Chapter 1
The State-of-art on Evolution of Cognitive-Aware Technologies Towards Intelligent Sensory Systems:
Review and Global Scenario of Cognitive-Aware Technology

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ABSTRACT

This chapter explores the evolution and development of cognitive-aware sensitive systems, i.e., an emerging class of human-computer interaction technologies that integrate physiological, behavioural, and contextual signals to deliver adaptive, user-centred experiences. Drawing upon multidisciplinary research from neuroscience, psychology, artificial intelligence, and user experience design, we examine how systems can utilize signals such as EEG, EMG, GSR, heart rate, and eye-tracking to infer mental workload, emotional stress, and engagement levels in real time.

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Present work gives the insights on a comprehensive overview of the key components underpinning these systems, including sensor technologies, cognitive and affective modeling, adaptive feedback mechanisms, and practical applications in education, healthcare, transportation, and assistive technologies.

1. INTRODUCTION

Human-computer interaction (HCI) has evolved beyond systems simply responding to direct commands. Today's focus is on building systems that understand and respond to users' thoughts and emotions. While early HCI aimed at making technology usable, accessible, and efficient, the current trend moves toward systems that are context-aware, adaptive, and emotionally intelligent. Cognitive-aware sensitive systems are gaining attention for enabling more meaningful interactions by connecting human emotions with machine intelligence.

This shift is largely driven by advances in body signal sensing, affective computing, and adaptive learning algorithms. Signals like EEG (brain activity), GSR (skin response), EMG (muscle movement), heart rate, eye tracking, and touch feedback are now used to infer stress, attention, emotional states, and cognitive load. These insights help systems offer real-time, personalised responses (Calvo & D'Mello, 2010; Zhai & Barreto, 2006).

Developing such systems requires an interdisciplinary axpproach neuroscience explains the origins of signals, psychology sheds light on emotions and cognition, AI helps interpret patterns, and UX design ensures ease of use. Together, these fields have led to tools like online learning platforms that reduce mental fatigue, mental health apps, and smart in-vehicle systems that adapt to the driver's state (D'Mello & Graesser, 2012; Healey & Picard, 2005).

Prototype systems are already in use. In education, content difficulty is adjusted based on mental fatigue, while in vehicles, infotainment features are limited when cognitive load increases to reduce distraction. These systems rely on real-time signal collection and adaptive mechanisms to respond effectively (Zhou & Wang, 2021).

Despite their potential, cognitive-aware systems face several challenges poor signal quality, difficulty interpreting complex or ambiguous mental states, privacy concerns, ethical use of sensitive data, and generalising models across different users. Still, research in education, healthcare, workplace well-being, and automotive UX has shown promising outcomes.

This chapter gives an overview of cognitive-aware systems, from core principles and sensing techniques to modelling approaches and adaptive designs. It also discusses key challenges and future directions, guiding research toward systems that interpret user behaviour and understand the thoughts and emotions behind it.

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Alka Singh Bhatt (2025). *Computer Vision and Internet of Everything (IoE) for Societal Needs (pp. 21-50).*
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