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ICT R&D Newsletter in Egypt

A Smart Public Parking System

Arab Academy for Science, Technology and Maritime Transport and Alexandria University/AIT Systems

Researchers from Arab Academy, Alexandria University, and AIT Systems Co. have developed a smart solution for reducing illegal parking, traffic jams and decreasing the average time for finding a free parking spot, which in return decreases polluting gases emissions and saves time and energy. The developed on-street terminal was thoroughly designed to seamlessly fit within the streets and to offer an extremely user-friendly, cloud-based system that can be accessed by users either through the on-street terminal's touch screen or through a mobile application. The terminal accepts different payment methods such as coins, notes, and cashless card payments. The system offers dynamic tariff that achieves maximum profit while maintaining highest customer satisfaction level. An efficient energy management system is implemented to maximize the solar energy contribution as a free and renewable power source while maintaining system reliability. Furthermore, a preliminary feasibility study for this proposed system was provided to determine how it would operate, potential obstacles, competition and market analysis to validate the success of this smart solution. Prof. Mostafa Saad Hamad – Professor at the Arab Academy and the project principal investigator - says, "Research in this field increased along with the huge technological advancements that occurred in the late nineties. Therefore, this on-street terminal must provide some unique features and solutions such as enabling charging mobile phones through a USB-Charger, the development of a virtual receipt, offering electrical vehicles charging ports besides detecting illegal parking and instantly applying fines and payment collection'.

EVU: Edge Vision Unit for Real-Time Smart City Video Surveillance

German University in Cairo

A research team from the German University in Cairo has innovated an Edge Vision Unit (EVU), which utilizes the emerging technologies of IoT and Cloud Computing together with the science of Deep Learning to perform advanced algorithms on the edge side of the surveillance systems.

Video surveillance technology has become a fundamental tool for safety and security, such as traffic monitoring, indoor monitoring, and crime & violence tracking. However, with the rapid increase in the usage of these systems increases dramatically the amount of video data. In turn, this overloads the hardware resources and the network to store and transfer this data. In unfortunate events, it is not feasible to analyze all the cameras' footage to extract meaningful information in a reasonable time. Here raises the need to have automated video processing and analysis in real-time and to be carried out at the side of the cameras. EVU is designed as a Raspberry_Pis that could be attached directly to the surveillance camera or integrated with the network. "Raspberry_Pi is a cost-effective widely available Computer-On-Board system. With algorithms optimization EVU can perform fundamental tasks as Summarization, Motion and Human Detection as well as advanced tasks as Face & Gesture Recognition, People Counting & Tracking, and Fire & Smoke detection in real-time' says Dr. Mohamed Abdelmegeed - Associate Professor at Faculty of Media Engineering and Technology German University in Cairo and the project principal investigator.

The proposed system has been tested on standard and custom datasets. It is found to produce the desired results with accuracies comparable to the standard systems that use powerful computing devices. It is found successful and robust when it has been implemented in real-world scenarios.

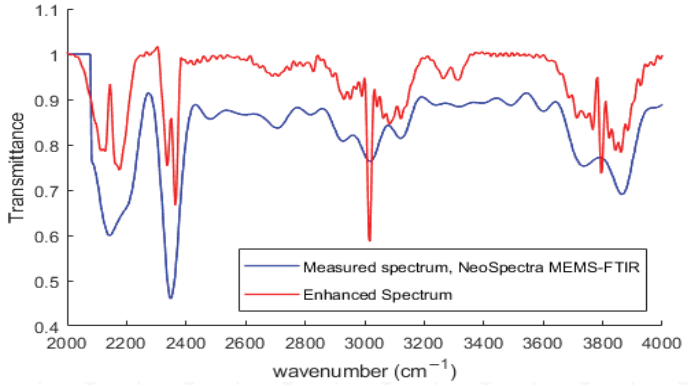
A Deep-learning system for resolution enhancement of miniaturized infrared spectroscopy for gas analysis

