A Survey on Different Applications of Hi-Tech Human Machine Interface

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Abstract--- Today, in the 21st century, progressively more, computing and communication-based technologies are being implemented for various applications and the complexity of the user-machine interface inceases day by day. The consumers are more sophisticated and expecting more content in the machines with higher levels of quality. They demand features those are smarter, better crafted and easier to use. They expect their machine to be safe. The problem addressed in this system is, therefore, how to find a holistic Human Machine Interface (HMI), which gives the operator a clear overview and good understanding of the active safety machine systems. To satisfy more demanding customers, system personalization also needs to be considered as well as its interactivity and flexibility. Further, we need to find out which demand are there for HMI in machine system, to be able to implement the design for safe interaction and usability in industry. To understasnd users behaviours and their relation with machine systems, analysiz of various systems based on HMI is done by us. The conclusions of our study is summarized in statements describing how an integrated and flexible HMI, for active safety systems, together with an intuitive interaction could be designed to meet the consumers and the markets increasing demands of today.

Keywords: Human machine interface,safety control system,models

I. INTRODUCTION

Human–machine interaction comprises all aspects of interaction and communication between human users and their machine via a human–machine interface. This human interaction with the machine, i.e., with an industrial plant or any other dynamic technical system, has nowadays been recognized as being essential for process safety, quality, and efficiency. The whole system of human users, the human–machine interface (HMI), and the machine is the so-called human–machine system (HMS). Different engineers, maintenance personnel and managers. The term “machine” relates to many diverse application domains. It indicates any kind of dynamic technical system (or real-time application), including its automation and decision support equipment and software. The automation components of the technical system are denoted as supervision and control systems. They interact directly with the pure technical (production) process. Examples of such processes are a power generation process, a chemical or a discrete-parts production process, an aircraft, a manipulator, a medical measurement system for human life functions, or a real-time software application. The decision support systems are more advanced, knowledge-based functionalities of the machine which provide advice for the human users, e.g., in fault diagnosis Tasks.

All displays in HMIs for supervision and control of dynamic technical processes and systems have to consider the very stringent real-time aspect. This means that appropriate dynamic display elements have continually to vary in their attributes in order to indicate the changes of a large number of dynamic process variables as well as the changes of component and system states under normal and failure conditions. Thereby, provisions are made for enabling the human users to successfully accomplish their supervisory control tasks based on the displayed information.

II. MODELING OF HUMAN MACHINE INTERFACE (HMI)

The concept of Human-Machine Interface has been defined in several ways, depending on which discipline is considered. The first domain that used this expression was electronics. In this context, "interface" means physical devices allowing energy and information exchange between systems. In the sixties, when Human-Computer Interaction science was coming up, interface meaning was extended by analogy to physical interaction between humans and machines. Thereby "interface" began to be used to indicate also systems' devices laying a bridge towards users in order to allow information exchange in two directions, that is input and output devices like dashboards, levers, pedals, keys.

In general, there are three principle approaches to deal with the concept of interface, namely Communication Model, Instrumental Model and Models Construction Model. [9]

A. Communication Model:

The most common interpretation of interface concept is that named Communication Model, the interaction between human and machine is like a communication relationship. Human and machine have a kind of dialog in which the system's interface acts as mediator. As a matter of fact it receives information coming from the user addressed to the system (input) and shows information coming from the system addressed to the user (output).

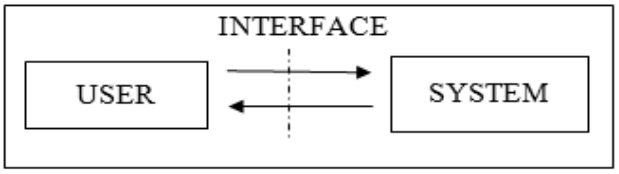

Fig 1: Communication model[9]

B. Instrumental Model:

A second perspective is known as Instrumental Model in that machine is considered just as an instrument to carry out

some tasks. According to this model the interface should be designed like an efficient extension of user's body, so that the user could "grasp" the instrument in order to reach the objectives. The best interface is the invisible one, the interface should "disappear" to allow the user to concentrate attention only on the task. [9]

