



Innovation Nation

# 2019 INNOVATION NATION

CONFERENCE & STUDENT SHOWCASE



**SUNDAY, JANUARY 20, 2019**  
LIUNA STATION, HAMILTON, ON



For information visit:

[www.innovation-nation.ca](http://www.innovation-nation.ca)



# Acknowledgement:

The National Centres of Excellence (NCE) are committed to building on Canadian expertise in engineering, health and natural, social and biomedical sciences to enhance Canada's economic competitiveness globally by developing new discoveries and transforming these discoveries into products and services that will create jobs, build a stronger domestic economy and improve the quality of life for all Canadians.

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By funding research partnerships between academia, industry, government, and not-for-profit organizations, NCE programs turn Canadian research and entrepreneurial talent into economic and social benefits for all Canadians.

NCE initiatives engage thousands of talented researchers, attract and train tomorrow's scientific and industrial leaders.

To date the NCE networks and centres have helped to train more than 36,000 highly skilled personnel and create over 100 spin-off companies, and since its inception, the NCE has invested more than \$1.5 billion in networks and centres,

funding research, commercialization and knowledge translation to enhance the lives of Canadians.

The NCE is mobilizing Canada's best research and development talent to build a more advanced, healthy, competitive, and prosperous Canada.

In support of these objectives the NCE Secretariat manages four national programs: Networks of Centres of Excellence (NCE); Centres of Excellence for Commercialization and Research (CECR); Business-Led Networks of Centres of Excellence (BL-NCE); and Industrial Research and Development Internships (IRDI).



Government of Canada  
**Networks of Centres  
of Excellence**

Gouvernement du Canada  
**Réseaux de centres  
d'excellence**

# welcome

## *Welcome to the 2019 Innovation Nation Conference and Student Innovation Showcase.*

### **This year we celebrate the 10<sup>th</sup> Anniversary of CSii.**

Since the inception of CSii's Innovation Nation Conference & Student Innovation Showcase we have continued to bring together thought leaders, nationally and internationally acclaimed voices from diverse fields, to open our minds to new concepts, new possibilities and new solutions to the challenges facing humanity today.

The Innovation Nation Conference showcases the talent, intellect and tenacity of innovators in; medicine, science, engineering, industry and the arts who share the insights gleaned from their journey of discovery.

Linking the present and future we showcase the work of elite professionals and the youthful, enthusiastic and gifted students who participate in our Student Innovation Showcase.

The Student Innovation Showcase provides us with the opportunity to showcase the outstanding work being done by young innovators who are determined to create a better and brighter future.

We encourage our colleagues, industry partners and friends to support the work of these dedicated students who spend their time and resources testing the limits of their imaginations and abilities.

We applaud their efforts and encourage them to continue to learn and grow so they can help to build a new entrepreneurial culture that will create jobs and enhance Canada's reputation as a world leader in advanced technologies.

To update you on our progress, the 2017 CSii start-up Insight Medbotics, jointly owned by CSii and MDA, will create over 100 high tech jobs in Southern Ontario and Canada, attract talented engineers, physicians and technicians, and facilitate the training of scores of highly qualified individuals.

2018 saw CSii moving forward with outstanding innovation, creating disruptive technology that will revolutionize healthcare systems and expand access to advanced medical care.

In 2019 CSii is continuing to push the boundaries of medical technology working with our partners at MDA and the Canadian Space Agency (CSA) to lead the way in the development of autonomous medical devices that will, benefit human life on earth and support the expanding medical needs of the space program as we prepare for missions to the moon and to Mars. In addition, CSii has partnered with IBM to adopt the Watson platform to layer these diagnostic capabilities over time into a fully autonomous product solution.

It is my sincere hope that you enjoy the 2019 Innovation Nation Conference & Student Innovation Showcase, the event provides an opportunity for all of us to learn from the accomplishments and ideas of our distinguished guest speakers and to once again be inspired.

I look forward to meeting you.

Best regards,

**Dr. Mehran Anvari**

Scientific Director, Centre for Surgical Invention and Innovation (CSii)





2017  
2018  
2019

## *Welcome to the CSii Innovation Nation Conference.*

The Centre for Surgical Invention and Innovation (CSii) is now 10 years old. Under the dynamic leadership of Dr. Mehran Anvari, CSii continues to make remarkable progress towards the goal of improving the speed and accuracy of minimal access surgery through innovations in image guided robotic tools. We have focused in the first application on developing a platform and tools for biopsy and ablation of breast cancer using magnetic resonance imaging (MRI). We began clinical testing in 2014 and have completed many tests to date. These tests demonstrated greatly improved accuracy and patient comfort. We have also now established a company, Insight Medbotics Canada Corp. (IMCC), to manufacture and market this image driven robotic surgical instrument. We have early stage funding for this startup and a recently retired leader from MacDonald Dettwiler and Associates (MDA) to lead this venture.

For our conference we are very fortunate to have a group of outstanding speakers who have advanced knowledge in many areas related to the goals of CSii. Their participation in this conference will give us opportunity to receive input and interaction that will be beneficial in our ongoing progress. We are a Centre for Commercialization and Research. Our goal is to demonstrate value in image guided robotic surgery and to establish the means to deliver that commercially to the world. Our time is short. We look forward to a productive and stimulating conference.

## **H. Douglas Barber**

Chair, Centre of Surgical Invention and Innovation (CSii)  
Distinguished Professor in Residence, McMaster University  
A Founder of Genuum Corporation



**The Centre for Surgical Invention and Innovation (CSii) was established in 2009 as a NCE research accelerator.**

**The Centre has continued to adapt Canadian expertise in space robotics and minimally invasive surgical techniques and leverage the technology to develop and commercialize a new class of advanced surgical image guided robotic systems. This will extend the diagnostic and interventional capabilities of surgeons and health care professionals through increased access precision and dexterity.**

The research driving these technical advances will enable highly effective diagnosis and treatment of disease down to the macroscopic and microscopic cellular levels while reducing the trauma caused by accessing the treatment

site. The development of the Image Guided Automated Robot (IGAR) breast platform is the first product of the CSii mission to adapt image guided robotic technology to provide a targeted solution to the detection and treatment of cancer.

CSii works in partnership with MDA, creators of the Canadarm, Canadarm2 and Dextre. MDA's advanced technologies span markets as diverse as manned and unmanned space exploration, robotic surgery and nuclear reactor maintenance and operation in the most challenging and demanding environments.

