Ministry of Science and ICT

IITP Institute of Information & Communications Technology Planning & Evaluation

APPLICATION FORM
(JOINT RESEARCH)
HIGH POTENTIAL INDIVIDUALS GLOBAL TRAINING PROGRAM)

AGREEMENT

As stated above, I submit this application form to IITP that conducts "High Potential Individuals Global Training Program" supported by Ministry of Science, ICT in South Korea. IITP may disclose the information below to the public for the purpose of providing information and matching a research partnership between your institute and a Korean university.

* IITP : Institute for Information & communications Technology Planning & Evaluation

Printed Name of Chief of Research	ALEXANDRE DOUPLIK	Date(mm-dd-yyyy)	January 31th, 2020
Signature of Chief of Research			

☞ ***(Note)*** *This application is to identify the willingness to participate in this research and to find a research partnership for research institutes in Korea. Therefore, in its sole discretion, it is acceptable to contain only minimal information. (max. 3 pages)*

1. Research Title	(Example) Development of Artificial Intelligence based Fault Detection System						
2. Research Area	**A.I.**	**Big Data**	**Cloud Computing**	**Block Chain**	**AR/ VR**	**ICT/SW Convergence**	**Other ICT /SW**
					X		**X**
3. Chief of research	Title	Professor		Contact	E-Mail: douplik@ryerson.ca		
	Name	Alexandre Douplik			Tel: +1 647-704-9026		
4. Affiliation	Name	Ryerson University		Classification	(X) University ( ) Research Institute ( ) Industry ( ) ETC.		
5. Capacity for students (5 or less)	5		**Support for students *(all necessary)***		(X) Visa support (X) Research Mentoring (X) Research Space (X) Accessibility to Research equipment		

6. Research Objective	**Title/Goal:** Development of Interactive Virtual and Mixed Reality Applications for Education **Objectives:** - Voice and Gesture Recognition for Remote Podium during Classes - Mixed Reality Interactive Labs for Distant Education in Physics (Mechanics) - Mixed Reality Interactive Labs for Distant Education in Physics (Optics)
7. Research Summary	The main goal of this proposal is to develop Interactive Virtual and Mixed Reality Applications for Education purposes. Such Applications have an enormous potential for Education market due to at least 2 reasons: (1) a necessity to improve efficacy of contact education, when both the lecturer and students are located within a certain space like a class auditorium, and (2) a growing demand for remote or distant education when the educators and students are located far apart. The proposed objectives are targeting to meet the both aspects of future education development. The sections below focus on analysis of those, and deliberately considering both forms of education improvements. Considering efficacy of a contact education, the most of pedagogical experts emphasize importance of involving the students into the lecture process during classes, making the classes interactive towards active students' participation. According to an American novelist Gail Godwin, "Good teaching is one-fourth preparation and three-fourths theater." The ratio of the content throughput between the lecturer and the student is heavily governed by the engagement and the integration of students in the lectures. There exists an unbridged gap between the content/information presented and the amount of user interaction with the content. The contemporary student-lecturer communication model, while being quite informative, is less interactive than in the past, when live demonstrations were very often performed. As a result, the information presented lacks of dynamism and the users (lecturers and students) have only partial interaction capabilities with the content, like for instance the lecturer is the main driver of information, and the students have relatively low interactive capabilities. My understanding that cognitive psychology considers the factor of the physical distance between the students and the lecturer to be critical for students' engagement: the greater the distance the less engagement and vice versa – the shorter the distance, the higher the engagement. It seems that the optimal distance has been conditionally "negative", i.e. when the lecturer is situated literally inside the audience. To reduce the distance, the lecturer must be able to facilitate the interactive slide sequence and slide activation/maintenance remotely, being able to travel across the class room away from the podium. The existing presentation remote controls do not provide the required level of autonomy interacting and controlling the presentation and even carrying a remote control restricts lecturer's ability of active gesticulation and expressions. Recently, inexpensive VR/AR platforms have been extensively explored in educational and vocational institutions. Programs such as Samsung Gear VR, Google cardboard, Oculus Rift and other dedicated VR platforms have allowed for the creation of immersive VR content that can be used for learning and teaching. Microsoft Hololens, Google ARCore and Apple ARKit have allowed for heightened learning experiences as a real environment can be augmented with annotations, diagrams or other specific informational sources overlaid in real-time on a particular environment. Several companies such as Veative, Unimersiv, Curiscope have been successful at implementing AR/VR solutions for a wide variety of higher learning and vocational programs. These programs pave the path to create focused virtual education platforms that can be used to supplement currently available distant learning programs requiring practical experience. Using Samsung VR or Google cardboard, virtual labs can be implemented that can be used by students enrolled in distant learning programs. Hololens and other AR/MR platforms can be used in physical lab locations in universities/schools/colleges to augment currently available experiments or can be used as virtual manuals for training on equipment for experiments. **The proposed original and novel research** will include both testing the existing hardware/software platforms and development of the original software applications as described below. There is a lot of potential to merge and improve the intuitive connection among the users and the content. **The first objective of the project** is to perform seamless integration of the

