A PLC-BASED SYSTEM FOR THE CONTROL OF AN EDUCATIONAL OBSERVATORY

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Figure 1: Telescope Celestron C14 and the solar telescope Coronado HELIOS on the Paramount ME mount, at the Astronomical Observatory of Basovizza

INTRODUCTION

A non-automatic dome at the INAF-Astronomical Observatory of Trieste, in Basovizza, hosts the telescope Celestron C14 and the solar telescope Coronado HELIOS. These telescopes are used for a project that proposes a modern tool to support the teaching of astronomy, through the study and experimentation of its observation methods [1].

The telescopes are installed on a german equatorial mount (see Fig. 1), that allows automatic pointing of the telescope and tracking. The totally completed "Paramount ME" mount, through the dedicated software *TheSkyX* and an appropriate control system, allows the remote management of the telescope. Although the telescope could be fully remotely controlled, the operations on the other equipment requires the physical presence of an operator. In particular the opening/closing of the roof is manual as well as the switching of the dome instrumentation. Here is described a new PLC-based control system aimed to make the dome and its hosting instrumentation fully robotic ensuring in this way safety and remote operations.

OVERVIEW OF THE SYSTEM

The whole instrumentation is placed in one of the buildings of the astronomical station. This building consists of two rooms: the first is the control room that contains the computers for the observations; the second room, with a sliding roof, contains the telescope and its instrumentation (CCD camera, filter wheel, focuser).

The roof is moved transversely by a three-phase synchronous motor. Since the total extent of the telescope exceeds the height of the roof, it is mandatory that the telescope is in park position when the roof is in motion. Near the telescope there are some outlets for switching on and off the telescope, the CCD camera, the CORONADO for the daytime observations and an auxiliary one.

THE NEW CONTROL SYSTEM

The new control system will be based on Beckhoff PLC (see Fig. 3) and will be organized as follows (see Fig. 2 for a general overview and Fig. 4 for a more detailed overview).

In the control room the CPU *CX1030* will be installed with the Beckhoff modules needed to control the devices hosted here.

The functions that will be controlled by the modules in this room are:

- Power on and off the PC in the control room
- Switch on and off the warning light and buzzer that announce the movement of the roof
- Manage the weather signal that will come from the weather sensor *Boltwood Cloud II*
- Manage the movement of the roof through the SIEMENS *MICROMASTER440* inverter
- Read the signal of the sensor that notifies if the door leading to the telescope room is open or closed
- Manage the control panel. This panel will allow to check whether the equipment is operated manually or remotely. In case of door opening with the remote management enabled, the equipment will be deactivated for safety reasons. In the telescope room the decentralization features of the Beckhoff PLC are exploited and a new row of PLC modules is foreseen. The *EK1100* module will assure the continuity of the EtherCAT communication with the CPU in the control room.

The functions that need to be controlled in the telescope room are:

- Power on and off the electrical outlets: TELESCOPE, CCD, CORONADO, AUXILIARY
- Read the status of the position of the telescope. Two positioning sensors will be placed on the telescope in order to control if the telescope is in park position.
- Move the telescope in the park position if needed (i.e. if the signal of the weather sensor warns about a rainy weather). This will happen through the movement of the joystick. In fact, a simple interface circuit will be built to allow this movement.
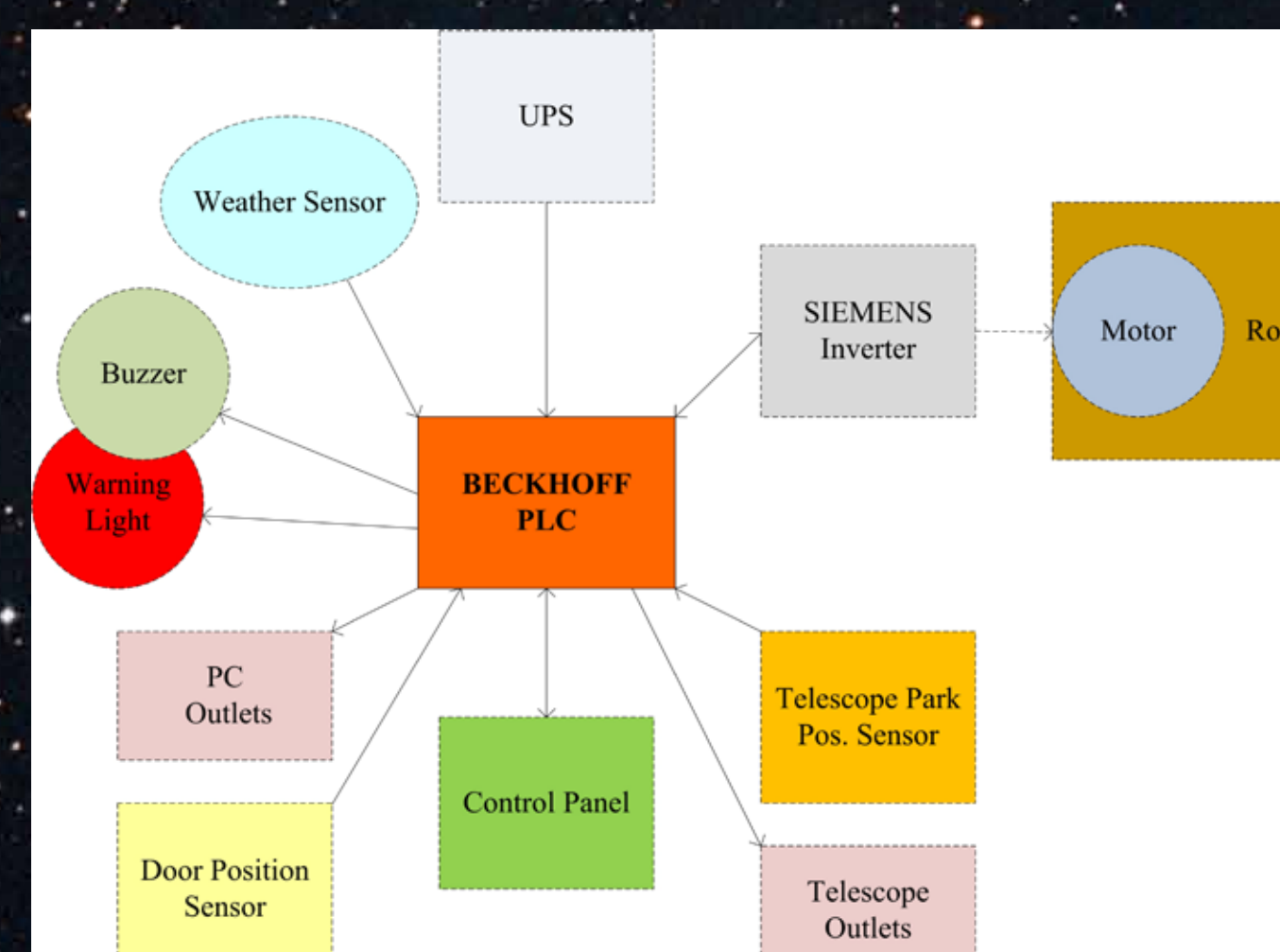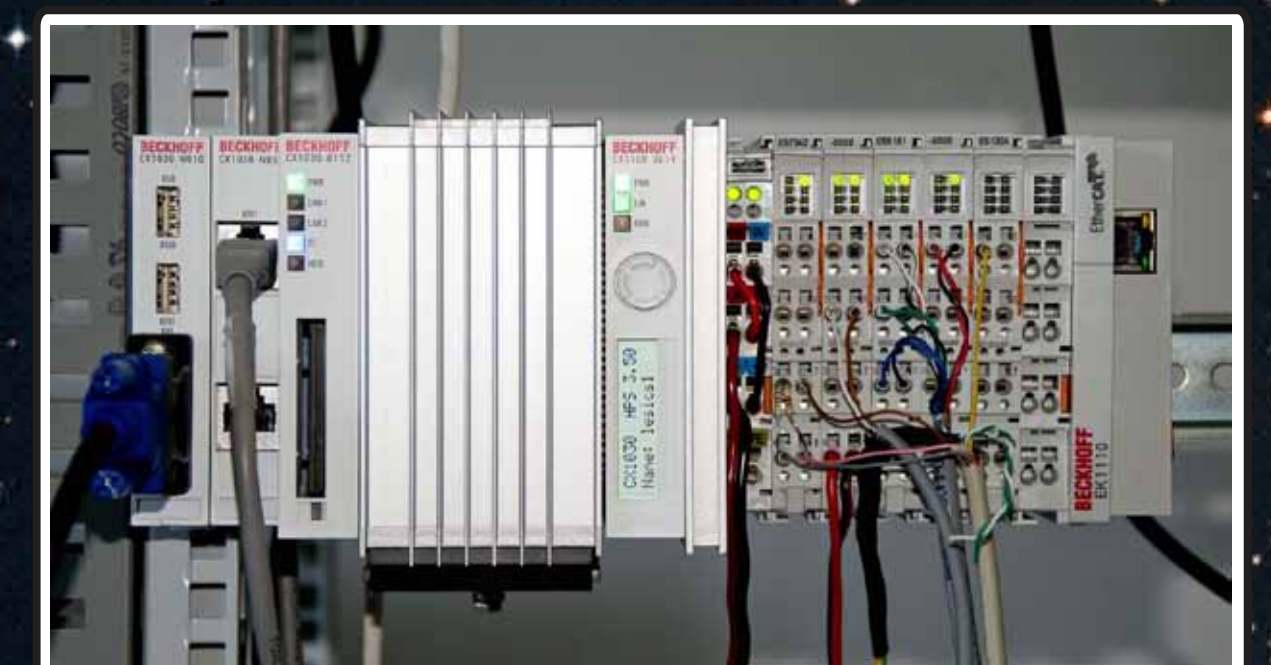