MDA has partnered with CSii through every step of this journey as the primary corporate partner for CSii's robotic development and continues to be keenly invested in the success of CSii.

# *The Centre for Surgical Invention and Innovation (CSii) was established in 2009 as a NCE research accelerator.*

Together CSii and MDA have launched **Insight Medbotics Canada** to successfully market our first commercial system, and to develop and build future platforms.

CSii received the support of the Canadian Space Agency (CSA) through the Build in Canada program established by the Government of Canada. CSii is working with MDA and CSA to develop telerobotic capabilities for IGAR-Breast and future IGAR platforms in development with the goal of increasing access to quality healthcare for Canadians living in remote areas of the country and beyond.

In 2018 CSii received additional financial support from the CSA to support the development autonomous robotic devices for use in the future Mars missions as well as here on earth.

With the benefit of significant financial support from the Government of Canada through the NCE CECR program. CSii has continued to adapt a multi-disciplinary approach to research and development that has enabled the Centre to combine the medical, engineering, biological, information technology and systems integration expertise available at McMaster University, St Joseph's Healthcare Hamilton and institutions and corporations located throughout Canada. Expertise developed with partners MDA and IBM has enabled CSii to take a leadership role in developing disruptive technologies that will revolutionize medical robotics systems and provide enhanced health care services.

CSii is committed to attracting exceptional human talent and Canadian industry support to accommodate new development projects working with clinical experts both here and abroad to refine our approach to the development of robotic instruments that have a direct impact on clinical use.

The Centre has continued to recruit key staff and position them within host facilities at St. Joseph's Healthcare Hamilton and McMaster University and has worked to consolidate and expand the number of valued corporate partnerships.

The outstanding success of the past Innovation Nation Conferences reinforced the Centre's commitment to professional development and educational outreach.

This year the 2019 Innovation Nation Conference will bring together an eclectic and interesting group of innovators to share their stories and network with the assembled, researchers, physicians, academics, students and participants in attendance.

## *A Message from the Honourable Fred Eisenberger, Mayor of the City of Hamilton*



Fred Eisenberger

It gives me great pleasure to welcome everyone in attendance today at LIUNA Station for the 2019 Innovation Nation Conference and Student Innovation Showcase.

This conference will give attendees the opportunity to hear from nationally and internationally acclaimed researchers, business and industry experts who are leaders in their field and network with peers in business, science, engineering and arts.

The ideas brought forward today will see the next generation of Canadian innovators help shape the world in which we live with their creativity and passion. I'm proud to have this conference take place in Hamilton, a city home to innovative, sustainable and technologically-advanced businesses and organizations.

During your time here, I hope you will find some time to explore our city. We are proud of our cultural attractions, heritage buildings and vibrant downtown.

On behalf of the City of Hamilton, I wish you an informative and enjoyable conference.

Yours Sincerely,

# Fred Eisenberger

*MAYOR OF HAMILTON*

## *A Message from the Honourable Filomena Tassi, Member of Parliament*

Dear friends,

I would like to welcome everyone to LiUNA Station for the 8<sup>th</sup> Annual Innovation Nation Conference & Student Innovation Showcase Innovation Showcase. This fabulous event where we celebrate our innovators!

I would like to express my gratitude to all those who have organized this event, as well as our key note speakers and guests.

The Federal government is firmly committed to innovation and research. We recognize that our innovators and researchers drive our economy and create jobs.

In 2017, the Federal government named Dr. Mona Nemenman as Canada's new Chief Science Advisor, ensuring that government scientists are free to speak to Canadians about their work. Additionally, we created up to 25 Canada 150 Research Chairs at universities around the world over the next eight years, allowing Canadian universities to have the funding to recruit top international researchers from all disciplines. These steps indicate our government's commitment to science and innovation.

Additionally, Budget 2018 made the single largest investment in fundamental research in Canadian history. Through budget 2018, the Federal government is supporting the next generation of researchers with nearly \$1.2 billion over five years for Canada's granting councils, and an additional \$1.3 billion to provide researchers with the cutting-edge equipment needed to make scientific breakthroughs and drive innovation. We are committed to strengthening scientific research in Canada in a way that reflects our diversity. This means more support for the next generation of women, visible minority and indigenous researchers.

Finally, I am delighted that this conference is taking place in Hamilton. We know that our ambitious city is on the move. Our research and innovation agenda is contributing significantly to our success. This conference is a great opportunity for attendees to collaborate and network with each other to share ideas and best practices. I commend you all for the important and meaningful work that you do!

Warm personal regards,



Filomena Tassi

## Filomena Tassi

*MINISTER FOR SENIORS AND MEMBER OF PARLIAMENT  
FOR HAMILTON WEST - ANCASTER - DUNDAS*

## *A Message from Bob Bratina, Member of Parliament*



On behalf of the Federal Government, it gives me great pleasure to welcome you all to the 2019 Innovation Nation Conference and Student Innovation Showcase, hosted by the Center for Surgical Invention and Innovation (CSii).

Our Government sees Innovation as a key factor in the performance of our economy. Canada is most prosperous when all Canadians have a fair chance at success, which is why we need to build Canada as a global center of Innovation – one that focuses on strengthening the middle class by creating jobs, driving growth across all industries and improving the lives of all Canadians.

Hamilton has always been the home and workplace for many innovators over its history. Whether speaking about industrial, agricultural, healthcare or robotic innovation, our city has seen it all.

I would like to wish you all a great time at this year's conference, especially students who are participating in the Student Innovation Showcase.

Sincerely,

# Bob Bratina

*MEMBER OF PARLIAMENT FOR HAMILTON EAST-STONEY CREEK*



Innovation Nation

WELCOME



# [ keynote speakers |

DATE: SUNDAY, JANUARY 20, 2019

LOCATION: LIUNA STATION – GRAND CENTRAL BALLROOM

7:30 am REGISTRATION – Main Lobby

8:25 am Opening Remarks:

