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Design and architecture of wireless body area network using android application

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Article Info	ABSTRACT
	Patients in hospitals have issue with health instrumentality that's connected with wires to their body. Wired health instrumentality restricts the quality of the patient. Moreover, health caretaker's area unit compelled to work the instrumentality and take the measurements. Hence, wireless observance of patient is incredibly effective resolution thereto drawback. The most target of this study was to analysis the present trend and prospect of wireless observance of patients within the hospitals. This study conjointly aims to create the epitome system to implement wireless observance. Additionally to that, this thesis conjointly studies most fitted technique for building the foremost effective wireless observance system. The sensing element nodes and receiver of the epitome were designed. Golem phone was used as entranceway to receive the information from sensing element node and forward the information into receiver. Bluetooth Low energy was wont to communicate between sensing element nodes and golem phone. LAN is employed to speak between golem phone and also the receiver that is connected to laptop. The sensing element readings were initially ascertained in Arduino Serial Monitor so sent to sink node. The sensing element readings of a body were displayed in golem phone and yet as within the web site. Real time information of sensing element was created and with success updated within the web site. The study of results and project showed that wireless observance would be terribly effective by exploitation Interference free, short vary and extremely secure suggests that of communication. Bluetooth low energy that is appropriate choice for the system. Style of sensing element nodes ought to be terribly tiny as a result of it's to be worn round the body. Therefore smaller parts ought to be used.

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1. INTRODUCTION

Patients United Nations agency ar hospitalized in medical care unit or emergency ward want constant observation to amass their important signs like pressure, graphical record, atomic number 8 quantity, temperature etc. Doctors and health professionals study these important signs to sight any forthcoming health complication. They fetch information from patient by connecting wired health instrumentality to the patient. Wired instrumentality adds complication to patients as a result of issue in movement. Moreover, nurses ought to of times visit the patient's wards to require the measurements of significant signs. This is able to take longer for health professionals to require measurements and operate the instrumentality. Moreover, attention takers ought to use for those works. In spite of frequent visit and observation, in some occasion health care takers may not able to attend throughout the intense health complication of patients. Hence, the necessity of period of time observation is incredibly crucial to health care takers.

There are several health care technologies offered within the market that gives form of wireless patient observation technologies. Choosing the simplest and reliable technology is incredibly important. Wireless observation technologies use completely different Wide space Personal Network techniques, for examples: Zigbee and Bluetooth to speak between device nodes and therefore the entranceway. This study implements Wireless Body space Network to create the paradigm wireless observation system. This project studies numerous WPANs and ultimately uses Bluetooth Low energy as appropriate WPAN for communication.

The most target of the study was to style paradigm system that would offer real time observation of patients. Whereas planning the paradigm, the study additionally aimed toward building the reliable, sturdy terribly intensely safe system that would offer very correct medical information of patients or persons to be monitored. The accuracy and confidentiality of noninheritable information were a lot of stressed within the project. Hence, Bluetooth Low energy was used as a result of encoding feature of it. Solely Health care takers would have access to the confidential information of patients that were saved within the patient's info server. The approved persons might have access to information solely with secured username and countersign from the medical web site. together with planning, the project aims at learning the trend and way forward for wireless body space network in medical applications for example bio-feedback application, help to senior individuals and interference and observation of diseases. The paradigm used low cost graphical record device (ECG) in its device node style.

2. WIRELESS NETWORKS

Wireless Network is the computer network that uses wireless data connections for connecting various devices in network. Basically, it uses radio waves (Electromagnetic wave) for connection to network.

Wireless Network Types:
a) WWANs: Wireless Wide Area Networks. Extends over a large area like cities or country 3G, 4G, GSM
b) WLANs: Wireless Local Area Networks. For a small area like a School, Home or University. It uses Radio waves signals. It follows IEEE 802.11standard
c) WMANs: Wireless Metropolitan Area Networks: It has range from 30 to 50 km. It is also known as Wimax,
d) WPANs: Wireless Personal Area Networks: It follows IEE 802.15.1 for instance Bluetooth and IEE 802.15.4 for instance Zigbee. They are suitable Power efficient, short ranging and Inexpensive devices.
e) WBANs: Wireless Body Area Networks: It follows IEE 802.15.6 [1].

