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RESEARCH AND CONTRIBUTION REGARDING THE ERGONOMIC PRINCIPLES APPLIED ON HUMAN-MACHINE INTERFACE DESIGN ANALYSE

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Abstract: In this paper, the main task of ergonomic principles applied on human-machine interface is to improve communication between the operator and the machine in order to provide minimal input to achieve the desired output. Another purpose is to reduce the negative consequences of a poor human-machine interface. Human-machine interface aesthetics and functionality is mainly involved in technical object characteristic improvement and working environment. Ergonomics must correlate notions about work organisation, psychology and manufacturing technology in order to ensure the worker's occupational safety and health.
Key words: human-machine interface, ergonomic principle

1. INTRODUCTION

Human functions are considerably transforming together with the ongoing modernization of the production force and a growing work standard. The rational efficient utility of means of production depends on the use of the most active and most dynamic element which is the human, who participates with his whole being and who consists of physic, psychic and moral complexity. Therefore, beyond the human activity results man-machine interaction which manifests strongly. The mutual conditioning between the man-machine interaction is created by human, technological, physical and psycho-social elements which interconnect themselves in a common network leading them to the same purpose. The use of machines keeps growing because the work system gets increasingly based on the socio-technical element and the human-machine becomes more prevalent in all domains of activity. [1]

2. HUMAN MACHINE INTERFACE COMMUNICATION

"Although it can refer to any type of interface device, the term human machine interaction usually refers to the display, computer, and software that serve as the operator's interface to a controller or control system." This quote was given by [2. 1] Another definition provided by [2. 2] as well by[2. 3] describes the human-machine interface like a part of an electronic machine or device which serves for the information exchange between the operator and the machine and consists of three parts as follows in the next figure:[2]
The full definition of a human-machine interface includes clear explanations which will be described as follows: Human-machine interface provides an interface that enables the user to operate a machine tool, edit a program partially, perform a program partially, set the parameters and transmit the data. In order to operate on a machine effectively and use its function optimally an operation panel is necessary to be designed for the usage according to the machine characteristics.

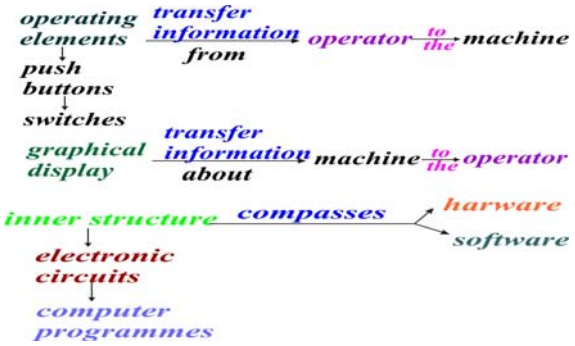

Figure 1. Information exchange between the operator and the machine

Taking into account a good design of the panel there are some important points of view such as design ergonomics, operation error prevention, key grouping and key allocation for specific machine tools which are related to the user's convenience. Human- machine interface allows the interaction between a human being and a machine and it consists of two components which are an important key between the human and the machine and these are represented by the input and the output components. These create a feedback between the user and the device. The input component allows operator to tell the machine what to do and this communication can be done through devices (that) are used for sending commands to a system or to a set of systems like keyboards, switches, touch screens. *The output component* keeps the operator updated with the progress of the commands executed in a physical space, for example the screen can display information and the human becomes able to see how the command was made. This component also includes status lights that may alert the operator when a switch was made. The technology behind a human machine interface gets constant improving so the outputs have become more complex/sophisticated over time [3].The human machine interface communication provides the control where a user operates a machine and enables him to do reliable operations of technology in every application and encompasses all the elements he touches, hears, sees, in order to perform control functions and receive feedback on those actions. The information setup of a human-machine consists of two independent information flows, described as follows:

The independent flow shows a requirement of the process that the user wants (discrete signals from him to the machine, animated diagram messages from the machine to him)

The linked flow interprets the operator defined action and in return it emits information that show whether the action was performed or not.

The third flow will be described in the next figure [4].

