TOWARDS A LANGUAGE FOR SELF-DIRECTED LEARNING BY COMPUTER FACILITATED INTERACTION WITH LARGE VISUAL KNOWLEDGE BASES

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The capabilities of the laser videodisc system, when interfaced with a computer are considered to have tremendous import for building visual databases and retrieving information from them intelligently. Such a hardware system is called an "interactive videodisc system". When such an interactive system is combined with software arising from the methods of artificial intelligence, "interactive visual knowledge models" can be created. Such models can have important implications for the uses of programmable systems in education, known as "computer assisted instruction", or CAI. We propose to create an "interactive visual knowledge modeling system" for use in visual **data base** retrieval and in computer-assisted education. Eventually, with extensions of the hardware systems to include sound and other forms of output, and with expansion of its capabilities for detecting human inputs, like touch, voice or kinesthetic gesture, a system with proprioceptive intelligence is created and is termed, an "interactive sensory knowledge modeling system".

Software development tools and a computer language have been conceived to facilitate the development of such a system.

Traditionally, there have been two schools of thought in computer-assisted instruction, or CAI. From one school have arisen computer languages like the PILOT lesson authoring system and the TUTOR language for Control Data's PLATO system. These systems facilitate rote-learning models where repetition and computer feedback about lesson exercises or test results is the primary means for interaction with the student user. Another school of thought believes the student should learn by programming the computer. From this thinking has arisen the LOGO language for very young users. Learning in this system takes place through individual discovery and self-analysis. We choose to term the first method, "computer assisted instruction", as contrasted with the second, "computer assisted education". Our approach is more closely allied with the second manner of thinking and extends the possibilities for student discovery by many orders of magnitude.

In addition, this approach may facilitate more intelligent search procedures for large visual databases than now exist.

Assuming a large visual database of imagery relevant to a given subject at hand, the user of this system may begin simply by observing the imagery at a starting point. Then, stimulated either by a system prompt or by his/her own inquisitiveness, he/she may stop the system. When this happens, the video image present will appear in a "freeze frame", over which will be printed a schematic representation of key elements contained in the frozen image. The method of schematization, an outgrowth of research in artificial intelligence, allows one to represent the information contained in the scene in the context of a knowledge model. This representation can include:

- foreground and background attributes of a scene,
- forms of interaction for these attributes,
- associations of attributes,
- context contingencies for the knowledge model,
- implications for other knowledge schemes,
- pointers to other scenes,
- conceptual dependencies,
- associations using a unique model of graphically mapping multidimensional "concept spaces".

All of this produces a rich form of cross-indexing of information in the visual "data" base "according to a knowledge model" and forming a visual "knowledge" base. This knowledge model can be changed, of course, by a user programmer, or it can be made to evolve dynamically, according to commonly encountered "association paths" arising from the "branching patterns" of user sessions.

The system user, upon seeing the knowledge scheme superimposed over the visual image, may proceed in several ways. He may wish more detailed information about something shown in a scene, either a foreground or background attribute. Then, by selection of "items" from the knowledge scheme, possibly made with some touch sensitive device, the system can be directed to branch to another point in the visual data base containing scenes having knowledge schemes, the elements of which bear relationships to each other which match corresponding relationships found in the old scene as closely as possible. This is procedure by "specified selection". Alternatively, the user may proceed by assertion of her/his own hypotheses, represented by the creation of her/his own knowledge scheme to describe a current scene. Subsequently, the system branch will be to that point in the visual database, the description of which most closely matches the user created scheme. Searches may proceed by three means: 1) by order (one after another), 2) by proximity (i.e. comparisons, A is more like B than C, etc.), or 3) combinations (programmed selection of sequences or groups). Feedback about the quality of matches, (closeness of comparisons), is provided.

In this way a user may proceed to create her/his own route through a knowledge base, learning by inquiry or by testing her/his own assertions about the knowledge system represented.

This method has been applied on a theoretical basis to the teaching of math concepts contained in the California State High School Math Competency Exam, to a topic in music history, "Jazz of the Forties", and to the socio-political history of the same era.

It is believed that such a system will facilitate profound learning opportunities. As Piaget has stated, an important aspect of play lies in "the modeling of one's own mind". Self-directed traversal of a knowledge base bears a close resemblance and involves the motivation for learning. We believe that a technological medium for facilitating this style of learning can be created with the above methods.

We are ready to develop such a system and believe it to have additional important implications for the technology of large visual data base management and retrieval.