Didactic simulators for IoT

The MiniSims are small simulators designed for educational use in the study of Internet of Things (IoT) technology and its applications in various sectors, such as: Agri-food, energy, automotive, manufacturing, etc. computer, health, chemical and biotechnological.

They simulate, through an internal microcontroller, the operation of a computer, a plant, a system, etc., interacting with the student and generating all the information for the connection to the IoT, thus allowing to achieve one of the main objectives of this technology, what is to be seen or controlled by both other objects and network users.
A real IoT system is composed of objects (equipment, plants, systems, etc.), communication networks, servers and clients. An important feature of the MiniSims is to reproduce the entire IoT system on a single workstation, in an 'open' way, where the student can interact autonomously with the different parts of the system.

To use the MiniSims you need the IoT module, in particular, the DevIoT unit for the physical connection of the simulator to the cloud and the DL Workspace application that contains the servers and clients for the full operation of the system.
Experiments can be performed on a single computer, using all the tools of the DL Workspace software

The simulators are connected to the DevIoT unit that sends the information from the simulators to a cloud server. All cloud components are present on the PC.
A LAN connection is used between the DevIoT unit and the PC, in which the MQTT server of the DL Workspace is activated, which receives all the information from the simulators and saves it in a database.
The DL Workspace HTTP server is then used to provide database information to a "remote" user via a web in-terface. On a PC (or on any mobile device) simply using a browser and opening the HTTP server web page with real-time updated information about the state of the simulated plants.

The simulators available are as follows:

- DL MiniSim-ENE1: Domestic photovoltaic system with remote monitoring of operating parameters.
- DL MiniSim-CAR1: Connected car, remote monitoring and diagnosis.
- DL MiniSim-MAN1: Simulation and control of an intelligent factory.
- DL MiniSim-BIO1: Telemedicine, electrocardiogram with remote viewing.
- DL MiniSim-AGR1: Agri-food 4.0 in greenhouses.
- DL MiniSim-CHI1: Chemistry 4.0, remote monitoring of a chemical plant.

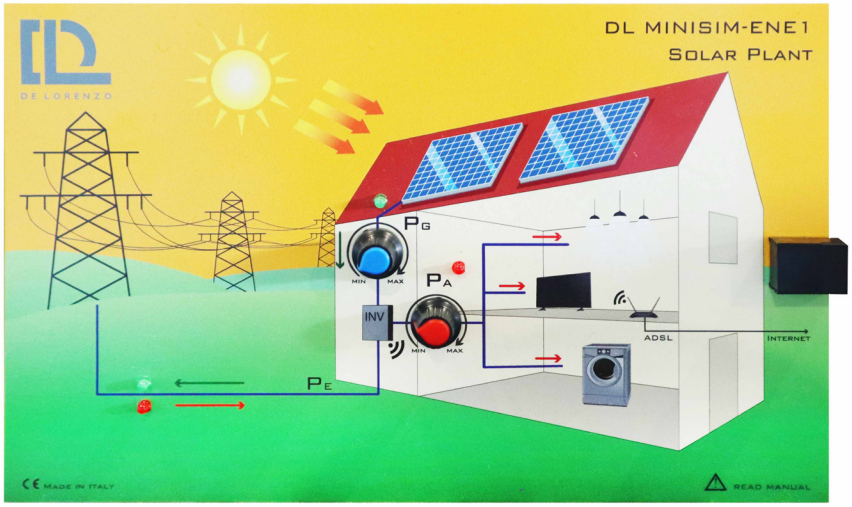
DL MiniSim-ENE1
Home photovoltaic system with remote monitoring of operating parameters

Electric power production systems using photovoltaic panels are increasingly used in the home.

Currently, most of them allow to monitor the system remotely using a PC or a mobile phone using IoT techniques.

The control unit present in the house that uses a domestic connection to the internet sends the production and consumption data via the IoT protocol to a server installed anywhere in the world.

From anywhere else in the world, you can connect to this server and view the data using a simple web interface and HTTP protocol.



