2020 Projects

Version 1

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- **Machine Learning and Blockchain-Backed Optimized Assignment Matching System Developed for PSWs in Ontario *(Funded by NSERC):***

TriNetra Systems Inc. (TriNetra) is an agile and fast-growing enterprise software development company specializing in IT-business alignment for service-oriented architectures, with clients like eHealth Ontario, Cigna and Element Fleet. TriNetra along with their blockchain-focused startup OctoChain Inc. (OctoChain) develops tools and solutions to aid in establishing a system of trust and transparency in the health-care human resources and staffing solution sectors. The system uses blockchain technology as a fast, easy and reliable way to confirm credentials of health-care professionals. TriNetra and OctoChain have been collaborating with ConnexHealth Inc., a health-care technology company offering an online portal that connects health-care users with professional health-care providers. Collaborating with TriNetra and ConnexHealth along with community, government and hospital stakeholders, Seneca's researchers from the School of Software Design & Data Science are actively developing and piloting a solution to extend the features of the blockchain-based platform to also include machine learning/artificial intelligence (ML/AI) capabilities. The newly developed system aims to match candidate health-care professionals to job assignments based on their entire professional profile, including certifications, training, geography, work history and availability. The overall goal of the system is to address a vastly changed PSW market and the constraints caused by the COVID-19 pandemic. For hospitals and long-term care homes, the system attempts to improve efficiencies and reduce risks. For individual PSWs, the system aims to empower, efficiently mobilize and sustainably deploy them within Ontario's health-care industry.

- **Using TensorFlow for Analysis, Learning and Optimization of Net-Zero Homes Energy Dat *(Funded by NSERC):***

Markham's I-EMS Group provides an energy management system (EMS) as a coherent solution for the distributed energy market, utilizing cutting-edge technologies in forecasting, network analysis and energy trade. Their solution helps energy providers and net-zero energy homeowners make the most from the energy generated by optimizing the

use of energy in their own home and the value of the surplus for the distributed market.

I-EMS Group collaborated with **Nooshin Beheshti**, Professor, and a student research assistant from Seneca's School of Information Technology Administration & Security to design, develop and test Artificial Intelligence-based algorithms and data mining methods. The team developed Artificial Neural Network (ANN) modules using case study data from New York and Los Angeles homes. The project successfully developed the ANN modules for I-EMS that can successfully predict Solar Photovoltaic generation and Electric Load for the company to implement into new energy profile optimization modules, advancing the company's innovative market offerings. I-EMS Group and Seneca have co-applied for funding to implement this new innovation on Seneca's new award winning Centre for Innovation, Technology & Entrepreneurship building on Newnham Campus in 2021. This project is a prime example of how Seneca Innovation's Applied Research partnerships advance local companies — impacting self-monitoring, analysis, and reporting technology (SMART) Greener cities.

- **Development of Drone-Based Inventory Auditing *(Funded by NSERC):***

Founded in 1996, Magic Information Systems Inc. (MIS) is a Toronto-based software developer specializing in integrated management information systems aimed at improving operational efficiencies for their users. They offer a broad range of solutions including their flagship product, "eWholesale", a comprehensive Enterprise Resource Planning (ERP) software. This modular and highly flexible solution helps companies to monitor all aspects of their operations, from order entry, to purchasing, to inventory control, to accounting and payroll. Their clients are mostly small and midsize businesses — namely wholesalers, exporters and importers, distributors and light manufacturers. The common thread for these companies is that warehouse operations are a vital part of their businesses. One of the most challenging, and costly, aspects of running a large warehouse is maintaining accurate information about stock quantity and location of inventory. MIS sees this as an opportunity to provide a value-added offering to its customers, and to generate additional revenue. MIS partnered with Seneca to build a proof-of-concept automated inventory audit system using drones, as an alternative to the manual approach to inventory management.

Once this R&D undertaking is complete and the design and technical challenges are resolved, the new drone-based inventory auditing solution aims to provide MIS clients with significant operating cost savings, allowing the company to increase and diversify its revenue stream and increase overall market penetration. The proposed technology is applicable across many industries, has no inherent geographic limits, and as such, has the potential of being successful globally resulting in new, high paying jobs in the sector.

- **Developing a Deep-Learning Volunteer Computing *(Funded by NSERC):***

Established in 2017, Featuremine Corporation is a Toronto-based Artificial Intelligence (AI) software developer of flexible tools for financial companies. The company provides a comprehensive ecosystem for quantitative financial research, Machine Learning (ML) and algorithmic trading, helping players in the financial sector, such as market makers and hedge funds, with deployment of AI/ML concepts into operational workflows.

