

# Research Proposal

## Title: AI-Enabled Human Activity Recognition and Wearable Systems for Cancer Care and Early Detection

### 1. Introduction

Wearable computing is increasingly becoming an integral part of modern life due to its compact size, affordability, and powerful computational capabilities. Equipped with a variety of sensors, wearable devices can continuously monitor a user's physiological and behavioral parameters such as walking, sleeping, or heart rate. This has enabled significant progress in Human Activity Recognition (HAR), a key area in artificial intelligence (AI) and healthcare technology.

HAR systems have immense potential in developing assistive and preventive healthcare technologies, particularly for chronic disease management and patients with special needs. Extending this technology to cancer care and detection represents a promising direction for personalized medicine and remote health monitoring.

### 2. Background and Motivation

Cancer remains one of the leading causes of death globally. Early detection and continuous patient monitoring can greatly improve treatment outcomes. However, traditional diagnostic and monitoring methods often require clinical visits and specialized equipment.

Recent advances in AI, deep learning, and wearable sensors enable real-time collection and analysis of physiological and behavioral data. Integrating HAR with AI-based biomedical data analysis can help:

Detect subtle changes in daily activity patterns that may indicate fatigue or disease progression.

Support remote monitoring of cancer patients undergoing therapy.

Assist in early detection of abnormal physiological signals associated with cancer-related conditions.

This study aims to combine HAR and AI-driven biomedical analytics to build an intelligent wearable system for cancer care and early detection.

### 3. Objectives

1. To design and develop a deep learning-based HAR model capable of recognizing human activities with high accuracy.
2. To integrate biomedical signal analysis (e.g., heart rate, temperature, oxygen level) into HAR frameworks for comprehensive patient monitoring.
3. To explore AI models for detecting anomalies in sensor data that may indicate cancer-related physiological changes.

4. To create a prototype wearable system that supports continuous monitoring and early alerting for patients under cancer care.

#### **4. Methodology**

##### **1. Data Acquisition:**

Use publicly available HAR datasets and biomedical signal datasets (e.g., UCI HAR, PhysioNet).

Collect real-time sensor data through wearable devices (accelerometer, gyroscope, temperature, ECG, SpO<sub>2</sub>).

##### **2. Preprocessing:**

Clean and normalize sensor data.

Perform segmentation and feature extraction (time, frequency, and spatial domains).

##### **3. Model Development:**

Implement deep learning architectures such as CNN, LSTM, and hybrid CNN-LSTM networks for activity recognition.

Train AI models for detecting deviations or patterns associated with cancer symptoms (fatigue, motion abnormalities, irregular vitals).

##### **4. Integration and Evaluation:**

Develop a unified framework integrating HAR and cancer care analytics.

Evaluate model performance using metrics such as accuracy, sensitivity, specificity, and F1-score.

#### **5. Expected Outcomes**

A robust AI-based HAR model for real-time human activity recognition.

A wearable prototype system capable of continuous monitoring of cancer patients.

A decision-support framework for healthcare professionals to assess patient well-being remotely.

Contribution to the development of AI-assisted cancer care technologies and e-health systems like Ambient Assisted Living (AAL).

#### **6. Significance**

This research bridges wearable technology, HAR, and AI-based healthcare analytics, enabling a new dimension of personalized, preventive cancer care. The integration of deep learning with wearable sensing can revolutionize how early detection and patient monitoring are conducted, reducing healthcare costs and improving quality of life.