The simulator of the DL MiniSim-ENE1 solar system is used, which shows a screen print of the components of the domestic system, and allows to vary, through the potentiometer, the energy produced by the solar panels (to simulate different environmental conditions) and the energy absorbed by the domestic charges. The power absorbed or sent to the network operator is calculated with a subtraction.

DL MiniSim-CAR1
Connected Car, remote monitoring and diagnosis

The connected car is a concept that until a few years ago was considered science fiction and has now become a reality. It is the foundation of many applications, including autonomous driving.
The first applications originated in Formula 1, where it was important to know the condition of the vehicle on the track. Then, with the advancement of technology, particularly that of the Internet of Things (IoT), they expanded to many other sectors.
In this simulator two important applications are proposed, one for remote monitoring of the vehicle to know its health, safety, etc., and another for remote diagnostic operations in real time.
The simulator shows a real system in which a car is constantly connected to the internet and therefore the information from it is available, anywhere, for the monitoring and diagnostic operations mentioned above.

Use the DL MiniSim-CAR1 that contains:

- The scheme of the connected car,
- A car start/stop switch
- A potentiometer to vary the number of engine revolutions.
- Software that calculates the machine's operating parameters in real time.
- A switch for inserting faults in the car.

The DL Workspace also contains a car dashboard, which displays the actual dashboard remotely, and an OBD scan tool for troubleshooting.

DL MiniSim-MAN1
Simulation and control of a smart factory

The Smart Factory is a definition used to describe the use of different digital technologies in order to manage all operations within a production reality.
One of the most suitable technologies to use in an intelligent factory is the Internet of Things (IoT), since it allows the exchange of information between different devices, without human intervention, to synchronize the general operation of the system.
The simulator shows a "real" system, in which 3 workstations cascade together to make a product. Station 1 represents the reception of semi-finished products, Station 2 represents the processing of the product, and Station 3 represents the packaging of the finished product.

In a traditional factory, the system would be governed by a control station (Master) that controls the three workstations (Slaves) and thus coordinates their operation.
In an intelligent factory that uses Internet of Things techniques, the 3 workstations are objects (things) that communicate their status to a server and receive information from the server relative to the status of the other stations, that is, they exchange the status between them.
Station 1 will inform when it is free to accept incoming materials, Station 2 will indicate that production is working, and Station 3 will give the availability of the outgoing product. In this way, each station is able to operate in coordination with the others without the need for superior control logic.

The DL MiniSim-MAN1 is used, which shows a screen print of the components of the complete system and shows the status of the different workstations through multi-colored LEDs.

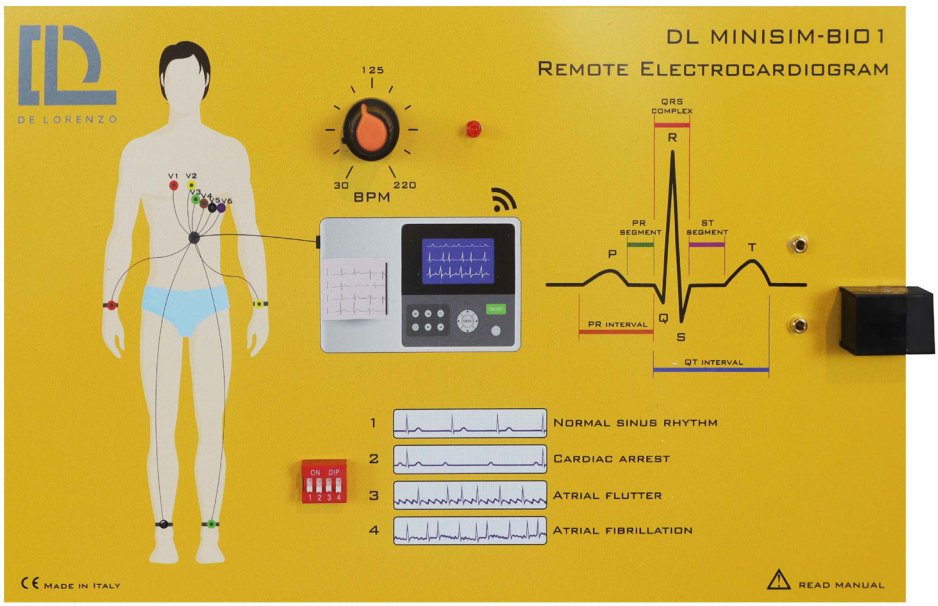
DL MiniSim-BIO1
Telemedicine, Electrocardiogram with Remote Display

