A CNN-based Human Activity Recognition System Combining a Laser Feedback Interferometry Eye Movement Sensor and an IMU for Context-aware Smart Glasses

JOHANNES MEYER, Corporate Sector Research and Advance Engineering, Robert Bosch GmbH, Germany
ADRIAN FRANK, Corporate Sector Research and Advance Engineering, Robert Bosch GmbH, Germany
THOMAS SCHLEBUSCH, Corporate Sector Research and Advance Engineering, Robert Bosch GmbH, Germany
ENKELJEDA KASNECI, Human-Computer Interaction, University of Tübingen, Germany

Smart glasses are considered the next breakthrough in wearables. As the successor of smart watches and smart ear wear, they promise to extend reality by immersive embedding of content in the user's field of view. While advancements in display technology seems to fulfill this promises, interaction concepts are derived from established wearable concepts like touch interaction or voice interaction, preventing full immersion as they require the user to frequently interact with the glasses. To minimize interactions, we propose to add context-awareness to smart glasses through human activity recognition (HAR) by combining head- and eye movement features to recognize a wide range of activities. To measure eye movements in unobtrusive way, we propose laser feedback interferometry (LFI) sensors. These tiny low power sensors are highly robust to ambient light. We combine LFI sensors and an IMU to collect eye and head movement features from 15 participants performing 7 cognitive and physical activities, leading to a unique data set. To recognize activities we propose a 1D-CNN model and apply transfer learning to personalize the classification, leading to an outstanding macro-F1 score of 88.15 % which outperforms state of the art methods. Finally, we discuss the applicability of the proposed system in a smart glasses setup.

CCS Concepts: • **Human-centered computing** → **Ubiquitous and mobile computing systems and tools**; • **Hardware** → *Sensor devices and platforms*; *Emerging optical and photonic technologies.*

Additional Key Words and Phrases: Human activity recognition, head and eye movement, Laser Feedback Interferometry, context awarness smart glasses

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1 INTRODUCTION

Followed by smart watches and smart ear wear smart glasses are considered as the next breakthrough in the smart wearable domain because they are able to enhance human perception and embedding user interfaces seamlessly into the user's field of view (FOV). In certain situations, e.g. when driving, this highly integrated

Authors' addresses: Johannes Meyer, Johannes.Meyer2@de.bosch.com, Corporate Sector Research and Advance Engineering, Robert Bosch GmbH, Renningen, Germany; Adrian Frank, Corporate Sector Research and Advance Engineering, Robert Bosch GmbH, Renningen, Germany; Thomas Schlebusch, Corporate Sector Research and Advance Engineering, Robert Bosch GmbH, Renningen, Germany; Enkeljeda Kasneci, Human-Computer Interaction, University of Tübingen, Tübingen, Germany.

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