WHITE PAPER

The Three Advancements in HMI Technology Changing Upstream Oil and Gas

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Abstract

Within the demanding and harsh environments commonplace on the rigger floor, Human to Machine Interface (HMI) technology has placed an emphasis on innovations with regard to resilience and environmental resistance over technological performance or processing capability. With this said, the recent push for safety and operational efficiencies has led to HMI technology becoming more capable, powerful, and portable around the rig environment, so much so that the term "HMI" is becoming antiquated in oil and gas operations. HMI's are now becoming synonymous with Industrial Panel Computers (IPCs), which are replacing the HMIs of the last two decades with the power of high-performance computing and advanced touch screen technology.

Introduction

The Oil and Gas industry is a vertical market that is heavily dependent on control, visibility, and operational intelligence. The ability for drilling and rig operators to not only control, but view their application in the field in real-time, has been a primary driver of continuous investment for years. Whether it's a network of wellheads subject to extreme temperatures and abrasion, or a remote oil rig in the middle of the North Sea, the use of onsite computers has always been a challenge. Due to the harsh environments commonplace within upstream oil, operational control and visibility has been relegated to central control rooms isolated from the immediate drilling site.

Due to the physical separation of control and site operations, upstream oil and gas applications have been at a disadvantage in comparison with other industrial operations in energy where advanced HMI and IPC technology can be more easily deployed and used by floor operation teams. This has been due to the lack of availability of highly portable, powerful, and industrialized HMI solutions that can offer processing power along with the industrial functionality required on the rig platform floor. However, that limitation is now changing, and is driving down the operational costs and risks of upstream oil operations. With advances in industrialized HMI and the IPC sector, the power of the control room switch house is now at the fingertips of the Rig Managers Driller and Derrickhand.

The convergence of the HMI and IPC is bringing increased operational control and data processing capabilities to the rig floor thanks to innovative leaps in three dominant technologies. These technologies include industrialized capacitive screen interface technology, robust industrial design, and powerful server performance. Moxa has been a leading provider

Released on October 1, 2015

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in IPC innovation and has enabled oil and gas companies to do more with less by leading the oil and gas industry in the direction of increased field-level control by integrating high-power computing technology with the industrial design required in the oil and gas environment.

1. Industrial HMI Interface

The idea of HMI usability is a broad concept that encompasses both screen visibility and user experience (UX). Historically, truly industrialized HMI interface usability has been challenged by the extreme temperatures and abrasive elements that are expected in industrial applications; especially upstream oil and gas. Touch screens have been extremely limited in their functionality and visibility due to the fact that for a number of years only resistive touch screen technologies were able to cope with UL Class 1, Division 2-rated environments. The use of resistive touch interface technologies has reduced the ability of oil and gas companies to deploy advanced HMI and computing technologies near oil rig applications simply because they were impractical. Most of the time, HMIs provided very poor visibility in direct sunlight and lack of "multi-touch" command technology made using them arduous and counter-productive. However, unprecedented advancements in the HMI interface technology have begun to redefine the capabilities of the HMI in upstream oil and gas applications. Prior to making an investment decision in HMI or IPC technology, it is important to understand what these advancements are and how they can redefine the upstream oil and gas process to be more efficient and safer.

Resistive and Capacitive Interface Technology

Resistive touch is the common technology used in IPCs and industrial HMIs because of the more durable screen material that this technology can provide over capacitive touch screen technologies. Additionally, resistive interfaces can be operated just as the name suggests—by resistance. In short, resistive interface technology allows oil and gas HMIs to be used while wearing gloves, which is very important to upstream oil and gas drilling applications. However, this has also been a limiting factor in the development of mobile computing in upstream oil and gas.

The limitations of resistive touch have long been its inability to allow for multi-touch use, meaning that the user must operate the HMI with only a single finger or stylus. The dexterous limitations of resistive touch technology have held back the proliferation and mass use of advanced HMIs and IPCs in upstream oil and gas simply because the practical use of better technology is limited by the harsh environments of standard drilling applications. Drilling operators lack the ability to use the standard HMI in an expedient and natural manner because of the limitations inherent in resistive touch interfaces. While advancements in portable computing as a whole have revolutionized nearly every industrial field, the oil and gas industry has been forced to use decades-old resistive touch technology due to legitimate environmental constraints.

