Operating Manual, Remote Networked Estop System for HET

August 18, 2021

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Overview

The Remote Networked Estop System (System) consists of a set of PLCs that integrate into HET's Estop system. The purpose of this System is to provide the on-site Telescope Operators the ability to assert an HET Estop while remotely controlling nighttime observing from their homes. This system does not meet the rigorous requirements necessary to protect human life. It is only intended to protect HET equipment while it is being operated remotely. Key to its operation is the dome audio, available to the TOs at their houses via the VLC Media Player app. This audio is injected onto the HET network using a Barix Instreamer, an audio-over-IP device.   An Estop will typically be asserted in the event of an abnormal sound coming from the telescope dome during science operations.

The System consists of 3 Remote units and 1 Central unit. The Remote units are installed at each of the three houses of the TOs that live on-site. The Central unit is located in the HET Control Room and interfaces with each of the 3 Remote units via the internet and to the HET Estop system through direct wiring.

 It is important to note the distinction between the two systems. The System defined here is the proposed Remote Networked Estop System. The HET Estop system is a functional hardware based system already in use at the HET.

Remote Unit

The Remote unit interface consists of 4 status LEDs and one Estop pushbutton (shown in Figure 1 below). These LEDs indicate 1) active communications to the Central unit, 2) whether the particular Remote unit has control of the System, 3) operational status of the System, and 4) presence of an HET Estop. The Estop pushbutton can be pressed to assert an Estop at the Central unit which then assert an Estop on the HET Estop system

Figure 1. Photograph of a Remote unit showing the user interface, 4 LEDs, 1 pushbutton.

A control PLC is mounted within the Remote enclosure. This PLC controls the LEDs, monitors the pushbutton and communicates with the Central unit. It also provides a web server through which the PLC can be programmed and configured to monitor the inputs, outputs and communications. This GUI is completely passive and is designed to mirror the physical interface of the Remote unit, as seen under the Monitor section. A separate section label Diagnostics is used for troubleshooting.   Access to this information is available through a web browser that is pointed to the fixed IP address assigned to each Remote unit.
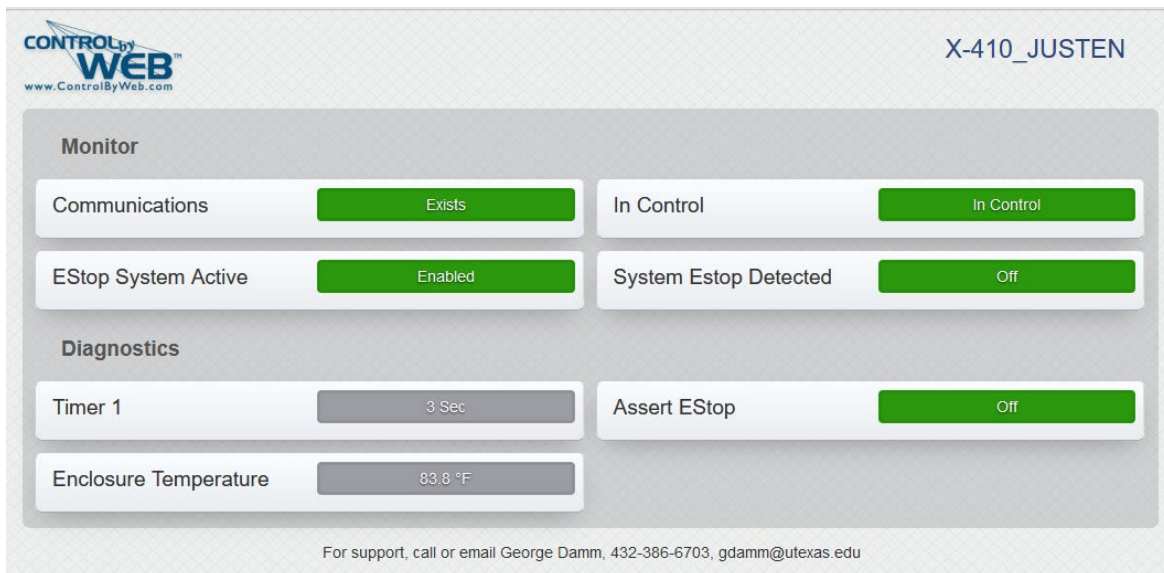

Figure 2. Screen capture of the Remote unit GUI.

