INTROUKTION

MULTIMEDIER I PROCESKONTROL

Multimedie interface er særdeles velegnet til at kommunikere informationer om processen til operatøren. Visse medier overfører bestemte former for information mere effektivt and andre.

- Hvordan vælges det bedste medium til en given opgave ?
- Vil brug af flere samtidige medier give højere effektivitet ?
- Hvordan defineres og måles effektivitet (performance)?

Litteratur:

1. J.L.Alty, Multimedia and process control interfaces: signal or noise? Trans Inst M C Vol 21 No 4/5 1999.

En indskannet udgave findes på
http://www.mii.itorg.auc.dk/2000/grunduddannelsen/intern/vejledere/MortenKnudsen/Multimedier_Procesk/Alty99_Multimedia.zip
Dette er er hovedkilden, hvor begreberner defineres, kriterier for valg af medier diskuteres, og et eksperimentelt eksempel gennemgås. Den følgende 'Lecture' bygger herpå. Noget er omtalt i tidligere publikationer af Alty.

2. J.L.Alty, Designing better interfaces for process control: Multi-media and expressiveness. DAu konference om Multimedier til industriel automation, Okt. 98
3. J.L.Alty and M.Bergan, Multi-media interfaces to process control: matching media to tasks. Control Eng Practice, Vol No 2 1995.
4. J.L.Alty. Operator interface in the nuclear environment: will multimedia help? Nucl Energy No1 1995.
5. M.Hoogeveen, Towards a theory of the effectiveness of multimedia systems, Intern J of human computer interaction 9, 1997. http://cyber-ventures.com/mh/paper/mmtheory.html

En papirudgave af disse artikler kan fås ved henvendelse til mk@control.auc.dk

LECTURE: MULTIMEDIA IN PROCESS CONTROL

MULTIMEDIA INTERFACE

Channel

sensory channel used to communicate between human beings. Five main channels of communication - visual, auditory, haptic (or touch), taste and olfactory

Medium

agreed mechanism for communicating information between human beings and computer systems
Three components: symbols (or lexicon), syntax (or structural rules) and the pragmatics (or conventions) of the medium.
The medium *speech* consists of the following components:

Lexicon All words of the language plus other non- word sounds ('ooh', 'ah', 'er', etc.)
Syntax The grammatical rules for combining words (not quite the same as for written language)
Pragmatics How we speak together, for example, taking turns, greetings, etc.
Channel Auditory channel

DESIGN OBJECTIVES

Efficiency Multimedia interfaces will enable the operator to appreciate more rapidly what is happening in a dynamic system. This may result from providing representations that are better matched to operator needs

Learning Multimedia interfaces will enhance the operator's ability to assimilate what is being presented in a learning situation

Stimulation Multimedia interfaces will provide a more stimulating problem-solving environment

FEATURES OF THE COMMUNICATION PROCESS

- The existence of an intermediary (these days a computer) between the participants. It can transform the information and selectively make decisions about what is displayed (and how).
- A lack of direct user feedback to the original designer of the interactions - common ground is not easily developed during the interaction. Assumptions have to be made by the designer.
- A resulting requirement for the computer to act as a remote representative of the interface designer in all interactions at the interface.

CHOOSING AN APPROPRIATE MEDIUM

- All the information required must be currently available (or accessible) in the representation chosen.
- The information should be presented in such a way as to be readily perceived and understood in the right context by the user. This means that the representation should generate, or match, some form of model in the user's head - an internal representation.
- Other information, not relevant to the problem- solving process, should be kept to a minimum.

