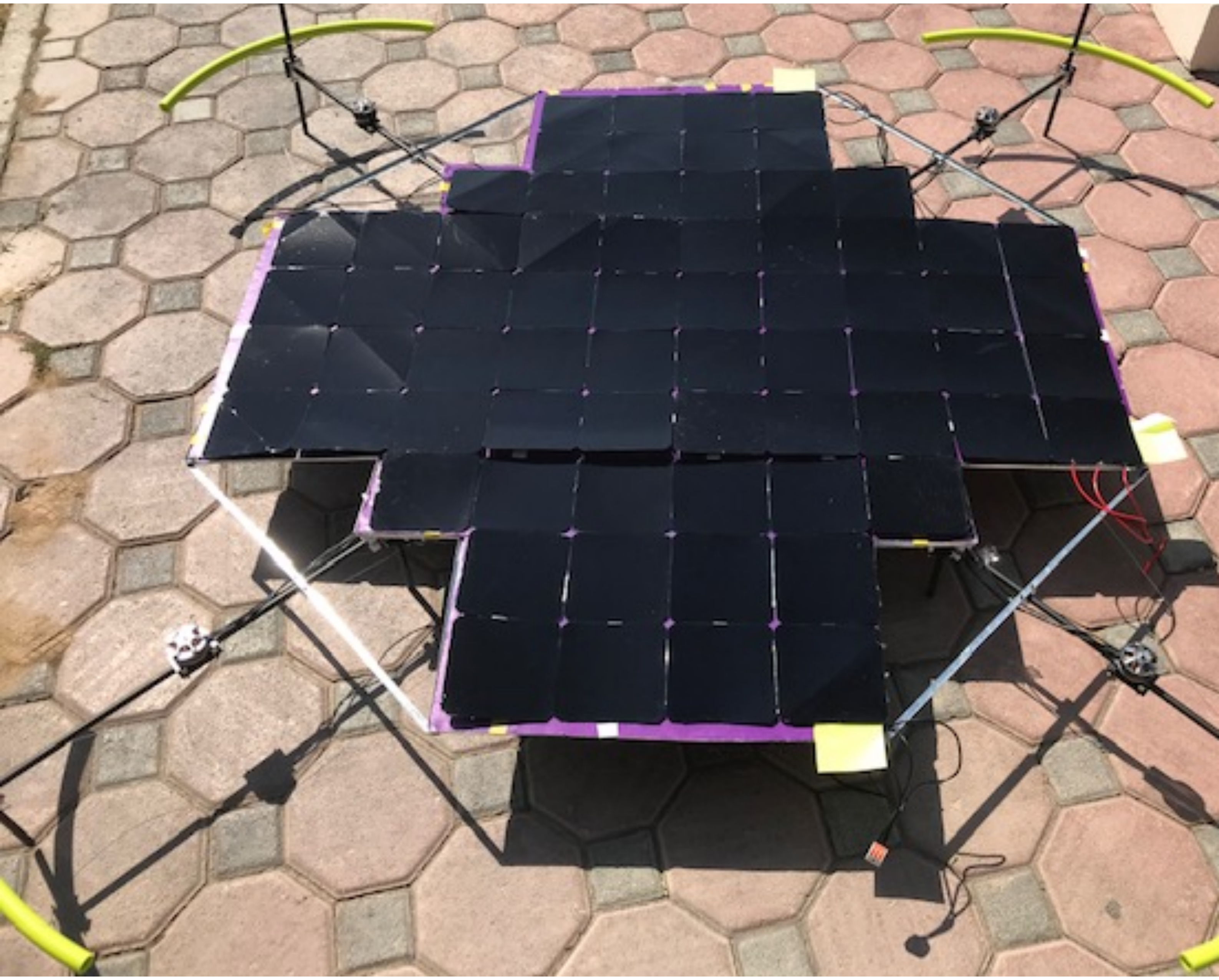
AUS | الجامعة الأميركية في الشارقة
American University of Sharjah

Petrofac Research Chair in Renewable Energy

AUS College of Engineering



Renewable Energy at AUS

The College of Engineering is currently working on numerous research projects focused on renewable energy. Dr. Rached Dhaouadi, Professor of Electrical Engineering and Petrofac Research Chair in Renewable Energy, has outlined the research work currently being conducted in the Renewable Energy Research Center.

