ST. CLAIR COLLEGE

RESEARCH AND INNOVATION

WHERE EDUCATION MEETS INNOVATION

OUR TEAM

RESEARCH AND INNOVATION

The team leverages their collective skills to collaborate with businesses and community partners, providing research-based solutions and technical services. Utilizing state-of-the-art facilities at the Ford Centre for Excellence in Manufacturing and the Centre for Applied Health Sciences, they empower growth through collaborative innovation. By developing innovative products and processes integrated into business practices, they drive innovation through strategic partnerships, advanced technology, and impactful research.

AREAS OF RESEARCH

St. Clair College's Department of Research and Innovation is dedicated to advancing academic excellence through a robust portfolio of research and development initiatives across various disciplines. Our focus areas encompass cutting-edge technologies and practical applications that drive innovation and address industry needs:

Artificial Intelligence and Simulations

We specialize in harnessing AI to optimize processes and enhance design across industries, providing tailored solutions through transformative AI models and simulations that predict outcomes and streamline operations.

Robotics and Automation

Our research in robotics spans hazardous environment applications, contributing to technological advancements in manufacturing and agriculture sectors, thereby addressing labor shortages and shaping future work environments.

Advanced Manufacturing and Industry 4.0

Through initiatives in advanced manufacturing and Industry 4.0, we integrate technologies to boost efficiency, quality, and agility in production processes. This includes material science advancements and leading additive manufacturing capabilities.

Advanced Automobility

Our focus on electric vehicle technologies, cybersecurity, and connected autonomous vehicles supports the automotive sector's transition to sustainable mobility solutions, enhancing safety and efficiency in transportation.

Battery Research

We conduct comprehensive research on battery performance, sustainability, and recycling to support Canada's commitment to ethical EV production and battery technologies.

Cybersecurity

Our expertise in cybersecurity protects critical infrastructure across automotive, agriculture, and manufacturing sectors, ensuring data integrity and operational continuity in an increasingly digital landscape.

Aerospace

Research in aerospace advances material science, additive manufacturing, and AI-driven simulations, optimizing safety and efficiency in aerospace systems through predictive analytics and industry collaboration.

Climate Change

Climate Change research at our institution focuses on understanding the impacts of global warming, developing sustainable solutions, and mitigating adverse effects through innovative technologies. Our multidisciplinary approach combines climate modeling, renewable energy advancements, and policy analysis to combat climate change and promote environmental resilience.

AREAS OF RESEARCH

Uncrewed Vehicles

We develop autonomous vehicle technologies, including drones and autonomous hovercrafts, integrating advanced sensors and AI for optimized performance and safety in various applications.

Mental Health Resources and Minimizing Barriers

Dedicated to improving mental health access, this project collaborates with healthcare providers and community organizations to reduce barriers and create a supportive environment for comprehensive mental health care.

Healthcare

Our healthcare technology research focuses on enhancing diagnostic accuracy, treatment efficacy, and operational efficiency, supporting improved patient outcomes, and streamlined healthcare delivery.

Cleantech

Innovation in cleantech drives sustainable solutions, developing renewable energy sources and eco-friendly practices to accelerate Canada's journey to becoming a net-zero nation.

Youth Homelessness

Focused on addressing youth homelessness, this project leverages innovative research and community collaboration to develop sustainable interventions, enhancing the quality of life and future opportunities for homeless youth.

Applied Nano Biotechnology

With expertise in nanobiotechnology, we innovate solutions for healthcare, agriculture, and environmental sustainability, leveraging microfluidic devices and lab-on-chip technologies.

Mining

Our mining initiatives aims to enhance safety of mines and improve mining equipment reliability and efficiency through AI-powered predictive maintenance. By utilizing IoT sensors on critical machinery, and safety equipment we continuously monitor key parameters like temperature and vibration, falls, near misses and if a forklift or heavy machinery is approaching. Advanced AI models analyze this data in real-time to predict equipment failures, minimizing costs, improving safety and extending equipment lifespan.

School Nutrition

Improve student health and academic performance through enhanced nutritional programs, promoting better eating habits and well-being among school-aged children.

Advanced Agrifood Research

Integrating IoT, robotics, and AI, our research enhances safety, productivity, and sustainability in agriculture, supporting smart farming practices and food industry predictions.

Through these diverse research endeavors, St. Clair College Research and Innovation department maintains a steadfast commitment to advancing knowledge, fostering innovation, and making a meaningful impact on industry, society, and the environment.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

5 Researchers focused on the supervision of all system requirements. Engineering and Technical Team focused on the development and implementation of automated systems and quality control integration. Student researchers participated in all phases of the project, gaining hands-on experience and contributing to the system's optimization and testing.

Automated CNC Mold Polishing and Quality Control Project

Project Overview

In collaboration with St. Clair College, industry leaders embarked on implementing a fully automated mold polishing system complemented by a 3D scanning-based quality control mechanism. This advanced system is designed to detect any deviations during the polishing process, allowing for real-time corrections, thus improving efficiency and precision in mold production.

Purpose/ Objective

The project aimed to automate the mold polishing process and integrate in- process quality control to enhance precision and reduce costs at partners Group. By automating this final and critical stage of mold production, the goal was to significantly decrease manufacturing time and expenses while maintaining high-quality standards.

Company Information

St. Clair College partnered with an industry leading company to specialize in precision mold manufacturing, serving critical sectors such as aerospace and automotive industries. This partnership between St. Clair College and industry leaders has allowed limits to be pushed in 3D scanning.

Deliverables

- **Automated Polishing System:** Developed and implemented a CNC-based automated polishing system capable of handling complex mold geometries.
- **3D Scanning and Quality Control:** Integrated a non-contact, in-process quality control system using 3D scanning to monitor and correct the polishing process dynamically.
- **Standardization of Procedures:** Established standardized practices for operating the new integrated technologies, enhancing the workflow efficiency at Windsor Mold Group.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

6 Student Researchers. Location scouting to electrical design. Tool for evaluating GIRCS locations. Focus on renewable energy sources. Detailed site plan for industry leaders.

