



CityU Industrial Workshop 2022



Name: **Rick, Tiande MO**

Company Name: **Hong Kong Productivity Council**

Positions:

Head of Green and Smart Mobility / Smart City Division

Head of Business Development Unit / Automotive Platforms & Application Systems R&D Centre



Description of Rick MO

Mr. Rick Mo is the Head of Green and Smart Mobility Unit in HKPC. He is also the Head of Business Development Unit of Automotive Platforms & Application Systems (APAS) R&D Centre. He has 20 years' working experiences in both academic and industry and managed more than 20 mega-size R&D projects funded by Hong Kong Innovation and Technology, including electric vehicles, chargers, smart on-board systems and autonomous driving technologies.

Title and Abstract

Title:

Next Generation AI Robotic Indoor Positioning System by Fusion of 3D Magnetic Sensor and Depth Camera
基於3D磁場感應器和深度相機融合技術的新一代人工智能機械人室內定位系統

Abstract:

Localization of autonomous mobile robots (AMR), the ability to identify its location in a given space, is a key element in autonomous navigation in many applications (e.g. inventory warehouse, exhibition hall and restaurants). LiDAR is a common indoor position system used in AMR navigation but the accuracy will be decreased in long corridor or large open space with less features. Others like iBeacon or Ultra-wide band (UWB) technologies require extra high cost for building infrastructure and continuous maintenance. 3D Magnetic localization is one emerging technology that identifies different “magnetic landmarks” based on ferromagnetic object arrangement in the Earth’s magnetic field. These landmark signatures, which are basically uniquely patterns of magnetic fields, are detectable and identifiable in an indoor even in long corridor or space with less features. The accuracy can be further increased by fusion of image positioning based on depth camera where the image positioning system will firstly identify a sub-region in a large space and then precisely localize the position by magnetic landmarks in centimeter level.

Magnetic localization is low power, low-cost, and compact size based on microelectromechanical system integrated circuits (MEMS IC). It requires no extra cost in building infrastructure and continuous maintenance. This shall be a promising new technology for AMR indoor navigation. A.I. neural network will be designed and developed to accurately classify and identify the data from 3D magnetic sensor and depth camera for localization in centimeter level.

This R&D project, realization of indoor positioning by fusion of magnetic and image landmarks, is led by HKPC and partner with APAS, to facilitate the local industry to enhance automation technology which can-line with Government’s initiative to create a social wider effect and Smart Mobility Roadmap for Hong Kong.

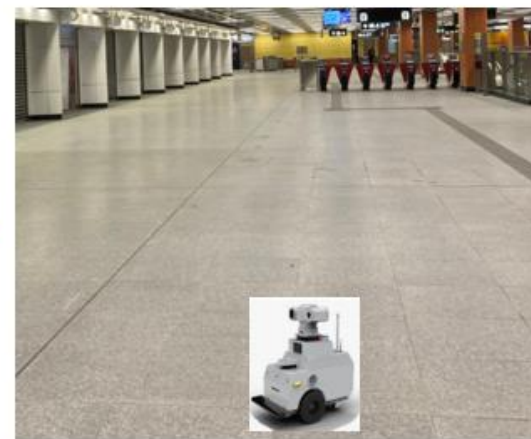
Reference

Problems Statement of the Project

- 1) LiDAR accuracy will be affected in space with less **finger-prints** such as corridor or a big empty room.



Not much features



Big empty room

- 2) iBeacon/WiFi/UWB need infrastructures



Autonomous MOBOT



Need infrastructure

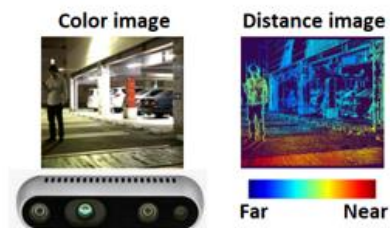
Reference Solutions of the Project

R&D of an indoor positioning device for localization of autonomous mobile robot (AMR)

Fusion of **Image Landmarks** and **3D Magnetic sensor** (Earth's magnetic field) to generate of **recurrent plot** (**Magnetic Landmarks**) of precise location identified by AI neural network.