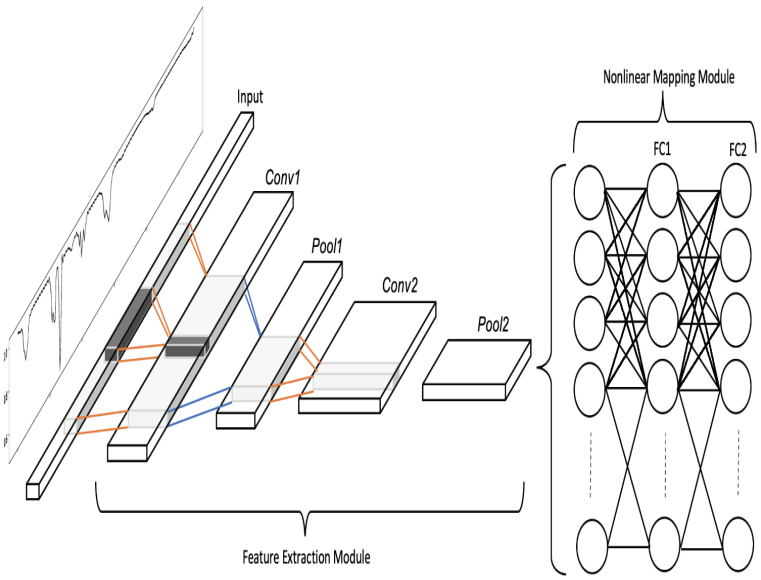
Port-Said University

Researchers from Port-Said University and Ain-Shams university have developed a proof-of-concept that uses artificial neural networks to enhance the resolution of low-resolution gas spectra that are measured using miniaturized MEMS (Micro-electromechanical systems) Fourier transform infrared spectrometers (FTIR). Infrared spectroscopy is used in identifying the composition of matter. It serves applications in various domains including gas analyses and air quality monitoring. Miniaturized Fourier transform infrared spectrometers (FTIR) serve market needs in such applications, but the miniaturization comes at the cost of lower spectral resolution. Higher spectral resolution is needed for better identification of the gas composition.

"In our project, artificial intelligence (AI) technique (namely, convolutional neural network (CNN)) was used for resolution enhancement of the measured infrared gas spectra using a MEMS-FT-IR spectrometer. The CNN was trained using synthetic transmission spectra of complex gas mixtures that contained simulated FTIR sensor non-idealities' says Dr. Sherif Abou El Aneen - Associate professor in Port-Said University and the project principal investigator. The CNN learned the nonlinear mapping to constructs high-resolution gas spectra from low-resolution versions. Higher resolution spectra were constructed from low-resolution measurements which enables better identification of the gases.

The project resulted in a proof-of-concept, a trained neural network, for AI-based resolution enhancement for gas infra-red spectra.





Smart Production Planning & Scheduling

German University in Cairo

A research team from the German University in Cairo developed a software solution with customized hardware that can be used to automate the generation of shop floor manufacturing schedules for small and medium-size manufacturing enterprises (SMEs) taking in consideration machine failures. Most Egyptian SMEs plan their production activities according to market demand. The production scheduling on the shop floor level is designed by the production planning staff in a form of a static schedule. However, disruptions to the planned static schedule such as: machine breakdowns, increased order priority, rush orders arrival, quality assurance tests failure and order cancellation require constant update to the initial static schedule. These disruptions complicate the scheduling task and changes its nature to a highly dynamic one, in addition to decreasing the overall ef ciency of the industrial entity. Dr. Lamia Shihata - Associate Professor at Faculty of Engineering in German University in Cairo and the project principal investigator says, “Resolving machine breakdowns is not a straightforward task. Since, machine repair time is unpredictable.’ The SW tool inputs are the decision-maker’s constraints and the data collected from the shop floor level. The SW tool engine solves the optimization problem using Genetic Algorithm and generate/regenerate the optimized shop floor schedule with minimum makes pan. To integrate the effect of machine failures, a PCB prototype was designed and manufactured. The PCB measures machine health vital signs for Condition Based Monitoring and predictive maintenance purposes. The sensors readings data can be used as a sign for the machine health; this will enable the SPPS user to reschedule the production plan whenever necessary.

