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Intelligent Feedback System (IFS) in Tele-Learning Environment

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Abstract

This paper describes the innovative Learner Intelligent Feedback System (IFS) in terms of a set of three agent: Interface Agent (IFA), Information Agent(IMA), and Intelligence Agent(ILA). The agent can deduce the correct answers to test questions and provide intelligent feedback and hints to the learner. The intelligent feedback system is : Firstly, system presents content in initial learning style. Secondly, learner takes a diagnostic test. Thirdly, system analyzes user performance. Fourth, system identifies concept deficiencies and chooses the best learning model. Finally, system dynamically creates a remedial course tailored to the learner. The learner takes the remedial course, at the end of which is another test. If the learner still does not get the concept, he or she is returned to another dynamically generated course presented in a different learning style. At the same time the tutor agent notifies that one of her students is having trouble. The Tutoring agents are the driving engine of the system. Their main tasks are to generate appropriate learning feedbacks for learners and provide new learning problems and advanced situations. IFS can be used for complete course training, including test from a remote site.

Keywords: *Interface Agent, Information Agent, Intelligence Agent, Intelligent Feedback*

1. Introduction

The AI technological development and the wider accessibility of high-quality telecommunications are benefit to bring about a significant change in tele-learning. Tele-Learning is an excellent source for educators and trainers who would like to teach online courses via the Internet. It explores many possibilities in planning, designing, implementing and managing different opportunities of Internet technology in learning evaluation systems[1]. Learner evaluation plays an important role of within the tele-learning, so evaluation system must be designed to satisfy several key requirements. These key requirements are derived from multimedia application development system which is interfaced with computer engineering, computer network technology, multimedia technology, AI technology, and education engineering[2]. Agents are being used in an increasingly wide variety of applications. Currently, agent software is a topic of growing interest to users and developers in the education field and learner feedback system[5]. The idea of intelligent software that performs the role of a human assistant is being explored in a wide range of education. IFS(Intelligent Feedback System) aims to provide learners with individualized, dedicated feedback based partly upon an analysis of the procedures followed by the user, which may

provide some assistance on how the user should progress. This can only be achieved if agent knows what they teach, whom they teach and how to teach it. In an IFS, the environment of each agent consists at least in part of other agents, all engaged in a similar learner evaluation process. To illustrate the multiple agent architecture, we describe a learning environment composed of multi-agent based on the IFA, IMA and ILA[9]. This system proposes the implementation of learner intelligent feedback system between learners within campus/at home and agent tutor in cyberspace[4]. During interactions with the domain experts, the agent learns general rules and concepts for test generation and explanation, through apprenticeship and multi-strategy learning, synergistically combining various learning strategies such as explanation-based learning, learning by analogy and experimentation, and empirical inductive learning for examples. The purpose of this study is to construct a companion agent learning environment within the framework of a multi-agent system.

2. Description

In this paper we focus on four aspects, learning style, intelligent feedback, agent process description, and student model. IFS provides continuous, intelligent feedback, guiding students into the learning style that's best for them[3]. The system also provides diagnostic quizzes after each key concept. The purpose of a diagnostic quiz is not to grade, but to confirm that the learner understands the concept. In order to teach interesting changes, IFS provides adaptive learning process. The adaptive learning process is : Firstly, system presents content in initial learning style. Secondly, user takes a diagnostic test. Thirdly, system analyzes user performance. Fourth, system identifies concept deficiencies and chooses the best learning model. Finally, system dynamically creates a remedial course tailored to the user. The student takes the remedial course, at the end of which is another quiz. If the student still does not get the concept, he or she is returned to another dynamically generated course presented in a different learning style. At the same time the tutor agent notifies that one of her students is having trouble.