PERFORMANCE

Effectiveness
might be measured through an examination of the use of the actual interface. We might measure the time taken to solve a problem using a particular interface representation

Information richness
The ability of information to change understanding in the recipient – overcome differen frames of reference:

- face-to-face
- telephone
- written document
- numeric document

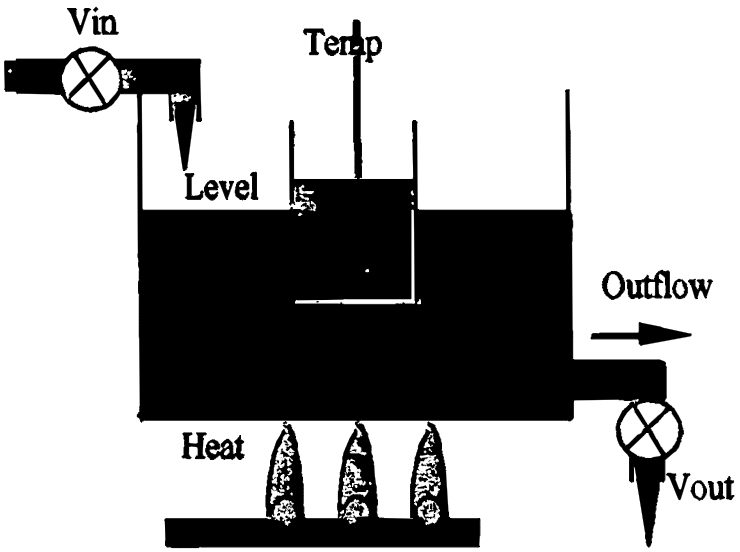
Expressiveness
The ability of a medium to support multiple levels of abstraction, and is therefore related to the information richness idea

MEDIA SIGNAL-TO-NOISE RATIO

$$= \frac{\text{Essential information}}{\text{Total other information presented}}$$

hard to measure in practise

EXAMPLE: Crossman´s wather bath



Dependent Variables
Level, Outflow, Temp

Independent variables (inputs): Vin, Vout, Heat

Task: Given the system in a particular state. Stabilize it at a new state defined by the dependent variables, by altering the independent variables.

50 test persons

- 21 simple tasks with increasing complexity
- test on their understanding of the state variables
- 11 complex tasks

The media used in the experiment

Medium	Description
Text	Display of single text values of each variable together with required limits
Scrolling text	The last 20 values of all variables were displayed in a text table
Graphics	A dynamic graphical representation of the water bath which reflected the current state
Sound	The sound of flowing water which reflected the inflow rate
Dynamic graph	A dynamic graph showed the recent history of all variables together with the current state,
Written	Written text giving warnings
Voice	Warning messages (male and female)

WARNING

given by the system when any variables went outside an acceptable envelope - can either inform the operator or remain silent.

Condition	Average completion time (s)
Warnings	77
No warnings	111

Warnings improve efficiency performance: higher signal-to-noise ratio

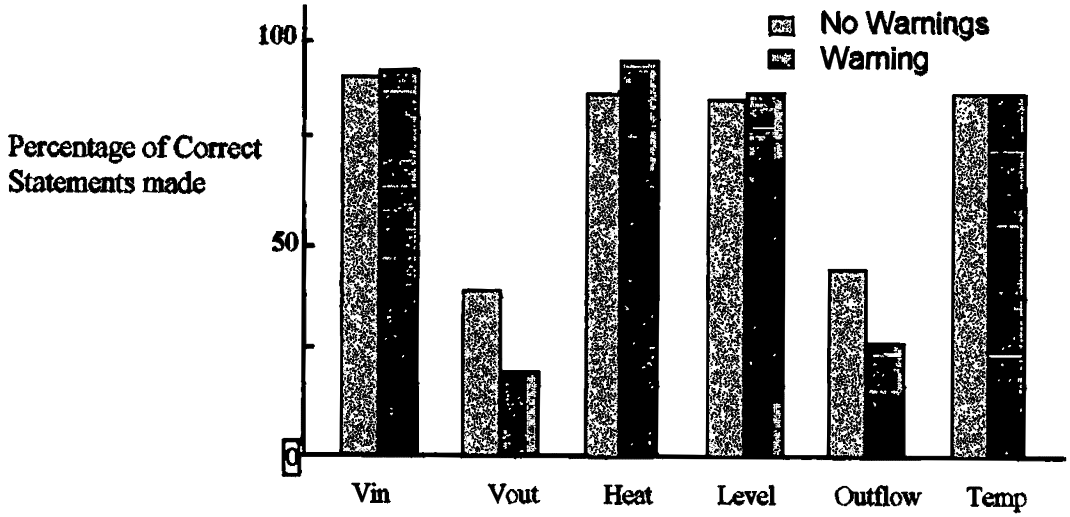
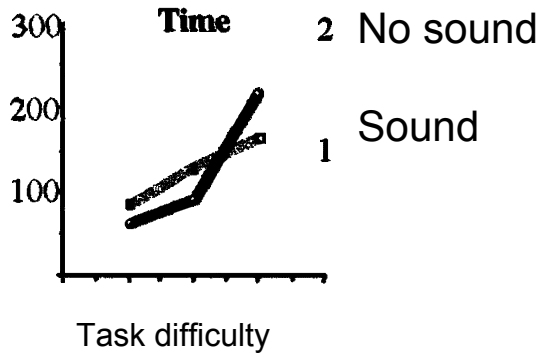