Capacitive touch technology is a more sensitive alternative to using a resistive interface. Capacitive interface technology allows the user to utilize multi-touch functionality, providing for a more intuitive navigation process, rapid typing ability, and overall better UX. The operation of a capacitive touch screen is more dexterous and suitable for SCADA control. However, such technology has typically required using a bare hand, special gloves, or stylus, to function because this technology relies on the electrical properties of the human body to detect when and where the user is touching the screen. Ironically, capacitive technology is something that the average consumer is likely more familiar with due to the massive adoption of tablet computers and smart phones. Capacitive touch interfaces, while highly accurate and usable in normal settings, have not been suitable for industrial environments. Capacitive screens are often highly brittle, prone to abrasion, and dependent on direct human touch, meaning that moisture, debris, and the standard rigger's glove render the standard capacitive touch screen useless in an industrial environment. Due to these limitations, the oil and gas industry has been limited in its access to capacitive touch HMI technology—until now that is.

Industrial Capacitive Interface

Industrial capacitive touch is the new gold standard for UL Class 1, Division 2 HMI technology. This technology has allowed a handful of leading HMI manufacturers to offer the oil and gas industry ready-access to the computing technology of the enterprise, with industrial reliability. Moxa's new EXPC-1519 exemplifies the industry's best-in-class attributes when it comes to industrial reliability, functionality, and usability of this technology. Of these attributes, a highlight is the innovative approach to multi-touch capacitive interface technology that allows the panel to be operated with the dexterity of a consumer tablet computer while wearing a rigger's glove. This innovation is a huge step forward when it comes to touch screen technology. From a functional perspective, this means that rig managers are now able to query reports or operate SCADA control dashboards just as they would on a natural keyboard. This amazing advancement allows for up to four simultaneous points of contact, or in other words, the use of four fingers at a time. Additionally, the screen visibility that one may be accustomed to on a consumer tablet computer is realizable with the new industrial capacitive interface technology. Since capacitive touch screen technology requires no polyester film and air gap spacers between the screen surface and the LED screen housing, visualization in dark and sunny environments is much clearer. The industry best practice of a 700+ nit rating (the industry standard rating scale for brightness) preserves its brilliance even in direct sunlight.

Thanks to industrial capacitive interface technology, rig operators no longer have to remove themselves from the point of operation to access an advanced control system. By bringing capacitive touch interface technology to the upstream oil environment, rig operators now have the ability to bring the advanced insights and SCADA control system directly to the area of significance where operational decision making is imperative.

2. Industrial Design

In the world of technology, processing speed and features can often distract manufacturers from sound and resilient form factor design. At its core, design is the foundation of a great product. For HMI and IPC design, this is no different. Considerations must be placed on unit resiliency and serviceability before an HMI's features can be deemed useful for a control application. Any modern HMI and IPC should be operable in a -40 to 70°C temperature range and carry all required industrial certifications, including Class 1 Division 2, ATEX Zone 2, IECEx, and totally sealed NEMA 4X/IP66. These rigorous standards are achieved not by software or firmware advancements, but by lengthy product design and testing. Only a few industrial automation vendors have led the development of truly robust and reliable advanced HMIs over the last five years. Their ability to meet the industry's stringent demands relies on resiliency. When evaluating HMI and IPC resiliency, a product's modular construction and thermodynamic performance are key indicators of that product's ability to last and perform.

HMI Modularity

A key best practice in IPC and Industrial HMI design is robust, industry-certified Ex and UL Class 1, division 2, modular construction. Fewer assembly parts equates to faster, cheaper, and easier asset repair and service. Most high-end IPCs have a backplane, front plane, and motherboard, with the option for an external cable gland for normal I/O, Cable, Zone 2, and dual AC/DC power supply connectivity. True modularity enables out-of-the-box functionality, with the ability for customers to stock replacement parts for quick onsite procurement. Modular construction further empowers the ease and speed at which the unit can be serviced in remote locations, which is imperative in most upstream oil and gas environments.

Additionally, attention to power supply modularity must be evaluated. Advanced HMIs or IPCs should provide dual AC/DC power, with optional WLAN, 100M fiber optic connections. The HMI or IPC must be designed to meet a wide array of connectivity demands and carry standard connectors with cable glands, terminal block with cable glands, and hazardous area connectors. This design approach allows the unit to integrate reliably and redundantly with a medley of network infrastructure requirements.

