An Approach for measuring nearest neighbour of Healthcare Management System

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Abstract- **Internet of Things (IOT) is a rising technology which has the capability to greatly influence the internet and communication technologies. Several applications of the IOT are possible and one of the most promising domains where it can be applied is the healthcare domain. Some of the IOT related technologies such as body sensor networks, advanced healthcare systems, cloud based platform for wireless transfer of data, storage and display of clinical data etc. are the results of wide utilization of technology into the field of medicines. A body sensor network scenario will be created using various body sensor nodes with Low power and Lossy networks (RPL) routing protocol. RPL is a distance vector routing protocol implemented using Contiki operating system. The free open source simulation environment called Contiki OS helps in analyzing the performance parameters of Wireless Personal Area Networks (WPAN). The Cooja simulator in Contiki OS simulates the network scenario, provides the means and tools to observe network behavior in different environments on different platforms. This paper presents work done on analysis of the RPL protocol of the Wireless Sensor Networks. Performance parameters like light, temperature and blood glucose levels of body are measured using sensor nodes and also the position of neighboring nodes are obtained. These parameters are measured in case of mobility as well. Then by using Dijkstra's algorithm, the shortest path to reach the record maintainer is measured. The proposed work focuses on the analysis of protocol standards used to monitor patient information in health care management system.**

Index Terms- **Cloud computing, Internet of things, Contiki.**

1. INTRODUCTION

Internet of Things (IOT) is a burgeoning technology in the field of internet and communication technologies. Generally, everything in the world is perceived as an object in the object oriented model, but in IOT archetype everything in the world is considered as a smart object, that communicates with each other either physically or virtually through internet technologies.IOT allows people all-round and all-time connectivity - anytime, anyplace, anyone and anything by making use of any network and any service. IOT integrates real world objects with virtual world where sensors, actuators, and other devices with each other and software agents on the Internet in addition to interactions with human beings. One of the method to make IOT data available is to make Internet users to utilize Web service technologies that can assimilate IOT data and Web functionalies through the Internet.

1.1 Wireless Mesh Networks

Recently, wireless networks have become increasingly important to computer networking and they have diversified into number of different types of networks. One popular way to categorize these wireless networks is according to the distance. This results in categories such as Wireless Personal Area Networks (a couple of meters, e.g. Bluetooth), Wireless Local Area Networks (up to 100m, e.g. Wi-Fi) and Wireless Wide Area Networks (several kilometers, e.g. WiMax). Another way to classify wireless networks is according to the number of wireless links that each end device is separated from a base station or target device.

Wireless Sensor Networks

A Wireless Sensor Network (WSN) is a network of many sensor nodes. Wireless Sensor Networks comes under IEEE 802.15.4 protocol. A sensor node is a device which senses the data, stores it and sends it to a sink node for collection and analysis. These sensors have flexibility which enables them to be placed anywhere randomly. The wireless sensor networks have many applications. There are many sensors that can be used in these type of networks, some of them are temperature, pressure, motion, humidity, etc. The sensor nodes sense the environment around them and obtain the data. These data are analyzed and operations are performed on them to find suitable actions.

Wireless Personal Area Networks

A Wireless Personal Area Network (WPAN) is a wireless network to interconnect devices that are used in the workspace of an individual. Generally, a WPAN uses a technology that allows communication within a radius of about 10 meter. An example of such a technology is Bluetooth which was used as the basis for IEEE 802.15 standard.

1.4. Wireless Body Area Networks

A Wireless Body Area Network (WBAN) is a wireless network for connecting sensors and actuators among many other devices, known as independent nodes, on a human body or under the skin of a person. This network spreads across the human body and the nodes are interconnected by means of a wireless communication channel. WBANs in healthcare applications are mainly used for patient monitoring tasks.

1.5. Contiki Operating System

Contiki is an open-source WSN-targeted operating system developed in Swedish Institute of Computer Science (SICS). It gives a platform to develop applications for different hardware. Its low power and cross platform development of applications is very helpful in situations where power or energy consumption is restricted like in WBANs. Contiki also provides a set of instructions which are helpful in communication in low power networks. Contiki features an IPv6 Routing Protocol for Low-Power and Lossy Networks (RPL). Border routers at used at the periphery of a network to connect it to other networks. Data exchange between a WSN (RPL network) and an external IP network is handled by the border router.

1.6. Cooja Simulator

Cooja Simulator, is a network simulator specifically designed for Wireless Sensor Networks . This is a discrete event simulator that provides a number of radio mediums such as UDGM (Unit Disk Graph Medium) and MRM (Multi-path Ray-tracer Medium). Cooja is supported by Contiki, that allows real hardware platforms to be emulated unlike other simulators. It provides fast and easier way to test the behavior of the application with slightly lesser precision than actual hardware. The programs or applications written can be tested with different platforms beforehand with the Cooja simulator.

