2024
Project Day

April 6, 2024
8:30 am - 4:00 pm
Education Building

FACULTY OF
ENGINEERING &
APPLIED SCIENCE

Welcome To PROJECT DAY 2024!

The Faculty of Engineering and Applied Science is proud to present PROJECT DAY 2024!

This conference-style event includes concurrent sessions where 4th year Engineering students
present their final year design projects, and a Trade Show & Poster Session where projects will be on display.

The Trade Show & Poster Session gives you the opportunity to speak to students directly about the projects that interest you and/or your organization.

To learn more about each project, feel free to attend any presentation.

The University of Regina is situated on the territories of the nêhiyawak, Anihšināpēk, Dakota, Lakota, and Nakoda, and the homeland of the Métis/Michif Nation.

The University of Regina is on Treaty 4 lands with a presence in Treaty 6.

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"Do the difficult things while they are easy and do the great things while they are small. A journey of a thousand miles must begin with a single step."

- Lao Tzu

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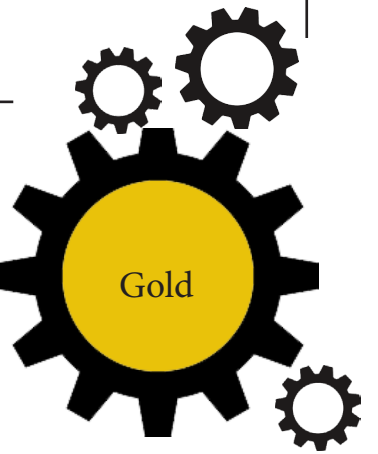

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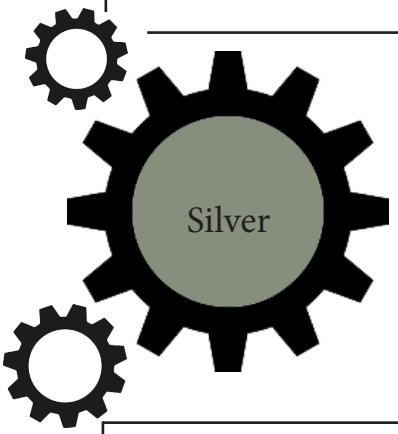
South Saskatchewan Section



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Long Term Donors

The U of R Engineering Project Day event would not be the success it is without the continued support of the engineering community in Southern Saskatchewan. This community supports us through project mentoring, evaluation feedback during the day, and also through direct financial and in kind support. Donors that have supported us over many years include:

ALFA Engineering Ltd.
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To these long time supporters, and to all who help make Project Day a success we say **Thank You!**

Sponsors

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APEGS

Association of Professional Engineers & Geoscientists of Saskatchewan

APEGS is the self-governing organization responsible to the people of Saskatchewan for licensing engineers and gescientists in the province, and for regulating the practice of these professions in the public interest.

APEGS ensures high standards of engineering/geoscience practice and education in Saskatchewan, by setting high standards for admission into the profession, by disciplining engineers/geoscientists who fail to uphold the profession's practice and ethical standards, and by preventing the misuse of the title "engineer" and "geoscientist" by individuals who are not licensed members of the professions.

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IEEE, an organization dedicated to advancing innovation and technological excellence for the benefit of humanity, is the world's largest technical professional society. It is designed to serve professionals involved in all aspects of the electrical, electronic, and computing fields and related areas of science and technology that underlie modern civilization.

IEEE's roots go back to 1884 when electricity began to become a major influence in society. There was one major established electrical industry, the telegraph, which since the 1840s had come to connect the world with a data communications system faster than the speed of transportation. The telephone and electric power and light industries had just gotten underway.

Sponsors

Thank You!

A big thank you to the people who help make Project Day possible:

- Sponsors
- Industry Evaluators
- Student Volunteers

Thank You from the Dean of Engineering & Applied Science!

Electronic Systems Engineering

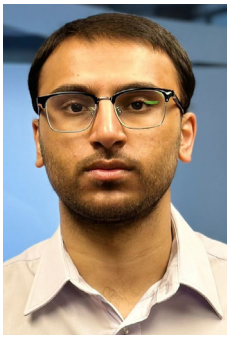
ESE 1: Analog Circuit Reliability for Low Earth Orbit Space Applications

Matthew Hajewich Evan Campbell Karim Ait-Allaoua

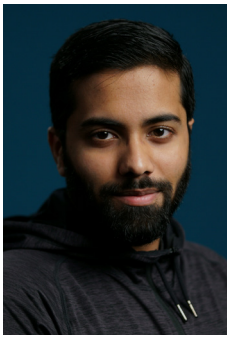
In collaboration with the University of Saskatchewan, we are contributing a payload board for the CubeSats Initiative in Canada for STEM (CUBICS). A CubeSat is a low cost, small and approachable design for students “to engage in an end-to-end space mission adapted to their needs and their level of comfort, expertise and readiness” (asc-csa.gc.ca). Our payload studies the effects of space radiation on commonly used surface mount analog Integrated Circuits (IC’s) in Low Earth Orbit (LEO). We compare different shielding to see which provides a better effectiveness to weight ratio.

Electronic Systems Engineering

ESE 2: Real-Time Road Monitoring System



Mubashir Hussain



Sarmad Alvi

We use roads daily and often are unaware of the effort needed to keep them functional. The City of Regina currently uses a variety of methods to collect data on road conditions and road usage, which are often costly and not time efficient. Our project, the Real-Time Road Monitoring System (RTRMS), aims to create a distributed real-time data collection system to augment data municipalities collect which will allow cities to optimize spending on road maintenance. The RTRMS consists of accelerometers mounted on a vehicle's suspension to sense when a car goes over a pothole. The system also monitors the vehicle's wheel speeds to determine when a vehicle is slipping. If any of these events occur, the information is logged along with the GPS position and sends it to a database via 4G. The system also sends periodic position updates to indicate road usage to the city for data analysis purposes. This data is then displayed on a user-friendly web interface.

