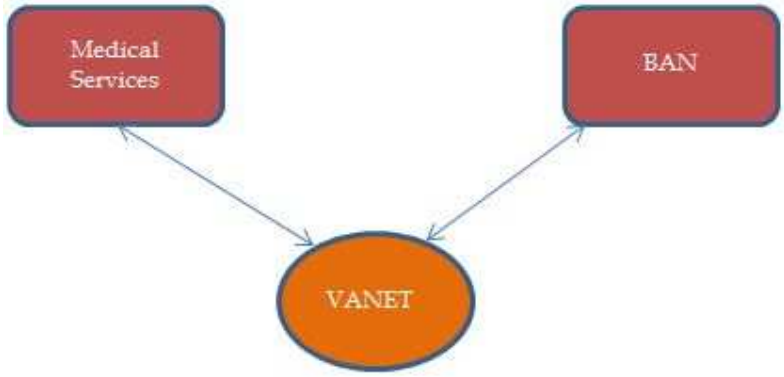



**Figure3. Integrating BAN with VANETs**

The patient's sensors gather the fundamental signs and side effects of the patient and check the variations from the norm in the qualities gathered. Any unusual conduct recognized by the sensors and the basic signs qualities are transmitted to the locally available units of the vehicle. The On-Board Units (OBUs) subsequent to gathering the data transmits it to the social insurance focuses by using the vehicular adhoc network. The medicinal services focuses break down the patient particular data by contrasting it and the patient history recorded in the restorative database kept at focal store. The medicinal database and the patient history record database are kept at the focal archive and are gotten to utilizing vehicular adhoc network. The health experts in the social insurance focus checks and break down the patient insights and also its record history and give the choices as needs be. The general data stream and the parts in V-Health System utilizing VANET.

## 4. PROPOSED SYSTEM

This section proposes the System which utilizes the Vehicular ad hoc networks for the wireless patient monitoring and analysis. This section covers the phases of system initialization, communication process and the VHealth system explained in detail.

### *A.* System Initialization

Let GI be the cyclic additive group and GII be the cyclic multiplicative group of the same prime order $p$ with generator point $P_1$. The bilinear guide e: GI × GI → GII is considered as a bilinear blending if the accompanying properties are fulfilled:

(1) Bilinearity: For any P, X, Y ∈GI ,$e(P, X + Y) = e(P, X)\, e(P, Y)$ and for any a,b ∈ Z∗q , $e(aP, bP) = e(P, P)ab = e(abP, P) = e(P, abP)$

(2) Non-ruffian: $e(P, P) \neq 1\ GII$

(3) Calculability: There exists P, R ∈GI, an effective calculation ought to exist to register e(P, R) for all P,R ∈GI. All the vehicular users, vehicles and health focuses are furnished with the same security open parameters params = {p, P, e, GI, GII, PTA, Pri , Phi} where PTA is the general population key of trusted power and is figured as $PTA = s.P$ where s is haphazardly chosen from Z∗q . Pri is the general population key of the Street Side Unit RSUi and Phi is people in general key of the health Center Howdy. TA is the trusted power of the system which is in charge of law requirement strategies and nonrepudiation in the system.

### *B. Secure Communication Process*

The individual vehicle and client is enrolled with the trusted power before beginning any communication process. Each enlisted vehicle has character $V = \{V1, V2, V3 \ldots . Vn\}$ and each enrolled client has personality U = {U1, U2, U3....Un} where V and U are the arrangement of enlisted vehicles and users individually. The body sensors of the client transmit the data gathered to the locally available unit of the vehicle by building up a common mystery key between them. Let a ∈ Z∗q be the mystery key of body sensors and $Ps = a.P$ be people in general key of body sensors. Give b∈Z*q a chance to be the mystery key of installed unit of vehicle and $Pv = b.P$be the general population key of vehicle. The common mystery key Pk is built up by body sensors as a.Pv and by vehicle as b.Ps which can be advocated as: $a.Pv = a.b.P = b.a.P = b.Ps$ In this way, the information is exchanged between the body sensors and the vehicle by building up a mutual mystery key Pk between them. The mutual key is just utilized between the body sensors and the vehicle. The rest communication in the system among the system substances out and about happens by method for Open key Cryptography. The data from the body sensors is sent in scrambled structure to the vehicle as ENCPk (M,Ui) → Vi which is unscrambled by the vehicle as DECk (M,Ui). In the wake of gathering the data from the body

