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May 2024



HUMBER

Faculty of Applied Sciences & Technology

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MESSAGE FROM ASSOCIATE DEAN

It is my distinct honour to present the inaugural issue of our Innovative and Inspiring FAST Scholarly Journal, a platform created to showcase the work of members of the Faculty of Applied Sciences & Technology at Humber College.

In this issue, we celebrate the exceptional achievements and expertise of our faculty members who are dedicated to advancing knowledge and academic excellence in their respective fields. This journal stands as a testament to their relentless pursuit of innovation and their commitment to inspiring future generations of scholars and professionals.

Within these pages, you will discover thought-provoking articles, groundbreaking research, and invaluable insights that embody the intellectual rigor and dedication that define our faculty.

I invite the FAST academic community to participate and submit to this semi-annual journal so we can witness the impactful contributions we are making to solve real-world challenges.

Francis Syms, P.Eng.
Associate Dean
Information & Communications Technology



MESSAGE FROM GEORGES LIVANOS

Early in the fall of this academic year, several of us on the FAST transformation committee came to the realization that there was an opportunity to showcase the outstanding research projects undertaken by our esteemed faculty members.

Senior Dean Paul Griffin encouraged us to explore the possibility of creating a periodic publication that would invite contributions from faculty and anyone else doing innovative work in FAST. Paul also urged us to organize a periodic event to showcase and celebrate the scholarly work.

We started with the latter and organized the FAST Symposium Scholarly and Professional Conference in February. The success of that event and the enthusiasm of the participants exceeded all our expectations.

To continue the momentum, we launched this journal to foster collaboration and cross-pollination of ideas across various fields of study. We welcome contributions spanning a wide range of topics, reflecting the diverse expertise and interests within the FAST community.

I hope you will be inspired because yes, indeed, there is tremendous talent in our Faculty!

Georges C. Livanos, M.E.Sc., P.Eng.
Professor, Electronics/Mechatronics

Creating Resilient Communities

Project Lead: Oruba Alwan

The World Economic Forum report on global risks pegs climate change, extreme weather, and threats to planetary systems as the highest risks for the global community over the next decade (WEF 2024). Post-secondary education has a moral responsibility to prepare students to meet the challenges and opportunities of the next economy, the one we are transitioning to now.

Students in Sustainable Building, as well as other design and business programs, need to understand the challenge of net zero housing that is also affordable. Such housing does not stand in isolation and must also contribute to adaptive and resilient communities. It is imperative that case studies, stories, and research projects for these students be up to date and inspiring so that they can face the future with optimism and make the most of new opportunities.

Housing in Canada is constrained, at least partially, by building practices, context, and costs. Building practices favor on-site construction and are often cheaper than high-level modular builds. The context of land-use planning discounts orienting buildings for best outcomes with passive homes and roof top solar for net zero construction. Costs make high-level housing generally custom builds for those who can afford them.

How do we engage with students in a new narrative of net zero, affordable, housing within climate adapted communities? We need to know what is happening in the Canadian context. There is a lack of information available about projects under construction or in the design and planning phases across Canada. This project seeks to fill that gap and in doing so, provide new teaching tools for Humber professors.

Affordability is a much-publicized Canadian problem. The voices calling for some sort of government intervention have only gotten louder in the post Covid years. The issue is covered in reports ranging from the Canadian Mortgage and Housing Corporation (CMHC) to global coverage on urban affordability. Various jurisdictions have implemented policies to restrict who can buy a home and to encourage new construction. Missing from the current national conversation is much about how the new housing will also need to be climate extreme ready. Yet the story is out there, ready to be known.

A CMHC research summary notes that the largest contributor to construction costs per square foot are the exterior enclosure, structure, and site work (CMHC July 2019). Climate adaptive housing is focused on exterior enclosure and must perform at passive house level before it can become net zero. There is a conflict between affordability and climate adaptive housing. Students will have to grapple with this when out in the workforce. They need to contribute solutions and to imaginatively think of new approaches. To do that they need to learn the story of climate adaptive housing, the financial issues, and how it can be practical for various social, political, and environmental contexts in Canada.

In a bid to promote new housing models that might be more affordable CMHC also examined the possibility of modular housing with a case study in Vancouver. The conclusion was that the project demonstrated the viability of temporary, modular multi-unit buildings to meet housing needs quickly and effectively (CMHC January 2019). Off-site construction is seen as an important approach for both affordable and climate adapted housing. Students need the knowledge of these changing construction practices and how they contribute to the future of Canadian housing that is affordable and climate adapted.

Can housing satisfy social needs, be affordable, and climate adaptive? Sasha Tsenkova explores those questions through case studies and focuses on private-public partnerships across the globe including some in Canada. Social housing can often lead the industry on housing quality especially in terms of energy use and sustainability. However, this can push the envelope and make accomplishing other objectives difficult (Tsenkova, 2021). The key is to promote innovation of flexible housing models with reduced costs often using modular building elements. Innovation to meet emerging social and economic needs can also promote greener and more climate appropriate housing. The financing options for new housing to make it affordable and climate adapted is critical information for students. It is part of the overall context in which this housing must be constructed.

Sue Horner explores how developers can choose to produce multi-unit passive housing. Using a case study from Hamilton-based developer Indwell, she demonstrates how they have found that indeed costs can be met while also creating greener, more energy efficient buildings (CMHC 2018). There are other developers and designers across Canada doing on-site and off-site construction of multi-unit passive house and net zero housing. Students should know their stories and be able to network with them as future employers. Shelby Green proposes that we address the issues of planning by first eliminating all exclusionary zoning, that is, outlaw single-family zoning. He contends exclusionary zoning can be replaced by inclusionary zoning that provides incentives for multi-unit and affordable housing. Then the design needs to be smart and meet the demands required by climate change. Homes should be robust and meet both water conservation measures and energy

targets. Solar energy could be encouraged by orienting homes to the sun. These are zoning issues as well as building code requirements. Green concludes that the end goal is to create resilient communities, able to meet needs and withstand the extremes of climate change (Green 2022). Students must be able to consider how building projects, especially affordable and multi-unit projects, fit in with municipal planning and how to leverage the best situation for the housing.

This project seeks to create a tool that will enable students to research and understand multiple aspects of affordable, climate adapted housing and communities.

There is a clear lack of updated documented case studies to inform us about affordable, climate adapted housing. Research into the Canadian construction industry across the country will add to the existing research and create a data base of projects useful for educating Humber students. It will provide the tools needed to give students a base level of knowledge and the ability to pursue it as more projects develop.

What do you hope to achieve

The research will result in a data base of completed, current and future projects across Canada of affordable climate adapted housing. It will give professors an up-to-date tool for student design projects, case studies and further research.

Supporting Data

Green, S. D. (2022). Equitable, affordable and climate-cognizant housing construction. *Arkansas law Review*, 75(2), 363-380. Tsenkova, S. *Cities and Affordable Housing, Planning, Design and Policy Nexus*. Routledge, 2021, <https://doi.org/10.4324/9781003172949>.
Horner, S. New Opportunities for Affordable Housing Include 'Passive

Additional Participants and Industry Partners

Dr. Cheryl Bradbee is employed as an instructional designer in the Faculty of Engineering at the University of New Brunswick. She is a former Humber professor and currently teaches courses in the School of Urban Planning at Toronto Metropolitan University. She brings 20 years of knowledge to the project. The non-profit organization, Resilience 2:1 will act as a backup resource and support for students as needed. They will also publicize the research project on their website.