Dr. **Mehran Anvari**, CEO and Scientific Director, CSii

## KEYNOTE SPEAKERS

- 8:30 am **Mini Thomas**, Professor of Electrical and Computer Engineering Department, Mohawk College  
Topic: Automated Real Time Seizure Detection using Wearable Body Sensor Network \_\_\_\_\_ **15**
- 9:00 am **Sri Krishnan**, Associate Dean, Research and External Partnerships  
Topic: Connecting Healthcare \_\_\_\_\_ **17**
- 9:30 am Innovative 3D Printer for Continuous Manufacturing Processes  
**S. Owais**, McMaster Engineering  
YuMi Assembly Station  
**J. Grimm, A. Hasselman, S. Nijjar, S. Riyaz**, McMaster Engineering  
Smart Wheelchair for the Physically Challenged  
**H. Mahdi, A. Alfakir, N. Hafez**, Ryerson University \_\_\_\_\_ **40-2**
- 9:40 am **Emma Mogus**, Student, Inventor, and Philanthropist  
Topic: No Bounds \_\_\_\_\_ **19**
- 10:10 am **Allan Miranda**, Head of JLABS, Canada  
Topic: The Digital Age:  
Getting Digital Health Startups to Commercialization \_\_\_\_\_ **21**
- 10:40 am REFRESHMENT BREAK – Grand Central Ballroom
- 11:05 am Portable Electric Wheel Chair Drive  
**M. Izzo, V. Naso, J. Breton**, McMaster University  
Inverted Pendulum, **M. Stewart, B. Harvey**, McMaster University  
AI for Facial Recognition  
**A. Gadhri**, McMaster University \_\_\_\_\_ **43-5**
- 11:20 am **Isabelle Tremblay**,  
Director, Astronauts, Life Science and Medicine, Canadian Space Agency  
Topic: Conquering the Challenges of Human Space Exploration \_\_\_\_\_ **23**

# CONFERENCE AGENDA

- 11:50 am **Liz Warren**, Ph.D., Associate Program Scientist, ISS National Laboratory, NASA  
Topic: Exploring New Frontiers:  
Science on the International Space Station \_\_\_\_\_ **25**
- 12:20 pm **Ryerson Rams Robotics Mars Rover**, F. Balsara, L. Subotincic, A. Yang, D. Cresta,  
N. Burdynewicz, H. Mahdi, Y. Ahmadzadeh, M. Kiflen, Ryerson University  
**Eco Pen**, A. Awais Amin, R. Kolte, McMaster University  
**Smart Cast**, C. Lamont, St. Margaret Mary, Catholic School  
**Home Lighting Automation**  
N. Ellis, McMaster University \_\_\_\_\_ **46-49**
- 12:30 pm **LUNCH & STUDENT SHOWCASE**  
Main Lobby – Tour Student Showcase and Cast Votes
- 1:00 pm **Kate Todd**, Actress, Singer, Songwriter, Speaker \_\_\_\_\_ **27**  
Topic: Footprints on the Moon \_\_\_\_\_
- 1:30 pm **Christopher Langley**, Ph.D., P. Eng., Sr. Engineer, Guidance,  
Navigation, and Control Robotics and Automation, MDA \_\_\_\_\_ **29**  
Topic: The Most Interesting Arm in Space \_\_\_\_\_
- 2:00 pm **Michael Plaza**, Principle Site Investigator, FROST Study \_\_\_\_\_ **31**  
Topic: Cryoablation: Innovation in  
the Treatment of Breast Cancer \_\_\_\_\_
- 2:30 pm **Natalia K. Nikolova**, Professor, Canada Research Chair in  
High-frequency Electromagnetics, McMaster University \_\_\_\_\_ **33**  
Topic: “Smart” Radar for Stand-off Security Screening  
in the Making at Mac \_\_\_\_\_
- 3:00 pm **Ross Lockwood**,  
Ph.D., Condensed Matter Physics, University of Alberta \_\_\_\_\_ **35**  
Topic: Mind Over Mars \_\_\_\_\_
- 3:30 pm **Arushi Nath & Artash Nath**, Co-Founders, HotPopRobot \_\_\_\_\_ **36-7**  
Topic: How NextGen can hack their way to  
Space Exploration, Science and Innovation? \_\_\_\_\_
- 4:00 pm **CLOSING REMARKS – Showcase Results Announced**  
Dr. **Mehran Anvari**, CEO and Scientific Director, CSii



## Mini Thomas

Professor of Electrical and Computer Engineering Department,  
Mohawk College

# MINI THOMAS

Mini Thomas is the Coordinator and Professor of Electrical and Computer Engineering Department at Mohawk College, and Researcher of the mHealth & eHealth Development and Innovation Centre (MEDIC), which specializes in the implementation of innovative digital health solutions to improve patient quality of life and care. Her current research is mainly focused on data monitoring and analysis for detection and prediction of seizures. The data analysis are applied to generalized tonic clonic seizures for epilepsy patients. She has presented her work in conference, and results are being published in IEEE paper. Her research is being supported by Mohawk College's IDEaWORKS Catalyst Fund and Medic Lab.

Mini is a Professional Engineer (P.Eng.), and is doing her PhD in software engineering at McMaster University. She received her Master's degree with distinction in Electrical Engineering from Indian Institute of Technology Bombay.

Mini believes in taking initiatives to "Be the change and Make the Difference"  
For more information, visit: [qa.linkedin.com/in/thomasmini](https://qa.linkedin.com/in/thomasmini)



## Sri Krishnan

Associate Dean, Research and External Partnerships  
Ryerson University

# SRI KRISHNAN

Prof. Sri Krishnan joined Ryerson University, Toronto, Canada in 1999, and currently is an Associate Dean (Research and External Partnerships) in the Faculty of Engineering and Architectural Science. Sri Krishnan is also the Co-director of the Institute for Biomedical Engineering, Science and Technology (iBEST), a joint research and innovation institute between Ryerson University and St. Michael's Hospital, Toronto. From 2007-2017 he was a Canada Research Chair in Biomedical Signal Analysis. His research expertise are in areas of wearable design, biomedical signal processing, and machine learning. Sri Krishnan is a Fellow of the Canadian Academy of Engineering, and a recipient of many awards including the Outstanding Canadian Biomedical Engineer Award, Achievement in Innovation Award from Innovate Calgary, Sarwan Sahota Distinguished Scholar Award from Ryerson University, Young Engineer Achievement Award from Engineers Canada, and eight best research paper awards. He is a registered professional engineer in the province of Ontario.

