ECT 663: Electronic Control Systems Design
Laboratory Exercise #3
PLC Sequential Control and HMI Parameter operations

Name: _____ Due date: April 27th, 2023

SIGNOFF:	NOTES:
PAC Project Operates as expected	_____
Emulator operation correct	_____
HMI works as expected	_____
Code Commented & tag database	_____

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Objective: A. Design a sequential control operation using Sequencer output commands and data arrays; B. Develop a HMI control system for the operation using parameter files, animations, & security logins.

Programming Assignment: Traffic Control Lights

A University Campus Police Department is responsible for traffic flow on campus during normal semester operations and special events (Graduation, sporting events, etc). The University has three traffic lights at cross street intersections. The intersections are at: (1) Oak St. & Main St.; (2) Washington St. & Lincoln Blvd.; & (3) Veterans Ave. & Old Bridgetown Rd. There are two categories (User groups) of employees (a) Supervisor Officers and Police Officers and (b) Office staff and student workers.

The normal daytime operation (6:01AM to 9:59PM) is equal amounts of Red, Green, & Yellow over a one minute total cycle (the entire pattern for traffic flow in both direction repeats every 60 seconds). The yellow caution time before a change to Red is 4 seconds. At each change of traffic flow direction there is a two second red overlap (both Red lights are on for two seconds at each change to ensure traffic has cleared the intersection). Each direction N/S & E/W have the same amount of Green time per one minute cycle for each traffic light. Normal operation between the hours of 10PM and 6AM all lights act as Stop signs, flashing Red in both directions in ~1.0s intervals.

The operation of the traffic lights can be monitored in real time by Campus Police from a central control screen. Student worker or office staff can log in through a program security password to see, but not change, the operation of each light in both directions (what mode of operation – normal day, normal night, or a special mode is the light at that intersection in; and the current status— what is the current state i.e. Red, Green, or Yellow, of each light) for each intersection by name. Supervisors & Officers can log in through their security password, observe the operation, AND change the mode to a special setting if needed of each individual light.
The controls to set the special modes would not appear if logged in as an office staff or a student worker

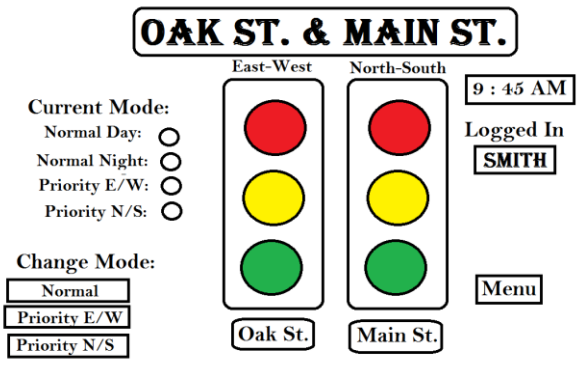
Each light can be individually set to one of three special modes (a) flash Red in both directions, (b) flash red N/S & flash yellow E/W; or (c) flash red E/W & flash yellow N/S to move traffic as needed for special events or emergencies. The special modes always override normal day or night modes when activated. Each light can only be in one special mode at a time. The operation can be returned to normal at any time from the HMI.

As the monitoring & operation of each light is essentially the same the HMI will utilize parameter files to use the same display for each of the three lights but by use of a parameter file

different tags will be transferred to the display reflecting which of the three traffic lights is being controlled. The operation can be returned to normal at any time from the HMI.

Program Specifications:

- Each of the three traffic lights operates from its own IO module in the PAC (you need to configure three modules for the Emulator chassis one for each light).
- Each of the traffic lights operate from their own subroutine called from the main-routine.
- The changing of the lights (G-Y-R) in normal daytime operation must be accomplished by use of sequencer commands and data arrays.
- The traffic light control is navigated to in the HMI from buttons in the Main display. The Main display also has the login, logout, and shutdown controls. The traffic light display will show the name of the intersection in a separate string box.
- The same HMI display is used for all three lights, parameter files are used access data and tags for each individual light. So there are two only displays: main and light control. Each time you navigate to a light, regardless of which one, you are actually looking at the same display. Parameters are variables you add to put a different set of tags to a common graphic.
- The HMI control display needs animated indicators for the traffic lights in normal run Red-Green-Yellow for N/S & E/W. The display needs control PBs to change the mode, and a clear indication of what mode the light is currently in. Each mode button should clearly indicate to the operator what it does.
- Create a "Splash screen" which only runs when the program (for about 10 seconds or so) is first started that identifies the program and has your information. After the time out the introductory screen will automatically go to the main display for login & menu options.
- The Main display should have a nice wall paper background, something a campus police dept would use to make it look professional. The main display should show the date/time, and have the navigation buttons to the actual displays for each light.
- Remember that in normal mode all the lights change to flashing red at 10PM and back to normal at 6AM. There are several ways of doing this.
- There are two levels of HMI security, staff (student workers) can only log in and see the operation of the lights & what mode they are in, they cannot change anything. Supervisors (campus police officers and regular staff) can log in and change the mode of operation, the mode change buttons only appear if a supervisor is logged in. Assign at least three individuals to each security group with passwords.
- If no one is logged in (Default) only the main display with the login screen can be seen. Once an individual is logged in a string display shows the name of the user on both available display screens.



This is a sample of what your parameter page might look like. You don't have to match it exactly. So you have control buttons to change mode (but only if supervisor or officer), indicators for current mode. Identify the intersection by name, The streets as the E/W & N/S. Who is logged in, what time it is, and have a goto link to the login page. Show which light (R-Y-G) is LIT on each light. You should also have an appropriate background to make it look professional.

How do I do this?

You should know from the last lab(s) most of what you need, security, color change graphics, etc. have been covered. Again, for sources beyond the manuals I gave you on BB you can use tutorials from Bryce Automation and there are a number videos from YouTube. Here are a few starters, you can probably find others if you search further.

How do I get the time of day and know if it is day or night?
http://bryceautomation.com/index.php/2017/06/03/controllogix-gsv-command-wallclocktime/

How do I Set up a parameter file in FTV?
http://bryceautomation.com/index.php/2017/10/31/factorytalk-view-parameters/

How do I make a FTV graphic object go 'invisible?' based on Login?
http://bryceautomation.com/index.php/2017/11/02/hiding-objects-logged/

How do I make a sequencer file in Studio5000?
https://bryceautomation.com/index.php/2021/08/19/controllogix-sequencer-instructions/

How do make a "splash" or start-up screen that runs on HMI start up?
There are two methods available, one in the PLC, and one in the HMI.
PLC Controlled → https://theautomationblog.com/view-studio-start-up-splash-screen-plc-controlled/
HMI Macro Controlled → https://lkjcontrols.blogspot.com/2018/01/factrytalk-view-me-start-up-splash.html

You can look at both, they are similar in how they work, the PLC uses tags, and the HMI uses macros. The PLC version is easier to implement in my opinion. I think there are video versions of these on YouTube but the written guide shows it pretty clearly step by step.

Most anything else is available on the Bryce Automation site for Studio5k and FTV.