Research Grants

SEED Research & Innovation Fund

Additional Information

I am looking for a Full-time professor as a Co-Investigator from You're the information and communications Tech to help with my project Tool development: Analyze the material collected and consider how best to develop it for classroom use. This may require a D2L course template or other online means of distributing the material and making it accessible to the Humber community. The lead will be taken by Oruba Alwan (professor) and Cheryl Bradbee (professor and instructional designer). A student with knowledge of web development will be hired to do the initial work of the searchable online tool.

Frass Grass Graffiti

Project Lead: Jakub Dzamba

This project proposes the creation of grass graffiti art at Humber College North Campus and the Humber Arboretum. The graffiti will be created using cricket frass, which is a 100% organic fertilizer and growth stimulant, that is produced as a by-product of cricket farming. The intent of this project is to raise awareness for the emerging industry of sustainable insect agriculture among the student population, and to provide students the opportunity to learn and engage with future projects that could build on the proposed undertaking.

What do you hope to achieve

This project will determine if cricket frass stimulates the plant, stimulates the soil microbiome and improves soil carbon sequestration.

Additional Participants and Industry Partners

Humber Arboretum, Guelph Turfgrass Institute (TBC), University of North Carolina (Pembroke), University of Louisiana (TBC)

FRASS GRASS GRAFFITI

This project proposes the creation of grass graffiti art at Humber College North Campus and the Humber Arboretum. The graffiti will be created using cricket frass, which is a 100% organic fertilizer and growth stimulant, that is produced as a by-product of cricket farming. The intent of this project is to raise aware-

ness for the emerging industry of sustainable insect agriculture among the student population, and to provide students the opportunity to learn and engage with future projects that could build on the proposed undertaking.



Jakub Dzamba
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April 11, 2024

WHAT IS CRICKET FRASS?

FOR ALL PLANTS. NO ADDITIVES. 100% ORGANIC. PEST CONTROL. NUTRIENT BOOST. BLOOM STIMULANT. IMPROVES DROUGHT RESISTANCE.

WHAT IS FRASS?

Frass consists of chitin (particles of sloughed off cricket shells), cricket feces, and fragments of a corn-based cricket feed. Frass consistency is that of dry, fine powder made of particles about 0.25mm in diameter.



INSTRUCTIONS FOR USE:

Typically Apply to Plants: Sprinkle 5ml (1 teaspoon) of frass around the stems and roots of the plants weekly or use 20ml (4 teaspoons) monthly. Use once a month during the growing seasons. Water the plants thoroughly.

Soil Mixing, New Plants, and Transplants: Incorporate 10% to 15% frass by volume into the soil or growing medium for potted or container plants. For transplants, mix 20ml (4 teaspoons) of frass into the planting hole, place the new plant as usual, and water thoroughly. Continue to fertilize with frass monthly using any method.

Tea Preparation: Add 20ml (4 teaspoons) of frass to 1L (4 cups) of water. Let it soak for 8 hours in an uncovered container, stirring occasionally. Apply 237ml (1 cup) of the prepared tea per plant on a weekly basis. Use the tea within 24 hours. Dispose of the remaining residue in compost or gardens as it serves as excellent organic material!

Ingredients: Manure and chitin (cricket shells).

Precautions: Do not ingest. Avoid contact with eyes, open wounds, or cuts. After use, thoroughly wash any exposed skin. Keep out of the reach of children.

Storage/Disposal: Keep in the original container in a dry location. Recycle the empty container.

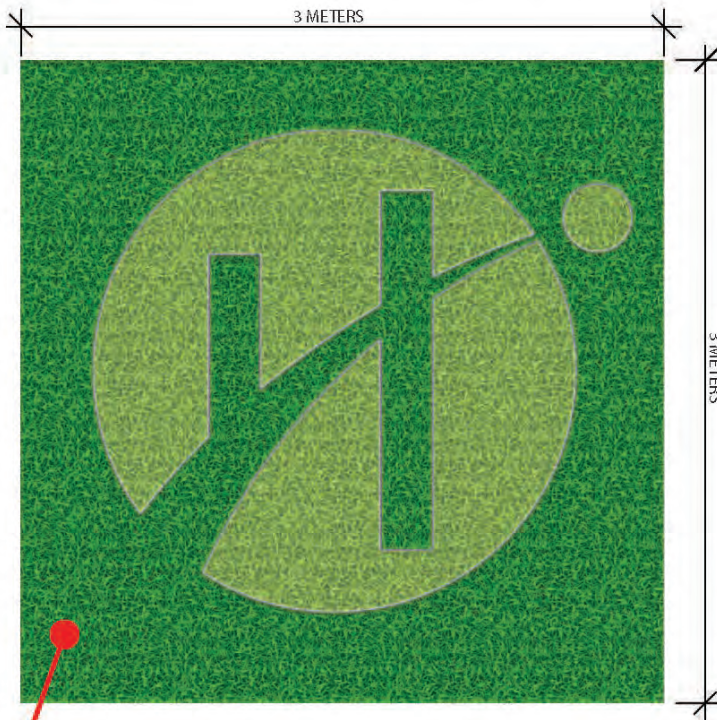


Above: Application of cricket frass on grass in a checkerboard pattern. The frass was applied on areas that turned dark green. Plants in areas with frass grew thicker stems and leaves, and demonstrated more resistance to drought.



Above: apply by dusting the area with frass, using about 500g/m². After application, water the area or wait for rainfall. Results should be visible within three days of receiving water.

GRAPHIC FOR LOCATION 1 & 2



The proposed graphic will be created using the following steps:

Stencil: It will be necessary to create a 3 meter x 3 meter stencil to create the proposed graphic. The stencil will be made from a 3 meter x 3 meter piece of mesh hoarding. The shapes that are congruent with the areas shown in light green will be attached to the mesh hoarding.

Application: The stencil will be attached to several pegs that will be driven into the ground. Once the stencil is secured, frass will be applied to the areas shown in dark green. After application, the stencil will be detached and stored. The pegs will remain in the ground to allow for re-attachment of the stencil.

Re-application: The stencil will be reattached to the pegs when reapplication of frass is required.

Left: an image of the proposed graphic to be created in the grass. The dark green represents the area that will be treated with frass. The light green is untreated area.



Left: an image of a special stake with a QR code. This will allow curious students to visit a web page dedicated explaining the project, and signing up for future updates or engagement with the project.

PROPOSED LOCATION 1



Proposed Location 1 for the stencil is the courtyard between the LRC building, N building, NX building and J building. This should allow prominent views from all buildings.

Left: a diagram of the Humber North Campus, showing the proposed location of the initial graphic.

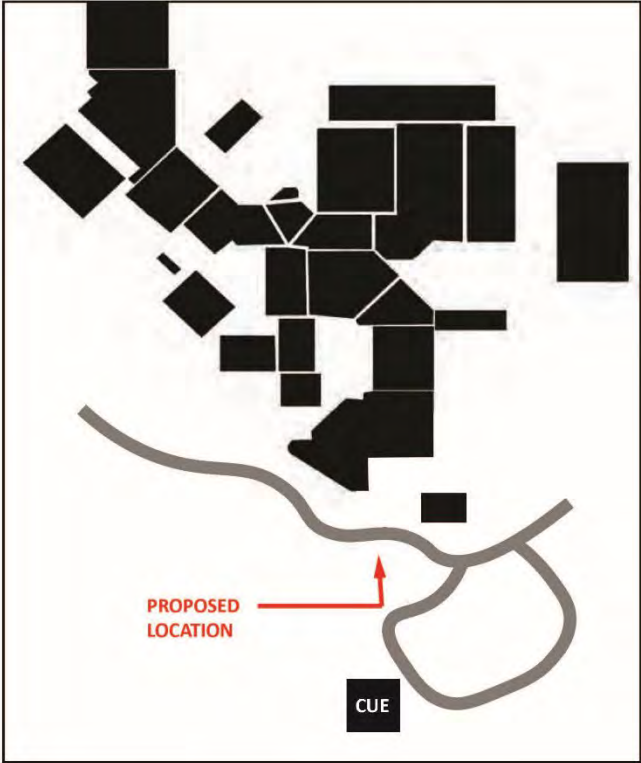


Above: a view of the courtyard, as seen from the second floor of the N building. The area of Proposed Location 1 is highlighted in red.