2.1. Learning Styles

Tutors have long understood that different learner learn in different ways. We have developed many learning models to describe the way people learn. IFS have synthesized learning styles that represent the broad spectrum of ways in which people learn. The learning styles are: Learner learns step-by-step, following the lead of the teacher. Learner learns through case studies or storytelling. Learner is exposed to a number of examples leading to a conclusion about a general principle. Learner learns a principle, then applies it to extrapolate trends or observe parametric variation. Learner learns by conducting experiments, then analyzing the results. In addition to a student's learning style preference, IFS also takes into account the student's preference for delivery media - text, audio, video, simulation, etc. IFS are many ways to experience an adaptive evaluation course, enough to let every learner learn the way he or she wants to.

2.2. Intelligent Feedback

By recording the various diagnoses made during the learner’s problem solving activity, the system can evaluate the learner not only on the basis of the present state of the exercise, but considering also the process through which the present state was reached. As a learner progresses through a course, IFS continuously collects data on the student's performance,

steering the learner into the learning style that best fits him or her and ensuring that every student masters the material. Meaningful interaction between the learner and the system is achieved by a number of means: First, learners provide natural language input rather than selecting exclusively from among pre-defined answers. Second, the IFS use ILA to analyze the learner's input and to provide error-specific feedback. Third, the system contains a Student Model which keeps a record of students' performance histories. The information about each learner in the Student Model determines the level of specificity of feedback messages, clues, and exercise difficulty.

2.3. Student Model

The Student Model is a representation of the current skill level of the student. The Student Model is based on the performance history of the student. For each student the Student Model keeps score across a number of error types. IMA contains detailed information on the student's performance. The score for each subject increases and decreases depending on the analysis of the student's performance. The amount by which the score of each subject is adjusted is specified in an IMA and may be weighted. Student Model also contributes to the interactivity of the whole system by providing error-specific feedback and adjusting to different learners. The information about each learner is recorded in the Student Model and determines the level of specificity of feedback messages and exercise difficulty.

The Student Model has two main functions: First, the current state of the Student Model determines the specificity of the feedback message displayed to the student. A feedback message is selected according to the current score at a particular subject. Second, the difficulty of the exercises presented to the student is modulated depending on the current state of the Student Model. If a student is rated as advanced with respect to particular area, then some of the exercises are made more challenging. The same thing can be found with some of the other exercises. The Student Model also performs error-check by the system in analyzing student input. This allows agents to quickly improve their Student Model, and learners to familiarize themselves with and better exploit the information space and capabilities of their agents.

3. IFS Configuration

The IFS can automatically contribute to the common good, because each agent can share information with other agents. Since users provide relevance feedback, we can view the process of determining whether a change is interesting as a classification task, and the process of learning a user profile is a supervised learning task. Learner actions are tracked. Patterns of interaction are captured and analyzed. Intelligent agent is also commonly associated with the study of learning style, which attempts to classify learners and their approach to learning.

Figure 1 shows the flow of information between user and agent. IFA in analyzing learner input is an answer check. The Answer Check module further matches the extracted learning style with the IMA. The Match Check looks for correct answer by matching the student answer with the IMA. After correcting the error, the learner restarts the checking mechanism. Learner performance in each exercise contributes to the Student Model(history DB). In addition, there are two ways in which this information is used by the system: Firstly, feedback messages tailored to student expertise, secondly, difficulty of exercise presented to student. We get updated and illustrate the feedback message and exercise difficulty modulation for each exercise type. Interactivity is achieved by a wide variety of exercise types which are

arranged in an independent order. ILA provides the ability to monitor the learner's behavior at an appropriate level and the ability to provide feedback to learners in a flexible evaluation environment.