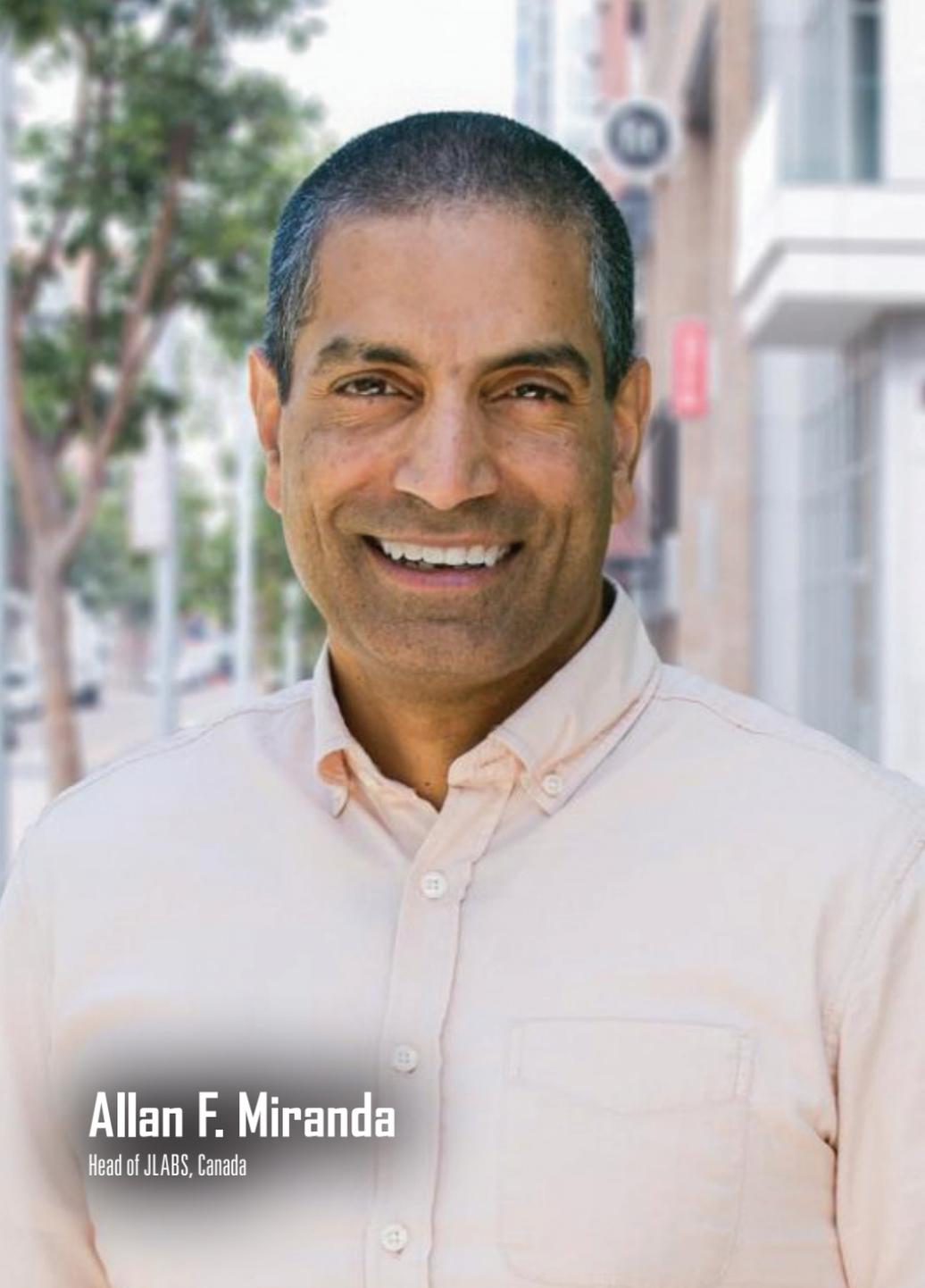


**Emma Mogus**  
Student, Inventor, and Philanthropist

# EMMA MOGUS

Emma Mogus is a 20-year-old student, inventor, and philanthropist. At the age of 13, she and her sister Julia cofounded Books With No Bounds which has distributed over 250 000 books and 100 000 school supplies to Indigenous children in remote northern locations in Canada, as well as Ghana, Uganda, India, the Philippines, Pakistan, and more worldwide. Her humanitarian efforts made her a Queen's diamond jubilee recipient when she was only 15, amongst other distinguished honors.

Through her passion to help those in need, she was inspired by a friend with ALS to design and invent a tongue controlled computer mouse for those with ALS, MS, or other physical and communicative limitations. Her invention is called TiC, short for Tongue Interface Communication. At the age of 17 she competed at the Intel International Science and Engineering Fair, where she placed 3rd worldwide in Biomedical Engineering. She was a recipient of the Ontario Science Centre's 2016 Weston Youth Innovation Award and last September appeared on The Tonight Show Starring Jimmy Fallon, where she showcased her invention to the world.



## Allan F. Miranda

Head of JLABS, Canada

# ALLAN F. MIRANDA

As Head of Johnson & Johnson Innovation, JLABS in Canada, Allan is responsible for external engagement, innovation sourcing, company onboarding, portfolio management, operational excellence, educational programming and P&L. He catalyzes and supports the translation of science and technology into valuable solutions for patients and consumers across the pharmaceutical, medical device, consumer and healthtech sectors.

Allan joined the JLABS team from Janssen Canada, where he has spent the last 12 years in positions of increasing responsibility in business development, marketing and market access. His most recent role was Therapeutic Lead Immunology and Primary Care where he was responsible for market access strategy for a complex product portfolio exceeding \$1 billion. Allan started his career at PARTEQ Innovations, the technology transfer arm of Queen's University at Kingston where he was responsible for technology assessment and new company start-up. He then moved to Paladin Labs, where he successfully completed numerous in-licensing transactions for specialty pharmaceutical products for the Canadian market. Allan subsequently worked in business development for two early stage biotechnology companies in Canada leading their business development and partnering initiatives prior to joining Janssen.

Allan received his Ph.D. in Neuropharmacology from Queen's University at Kingston, Ontario and his MBA from McGill University in Finance and Strategy.



# Isabelle Tremblay

Director, Astronauts, Life Science and Space Medicine  
Canadian Space Agency

# ISABELLE TREMBLAY

For more than 20 years, Isabelle Tremblay has devoted her career to space exploration, with the conviction that this audacious quest, intrinsic to humans, has the power to project us into the future, to catalyze innovation and to unite us.

As the Director, Astronauts, Life Sciences and Space Medicine, Isabelle is accountable for Canada's participation in human spaceflight missions. This includes Canadian astronauts, operational space medicine, as well as Canada's utilization of the International Space Station (ISS), which is centered on health and life sciences research to identify, characterize and mitigate health risks associated with spaceflight. Currently, her team is also evaluating potential contributions in the area of health and biomedical technologies for deep space exploration, beyond Earth orbit, such as to the Moon and Mars.

