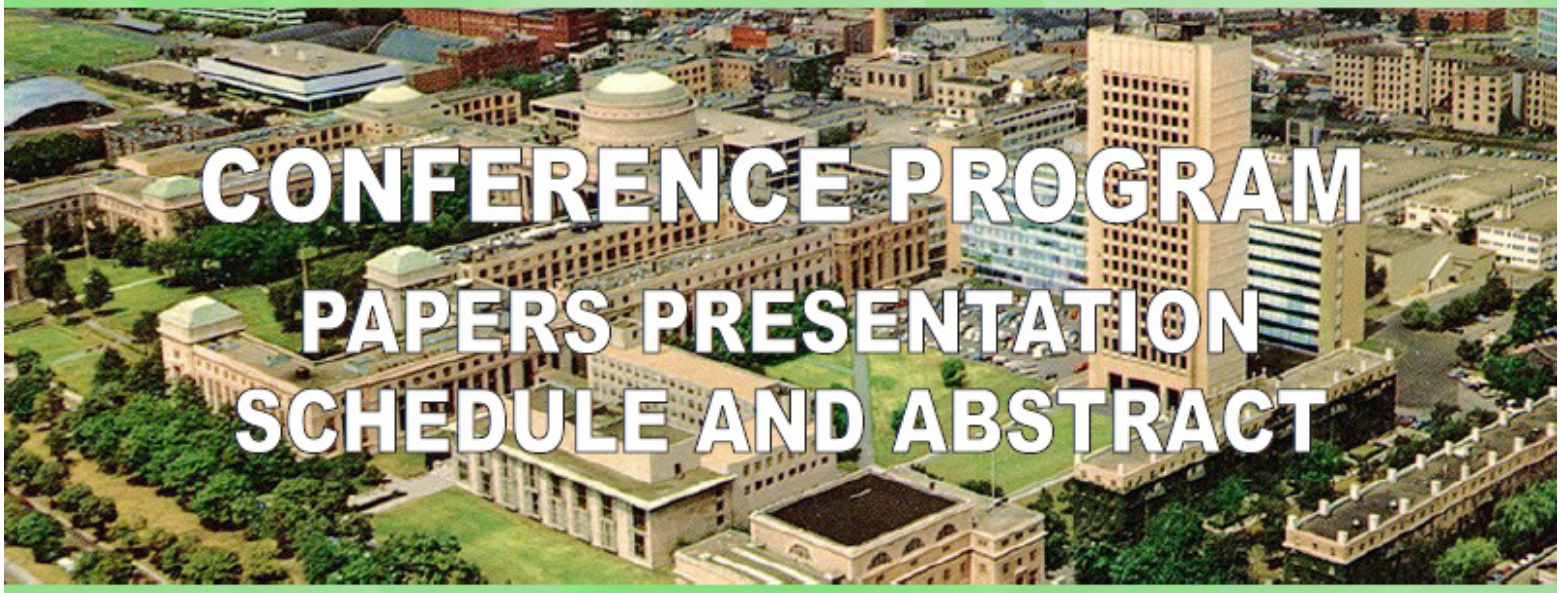
IEEE MIT URTC 2020

UNDERGRADUATE RESEARCH TECHNOLOGY CONFERENCE

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

MEET INNOVATIVE TECHNOLOGY



CONFERENCE PROGRAM
PAPERS PRESENTATION SCHEDULE AND ABSTRACT

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October 10, 2020 (Saturday)

Technical Paper Oral Presentation (AM Track #1)

EST 8:00am - 10:00am HOPIN Session Room A

Machine Learning / Artificial Intelligence (AI) Track #1

Track Chair: James Byleckie

➢ **8:00am (PA20-0011)**

Increasing OCR Accuracy on Images with Motion Blur via GAN Derivatives

Kyoungwan Woo (Phillips Exeter Academy)

OCR (optical character recognition) describes a widespread technology that converts images containing text into machine-readable text. OCR has many applications such as the recovering/analyzing of historical documents, data entry automation, search engine document indexing, automatic license plate recognition, etc. In the context of assistive technology, OCR can translate photos to text to speech, which enables individuals with visual impairment and/or linguistic deficiency to gain better access to the information within street signs, physical books, and other forms of common text. However, these programs do not take into account vertical and lateral motion blur caused by spontaneous vibrations, hand movement. Breathing, muscle fatigue, and other issues commonly associated with photography. Furthermore, medical conditions such as HAVS and muscle sclerosis can further degrade the quality of the photos. For an unimpaired individual, the text may still be visible, but for an OCR program, the loss of pixel accuracy is critical. For example, in the PyTesseract OCR program, motion blur results in an average 56% loss in Levenshtein accuracy over 100080 entries. This research presents a method to recognize and minimize the effects of motion blur on OCR accuracy using a GAN derivative dubbed IMG2IMG.