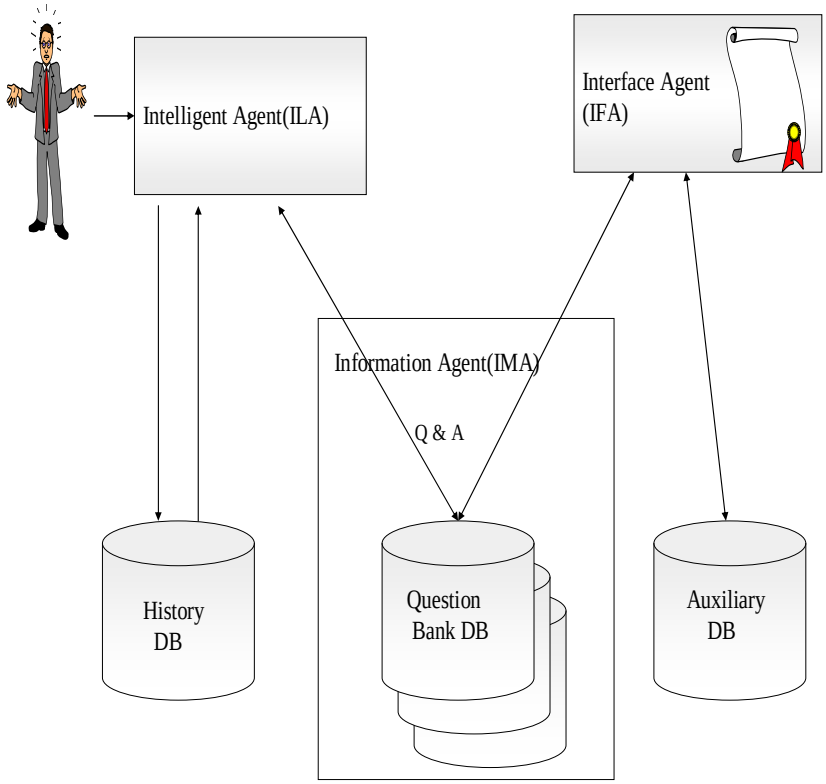

Figure 1. Configuration of the Intelligent Feedback System(IFS)

4. Agent Description

The agent should be able to personalized; it should learn what the individual learner is trying to do. The tutor controls the agent by teaching it. The tutor develops a mental model of what the agent knows about the task. The agent learns from its mistakes. The agent learns continually, integrating new cases with prior knowledge. The learner should not be required to interact; the agent can learn by watching the learner work. The actions of each agent thus affect not only its reward and information state but also the future rewards and information states of other agents. In order to track interesting changes, an agent needs to know what changes are interesting and where to find them.

4.1. InterFace Agent(IFA)

IFA monitors learner activity through Audio/Video. It is also controls the evaluation session starts, terminates, joins and invites. Structured presentation of test paper form is determined by tutor. The tutor distributes the test paper to the learners, and a test starts. IFA provide assistance to user by presenting them with examples of relevant experience. Test

papers are encrypted to prevent illegal access. IFA also provides a subject evaluation content, feedback, and learner advisement on demand from the learner. Proper links has to be provided as the reference materials. Links and references to internal and external sites can also be provided. Learner-focused testing services include: excellent test paper creation/deletion/registration.