Telemedicine is defined as a way of providing health services using innovative technologies, in particular Information and Communication Technologies (ICT), in situations where the healthcare professional and the patient (or two professionals) are not in the same place. Telemedicine involves the secure transmission of medical information and data in the form of texts, sounds, images or other forms necessary for the prevention, diagnosis, treatment and subsequent follow-up of patients.

Telemedicine services can be used with any diagnostic or therapy health service.
However, the provision of telemedicine does not replace the traditional provision of health care in the doctor-patient relationship, but complements it to potentially improve effectiveness, efficiency and adequacy.

The simulator shows a 'real' system in which a patient performs an electrocardiogram, and the doctor controls it in real time remotely.
On the DL MiniSim-BIO1, the ECG signal is generated continuously. A potentiometer allows you to vary the rate from 30 to 220 beats per minute.

It is possible to generate different types of ECGs (the waveform is generated by the microcontroller within the panel) and a dip switch on the panel allows you to select different ECGs with different pathologies.

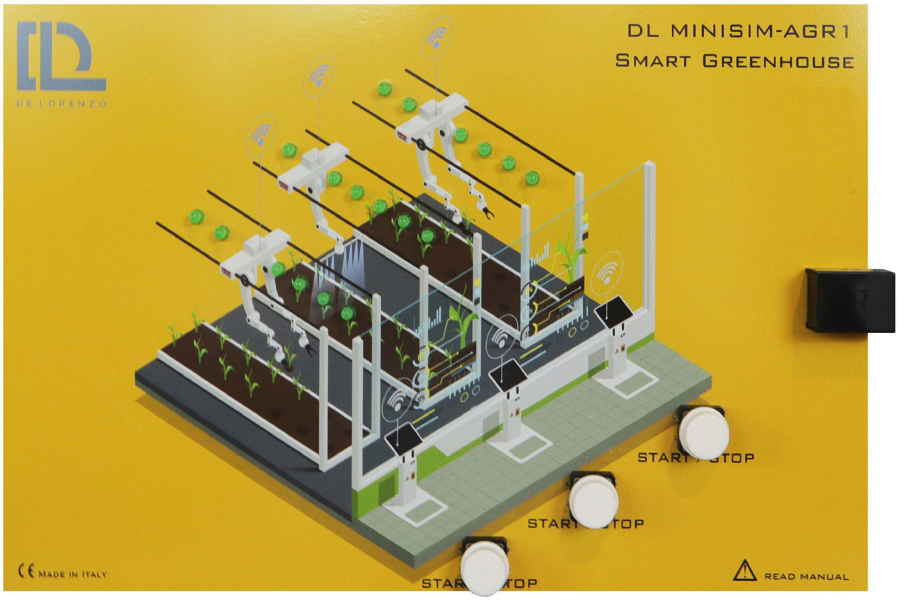


The DL MiniSim-BIO1 is used, which displays a screen print of the entire system components and generates a simulated voltage ECG signal.

DL MiniSim-AGR1
Food Agriculture 4.0 in greenhouses

Food agriculture 4.0 aims to integrate digital technologies and agricultural production to achieve a reduction in energy consumption and resources used in the greenhouse and in the field.
Information technology, which allows remote monitoring of the environment and plants, can ensure favorable environmental conditions for the crop, leading to the objective of increasing the productivity and health of crops, also reducing the use of agrochemicals. In particular, Internet of Things (IoT) technologies together with new intelligent algorithms allow monitoring plant health remotely and coordinating phytosanitary and greenhouse energy management in an integrated manner, in order to optimize crop health and energy consumption.