➢ **8:10am (PA20-0017)**

Using Neural Networks to Reinforce Absence of Gender Bias in Dyslexia Screenings

William Hobbs (University of South Carolina)

This study explores the potential of neural networks to detect the gender of a student given a student's score on the Carolina Automated Reading Evaluation (CARE), a collection of thirteen assessments of reading disabilities created by researchers at the University of South Carolina. Data from prior administrations of the CARE at two elementary schools in South Carolina was parsed and read into dictionaries that contained a randomly created ID number, the student's gender and grade level, and their scores on the individual assessments they were administered. A neural network was created in Python using prominent machine learning libraries, taking test scores as inputs and attempting to train gender as an output. Since not every student was administered every assessment, only assessments that had been taken by more than 60% of the students were used in the neural network. These assessments were used to train the neural network to detect gender. After repeated attempts to train the network to this data set failed, a data set of similar size from the University of California, Irvine machine learning repository was used to test the network built to determine if there was a structural defect in its construction. As shown in Figure 3, the constructed network was able to train to an appropriate degree on the data set from UC Irvine but despite repeated attempts was unable to train on the data with respect to gender from the CARE administrations. From this, it was interpreted that the CARE data follows similar patterns to previous studies of other tests of reading disabilities, which concluded that students in lower grades show insignificant differences in reading ability by gender.

➢ **8:20am (PA20-0020)**

Stock Prediction via Machine Learning and Factor Analysis

Zhaowen Yun (University of Nottingham Ningbo China)

The curse of human nature makes trading process a speculation rather than an investment, and the nature of such behaviors are no different from gambling. Specifically, traditional investment process is typically driven by human experience and vague interpretation to business cycle, this essay aims at using quantitative investment modeling as circumvention device of unobserved risks and furthermore, improving the efficiency of stock selection. The main task of this essay is to transform the selection process into a classification problem in machine learning and then take a step further to optimize the model of use. Random forest framework has been adopted, and the strategies used are evaluated at the end of the essay.

➢ **8:30am (PA20-0021)**

Comparative Analysis of Image Processing Algorithms for Airport Security

Sasha Callaway, Jeffrey Cheng, David Fu, Alexander Contratti, Harshika Gelivi (Rutgers University)

In the current age of increased air travel, safe airport security is imperative. And while correctly detecting potential threats is a top priority, it is also important that these security checks are performed as efficiently as possible to maintain the flow of travel. Current security methods utilize machine learning algorithms to analyze and detect threats on millimeter wave scans of individuals. This paper implemented and compared various classification algorithms on a dataset of millimeter waves scans to determine the most effective algorithm at detecting threats. This paper also examined different data preprocessing and model optimization techniques and their effect on the performance of the models. It was concluded that the convolutional neural network and long short-term memory network, trained on a specific zone of the body, were the most effective models for detecting potential threats.

➢ **8:40am (PA20-0027)**

Small-Sized Neural Network for DetectingCOVID-19 from Chest X-rays

Rahul Thapa (Villanova University)

COVID-19 is a highly contagious infection that has now reached almost all countries in the world infecting over 20M and killing 0.75M people as of the time of writing. Therefore, it is essential to diagnose it early so that health care professionals can prevent the chance of a person spreading the virus. Because the disease often presents with respiratory symptoms, one method for detecting it is by radiology examination using chest radiography. Healthcare professionals examine the chest X-ray for abnormalities that are characteristics of those infected with COVID-19, which must be distinguished from other conditions with similar presentation such as pneumonia. This requires significant expertise, which may not be available in all parts of the world, so computer-assisted diagnosis would be highly beneficial. We propose a deep neural network for extracting those abnormalities as features and classifying the infection. In this study, we examine the efficiency of small-sized deep neural network tailored for the detection of COVID-19 infection from chest X-ray (CXR) images. We designed a modified version of SqueezeNet and Capsule Network and show that even with a relatively small number of free parameters, it can achieve a competitive result while having modest hardware requirements. We use a modified version of fire modules to ensure better convergence. For our Capsule network, we used fire modules as two of its upper layers. To our knowledge, this is the first time that a fire module has been used in conjunction with capsules. Without any pretraining or transfer learning, our SqueezeNet was able to achieve an accuracy of 94.8%, sensitivity of 88.0%, and specificity of 98.4%. Additionally, our CapsNet achieved an accuracy of 93.8%, sensitivity of 88.0%, and specificity of 96.9%.

