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A SURVEY OF VIABLE RESOURCES OF AUTONOMOUS WIRELESS MICRO SENSORS IN BIOMEDICAL APPLICATIONS

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ABSTRACT

In the fields of computer science and healthcare application sectors, wireless sensor network (WSN) technologies are regarded as one of the most important study areas for the purpose of bettering people's overall quality of life. Sensor networks make it possible for data collection and computing should be thoroughly included into the setting in which they being gathered. Machine intelligence (AI), fitness trackers, home automation, and research and development (IT) had come together to build a new interdisciplinary field of biomedicine. The goal of this branch is to develop solutions to the problems that are encountered in everyday life. Integration of sensing technologies and consumer electronics technologies is one potential use in this field. Such an application would make it possible to continuously monitor individuals. The primary purpose of this research is to carry out an investigation into the available resources of self-sufficient wireless micro sensors that can be used in medical applications. The methodology that was utilised in this research was a systematic literature review. The ability to track, monitor, research, comprehend, and respond to a specific occurrence or event is this wireless sensor technology's key advantage. It is possible to draw the conclusion from this research that the development of mobile iot devices still has a long way to go. The first-line anticipated development for use in coming Heterogeneous networks and the possibilities with their consumer product are currently centred on science is a discipline therapeutic diagnostics are quite encouraging.

Keywords: *Healthcare; Wireless Sensor Network; Wireless Biomedical Sensor Networks, Biosensors; Wearable, Implantable, Sensors.*

INTRODUCTION

Breakthroughs have enabled the fusion and simplification of sensors, incorporated embedded processors, and radio interfaces into a single microprocessor; wireless wireless sensor networks (WSN) but also microelectronics have enabled a new phase of Wireless sensor nodes that also is suited for a variety of applications for a wide variety of applications. The monitoring of patients' health is one of the most fascinating and significant areas where this technology can be applied. This same term "WBSN" refers to the wireless personal area system (WBAN), which utilises a cellular structure comprised of many bodies detector (BSUs) working in tandem with a solitary human mainframe computer (BCU). Such a channel is constructed out of many wearable computing devices that are currently in the process of being developed. The WBAN is a sensor worn on the body that uses very little power and can incorporate wireless devices for straightforward and simple operation (Fernandes & Taurino, 2022). In this kind of architecture, the conditions of multiple different patients are tracked and evaluated on a continuous basis in real time. That it may keep an eye on the

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many physiological markers. Nevertheless, the design process for this kind of application entailed overcoming a number of obstacles. For instance, the communications between the sensors need to be dependable, free of interference, and flexible for the users. In addition, the sensors themselves need to be adaptable. According to Lopez (2011), the expansion of WBAN has to include the development of diagnostic tools that can be used by the medical monitoring system (Lopez, 2011).

A WWBAN might contain a position sensor, weather sensors that actually measure, damp, and light, as well as physiology sensors that track health status. Location sensors may also be included. The WWBAN is made up of sensors that are inexpensive, lightweight, and miniature in size (Ghafari, 2021). It has the potential to allow enabling long-term, distinct, and mobility monitoring, as well as providing the users with formative assessment on their health status in real-time and access to existing medical data. Computing can handle the course of therapy in a diverse range of situations with a method just like, and it might even spot health needs in the preliminary stages. According to Dimitriou and Ioannis (2008), the enormous amount of physiological data that was obtained will make it possible to conduct quantitative analysis of a variety of situations and patterns. Recent developments in the downsizing of intelligent biosensors opened up new doors for the possibility of continuously monitoring patients (Dimitriou and Ioannis, 2008). According to (Dinis, Colmiais and Memdes, 2022), unobtrusive little wearable sensors would collect huge volumes of data automatically, hence decreasing the cost of and the discomfort associated with regular visits to the physician (Dinis, Colmiais and Memdes, 2022). This study's primary purpose is to examine the sources of wireless micro sensors that are self-sufficient and can be employed in medical applications.

