Multi Software Agent Based Intelligent Tutoring System

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***Abstract* - This system deploys the multi agent approach which is one the Artificial Intelligence (AI) techniques of problem solving via software agent in carrying out training, teaching as close as human could handle it. Human beings could tell when a student is following a lecture or not by looking at the disposition of the students or their immediate reaction while the lecture is going on. The multi agent is deployed whenever the problem at hand is complex. The complexity here is being able to teach, and monitor the level of assimilation of the student concerned at the same time to be able to choose the right learning path while tutoring. This became pertinent at this time because of the mass failure during examination especially in Nigeria. Greater percentage of students fails examination because of lack of understanding of the subject matter. The only way the previous systems where able to know the level of assimilation of students under tutor is by conducting examination. It widely believed that if a student passes examination then he or she understood the subject matter and in the case of failure the opposite is the case. However, this is not always true. Recall that examination is not the true test of knowledge. Failure could be caused by many factors and one major factor which this system handles is proper assimilation while learning. Therefore, this system serves as a solution to the problem of mass failure in examination by ensuring that students grasp the subject matter on learning before facing examination. In this paper, we x-rayed the architecture of a typical Intelligent Tutoring System (ITS) which is formed by the three components that generally characterize an ITS – the Student Model, the Domain Model, and the Pedagogical Model with special emphasis on the software agent that monitors students progress within the Pedagogical model and lastly draw conclusions.**

***Keywords* - Intelligent Tutoring System, Multi Agent, Software Agent, Human Agent, Multi Agent base, Intelligent Computer-assisted Instruction**

I. INTRODUCTON

Over a decade, there had been a detailed study in the field of ITS. However, the ITS development is still a complex process because the functionality of ITS is complicated[17].Therefore this paper was tailored towards a model of ITS that will teach a subject matter exactly the way human agent (human beings) will do. Human beings have that excellent teaching ability that makes them better that any system developed to mimic it. But as the years goes by, researchers have being trying to get closer and closer to human. With other Intelligent Tutoring Systems, verifying the understanding level of students was practically impossible without testing the student in the end of the session. Reverse is the case with this system. This system has the ability to ascertain the comprehension level by teaching and as well monitoring the comprehension level of the students so as to continue in the existing teaching path or choose another path which the student will understand. This ensures that the teaching process does not come to an end before the system gets the understanding level of the students in question. This makes this system closer to the natural human teacher who has the ability to be teaching and could ascertain if the students are following or not by their reactions. This system eradicates that stereotype teaching methods often deployed in Artificial Intelligence (AI) and making it more interactive and enjoying. For example, if this system is to be teaching a subject say

a General study course in tertiary institution (GNS 101-Use of English) with subject caption PRONOUN. This system will have 2-3 meaning of the above caption within the system. If it defines it or explain it with one path and prompts for continuity and the student declines it then it follows the second path to ensure the students understands it before it proceeds. This is how this system is meant to works and we know that this system will really serve in great capacity for corporate, tertiary institutions etc if fully deployed. This system does not underscore or eliminate the examination of students. Examination of students is still very relevant and that is where other previous researchers have focused on in attempt to get out or test student understanding of a subject matter. Therefore, this paper, focuses on the learning process as a means of impacting students and at the same time ensuring the students comprehension before forging ahead without examining the students. This is a very complex process which will be achieved by multi software agents that could be teaching and at the same time monitor the comprehension level of the students and thereby choosing the right path that the students will comprehend while teaching.

II. HUMAN AGENT BASED TUTORING

This is the tutoring system commonly used in teaching students. Teaching without the application of Information Communication Technology (ICT) in the area of artificial intelligence. This is the manual tutoring system where the human being itself (human agent) is directly involved in the teaching process and as well conduct examination. This is what is obtainable in most tertiary institutions in Nigeria and environs. This has lots of short comings as well as its strength. The imperfection, unreliabity, and inaccuracy of human agents are the reason for this new system. The flexibity in using human agents while teaching, in terms of knowing when the students are not following as the teaching is going on and possibility to explain the subject matter in another way immediately is one of its advantages which this new system intends to incorporates. Artificial intelligence in teaching is advancing, coming closer to the human agent as the year goes by [3], [4].This advancement was possible by the use of authoring tools [2].