Grid Independent Remote Charging Station (GIRCS)

Project Overview

Through industry leader's funding, St. Clair College partnered to advance EV charging infrastructure research, focusing on remote, grid-independent solutions using 100% renewable energy.

Purpose and Objectives

Develop a tool for evaluating potential GIRCS locations and creating a site plan for a prototype in Ontario, emphasizing sustainability and remote access.

Company Information

St. Clair College partnered with industry leader, based in Windsor, Ontario, to specialize in affordable and sustainable EV chargers for both residential and commercial use, collaborating with leading brands to push the boundaries of EV charging technology.

Approach

- **Constraints:** GIRCS must be remote, in Ontario, and utilize renewable energy exclusively.
- **Energy Assessment:** Total energy needs and autonomy days calculated, ensuring safety for non-generation days.
- **Location Scouting:** Identified potential sites with no nearby charging stations.
- **Tool Development:** For calculating energy storage, generation mix, annual energy fluctuations, and cost analysis.
- **Site Planning:** Including layout of energy devices, storage, and overall land use, paving the way for construction readiness.

Deliverables

- A comprehensive tool for evaluating GIRCS locations, focusing on renewable energy sources. A detailed site plan for a GIRCS prototype, including:
  - Energy generation and storage layout.
  - Land use planning.
  - Electrical design and drawings.
- Prepared documentation for professional engineering review and future construction.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

2 Researchers conducted biodegradability testing of 3D printing filament blending for effectiveness of combining materials.

3D Printing Filament Development Project

Project Overview

The St. Clair College Research and Innovation department partnered with industry leaders to explore the potential of using filled materials for 3D printing filament by incorporating recycled or waster materials. The study compared the mechanical properties of three blends of biodegradable polymers using tensile and impact tests. The results found that the blended Polyhydroxybutyrate (PHB) and Polylactic aid (PLA) filaments offer sustainable manufacturing solutions, but their sustainability depended on application requirements. Also highlighted within the project is the importance of cautious considerations of the material properties and production development in achieving high-quality filament blends.

Purpose/ Objectives

The purpose of the project was to explore the feasibility of suing biodegradable PHB blending with PLA for 3D printing filaments. The study determined that combining the two materials can improve filament properties while also still incorporating silane can enhance the compatibility between them. The examination of the two materials also had to consider the advantages and disadvantages of each material property to evaluate the feasibility of using blended PHB and PLA filaments based on specific application requirements.

Company Information

The team excels in developing mobile robots for diverse applications, including material handling and tool manipulation on shop floors. Industry leader leverages extensive experience in the automotive and agricultural sectors to create robust, reliable systems that enhance productivity and efficiency. Their current project include advanced agricultural rovers and autonomous grass-cutting robots, showcasing their commitment to innovation and excellence in the field of robotics.

Deliverables

Biodegradable materials like PHB and PLS result in an encouraging solution for sustainable manufacturing using 3D printing. The testing for biodegradability was unable to be performed for all three of the blends due to restrictions with the industry partner, but heat resistance testing was performed for 100% PLA blend and the 75% PHB-25% PLA blend using a third party testing service. Filament blending can offer both disadvantages and advantages in comparison to single-material filaments, but it comes with many different printing challenges.

Technologies

3D Printing Technology: This research study focused on showcasing the development of biodegradable plastic filament for 3D printing.

AT A GLANCE

2 Researchers led the project in conjunction with industry leaders as the community partner with senior controls engineering and electrical engineering experiences. 3 Student Researchers were guided and gained practical experience regarding robotics programming, vision, end of arm tooling design and manufacturing and an analysis.

Automated Technology: AGV Project

Project Overview

This project developed a proof of concept process applying various automated technologies in combination to be utilized in industrial inspection applications. The study focused research efforts by the merging of four pieces of technology in a unique manner;
1) an Autonomous Guided Vehicle (AGC)
2) a collaborative robot with designed end of arm tooling
3) a mobile vision application
4) a target based visual tracking and positioning system.
The overall concepts involve an AGV which can be programmed to follow a predefined path to determine locations where the mounted collaborative robot and the end of arm tooling will position a vision system in place to photograph a distinct location or area.

Milestones

Milestone 1: Establish communication between the AMR and the UR Robot.
Milestone 2: Autonomy of the AMR.
Milestone 3: Incorporation of vision systems to the UR Robot.

Key Findings

The team was able to successfully complete one of the the three main milestones. The Autonomy of the AMR had not been completely achieved due to the issues with the AMR sensors. The incorporation of a suitable vision system to the UR Robot had been completed successfully. The ROBOTIQ vision system software functioned appropriately with the robot arm and can make decisions based on the results of the vision system. The key findings from the project include:

- Basic vision systems were successfully implemented to the UR Robot and could be improved upon in the future.
- The Autonomy of the AMR is a work in progress as the issue of the sensors needs to be resolved before further progress can be made.
- Communication between both robots can be accomplished using programming languages such as Python over ethernet connection and will be integrated as soon as the AMR is fully operational as expected.

AT A GLANCE

2 Researchers. 2 Student Researchers design of solar-powered charging solution. Focus on green energy sources and solutions.

Mobile Solar EV Charger

Project Overview

This initiative, supported by partner Funding, involves St. Clair College and industry leaders collaborating to support EV charging research. The project aims to create a flexible, mobile solution for EV charging that leverages solar energy, aligning with automobility ecosystem advancements.

Purpose and Objectives

The purpose of the project was to develop a mobile solar-powered charging system for electric vehicles (EVs) and other electrical devices, promoting the use of green energy sources.

Company Information

St. Clair College, is at the forefront of educational and research technology, often partnering with industry leaders to further push limits of electrical and structural design. Partnering with industry leaders has allowed the colleges to expand its reach and offer student researchers opportunities for a hands-on experience.

