Project Specification Form (2017/18)
Department of Electrical and Electronic Engineering

Project Title: Navigation Positioning Control of Automated Guided Vehicles (AGVs)	
Project field: Optimisation, Machine Learning	
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Project Specification

1- Project Description and Methodology

Automated guided vehicles (AGVs) are mobile robots that are able to navigate automatically as guided. They are used as a material handling device at manufacturing systems, warehouses or transportation systems. Different methodologies have been proposed to optimise the AGV systems, especially for the optimal scheduling and routing with the ability to avoid deadlocks/collision and assure efficient vehicle utilisation. Potential candidates for the solutions may be mathematical methods (exact and heuristics), metaheuristic techniques and artificial intelligence based approaches.

This project aims to build up a **prototype** of multi-AGV system with Arduino or Raspberry Pi robots. Each AGV is a standalong system and able to **communicate with other AGVs** to avoid conflict, deadlock and collision.

The project will be carried out via the following steps:
1) Learning of the specifications of different robots available from the commercial market; identifying a robot to fit the needs of the project under a specified budget.
2) Learning of the integrated development environment (IDE) of selected robot.
3) Learning the communication mechanism of robots and related control commands/programming functionality.
4) Designing a **prototype multi-AGV system** to demonstrate **functional communication** between AGVs and **effective navigation position control** under **designated testing scenarios**.

2- Requirements

The project involves substantial **programming** and **experiments** with robot vehicles. The student is required to have a **strong** interest and **solid** knowledge/experience in
1) C++/Java/Python/Linux
2) Optimisation.
3) Machine learning.

3- Project Rationale and Industrial Relevance

This hands-on project will provide the opportunity to explore industrial application of optimisation theory and navigation control methodology. The designed prototype system may serve as the platform for exploring more energy efficiency deployment of AGVs and other intelligent control systems.

4- Indicative literature

1. H. Fazlollahtabar and M. Saidi-Mehrabad, *Methodologies to Optimize Automated Guided Vehicle Scheduling and Routing Problems: A Review Study*, J. Intell. Robot. Syst. (2015) 77:525–545

2. V. Bobanac and S. Bogdan, *Routing and Scheduling in Multi-AGV Systems Based on Dynamic Banker Algorithmm,* 16th Mediterranean Conference on Control and Automation, June 25-27, 2008

3. L. Kalinovcic, T. Petrovic, S. Bogdan and V. Bobanac, *Modified Banker's algorithm for scheduling in multi-AGV systems*, IEEE International Conference on Automation Science and Engineering, August 24-27, 2011

4. P. Kumar and Umesh Chandra Pati, "Arduino and Raspberry Pi based smart communication and control of home appliance system," *2016 Online International Conference on Green Engineering and Technologies (IC-GET)*, Coimbatore, 2016, pp. 1-6.

5. M. Kajan, J. Šovčik, F. Duchoň, L. Mrafko, M. Florek and P. Beňo, "Sensoric subsystem of automated guided vehicle: TCP communication between SIMATIC S7 PLC and Arduino," *2014 23rd International Conference on Robotics in Alpe-Adria-Danube Region (RAAD)*, Smolenice, 2014, pp. 1-6.