III. INTELLIGENT TUTORING SYSTEM (ITS)

It is a collection of software that contains a knowledge-base on a subject matter which is designed to emulate a human tutor by transmitting knowledge to students through an interactive individualized process, thus facilitating a student in his learning process. Commonly, an ITS is composed of at least three modules: an expert (or domain) model, a student model, and an instructor (or pedagogical) module [1]. The expert model represents information specific to the subject being taught, the student model portrays the current student understanding or misunderstanding of the subject domain [6] and the instructor module contains knowledge required of teachers to select meaningful lessons for their students. For example, if the educational topic of interest is a subset of Euclidean geometry such as geometric proofs, the expert model might contain information such as the relationships between angles in a triangle, e.g. the sum of the measures of the interior angles in a triangle is 180 degrees. The student model would then contain a representation of the geometric knowledge the student has grasped, possibly including any misconceptions the student has apparently formed. In contrast, the instructor module should be wholly, or at least primarily, independent of the domain. It would contain, for instance, generic information about what criteria determine when a student needs to repeat a portion or all of a topic, and an engine for generating or selecting relevant questions. One of the most difficult problems when designing an ITS is effectively determining and representing the student's current knowledge of the subject at hand. While important progress has been made in ITS development, effectively modeling the student continues to present the designer with significant challenges [6]. These challenges arise primarily from inconsistencies in student reasoning. Students sometimes change their minds, learn new material, unlearn old material, and make careless mistakes [7, 8]. Moreover, students do not necessarily have the ability to completely search their knowledge [7]. They may know a concept but not recall it for an application. In order to model the student's state of understanding, the program must attempt to follow the student's reasoning. A common method for modeling the student is through the use of state models. By providing expert solutions in the form of state models, an overlay method can be used to track the student's progress towards expert solutions [5]. The overlay method treats student knowledge as a subset of expert knowledge. When the student attempts a solution to a posed problem, an overlay student model tries to "overlay" the student's solution onto the expert solution. This works fine when there is one expert solution to the problem. In such a case, the student is either working on the expert solution, or not. A problem arises when there are multiple solutions to the given problem [1]. Since the student could choose one of many solutions, or possibly try several before settling on one, tracking these many

approaches with a state model has been a problem. Recalling the inconsistencies in student reasoning discussed in the previous paragraph, it is evident that multiple expert solutions magnify the problem of the student changing his mind. One proposed solution is to use multiple agents to simultaneously represent states in several different solution paths [1]. Using independent agents allows representing several possible states for the student. These states can then be used to help predict the next state the student will enter. By using expectation driven analysis, the best student model can be selected based on how well it's predicted state agrees with the student's actual behavior. In most other student models, only one path for modeling the student is tracked, thus restricting the expected next states to those that follow the selected line of reasoning. Since it is not uncommon for a student to try multiple approaches to a problem before settling on one, the multi-agent method allows for more flexibility in modeling student behavior, and thus a better match with the student's real behavior. A shortcoming of the multi-agent model, as presented by Leman, [1], is the inability to learn from student solutions. The student model expects to have a complete set of solutions for the problems presented. Any solutions not found in its knowledge base are considered wrong. Acquiring knowledge from the student would avoid classifying potentially correct student solutions as wrong, and would provide for a more robust, complete domain model. This author is aware of ITS research effort that explores learning from the student [9].

Commonly, an ITS is composed of three modules [1]:

1. An expert (or domain) model,

2. A student model, and

3. An instructor (or pedagogical) module.

General consensus among researcher often times includes the user interface model to make it four module [10,11] but emphasis will not be on the user interface as it is how the user or students interacts with the system. The expert model represents information specific to the subject being taught, the student model portrays the current student understanding or misunderstanding of the subject domain [6], and the instructor module contains knowledge required of teachers to select meaningful lessons for their students. Hartley and Sleeman [12] identified these same basic requirements for an ITS in 1973. In fact, an ITS can be regarded as a distinct type of Intelligent Computer Assisted Instruction (ICAI), with these three components making the distinction [5]. Some authors have even come to regard ITSs as the ICAI of the 1980's [13], while ITSs have come much closer to realizing their full potential in the 1990's. The prototype for this research makes use of expert and student models, and the functionality of the instructor module is provided by a human instructor. A graphical interface module is also included in the implementation. Despite numerous examples of ITSs employing many different approaches to *intelligence* in tutoring, there are two terms most often associated with them [5]:

1. Cognitive diagnosis, and
2. Adaptive remediation

Cognitive diagnosis entails forming an idea of the student's cognition or knowledge, usually in the form of student modeling. Cognitive diagnosis is addressed again in the course of this work, where it is applied to reasoning about student knowledge. Adaptive remediation is the dynamic application of tutoring based on specific difficulties encountered by the student. Adaptive remediation is typically included in the instructor (or pedagogical) module.

