

Information Layout Designing of ‘Barco Display Screen’ used in State Load Despatch Centre at MPPTCL

Pratibha Sahu

Master of Design, Design Discipline

PDPM Indian Institute of Information Technology Design & Manufacturing,

Jabalpur, M.P., India

1610420@iiitdmj.ac.in , pratibhassahu@gmail.com

Abstract

Control rooms are involved with human-computer, human-human and human-machine interactions which are often more complex and considered more sociotechnical systems. In SLDC, State Load & despatch Centre, control rooms are meant for handling crucial information regarding transmission, generation, distribution of power flow, major to remote substations across the state and connected to the central Power Grid system of the country. They handle activities ranging from day to day normal transmissions, general operations and distributions, synchronization and optimisation of the system, play significant role in balancing frequency and also handle disastrous situations. They also predict and plan distribution a year before based on the previous year demand and supply graphs. It includes long shift hours, stressful tasks and efficient decision making process for the safe operational flow. An “operator-first” approach towards the designing of interfaces used in control rooms has been adopted by HFEL (human factors and ergonomics literature) and by many other industrial standards (ISO 11064, EEMUA 201, etc.), where the designing of interfaces, displays and control room design considered from users perspective, with the operator/user being the starting point. Similarly in SLDC, information gathered through implemented SCADA system, provides System Overview for easy operation and control through Barco Display Screen.

Keywords

Control room, Human Machine interaction, Barco Display Screen, System Overview screen, and SCADA system.

1. Introduction

Human-Computer Interaction (HCI) focuses on the interfaces between computers and users. Mostly HCI researchers observe the how human interact with the computers or machines (Juhannsen). Many organizations now a days preferring **Visual Display Terminals (VDT)** screens to either showcase their findings/products or for monitoring/investigation purposes. VDT often includes LCD/LED terminals available in flat and curved shape. Ergonomics involved in VDT varied from the type of control rooms used in different offices (Bevan, 2001). SCADA stands for **Supervisory Control and Data Acquisition** system are used by industrial organizations and companies in the public and private sectors to control and maintain efficiency, distribute data for smarter decisions, and communicate system issues to help mitigate downtime (What is the SCADA system, 2018). **Madhya Pradesh Power Transmission Company Limited (MPPTCL)** is the governing body in state which controls, distribute, supervise and channels power across the MP state. It is responsible for governing electricity power generation, distribution, testing and setting up of the distribution channels across Madhya Pradesh and other related regions (MP Power Transmission Compay). The central part of operation in **State Load & Dispatch Center (SLDC)** is Control rooms which governs all the operations and production units across other dispatch centers. Thus control rooms play significant role in company’s profit or loss conditions. Tasks like early prediction of catastrophic incidents, their mitigation opportunities are also handled through the control room display screens which dedicatedly operate 24x7. Here the role of Operators comes into the picture who handles these screens, monitor their data values and works continuously in long hours in front of computer screen ensuring safety and balance system frequency. Human are not very good at monitoring operations and it has also observed that the operators suffered with eye strain, stress, repetitive motion impairment and slow response time during abnormal condition events. Barco visual display

information screen in SLDC is monitored 24x7 hours where it is continuously observed for taking decisions to control loading – despatch for different intra state and interstate power lines. Each display belongs to a unique set of time frame within a block (block consists of 15min time frame) and it can store last 6 months of information for any distribution analysis purpose or for future reference.



Figure 1 Barco Display Screen [Author]

2. Objective

Main objective of this study is to make user friendly interface which is more profound and effectively segregated as per the user's requirement resulting in the final decision making for the electricity flow in state, Interstate & other transmission lines, also it reduces the chances of whole system failure due to the cascade effect. This study play a significant role as it increase more visibility of information display system, implementation of proper alert alarm signals and handling power failures due to any unfavourable circumstances like natural calamities, heavy rainfall, earthquakes in certain parts of the country. Thus lines tripping, shutdown due to maintenance, automatic line failure, thermal load shedding, transformer failure, force tripping, planned shutdown, selective tripping, line breaker, overloading on transmission lines or during load management, all these types of management need high quality data for controlling and monitoring system across various stations and sub-stations.

3. Methodology

For the purpose of data collection, methods namely questionnaire, interview and direct observation, task analysis, workspace study, perception test and ranking test were used. The Questionnaire was used to determine needs and problems in the existing system overview. Questions were asked to different set of employees who had worked or currently working on the system as well as employees who monitor it indirectly and supervise decision making authority when in need. Mainly questions included were related to the employee's age, working experience, time taken for retrieving information from the screens, decision making process, data visibility, readability and legibility from their respective sitting distance from the main display screen. Also how did shift hours working load affect

their behavior. The interview was conducted for getting deep insights into the working process of the existing system. Analysis performed in SLDC control room center and was observed directly, to get more reliable data in the real environment. Wherever allowed, video and photos were clicked for Task Analysis and workspace study. Test of perception was also performed to check the mental model of participants to generate concepts of new graphical symbols. Ranking test was performed to select the color selection of graphical symbols from four different color combinations of concepts. Once we received mental model data and color combination new concepts for system overview window was proposed.

