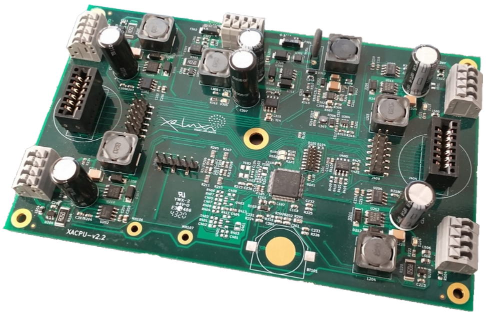

Xaluxi modular control gear

FEATURES

- Smart power engine for local management of power delivery to DC and AC loads
- 2 DC power inputs:
  - main high voltage DC power input (24V – 90V @ 4A)
  - auxiliary low voltage DC power input, with battery charging capabilities (12V – 48V @ 2A)
- 2 or 4 DC outputs, according to the selected model
- 3 selectable outputs mode:
  - Constant Voltage
  - Constant Current
  - Constant Power
- Fine regulation of output currents and voltages (4096 steps)
- True constant outputs (no PWM modulation)
- RTC with coin Li-battery
- Firmware updatable on the field, without specific knowledge requirements
- Plug-in modules for sensing:
  - Ambient light sensors
  - Temperature and humidity sensors
  - Movement sensors
  - Gas sensors
- Plug-in modules for actuating:
  - AC 265V 1.5A or 3A solid state power switch with zero cross turn-on
- Plug-in modules for communication, based on widely adopted standards:
  - BLE/Thread/ZigBee certified module supporting mesh topologies
  - LTE NB-IoT certified module for worldwide connection to cellular network
- Plug-in modules for appliance reconfiguration (firmware update, features enabling/disabling)
- Local intelligence: the device can operate and take decisions without a network connection
- Interoperability: the device can be integrated in a complex system, to optimize overall system performance
- Cloud compatibility: if required, the device can exchange data with web applications hosted on-premise or in the cloud
- Physical dimensions: 100 x 160 x 30 mm

DESCRIPTION

The Xaluxi modular control gear is a smart engine which can be used as a standalone smart appliance, to control several devices according to a specified behaviour, eventually related to the analysis of sensor inputs. Moreover, it can be used, via its communication capabilities, to build IoT based systems in industrial, residential and retail fields.
The main difference from similar devices is the fact that the module has local intelligence. It means that it do not need a central control gear, or an Internet connection, to operate and interact with the environment and the users. A complex system of these devices can be built, again without Internet connectivity.
If required, the device can anyway be connected to a web application, hosted on-premise or in the cloud, to allow remote monitoring and control.
The core of the module is a high performance 32 bit micro-controller, which manages, via a customizable firmware, the behaviour of the system.
The module, in its basic configuration, is capable to drive, in constant current (CC) or constant voltage (CV) mode, up to 4 loads. These loads can be mainly LED based lighting devices, but also DC motors, heaters, etc.

The outputs are independently driven by high efficiency, DC-DC converters, which adapt inputs to the voltage required by the selected loads. The ripple on the output is very small, to avoid flickering effects if a lighting application is deployed.
Two different DC power inputs are available, optimized for different usages. The main one is used when full power must be sent to the outputs, and it has a current limit of 4A. The second power input, called auxiliary one, can be used for different purposes, among them emergency management, in which it is fed by a generator or rechargeable battery, or to couple low voltage power sources to higher voltage loads. The auxiliary connection is bidirectional, as it can also source power, e.g. to recharge an external battery.

The status of the system (on, off, output levels, etc.) can be preserved even in case of a full power outage, due to the presence of an RTC and an SRAM supplied by a coin Lithium battery. The configuration of the system (output characteristics, network addresses, encryption keys, etc.) is saved in a non-volatile memory, instead.

As said before, the behaviour of the device is managed by a firmware, installed in the system. The firmware can be easily upgraded on-the-field, through the usage of a smart standalone plug-in able to fully reprogram the micro-controller memory. The same plug-in can be used to perform partial reconfiguration, too, or just to enable or disable specific feature (e.g. turning on presence sensor effect on the outputs).

