ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS INSTITUTION
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Department of Biomedical Engineering

VI Semester

CBM 370 - Wearable Devices

Unit- 5 APPLICATIONS OF WEARABLE SYSTEMS

5.2 Medical Monitoring-Patients with chronic disease

Remote patient monitoring for chronic disease management is an effective solution for patients with chronic disease. According to the Journal of Medical Internet Research, telemonitoring is a valid alternative to usual care, reducing mortality and improving disease self-management in patients who report satisfaction and adherence. Because chronic diseases are the leading cause of death and disability nationwide.

Remote patient monitoring improves the management of various chronic diseases, including:

- ✓ Cardiovascular Health monitoring
- ✓ Diabetes Management
- ✓ Respiratory Health
- ✓ Neurological Applications
- ✓ Oncology – Post Surgical Recovery
- ✓ Mental Health Management
- ✓ Personalized Medicine
- ✓ Remote Patient Monitoring

1. **Cardiovascular Health monitoring:**
   - ❖ ***Heart Rate and ECG Tracking***: Devices like smartwatches and wearable ECG monitors detect arrhythmias, monitor blood pressure, and aid in cardiac rehabilitation.

- ***Blood Pressure Monitoring***: Continuous blood pressure (BP) monitoring is of great significance for the real-time monitoring and early prevention of cardiovascular diseases. Recently, wearable BP monitoring devices have made .great progress in the development of daily BP monitoring because they adapt to long-term and high-comfort wear requirements. Continuous blood pressure monitors help manage hypertension by providing real-time data.

2. Diabetes Management:

- ***Continuous Glucose Monitors (CGMs):*** Wearables like CGMs provide real-time glucose readings, enabling better glycemic control and reducing the risk of complications. Studies have shown that CGMs can substantially reduce hemoglobin A1c levels in type 1 diabetes, enhancing overall diabetes management.

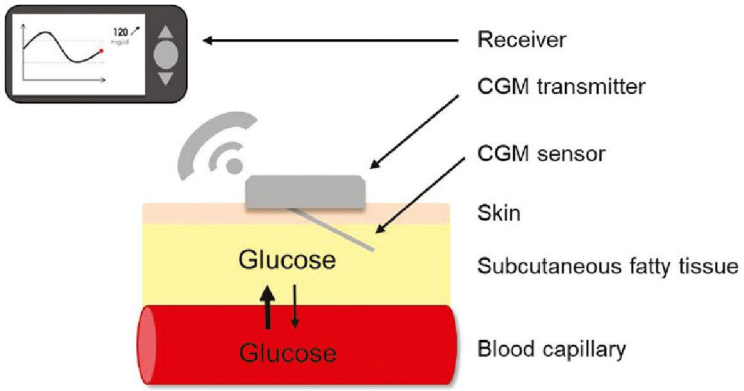


Figure 5.2.2 Continuous glucose monitors

[Figure: https://mydiagnostics.in/products/abbott-libre-diabetes-sensor]

- ***Lifestyle Feedback***: Integration with apps helps patients track diet, exercise, and medication adherence

3. **Respiratory Health**:
   - ***Asthma and COPD Management***: Devices monitor respiratory rate, oxygen saturation, and other vital parameters to detect exacerbations early. For individuals at high risk (e.g., those with asthma or COPD), wearables can help identify triggers and patterns that lead to respiratory problems, enabling proactive management and preventative measures.