The Renewable Energy Research Center (RERC) at AUS is an interdisciplinary research center under the College of Engineering that carries out research and development in the field of renewable energy and sustainability. The center was established in September 2017 under the umbrella of the Petrofac Chair Endowment. It involves faculty members, research assistants, undergraduate students and graduate students, working together in a single integrated and collaborative environment. The center has a particular focus on solar energy, energy efficiency and remote monitoring. The center also aims to develop regional knowledge and leadership in solar resource assessment and forecasting for the UAE and Gulf region.

The research center is looking at three main areas affecting solar energy systems: efficiency and IoT monitoring for optimal performance, inspection through remote digital and thermal photography, and automated robotic cleaning.

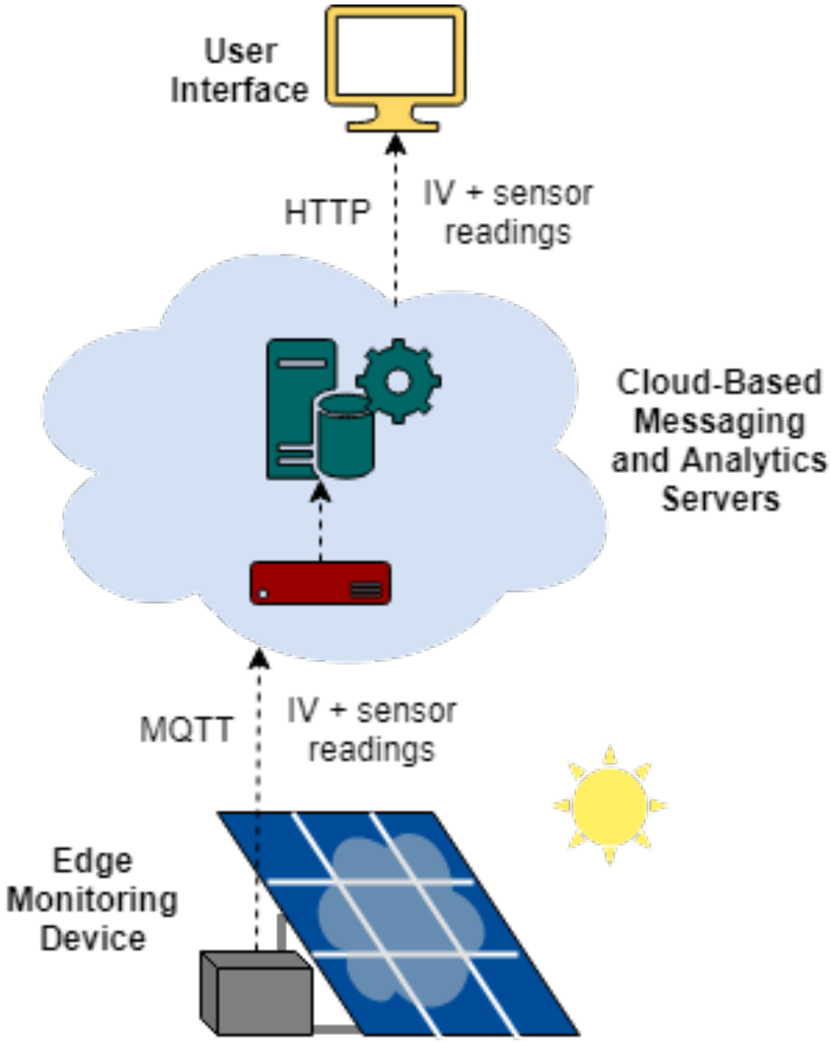
Solar Energy Assessment and Energy Efficiency

The research group monitored the efficiency of solar panels within the environmental context of the UAE. The research looked at the real effects of the humidity, dust (soiling) and temperatures, and how these factors impacted the level of energy output of a PV panel versus a reference panel that was clean and maintained in ideal conditions. The team was able to analyze the data and recommend the optimal frequency of cleaning to maximize the energy output and cost of cleaning. The system uses low-cost hardware and IoT networking technologies to remotely perform and communicate IV curves from individual modules or strings in a remote solar facility.

The obtained results show that soiling has a major impact on PV modules efficiency with up to 40 percent power loss after two months of soiling. The PV soiling index and PV soiling loss are evaluated to allow solar facility operators to reduce cleaning costs, optimize power output, and enable preventative maintenance in city-wide distributed solar facilities.