Below: a panoramic view of the courtyard, as seen from the fourth floor of the NX building. The area for Proposed Location 1 is highlighted in red.



PROPOSED LOCATION 2



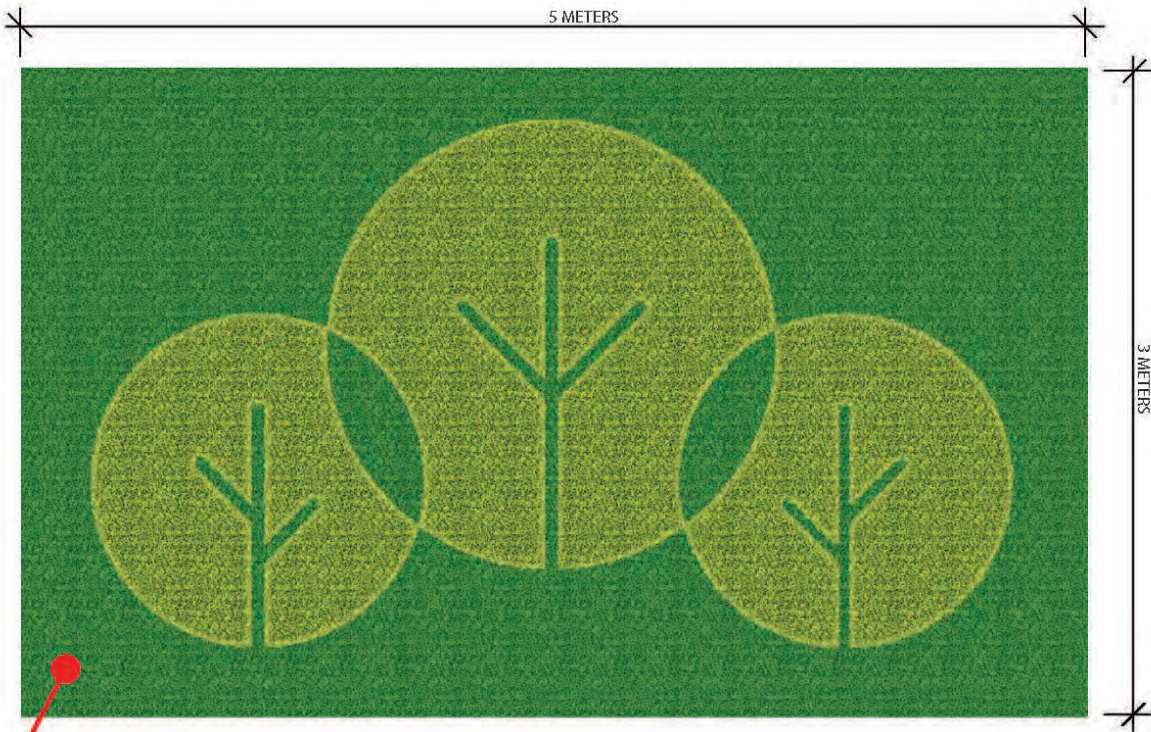
Above: Proposed Location 2 for the stencil is the embankment on the Arboretum grounds, across the road from Humber College.

Above Right: a view of the proposed location on the embankment as seen walking towards the Arboretum from the Humber grounds.



Below Right: a view of the proposed location, as it sits between two staircases along the embankment.

GRAPHIC FOR LOCATION 3



Above: the proposed graphic to be used on Arboretum lands, where the three overlapping circles of the Arboretum's logo represent its three founding partners: Humber College, City of Toronto and the Toronto Regional Conservation authority.

Left: an image of a special stake with a QR code. This will allow curious students to visit a web page dedicated explaining the project, and signing up for future updates or engagement with the project.

PROPOSED LOCATION 3



Proposed Location 3 for the stencil is the slope next to the pathway to the CUE building. This will allow prominent views for pedestrians moving between the Humber Campus and the Arboretum grounds

Left: a diagram of the Humber North Campus, showing the proposed location of the initial graphic.



Above: a view of the slope as seen walking towards the CUE. The area of Proposed Location 3 is highlighted in red.

Below: a panoramic view of the CUE and Proposed Location 3. The area of the proposed graphic is highlighted in red.



METHODOLOGY

PREMISE:

Based on experiments where frass was applied to grass, two things have become apparent. First, plants treated with frass experience growth stimulus that becomes visually apparent within 72 hours of application. The stimulus presents as grass blades that are relatively darker green, thicker and faster growing. Academic research pertaining to frass hypothesizes that the growth stimulus is the plant's reaction to the detection of chitin (cricket shells), which it recognizes as an indication of invasive insects.

The second thing that becomes apparent is that the beneficial effects of frass last at least nine months, which implies the impact of frass is perennial.

HYPOTHESIS:

The initial growth stimulus is the plant's reaction to the detection of chitin (cricket shells), which it recognizes as an indication of invasive insects. However the long term growth stimulus results from the chitin feeding the microbiome beneath the plant. This may occur as an increase in beneficial bacteria, but it may also involve beneficial fungi and mycorrhizae networks.

METHODOLOGY:

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- 1) Apply frass at a rate of 0.5kg/m² topically to the designated area.
- 2) After application, water the area thoroughly. This will prevent the wind from blowing the frass away, by ensuring it is dissolved into the soil.
- 3) Reapply the frass once per week, for three weeks in a row.

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- 4) Re-apply frass at a rate of 0.5kg/m² topically to the grassy area.
- 5) Apply only once.

OBSERVATIONS:

6) Install a camera that takes a still image of the applied area, plus 2-meter surrounding perimeter, once/hour. Camera will remain active for two years. The ability to compare the grass in the applied area to unapplied area will demonstrate the difference made by the application of frass. The ability to compare results from one year to the next will demonstrate perennial impact that frass can make.

