EXPLORING THE POTENTIAL OF IR-UWB RADAR IN HUMAN ACTIVITY RECOGNITION: A BRIEF SURVEY

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OUTLINE

Introduction

❖ Human Activity Recognition (HAR) is a cutting-edge field of study that involves using technology to automatically identify and classify human actions and behaviors.

❖ HAR enables computers and systems to understand and respond to human behavior, making it a key component in the development of smarter and more interactive technology.

❖ HAR typically relies on data collected from various sensors, such as accelerometers, gyroscopes, radars, or cameras, to detect and interpret activities..

Types of human activity

❖ Gesture: defined as the elementary movement of only one human's body limbs.

❖ Action: defined as a simple activity, which combines a series of gestures.

❖ Interaction: involves the presence of two subject; one must be a human, while the other can be a human or an object.

❖ Activity: often called an event, is a more complex bodily movement, which describes the gestures or actions of one or multiple persons.

❖ Group activity: known as the most complex type of activity. It can be seen as a set of activities performed by groups of several people and/or objects.
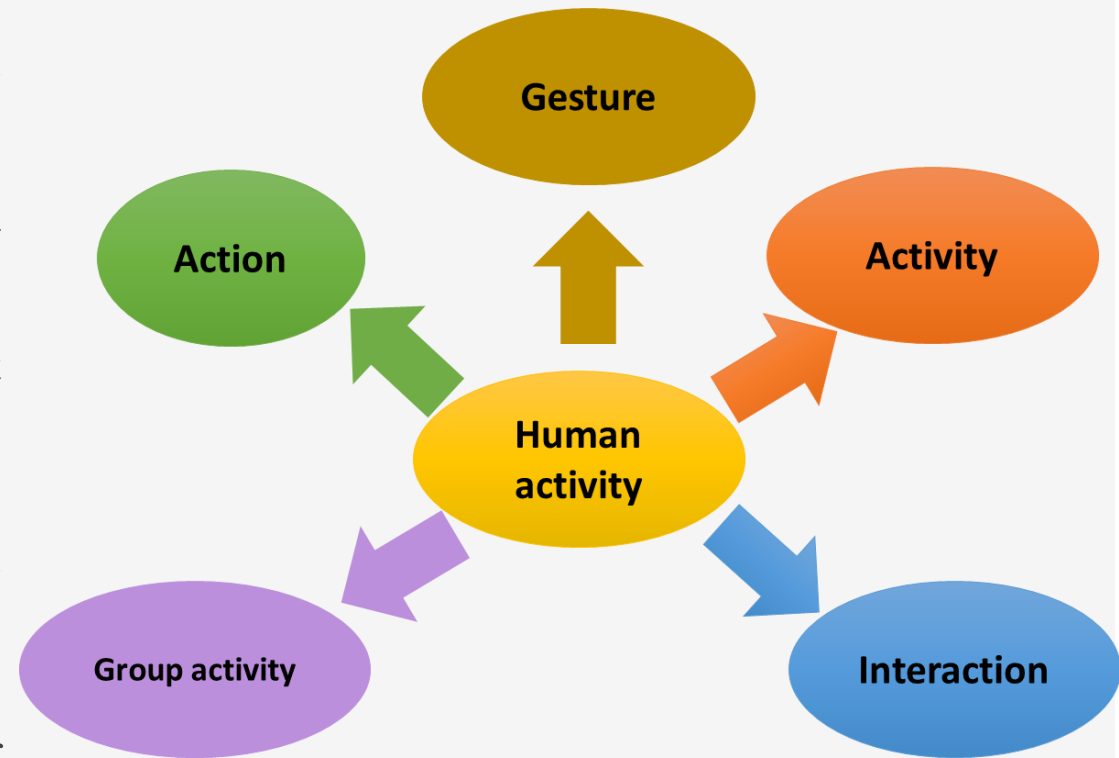
HAR applications

❖ Applications of HAR are incredibly diverse, spanning healthcare, fitness tracking, and elderly care. HAR can monitor an individual's physical activities, helping doctors and caregivers provide better healthcare.