Electronic Systems Engineering

ESE 3: Power Wheelchair with Enhanced Safety Features and Automation

Emily Schwab

Mitchell Brough

Bailey Armstrong

Our project aims to enhance the functionality of an electric wheelchair, donated to us by the Associate Dean of Research, Dr. Raman Paranjape. The wheelchair exists as part of a larger project to create a fully autonomous wheelchair system, with the ultimate goal of using it in care facilities to help a range of users navigate and thereby improve their quality of life. The existing system has aspects that have been worked on by previous graduate students; however, our design tries to improve or re-implement the subsystems that play a role in the user's overall safety. Along with upgrading manual controls, newly incorporated features include an emergency stop, tilt sensors, and obstacle detection. Our wheelchair operates on two low-power microcontrollers, providing connectivity options to high-power computers that are common in autonomous systems. Well-documented and widely available devices are used in construction, many of which are modestly priced. Modularity, documentation, and cost all play a role in our design, which will assist future teams in working towards full autonomy.

Electronic Systems Engineering

ESE 4: SSKC Raceway Signal and Control System

Lucas Carbone Lepsch Samuel Reddekop Michael King

This project introduces a new signal light system for the South Saskatchewan Kart Club (SSKC). It uses Zigbee technology to wirelessly control lights around the track and was chosen for its ability to send signals reliably over long distances with low latency. Our system also incorporates the existing pitlane light and adds a lapcount display using a robust, wired RS485 based network. By implementing these electronic upgrades, officials will be allowed to communicate with drivers more quickly and effectively, and will also allow them to host more and larger events in the future that require electronic signal light systems. This project could serve as a model for other clubs looking to upgrade their race management technologies.

Electronic Systems Engineering

ESE 5: Automated Insect Trap Monitor

Jakob Clinton Angelo Walsh Joshua Perez

Monitoring insect density is a pivotal factor in determining the optimal time to spray crops. This long and monotonous process is done by trapping insects and manually counting them. To alleviate this, the Graduate Research Team at the University of Regina implemented a solution to automate the counting of insects; our client asked us to redesign the hardware for the system due to complications during continuous operation. The Automated Insect Trap Monitor captures an image of the trap and processes it locally using a Jetson Nano. A computer vision model on the Jetson then counts the number of insects and transmits the data and image to the cloud. The redesigned system addresses power management concerns, provides nighttime functionality, allows for flexible sampling periods, and tags each photo with the field conditions and location data.

Electronic Systems Engineering

ESE 6: Yeti-Fist: The R/C Snow Plow

Mason Dyck

Vlad Kutsenko

Davis Ward

Yeti-Fist is a battery operated, Wi-Fi controlled snow plow designed to allow the user to clear a driveway or surface of snow without needing to go out into the cold and manually move it themselves. Yeti-Fist uses a controller connected to a laptop, which is connected through Wi-Fi on the plow for controls. A camera module on the plow allows the user to see in front of the machine while the plow is outside or out of sight. Various sensors allow current and temperature monitoring of various systems to ensure safe operation.

Electronic Systems Engineering

ESE 7: Spydersense: A Thermal Monitoring Hexapod Robot

Yash Gotherwal

Selamawit Temnewo

SpyderSense, introduces a spider-inspired hexapod robot which intends to support emergency responders in assessing hazardous environments. Our prototype combines thermal detection and a remote camera feed to the operator and demonstrates the usefulness of an advanced, yet affordable robotic solution to improve emergency response capabilities. Additionally, the prototype supports short-range Bluetooth remote control, providing flexibility and ease of operation for emergency responders. Through the utilization of customizable construction materials, SpyderSense aims to adapt to diverse environmental challenges.

Electronic Systems Engineering

ESE 8: LoraFireNet: A LoRa-WAN Based Wildfire Detection and Prediction System

Ashley Kanyatte

Salman Shuaib

Wildfires threaten remote forested regions and require timely detection to prevent uncontrollable spread. Current detection methods, relying on satellite imagery and human surveillance from watchtowers, suffer from delays and scalability issues. Moreover, the challenges of remote terrain and high-risk areas (like campgrounds) exacerbate these limitations. Our design implements a wireless sensor network for real-time wildfire detection and prediction. By leveraging sensor and prediction technologies, the system aims to detect fires swiftly. It communicates critical information via a low power long range mesh, linked to a cellular communications device, using renewable energy and power management.

Electronic Systems Engineering

ESE 9: QuadraVision: Telemetric Reality Bot

Savankumar Patel Jay Patel

Quadravision is an advanced mountable system designed for real-time environmental monitoring, engineered to be compatible with different types of robotic platforms across various terrains. It integrates a microcontroller with an FPGA board for the processing and overlaying of telemetry data onto live video streams. This integration enables detailed environmental analysis and enhances decision-making in complex scenarios. The system is mounted on the rover with durable DC motors and is controlled via a Bluetooth interface, emphasizing mobility and adaptability in its design. Quadravision demonstrates potential applications in areas ranging from disaster response to environmental surveillance.

Electronic Systems Engineering

ESE 10: Tap Changer Position Monitoring System

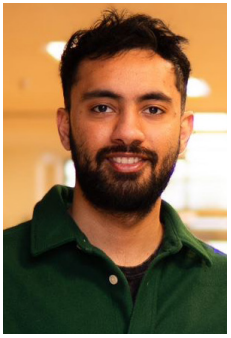
Justin Woloshin

Brennan Rotelick

Power utilities rely on adjustments of power transformers under load to meet customer voltage requirements. Several of SaskPower's substation transformers lack local indication for transformer tap position and require an engineered solution. Our project creates a retrofit design using industrial components, and a custom user interface to provide this information.