Approach

- Standards Evaluation
- Electrical Components
- List CAD and Structural Design
- Project Coordination

Deliverables

- **Mobile Charging System:** A solar-powered charging solution designed for EVs and electrical devices, emphasizing mobility and green energy use.
- **Electrical and Structural Design:** A comprehensive design including a wiring diagram, parts list, and CAD files for the structural components using industry leaders aluminum mounting system.
- **Bill of Materials:** Completion of the design phase led to the creation of a detailed bill of materials, setting the stage for the procurement of necessary components.
- **Next Steps:** The upcoming phase involves purchasing electrical and structural components, assembling the system, and conducting configuration and testing to ensure efficiency and functionality.

AT A GLANCE

2 Researchers and community partner specialists lead the technical aspects of the project, provided guidance to students, technical advice, and industry partner communication. 2 Student Researchers in the Mechanical Engineering Technology and Biomedical Engineering Technology programs were integrated into the project.

Breath Analyzer Project

Project Overview

Breath analyzers have significant potential as non-invasive medical diagnosis tools, however, their use is limited because of their inability to accurately measure break volume - required to report concentrations of volatile compounds of interest that are used for diagnostic purposes. This project designed, developed, and tested a breath volume measurement system that can attach to commercially available breath analyzers. Project outcomes aimed at opening a new market for the industry partner and provide students with unique industry-relevant and practical experiences.

Purpose/ Objective

1. To design, fabricate and program an electronic device capable of measuring the flow volume of a human breath sample.
2. The device should be handheld and low-power.
3. The data obtained from the device should be fully made available on an integrated display and/ or smartphone application.
4. The device should be enclosed by a 3D printed case protecting is from physical damage and corrosion due to exposure to moisture.

Milestones

Milestone 1: Design and construct sensor package.
Milestone 2: Design and construct a testing system.
Milestone 3: Test sensor package.
Milestone 4: Dissemination.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

2 SCC Researchers. 2 SCC Student Researchers.

Technologies:

- **C# Development**
- **Unity Development**
- **Application Development**
- **UI/UX Development**

Construction Inspection Process

Project Overview

This initiative sought to replace industry leaders informal visual inspection with a sophisticated AR solution, facilitating precise pipeline verification. By leveraging AR technology, the project aimed to introduce a more accurate, efficient, and user-friendly inspection method.

Purpose

The goal was to transform industry leaders inspection process by developing an AR application to overlay building CAD designs onto the real world, enhancing the accuracy and efficiency of pipeline inspections.

Company Background

Through a partnership between academia and industry, this project represents an innovative blend of theoretical knowledge and practical application. It emphasizes the commitment of both St. Clair College and industry leaders in advantaging construction systems.

Deliverables

- **AR Application:** Transfers partners building CAD designs into an augmented reality environment, offering a more interactive and precise inspection process.
- **Vuforia Area Target Recognition:** Integrates advanced area target recognition capabilities to accurately localize AR assets within physical space.
- **Cross-Platform Application:** Develops a versatile application using Unity, ensuring accessibility across multiple platforms for widespread use.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

Researchers Coordinated the research efforts, focusing on integrating simulation technologies with practical applications. Software Development Team, Worked on developing the software tools necessary for creating and managing digital twins within the VR environment.

Digital Twin Enhancement Project

Project Overview

St. Clair College partnered with industry leaders and utilized funding to advance their digital twin technology. The project focused on creating detailed virtual models of physical systems and enviornments facilitating advanced simulations and interactions within a virtual reality framework. This initiative aimed to provide a more dynamic and interactive platform for both teaching and rseaerch, fostering deeper understanding and innovation.

Purpose/ Objective

This project aimed to develop a comprehensive digital twin model that integrates real-time data and simulations to improve the design and testing processes at St. Clair College. The objective was to enhance research capabilities through virtual reality (VR) and simulation technologies, enabling more efficient and innovative approaches to academic and industry projects.

Company Information

St. Clair College is at the forefront of educational and research technology integration, often collaborating with industry leaders to push the boundaries of digital simulation and modeling. The college's dedication to adopting cutting-edge technologies ensures that its students and faculty are well- equipped to meet the challenges of modern industry demands.

Deliverables

- **Advanced Digital Twin Models:** Developed sophisticated digital representations of physical systems for simulation and analysis.
- **VR Integration:** Implemented virtual reality technology to create immersive and interactive research and learning environments.
- **Simulation and Analysis Tools:** Utilized software to enhance the capability for complex simulations, improving accuracy and efficiency in project outcomes.

Technologies

- **ANSYS Software:** Utilized for creating and managing simulations within the digital twin framework.
- **Virtual Reality (VR):** Deployed to enhance the interactivity and immersion of the digital twin models.
- **3D Modeling and Simulation:** Advanced modeling techniques were used to construct detailed and accurate representations of physical and virtual objects.

AT A GLANCE

Researchers spearheaded the project, focusing on the integration of digital and robotic programming. Simulation and Modeling Team worked on the development refinement of the digital twins models ensuring and accuracy. Technical Support Team provided ongoing support for software and hardware issues, ensuring smooth the virtual environment.

Digital Twin of an Automated Robotic Cell Project

Project Overview

In partnership with Industry leaders, St. Clair College utilized the capabilities of Tecnomatix Process Simulate software to simulate and optimize robotic operations. The project focused on developing a seamless process from digital twin creation to robotic programming and execution within a virtual setup, allowing for enhanced design, testing, and validation of manufacturing processes.

Purpose/ Objective

The project aimed to create a digital twin of an automated robotic cell for virtual commissioning, integrating robot programming within a virtual environment. The objective was to refine the development environment. The objective was to refine the development and operational processes using digital twins, enhancing the efficiency and accuracy of robotic cell setups.

Company Information

St. Clair College continues to lead in the integration of simulation technologies into educational and practical applications, partnering with industry leaders to push forward the capabilities of digital manufacturing and robotic automation.

Deliverables

- **Digital Twin Creation:** Developed a detailed digital twin of the robotic cell, enabling precise simulation and analysis of robotic paths and operations.
- **Robot Programming Integration:** Integrated robot programming within the virtual environment to simulate actual manufacturing processes accurately.
- **Virtual Commissioning Platform:** Established a robust platform for virtual commissioning, allowing for the identification and rectification of potential issues before physical implementation.

