1. DESIGN OF COGNITIVE SYSTEMS:-

The problems associated with the ergonomic issues in the process of designing cognitive systems are usually at the abstract, symbolic level. Rasmussen and Rouse have identified 3 types of task performance. Skill-based performance depends on the existence of specialised subroutines for the performance of routine tasks and Rule based performance makes greater demands on conscious processing capacity as explicit rules have to be kept in mind and followed during execution. Knowledge based performance is eminent in complex tasks and the operator is involved in problem solving and decision making.

Eg:- Operating a power station is a cognitive control task.

i) COGNITIVE SYSTEMS AND INTELLIGENT ACTION:-

→ Hollnagel and Woods argue that human machine systems should be analysed, conceived of and designed at a cognitive level - as cognitive systems in which.

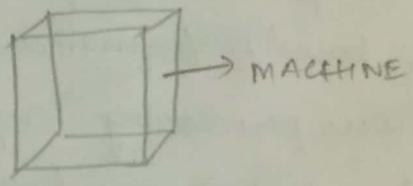
"A cognitive system produces intelligent action, ie., its behaviour is goal oriented based on symbol manipulation and uses world knowledge for guidance".

→ Such a system is adaptive and views a problem from multiple perspectives.

→ It has self knowledge and environment awareness and is capable of planning and modifying its actions at any given point.

→ They are both data driven and concept driven.

MAN - COGNITIVE SYSTEM.



POTENTIALLY COGNITIVE.

ii) COGNITIVE MODELS OF HUMAN OPERATOR:

→ Initially developed cognitive systems were used in the process control industries.

→ operator monitors the system and system controls the process.

→ We need to discover facts and rules and how they are used to carry out the task.

→ Operators are information processing systems that have to solve a finite set of problems using system information and application programs.

The key elements are:-

a) The rules the operator uses to control the system.

b) The strategies that determine how the rules are used.

c) the types of system feedback employed.

Some models of the operator and their uses.

* Prediction of operator behaviour.
* Facilitation of task load evaluation.
* Direction of equipment design evaluation.
* Evaluation of the adequacy of operating procedures.
* Evaluation of training programmes.
* Implementation of the model in a digital setup for behaviour simulation.

2. PSYCHOLOGICAL ASPECTS OF HUMAN ERRORS:-

Human machine interaction can be conceived as a behaviour stream governed by user intentions, expressed as goals and subgoals executed via plans.
Norman calls these action schemas and they are well learnt and carried out in full consciousness. Error occurs due to disassociation between the behaviour and intention. Error can occur when the intention is correct and the devised action schema is faulty. Every intention is broken down in to sequence of steps for orderly execution. A particular disparity in the sequence called action slip leads to dissociation and eventually an error occurs.

ERROR CATEGORISATION:-

→ The power of error categorisation lies in making explicit the psychological processes underlying is commonly the error and preventing them using ergonomic interventions.

→ A distinction is commonly made between errors of omission, errors of commission and psychomotor or bumping errors. Error of omission involve an operator not doing something they were supposed to have done.

→ Errors of commission involve execution of a correct action at the corong time or performing an incorrect action.

→ Psychomotor errors involves accidently operating a control or executing a sequence of actions in the corong order, Errors according to level of human info processing are:

* Skill based errors are slips and lapses.
* Rule and knowledge based ones are mistakes violation.

Errors are a process that develops over time as:-

* Error production.
* Error detection
* Error identification.
* Error Recovery.
* Error prevention

ERROR PRODUCTION:-

* Errors in the formation of intention to act.
* Faulty activation of the action schema.
* faulty triggering of schema.

Norman describes the following kinds of slips associated with the forming goals and execution of goals.

a) Errors in intention Formation:-

→ Mode Errors involve situation misclassification. In such errors actions are correct but are applied in the wrong situation. They are difficult to detect.

Eg:- Setting an alarm in clock when it is not in alarm mode.

→ Description Errors occur when intention is insufficiently specified due to memory limitations or high workload.