One of the barriers that the company identified, and which may limit market adoption of such products, is the computing cost of operationalizing these analytic concepts. As it is typical for AI-based solutions, algorithm training often requires substantive computing power, making it very costly, and prohibitive for smaller players to enter and/or operate in this market segment. In order to reduce this barrier, Featuremine is partnering with Seneca to research and develop a secure distributed volunteer computing framework that will enable development and commercialization of their new Deep Learning product for financial markets.

- **Development of Knowledge Base for Contextualized Recommendation Engine for the 'Your Doctor Online' Telehealth Platform *(Funded by NSERC):***

Founded in 2016 and based in Mississauga, Ont., HealthATech Solutions Inc., owns and operates a website called yourdoctorsonline.com (or YDO). The platform allows users to access accredited health-care professionals 24-7 to consult with a clinician about their health concerns. A typical doctor's session involves parallel text-based chats, during which the doctor interacts with several users. This model requires the doctor to spend time typing responses while keeping track of each conversation, which has a significant negative impact on clinician productivity. The company identified this as one of the main barriers to YDO's profitability, revenue growth and market adoption.

To overcome this barrier, the company needs a solution that will minimize the time doctors spend typing, while providing high-quality standard of care communication, consultation and clinical record keeping. More specifically, the company aims to build a Phrase Recommendation (PR) engine to suggest a set of phrases or sentences applicable to the topic and the context of the conversation.

The first step in developing such a tool is to build a knowledge-base (or ontology), where the existing YDO data, with over 300,000 conversations on topics ranging from child health, conception, pregnancy, and other leading consultation domains — will be clustered and classified (labelled). HealthATech is partnering with Seneca to use Artificial Intelligence/Machine Learning techniques with the goal of building a knowledge-base to enable further development of the YDO PR engine.

- **Next Generation Candidate Screening and Assessment Platform Featuring Psychological Profiling Though Gamification *(Funded by NSERC):***

This project is the first step to providing Thinking North's Purple Squirrel recruitment platform to go beyond traditional matching with a novel, data-backed holistic candidate matching process. To provide a robust system, Thinking North is collaborating with Seneca's School of Software Design & Data Science to use advanced artificial intelligence and gamification techniques to combine "psychology" and "gamification," known as "psychification," to enhance the screening aspect for a recruitment process. Psychification builds on the data at Thinking North to create a gamified, interactive way to assess how motivated candidates are for open positions within select technology industries. This psychification and screening platform will benefit companies that are challenged by the need for speed and accuracy in recruiting. Specifically, the project is addressing the emerging gig economy where staffing for projects and shorter commitments calls for an even more effective process than before.

- **Development of Machine Learning-Based Tools for Clausehound Platform *(Funded by NSERC):***

Toronto-based Clausehound Inc. supplies business law training, tools and curriculum to educational organizations: universities, colleges, incubators and accelerators. Clausehound helps its customers, which also include lawyers and entrepreneurs, to create customized contracts, allowing them to effectively and efficiently identify and resolve problems during contract drafting and negotiation. Fast and automatic processing (indexing) of legal documentation (contracts, textbooks, etc.) to identify, categorize and analyze clause language and clause explanations is the essence of Clausehound's business. The company is partnering with Seneca to develop a new Natural Language Processing, clause-matching software that will provide automatic linking of clause segments with legal commentary. By automating the matching process, Clausehound will be able to ingest new legal documents, texts and commentaries at higher speed, with better accuracy and at much lower cost, compared to manual approaches. This will remove a significant barrier to growth, currently faced by the company. Upon completion of the project, Clausehound will be able to accelerate market adoption of "private library postings". This new platform feature allows organizations to post private libraries of contract terms, creating a portal specific to the client.

- **Incremental Video Categorization Using Audio and Visual Features *(Funded by NSERC):***

Incorporated by seasoned media executives Tessa Sproule and Katie MacGuire in 2014, Vubble is a media and education technology company that builds and offers innovative solutions for trustworthy digital video curation, assessment, and distribution. Vubble has a team of editors, journalists and teachers who curate quality online video content. Curators select the best, most informative videos; and assess their veracity using the Vubble Credibility Meter, which Vubble developed at MIT, in collaboration with the Nieman

Journalism Lab, in February 2017. Vubble's editors add structured data to each video, through their "data labelling" process — tagging content using their taxonomy, which includes categories such as "topic", "tone" and "grade level".

Categorization and assignment of textual labels to the videos takes valuable time and limits the number of videos an editor can process in a day. This manual process is a hindrance to Vubble's ability to scale its operations to meet the increasing needs of its current customers and grow its customer base. Vubble is partnering with Seneca to develop and implement an automatic system, customized for video editors/curators, to categorize video material based on both visual and audio cues. Implementation of the system will enable Vubble to increase its productivity and address existing and new market demand, ultimately enabling the scaling of its business.

