GORBI: Autonomous Intelligent Agents Using Distributed Object-Oriented Graphics

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Keywords

graphics, cad, internet, evolutionary, generative, distributed, decentralised, object, request, broker, CORBA, OpenGL, Java, C++

Introduction

Autonomous agents represent a new form of thinking that is of primary importance in the age of the Internet and distributed networks [8, 11, 15], and provide a platform on which Turing's model of sequential instruction-executing machines [6] and von Neumann's connectionist vision of interconnected, concurrent fine-grain processors [16] may be reconciled. In this paper we map this emergent paradigm to design and design intelligence by to illustrating examples of decentralised interacting agents projects.

Agent-Type Experiments in Architecture

The today's mainstream preoccupation with agents, "bots", "helpers" and "wizards" on the Internet evokes consideration for it as a complex artificial life form [11]. In fact, this is more than coincidental: Agents emerged as part of Artificial Life (AL) research [9], which has been mainly inspired by behaviour observable in living systems in nature [14]. Both authors have employed the agent paradigm in theoretical simulation projects at the Architectural Association in London in the mid-1990s, under the guidance of John Frazer, one of the fathers of evolutionary design computing [4].

Patrick Janssen's work concentrated on research on the emergent behaviour of autonomous agents, and how the growing complexity of this behaviour can be controlled through evolution [7]. The work is based on the autonomous life forms described by Mitchel Resnick [13], implemented in software form. Genetic programming techniques are used to evolve the software code that controls each agent, and produce ever more sophisticated agent control mechanisms (Fig. 1).

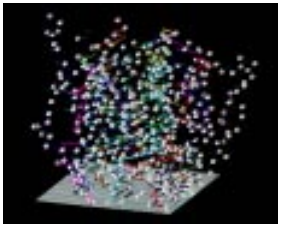

Figure 1:
Evolution tree of genetically programmed agents (Janssen 1995)

Cristiano Ceccato developed a model of agent-driven urban growth [2, 3]. The model was implemented as a multi-state Cellular Automaton, in which each cell not only behaved according to rules of spatial proximity, but also as economic agents as governed by the basic laws of microeconomics. The model's goal was to iteratively generate desirable [urban] spatial patterns, which it could match to a successful set of established patterns through pattern recognition (Fig. 2). A Genetic Algorithm [5] was then used to evolve ever more efficient microeconomic parameters for the system to use in the next iteration. The agents' economic interaction produced growth patterns very similar to those that emerge in large-scale urban conditions.

GORBI – Graphics Object Request Broker Interface

A new research project proposes GORBI (Graphics Object Request Broker Interface); a CORBA [12] based graphics distributed objects API. The purpose of GORBI is to create a family of compatible intelligent 3D graphics software components, which can be developed by different people, and yet function together seamlessly across distributed environments. Applicability includes the creation of a common distributed 3D CAD software standard that overcomes current problems arising from proprietary file types. GORBI objects can be combined to form a set of intelligent, interacting set of tools over a network, including the Internet.

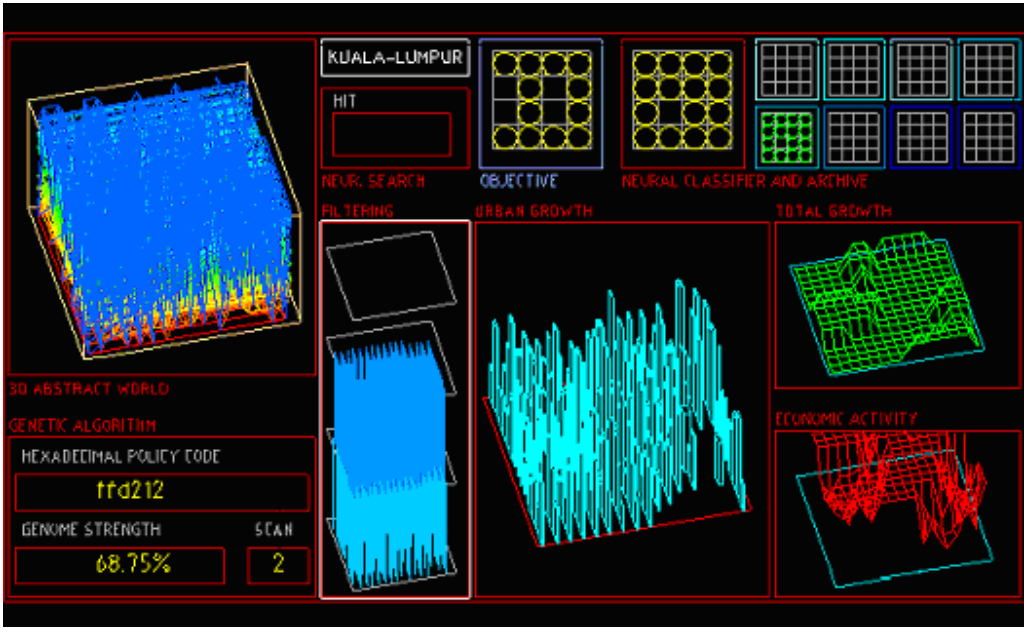

Figure 2:
Computational urban growth model using economic agents (Ceccato 1996, 1998)

Distributed 3D graphics libraries and collaborative systems have been developed successfully elsewhere [10] and more are under development at several institutions. Ours focuses on both distributed 3D drawing and the embedding of autonomous intelligence in the distributed components. Distributed components may include:

- **Proximity Sensor / Collision Agent**: senses and resolves collision detection in a VR environment.
- **Level of Detail Agent**: determines, selects and renders level-of-detail data in a 3D display by analysing camera flight path.
- **3D Graphic Object Agents**: extendable graphic objects contain sensors for other entities and automatic snapping, Boolean operations, interconnection auto sensing mechanisms.
- **Evolutionary Agent**: when used in a complex distributed design environment, agents are able to independently analyse and generate more efficient design solutions to all or parts of the design under development.
- **Hybrid Agent**: A special agent class, which has a physical component, such as environmental sensors for input and robotic controls for output, to overcome the physical-virtual boundary.

The Hong Kong Polytechnic University has funded the GORBI project as a Departmental Research Grant in early 2000. Initial implementation is expected to use the CORBA engine and an OpenGL display system for local workstation and Java3D or VRML for Internet applications. The outcome of this research will be presented at a future conference.

Conclusion

Graphics software no longer function as self-contained closed packages, but are instead decentralised into powerful, graphics-intensive front-ends and common object broker back-ends which store and dispatch autonomous data components as required. Distributed Objects provide the ability for different computers to share information without translation and the risk of data loss, allowing different people to concurrently work on different objects on their platform of choice, with the added power of embedded intelligence though Agents.

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