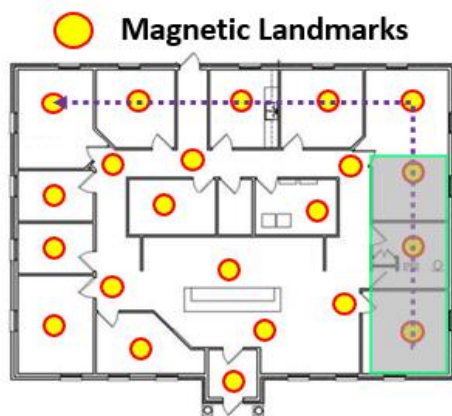
- High precision in cm
- No infrastructure
- Low-cost



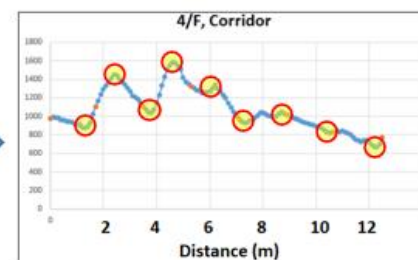
3D Magnetic Sensor



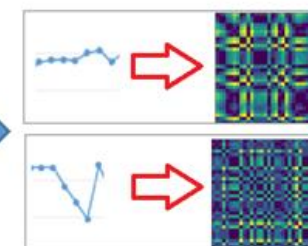
Magnetic Landmarks



AI Image Landmarks Identify sub-region

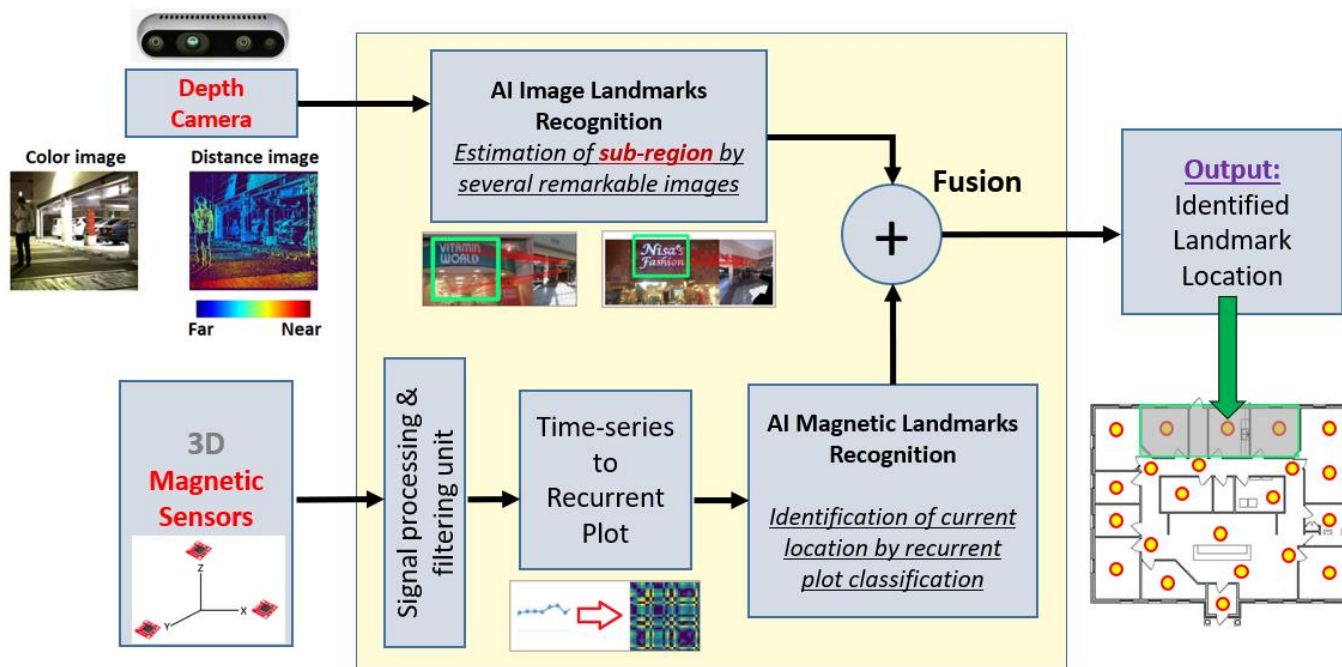


AI Identify precise location



Recurrent plots

Reference System Architecture



Procedures of using this system.

1. Before use this system, **magnetic and image mappings** in a venue must be conducted once by moving the AMR manually by operator.
2. After mapping, magnetic and image landmarks can be identified manually by operator.
3. Afterwards, the AMR can work automatically now.
4. When the AMR is moving in a venue, it will use depth camera to identify a sub-region in the venue with accuracy in meters.
5. When a sub-region is identified, the AMR will use magnetic landmark to identify its location precisely in centimeter level with LiDAR location information.