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Review on Wireless Body Area Network

[1] Vijay Ramalingam
[1] Department Of Computer Science and Engineering, Galgotias University, Yamuna Expressway Greater Noida, Uttar Pradesh
[1] r.vijay@galgotiasuniversity.edu.in

Abstract- The growing use of wireless networks and the continuous miniaturization of intrusive / semi-invasive electrical equipment have allowed Wireless Body Area Networks (WBAN) to expand.A WBAN offers a client with underlying health surveillance with no restrictions on a person's daily routine activities.Currently, there has been a growing interest in wireless body area networks as it allows for actual-time and constant tracking in different fields like telehealth, culture, sports, and weapons training, particularly advantages for diagnosis and treatment of chronic illnesses.Wireless Body Area Network is known as a type of wireless extremely-short-range wireless technology.Several innovations have demonstrated its effectiveness in promoting WBAN programs, like remote access, biofeedback, and dialysis by fulfilling its particular needs for quality of service.Choosing the latest technology for a healthcare application is a difficult task because of the various tools available. The paper gives a comprehensive overview on the developments of Wireless Body Area Network, its challenges, architecture followed by its application in various domains.

Keywords- Applications of WBAN, Architecture of WBAN, Challenges of WBAN, Wireless Body Area Network (WBAN).

INTRODUCTION

Wireless Body Area Networks (WBANs) is a field developed in the past many years as a result of applying Wireless Personal Area Networks (WPAN) to the communications on, near and around the human body[1]. This was possible due to research advancements in wireless sensors design and miniaturization, low-power sensor circuitry, signal processing and communications protocols.It is possible due to developments in the layout and mass production of remote sensors, small-power detector circuits, image processing and interfaces for interaction.The domain presents many of its problems with Wireless Sensor Networks (WSNs), which is more common. Nonetheless, there are also many differences between the two, particularly regarding implementation, distance, data rate, bandwidth, and flexibility.The WBANs are composed of several diverse biomedical detectors.Such detectors are mounted in different parts of the body, which can be portable or inserted under the body of the patient[2].Each has particular requirements and used for specific missions.Such instruments are being used to monitor improvements in vital signs of a person and to identify feelings or individual status updates, like anxiety, tension, joy, etc.It is capable of sending the person's genetic transmissions to the doctor and provides health diagnostics in real time and helps him make the right choices.Detectors in WBANs are much less large, as duplicate networks are not necessary.The networks also show a relatively constant, more frequent and consistent throughput, and its duration can be exchanged off based on particular implementations for increased performance and reduced power use.Compared with the typically high staticity of Wireless Sensor networks, they can be found very versatile too[3].WBAN's apps range from medical care and telemedicine to exercise and athletics practice, immersive playing games, and exchanging and verification of personal data.WBANs can even be dispatched to better protect troops, first emergency workers and profound-sea or space adventurers in life-threatening situations.Wellness-checking is a primary utilization WBAN.Mobile detectors are placed on the human organism or implanted in the body to track basic indications such as circulatory pressure, temperature, blood pressure, insulin rate, etc.Using WBAN advancement to monitor wellbeing variables significantly reduces patient usage in the clinic.

Challenges:

The various challenges of WBAN are-

Efficiency-Reduced by their dimensions, clusters installed in WBAN are typically inadequate in power devices, processing capacity, storage capacity, and range from contact. It is not possible to conduct computational activities that are complicated and power-intensive.The security infrastructure should then be built as quickly and

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easily as practicable with a view to decreasing overhead connectivity and energy demand[4].

Scalability- It is plug-in and functions.Taking into consideration the functionality of systems, any growing computational content between various devices is challenging to share.At the other side, since the human species has always been in movement, nodes can at any point exit or enter the system; thus, tedious protection activity is unenforceable for WBAN.Scalability will not only imply that size; restructuring problems are sometimes overlooked. In when a node leaves the system, the report points out the security issues.

