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	Seon Ho Kim	Date(mm-dd-yyyy)	01-27-2020
Signature of Chief of Research	Seon Ho Kim		

☞ ***(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	Development of Intelligent Visual Data Management Platform for Smart City						
2. Research Area	**A.I.**	**Big Data**	**Cloud Computing**	**Block Chain**	**AR/ VR**	**ICT/SW Convergence**	**Other ICT /SW**
	X	X			X		
3. Chief of research	Title	Research Scientist	Contact	E-mail : seonkim@usc.edu			
	Name	Seon Ho Kim		Tel : +1-213-290-3352			
4. Affiliation	Name	University of Southern California	Classification	(X) University ( ) Research Institute ( ) Industry ( ) ETC.			
5. Capacity for students (5 or less)	2	**Support for students *(all necessary)***	(X) Visa support (X) Research Mentoring (X) Research Space (X) Accessibility to Research equipment				
6. Research Objective	Propose a joint research project for the development of intelligent data platform to collect, manage, analyze geo-tagged visual data for a city, which enables participating community partners connected not only to enhance their individual operations but also to smartly incorporate visual data acquisition, access, analysis methods and results among them for smart city applications.						

7. Research Summary	Images tagged with their spatial properties such as geographical location are termed as *geo-tagged images*. Due to the ubiquity of sensor-equipped cameras which are rapidly evolving to smart mobile edge devices such as smartphones and drones, people and automated systems are able to capture increasing amounts of geo-tagged images and videos from various modalities. There are a couple of main observations in recent visual data (images and videos) applications; 1) more and more visual data are being collected with location data using embedded sensors (e.g., GPS, digital compass) from mobile devices (e.g., smartphones, bodycams, drones), 2) fast network such as 5G promises a quick delivery of visual data wirelessly. Thus, visual data with detailed location metadata can be easily collected whenever, wherever, and transferred to anywhere. Such massive datasets of geo-tagged visual data provide various information about recorded areas such as the objects recorded, people's perception of areas and can be utilized in many applications such as surveillance, situation awareness in disasters, and smart city. The success of such applications depends on obtaining sufficient visual data related to particular geographical regions of interest and efficiently managing them. Furthermore, new intelligence to utilize such massive visual content is being developed and emerged in research to utilize the spatial context of geo-tagged images in more advanced applications (e.g., image machine learning for smart city). However, there still exist gaps between the abundance of geo-tagged visual data and their efficient management and exploitation for present and, more importantly for future applications. When we deal with a large amount of geo-tagged visual data, especially including available online data, there exist well-known bigdata challenges. Most data are being collected and stored in an independent and decentralized way so there are few systematic methods to know the availability of data, to measure the geographical coverage of image scenes, or to efficiently access needed data with regarding to a specific region of interest. To enable advanced image exploitation at scale, an autonomous *visual data acquisition and management* solution is needed. Therefore, we propose 1) to design a scalable data management platform to store and search geo-tagged visual data for smart city applications, 2) to device measures of *visual coverage* and *completeness* of the interested area relevant to a task, 3) to provide an autonomous data acquisition mechanism based on spatial-visual coverage to allow for efficient and automatic data collection by edge devices, and 4) to better support spatial-visual intelligence in image machine learning applications. Specifically, our proposal focuses on *geo-tagged visual data* since location information is essential in most smart city applications and provides a fundamental connection in managing and sharing data among collaborators. Furthermore, our study targets for an image-based machine learning platform to prepare community partners for upcoming era of machine learning and AI applications. The proposed project will be used to pilot, test, and apply various image based smart city applications among community partners to improve community functions and quality of urban life. New data, methods, and extracted knowledge from one application can be effectively translated into other applications, ultimately making visual data and analysis as urban infrastructure. The goal is to make value creation through visual data and their analysis as broadly available as possible, thus to make social and economic problem solving for smart city more distributed and collaborative among community partners. The proposed platform is to autonomously collect and manage geo-tagged visual

	data, especially using mobile edge devices (i.e., smartphones and drones), targeting for a scalable system that can accelerate collaborative collection of visual data and address the main challenges that prevent a large-scale visual data exploitation. Based on a new definition of the spatial visual coverage measurement with an image dataset, it will incorporate a new data acquisition mechanism to automatically identify and collect missing visual data needed in an application. In accessing the collected data, it provides new spatial-visual indexes and subsequently providing a fast searching and query capability with a proper spatial coverage model of visual content. More importantly, as emerging applications requiring spatial-visual intelligence to cover a wide geographical area are gradually adopting more image machine learning algorithms utilizing ubiquitous camera sensors, an edge computing paradigm focuses on processing large amount of visual data at the edge to offload processing cost and reduce long-distance traffic and latency. However, existing frameworks lack appropriate mechanisms to integrate visual data collection for machine learning at edge devices and, furthermore few ways to automatically feed the collected data from the edge devices into the retraining process at a server for quality and performance enhancement of the model. To address the above issues, the platform integrates autonomous crowdsourcing of geo-tagged visual data, image machine learning and edge computing in one framework. One straightforward approach for crowd-based learning framework is to exploit all of the crowdsourced data; however such mechanism may be infeasible in image machine learning applications due to high visual redundancy and spatial imbalance, network constraints between a server and edge devices, the high computational requirements at the server and the potential degradation of the accuracy of learning model. Consequently, we propose a distributed visual data selection algorithm that prioritizes the crowdsourced data, transfers only a selected subset of data, and still efficiently upgrades the learning model at the server end.
8. Need for funding from Korean government	Some parts of this project have been supported by US government and industry. Especially, it has been tested with the City of Los Angeles as a prototype system such as automatic trash/graffiti recognition and classification from street images, road damage detection and classification. We would like to extend our project to other cities such as Korean cities which are interested in visual data applications for smart city. It requires some funding for local data collection and international collaboration.
9. Request for Korean Universities	This is a large-scale research project with ongoing effort so I need student support for some partial solutions such as automatic spatial crowdsourcing with mobile cameras, image machine learning, indexing, edge computing, and augmented reality. Understanding image machine learning, database, mobile programming, multimedia would be helpful. Please refer to the following web page for details: http://mediaq.usc.edu:8080/TVDP/index.html. The selection of students studying abroad should be conducted after mutual consultation. Students are supposed to work in our existing project group so English proficiency is required.