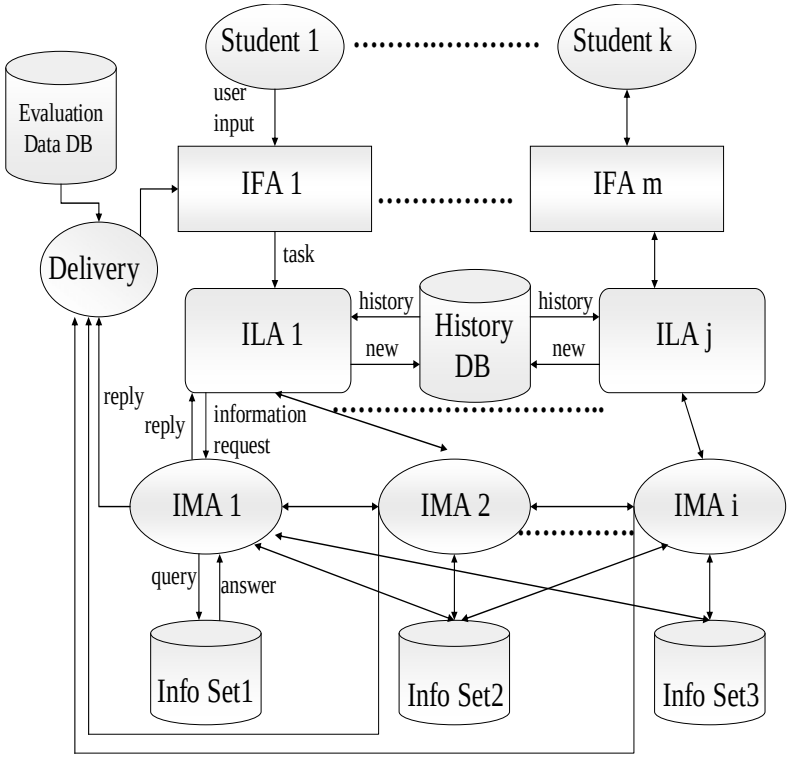

Figure 2. Process Description of the Intelligent Feedback System(IFS)

The instructional objectives, process, and methodologies are used to the test paper. A test paper is highly refined learner-centered a test paper methodology ensures understanding of subject concepts and features. IFA prepares a test paper using the various tools to create, edit and format a document. IFA also provides an editor form make anyone facilitating. It is possible to compose test material using the document editor. Authentication was guaranteed because only enrolled learners received a learner name and password. A login and a password identify each learner. Learner response data are automatically collated and processed via IFA. The development of evaluation content based on such technology as graphics, image, voice, and video has become the resource for learner evaluation service. The IFA serves two functions. Firstly, to present the system generated exercises and associated information to the learner. Secondly, to translate the learner responses which are to be processed by a ILA. However in view of the argument that a system appears only as intelligent as its interface, the decision was taken to enhance the user interface as an important component in the architecture of the IFA.

4.2. InforMation Agent(IMA)

IMA is a realistic knowledge base and associated exercises to enable an effective evaluation of the potential use of the system. In developing the realistic knowledge base several problems came to light. Firstly, it was apparent that the system deeded to be flexible. Negated conditions in an argument had to be recognizable. Although the main idea behind tutor was to treat the system's ability to construct an agent as analogous to answering a case analysis exercise, it was apparent that learners could not always be expected to complete an exercise to the level of detail expected by the system. Agent could not be adjusted to suit the needs of individual users. IMA presents information in an interactive and informative way. The agent should teach users its subject knowledge and its background knowledge through the feedback it gives.

IMA provides a various function: creating and modifying a database structure, and adding, editing, deleting, and retrieving records through querying, and, working with multiple tables in both queries and reports. IMA is also included generating links, creating tables, capturing data. The IMA has an object with various information for each evaluation session. The list of valid response/invalid response is stored in a database. IMA examines known test results for interesting changes as specified by a Student Model. IMA is the main body of knowledge about Student Model. IMA contains sufficient knowledge to generate a series of exercises with system generates solutions.

4.3. IntelLigence Agent(ILA)

ILA guarantees learner responses. Once the learner starts taking test, ILA automatically calculates the total time taken to complete it. After the test is activated, questions and answers are done interactively in the evaluation session and evaluation can be taken either an online or an oral. ILA is responsible for the step-by-step instruction and evaluation of a learner learning. ILA combines a test result with the natural incentives for individual learners to maintain and train their own agents. ILA defines as the program that is able to evaluate and offer advice to the learner using the tool. ILA provides the ability to monitor the learner's behavior at an appropriate level and the ability to provide feedback to learners in a flexible evaluation environment. That is, the ILA offers the same evaluation of learner performance and the same advice to learners, regardless of the tool that it is working with. This is accomplished by creating a library of prototypical cases of success and failure, treating the learner's experience as though it were a case, and matching the learner's case and retrieving the most similar, relevant case for remediation.

ILA acts as sub-topic experts who have access to problem solving experiences, context sensitive help and advice, conceptual and procedural tutorials, and histories of success and failure within their particular sub-topic. ILA assists in tutoring the learner about how to apply the particular higher order thinking skill to the writing task. As a result of this reasoning process, ILA can deduce the correct answers to test questions and provide intelligent feedback and hints to the learner. If the response entered by a learner is valid, the unfilled evaluations are presented to the learner. Once the response is submitted by the learner, the data are then collated and stored in a database. ILA monitors test result previously examined by the learner to be relevant for any changes. Simply by pointing sub-agents at other agents, changes and opinions can be propagated from agent to agent automatically. By actively involving IMA in the search, ILA obtains immediate feedback about learner's suggestions.

