# WBAN Implementation in a Parallel Processing Environment for E-Healthcare Applications

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**Abstract:**

Wireless sensor network inRemote patient monitoring and storage, analysis of physiological information holds great significance in present day medical practice. In recent years, many processing techniques and different architectures and frameworks have been developed to meet the requirements of remote patient monitoring. In this paper we implemented an architecture which comprises a wireless sensor network to make WBAN and integrated the same in a parallel processing environment using a java-based framework, also the extension of community cloud to help e-healthcare application.

**Key words**: JPPF, WBAN, E-Healthcare

## Introduction

Recent technology developments in the large scale integration of physical sensors, microelectronics and radio connectivity on a chip have aided the generation of wireless sensor networks .In the past, Wireless Sensor Networks have received attention in both industry and academia since there are many unsolved research challenges exist, and since the WSN are small and easy to install them different for attractive applications offer a myriad of industries. A wireless sensor network (WSN) includes of spatially scattered autonomous sensors to monitor environmental or physical conditions, such as motion, pressure, temperature, vibration, sound or pollutants and to supportively passing their information through the network to a primary location. The more advanced networks are bi-directional, also allowing control of sensor activity. The progress of wireless sensor networks was inspired by military applications such as combat zone observation; Today these networks are used in numerous consumer and industrial applications.

One major attractive application for WSN is in patient monitoring. The wearable sensors can be used for healthcare applications, which can be integrated with different wireless sensor networks and gateways in a system to receive and store for future analysis. In Health care applications, the network is termed as Wireless body area network (WBAN)

In recent years, distributed/parallel computing has increased interest around the world of industry, academic, and government with rapid development. In particular, a variety of applications ranging from physics, chemistry, bioinformatics, finance, aerospace, astronomy, environment, and Health care have been recognized. A relationship between Wireless Body Area Networks (WBANs) and distributed

computing will be a nice area to discover. By combining these systems, the WBAN would collect huge numbers of data which will be processed and stored efficiently in a high-performance and cloud-based systems. The combination of such systems, that is, the wireless sensor cloud, would provide a commanding platform for a range of research studies, medical applications, large-scale military operations, and commercial organizations.

**Related works**

In the recent past, there are various methods have been proposed for the implementation of wireless sensors and high-performance computing interface.

In [1], the authors presented a new architecture for diagnosing chronic heart disease, which comprises WBAN with secure data transmission. Also, the author explained the various MAC protocols used with its merits and demerits. Different wearable bio sensors and physiological signal devices are used by the authors in [2] to create a ubiquitous healthcare system, which helps the patient to monitor their health status.

Different design considerations and security solutions of Wireless sensor networks used for healthcare applications are present in [3]. The usage of Wireless sensor networks in human health monitoring, activity monitoring, applicability in sports, disability assistance with various application specific comparison were present in[14].

The usage of distributed computing in wireless sensor networks to access the physiological signs of the patient is explained [5][6], also present the need on high-performance computing in patient monitoring via a different architecture. Wireless grids and cloud for various applications were present in [4].

The use of cloud computing in healthcare applications and challenges in implementing such system, future opportunities were present in [7]. Different sensor cloud architectures for health care applications along with numerous analysis were presented in [8][9]. Internet of things in a healthcare industry, WSN integration with the new IoT [15] the big data collected by the healthcare industry using the IoT technology and the different data analysis methods the usage of high-performance computing in the big data analysis were explained [17].

The resource utilization in cloud computing [12], usage of various load balancing in grid and cloud [16] was experimented and different platforms to implement the same also explained. A java-based application [13] to utilize the computing resources in a protein sequence study was present. A Java based parallel processing framework [11] gives a better idea to utilize the same for the WSN implementation.

Based on the existing literature, different methods, frameworks, algorithms to implement a Wireless sensor network architecture for healthcare application in a high performance computing environment. By the knowledge gathered from the existing work, the proposed model is an implementation of Wireless sensor network and JPPF for healthcare application.

