**Final exam report**

**Intelligent Systems – Prof. Jo, Kang Hyun**

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<https://forms.gle/wxUP3egKy4fH9HTP9>

**Q1. Submit your project process and result related to intelligent system.**

Dear Professor Jo,

My research focuses on monitoring toothbrushing techniques, a field I began exploring upon arriving in Korea in March. As of now, my progress stands at approximately 20%, and the outcomes related to developing an intelligent system are preliminary. I have reviewed 16 research papers so far, with 11 of them utilizing Artificial Intelligence (AI) or Machine Learning (ML). Undoubtedly, AI and ML are essential to my work, and I am committed to mastering these disciplines to effectively address my research objectives.

**Q2. Please explain the main idea and relationship with your PBL-IS(Intelligent Systems) related research work.**

Oral hygiene is essential for maintaining overall health. Proper toothbrushing is one of the most important measures against dental problems. In my work, I approach the compliance to the standard toothbrushing method as an activity recognition problem. I break down the toothbrushing activity into 16 sub-activities and employ a machine learning model to recognize those activities. There are two main stages as follows:

First stage: I propose a solution based on an Inertial Measurement Unit (IMU) for monitoring the toothbrushing activities. I use a detachable IMU, which can be attached and re-attached to different toothbrushes, thus making it re-usable after changing the toothbrushes. Acceleration and gyroscope data are transferred to an edge computing device which can be a smart phone or a laptop via Bluetooth. Hence, all the processing will be done on the edge device. More specifically, the raw sensor data is cleaned to remove any noise. The cleaned data is then passed through device variation removal phase in which a filter is applied to remove any variation caused by the differences of brush types.

Second stage: Following data cleaning, features are extracted to train the machine learning models for recognition of the brushing activity. I plan to evaluate the performance of four models including Random Forest (RF), Support Vector Machine (SVM), Gradient Boosted Decision Tree (GBDT), and Gaussian Naive Bayes (GNB). Next, I shall select the most effective model as my classification model for all the experiments. Additionally, I intend to collect my own dataset and compare my approach with the wearable-based and camera-based approaches to show that my system is able to correctly recognize these sub-activities.

**Q3. What was the most impressive session(s) of IEEE ISIE2024 where you were participated and the magazine article(in IEEE IS Magazine, 2023 version.) you think?**

As regards a magazine article, I found that I am really interested in the article named “A Semantic Web Approach to Fault Tolerant Autonomous Manufacturing” in Volume 38, Number 1 of IEEE IS Magazine. It addresses a problem faced by medium-sized enterprises in Vietnam - they struggle with limited access to technology and innovation resources to scale efficiently. To address this gap, I founded a technology company aimed at assisting two manufacturing factories in enhancing their quality control processes. I think reading this article could help me improve how I manage the production lines by using different data sources and knowledge from various fields.

In IEEE ISIE 2024, I participated in the WiP TT 06 Control Systems session because I realized I could benefit from its four presentations, particularly the paper titled “Virtual inertial sensor data generation using angular velocity splines”. In this presentation, the authors described a method for combining sensor and camera models to enhance their recognition capabilities.

**Q4. If you have an additional comment, please describe here. (optional : but supplementary)**

Reading the papers and sharing those invaluable experiences and advices are definitely useful for post graduate students, especially those who are the first-semester students like me.