Environmental Systems Engineering

EVSE 1: Design of an Earthen Manure Storage Facility for Swine Waste Treatment



Ali Safwan Khan

Vedya Maharaj

Raj Patel

Manure produced from pigs and other types of livestock can be a significant threat to the environment. Pig farm operators take great care in ensuring that the pigs are not affected or infected. Their sanitization techniques and processes are rigorous and stringent due to the risk of the pigs being infected easily. To protect the operators, animals and the environment, the government has set standards, policies, procedures, requirements and approvals to which Saskatchewan farmers must adhere before constructing a pig farm. This project focuses on designing an Earthen Manure Storage facility for a pig farm in Southern Saskatchewan. This is crown land, and therefore the site is selected according to its geological location and the results from the soil testing performed. The Earthen Manure Storage (EMS) design accounts for all significant processes: collection, transfer, storage, treatment, and reuse. The project demonstrates this by using 3D imaging, the projected image of the design. During the project analysis, it was determined that the project would reduce or eliminate the risks associated with the pig farm, such as GreenHouse Gas emissions, groundwater pollution, diseases and bacteria transmission. This project, if implemented, will help all stakeholders reduce the environmental footprint and ensure profitable production.

Environmental Systems Engineering

EVSE 2: Alternative Design to Traditional Septic Systems for Ochapowace Nation

Ruth Samara Mamani Marianne Manaois Trisha Mae S. Junco Lanzer Ej Cruz

This project worked with the Ochapowace Nation to design three wastewater systems that serve as alternatives to existing traditional septic and holding tank systems. The project aims to achieve the primary objectives and limitations as communicated by the community's operator and by the president of the Saskatchewan First Nations Water Association (SFNWA). This includes low maintenance, low cost, clean effluent, operator-friendly and autonomy support for the community. The first alternative includes a vermicomposting system and a greywater mulch basin design for homes with septic and holding tanks. The second alternative proposes expanding pipelines to connect an additional 19 homes to the existing lagoon and the adoption of the vermicomposting system and a greywater mulch basin design for the rest of the community. The third alternative includes an Aerobic Treatment Unit retrofit for septic tanks and expanding pipelines to connect a specific number of homes to the existing lagoon. After careful evaluation, the first alternative emerged as the recommended option, receiving the highest rating on the weighted matrix created based on the community and the president of SFNWA's input. This choice reflects its alignment with the community's concerns and recommendations provided by our supervisor.

Environmental Systems Engineering

EVSE 3: Slope Stability Analysis of Saskatoon Freeway Bridge

Aditya Deshmukh Mashiyat Moumee Anand Marfatia Sukhraj Brar

The Government of Saskatchewan, through the Ministry of Highways, is in the process of a functional planning study of the proposed Saskatoon Freeway. The project is designed to reduce the congestion on the internal roads of the city by bypassing the inner-city traffic, improving the traffic flow, alleviating congestion and improving the safety. The proposed construction of the 4 lane, 55-kilometre highway routes around the perimeter of the city of Saskatoon and passes over a major river crossing. Phase 2 of the project crosses over the South Saskatchewan River, where the construction of a bridge will be required. This report analyses the slope stability considerations for the south Saskatchewan riverbank while maintaining a factor of safety (FOS) of 1.5. The typical worst-case construction loads that occur during bridge construction and the resulting impact on the riverbank slope are analyzed. GeoStudio - Slope/W is used to create 20+ models of the location of the slope under current conditions, after abutment construction, as well as the various relevant geotechnical specifications. The lithology of the site, groundwater levels, river water elevations and maximum flood events are all considered for the models created. The worst-case construction loads are considered, the placement of the equipment and the construction sequencing are outlined to maintain the FOS. The construction sequencing outlines the steps of a preliminary abutment design used for the GeoStudio models, as well as recommendations for reinforcements for longevity of the project. Erosion prevention and sediment transport control methods are outlined to prevent a compromised foundation as well as recommendations for reinforcement of the construction site and riverbank. Recommendations for the short term and long-term monitoring of the construction loads, abutment, and riverbank are also discussed in this report. Environmental concerns, mitigations, monitoring and restoration practices are outlined for minimal disturbances to the construction site. Geotechnical instrumentation for short- and long-term monitoring are also discussed for the lifetime of the project.

EVSE 4: Predicting Air Quality and PM 2.5 Levels from Western Canadian Wildfires Using AI

Jacob Stewart Doug MacDonald Christian Anderson

This project looks at training a supervised random forest machine learning algorithm on historical data to predict the AQHI of Mosaic Stadium and the Greater Regina Area. Our group has placed sensors at Mosaic Stadium and at the University of Regina Field to aid in up-to-date air quality information for players and fans of our local teams. All air quality data is output in widgets, usable webpages accessible on any device.

Environmental Systems Engineering

EVSE 5: Moose Jaw River Weir Modernization and Fishway Integration near Burdick

Austin Daley Cole Weatherall Rylan Neiszner

Throughout Saskatchewan, many hydraulic structures, such as weirs, have been constructed to improve water resources management. As many of the weirs throughout Saskatchewan reach their life expectancy, they often show signs of significant deterioration and require replacement. While these structures are useful for water resources management, they also act as obstructions in rivers, which may slow or prevent fish migration upstream. Fish require the freedom of movement to reproduce and grow throughout a series of upstream and downstream movements. Therefore, many of the weirs constructed throughout Saskatchewan have disrupted the fish movement in rivers. This project developed a weir and fishway design that could replace a deteriorating weir while also integrating a fishway to re-establish fish migratory pathways. To develop a weir and fishway design that could be used to replace a deteriorating weir, an existing weir located east of the City of Moose Jaw within the Moose Jaw River was chosen as the site location. The first stage of our project involved conducting a site survey to collect topographic data. This led to the creation of a HEC-RAS model and a topographic map using LIDAR data. Following the data collection stage, multiple options were considered and a final design was created and drawn in Civil 3D. This allowed for the weir and fishway to be shown relative to the geographical location. A physical model was also built, as a visual demonstration of our design.

