HMI design


BÜHLER
Test - Running
Modules
Product Feed (%)
Rejections (min)
Sort Sensitivity (%)
Tertiary
Secondary
Primary
Front
Rear
Menu
Home
Help
Fault
Start

HMI design

- Human machine interfaces (HMIs), enable the operators for complicated machineries to see, touch and control high stress industrial processes through touch screen displays.

- As HMI systems are turning to be the principal point of interaction between the user and the machine/process in automation industry, a good HMI display makes this interaction flawless and smooth.

- In the process industry, high performance HMI display design focuses on providing maximum amount of effective information related with a machine/process.

HMI design

- Well-designed HMIs result to visually better system understanding and easy troubleshooting for the operators.

- Graphical hierarchy in multiple page display, proper system alarm status etc, are critical for designing a operator friendly and efficient HMI.

Design Methods for Efficient HMI Displays

- While designing an HMI monitor with multiple visual displays, two major factors should always be taken under consideration

(1) the screen must be able to hold operator's attention with maximum display clarity.

(2) the design must allow a person with no training or little experience to be able to successfully operate a machine.

Design Methods for Efficient HMI Displays

- Generally, a human operator scans an HMI screen, as any other regular screens, starting from top left corner to right and then down the screen. So, the important objects of a system should be in an area within the page where the operator's attention goes easily. The alarms should be on the top of the page.

- Any graphical image object should be on the center left with key data on the center right of the page. It is recommended that start, stop or controls are kept in the lower left side and the navigation on the lower right side of the page. All objects should be highlighted with black outlines.

Design Methods for Efficient HMI Displays

- **Color Issues:**
  - Color is a very powerful tool for visual presentations. At the same time it can cause danger in operation if misused. Therefore, choosing the right color for the background, control buttons, alarms, text and other objects is very critical for good HMI design.

Design Methods for Efficient HMI Displays

Background Color

- Primary colors (red, green, blue) **should never be used** as background color in an HMI. Although black and white provide good color contrast but using these in background makes the screen look glare. Therefore, these are also not right choice as screen background.
- For an HMI display background, it is always recommended to use **pastel shades** such as light grey, light brown etc. These colors are easier to look and provide good contrast for the dark/ brighter colors (i.e. red, yellow, green, blue etc) used for other components in the display page.
- While incorporating multiple pages within one display, it is wise to use multiple shadows for each page so that the operators can visually identify different pages at a glance even from a distance..

Design Methods for Efficient HMI Displays

Display Colors for Objects

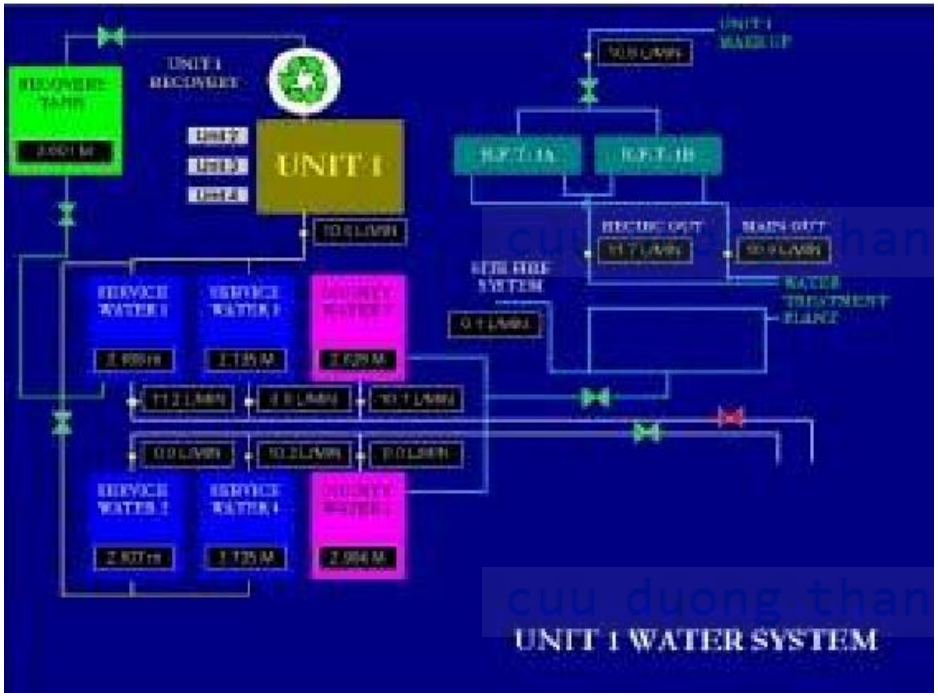
- According to SCADA/HMI Design Standard, there are few colors those specifically should be used for representing certain operations. They are:

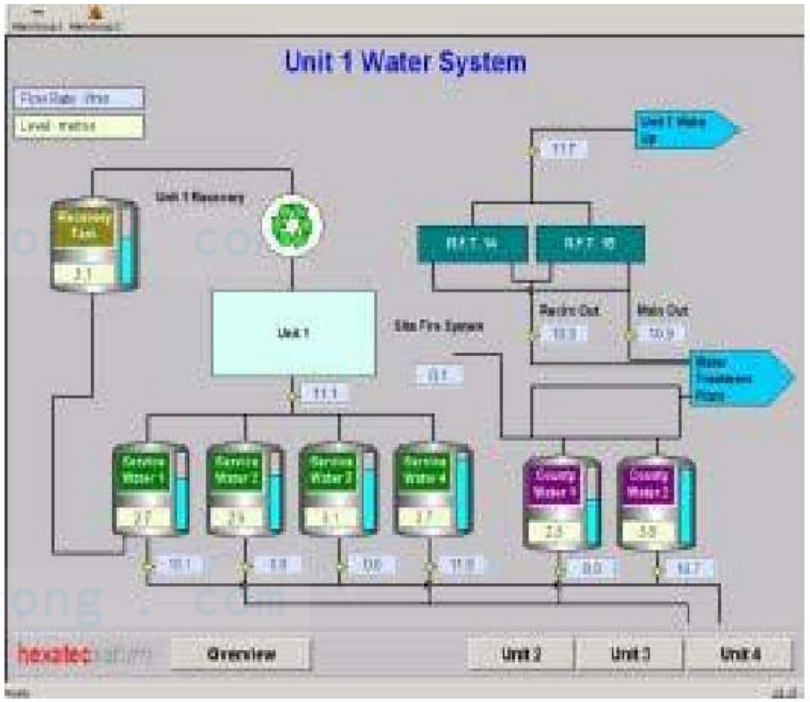
Red	⇨ Stop, Emergency or Prohibition
Green	⇨ Start or Safe Condition
Yellow	⇨ Warning
Blue	⇨ Mandatory Operation

- These colors should never be used for any other purpose because it can result to misinterpretation or confusion for the operator.
- Dark colors should not be used on screen in large blocks because they can create complementary color image retention on the retina.

Design Methods for Efficient HMI Displays

- **Display Colors for Objects**





Design Methods for Efficient HMI Displays

Graphics and Picture Issues

- An HMI graphics should look “boring” rather than “cute” and “fancy”. This means a good HMI graphics will never have big flashing animated lights, 3D vessels with bright colors, spinning pumps or moving conveyors.

- Putting an exact representation of P&ID or big bright measurement units are worse ideas while designing an HMI Screen.

- An HMI graphic should always have a gray background. There should be no animation and lots of crossing lines should be avoided, so that the operator does not get detracted from important dynamic data.

