


# Chapter 2

## Emotion and Engagement Detection Using Behavioral Inputs: Gesture and Touch Interaction Data

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### **ABSTRACT**

*Natural behaviors for expressing emotion are utilized in gesture and touch for emotion detection, in real time, and reshaping human computer interaction. System can dynamically adapt because deep learning and multimodal fusion are advanced, and experiences in education, gaming, healthcare and customer service benefit. One of the challenges however remains with their variability in the culture and privacy*

DOI: 10.4018/979-8-3373-6385-1.ch002

*concern. These technologies of ethical AI, federated learning and edge computing are bringing more emotional intelligence, intuition and intention into digital systems in an increasingly variety of applications.*

## **INTRODUCTION**

The integration of emotion and engagement detection into Human-Computer Interaction (HCI) is revolutionizing technology by moving beyond simple cognitive interactions and introducing emotional sensitivity and adaptive engagement. With the rapid development of immersive technologies like Virtual Reality (VR) and Augmented Reality (AR), paired with advancements in machine learning algorithms, real-time emotion and engagement detection has become more accurate. VR completely immerses users in a digital world, while AR overlays digital elements onto the real world, allowing for personalized and dynamic interactions based on emotional states such as excitement, confusion, or frustration (D'Mello & Kory, 2015; Zhang et al., 2020). Emotion detection, especially in e-learning platforms like ENGAGE and ClassVR, enables real-time adjustments to learning content based on student engagement and emotional responses (Radianti et al., 2020; Lee et al., 2021).

Machine learning has significantly advanced emotion detection by processing complex physiological, behavioral, and contextual data in real-time. Systems now incorporate facial expression recognition (Ekman & Friesen, 1978), voice modulation analysis, heart rate variability, and galvanic skin response to gauge emotions. Companies like Affectiva have developed emotion AI software capable of detecting subtle facial expression changes to determine emotional states, widely used in the automotive and advertising sectors (McDuff et al., 2016; Ng et al., 2022).

Gesture and touch interactions, prevalent in devices such as smartphones, wearables, and interactive displays, provide non-intrusive ways to assess emotional states. For instance, research by Kim et al. (2018) demonstrated that analyzing touch inputs like pressure and swipe speed could accurately predict users' emotional states. Depth-sensing cameras and motion sensors (Microsoft Kinect, Apple's Face ID) enable systems to detect emotions without explicit input, making interactions feel more natural (Lee & Wang, 2021). These technologies are applied in healthcare, with systems like 'Ellie,' a virtual therapist that uses facial and vocal analysis to monitor patient emotions and adapt counseling strategies (DeVault et al., 2014; Williams & Liu, 2022). Retailers, such as Walmart, use emotion detection cameras to monitor customer reactions and adjust marketing strategies accordingly (Brown et al., 2023).

Emotion detection also plays a significant role in gaming, offering personalized experiences by adjusting game difficulty based on the player's emotional state. For

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