IV. MULTI AGENT TUTORING SYSTEM

A multi-agent system (M.A.S.) is a computerized system composed of multiple interacting intelligent agents within an environment which is called software agent. Multi-agent systems can be used to solve problems that are difficult or impossible for an individual(single) agent or a monolithic system to solve. This is the reason it was decided to involve a multi-agent at this point as to resolve the problem created as a result of using an ordinary or single agent ITS. Single agent tutoring systems cannot teach and at the same monitor the progress of students understanding at the same time. This is the essence of the multi agent intelligent system. Intelligence may include some methodic, functional, procedural or algorithmic search, find and processing approach. Although there is considerable overlap, a multi-agent system is not always the same as an agent-based model (ABM). The goal of an ABM is to search for explanatory insight into the collective behavior of agents (which do not necessarily need to be "intelligent") obeying simple rules, typically in natural systems, rather than in solving specific practical or engineering problems. The terminology of ABM tends to be used more often in the sciences and MAS in engineering and technology. [13] Topics where multi-agent systems research may deliver an appropriate approach include online trading, [14] disaster response, [15] and modeling social structures. [16].Below is the diagram representing a typical Multi-agent Intelligent Tutoring System and how it works.

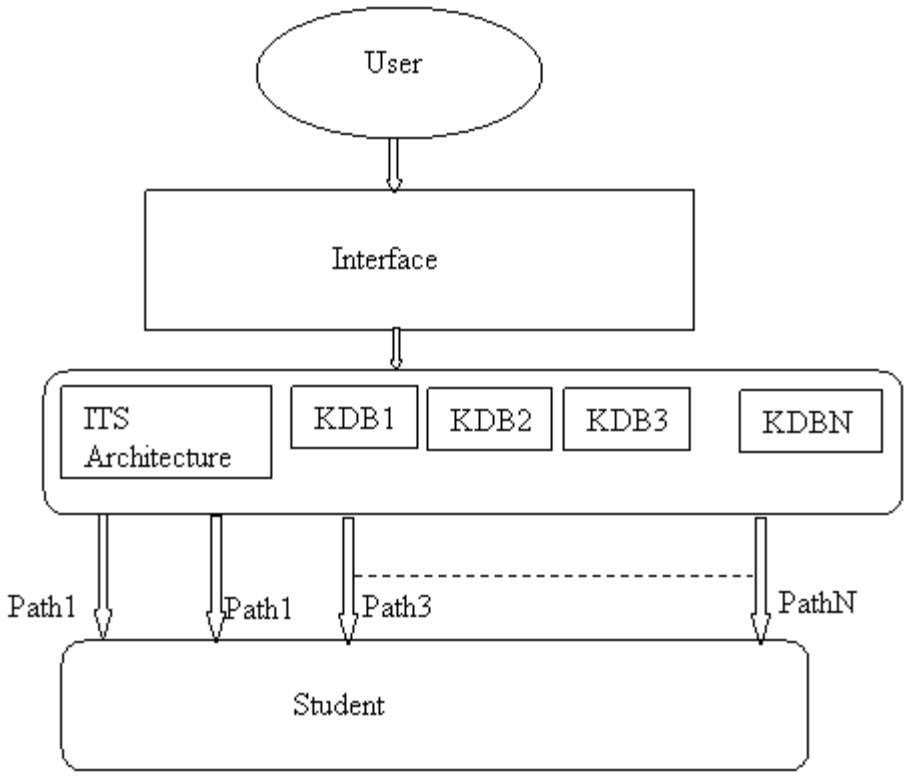

Fig: Multi Agent Student Model System

The above diagram shows the user of the system and the different knowledge sessions in the knowledge base as well as the different path to tutoring the student. We have within the knowledge base from knowledge base 1 called knowledge database (KDB1) to knowledge database N(KDB N) 'N' mean any number of knowledge database or knowledge base or any number of path respectively. Then path 1 to path N represents the different path to knowledge. The system is meant to select path automatically and when the student understands then there will not be any need to choose another path. In a case where the student does not understand, then another path will be chosen automatically.

V. CONCLUSION

This multi agent intelligent system will demonstrate a method for expanding the solution library in the expert module through the use of a learning student model. The method that will be demonstrated has application in a wide variety of tutoring domains, including most training scenarios.

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