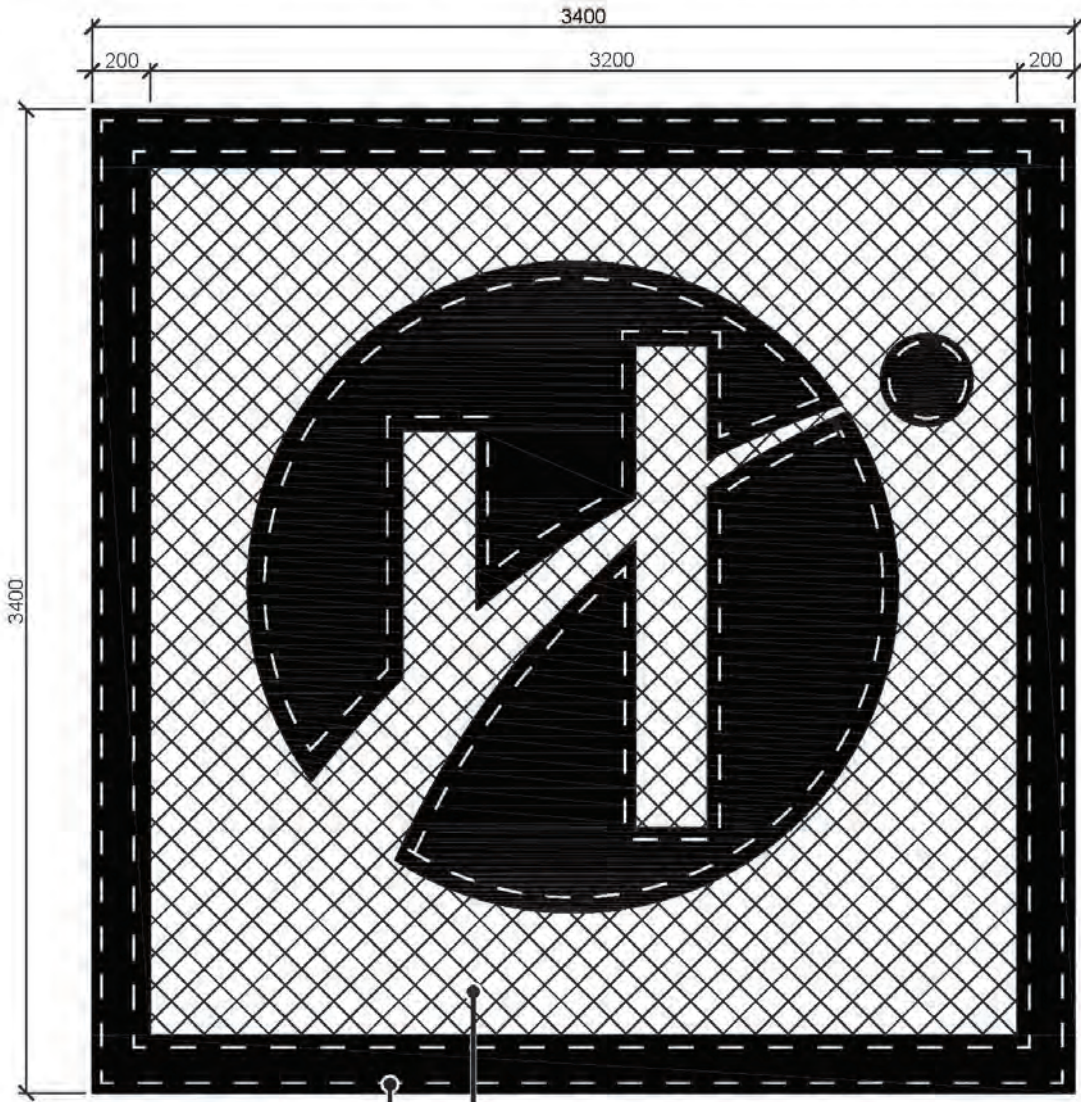
7) [This step to be reviewed, and details provided by, Jeffrey Beasley from University of North Carolina] Testing of soil of applied area and unapplied area at three months, six months, nine months, 12 months, 15 months, 18 months 21 months and 24 months. Test for soil bacteria, fungi and mycorrhizae network.

OUTCOMES:

It is possible that reapplication of frass annually may have a cumulative effect. If true, this would be a novel quality that distinguishes frass from traditional fertilizers, which produce diminishing returns year over year.



FRASS STENCIL DRAWING



SCALE 1:20

48" ORANGE PLASTIC HOARDING WITH 1.5" X 1.5" MESH. LASH HOARDING TOGETHER WITH SMALL ZIP TIES AT 150MM O.C. TO ACHIEVE DESIRED SHAPE AND SIZE.

48" BLACK FILTER FABRIC. CUT PIECES OF FABRIC AS REQUIRED. LASH PIECES TO HOARDING WITH SMALL ZIP TIES AT 150MM O.C.

A SIMILAR STENCIL WILL BE CREATED FOR THE ARBORETUM LOGO.

MyGigz

Project Lead: Yasemin Fanaeian

There is a disparity in securing successful live and streamed performance opportunities for independent and racialized performers in live entertainment. The fact is that the internet has spawned thousands of entertainers but the number of opportunities to host live and streamed performances has not been able to stay on par with the exponential increase of live performers. MyGigz will be a digital application that integrates the existing platforms of social media, crowdfunding, and live/streamed performance, as a way of creating an equal opportunity, independent artist, and audience driven touring industry.

The digital application requires information derived from social media analytics, venues (live/virtual) and the accumulated commitment from audiences to attend pending shows in order to generate confirmations - this is described as the conversion rate of a "plicket" (pledged ticket) becoming a hard ticket. MyGigz increases the number of live show experiences available to audiences, mitigates risk for venues/promoters and increases revenue potential for performers at a significantly earlier stage in their careers. This application model currently does not exist in industry and the "plicket" model will be developed.

This will be an opportunity for newer artists, especially independent and racialized performers, to have the opportunity to have venues/promoters book them as they will be mitigating their risks of loss. The application model will also integrate a variety of platforms, to increase the visibility of the artist and promote the sale of plickets.

What do you hope to achieve

Once the MyGigz app is developed in partnership with Professors Yasemin and Arman and students at Humber College, it will help change the entertainment industry by helping independent and racialized performers in live entertainment secure successful live and streamed performance opportunities. It will be a digital application that integrates the existing platforms of social media, crowd funding and live/streamed performance as a way of creating an equal opportunity for independent artists while developing an audience driven touring industry. It will increase the number of live show experiences available to audiences and it will mitigate the risk for venues/promoters and increase revenue potential for performers at a significantly earlier stage in their careers. Once MyGigz is marketed and promoted to the targeted users it will be monetized through a percentage of transactions made over the platform.

Additional Participants and Industry Partners

Arman Hamzehlou Kahrizi, Co-Investigator

Farley Flex, President and CEO of Plasma Management & Productions Inc

Mohammad Alhawamdeh and Joseph Gonsalves, Research Assistants

Research Grants

NSERC – Mobilize Greenfield Research Innovation Fund

wraparound 360

Project Lead: Yasemin Fanaeian

wrAPP or wrAPParound 360 is a digital application that will provide a list of all the available and accessible public and social services in low-income neighbourhoods. There will be many community agencies that represent an enhanced sense of cultural competency that are currently not listed on similar services. Another feature of this application that differentiates it from other similar services is that it will accumulate data on ratings and comments about the public and social service interactions and experiences of lower-income individuals and families when accessing these services in their neighbourhoods. This will then be used to identify and rank accessible supports.

The goal is to inspire public and social service providers to ensure that they are providing the highest quality, most accessible, customer experience to people from diverse backgrounds in the communities that they are meant to serve. As part of the suite of social services that Farley Flex's company, Urban Rez Solutions provides, is their work with federal and provincial correctional facilities. They are currently conducting programming in nine facilities that is aimed at reducing rates of recidivism for Black and racialized individuals upon re-entry and reintegration after release. One of the most critical contributing factors to recidivism is access and awareness of and availability to services such as housing, employment, substance dependency support, etc.

That said, it is important to recognize that the social deficiencies that wrAPP is meant to assess and address are directly aligned with the people in custody both before and after incarceration based on the neighbourhoods that they largely come from. The goal of Urban Rez Solutions is to ensure that part of their clients' reintegration includes becoming contributors and productive members of the homes and communities they live in. Another feature of this app compared to available services is that Urban Rez Solutions plans to integrate wrAPP with the Inside/Out Program that they currently provide in federal and provincial correctional facilities across Canada because the necessities and concerns are virtually identical between people living at or near the poverty line and those coming out of incarceration, as far as reintegration is concerned, who will then be able to take advantage of the services and features that wrAPP provides.

Urban Rez Solutions also plans to tie the wrAPParound Project to a Project they call Live After 5 which is a support hotline that will take calls during the currently unaddressed hours of need (5pm-9am) for people living at or near the poverty line and those coming out of incarceration. This is essential as current services are limited to hours of the day whereas

most individuals are released from incarceration in the late hours and require critical initial assistance as part of their assimilation back into their communities. Once wrAPP is marketed and promoted to the targeted users it will be monetized through advertising revenue generated from services and businesses that target the same demographic.