❖ In security and surveillance, HAR is instrumental in identifying unusual behavior, enabling early threat detection and improving public safety.

❖ HAR also finds use in sports and fitness, tracking athletic performance and providing insights for coaching and training.

❖ From smart homes that adapt to occupants' needs to gesture-based interfaces for controlling devices, HAR is transforming the way we interact with technology, making our lives more convenient and efficient.
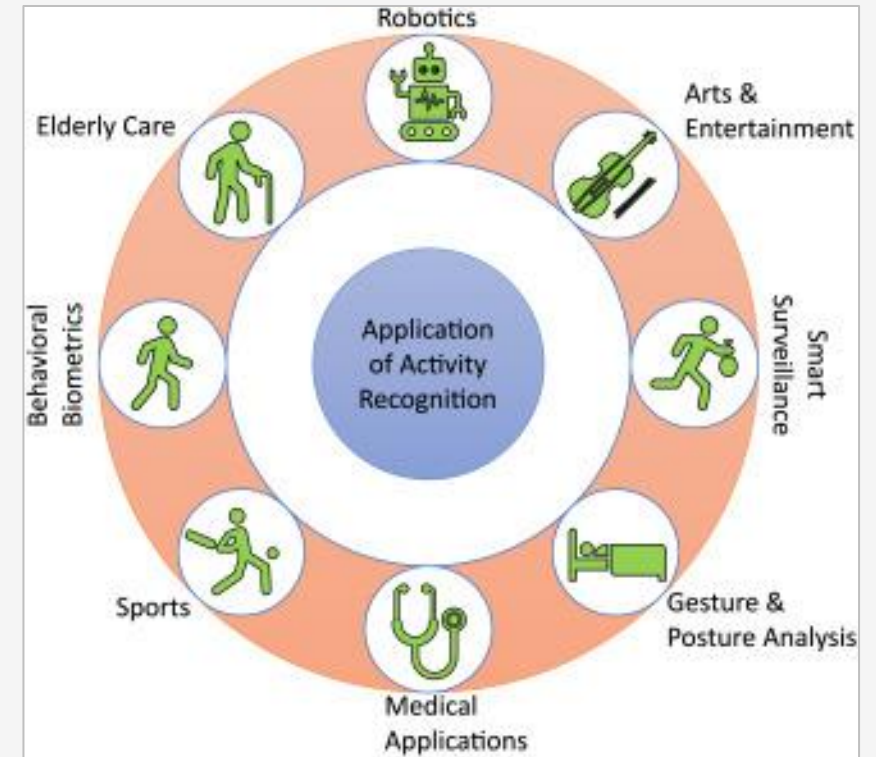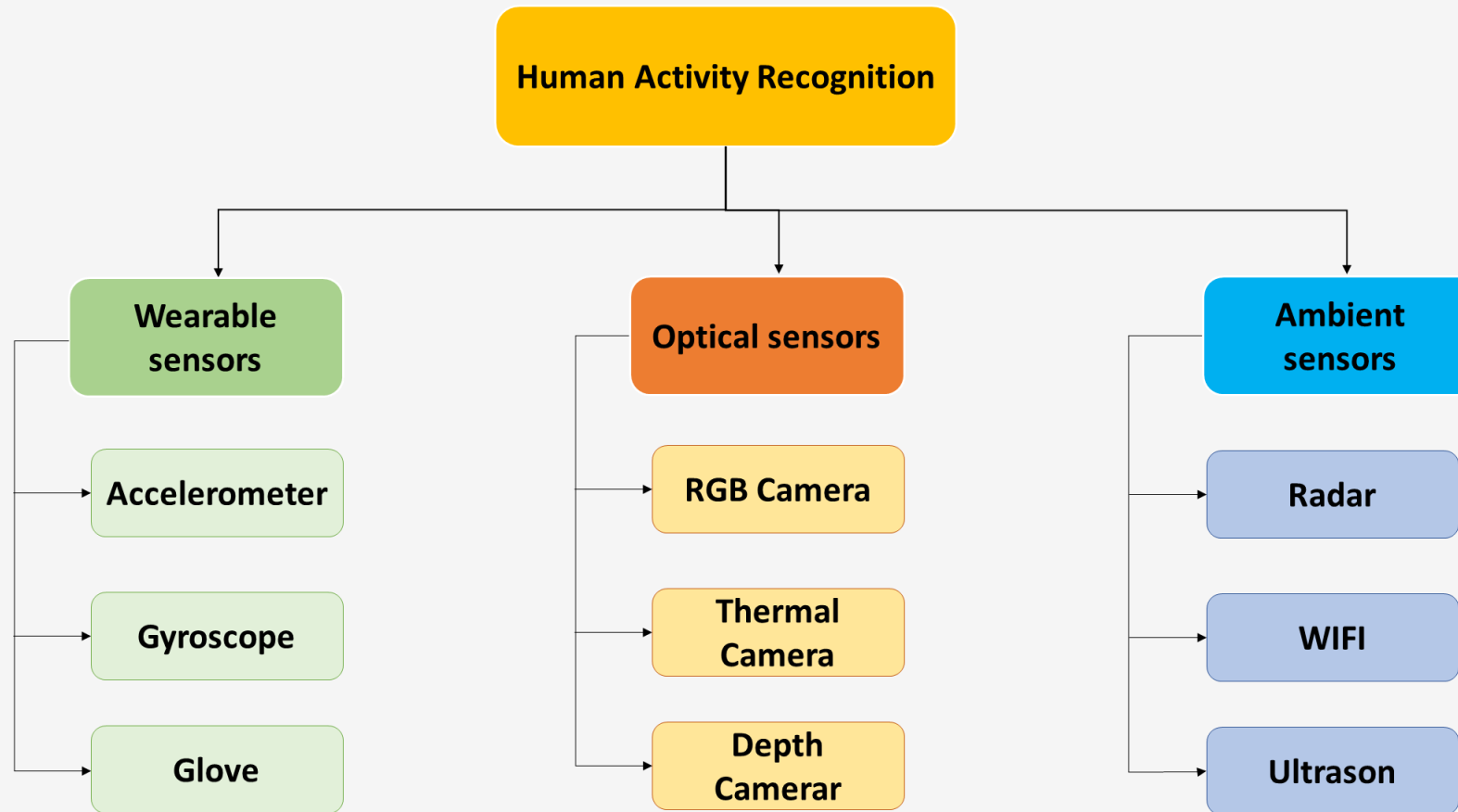
HAR system

