bitlismen™

BITLISMEN

EDUCATIONAL LABS

www.bitlismen.com

About

Bitlis-MEN LLC has been established in 2004. We have our own Hydro Power Plant built on irrigation channel, medium voltage Transmission Lines, Power Distribution Substation, ad Consumption. Whole this infrastructure was designed and developed by our company and now we are operating it. This is why we have a strong theoretical and practical background knowledge in traditional and renewable energy grids from generation up to the consumption and protection, irrigation, water treatment plants, pumping stations, irrigation channels, etc. This is why we understand the industry needs and trends.

In addition to our internal engineering forces while designing the Educational Labs we used to involve professors and scientists from different engineering universities and Academy of Science.

The designs and development are based on National Instruments' graphical system design technologies, LabVIEW graphical programming environment and modular hardware platforms.

The company is National Instruments Silver Level Alliance Partner.

We successfully designed, developed and delivered educational systems to the leading universities in Singapore, Vietnam, Saudi Arabia, Pakistan, Russia, Armenia, etc.

Find more at www.bitlismen.com

Benefits and Advantages

- Unlike the competitors, the trainer uses real (but small scale) components, to make the trainers to be as similar to real power plants as possible. This means after studying on our trainer, the student can easily understand any real power plant structure.
- Unlike the competitors, the trainer components have transparent enclosures to make them and the internal processes to be visible during operation and make the experiments more deductive, thus keeping students exited and involved during the process.
- The software has user friendly, easy to use and nice-looking user interface with graphical animations to be more attractive for the students.
- Unlike competitors which use only simple power meters and/or other standalone measuring devices the trainer implements power measurement and quality analysis on the reconfigurable myRIO and RIOsys platforms. It allows to have not only the RMS values of voltage, current, frequency, power factor etc., but as well as the real-time vector diagram, real-time sine waveforms of the voltages and currents, which makes much easier to understand how the components operates and how they affect into each other and power network itself thus making the system self-explanatory for students.
- Unlike competitors, the trainer is modular, meaning the components are free to move and can be interconnected by the students as per the need for each experiment. This allows the students to get fully involved in the process of interconnection of the components and understanding the aim and functionality of each of them. All the interconnections of components are done by students based on the straightforward instructions in the user manual thus students have better visibility and understanding of the entire system.
- Comprehensive and well-structured user manuals are provided for students and instructors. Each experiment has the following sections: Lab Objective, Prelab (theory associated to the experiment), Prelab Assignments (questions to the theory), Application Software Description, Step by Step Instructions, Experiments. Following all these sections the student will easily get a clear understanding of the aim of the experiment and the results he gets.
- In order to provide better safety to the students and eliminate the risk of shock, unlike competitors who use 220V for connections from one to the other component, we use 12V AC and 24VDC, so even if students make wrong connections the trainer is still safe and will not harm them. In addition, our components have residual current circuit breakers and overcurrent circuit breakers thus any short circuits or wrong terminations by the students will be handled by the system.
- Unlike competitors, the trainer includes different types of loads resistive, capacitive and inductive. Each load has 3-phase input and there are 3 switchable stages to have different load configurations on each phase.
- Each trainer is compatible with other trainers of Power Labs Ecosystem™, so the customer will be able to get other trainers like traditional and renewable power generation, transmission and distribution trainers and operate them synchronously together having a smart microgrid system.
- The myRIO and RIOsys have state of the art technical specs and capabilities like real-time operating system, and reprogrammable FPGA.
- The system is software defined and fully open, meaning the LabVIEW source codes of all software components will be provided. This will add flexibility of adding custom labs to the trainer. The professors will be able to investigate the internal functionality and algorithms as well as be able to define new experiments, functionality and behavior.

Bitlis-MEN has a variety of Educational Labs in the fields of Energy, Water, SCADA, Smart City, etc. Below please find the list:

1. Power Labs Ecosystem™
2. Solar Power Generation Trainer
3. Wind Power Generation Trainer
4. Solar & Wind Power Generation Trainer
5. Hydrogen Fuel Cell Trainer
6. Hydro Power Generation Trainer
7. Traditional Power Generation Trainer
8. Power Transmission Trainer
9. Power Distribution Trainer
10. Substation Automation Trainer
11. Electromechanical and Microprocessor Relay Protection Trainer
12. Smart Grid Trainer
13. Distance Learning
14. Solar Thermal Energy Trainer
15. Substation Automation Trainer
16. Smart Grid Research Trainer
17. Net Simulator Current Adaptor
18. Net Simulator Voltage Adaptor
19. Industrial and consumer IoT Trainer
20. Smart House Trainer
21. Heat Supply and Heating Equipment Trainer
22. HVAC Trainer
23. iLAB Educational Platform
24. Cell Division Trainer
25. Plant Cells Examination Trainer
26. Chemical Bonds Trainer
27. Acids and Bases Trainer
28. Corrosion Trainer
29. Mathematics Trainer
30. Gravity Trainer
31. Electrical Waves Trainer
32. Light Sources and Energy Saving Technologies in Lighting Engineering Trainer
33. Traffic Lights Management Trainer
34. Wiring Installation Trainer

POWER LABS ECOSYSTEM™

Overview

Along with technological development and the birth of Industry 4.0 the world needs better educated people. The traditional educational methods and approaches are no longer effective and do not provide the required knowledge and expertise to future specialists. The educational trainers should be transformed from a fixed, static trainer into open, flexible and software defined platforms.

Biltlismen's Power Labs Ecosystem comes to fulfill these needs. It is an ecosystem of energy related trainer/platforms which are designed to be open, flexible, expandable, reconfigurable and reprogrammable. The trainers have two parts software and hardware. The software is implemented using LabVIEW graphical programming language with an open-source codes. The hardware includes a reprogrammable NI myRIO platform for data acquisition, power analysis, monitoring and control. We can provide on-site installation assistance and training, so the students and professors can fully understand the trainer hardware and software structure and do further modifications if needed.

The ecosystem consists of:

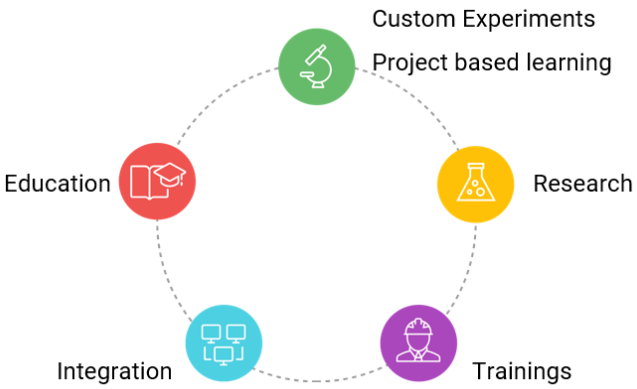
- ✓ Solar Power Generation Trainer
- ✓ Wind Power Generation Trainer
- ✓ Solar & Wind Power Generation Trainer
- ✓ Hydrogen Fuel Cell Trainer
- ✓ Hydro Power Generation Trainer
- ✓ Traditional Power Generation Trainer
- ✓ Power Transmission Trainer
- ✓ Power Distribution Trainer
- ✓ Substation Automation Trainer
- ✓ Electromechanical and Microprocessor Relay Protection Trainer
- ✓ Smart Grid Trainer
- ✓ Distance Learning
  - Per-Student Power Quality Analyzer
  - Per-Student Microprocessor Relay Protection Trainer

In addition to the Power Labs Ecosystem product family our company introduces the ENERGY OF THE FUTURE | ENERGY 4.0 Ideology. Within it, we provide the integration with 4 leading industrial technologies:

- ✓ Augmented Reality
- ✓ Artificial Intelligence
- ✓ Industrial IoT
- ✓ Mixed Power Microgrids

Benefits and Advantages

- PLE trainers have multiple use cases:
  - Education – The trainers can be used for teaching purposes to be able to learn the theory and implement the experiments.
  - Custom Experiments – Students can use it to create new custom experiments, implement course works or graduation projects on them, so those are perfect fit for Project Based Learning.
  - Research – The trainers can be used as research platforms for investigation of different phenomenon in in-lab environment, develop new monitoring and control algorithms.
  - Trainings – The trainers can be used to train industry operators to develop their skills.
  - Integration – The trainers are from the same product family so it is possible to investigate each discipline separately or they can be interconnected to each other forming bigger systems like microgrids.