sensors, the vehicle transmits the data to the closest vehicles and the roadside unit. The data transmitted by the vehicle is digitally marked with the private key of the vehicle and transmitted as SIG (M,Pixml, Vi, Ui, loc; b) → *. The telecasted data is validated by the vehicles and the closest RSUs by utilizing people in general key of the vehicle. The data got by the RSU is validated and confirmed for the therapeutic services asked for by the client. The private key of RSUi is yi∈Z*q and the general population key is processed as $= yi.P$ . The RSU recognizes the sort of service and chooses the closest medicinal services unit in like manner. The data is transmitted to the human services Center by scrambling it with people in general key of social insurance Center Phi = xi.P where xi is the private key of the health Center Howdy and xi is haphazardly browsed Z∗q . The message transmitted to the medicinal services Center is ENCPh (M,Pixml, Sixml, Vi, Ui, loc) which is broke down by the health Center and in light of it, the restorative reaction is made as therapeutic XML. The restorative XML is sent to the individual RSUi as ENCPri (M, Mixml, Vi, Ui, loc) and the RSUi in the wake of accepting the message unscrambles the data and transmits it to the encrypting so as to ask for vehicle it with people in general key of the vehicle. In this way, the protected end to end network is kept up between the social insurance experts and the versatile patients or users.

### *1.4. Structure*

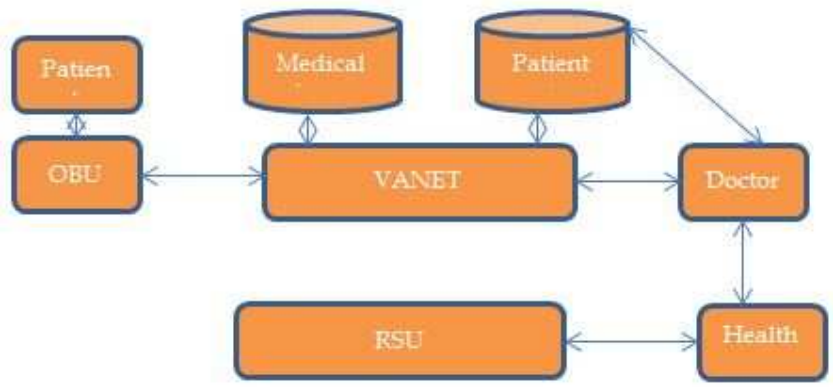



**Figure 4. The General System Model for System using VANETs**

### *1.5. Structure*

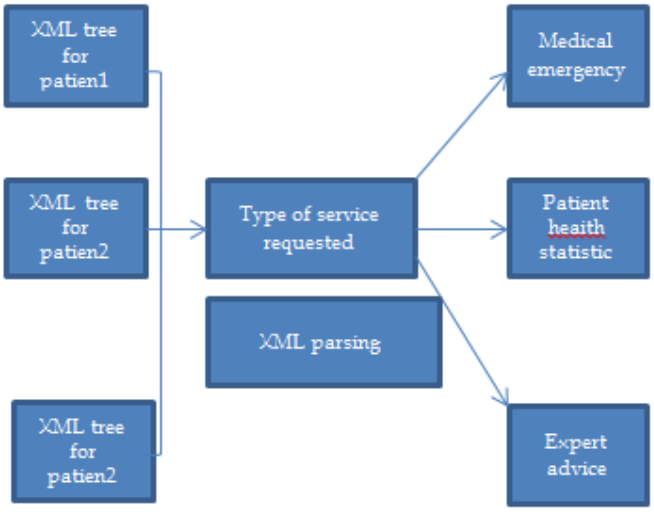



**Figure 5. The XML tree built for the Medical Services Requested**

### *C.* System

The system transmits the patient specific personal information from the body sensors to the medical professionals via vehicular ad hoc networks. The onboard unit of the vehicle collects the information from body sensors and transmits the health symptoms of the patient in the form of XML dependency tree. The XML file is generated for each patient by the vehicle and patient record is transmitted in the network to the nearest road side infrastructure. The RSU does the XML parsing of the patient XML and helps in selecting the type of service

