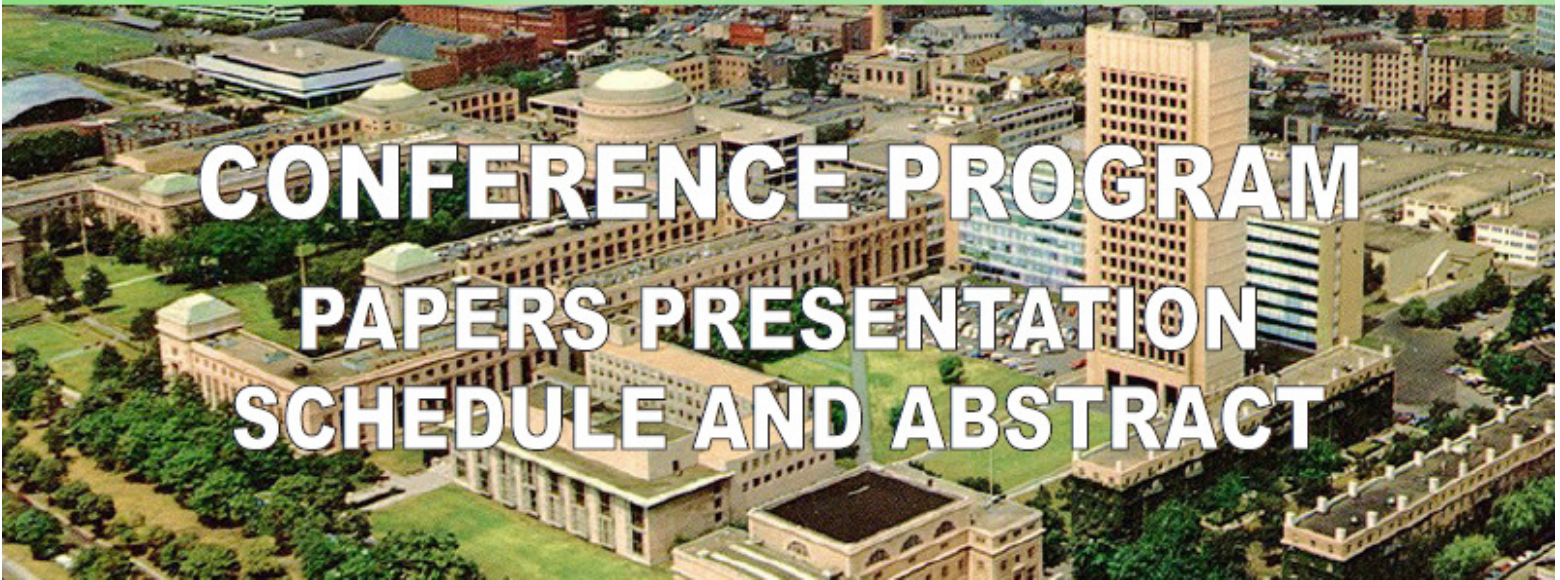# IEEE MIT URTC 2020

UNDERGRADUATE RESEARCH TECHNOLOGY CONFERENCE

October 09 - 11, 2020 | Cambridge, Massachusetts, USA (Virtual)

MEET INNOVATIVE TECHNOLOGY

CONFERENCE PROGRAM
PAPERS PRESENTATION
SCHEDULE AND ABSTRACT

Organized and Sponsored by IEEE Boston Section and MIT IEEE Student Branch

https://urtc.mit.edu

mit ieee
urtc 2020

Track Chair: Ivy Wang

➤ **12:30pm (PA20-0012)**
MobSF: Mobile Health Related Android Applications Through The Lens of Open Source Static Analysis
Grace LaMalva (St. John's University)

Data security has become an increasing concern with rampant data security regulation changes and the rampant deployment of technology. The necessity to lock down user data has never been greater. This research contributes to the secure software development of Android applications by identifying data processing concerns following the guidelines put forth by the Open Web Application Security Project (OWASP) Mobile Top 10. We found that 43.62% of the applications contained at least one security violation. We will be using an open source tool static analysis tool, MobSF, to review the security of 200 health related Android applications. The security of healthcare related applications should be given special attention, as they store and process highly sensitive information such as blood pressures, pulse< rate, body photos, mental-state, OBGYN status, and sleep patterns. Partial automation techniques were utilized. This paper also suggests possible security remediation for the identified security concerns.

➤ **12:40pm (PA20-0120)**
Aquaculture: A Cost-Effective Automated Aquaponic Gardening System
Justin Cooper, Macone Connor (Wentworth Institute of Technology)

The paper presents the design and implementation of Aquaculture, a system that aims to provide a cost-effective solution for people who want to grow their own fruits and vegetables, especially in the time of crisis when food resources are scare. Aquaculture automates certain processes and integrates with an easy to use web application. The evaluation results show that this system has low cost, significant time savings, and much greater ease of use as compared to other available aquaponic systems on the market.

➢ **12:50pm (PA20-0032)**

Share &Care: A Senior-Friendly Family Interaction Application

Jin Chen (The City College of New York CUNY)

Seniors, or older adults, living alone often experience loneliness and face technical challenges when using mobile applications to interact with their families. We first performed a user study on older adults' family interaction and their mobile phone usage from in-person interviews with 12 older adults and an online survey for 28 people with an age range from 16 to 35. Then we proposed and designed Share&Care, a senior-friendly communication application that aims to increase the seniors' experience with mobile app and promote family interaction to reduce senior loneliness. This solution integrates senior-friendly user interfaces, multi-language voice interaction, senior managers, and multiple databases to increase the seniors' comfortability and trust in our application. Interesting readers might watch a YouTube Video introducing the Share&Care app at https://youtu.be/KeDxeV-5_Rk.