Solar Power Generation Trainer

Overview

The Solar Power Generation Trainer consists of a low power solar panel and a halogen lamp. The halogen lamp is used as a sun simulator, which brightness can be controlled by a dimmer. The solar panel generates energy using the light produced by the sun simulator. The trainer also includes charge controller, small capacity battery and an inverter.

List of Experiments

- Structure and design of a solar photovoltaic power plant
- 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
- Operation of on-grid solar power plant
- Protection in solar power plant in case of emergencies

Wind Power Generation Trainer

Overview

The Wind Power Generation Trainer consists of a wind tunnel and wind turbine-generator set. The wind tunnel applies mechanical energy to the generator, which generates low power energy. The wind tunnel fan is controlled by a VFD controller.

List of Experiments

- Structure and characteristics of wind turbines and wind power plants working off-grid.
- Structure and characteristics of wind generators used in wind power plants.
- Characteristics of electrical loads of wind power plants.
- Characteristics of on-grid wind power plant depending on airflow.
- Characteristics of wind power plant in battery charging mode.
- Characteristics of off-grid wind power plant supplying the load.
- Protection in wind power plant in case of emergencies

Solar&Wind Power Generation Trainer

Overview

This trainer allows to investigate the synchronous operation of Solar Power Generation and Wind Power generation as small microgrid. The solar part consists of a PV panel and an array of halogen lamps as a sun simulator. The positions of both the PV panel and Sun Simulator can be controlled manually using joysticks. It to simulate real light, daytime, yeartime and investigate the PV performance in different irradiation. The wind part consists of a wind tunnel and a real wind turbine-generator set. It allows to simulate real wind and investigate the generator performance in different wind speeds. In off-grid mode it allows to investigate the battery charging process using a DC charge controller and also the discharge using an AC-DC Inverter and loads. In on-grid mode it allows to implement the synchronization with the Wind Power Generation using a Grid-tie inverter.

List of Experiments

- Structure and design of a solar photovoltaic power plants
- 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
- Protection in solar power plant in case of emergencies
- Structure and characteristics of wind turbines and wind power plants working off-grid
- Structure and characteristics of wind generators used in wind power plants.
- Characteristics of electrical loads of wind power plants.
- Characteristics of wind power plant in battery charging mode.
- Characteristics of off-grid wind power plant supplying the load.
- Protection in wind power plant in case of emergencies
- Operation of PV and Wind systems in synchronized mode.

Hydrogen Fuel Cell Trainer

Overview

This option of the Hydrogen Fuel Cell Trainer can work in off-grid mode. It consists of a hydrogen cylinder, PEM fuel cell stack, DC-DC converter, load, pressure meter, flow meter, etc. The trainer allows to investigate the main principles of fuel cell operation and its characteristics. The students will learn how the hydrogen and air reaction can produce electrical energy.

The fuel cell stack uses ambient air. The hydrogen cylinder should be refilled with 99.99% purity hydrogen by the user

List of Experiments

- Structure and design of hydrogen fuel cell
- Structure and design of electrolyser
- V-I and P-I characteristics
- Dependence of cell temperature on load
- Dependence of hydrogen flow on load

Hydro Power Generation Trainer

Overview

The Hydro Power Generation Trainer consists of a low power hydro turbine-generator set and a water pump. The Pump is used to simulate water flow and pressure. The trainer is for studying the conversion of water energy to electrical energy. It allows the students to get acquainted to main principles of hydro power generation and their characteristics.

List of Experiments

- Structure of the Turbine
- Structure of the Generator
- Measurement of the Generated Current, Voltage and Power
- Main Characteristics of the turbine
- Main Characteristics of the generator
- Main characteristics of off-grid hydro power plant
- Synchronization with existing network
- Overvoltage Protection
- Overcurrent Protection
- Undervoltage Protection
- Under/Over Frequency Protection

Traditional Power Generation Trainer

Overview

The Traditional Power Generation Trainer consists of a motor generator set. The motor applies mechanical energy to the generator, which generates low power energy. The mechanical energy can be controlled by a VFD controller. The excitation current is controlled by a manual potentiometer.

List of Experiments

- Types of traditional power plants
- Energy sources and drive engines of traditional power plants
- Electric generators of traditional power plants
- Operation of autonomous traditional power plants
- Operation of on-grid traditional power plants
- Protection in traditional power plant in case of emergencies

Power Transmission Trainer

Overview

The Power Transmission Trainer is a combination of physical models of power transmission lines, transformers, etc. It allows to investigate the capacitive, resistive and inductive components of transmission lines, and explore their effects on the power parameters. It is also possible to simulate short circuits on the lines and investigate the behavior of the power parameters during the faults.

List of Experiments

- Power transmission channel structure
- Voltage transformation in power transmission
- Power transmission lines
- Loses and power quality distortions during power transmission
- Reactive power compensation in power transmission
- Protection during emergencies in power transmission channels

Power Distribution Trainer

Overview

The Power Distribution Trainer is a combination of physical models of power busbars and switchgears. It allows to manipulate the interconnections of different buses, and investigate the system behavior in case of different emergency situations.

List of Experiments

- Substation structure and layout for power distribution
- Electrical loads of consumers
- Switching operations in substation when changing the scheme of power distribution
- Protection of the distribution substation in case of emergencies

Substation Automation Trainer

Overview

The trainer has been designed for hands-on study of substation automation system.
The automatic monitoring and control (RTU) system is implemented in hardware using NI myRIO platform.
The educational trainer is a part of a real SCADA system.
The system consists of two components:

- Software component for emulation of 3phase network and study of the influence of various parameters on the power quality of the network
- Model of the real network automation with the real SCADA software

List of Experiments

- Active resistance in AC Circuits*
- Inductance in AC Circuits
- Capacitance in AC Circuits
- Resistance, Inductance and Capacitance connected in series in AC Circuits
- Resistance, Inductance and Capacitance connected in parallel in AC Circuits
- Reactive Load Compensation*
- 3phase Circuits with Wye Connection of Consumers
- Emergency Situations in the 3phase Circuits with Wye Connection of Consumers
- 3phase Circuits with Delta Connection of Consumers
- Emergency situations in the 3phase Circuits with Delta Connection of Consumers

The experiments that are marked with (*) can be achieved both in the software environment and with real loads.

Electromechanical and Microprocessor Relay Protection Trainer

Overview

The Power Protection Trainer is a combination of different types of protection relays including microprocessor relay protections. This trainer allows to concentrate on different protection circuits and algorithms that are used in different points of real power network. It allows to investigate the relays as separate equipment, as well their use in advanced protection circuits.