Vubble is partnering with Seneca on a third project to develop and implement an automatic system, customized for video curators, to categorize video material based on both visual and audio cues. Led by Professor **Vida Movahedi** and supported by students from Seneca's School of School of Software Design & Data Science, the team will work to develop a solution which will have capabilities for multi-label classification and incremental learning, thus enabling it to adapt and improve over time. Implementation of such system will enable the company to increase its productivity and address existing and new market demand, ultimately enabling its business to scale. By developing automated categorization tools, Vubble will be able to process significantly more content in a comparable time, while maintaining system accuracy and relevance, and without significant increase in operational costs.

- **Building Systems Operational Dashboard & Analysis *(Funded by NSERC):***

Mircom is a Canadian company that operates as a global player in the building solutions sector and is the largest independent fire alarm system manufacturer in North America. Mircom has large a repository of transactional data originating from its in-house enterprise-wide system. This data has been key for operational development projects and pricing of Mircom products. However, current data analysis involves substantial manual configuration and data management where the extraction of data and custom creation of spreadsheets results in delays and unoptimized pricing and forecasting of new and existing products.

Mircom's collaboration with Seneca's School of Software Design & Data Science seeks to create new knowledge systems and tools that can be scaled to the company's manufacturing and supply chain operations. Moreover, outcomes of the project will include system design and documentation of the data architecture, and machine learning tools to support advanced analytics and forecasting using data collected internally and externally. The results of this project will boost the competitiveness of Mircom in global

markets by using data effectively to improve operating margins. By implementing the tools developed, Mircom anticipates pricing reductions to enable a competitive edge in the important U.S. and Canadian markets.

- **Decreasing Barriers Faced by Low Income Communities Through the Development of Innovative Online Assistance System for Tax Filing *(Funded by NSERC):***

Income tax filing establishes eligibility for low-income Canadians to access income benefit programs. However, many individuals living within low-income brackets do not file personal tax returns due to service costs and the complexity of the process. There are community-based organizations that run free tax-filing assistance programs staffed by volunteers that provide coordination and tax expertise to help Canadians in this position confidently file their returns. However, these programs are in-person services only, making them inaccessible to people with mobility issues or those in remote communities where there is no local organization providing the service. Naturally, public health restrictions in the spring of 2020 precluded citizens' ability to access these in-person services.

In this interdisciplinary three-year project, Seneca researchers in the School of International Business & Management and School of Information Technology Administration & Security will collaborate with Prosper Canada to develop a new service with an online communications tool to support community organizations across Canada in delivering this needed tax-filing assistance to people living on low income. Consulting closely with community organizations, volunteers, and tax experts to create this new virtual service and tool, the project aims to ensure that a virtual tax preparation platform directly supports the organizations that deliver this free tax-filing assistance. This virtual service and supporting tool are a social innovation that will enable effective support of individuals living on low incomes to confidently file taxes, while also enhancing the ability of front-line community organizations in their delivery of this tax-filing assistance.

As part of the proposed project, the new virtual service and tool will be piloted in communities to study its effects on improving access and reducing the burden on the organizations delivering the tax programs. The results from this study will be presented at major conferences, provided as webinars, and the final report will be available on Prosper Canada's website. Additionally, once pilot implementations of the service and tools are completed, Prosper Canada intends to work with their network of community organizations across Canada to further implement the innovation to benefit Canadians across the country. The Principal Investigators on this project are **Varinder Gill** and **Lisa Li**.

- **Research on Software-Aided Long-Form Text *(Funded by NSERC):***

Located in Toronto, Quillsoft Ltd. is a leader in assistive technology software advancing

literacy skills — helping people read and write. In partnership with Holland Bloorview Kids Rehabilitation Hospital, Quillsoft's products, including WordQ, are used by more than 2.5 million end-users, primarily in the education field.

While WordQ, and other competing solutions primarily focus on writing, Quillsoft consistently hears from educators that students can continue to struggle with text comprehension. One of the most common complaints, from writing centres at colleges and universities, is that students can lack the capacity to properly understand relatively simple assignment questions. Teachers have consistently requested a true comprehension solution at the discourse level (e.g., understanding cause-and-effect, argumentation, etc.). Quillsoft sees a business opportunity in developing text comprehension technology and is planning to include such technology in the next generation of its products, scheduled for market release in 2022.

Quillsoft is partnering with Seneca to build a proof-of-concept addition to its technology for a visualization tool that will provide readers with insight into multi-level relationships between concepts contained in long-format texts. Once fully developed, this new and unique text comprehension solution will enable Quillsoft to increase and diversify its revenue stream and increase global market penetration.