ILA automates periodic visits to IMA to detect interesting changes on behalf of agents. ILA monitors learner's progress when they need their particular help. ILA will coach the learners by sharing their expertise in the form of prototypical case studies, problem-solving

dialogs, and pre-packaged tutorials. Instead of judging learner actions on a step-by-step basis, the ILA considers complete solution paths and offers advice only when the learner completes the problem. In the agents presented here, we might have a situation where multiple agents want to present a feedback at the same time. ILA maintains a list of test results that it is monitoring. The tutor receives messages from each of the agents and resolves disputes based on a conflict resolution strategy for each area of activities. After each learner action, the translator collects all types of feedback, evaluations and suggested activities, applies the conflict resolution strategies and then implements the winning actions.

The ILA defines several types of feedback, including presenting text messages, flagging, pointing and selecting. For text messages, the conflict resolution strategy considers three things: the source of the message, the message category and the message presentation format. Since this request can be refused, the translator sends a feedback content message to all tutor agents, indicating the feedback to be presented to the learner. Pointing and selecting are considered to conflict if they specify different objects. This kind of conflict is resolved by the ordering of agents. For this reason, in response to a feedback content message, a tutor agent can send a cancel-feedback message, indicating that it no longer wants the feedback presented.

Following all cancellation messages, the ILA sends an acknowledge feedback message, indicating that the tutor agent should go ahead and present the feedback to the learner. When the IMA receives acknowledge feedback messages from all ILAs, it proceeds with presenting the feedback to the learner. The feedback content messages serve another purpose. Since they are sent to all ILAs, each agent can tell what kind of feedback is being given to the learner by other agents. In general, ILA in the same system might have different evaluations of learner performance.

5. ILA (Tutoring Agent) Description

In our proposed intelligent feedback system based on intelligent agent, the Tutoring agents are the driving engine of the system. Their main tasks are to generate appropriate learning feedbacks for learners and provide new learning problems and advanced situations. In this section, we will explain how the Tutoring Agents function and how the behavior process of each agent is implemented [3].

5.1. Tutoring Agent

A Tutoring Agent is usually related to Student Model (Learner Modeler) and didactic decision-making [7]. This agent delivers questions and provides immediate feedback to learners. The Tutoring Agent of this system offers an adaptive tutoring environment, where learners with different learning goals, different preferences, different learning profile, and different learning aptitudes are treated differently, by building a model of learning knowledge and preferences about each learner. In an effort to provide a more verisimilitude, this system is emulating a mentor who analyzes each learner's documented activities to provide feedback. In order to initiate problem-solving activities, the tutor or learner using the system may invoke the IMA to perform search of relevant information either from the learning material within the system or on the web. According to the needs of the learner, the tutor can adapt and teach the course again. During the tutoring process help or feedback also takes place in an indirect manner. The Tutoring Agent acts as a sub-topic expert who has access to problem-solving experiences, context sensitive help and advice, and conceptual and procedural tutorials. The proposed system adapts the level and content of learning to individual learner

by analyzing the learner's learning profile and preference and presents the needed course content in a desired form of presentation.

The Tutoring Agent controls a problem solver since it is capable of solving both pre-specified problems and the problems entered by learners. The problem solving KB consists of constraints used for testing the learner's solution for syntax errors and comparing it against the system's ideal solution to find semantic errors. It enables the tutor to identify learner solutions that are identical to the system's ideal solutions. More importantly, it also enables the system to identify valid alternative solutions, that is, solutions that are correct but are not identical to the system's solution. Each constraint specifies a fundamental property of a domain that must be satisfied by all solutions.