List of Experiments

- Indicating Relay
- Auxiliary Relay
- Time Relay
- Undervoltage Relay
- Overvoltage Relay
- Overcurrent Relay
- Reverse Power Protection
- Undervoltage Protection
- Undervoltage Protection (with Generator)
- Overvoltage Protection
- Overvoltage Protection (with Generator)
- Under and Overvoltage Protection
- Under and Overvoltage Protection (with Generator)
- Overcurrent Protection
- Overcurrent Protection (with Generator)
- Current Cutoff Protection
- Current Cutoff Protection (with Generator)
- Overcurrent and Current Cutoff Protection
- Overcurrent and Current Cutoff Protection (with Generator)
- Thermal Relay Protection
- Three Phase Undercurrent Protection
- Three Phase Overcurrent Protection
- Earth-Fault Overcurrent Protection
- Voltage Controlled Overcurrent Protection
- Phase Overvoltage Protection
- Phase Undervoltage Protection

- ✔ Residual Overvoltage Protection
- ✔ Over/Under Frequency Protection
- ✔ Directional Power Protection

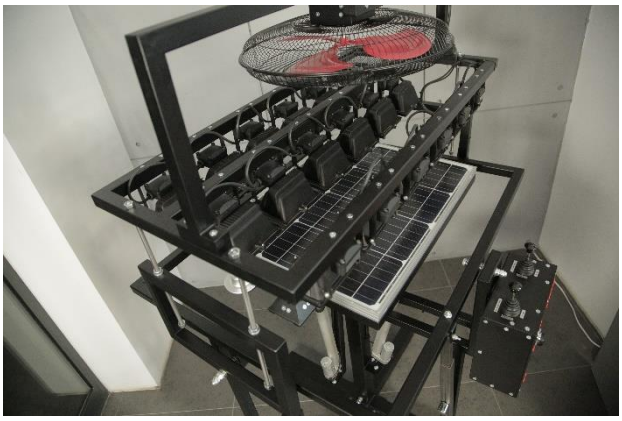
Smart Grid Trainer

Overview

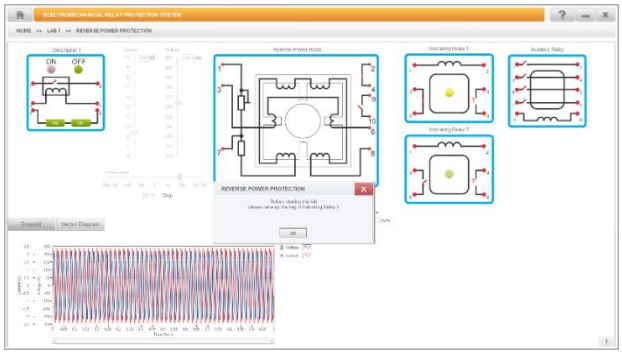
When having Power Labs Ecosystem Trainers, with a use of the Smart Grid Software it is possible to have a Smart Grid system.

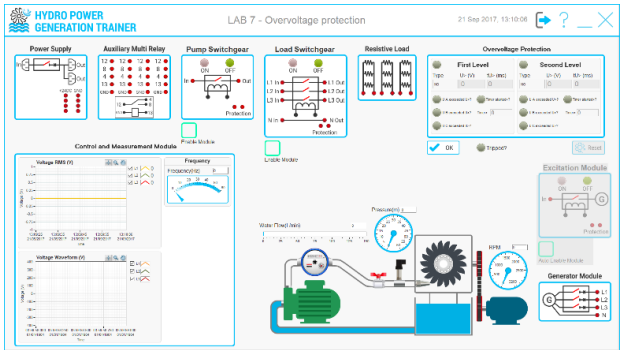
The system allows to study the main concepts of smart grid, to explore its benefits and advantages in power network. The system includes a chain of power network (traditional, hydro, wind and solar power generations, power transmission and power distribution, etc.). The system is being monitored and controlled form the SCADA software.

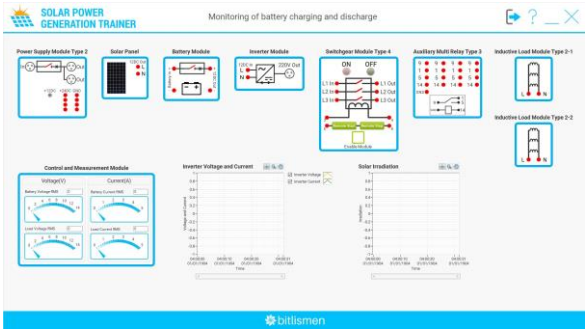
Hardware Pictures

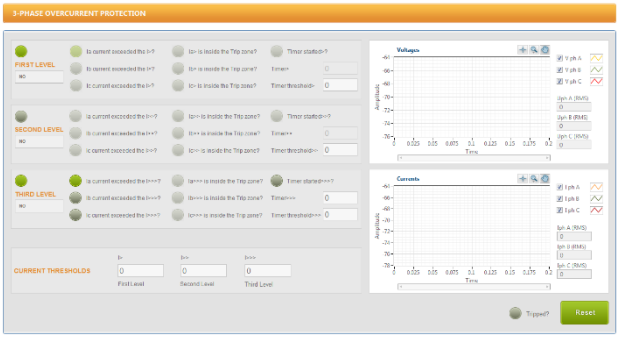


Software Screenshots









SOLAR THERMAL ENERGY TRAINER

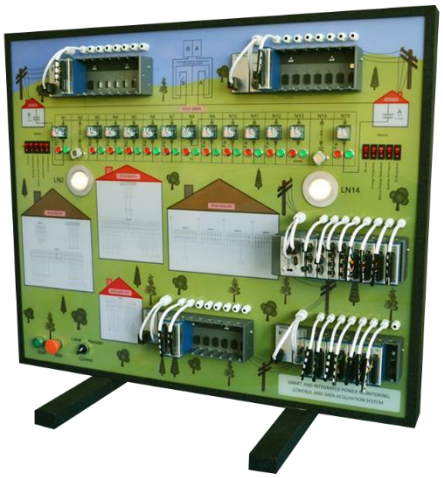
Overview

This option of the Solar Thermal Energy Trainer consists of a solar thermal panel and an array of halogen lamps as a sun simulator. The position of Sun Simulator can be controlled manually using joysticks and also from the software. The trainer allows to simulate real light, daytime, yeartime and investigate the performance in different irradiation. The trainer allows to study the main principles of converting solar energy to thermal energy.

List of Experiments

- ✓ Structure and design of a solar thermal panels
- ✓ Study of the efficiency of the solar thermal panel
- ✓ Study of the influence of the inclination angle of the sun simulator on the unit efficiency
- ✓ Study of the relation between the flow and the temperature
- ✓ Determination of hydraulic resistance of pipelines

SUBSTATION AUTOMATION TRAINER



Overview

Laboratory facility has been designed for hands-on study of substation automation system.
The automatic monitoring and control (RTU) system is implemented in hardware using NI cRIO platform.
The educational stand is a part of the real SCADA system.
The system consists of two components:

- Software component for emulation of 3phase network and study of the influence of various parameters on the power quality of the network
- Model of the real network automation with the real SCADA software

List of Experiments

- Active resistance in AC Circuits*
- Inductance in AC Circuits
- Capacitance in AC Circuits
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- Reactive Load Compensation*
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- Emergency Situations in the 3phase Circuits with Wye Connection of Consumers
- 3phase Circuits with Delta Connection of Consumers
- Emergency situations in the 3phase Circuits with Delta Connection of Consumers

Benefits

- Ability to work with real SCADA system
- Ability to implement control and monitoring over any existing apparatus of the system
- Ability to add/modify different parts of the system, create new functionalities to control and monitor the SCADA system
- Ability to go deeper in learning the working principles of the substation automation

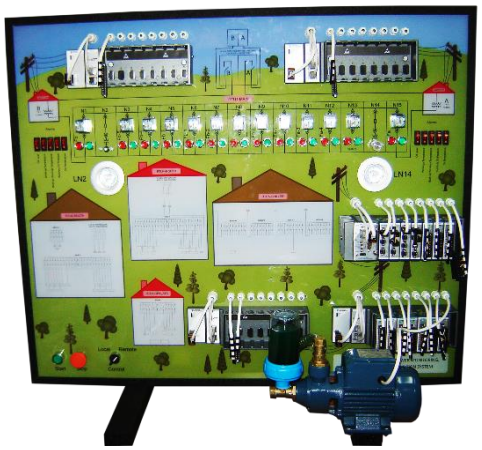
Ability to simulate real emergency situations, without any real risks for the operators.