Technologies

- **Tecnomatix Process Simulate:** Utilized for creating and managing digital twins and simulating robotic operations within a virtual environment.
- **Robot Simulation Tools:** Employed advanced simulation tools to create accurate and efficient robotic programming paths.
- **Virtual Reality Integration:** Applied VR technology to enhance the interactivity and realism of the digital twin models.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

2 Researchers focused on the design and integration of flexible PCBs into plastic molds. 2 Engineers specialized in the adaptation of the molding process to accommodate electronic components. 2 Student Researchers contributed to the prototype development and testing, gaining hands-on experience in a cutting-edge manufacturing environment.

Wireless Charger Integration Project

Project Overview

Industry leaders partnered with St. Clair College to leverage advancements in flexible electronics to enhance their manufacturing process. The project involved developing a wireless charger prototype to showcase the company's embedded electronics manufacturing capabilities. This initiative positioned partners to meet growing demands for integrated electronic solutions in plastic components.

Purpose/ Objective

This project aimed to integrate flexible PCB technology into plastic molded parts, enhancing molding capability to embed advanced electronics directly into industry leaders products. The goal was to develop a proof of concept for a solar-powered wireless charger embedded in a cellphone case, demonstrating the practical application of embedded flexible circuits in consumer products.

Company Information

St. Clair College is at the forefront of educational and research technology , often partnering with industry leaders who specialize in plastic injection molding. Their Partnership together has allowed for boundaries to be further pushed and researched in Virtual Reality and simulation technologies.

Deliverables

- **Embedded Wireless Charger Prototype:** Developed a cellphone case with an integrated solar- powered wireless charger, showcasing the application of embedded flexible circuits.
- **Flexible PCB Integration:** Demonstrated the ability to embed flexible PCBs into plastic molded parts, enhancing the product's functionality without compromising design or durability.
- **Solar Power Functionality:** Integrated a solar cell into the prototype, providing a renewable energy source for the wireless charger, aligning with sustainable manufacturing practices.

AT A GLANCE

2 Researchers were responsible for leading the connections with industry partners, access to existing data, and work alongside partners staff for the optimization, implementation, and maintenance of research outcomes. 2 St. Clair College Data Analytic Student Researchers gained practical data entry, management, and analysis experiences.

Digitized Health Data Project

Project Overview

The digitization of a data collection tool with automated database repository and reporting dashboard has provided a for-profit in-home health care service provider the capacity to monitor and assess clients regarding their need for non-medical preventative health care services. Research outcomes diversified service offerings and improved clients' quality of life and supported a growing community-based preventative care initiative. The project trained St. Clair College Data Analytics students in an industry-relevant field.

Purpose/ Objective

The project saw the early adoption of digitized health data in the region, increasing partners capacity to implement industry leaders tool. Digitization took place by developing a prototype system that included a web form to collect digital data, creating a database that automatically received web form data, and designing a reporting dashboard to analyze the web form data and generate reports on client trends and needs.

Milestones

Milestone 1: Development of web forms.
Milestone 2: Development of database.
Milestone 3: Development of dashboard.
Milestone 4: Syncing, validation, and dissemination.

AT A GLANCE

2 Researchers who guided the project's research phases, focusing on system design and data integration strategies. Software Development Team comprised of 2 software developers who built the web application and integrated the database system. Data Management Team, 2 Data Analysts responsible for structuring the database and ensuring the accuracy and usability of the data within the system.

Knowledge Database and Estimating Application Project

Project Overview

In collaboration with St. Clair College, partners embarked on developing a web-based system that integrates customer standards into a dynamic knowledge database. This system enables enhanced data-driven decision-making processes and facilitates real-time updates and access.

Purpose/ Objective

The project aimed to create a knowledge database and an estimating application for industry leaders to improve the accessibility of real-time and historical data for sales and customer standards, enhancing communication across company departments.

Company Information

St. Clair College partnered with an industry leading company to specialize in a dynamic knowledge database, serving critical sectors such as Web Interface for Data Input and Retrieval. This partnership between St. Clair College and industry leaders has allowed limits to be pushed in knowledge database and estimating application.

Deliverables

- **Knowledge Database Integration:** Established a comprehensive database capturing customer standards and facilitating real-time data integration and access.
- **Estimating Application Development:** Developed an application that automatically generates estimates based on the real-time and historical data housed within the knowledge database.
- **Web Interface for Data Input and Retrieval**: Created web pages for inputting customer standards and viewing these standards, enabling seamless data management and accessibility.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

2 Researchers Engineering and Production Team managed the hands on manufacturing and assembly of the prototype, adhering to the technical specifications and design requirements. The Quality Assurance Team, 2 Quality Assurance specialists employed precision tools like the Keyence CL-sensor to verify the prototype's performance and adherence to industry standards.

Ice Skate Sharpening Enhancement Project

Project Overview

The initiative focused on developing a prototype for an automated deburring system to integrate with existing sharpening equipment. By innovating the manual process that often led to uneven sharpening and presented safety risks, the project sought to standardize results and reduce the need for extensive operator training.

Purpose/ Objective

This project aimed to improve the quality and consistency of ice skate sharpening by automating the deburring process, enhancing both the operational efficiency and safety in skate sharpening provided by partners.

Company Information

Through a partnership between academia and industry, this project represents an innovative blend of theoretical knowledge and practical application. It underscores the commitment of both St. Clair College and industry leaders leveraging safety in skate sharpening.

Deliverables

- **Automated Deburring Prototype:** Created a first-of-its-kind automated machine that integrates seamlessly with existing sharpening processes to enhance quality and consistency.
- **Precision Metrology Measurements:** Employed advanced measurement techniques to ensure that the deburring process maintains high standards in blade quality.
- **3D Surface Mapping:** Utilized to further refine and perfect the automated deburring process, ensuring all types of skate blades are honed accurately and uniformly.

AT A GLANCE

1 Researcher implemented the curating of prototypes using biodegradable or recycled materials. 1 Researcher oversaw the project design and development. 1 Student Researcher assisted the team with project designs.

