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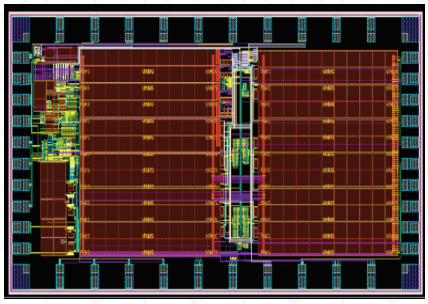
ICT R&D Newsletter in Egypt

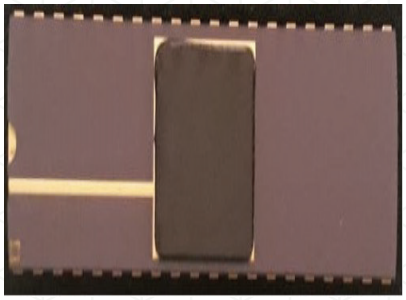
Adaptive Fully-Integrated High-Efficiency Microscale Energy Harvesting System with Storage Capability in 180nm CMOS Technology

Cairo University

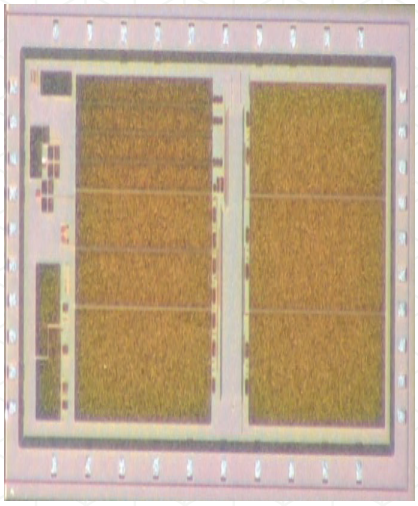
Researches from Cairo University implemented a PMU for microscale energy harvesting systems with the aim of maximizing efficiency and minimizing redundancy. Energy harvesting sources have been recently emerging as a promising power source that can be used in low power portable systems such as Internet of Things (IoT) and biomedical implanted devices. In such systems, these sources after proper signal conditioning can be used either to directly power the circuits of the application or to recharge small batteries that can be later used for the same purpose. “Due to area constraint, used energy scavenging sources such as thermoelectric generators, solar cells, and wirelessly transmitted power can only produce a few tens to hundreds of millivolts. Such low voltage is usually inadequate to power the circuits directly until it is raised to a well-regulated voltage suited for system on chip (SoC). This triggers the need for power management unit (PMU) in such systems’ says Dr. Ahmed Nader – Professor at Faculty of Engineering in Cairo University and the project principal investigator. Two architectures have been proposed. The first architecture operates from a DC source and it implements a secondary path to regulate the output voltage and store the additional power on a supercapacitor. The second architecture operates from a DC/AC source. It employs a fractional charge pump followed by a low dropout regulator (LDO) for voltage regulation. An ASIC prototype, in a low-cost 180nm CMOS technology, using the proposed techniques was fabricated. The performance of the fabricated prototype was tested and the measurement results are in good agreement with the theoretical and simulation results.



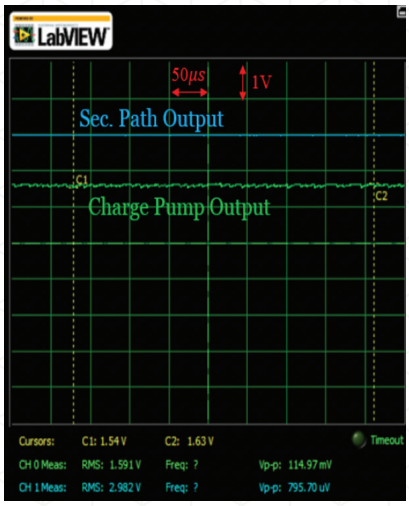
Chip Layout



DIL-40 Chip Package



Fabricated Chip Micrograph
(180nm CMOS)



