

AUTONOMOUS INTELLIGENT COMPUTER BASED TRAINING – ROBOTICS

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Abstract

This paper seeks shows how to extend Computer Based training - C.B.T by building independent components with intelligence. It explains the methodologies that could be employed given the new programming frameworks. Historically, CBTs growth has been hampered by enormous resources required: human resources to create a CBT program, and hardware resources needed to run it. However, the increases in PC computing power and especially the growing prevalence of computers equipped with CD-ROMs is making CBTs a viable option for corporations and individuals alike. Many PC application come with a modest form of CBT, often called a tutorial (Webopedia, 2009). A common example of a CBT is Microsoft's Encarta. Despite this goodness of a CBT, they suffer a really big problem, that is, they are only accessible on a mainframe, not from a remote site. This makes such systems not offer the goodness foretold by e-learning systems. But then, there must be a solution for this. The answer is yes. The answer is:

"... several distinct physical components working together as a single system." (Barnaby, 2002)

Following Barnaby's approach, it is natural to think about a central controlled system managing intelligent agent that teaches in class rooms.

Key words: Artificial intelligence, agents, e-learning, robots, computer based training

1.0 Introduction

The main goal of training is to impart relevant information and knowledge to trainees in a cost effective and suitable manner. Relevant information should be up-to-date, from reliable sources and timely presented. A while back, education was only limited to four walls and a roof, that is, a class room. Professionalism was practiced to its acme; even courses geared on teaching teachers how to teach were incepted. The ultimate goal of such efforts was to make training more productive. However, the dynamics of the last quarter of the 20th Century did not allow confinement to a physical four-walled classroom in order to pass knowledge. Computer Based Training (C.B.T.)¹ came to the rescue. Initially C.B.T.s were implemented as standalone² applications. The 21st Century has seen the Internet prevail on every aspect of our lives including knowledge acquisition. This has seen C.B.T. programs being enhanced to allow the reception of updates to ensure up-to-the-minute information. A typical example is Microsoft's Encarta encyclopedia. However, we need a mechanism that exhibits some form of intelligence to facilitate timely search and retrieval of relevant information and knowledge in a cost effective and delegated manner from designated sources. How can we actualize this?

1.1 Agents

An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors (Russell and Norvig, 2002). A Web searching agent is a program that automatically traverses the Internet using the Web's hypertext structure. The agent can either retrieve a particular document or use some specified searching algorithm to recursively retrieve all Web documents that are referenced from some beginning base document (Jaasen *et al.*, 2003) Just as humans search for items over the internet, so can the same be accomplished by the use of a web searching agent. These agents can be sent 'outside' there to obtain information and bring to where it is needed. A computer based training program can really be of great use if it can make use of this agent. The C.B.T. needs to exhibit some level of autonomy³ through the agents. These agents are supposed to look for credible information from designated sources.

As a description of how the autonomous agents will work, there will be two types of cooperating agents. One will be a worker agent and the other will be a supervisor agent. This interaction is depicted in Figure 1 below:

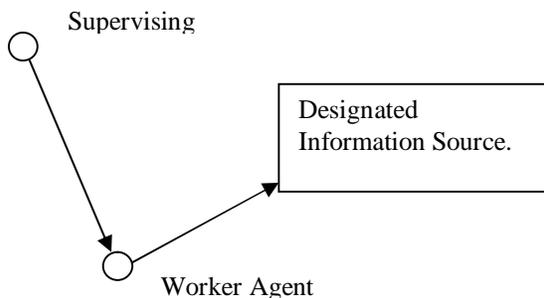


Figure 1: A Supervising agent observing a worker agent retrieving required information from a designated source that has been found

The supervising agent monitors the tasks carried out by the worker agent to ensure non-deviation from intended actions. Of course, it doesn't mean that a supervising agent can only be attached to one worker agent. Actually multiple workers can be supervised by one or more supervising agents as deemed appropriate. How does this work?

¹ Computer Based Training: it is a type of training in which the student learns by running special training programs on a computer.

² Standalone: Able to operate as a self-contained unit independently of a computer network or system.

³ Autonomy: working independently of external intervention.

Suppose that in the training process the C.B.T. realizes a need for information and/or knowledge not currently held, it invokes agents to go for an information search, location, and retrieval mission. We propose that at the initial phase of information search, one or two agents can be sent to the field⁴ together with one supervisor agent. Then the worker(s) is allocated a reasonable amount of time within which to find the target information. If it (worker agent) takes longer than anticipated, then more worker agents and associated supervisors are dispatched to aid in the target information location and retrieval. The major advantage in using multiple agents, similar to using multiple people in human teams, comes from the concept of synergy. Synergy is the concept that the behavior of a system as a whole is more than just the sum of its parts. By having multiple agents in a given environment operating in parallel there are obvious advantages as to the amount of work which must be done by each to complete a task or tasks at the global level (Randall Fletcher and Dan Corbett). Synergy means that the relationship which the parts have to each other is a part in and of itself (Covey S.). Covey asserts that it is not only a part, but the most catalytic, the most empowering, the most unifying, and the most exciting part.