Improvement of 3D Printing Processes and Products

Project Overview

In collaboration with partners, the St. Clair College Research and Innovation department has demonstrated strong successes for industry leaders and the 3D printing industry by innovating previously difficult complex print to produce sufficiently with less waste materials. This was demonstrated along with less errors, increased reliability, and increased accuracy. This project utilized the Core XY system and Voron 2.4 open- source printer design which was set in place to reduce all excess materials and equipment that may have been needed for tool changes. The implementation of this project has made advancements for 3D printing tools to allow production of complex prints with various materials as well as improving overall print quality.

Purpose/ Objective

The focus of the project was to develop an enhanced 3D printing automatic tool changer to improve the efficiency of multi-material printing in the 3D printing industry by addressing challenges such as increased costs, maintenance requirements, longer printer times, and additional waste generation. A 3D printing automatic tool changer with independent extruder heads was implemented to lower waste material and utilize biodegradable and eco-friendly materials. This type of development will make significant advances to ensure it can be used into industry practices.

Company Information

Through a partnership between academia and industry, this project represents an innovative blend of theoretical knowledge and practical application. It underscores the commitment of both St. Clair College and partners leveraging the 3D printing industry.

Deliverables

E3D Tool Changing System: curated to simplify the swapping of hot ends, extruders, and other tools through its modular tool head system.
Markforged Mark Two: the button head screw design from the bed was used for stability and realignment advantages.
Dual Extruders: extra extruders were added as secondary extruders to both Curra and Klipper software to be switched using G-Code commands to make the program more efficient.

AT A GLANCE

Over the course of three years, the research team 6 Researchers focusing on utilizing Bronfenbrenner's Ecological Systems Theory as the primary methodology. Additionally, 12 Student Researchers supported the literature review, focus groups, and pre/ post program survey analysis.

Addressing Child Literacy in Windsor- Essex County

Project Overview

The literature review of the project outlines that there is a high correlation between poverty and literacy levels as 46% of adult Canadians in the lowest literacy levels live in low-income households. Children from low-income households struggle with literacy more than their higher income counterparts. From the previous research, the research team decided to implement the One-Thousand Books Before Kindergarten program. This is a free literacy program targeted at children under six years of age. This program was designed to build a positive attitude towards reading as well as build rapport with librarians and increase library usage.

Purpose/ Objective

The overall goal of the project was to make a positive impact within the target communities both in promoting literacy learning and community support. The first milestone of the cradle-to-career strategy was meant to ensure that children are school-ready through a literacy lens. This is intended to provide the children with an opportunity at a better start to their education that they may not other have. The team at St. Clair College, along with industry leaders provided a community program that addressed both literacy needs for target neighborhoods and build more connections between families and Windsor's community supports and resources.

Results

Overall, the project has demonstrated a connection to children's engagement and literacy development to reading as well as parent's comfort in supporting this process. However, the project suggests that the fundamental positive outcome is the increased literacy engagement through local libraries and engaging families in literacy supportive activities. This can be achieved by aligning library workshops to meet the needs of families as well as providing accessibility such as online options and preferential times. The 1BBK program provided families an opportunity to engage in literacy activities at home as well as within the community.

AT A GLANCE

5 Student Researchers 5 designs, analysis, and testing. Battery management system + 120 batteries. 13 prototypes. 7 Innovations; 3D print material suitability, heat transfer & conductivity, fluid pump system and pressure, consistent flow rate and leak tests.

Lithium-ion Batteries Project

Project Overview

The partners Funding provides an ongoing framework for St. Clair College to help industry and students innovate on new or improved product, service, or process that creates added value to those impacted or influenced by it. Examples of innovations could be the application of state-of-the-art digital simulation technologies in advanced manufacturing practices to improve product quality and manufacturing time; the development of a new wearable medical monitoring device that predicts the need for medical assistance; the implementation of an improved method for monitoring differences in the use of specific social services across a city with diverse demographics. Innovations are important to historical and modern times, each collectively contributing to societal advancements and satisfying human's innate desire to explore, create, and drive change for future generations.

Purpose and Objectives

The partners solution is based on stabilizing the impact of temperature on Lithium-ion batteries. The approach includes prototype methods to develop a battery pack and immersion cooling technology that is already used in hyper cars. The services involved students from the College Mechanical Engineering APD (Auto Product Design), Mechanical Engineering Robotics, Electronics Engineering, and Data Analytics Programs. The partners solution requires innovation to make cost effective for mainstream industries ranging from energy storage to electric mobility. The main outcome is to stabilize temperature change capacity by 10-20% in extreme cold and warm environments. When such variations in cell capacity are observed, then Lithium-ion cell life drops significantly, and costs increase.

Impact

The approach includes prototype methods to develop a battery innovation to make cost effective for mainstream industries ranging from energy storage to electric mobility. The immersion cooling involves lithium-ion cells partially or fully submerged in a non-combustible, non-toxic dielectric liquid proven in hyper cars. The industry impact attracts new customers who need to maintain optimum battery temperature between 20-25 degree Celsius. The optimized battery in dielectric coolant means that industry leaders goal is to introduce a new and more efficient battery solution. The College Impact helps students gain real-world experience with hands-on learning to showcase their knowledge.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

- 1 Researcher, and 2 Student Researchers
- Vision system development
- Material construction
- Implementation

Automating Greenhouse Pepper Packaging Operation

Project Overview

The automation of a vegetable packing process will create cost efficiencies by increasing productivity and reducing labour costs, by eliminating repetitive manual tasks, allowing the reallocation of resources to more value-added roles. A local greenhouse grower of sweet peppers is seeking to use a robot to automate a custom packaging operation currently conducted by hand. Partners have had a demand opportunity to deliver a package which consists of 6 coloured peppers, where workers manually retrieve 2 peppers of 3 different colours from a conveyor belt and place them into a plastic bag. The operator then removes the bag from the station and places it into a sealer to secure the peppers. Due to the tight margins on this package the cost of packing manually with 2 operators is not a profitable endeavor. Thus, they are seeking a more cost-effective process through automation with the aid of a robot to visually detect, pick and pack peppers.