❖ A typical HAR system works in three basic steps, which involves :

1. Data collection

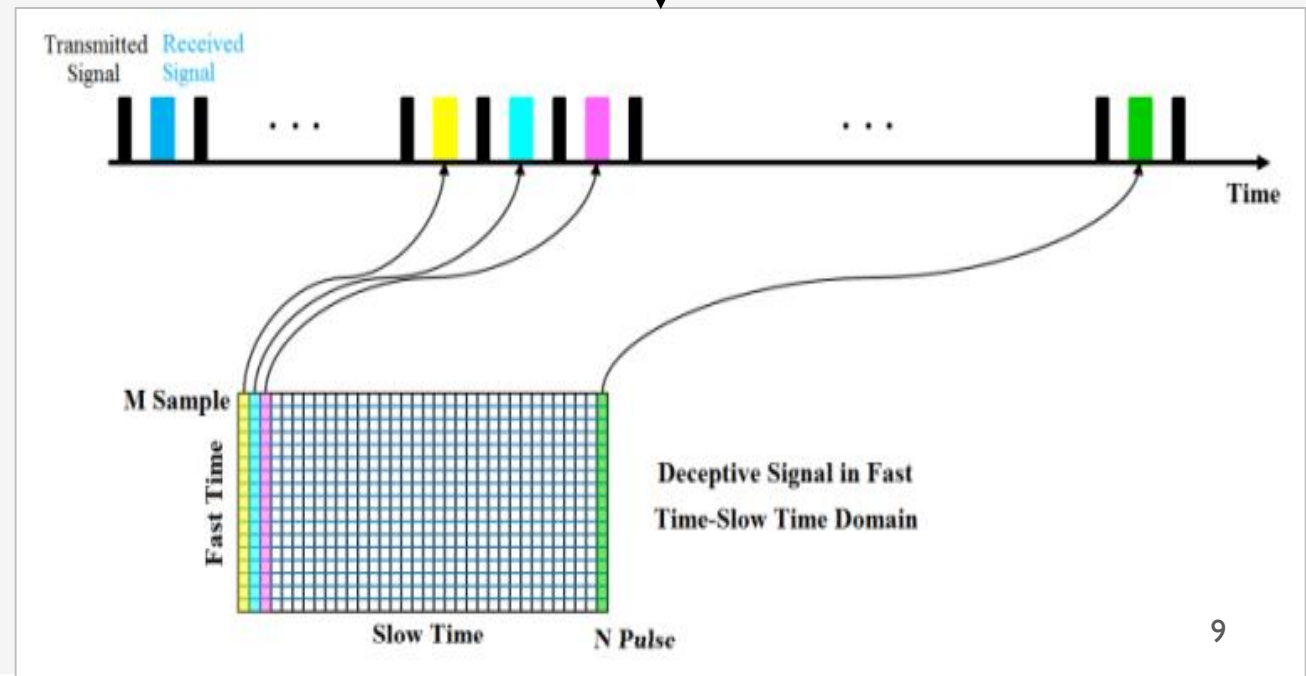2. Data processing