What do you hope to achieve

Once the wrAPParound app is developed in partnership with Professor Yasemin and Professor Arman together with students at Humber College, it will help address the barriers and challenges that racialized communities whose residents live at or below the poverty line are experiencing with respect to what are widely accepted as the Social Determinants of Health. It will empower members of racialized communities living at or below the poverty line to document customer and public and social service interactions by accumulating ratings and comments about their experiences when accessing services in their neighbourhoods.

It will provide a list of all the available and accessible public and social services in low-income neighbourhoods and then the app will accumulate data on ratings and comments about the public and social service interactions and experiences of lower-income individuals and families when accessing these services in their neighbourhoods which will then be used to identify and rank accessible supports. The goal is to inspire public and social service providers to ensure that they are providing the highest quality, most accessible, customer experience to people from diverse backgrounds in the communities that they are meant to serve.

Urban Rez Solutions also plans to integrate wrAPP with the Inside/Out Program that they currently provide in federal and provincial correctional facilities across Canada because the necessities and concerns are virtually identical between people living at or near the poverty line and those coming out of incarceration, as far as reintegration is concerned, who will then be able to take advantage of the services and features that wrAPP provides. Urban Rez Solutions also plans to tie the wrAPParound Project to a Project they call Live After 5 which is a support hotline that will take calls during the currently unaddressed hours of need (5pm-9am) for people living at or near the poverty line and those coming out of incarceration.

Once wrAPP is marketed and promoted to the targeted users it will be monetized through grants and advertising revenue generated from services and businesses that target the same demographic.

Additional Participants

Arman Hamzehlou Kahrizi, Co-Investigator

Farley Flex, Co-Executive Director and Co-Founder of Urban Rez Solutions

Tertius Kofi Obour Erskine and Justin Kyle Pimentel, Research Assistants

Research Grants

NSERC Mobilize – Greenfield Research and Innovation Fund

Sustainable Microgrid and Renewable Technology (SMART) Lab

Project Lead: Savdulla Kazazi, Ph.D., P.Eng.

The Sustainable MicroGrid and Renewable Technology (SMART) Lab at Humber College's North Campus underscore Humber's steadfast commitment to sustainability. Developed in collaboration with Siemens Canada, the SMART Lab serves as a pioneering Living Lab, offering an educational and experimental platform for training students and professionals in the utilization and control of distributed energy resources (DER) within microgrid environments.

The SMART Lab features a 2.5 KW PV Smartflower, an innovative solar energy solution inspired by the sunflower, which represents a groundbreaking approach to generating clean and sustainable energy. Equipped with state-of-the-art photovoltaic solar panels that dynamically track the sun's movement, the PV Smartflower showcases exceptional energy conversion capabilities, surpassing traditional stationary solar panels by up to 40%. Moreover, its advanced control systems facilitate intelligent sun tracking, thereby optimizing energy production. Additionally, the PV Smartflower boasts a self-cleaning feature, further enhancing efficiency by ensuring peak solar utilization.

The SMART Lab also hosts an array of field assets, including a 6 KW charge/discharge Battery Energy Storage System (BESS), a 5 KW Photo Voltaic (PV) System, a 9.6 KW level II Electric Vehicle (EV) charger, and two 3.6 KW programmable loads, among others. Through control-based algorithms programmed in the SICAM A8000 Siemens microgrid controller, the microgrid operation prioritizes economic, reliability, and sustainability considerations. The microgrid controller functions as a server for an HMI screen, enabling operators to monitor and control the microgrid's operational modes, such as grid-connected and island mode. Furthermore, it incorporates smart power quality meters for assessing harmonics, data logging capabilities, and web services integration.

Microgrids, considered as the future of energy management, represent decentralized energy systems capable of generating, distributing, and controlling electrical power. Leveraging primarily renewable energy sources, microgrids offer numerous benefits, including reduced global warming, enhanced public health, economic growth, and energy price stability.

Students at Humber gain invaluable knowledge and skills related to microgrid design, operation, and maintenance through hands-on learning experiences in the SMART Lab. This experiential learning approach fosters a holistic understanding of the multifaceted aspects

of electrical power generation, equipping students with expertise in advanced metering infrastructure, renewable energy integration, demand response, and energy management.

Furthermore, the SMART Lab serves as a collaborative hub, bringing together students, faculty, and industry partners to address real-world sustainability challenges. By bridging academia and industry, the SMART Lab not only addresses the current skills gap in renewable energy management but also fosters innovation and supports applied research initiatives in the field. Moreover, since fall 2023, it has paved the way for the offering of micro-credentials in microgrids and renewable energy, thereby bolstering the workforce with highly skilled professionals capable of driving the transition towards a sustainable energy future.

What do you hope to achieve

The SMART Lab has three main goals:

1. Hands-on learning: Students engage in real projects to gain practical experience in microgrids and renewable energy, preparing them for careers in sustainability.
2. Innovation and research: The lab collaborates with industry and faculty to explore new solutions for energy sustainability challenges.
3. Workforce development: By offering training and micro-credentials, the lab helps prepare professionals for the growing renewable energy sector, contributing to a sustainable future.



Dr. Ann Marie Vaughan, president & CEO, Humber College:

“Our energy transition to address climate change and a greener planet requires all hands-on deck. This partnership with Siemens Canada will allow our students to learn about and research the latest in microgrid technology. Humber is a national leader in infusing sustainability not only in our administration and building practices but also in our teaching and learning. Working with Siemens will enable us to train the next generation of professionals in the field of green technology and the SMART Lab will bring Humber another step closer to achieving its own sustainability goals.”

Faisal Kazi, president and CEO, Siemens Canada:

“An effective energy transition to enable decarbonization is a complex effort, and it requires a growing system of partners to tackle this enormous challenge. Siemens is proud to support Humber in offering students training on technologies that prepare them for careers vital to our climate change response and energy economy.”

Jill Dunlop, Ontario Minister of Colleges and Universities:

“It is essential that post-secondary institutions have the latest learning tools and equipment so students can develop the skills they need to succeed in the workforce. That’s why our government is proud to support this new SMART lab and the collaborative partnership between Humber and Siemens, which will provide students with the hands-on education and training they need for the in-demand jobs of today and tomorrow. It is projects like this that help find sustainable solutions within industries, prepare students for the workforce, and help drive our economy forward.”