Outcomes

- **Design and program automated packaging processes:** development of a vision system that differentiates various coloured peppers. Programming of the robot to pick and place the peppers into a bag. Modified the bag stand and a process to fill the plastic bags.
- **Construct the process:** building of the process on the college site with actual peppers and conveyor belts. Conducted performance testing to meter task standards.
- **Process implementation:** incorporate the newly designed process into the operation at industry leaders.

Deliverables

The project implemented robotics technology into a Canadian greenhouse from a Canadian source rather than from overseas, as has been previously done with other greenhouses. This is an example for other greenhouses to implement Canadian robotics solutions. Student benefited from experiential learning in an industry setting, a movement that is in high demand nationally across the manufacturing sector.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

4 Researchers. 4 Student Researchers Development of augmented reality (AR) toolkit and platform. AR interface and AR test server developed for industry leaders. Integration of user-friendly AR interface.

Manufacturing Production AR Toolkit

Project Overview

St. Clair College and Industry leaders embarked on a project to develop an AR toolkit. This toolkit is designed to revolutionize how production data is accessed and utilized on manufacturing floors, particularly in the automobility sector.

Purpose and Objectives

To enhance the efficiency and decision-making of on-the-line managers in automobility manufacturing by providing real-time data through an innovative augmented reality (AR) platform.

Company Information

St. Clair College alongside of a Windsor based company known for its advanced software packages that capture and analyze manufacturing data. Their technology enables predictive and prescriptive analysis to redefine production strategies. Together their collaboration allows St. Clair College to continually push the boundaries of AR development.

Approach

- Project Evaluation and KPI Organization
- UI and Design Development
- Server and Data Management
- AR Functionality Development

Deliverables

- **AR Data Display Platform:** An AR interface developed for displaying key performance indicators and manufacturing data in real-time to enhance operational transparency and efficiency.
- **Replica Test Server:** A dedicated server to simulate manufacturing data handling, ensuring the system's functionality and reliability.
- **Phase I Completion:** Successful integration of real-time data into a user- friendly AR interface, with functionalities for data fetching and graphical representation.
- **Next Steps (Phase II):** Expansion of the application to HoloLens technology, allowing for a hands-free experience and further enhancing the suability and accessibility of manufacturing data.

AT A GLANCE

Researchers collaborated on the programming and implementation of the robotic system. Industry Expert provided industry-specific knowledge and requirements to ensure the system met operational standards. Technical Support Team supported the integration of hardware and software, ensuring seamless operation of the robotic system.

Manufacturing Automated Residual Stress Measurement Project

Project Overview

Industry leaders partnered with researchers to develop a robotic system capable of performing automated residual stress measurements. The system used computer-assisted design (CAD) drawings to guide the robot's movements, ensuring precise positioning of the measurement head at various points on complex geometries without manual intervention.

Purpose/ Objective

The project aimed to automate the process of residual stress measurement in manufacturing components using a robotic arm. The goal was to increase measurement precision and efficiency, reduce training requirements for personnel, and integrate advanced robotic and sensor technologies to enhance the overall measurement process.

Company Information

St. Clair College partnered with industry leaders known for its expertise in precision manufacturing and advanced measurement techniques. The company specializes in utilizing innovative technologies to enhance the quality and accuracy of its manufacturing processes. The partnership between the two, has allowed for boundaries to be pushed further within robotics.

Deliverables

- **Automated Robotic Measurement System:** Developed a robotic system programmed to perform stress measurements autonomously at designated points on manufactured parts.
- **CAD Integration for Automated Guidance:** Implemented CAD integration to automate the positioning of the robot's measurement head, enhancing accuracy and efficiency.
- **Advanced Sensor Implementation:** Utilized high-precision sensors, including the Keyence Laser IL-100 and X-Ray heads, to measure residual stress with high accuracy.
- **Robotic Flexibility:** Enabled the robot to rotate at +/- 45-degree angles at each measurement point to accommodate parts with complex geometries.

Technologies

- **Robot Programming:** Utilized advanced programming techniques to control the robotic arm's movement and measurements processes.
- **Sensor Technology:** Integrated precision sensors to accurately detect and measure residual stress within the manufacturing components.
- **CAD Software:** Employed CAD software to guide the robotic system in identifying and reaching measurement points accurately.

AT A GLANCE

20 St. Clair College robotics students and 15 Faculty of Education pre-service education students were hired as partners to deliver the program. Administrative staff were responsible for managing the project.

Regional Future Workforce Program

Project Overview

The Region Workforce Program set out to prepare the next generation of students for the shifting economic needs of the region/ nation. The program was developed to spark student interest in post- secondary and career pathways in STEM and Automobility to create a talent pipeline by developing an evidence-based summer camp and in- school robotics program for students in grades 7 and 9. St. Clair College along with community partners developed a robust STEM robotics program/ curriculum with the capacity for replicability and sustainability. The data on the following pages is a preliminary analysis of the data captured pre- and post-test, via surveys distributed to both teachers and students who participated in the program. The pre-post student survey was developed for both elementary and high school students (Grade 7 and Grade 9) utilizing Unfried's et al. (2015) S-STEM survey.

Objectives

- 400 LEGO SPIKE Prime robots were purchased from industry leaders for the in-school program. These are provided at a ratio of 1 robot to 2 students.
- 3 St. Clair College Robotics Faculty and 2 PhD candidates from partners Faculty of Education were hired to develop the curriculum in conjunction with the LEGO robots.
- 4 resources per lesson:
- Lesson Plan document
- PowerPoint Lesson
- Teacher Resource
- Student Resource

Results

- 4 local school boards
- 11 different schools
- 33 different classrooms
- 15 community partners
- 1000 student participants

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

2 Researchers led the project by focusing on determining the best materials suitable for crimping and welding.
1 Student Researcher supported by utilizing sustainable values for welding parameters to meet high volume production targets required by automotive OEMs.