Thermodynamic Construction

Intelligent temperature regulation and management within the industrial technology sector has long been characterized by a unit's energy consumption rate and whether or not the unit requires a fan, or internal heating mechanism, to regulate the core temperature. Today, HMI and IPC construction have reached an unprecedented level of thermodynamic design and CPU performance so that internal cooling fans, or intelligent heating systems, are not required to operate in a -40 to 70°C temperature range. When considering a provider of industrial HMI and IPC products, paying attention to the number of internal systems required to support the unit's operational temperature spread is a strong indication of that product's resiliency and reliability over the product's lifetime.

Modern, leading providers of industrial HMI and IPC technology will place an emphasis on intelligent thermodynamic design in an effort to evenly disperse internal heat energy throughout the chassis, while retaining operational functionality in extreme sub-zero temperatures without a heating mechanism. Asking for hot and cold temperature stress-test results for the product of interest can provide valuable information on an industrial HMI and IPC product's points of failure. In upstream oil, rig operations are often located in some of the world's most remote locations and extreme temperatures. An HMI or IPC design that operates under warranty in -40 to 70°C temperatures without internal cooling or heating mechanisms is a product that is ideally suited for the upstream oil and gas vertical market.

3. Processor Performance

Many industrial HMI providers servicing the upstream oil and gas market tend to offer one of two options: high industrial utility with low functionality, or high functionality with low industrial utility. The topic of "cost" has typically been of secondary importance. This binary tradeoff between computing performance and industrial reliability has been a serious impediment to the use and benefit of mobile computing technology in upstream oil and gas operations. As a result, the oil and gas industry has been subject to rising operational costs for the last 20 years, with little ability to capitalize on the many benefits that advanced HMI and IPC technology would otherwise be able to provide in improved operational efficiencies. For example, the EIA's (Energy Information Administration) 2009 report shows the production cost of crude oil was at an estimated $12 per barrel for the United States and less than $10 per barrel for the Middle East. However, recent estimates place the cost range between $20 and $25 per barrel, further straining the industry amidst historically low oil prices. Massive HMI integration at the field level is as important as it has ever been within the industry.

Today, leading manufacturers of advanced industrial HMI and IPC products should not make the consumer choose between immediate function and reliability. As a movement toward Cloud-SCADA systems enable oil and gas companies to rapidly and inexpensively deploy and support customized SCADA systems across various upstream networks, the utility of advanced HMIs and IPCs will only rise for oil and gas companies looking to cut costs with real-time data processing and decision making. Industrial HMIs should be able to support central SCADA systems as an extension of the control room. Selecting an HMI with the internal processing speed to grow with your SCADA platform will be a key consideration.

A modern HMI or IPC should include a powerful processor that is capable of supporting the influx of data from a growing network of sensors. For example, the Moxa EXPC-1519 IPC comes with a high performance Intel® 3rd generation Core™ i7-3555LE or Celeron 1047UE CPU and up to 2.5 GHz processor so that customers can bring the control and insights of the control room to the drilling rig operation. Being able to bring intelligent, real-time decision making capabilities to the rig floor has huge implications in the reduction of operational risk, required labor force, and drilling efficiency.

Summary

The definition of HMI for upstream oil applications is evolving due to the way various aspects of the control room are broken down. The three key advancements in industrial HMI technology—capacitive touch interface, industrial design, and simple processing performance—make it clear that benefits to empower upstream oil and gas are numerous. With this said, selecting the right HMI and IPC features can have a monumental effect on the resilience and operational benefits of your operation.

Consider the following points prior to making any HMI or IPC integration in your upstream application:

1. What are my regulatory or certification obligations? (e.g., Class 1 Division 2, ATEX Zone 2, IECEx, and totally sealed NEMA 4X/IP66)
2. Does the system support my SCADA system? (Is the processor powerful enough to support a scaled system should we decide to expand?)
3. What are my temperature requirements? (-40 to 70°C.)
4. How does the system regulate temperature internally? (How many points of failure exist?)
5. Does the system need to boot up in extreme low temperatures?
6. What touch interface is required? (Do I require multi-touch functionality?)
7. What kinds of connectivity method do you use? (Cable gland or standard I/O.)