The experiments that are marked with (*) can be achieved both in the software environment and with real loads.

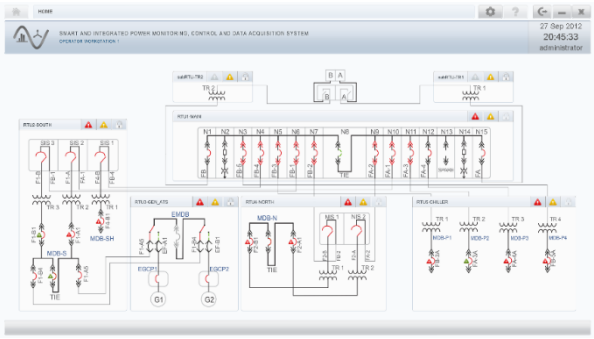
Specifications

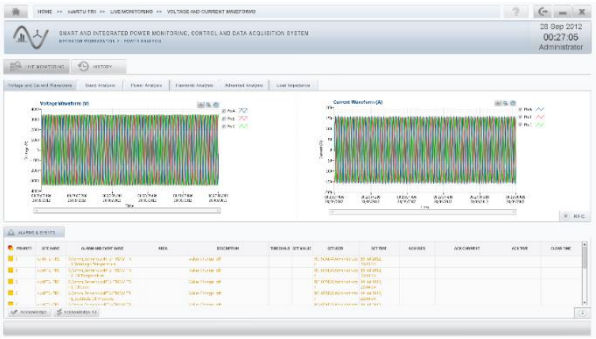
Parameter	Value
Voltage Analog Inputs	6-channels, 300Vrms, 50kS/s, 24-bit, simultaneous
Current Analog Inputs	8-channels, 5Arms, 50kS/s, 24-bit, simultaneous
High Voltage Digital Inputs	28-channels, 250VAC/DC, universal sinking/sourcing
Digital Inputs	32-channels, 24 V to 60 V, 250 µs, sinking/sourcing
Digital Outputs	32-channels, 5 to 30 V, 1 µs, sourcing
Loads	Capacitive, Resistive, Inductive, less than 5A consumption
Operator Workstations	2, based on regular desktop PCs with two large screen monitors
Engineering Workstation	1, based on a regular desktop PC
Communication Server	1, based on a regular desktop PC
Power Supply	220VAC, 50/60Hz

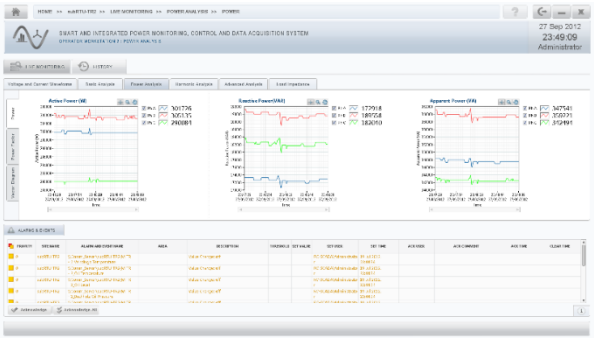
Hardware Pictures

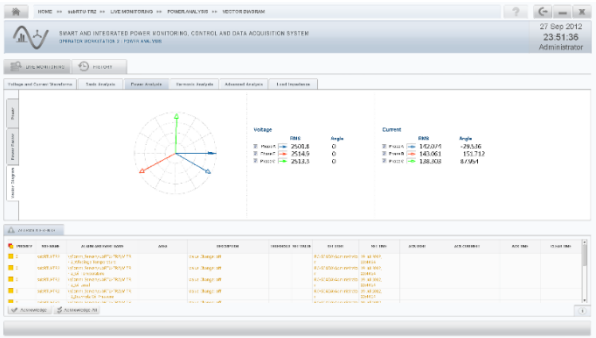


Software Screenshots

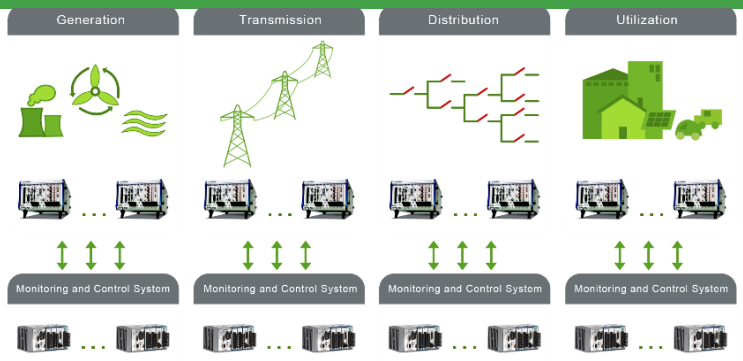








SMART GRID RESEARCH TRAINER



Overview

The laboratory facility is designed for research and development of Smart Grid SCADA System for power Generation Transmission, Distribution, and Utilization. The trainer allows investigation of concepts of active adaptive network of MicroGrid system.

The emulation of the Smart Grid subsystems are implemented in hardware-in-the-loop (HIL) architecture using NI PXI and NI CompactRIO platform.

The whole system is implemented in LabVIEW graphical programming language. User can modify any section of the platform.

System Functions

- Power generation plant
  - Simulation of the environment
  - Simulation of the electrical substation
  - Monitoring and control with NI cRIO platform
- Power distribution substation
  - Simulation of the environment
  - Simulation of the distributive points
  - Simulation of the transformer substation
  - Monitoring and control with NI cRIO platform
- High voltage transmission network
  - Simulation of the environment
  - Simulation of the high voltage lines
  - Simulation of the high voltage switches
  - Monitoring and control with NI cRIO platform
- Power utilization
  - Simulation of the environment
  - Simulation of a house
  - Simulation of a factory
  - Monitoring and control with NI cRIO platform

System Components

- Communication Server
- Operator Workstation
- Engineering Workstation
- Generation Models
- Transmission Model
- Distribution Model
- Utilization Models

Benefits

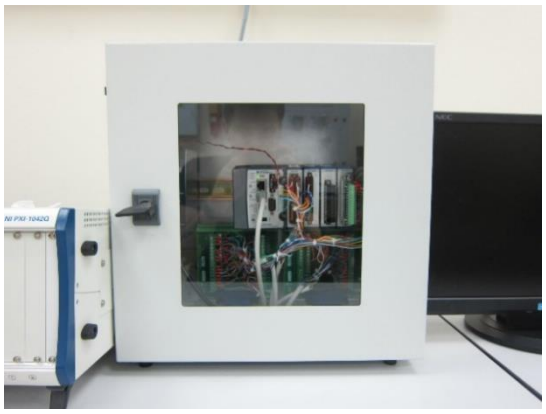
- Several users can work on the trainer simultaneously
- The laboratory facility gives chance to the students to understand the state-of-the-art Smart Grid Systems in user friendly, safe, easy to use and classroom environment

- ✓ Users can investigate different control and optimization algorithms of Smart Grid, different models for digital protection and advanced power quality analysis
- ✓ User will have chance to get deeper into local active adaptive grids and ability to understand the working mechanism of every field
- ✓ Simulation of real emergencies without any real physical danger for users
- ✓ Users can develop and test their own simulations of generation plants into the emulated environment
- ✓ Easy modification of algorithm using LabVIEW graphical programming language

