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# A WSN based System for Enhancing Intra Mobility Solution for Healthcare – A Review

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***Abstract*—** Currently, several solutions are available for monitoring patient health using body sensors. In hospitals, healthcare wireless sensor networks (HWSNs) offer support to access these sensors to allow for continuous patient monitoring. In order to improve the quality-of-life of hospitalized patients, it is important to let them walk around the monitored area. This ability brings several challenges to HWSNs with mobility support. Due to the crucial importance of the sensed parameters the HWSNs must be in continuous communication with the body sensors. The connection between body sensors and a healthcare wireless sensor network is performed through an access point. Indoor communications are limited in terms of signal propagation and, therefore, several access points to cover large areas are deployed. In order to maintain the sensor's accessibility these should frequently change their point of attachment by performing a mechanism known as a handover. Handover mechanisms are able to support the intra-mobility of sensors in networks within the same domain. This paper surveys the most recent intra-mobility solutions with special focus on handover approaches that can be used in healthcare wireless sensor networks. An in depth review of the related literature is performed in order to present the state of the art on this topic, to discuss the available solutions, and to point out open issues for further research work. In healthcare scenarios it is important that technology maybe focused on the patients' quality-of-life. The use of HWSNs improves patients' health monitoring. These technologies can be used for patient monitoring in both a real-time and continuous manner. When hospitalized, the patients should be autonomous and their mobility should be preserved whenever possible. That way the HWSNs should support this mobility and ensure continuous patient monitoring.

***Keywords*—**HWSNs; Healthcare Wireless Sensor Networks; Body Sensor; Quality-Of-Life; Intra-Mobility.

## I. INTRODUCTION

WIRELESS sensor networks (WSNs) technologies have risen to the top of research topics over the past few years. Currently, these networks are one of the most promising technologies for the future, including the Internet of Things vision. Several small sensors collecting data and sharing it wirelessly over the Internet are the fundamentals of the WSNs. These technologies are applied to solve several challenges in different areas like military surveillance, building structure monitoring, tracking animals, and fire detection in forests, traffic monitoring, environmental monitoring, and healthcare solutions. Healthcare wireless sensor networks (HWSNs) are a specific field of wireless sensor networks when applied to healthcare solutions. This field is one of the most promising WSN applications. Nowadays, in hospital wards, the medical staff performs most of the monitoring tasks near the patients at periodic intervals. This behavior does not allow for real-time control over the monitored parameters and in some cases a tight control may fail in some parameters that need more attention. The use of small sensors (with bio feedback capabilities) attached to hospitalized patients could be the ideal solution to perform the regular daily monitoring tasks in real-time.

This could also potentiate a more accurate control of bio-parameters of patients suffering from diseases that need close attention. These sensors, (known as sensor nodes in WSNs terminology) compliant with wireless technologies, could be part of a HWSN to send the collected data to remote locations. This ability allows remote monitoring and control of patients' health in healthcare facilities. This way the sensor's data can the accessed anywhere, at any time over the Internet. Despite all this potential, the sensor nodes are tiny devices with limited resources and as such have some drawbacks. Typically, these sensors are comprised of four main parts, namely, sensing module, processing module, communication module, and power supply module. The sensing module provides the ability to collect certain parameters; the processing module includes the microcontroller, which determines the capacity of the sensor node to run programs and process data; the communication module is able to send data wirelessly to a network typically compliant with IEEE 802.15.4 standard, the power supply module includes the energy source to keep the node alive. The enabling mobility of sensor nodes became a new challenge in WSN research. When patients are hospitalized they should keep their mobility as much as possible in order to promote their quality of-life. This means that HWSNs used to monitor hospitalized patients should offer mobility support of the sensor nodes arrived by the patients. Supporting mobility in HWSNs brings slots of new challenges and issues to the evolution of these networks and, thereby, it is now a hot topic in HWSNs research.

