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Drug Administration using Body Area Sensor Network (BASN)

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***Abstract*—** Wireless sensor networks can be defined as a network of sensors which can communicate sans wired networks. The goal of these types of networks is to collect data from different sensors and to forward it to the sink nodes. Body area sensor network (BASN) is a sensor network that can be placed on a human body. The purpose of this research study is to continuously monitor subjects in a hospital and to provide the Physicians and Registered Nurses (RN) with efficient Drug Administration methods by making use of body area sensor networks. If sensor nodes can be connected to medication lists, subject history and the live monitoring feeds of subjects, the possibility of administering and prescribing incorrect medication that might pose serious undesired effects on patients can be countered and mortality rates can be reduced. Thus, this study focuses on implementing sensor nodes on subjects to keep a tab on the allergies and history of diseases the patients might have been subject to and to provide the required medical assistance and the necessary drugs to subdue illnesses.

***Keywords*—** Body Area Sensor Network, Patient Monitoring, Sensor Nodes, Gateway, Sink Node

I. INTRODUCTION

Wireless sensor networks are proactively used for efficient patient monitoring in hospitals and aided living facilities. Body area sensors are a collection of light-weight wireless sensor nodes that are used to track and sense data which can be communicated amongst them to process information. The challenges faced by these wireless networks include devices with limited energy, small storage capacity, limited processing power and relatively lower communication range. In recent times, the field of Body area sensor networks has improved exponentially due to varied usage in applications, especially in the field of healthcare. Wearable health monitoring systems that are built using Body area sensor networks are in vogue nowadays, what with real-time medical monitoring in static or in mobile scenarios. Vital signs like body temperature, blood pressure and heart rates are regularly monitored and analysed by medical personnel in real-time and the system can also double up as an autonomous caretaking device. In this sort of a setup, ECG sensors, distance measurement sensors, body temperature sensors, blood pressure sensors etc., will be attached to the patients. At present, Body area sensor network uses in a patient monitoring system. In this proposed paper, one mobile device (medicine tray) will be there which will show details of patients with the help of sensor nodes. Distance measurement sensor and other sensor nodes will send data to the mobile device. A distance measurement sensor will check the distance between the medicine tray and the subject. The on-board display of the medicine tray will display the details of the subject which is closest to the medicine tray. The information displayed includes patient details, medication history, history of illnesses, allergies, recommendations by physicians, physician notes, clinical interventions etc.

II. RELATED WORK

Many algorithms have been proposed in Body area sensor network. In [1], an algorithm has been proposed which makes link cost perform collectively in every node to settle on the most effective next hop node. The link cost function includes the residual energy, free buffer size, and therefore the link responsibility of the neighbouring nodes, that is used to balance the energy consumption and to satisfy QoS needs regarding end to end delay and responsibility.

In [2], talks about a particle filtering and a Kalman filtering based location tracking system using a Bays algorithm. Results show that particle filtering performs well in nonlinear and non-Gaussian environments. However, Bays algorithmic program isn't thought about the impact of noise in location chase. For loud surrounding, they tend to compare the results of hidden Markov Model(HMM) and Bays algorithmic program.

In [3], analysis hardware and then software design WBAN for fatness observation. A planned framework consists of few sensing element nodes that monitor body motion, calories calculator, and a private server running on a private smart phone or a personal computer. A focus of this analysis is to form fatness patients easier to induce obviate this illness.

In [4], the study explains the vital role of body sensor networks in drugs to reduce the requirement for caregivers associated facilitate the inveterately unwell and aged folks live an independent life, besides providing folks with quality care.

Mi Zhang et al [5] have proposed a system based on a software architecture which concentrates on different sorts of sensors that focuses son computing capabilities that allows dynamic body area network construction along with fast, adaptive data collection and processing as per the requirements. This system was evaluated by using Rehab SPOT for a rehabilitation program which has significance on physical therapist's daily work.

[6], put forwards an energy efficient routing architecture with uniform clustering algorithm. Both centralized and cluster-based techniques are used to make a cluster-tree routing architecture for sensor nodes. Distances between the sensor nodes and remaining energy are accounted to select the proper cluster head nodes. An adaptive multi-hop approach is introduced to reduce power consumption.

In [7], They talk about an approach which will be accustomed monitor patients by the utilization of body area networks is reviewed. Also, the present secure methods which will impede attacks featured by wireless communications in health care systems and improve the protection of mobile health care mentioned.

In [8], the study presents an observance system that has the aptitude to observe physiological parameters from multiple patient bodies. Within the planned system, an organizer node has connected on a patient body to gather all the signals from the wireless sensors and sent them to the bottom station. The connected sensing elements on patient's body type a wireless body sensor network (WBSN) and that they can sense a heartrate, blood-pressure so on. This method will observe the abnormal conditions, issue an alarm to the patient and send an SMS/E-mail to the doctor. Also, the planned system consists of many wireless nodes that are responsible for relaying the information sent by the coordinator node and forward them to the base station.