Chip Testing

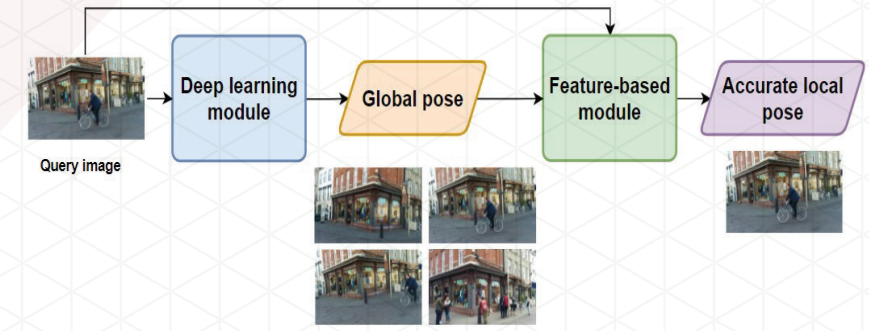
Smart Image-Based Localization for Augmented Reality application

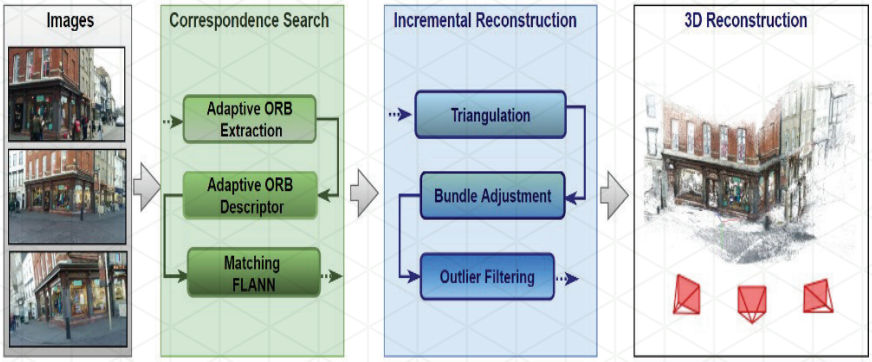
Electronics Research Institute (ERI) and Faculty of Science (Al-Azhar University)

Researchers from Electronics Research Institute and Faculty of Science (Al-Azhar University) created a smart Image-Based Localization system for AR applications. Nowadays, Virtual Reality (VR) and Augmented Reality (AR) technologies play a major role. AR allows real-time interaction by incorporating virtual objects into real-world environments. "One of the most difficult challenges of augmented reality is that it relies on precisely localizing a user to determine what is visible in their camera view, and then placing virtual objects in the appropriate locations' says Dr. Samia Mashali – Professor in Electronics Research Institute and the project principal investigator. Localization means determining the position and orientation of a camera viewpoint in order to align virtual elements with the real-world scene.

This system uses a hybrid of deep learning and feature-based techniques to achieve the highest accuracy in real-time. The significance of this project is that it benefits more than one vital sector, such as:

- In the field of education: the project will help to produce scientific and interactive materials using AR technology, which keeps up with the Egyptian government's plan to develop education using modern techniques.
- In the field of tourism: the project can help to build a wonderful impressive AR experience to promote ancient and modern Egypt.
- In the field of healthcare: the project can contribute to the development of a healthcare robot that can detect and move around the hospital.