**System Design**

Proposed Architecture combines the best features of Wireless sensor network, Grid computing and community cloud. The architectural design of the combined technologies in healthcare application is depicted in figure-1.
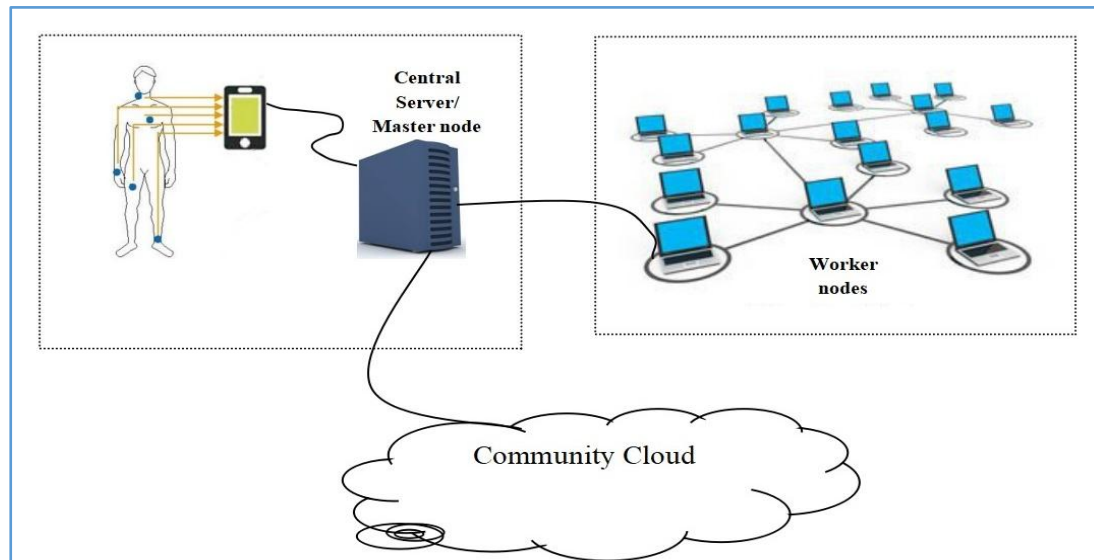


**Figure 1- Architectural design**

Wireless sensors with a high-performance computing is evolving as their technology permits the sharing and utilizing of computer resources, in an effective manner. This permits the users to share the database of different sets of patient's physiological condition from which high-value computations like decision-making, analysis and estimate of diseases can take place. Typically, the patient's physiological data is collected from numerous wireless sensor networks to monitor carefully and diagnose the patients or improve the data fed into clinical trials. The data can be shared between various devices in the distributed network. The physiological information of the patient is stored in the central server of the hospital which can be viewed by the doctors in the hospital. Similar structure is followed in different hospitals. The central servers of different hospitals are connected to a community cloud, from that the analysis software as well as the patients' health related data are easily accessed through the internet by any network device's browser. By this, the suggestions of the doctors from various hospitals can be shared easily. The level of time consumed for the computation process is minimized. Access and analysis processes are made simple. Various software and hardware involved in our design are explained in further section.

**Implementation and Results**

The wireless sensor node used here is National instruments WSN-3202, which is a 16-bit 4 channel analog input for wireless sensor network and has an outdoor range of up to 300m with line of sight. This sensor node is paired with NI 9792 gateway, which uses 2.4GHz IEEE 802.15.4 to communicate up to 8 WSN nodes via star

