A MULTI-AGENT SYSTEM (MAS) BASED ASSISTIVE LEARNING SYSTEM FOR DISABLED STUDENTS

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Abstract: Assistive and intelligent learning system is one of the best alternatives to provide education to handicapped and disabled persons. This kind of learning system may work well because handicapped and disabled students will not be encountered with the limitations and problems of the conventional education systems. This assistive learning system is mainly a multi-agent system based scheme. Those agents are autonomous agents and they have the cognitive behaviour and adaptability. This scheme is based on the centralized as well as distributed multi-agent planning for agent communication, collaboration and negotiation.

Keywords: Education, learning system, handicapped, disabled, multi-agent system.

INTRODUCTION

Providing quality education to all people has been one of the major challenges for our country. It was our hope that India might reach the notch in education within twenty first century. But practical situation tells something different. Majority of our population resides at villages, and opportunities for higher studies or professional courses are practically unavailable in the villages. Most of the higher study centers, institutes, Universities are constellated at the big cities or out skirt of the cities. Higher studies or professional courses are one of the best solutions to convert the huge population of our country to potential and efficient human resource. But, if compared, the ratio of the population which can be the potential human resource of our country to the number of seats available at the universities is very poor. Besides these, scope of having quality education for handicapped as well as disabled persons does not come into the scenario. In our country, we can hardly find out any proper institute or education system only for them [1]. Education system in India facing some basic problems which can be classified as:

a. Insufficient teacher-student ratio, i.e. huge scarcity of qualified Teachers/tutors in institutions.
b. Scarcity of available and suitable seats in respect of total population.
c. Institutes, Universities do not meet the needed requirement.
d. Course fees for professional courses are, in most of the cases, beyond the reach of the majority portion of Indian population.
e. Lack of proper communication as well as geographical barrier.
f. Lack of proper education and learning system for handicapped.
g. Socio-economic barrier and indulgence in people towards education of handicapped students.

SCENARIO OF EDUCATION SYSTEM IN INDIA

Education in India is mainly provided by the public sector, with control and funding coming from three levels: federal, state and local. Child education is compulsory. Western education became ingrained into Indian society with the establishment of the British Raj.

Both the Union Government and the states control the education system in India, with some responsibilities lying with the Union and the states having autonomy for others. The various articles of the Indian Constitution provide for education as a fundamental right. Most universities in India are Union or State Government controlled.

India has made progress in terms of increasing primary education attendance rate and expanding literacy to approximately two thirds of the population. India's improved education system is often cited as one of the main contributors to the economic rise of India. Much of the progress especially in Higher education, Scientific research has been credited to various public institutions. The private education market in India is merely 5% although in terms of value is estimated to be worth $40 billion in 2008 and will increase to $68 billion by 2012.

However, India continues to face stern challenges. Despite growing investment in education, 35% of its population is still illiterate; only 15% of Indian students reach high school, and just 7% graduate. As of 2008, India's post-secondary high schools offer only enough seats for 7% of India's college-age population, 25% of teaching positions nationwide are vacant, and 57% of college professors lack either a master's or PhD degree [1].

Status of Mainstream Education of Disabled Students in India:
According to the audit report, submitted by NCPEDP, Govt. Of India in 2005, status of mainstream education for disabled and handicapped students is alarming. The audit report was prepared on the basis of some research work [1].

Research questionnaire were sent to 322 Universities in India. Total 119 (36.9%) Universities responded to that questionnaire. Out of those 119 Universities, 48 were Autonomous, 35 were State Govt. Universities, 16 were belonged to the Central Govt. and 20 were belonged to other category.

Responses were good except from north-eastern states. All the universities from Bihar remained silence. Responses were good from IITs of India.

Some notable Universities were there who did not respond in spite of several reminders given to them. Those universities were Delhi University, All India Institute of Medical Sciences (New Delhi), Indira Gandhi National Open University (New Delhi), Jamia Millia Islamia University (New Delhi), Bangalore University (Karnataka), University of Calcutta (West Bengal), University of Calicut (Kerala), and Indian Agricultural Research Institute (New Delhi).Maintaining the Integrity of the Specifications [1].