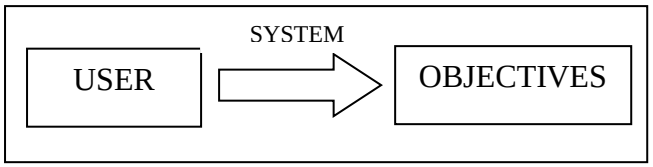

Fig 2: Instrumental Model [9]

C. Construction Model:

The user constructs such model on the basis only of the system's appearance and components and by observing the system reactions to actions. Supporters of this 1 that most of user errors derive from a wrong mental model, there by from design errors. Designers can guide the user to understand how a system works by means of two kinds of features, namely affordances and constraints. Affordances suggest object's use possibilities, while constraints limit them. For example, a button suggests the action of pushing it, while a hinge prevents from separating two parts of an object. A strategic distribution of affordances and constraints guides the user to correctly use an object, even in a new situation. [9]

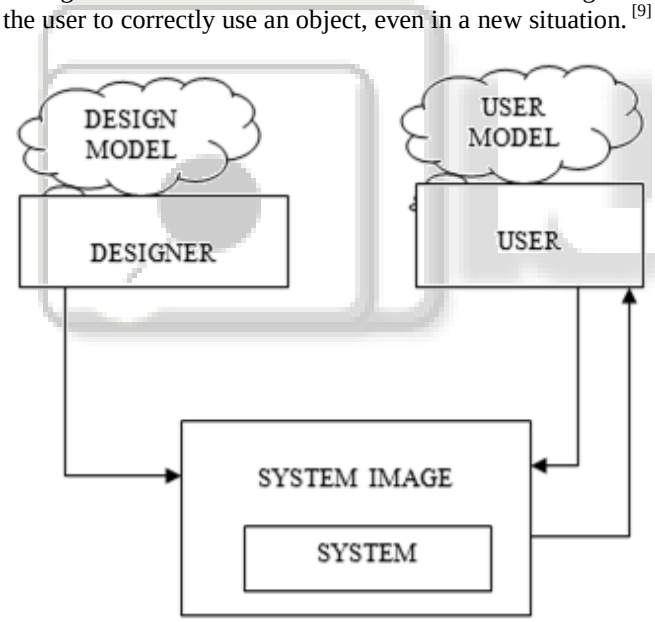

Fig 3: Construction Model [9]

III. GENERAL PRINCIPLES FOR DESIGNING HMI:-

This is grouped into two categories: Principles and rules.
The principles are general indications, at high level, that can be applied in several spheres of human-machine interaction. Since they are transverse suggestions, the designer has to interpret them on the basis of their particular context of use. It is not simple for the designer to use the principles. This kind of indications can be like "reduce the user workload" or "suit the system language to the one of the users".
The rules instead are detailed indications of practical nature that can be applied in narrow spheres of human-machine interaction. They are easy to use and the designer has to do just a little effort of interpretation. The *rules* can derive from psychological theories or from practical experience. This kind of indications can be like "put the 'esc' button in the bottom-right side" or "begin the numbering with 1". Unfortunately, *rules* sometimes contradict and overlap each other, as they are every detailed and try to give indications suitable for different situations. For example, regarding the presentation of the information, certain *rules* suggest to order them according to their function, while others suggest to follow the alphabetical order, and others suggest to consider the frequency of use, or their importance, for the user. In these cases, it is up to the designer to define the priorities. In order to come out from these types of ambiguities, first of all the designer has to take into account the context of use of the system and, in particular, the characteristics of the users. Moreover, she/he has to understand the deep meaning of the designing rules, exploiting practical experience or the knowledge of the psychological theories that lay behind them.
After a literature review on this topic, it seems preferable to base the human-machine interface design on general principles, rather than rules. As a matter of fact, although general principles are more complex and difficult to understand, they summarize in few advices the most relevant aspects to take into account in designing user interfaces. Therefore, with some kind of adaptation and creativity, the design can apply them in a variety of situations. On the contrary, rules can increase in number to the infinity and may take every decision, making ability, without been exhaustive. Moreover, general principles suit better the progressive changes in preferences and styles of human-machine interaction, simply because they allow the designer to be more flexible. Rules, instead, hinder the evolution in the human machine relationship, limiting the introduction of brand new solutions.[7]