topology. For testbed setup a Cardio microphone to measure heartrate, a temperature sensor to monitor skin temperature and three node ECG electrodes connected with the wireless sensor node. The connection scheme is depicted in figure 2.
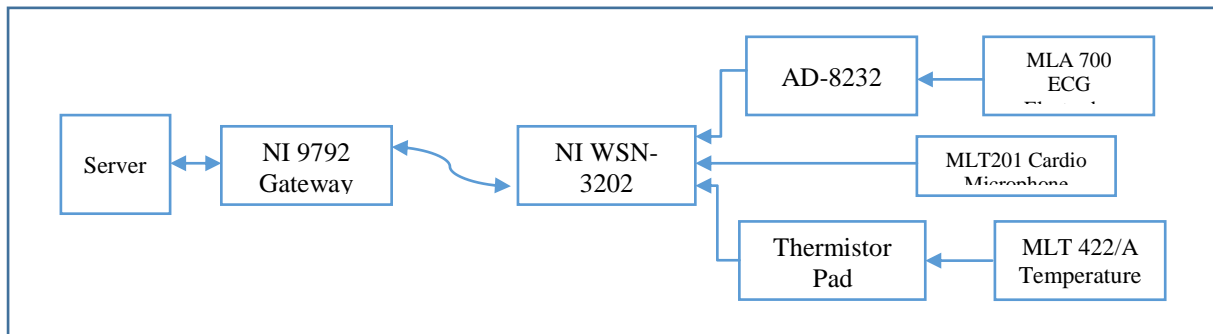


**Figure 2- Connection Scheme**

The gateway is the receiver connected with the server which is configured with JPPF for distributed processing. In this test, the sever and three nodes are connected and used to share the scheduled task. The operation of JPPF is depicted in figure-3 where the application program received by the server will be distributed to the nodes and the nodes will execute the tasks and send the results to the server. The server then combines the results and give them to the client. In our experimental setup three nodes and a server is used with the WSN gateway. The application program runs on the server and the server is connected with the community cloud for the remote access of the patient data. JPPF allows us to run non java applications either by file location, URL location or memory location. Which is a greater addition to run any bio-signal analysis software that needs high performance computation. Also, it has multiple built in load balancing algorithms to distribute the workload.
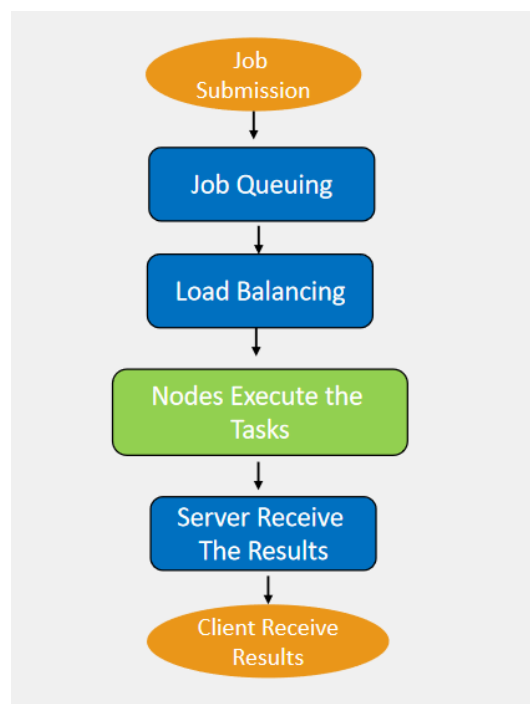