Eg: Putting the lid of the sugar container onto the coffee cup due to similarity in shape.

b) Faulty activation of Schema:-

→ Unintentional activation occurs when a familiar habit is invoked at an inappropriate time. William James

says that well learnt behaviours will often be triggered by environment cues when attention is diverted elsewhere. Daydreaming and distraction are conducive for this error.

→ External Activation of action schema occurs when stimuli in the environment trigger unintended actions. Norman says one guy who wanted coins to buy cigarettes got more coins but instead put into the coffee vending machine.

→ Associations Activation of action schemas is similar to external activation and occurs when the stimulus is strongly associated with the desired response. It often occurs in speech when a name is misspelt.

Loss of activation :-

→ Classic example of this type is oneself standing in a room blankly with no knowledge of what one is searching for.

→ There is an interference in memory either by external events or internal thoughts.

→ Loss of activation affect the execution of steps in an action schema. Also steps might repeat.

Eg :- pouring boiling water into a tea pot.

d) Faulty Triggering :-

It involves wrong selection of schema or failure to execute actions appropriate to the given situation.

ERROR DETECTION :-

Sellen carried out a study in which people kept diaries of the errors they made in everyday life and then described their own methods for error detection. There are 3 mechanisms for error detection they are the following :-

→ Action based detection involves catching one in the act. Incorrect actions are identified as and when they are performed. In skilled activities like typing and speech, people identify it because of tactile feedback and mismatch of words respectively. It requires the user's constant attention for task feedback. If wrong action schemas are in place, the executive processor monitoring the task is capable detecting the error. Feedback of actions detects a mismatch between the actions being performed and intended. Evaluation of actions with respect to the goal state leads to the realisation that an error is being performed, but it requires constant attention.

→ Outcome based detection comes into play when the actions aren't monitored to detect errors.

Eg:- pouring coffee into a cup with a teabag.

If the intention and action don't correlate, the detection of the error becomes impossible. This detection can't be effective in preventing possible accidents. There are some requirements for this method.

* Proper expectations for outcome & behaviour.
* Effects of actions must be perceptible.
* Behaviour and actions need to be monitored.
* Mismatches should be abbitrated to the person's schema.

The method works in two ways.

* Detection of a mismatch between actual and expected outcomes.
* The person must be conscious about the possibility of an error.

→ Process based Outcomes occur when external events distract action schema. The constraints are called forcing functions.

Eg:- putting a barrier on ground floor of stairways in buildings.

the key difference between forcing functions and other methods is that error detection is cued by design of environment and not feedback.

3. HUMAN ERROR AND EQUIPMENT DESIGN:-

a) Interface Feature and operator error:-

Mosenkis reviewed problems of medical device design that can increase the likelihood of error.

→ Unusual or inconsistent operation stems from users assuming that they can operate a device with minimal experience. Different devices have different control logic. Dixon told that if two devices differ conceptually, a similarity in operating procedure enhances the productive learning of both.

Eg:- flying a plane and closing down a nuclear power station.

→ Lack of protective incompability occurs when devices are misconnected owing to design of their leads and plugs.

Eg:- An apnoea monitor had an electrode at one end and plug at the other end could be attached to AC mains. Infants got electrocuted due to faulty connections.

Such errors occur due to affordances offered by unrelated components. This usually leads to disastrous results.

→ Unclear/incompatible control/display relationships. Medical units have analog displays. Sometimes the codes might be obscure. The problem is with designer who designed the panels in the first place

→ Defeatable or ignorable safety features LCDs or other power displays are less effective than flickering lights. Smell and vibration are non directional warnings. Auditory warning systems can be turned down so they don't work in case of serious situation.

→ Lack of cues to aid discrimination. Contact lens packaged together identical each being texture wise different. Failure to consider user capacity in task is always an error.

Eg:- A contact lens manual does not take into account user's vision.

Shape and colour are widely used for distinguishing materials.

b) MODES :-

→ Modes are states of a system where it behaves differently according to user's actions. Johnson analysed everyday objects and their modes.

→ Modes can make actions error-prone - when they aren't explicit or when we don't expect a system to have modes. Eg: electric toothbrush.

Eg: In a slideshow, forward and recall buttons are for moving forward or backward the only cue to them is their placement.