Figure 2: General system overview

Figure 3: Beckhoff PLC CPU CX1030

THE SOFTWARE INTERFACE

The remote operations will be available through a web interface installed on a Windows web server in the main building of the observatory. There will be an authentication system with different authentication levels to log the accesses. The web browser (see Fig. 5) will show live weather situation using the weather sensor and two webcams: one showing the surrounding environment and the other the telescope room. From the web interface it will be possible to start the observations (turn off the lights, open the roof, power up the telescope and the control room computers). The software will be connected to the PLC library using the ADS system. From the web interface it will be possible to start the observations allowing fully robotic safe operations.
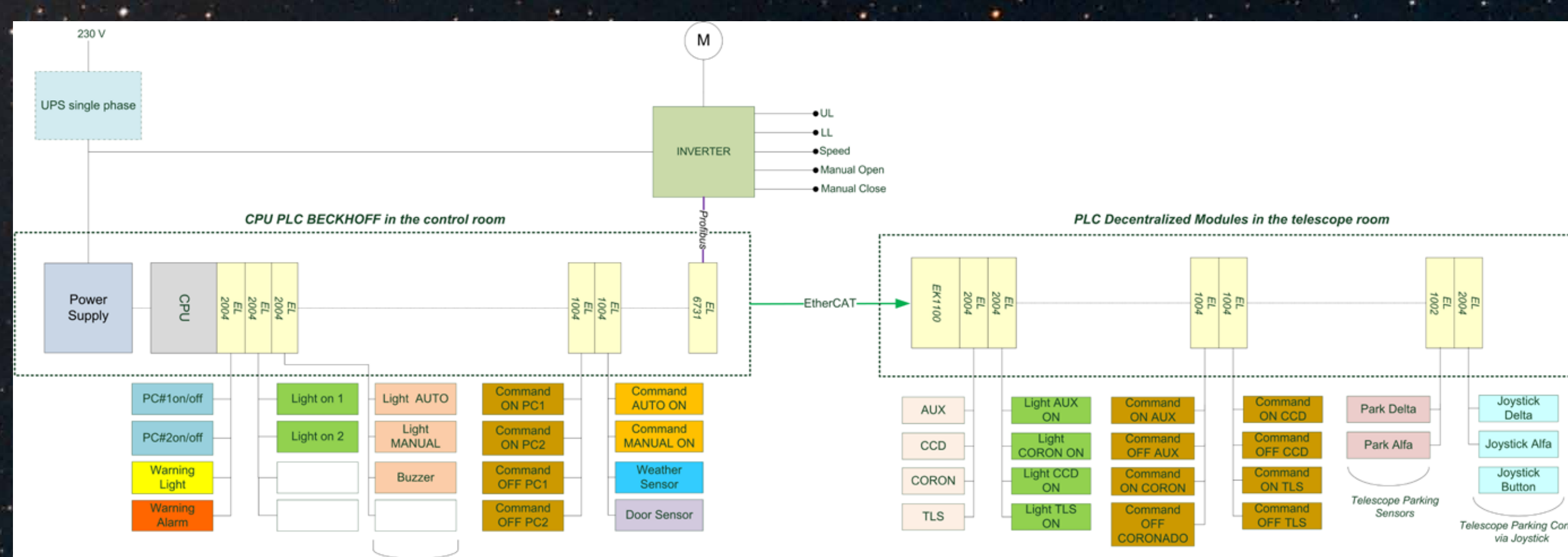