Fig 4 The effect of warnings on comprehension

Warnings decrease learning performance for complex tasks: lower signal-to-noise ratio, the warnings become part of the noise

SOUND



Sound decrease efficiency performance for simple tasks, but improve efficiency performance for complex tasks

Sound, like warnings, decrease learning performance for complex tasks

GRAPHICS

Graphics, like sound decrease efficiency performance for simple tasks, but improve efficiency performance for complex tasks

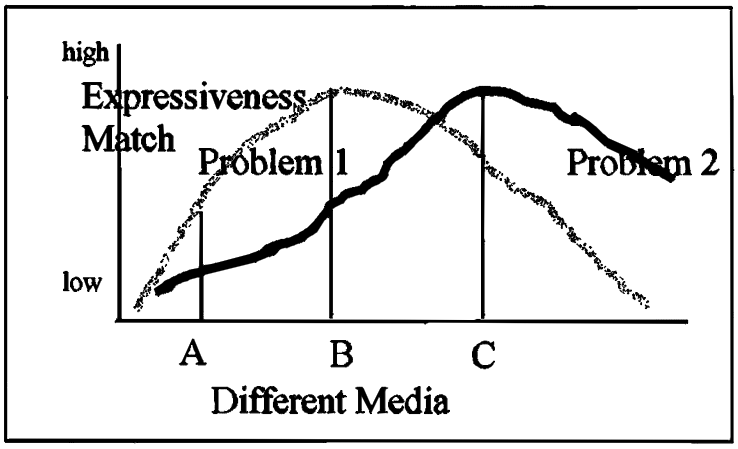
- but increases learning performance for complex tasks

STIMULATION AND THE MEDIA SIGNAL-TO-NOISE RATIO

The overall results did indicate that using multiple media in parallel had an overall effect on improving the understanding of complex variables in the water bath case.

MEDIA EXPRESSIVENESS

provide a measure of how well a chosen medium communicates the desired information to enable an operator or user to carry out a particular task most effectively



Media, problems and expressiveness

A medium can have too little expressiveness for communication a particular problem situation (medium A for problem 1 and 2, medium B for problem 2)
- but a medium can also have too much expressiveness (medium C for problem 1): too much noise is communicated

CONCLUSION

multimedia interfaces may assist in achieving the following goals in process control:

Efficiency to enable the operator to appreciate more rapidly what is happening in a dynamic system. This may result from providing representations better matched to operator needs.

Learning to enhance the operator's ability to assimilate what is being presented in a learning situation.

Stimulation to provide a more stimulating problem- solving environment

- likely to be trade-offs between these goals, media that increase performance can inhibit learning. Furthermore, the usefulness of media can change with task complexity

- graphical presentations appear to support performance over textual approaches particularly when the tasks become more complicated. Graphical interfaces supported learning as well

- expressiveness and the signal-to-noise ratio is a way of measuring a medium's capacity for supporting performance or learning - did enable us to discuss the water bath results and compare media effects