Design Methods for Efficient HMI Displays

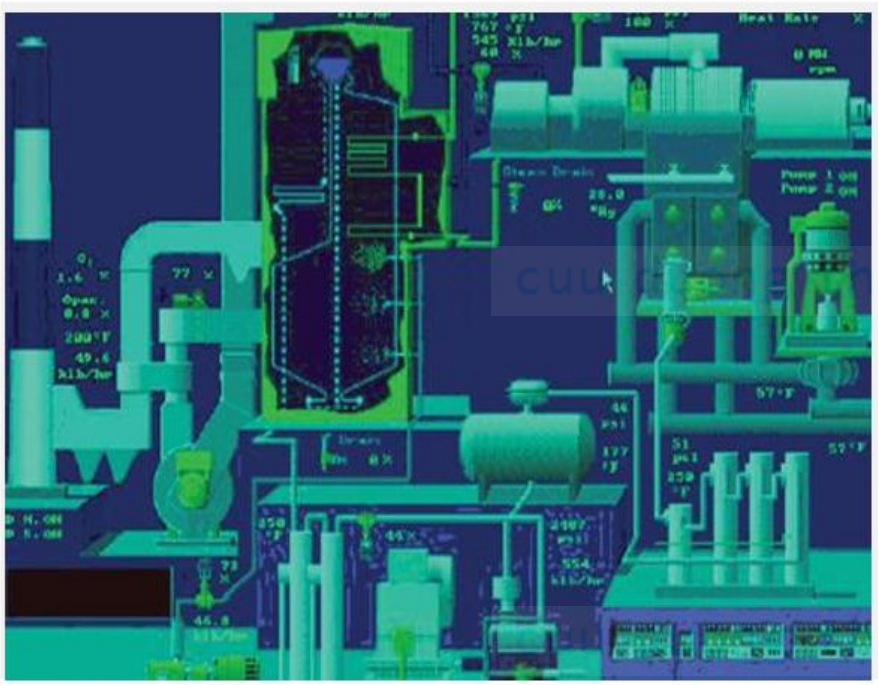
Graphics and Picture Issues

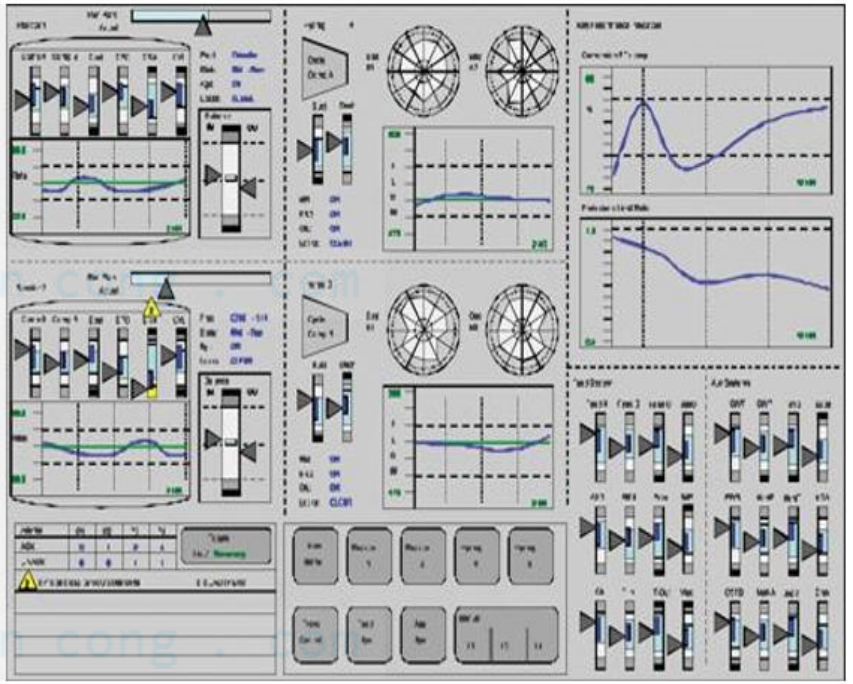
- Mostly while designing HMI, it is important to include a representation of the complete process flow in the HMI screen. This makes the operators to visualize the plant and identify the locations of the measurements.

- A good HMI should always have consistent black process flow direction and the use of color must be limited. An HMI graphics should always include trends so that the operator can easily follow the behavior of a plant and monitor possible excursions.