requested by the patient and the request for that medical service is generated by the road side infrastructure. Thus, the medical service requested is sent to the patient accordingly. The XML tree parsing for the selection of the required medical service is shown in Fig. 5. The medical services are selected from the medical database stored at the central repository which contains the database of all the patients' record history, patients' latest health statistics etc. as shown in Fig. 6. The XML file for the patient is built by the OBU of the vehicle for the medical services is built by RSU and for medical responses generated by the healthcare professionals is generated by the Healthcare systems. The *Patient XML*, *Services XML* and *Medical XML* are the XML files generated for the patient data, medical services requested and the decisions by medical professionals respectively as shown in Fig. 7. The *Patient XML* contains the vital signs of the patient including heart rate, pulse rate, breathing, balance disorder, dizziness, body temperature and blood pressure. Then it contains the information regarding any emergency event requested by the vehicle as the road accident may lead to critical condition requiring the medical emergency instantly without the loss of lives. Further, any mobile patient may want to seek any sort of medical advice while travelling. The patient location is also sent along *Patient XML* while it is transmitted in the network. The *Services XML* contains the information regarding the type of service requested by the patient and the services included are medical emergency, patient health statistics (which includes the patient's vital signs and symptoms) and expert advice from the medical professionals. The *Medical XML* contains the information regarding medicines required by the patient, list of nearest healthcare Centre, report generated from the vital signs and symptoms of the patient, medical expert advice, list of experts in specific area and the real time monitoring of the patient. The medical services provided to the mobile patients may include the medical advice to the patients by medical professionals, any changes in the vital signs of the patient by comparing it with the medical history of the patient stored in the database placed at the central repository of the network. There may be reporting of any accident on the road by the vehicular users through VANETs and in response to which the ambulance with all the medical facility is sent to the accident location by the nearest hospital to give the treatment to patients as soon as possible. Thus, the medical aid is provided to the patients in the timely manner in emergency events to prevent the loss of lives due to unavailability of medical help. The information of the particular patient is stored in XML form to provide the data in an effective manner and the data stored in the form of XML dependency tree needs less storage space. Thus, the patient monitoring is done effectively using the XML based system which effectively monitors the patient's health using vehicular ad hoc networks as a middleware platform which acts as a bridge between the patient's health information and the healthcare Centre. The complete process of the information flow is shown in the Fig. 8. The data collected from the body sensors is transmitted in form of *Patient XML* to the nearest roadside unit by the vehicle where the service selection is made. The *Service XML* and *Patient XML* is transmitted to the healthcare units by the roadside units. The information collects from the medical database and patient history database is used to make decisions by the medical professionals in response to the received requests from the patients. Finally, the *Medical XML* which is a Response from the medical units is sent to the patients via VANETs and it completes the process of the effective patient monitoring system.