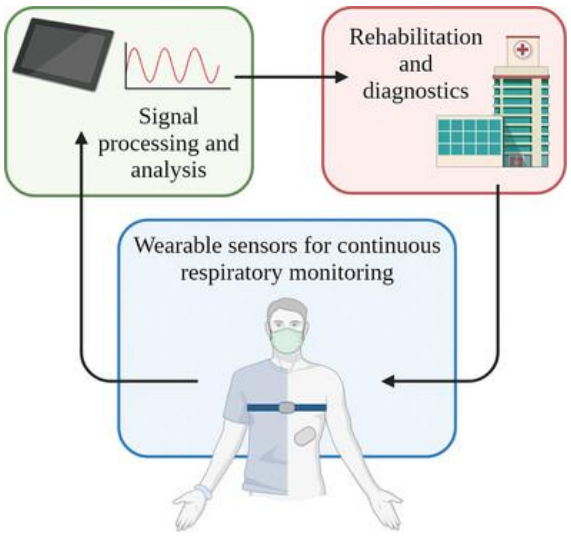
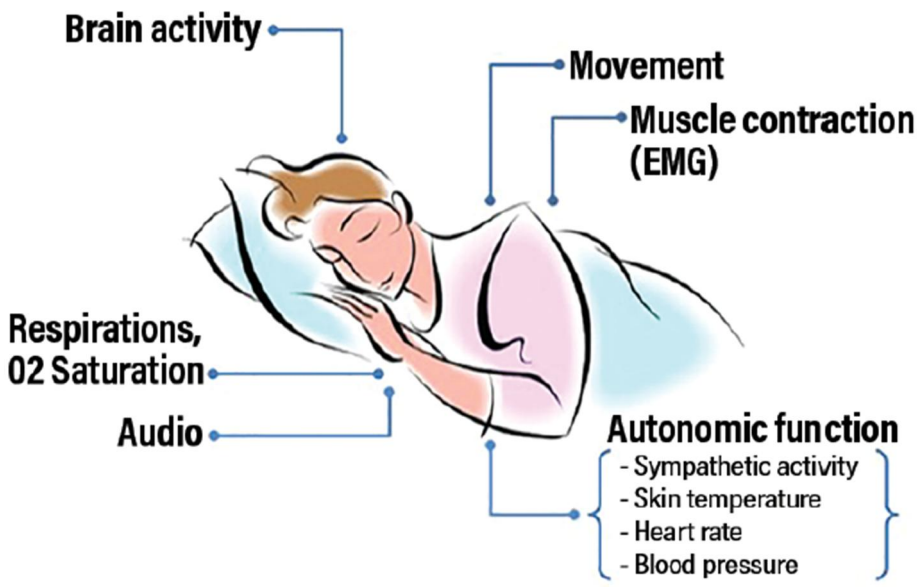


Figure 5.2.3 Wearable Sensor for Respiratory Rehabilitation

[Figure: https://advanced.onlinelibrary.wiley.com/doi/abs/10.1002/adfm.202404348]

- ***Activity Monitoring***: Wearables like Fitbit trackers improve physical activity and self-management in patients undergoing pulmonary rehabilitation

4. **Neurological Applications:**
   - **Seizure Detection**: Wearable EEG devices help monitor brain activity for epilepsy management. Wearable devices for epilepsy use sensors to track various physiological signals, such as body temperature, electrodermal activity, accelerometry, and photoplethysmography. By combining these data streams with machine learning algorithms, wearable epilepsy devices can accurately identify different types of seizures.



*[**Figure**: https://practicalneurology.com/diseases-diagnoses/child-neurology/seizure-detection-and-sudep-prevention/30160/]*

- **Parkinson's Disease**: Smart systems track tremors and gait abnormalities to optimize treatment plans.