TECHNOLOGIES USED IN WSN IN MEDICAL APPLICATIONS

The WSN is widely applicable in this area and may be used in almost all settings. However, all WSN-related products, notably monitors and GPS-based gps, may be utilised in the health-care industry. For addition, ad hoc transportation is used in the wireless transmission, which is a reversible electromagnetic link. A hospital's terminal may transfer signals to a core network via this kind of contact, regardless if they aren't within your base channel's direct wireless environment. The following figure, taken from (Ghafari, 2018) study, demonstrates:

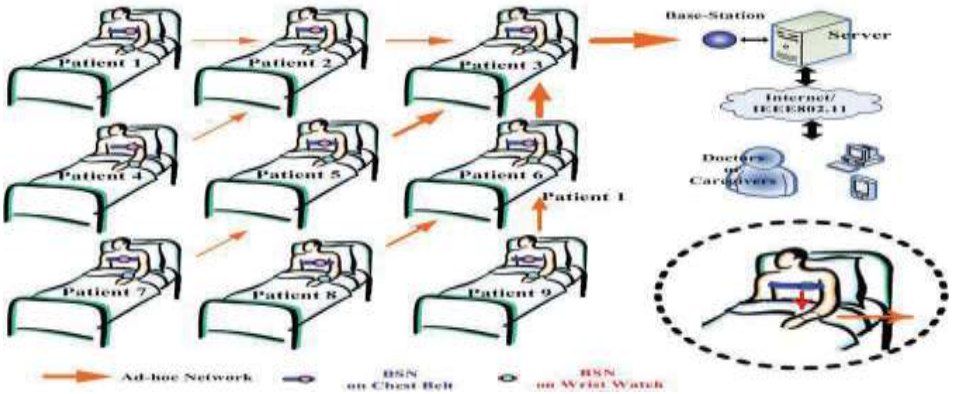

Figure 1.4: An illustration of the framework of a WSN-based health sector (Ghafari, 2018)

A pilot of a hospital-specific global medical system was created by Aminian and his colleagues. The term "widespread" refers to the discreet implantation of sensing devices in a human's body to create a cellular connection that can convey the patient's current state of well-being to the bs attached to the

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computer display. Aminian and his group created the idea for the universal healthcare systems (Aminian et al., 2013). The network nodes in the beginning of the chain, however, enable able to communicate the content but use a summary products and services that make and do not necessitate utilisation of a high - frequency range (RFM). Furthermore, it is crucial to think about that certain therapeutic bands, such as MICS (Clinical Insert Telecommunication Service), are acceptable for use in chest lan technologies since they use low voltage transmits and have 15 feet of 402-405 2.4 ghz region range. (Ghafari, 2018).

REQUIREMENTS FOR WIRELESS MEDICAL SENSORS

Wearable and implanted sensors are deployed in way to instantly transmit genomic data out from patient's psyche across a close walk after sensing it there. These sensors transmit the data they have collected to a microcontroller that has been either put mostly on face or put in a convenient position. The information gathered as from switches is subsequently sent to distant places over a wearable sensors network either therapy and diagnostic purposes. This is accomplished by including additional wireless networks for long-distance transmissions (Ghafari, 2021)). In particular, the following criteria need to be met by sensors before they may be integrated into wireless networks for use in medical applications:

UNOBTRUSIVENESS: The light weight and microscopic size of wireless medical sensors is the most crucial criterion in their design, since these features allow for continuous monitoring of health that is gentle and non-intrusive. This requirement must be followed in the manufacturing of wireless physical devices. A sensor's dimension and weight depend on the size and load among its fuel. A current battery size has a direct bearing on its discharge, therefore the larger the battery, the more power it can store. (Patron et al., 2014). Wearable technology could benefit greatly from both flexible and printable battery technologies. There are many different wearable applications, such as skin patches for transdermal drug delivery, patient temperature sensors, or RFID monitoring (Nia et al., 2015). Flexible batteries offer a particular benefit in each of these wearable applications.

SECURITY: The safety of the entire network is an important aspect that must be taken into consideration during the design phase of a wireless body area network. In order to maintain data integrity, the sensors themselves need to be able to satisfy the privacy criteria stipulated by the legislation. In point of fact, fundamental software components need to be discovered and built in order to accommodate safe and effective wireless networks. (Mukherjee & Mukherjee, 2019)

INTEROPERABILITY: The safety of the entire network is an important aspect that must be taken into consideration during the design phase of a wireless body area network. In order to maintain data integrity, the sensors themselves need to be able to satisfy the privacy criteria stipulated by the legislation. (Mukherjee & Mukherjee, 2019)

RELIABLE COMMUNICATION: The dependability of the communication link is of the utmost significance for medical applications that rely on WBANs. Because different sensors have varying sample rate requirements, the communication limitation must adapt to the needs of each individual node. (Abib & Anacleto, 2014).

