

3.3 Challenge and issues of WBANs.

The WBANs face too many challenges and issues which still needs some proper solutions. The confidentiality of patient's data in the WBAN is the most critical ethical issue of WBANs which is still not correctly addressed yet [9]. Some of the major challenges of WBANs are as follows:

- **Scalability:** It deals with the human body [10].
- **Node size:** It deals with invasive monitoring and they are mostly required for minimization [10].

Table a: Summary of methodologies along with their advantages and limitations.

Paper Title	Methodology	Advantages	Limitations
A Web-based system for home monitoring of patients with Parkinson's Disease using wearable sensors	A platform named MercuryLIVE holding the capability to have video interaction with the clinicians.	Analyses the sensor data and estimates the clinical scores as per the severity. Allows the clinicians to access the sensor data, upload it and estimate UPDRS scores. Latency for data upload and video upload is reduced.	Heavily dependent on fast internet connection. Reliable transmission is overlooked. Applicability area is restricted.
Improving the reliability of WBANs	Cooperative Network Coding with MIMO systems	Fights packet loss. Reduces latency due to re-transmissions. Avoids single points of failure. Increases probability of successful data recovery.	Complexity increases due to computation at each node. Requires large number of wireless tools, so not that much economic.

- **Number of Nodes:** Only required number of nodes is meant to use. No need of using extra unwanted nodes [10].
- **Data Security:** The patient's must be secured. It must not be prone to any attacks [10].
- **Contact:** Implantable sensor substitutes are difficult and they need biodegradability [10].
- **Event Recognition:** The early adverse effects must be recognized as the human tissue failure is irrevocable [10].
- **Wireless infrastructure:** The infrastructure used must be small enough and must have low power along with the capability of signal detection [10].
- **Bio Compatibility:** The implantable sensors must be human body friendly and they are likely to have huge market price [10].
- **Context Consciousness:** The WBAN set up on the body must be conscious to the changes in the context as the human is very sensitive to the context change [10].

Table b: Summary of methodologies along with their advantages and limitations.

Paper Title	Methodology	Advantages	Limitations
A Reliable Transmission Protocol for ZigBee-Based Wireless patient Monitoring	A hybrid approach of a reliable transmission protocol AODV and anycast message forwarding technique.	Reliably transfers data. Fast re-routing. Reduces network congestion. Reduces end-to-end transmission delay or latency.	It does not take into consideration the problem of packet loss and its recovery.
Interference Mitigation for Cyber-Physical Wireless Body Area Systems using Social Networks		Minimizes interference. Improve the system's utility. Reduce the total power consumption.	Focuses only on interference mitigation. Does not bother about QoS.

4. Protocols in WSNS for Improving

4.1 Reliability

WBAN is one of the application areas emerged from the

WSN's family, so some of the approaches, schemes and protocols of WSNs can also be utilized and implemented with WBANs and eventually in wireless patient monitoring systems. As mentioned earlier WBANs differ in the network setup and topology from WSNs while the working and inter-network communication and QoS are similar things to achieve in both. The following table enlists and summarizes some reliable transport layer protocols that can be used in WBANs for monitoring patients.

Table c: Enlisting some of the protocols for improving reliability in WSNs as well as WBANs.

Paper Title	Protocol	Advantages and feasibility in WBANs
SPEED: A stateless protocol for real-time Communication on in sensor networks.	SPEED.	It ensured desired delivery speed and real-time communication [11] [12]. This can help in WBANs for real-time patient monitoring with certain advancements
MMSPEED: Multipath Multi-SPEED Protocol for QoS Guarantee of Reliability and Timeliness in Wireless Sensor Networks.	MMSPEED	Provides packet routing decisions without a priori path setup and differentiated QoS options in timeliness and reliability domains [11][13]
ESRT: event-to-sink Reliable transport in wireless Sensor networks.	ESRT (end-to end)	Provides reliability and Minimizes energy consumption. It also provides event and packet reliability [11] [14]
STCP: a generic transport layer protocol for wireless sensor networks.	Sensor Control Protocol (end-to end)	Provides controlled variable reliability, congestion detection, its avoidance and multiple applications in the same network. It also provides event and packet reliability [11] [15].
RMST: Reliable Data Transfer in Sensor Networks.	RMST	Provides guaranteed delivery and fragmentation or reassembly to the needed applications [11] [16].

Table b: Enlisting some of the protocols for improving reliability in WSNs as well as WBANs.

Paper Title	Protocol	Advantages and feasibility in WBANs
Reliable Bursty Converge cast in Wireless Sensor Networks	Reliable Bursty Converge cast (RBC).	It addresses the issue of bursty converge cast .It improves channel utilization and reduce ack-loss. It also improves the packet delivery ratio and reduce end-toend delay [11] [17].

There other protocols also like GARUDA [18], PSFQ [19], etc. which also provides the mechanisms to improve the reliability of WSNs and can also do the same in WBANs. These protocols can be modified and used in WBANs for healthcare as well as other applications.

5. Conclusions

So from the above study we can conclude that there still exist a number of limitations in the WBANs for patient monitoring systems. Of all, reliable transmission and other factors like minimum energy consumption of sensors, reduced latency etc. are the most important factors are major needs in WBANs. The study also reveals that there are different approaches through which the better patient monitoring systems can be developed. This survey also clears that there are ideas coming in from every possible direction to enhance the functioning of wireless patient monitoring.

6. Future Scope

The WBANs for patient monitoring systems is a new popular research area which holds a big scope for improvement for different fields like computer engineering, biomedical engineering and others as well. The reliability of transmission is a major issue to focus on for the research people from computer. The development of low power yet highly reliable sensors can be a big part of the work to be done by people from electronics and communication stream. The Biomedical and telemedicine field has the ability to come up with new ideas to build wireless patient monitoring systems.

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