List additional participants

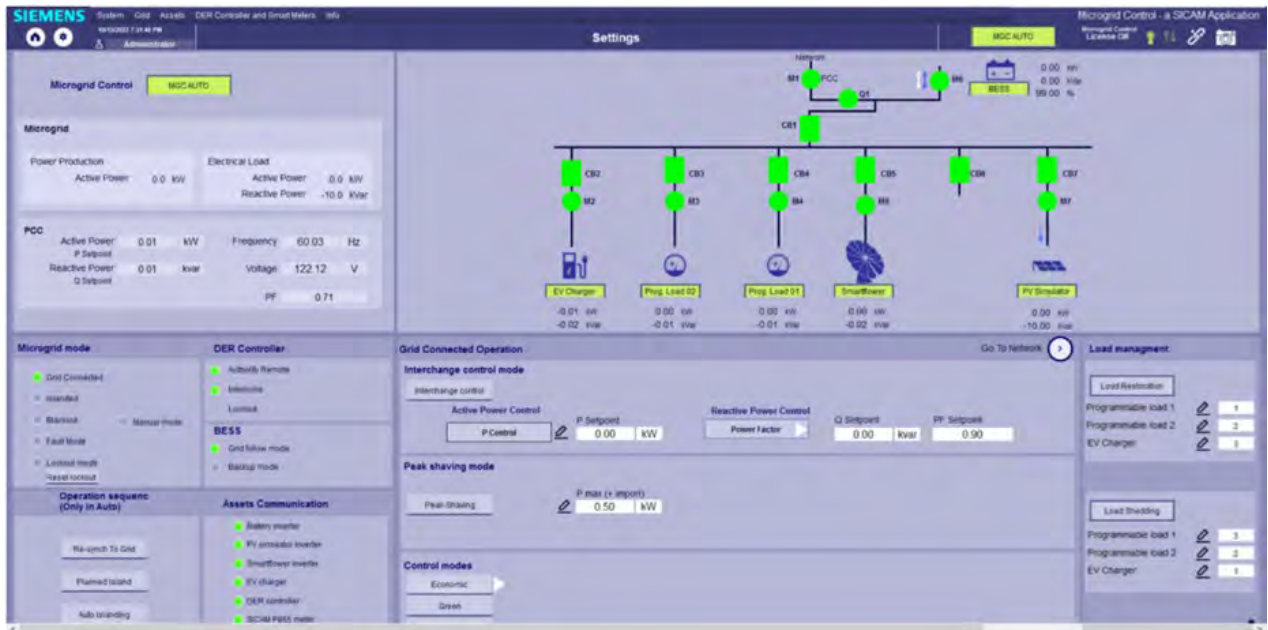
SIEMENS and other Post Secondary Institutions

Research Grants

FAST & Central CPL Secures 100K to Create Humber’s First C2R2 Micro-Credential

Additional Information

The Microgrid Credential Course has been offered twice, with each session attracting over 50 participants. These participants include a diverse mix, with 40% being Humber students and 60% representing industry and community professionals.



Cybersecurity-based IT Project Risk Management Framework

Project Lead: Haidar Jabbar and Samir Al-Janabi

In today's digital era, the prevalence of cybersecurity threats poses significant challenges for organizations globally. With these threats on the rise, the need for robust cybersecurity measures has become increasingly urgent. This project explores the critical necessity for organizations to prioritize the development and deployment of secure IT products in response to the growing risks posed by cyber threats.

At the core of ensuring the security of IT products is the implementation of a comprehensive and secure project management life cycle. This life cycle serves as the foundation through which organizations can protect their products from the initial stages of development to their eventual decommissioning. A key aspect of this approach is the seamless integration of security considerations into every aspect of IT project management. By incorporating security measures from the outset of the project life cycle, organizations can proactively identify and address potential vulnerabilities, effectively mitigating cybersecurity risks.

To address this imperative, this project introduces a pioneering framework that harmonizes cybersecurity risk management with the IT project management life cycle. This framework represents a systematic approach to cybersecurity integration, delineating a methodical sequence of steps, each encompassing a distinct set of activities. By following this structured approach, organizations can ensure that cybersecurity considerations are woven into every stage of the project life cycle, thereby enhancing the overall security posture of IT projects.

Furthermore, this project advocates for not only the inclusion of cybersecurity measures in IT projects but also their strategic, organized, continuous, and systematic integration throughout the entire product life cycle. This approach ensures that cybersecurity remains a central focus throughout the lifespan of the product, rather than being treated as an afterthought or add-on feature. By embedding cybersecurity into the DNA of IT projects, organizations can proactively address security challenges and minimize the risk of cyber threats.

To ascertain the efficacy and practical usability of the proposed framework, a thorough case study centered on the Personal Health Records (PHR) System is provided. This real-life scenario acts as a platform to evaluate the framework's capability in tackling cybersecurity

challenges within a particular domain. The outcomes of the study illustrate the framework's effectiveness in bolstering the security stance of IT projects, underscoring its versatility and scalability across various applications.

In summary, this project emphasizes the vital role of integrating cybersecurity seamlessly into the fabric of IT project management. By embracing a proactive and systematic approach to cybersecurity integration, organizations can effectively safeguard their assets, mitigate risks, and strengthen their overall cybersecurity resilience. Through the adoption of the proposed framework, organizations can navigate the intricate cybersecurity landscape with assurance, safeguarding the security and integrity of their IT products in an increasingly interconnected world.

What do you hope to achieve

The objective of this project is to emphasize the crucial significance of seamlessly integrating cybersecurity within the domain of IT project management. By stressing the necessity of a thorough and secure project management life cycle, the paper aims to underscore the urgency for organizations to prioritize the creation and implementation of secure IT products. Furthermore, it introduces an innovative framework that aligns cybersecurity risk management with the IT project management life cycle, offering a systematic method for integrating cybersecurity measures.

Supporting data

<https://www.infosecurity-magazine.com/news/cybercrime-costs-1trillion>

<https://www.verizon.com/business/resources/reports/dbir>

<https://www.bcs.org/articles-opinion-and-research/a-study-in-project-failure>

<https://www.gartner.com/en/articles/gartner-top-10-strategic-technology-trends-for-2023>

Additional Participants and Industry Partners

Samir Al-Janabi, McMaster University

Framework for Critical Incident and Emergency Response Training in Virtual Environments

Project Lead: Arman Hamzehlou Kahrizi

This dissertation presents a novel framework and a software prototype for training and evaluating the effectiveness of first responders and explosive ordnance disposal (EOD) technicians in critical incidents and emergency response scenarios. The framework, called CIERT, incorporates multiple dimensions and metrics to measure the efficacy of software-based simulations, such as virtual reality (VR), for handling improvised explosive devices (IEDs) and other high-risk situations. The software prototype, called USP, is a VR simulator that allows the implementation and participation of various real-world scenarios, such as IED detection and disposal. This work validates the CIERT framework and the USP simulator through a series of experiments and statistical analyses, demonstrating their potential and practical implications for enhancing the training and preparedness of first responders and EOD technicians.

What do you hope to achieve

This work introduced the CIERT framework and the USP simulator, which assess the effectiveness of virtual reality simulations for training first responders and EOD technicians in critical incidents. Through validation experiments, it demonstrated the potential of these tools to enhance preparedness in handling high-risk scenarios like IED detection and disposal.

Supporting data

- 1) H. Kahrizi, M. Miu, C. C. Ki Chan and A. Ferworn, "Universal Simulation Platform, a VR Simulator for IED Neutralization Training," *2022 IEEE International Symposium on Technologies for Homeland Security (HST)*, Boston, MA, USA, 2022, pp. 1-7, doi: 10.1109/HST56032.2022.10025428.
- 2) H. Kahrizi, C. Chun Ki Chan and A. Ferworn, "Universal Simulation Platform Online, A Multi-Participants I.E.D. Disposal Simulator," *2023 11th International Symposium on Digital Forensics and Security (ISDFS)*, Chattanooga, TN, USA, 2023, pp. 1-5, doi: 10.1109/ISDFS58141.2023.10131674.
- 3) H. Kahrizi and A. Ferworn, "Validating the CIERT Framework for Critical Incident and Emergency Response Training," *2023 16th International Conference on Advanced Computer Theory and Engineering (ICACTE)*, Hefei, China, 2023, pp. 1-7, doi: 10.1109/ICACTE59887.2023.10335298.
- 4) H. Kahrizi and A. Ferworn, "CIERT: A Framework for Measuring Efficacy in Software-Based Simulation Training for Critical Incidents and Emergency Response," *2023 16th International Conference on Advanced Computer Theory and Engineering (ICACTE)*, Hefei, China, 2023, pp. 1-7, doi: 10.1109/ICACTE59887.2023.10335242.