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CHALLENGES OF WIRELESS MICRO SENSORS IN BIOMEDICAL APPLICATIONS

When it comes to the implementation of wireless body area networks, the physical layer has a variety of problems that must be overcome. Table 2 lays out these problems and offers some potential solutions to them.

Challenges	Improvement Techniques	Outcome
Bandwidth Limitations	The authors (Fernandes & Taurino, 2022) recommended using low data throughput and sending many bursts each bit.	By implementing the configuration available in (Fernandes & Taurino, 2022), Overcoming the spectral restriction of conventional followed shortly.
Receiver Complexity	The authors in (Thotahewa, Khan & Yuce, 2013) recommended adopting a dual pop group arrangement, which would employ a downlink transmission for output now at transceiver and now an IR-UWB radio for the device.	Receiver complexity and Routing protocol focus is to reduce power utilization. But, in the event of short wait time, software defined arrangement is not appropriate.
Power consumption is higher in dynamic conditions.	The authors in (Ho, See and Yuce, 2012) suggested different optimum receiver positions for different s	By choosing the best receiver location for certain instruments, average throughput may be lowered by 26 dB.
Small distance between the transmitter and receiver antennas	The authors in (See et al., 2012) recommended the use of alternative radar systems configurations for different parts of the body	If the right kind and polarisation of dish are used, transmission distance may be decreased by 20 dB and more selected for the different body locations

Table 1: Challenges of Wireless Micro Sensors

FUTURE OF WIRELESS MICRO SENSORS IN BIOMEDICAL APPLICATIONS:

Future sensor nodes must be powerful and affordable. In this portion of the research, prospective wireless network expansion options in healthcare will be examined. The problems outlined By lowering the power used by global medicine different sensors, the issues discussed in the preceding section may be resolved. This is done via optimising code, memory, and data processing methods. When inactive for a long time, the sensor's sleep mode should be activated. This increases data throughput and improves slot time synchronisation. Reducing wireless data transmission reduces protocol overhead. Compressing and transmitting non-raw data are two ways to do this.

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Developing energy-saving solutions by integrating wireless devices' connection and physical layers. This extends the battery's and sensor's life. Developing small antennas for sensor nodes to improve transmission consistency and reduce interference. Variable sample rate to optimise each wireless sensor based on its features. Planning and developing gateway devices that can communicate with the current wireless network in healthcare to maintain continuous remote monitoring in a wireless body area network. Sensors in a wireless healthcare network should be flexible and able to integrate with third-party devices. Wireless body area networks need their own protocols to collect and store data and avoid coexistence issues. Wireless sensor networks in healthcare have temporal limits in dynamic contexts due to resource constraints. Wireless sensor networks challenge real-time computer central data, tailored content, system software, communications, and theoretical foundations. Time-sensitive systems are commanded in real time via bluetooth (mesh) iot systems.
Using a cognitive sensor network to acquire localised and positioned information of the sensing environment through intelligent and autonomously deployed sensors. Swarm intelligence and quorum sensing are two examples of cognitive sensing. First, decentralised, self-organized systems' collective behaviour is studied. Because it's an example of bioinspired networking, it's gained popularity in recent years. Quorum sensing is bacteria's ability to interact and coordinate behaviour using signalling molecules. Scalability, individualised service supply, and energy efficiency should be goals of wireless network organisation. Due of unpredictability, the wireless network as a whole should be programmed, not the individual nodes. In this context, precise and effective topology control algorithms are needed to monitor network performance and suggest mathematical models.

CONCLUSION

After reading through a number of articles and studies, this research may draw the conclusion that there is still more work to be done in the field of wireless sensor networks. The first-line possible study for usage of WSNs in the future is on existing medical applications based on sensor networks, and their medical device appears very promising. There are still several big obstacles to be solved in the field of security, which is a significant one. Specialized medical technology with WSN should be part of the future; this technology will increase real-time data collecting and enable better medical treatment in homes and smart homes. Additionally, the costs of testing and frequent trips to the doctor will be reduced by the ongoing collecting of medical information from customers. Continued development of sensors will also depend critically on the intersection of biologic, biotechnological, and nanotechnologies (nanotubes).

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