This approach is precast around work (Sabu *et al.*, 2005), in their seminal paper titled "An Agent Based Peer-to-Peer Network with Thesaurus Based Searching, and Load Balancing" presented at the *International Conference on Computational Intelligence for Modeling, Control and Automation, and International Conference on Intelligent Agents, Web Technologies and Internet Commerce (CIMCA-IAWTIC)*. They propose a system that makes use of several types of cooperating agents that enables efficiency i.e. a master agent that manages and controls the collection of other agents referred to as search agents and resource watcher agents.

To eliminate chances by the newly dispatched agent group from visiting an already searched information repository, the supervisor(s) of the initially dispatched group will keep track of all the nodes traversed but bearing no fruits, and inform the supervisor(s) of the newly dispatched agent group. In turn, this supervisor(s) informs and ensures that its worker agents do not traverse these already visited nodes. This logic is depicted in the figure below.

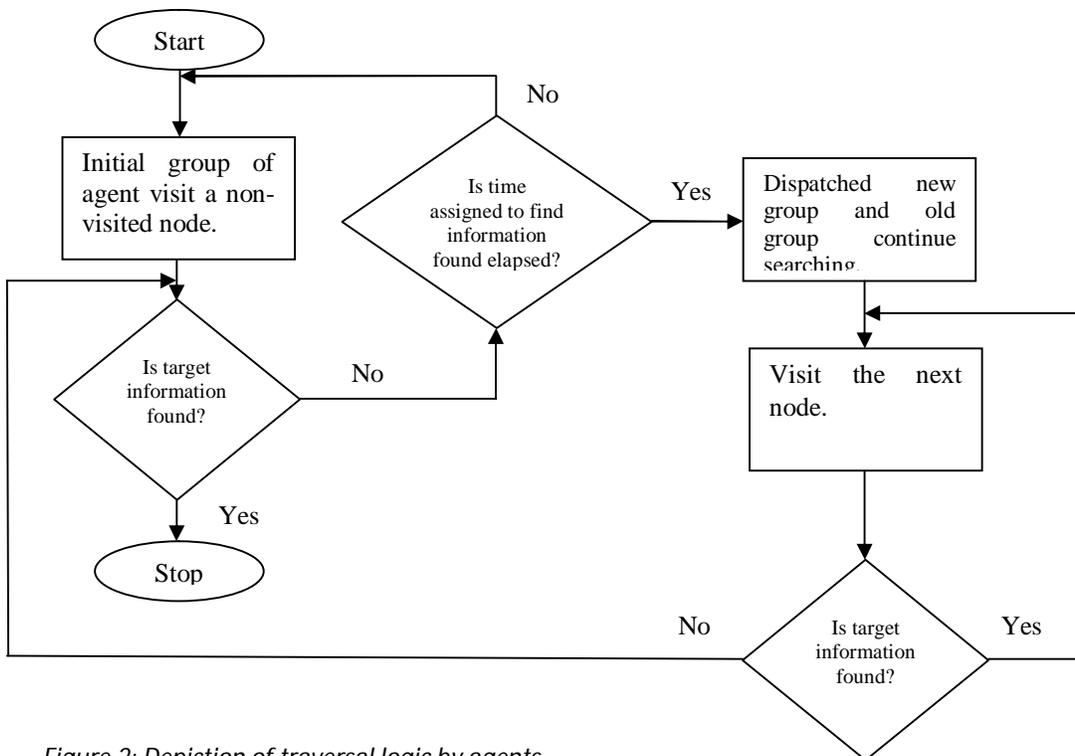


Figure 2: Depiction of traversal logic by agents

⁴ Field: The world wide web.

The goal of all this is to avail needed information and/or knowledge to the C.B.T. program in a timely fashion. But is such kind of interaction, traversal and communication even possible?

1.2 A proposed Architecture

1.2.1 The Worker Agent

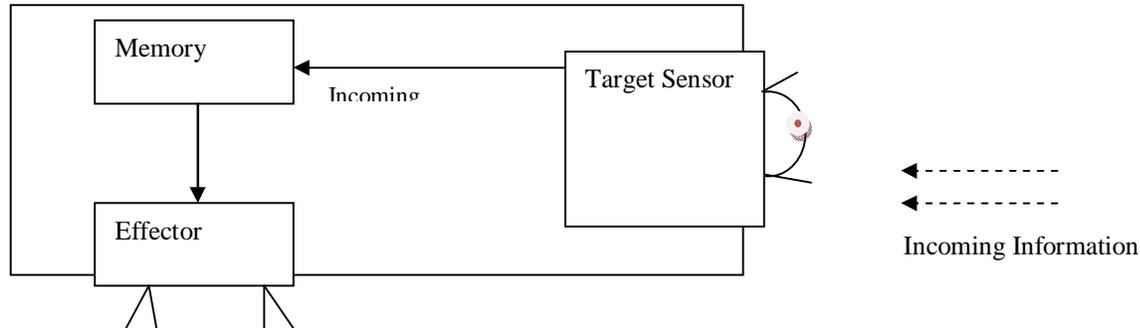


Figure 3: The worker agent architecture

1.2.2 Memory

Stores current state for example current position in the field, intended location, log (errors encountered and environmental threats).