### *1.6. Structure*

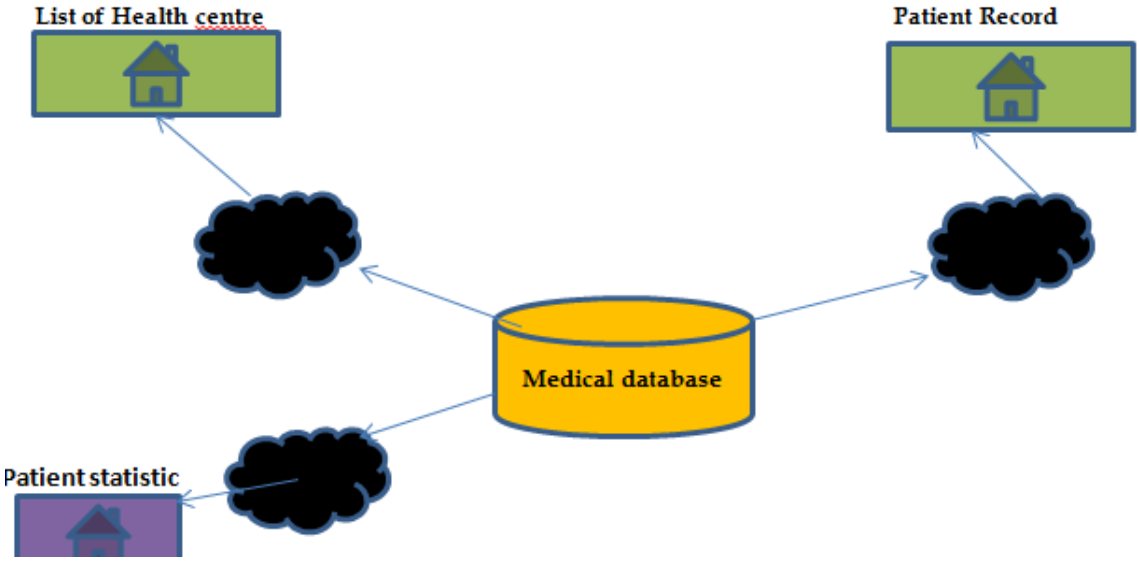



**Figure 6. Medical service selection**

### *1.7. Structure*

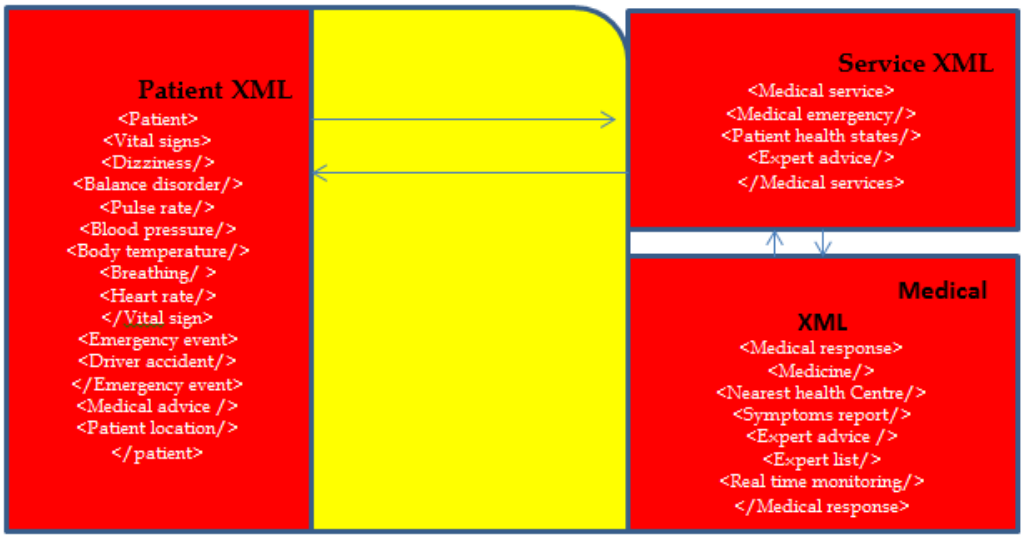



**Figure 7. XML Dependency Tree for Patient, Medical Services and Medical Responses**

### 1.8. Structure