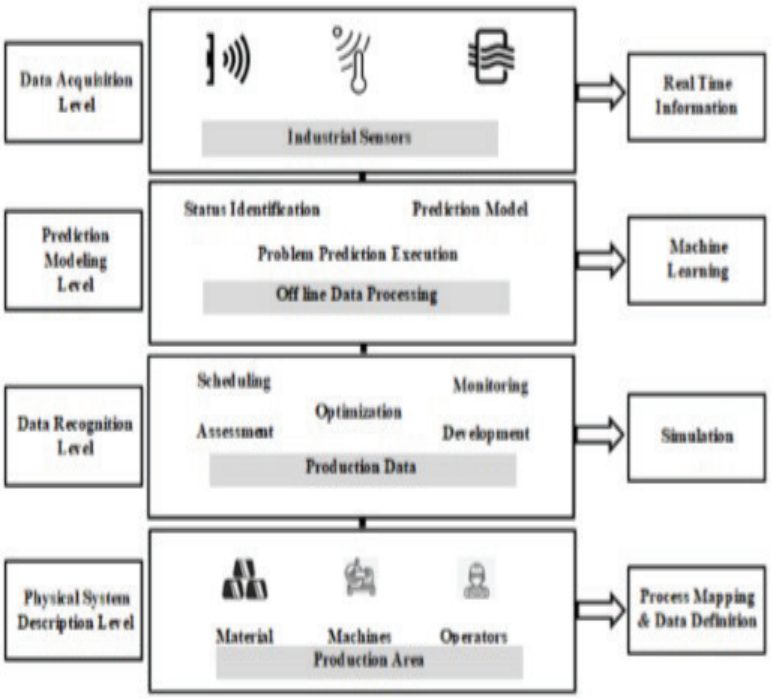


Figure 1. Proposed Framework.

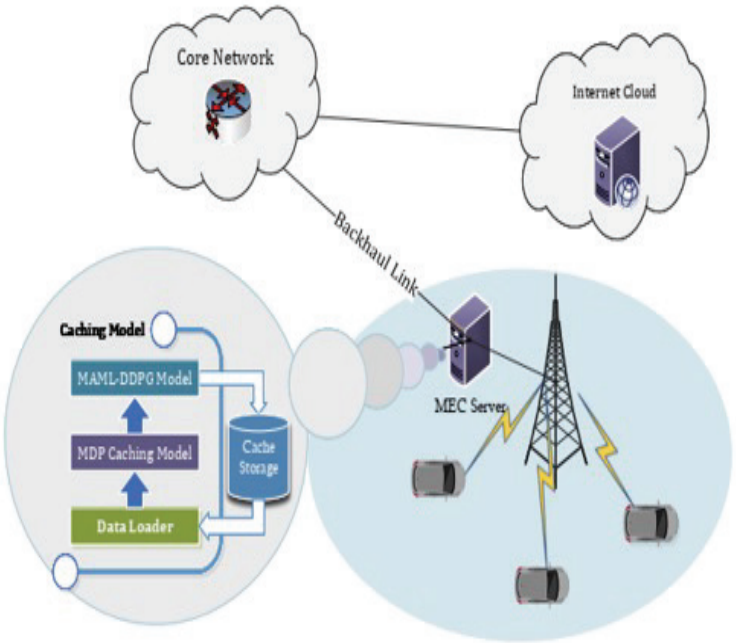
Meta Learning core for Vehicular Networks

Egypt-Japan University of Science and Technology

Researchers from EJUST introduced a meta learning core for vehicular communication networks. With the emergence of vehicular communications as a key technology in 5G and Beyond 5G (B5G) communications systems and the growing interest of Egyptian ICT companies in the field, it is to introduce machine-learning technology to vehicular communications. The project proposes applying meta learning as the most suitable machine learning to address the shortcomings of fixed model assumptions for the deep learning models and make them more appealing for applications do not have the luxury to assume stationary and fixed non-volatile model of the network.

The project developed two meta learning engines. The first core targets the problem of channel estimation in vehicular networks, which is dilemma in this aggressive highly mobile environment. The developed meta learning core is adaptable to sub 6 GHz DSRC standard as well as massive MIMO mmWave vehicular communications. The second meta core focuses on the problem of caching at the edge. "With content caching expected to play a major role in timely content delivery and improved Quality of Experience (QoE), learning techniques are expected to play a major role in optimizing the performance of the caching in different networks. However, for the fast-changing dynamic vehicular scene, flexible learning algorithms are specially appreciated. The meta caching core is based on meta reinforcement learning' says Dr. Maha Sabrouty – Professor at Egypt-Japan university of Science and Technology and the project principal investigator.

The project impact goes beyond the developed cores to provide expertise in meta engines that can be further utilized in other vehicular and wireless applications.



The System Model of the proposed edge caching framework