Usability-Patients are typically too unqualified to manage the procedure of the device, meaning that the safety structure must be easy enough and easy to conduct. Complex skilled activities can cause the systems to be configured incorrectly and poor customer knowledge.

Power conversation-Lithium-ion batteries can't squeeze a small quantity with just enough power.Another decision for energy storage is through hyper-capacitors and carbon-nanotube-based devices, which are still not readily available.Many evolving approaches for re-charging detector storage are provided by energy recovery instruments that capture energy from multiple sources, outside the node.

Antenna Design-The antenna structure is perhaps one of the most challenging tasks in WBAN architecture as it is very essential for interaction quality. It also impacts significantly on a few network's inherent criteria such as energy consumption, efficiency, distance, BER, and protection.The weight, stance skin type of the individual wearing the WBAN node influences the antenna. The size and shape rely on the position of the node and the radio equipment used for delivery; warming consequences and peak power are several significant concerns for this purpose.

ARCHITECTURE

A standard WBAN made up of multiple sensor/actuator modules and a “body control unit (BCU)” (i.e., a Touch screen or Smartphone).Sensor nodes obtain behavioral transmissions like pulse, skin temperature, heart rate, insulin degree, and “electrocardiogram (ECG)” from people. Actuators behave as per sensor texts or through “BCU” (i.e., a glucose tube) communication. BCU collects all the medical information from the networks and then communicates them over channels to the regional/distant health database along with the individual information[5].Medical staff will provide prompt healthcare services after receiving and reviewing the information relating to the person. In particular, a WBAN has a configuration of stars with the main node being the BCU. Detectors submit the information through Body Control Unit to a health server or staff. Hospital staff place orders through Body Control Unit for detectors. The Architecture of WBAN is shown below in Fig. 1 Architecture of WBAN.

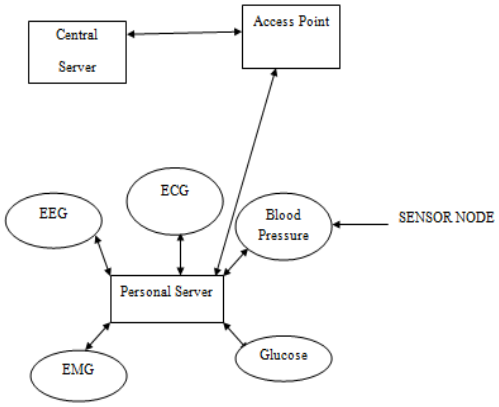

Fig.1: The Figure Portrays the Architecture of WBAN

A more complex WBAN might have broadcasts residing among detectors and BCU. If a detector cannot enter the BCU because of the nature of the human psyche (e.g., the detector is positioned at the rear while the BCU is mounted at the stomach).Some of the detectors just react and collect data on noxious stimuli, and then electronically store and submit such data to the mobile PD.A few others, called actuators, conduct medication management given the information obtained in same channel from many other detectors, via user intervention.The PD is that which collects all of the knowledge that detectors and actuators obtain. After this data is collected by the PD, it must be conveyed to other channels which are readily available via access points (AP).Interaction within body area network signifies secure communication between wireless body detectors and the WBAN main node[6].Sensor hubs in Wireless Body Area Network are equipped with a minimal source of vibrancy.Using the least power to carry data from sensor hubs to the sink is needed.One of the major obstacles in WBANis to energizing the capacitors.To overcome such a problem of energizing capacitors, a

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successful guiding convention is needed.The ECG and Glucose level detectors are mounted near to the sink.Each of these detectors has simple patient data and therefore needs minimum blockage, strong steadfast efficiency and lifetime; these detectors relay the specific information to sink reliably.