	machine-human interaction technology with the lecturer-student communion. As a result, the students would benefit from the enhanced interactivity with the lecturer and, the lecturer benefits from the freedom of movement across the classroom while maintaining the slide presentation including changing slides, jumping to the right slide or clip, zooming in and, virtually annotating or highlighting via gestures and voice. **The first objective** aims to design and use an architecture that supports voice and gesture-based input from the users in a classroom. The users and the content are planned to be unified into a live-interacting environment. The opto-electronic setup would be designed for continuous image acquisition which would be fed to a data processing algorithm. A combination of voice and gestures would result in a pre-programmed response which initially would include navigating the slides, zooming and, annotating the slides in real-time. The algorithm is planned to be designed in a flexible manner which would allow adding further functionality with relative ease. This would allow the lecturer to move freely across the classroom, present and manage the information at the same time. We expect that putting the lecturer in a middle of audience would result in an enhanced throughput of information and would increase the audience engagement as well as open novel pathways for delivering information. During teaching, the lecturer will not carry any device in the hand thus acting naturally. As the opto-electronic platform for voice and gesture recognition we use Kinect (Microsoft) and Leap Motion or their combination. We plan to ultimately compare the class test results for control and experimental audiences to check the hypothesis of greater efficacy of the Voice and Gesture Recognition for Remote Podium during Classes for students' cognition across several courses where the control group will receive a routine "stick to the podium" lectures. Distant education for experimental science, technology, engineering, and mathematics (STEM) courses is limited by difficulties providing their lab practice. We propose to develop interactive mixed and virtual reality based interactive labs to test how well the virtual lab can replace a real lab practice. **The second and third objectives** of the project develop (1) 3D bare hand gesture-interactive models based of second generation of Microsoft Hololens (MR option) and (2) 3D haptic feedback glove - interactive models based on VR cardboard with Samsung and Apple smartphones (VR option). These two options will be compared within cost-education efficacy coordinates. The education efficacy will be statistically analyzed via class tests between the control and experimental groups where the control group will receive a real lab practice. For t**he objective of Mixed Reality Interactive Lab for Distant Education in Physics-Mechanics** we consider development of ball tossing projectile experiments varying the force and angle tossing the ball while registering the results in the same manner as in the real lab practice. **For the objective of Mixed Reality Interactive Labs for Distant Education in Physics-Optics** we consider development of Michelson Interferometer experiment varying the distances and alignment within the optical schematics while registering the results in the same manner as in the real lab practice. We plan implementation of each objective in both MR and VR options. Based on the objectives proposed we can consider placement for 5 students: Student 1 – Objective 1 project Student 2 - Objective 2 MR option project Student 3 - Objective 2 VR option project Student 4 - Objective 3 MR option project Student 5 - Objective 3 VR option project
8. Need for funding from Korean government	Living cost, travel cost, visa fees as mentioned in the call description. 25K per student for research (2nd generation of HoloLens, Samsung & Apple smart phones, paid apps, 3D tracing devices, haptic feedback devices, accessories)
9. Request for Korean Universities	The selection of students studying abroad should be conducted after mutual consultation, and please cooperate as much as possible to prepare for VISA. Working knowledge of programming (e.g. C, C++, Python) is a must.