Realtime Asset Tracking – A prototype using Nordic Thingy:91

Project Lead: Baha Uddin Kazi

Internet of Things (IoT) refers to the interconnected devices and applications for the purpose of collecting and exchanging data and interact with each other over the internet. According to the several studies, it is projected that the number of connected devices globally will reach 125 billion by 2030 and global data traffic volume is expected to increase from 62 exabyte (EB) per month in 2020 to 5016 exabytes per month by 2030. One of the key drivers behind this exponential growth of connected devices and data exchange is the widespread adoption of IoT applications across various sectors in our everyday life. Asset tracking is an application of IoT technology, used for better asset management. It connects tagged objects to asset management ecosystem, providing real-time visibility into where each item is in the globe. Tracking an object in real-time can enhance logistics, resource management, and security of asset.

The objective of this project is to perform in-depth research on cellular IoT asset tracking technologies and utilize one of them to develop an asset tracking prototype. In this project we use Nordic Thingy:91, a multi-sensor cellular IoT prototyping platform. It suits a various of single device low power cellular Internet of Things (cIoT) designs. In this project, we first setup the hardware and software components of the IoT kit and connected that to the cellular network. The nRF9160 cellular module transmits sensor data to the nRF cloud using cellular network for analysis and then using the API to pull the data from the cloud to the smart phone app. We developed python scripts to extract information from the cloud using the REST API. We then explore map libraries such as Folium and ipyleaflet to determine the most effective method for implementing a real-time map solution while using python scripting.

We also use Flask, a lightweight web application framework to create a web client. Apache Kafka, an opensource distributed streaming platform has also been used to pipeline all the real-time data in the background of the client application. The simplified architecture of the project is shown in figure 1, and our developed web application featuring the visibility of real-time tracking of object movement is depicted in figure 2.

Additional participants and industry partners

Jesus Rigoberto, Gaitan Castellanos, Joseph Keaveny, and Himanshu Thakur.

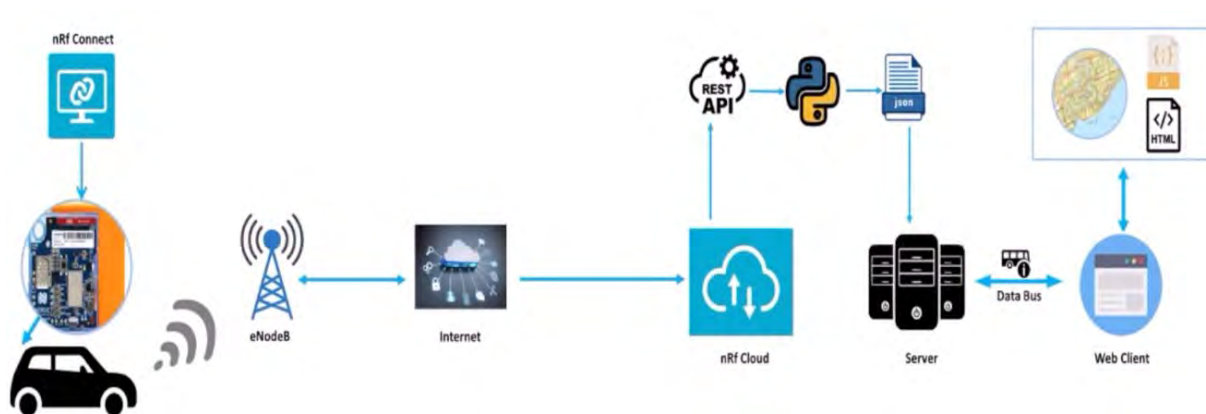


Figure 1: Simplified System Architecture

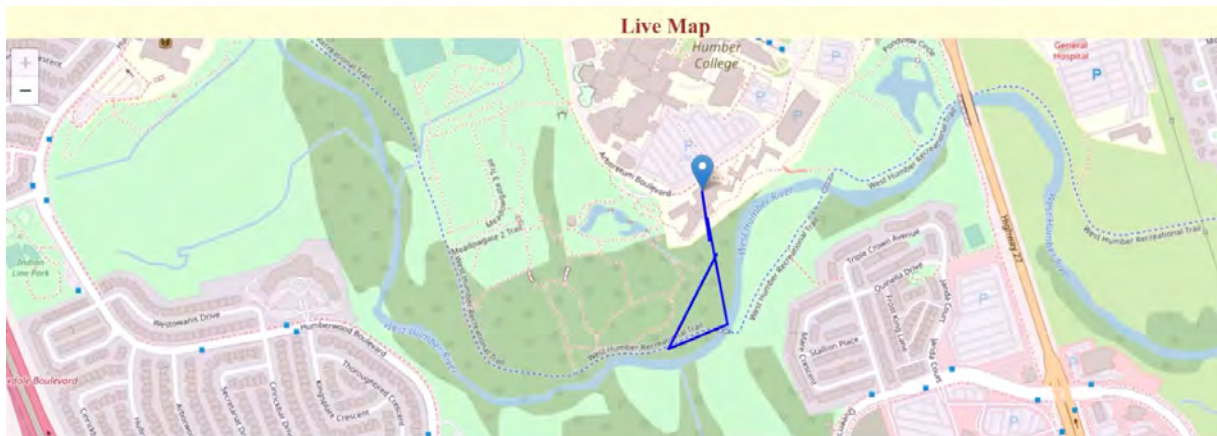


Figure 2: Real-time map of an object movement

Mobi Robot Re-design Project

Project Lead: Imran Khan

In a collaborative effort between Locomobi, FAST students and Humber's Barrett Centre for Technology Innovation (BCTI), the Locomobi Robot Re-design project aims to deliver a retro-fit parking enforcement solution. Locomobi, a renowned innovator in parking solutions, provides invaluable insights on the Mobi Robot, while the BCTI team spearheads project execution with FAST students. Addressing the evolution of parking from manual to automated systems, Mobi seeks to revolutionize the industry, introducing an automated attendant that not only complements existing systems but also explores new frontiers of efficiency and security.

This is a multi-phase project where the first phase of this project (January 2024 to April 2024) will be a design-discovery phase and will have a primary objective to deliver a comprehensive test bench demonstration of various systems for the robot, including but not limited to the following:

- Drive & Steering system
- Lighting and sound system
- Navigation and mapping solution
- Camera system

Activities that the FAST students are working on under the guidance of Locomobi and BCTI are:

- Software programming and integration of: i) drive system to control motion of robot and ii) lighting and sound system
- Explore 3D Lidar Scanners and integration with mapping softwares and libraries in order to create and save useful 3D maps
- Integration of software and mapping systems
- Research, identify and test required control boards for various systems (drive, mapping, lights and sound)
- Identify required industrial-grade components for various systems on robot (lights, wheels, speakers etc.)
- Mechanical and electrical assembly of test benches for robot's drive, mapping, light and sound system
- Formalize design recommendations to be used by the client for commercialization

The next phase of the project will start in May 2024 and is projected to be complete in December 2024.

What do you hope to achieve

During this phase of the project, we hope to demonstrate via test benches, the technologies that Locomobi can use for various systems for their parking enforcement robot which can eventually be implemented (via a retro-fit) into their existing parking enforcement robot.

Additional Participants and Industry Partners

Phase 1 FAST (Electromechanical Engineering Technology, 2nd Year) Student Participants:

- Vincenzo Lombardo
- Isaac Ruchlemer
- Aiyman Mourad
- John Flores

Industry Partner: Locomobi World Inc.

Research Grants

GRI (Greenfield Research Initiative)

Preparing IoT Comprehensive Lab for Applied Capstone Projects and Research

Project Lead: Ali Owayid

The Internet of Things (IoT) has emerged as a transformative technology, revolutionizing how we monitor, manage, and interact with our environments. Through a series of five workshops centered around diverse IoT applications, our project seeks to equip students with applicable knowledge and skills in the field of IoT through connecting these workshops to the datacentre of BCTI and configuring these workshops according to the required projects as well as encourage professors and students to conduct their capstone projects by involving partners from industry.