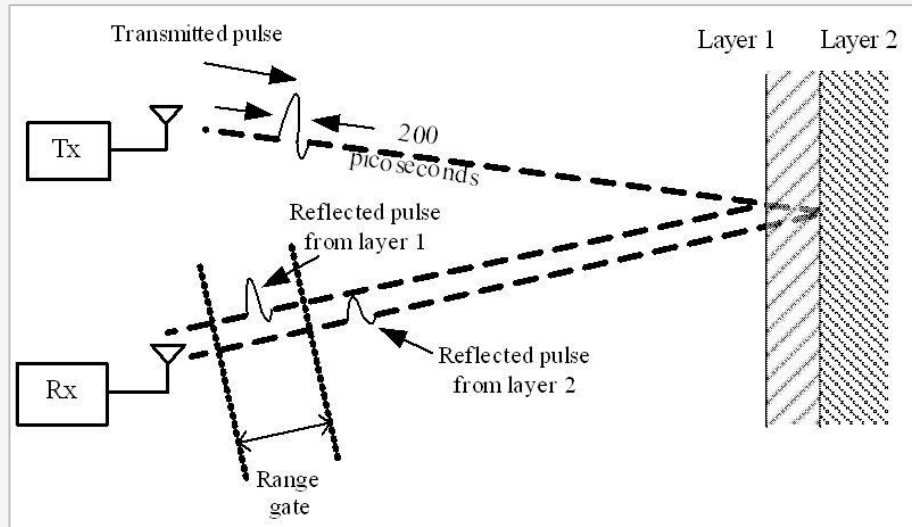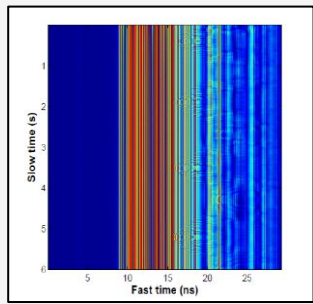
3. Activity classification
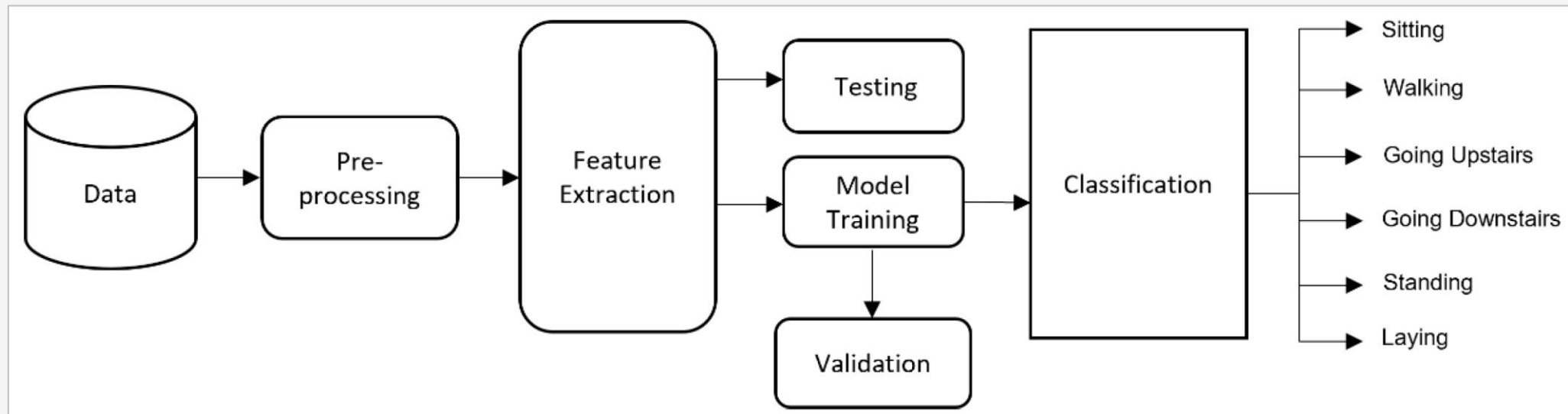
Type of sensors used for HAR