Remote Unit Indicators, Monitor

During the description of operation, reference will be made to the **LED**, mounted on the Remote enclosure and the **GUI Indicator** which is the appropriately labeled button on the Remote unit PLC web server GUI.

Communications
This LED/GUI Indicator monitors the communications between the Central unit and the Remote unit. The Central unit sets a variable to 1 at each of the 3 Remote units, every 2 seconds. Each of the Remote unit changes this number to 0 and starts a local 6 second count down timer. Within 2 seconds, the Remote units should see this number change back to 1 and the local timer should again start counting down to from 6 to 0.   If the local timer reaches zero, this indicator turns Red indicating lost communications. As long as the local timer is not zero, the indicator shows Green, indicating good communications.

In Control
This LED/GUI Indicator monitors which of the three Remote units has control of the Estop through the Central unit. Control is selected through the GUI on the Central system, discussed later under Central unit topic. Only one Remote unit can have control. When control is granted, this particular LED/monitor turns Green. The LED/monitor turns Red on the other 2 units. The Central unit will only respond to the Estop pressed on the Remote unit that is in control. The Estops on the other Remote units will be ignored.

Estop System Active
This LED/GUI Indicator displays the state of the system, Active or Inactive. Active shows Green, Inactive show Red. This state is selected through the GUI on the Central system, discussed later under Central unit topic. When the state is inactive, the System will not respond to a Remote unit's Estop

System EStop Asserted/Detected
This LED/GUI Indicator displays the state of the HET Estop system. It monitors a set of contacts that indicates an HET wide Estop. This indicator will show Red if it activated by an Estop button at the HET or by one of the Remote units. This indicator will show Green if there is no Estop asserted at the HET. This indicator is independent of the state of the local pushbutton on the Remote unit.

Remote Unit Indicators, Diagnostics

Assert Estop
This GUI Indicator is only located on the Remote unit GUI at the assigned IP address. It indicates the state of the local pushbutton, independent of the state of the HET wide Estop status.

Timer 1
This GUI Indicator shows the state of the 6 second timer used in the communications monitor to the Central unit. If this display is static and the Communications indicator is Red, it indicates a communications problem. It is possible that this problem can be resolved through software, discussed later in a Central unit topic.

Enclosure Temperature
This GUI Indicator shows the internal temperature of the Remote unit via an internal 1-wire sensor.

EMO Button

This Estop pushbutton on the bottom right of the Remote unit should be pressed to assert an Estop. When pushed, the button will be physically latched in the asserted state, that, is in the down position. To de-assert an Estop, this button should be rotated clockwise, at which time, the button will unlatch and pop back to the up position.

Central Unit

The Central unit consists of 3 status LEDs and 1 Run/Stop toggle switch (shown if Figure 3 below). These LEDs indicated: 1) active communications to whichever Remote unit is in control, 2) operational status of the System and 3) the presence of an HET Estop. The Run/Stop toggle switch is defaulted to Run mode but can be moved to Test mode to check System operations.
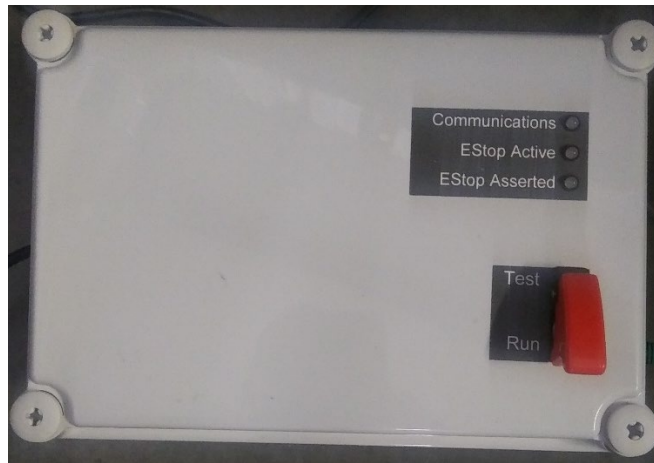