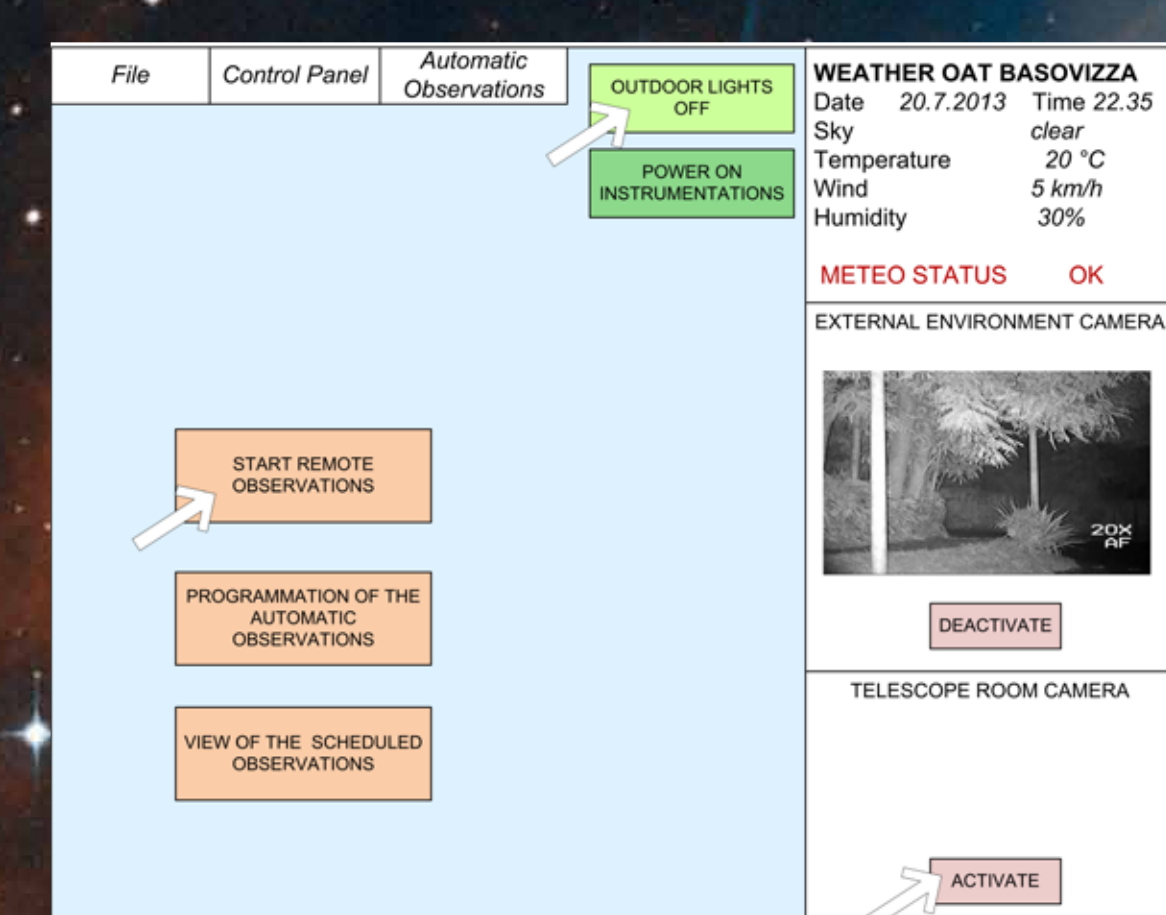Figure 4: Functions controlled by the PLC modules in the control and telescope room

Figure 5: Example of the software interface

REFERENCES

[1] http://scuole.oats.inaf.it/svas-en.html
[2] https://www.beckhoff.com, 2013

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