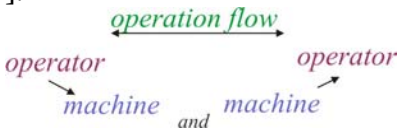

Figure 2. The operation flow

Actions that an operator does and deals with will be presented in following figures:

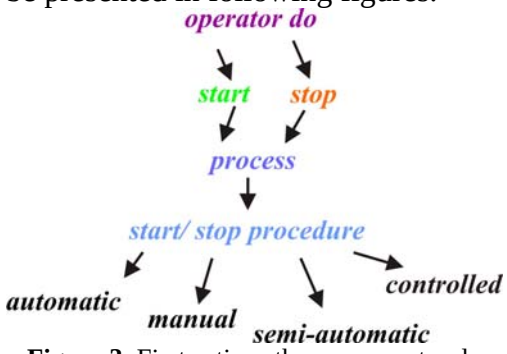

Figure 3. First actions than an operator do

Figure 4. Second actions than an operator do

Unexpected events that an operator may encounter will be shown in the next figure:

Figure 5. Unexpected events encountered by the operator

3. HUMAN MACHINE AESTHETICS AND ERGONOMIC ASPECTS

INVOLVED IN HUMAN MACHINE INTERFACE

The aesthetics of an interface will always receive positive responses from the operator. The interaction design maintains the balance between usability and visual attractiveness, its purpose being to please the user and go smoothly, which can also help selling the product successfully. From the comfort point of view the modern technology manages and optimizes the designing method for the human-machine interface. This can take place in the earliest part of the design development of the product which allows designers to appreciate and reduce time by improving and inovating the comfort performance on the market. The most used controls must be placed in a place that let the easiest access to the operator. For example controls for operating the major functions of the machine are placed either straight in front of the user or close to his side where they are easily reached. The unimportant/ infrequent/less necessary used controls can be placed in less accessible locations like overhead panels where the operator can find them. Unless the frequently used controls are placed in a convenient position (appropriately designed) the user will be distracted from his primary task and accidents may happen. The controls can be small, not too visible from their background, identical and difficult to choose by touching and having small labels hardly readable or labels lacking contrast with their background. A good spacing of grouped controls is important and allows sufficient room between them so that the operator will not inadvertently/mistakenly activate one while operating the intended control. When working on their development the designer must space them further apart in order to accommodate them with the user's fingers. If the attention is directed toward a display, for example, the static display which provides information that does not change on it. The information can be words, numbers or symbols depending on their purpose. In order to be effective:

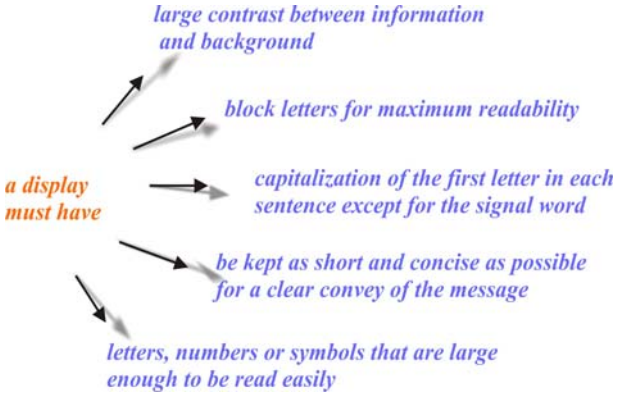

Figure 6. Must haves for an effective display

Design interaction comes up before the design provides effectiveness because not infrequently/often what seems to be a well designed caution warning display for the designer turns out not to be effective under a realistic test. So when preparing caution or warning signs, next figure will explain how a prototype sign must be tested in order to see:

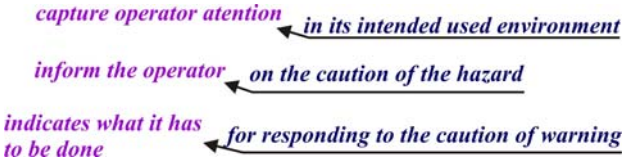

Figure 7. A tested prototyped sign

The displays arrangement is grouped on four principles as follows: The first two principles are about and the second two principles are about: [5]

