Intelligent Voice User Interface to enhance the efficiency and reliability of Air Traffic Controllers  
- Proposal for M.S. Thesis

Intelligent Voice User Interfaces have the objective of making communication between man and machine more effective. It makes use of the mode of communication people are most comfortable with – speech. Voice User Interfaces are in fact only a special case of the Command Line Interface where the user must learn special syntax to communicate with the system. This is not a very intuitive way of communication. That is why Voice User Interfaces must have enough intelligence to understand natural language and inquire about the information it needs and it finds lacking, to ask when it doesn’t understand and to respond appropriately to the commands given. Such intelligence is built into the system via an intelligent agent (chat bot), which can understand natural language and is designed to respond to it with natural language. Agents like that are commonly rule based and designed to listen after triggers in the input, which they have predefined responses to.

According to the National Plan for Civil Aviation Human Factors (National Aeronautics and Space Administration, Department of Defense and Federal Aviation Administration, 1995) the biggest problem in Air Traffic Control (ATC) is efficiency and reliability of the humans involved. The controllers are presented with a lot of information, which they need to respond to. They have automatic input from radars and they have manual input from the pilots. The controller oversees information from many airplanes at a time that are entering or leaving his airspace. Therefore it is interesting to study how the input and output of information to and from the controller can be made so that the controller is more efficient and reliable, even in highly stressful situations.

All traffic controllers use headphones and microphone in communication with the pilots. Therefore they have all the equipment at hand for Voice User Interfaces. Traditionally the controllers use the headphones and microphone for communication with the pilots. However, some research has already been done into how the controller can make better use of his headphones and microphone. To take an example, at the latest conference on ATC held by the Eurocontrol there was a lecture on VUI which focused on making the system understand the speech better (Schaefer, 2001) this is done so that the user really can control the air traffic by voice only. The commands given are registered in the system and the user never needs to type in anything.

However, little effort has been put into research on how a Voice User Interface can support the process of air traffic control. Like discussed above, an Intelligent Voice User Interface is able to support the controller by listening to what the controller says and respond to it when appropriate. Therefore, the proposal here is to introduce an intelligent artificial agent into the communication between the controller and pilot to enhance reliability by e.g.:

1) Listening for information that is missing
2) Listening for information that is wrong
3) Inputting the information into the system so that there is no mismatch between what is said and what is input and to reduce the load on the controller of inputting the information.
4) Assist with training – the artificial agent can simulate the communication so that it is certain that the controller will give the correct information in the correct form and in correct order.

The intelligent agent is designed to support the controller by responding to the controller’s input. Since the communication the controller is taking part in is highly structured it is very convenient to design an agent that can listen to input and respond to it. When communication is ongoing smoothly the intelligent agent is silent but can intervene when there is something unusual going on. This is dependent on workload on the controller i.e. in emergency or otherwise stressful situations or when there is too little traffic. Then the artificial agent can
support the controller in focusing on what is going on, e.g. by double-checking and by entering information into the system so that the controller doesn’t have to do that himself.

This case is very interesting for Intelligent Voice User Interface research because it is a good example of how such interfaces can be used and is an opportunity to research the effects of it in circumstances, which are well defined but nonetheless real and important.

**Thesis**

*Proposed thesis:*

*To research how the use of an Intelligent Voice User Interface can enhance the efficiency and reliability of Air Traffic Controllers.*

The National Plan for Civil Aviation Human Factors (NASA, DOD, FAA, 1995) stresses two things that are highly relevant for this thesis: Human-Centered Automation and Information Management and Display. These problem areas serve as a direct input into this thesis and therefore should be researched in preparation for this research:

1. Information exchange between people
2. Information exchange between people and systems
3. Information display
4. Communication processes
5. Interface Alternatives
6. Workload
7. Automation Dependencies and Skill Retention
8. Operational Situation Awareness and System Mode Awareness

For example, the study of information between people in these circumstances has been documented and researched (Prinzo, 1995; Ward, 1992) and even a corpus has been collected (Godfrey, 1997).

**References**


[http://www.ldc.upenn.edu/Catalog/LDC94S14A.html](http://www.ldc.upenn.edu/Catalog/LDC94S14A.html)


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