Announces the Ph.D. Dissertation Defense of

Muhammad Tanveer Jan

for the degree of Doctor of Philosophy (Ph.D.)

Machine Learning for Elderly Behavior and Risk Incident Modeling

February 16th 2026, 10:00 AM
Engineering East, Room # 407
777 Glades Road
Boca Raton, FL

DEPARTMENT:
 Electrical Engineering & Computer Science

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ABSTRACT OF DISSERTATION'

The rapid expansion of the aging population presents critical challenges to healthcare systems, particularly in maintaining independent living, ensuring mobility safety, and optimizing emergency interventions. Traditional monitoring solutions are often fragmented, reactive, and hindered by the scarcity of data regarding rare high-risk events. This dissertation proposes a comprehensive, multi-modal machine learning framework designed to model elderly behavior and predict risk incidents across three critical environments: the home, the vehicle, and the clinical setting.

To address the fundamental challenge of class imbalance in medical and behavioral datasets—where risk events are statistically rare— this research first introduces a dual-phase data augmentation strategy. By utilizing Auxiliary Classifier Generative Adversarial Networks, the framework synthesizes realistic minority-class data, significantly enhancing the sensitivity and robustness of predictive models against bias.

Building upon this foundational capability, the research applies these optimized models across three domains. First, in-home monitoring is addressed through the evaluation of wearable inertial sensor networks, focusing on usability and the reliable detection of falls and abnormal gait patterns. Second, the dissertation explores in-vehicle cognitive function analysis, positioning the vehicle as a digital diagnostic tool. A novel sensor fusion pipeline—integrating driver-facing oculometrics, road-facing scene analysis, and OBDII vehicle telemetry is developed to detect markers of Mild Cognitive Impairment and real-time cognitive load. Finally, in emergency care settings, a computer vision-based methodology and deep learning segmentation is proposed. This system enables non-contact patient localization and precise anthropometric volume estimation to calculate accurate, weight-based drug dosages without physical manipulation.

Experimental results demonstrate that the proposed generative augmentation strategies significantly outperform traditional baselines

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in handling data imbalance. Furthermore, the integrated applications exhibit high efficacy, delivering accurate fall detection, robust correlation between driving telemetry and cognitive state, and precise weight estimation for medication safety. Collectively, this work advances the field of geron-technology by moving from reactive alarms to predictive, personalized care ecosystems.

BIOGRAPHICAL SKETCH

Born in Peshawar, Pakistan
B.S, University of Peshawar, Pakistan 2016
M.S University of Salerno, Italy, 2020
Ph.D., Florida Atlantic University, Boca Raton, Florida USA 2026

CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2021-2025

Qualifying Examination Passed: Fall 2021

Published Papers:

Jan, Muhammad Tanveer, Ali Hashemi, Jinwoo Jang, Kwangsoo Yang, Jiannan Zhai, David Newman, Ruth Tappen, and Borko Furht. "Non-intrusive drowsiness detection techniques and their application in detecting early dementia in older drivers." In *Proceedings of the Future Technologies Conference*, pp. 776-796. Cham: Springer International Publishing, 2022.

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