# ICT R&D Newsletter in Egypt

Smart Integrated On-Board Battery Charger for Electric Vehicle Applications

Alexandria University and Arab Academy for Science and technology AAST

Researchers from Alexandria University and Arab Academy for Science and technology AAST have developed an integrated six-phase-based on-board battery charger for electric vehicles, which is completely monitored, and controlled through a smartphone application via internet of things (IoT) technology. The main advantages of the integrated on-board charger (OBC) over classical commercial chargers are their reduced cost, size, and weight since all propulsion components are simply utilized in the charging process instead of having separate charging circuits. A 2kW prototype system using a 6-phase PM machine is implemented to validate the proposed system using simulations and experiments. The optimal design of the employed propulsion motor has been carried out based on finite element simulations. A novel predicative control-based controller has been proposed under both three-phase and single-phase charging and for both G2V and V2G modes. "The proposed IoT-based supervisory control of the integrated OBC allow the user to control the charging rate and participate in potential demand response activities which are crucial in the expected wide EV adoption scenario in future smart cities,' says Prof. Ayman Abdel-khalik, Professor at Alexandria University and the principal investigator of the project.
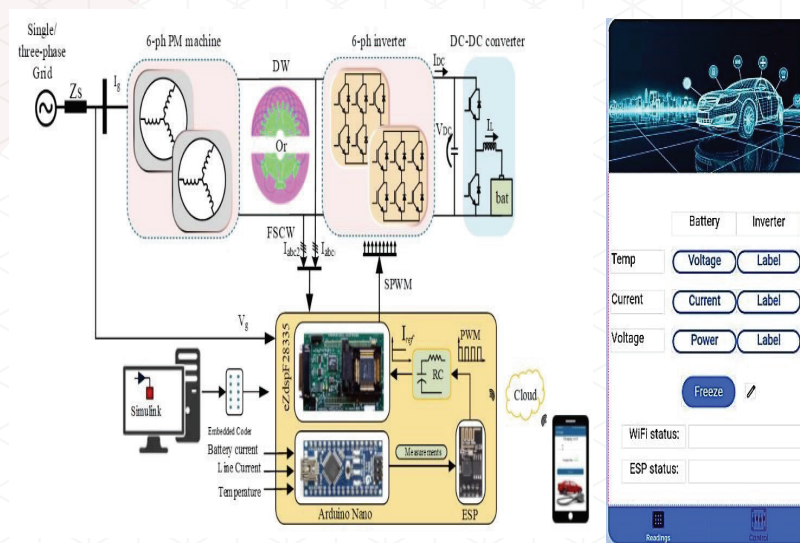

System Block Diagram   Mobile Application
Proposed IoT-based supervisory integrated OBC

A Software Defined Radio-based LoRa Receiver for Dense IoT Deployments within Smart Cities

German University in Cairo

Researchers from the German University in Cairo have designed and implemented a real-time receiver based on software-defined radio (SDR) for IoT LoRa signals. The LoRa decoder has been developed using python programming and has been tested to be compliant with nominal LoRa off-the-shelf transceivers. "Since LoRa IoT networks are projected to be deployed in dense IoT environments within smart cities, a new list decoding technique for receiving LoRa has been proposed and installed in the SDR receiver with the outlook to improve LoRa reception performance and combat same technology interference' says Prof. Tallal Elshabrawy, Professor at German University in Cairo and the principal investigator of the project. Practical results of proposed list decoding scheme have demonstrated approximately 15dB performance gain of LoRa reception under interference particularly at extreme Signal-to-Interference-Ratio (SIR) conditions. Moreover, the research team have leveraged the SDR platform to develop a LoRa network emulator that provisions the LoRa network capacity with thousands of IoT devices. In the emulator, the SDR device mimics the traffic generated from thousands of IoT sensors and a commercial off-the-shelf LoRa transceiver represents the gateway. Experimental results indicate that a single 125 KHz channel supports a capacity of approximately 3,000 IoT devices with packet transmissions every 10 minutes.
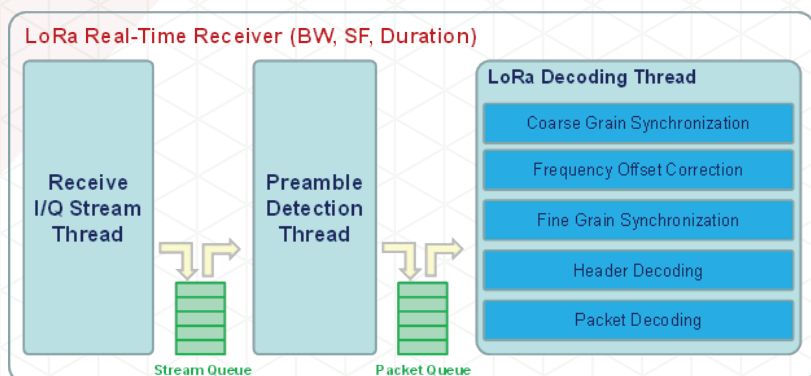
SDR LoRa Receiver Architecture
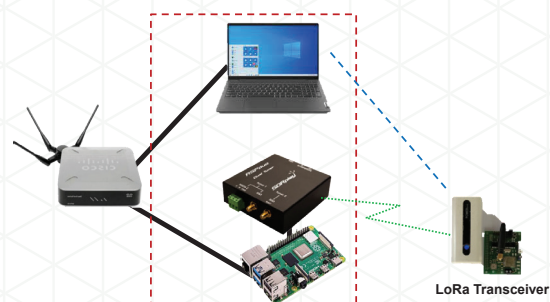
LoRa Reception Experimental Setup