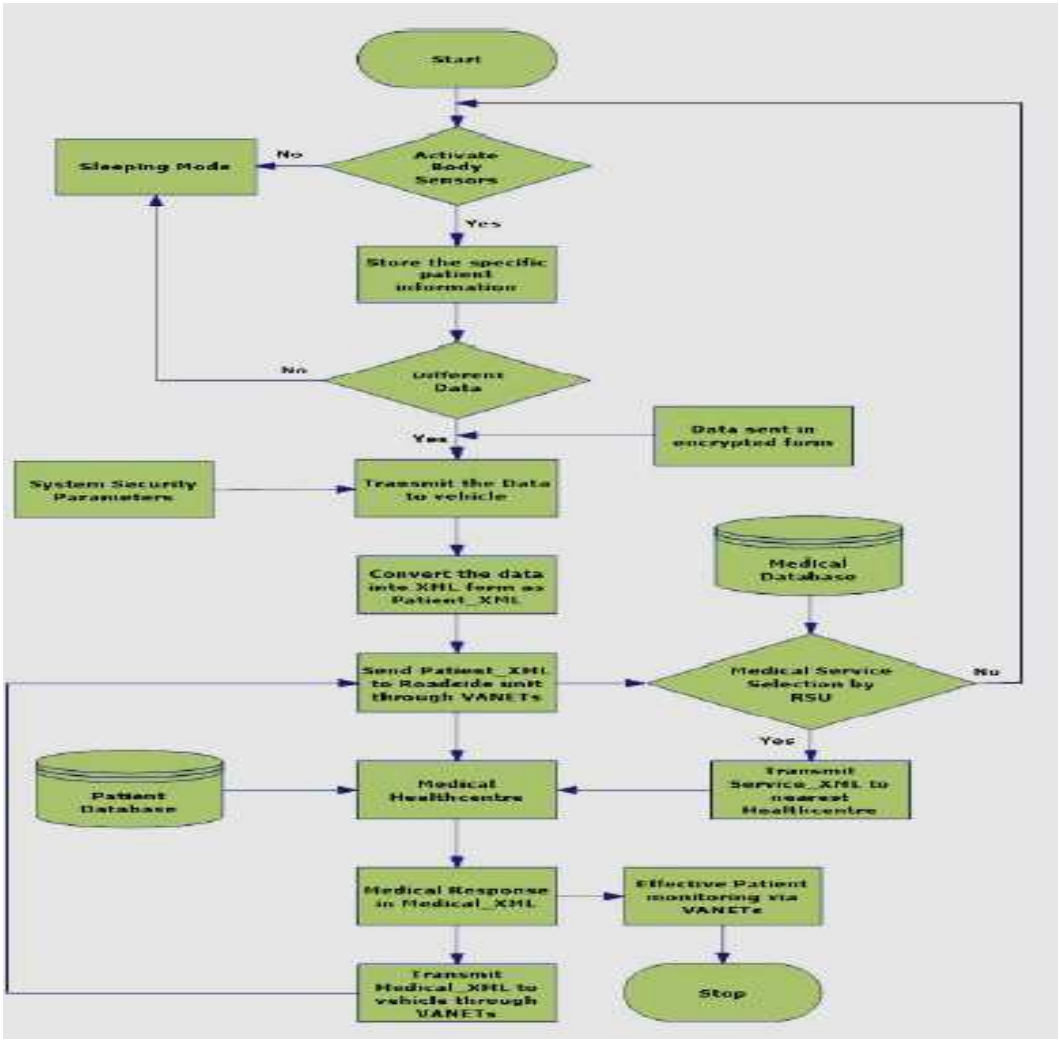



**Figure 8. Flowchart for the information flow in System**

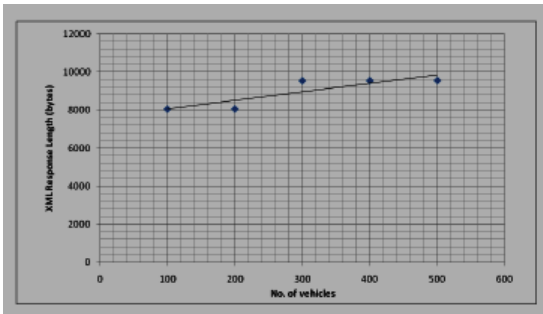



Figure 9. XML Response length vs no. of vehicles

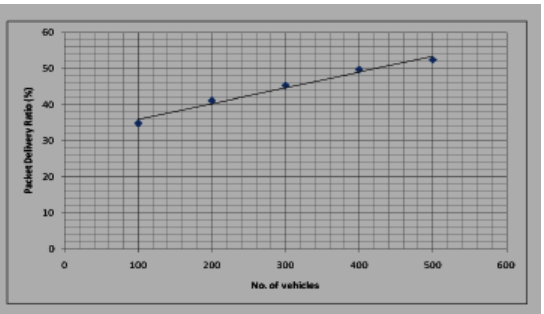
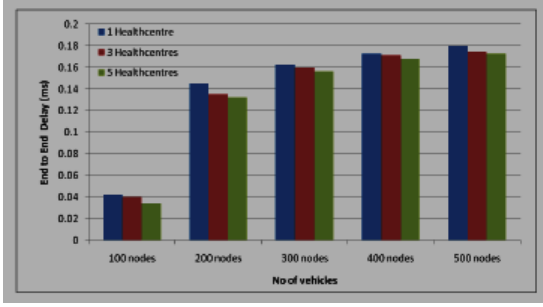