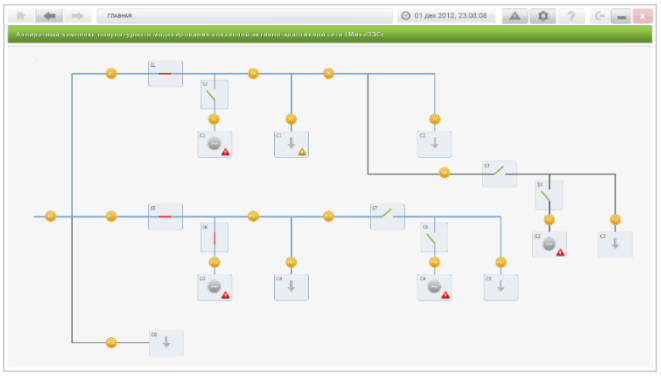
Specifications

Parameter	Value
Number of RTUs	4
Analog Inputs	32-channel, ±200 mV to ±10 V, 16-Bit, 250 kS/s
Digital Input/Output	32-channel, 5 V/TTL Bidirectional Digital I/O Module
Relay Channels	8-Channel, 60 VDC/30 Vrms, 750 mA
Number of Component Emulation System (CES)	4, based on NI PXI
Network Emulation System (NES)	1, based on NI PXI
Analog Input/Output	R Series Multifunction RIO with Virtex-5 LX30 FPGA
Communication Server	1, based on NI RMC server
Operator Workstations	2, based on regular desktop PC with two large screen monitors
Power Supply	220VAC, 50/60Hz

Hardware Pictures



Software Screenshots



NETSIMULATOR CURRENT ADAPTOR

Overview

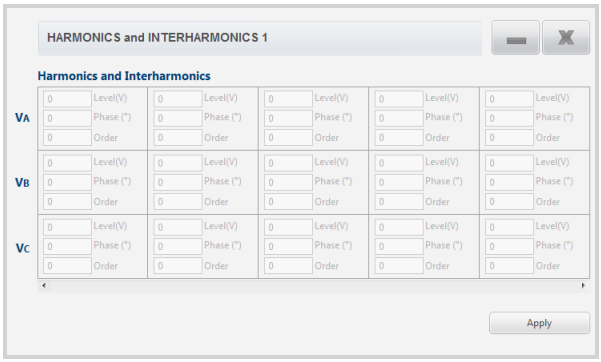
The NetSimulator Current Adaptor is used to generate real current flow from simulated signal in 3phase power networks. It can be used together with Multipurpose IED, Relay Protection and other devices.

Specifications

Parameter	Value
Inputs	
Number of Input Channels	4
Input Signal	7V RMS
Input Frequency Range	45 – 65 Hz
Input Network Type	50/60 Hz
Input Waveform Type	Sinewave, DC
Outputs	
Number of Output Channels	4
Output Signal	1.5A RMS / 5A RMS
Accuracy	0.5%, ±0.025A (after warm-up time)
Output Frequency Range	45 – 65 Hz
Output Network Type	50/60 Hz
General	
Supply Voltage	240 VAC ±2% stabilized grounded network, 50/60 Hz
Power Consumption	300 W (maximum)
Bandwidth	3.84 kHz, 64th order for 50/60Hz networks
Warm-up Time	10 min
Operating Temperature	15°-25° C
Base Enclosure	Steel
Form Factor	Rack mount, 5U
Environment	Indoor use

Hardware Pictures

Software Screenshots



NETSIMULATOR VOLTAGE ADAPTOR

Overview

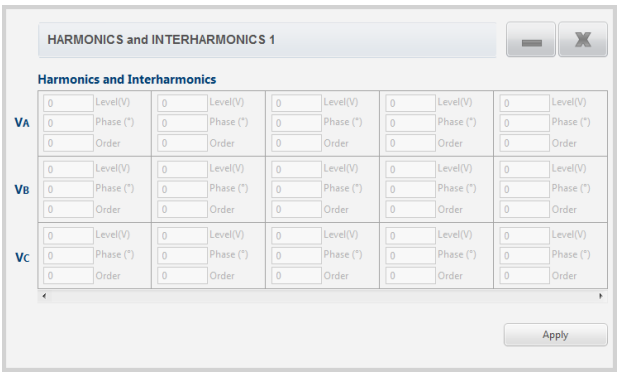
The NetSimulator Voltage Adaptor is used to generate real voltage from simulated signal in 3phase power networks. It can be used together with Multipurpose IED, Relay Protection and other devices.

Specifications

Parameter	Value
Inputs	
Number of Input Channels	3ch, +/-10 VAC
Input Signal	7V RMS
Input Frequency Range	45 – 65 Hz
Input Network Type	50/60 Hz
Input Waveform Type	Sinewave, DC
Outputs	
Number of Output Channels	3
Output Signal	220V RMS
Accuracy	1%, ±2.2V (after warm-up time)
Output Frequency Range	45-65 Hz
Output Network Type	50/60 Hz
General	
Supply Voltage	240 VAC ±2% stabilized grounded network, 50/60 Hz
Power Consumption	300 W (maximum)
Bandwidth	3.84 kHz, 64th order for 50/60Hz networks
Operating Temperature	15°-25° C
Warm-up Time	10 min
Base Enclosure	Steel
Form Factor	Rack mount, 4U
Environment	Indoor use

Hardware Pictures

Software Screenshots



INDUSTRIAL and CONSUMER IoT TRAINER

Overview

The NI Wireless Sensor Network (WSN) system is built on an IEEE 802.15.4 wireless mesh network. The 802.15.4 radio in each NI WSN device provides for low-power communication of measurement data across a large network of devices. NI-WSN software builds on top of that to provide network configuration and reliable communication from the host PC or Programmable Automation Controller (PAC) to the NI WSN-32xx node devices. This is a great trainer to introduce Industrial Internet of Things (IIoT).

List of Experiments

- Sensors/Instruments
- Basic Functionalities of the Sensors/Instruments
- Setting up a Simple Wireless Network
- Link Quality
- Setting up a Complex Wireless Network
- Topology Wireless Network
- Routing
- Redundancy
- Connecting the System to External Systems
- Performing Software Development
- Network Coverage
- Channel Configuration
- Lab Tests
- Mini Project
- Custom Lab

Benefits

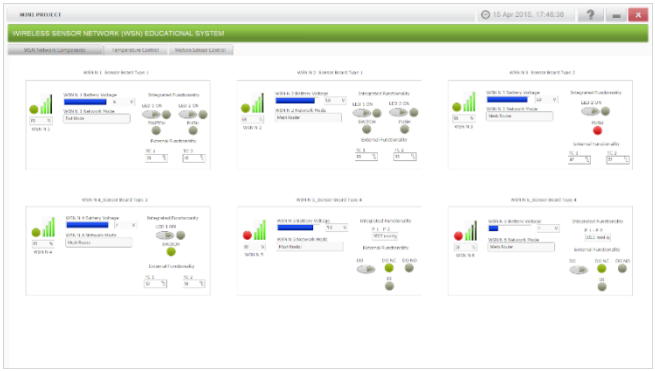
- Educational Facility gives opportunity for investigation of Zigbee Network
- The specialized control software is implemented in LabVIEW graphical programming language
- Ability to learn how to work with NI WSN platform
- Ability to create a System configuration based on different topologies (star, tree, mesh)
- Ability to use Web-based access capability
- Ability to develop customized solutions
- Ability to develop operation monitoring and graphic visualization functions