Wired networks:
Although wired networks are reliable, constant power supply, stable and have high data transmissions, it has some disadvantages. They are as follows:
a) Problems with installation.
b) High cost and maintenance and installations.
c) Burdensome

3. WIRELESS BODY AREA NETWORK

The technological advances in data and communication technology and natural philosophy like MEMS have sealed the manner for the Wireless Body space Network .Wireless body space network is extended version of WSN to medical applications [2-4]. In contrast to different sensing element networks, WBAN encompasses a network of biosensors nodes that are fitted with bio sensors to produce individual health parameters of a private. WBAN has the contributions from several knowledge domain sciences. Presently WPAN are principally appropriate for industrial application [5]. As an example, Bluetooth is appropriate for sensing element networking application. However Wi-Fi is suitable for knowledge network with higher knowledge transmission rate. Completely different technology and standards are there to support WBAN. IEEE 802.15.6 was designed for WBAN. It offers Figure 1.
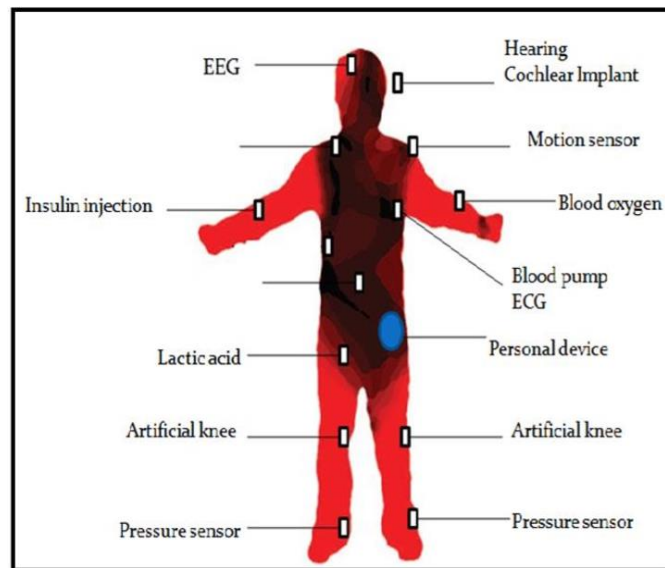
Figure 1. Health monitoring system reprinted from ramshedda. k wireless body area network [6]

4. SYSTEM ARCHITECTURE

The typical architecture of WBAN is comprised of three tire communication: Intra BAN communication, Inter BAN communication and Beyond BAN communication [7].

Tier 1 Architecture

This layer has intra communication. The communication is among the body sensors nodes and the master node or sink node. Sensor nodes are placed on human body as on body sensors, wearable sensors or implanted under the skin. The sensor node is capable of sensing, sampling, processing and communication.

Tier 2 Architecture

This layer involves the inter BAN communication between the central unit or master node and the personal devices such as mobile phone or note books. The master node has the user interaction interface. Different sensor nodes have different communication protocols. For example, Bluetooth based sensor nodes have Bluetooth for communication. The sink node is linked with medical server through WLANs, or 2G or 3G [5].

Tier 3 Architecture

This layer connects the personal devices to the internet. This structure has one decision measuring Unit which does an automatic computation. It gathers and sorts out the information. The DMU is linked with medical institutions for example, hospitals; where health care takers can analyse the data [8]. Figure 2 Illustrates the three tier Architecture of WBAN.
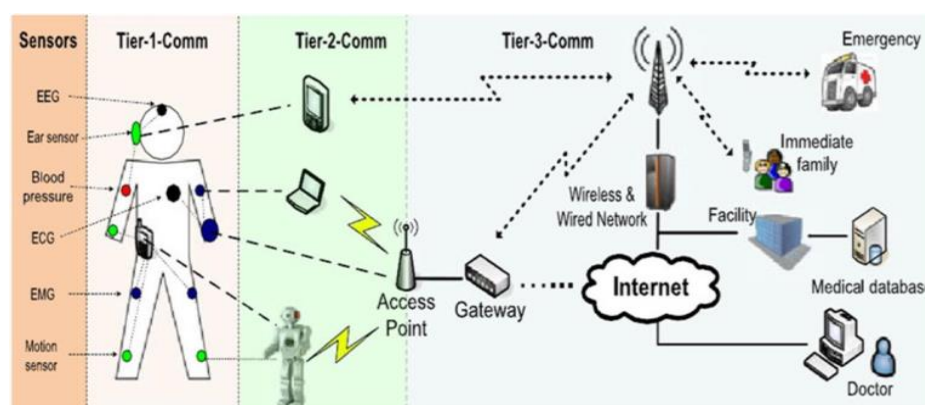

Figure 2. Three tier architecture of WBAN reprinted from RAJEEV NARAYAN [9]

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4.1 Gateway

Gateway is also known as Body control Unit or Central control Unit in this WBAN system. Personal Digital Assistant is another popular name for Gateway. The role of Gateway is sink node. They collect the sensor data and process it to forward to remote stations or main health server. They communicate with server using standard telecommunication network for example WiFi or Mobile network [10].