Figure 10. Packet Delivery Ratio vs no. of vehicles



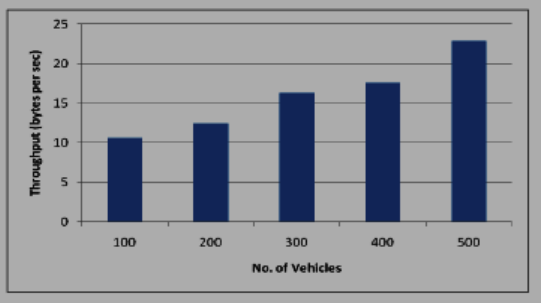




**Figure 11. End to End delays vs no. of vehiclesFigure 12. Throughput vs no. of vehicles**

## 5. RESULTS AND ANALYSIS

The System designed is evaluated using the network simulator *NS*−2. The performance of the proposed model is evaluated on the simulated environment by using various performance metrics on the networking simulator *NS*−2. The results are provided on the basis of performance parameters used in the proposed scheme. The XML analysis is done using the Membrane tool [31] for the interpretation of network traffic. This tool is used in the following mentioned cases like

- Inspection of HTTP traffic in real time
- Formatters for XML,SOAP and JSON
- Syntax highlighting
- Block and resend messages
- Works as normal proxy and as reverse proxy

Table I presents the simulation parameters configured for the proposed System. The XML response length is calculated for the 100 to 500 vehicles using the membrane tool. It gives the response length of XML in bytes when it is transmitted in the network. The XML tree length almost follows the linear trend as appeared in Fig. 9 with slight varieties as it increments by only 15.63% as the vehicles increment from 100 to 500. The parcel conveyance proportion is computed for the situation which is appeared in Fig. 10 which takes after the direct pattern. The PDR increments from 34.82% to 52.38% with expansion of vehicles from 100 to 500 individually. The expansion in the estimation of PDR shows the effectiveness of the system as with less number of vehicles, the system might confront the issue of end to end transmission because of system dividing. The end to end postponement is the deferral from the time understanding sends its data and gets the reaction from the medicinal services centers.

The increase in the value of PDR indicates the efficiency of the system as with less number of vehicles, the network may face the problem of end to end transmission due to network partitioning. The end to end delay is the delay from the time patient sends its information and receives the response from the healthcare centers

The end to end postponement is computed more than three situations for the given zone with 1 health Center, 3 health centers and 5 health centers as appeared in Fig. 11. The end to end delay diminishes as the quantity of health centers increments in the region as it abatements by 3.26% when health centers increments from 1 to 3 and by 2.45% when health centers increment from 3 to 5 in light of the fact that the productivity of the system increments with more number of social insurance services accessible. Hence, the proposed scheme is effective as it decreases the deferrals in the system. The throughput of the system is likewise measured which is computed in bytes per sec and expansions with number of vehicles as appeared in Fig. 12 demonstrating the dependability of the system. The Throughput increments from 10.601 bytes/sec to 22.904 bytes/sec with expansion of vehicles from 100 to 500 vehicles. Along these lines, the proposed System is adaptable as the investigation of the

outcomes demonstrates that the system performs better as the quantity of vehicles increments. Along these lines, the proposed scheme is exceptionally proficient in taking care of the XML records for the web monitoring of the portable patients and the vehicular users utilizing VANETs.

**Table:1**

| PARAMETER | VALUE |
|---|---|
| **Simulation time** | 100 seconds |
| **Simulation area** | 5000X100m |
| **No. of nodes** | 100-500 |
| **Node placement** | Random |
| **Movement model** | Dynamic |
| **MAC protocol** | IEEE 802.11p |
| **Transmission range** | 500m |
| **Physical bandwidth** | 5.88 GHz |
| **Velocity range** | 30 m/s |
| **Traffic type** | C |

## 6. CONCLUSION

The paper proposes the System for the online patient monitoring of versatile patients or the vehicular users by adjusting the vehicular adhoc network as the middleware stage. It utilizes the utilization of XML reliance tree for the transmission of patient information between the patient and the medicinal services. The individual health data gathered by the body sensors is exchanged safely to the vehicles by incorporating the body region system with VANETs for the protected remote monitoring of the patients. Through broad execution investigation, it has been shown that the system is the practical and versatile with expanding number of vehicles or the patients. Hence, the system is extremely powerful in taking care of the versatile patients out and about which might require the crisis assistance from the restorative health experts. The system is successful utilization of VANETs to screen the crisis occasions of vehicular users. The future extent of the work incorporates the ongoing monitoring of the proposed scheme with constant activity. The work could likewise be stretched out to incorporate the wearable figuring in doctor's facilities, wifi arranges everywhere throughout the city and to coordinate every one of the innovations to give the better and productive stage for remote patient monitoring and to decrease the restorative costs radically.

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