EVSE 6: Proposed Upgrade Alternatives and Facility Upgrades for Okanese Cree Nation Drinking Water Treatment Plant

Alora Eberle Caitlin Gillis Areeg Ahmed Nada Hosni

Okanese Cree Nation, located northeast of Regina Saskatchewan, was a community of approximately 303 people in 2018 (BCL Engineering Ltd.). It has had a boil water advisory in effect since August 2020 (Government of Canada, 2024). Three water treatment process alternatives will be proposed to upgrade or replace the current system. The design objectives for the treatment processes must meet the Saskatchewan Drinking Water Quality Standards (Water Security Agency, n.d.) for all constituents. They must fit the upgrades into the existing building, keep the operation and maintenance requirements minimal for the local operators, be cost-effective and provide sustainable solutions. In addition to the treatment process, several facility upgrades will also be recommended. The contaminants identified in the raw water requiring treatment are ammonia, iron, manganese, sulphate, sodium, turbidity, and total dissolved solids. The recommended design of the three alternatives will consist of an upgrade of the two existing greensand filtration units to an iron and an ammonia biofilter in series. This will be followed by reverse osmosis, corrosivity treatment and chlorination. This design treats all required constituents, has a small physical footprint, minimises reverse osmosis membrane fouling with biofiltration as pretreatment, can be highly automated, and has been successful in many Saskatchewan First Nations communities due to manageable maintenance requirements.

Industrial Systems Engineering

ISE 1: Lathe Modification For Disc Machining

Sami Akbar Kunal Desai Deep Patel

Ralph McKay Industries Inc. manufactures 13” Shark-tooth disc blades and plans to improve productivity by implementing vertical turning lathes (Doosan Puma V550). The lathe modifications required designing a gripping system for self-centering, cutting, and work-holding. Twenty-six (26) parts were custom-designed for functionality, machinability, and safety by modifying the top jaw and other easily accessible parts. This project included completing engineering drawings, bill of materials, design calculations, finite-element analysis and operating guidelines for the constraints and operating conditions. Stress concentration occurred on the top jaw with the maximum von Mises stress being 140 MPa. The factor of safety based on yield for the prototyping material of CSA G40.21 Grade 44Ws is 2.5, and for the final product material of Viking tool steel is 12. The industry-approved design is ready for prototyping and future assessments.

ISE 2: Vibration Elimination in Potash Dryer-Cooler

Ali Anbagi

Oneil Dsouza

Layne Froehlich

K&S Potash Canada is experiencing a significant disturbance to equipment, surrounding components and structure in the Bethune Saskatchewan potash mill. The glazing circuit of granular potash processing is done through a vibratory fluidized bed dryer-cooler. Potash is conveyed through the system with vibration, and moisture is controlled through air plenums that heat to dry, then cool for output. The objective of this project is to remediate the vibration disturbance created by the glazing circuit vibro-assisted fluidized bed dryer-cooler. Product characteristics are provided by industry and are utilized for calculations alongside ANSYS simulation and test benching to find the appropriate functional parameters required to convert the current system to static fluidized drying and conveyance. Key elements that are considered critical in the system are the pressure drop, minimum fluidization velocity as well as product heating and cooling times. ANSYS simulation is used to replicate the system with the calculated parameters to verify theoretical results. Test benching is a component that is used to provide a scaled down representation of the dryer cooler's required conveyance regime using only air flow. This in turn is used to interpolate parameters for the actual system without disrupting the production process at the mill. A functional recommendation is given to K&S through a test plan that outlines the procedure and parameters required to be adjusted, primarily the controls of the input air to the dryer-cooler and its supporting theory. An additional evaluation of the costs and benefits of the suggested solution, as well as the risk assessment of changing set-points, is provided to solidify the conclusions reached.

ISE 3: Wheelabrator Abrasive Recycling & Collection System

Yug Patel Darlynton Ogotomo Kale Mattern Samarth Singh

A Wheelabrator machine owned by CNH Industrial faces one major problem: it leaks the abrasive shot that it uses to smooth, peen and process metal into a room below the machine. This is a large problem due to the weight of the material as well as its flammability. Our solution is to collect and recycle this material into a hopper in the room below the Wheelabrator. This will be done via a custom vacuum system that will allow employees to clean up and re-use the shot without the labour of having to move the steel physically with a shovel as in the current system. The system must be powerful enough to pick up the small steel pellets across a room 12 meters in length, be durable enough so the abrasive will not destroy the system from the inside, and be able to deposit the collected shot into a hopper for recycling or disposal using a cyclonic separator. Additionally, it is possible that this project should be easily adaptable for use in other Wheelabrator Machines with the same issue.

ISE 4: Assembly Tool Storage/Management System

Kaye Benlot

Itunu Durojaiye

Assembly work bays often face challenges of misplacement, loss or mistreatment of tools such as but not restricted to wrenches, sockets, impacts, ratchets, and others. This adversely impacts quality, productivity, efficiency and cost. A tool storage and management system is required. The root cause analysis determined the underlying factors that included human causes, lack of accountability, poor tool organization, redundant or insufficient tools, and poor tool specification. Based on an Analytic Hierarchy Process (AHP) and DEMATEL, the most important factors were tool organization and tool quantity. The relationship between the factors were determined. The solution included using sign out sheets, colour-coding tools, reorganizing tools using industrial, sturdy tool storage units, utilizing Bluetooth Low Energy tracking technology and implementing 5/6S Lean Management. Education and monitoring resources were developed. Production analysis examined tool gathering, tool preparation, tool usage and tool return to storage both before and after implementing the solution. The results showed reduced tool loss and improved productivity.

