Introducing Recent Electrical Engineering Developments into undErgraduate cuRriculum

IREEDER NEWSLETTER
Issue 4, December 2021

Co-funded by the Erasmus+ Programme of the European Union

IN THIS ISSUE

IREEDER Project

The key objective of the IREEDER project is to increase the capacity of higher education in Jordan by utilizing cutting-edge technologies and training faculty members to improve the quality of the courses taught by optimizing these technologies. The themes explored will be targeted toward advanced electrical and computer engineering technologies such as renewable energy, the Internet of things, and cybersecurity, along with their numerous applications. The IREEDER target can be • Modernizing university courses through the use of cutting-edge technology such as Renewable Energy (RE), Internet of Things (IoT), and cybersecurity (CS).

• Strengthening Jordanian partners' capacities by constructing new laboratories outfitted with learning platforms to assist students in improving their understanding and skills in the disciplines of renewable energy, Internet of things, and cyber security.

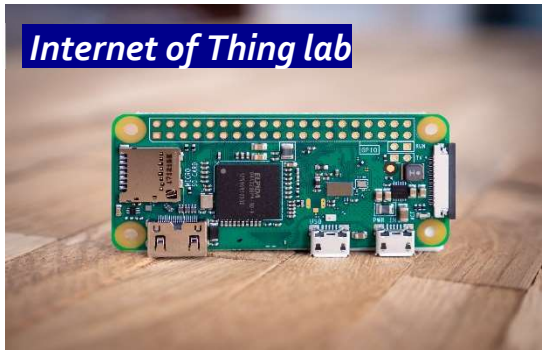
• Improving the knowledge, teaching, and training abilities of Jordanian university teachers and technicians.

• Providing competent engineers with wide understanding of contemporary technical breakthroughs to the Jordanian labor market.

• Establishing national training centers in Jordan for cutting-edge technology advances such as renewable energy, the Internet of Things, and cybersecurity.

Established IREEDER labs

The IREEDER project will create teaching and training materials for undergraduate students in electrical engineering and other relevant fields on renewable energy (RE), the Internet of Things (IoT), and cyber security (CS). The practical component will be handled by the establishment of advanced laboratories at Mutah University (MU), Tafila Technical University (TTU), and Al Hussein Bin Talal University (AHU), while other Jordanian partners will be able to access them via remote labs technology. Indeed, the remote laboratories established by the IREEDER project will allow for remote control and monitoring of laboratory equipment, allowing engineering students to conduct experiments in real time, at their own schedule, from anywhere, and whenever it is convenient for



This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the partners of IREEDER project and do not necessarily reflect the views of the European Union.

them. Aside from the experimental training provided by the internet laboratories, the system is also a great teaching tool since real-time demonstrations of the experiments may be done and concurrently watched by a group of students. This strategy is extremely useful for engineering schools, particularly in Jordan, because resources can be shared through the Internet even during the present challenging COVID 19 time.

RE lab at Mutah university

The established RE lab at Mutah University consists of two parts: the remote access RE lab, which allows students to undertake various experiments in solar, wind, and fuel cell technologies, and the on-site RE lab. The other major component is the PSIM program, which is a specialized software for electrical engineering that allows students to model more sophisticated RE systems.

On August 9, 2020, the tendering procedure for RE equipment began at MU. The first RE public tender was issued on October 6, 2020, and the technical committee chose one offer on December 3, 2020. On January 3, 2021, the final resolution was sent to the selected supplier. The equipment for the RE lab was delivered and installed on June 17, 2021.

Remote Access RE Lab

The Solar, Wind, and Fuel Cell Power Generation Trainer is made up of subtrainers for solar power generation, wind power generation, and hydrogen fuel cell power generation. The remote access RE lab at MU is briefly demonstrated in the following link from the IREEDER YouTube channel (https://www.youtube.com/watch?v=KwVB3Og5XBY).

The Solar Power Generation Trainer

The Solar Power Generation Trainer is made up of a solar panel, a solar simulator, a battery, a charge controller, an inverter, several types of loads, a solar irradiation sensor, a power supply module, and a control and measurement module that can be programmed using LabVIEW. It contains four stoppers that are positioned such that the PV panel does not come into contact with the halogen lamps. This trainer is intended for investigation on the conversion of solar energy to electrical energy. The customized control software is written in the graphical programming language LabVIEW. The program visualizes a virtual operational diagram of the facility and offers interactive monitoring and management over the system. Using this trainer, the following experiment may be carried out both physically and remotely:

- Study of photovoltaic solar panels.
- Operation of the solar power station in battery charging mode.
- Autonomous operation of a solar power plant supplying a load.