Previously, Isabelle worked as a research and development engineer in space robotics and as a senior engineer and technical lead for Canadian contributions to international planetary exploration and astronomy missions, namely NASA's Phoenix Mars Lander, which operated on Mars in 2008, and the James Webb Space Telescope, Hubble's successor, scheduled for launch in 2021.



## Liz Warren

Ph.D., Associate Program Scientist, ISS National Laboratory, NASA

# LIZ WARREN

Liz Warren, Ph.D. is an Associate Program Scientist for the ISS National Laboratory, the organization that enables access to the International Space Station to a broad range of U.S. commercial, academic, and government users. This unique platform takes us beyond the current thresholds of science, engineering, technology, and education to create a more vibrant and thriving future for all citizens of the planet.

Dr. Warren was born and raised in the San Francisco Bay Area, and attended the University of California at Davis for both her undergraduate and doctoral degrees in Molecular, Cellular, and Integrative Physiology. For her doctoral work, she investigated the effects of gravity as a continuum on energy balance in a rodent model. She completed post-doctoral work in cancer biology at the San Francisco Veterans Affairs Laboratory of Cell Growth, and in the Neuroscience Laboratory at NASA's Johnson Space Center. She has performed a variety of roles at NASA, including serving as Deputy Project Scientist for the NASA Bed Rest and Artificial Gravity Projects. Dr. Warren also spent several years as an Operations Lead in Mission Control for the ISS Medical Project. Liz is a passionate science communicator and an advocate for human spaceflight and STEM.



# Kate Todd

Actress, Singer, Songwriter, Speaker

Kate Todd has been a working artist in the entertainment industry for over 17 years. Her extensive resume and wide range of abilities have landed her roles on award winning TV shows throughout her vibrant career. Never one to be put into a box, Kate has played a vast array of characters and has landed lead roles in several hit TV shows including but not limited to: 'Radio Free Roscoe,' 'Life With Derek' and 'My Babysitter's A Vampire'. She has worked alongside names such as Ellen Page in the dramatic film 'The Tracy Fragments' directed by Bruce McDonald and award winning actor Ving Rhames in 'Saving God.' Her voice acting talent has scored her credits on the hit show "Family Guy" and the popular video game franchise "Assassin's Creed: Unity." While on set throughout her young teens portraying the singer/songwriter 'Shady Lane/Lily' Kate taught herself guitar and to write songs. Upon returning to Canada from living and working in Los Angeles, Kate enrolled at York University on a scholarship studying toward her Bachelor of Music degree while continuing to teach and perform with her band both on TV and in concert. Todd has released two albums: 'Finding My Way' and 'Anywhere With You' under the world's largest Independent Record Label, eOne Entertainment and most recently released her latest EP 'One' recorded at Villa Sound.

Kate's caliber of songwriting has been recognized by the Canadian Songwriting Competition with multiple nominations and her music gained international attention in 2016 when she won 'Versatile Entertainer of The Year' at the Josie Music Awards held at the prestigious Schermerhorn Symphony Center in Nashville TN. Her most recent EP release 'One' (Villa Sound) showcases Kate's introspective side of songwriting and has allowed her to return to her alt country rock roots. Most recently, Kate was honoured to open for the legendary singer/songwriter Ron Sexsmith at the Historic Gayety Theatre in Collingwood, ON.

Throughout her career Kate has served as official spokesperson and keynote speaker at several events and charity fundraisers. She was honoured to represent Proctor & Gamble in launching their 'Being Girl' web campaign for young women and has been invited as a keynote speaker at various events such as the Ted Rogers School of Management conference at Ryerson University, Girl talk and has acted as host for the annual SIPO Foundation conference. She has also addressed the graduating media class at Guelph/Humber College at the Emerge TO conference and was invited to be the keynote speaker at the 2014 Geneva Park YMCA Leadership retreat.

In 2018 Kate was presented the International Women's Achievers Award in recognition of her extensive community service and volunteer work. Since graduating university with a Media, Performance and Design degree and being honoured with an induction into the exclusive Golden Key International Honor Society for grade performance, Kate now resides in Washington, DC with her husband where she focuses her time on KTE, her music and acting coaching business Kate Todd Entertainment.



## Christopher S. Langley

Ph.D., P.Eng.

Senior Engineer, Guidance, Navigation, and Control, Robotics and Automation

MacDonald, Dettwiler, and Associates (MDA)

# CHRISTOPHER S. LANGLEY

*How do you maintain a space station with no one on-board – especially when you can only communicate with it once a week? This talk will describe how technologies originally conceived for Mars rovers, naval warfare, and video games are being tagged for use by the next generation of Canadian space robotic manipulator.*

Chris Langley is a Senior Engineer in the Guidance, Navigation, and Control department at MacDonald, Dettwiler, and Associates (MDA) in Brampton, Ontario. He has 14 years of experience working on research and development of autonomous systems. Dr. Langley co-lead the guidance and navigation design for the Mars Exploration Science Rover (MESR) and the “Hercules” Lunar Exploration Light Rover (LELR), planetary rover prototypes which were delivered to the Canadian Space Agency in 2012. He was the technical lead for the System of Autonomous Planning and Intelligent Execution Technologies (SAPIENT) R&D program, which developed a proof-of-concept architecture for autonomous robotic operations in deep space, where communication latency and availability prevent the traditional methods of ground control used for Canadarm2 and Dextre from being applied. Currently he is engaged in systems engineering for the next generation of Canadian space manipulators, called Deep Space eXploration Robotics (DSXR), envisioned to reside on an international lunar orbiting platform.

Dr. Langley holds a Ph.D. from the University of Toronto Institute for Aerospace Studies, and is a Professional Engineer.



# Michael Plaza

Principle Site Investigator, FROST Study

# MICHAEL PLAZA

Michael Plaza is a Physician, certified in Diagnostic Radiology and holds a fellowship in Breast/Body Imaging. He is bilingual, dedicated and motivated.

Since 2018 he has been with the Diagnostic Center for Women, Miami, Florida serving as; a breast radiologist, Head of Clinical Research, Head of Clinical Research and Director of MRI. Dr. Plaza spearheaded the breast cryoablation program for minimally invasive treatment of fibroepithelial lesions and carcinoma. He is the Principal site investigator for the FROST trial and ECOG-ACRIN 1141

From 2013 to 2014 he was with Memorial Sloan-Kettering Cancer Center, New York, NY as; Clinical Instructor, Neuroradiology Department, Clinical Instructor, General Radiology Department.