In the system, quiz is randomly generated from a problem solving KB when the learner needs to take the quiz. After submitting his or her answers, the learner immediately receives his or her score with a brief explanation of the answers and a link to the course content where that topic was covered. Immediate feedback and remediation are key components of an IFS to provide appropriate response and reinforcement. Result visualization is followed after interpreting the test result. Also, result visualization is constructed along with the input from the learner. The learner may set up the initial parameters of the problem solving paradigm and interpreting the results. They access the graphical feedback only to verify and correct their proposed solution.

5.2. Feedback diagnosis

In any tutoring system, it is important to consider not only how feedback is given to the learner but also when it is most useful. In the IFS system, the learner has options to choose when feedback is provided. By recording the various diagnoses made during the learner's problem solving activities, the system can evaluate the learner's learning not only based on the present state of the exercise, but considering also the process through which the present state is reached. The feedback mechanism provides a means of controlling the type of feedback provided to the learner. In contrast to the immediate feedback that the system intervenes after each error made by the learner, the final feedback that is given only at the end of the exercise without considering the intermediate steps may cause the learner makes significant errors before there is any intervention. The learner who needs more frequent feedback is most likely to be one who needs more learning exercise for certain learning content. The feedback diagnosis performs an analysis of the learner's answer by calculating the semantic closeness between the learner's answer and the correct one.

5.3. Tutoring Behavior Process

The Tutoring Agent coaches the learners by sharing its expertise in the form of problem-solving KB and pre-packaged tutorials. After each learner's action, the Student Model collects all types of feedbacks, evaluations, and suggested activities, and then applies the conflict resolution strategies to implement an appropriate tutoring action. The feedback and assessment content and activity content messages, along with the acknowledgement messages, provide indirect clues for tutoring. According to the information obtained from the Student Model, the tutoring process follows several consequent steps. First, after a learner spends some time to solve a learning problem, if the problem does not look familiar, the learner asks the tutor for a hint. Next, after reading the hint carefully, the learner should decide whether a more detailed hint is needed or not. Through this reasoning process, the

agent can deduce the correct answers to test questions and provide intelligent feedback and hints to the learner.

The Tutoring Agent evaluates the learner's answers and gives specific feedback. In synchronous mode, learner can ask questions about the learning material and learning question at any time, then the human tutor can answer with a relevant reply. The tutoring activities are also connected to the learning profile of the learner. For example, when making suggestions about how to set initial parameters for learning, the Tutoring Agent advises the learner more or less, depending on the learner's profile. During the tutoring process the system selects a problem and compares its solution with that of the learner and then performs a diagnosis based on the differences. After giving feedback, the system reassesses and updates the Student Model and the entire cycle is repeated. As the system is assessing what the learner knows, it is also considering what the learner needs to know, which part of the course is to be taught next, and how to present the material. It then selects the problems accordingly.