Total Number and Percentage of Disabled Students:
The total 119 Universities responded to the questionnaire represent around 7280 colleges and institutes. The audit report shows that,, the total number of disabled students studying were only 1635 (Male-76.3%, female-23.7%). Though the report was made on the basis of 119 out of 322 Universities in India, it is likely to be highly representative of the overall situation of the country. According to University Grant Commission (UGC), only 6% of youth population of India is in Universities and colleges.

Proportionately, based on the most conservative estimation for disabled youth population in India (National Sample Survey, 2003), at least 3160, 000 disabled youth should be in the Universities and colleges in India. However, just 1.2% of the 6 laks disabled youth, who should have been studying according to India's norm for the general youth population, are in the Universities and Colleges. It brings the stark reality into an established truth that India's higher educational system is not accessible to 98.8% of its disabled youth.

A total number of 52 Universities out of 322 were asked about the total percentage of disabled students versus total number of students. The tables given below show the scenario.

Table I. Number of Disabled Students versus Total Number of Students
(Data from 52 Universities)

Total No. Of Students	Total No. Of Disabled Students	Male Students	Disabled Male Students	Female Students	Disabled Female Students
7, 13,167	694	4, 96, 209	489	2, 16, 958	205
100%	0.1%	69.5%	0.07%	30.4%	0.03%

DISABILITY AND ITS CLASSIFICATION

It is important to define disability of a person properly and to identify the kind of disability also. In 1976, World Health Organization (WHO) drew a clear three-fold distinction between impairment, disability and handicap. According to WHO:
a. Impairment is any loss or abnormality of psychological, physiological or anatomical structure or function.
b. Disability is defined as any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being.
c. Whereas, handicap is a disadvantage, for a given individual, resulting from impairment or a disability, which prevents the fulfillment of a role that is considered normal for that individual.

WHO reaffirmed this classification in 1980. In 2001, WHO issued the International Classification of Functionality, Disability and Health (ICF). The ICF distinguishes between body functions (either psychological or physiological, such as vision) and body structures (anatomical parts such as eyes) in 2002. The ICF enlisted 9 broad domains of functioning which can be affected mostly. These domains are:
a) Learning and applying knowledge
b) General tasks and demands
c) Communication
d) Mobility
e) Self-care
f) Domestic life
g) Interpersonal interactions and relationships
h) Major life areas
i) Community, social and civic life

The ICF was endorsed officially by all 191 WHO Member States in the 54th Health Assembly on 22 May 2001.

Prevalence of Disability in India:

There are different kinds of prevalence rates of disability available in India. According to Census 2001, there are almost 2.19 thousand people with significant disabilities in India, constituting 2.13% of the total population of the country. Out of the 21, 906, 769 people with disabilities, 12, 605, 635 are males and 9, 301, 134 are females including persons with hearing, speech, visual, locomotors and mental disabilities.
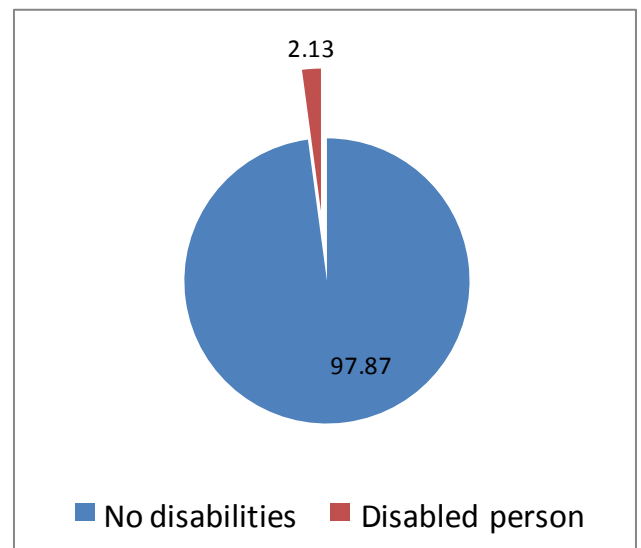

Chart I: Ratio of disabled persons in India (Census 2001)

In contrary, in 2002, the National Sample Survey Organization (NSSO) estimated that only 1.8% (40-90 million) of the Indian population is disabled. Almost 75% of persons with disabilities live in rural areas, 49% of the disabled population is literate, and only 34% are actually employed. NSSO also included the persons with visual, hearing, speech, locomotors and mental disabilities.