From 2011 – 2013 Dr. Plaza was with the University of Miami/Miller School of Medicine, Miami, Florida as Voluntary Assistant Professor of Radiology and an Associate Physician at the Miami Children's Hospital, Miami, Florida.

His faculty Appointments include: University of Miami/Miller School of Medicine, Miami, Florida from 2014 to the present, as Voluntary Assistant Professor of Radiology

Nova Southeastern University College of Osteopathic Medicine, Miami, Florida from 2015 to the present as Clinical Assistant Professor of Radiology, Breast Imaging Department.

Dr. Plaza is a graduate of Wake Forest University School of Medicine, Winston-Salem, NC where he receive his Doctor of Medicine. His post graduate training, Breast and Body Imaging Fellowship, was done at the Memorial Sloan-Kettering Cancer Centre, New York, NY.



## Natalia K. Nikolova

Professor

Canada Research Chair in High-frequency Electromagnetics, Dipl. Eng. (Technical University of Varna, Bulgaria), Ph.D. (University of Electro-Communications, Tokyo, Japan), Fellow of the IEEE, Fellow of the CAE, P.Eng. (ON)

# NATALIA K. NIKOLOVA

Natalia K. Nikolova received her Dipl. Eng. (Radioelectronics) degree from the Technical University of Varna, Bulgaria, in 1989, and her Ph.D. degree from the University of Electro-Communications, Tokyo, Japan, in 1997. She is a Professor in the Department of Electrical and Computer Engineering at McMaster University. Her research team works on problems in inverse scattering, radar imaging, as well as aspects of the computer-aided analysis and design of antennas and high-frequency electronic components. Prof. Nikolova is a Canada Research Chair in High-frequency Electromagnetics. She is a Fellow of the Institute of Electrical and Electronics Engineers and a Fellow of the Canadian Academy of Engineering.



# Ross Lockwood

PhD

# ROSS LOCKWOOD

Ross Lockwood is a scientist with a passion for learning, experimentation, and scientific outreach. He graduated with a PhD in Condensed Matter Physics from the University of Alberta, and has served as systems and communications engineer on the NASA-funded HI-SEAS Mars Simulation, a spacesuit tester for the Project PoSSUM microgravity simulation, and as a guinea pig for a multitude scientific studies on how space travel affects the human mind and body. Ross recently finished work on a Massive Open Online Course called Black Holes 101, which is available for free on *Coursera.org*.



# Arushi Nath

9 years

Co-Founder, HotPopRobot

We love music, making cool space projects and participating in hackathons (27 so far)! Five years ago, we participated in our first hackathon – the NASA SpaceApps Challenge at the Ontario Science Centre. Our project “Curious Bot” – an autonomous Mars rover made using Arduino won one of the top 5 NASA SpaceApps Award 2014.

It ignited our passion for space, and give us the confidence that science can turn our dreams into reality. We ended up making over 25 space projects: rovers, robots, battle bots, model rockets, and artificial intelligence algorithms, often mixing arts, science, and music. Our

projects have won many awards including the NASA SpaceApps 2018, 2017, 2014, the Canadian Space Agency Space Apps 2017, Science Odyssey Grand Prize 2018, Emerald Code Grand Prize 2018, and the Jesse Ketchum Award 2018 by the Royal Astronomical Society of Canada (Toronto) for our science equipment made from Lunch Box to measure Total Solar Eclipse. But our favorite award was an invitation by the Canadian Space Agency for an exclusive visit to their headquarters in Montreal, to present our Canadian SpaceApps winning project “Yes I Can” (which uses data from RadarSat-2 satellite of Canada to make the Canada150 logo) and to meet the new astronauts.

A close-up portrait of a young boy with dark hair, smiling slightly. He is wearing a dark blue collared shirt. The background is a plain, light-colored wall.

# Artash Nath

12 years

Co-Founder, HotPopRobot

We are passionate about communicating science and demonstrating our projects. In 2014, we co-founded the HotPopRobot initiative with our family to carry out science outreach to other kids, families, and schools. Our projects have been displayed at Maker Festival Toronto, MakerExpo Kitchener, Maker Festival Delhi, International Space Development Conference (USA), Toronto International Film Festival, Science Rendezvous, NASA Youth Space Apps, Ontario Science Centre, Toronto Reference Library and schools. Our projects have been featured on the cover page of Toronto Metro Newspaper, The Star, TVO Kids, CBC, and Global News.

Artash was a Speaker at the Science March Toronto 2018 while Arushi was a speaker for the International Day for Women and Girls in Science 2018 at the Ontario Science Centre.

We believe that the best way to learn science is by making things and then teaching others how to do it!

Social Media Handles: Twitter: @wonrobot      Website: [www.HotPopRobot.com](http://www.HotPopRobot.com)

# [ student innovation showcase ]



# SHOWCASE PARTICIPANTS

DATE: SUNDAY, JANUARY 20, 2019

LOCATION: LIUNA STATION – MAIN LOBBY

INNOVATION NATION STUDENT SHOWCASE

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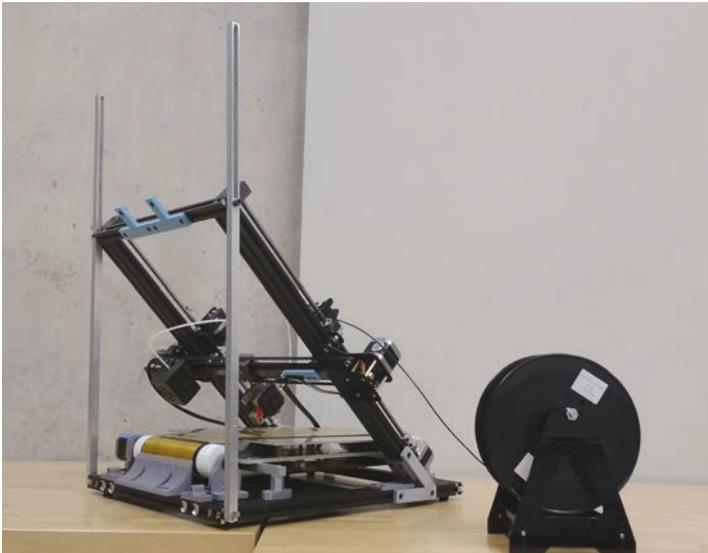
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# SWALEH DWAIS

McMASTER UNIVERSITY - ENGINEERING, HAMILTON

## An Innovative 3D Printer for Continuous Manufacturing Processes

DESCRIPTION: 3D printing has the potential to democratize manufacturing. Since 3D printers are easy to use and low cost, they allow anyone to make incredibly complex things. I'm confident that anyone reading this has seen something cool made on a low cost hobby grade 3D printer. The technology has opened up new doors to makers and hackers. However the capabilities of 3D printers are limited by requirement of human operation. The need of manual part removal prevents 3D printers from being used for mass production purposes. Therefore, the purpose of this project is to build a fully autonomous 3D printer. A 3D printer that can print a continuous stream of parts without user interaction. The finished machine is capable of independently ejecting and starting print jobs. Additional, the 3D printer's conveyor belt mechanism allows it to make infinitely long prints. The Automatic Infinite 3D Printer (i3D) allows any small business, organization, and person to leverage the power of a factory.