4.2 Monitoring of Vital Signs

There are four primary vital signs for assessing the general physical health of a person .The normal range of readings of vital signs is different with age, weight, gender and overall health of a person [11]. Early warning scores data gathered is shown in Table 1.

They are listed below:
-   Human body temperature
-   Blood pressure
-   Heart beat rate
-   Respiration rate often noted as BT, BP, HR and RR.

Table 1. Early Warning Scores Data Gathered From [12]

Score	3	2	1	0	1	2	3
Respiratory rate (breaths/min)	>35	31-35	21-30	9-20			<7
SpO2 (%)	<85	85-89	90-92	>92			
Temperature (C)		>38.9	38-38.9	36-37.9	35-35.9	34-34.9	<34
Systolic BP (mmHg)		>199		100-199	80-99	70-79	<70
Heart rate (bpm)	>129	110-129	100-109	50-99	40-49	30-39	<30
AVPU				Alert	Voice	Pain	Unconcious

4.3 Gateway Design

Actual entranceway or sink node for wireless body space network had to act as personal digital assistant with freelance device that has microcontrollers and twin mode of communication. It might receive the info from sensors in BLE medium and at a similar time forward the info to the receivers in server facet in several mediums. However the model during this study uses the golem phone as entranceway. Golem OS version 4.3 or later supports the Bluetooth low energy. Similarly, IPhone 4s and latest version use the Bluetooth low energy. These sensible phones contain each WLAN and Bluetooth low energy modules in them. Hence, they will be used as entranceway to receive the info from device nodes in BLE mode and forward the info to receiver in WLAN mode or directly.

Update to the server mistreatment the net affiliation of the portable. There area unit heap of associate open supply application that receives the info from device nodes and show the info however they are doing not have practicality to update it to the server. Hence, either complete application should be engineered or associate open supply application should be accustomed work as entranceway. Figure 3 the whole WBAN system that has device nodes and Receiver with ESP8266.
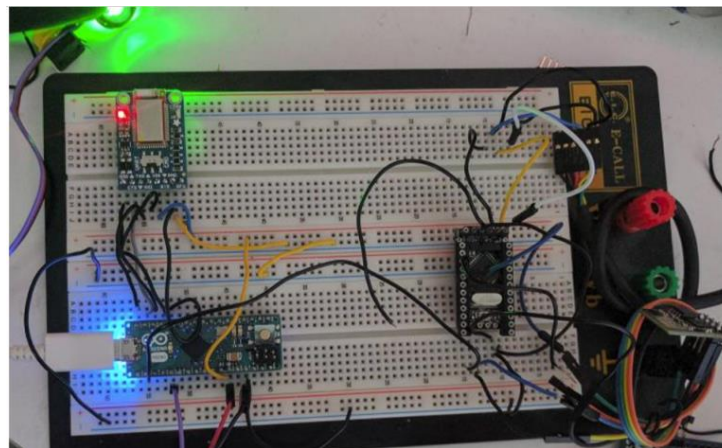

Figure 3. Prototype WBAN Systems

4.4 Android Application

The project uses android version of nRF tool box application. This application supports following profiles.

- Heart Rate Monitor
- Proximity Monitor
- Glucose Monitor
- Blood Pressure Monitor

nRF tool box does not have functionality to update the information to the server. Figure 4 is the screen shots of nRFtool box. Figure 4b is showing the plot of graph from the sensor data received from Adafruit BLE module. This application does not have functionality to send the information to the receiver. However, it is possible to implement Client server in the application to send the sensor data to the server.
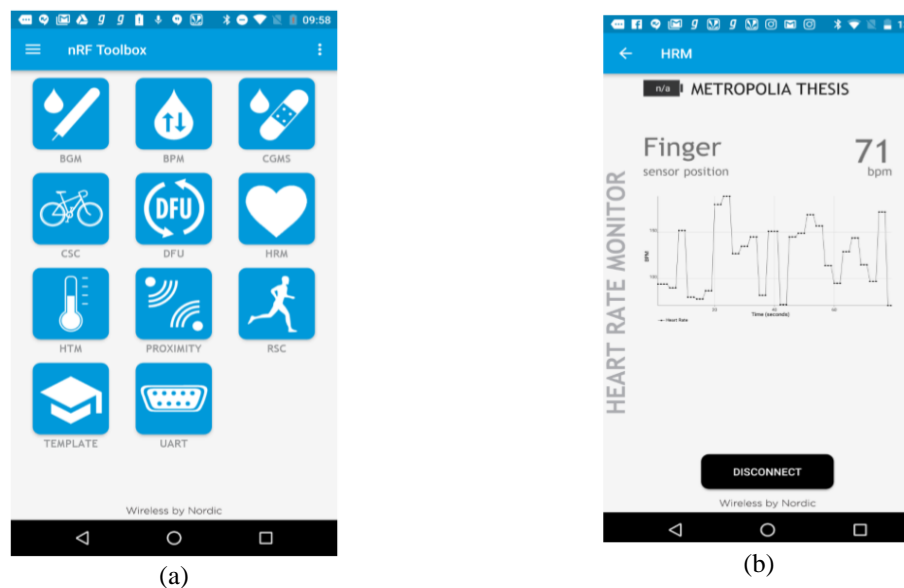