According to NSSO 2002
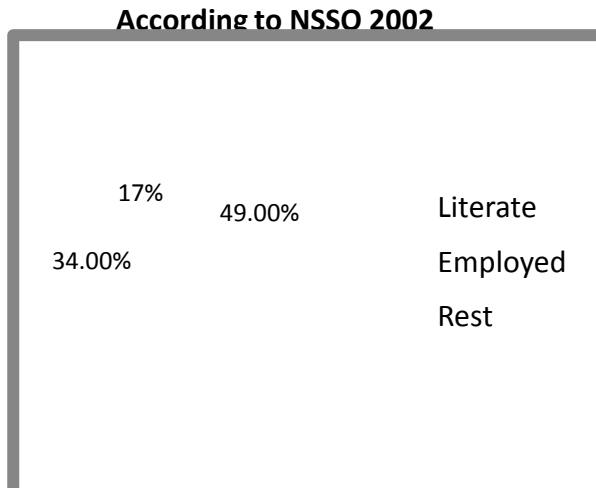
17%

49.00%

34.00%

Literate

Employed

Rest

Chart II: Scenario of disabled persons in India (NSSO 2002)

While the estimation varies, it is evident that people with disabilities comprise between 4 to 8 percent of the Indian population (almost 40-90 million). And like any other group, education is critical to expanding the life of people with disabilities. Additionally, the socialization of children with disabilities through education assumes an unusually important role in societies like India, where social exclusion of persons with disabilities is much significant. Despite its importance, reality says that educational outcomes for children as well as adults with disabilities remain very poor. Illiteracy rates for all persons with disabilities and school-age disabled children remain much higher than the general population [2].

REASONS BEHIND POOR EDUCATION OUTCOMES FOR PEOPLE WITH DISABILITY

Education policies in India, no doubt has gradually increased the focus on children and adults with special needs. But there are several reasons for very poor education outcomes for disabled people in India. These reasons can be enlisted as:
a. Weak institutional coordination, poor expenditure performance, and a range of issues in delivery of education limit the inclusion of children with disabilities in education.
b. Poor identification and access of disabled children (also adults) to the education system.
c. The quality of the education available for students with disabilities is also limited (some states have made a positive starts).

Finally, till date, there is no effective system for monitoring and evaluating the educational attendance and attainment of children with disabilities that would help inform the development of inclusive education strategies and allow feedback on their performance [2].

NEED OF A NEW SYSTEM: A MULTI AGENT BASED APPROACH

Here is the big picture about quality and mainstream education of disabled and handicapped students in India. To provide quality education for handicapped and disable people, and due to the remarkable advent of computer as well as Internet technologies, a distributed, automated and intelligent education system is one of the best alternatives at this situation. This type of education system (virtual classroom environment, intelligent tutor etc.) may help to wipe out the current situation and may increase the education outcomes for disabled students, because these systems do not contain the limitations and problems of the conventional education systems in India stated earlier. Education or learning systems, for example, a school, or a University, is a complex system, where different sections/departments have their own tasks/ responsibilities and they are located at different sites. Those different agencies/departments have to communicate between themselves to accomplish a specific task, such as conducting regular classes, examinations, publication of results etc [3][4]. This kind of complex, distributed system, where collaboration, negotiation and communication between separate and independent sections/departments is necessary to accomplish a desired task can be designed best with the help of multi-agent system (MAS).

If we look to the most emerging software paradigm of this century, the agent based system or the multi-agent system (MAS), we shall find out that automated and computerized education system can be implemented using the concept of multi-agent system (MAS). In this research paper, a scheme of the computerized automated intelligent education system using the Multi-agent system (MAS) is presented.

WHAT IS AGENT AND MULTI-AGENT SYSTEM

According to Michael Wooldridge, An *agent* is a software entity that applies Artificial Intelligence techniques for choosing the best set of actions to perform in order to reach a goal specified by the user. It should react in a flexible, proactive, dynamic, autonomous and intelligent way to the changes produced in its environment.