Crimping/ Welding Process Automation

Project Overview

The project investigated the wire connections and multi-thing strands of wire with insulation and insulated structures. The project conducted the research process to determine the best materials for crimping and welding using different materials and procedures for the trials and concluded the most success in the final report. This process consisted of three unique steps: crimping, welding, and measurements while navigating challenges such as the process of connecting two different kinds of wires.

Purpose/ Objective

The project aimed to find the best materials from crimping and welding, as well as appropriate values for welding parameters to prevent any loss in strands to keep the conductivity of the wires. This consisted of developing a two- stage crimping/ soldering process for connecting the wires without reducing finished part quality. The team focused on the development by identifying both the high demand combinations and most difficult configurations, using the parametric study, analysis of the influence of total wire gauge, and testing the proposed crimping/ welding operations to examine quality.

Company Information

St. Clair College partnered with industry leaders known for their expertise in welding. Their partnership allowed the Student Researchers for a hands-on analysis to redefine the developments of Crimping/welding Automation. Industry leaders technologies were used to enable the research on the Tungsten, Tapered Tip Copper, and The Larger Tip Diameter.

Deliverables

- **Tungsten:** an electrode that is used for fusing very small workpieces like wires or ribbons together.
- **Tapered Tip Copper:** can be used if the distance between tips isn't as critical, energy will become more focused and penetrate more fully.
- **Larger Tip Diameter:** using a larger tip diameter for electrodes, can solve the concern of connection cross section while also eliminating the tripping and twisting of the wires.

Technologies

- **Welding Machine:** the welding machine was a key component to this project when conducting the resistance and bulk resistance.
- **Semi-Automated Crimping Machine:** this is a flywheel-based drive design that uses 1/3HP, 110V, 230V, single-phase electric motor to produce uniform crimps.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

2 Researchers managed the project's strategic direction, ensuring alignment with partners technical and business goals. Engineering Team, 2 Engineers who were instrumental in the mechanical design, testing setup, and simulations. Student Researchers assisted with data collection analysis, gaining practical experience in applied engineering research.

Optimization of Injection Mold Slide Project

Project Overview

In partnership with St. Clair College, industry leaders embarked on optimizing a novel slider design to streamline mold setups and reduce the complexity of manufacturing processes. The project focused on extensive mechanical testing and simulation to validate and refine the slider's design for better performance and durability.

Purpose/ Objective

This project aimed to enhance the design and efficiency of a slider component used in plastic injection molding at partners facility. By optimizing the slider through mechanical testing and finite element analysis, the goal was to increase manufacturing efficiencies, reduce costs, and improve the component's lifecycle.

Company Information

St. Clair College is at the forefront of educational and research technology integration, often collaborating with industry leading company's to further push the limits of plastic mold injection molding. The college's dedication to adopting innovative technologies ensures that students and faculty are well - equipped to meet the challenges of modern industry demands.

Deliverables

- **Optimized Slider Design:** Developed through mechanical testing and simulations to ensure reliability and efficiency in injection molding processes.
- **Mechanical Testing Framework:** Constructed a testing device to evaluate the slider's performance across numerous cycles under real-world conditions.
- **Simulation Insights:** Utilized finite element analysis to identify potential areas for improvement and to forecast long-term performance and failures.
- **Technical Documentation:** Produced detailed analysis reports and optimization recommendations to guide future production and design strategies.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

3 Researchers and Professors with 8 Student Researchers. Development of gripper system designs and slicer designs. Results focus on gripper designs and force tests.

Mushroom Picking Automation Prototype: Mushroom Gripper Project

Project Overview

Mushroom harvesting automation is being pursued in both industry and academia as this is a labour intensive process. This project focuses on understanding the mushroom picking process in a systematic manner, and developing a prototype robotic solution for white button mushrooms. To determine the baseline requirements for an automated system:

- The environmental characteristics were determined;
- The mushroom bruising characteristics were experimentally derived for wide ranges of sizes;
- Data collection was performed at industry leaders to assess the dynamics of the mushroom picking process using a specialty data collection glove and motion analysis tools; and
- Chemical resistance data was collected for potential polymer gripping tips and common fungicides and chemicals used in the growing process

Purpose

The **system components** include a stand-alone collaborative robot with custom end of arm tooling specifically designed to pick mature mushrooms from a selected area. This includes a vision system. A test bed for mounting mushrooms at different locations and orientations is used for the initial validation. **Several compliant gripper tip designs** were built using 3D printing, and tested using the force-deflection data from the mushroom bruising and the dynamic analyses as input. A 3D printing approach is taken for the fabrication as components can be made on demand and issues such as mold design and costs, and inventory management, are eliminated. Preliminary durability tests have been conducted. A calibrated finite element simulation model has also been developed to rapidly test new designs in a virtual environment. **A standalone mushroom stem slicer is designed** and tested. This approach may introduce new packaging and material handling strategies.

Looking Ahead

The long-term solutions need to include infrastructure to traverse the beds – both longitudinally and vertically. Multiple robotic systems may be required to meet the cycle time requirement. Therefore, a targeted simulation environment needs to be developed such that the system design is optimized for the farm environment.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

- 3 SCC Researchers
- 3 SCC Student Researchers
- IoT sensor implementation
  - Data Collection
- Dashboard Development
  - Data analysis

Smart Waste Management IoT Project

Project Overview

In collaboration with industry leaders and under partner funding, St. Clair College developed a smart waste management system. This innovative project utilized IoT sensors in public waste bins to gather data on fill levels, which was then processed and displayed on a custom dashboard. This technology enabled the city to monitor waste bin statuses in real time, allowing for data- driven decision-making to optimize waste collection schedules and routes.

Purpose

This project's objective was to revolutionize the public waste management system through the integration of IoT sensors. By equipping public waste bins with smart sensors, our goal was to optimize waste collection routes, enhance operational efficiency, and reduce environmental impact, thereby improving overall citizen health and safety.

Company Background

The project, a joint effort by St. Clair College and industry leaders with grant support, leveraged IoT technology under the endorsement of City officials, showcasing a successful academia-industry- government partnership.