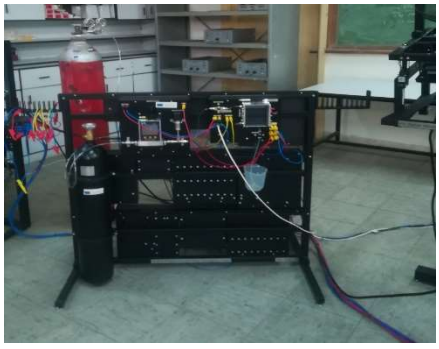
The Wind Power Generation Trainer

The Wind Power Generation Trainer comprises primarily of a wind turbine-generator set, a wind tunnel with a controllable air fan, a wind speed meter, a charge controller, a battery, an inverter, as well as several types of loads. It is intended for hands-on investigation of the conversion of wind energy to electrical energy. The trainer can only be used when it is not connected to the power grid. The specialized control software is written in the graphical programming language LabVIEW. The program generates a virtual operational diagram of the facility and enables interactive monitoring and control of the system. Using this trainer, the following experiment may be carried out both physically and remotely:

- Structure and characteristics of wind turbines and wind power plants.
- Characteristics of wind power plants in battery charging mode.
- Characteristics of off-grid wind power plant supplying a load.

The Fuel Cell Energy Trainer

The Fuel Cell Energy Trainer is composed of a PEM fuel cell stack with a controller, a hydrogen cylinder, a hydrogen flowmeter, a pressure meter, a resistive load, a power supply module, and a control and measurement module that can be programmed using LabVIEW. The controller operates the fuel cell by turning the hydrogen inflow valve on and off and controlling the output purging valve. It also handles any situations such as overcurrent, overtemperature, lack of gas pressure, and so on. This trainer is intended for investigation on the conversion of chemical energy to electrical energy. The customized control software is written in the graphical programming language LabVIEW.



The software creates a virtual operating diagram of the facility and allows interactive monitoring and control of the system. Students may use this trainer to investigate fuel cell technology in a physical or virtual

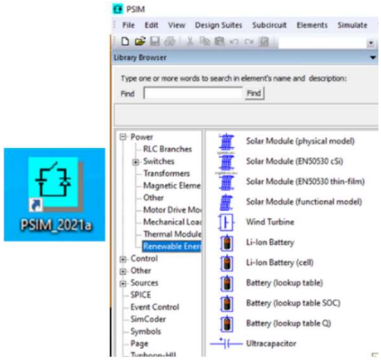
Co-funded by the Erasmus+ Programme of the European Union

This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the partners of IREEDER project and do not necessarily reflect the views of the European Union.

environment, including the construction and design of hydrogen fuel cells, as well as their voltage-current, power-current, and temperature-current properties.

PSIM software

PSIM is a specialized circuit modeling software package created by Powersim for use in a variety of electrical engineering topics. PSIM contains both a schematic capture interface and a waveform viewer called Simview. PSIM's capabilities is extended into specific sectors of circuit modeling and design by modules such as control theory, electric motors, photovoltaics, and wind turbines, to name a few. PSIM is frequently used in educational settings for research and teaching, as well as in industry for product development and research.



The PSIM software has been put on a server at Mutah University, allowing additional Jordanian partners to fully utilize it. In addition, five experiments were constructed to let the student to undertake simulation experiments on advanced RE technology topics. The following is a list of these experiments:

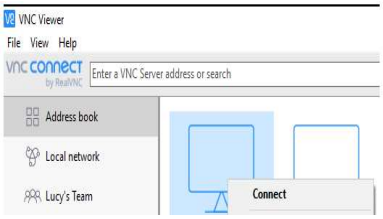
- Introduction to PSIM software.
- Solar Module and PV Array connection.
- Lithium-Ion Battery Model.
- Ultracapacitor Model.
- cSi and Thin-Film Models.

IoT lab at Al Hussein Bin Talal University

On July 2021, the tender supply process of IoT lab equipment started by *cleanwave for tech* company at Al hussain Bin Talal university. The lab installed with different integrated IoT systems such as Raspberry Pi, ETS IoT Kit, SparkFun training kit, STM32 microcontroller, mBot Trainer, and diversity of separate sensors and actuators. The Cleanwave technician provided a technical training on how to work and program these IoT systems by establish many demonstrations. Furthermore, the IoT lab supports onsite and offsite (remote access) which help students from other universities to access and work with the lab experiments.

Remote Access IoT Lab

In order to make students be able to control and access the IoT system. EST IoT kit, and sparkfun training kit can be accessed by install the (RealVNC) viewer and server. This software provides a GUI control which allows ease of use feature and gives the students the ability of create the source code by using the proper IDE (integrated development environment).