Figure 3. Photograph of the Central unit, showing 3 indicator LEDs, 1 toggle switch.

A PLC within this Central enclosure controls the state of the LED indicators, reacts to the state of the Run/Test button, monitors the state of HET's Estop system and asserts an Estop to HET's Estop system if the conditions warrant it. It also provides a web server through which the PLC can be programmed and configured to monitor the inputs, outputs and communications. In the GUI Controls section, this program provides push button controls. In the GUI Monitor section, it provides indicators designed to mirror the physical interface of the Remote unit. A separate GUI Diagnostics section shows variables used for troubleshooting. Access to this information is available through a web browser that is pointed to the fixed IP address assigned to this Central unit.
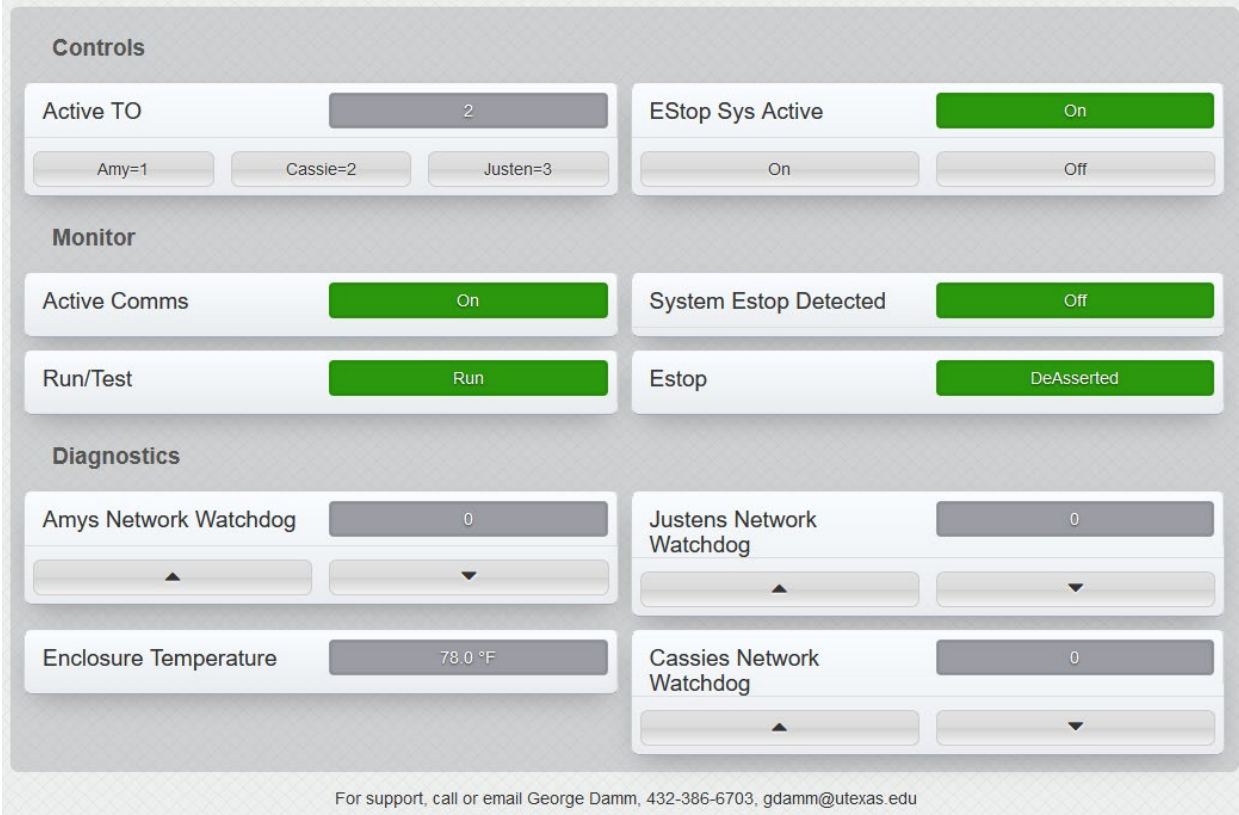
Figure 4. Screen capture of the Central unit GUI