In [9], Analyses the important security problems which will place the eHealth system in danger. The particular security goals and needs vulnerabilities, threats, and attacks square measure analyzed and few potential security recommendations with direction for future work area unit mentioned

In [10], Relay selection scheme is planned below the topology constrains specified in the IEEE 802.15.6 customary to maximise the period of WBANs through formulating associated determination an optimisation drawback wherever relay selection of every node acts as improvement variable. Considering the range of the sensor nodes in WBANs, the improvement drawback takes only energy consumption rate however additionally energy distinction among sensor nodes under consideration to enhance the network period performance.

In [11], the authors talk about WBAN for patient monitoring system which monitors body motion and heart activity by a network coordinator. An architecture with various sensor nodes and among which the coordinator node of a WSN sends across data to the main server.

Sana Ullah et al [12], in their research survey, tell us about the central components of WBAN including the design, topology, low-power Medium Access Control (MAC) and routing protocols are studied and talked about for every layer thereby highlighting WBAN applications**.**

Jian Shen et al [13] also proposed an efficient authentication protocols for wireless BANs. A one-to-many group authentication protocol along with a group key establishment algorithm between every sensor nodes and PDAs. The new authentication protocol is certificate-less and energy efficient. Since it uses ECC algorithm, it has low computational costs and high security.

In [14], elegant network facilitates a broad range of ubiquitous computing applications like Health, Military, Aviation, Environment and Entertainment etc. Concerning the huge demand and elevated cost of health, a novel and excellent WBAN architecture was developed in the area of Healthcare systems for providing intelligent and dynamic services. The innovation of this architecture lies in dynamic prioritization for handling heterogeneous traffic in healthcare WBAN. This paper explores principle for accurate identification and notification of frequent change in various parameters (i.e. traffic flows, vital signals, available resources etc.), classification and scheduling of heterogeneous packet, and generation and transmission of alerts to the MSU. The proposed architecture is validated through comparison with existing architectures.

In [15], the authors propose to integrate the QoS design into the application layer using the standard CoAP framework. CoAP architecture is a platform independent standard intended to be used in simple electronics devices such as Internet of Things (IoT). Here, they introduce three CoAP features such as *Caching*, *Confirmability* and *Multicast addressing*. They examine these options to deploy the QoS mechanism in the WBAN composed of sensors with heterogeneous priorities. The proposed solutions are universal and can be deployed on any sensor platform which supports the standard CoAP software protocol.

III. Materials and Methods

In this part, the details about the network model and assumptions, initialization phase, proposed architecture and algorithm are provided.

A. Network Model and assumptions

A Body area sensor network with a single sink node and a couple of other nodes is considered to be an intra BASN communication system. The algorithm mentioned in this paper is based on the hop to hop structure. Each node generates packets and forwards it to the next node. A sensor node on the subject's body will sense data and forward it to the next hop node which happens a gateway node. From this gateway node, data packets will be forwarded to the next hop, which is the display module, to show the details of the subject's behaviour and his vital readings. Data packets will be forwarded hop to hop in this network.

B. Initialization phase

Every sensor node will generate data packets and forward it to its neighbouring node. Some of the attributes of the packets shared are *PacketId* – the identification number of a data packet. This number will prevent a conflict with another sensor node. Every node has a unique id so that there will not be any confusion between the different nodes. With this packet id, it will be easy to identify a particular sensor node. *SourceId* – It is the identification number of the source node of the data packets. *E* - is the Energy of a sensor node.

In the initialization phase, all sensor nodes of the patient's body will perform a particular task. There will be sensor nodes such as ECG sensors, Transmission range Sensors, Temperature Sensors, Blood pressure Sensors and SPO2 sensors.

- ***ECG sensor*:**

The ECG sensor will be attached to the patient's body. Right side on a patient's chest a sensor will be placed. This sensor will sense a data of a patient's heart like measure of heart rate.

- ***Transmission range sensor*:**

A Transmission range sensor, or TRS, will check the distance between the patient's body and the tray. Whichever sensor is nearest to the tray will be active and perform the necessary task.

- ***Temperature sensor*:**

Temperature Sensor will sense the temperature of a patient's body and send the details of the body temperature to the sink node.

- ***Blood pressure sensor*:**

Blood pressure sensor will sense the blood pressure of a patient**.** A variety of analysis algorithms can be employed to estimate the systolic, diastolic, and mean arterial pressure.

- ***Spo2 sensor*:**

SpO2 is used to check oxygen evidence in a human body. This is an estimate of arterial oxygen saturation, or SaO2, which refers to the amount of oxygenated haemoglobin in the blood.

When the medicine tray comes near a patient, the distance sensor will be active and when the tray identifies the closest subject, all of the other sensors will kick off and perform specific tasks and gather all the data about the patient's body and sends it to the sink node.