2. LITERATURE REVIEW

Movassaghi S. et al. in their paper titled "Wireless Body Area Networks: A Survey" [1], introduces us to WBAN and IEEE protocol 802.15.6. Thier paper discusses about the applications of WBAN in different fields, characteristics of WBAN, types of nodes, number of nodes and topology. The authors then presents the architecture of WBAN, the layers in WBAN, their functions and responsibilities. The authors also mentions the challenges in implementing WBAN.

Kulkarni & Sathe in their paper titled "Healthcare applications for Internet of Things: A Review" [2], used the concept of Ultrasound-based technology to locate and to keep a tab on an old patient's activity and detect falls. IOT driven, non invasive monitoring systems were used for hospitalized patients with close attention to physiological status. Different kinds of sensors and complex algorithms are used to analyze the data collected from the sensors and shared through wireless connectivity.

Adnane et al. in their paper titled "Detecting Specific Health-Related Events Using an Integrated Sensor System for Vital Sign Monitoring" [3], describes an integrated sensor system for monitoring long-time cardiorespiratory signals and detecting apnea / hypopnea periods in physiological data using dedicated signal processing packages. A conventional system for sleep study, polysomnography (PSG) and specific hardware for ECG and respiratory signals using cardiorespiratory belt sensor has been developed. The authors then discuss the PVDF (polyvinylidene fluoride) sensor with piezoelectric properties for detecting the movement of surface of the body corresponding to heartbeats.

Blum & Magill in their paper titled "M-Psychiatry: Sensor Networks for Psychiatric Health Monitoring" [4], illustrates the procedures for integrating the data reported by the patient with the data collected from the remote small wireless devices placed on patients and in their homes. Patients were taught to self-monitor using handheld devices. Patients can be given the access to control the monitoring system through their mobile phones or other personal devices.

Adam Dunkels et al. in their paper titled "Contiki –a lightweight and flexible operating system for tiny networked sensors" [5], who are also the creators of the Contiki operating system have introduced the Contiki operating system for light weight sensing devices.

Bui & Zorzi in their paper titled "Health Care Applications: A Solution Based on The Internet of Things" [6], explores the capability of Internet of Things when used as a framework for e-Health communication and demonstrates the improvement in the quality of life of people suffering from chronic diseases or during emergencies by using low-cost and low-power devices. They also discuss the electronic health-care solutions in terms of Health Care Record (HCR) databases and formats that contain healthcare information about each patients as well as small wearable sensors.

Adam Dunkles et al. in their papers "Contiki Programming Course: Hands-On Session Notes" and "Contiki IPSN 2009 Tutorial Handouts" [7], [8], give introductory course on programming in Contiki and Cooja simulator.

3. RESULT AND DISCUSSIONS

Deploy 6 numbers of sensor motes in a simulation window. Once the motes have been added it is possible to position them as per the location requirement. Consider any one mote as a record maintainer and remaining motes will act as a neighbouring patients as shown in the Fig 3.1.

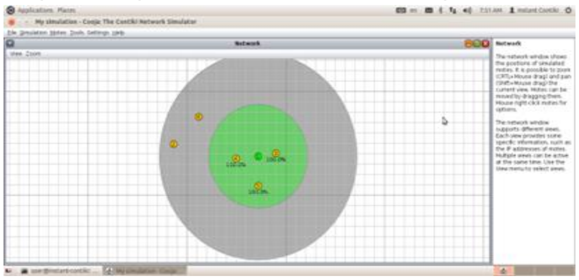

Fig 3.1 Neighboring patients

To differentiate the record maintainer and the patients each mote has been given a unique identity. This will generate the server IPv6 addresses as shown in the Fig. 3.2

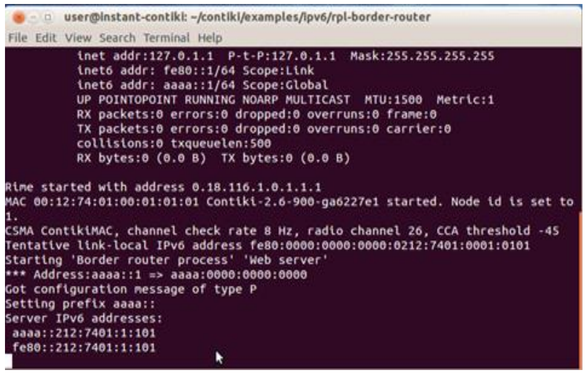

Fig 3.2 Server IPv6 addresses

By using IPV6 address of the record maintainer mote, it is possible to find out all its neighbours and the path or routes to be followed as shown in the Fig 3.3. It will display the neighbouring patient's information as it can be seen in the Fig 3.3. that 404, 606 and 303 are the nearest patients.