Central Unit Indicators, Controls

Active TO
This GUI Push Button/Indicator allows anyone logged into the Central unit to change the Active TO. By selecting a Number/TO, control of the system is passed to the particular TO.

Estop Sys Active
This LED/GUI Push Button allow the user to turn the System On or Off. The indicator associated with this button will show Red when off and Green when on. These colors mirror the LED color on the front of the Central unit.

Central Unit Indicators, Monitor

Active Comm/Communications
This LED/GUI Indicator shows when the selected TO has communications with the Central unit. It ignores any communications problem with the other 2 TOs not selected. Green indicated communications, Red indicates no communications.

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System Estop Detected/Estop Asserted
This LED/GUI Indicator shows when an HET Estop at has been detected. This is sensed independent of this System as it monitors an Estop contact in HET Estop system. Any Estop, be it from this System or any other input at HET, will be detected and displayed. Green indicates no Estop detected, Red indicates that an Estop has been detected. When an Estop has been detected, this will also be indicated on all of the Remote unit LEDs and GUIs., regardless of which one has control

Run/Test
This GUI Indicator monitors the state of the Run/Test toggle switch on the Control unit enclosure. Details of its operation will be described below.

Estop
This GUI Indicator monitors the state of the EMO pushbutton on the Remote unit that is selected for control. It ignores the other two Remote units. It does not indicate that an HET Estop has occurred, only that the System has requested an HET Estop. Positive indication that an Estop has occurred is obtain from monitoring the System Estop Detected indicator above.

Central Unit Indicators, Diagnostics

Amy(or Justen or Cassie) Network Watchdog
This register show the variable in the Remote units that is toggled by the Central unit every 2 seconds. There have been occasions in the past where this variable has spontaneously stopped changing. This is unusual since this variable is set to constantly toggle, as long as the PLC is running. The Remote units see this as a loss of communications. This will typically occur on only one of the remote units and not affect the others. If there is a loss of communications and this number is not toggling, then the up/down arrows should be pressed to change the 0 or 1 value shown. When this is changed, the 2 second timers start working again. Xytronics has been notified of this problem and we are told to expect a fix in the next firmware upgrade within a year.

Enclosure Temperature
This GUI display shows the internal temperature of the Central unit via an internal 1-wire sensor.

Central Unit, Toggle Switch

The Run/Test toggle switch is located in the bottom right corner of the Central unit enclosure. For normal operations, this switch should be in the default Run position. When placed in the Test position, the System is configured to test the Estop functionality without tripping the HET Estop system. In the test position, the switch 1) shorts the HET Estop system line to prevent inadvertent HET Estops (from the System only) and 2) bypasses the detection of an Estop on the HET Estop system and instead routes the System assertion of an Estop to the detection of an HET Estop. For this reason, this switch should not be left in the Test position. If it is, it will appear that the Estop is working at both the Central and the Remote units when it actually is not. The Run/Test indicator on the Central Unit GUI will alert the operator when the switch is in the Test mode.