One of the emerging challenges caused by the mobility of the sensor nodes is their network coverage. To deal with this issue hwsns should enclose multiple access points and support route variations in order to reach each sensor node. Moreover, to get continuous access to the sensor nodes, a valid route to each one at all times must be available. The mechanism to support the point of attachment change to the network is known as handover. One of the most difficult challenges in handover mechanisms is determining the

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exact moment at which to perform the attachment point change. Several metrics are used to estimate the best moment to perform a handover. The accuracy of handover mechanisms can allow for continuous connection to the sensor nodes in hwsns. Handover mechanisms support intra-mobility in hwsns. Intra-mobility is characterized by the mobility of sensor nodes between different access points, but always within the same network domain, i.e., the nodes addresses always remain the same. This surveys the state-of-the art on solutions for intra mobile support of sensor nodes that can be used in healthcare wireless sensor networks. Special focus is dedicated to the most recent handover mechanisms that support sensor nodes intra-mobility in these types of networks from a specific monitored phenomenon. Typically, this phenomenon does not need close control (in real-time) and the data acquisition is sparse on time. HWSNs promote health control of human beings. The accuracy of this control may be the difference between life and death. Starting with this principle there are several variations between traditional and healthcare WSNs. The main principles of HWSNs are the following:

• Real-time monitoring. In HWSNs it is important to have continuous access to the patient's sensors. This feature allows for close control over the patients' health. Then, if an abnormal behavior occurs in the monitored human parameters, the system can detect it and alert the medical staff immediately.

• Random and continuous motion of sensor nodes. Due to the fact that sensor nodes are attached to people with random and constant motion, the HWSNs should support fast and seamless mobility mechanisms. These mechanisms are the key point for real-time and continuous access to sensor nodes.

• Desirable long life of nodes' batteries. The sensor nodes depend on their batteries to stay alive. Reducing the waste of energy in sensor nodes' operations is crucial to increase their lifetime. So, the design of optimized algorithms and procedures to operate these devices is extremely important. The use of HWSNs can contribute to better life support system. As described above if these technologies can ensure a close monitoring of the patients' general health, they can reduce the time required detecting an abnormal situation when compared with traditional methods. Therefore, it can guarantee a more efficient service at healthcare facilities and help medical staff to anticipate timely abnormal health conditions that patients might suffer. The remote access to patients' data can also improve the collaborative work between physicians.

## II. LITERATURE SURVEY

Jiao ET at. [1] author's in this paper deals with the several solutions are available for monitoring patient health using body sensors. In hospitals, healthcare wireless sensor networks (HWSNs) offer support to access these sensors to allow for continuous patient monitoring. In order to improve the quality-of-life of hospitalized patients, it is important to let them walk around the monitored area. This ability brings several challenges to HWSNs with mobility support. Due to the crucial importance of the sensed parameters the HWSNs must be in continuous communication with the body sensors. The connection between body sensors and a healthcare wireless sensor network is performed through an access point. Indoor communications are limited in terms of signal propagation and, therefore, several access points to cover large areas are deployed. Jiao ET at. [1] Surveyed the most recent literature on intra mobility approaches for WSNs regarding their application in healthcare, and presented a detailed comprehensive analysis of it.

The use of these technologies for hospitalized patient monitoring can be a key asset for health care promotion. The patients using body sensors can be monitored remotely through a HWSN. Furthermore, to give patients the possibility to move across an infirmary it is important that their sensors are kept under constant monitoring without interruption. After the characterization of HWSNs, the mobility issues in HWSNs supported by handover mechanisms were addressed. Handover mechanisms allow sensors to change their point of attachment to the network. Description and performance comparison of the most recent approaches for handover were considered.

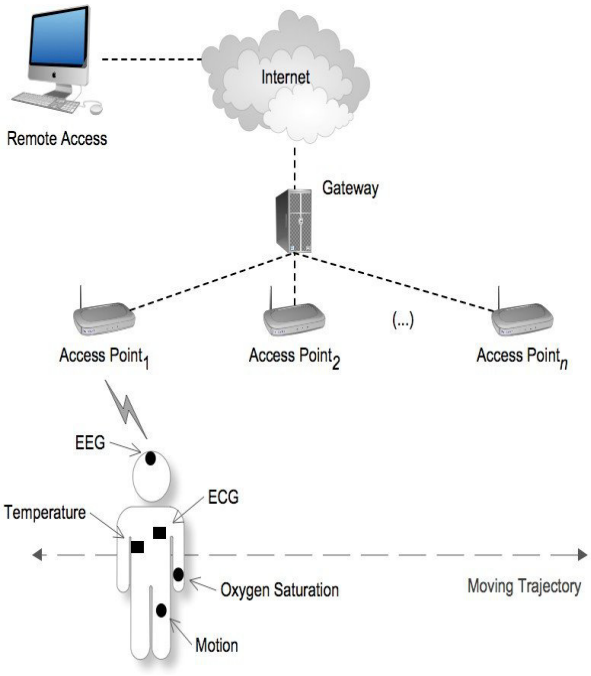



Fig. 1. Illustration of healthcare wireless sensor network

Architecture taken from Jiao ET at. [1]