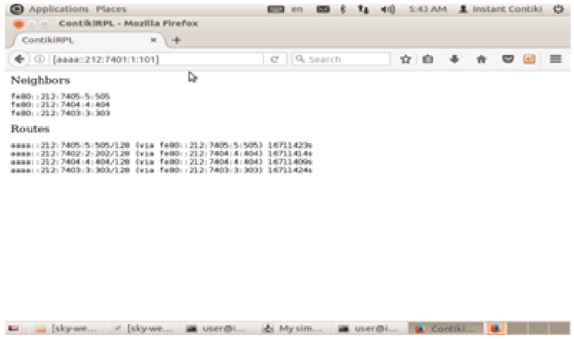

Fig 3.3 Contiki RPL

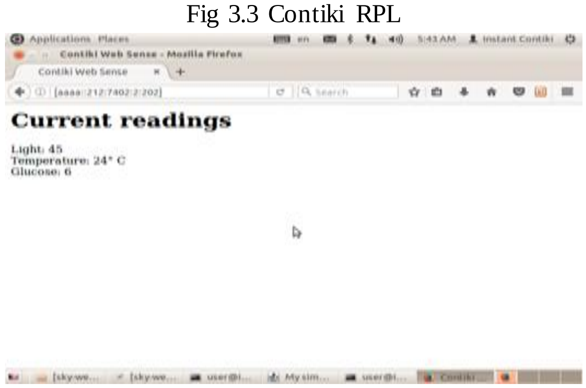

Fig 3.4 Current Readings

For each mote, light, temperature and blood glucose levels of a particular patient can be measured by deploying 3 sensor nodes as shown in the Fig 3.4. The main aim is to find out the nearest path between the record maintainer and a patient. Hence , by using Dijkstra's algorithm the shortest path for the patient to reach the record maintainer is measured is as shown in Fig 3.5.

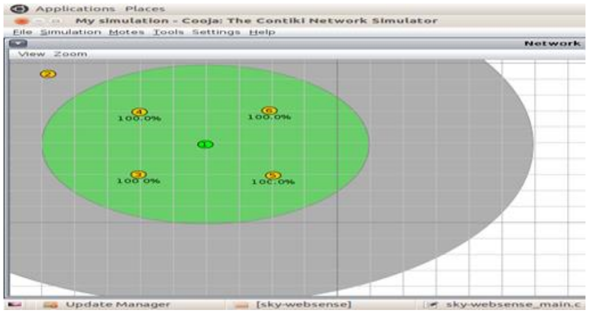

Fig 3.5 Simulation using Dijkstra's algorithm

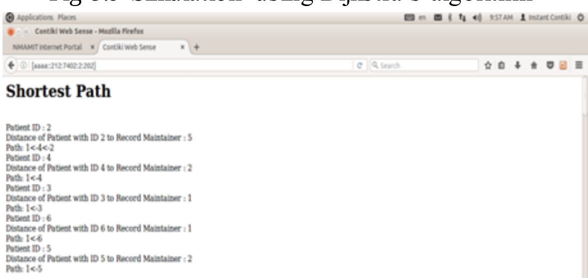

Fig 3.6 Shortest Path

As it is evident from the Fig 3.6, that the best suitable shortest path from the patient to reach the record maintainer is obtained.

4. CONCLUSION

Wireless Body Area Networks offers great flexibility in operation and usage. They cost less and have minimum hardware requirements resulting in low power consumption. It supports several network topologies and multi-hop transmission grant scalability for building dynamic networks. The proposed work demonstrates the performance of RPL. Cooja is proved to be an excellent tool for the simulation of RPL in WSNs. Here motes are considered as the body sensor nodes and the light, temperature and blood glucose levels of each of the nodes are measured. These parameters are also measured in case of mobility as well. Also the best suitable shortest path for the patient to reach the record maintainer is measured too. Motes can be emulated at the hardware level which makes it slower but allows precise inspection of the system behavior, or at a less detailed level which renders it faster and allows simulation of larger networks. The simulator Cooja with its abilities and features makes the Contiki OS more suitable for Internet of Things. Since Contiki is an open source Operating System, the codes can be modified further and various performance statistics can be obtained thereby achieving a better performance.

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