# JUSTIN GRIMM, AMY HASSELMAN, SIMRAN NIJJAR, SAMONY RIYAZ

McMASTER UNIVERSITY, HAMILTON

## YuMi Assembly Station

DESCRIPTION: The W. Booth School of Engineering Practice & Technology (SEPT) Learning Factory (LF) at McMaster University houses some of the university's most advanced industrial technologies to teach students to solve real-world problems using a holistic, innovative approach. The ABB YuMi Collaborative Robot (CR) is used as a multi-faceted tool within the SEPT LF, allowing students to learn about robot programming, complex sensor systems, data collection and analysis, and networking within an industrial environment. These are vital to the rapid integration and expansion of the Industrial Internet of Things (IIoT) and Industry 4.0 concepts in the automation industry. The YuMi CR is also an excellent example of how the concepts of Internet of Things (IoT) can be integrated into an industrial environment. In this case, the YuMi works with an operator to assemble an electronic screwdriver – a product both designed and manufactured within the SEPT LF. The application is controlled and streamlined by collecting real-time production data from the YuMi into a database and then optimizing the process to improve product quality and production efficiency



# HAMZA MAHDI, ABDALRAHMAN ALFAKIR, NADIM HAFEZ

RYERSON UNIVERSITY, TORONTO

## Smart Wheelchair for Physically Challenged Individuals

DESCRIPTION: A wheelchair is an essential item in the life of individuals with cognitive or motor impairments because it enables their mobility. Traditionally, the movement of a powered wheelchairs is controlled by a joystick. However, for many individuals with certain disabilities such as a quadriplegia are unable to control a joystick with hands. Therefore, in such cases there is a need for another mechanism to enable the user to control the movement of the wheelchair. Another issue that wheelchair users encounter very often is encountering and bumping obstacles that can cause accidents and injuries. Enabling the wheelchair to detect these obstacles and act accordingly in a timely manner will help the user avoid many accidents and the damage that can be associated with it.

The objective is to design a smart wheelchair that can be controlled by a quadriplegic with an input mechanism other than a joystick. The wheelchair should also be able to detect obstacles, alert the user and act accordingly to avoid hitting these obstacles.



# VITO NASO, MILAN IZZO, JON BRETON

McMASTER UNIVERSITY - B. TECH PROGRAM, HAMILTON

## Portable Electric Wheel Chair Drive

**DESCRIPTION:** The goal of this Capstone project is to produce something that would make a difference to someone; to introduce an innovation in an industry that has not necessarily had much progress in the last few years. Our design team decided to choose the principle of helping the disabled community with mobility, noticing an opportunity with manual wheelchairs. With the objective being to make an inexpensive and versatile attachment to the generic wheelchair that makes use of an electric motor and the capability to 'pull' a user along. Since we are incorporating the elderly in our scope of the project, this sets many restrictions with regards to price, weight, and range, this is because the user must be able to pick-up the system easily as well as be affordable for the elderly's annual salary (approximately \$30,000). The system must also be versatile enough to fit to any wheelchair on the market and adjust to each individual need.

This has resulted in the design you see below, it is capable of fitting on any manual wheel chair and has a speed of 15km/h (average jogging speed is 11km/h) with an approximate 2-4h operating range. It also includes an HMI (Human Machine Interface) display that is easy to use and provides system data to the operator, in addition to features such as navigation and efficiency monitoring.



# MATT STEWART, BEN HARVEY

McMASTER UNIVERSITY - B. TECH PROGRAM, HAMILTON

## Inverted Pendulum

DESCRIPTION: The goal of the project is to create an inverted pendulum system that is capable of self-balancing. The system balances a mass at the end of a pendulum upright by moving a cart at the base of the pendulum. The cart is controlled by a DC motor and an Arduino microcontroller which reads the pendulum angle and cart position from sensors in the system and adjusts the speed of the motor based on the required force needed to balance the pendulum. This project incorporates concepts from several engineering courses including; kinematics and dynamics, electronic control systems, advanced CAD, manufacturing processes, mechatronics, and project management.

The system is 27" long by 5.5" wide by 5.2" tall and weights 2.89 kg. The goal of the project is to have the pendulum recover from 5-degrees either side of vertical and return to steady state in under 3 seconds. The total cost of the system is \$640.22. The scope of the project includes; full design of the project using AutoDesk Fusion360 CAD software, dynamic simulation using ADAMS software, controller simulation and programming using MATLAB Simulink, creating manufacturing toolpaths using AutoDesk Fusion360 CAM software, and assembly and testing of the final product.



# ANOOP GADHRI

McMASTER UNIVERSITY - ENGINEERING, HAMILTON

## AI for Facial Recognition

DESCRIPTION: The problem statement at hand was to try and create a better method of employee verification for entry into a building or room. The conventional method requires a carry on identity device which brings issues such as ease of transability to unauthorized employees, on top of tedious tags you must carry that can easily be lost. The purposed solution our project offers is a facial detection and recognition software based on a feed forward neural network algorithm that directly integrates with IoT based unlocking mechanism.

The software will recognize and unlock the door based on who is standing in front of the door. This solution is non invasive, does not require a carry on tag and provides high enough accuracy to scale to a large extent.