João et at. [1] author's described that in figure.1 the sensor's are directly attached to the patient like EEG, ECG, temperature, motion and oxygen saturation sensor's .Then sensor's communicate with the access point's through wirelessly and wirelessly connected to the gateway and then through internet remote access to the patient is possible but it is very complicated and very costly.

Sergio et al.[2] author in this paper deals with the simple but effective handoff protocol that enables continuous monitoring of ambulatory patients at home by

means of resource-limited sensors. Author's proposed system implements a 2-tier network: one created by wearable sensors used for vital signs collection, and another by a point-to-point link established between the body sensor network coordinator device and a fixed access point (AP).Author's practical implementation of the proposed scheme reveals that this relayed data operation decreases packet loss rate down to 20% of the value otherwise obtained when solely using the point-to-point, coordinator-AP link.

Sang et al. [3] author's presents a prototype machine-to machine (M2M) healthcare solution that combines mobile andIPv6 techniques in a wireless sensor network to monitor the health condition of patients and provide a wide range of effective, comprehensive, and convenient healthcare services. A low-power embedded wearable sensor measures the health parameters dynamically, and is connected, according to the concept of IPv6 over low-power wireless personal area network, to the M2M node for wireless transmission through the internet or external IP-enabled networks via the M2M gateway. A visualization module of the server program graphically displays the recorded biomedical signals on Android mobile devices used by patients and doctors at the end of the networks in real-time. Our approach for a global M2M healthcare solution is managed to process the large amount of biomedical signals through the extended network combining IPv6 technique and mobile technology for daily life style to users appropriately.

Praveen et al. [4] author's in this paper deals with the Health monitoring of patients is a common task in healthcare areas from nursing homes to hospitals. Medical staff needs to monitor patients closely and collects their monitoring body parameters. This proposal will help the medical staff to control the overall state of monitored patients in autonomous, real-time and remotely way. The application of healthcare wireless Sensor networks to these scenarios could perform this job. Through a network it is possible to reach each one of the patients' nodes anytime anywhere as long as a network terminal is accessible. Here the main idea is to propose a reliable continuous monitoring solution of hospitalized patients (in a hospital infirmary) based on a healthcare wireless sensor network (HWSN) with mobility support.

The patients carry a batch of body sensors (according to their pathology needs) to collect their body parameters. Medical staff evaluates the overall state of each patient and analyzes the values gathered by these nodes.The use of WSNs with nodes mobility support in healthcare environments allows patients to be monitored continuously and remains always under medical control. These solutions provide continuous access to the patients' sensor nodes through a network infrastructure. This infrastructure provides remote access to the nodes. Therefore, the patients' state can be monitored from the place where a network terminal is available.Here Praveen et al. [4] propose a new mobility management protocol for 6LoWPAN which uses the technology of Proxy Agents and aims to enhance the handoff time by predicting or rapidly responding to a handover event. The proposed protocol lessens the involvement of the mobile node in mobility-related message exchange. In order to support a network-based solution an entity called 6LoWPANproxy agent (PA) is introduced. The 6LoWPANPA belongs to the Full Function devices category.

Kyung-sup Kwak et al. [5] the author's focuses on the the recent advances in Wireless Sensor Networks have given rise to many application areas in healthcare. It has produced new field of Wireless Body Area Networks. Using wearable and non-wearable sensor devices humans can be tracked and monitored. Monitoring from the healthcare perspective can be with or without the consent of the particular person. Even if it is with the consent of the person involved, certain social issues arise from this type of application scenario. The issues can be privacy, security, legal and other related issues. Healthcare sensor networks applications have a bright future and it is a must to take up these issues at the earliest. The issues should be carefully studied and understood or else they can pose serious problems. In this paper we try to raise and discuss these issues and find some answers to them.

