Personalized Intelligent Tutoring System using Reinforcement Learning for Autistic Student to Teach Skating
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Abstract— Many intelligent tutoring systems have been developed using different artificial intelligence techniques. In this paper, we propose the use of reinforcement learning for building a personalized intelligent tutoring system to teach skating to an autistic student who can't communicate well with others. We make use of personalized intelligent tutoring system that uses Reinforcement learning techniques to teach autistic basic rules regarding skating and provide instruction to a student based on their needs. The proposed system also gives the test to assess his learning.

Key words: Intelligent Tutoring System, Reinforcement Learning, Artificial Intelligence, Autistic

I. INTRODUCTION

An intelligent tutoring system (ITS) is a computer system that aims to provide immediate and customized instruction or feedback to learners, usually without intervention of a human teacher. An ITS have a common goal of enabling learning in a meaningful and effective manner by using variety of computing technologies. ITS is a system which adapts to what is need of learner and it takes care of learner’s sense and also presents input based on students learning behavior and needs. [1]

In this paper, we propose to use Reinforcement Learning for building an intelligent tutoring system to teach Skating to autistic students, who can’t communicate well with others or they may have exceptional learning skill of unknown origin.

The main purpose behind the use of Reinforcement Learning is that it implicitly trains with an adaptive student model that estimates the students learning behavior and pattern. It has an advantage of not requiring training data to learn as it automatically picks a data which suits in a situation of unavailability of student-specific data.

Based on knowledge of the topic and experience gained during interaction with the student, the system is required to suggest more relevant inputs to the student. To achieve this, the proposed system must have a representation and understanding of the topic or subject being taught i.e. Knowledge Module, the student being taught i.e. Student Module and Teaching Module to pass instruction on students input in an optimal way.[2]

The Knowledge Module consists of problem statements with solutions through which the student learns the measure of difficulty level. It provides hint whenever needed, details of knowledge required to solve a problem and relations between different problem and topic.

The Student Module is based on prior knowledge of student on related topic, his learning habits and environment in which training takes place.

The Teaching Module represents a tutor who has the knowledge about the methods of instruction and defines a solution for a particular method.

II. RELATED LITERATURE STUDY

A. Overview of Intelligent Tutoring System:

Intelligent Tutoring Systems (ITS) are computer-based tutors which act as a supplement to human teachers. An ITS can help to learn student and test knowledge without being controlled by a teacher. The main advantage of an ITS is that it acts according to students cognitive abilities.

The classical model of ITS architecture has four main modules:

- Knowledge Module
- Student Module
- Teaching Module
- User Interface Module. [3]

1) Architecture of Intelligent Tutoring System:

Fig. 1: Traditional Intelligent Tutoring System [4]

a) The Knowledge Module:
The Knowledge Module focuses on what to teach. This module is concerned with the knowledge of the particular domain to be taught. It coordinates the particular concepts within a particular domain.

b) The Student Module:
The Student Module focuses on whom to teach. This module creates student profile based on his learning abilities, learning style, behavior and current knowledge state of the individual student. The main goal of student module is to provide adaptive and personalized tutoring to individual student based on his profile.

c) The Teaching Module:
The Teaching Module focuses on how to teach. It is the most important part of an ITS. This module is the heart of the whole system. It works with the other modules and does the entire decision making.

d) The User Interface Module:
The User Interface is responsible for providing an environment for interaction between the system and students.

B. Overview of Reinforcement Learning:

Reinforcement Learning is a type of Machine Learning and thereby also a branch of Artificial Intelligence. It allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance. Simple reward feedback is required for the agent to learn its behavior. In Reinforcement Learning, the agent is supposed to decide the best action to select based on his current state.[5]
Fig. 2: Working of Reinforcement Learning

Reinforcement Learning helps to decide what to do, how to do and how to map multiple situations to actions in order to maximize numerical signal award. The learner is not told which actions should be taken. This learning method discovers which actions yield the most reward by trying them.

