Chapter 5
Real-Time AIoT-Based Fatigue Detection System for Enhancing Worker Well-Being and Learning Efficiency

Mengjia Long
https://orcid.org/0009-0008-1599-3507
Hong Kong Polytechnic University, Hong Kong

Ka Ni Lo
Hong Kong Polytechnic University, Hong Kong

Lin Peng
Hong Kong Polytechnic University, Hong Kong

Aquil Mirza Mohammed
Hong Kong Polytechnic University, Hong Kong

Cong Wu
Liaoning Technical University, China

ABSTRACT

In today's fast-paced work environments, fatigue among workers can decrease productivity and health. To address this, we developed a real-time fatigue detection system using Artificial Intelligence of Things (AIoT). It integrates sensors—including cameras, simulated physiological sensors, environmental monitors, and logs—to

DOI: 10.4018/979-8-3373-9245-5.ch005

assess workers' cognitive and physical states. Key indicators such as eye aspect ratio (EAR), head pose, and behaviors are extracted. A weighted fusion algorithm combines these to generate a fatigue score, triggering alerts when thresholds are exceeded. This non-intrusive system enables timely interventions, promoting well-being and productivity. Achieving 86% accuracy, it effectively monitors fatigue via vision, physiological, and behavioral data, offering personalized feedback. Ultimately, this AIoT solution shows great promise for improving worker health and efficiency.

1. INTRODUCTION

Research over recent years has increasingly highlighted the vital role sleep plays in academic achievement. Not merely a matter of rest, sleep duration directly influences cognitive processes, memory consolidation, and overall learning effectiveness. Studies reveal a clear positive correlation: students who sleep more than 6.5 hours tend to score higher; averaging around 69.4%; compared to their peers with moderate sleep (5.5-6.5 hours), who average about 64.8%. Meanwhile, students with less than 5.5 hours of sleep often score even lower, at approximately 59.2%. This pattern underscores that longer sleep durations; within healthy limits; significantly contribute to better academic outcomes.

Yet, despite these findings, a concerning trend persists among Chinese students. Compliance with recommended sleep durations remains alarmingly low. For primary school students, only about 35.8% manage to get sufficient sleep, and this percentage diminishes further; down to just 17.8%; among junior high school students. The underlying causes are multifaceted, primarily linked to intense academic workloads, extracurricular activities, and societal pressures that often prioritize academic success over health. This imbalance not only hampers students' sleep quality but also exposes them to grave health risks.

Indeed, the implications extend beyond academic performance. Excessive academic stress and insufficient sleep contribute heavily to health issues such as myopia. Data from 2022 indicates that the overall myopia rate among Chinese children and adolescents stands at a staggering 52.7%. Among high school students, this rate escalates to an alarming 80.5%. The primary culprit appears to be prolonged near-vision activities; reading, writing, and screen time; highlighting a direct link between academic demands and visual health deterioration. Furthermore, physical activity levels are alarmingly low; over 75% of students fail to meet the World Health Organization’s recommendation of at least one hour of moderate-to-vigorous exercise daily. Academic workload remains the main obstacle, often leaving little time for outdoor activity or exercise, further compounding health risks like obesity and mental health issues.