Design Methods for Efficient HMI Displays

- **Graphics and Picture Issues**





Design Methods for Efficient HMI Displays

Display Text

- Text in an HMI screen is the most versatile way to convey information to the operator.
- It is always wise to choose fonts which are commonly available in most of the computers, such as Arial, Times New Roman etc.
- The size of the text should be as such that the operator can read the key information from several feet away without any trouble and all the text should be black.
- The texts for the heading and labels should be larger than the texts used for buttons and alarms.

Design Methods for Efficient HMI Displays

Display Text

- Limited use of Upper-Case letters and underlines keep the operators from having eye strain.
- The heading of an HMI and the first letter of the labels should be in upper-case.
- All the rest of the texts should be in lower case letters. It is better to use underline for the heading.
- For labels and other texts on screen, sans-serif font is easier to read than serif.

Design Methods for Efficient HMI Displays

Presenting Data Values

- Proper representation of data values of the system is very important for the operator to be able to read and observe important system parameters.
- The data values should be grouped in areas of an HMI screen. Data values place around pictures are often hard to scan.
- If an operator needs to compare between data values then the respective data values should be placed in table next to each other on the screen.
- In case of multiple data values the units should be mentioned with proper labeling and the data values should be placed in proper order.

Design Methods for Efficient HMI Displays

Presenting Data Values

- It is always preferable to present data graphically. People often can understand and respond to data presented graphically much quicker than they can to data presented alpha-numerically.

- For example if an analog meter is used for representing some reading, it is much easier to visually get an idea of the value. This is significant to observe continuous changes of the readings.

- But when a user needs to know an exact value then numerical data is needed to be presented. It is always preferable to avoid unnecessary decimal places.

Design Methods for Efficient HMI Displays

Alarms and Event

- Alarm and event information are vital parts in HMI screen design because it enables the operator to identify system operations and avoid critical situation those may arise during a process.

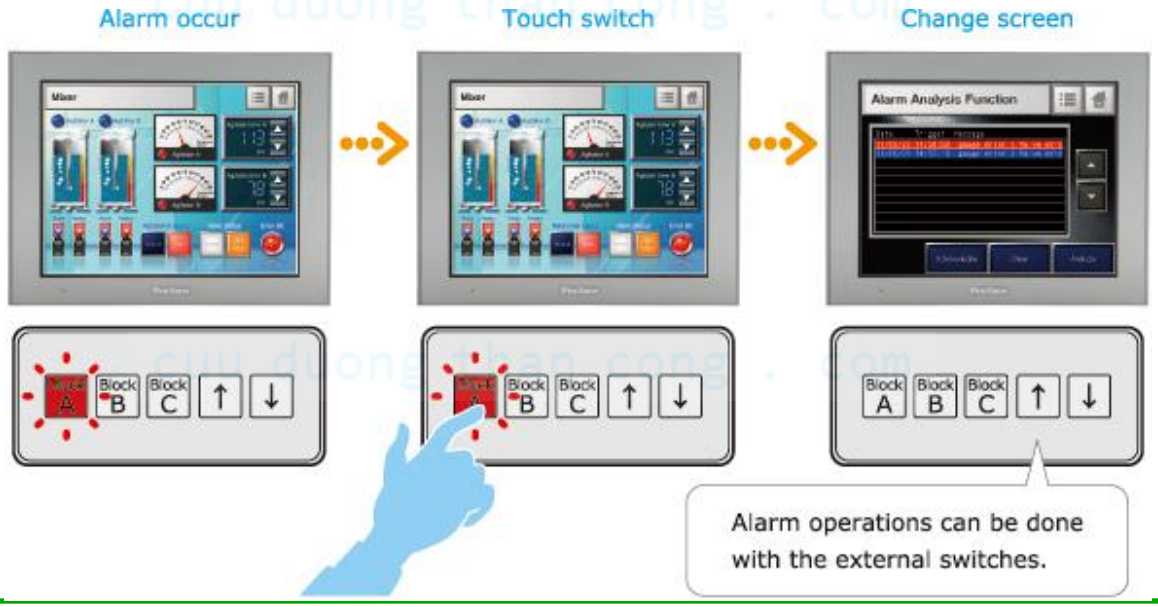
- Alarms consider changes in a process or in its control system (e.g. operator action, configuration changes etc) those need to be recorded. While designing an HMI touch-screen, alarms should consist of the following characteristics:

  1. Informative: No action required, e.g. Process stopped at 11.00 am.
  2. Warning: Process could "Stop" or could be "Damaged" if no corrective action is taken soon, e.g. Bottle is not oriented accordingly.
  3. Blocking: The controller takes an action against any risky condition to protect the process and further operation is prevented until the reason is cleared, e.g. "Cup Jam"

Design Methods for Efficient HMI Displays

Alarms and Event

- An event occurs whenever an operator reacts to alarms or makes any changes to the system.
- Alarms with different audio effects are often helpful for operators to quickly determine normal process conditions and when an error occurs that needs to be fixed.



Design Methods for Efficient HMI Displays

Navigation and Controls

- Operator of a process should be able to change between HMI pages quickly and easily. Proper navigation button is needed for this purpose.
- Generally, these buttons are put in the bottom right corners so that the operator can easily determine it.
- A good HMI should always have a page with entire system overview. This is important for making it easy for the operator to determine which page to be at for different segments of a large process.
- Navigation buttons must consist of “Next” and “Previous” functionalities.

Design Methods for Efficient HMI Displays

Navigation and Controls

- Control buttons can be used for controlling a machine through an HMI touch-screen.

- All the buttons should be labeled properly with enough large space to hit easily with fingers. Start, stop and mandatory operational button should be designed as SCADA color convention.

- All the Control Buttons should be grouped together on the bottom portion of an HMI touch screen. There should be pop-up windows containing “OK” and “Cancel” with each control button in order to avoid unwanted activation which may cause danger or injury.

Design Methods for Efficient HMI Displays

Page Hierarchy

- According to the present industrial standards, the first page of an HMI is an “Overview” screen. This shows the operation of a process at a given time. Then the next pages comprise of detailed information where the actual interactions with a process occur.

- Page hierarchy enables operator to move down from overview to details in a logical manner.

- An HMI graphics hierarchy can be expressed in several levels as following:

Design Methods for Efficient HMI Displays

Page Hierarchy

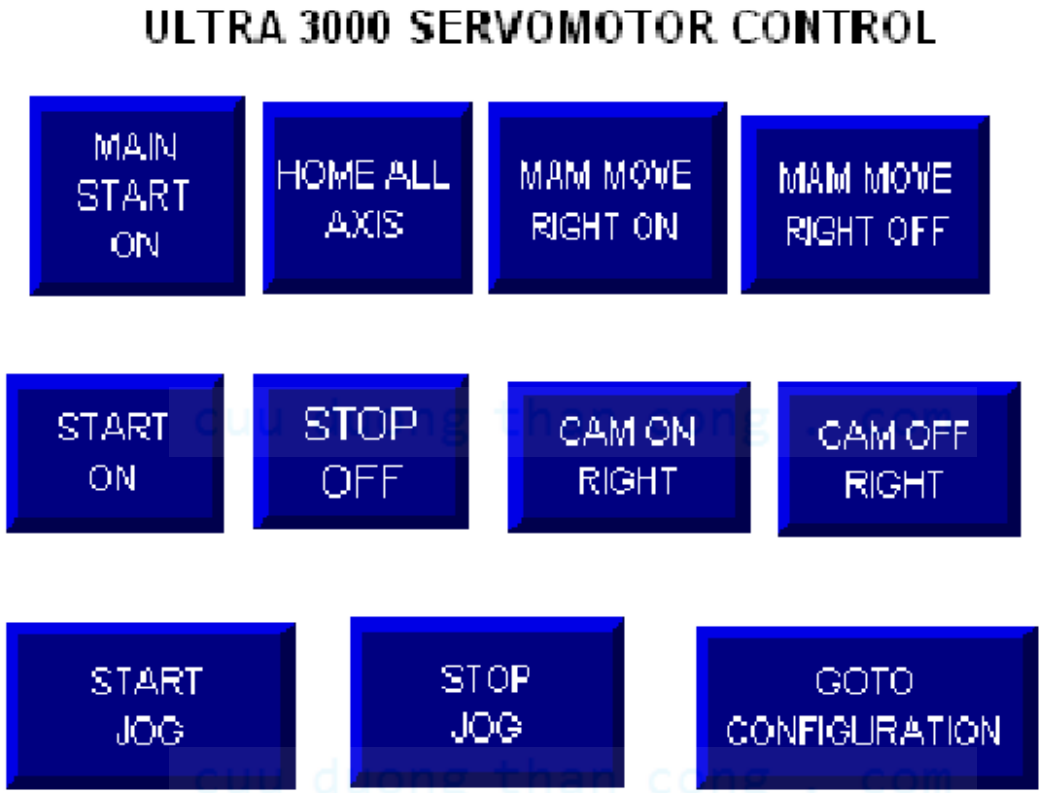
- Level 1: This page contains an overview that covers the entire process control. By seeing this page operators should be, at a glance, able to tell the overall operational condition of a process for which they are responsible.
- Level 2: This screen shows the sub-units of a large process. This screen should show all the information and controls necessary to perform task for each of the sub-units.
- Level 3: These pages show all the detail about each single piece of equipment or process control scheme. These screens are used for system diagnostic purposes.
- Level 4: This level shows details of subsystems, sensors or components and miscellaneous information.