Impulse Radio Ultra Wide-Band : IR-UWB

❖ Non-contact and non-intrusive sensor.

❖ Low power consumption.
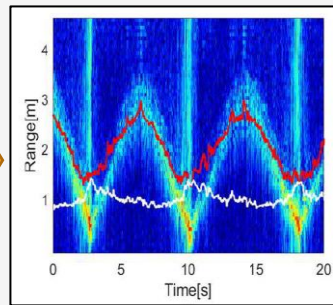
❖ High performance.

❖ Simple and inexpensive.

IR-UWB data processing

Transmitted pulse

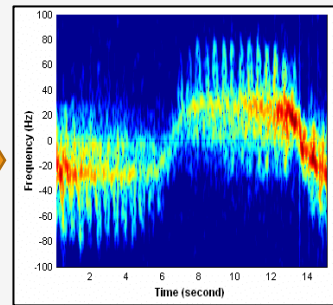200 picoseconds

Layer 1   Layer 2

Tx

Reflected pulse from layer 1

Reflected pulse from layer 2

Rx

Range gate

Transmitted Signal   Received Signal

Time

M Sample

Fast Time

Slow Time   N Pulse

Deceptive Signal in Fast Time-Slow Time Domain

IR-UWB data processing

Fast-time Slow-time

FFT Fast-time

Range-Time

FFT Fast-time

Doppler-Time

FFT slow-time
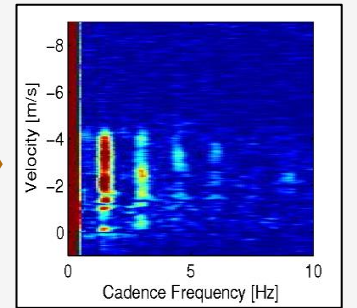
Cadence-Velocity Diagram

FFT Slow-time
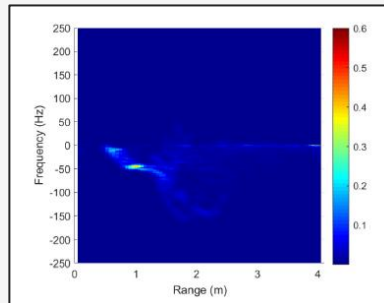
Range-Doppler

Classification approaches

2D Radar data representations

Directly

Manual features extraction

Deep Learning

Vector of features

Machine Learning / Deep Learning
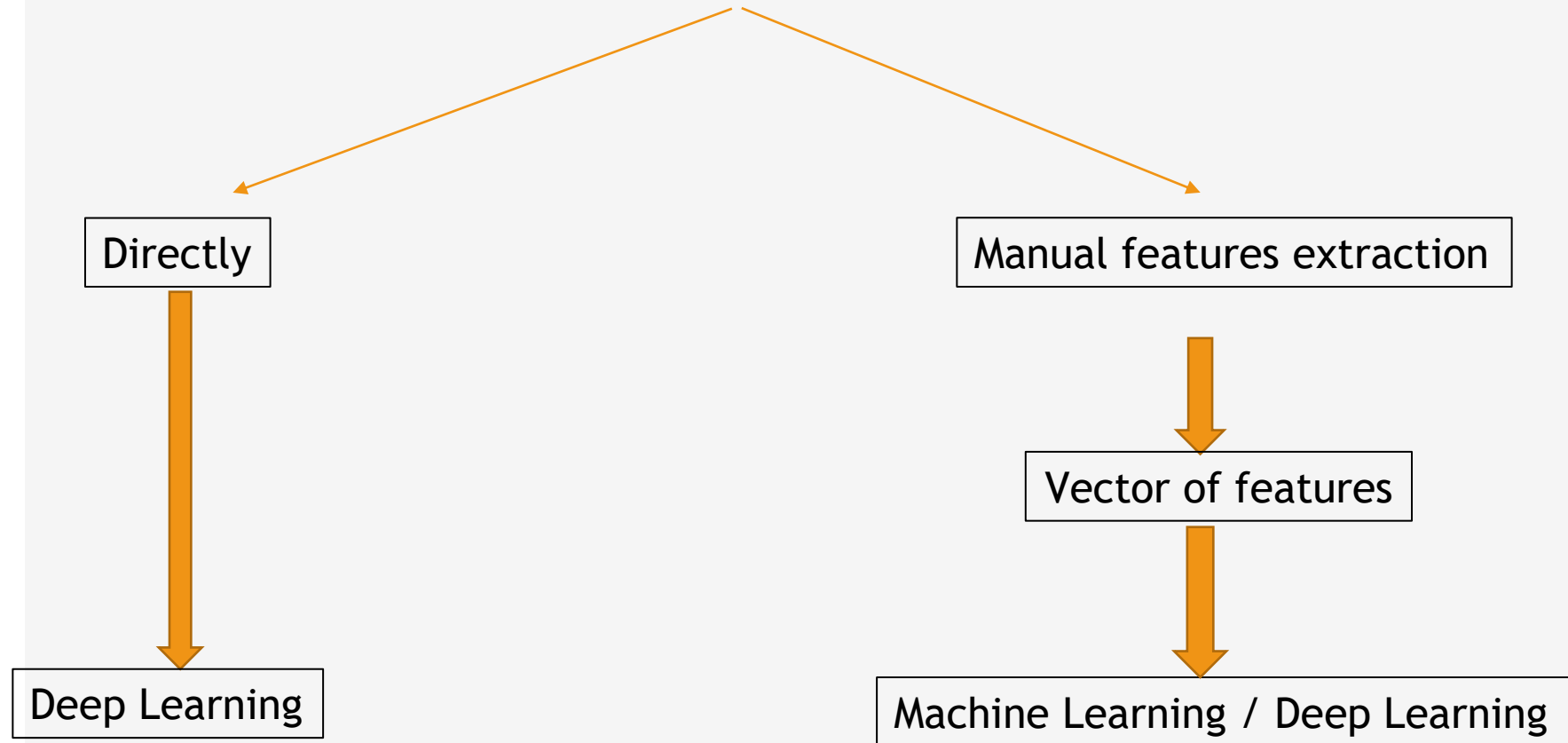
Temporal	Frequential
Mean	Maximum
Standard Deviation	Dominant Frequency
Energy	Median
Power	
Kurtosis	
Skewness	