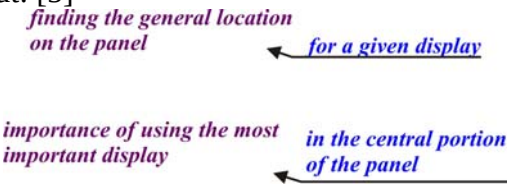

Figure 8. First two principles

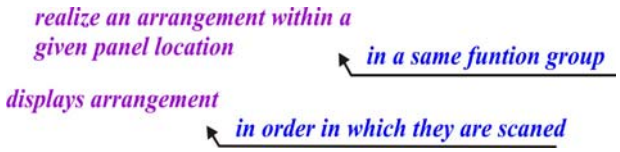

Figure 9. Second two principles

Using a machine in order to judge human safety and comfort during interaction with the commands needs time and attention. Main task of an ergonomic analysis is to observe different involvement degrees of the user in the comfort of his action range. The human fit function becomes the most addressed guideline for improvement and the appeal of a product in the

current demanding global market place increases. A machine ergonomic study can develop the design evaluation parameters in order to provide some help to the designers and users by choosing design and product solutions. The ergonomic design approach deals with improvement of comfort and usability of a product. An ergonomic analysis can be realized during an entire working day and it is divided in the following steps like standards which can fix several geometric steps/ parameters in a machine design process, as the next figure will explain:

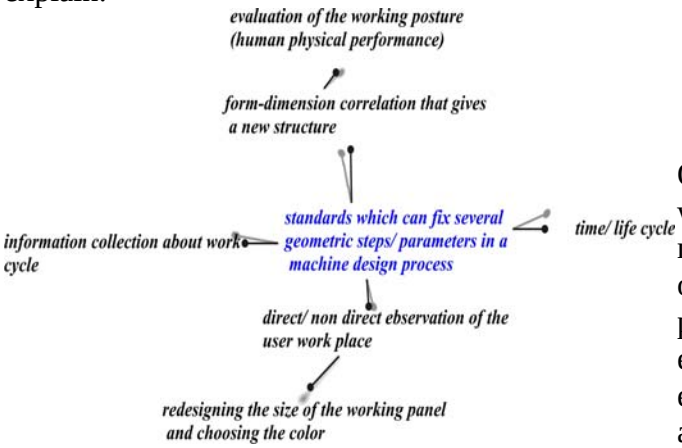

Figure 10. Ergonomic analysis

An operator uses a machine for a period in which repeats actions several times per hour/ day. The stress due to repeated action often depends of the position of the commands on a working panel. This is how a dynamic ergonomic analysis can help a designer react during the product development process by giving him an easy and fast instrument the check the comfort performance in designing a human-machine interface command panel. [6]

4. BAD DESIGN OF A POOR HUMAN MACHINE INTERFACE SEEN AS AN EMERGING RISK

[4. 1] explains how failure apply dialogue principles can result in higher mental workload: inconsistency with user expectations or common conformities *if an emergency stop button were to be given a color other than red.* Highly complex technical systems cannot match the flexibility of the human operator intelligent, context-based thinking. Unfamiliar alarm can signal increase mental stress while the operator is trying without success to identify the cause of the alarm. In one can say that an inadequate ergonomic design of the interaction interface increases control difficulty or impedes successful control, which is associated with an increased strain which leads to a less effective and less efficient process. The next section will concern ergonomics involved in work organizing and some helpful ideas for human machine interface designers to appreciate more the ergonomic design [7].

5. ERGONOMICS ABOUT WORK ORGANIZING, PSYCHOLOGY AND ENSURING WORKER AN OCCUPATIONAL SAFETY AND HEALTH

Occupational ergonomics is meant to make workplaces healthier, safer, more efficient and more pleasant for the workers. Apart from the occupational ergonomics it also deals with people experienced in designing healthy and efficient workplace. With the help of ergonomics human factors the operator safety and health keeps improving by adapting machines and tools to his limitations, anatomy and skills, so the ergonomic design concerned with the human- machine interface must be designed with clarity and ease of use in mind, as a layout of the entire workplace. The system gets increasingly built as a socio-technical one consisting of workers, tools, tasks and work contexts..[5. 1] Governments invest funds in occupational ergonomics research viewed as a public health initiative which cuts costs in the long term by making workplaces safer reducing accidents, injury rates and improving the employees' morale. Ergonomics comprises use of anthropometrics in design of equipment and workplace concept of usability. "The focus is maintained on user-friendly design of technical equipment which provide effective support for user improving efficiency and productivity gaines are far more common as a reason for applying ergonomic principles." [5. 2]. *Emerging physical risks was identified by an expert forecast (EU-OSHA 2005) regarding issues related to ergonomics*