Using IoT and Big Data to Monitor Large-Scale Distributed Solar Farms in Smart Cities (SCRI Faculty Research Grant)

In this project, the research group proposes a novel monitoring and control architecture that combines Internet of Things (IoT) and big data technologies to collect sensor data from smal (< 2 MW) PV systems distributed throughout a smart city or located in large solar parks (> 100 MW). The architecture utilizes multiple network technologies such as 1-Wire, ZigBee-based mesh, and narrow-band IoT to deliver the sensor data from solar parks to centralized servers. The servers for storage and manipulation data are based on state-of-the-art streaming and storage technologies such as the Message Queueing Telemetry Transport (MQTT) protocol. The architecture minimizes the cost of processing sensor data, is reliable and robust, and can scale to very large solar parks generating sensor data in petabytes. The proposal calls for an implementation of a 56-panel solar park in AUS as a testbed to test and tune the proposed architecture. After validation, the data continuously collected from the solar park will be used to attack the soiling and other problems with solar parks in the UAE.



Remote Inspection

The Renewable Energy Research Group is also conducting a design project sponsored by DEWA to collect information remotely by drones. The group is testing remote digital and thermal photography to observe the state of solar panels. Many solar farms are in remote locations and have thousands of panels, making it difficult to monitor. Installing sensors and cameras for each panel is possible but requires large amounts of hardware, maintenance and cost. The thermal photography can show hotspots that may indicate poor panel performance or maintenance issues.

Design and Development of an Autonomous Quadrotor with Extended Flight Time Operation (Faculty Research Grant)

The objective of this research project is to conduct a comprehensive study of quadrotors and develop a new, autonomous platform combined with a solar-based charging system to extend their flight time. An accurate control algorithm will be devised for autonomous take-off and landing to allow optimal charging. We intend to investigate this aspect and propose an integrated wireless charging circuit that, in conjunction with an optimal wireless charging station, would allow contact-free, flexible charging of the onboard quadrotor batteries.

For commercial quadrotors, the proposed solution will allow multiple solar charging stations to be installed in different areas along the route of the quadrotor mission. The quadrotor can then fly over a longer distance and make stopovers in the recharging stations to recharge the battery. Thus, the battery requires just enough charge to get to the next stop. The decrease in battery size allows for a significant saving in energy cost. This solution makes a quadrotor that is self-sustainable over a longer period of time. In addition, with this technology, a vehicle has essentially unlimited electric range while using a relatively small battery.

Solar-Powered Quadcopter Drone

The solar-powered drone project was initiated as a student design project in Fall 2017 and is now pursued as a research project under the Renewable Energy Research Center. The solar drone is designed to take-off and land vertically autonomously without human assistance. Constructed using lightweight carbon fiber material, the quadcopter drone is fitted with individually characterized silicon solar cells and supported by a frame equipped with four rotors. Unlike conventional quadcopter drones, the aircraft relies only on a small backup on-board battery and hence it is not limited by flight time.

The solar drone will have the ability to land on any flat surface and fly out of the ground in a controlled way, which makes it suitable for many practical applications such as surveillance and inspection of solar farms. The backup battery is incorporated to power the aircraft when there is no sunlight or for charging to take place during flight to enable operation when it is cloudy or dark.

The research team will continue to fine-tune the solar drone to further improve its efficiency. With these enhancements, they hope to bring the technology closer to commercialization in the near future.

Automated Robotic Cleaning

The group is also working to develop an effective automated robotic cleaning system for solar panels to maximize the efficiency of PV panels and to reduce the need for costly manual cleaning in harsh conditions.

Rooftop PV Test Facility

A PV Test facility is needed to support the Research Center activities. The purpose of the test facility is to evaluate different photovoltaic products and to monitor the performance of these products under different environmental conditions. This will allow the study of long-term performance, reliability and failures of PV components and systems used within residential and industrial settings.

The test facility will consist of an 8 KW rooftop array separated into many subsystems. Each subsystem is comprised of a different combination of collector panels and inverters. The objective is to install the solar PV system over the roof of the AUS Engineering and Sciences Building. The system will be an off-grid system.

The PV system can generate AC power that can run regular electric devices. Power will be stored in batteries used to supply power when sunlight is not available.

An Internet-based monitoring system will be developed to ensure a constant and effective operation of the PV system. The Internet-based monitoring system gives the opportunity to visualize the performance history of the entire energy production and events occurred. History-related event evaluations will help to study methods for preventive maintenance activities. The monitoring system will be also used to monitor and study the real time soiling loss (effect of dust on solar panels).

College of Engineering

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