Machine Learning for HAR

Deep Learning for HAR

Deep Learning Algorithms

Convolutional Neural Networks (CNN)
- Automatic features extraction
- Multi-level features learning

Recurrent Neural Networks (RNN)
- Analyze time-series
- Capture and store temporal information

Hybrid models (CNN+RNN)
- Use both spatial & temporal features
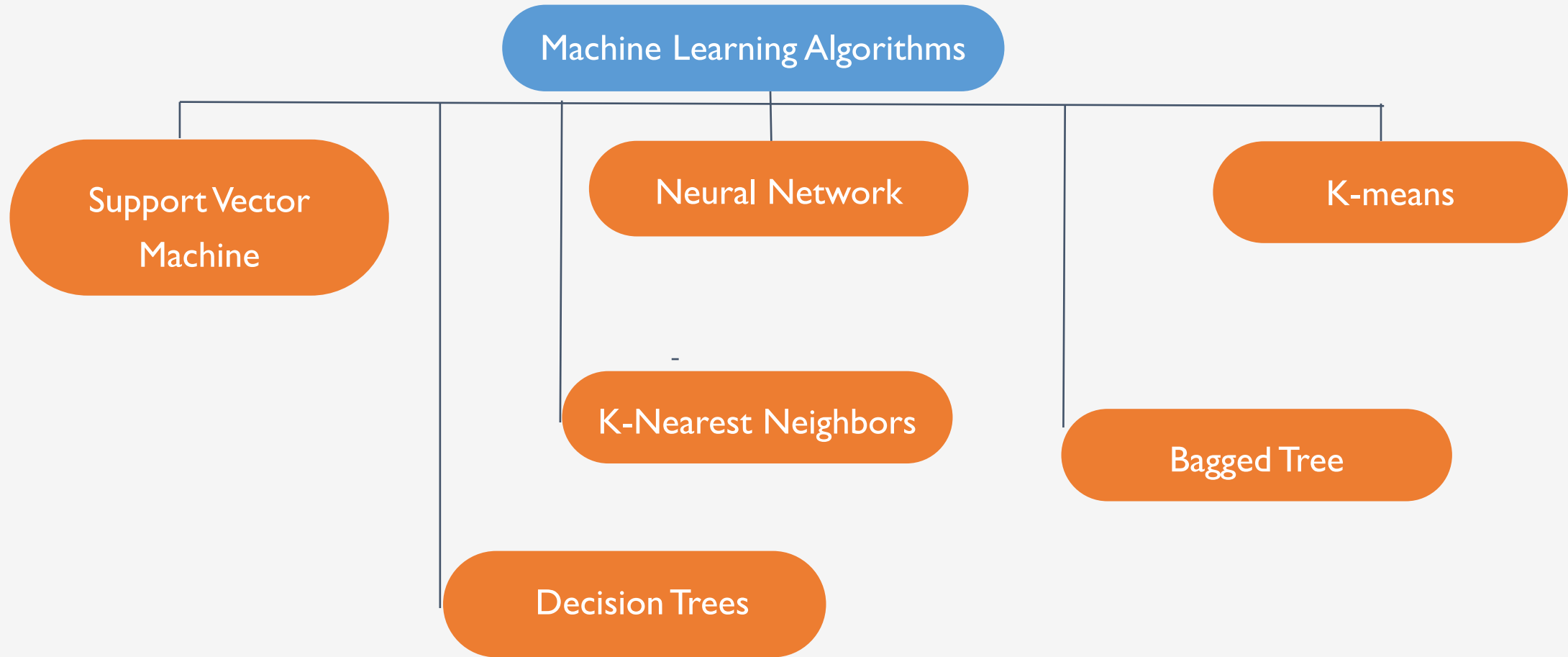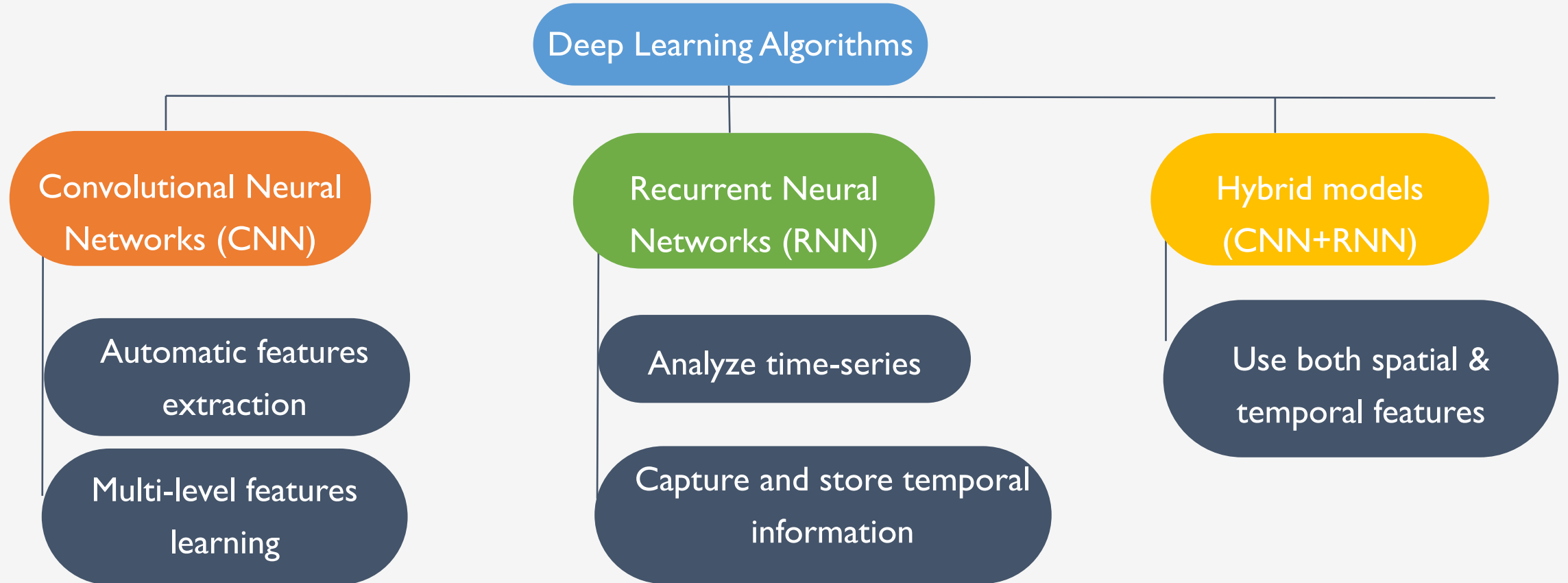
Conclusion

HAR serves as a fundamental step in understanding and interpreting human behavior. This review offers a concise exploration of established methodologies centered around activity recognition using IR-UWB. It delves into the fundamental elements shared by recognition systems, encompassing data representation, feature extraction, and activity classification. By shedding light on these key components, this review contributes to the comprehensive understanding of the HAR process, demonstrating its significance in in a variety of fields.

Conclusion

Thank you !