The information derived from environmental, energy and agricultural monitoring exploits the transmission on the Internet, to be processed remotely from any point thanks to the development of new intelligent algorithms in order to visualize and implement control strategies.
The simulator shows a "real" 4.0 greenhouse system, with an automatic irrigation system, sensors to monitor the weather conditions and actuators to adjust the conditions themselves.



The DL MiniSim-AGR1 which shows a screen print of the components of the complete system, also contains:

- A LED bar showing the position of the irrigation cart.
- A cart start/stop switch.
- The following DevIoT unit resources are also used:
- The actual temperature sensor with PT100 probe.
- The real DC motor for a simple remote temperature control.

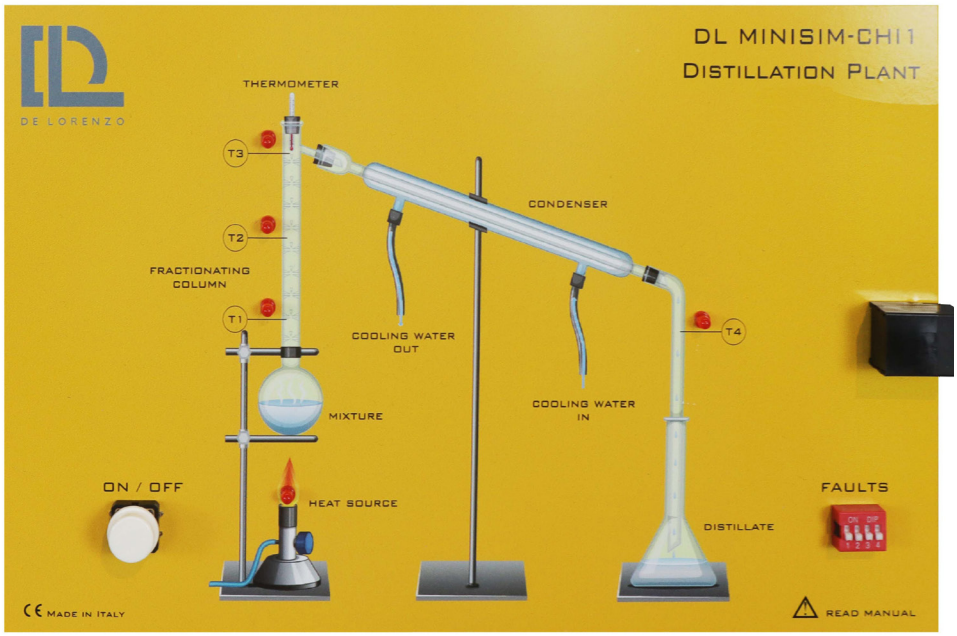
It is possible to observe in real time the position of the irrigation cart and the temperature value and start or stop the irrigation cart and the fan motor.

DL MiniSim-CHI1
Chemistry 4.0, remote monitoring of a chemical plant

While Chemistry 1.0 can be identified as that of coal, Chemistry 2.0 as petrochemistry, Chemistry 3.0 as that of globalization and specialization, Chemistry 4.0 means above all circular economy and digitalization (new paradigms of material production and recovery are used to maximize the use of existing molecules.)

Internet of Things (IoT) technologies are also located in Chemistry 4.0 as tools for the digital collection of all plant data, for real-time monitoring operations, for operations to verify their health status and early detection of possible breakages, and for operations to verify their health for the optimization of production and the reduction of raw material consumption.

The simulator shows a 'real' Industrial Distillation Chemical Plant, in its various components that make it controllable and manageable remotely through IoT technologies.



The DL MiniSim-CHI1 which shows a screen print of the distillation system in all its components, also contains a microcontroller inside which allows the simulation of the operation of the plant.
During the simulation, all the values of the main physical magnitudes that characterize the system are calculated in real time.