The workshops cover a range of topics, including surveillance systems for remote locations, environmental monitoring in data center cabinets, machinery health monitoring in industrial settings, outdoor environmental monitoring, and Wi-Fi-based security camera systems. Through hands-on experience, participants will explore the details of IoT infrastructure, sensor deployment, network communication protocols, and data management.

In the "Camera Monitoring System for Remote Location" workshop, students will explore modern security camera technologies and build networks suitable for remote monitoring, enhancing their understanding of IoT applications in surveillance.

The "Monitoring of Ambient Conditions of Data Center Cabinet" workshop equips students with skills to monitor critical environmental conditions in data center cabinets, ensuring optimal performance and safety of equipment housed within.

In the "Monitoring of Machine Motor Temperature and Lighting Intensity for Cyber-Physical (CP) Factory" workshop, students gain insights into monitoring critical components in industrial settings, contributing to enhanced efficiency and productivity.

The "Monitoring outdoor environment temperature and humidity in addition to soil moisture level" workshop focuses on environmental monitoring applications, enabling students to develop effective IoT solutions for real-world scenarios.

Finally, the "Camera Monitoring System Using Wi-Fi Camera" workshop provides hands-on experience in building IoT-based security camera systems, emphasizing the deployment of Wi-Fi IP cameras and industrial Wi-Fi network features.

In Summary, through these workshops, we aim to equip students with the necessary skills and knowledge to design, deploy, and manage IoT solutions across diverse applications, preparing them for careers in the rapidly evolving IoT industry.

What do you hope to achieve

Our goal is to provide students with useful IoT knowledge and skills so they may take on real-world problems and further the development of IoT technology. Our goal is to equip students with the necessary skills to succeed in the IoT business by giving them practical experience in developing and overseeing IoT systems.

Additional Participants and Industry Partners.

Additional participants include faculty members from relevant departments who provide guidance and support throughout the workshops. We are trying to involve our industry partner in this project like BData company which specializes in the cybersecurity field. In addition to that we are trying to include companies specializing in IoT technologies, who may provide expertise, resources, or sponsorship to enhance the workshop experience.

Additional Information

With an emphasis on real-world learning experiences, these workshops are meant to be practical learning experiences. Modern IoT technologies will be available for participants to work with, and industry experts will provide insightful commentary. In addition to improving students' academic understanding, we think that these workshops will encourage innovation, creativity, and teamwork in the IoT space.

Utilize Data Analytics to Identify common Communication Challenges for Autistic Children and Develop Customized Visual and Textual Content to Address these Specific Issues

Project Lead: Parisa Pouladzadeh

Identifying common communication challenges for autistic children and developing customized visual and textual content to address these specific issues is an important endeavor aimed at improving the communication and social interaction skills of children on the autism spectrum. Autism, or Autism Spectrum Disorder (ASD), is a neurodevelopmental disorder characterized by a range of challenges in social communication and behavior.

The project centers around the utilization of data analytics to pinpoint prevalent communication challenges experienced by autistic children. It aims to develop customized visual and textual content tailored to address these specific issues. This innovative approach seeks to enhance communication outcomes and support the unique needs of autistic children, ultimately fostering improved interactions and engagement.

What do you hope to achieve

It aims to develop customized visual and textual content tailored to address these specific issues. This innovative approach seeks to enhance communication outcomes and support the unique needs of autistic children, ultimately fostering improved interactions and engagement.

Additional Participants and Industry Partners

Researcher: Sagar Vaiyata

Research Grants

NSERC ARTP1

Additional Information

Customized visual and textual content can be a valuable tool in addressing communication challenges in autistic children, promoting their social interaction skills, and enhancing their overall quality of life. However, it's essential to remember that there is no one-size-fits-all solution, and the strategies should be tailored to meet the specific needs and preferences of each child with autism.

Application of Machine Learning in Intrusion Detection and Prevention

Project Lead: Debashish Roy

(This is a student paper: I asked the students of IEDS3525 to review articles on the application of machine learning in Intrusion Detection and Prevention Systems)

This paper reviews the advancement of Machine Learning in Intrusion Detection and Prevention Systems. Here is the abstract for the paper:

The integration of Machine Learning (ML) techniques into Intrusion Detection and Prevention Systems (IDPS) marks a significant milestone in the realm of cybersecurity. This review delves into the extensive application of ML algorithms, encompassing supervised, unsupervised, and semi-supervised learning across diverse domains such as network security, Internet of Things (IoT), industrial control systems, and smart grid networks. By meticulously examining the capabilities and limitations of ML approaches, particularly in detecting novel threats and adapting to emerging attack vectors, the article underscores the proactive defense mechanisms facilitated by ML-based IDPS.

Additionally, it emphasizes the importance of hybrid approaches, combining multiple ML techniques, to bolster intrusion detection systems' effectiveness. Critical factors such as data quantity, quality, interpretability, and collaborative efforts are highlighted as pivotal aspects in optimizing intrusion detection systems. Overall, this review provides invaluable insights into leveraging ML to enhance cybersecurity defenses, improve threat detection accuracy, and reinforce the resilience of networked systems against the evolving landscape of cyber threats.

What do you hope to achieve

This paper will be helpful in order to develop new ideas on Machine Learning for Intrusion Detection and Prevention Systems.

Additional participants and industry partners

Rupinderjit Kaur and Jaspinder Kaur

Automated Solution for Bending of Heating Elements

Project Lead: Ali Taha

In collaboration with StackTeck Systems Ltd., Humber's Mechanical Engineering degree students and the Barrett Centre for Technology Innovation (BCTI), students are working to develop an automated solution to bend heating elements required for plastic forming equipment.

StackTeck is a local Brampton-based provider of plastic tooling solutions for the injection molding industry, delivering higher productivity to the Caps, Closures, PET Preforms, Thin Wall Packaging, Technical and Medical worldwide market.

Since the end of January 2024, Humber electromechanical engineering degree students have started working to research & design a prototype concept to automate the bending of heating elements used in Stack Teck's plastic forming operations.

Project Deliverables for the prototype concept which the students will be working on include the following:

- Final Report (design calculations, components list etc.)
- 3D CAD Models
- 2D Drawings:
 - Mechanical drawings
 - Electrical drawings

Thus far, students have been able to design and fabricate preliminary concepts of what the heating element bending solution could look like. Preliminary concepts were developed based on a review of the students' research and the customer's design requirements.

Students have worked with Humber's BCTI staff to 3-D print and laser cut components based on 3D CAD files the students designed for concepts of the prototype solutions. The 3-D printed and laser cut components for each prototype concept were then assembled, and in a team of 2, the students manually tested each prototype solution and evaluated the capability of each solution in a variety of categories, including but not limited to the following:

- Ability to achieve minimum and maximum required heating element bend radius
- Ability to achieve minimum and maximum degree of bend
- Ease of bend operation

As students are nearing the completion of the initial term of the project, students will present the results of their prototype testing to the customer and will discuss which prototype solution to move forward with in the design process. The project is expected to be complete in December 2024.

What do you hope to achieve

We hope to deliver an initial 3D model concept to demonstrate automated bending of heating elements that are assembled into injection molding equipment.

Additional participants and industry partners

FAST (Mechatronics Engineering Degree) Student Participants:

- Amelia Soon
- Oscar Emiliano Rodriguez

Industry Partner: StackTeck Systems Ltd.

Research Grants

GRI (Greenfield Research Initiative)