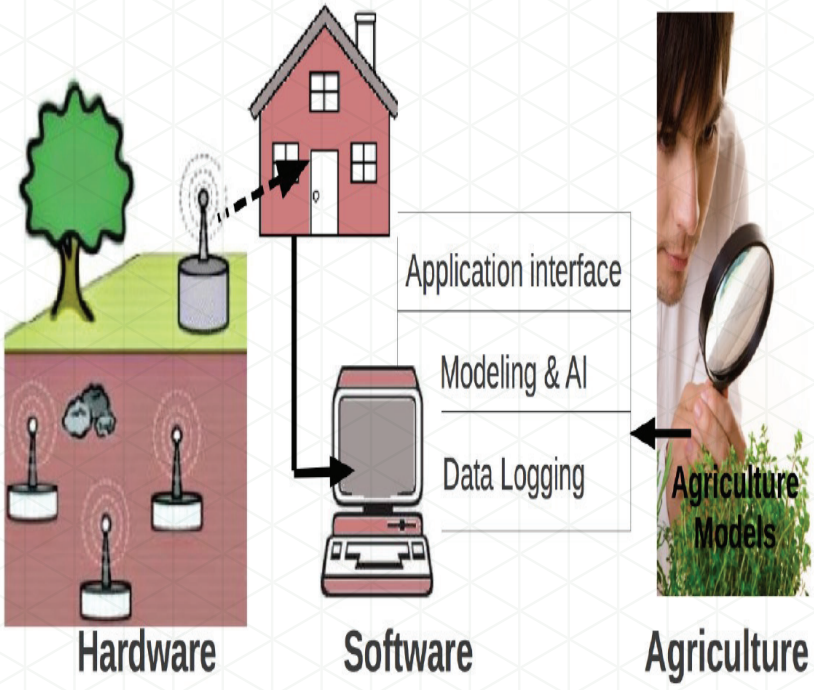




CIPOLIVE: Cloud-based Integrated Platform for Monitoring Pests, Salinity and Efficient Irrigation in Olive Precision Farming

Cairo University (Egypt), Smartec Systems (Egypt), Seresco, S.A. (Spain)

Researchers from Cairo University, Smartec Systems and, Seresco, S.A. (Spain) taking a step forward in the Egyptian and Spanish strategies of using ICT technology to improve agricultural practices. The goal of the CIPOLIVE project is to develop an integrated cloud-based IoT system that is used to reduce olive crop losses due to airborne pests and disease infections, while monitoring the irrigation water and soil salinity characteristics and how they affect the crop. This will have a great impact on increasing the olive production quality and quantity and will reduce the environmental pollution. "Producing a high-quality crop with no chemical residues will have a great economic impact as it will increase the economic value of the crop and open new markets for the exporters. To achieve these goals, CIPOLIVE project team is designing, implementing and validating an integrated cloud-based IoT system that is composed of various monitoring stations that are deployed in the farms' says Dr. Ahmed Khattab – Associate Professor in EECE Department and the project principal investigator. The software that models the major target infections and salinity-related problems affecting the olives crops in Egypt and Spain will suggest proper actions. The CIPOLIVE research components include embedded systems, IoT, cloud computing, artificial intelligence, and precision agriculture. Through CIPOLIVE cloud-based platform, we present new services for the farmers, based on our innovative approaches for storing data, remote sensing, and data analytics. These new services are aimed to improve the competitiveness of the farmers, facilitating the adoption of technological innovations. At the same time CIPOLIVE precision agriculture approach will also help sustainable agricultural development, something that, today, is an important concern for all.



Low cost/complexity equalization system for enhancing the capacity and reach of optical multimode fibers

Zewail City of Science and Technology

Researchers from the Center for Photonics and Smart Materials at Zewail City for Science and Technology are tackling the problem of inter-modal coupling in fibers operating in environments plagued with mechanical disturbance. Electric cars are rising in popularity and their next generation smart versions will rely heavily on fiber links for connecting the plethora of on-board sensors that are a core enabler of car cognition. To achieve the high capacity latent in multi-mode fibers, the mode coupling equalizer is a critical component that must be enhanced to deal with scenarios of severe inter-modal coupling caused by rapid mechanical disturbance. Prof. Salah Obayya founding director of Center for Photonics and Smart Materials, PI Dr. Karim Abdel Fattah and Co-PI Dr. Salem Hegazy have devised a mathematical treatment that uses basis expansion models in confronting the high dimensionality of rapidly time-varying multi-mode fiber channels. “This technique rests on the teams’ discovery of a mathematical basis that was proven to be aligned with the particular time-varying behavior of a typical fiber channel. The culmination of this work was the realization of feasible equalizers that can operate in scenarios of high rapidity while guaranteeing useful levels of performance’ says Dr. Karim Abdel Fattah – Senior researcher at Zewail City for Science and Technology.