

Chapter 15

Human–Centric Design of Emotion–Aware Systems for Automotive Safety

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ABSTRACT

The integration of emotion-aware systems into automotive safety frameworks is an evolving field in the application of artificial intelligence (AI) and human-computer interaction (HCI). This paper proposes a comprehensive, human-centric model designed to monitor drivers' emotional states in real-time, providing adaptive feedback to minimize risks associated with stress, fatigue, anger and distraction. By addressing critical gaps in the literature, such as the integration of multi-sensory data, the provision of real-time adaptive responses, and the emphasis on user-centered design, this model advances the field of intelligent automotive safety systems. The proposed framework combines affective computing with advanced machine learning algorithms to create a system capable of strengthening drivers' safety and well-being.

INTRODUCTION

The automotive industry has always been a beneficiary of technological innovation, especially behind improving safety features of vehicles, thus enhancing the driver's well being. Traditional safety systems, such as seat belts, airbags, and anti-lock braking systems focus primarily on minimizing the physical

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impact of accidents. However, these systems do not address the root causes of many accidents, which mostly happens as the driver's emotional and cognitive state.

In the light of recent advancements in AI technologies, the integration of AI and HCI into automotive systems has opened new horizons for improving road safety. Affective computing, a subfield of AI, focused on understanding and processing human emotions has emerged as a key technology in this regard, catalyzing the development of systems that can monitor and respond to drivers' varying emotional states. These emotion-aware systems have a high potential to significantly reduce accidents caused by stress, fatigue, and other emotional factors experienced by the drivers. These systems promise to provide a more holistic approach to automotive safety by addressing not just the physical but also the emotional states of drivers, which are often precursors to risky driving behaviors.

Despite several promises made by many emotion-aware systems, existing models often suffer from several limitations. Most of these systems rely on single-modal data, such as facial expressions or heart rate, which may not provide a comprehensive assessment of the driver's varying emotional state. Some of these systems even offer real-time, adaptive feedback that can dynamically respond to changes in the driver's condition. Although, most of these models do not prioritize human-centric design, resulting in systems which are technically advanced, but still lack the user acceptance.

Most of the systems also lack the ability to provide real-time adaptive feedback, which is a necessity for timely interventions. For instance, a system that detects stress but cannot immediately suggest a calming action, such as adjusting the vehicle's climate control or suggesting a break, may fail to prevent an accident.

This model not only monitors the driver's current emotional state but also predicts potential future states based on a combination of physiological, behavioral, and contextual data. By doing so, it offers a cutting-edge solution to enhance automotive safety through real-time emotional monitoring and response, providing interventions that are both timely and personalized.

Apart from anything else, the model emphasizes a human-centric approach, ensuring that the technology enhances rather than detracts from the driving experience. This is achieved by designing user interfaces that are intuitive and non-intrusive, as well as feedback mechanisms that are adaptive to the individual driver's needs and preferences. By prioritizing these aspects, the proposed model seeks to overcome the limitations of existing systems and set new standards for the integration of emotion-aware technologies in the automotive industry.

In summary, this paper presents a comprehensive and conceptual framework for a human-centric emotion-aware system that addresses these existing gaps to deliver an automotive safety system. By addressing the limitations of current models and introducing new features such as predictive analytics and dynamic adaptation, the proposed framework offers significant potential for improving both road safety and the overall driving experience.

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