A CLI (command line interface) access is another remote access way which can be established by using the SSH protocol. In this way the user can use the command interface to program the microcontrollers of the IoT systems.

The ETS IoT KIT

The IoT Trainer Kit is a complete prototyping platform for sensor-based Internet of Things projects. It's jam-packed with cutting-edge sensor technology and ready-to-use software applications that can handle any IoT application. It comes with a Raspberry Pi 3 and an all-in-one sensor platform, allowing for endless IoT application prototype possibilities.

It also includes a GPS module for IoT projects that require localization. It also includes pushbuttons, an OLED display, and status LEDs for demonstrating or visualizing IoT applications. The student will use 2.7 or 3.X python programming to write different codes which perform specific tasks on the kits The following experiment can be done both physically and remotely using this trainer:

- Push button based led, buzzer control.
- Monitoring temperature, pressure, and humidity of environment using BME280 sensor.
- Monitoring ACC,GYR using BMI160 sensor.
- Controls servo motors rotation (180,360).
- Interface RF transmitter and receiver.

Spark Fun Invetor Training Kit (SIK)

The SIK is great way to start programming IoT project and hardware interaction with the Arduino programming language . the kit include contains an extensive array of electronics components that could be used to build simple and complicated IoT projects.

The SparkFun Qwiic Connect System is an ecosystem of I2C sensors, actuators, shields and cables that make prototyping faster and less prone to error.

The following is a list of experiments using SIK trainer:

- Light control projects (LED, Potentiometer, photoresistor, RGB Array).
- Sound control projects (Buzzer, digital trumpet, Simon Say game).
- Motion control projects(servo motor, distance sensor, motion alarm).
- Display Control project (LCD sensors reading display).
- Remote control robot and autonomous robot.

Co-funded by the Erasmus+ Programme of the European Union

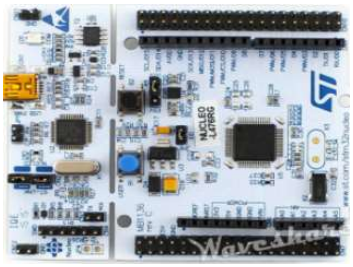
This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the partners of IREEDER project and do not necessarily reflect the views of the European Union.

mBot STEM coding RoBOT

Beginners can use this robot to learn how to code. mBot is a great educational robot toy for learning electronics, robotics, and programming in a fun and easy way. It teaches students how to program in a step-Beginners can use this robot to learn how to code, from scratch to Arduino, using interactive software.

STM32 Nucleo L476RG Microcontroller

The Stm32-Nucleo device is Ultra-low power microcontroller based on the high-performance Arm –cortex –M4 32-bit RISC .the device embed high-speed memories, it has great security features, the device has advanced communication abilities and used



to design low-power IoT applications. To program the microcontroller it is possible to use Arduino IDE programming with C language . the most used programming is the STM32Cube Programming by use C++ languages. This tool allow the user to specifies the interfaces and peripherals that would be used in the project.

The experiments list of STM32-nucleo :

- Multiple Blinking LEDs at different rates.
- Using a Digital Temperature Sensor.
- Interfacing NRF24L01 Transceiver Module with STM32 Tx/Rx.
- Interfacing 433Mhz RF Module with STM32.
- How to connect RFID with stm32-nucleo .

CS lab at Tafila Technical University

The CS lab at Tafila Technical University consists of two parts: the remote access CS lab, which allows students to undertake various experiments in cyber security, and the on-site CS lab.

The equipment for the CS lab was delivered and installed on December, 2021.

CS lab components:

The CS lab consists of 15 PCs, 2 servers, and other supporting equipment.

CS experiments

Several experiments are supported by this lab including reconnaissance using Maltego (open source intelligence tool), port scanning using 'Nmap', vulnerability assessment, remote SHE buffer overflow, post exploitation, hack windows using Kali, active online attack, DDL hijacking and privilege escalation, and exploiting the web.

Besides these experiments, this lab is used for training on administrative procedures to configure network assets. The available training experiments include disabling network services and configuring basic switches security, securing Cisco routers, disabling network device information, implementing and configuring IPv4 ACLs, switch port security, implementing simple firewalls, implementing VPN using GRE protocol, and configuring AAA authentication on Cisco routers.

Partners

For more information about IREEDER project

PLEASE VISIT OUR WEBSITE

http://ireeder.ahu.edu.jo/

Co-funded by the Erasmus+ Programme of the European Union

This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the partners of IREEDER project and do not necessarily reflect the views of the European Union.