Design Methods for Efficient HMI Displays

Operational Security

- While designing an HMI screen, security options should be taken under consideration.
- Security level functions are used in order to restrict user access depending on operator levels.
- Password protections restrict access to specific screens, such as management and maintenance screens. This helps to improve screen security which in turn ensures both machine and operator's safety

Design Methods for Efficient HMI Displays



Design Methods for Efficient HMI Displays

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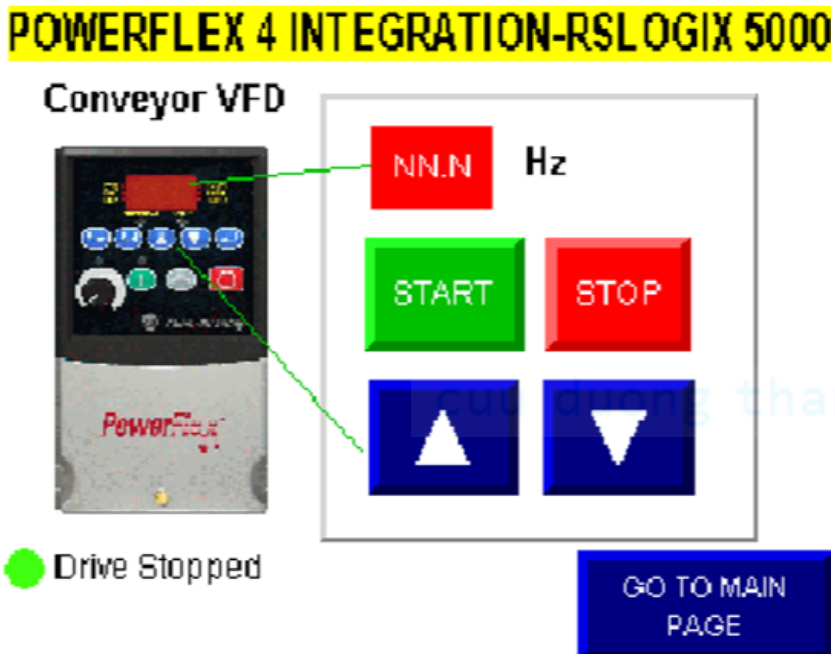