A. The Principles must be based on following:

- Consistency
- Feedback
- Workload
- Language
- Errors

IV. ADVANTAGES OF HMI

1. High quality graphics for realistic representations of machinery and processes:
   This will give the operator and the management a very realistic view of the plant. The operator can control plant without in one central location, this could be very useful when there is a security concerns. The operator does not need to be close to the equipment to control of monitor.
2. Alarms:
   Viewing alarms will help the operator to locate and react faster to any malfunction of any anomalies. Alarm logging is very useful to track problems. It could be used to optimize process and reduce lost time.
3. Trends (Real Time/Historical):
   Trends are very useful with PID's. You can view the curve used to reach a certain set point. Study of certain values will result in optimizing your

process, and it will certainly make if much more efficient.

4. Simulation:
   Some of the high quality HMI's will be so flexible that you can simulate a plant in your office. This will help PLC program developers test their program without having a single equipment or devices. This kind of simulation is used more and more to reduce startup time.
5. Messaging:
   This is a very interesting functionality. You can message, page or fax someone when a certain event happens.
6. Reduce the cost of Hardware:
   An HMI can replace hundreds of Push buttons, selectors, Lights and so on. As a result less consoles and panels and definitely less cables all over the plant
7. Communication:
   Today, most HMI's can communicate with many different brands of PLC's. Here is a list of most used communications.
   - Serial Port
   - Data Highway plus(DH+)
   - Remote I/O
   - Ethernet(TCP/IP)
   - DDE(Dynamic Data Exchange)

V. APPLICATIONS OF HMI:

There are so many applications on HMI. This HMI is used in following:

1. Industrial Control:
   (HMI) The user interface in a manufacturing or process control system. It provides a graphics-based visualization of an industrial control and monitoring system. Human machine interface (HMI) software enables operators to manage industrial and process control machinery via a computer-based graphical user interface (GUI). It monitors and controls the parameters of the system. This HMI is used in many industries.
2. Medical System:
   (HMI) Systems provide the controls by which a user operates a machine, system, or instruments. It enables reliable operations of technology in every application, including CNC machining centers and medical diagnostic and laboratory equipment. HMI systems encompass all the elements a person will touch, see, hear, or use to perform control functions and receive feedback on those actions.
3. Vehicle Control System:
   To create a HMI solution to make the driver more aware of the car's active safety systems a clear overview with consistent information is important for understanding. Understanding is attained by presenting the most important information to the driver of the vehicle. Designing a flexible HMI solution that is not restricted to a specific car model or a permanent number of active safety systems implemented, could be reached by developing a computer-based driver-vehicle interface. By using computerized technology the information presented can easily be exchanged and used for communicating other information to the driver. By using HMI the drive can control the vehicle.
4. Marine Applications: Human Machine Interface (HMI) Systems provide the controls by which a user operates a machine, system, or instrument. From the captain's bridge to the power distribution system in the engine room, or the multimedia entertainment system on a yacht, HMI Systems encompass all the elements an operator will touch, see, hear, or use to perform control functions and receive feedback on those actions. In marine applications, the user might be engaged in navigation, communications, guidance, lighting, or Passenger access and accommodation, or multiple simultaneous operations which make intuitive design a necessity [8]

VI. CONCLUSION

Through this research, we came to know that creating a HMI solution is necessary to make the user more aware of the machine's active safety systems. A clear overview with consistent information is important for understanding the HMI. Understanding is attained by presenting the most important information to the user. Designing a flexible HMI solution that is not restricted to a specific machine or a number of systems implemented, can be implemented by developing a computer-based user-machine interface. By using computerized technology the information presented can easily be exchanged and used for communication.

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