Scientific Journal Impact Factor (SJIF): 1.711

e-ISSN: 2349-9745
p-ISSN: 2393-8161

IJMTER

International Journal of Modern Trends in Engineering and Research

www.ijmter.com

Monitoring a Patient Using Wireless Sensor Networks and Internet of Things

P.Janani*[1], S.Jagadeeswari*[2], Dr.N.Purushothaman*[3]

[1] *Department Of Information Technology, S.K.P Engineering College*
[2] *Department Of Information Technology, S.K.P Engineering College*
[3] *Department Of Information Technology, S.K.P Engineering College*

Abstract— Nowadays e-Health system had achieved a tremendous improvement through Wireless Sensor Networks (WSN) and Internet of things (IoT). It helps the physician to monitor a patient continuously by using the sensor at lower cost and it does not disturb in routine than older monitoring equipment does. Physical therapy system contains specific features, needs concerning equipment and software. This system is used by the physician for accessing the joint angle and other important signs. This kind of system is also applicable in hydrotherapy which focuses on sensing, packaging and communication challenges. We created our design based on this application.

Keywords- Internet of things, Wireless Sensor Networks, e-Health system.

I. INTRODUCTION

Generally Internet of Things (IoT) [1] is considered as a set of physical objects in the network accessed by the internet. In IoT, this physical object is involved in various functions about the world. Wireless Sensors Networks (WSN) [2] act as an important component of IoT which is mainly used for the growth of e-Health system.

This proposed system has different intrinsic elements when compared to general healthcare monitoring system. The intrinsic elements are as follow as quality of service, sensor nodes, sensor fixation, energy efficiency, routing, feedback, calibration. Thus type of same requirement is used in physical therapy clinic.

For Example [3]: The problem which cannot be monitored by the sensor nodes could be achieved with smaller sensor nodes. This small sensor nods have limited battery size and provides small amount of energy. Multiple sensor nodes are fixed in different positions of the patient body and it is used by the physician to assist the patient.

If the sensor node is not placed in correct position in the patient body or if it is moved then the data which is obtained is incorrect. There are different types of sensors and each sensor type has a peculiar data acquisition rates and bandwidth. By using Medium access control and routing protocols the network should provide reliability and quality of service (QoS) [4].

Before using wireless sensor networks, the therapist uses goniometry to measure the joint angles. At the time of measuring the therapist stop the patient activity and place the device in their body to get related angle. If the patient is very ill at that time the therapist can even monitor the heart rate and blood pressure.

Our aim is to develop a system that help the therapist to access the patient both in soil and water. In order to reach our goal we design, develop and deploy this system.

In this system we use off-the-shelf hardware, standard communication protocols and software to obtain the feedback.

Our paper is organized as follows. Section II describes the designed system, detailing the architecture and platforms used. Section III and Section IV present communication and sensing design, implementation, results and faced challenges faced while developing the system. Section V concludes this paper and indicates future work.

II. SYSTEM DESCRIPTION

This system contains the architecture and objectives which are needed to assist physical therapy and the usage of hardware.

2.1. Objectives

The main objective is to monitor physical therapy patients for assessing joint angle and collect their reports regarding pulse and oxygen saturation. The report collected is also provided to user and specialist doctor.

2.2. Architecture

In this architecture, we discuss that the sensor nodes are placed in the patient body by the therapist. The reports are collected and sent to the local user by base station. Processing of data is done in the local computer. The results are used in real time and stored for later use. Even the therapist can view the reports whenever there is a need.

2.3. Software

In this section, we are going to discuss about the hardware and software implementation.

