DEVELOPMENT AND EVALUATION OF INTELLIGENT TRAINING SYSTEMS FOR AIR TRAFFIC CONTROL

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INTRODUCTION

Intelligent training systems (ITS) concepts aspire to provide advanced features in the computer-based learning environment. Aspects of intelligence can provide systems with adaptability and flexibility in the structure and presentation of instructional material. Modelling of the user's knowledge and experience allows a greater degree of individualisation of training. Representation of teaching strategies allows the system to tailor its presentation to the individual. The dialogue structures which can be maintained by the system allow users much more control over the direction of the dialogue.

With such potential and so many advantages, it would be expected that ITS would be exploited in many application areas. However, the goals of ITS may take rather longer to be realised than expected. In this paper we present a series of projects which chart the progress to usable and useful ITS systems, and we comment on the issues of importance and the essential elements to ensure good intelligent training systems.

BACKGROUND

Logica’s first ITS project was concerned with the evaluation of Expert Systems techniques for use in training. Funded by Royal Signals & Radar Establishment (RSRE), it was awarded in 1983. It lasted two years during which time a number of evaluation prototypes were produced.

It was clear that knowledge-based systems (KBS) with their explicit representation of knowledge and models of expertise could be of significant value for instructional
purposes. However, as a result of this study we concluded that the use of expert systems and knowledge bases in themselves do not provide sufficient facilities or functionality for training. Instructional systems require additional flexibility and expressive power not commonly found in most KBS implementations. The requirements for advanced instructional systems could be stated broadly as having:

- some knowledge and expertise in the application area
- some understanding of the type and level of the individual student
- methods to manipulate the conditions of learning

Based on this approach, the project produced a prototype architecture with the now usual components of dialogue manager, student model and domain knowledge in declarative and procedural forms. This formed the conceptual basis for our subsequent work in ITS.

The subject knowledge contains an explicit representation of the facts, relations and rules in the application domain. Broadly, this knowledge base covers the areas of declarative knowledge and procedural skill.

The student model is an individual fine-grained representation of the student. This model is built up over the course of interactions with the system and contains information on the level and skill of the student.

The difference between the model of competence represented in the knowledge base and the student model defines the training requirement. This requirement is interpreted by the teaching strategy component to determine the content and structure of the next instructional event or sequence. The interactions in which the student engages are used to update the student model.

In 1986, we began a programme of work in air traffic control (ATC) training systems for the UK Civil Aviation Authority (CAA). The CAA believed that in the medium term KBS technologies showed promise in ATC training applications.

This paper is concerned with the development of a series of prototype ITS for ATC. Each of these training systems embodied ITS concepts, but addressed a different type of training need, from intelligent courseware to simulation training. The evaluation of these projects offers a perspective from which we discuss the essential elements involved in ITS development.

**AERODROME CONTROL SIMULATOR**

The overall aim of this project known as CAI was to demonstrate the use of KBS technology in the context of ATC. This aim was refined into an objective to develop a generic knowledge-based instructional framework which would address the transition between theory/knowledge and practice/skill in ATC training.

The area of ATC selected for the training system was aerodrome control. Aerodrome Control is the first practical (simulation) exercise encountered by students at the College of ATC (CATC); the practical sessions follow on from a course of lectures on theory. Students try to implement what they have learnt in an existing rudimentary aerodrome simulator under the guidance of an instructor.

**Training Requirements**

The training need on which CAI concentrates is the strategic management of traffic and information passing aspects of Aerodrome Control. Students must apply their knowledge of the wide-ranging theory on aerodrome layout, rules and limitations by which the traffic is constrained. The complete task of Aerodrome Control also incorporates the skills of Radio Telephony (RT) and flight strip management which are not addressed in the CAI system.