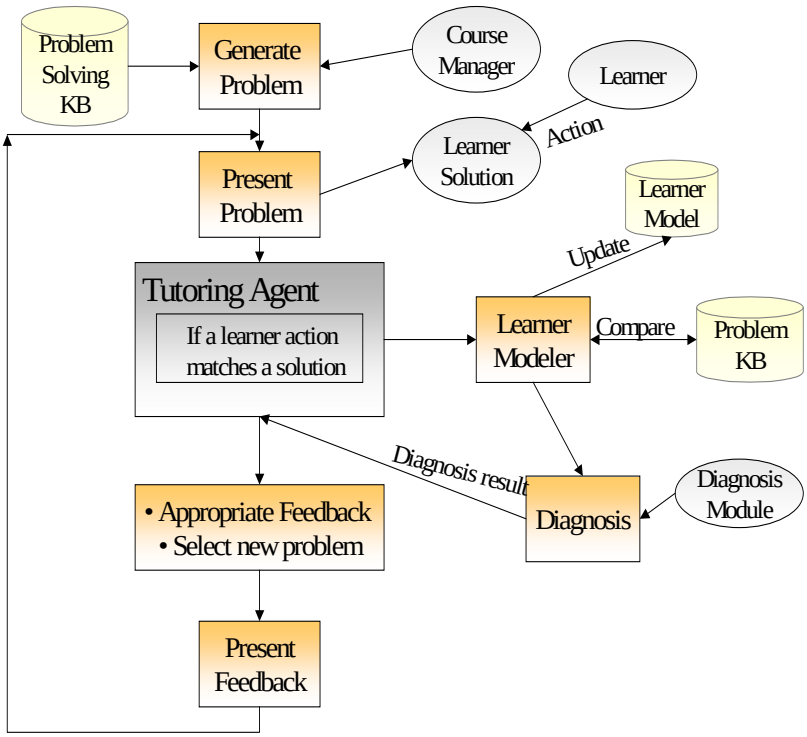

Figure 3. Process of the tutoring behavior

All learner actions are then sent to the Tutoring Agent. If a submitted action initiates a solution to the current step, the Tutoring Agent sends it to the Student Model, which diagnoses the solution, updates the Student Model, and sends the result of the diagnosis back to the Tutoring Agent, which generates feedback. If the learner performs an incorrect action, that action will violate some constraints and the system responds by generating an appropriate feedback message which explains the general principle violated by the learner's action. In tutoring process, feedback can be very detailed by instantiating parts of the feedback according to the learner's action.

The Student Model evaluates the learner's solution against the knowledge base and updates the Student Model. Student Model is used to select problems of appropriate complexity for the learner, and to generate feedback. The level of feedback is incremented with each submission until the feedback level reaches the detailed hint level. Regarding the level of feedback the system gives the learner the freedom to manually select the level of feedback according to individual needs. Also the system implements rules for generating a variety of tutorial actions including tutoring steps and giving positive or negative feedback.

6. Conclusion

This work proposed the implementation of an intelligent learning system between learner and tutor in tele-learning environment.[6] The goal of this system is to use the disciple approach to build intelligent agents that expand the capabilities, generality and usefulness of intelligent learning software. The agent-oriented learning system aims to develop a new programming paradigm.[7] IFS consists of various agents : IFA, IMA, and ILA. IFS has a various communication type, a question and an answer, multi-test session, high degree of efficiency, high degree of cooperative, low degree of periodical cost and time constraint. IFS is to provide an easy to use interface, so that the learners are motivated to use it for their learning. IFS is designed to include a test paper editor to conduct tele-learning system. We also developed a set of requirements that must be supported by agent in order to perform an effective learner tele-evaluation.[8] IFS has many other advantages, which enable online test, high degree of data management, intelligence agent and management of attendance. We considered our IFS, usability and applicability, and concluded that it can be used for the tele-learning environment. During interactions with the learners, the agent learns general rules and concepts for test generation and explanation, through apprenticeship and multi-strategy learning, synergistically combining various learning strategies such as explanation-based learning, learning by analogy and experimentation, and empirical inductive learning for test. The use of IFS in a teaching domain has several advantages. A practical advantage is that the learner has to implement an intelligent agent for the new domain and not a complete new system. A Second, theoretical advantage is that the main knowledge of the shell can be oriented toward general theories and strategies of tutoring whilst at the same time providing a means to test their generality in different domains. IFS was designed to help learners train interesting course, using both technical and Student Model. Student Models are obtained directly from users while they are browsing and require their active participation. There has been considerable effort devoted to the Student Model on the KB, focusing on flow process of agents. In the IMA, index creation and lookup systems, treat the Web as a database of information to be cataloged and indexed. There are also IMA that check ILA for any modification. ILA automates periodic visits to selected pages to detect interesting changes on behalf of individuals. An intelligent agent in feedback system which is designed to teach consultants how to identify problems that may face a learning, and to expose them to potential solutions to those problems. The Tutoring agents based on ILA are the driving engine of the system. Their main tasks are to generate appropriate learning feedbacks for learners and provide new learning problems and advanced situations. The purpose of this study is to construct a companion agent learning environment within the framework of a multi-agent system. IFS is become a more capable feedback system so that learner can get learner's test done more efficiently.

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