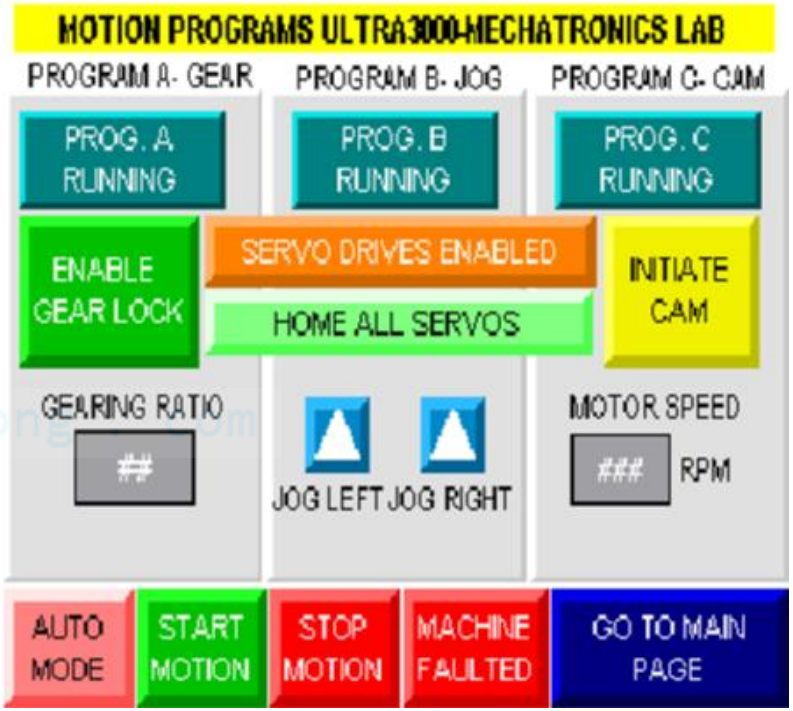

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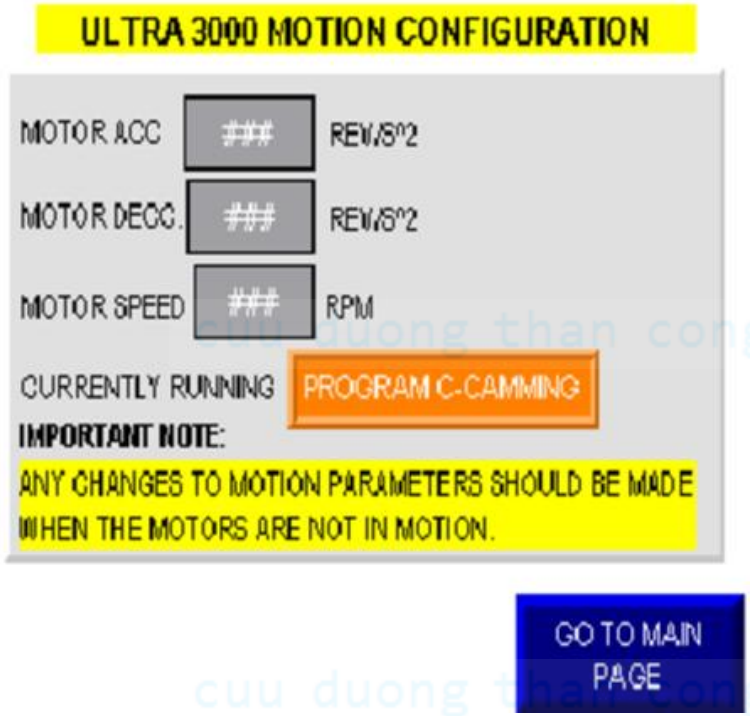