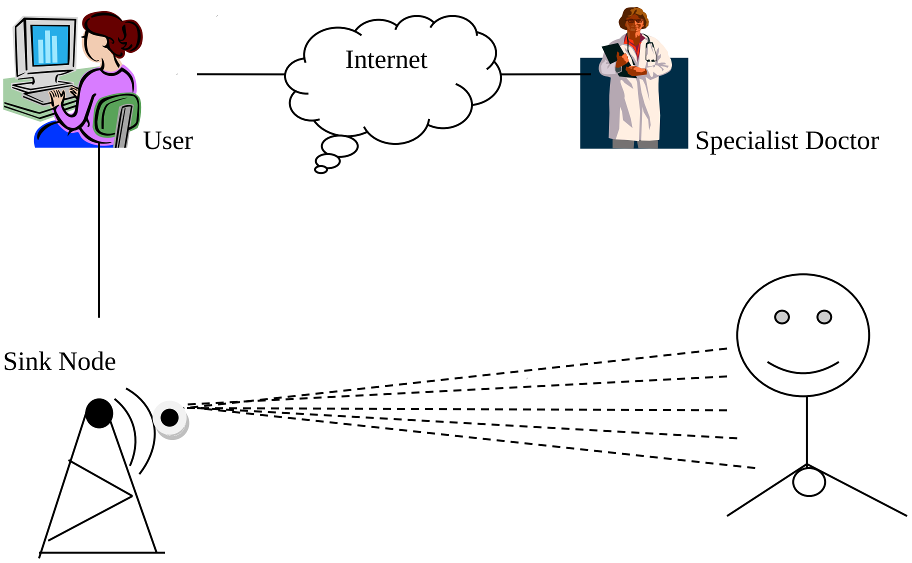

Fig: 1.1. System Architecture

2.4. Hardware

In this system we used different types of hardware for various purposes. We used I. Shimmer version 2r motes, II. TelosB mote and III. Microsoft .NET Gadgeteer platfor. Shimmer motes have three axis accelerometer and battery. An additional sensor node may be coupled to the basic node, such as magnetometer or electrocardiogram sensors. TelosB mote is used as base station to interface with the computer.

Otherwise we can also implement it by using the Microsoft .NET Gadgeteer platform based on FEZ Spider Main board, the main feature of which is its modularity. The joint angle can be accessed only depending on the sensor attached to the main board.

2.5. User Software

The software processes the sensor data and run in user's computer.
Software is composed of two threads:

- Receiving Thread,
- Processing Thread.

The main job of receiving thread receives sensor data from the motes through the base station and stores the data in a file.

The processing thread processes all the data received from the other thread.

The results are displayed in graphical interface. The processing threads also record the maximum, minimum and mean angle values at the end of therapy.

The database is presented in three tables:

- Patient,
- Session,
- Measurement.

They store the information regarding the patient data, therapist notes and a measurement summary.

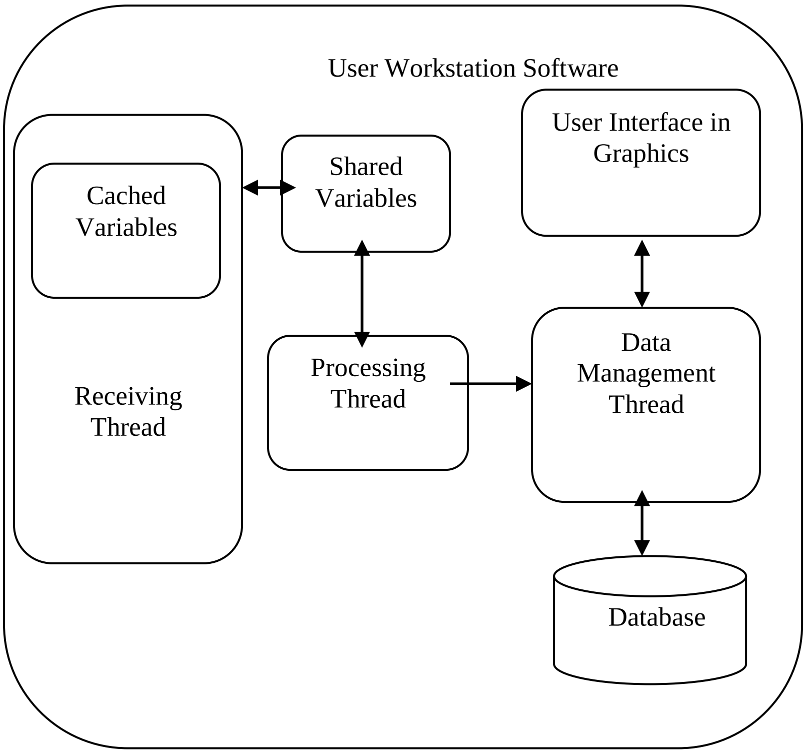

Fig: 1.2. User Workstation Software

III. CHALLENGES TO COMMUNICATION

This section explains and to discuss the challenges faced throughout the prototype development regarding communication issues.

