The ‘Internet of Things’ (IoT) envisions the combination of connectivity and machine learning in devices participating in personal area networks for smart monitoring. The IPv6 addressing allows for billions of such devices to communicate over the Internet. In recent years, wireless sensor networks (WSNs) have earned a growing deliberation in the world of engineering applications, as important segments that constitute the IoT. WSNs that monitor complex environments and systems across a range of applications are helped by advances in coordinated, intelligent computing. Wireless body area sensor networks (WBASNs) are special utilizations of WSNs that promise neoteric uses in healthcare, fitness, and entertainment. Each WBASN consists of a network of low-powered nodes on, in reach, or inside a human body. Using these nodes, the WBASN facilitates real-time sensing, processing, and communication of physiological and biokinetic parameters that require continuous monitoring for proper diagnosis and rehabilitation. If the technical and social challenges are met, WBASNs have immense potential to remodel how people relate with and profit from the developments in this area. Although WBASNs share some of their problems with conventional WSNs, many issues specific to WBASN research and design that have emerged warrant new lines of research.

My work

While Gordon Moore’s prophecy has been true about the development in the microelectronics devices, the power-packs of circuits involving such devices could not catch up, and pose a major bottleneck in their design. The sensors employed in WBASNs are limited in resources, with battery power being at a premium. I have looked into the various ways of conservation of network energy and evaluated the bearings of my proposed solutions on the longevity of the network. I have proposed a dual framework for using modern machine learning techniques in WBASNs. The framework helps with decisions pertaining to body data transmission and is aimed at saving energy consumption while trying to limit errors to an acceptable minimum level. I have also studied the amount of network energy saved as a result of my efforts and tried to compare it with other contemporary techniques. I have also tried to evaluate the performance of such networks with respect to mobility.
In my second work, I have tried to look at issues related electromagnetic interference within a WBASN and the interference across multiple co-existing WBASNs in the same area. Within a WBASN, receiving accurate real-time data from each sensor is critical in order to ensure the quality of service (QoS) promised by the monitoring application. If several WBSNs exist in a restricted space, there could be severe degradation of network performance due to loss of data resulting from interference among multiple WBANs and an appreciable waste of energy. I have worked on priority based scheduling schemes involving fuzzy reasoning and decision making for fair bandwidth sharing, so that multiple WBASNs can co-exist gracefully, with minimal energy wastage.

In my third work, I have developed interfaces for externally available transducers to be attached to the sensor nodes, thus enhancing their capability. We have used such nodes successfully in simple control applications for entertainment and home automation, with promising results. Extending the applications for more involving control applications, I am trying to study if BASNs can address the needs of complex control in order to augment and uphold body functions and human life.

**Future Plans**

As important constituents of the IoT, BASNs offer impressive opportunities for assisting and enhancing the functions of a human body. I aspire to explore control applications that could involve prosthetics or robotic assistive devices. I am also inclined to check on the possibility and efficacy of applications like control of household appliances, door movement or that of prosthetic limbs can be actuated by EMG signals. I would also like to experiment with the use of implantable biochemical sensors used for feedback control to make drug delivery and other release and regulation mechanisms inside human body possible.

BASNs must be reliable in order to control or help assess life-critical physiological events. While the failure of a sensor in a WSN would not be so critical, it could be life-threatening in case of WBASN sensors. I plan to look into what would go into the design of fail-safe, fault-tolerant WBASNs.

I also plan to look into energy harvesting as a viable solution to energy woes in WBASNs. Recharging batteries with harvested energy could serve to extend battery life, while simplifying the use of WBASNs. Given the uncertainty and constraints with respect to the user’s exposure to ambient energy and the variability in node placement, this could be an imposing challenge.