TECHNOLOGIES

The various technologies enabling WBAN are-

Bluetooth-Bluetooth technology is developed as a wireless transmission standard for short distance, designed to preserve higher levels of security.Due to this innovation, each computer can interact concurrently with up to 7 additional computers within a unified “piconet”, an ad hoc system with one computer operating as a master and up to 7 other computers serving the piconet's lifespan as “slaves”.Slaves need to coordinate with the master's machine clock, and obey the master's hopping sequence. In addition, each computer will belong to many piconets at the same time as they join other master devices ' radar vicinity[7].Bluetooth's primary important characteristic is to allow a broad range of Wireless-enabled devices to communicate and interact with each other, just about anywhere in the globe.Another major component is the computers ' ability to connect with no need to put "connected devices" in section-of-sight. The Bluetooth Technology is explained below in Fig. 2 Bluetooth Technology.

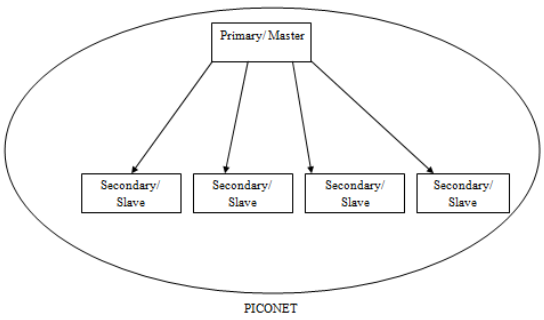

Fig.2: The Figure Demonstrates the Bluetooth Technology

Bluetooth Low Energy-a generated alternative of the Bluetooth specification is the “Bluetooth Low Energy (BLE)”, which is implemented as a more appropriate option for WBAN implementations where limited-duty cycle activity allows for less energy consumption.Bluetooth Low Energy is developed to link portable devices electronically to mobile devices.Much these devices are too low to accommodate the energy consumption and the costs related with a typical Bluetooth device, but they are perfect options for implementations like health monitoring[8].The Bluetooth Low Energy system is expected to offer up to 1 Mbps of information.Parallelization can be achieved in a few seconds, relative to Bluetooth seconds, utilizing fewer networks for linking units.This supports bandwidth-critical Body Area implementations, like alarm creation and crisis response, and increases power savings.Bluetooth Low Energy is ideal for interaction among “mobile sensor nodes and the access point (AP)” due to its marginal bit rate, scalability, and low power usage.Furthermore, the adjustable-rate hop distributed range enables Bluetooth Low Energy to live side by side with Wi-Fi.

Zigbee and 802.15.4- ZigBee described by the ZigBee standard is one of the most commonly used wireless internet innovations from the minimal-power environment.Owing to its 128-bit protection aid, ZigBee is aimed at radio spectrum web applications small data speed, good battery life and safe connectivity to conduct encryption and promise the confidentiality and security of the communications.The ZigBee platform divides into two sections. Next, the ZigBee partnership specifies the levels of the framework, identifying the levels of network, safety and software applications.Some of Zigbee's major disadvantages for Wireless Body Area Network applications are involvement with "wireless local area network (WLAN) transmission", particularly at "2.4 GHz" where various wireless systems function.Another drawback for Zigbee is its limited data speed which tends to make it unsuitable for WBAN implementations on a massive scale and in real-time[9].In reality, it is difficult to enforce in laboratories or hospitals (numerous sufferers) because of the small data pace; however, it is suitable for private usage (single patient).

IEEE 802.11- IEEE 802.118 is a compilation of “WLAN (Wireless Local Area Network)” specifications.Depending on the norms of IEEE 802.11, Wi-Fi enables customers to browse the web at connection speeds when linked to an entry point or in ad hoc mode.By offering high-speed internet capabilities and enabling teleconferencing, voice calls and music streaming, it is perfectly suited for large amounts of data transactions.

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IEEE 802.15.6- IEEE 802.15.69 is the first WBAN norm to meet a variety of health and non-medical purposes, enabling connectivity within and around the organ.Such specification represents a step forward towards mobile wireless detector systems as it is originally designed for use with a broad range of data levels, reduced energy usage, low latency, sufficient amount of routers per body area network and various network preferences as per network specifications.Connection to the network is done utilizing "CSMA / CA" or the slotted method for accessing Aloha.However, it can find other body movements (i.e., direct moving from one stage to the next), which are not appropriate for evolving WBAN technologies involving situations like resting, lying, standing up, going for a run, sailing and playing.