➢ **1:00pm (PA20-0049)**

Integrating Natural Language Processing & Computer Vision into an Interactive Learning Platform

Rithesh Rajasekar, Benson Liu, Aditya Shukla, Lucy Xu (Rutgers Honors College)

Virtual learning platforms are digital interfaces that allow educators and learners to communicate and share resources to facilitate learning. Currently, many of them fail to retain engagement amongst a wide demographic of students. Barriers such as language differences and poor digital literacy often make platforms difficult to use. The purpose of this research was to create a comprehensive learning platform by incorporating Natural Language Processing (NLP) and Computer Vision (CV) to promote an improved user experience through human-computer interactions and graphics. The platform was developed in Python using the Google Speech Recognition API for NLP and the OpenCV library for image processing. After integrating these features into the socket server platform, they were rigorously tested for accuracy to assess the success of a more comprehensive learning environment.

➢ **1:10pm (PA20-0098)**

Programming an Educational Chatbot to Support Virtual Learning

Rachel Ai, Disha Kohli, Lee Maina, Evelyn Manelski (Rutgers School of Engineering)

With the educational hardships presented by the COVID-19 pandemic, the connections between teachers and their students as well as club leaders and their members have been compromised. These circumstances prompted the creation of a Discord education management chatbot to serve as an efficient communication assistant to help schools and clubs overcome the barriers of virtual and/or hybrid learning. This chatbot supports diverse features including reminders, stopwatches, polls, and breakout rooms that aim to streamline and enhance the virtual learning experience, but could also appeal to a variety of interests and audiences outside of the classroom. Its features also remain helpful in in-person schooling due to the wide variation of commands.

➢ 1:20pm (PA20-0115)
Exploration of SVD for Image Compression and Time Series Processing
Jesse Redford (University of North Carolina)

This paper explores the block-based singular-value-decomposition (SVD) with applications to image compression and processing in both static and dynamic cases. Results include a comprehensive performance study of rank-1 asymmetric block sizes in comparison to conventional uniform square blocks for static image compression. In addition, a method of movement detection for video streaming applications are presented and discussed in this paper. We show that by tracking the Frobenius norm of the derivatives of sequential images, represented as a time series matrix, allows one to infer change points in varying lighting conditions and foreground movement in video sequences. We show that by combining SVD background subtraction we can create a more clear distinction between movements and changes in lighting intensity. It is also demonstrated that one can maintain the original derivative feature after re-scaling the images of the video stream to a fraction of their original resolution via locally averaging.

➢ 1:30pm (PA20-0009)
System Design for Remote Pulse Examination
Tung Pham (Wentworth Institute of Technology)

In Traditional Chinese Medicine (TCM), the diagnosis relies on a comprehensive analysis of clinical syndromes by using four methods: inspection, auscultation and olfaction, interrogation and palpation. Pulse examination is one of two practices used in palpation. The doctors normally put three fingers on top of the patient's wrist and determine the type of pulse with different pressing level. Each finger position is related to a specific organ. With each press and a reflection from the pulse, the doctors gain knowledge of their patient's organ condition, which normally is combined with multiple factors, such as diet, urine color, skin color, etc. and can finalize their diagnosis. In this research, we argue that it is possible to shorten the gap to support TCM doctors to diagnose patients in distance. In this paper, we propose a new interactive design that uses existing components to demonstrate the possibility for pulse measurement. The design uses a customized circuit layout, a piezoelectric pressure sensor, Arduino Uno, Bluetooth Low Energy (BTLE) breakout and Android application. Our findings, conclusion and future work are discussed at the end of this paper.

➢ 1:40pm (PA20-0077)
MusCare: A Mobile Design for Muscle Monitoring
Chrishopher Dombele (Wentworth Institute of Technology)

Muscles not only help people move, but they also help the body work. However, muscular disorders have become common nowadays, such as Muscular Dystrophy (MD) and Muscle Atrophy (MA), which are genetic and lifestyle diseases causing the loss of muscle mass. The research question we have is whether Internet of Things (IoT) and mobile engineering techniques can help monitor muscle conditions, such as overuse of muscles, muscle recovery from surgery, etc. We propose MusCare, a microcontroller-based system with EMG sensors and an Android mobile app, to help monitor muscle status and visualize the results for the users. The current results show that the system can provide real-time monitoring results on a mobile device. In addition, a neural network algorithm was able to be implemented on a mobile phone to detect anomalies from the EMG data. Currently, the prototype system uses a MyoWare EMG sensor to keep track of the targeted muscle group, but the design of the system can be extended to work with vibrators to provide an advanced improvement in the interaction.

Mobile Microclimate System for Architectural Fieldwork

Qian Ying Zeng (Wentworth Institute of Technology)

Architectural fieldwork normally needs to understand different factors that affect traditional and modern vernacular architecture, such as temperature, humidity, etc. However, researchers are used to carry different data loggers for this purpose. These devices not only are bulky and pricey, but data access needs manual connections to a computer by the researchers. In this research, we proposed a new microclimate system that provides data collection for architectural fieldwork. The design of the system uses a mini-computer, Raspberry Pi 4, an embedded Linux board, and Web application for detecting surrounding environmental parameters, including light intensity, humidity, temperature and other indexes around various construction sites. We found that the prototype system not only can monitor and record environmental parameters around the building, but it also allows the researchers to view the recorded data remotely. Although a further investigation is needed to understand the usage and scalability of the system in a real situation, we believe it is an important step to help architecture specialists to ease their fieldwork.