The basic configuration can be easily expanded adding plug-in modules for sensing, actuating, and communication.

DETAILED TECHNICAL SPECIFICATIONS

Input Characteristics					
Symbol	**Parameter**	**Conditions**	**Min**	**Max**	**Units**
V_{MAIN}	Main power supply	$V_{MAIN} > V_{AUX}$	24	96	V
V_{AUX}	Auxiliary power supply	$V_{MAIN} > V_{AUX}$	12	48	V
V_{COIN}	RTC backup battery		1.65	3.6	V
I_{MAIN}	Total input current			4	A
I_{AUX}	Total auxiliary current			4	A
Main Output Characteristics (channels 1 to 4)					
V_{OUT}	Output voltage		$0.2 \times V_{MAIN}$	$0.8 \times V_{MAIN}$	V
I_{OUT}	Output current	Current for each single channel Total input currents must be below limits	0.02	2.0	A

APPLICATION EXAMPLE 1 - Standalone

The XA-BRAIN board can be used in a variety of applications, just changing the installed firmware. A possible application is the standalone intelligent lighting system depicted in figure 1. The green coloured blocks are based on Xaluxi technology, while blue ones are off-the-shelf components.
The application is designed around the XA-BRAIN board, and integrating environment sensing and actuation with flexible programmable behaviours.
In more details, a presence detector and a light sensor send data to the main board, to establish a comfortable level of illumination, according to the presence or absence of people, and to the natural light entering the room from the windows.
The board directly drive up to four led engines, in constant current mode. If no people are detected, then led current is held at a minimum. Otherwise the led’s are driven to obtain a fixed level of illumination, as sensed by the integrated

light sensor. In other words, they are driven at full power only if no light enter the windows, and they dim, saving energy, if an external contribution is present. Due to the presence of a fully digital control, speed of light level changes can be tailored to minimize user discomfort (i.e. dazzling for an instantaneous turn-on, or temporary blindness for a fast turn-off).
In this application, the main power supply is derived from AC main through a low cost standard AC/DC adapter.
Moreover, the auxiliary input line is used to implement an emergency function, via the usage of an external lead-acid battery, turning lights on, even if at reduced power, in the case of a fault of the main supply line. The battery is held charged by the XA-BRAIN itself, as the energy flow on the auxiliary port is bidirectional.
Last, a fan is turned on when people are detected, and it is left on for a programmable amount of time (e.g. 5 minutes) after the last detection (e.g. for a closed bathroom).

