FWI Funding Statement

Name: Rong Zheng
Faculty/Area: Faculty of Engineering
Project title: Enhancing Teaching through Wearable Technologies

Please summarize how the FWI funds have been spent:
A summary by broad category is sufficient, line by line accounting of individual expenditures is not required unless specifically requested. Alternatively, please provide a copy of your FAS for the accounts that have been used for the FWI funds.

Salaries and benefits: One undergraduate student (Mingzhi Yu) was supported working on the projects for 2 months in the summer
Equipment: Two Recon Jet glasses (599 USD each) were purchased through this project

Event Costs: 0
Travel: 0
Other (please specify):

Balance remaining: 0
Please indicate how the balance will be spent and when you anticipate that the funds will be exhausted.

Please submit separately a maximum 2-page summary of the results of the project with particular attention to the following details:
1. How has the activity enhanced the competence and effectiveness of an individual (or group) with respect to teaching, research, service and/or leadership?
2. How was the proposed activity/intervention aligned with the goals of a course/program/department/Faculty?
3. How was the quality of the expected development and its potential impact measured and evaluated?
4. How have the insights gained from the intervention/experience been shared with peers and if appropriate, with broader McMaster communities?
5. What are the next steps in this project/initiative? How will the impact be sustained?

The financial and project reports can be submitted to fwi@mcmaster.ca.
Project Report

The ultimate goal of the project is to enhance the student classroom experience while exploring the capabilities of wearables devices. In particular, we have developed techniques to use HUD to recognize faces. Face recognition provides the name of the student the instructor is speaking to, as we often observe that in the large classes in CAS, the instructor cannot always remember most of the students’ names.

Though there are existing implementation and software libraries that can be readily used for face recognition, implementing face recognition on wearable devices faces the challenges in i) limited computation, and ii) limited battery power. To address these challenges, we partitioned the face recognition pipeline into two parts, namely, face detection and face recognition. A client-server architecture is devised where a wearable device runs client processes and a mobile phone serves as the server. Images are captured on the wearable device, and upon the detection of a face or multiple faces, the parts of the images that contain the interested faces are transmitted to the server for recognition. At the same time, labels are assigned and faces are continuously tracked so that the recognition results can be tagged to the corresponding faces (Figure 1). The mobile phone runs face recognition tasks and trains the machine learning model. Preliminary experiments show that under normal lighting conditions, we can successfully identify multiple faces in the field of view. By partitioning the computation tasks between the wearable and the mobile phone, we can strike a good balance in computation time and energy costs. Further work is being carried out to quantify the energy saving on wearable devices as a result of computation partitioning. In summary, the major deliverables include:

- A working prototype on Recon Jet and an app on Android devices that implement the client-server architecture and computation partitioning scheme
- Profiling of energy consumption of various modules of Recon Jet.
- The project demo has been shown to various visitors to my research lab and has been uploaded to YouTube (33 views to-date).

In terms of enhancing the competence and effectiveness of an individual (or group) with respect to teaching, research, service and/or leadership, this project provides a proof-of-concept of using HUD to enhance individual interactions. This is clearly a timely work that is in line with the goal of the department and faculty to improve effectiveness of teaching, in particular, addressing the needs in large classrooms. This project also helps training HQP in gaining critical skills including mobile programming, embedded systems and machine vision. Evaluation has done in laboratory settings.
with 3 - 4 people. Unfortunately, at this stage, further development and large-scale evaluations are still needed to assess the effectiveness of the approach in classroom settings, where light conditions can be suboptimal and the number of possible candidate faces is large.

*As the next step*, we would like to pursue two directions at the same time. As a pedagogic tool, we would like to start limited trial and collect feedback starting from small classroom. On the research front, we would like to further investigate and generalize the computation partition paradigm to compute-intensive interactive tasks on wearable devices. Currently, one PhD student starts to work on this topic. We plan to seek internal and external findings to support the continuation of the work and transfer the insights and technologies to a larger community.