Deliverables

The project resulted in several key deliverables:

- Implementation of IoT sensors across 360 garbage bins and 160 recycling bins, providing real-time data on fill levels.
- Development of a custom dashboard for staff, featuring geographical graphs, line charts, and bar charts to visualize data for efficient monitoring and planning.
- A comprehensive business case and cost-benefit analysis, showcasing the potential savings in operational costs, reduction in environmental impact, and improvements in service efficiency.

Smart Waste Management IoT Project represents a significant step forward in municipal waste management, leveraging technology to create a cleaner, safer, and more efficient city environment.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

1 SCC Researcher. 5 SCC Student Researchers.
Industry partners. Technologies:

- **Python Development**
- **Application Development**
- **SQL Database Management**
- **UI/UX Development**

Time Management System Project

Project Overview

This collaboration between St. Clair College and industry leaders focused on the development of a sophisticated time management system. Leveraging advanced technologies such as Python for application development, SQL for database management, and UI/UX principles for design, the project aimed to deliver a comprehensive solution for efficient and secure time tracking.

Purpose

The project aimed to modernize time tracking at partners facility using the latest technologies. Our mission was to implement a system that improves accuracy, enhances operational efficiency, and is simple for all employees to use, paving the way for more streamlined business operations.

Company Background

Through a partnership between academia and industry, this project represents an innovative blend of theoretical knowledge and practical application. It underscores the commitment of both St. Clair College and industry leaders leveraging technology for operational improvement and efficiency.

Deliverables

- **Advanced Face Recognition Technology:** A leap in secure and efficient employee identification, eliminating the need for traditional timecards.
- **Intuitive User Interface:** Ensuring ease of use for employees, with minimal training required.
- **Real-Time Management Dashboard:** Providing managers with instant insights into time tracking data for informed decision-making on payroll and resource allocation.
- **Cross-Platform Accessibility:** Making the system available on various devices and operating systems, ensuring flexibility and accessibility for all users.

Impact

The Time Management System Project sets a new standard in employee time tracking. By automating the process, the project significantly reduces the potential for errors, enhances data security, and improves operational efficiency. It stands as a testament to the power of collaborative innovation in the workplace.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

1 Researcher conducted the research elements focusing on using three different adhesive materials. 3 Student Researchers coordinated the research study efforts to assist the Researcher in the developmental phase. Software developing team: the three-dimensional finite element (FE) model of the new intermodular connection was developed using commercially available general-purpose FR software.

Vertical Connections using Mesh Adhesives Phase II

Project Overview

The project aimed to show a numerical analysis within a new beam column and intermodular connection model developed by Z Modular and the experimental testing for a simplified model. The project also showed an alternative method of performing vertical connections using adhesives. Three different adhesive material was used and tested for this project based on mesh convergence. The best choice of the adhesive was determined based on the experimental results.

Purpose/ Objectives

The St. Clair College Research and Innovation department partnered with Z modular to the demonstrate alternative methods of performing vertical connections using mesh adhesives instead of the main and smaller screws. Additionally, the University of Windsor partnered with this research project to conduct the experimental portion demonstrating how the adhesive component can enhance strength of the model on the VectorBlocs and other components of the intermodular connection.

Company Information

St. Clair College Research and Innovation in collaboration with Z Modular are known for providing researcher-based solutions into educational and applicational practices. Z Modular is a proud division of Zekelman Industries, the largest independent steel pipe and tube manufacturer in North America. Z Modular is the one-stop shop for modular buildings and services, offering a more complete factory solution than other offsite construction systems. The University of Windsor also partnered on the project for experimental application purposes.

Deliverables

- **Simulation and Analysis Tool:** FE software along with ANSYS Mechanics were utilized to fully understand the structural behaviour of the connection under axial loads.
- **Three-dimensional finite element (FE) model:** A new intermodular connection developed using commercially available FE software's to fully understand the structural behaviour of the connection under axial tension loads

Technologies

- **CAD Design modeling:** A three-dimensional CAD model for the new intermodular connection was simplified and used in this project for the stress analysis.
- **CNC Machining:** A simplified FE model for the experiment was manufactured using a CNC machine.

ST. CLAIR COLLEGE
RESEARCH AND INNOVATION

AT A GLANCE

6 Researchers on scanning and CAD modeling, animation, and programming and system development. 8 Student Researchers on animation/ modelling and programming and system development. Fully integrated virtual reality digital twin of partner's facility. Virtual models, user interfaces, and predictive modeling developed for industry leaders.

Digital Twin Project

Purpose/ Objective

The project aimed to innovate battery manufacturing for electric vehicles, addressing the need for advanced development processes. By creating a digital twin of the research facility, we sought to enhance production efficiency and innovation, making complex data and production analyses accessible in a virtual reality environment.

Project Overview

St. Clair College collaborated with industry leaders, under partner Funding, to develop a digital twin of industry leading battery manufacturing research facility. This cutting-edge project integrates virtual reality to mirror the real-world manufacturing process, allowing for detailed production data analysis and optimization in a virtual setting.

Company Information

St. Clair College, is at the forefront of educational and research technology integration, often collaborating with industry leaders to push the boundaries of battery manufacturing development. The college's dedication to advance development, enhance production, and innovation ensures that its students and faculty are well-equipped to navigate and analyze through production scenarios.

Deliverables

The collaboration produced a fully integrated virtual reality digital twin of industry leaders facility, complete with: • A detailed CAD model of the facility, forming the base for further development. •Virtual models of manufacturing processes, enriched with real-world data. • A user interface and central menu system for navigating and analyzing production scenarios. • Predictive modeling and scheduling systems to optimize production planning and cost analysis. The project not only showcases the potential of virtual reality in manufacturing but also sets the stage for future advancements in production efficiency and innovation.

ST. CLAIR COLLEGE

RESEARCH AND INNOVATION

CONTACT US

Sonja Poposki
Business Development Manager

Spopovski@stclaircollege.ca

GET IN TOUCH

stclairresearch.ca

@scc.researchandinnovation

@StClairResearch