IV. PROPOSED SYSTEM

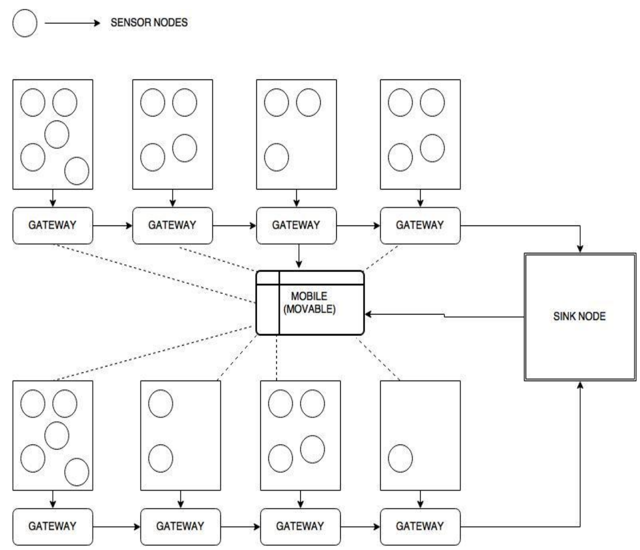

Figure 1. Proposed Architecture

In the planned architecture proposed in this research paper, the sensors are placed onto the patient's body and each of these sensors will perform a particular task where it will sense and fetch a particular data. For example, an ECG sensor will count heartbeats; a Blood pressure sensor will check the blood pressure of the patient's body etc. All of the sensor nodes will be in a network and each sensor node will send data to the network Gateway. From the network gateway, data will be sent to the sink nodes where all the information about the patient will be stored. When a patient registers at a hospital, all the details of that patient like his name, id, age, sex address, history, prescriptions, advice etc. will be registered to the sink node.

Algorithm 1 *Data collection from sensors*

The patient will be on a bed which has one gateway node and there will be different patients on different beds. Each bed has one patient and each patient has at least one sensor node. Sensor nodes will be attached to the patient's body to collect data from the patient's body. The Data collection algorithm is presented here in algorithm 1. This algorithm will collect data from every sensor node in a network and forward that data to the gateway node. First it will check all the networks starting from bed 1, which is first network in this architecture. Then, the network will get data from all the sensor nodes if the sensor node is greater than 0. After fetching data from every sensor node, data will be forwarded to the gateway node. This process will happen until sensor nodes are 0. After completion of one network (bed), it will be move on to the next network and repeat the same steps.

SN = Sensor Nodes

For (all nodes in a network) {

While (Number of SN <0) {
If(SN>0)
{Collects data from every node}
Send a data to the Gateway
}}

Algorithm 2 ***Routing Of Data***
After collecting data from sensor nodes, all of the data will be forwarded to the sink node and the sink node will store the data. In this algorithm, two protocols have been used to send data from the gateways to the sink node. For all gateway nodes, if the protocol used is reactive, all the collected data is directly sent to the sink nodes from the gateway nodes. If proactive protocol is used, then one gateway node stores packets and then forwards it to all of the gateway nodes and at last, the data will be stored at the sink node.

GN = Gateway Nodes

For (all GN)
{
if (protocol is reactive)
all collected data send to the sink node
else if (protocol is proactive)
{ GN++; //through every gateway
Send data to the sink node.
}}

Algorithm 3 ***Mobile data Fetching and Report***
All the details of the patient are in a sink node. Every gateway has its unique id. In this step we make gateway as the interface between sink node and mobile. The mobile finds its nearest gateway and retrieves its id. This id is then synced to sink node. If valid id is found then all the patient's details are forwarded to mobile from the sink node through concerned gateway.

The mobile is now responsible to analyze the patient details and find the ailment. Once the ailment is known the mobile searches for the medicines that are used to cure the ailment. These medicines are then compared with patient's allergies to check if they can be administered with the medicine or not. If patiently is allergic to the medicine an alert is shown otherwise the medicine and its other details are displayed on the mobile.

Gid= Gateway Node id
GN= Gateway Node
F= Frequency

If (F is higher than other GN)
{
Mobile will get id of GN
Compare Gid in sink node
Get All details which are related to that Gid
Show Information on mobile device

If (Medicine is harmful/allergic)
{
alert(harmful/allergic);
}else {Show legal medicine and other details }}

V. CONCLUSION

In this paper proposed a system through which a patient is prescribed medicines based on his/her ailments. Body area sensor networks used to fetch data from patient's body using different sensors. These data are stored, fetched, analysed to prescribe the correct medicine for the patient's problem. This has a basic advantage over the traditional system is that there is no middle man. Unlike traditional system which have a doctor diagnosing the patient, a system that analysis the patient and provides diagnosis. If this proposed system can be applied in hospital then this would save a lot of time as the patient can be diagnosed without the help of a doctor. The doctor is also burdened free with minor ailments can be ignored and only high-risk patients have to be attended. The minor ones can be easily handled by the system. This system can also upgrade the propose system in future to work as a individual drug dispensing machine. The common ailments and the data is reported through the patients can be processed to not only prescribe but also dispense medicines. If setup at hospitals then from diagnosis to drug purchasing can be automatic and more efficient

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