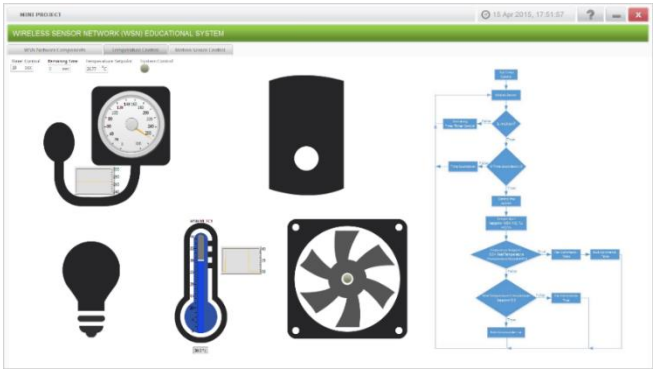
Specifications

Parameter	Value
Number of WSN nodes/ gateway	6 / 1
WSN nodes	4-channel, RTD/±10V, 4 channel, 24-Bit, Thermocouple
Sensor Board Type 1	2, Thermocouple
Thermocouple	1, K-type
LED	1, Red, 3mm, 2V, 20mA
Battery	2, AAA , 1.5V, 50x10mm
Sensor Board dimensions	39x63x14.5mm
Sensor Board Type 2	1
Push Button	1, Switched until released
LED	1, Red, 3mm, 2V, 20mA
Battery	2, AAA , 1.5V, 50x10mm
Sensor Board dimensions	39x63x14.5mm
Sensor Board Type 3	1
Switch Button	1, Switched when released
LED	1, Red, 3mm, 2V, 20mA
Battery	2, AAA , 1.5V, 50x10mm
Sensor Board dimensions	39x63x14.5mm
Sensor Board Type 4	2
Pressure Sensor with Hand Pump	1, 0-5V Voltage Output
Battery	2, AAA , 1.5V, 50x10mm
Sensor Board dimensions	39x63x14.5mm
Host PC	Regular desktop PC, FULL HD display

Hardware Pictures

Software Screenshots





SMART HOUSE TRAINER

Overview

Laboratory facility is designed for hands-on study of Lighting Control, Air Ventilation and Security System for household areas. It's a model of real home with air ventilation, motion and occupancy detection systems, security system (day and night video surveillance, door monitoring) and lighting control. The power analysis is also included to monitor the energy efficiency.

The whole system is connected to the specialized control software that is implemented in LabVIEW graphical programming language. The software visualizes a virtual operating diagram of the facility. It allows interactive monitoring and control over any modeled processes and simulated in hardware emergencies

List of Experiments

Study of components

- Motion Detection Sensor
- Occupancy Detection Sensor
- Gate Status Sensor
- Temperature Sensor
- Photodiode Sensor
- Loudspeaker and Microphone Sensor
- Proximity Reader
- Lighting
- HVAC Control
- Day and Night Video Camera
- Video Camera Based Motion and Occupancy Detection Sensor
- Email Notification
- Power Analysis
  - Voltage and Current Waveforms, RMS
  - Active, Reactive, Apparent Powers
  - Power Factor
  - Harmonic Analysis, THD
  - Flicker
- WSN Technology
- CompactRIO Technology

Benefits

- Student will have chance to learn how to work with real Home Automation system
- Student can control and monitor lighting system, air ventilation system based on people presence
- Investigate the work of motion and occupancy detection systems
- Student can investigate security systems which includes the surveillance system
- Student will have chance to get deeper into Home Automation Systems and ability to understand the working mechanism of every fields in the system using LabVIEW graphical programming language
- Student can add/modify different parts of the system, create new laboratory works

Study of Sub-Systems

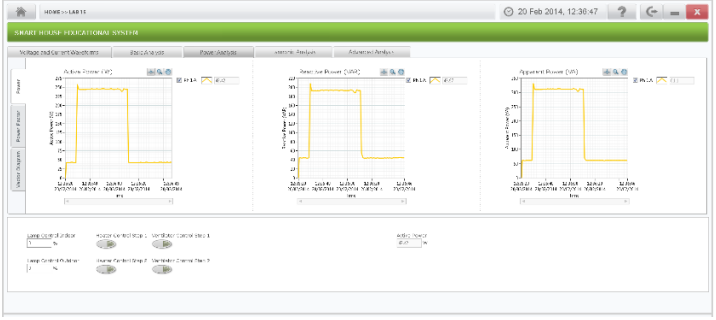
- Outside Lighting Control System
- Room Lighting Control System
- Room HVAC Control System
- Roof Authentication Control System
- Main Entrance Authentication Control System
- Surveillance Control System
- Absence Control System
- Smart House Complex Control System

Specifications

Parameter	Value
Number of RTUs	1
Number of Programmable WSN nodes	3
Number of WSN Gateways	1
Programmable WSN nodes	4 channel, 24-Bit, Programmable node, Thermocouple
Voltage Inputs	3-Channel, 300 Vrms, 24-bit, 50kS/s, simultaneous
Current Inputs	4-Channel, 5Arms, 24-bit, 50kS/s, simultaneous
Digital Input/Output	24 V, 16 Ch Digital Input, 16 Ch Digital Output
4-20mA Input	8-channel, ±20 mA, 200 kS/s, 16-Bit
Digital Input	4-channel, 24V,Universal sinking/sourcing
Analog Output	Channel-to-Channel Isolated 10 V Analog Output
Cameras	3, Basler IP Camera
Motion Sensors	3, IR motion sensors, 24VDC
RFID Reader	1, RFID Reader, 3 cards, RS-232 port
Car	1, Remotely controlled car
Helicopter	1, Remotely controlled helicopter
Host PC	Regular desktop PC, FULL HD display
Stand Dimensions (H x W x D)	900x1500x1500mm
Weight	80kg

Hardware Pictures

Software Screenshots



HEAT SUPPLY AND HEATING EQUIPMENT TRAINER

Overview

The educational system is dedicated for studying the heating supply mechanisms and working principles. The system allows the students to get acquainted to main principles of the heating sources and their characteristics.
The system consists of a heating equipment, water source, different measurement equipment, and a PC

List of Experiments

- Loses of Heating Energy in the Supply and Return Pipeline
- Hydraulic Resistance on the Pipelines
- Hydraulic Resistance on equipment unit
- Programmable Microcontrollers
- Experimental Studies of the Automated Heat Supply Management System Using Microcontroller
- Experimental Studies on the Efficiency of the Heating System
- Main Characteristics of the Heating Equipment
- Needed and Installed Heat Capacity Compliance of the Heating Equipment
- Experimental Studies on the Efficiency of the Electrical Heating Boiler Operation

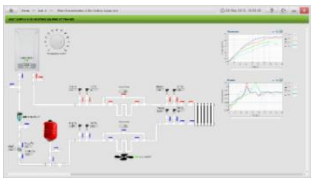
Benefits

- Ability to get acquainted to working principles of different heat supply and heating equipment
- Ability to study the characteristics of heat equipment
- Ability to study the efficiency technics in heat supply
- Ability to estimate the losses in heat supply

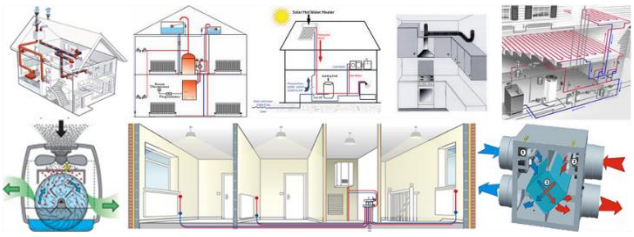
Specifications

Parameter	Value
Number of RTUs	1
Water heater	1, 220VAC, 2kW
Water pump	1, 220VAC, 350W
Water pressure meter	2, 0-5atm, mechanical
Water pressure meter	2, 0-5atm, 4-20mA output
Water temperature meter	2, 0-150°C, mechanical
Water temperature meter	2, 0-150°C, 4-20mA output
Heat meter	1, 0-150°C, pulse output, thermocouple sensor
Water tank	8 litre
Heating terminal units	H=350, H=600
Valves	28, Mechanical and solenoid

Software Screenshot



HVAC TRAINER



Overview

Laboratory facility is designed for hands-on study of cooling, ventilation and Air Conditioning Systems for household and industry areas. It's a model of real Air Handling Unit (AHU) with air conditioning, cooling, humidifying and fire detecting sections.
The sections are connected to each other by flanges that can provide easy transporting and installing of the system.