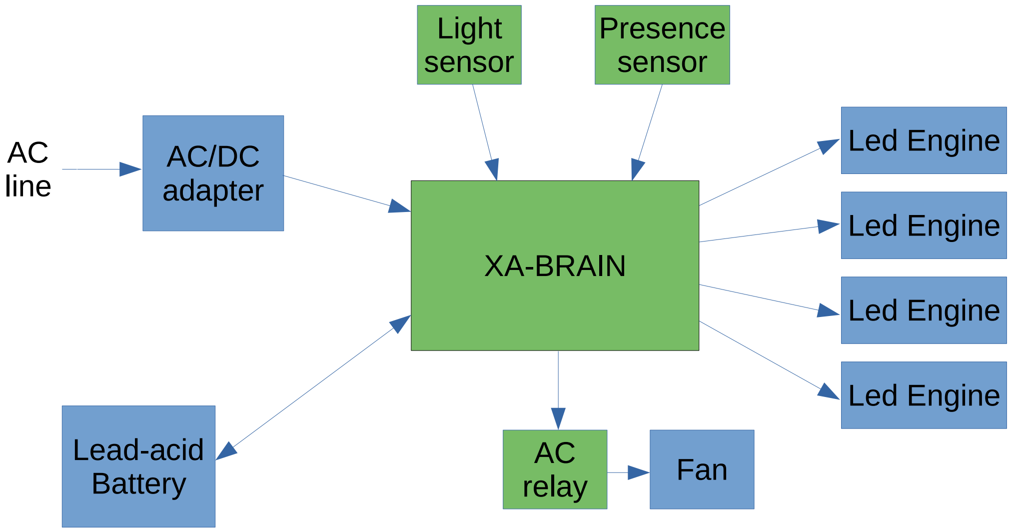

Figure 1: Block diagram of a standalone system

APPLICATION EXAMPLE 2 – Connected

Besides being operated as a standalone, independent device, the XA-BRAIN module can be easily integrated in a fully interconnected system, able to fully exploit the potential of Xaluxi technology. In this situation, with the simple addition of a communication module, several XA-BRAIN devices exchange information about their status, including attached sensors and actuators one. These informations are then used by each node to modify its behaviour.
A possible application, shown in figure 2, is the management of a light paths in a public underground parking, or in an exhibition. The standard approach is to have presence sensors which turn on the lights of a corridor, or of an entire floor, but this solution is not efficient, as it wastes energy to turn on lamps which are not useful to a walking user.
Our solution, instead, allows to turn on only a fixed amount of lamps around the detected user, so creating like a “light cloud” around moving people.
The proposed implementation is realized using a Xaluxi BLE 5 communication plug-in, and deploying a standard mesh architecture. Every node send status change information, specifically related to the presence sensor, and adjacent nodes behave accordingly, anticipating light turn-on, even if their own sensor has not detected people, yet.

The choice of the BLE standard allows for further development of the infrastructure, just with software modification. As an example, an application deployed on a cell phone can read data from the network, and find the user position on a map. And, once the position is known, more specific informations can be downloaded to the app, like the title and the author of a painting or a sculpture.
An important feature of the Xaluxi architecture is that in this structure no node is privileged, or has a master role. As a consequence the system is inherently fault tolerant, and works seamlessly even if some nodes fail.
Last, one of the nodes, with the addition of an IP capable communication module, can interface the mesh to the Internet. There, data can be collected, managed and analysed by servers, on-premise or in the cloud. As an example, statistics can be gathered, about power consumption or pollutants level in a parking lot, or visitors behaviour in an exhibition.

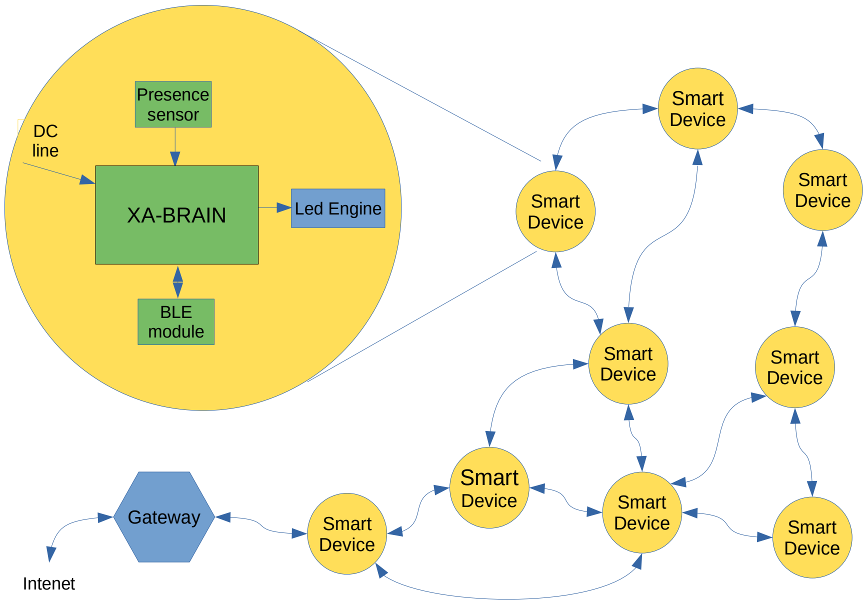

Figure 2: Block diagram of a connected system. The upper left yellow circle shows inner details of each smart device node

IMPORTANT NOTICE – PLEASE READ CAREFULLY