The prototype was composed of six sensing nodes and the data were directly transmitted to the base station. The total payload size was 20 bytes; it has sensed data and application control fields.

Normally the data was sent through CSMA/CA mechanism from the IEEE 802.15.4 standard. In a star topology, if a data transmission rate is high we noticed that packet loss occurred, and thus we plotted in a graph. In order to improve communication performance, we could increase frame inter arrival.

We made an experiment in order to verify the possibility of adapting the system to hydrotherapy use. The major problem while we use this system is to select the appropriate communication medium between the sensing nodes in underwater environment. The electromagnetic signal is very high if we compared to the air, so we have an approach to avoid radio communication.

Underwater acoustic communication is mainly used for long distances, using hydrotherapy it will generate many interfering reflections. The transceiver devices are usually too large to be used in a BAN (Body Area Network).

Using the limitations given by the two alternatives, we decided to measure how the communication would behave underwater. Transmitting the data by this way is not as simple as expected.

IV. CHALLENGES IN SENSING

This section explains and discuss about acquiring sensor data. It includes the sensing devices employed, prototype results.

4.1 Joint angle measurement

Sensor details: The accelerometer available in Shimmer version 2r motes, which has reduced in size, low current intake and set the lowest value of 1.5g.

Results: It contains the angle measurements results. The sensing nodes was fixed and attached to the goniometer to form the chosen angle. A four angle were chosen from the interval. Two nodes were placed parallel to each goniometer arm, so that both devices would measure at the same angle. Each reference angle was measured 20 times by the system.

The system mean error and its standard deviation are presented. Mean error was obtained by subtracting the measured angle from the reference angle.

The next validation step is to validate the system to joint angle of human beings. It is focused on the knee joint according to the physical therapy. The sensing nodes were placed parallel to lateral fibula, aligned to the lateral malleolus. The other mote was placed parallel to the femur lateral surface, aligned to the larger trochanter.

4.2 Improving joint angle measurement

This section is used to improve joint angle measurement. It was assumed that the Earth magnetic field is parallel to the ground and perpendicular to gravity. Data were collected by rotating the sensor in each of its axis on a flat surface, a total of 200 points were collected.

The calibration procedure was repeated, with a larger sample and the results were not different from the last calibration, differing from by 1%.

4.3 Pulse Oximeter

We are using a Pulse Oximeter Module, to monitor medical data. It uses an LED to generate wavelengths that are passed through the patient to a photo detector, providing the patient's O2 saturation and pulse.

V. CONCLUSION

Wireless Sensor Networks (WSN) and Internet of Things (IoT) have been used for various e-Health systems. We focused in physical therapy, with specific characteristics and requirements, software and system. We presented a system architecture and to assess patient joint angles and vital signs in TinyOS and .NET Gadgeteer.

REFERENCES

[1] Carl Falcon. Wireless medical devices: Satisfying radio requirements. Medical Device & Diagnostic Industry, page 80, September 2004. URL: http://www.devicelink.com/mddi/archive/04/ 09/018.html, Oct. 15, 2004.

[2] National Association for Home Care. Basic statistics about home care 2001. URL: http://www.nahc.org/ Consumer/hcstats.html, visited Oct. 12, 2004

[3] Population Projections Branch U.S. Census Bureau, Population Division. National population projections, population pyramids. URL: http://www.census.gov/population/www/projections/ natchart.html, Oct.12, 2004.

[4] OpenSSL Project-[Online]. Available: http://www.openssl.org/