➢ **8:50am (PA20-0036)**

ParaShop: A Mobile AR App in Assisting People with ASD to Shop

Mengting Xia (The City College of New York)

Approximately 1 in 160 children worldwide is diagnosed with Autism Spectrum Disorder. ASD prevalence is on the rise in the United States. Virtual reality (VR) techniques have been tried in several studies in order to improve the shopping skills of people with ASD. However, in these VR applications, tests of the effectiveness of the training of people with ASD are not performed in the real-world environments of shopping. Our studies show that they become anxious when they are exposed to a new environment such as a supermarket without knowing what to do next. In addition, VR applications are less accessible, portable, or affordable compared to the emerging mobile augmented reality (AR) applications. Therefore, we have created a mobile AR application that augments real shopping scenes with visual-audio annotations via object recognition, barcode reading, and automatic categorization. Through a user-friendly visual interface, the app can help people with ASD learn shopping skills effectively, by guiding them through the shopping process step by step in a real environment with AR. A short YouTube demo video can be found at https://youtu.be/77tp3julNZ0.

➢ **9:00am (PA20-0037)**

Random Forest Regression of Markov Chains for Accessible Music Generation

Vivian Chen, Jackson DeVico, Arianna Reischer, Ananya Vasireddy, Nicholas Zhang, Leo Stepanewk (Rutgers University)

With the advent of machine learning, new generative algorithms have expanded the ability of computers to compose creative and meaningful music. These advances allow for a greater balance between human input and autonomy when creating original compositions. This project proposes a method of melody generation using random forest regression, which increases the accessibility of generative music models by addressing the downsides of previous approaches. The solution generalizes the concept of Markov chains while avoiding the excessive computational costs and dataset requirements associated with past models. To improve the musical quality of the outputs, the model utilizes post-processing based on various scoring metrics. A user interface combines these modules into an application that achieves the ultimate goal of creating an accessible generative music model.

➢ **9:10am (PA20-0041)**

Associating Exposures to Adverse Health Outcomes using Decision Trees

Aditi Purandare, Heidi Yap (Northeastern University)

The rate of preterm birth in Puerto Rico is among the highest in the United States, a serious public health issue. Environmental exposures, particularly contaminated drinking water and phthalates, chemicals widely used in industrial and consumer applications, are thought to contribute to preterm birth. We used data from a birth cohort based in the northern region of Puerto Rico, known as PROTECT, to examine phthalate levels in drinking water and corresponding phthalate concentrations in the urine of pregnant women. We identified and evaluated predictors of preterm birth based on these findings. In this project, we performed two analyses: i) compared tap water contaminant concentrations and participant health status, and ii) evaluated associations between water and urinary concentrations of phthalate metabolites. We leveraged Decision Trees to predict preterm birth and learn the important features. We addressed the issue of using highly imbalanced data by utilizing an AUC split criterion. For the tap water model we found the key features included health indicators, phthalate concentrations, and water pipe materials. For the urine phthalate model we found the most important features to be MCNP and MCOP, followed by 12 additional phthalates. The most important features for the tap water model indicated that health, water processing, and phthalate levels were crucial to accurately predicting adverse birth outcomes using our analysis.

➢ **9:20am (PA20-0046)**

Object Permanence in Videos: DNN Performance vs Human Ability

Irene Zhou (Massachusetts Institute of Technology)

Object permanence, the idea that an object still exists when not in view, is something that comes naturally for humans. However, machine vision models are severely lacking in this area, and are often trained with datasets of objects in full view. This can be concerning, especially when we are becoming more dependent on machine vision. In order to test object permanence capabilities in humans and machine models, we have built a custom video dataset of shapes being occluded. The data was tested on human subjects via survey, as well as the SOTA object detection algorithm YOLOv3, and a novel model we call YOLO-LSTM. Results found that although human performance degrades with respect to exact object location, human subjects have high accuracy with recognizing that the objects still exist, while the YOLOv3 has linearly decreasing performance as objects become more occluded. YOLO-LSTM demonstrates more humanlike performance, but has a lower accuracy overall.

➢ **9:30am (PA20-0059)**

Real time Attention Span Tracking in Online Education

Rahul Rangarajan Kannan (Sri Venkateswara College of Engineering)

Over the last decade, e-learning has drastically changed how students learn by providing them the flexibility to learn from anywhere and any time. However, students often have the tendency to get distracted due to various reasons which reduces the learning capacity by a great extent. Many researchers have been trying to improve the quality of online education, but a holistic approach is required in order to address this issue. The intent of this paper is to monitor the real-time attention level of students during online classes. This study proposes a system which uses six parameters: blink rate, eye gaze, emotion, facial recognition, body posture and environmental noise to calculate the attention level of the student. The calculated attention level is used to generate the feedback for the student attending the online class. Various image processing techniques and machine learning algorithms are explored throughout this study. The generated feedback can be used by both students and the organization as a heuristic value in determining the overall performance of students as well as teaching methodology of the lecturers.