Ultra Wideband Technology- Ultra-Wideband technology provides "high bandwidth" and used for "short-range communications" networks.Since consumer position is especially relevant for interior location in long term care services and clinics, UWB offers only an effective optimization tool.It is nonetheless inappropriate for portable applications owing to its intricacy.

APPLICATIONS

For instance, WBAN implementations cover a wide area, including military, omnipresent social work, game, enthusiasm and various categories. WBAN uses both therapeutic and semi-medicinal procedures. The various WBAN Applications are-

Medical Applications- WBANs have enormous potential to change the ultimate fate of examining social services by identifying various life-saving diseases and providing continuing patient inspection.The company and adjustment of social services administrations will be altered and streamlined at a really fundamental level in the context of advancements in innovation ("smaller-scale electronic" balancing down and mixture, detectors, the Web and distant structure administration)[10].The use of WBANs as a component of medical methods takes into consideration continuous monitoring of one's physical characteristics, such as breathing, heartbeat, and skin temperature.Of instance, in cases where abnormal situations are known, data collected by the detectors could be sent to a gate, such as a PDA.

Distant Patient Monitoring-WBAN's core applications are electronic health records and distant patient supervising.Telemedicine involves the appropriate treatment utilizing information systems of people situated at a distant location.WBAN has made it easier to provide people at a remote location with such kind of medical services.It is possible to treat more and more people using telemedicine.Body detectors gather stimuli from the body and relay them for transmission to distant doctors and surgeons.Experts may use this data for clinical diagnosis and prescribing safety estimates.That will build a successful network of medical care.

Biofeedback-Auto-remote person's body tracking is now feasible, utilizing WBANs to control sensor-gathered data.Detectors are inserted or mounted in the human psyche to track certain activities or dysfunctions and help people preserve their safety through biofeedback processes like heat monitoring, measurement of heart rate, “electrocardiography (ECG), electromyography (EMG)”, among others.Biofeedback relates to physical behavior measurements and other possible beneficial parameters and feeds them back to the customer, enabling them to learn how to handle and adjust his physical behavior in order to enhance his fitness and strength.

Assisted Living-The growing population, the rising price of structured medical care and the value that people place on assisted living all drive the creation of inventive-assisted living solutions for healthy aging.Tools in this area improve the environment so that a relatively autonomous lifestyle can be achieved utilizing a smart home.In addition, as in care or old folks homes, assisted living services have arisen as an affordable living option for disabled people and older people who are not deemed stable but do not require medical treatment across the world.A system of ambient sensors will detect and monitor the operating atmosphere variables and then supply the body information to the main station.Such people's health status can be determined from the information on heart beat rate, cholesterol, and gyroscope.

Rehabilitation-Patients can regain the usual cognitive capacities via restorative treatment methods. Reasonable steps of recovery and rehabilitation will allow a person who has an injury to operate independently. To establish a correct movement pattern, these clinicians are monitored closely.Such people's health status can be determined from the information on heart beat rate, cholesterol, and gyroscope.

CONCLUSION

Wireless Body Area Network has arisen in the medical sector as leading software that can provide substantially better-time patient care surveillance approaches in clinics, mental hospitals even in their residences.Because of its critical role and a broad range of applications in medical disciplines, Wireless Body Area Network has recently achieved strong interest and demonstrated as one of the most examined systems by medical facilities.Wireless Body Area Network is a Radio Frequency dependent wireless networking software that links a variety of small devices with functionality for sensors or actuators.WBAN innovation is strongly regarded in the clinical research and human medical sector. In the field of Biomedical and other research fields, there is also an important contribution.In addition to protecting people from conventional clinics and hospitals, WBAN can also reduce the impact of disease prevention particularly to those with chronic conditions like diabetes and asthma. The paper gives a overview on emerging trends in WBAN, its architecture, its challenges, technologies enabling WBAN followed by the applications in various domains.

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