Industrial Systems Engineering

ISE 5: Storage Source Heat Pump Feasibility Study

Louise Galido

Karen Montaron

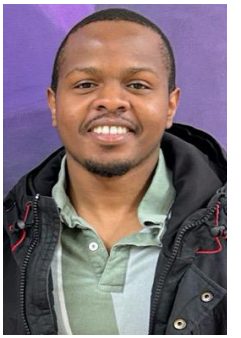
Jon Cascagnette

This feasibility study aims to determine if the installation of a thermal energy storage system with heat recovery in the College West (CW) building at the University of Regina can reduce energy costs. The proposed system would fully or partially shift the chiller operation to nighttime hours when electricity demand is much lower. The chiller would extract heat from the tanks at night to create ice and deposit heat during the day to produce chilled water. The condenser loop of the chiller will recover waste heat by tying into a hot water distribution loop. An initial budget of $2M with a maximum ROI of 10 years are requirements of feasibility set by stakeholders. The thermal energy storage shall not interfere with the existing air side loop's equipment. Furthermore, any modifications on the Central Plant's infrastructure are not permitted. Project deliverables include an economic and energy analysis, investigation of multiple design options, mechanical design of the best option including drawings, and costing. Ultimately, due to the low energy efficiency of the ice creation/heat recovery chillers and high efficiency of the existing chiller system this project was found to be not feasible. The study will demonstrate an energy and economic analysis consisting of capital, installation, and operating costs which is the basis for finding the targeted payback period.

ISE 6: Waste Heat Recovery from a Cure Oven

Steve Githinji

Emmanuella Owusu



James Theuri

The imminent global goal in forging a sustainable future has led to an increase in demand for efficient utilization of resources. Industrial waste heat recovery has emerged as a significant avenue to achieve proper utilization of thermal energy dissipated as a by-product of industrial processes. Minimizing and recovering waste heat presents a valuable opportunity to enhance efficiency, decrease energy expenses, and potentially reduce maintenance expenditures. Furthermore, it can lead to enhanced equipment productivity by allowing for reduced intensity of operation for energy-consuming equipment. Case New Holland aims to harness waste heat from its curing oven to heat a shipping and receiving area via an HVAC system, with the goal of curbing natural gas expenses.

ISE 7: Automated Blank Separator and Sorter

Sonakkumar Patel Divyesh Kotadiya Umang Suthar Rushi Patel

This research, which was produced in cooperation with Ralph McKay Industries, provides an in-depth examination of a revolutionary project that aims to replace their current blank splitting machine into a completely automated splitting and stacking system. The main goal is to improve overall production process cost-effectiveness, optimizing the processing speed and overall efficiency while removing the need for manual labor related to handling divided pieces. The underlying inefficiencies in the current blank splitting procedure are the motivation behind our effort. As things stand, the separated parts are haphazardly thrown into a bin, which can cause disruption and even damage from collisions or improper orientation. In addition to decreasing workflow efficiency, this unpredictability makes it necessary to manually sort and feed parts into later manufacturing steps. The project aims to fully address these issues by switching to an automated approach which involves organised stacking into a bin. Using this approach, split pieces are easier to reach, easier to orient, and easier to feed into the next manufacturing cycle where they are arranged into a bin. This systematic strategy minimises the need for manual intervention while optimising production processes, which lowers labour expenses and improves the overall effectiveness of operations. Delaying, Flipping, and Stacking are the three essential processes of the approach. The previously mentioned processes are carefully crafted to maintain time intervals between split parts, ensure their correct orientation, and systematically arrange them in a magazine to facilitate their smooth integration into later phases of manufacturing. The project blends theoretical knowledge and actual industrial expertise by utilizing ideas from broad literature surveys. All things considered, this paper offers an in-depth review of a complex project at the cutting edge of industrial automation innovation. It seeks to revolutionise blank splitting and bring in a new era of efficiency and automation in industrial setups by integrating theoretical understanding with real-world abilities.

ISE 8: The Decarbonization of Kisik Towers: A Conceptual Case Study

Blake Ackerman Kyle Bachelu Justin Gwilliam Mathieu Perron

The objective of this project is to assess the feasibility of transitioning from natural gas heating to an electric-based heat pump system in the University of Regina's Kisik Tower Student Residency Building. By conducting energy modeling of both the current radiant slab system and the proposed electric heat pump system using Trace 3D Plus, this project aims to explore the implications and solutions related to electrification and building decarbonisation. The key phases of the project involve validating the existing building systems with actual energy usage data, integrating a new heat pump system into the model, and comparing the outcomes of each option. Alternatives for the heat pump system include air-source, water-source, ground source, or geothermal. The primary goal is to identify a solution that aligns with the Paris Climate Accord's 2030 target of achieving a 50% reduction in carbon emissions from HVAC systems compared to 2005 levels. By comparing the energy consumption levels, the CO2 emissions of the current and selected water source heat pump system will be compared. As the initial targets will not be fully met with the heat pump alone, the study will also consider additional solutions for decarbonisation.

ISE 9: Anti-ooze Valve System for Pellet-based, High-flow Extrusion 3D Printing

Syed Danish Hasan Daniel Slogoski Teagen Biette

This project is aimed at addressing a critical flaw in pellet-based 3D printing processes - the unwanted oozing of molten material through the nozzle during temporary stops in printing. Due to the nature of melted pellets, these extrusion systems are incapable of retracting material - resulting in excess flow of material through the nozzle. This affects the integrity of the print structure and overall print quality. The team focused on designing and developing a valving system with the objective of mitigating this oozing issue by temporarily redirecting the material flow to a designated storage reservoir, sized appropriately to accommodate anticipated material volumes. This reduces the need for frequent manual intervention. The design consists of a strategically positioned, two-channeled shaft sliding into a prudently dimensioned heater block integrated into the printing assembly. During pauses in printing, the valve is programmed to actuate, diverting the molten material into the custom-built reservoir. The materials selected for the valve components display a resistance to high temperature environments, while effectively transferring heat as needed for the extrusion processes.