List of Experiments

- ✓ Practical Principles of Air Conditioning and Ventilation Technology
- ✓ Design and Servicing of an HVAC System
- ✓ Principles of Room Air Conditioning (H-X Diagram)
- ✓ Explanation of Components: Filter, Air Heater, Air Cooler, Humidifier, Condensing Unit, Air Conditioning Controller, Flaps, Outlets
- ✓ Operation of Safety Devices
- ✓ Operation of the Energy Efficiency Sensors
- ✓ Measurement of Pressure Curve and Pressure Losses on HVAC Sections
- ✓ Effect of Air Cooler, Air Heater And Humidifier on the State of the Air at the Outlet
- ✓ Investigation of the Control Behavior of an Automatic Air Conditioning Controller, Determination of Limiting Factors
- ✓ Briefing the State of the Art HVAC Systems and the Modern Trend of HVAC
- ✓ Bringing intelligence by additional sensors and control algorithms

Benefits

- ✓ Educational system is a copy of Real HVAC system
- ✓ Ability to learn how to work with real HVAC system
- ✓ Ability to control temperature, humidity and air flow in the household and industry areas.
- ✓ Ability to do electrical measurements
- ✓ Ability to get deeper into HVAC Systems and to understand the working mechanism of every fields in the system using LabVIEW graphical programming language
- ✓ Ability to add/modify different parts of the system, create new laboratory works

iLAB EDUCATIONAL PLATFORM

Overview

The iLAB educational platform is a web service infrastructure that provides a unifying software framework, which can support access to a wide variety of online laboratories for students. Users and the online laboratories can be globally distributed across an arbitrary number of locations linked only by the Internet. Users access these remote laboratories through single sign-in and a easy to use user interface

System Components

- Biology Trainers
  - Cell Division Trainer
  - Plant Cells Examination Trainer
- Chemistry Trainers
  - Chemical Bonds Trainer
  - Acids and Bases Trainer
  - Corrosion Trainer
- Mathematics Trainer
- Physics Trainers
  - Gravity Trainer
  - Electrical Waves Trainer
- Laboratory Stands Software
- Main Communication Server Engine
- Video Communication Server
- Web page
- Clients Application

Benefits

- Ability to have 200,000 user registered for the system
- Creating and managing client queues in case simultaneous access to the same Lab
- Report functionality
- Ability to easily open theory document of specific Laboratory Video
- Run the laboratory without human interaction at Laboratory area
- Ability to add new laboratories to the system
- Ability to add smartphone, tablet clients
- Ability to add other operation system clients

BIOLOGY TRAINERS

Cell Division Trainer

Overview

This laboratory system consists of four main experiments: mitosis, meiosis, Comparative analysis of mitosis and meiosis, protein biosynthesis.

List of Experiments

- ✓ Cell division - mitosis (mitotic division)
- ✓ Cell division - meiosis (maturation of sexual cells)
- ✓ Cell division - Comparative analysis of mitosis and meiosis
- ✓ Protein biosynthesis

Plant Cells Examination Trainer

Overview

This laboratory system consists of five main experiments: The study of osmotic water movement, Observation of root pressure and the study of capillary flow of water through the vessels, Meaning of transpiration for cooling a plant, Gas exchange in the plants in the dark and in the light, Study of the rate of photosynthesis depending on the solar spectrum.

List of Experiments

- ✓ Study of osmotic water movement
- ✓ Observation of root pressure and the study of capillary flow of water through the vessels
- ✓ Meaning of transpiration for cooling a plant
- ✓ Gas exchange in the plants in the dark and in the light
- ✓ Study of the rate of photosynthesis depending on the solar spectrum

CHEMISTRY TRAINERS

Chemical Bonds Trainer

Overview

The purpose of this experimental work is to learn the properties of ionic and covalent substances. The physical properties of a substance such as melting point tell us a lot about the type of bond in a compound. In this experiment the student will conduct tests on the properties and compile data enabling to classify compounds as ionic or covalent.

List of Experiments

- ✓ The disclosure of the nature of chemical bonds with the help of the device conduction of electric current
- ✓ The emergence of chemical bonds on the example of turbinegen chloride and sodium chloride (method of atomic orbitals)

Acids and Bases Trainer

Overview

There are three goals these experiments will strive to achieve: To classify substances as acids or bases using their characteristic properties, to determine the pH values of the acids and bases used, To examine the reactivity of acids with metals.

List of Experiments

- ✓ The impact of acids and bases on indicators
- ✓ Interaction of metals and acids
- ✓ Obtaining insoluble bases

Corrosion Trainer

Overview

Students will be able to observe and record the corrosive nature of oxidation-reduction reactions and to determine the electro-chemical series of selected metals (relative strengths of oxidizing and reducing agents).

List of Experiments

- ✓ Corrosion in contact with two different metals
- ✓ Corrosion of iron in contact with two different metals
- ✓ Corrosion of iron in various electrolytes

MATHEMATICS TRAINER

Overview

This trainer will demonstrate solution of differential equation, determination of stability of the dynamic system, analyses of periodic functions, probability density functions.

List of Experiments

- Solution of differential equation
- Determination of stability of the dynamic system
- Analyses of periodic functions
- Probability density functions
- Definition of probability density function of a pendulum displacement

PHYSICS TRAINER

Gravity Trainer

Overview

This laboratory system consists of three main experiments: Measurement of the gravitational acceleration using a pendulum, Total mechanical energy, Simple pendulum and inverted pendulum dynamics.

List of Experiments

- Measurement of the gravitational acceleration using a pendulum
- Total mechanical energy
- Simple pendulum and inverted pendulum dynamics

Electrical Waves Trainer

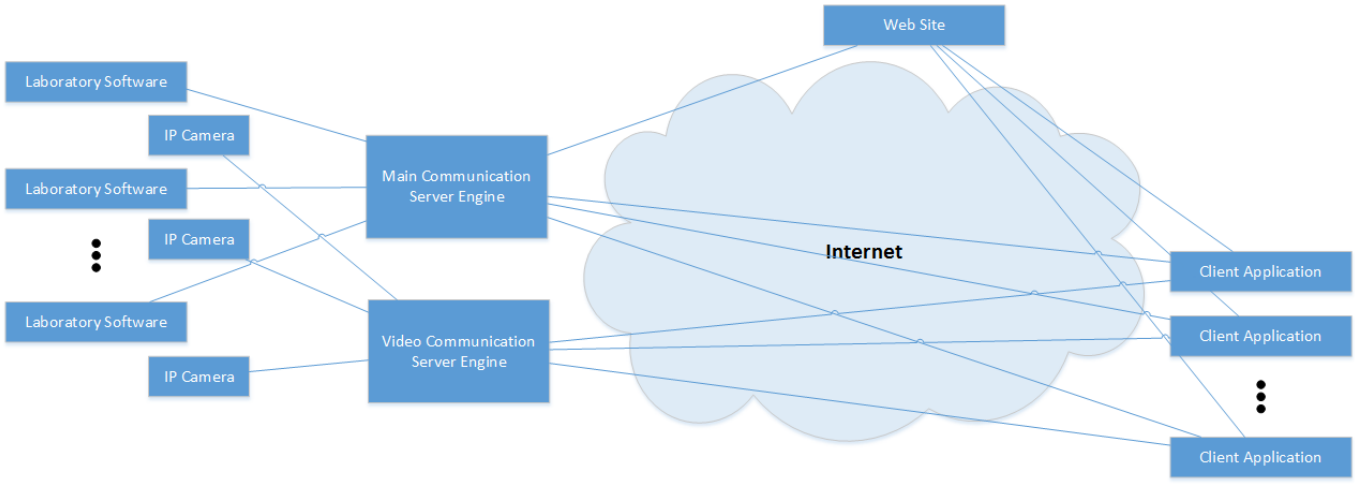
Overview

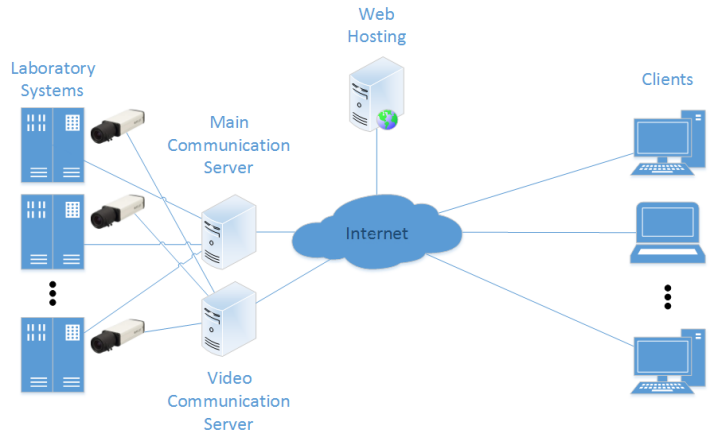
The purpose of this system is to demonstrate the differences of the AC and DC electrical signals (voltage, current), the magnetic characteristics of the AC and DC electrical signals, the idea of electromagnetic fields. Following the experiments students will understand how exactly the electromagnetic fields are working and interacting with each other, and how they are influencing to the metals and magnets.