A multi-agent system can be defined as a collection of autonomous agents that communicate between them to coordinate their activities in order to be able to solve collectively a problem that could not be tackled by any agent individually.

Multi-agent systems may be considered as the latest software engineering paradigm in the recent era. This kind of systems may be used in those domains which consist of the following features:
a. Knowledge is distributed in different locations.
b. Several entities, while keeping their autonomous behavior, have to join their problem-solving abilities to be able to solve a complex problem.

The problems in the domain may be decomposed in different sub-problems, even if they have some kind of inter-dependencies [4].

PROPOSED SCHEME

The multi-agent based scheme of assistive learning system presented here may be a better place for disabled students, both children as well as adult, of India to start and continue their education without attending any kind of conventional learning centre, such as school, college, university etc. This learning system will not entirely wipe out the conventional learning methods the disabled students can opt. This system may work properly and may give the maximum outcome if implemented or installed along with the conventional systems.

The entire learning system is segmented into some modules. These modules are independent and has specific goal to accomplish. But, modules can communicate between themselves for the purpose of achieving some common goal when necessary. Every module are driven or coordinated by some module specific coordinator agent. Some of those modules are composed of two or more agents, while some modules has single agent. Here is the schematic diagram of the assistive learning system.
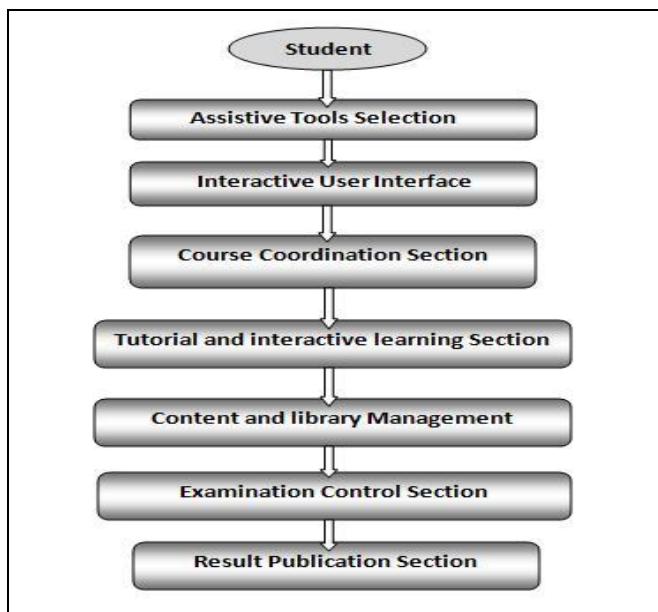

Figure 1: Modules of learning system

It is clearly depicted in Figure I that the entire learning system is divided into several modules or sections. That means knowledge (whether it is specific for a module or the knowledge is global for the entire system) is distributed in different locations, and different entities or modules has to communicate between themselves to solve a complex problem [5][6]. An important aspect of this agent based learning system must be mentioned here. This system is not totally devoid of explicit human intervention, because subjective knowledge and expertise of experts is necessary. In the consecutive text, each module of the system has been described briefly.

DESCRIPTION OF THE LEARNING SYSTEM

This multi-agent based learning system has seven modules. Before describing the modules, a schematic diagram of multi-agent based approach will be more helpful to understand the learning system. The following picture is

showing the role of agents and coordination, communication and negotiation between them [7].
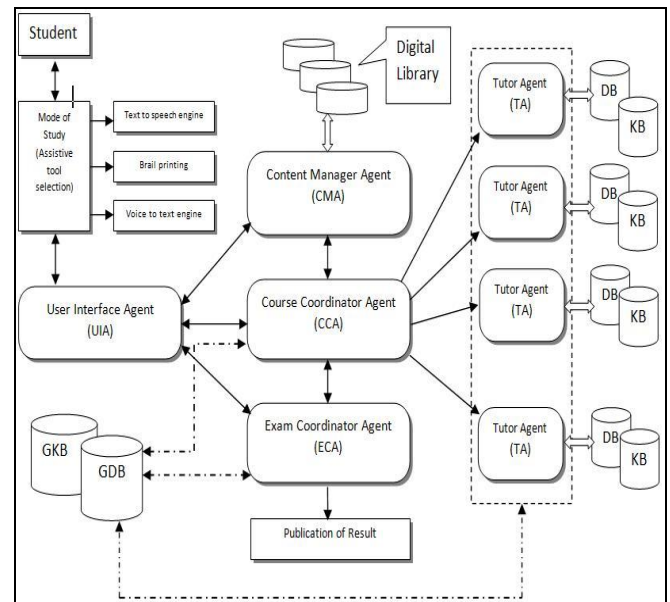