ISE 10: Automated Saw Chip Collection System

Arbaz Asif Yvan Nico Navarro Geric Paul Sikat

This project presents an innovative approach to streamline the cutting operations of hollow structural steel tubes by designing an Automated Saw Chip Collection System that utilizes pneumatic rodless cylinders for motion and a shop vacuum for cleaning. The use of pneumatic rodless cylinders allows the system to achieve precise movements, ultimately contributing to operational efficiency, decreased downtime, and improved overall productivity. The project presents potential to optimize the tube cleaning process in a cost-effective and efficient manner while aligning with the industry demands of smart and automated solutions.

Industrial Systems Engineering

ISE 11: 3D Printing of Lunar Regolith-based Structural Components

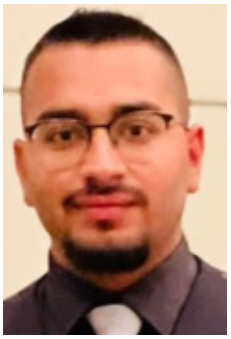
Kyza Kempa

Mohammad Hassan

Seongpil Jang

Addressing the costly difficulties of transporting building materials to space, this Capstone project explores the possibilities of 3D printing using lunar regolith, a sediment found naturally on the surface of the moon. Dr. Mohammad Khondoker of the University of Regina supervised our group of Kyza Kempa, Mohammad Hassan, and Seongpil Jang on an aim to harness in-situ resources for the creation of sustainable construction materials. We hope to transform the way structures are produced in space by combining the unique features of lunar regolith with a liquid state material, thereby considerably decreasing the expensive burden of material transportation. Our method included extensive testing using clay as a substitute for lunar regolith, which allowed us to optimize the 3D printing process by modifying Parameters of the printer, including line width, flow, infill percentage, layer height, and printing speed. This framework was critical for determining the optimal mixture ratio and print settings for a material that not only meets the mechanical demands of space construction but also paves the way for effective and large-scale manufacture on the moon. The mechanical analysis offered positive results for this project, demonstrating the possibility for durable and reliable construction materials from lunar regolith. In addition, it identified and suggested modifications to the 3D printer mechanism to improve printing efficiency and quality. These findings contributed to the growing field of in-orbit manufacturing, which provides a sustainable way for generating construction materials directly on the Moon. Finally, the goal of this research is to enable future space exploration and habitation by facilitating the construction of structures necessary for human survival beyond Earth.

ISE 12: Snow Removal Air Blower



Ibrahim Javed

Omar Alsaady

In the pursuit of advancing snow removal techniques for commercial vehicles, this project introduces a novel system. It is predicated on the principle of distributed air pressure, aiming to supplant the prevalent usage of leaf blowers, which offer suboptimal efficiency and potential vehicular harm. The design methodology encompassed a rigorous comparative analysis via a design matrix, iterating through various material selections and structural configurations to distill an ideal prototype. The investigative process incorporated Finite Element Analysis (FEA) for structural verification, coupled with thermal dynamics assessment to calibrate the pneumatic snow displacement mechanism. Empirical outcomes from the prototype demonstrated a marked escalation in snow clearance efficiency, underpinning the design's superiority over traditional methods. The analytical examinations substantiated the system's structural resilience and thermal efficiency, corroborating its suitability for the rigors of commercial application. Consequently, the engineered solution posits a significant leap forward in operational efficacy for vehicular snow removal, suggesting a transformative impact on the maintenance protocols for commercial fleets during winter seasons, thus enhancing safety and diminishing operational interruptions caused by snow accumulation.

Petroleum Systems Engineering

PSE 1: Designing of a Machine Learning Model to Optimize Hydraulic Fracturing Treatment In the Viking Formation

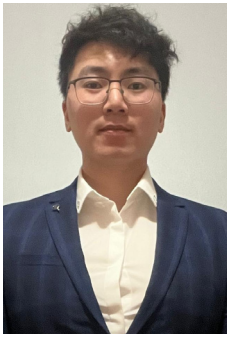
Cody Murray Hamza Ghelle

In the oil and gas industry, technological advancements and discoveries are made public very quickly. Because of this, operators are always looking for ways to optimize their operations to gain an edge on competitors. One method is through artificial intelligence and machine learning. Machine learning models allow researchers to take large swaths of data and read it to solve various problems. In this project, we designed an artificial neural network (ANN) machine-learning model to optimize well, completions and hydraulic fracture design within the Viking formation in Saskatchewan. The machine-learning model looks at well, completions and fracture parameters including lateral length, true vertical depth, perforation type, average pumping pressure, average pumping rate, Stage spacing, proppant pumped and fluid pumped. Additionally, the machine-learning model takes in gamma ray and neutron information that has been obtained from well logs. The well logs were processed using code we wrote so that they now only obtained data from depths within the Viking formation. The machine-learning model takes the data for all these parameters and well logs from each well in the data set to see which parameters have the greatest effect on the cumulative oil production over the first 365 days of oil production (IP365). Additionally it can predict the IP365 of an oil well based on the values for the input parameters. It also gives optimum ranges for these parameter values so that any future wells to be drilled in the Viking formation will have the highest (IP365).

Petroleum Systems Engineering

PSE 2: Implementation of CO2-Polymer Flooding for Enhancing the Recovery of Lloydminster Heavy Oil Reservoir

Vrushabhkumar Kantibhai Shiroya



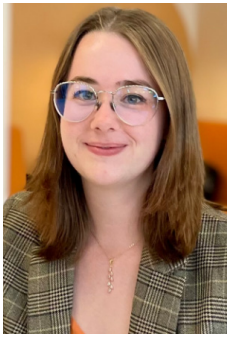
Yinbo Ma

Canada has one of the largest heavy oil reserves in the world. Numerous pilot projects across Canada are currently underway to explore enhanced recovery methods for heavy oil reservoirs. The objective of this project is to improve heavy oil recovery within the ongoing Landrose project located in Saskatchewan' Big Gully North field. The project specifically targets the Lloydminster formation and employs CO2-polymer flooding techniques to enhance heavy oil extraction efficiency. CO2-polymer flooding for heavy oil recovery uses an optimal Combination of carbon dioxide (CO2) and polymers to enhance the extraction of heavy crude from reservoirs. The problems with heavy oil, that is its high viscosity and poor mobility, are especially addressed by this enhanced oil recovery (EOR) technique. The primary goals include improving sweep efficiency, reducing viscous fingering and optimizing fluid displacement within the reservoir. By combining the solubilizing effects of CO2 with the viscosity-reducing properties of polymers, the objective is to achieve increased heavy oil recovery rates, elevate overall oil production, and extend the economic viability of reservoirs with heavy oil deposits. Proper design of CO2-polymer based EOR and storage of greenhouse process will be conducted based on reservoir fluid, rock properties, and other geological parameters and operating conditions.

