

# Protohuman Project

## Introduction

Artificial Intelligence is an evolving aspect of computer science. One thing that makes humans intelligent is our ability to learn from experience. Not only can we learn from our own experience, but also from experiences told to us by other people. In order to decide how much to trust this information, people need to form long-term relationships with each other. This is a first step toward forming communities.

The focus of the proposed research is to develop a virtual world that contains autonomous agents that form relationships with each other and with people. These agents will be capable of simple communication with each other, passing information between the agents. This combination of social relationships and information passing will help form a community of autonomous agents inside the virtual world. Once it is developed, this virtual community may be used to study how humans form relationships.

The software installation will be based on an existing research project called the Making Friends Project. The Making Friends Project uses a code base developed by the Synthetics Characters Group at the MIT Media Lab, with significant modifications by my faculty mentor and me. It is mostly written in Java and has a thin layer of C and C++ to communicate with the DirectX graphics.

The Protohuman Project contributes to the areas of multi-agent systems, human-computer interaction, and interactive animation.

## Program Plan

The project will be divided into the following four main components:

### *1) Generalization of relationships in a multi-agent system:*

The focus of this part of the research is to develop algorithms for the autonomous agents to form social relationships with each other in a multi-agent community. It will explore how people generalize from previous relationships and other information when originating a new relationship. This project will involve the implementation of a novel construct that we call a Generalizing Emotional Memory (GEM). It is derived from the Context-Specific Emotional Memory (CSEM) [15]. Specific attention will be paid to the phenomenon of negative stereotyping, a pathological phenomenon that appears to be caused by humans' broader abilities to generalize and to learn from the experiences of others. This project will consult previous research in multi-agent systems [2, 10, 15], artificial intelligence [16], psychology [4], and animal behavior [8], among others.

The Generalizing Emotional Memory mechanism involves models of emotion, perception and learning. This implementation uses a very simple model of emotion. Each autonomous agent will have a single floating-point value for valence, which varies from 0.0 to 1.0. The system blends between example animations to give an expressive range to the behavior of the characters [3]. The characters disambiguate among their social partners by perceiving several attributes, which include a unique identification tag, color and size. The first thing that the autonomous agents perceive will be the attributes color and size. Then they will notice the identification tag. Finally, they will be able to perceive the Object of Attention of the partner. Each character may have one other character as its Object of Attention. Mutual attention (when two characters have each other as their Objects of Attention) defines the start and end of an interaction episode. After each interaction the character will revise the emotion and confidence values that are stored in its Generalizing Emotional Memories for each of the attributes – color, size and unique ID. When a character encounters a new social partner, it will begin a relationship with it based on the values in the GEMs for the correct color and size, even though it does not yet know anything about that partner's unique ID.

The implementation of the GEM system will be my primary research goal in this project.

### 2) *Information passing in a multi-agent system and interface design:*

This part of the research is to develop a system that allows agents to pass information to other agents in the multi-agent system. The ability to exchange previously learned information is one of the ways in which humans exceed other animal species. The implementation of information exchange between agents will turn the system to from a *group* of agents to a *community* of agents. It will also develop a human computer interface by which people may interact with the community of agents. The interface for the project will be designed to operate on a handheld computing device to allow the interaction between human participants and the agents in the virtual world. This effort will be informed by previous work in multi-agent systems[18], artificial intelligence[7], information theory[12], philosophy of language [17] and the evolution of communication[5], among others.

### 3) *Interactive animation:*

This part of the research involves the creation of the set of animations for the autonomous agents. These animations will be designed to give an expressive dynamic range of behavior to the agents. Rather than focusing on a scientific research goal, this project is an aesthetic undertaking in its own right. This effort will draw on previous work in animation[13], 3D computer graphics[3], computer game design [1] and affective computing[11], among others.

### 4) *Integration and coordination:*

As the Protohuman Project is a large-scale project, the integration portion is very important. All the student researchers will be collocated in the same room during the development process, and will be encouraged to collaborate closely. Research has shown this extreme programming style of yield successful results [9] and a positive educational experience [6]. This software engineering paradigm has been successful in previous projects [14], and will hopefully lead to a very high quality final product and a significant positive learning experience for all of the students involved.

## **Responsibility of team members**

There are four team members in this research project and each member is responsible for an individual component described in the previous section. I am responsible for the *generalization of relationship in a multi-agent system*. Student #2 is responsible for the *information passing in a multi-agent system and interface design*. Student #3 is responsible for the *interactive animation*. My faculty mentor is responsible for the *integration and coordination*.

## **Timeline**

Week 1-2: Background reading, group planning

Week 2: Prototyping of multi-agent system, interface design and the animation

Week 3-5: Development of the actual system based on the prototype

Week 6: Overall integration

Week 7-8: Testing, revision and integration

Week 9-10: Documentation

## **Deliverables**

The target end results of this effort are:

- a paper on the generalized social relationship mechanism for the Autonomous Agents and Multi-Agent Systems conference (deadline: Jan.)
- a paper on the design of the interface for the CHI conference (deadline: Sep./Oct.)
- a paper on the design of the system for the Game Developer's Conference (deadline: Jul./Aug.)
- an installation exhibited in the Emerging Technologies program at SIGGRAPH (deadline: Jan./Feb.)
- an installation exhibited at Ars Electronica (deadline: Mar.)

## References

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