List of Experiments

- Comparison of AC DC electrical signals
- Magnetic characteristics of the AC and DC electrical signals
- Electromagnetic fields
- Probability density functions
- Effect of electromagnetic fields on metals and magnets

System Architecture





LIGHT SOURCES and ENERGY SAVING TECHNOLOGIES in LIGHTING ENGINEERING TRAINER

Overview

The educational system is dedicated for studying the disciplines of energy efficiency in lighting engineering. The system allows the students to get acquainted to main light sources, their working principles and characteristics. The students will learn about the advantages and disadvantages of different light sources in terms of energy efficiency and usability in different applications.

List of Experiments

- Main Characteristics of the Incandescent Lamp
- Main Characteristics of the Halogen Lamp
- Main Characteristics of the LED Lamp
- Main Characteristics of the Linear Fluorescent Lamps of Low Pressure
- The Use of Motion Sensors to Reduce the Energy Consumption of Electric Lighting Systems
- The Use of Photo Relay to Reduce the Consumption of Electric Lighting Systems
- The Use of Timers to Reduce the Consumption of Electric Lighting Systems
- The Use of Dimmers to Reduce the Consumption of Electric Lighting Systems
- Comparison of the Energy Efficiency of Various Light Sources

Benefits

- Ability to get acquainted to the types and working principles of different light sources
- Ability to study the usability of light sources in different applications
- Ability to study the energy efficiency technics in lighting

Specifications

Parameter	Value
Number of RTUs	1
Voltage Analog inputs	3-channels, 300Vrms, 50kS/s, 24-bit, simultaneous
Wolfram lamp	1, 220VAC, 60W
Halogen lamp	1, 12VDC, 30W
LED lamp	1, 12VDC, 10W
Luminescent lamp	1, 12V, 30W
Brightness sensor	0-100000lux, 4-20mA

Software Screenshot

TRAFFIC LIGHTS MANAGEMENT TRAINER

Overview

The system is dedicated for educational trainings in traffic lights management. The students are able to study the different technologies that are used to manage and control the traffic lights, study the role and working principle of the components used, get acquainted with the variety of control algorithms as well as create their own custom algorithms.

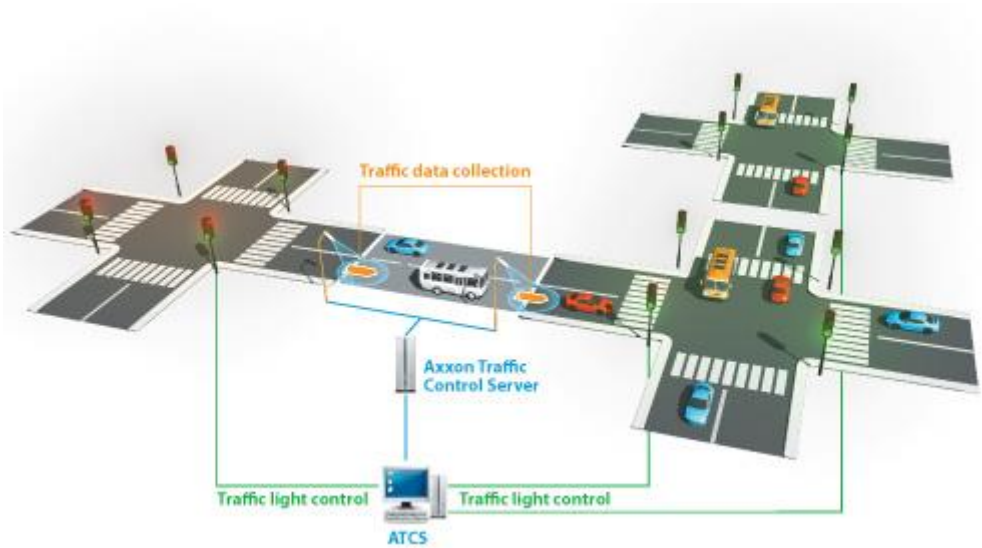
List of Experiments

- Traffic Detection
- Light Sensor
- Traffic Lights Control
- Digital Display
- Pre-timed Light Control
- Manual Light Control
- Light Control Based on Semi-Actuated Signals
- Light Control Based on Fully-Actuated Signals
- Signal Coordination
- Street Light Control Based on Ambient Lightness and Day-hour
- Street Light Control Based on Traffic
- Overall Traffic Light Management System

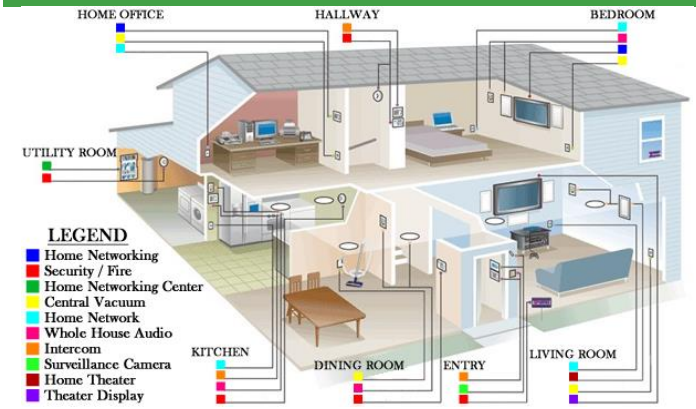
Benefits

- The students will get acquainted with different types of street light sources
- The students will be able to define the most power efficient light sources
- The students will be able to investigate different light-control algorithms and define the most efficient one

System Architecture



WIRING INSTALLATION TRAINER



Overview

The facility has been designed for hands-on study of training and further education of installation of electrical wires. Wiring installation training system is a unique, comprehensive experiment hardware system.

The whole system is connected to the specialized control software that is implemented in LabVIEW graphical programming language.

System Components

- Power supply
- Fuses
- Microprocessor electric power meter
- Circuit breakers
- Differential circuit breakers
- Protection relays
- Power sockets
- Power plugs
- Power distribution terminal
- Cables with different cross-sections
- Multicore and single core cables

List of Experiments

- Introduction to system components
- Calculation of total power consumption
- Calculation of required amount of outgoing electrical groups, the power consumption of each electrical outgoing group
- Definition of installation place of the electric meter
- Identification of types of loads (capacitive, inductive, and mixed loads)
- Definition of correct cable type to be installed based on load type and value
- Definition of correct cable cross-section to be installed based on load type and value
- Installation of circuit breakers
- Installation and testing of differential circuit breakers
- Grounding

Benefits

- Learning the principles of correct wiring installation
- Learning the principles of correct distribution of consumed power within the wires
- Achieving lower risks of cable damage due to overload or short circuit
- Achieving safer power consumption
- Achieving lower risk of cable damage due to heat dissipation in case of high power consumption

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