**Figure-3 JPPF operation**

For the experimental study, JPPF server and nodes are configured in intel dual core processor system running ubuntu Linux in 2GB RAM configuration, figure-4 shows the JPPF monitoring tool which gives the system configuration, node health, job details. SQL server is the local Database used to store all the physiological signs received, which also running in the server under the JPPF Configuration.
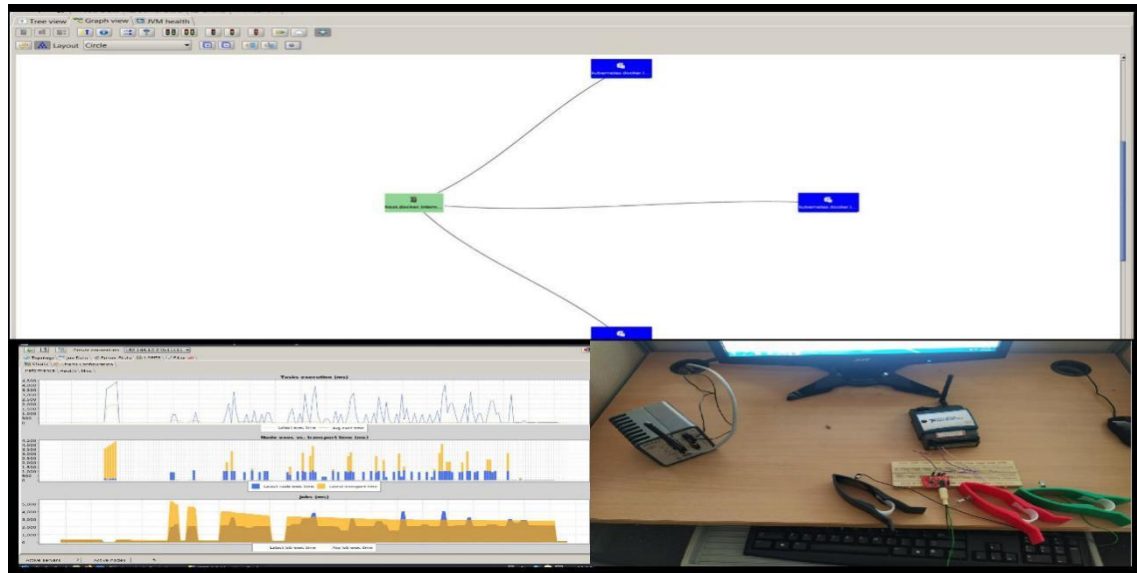


**Figure-4 Testbed setup and the JPPF monitoring**

The data stored and the real time data can be remotely accessed by different systems by using the user interface designed which is shown in figure-5. As per the architectural design, the server is connected to the community cloud.
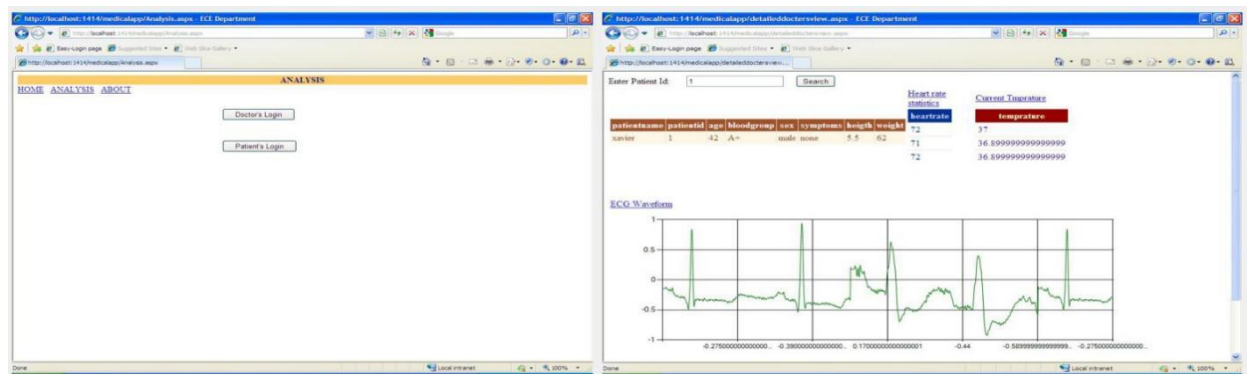


**Figure-5 Remote access of the Live data**

The real time implementation of the system will provide a scalable and open source platform for wireless sensor and community cloud integration for e-healthcare applications. The integration of this system provides easier access of patient's health records.

**Conclusion:**

This paper provides WBAN integrated Cloud Computing for E-healthcare applications. It offers various featured components, including Parallel processing, integration of WBAN and Community Cloud, dynamic collaboration between community clouds to provide numerous E-Healthcare services. We also present our primary results of development, and then discuss about its potential benefits. Furthermore, a cloud computing environment offers flexibility in building low-cost, scalable health record systems. Our framework offers care takers can ready to perform exploratory data analysis so as toextend insight into the distributed databases, and uncover important events.

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