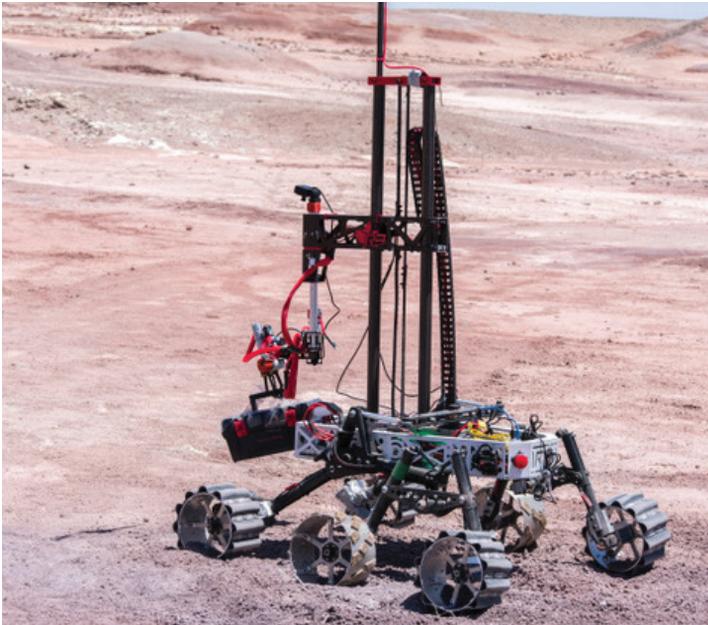


FEROZ BALSARA, LUKA SUBOTINCIC,  
ADAM YANG, DANIEL CRESTA, NICOLE BURDYNEWICZ,  
HAMZA MAHDI, YASAMIN AHMADZADEH, MICHEL KIFLEN  
RYERSON UNIVERSITY, TORONTO

## Ryerson Rams Robotics Mars Rover

DESCRIPTION: The Mars Rover is a fully automated robot complete with an on-board scientific laboratory for analysis of signs of life as well as an advanced robotic arm to enable various dextrous tasks. The robot is built to meet the requirements of the University Rover Challenge competition (URC).

The University Rover Challenge (URC) is the world's premier robotics competition for college students. Held annually in the desert of southern Utah in the United States, URC challenges student teams to design and build the next generation of Mars rovers that will one day work alongside astronauts exploring the Red Planet.



# ALI AWAIS AMIN, RUCHA KOLTE

MCMASTER UNIVERSITY, HAMILTON

## Eco-Pen

DESCRIPTION: Since 1950, more than 100 billion disposable plastic pens have been sold, that is equivalent of selling almost 47 pens per second for the last 67 years. These pens are made from the non-biodegradable petroleum based plastics. These plastic pens may look small in size but the mountains of pens that end up in the landfill creates a huge problem due to the toxic waste leached from the materials as they degrade. There are many bio-plastic pens in the market that try to address this, but it's very difficult for consumers to discern which are biodegradable or compostable. Many bio-plastics do not get discarded properly and some municipalities don't even have the facilities to sort, compost, or recycle bio-plastics, so they end up in a landfill.

Our solution is to engineer a pen to overcome this problem using recyclable materials. Among all the possible materials to choose for the pen, recycled paper is a superior option. Recycled paper has benefits of not only limiting the use of plastic but also reduce the flow of paper to landfills by 500,000 metric tons over the similar time period equivalent to the existence of plastic pens. Additionally, we have included as part of our engineering design tree seeds in the pen construction. Upon disposal the user plants the pen in soil allowing it to germinate and grow into a tree. Trees benefit everybody because they filter air, mediate water run-off and help retain soil not to mention the thermal benefits one can enjoy on a hot summer day, as well as the positive impact it has on the reduction of global warming. The pen is made by using roller press technology which is also used to make various other green products. This machine has two rollers that pressurize the materials which improves the grinding efficiency and thus reduces energy consumption.

We have made our first prototype of the pen and showed it to our customers to receive their feedback. Further, we also received Letter of Intents (LOIs) from them about their willingness to buy and support Eco-pen. This validates our value proposition and we are now ready with our second prototype. Also, we are in the process of developing a minimum viable product (MVP) and forming a company to commercialize the solution within next year.



# CHRISTOPHER LAMONT

ST. MARGARET MARY, CATHOLIC ELEMENTARY SCHOOL, HAMILTON

## Smart Cast

DESCRIPTION: Acute Compartment Syndrome (ACS) is a devastating medical complication that can occur in up to 6% of limb fractures after casting and can result in permanent loss of function or amputation of the limb. Currently, there is no monitoring system available to detect ACS before it occurs. The purpose of this project was threefold: (1) to develop a simulated model of cast induced ACS (2) to create a Smart Cast to aid health care practitioners in the early detection of high intracast pressures and (3) to enable a Smart Cast with a mechanism to automatically reduce intracast pressures when they become critically high. A fibreglass cast was applied over an empty intravenous (IV) bag that could be inflated with air to simulate increasing intracast pressures as seen in ACS. A force sensitive resistor (FSR) was then embedded into the Smart Cast and connected to an Arduino board programmed to read voltage outputs and convert these to pressure in mmHg. Pressure readings were calibrated using a blood pressure cuff. Code was written to send data to a serial monitor (Prototype 1), LCD (Prototype 2) and android device via blue tooth (Prototypes 3, 4, 5). High intracast pressures triggered auditory (Piezo buzzer) and visual (LED flash) alerts. For Prototypes 4 and 5, a custom designed android application was developed to read the intracast pressures on an android device and send a warning text message to a phone of choice. Prototypes 4 and 5 also included a mechanism to enable decompression of high intracast pressures. In Prototype 4, a manual release valve was used and in Prototype 5, a normally closed solenoid valve was included in the cast re-design and coded via the Arduino to enable an automatic pressure release response from the Smart Cast when intracast pressures were high. The innovative model of ACS was able to effectively simulate intracast pressures and the pressure calculation from the FSR voltages were linearly related to calibrated pressures with  $r=0.99$ . Each Prototype of the Smart Cast demonstrates evolution and improvement over its development. By leading to earlier detection, the Smart Cast could help to reduce the risk of limb dysfunction or amputation due to ACS after casting and has the potential to reduce the health care resources and costs associated with cast induced ACS.

# NILE ELLIS

McMASTER UNIVERSITY - B. TECH PROGRAM, HAMILTON

## Home Lighting Automation

DESCRIPTION: This project was started to improve understanding of automated systems and all their requirements within Industry 4.0. The project is made up of a hardware portion that reads the light level in a given room and a software portion that processes the raw light reading data, stores readings in a database, uses logic to make changes to the controlled lighting based on the readings, and a web interface to display metrics for operators. Using custom written software was the key to making this project successful; a module was written for each key feature making it easy to modify and removing many limitations of proprietary and cloud-based software. This means that Industry 4.0 is not only here, but is easily achievable for companies and individuals looking to take advantage of its benefits.





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