Shantala et al.[6] author in this paper deals with the one of the major challenges of the world is the increasing old age population and those who are suffering from diseases. The old age population and the diseased want to live independently and perform tasks on their own. This creates a necessity to monitor them continuously and provide a better quality healthcare service while still they are able to live a normal life. The healthcare provided should be improved with the help of the present day technology for early detection and diagnosis of any abnormal conditions of the patient's health. Wireless Sensor Networks (WSN) promise a low cost.

Mittal et al. [7] author's in this paper deals with the Body Sensor Network (BSN) that is linked by a wireless network interface roams from one coverage zone to another then interference between wireless-body-area-networks (WBAN) created, which can cause serious throughput degradation, Scattering of WBAN and Remote Base Station (RBS) will not be in range. When a wireless body area network become mobile then problem arises of inter process interference A necessity appears for efficient WBAN monitoring information extraction, high spatial reuse, dynamically fine tuning the monitoring process to suit the data quality, provision for allowing the translation of high-level requirements of medical officers to low-level sensor reconfiguration. Issues related to security and possible solutions must be taken in the research. Study brings out that the current proposed solutions in security are still having limitations needing further research. This paper proposes an optimized BSN handover strategy, and hop by hop method to reach RBS (Sink), and a method to maximize the network throughput by using stable routes to avoid inter- and intra-flow interferences based on mobility prediction.

Gayathri et al. [8] author's in this proposed a wireless sensor networks (WSNs) have gained increasing attention from both the research community and actual users. Wireless Sensor Networks (WSN) are used in variety of fields which includes environmental, healthcare, military, biological and other commercial applications. The critical aspects to face concern "how to reduce the energy consumption of nodes" and sensor nodes are generally battery-powered devices so that the network lifetime can be extended to reasonable times. However, we conducted that first break down the energy consumption for the

components of a typical sensor node i.e. discussion of the main directions to energy conservation in WSNs. They present a systematic and comprehensive taxonomy of the energy conservation schemes that are subsequently discussed in depth. A technique for energy efficient data acquisition special attention has been devoted to promising solutions that have not yet obtained a wide attention in the literature. V. Shrinithi et al. [9] Wireless sensor networks are the networks which can sense, analyze and then communicate the data. The data collection at sensor nodes consumes a lot of energy but sensor nodes are energy constraints. Most of the WSN architectures consist of stationary nodes which are heavily deployed over a sensing area. In recent times, several WSN architectures based on mobile elements (MEs) have been proposed. The usage of Mobile elements resulted in a newer mode in order to minimize and provide a energy consumption in wireless sensor networks (WSN). Most of them develop mobility to deal with the problem of data collection in WSNs. The scheduling of mobile elements need to address the traverse pattern and also the time of data collection from respective sensor nodes. Wireless Sensor Network with MEs and provide a complete arrangement of their architectures, based on the role of the MEs. Mobile element trajectory control scheme to reduce the sensed data collection delay against obstacles. It will reduce the data collection delay and balance the energy consumption in WSN.

Jara et al. [10] Low-power personal area networks (LoWPANs) are still in its early stage of development, but the range of conceivable usage scenarios is tremendous. The numerous possible applications of Wireless Sensor Networks (WSNs) make obvious that mesh and multi-technology topologies will be prevalent in LoWPAN environments and mobility is one of the most important issues in the Future Networks. Mobility based communication can prolong the life time of devices, increase the connectivity between nodes and clusters, and support fault tolerance. Using distributed LoWPANs is possible to sculpt the devices density to cluster around areas of interest, cover large areas, and work more efficiently. The required mobility is heavily dependent on the individual service scenario and the LoWPAN architecture. For that reason in this paper is presented a mobility protocol oriented to clinical environments. This protocol is based on our monitoring architecture oriented for continuous vital signs monitoring. Thereby, it has been defined and optimized to exploit the other elements of the architecture with high capacity and resources (6LoWPAN Border Router and gateways) to reduce latency and node's overload with respect to other IPv6 mobility solutions such as Mobile IPv6 (MIPv6).

## III. MOTIVATION

Motivation of this project is to simulate the intra-mobility solutions with special focus on healthcare wireless sensor networks. An in depth review of the related literature is performed in order to present the state of the art on this topic, to discuss the available solutions, and to point out open issues for further research work.