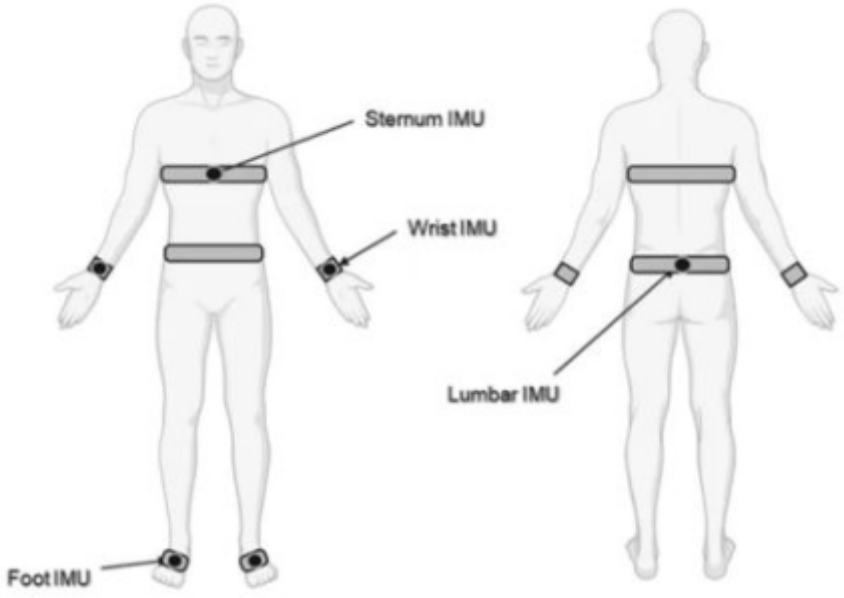


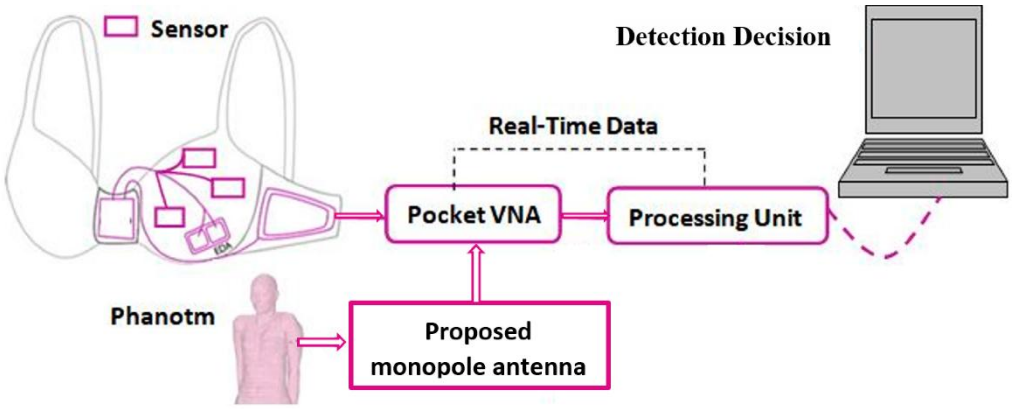
Figure. 5.2.4 sensors provide early detection of progression in Parkinson's Disease

[Courtesy: Professor Chrystalina Antoniades in Oxford's Nuffield Department of Clinical Neurosciences]

The image illustrates a typical setup for motion capture or biomechanical analysis using IMU sensors placed on the sternum, wrists, lumbar region, and feet. This configuration allows for the tracking of the movement and orientation of the torso, arms, and legs. The analysis of data from wearable devices using machine learning algorithms can help with accurate diagnosis.

5. Oncology – Post Surgical Recovery:

- **Cancer Monitoring**: Wearables track vitals during chemotherapy or radiation therapy to detect complications early.
- **Rehabilitation**: Devices monitor mobility and recovery progress after surgeries or injuries



The system appears to use wearable sensors to collect physiological data. A proposed monopole antenna and a Pocket VNA (Vector Network Analyzer) are used to interact with or interrogate the sensors (possibly wirelessly). The data is then processed to make a detection decision, which is presented to the user. The phantom likely serves as a test subject for evaluating the performance and safety of the radio frequency components of the system.

6. Mental Health Management:

Biofeedback wearables help manage stress, anxiety, and PTSD by tracking physiological responses like heart rate variability. Heart rate (HR), Heart Rate Variability (HRV), skin temperature, SpO2, electrodermal activity (EDA) are sensed

by the sensors. These gadgets, which range from sophisticated biosensors to smartwatches, offer real-time data on vital signs related to mental health, such as stress levels, physical activity, and sleep patterns. They contribute to improved diagnosis, management, and patient outcomes.

7. Personalized Medicine:

By continuously collecting data such as heart rate, blood glucose levels, respiratory rate, and activity patterns, wearable devices enable tailored treatment plans that adapt to individual patient needs. By analyzing this data alongside genetic information and medical history, doctors can gain deeper insights into a patient's specific needs.

8. Remote Patient Monitoring:

- Wearables transmit health data to healthcare providers via telehealth platforms, allowing for timely interventions without frequent hospital visits.
- Examples include monitoring medication adherence or detecting signs of disease progression in real-time.

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