1.2.3 Target sensor

Extracts and uploads the required information from the environment and stores in memory. Information includes target information for the C.B.T., security threats in the environment, and errors encountered. It also accepts instructions from the supervisor agent.

1.2.4 Effector

Interacts with the environment as well sends information held in memory to the supervisor agent. It is responsible for navigation through the field as guided by the supervisor through the target sensor.

1.2.5 The Supervisor Agent

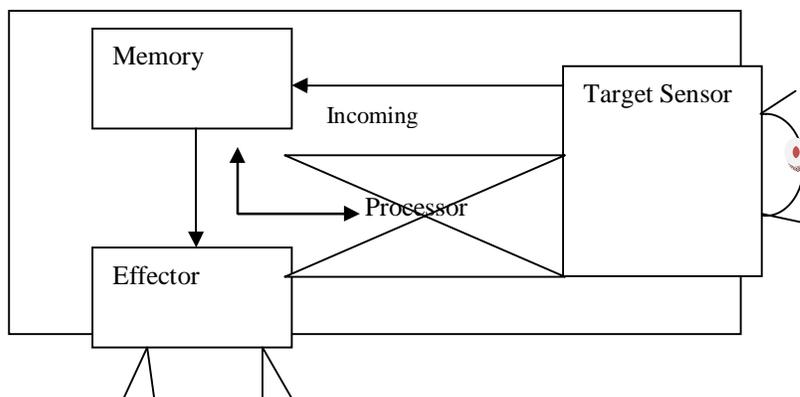


Figure 4: The supervisor agent architecture

2.0 Memory

Stores current state information, for example, the intended and current position of itself and the worker agents under its supervision in the field, worker agents' entire field-life time state. This information is valuable to the developers of agents for possible future improvement. Such improvements, we propose, could be like getting permissions from servers containing target information since, as of late, there have been serious efforts on enhancing server security. The memory also stores information regarding errors encountered by agents i.e. the

supervisor and the workers under its supervision, and any environmental threats encountered by both, for example, virus attacks or hackers⁵ and sniffers⁶.

2.1 Target sensor

This, just like the worker agent's target sensor, extracts and uploads required information from the environment and stores the same in memory. Information includes target information for the C.B.T., security threats in the environment, and errors encountered.

2.2 Effector

The supervisor agent interacts with the environment as well sends information held in memory to other agents through its effector. The effector is responsible for facilitating navigation through the field.

2.3 Processor

This is the part within the supervising agent that performs various operations such as logical deductions pertaining it and the worker agents. A typical example of when a processor comes in handy is when the supervisor has to decide on what to do in case the target site⁷ is compromised by viruses, or the agents themselves are threatened by the viruses.

3.0 Conclusion and Recommendation

Computer Based Training programs play a vital role in the process of knowledge acquisition. The pervasiveness of the internet in the 21st century in almost every aspect of human life can be positively utilized for the enhancement of the quality and effectiveness of computer based training in the teaching-learning process. This paper proposes the use of autonomous agents that can aid in the process of information searching, location, retrieval and subsequent use by a computer based training program to meet training needs. Cooperation between the agents helps in reducing task completion time (in this case, information searching, retrieval and availing for use) and enhances the quality of information presented since information is gotten from a variety of sources.

The paper presents a theoretical and idealistic approach, which if implemented, would enhance the quality of training offered by computer based training programs to meet the knowledge needs of the modern world.

This C.B.T. can be implanted in a robot and the robot can be placed in front of a class room and would lecture like a real teacher. A student can even ask question and by use of these agents and additional existing technologies such as Natural Language Processing and Machine Learning, a robot can easily train using this embedded computer based training module. Companies, such as Lego, have come up with programmable robots like the Lego MindStorm NXT and these robots are quite inexpensive (available at <http://shop.lego.com/Product/?p=8527>). Morgan (2008) observes that:

"Robotics is a field that has been around for several years. It has long been associated with artificial intelligence, but, for many people, robotics is seen as a practical solution in a world desperate for automation."

Thus, the use of autonomous agents in eLearning is revolutionary and fulfills the promise foretold. As a future direction, we plan to actualize these agents in real robots.

⁵ Hacker: A computer user who gains unauthorized access to a computer system or data belonging to somebody else

⁶ Sniffer: A program on a computer system designed legitimately or illegitimately to capture data being transmitted on a network, often used by hackers to appropriate passwords and user names.

⁷ target site: This is a location, such as a server on the www, that holds information that the C.B.T. is interested in.

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