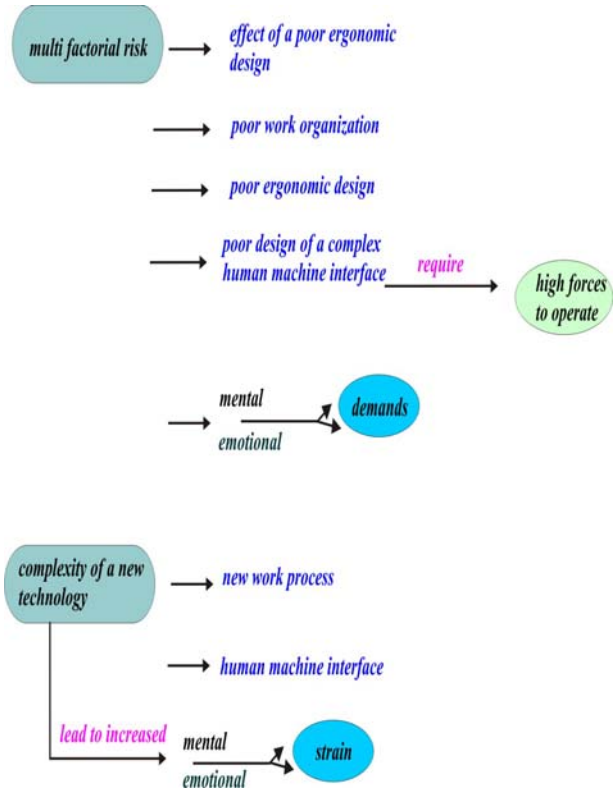

Figure 11. Risks related to ergonomics

Important points which ensure safety, health, efficiency and productivity, that literature generally focuses on:

Figure 12. Focus

The points are identified as risk sources which may affect safety and productivity at work. Human-machine interactions can be seen like error-prone and the environment may give rise to unpredictable situations that may lead to danger [5. 3]. Working environment and human/ machine quality must be taken to account when referring to an adequate design of a human-machine interface. Machines can control a process but a human hardly does reach to their performance and the good thing is that he is flexible and can cope better with unexpected and unforeseen situations[5. 3] Usually the task is divided appropriately between the human operator and computer-operated technical system according to working situation and working environment. The important part is to take account of operators when creating usable and safe systems and the error from the design process are reduced. Operator opinion will always be important as the task for which the product will be used and technical, physical and organizational conditions in which the system is about to be implemented. User involvement can help in the design process and allows adaptation of the end product to his needs. At the end of design process changes identified through users are carried out and far more costly to implement than identified earlier on. An approach that puts these principles into practice is the “user-centered design process” known also as “usability engineering process” which incorporate feedback loops in human-machine interface design process [5. 4]. Looking to the future new human-machine interface challenges will arise as human work evermore closely with increasingly complex machines and new control interfaces designed.[7]

6. CONCLUSIONS

Human-machine interface is the domain that made a great progress in last few years due to increasingly sophisticated and user-friendly means of communication. An interface configuration under user control can ofer exactness and undertake diagnostics, preventing maintenance in order increase productivity. [3]

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CERCETARI SI CONTRIBUTII PRIVIND PRINCIPIILE ERGONOMICE APLICATE ASUPRA PROIECTARII UNEI INTERFETE OM-MASINA

Rezumat: In acest articol sarcina esentiala a principiilor ergonomice aplicate asupra proiectarii unei interfete om-masina este aceea de a imbunatatii comuncarea dintre masina si utilizator. Alt scop este acela de a-i reduce consecintele negative atunci cand ea este slab realizata. Estetica si functionalitatea interfetei sunt elemente care tin de caracteristica tehnica a acesteia. Ergonomia este domeniul care va fi luat in considerare atunci cand ne vom gandi la un loc de munca sigur si fara accidente pentru utilizator.

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