Figure 2: Agents and their role in this system

Among these modules, the first one is named as Assistive Tools Selection module. This module is for selection of appropriate assistive tools for disabled student. Assistive tools will be selected and as per the nature and kind of disabilities of individual student. For example, for blind students, voice recognition system, text to speech engine, brail printing system and other aids will be selected. Once this set of assistive tools is selected for a particular student, the set of tools will be fixed for that student for the entire course.
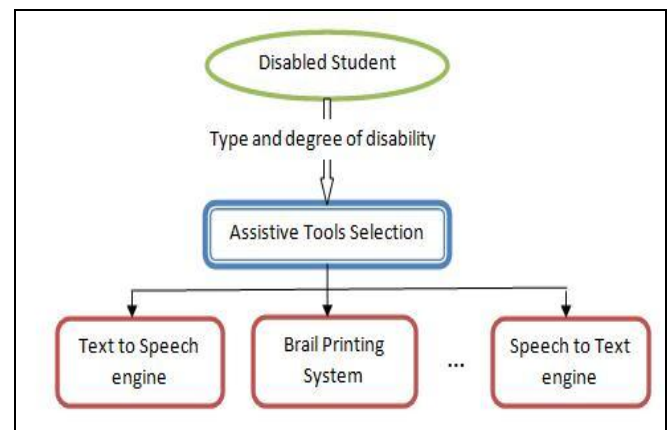

Figure 3: Assistive Tools Selection Module

After selection of appropriate assistive tool, or set of tools, an interactive user interface will help the student to interact and feed their queries to start interactive learning process. Here, an intelligent software agent is entirely responsible for these kinds of interactivities and coordination. This agent is named as User Interface Agent (UIA). This UIA serves the users (students) with the help of its local knowledge base as well as global knowledge base and global data base of the system. UIA receives input from user, and then communicate with agents of other independent modules such as Course Coordinator Agent (CCA), Content Manager Agent (CMA) or Exam Controller Agent (ECA) etc.
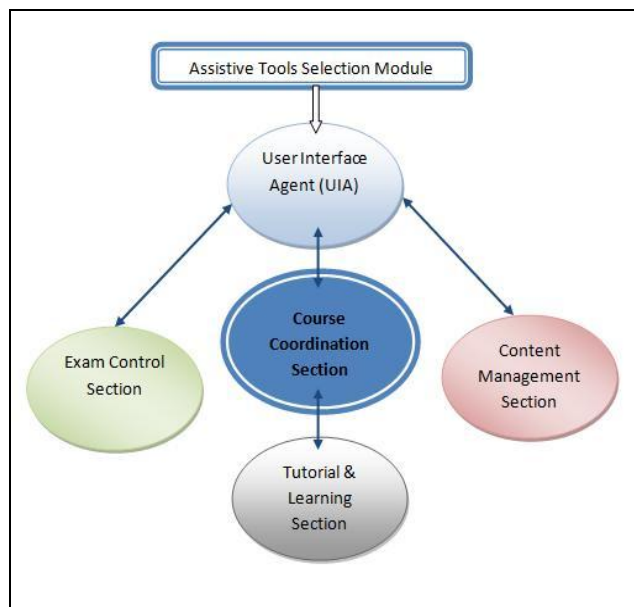
Figure 4: Role of User Interface Agent (UIA)

UIA actually communicate with agents of Exam Control section and Content Management section directly, but in some goal specific situation, it communicates through the agent of Course Coordination section. UIA eventually works on the basis of distributed multi-agent planning, because UIA has to achieve different goals at different time, by communicating and negotiating with other agents (such as CCA, ECA, CMA and also various Tutor Agents or TAs).