Two characteristics trial and error search and delayed reward are the two most important distinguishing features of reinforcement learning. In the most interesting and challenging cases, actions may affect not only the immediate coming reward but also the next situation and, through that, all upcoming rewards.

To get more reward [6], an agent should select actions that he has tried in the past and which were efficient in producing the high reward. But to find such actions, it has to try actions that it has not selected earlier. The agent not only has to exploit what he already knows to obtain a high reward but also has to explore to make better action selection in future.

C. Research Methodology:

The aim of this research is to investigate the best way to teach autistic student skating. To do this we have to search and understand the feature of ITS and Reinforcement Learning. We will examine all necessary knowledge material which is to be placed in database/repository and skating learning guides and we also have to maintain separate repository to maintain each student profile.

III. A PROPOSED ITS FRAMEWORK USING REINFORCEMENT LEARNING TO TEACH SKATING TO AUTISTIC STUDENT

The autistic student is the one who can’t communicate well with others. The autistic student has verifies and different learning styles. It can be tough for a student with autism to adjust and adapt to having all those different aspects of the environment thrown to them, so by using this framework, the system will help them to learn a new physical skill and participate in a group.

We educate student by illustrating material before finding the one that works best for the student. If the material in the knowledge base is presented in a way that does not suit with the child’s learning style, that child may appear bored and fidgety. The level of the knowledge may also be a problem. If a child is presented with concepts that are too difficult for his cognitive level, he might “tune out” and appear inattentive. A child who is bored with overly easy knowledge material may also attend poorly and act out.

So we need to take care of each and every little thing. In order to build ITS for the autistic student to teach Skating, some points have to be taken into consideration.

- Repetition: We have to repeat the information to the autistic student more than once in order to make them learn.
- The way of learning: Each student has its own way of learning. We can find a child who learns by animation and graphics and can’t learn from text. Also, we can find one who learns by sound and music, and so on.
- History: We have to keep history about each student, his information, his preferences, and lessons he learned and the grade of each lesson, and so on. This helps to create a profile of the individual student.
- Assessment: It is not important how much an autistic student is learned and how much time he takes, but it is very important that he understand the information very well.

Since the traditional ITS (Fig. 1) can’t fit the needs of an autistic student therefore there are some modules to be added to the traditional ITS, in order to fit the needs of autistic students.

Fig. 3: ITS Framework

A. Component Of Framework :

1) Skating Learning Methodologies :
Skating learning methodologies contain skating learning methods database in order to pick the best learning method by the Teaching Module that fit for the student.

2) Skating Knowledge Base :
Skating Knowledge base contains skating preferences which are stored in database to know every preference of that child. It also contains knowledge base that saves the student’s knowledge to help the student knowledge base to give the teaching module there commended preference that the child should learn.

3) Skating Learning Guides :
Skating learning guides contain the ILOs that fit the autistic student and also the learning object repository database to help the expert module to know the suitable learning concepts that fit every student.

4) Assessment process :
The Assessment process is very important component of this framework because it measures if the student has learned well the skating knowledge material he/she took or it has to be repeated for the student.
IV. WORKING OF PROPOSED SYSTEM
In the proposed system, student’s learning style and emotions are the factors for personalizing the learning environment. Both are important variables. When students use the system for the first time, they have to fill some questionnaires that will help system to create his/her profile, and the facts about their learning style and emotions will be inserted into the knowledge base. The system starts teaching according to the student’s learning style and then an assessment test based on their current level is provided. The proposed system will be adaptive that means it will set difficulty level based on current knowledge of a student.

Fig. 4: Flow of System
Whenever the student asks for any material or test, this information will be stored into knowledge base in order to maintain a history of student activity.

V. CONCLUSION
In this paper, we have discussed the development of an Intelligent Tutoring System (ITS). We started the paper by discussing ITS, Reinforcement Learning and some of its general features. We described the complete proposed system with full description of its each module.

The main objective of our work was to develop a system that can teach skating in a customized and adaptive manner. The system considers the cognitive ability of each student and decides teaching plans which would suit them best individually and maximize their performance. In summary, we can claim that the system exhibits moderately good performance.

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