4. Results

During interviews, it is observed that employees usually work from 6-11 hours during their respective shift hours (9am -4pm shift, 4pm -10pm shift and 10pm-9am shift). It was derived from the study that 43.5% of employees belongs to the age group of range 46-62 years, 30.4 % employees belongs to 31- 45 years of age group. Where first set of users 43.5 % were found to be responsible for the main decision making process. 56.5 % of users needed average 300 seconds to make any decision after viewing Barco display screen and on the other hand 47.8% of users can gather information within 30-90 seconds of time frame during regular shift hours. It is observed that 43.5% of engineers belong to 45-62 years of age group and they face mostly age related cognitive issues during work. Also found that the average distance from the display screen for main executive was 28.2 feet. So there are chances of slippage of information and risk of effective decision making during their shift hours. It was found that 59.1 % of total users viewed nearby computer screen more than the main Barco display screen for any decision making purposes. 65.2 % of users wanted changes required in alarming and alert system in the existing screen. Questionnaire results showed in Table 1 display data for Executive Engineer who is final decision-making authority during shift hours. Results obtained also showed that the information displayed on the screen was very randomly organised. Also the decision making time had drastically affected during hectic shift hours.

Table 1. User's details

Users (n=29)	Mean	Range	SD
Age of Engineer (in years)	53.6	>45-62	4.8
Distance of screen from sitting position of EE employee (in feet)	28.2	28-32	1.5
Time taken for decision making process (in seconds)	352.8	240-520	120.3
Working experience (in years)	13.2	10-17	2.4

5. Discussion

In the current display screen, color coding was done on the basis of preferred guidelines which were used by the system earlier. Problem arises when alert and warning signals mix and match with the other highlighted color for the column headlines. Some of the alert colors like red and purple are also used for the column names such as 'RE TOT' Total Renewable Energy & 'Surrender Power' respectively. It was observed that when Indian Energy Exchange limited and Power exchange India limited came into the picture, banking of energy becomes easy across the states as well as across different neighbour countries. Regional Exchange (REG EXCH) section was involved in the System

Overview screen for gathering exchange related real time data. Banking of surplus amount of energy generation was also decided after looking over the System Overview window. Prediction for the next two blocks ,balanced schedule cycle running in real time for the demand and generation values were certain factors which were taken into consideration during decision making for banking of power to other state or needy organization as well as banking for themselves if they were in need of energy from other state /organization. Also found that MP state can generate more energy than the state's scheduled power distribution and hence they were having enough power to sell it. In such situations, organization decided to get intimation by SLDCs in advance to manage all distribution and maintain the supply. Now it was very clear that how important was to use appropriate grouping of data to make better understanding by the user.

6. Conceptualization

It was found that data arranged randomly on the screen and not specific colour coding pattern for representation of various sections was followed. Results from methodologies have been considered for grouping, data positioning and data correlation used during decision making process. Keeping process sequence, frequency of use of data and positioning with respect to the data connectivity in mind final concepts were generated both in graphical representation as well as only data representation for highly prioritised data.

7. Conclusion

Above project work showed the issues related with the information system overview of Barco display screen used at SLDC. In this project our main focus was on system overview screen information layout presentation redesign and testing of the same. After the final proposed system layout design user ranking test & Likert scale (Rajabi-Vardanjani, 2014)were performed for a set of 25 working employees of the company and results clearly showed need of improvement in the existing design. This study can be used as a reference in future for control room display task analysis and layouts designing.

References

- Bevan, N. (2001).International standards for HCI and usability. *International journal of human-computer studies* 1,55(4), 533-552.
- Juhamnsen, G. (n.d.). Human-computer interaction. *Control System Robotics and automation, Volume XXI: Elements of Automation*, 132-138.Retrieved from en.wikipedia: https://en.wikipedia.org/wiki/Human-computer_interaction
- MP Power Transmission Compay . (n.d.). *About Us*. Retrieved January 2018, from www.mptransco.in: <https://www.mptransco.in/AboutUs>
- Rajabi-Vardanjani, H. H. (2014). Designing and Validation a Visual Fatigue Questionnaire for Video Display Terminals Operators. . *International Journal of Preventive Medicine*, 5(7), 841–848.
- What is the SCADA system*. (2018). Retrieved from Inductive automation: <https://inductiveautomation.com/what-is-scada>
- Mark S. Sanders, E. J. (1993). Introduction, Human Factor Defined, discussion. In *Human Factors in Engineering and Design*. Singapore: McGraw-Hill, Inc.

Biography

Ms. Pratibha Sahu is a Master of Design student at Indian Institute of Information Technology Design & Manufacturing, Jabalpur, India and Co-founder of Umeed Swasthya Bhavisya foundation. She earned B.Tech in Bioinformatics from Vellore Institute of Technology University, Vellore India. She has presented her work in the National Forum of Load Despatchers conference as well. Ms. Pratibha has also worked as a Systems Engineer at Infosys Ltd where she worked in the website and mobile applications related to Medical and Sport domain projects. She had also successfully completed her training program within three and half months at Infosys Global Training Institute Mysore. Her research interests include user experience research and design, strategy designing, ergonomics, user centered design, and interfaces.