Software Systems Engineering

SSE 1: VisuSpeak

Archisha Bhattacharya



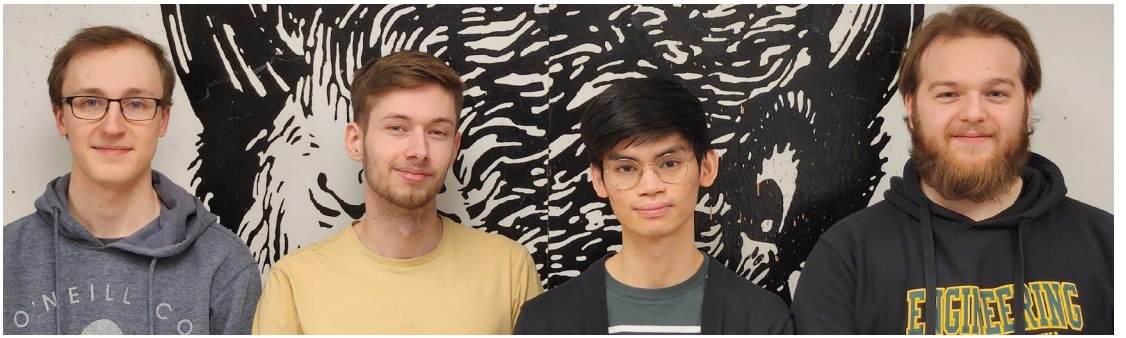
Brooklyn Coulson

Jasmeet Singh

Team VisuSpeak is developing an app to translate ASL to English using Machine Learning. Many people who are non-verbal or individuals with hearing loss use ASL as their language of communication. However, there is often a significant gap in communication between ASL users and English speakers unfamiliar with ASL. People with special needs may feel left out while seeking help in places like schools, stores, jobs, healthcare, and social interactions as it can be hard to get quick answers. In these situations, getting customer service can be frustrating if no interpreter or writing tools are available. Team VisuSpeak's proposed solution will help ASL users communicate with English speakers seamlessly, thereby bridging the language barrier. The app will translate ASL to English in real-time, making communication easier for everyone.

Software Systems Engineering

SSE 2: Project Valence



Michael Osachoff Nicolas Ansell Julian Gonzales Cameron Wilson

Project Valence is a 2D, top-down casual strategy game. Players are spawned in a chemistry laboratory where their goal is to complete a contract provided by various clients. With a new one provided each day, these contracts require the player to synthesize and deposit products generated in their laboratory. Failure to complete the day before the time runs out will cause the player to complete their run. After completing each day, the player will receive payment for the contract and move on to the next day. The products are created by combining the correct ingredients in the correct machines, otherwise garbage will be created. The recipes for these products are provided to the user to allow them to create the correct result. The physical structures of these labs are from a few predefined sets, but the machines and depots of ingredients are randomly generated to create a unique experience for every playthrough.

Software Systems Engineering

SSE 3: Intelligrain

Dillan Zurowski Brandon Hillbom

The current grain grading process in agriculture leaves farmers in the dark about the factors influencing their crop grades, resulting in inaccurate assessments and financial uncertainties. Each bin of grain receives a single grade without disclosing the grading factors, leaving farmers unaware of the true quality of their crops. Grading directly corresponds to how much farmers are paid for their crops. With farms spanning thousands of acres and numerous bins, farmers struggle to obtain accurate quality assessments and negotiate fair contracts. Intelligrain, powered by Ground Truth Agriculture's advanced Computer Vision technology, disrupts this paradigm by offering real-time insights into grain quality during harvest. Our innovative mobile application revolutionizes the grain analysis process, empowering farmers and combine drivers to optimize quality, pricing, and sales strategies. By leveraging periodic sampling during harvest, Intelligrain provides a detailed breakdown of contributing factors to crop quality, enhancing farmers' ability to make informed decisions and improve crop yields year after year. Through a user-friendly interface, farmers can visualize the makeup of their fields, filter predictions by grade and specific characteristics, and identify factors affecting crop quality. Intelligrain's transformative capabilities enable farmers to mitigate risks, negotiate fair contracts, and maximize the value of their crops, ushering in a new era of precision agriculture.

Software Systems Engineering

SSE 4: SecureMe

Charles Samonte Kawthar Alkhateeb Kristina Langgard

SecureMe is a mobile application designed to enhance personal safety and provide immediate support for individuals facing danger or requiring assistance. The app is equipped with a quick assist button (SOS button) that enables users to quickly send a distress message to their designated emergency contacts. Additionally, SecureMe ensures the prompt sharing of the user's location, facilitating rapid access to the individual in need. Beyond its emergency response capabilities, SecureMe serves as a centralized hub for accessing critical local resources. Users can seamlessly locate nearby shelters and helplines, offering a comprehensive solution for those facing imminent danger. The app aims to bridge the gap between technology and personal safety. With SecureMe, we envision a safer and more connected community where individuals can rely on advanced mobile technology to secure help and resources at their fingertips. Our commitment to security, efficiency, and community support sets SecureMe apart as an invaluable tool for those navigating challenging situations.