Agents of the learning system work on the basis of both centralized as well as distributed multi-agent planning for communication, cooperation and negotiation between them [9]. The Course Coordinator Agent (CCA) of the corresponding course coordination module acts as the major part of centralized multi-agent planning, CCA communicate with agents of every modules of the learning system. It communicates with User Interface Agent (UIA), Exam Controller Agent (ECA), Content Manger Agent (CMA), and all the expert agents of the tutorial and learning section. Actually, each agent communicates and negotiates with other agents in the system through the CCA, which means, CCA acts as the central coordinator. CCA rectifies communications between agents if there is any flaw. Every agent is associated with their respective local database and knowledgebase, and they can also access the global database and global knowledgebase, through the CCA, if required. CCA directly accesses the global database and global knowledgebase of the system. CCA also keep track of all the subject wise expert agents (Tutor Agent or TA) and their activities. In figure II, it is clearly depicted the role of CCA and communication between other agents within the system.

Among the agents, CMA is also associated with the digital library databases, local (library of the learning system and maintained within the system) as well as global library through Internet and other networks. Human intervention is necessary here to develop the local library of the system, because contents, tutorials, questionnaires, books, research papers, articles etc. must be stored and into library to enrich and upgrade it. This content development needs direct human intervention. Communication between CMA and TAs is very important to conduct a course. TAs must have

access to the digital library. CMA also communicates with UIA during the learning process and accessing of library by a student through user interface.
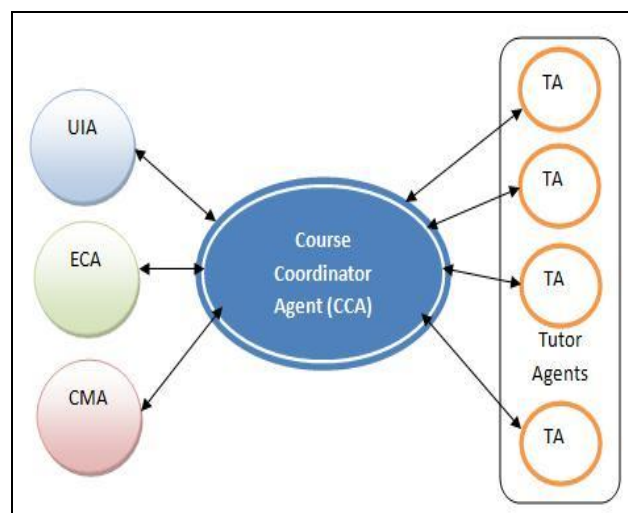

Figure 5: Role of Course Coordinator Agent (CCA)

Other agents have their own goals and responsibilities like UIA and CCA. The Exam Controller Agent (ECA) has the responsibilities, such as evaluation of the copies (human intervention is necessary if examination is hand written or voice based etc, but if it is computer based test, agents can do the evaluation process) tabulation of marks of a student, and mainly publication of results. ECA communicate with UIA during the examination as because students use the user interface for exam purpose, and also communicate with CCA during evaluation, tabulation and publication of result [9][10].

Individual agents are there to conduct classes and tutorials of specific subjects during the entire course. These agents are named as Tutor Agents (TA). These TAs maintain their respective local database and local knowledgebase. They have access to the global database and global knowledgebase through the CCA. TAs can also access digital library through CMA. Local database and local knowledgebase of TAs are to store and maintain tutorials, contents, books etc. for the specific subject the TA is assigned for. TAs and UIA communicate through CCA during the class hour and tutorial session.

CONCLUSION

Here is the brief sketch of the proposed work. During the description of the scheme, human intervention came at various points. This is obvious because without human intervention, many aspects of the system, where knowledge is required, may not give its proper outcome, such as content development, tutorial selection, question paper preparation, evaluation of examination copies etc. This assistive learning system is a multi-agent based system, and this system can be no doubt a better alternative for the disabled students to continue their studies. This system can be accessed from home through the Internet. That means, a student with disability does not have to go to any institution for his/her study. This aspect may hopefully increase the ratio of literate disabled students in India.

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