→ Modes simplify layouts and consoles. Modes can boost the efficiency of a device.

modes can be degraded with computerisation that will give birth to modeless devices.

Eg: To operate a car, we require to operate clutch and gear in unison. between disengage and drive mode.

→ User difficulties and errors are likely to be further compounded if the user model of the system is compatible with the system model.

c) MENTAL MODELS CAN REDUCE LIKELIHOOD OF ERROR:-

→ Learning to use products is an mental exercise. The way the user interface is designed can influence how the operations have to be performed and the types cognitive processing used for operations.

→ As when the user uses a device, he/she creates a mind map of the various controls. This is the user model of the system.

→ Interactive devices help users in controlling & assisting the users. In the research of Anders and Flowers, users had created a mental map of the devices behaviour in several situations.

→ Young investigated the design of pocket calculators Error free operation depends on how good a mapping exists between users model and system's model.

A) DESIGNING INFORMATION IN EXTERNAL MEMORY STORES:-

GUIs should facilitate facial recognition and retrieval using multidimensional coding, within a visual frame of reference. People have preferred thinking styles- what is appropriate for a Visualiser may be inappropriate for a Verbaliser.

i) Database Retrieval using Keywords:-

→ Gomez, Lochbaum investigated performance on an information retrieval system using the keyword method.

→ Subjects were required to find one # of recipes with entering appropriate keywords. People use the same words to describe more than one object.

→ The larger vocabulary set was found to increase the number of recipes retrieved by the subjects. This was believed to lead to a performance cost and increased ambiguity but subjects did not experience these.

→ The enriched keyword technique works well for semantically rich domains.

ii) Keywords should reflect common usage:-

→ Problems caused by inappropriate keywords or a redundant descriptor that might be potentially correct but adds no useful search information.

Eg:- In Universities, the name of the department can be prefixed with 'University' to no pleasure.

iii) Automatic Categorisation of search Results :-

→ Searching in WWW can be difficult because a single keyword can reference multiple sites. Chan and Dumais developed a UI that produced meaningful websites.

Eg: The term Jaguar refers to an animal, automobile, plumbing etc.

→ Searching by category produced relevant and faster results. Even with complex databases in place categorisation of results improved performance.

iv) Personal Information storage :-

→ Lansdale inspected how people organise info at offices and found that pen-paper data storage didn't pave way for paperless storage.

→ Occupants were judged based on how they maintained their personal spaces at office. Repetitive jobs resulted in neat spaces as there was minimal data generation. Data rich jobs with increased categorization lead to messy spaces.

→ Filing systems will be replaced by piling when categorisation becomes impossible. Storing documents in a pile reminds a user of its presence. Physical appearance gives a cue of how long a pile has been at a place.

→ Electronic info system should provide ways for people to cope with ambiguity and categorisation. Task of filing and implementing this is a design issue.

→ Enriching info has to be provided for every document to promote better recall. Encoding an item using a diverse set of modalities enhances the recallability.

v) Retrieval Cues for Web Pages :-

→ The web is a vast & complex database. Bookmarks and favourites are tools which help us in saving our most preferred websites.

→ Czerwinski inspected the retrieval cues of many websites. which included title of webpage, short description, thumbnail of the page. Title had an RT of 10s. Thumbnail was 17.5s.

→ Multidimensional cueing may assist retrieval from memory but not recognition. Thus, title alone is enough for retrieval.

vi) Designining Icons for ease of recognition :-

→ Icons are ubiquitous these days and designing icons has improved over time. Mostly relevant objects are used to indicate icons. Stott inspected graphically abstract icons.

→ Concrete icons were useful in speeding search and select times when the icons were functionally representative of their referrents

→ Icons assessed MS-Word for identifiability. Each icon was presented and task was to identify its function. frequently performed actions and their icons were identified

Eg: Bold, Italic, underline, cut, copy paste.

→ Infrequent icons were not identified easily. As the purpose of using icons is to increase usability it calls for some redesign

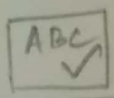
 – OPEN

 – SAVE

 – CUT

 – UNDO

 – REDO

 – spellcheck.