Software Systems Engineering

SSE 5: Safety Toolbox

Mackenzie Kot

Mikayla Peterson

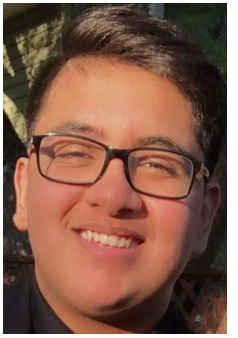
Safety Toolbox is a centralized safety information tracking application. Safety compliance requires keeping track of many different kinds of documentation. This application is able to keep track of employee training records and certifications, as well as Toolbox Talk (safety talks that occur at the beginning of a shift) items such as prompts, attendance records, and notes. There is also an in-app library that can be used to store work procedures and employee training matrices (a document that shows what training is needed for a specific position compared to the training an employee already has). Along with being able to view all the certification information in the application, users can also choose to generate and export reports containing this information. Occupational Health and Safety compliance requires companies to keep track of certain documentation, and they must be readily available if requested. Additionally, companies also often have their own self-imposed safety documentation. Keeping track of all this can get very difficult. Often this information gets scattered between different folders, physical documents in various places, and some information is even stored in people's heads. Our application aims to solve this problem.

Software Systems Engineering

SSE 6: FurScan

Aryan Chandra

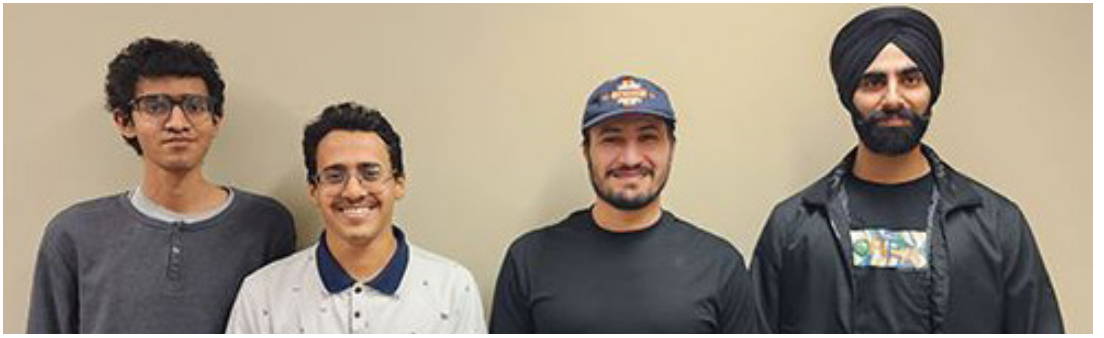
Mubarak Abiola Keshiro



Hasaan Toor

FurScan is an application designed to enable the average household pet owner to quickly and accurately detect common health problems their pet might have. By utilizing an AI model built and trained by our team, users are able to upload photos of their animals and get a quick response from the app providing information on the potential disease that the pet could be suffering from. Additionally, with the help and information gained from advice by local veterinarians, users are also able to answer questionnaires regarding their pet and their potential condition. With the combination of these two aspects, the app can identify not only visual ailments, but also underlying health concerns. Users are then provided with information on the disease, what actions they can take to best help their pet, and finally, a plethora of sources of information to further learn about the disease and its remedies. The key to protecting our furry friends and keeping them healthy is early detection and knowing what actions to take.

SSE 7: Freight Shield



Alok Paranjape Mohammed Alharbi Amandip Padda Ramanpreet Singh

In the trucking industry, there is an incentive for companies and their employees to complete assignments with the greatest possible efficiency. At the same time, there are worker protection laws in place to prevent employees from driving excessive hours, putting themselves and others at risk. Freight Shield is an attempt to resolve these two conflicting factors. Freight Shield is a combination of a mobile application and a web client. The mobile application is used to track driver information, manage the logging of drivable hours, and inform dispatch of that status. The web client acts as an assignment platform, allowing dispatch to view potential freight tasks and assign them to available drivers. At the same time it performs the crucial task of preventing job assignments to employees without sufficient drivable hours. Freight Shield is a new effort toward maintaining adherence to worker protection laws, while also streamlining the allocation of drivers to specific tasks through improved information sharing. The widespread use of this application would result in much safer roads for both the public and the truckers.

SSE 8: VisiLake: Self-Service Data Lake Exploration & Analysis on AWS

Daniil Aleshechkin

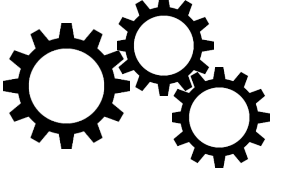
Benjamin Hajdukiewicz

Adam Metz

VisiLake is a cutting-edge solution unifying data management and analysis, and providing a self-service platform that greatly improves the ease of data retrieval and analysis. This marks a paradigm shift from traditional, labor-intensive data handling techniques, such as reliance on Excel spreadsheets, towards an efficient, sustainable, and intuitive approach. Integrating with a data lake built on Amazon Web Services (AWS), VisiLake offers a solid foundation for data storage and management. This includes integration with Microsoft PowerBi and removes the need for users to learn complex SQL or DAX queries. Central to VisiLake's innovation is its web application, enabling users to manage customizable analysis jobs. This functionality, combined with the platform's user-friendly interface, democratizes data analysis, making it accessible to users without programming knowledge to conduct exploratory data analysis and generate PowerBI reports. VisiLake enhances organizational decision-making by providing broad visibility on the analysis used to support data-driven decisions, enhancing trust and encouraging collaboration. It signifies a move towards a contemporary, flexible data platform.

The Project Day 2024 Program is sponsored by:

Feedback



This is the 25th Annual Project Day.

We would greatly appreciate your feedback on how things went.

Please send an email to engg@uregina.ca with your feedback

Thank you for helping us ensure next year is even better!

"The will to succeed is important, but what's more important is the will to prepare."

- Bobby Knight