(a)   (b)

Figure 4. (a) nRFtool box layouts, (b) nRFtool box, graph of Heart Rate Monitor

5.   RESULTS AND DISCUSSION

The example wireless watching system was designed. From the results of study, it had been found that Bluetooth Low Energy is that the best PAN for human activity between device nodes and sink node than different commercially obtainable suggests that of wireless communication. What is more Bluetooth five is preferred than that of Bluetooth 4. Since the device nodes are worn round the body, the device nodes ought to be as little as doable and so smaller elements ought to be used. nRF52832 or nRF52840 is that the appropriate option to build device node thanks to its appealing options that features Bluetooth five though the project has used "Adafruit Bluefruit lupus uart friend". The devices employed in device nodes ought to be properly tested on an individual basis before integration within the sensor nodes as a result of the sensors someday don't offer correct readings. The readings from device nodes within the project failed to offer the stable readings. It had been in all probability as a result of a budget pulse device wasn't functioning well. The sink node ought to have Bluetooth Low Energy that ought to support each central and peripheral mode of communication. Adafruit BLE module employed in the project supports solely peripheral mode. But its new BLE module supported Nordic semiconductor nRF52832 have each mode of communication. Relying upon the types of application that need varied latency, lower association interval can decrease the time it needs to send knowledge from central to peripheral or contrariwise. Within the application like this project, it needs lower latency. I.e. it wants less quantity of your time to send the info. Therefore, reduced association interval technique may be used at the price of relatively higher power consumption. The robot phone that has nRF tool box robot application was used as sink node however it doesn't have practicality to send the info to receiver over wireless fidelity. The study had original decide to obtain the assistance from fully fledged robot app developer on robot application half however it had been aborted later. The study additionally discovered that EspressIf32 was best module to be used for planning sink node thanks to its twin mode of communication. It's each Bluetooth low energy that is truly BLE 4.1 and wireless fidelity mode of communication. whereas victimisation thingSpeak platform to

log the device knowledge, it had been terribly slow around eighteen to twenty seconds as a result of it's used communications protocol POST request.
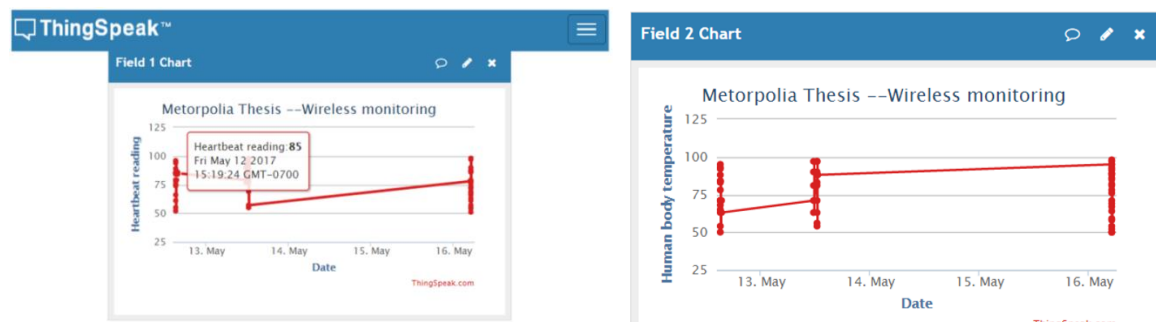

Figure 5. Observation of sensor data in ThingSpeak website

From Figure 5, it shows that sensor data has been updated very slowly. This slow updating of data is problematic to application like Heart Beat sensor reading because it needs frequent data logging. As a whole the primary goal of the study was met.

6. CONCLUSION

The primary goal of this project was to analysis the trend of wireless watching and style the foremost acceptable watching system. Though the entire image system wasn't engineered as a result of this project needed the expertise of functioning on robot Application, the totally functioning image was created exploitation simulated values. As a whole, the image worked and first goal was achieved. Wireless watching of Patients has been researched by several before however as a result of poor technology in Wireless technology and fewer varieties of sensors, the effective system wasn't developed. Now, there are important enhancements also as advancement within the field of MEMS and digital physical science that coming up with of the system isn't terribly difficult. The supply of the many body sensors additionally to the utterly revolutionary Personal space Network Bluetooth five have created the wireless watching terribly straightforward to style.

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