In the existing system a patients go to the hospital get appoint to meet with doctor. And there is no electronic medium that patient can directly communicate with the doctor. In this procedure patient have to wait long time.

## IV. PROBLEM DEFINITION

In the hospital, patient has to wait long time to meet with doctor. In the case of critical condition patient cannot wait. In the case of fever detection, it will very less time but still patients have to wait long time. And all patients get a precaution on the disease in face to face it is thought to remember all time. In any condition of patient's, they have to wait for appointment to the doctor then the patient can meet to the doctor. And then the patient getting the treatment and tablet's through the doctor's prescriptions.

Another problem in the existing system is patient want to me meet with the doctor he or she must go to the hospital. There is only one to one communication with the doctor only. For example like, first the patient's detect symptoms then they was gone to the hospital then taken appointment to meet the doctor for diagnosis then they was call by appointment number one by one. After this the patient had been given treatment by doctor.

## V. OBJECTIVE

1. Objective of this project to develop a software that get a input via sensor like temperature, Blood pressure, pulse rate or any other sensor's.

2. This provides predicted precaution to the user.

3. The predicted precaution is in the text format so that user can read it whenever he wants.

4. Main objective of this project is to provide the very important thing to the patient via software to diagnosis the disease and giving the precaution to the patient instantly without any effort or any other torcher to the patient.

5. This project is very important to the patient like, who cannot walk or stand for long time and mostly for the critical condition patient who can't wait for a second.

6. In this project the patient is a user and we develop software that get input from sensor's and provide precaution to the user or patient.

7. In the case of emergency a patient don't want to meet with doctor. If patient is in range with hospital network patient can communicate with doctor. And user can store its symptoms for the next prescriptions.

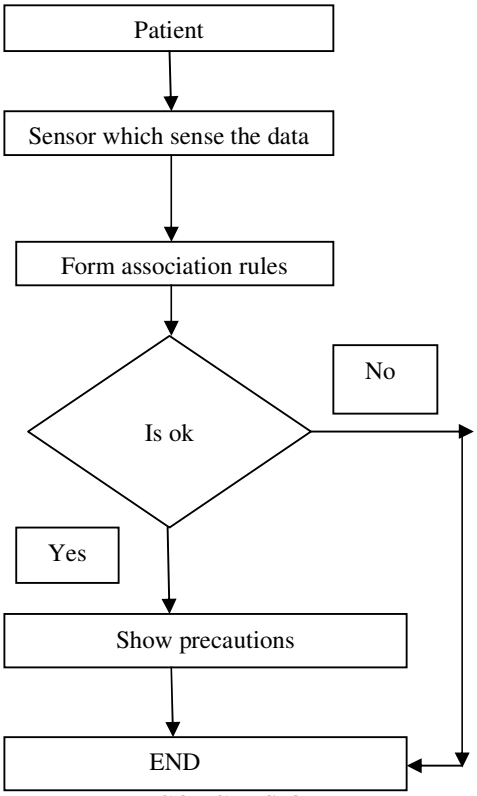
## VI. DESCRIPTION OF THE PROPOSED WORK

### *A. Methodology*

The environment in which we build our simulation model was MATLAB. The name MATLAB stands for matrix laboratory. MATLAB, developed by Math Works Inc., is a software package for high performance numerical computation and visualization. The combination of analysis capabilities, flexibility, reliability, and powerful graphics makes MATLAB the premier software package for scientific researchers. The most important feature of MATLAB is its programming capability, which is very easy to learn and to use, and which allows user-developed functions.

In this project we simulate the environment in that user sent its symptoms like temperature, blood pressure reading, ECG, heart bit and etc, via sensor. We store the lot of database with the related symptom and form the association rule by using Apriori algorithm. And get the prediction by giving the symptom of the user.

*B. Workflow*




## VII. CONCLUSION

In our simulation, we study the recent literature on intra-mobility approaches for WSNs regarding their application in Healthcare, and presented a detailed comprehensive analysis of it. And our proposed simulations provide textual information to the patient so that patient can read it whenever he wants. In this the patient is a user and we develop software that get input from sensors and provide precaution to the user or patient.

## ACKNOWLEDGMENT

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