PVOLTAI4.0: Research and Development of O&M Technologies for PV Plants Management
American University in Cairo and Empower Energy System

Researchers from American University in Cairo and Empower energy system developed an Industry 4.0 system capable of monitoring and controlling a solar PV power plant, Constructing an IIoT enabled PV power plant, designing new sensors and inspection technologies for PV plants monitoring, defining and implementing novel O&M data science algorithms, based on Artificial Intelligence techniques, and building a 27.5 KWP PV demo plant. The energy demand in Egypt increases by 2.6% per year according to the International Energy Agency (IEA) report. The Egyptian government has adopted a strategic plan to use renewable energy sources. "Predicting production and preventing failures is a game changer for electricity producers, which can be achieved through remote monitoring of the plant and advanced analysis of the data collected' says Dr. Yehia Ismail, Professor at American University in Cairo and the principal investigator of the project. A new concept of Smart Factory is raised through the application of the Key Enabling Technologies (KETs): Big Data, Internet of Things (IIoT), Cybersecurity, among others. Following this approach, an Industry 4.0 system connected to the plant along with artificial intelligence (AI) algorithms could give the plant operator a better chance of quantifying the amount of energy produced by the plant. The project allowed us to take decisions based on the given resource conditions and its predictions, constituting a huge step towards a more productive, reliable, and economic power plant. In addition, the plant lifetime will be enhanced by regular and preventative maintenance and its technical problems would be avoided by predictive maintenance.

EduEdges: A unique paradigm shift from teaching to learning based on AI technologies
AI - Azhar University and 4S Technology

Researchers from Al-Azhar university and 4S technology developed an intelligent e-learning platform called EduEdges, that uses artificial intelligence technologies, data science and big data for analytics, and many other theories related to education. When EduEdges integrates with an LMS, for example, Moodle, it offers a complete e-learning solution, which is a unique and innovation. It sets a new paradigm that, among its goals, overcomes the need for private tutoring. The EduEdges project introduced several new technologies which work on two main dimensions - adaptive/personalized learning, and language-rich learning contents. Adaptive learning considers individual differences among learners to automatically customize the presentation of learning contents and lessons to suit each individual student. Personalization considers several dimensions, three of which have already been implemented, namely Learning Style, Background Knowledge, and IQ.

EduEdges also applies Bloom's instructional design theory and customizes each Bloom level differently. On the other hand, Intelligent Language Processing (NLP) and Machine Learning are generally used to process learning objects of different types of media automatically, for example, STT and TTS to extract video or audio transcripts and add voice-overs in the student's preferred language, narrating Video scripts, subtitles, text summarization, keywords and terms extraction, etc. This language processing enables the exchange of Learning Objects (LOs) to spread globally with better understanding in the learner's preferred language. "EduEdges is built using the modern design and programming technologies, for example, component-based design, micro services architecture, and other advanced technologies. Several branded educational platforms have also been developed on top of the underlying smart component layer (S3 Smart Suite of Services)' says Prof. Shehab Gamal, Professor at Alexandria University and the principal investigator of the project.