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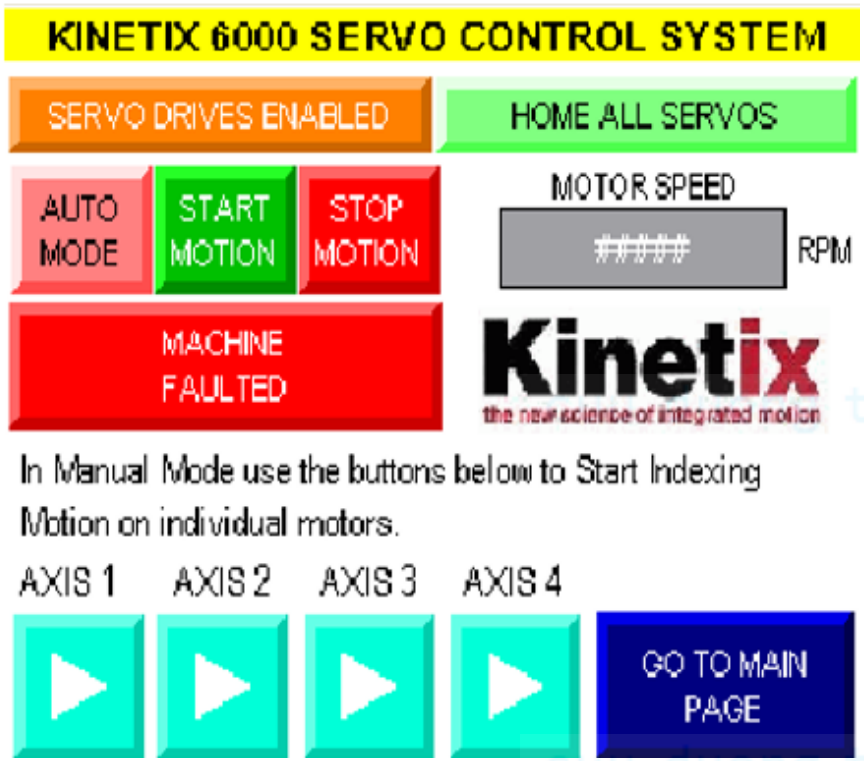

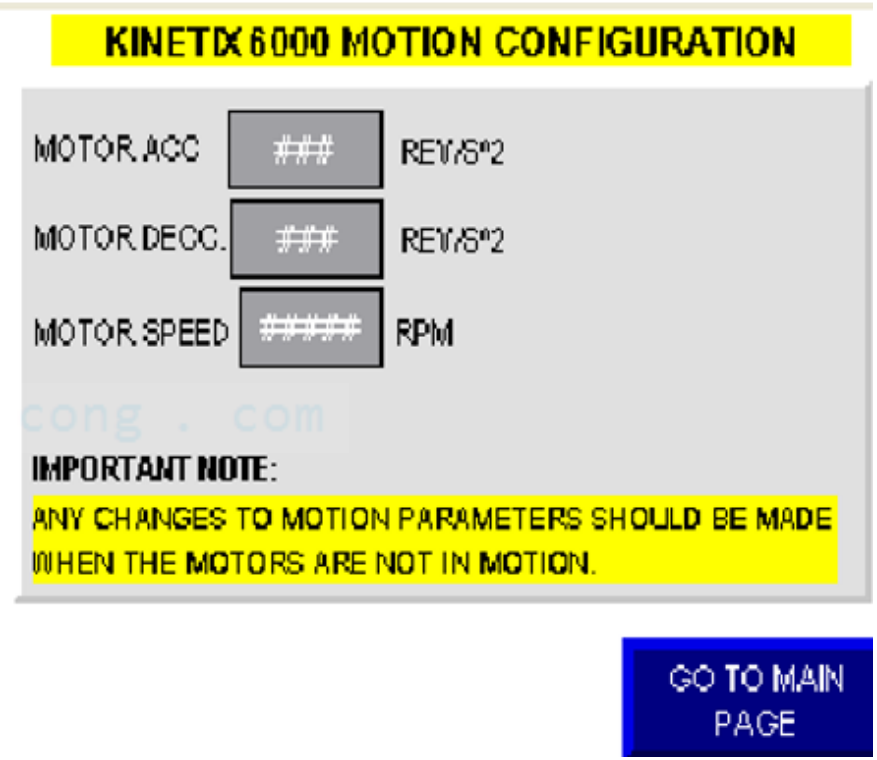

Design Methods for Efficient HMI Displays