eGuardian Angel Social Network Analysis Through Agent-Based Simulation

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Introduction

Guardian Angel Concept

- Current social networks usually have a very dense network structure where each individual has a very large number of connections. However, this means individuals are less likely to stay in contact with others.

- The Guardian Angel concept provides a network where individuals are in charge or focused on specific users to help them achieve their goals in a specific domain.

- The Guardian Angel Concept involves:
  - **Child –** Individual who is pursuing a goal
  - **Guardian –** Individual who is responsible for providing support and monitoring an assigned children with their goals

eGuardian Angel Mobile Application

- An eGuardian Angel mobile application has been developed based upon the Guardian Angel concept where individuals are assigned children which they monitor using:
  - Messages between guardian and child
  - To do lists
  - Reminders

- In the eGuardian Angel application network, users are both guardians and children, and in this case, the guardian to child ratio is one to one.

- Every user in the system is pursuing a goal and is assigned another user as their guardian for support for their goal.

- This application is still in it's early stages and the effectiveness of it is unknown.

Aim/Motivation

- To model and simulate the eGuardian Angel mobile application to determine important parameters for a basis for future development.

- To determine what types of groups would benefit from the application and the most ideal guardian to child ratio which would provide the most benefit to users.

- This information will influence the emergence of social pattern formation and will show how these parameters impact individuals and social benefit.

Background

Agent Based Simulation

- Type of simulation where autonomous agents are defined to model a complex system.

- Allow detailed agents to be defined to model the diversity of agents involved and observe effects at a macro level.

- Generally have 3 elements:
  - Agent **relationships**
  - **Agents** defined by their attributes and behaviours
  - Agents' **environment**

Design

Network

- The network modelled is a directed graph, $G(N, E)$, consisting of the set N of nodes representing users and the set E of edges representing the relationship between users, which are ordered pairs of elements of N

- An edge $E(u, v)$ would indicate u is a guardian of v and in this

- Since each user is both a guardian and a child, and the guardian to child ratio is one to one, it results in the following network:
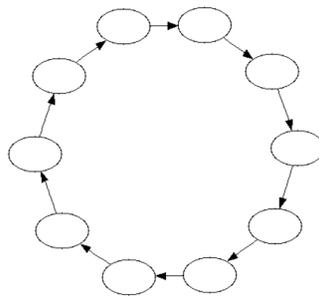

Figure 1. eGuardian Angel application with a guardian to child ratio of one to one

Agents

- The attributes of an agent are defined as follows:
  - **Positivity** indicates the effect the user will have on their children
  - **Motivation** indicates how motivated they are to achieve their goal

- Behaviour
  - Given ρ_c the probability of a child receiving a message from their guardian and p_g the positivity of a guardian:
  $$\rho_c = \frac{p_g}{1000}$$
  - If a message is received by their guardian, the users new motivation
  $$m_{new} = \left(m \cdot \left(\left(\frac{p_g - m}{m}\right) \cdot 0.01\right) + 1\right)$$
  This causes the motivation of the child to tend towards the positivity of their guardian according to their motivation so that motivation that has a higher difference to their guardians positivity will tend faster.
  - Over time, an users positivity will be influenced internally by their motivation through:
  $$p_{new} = p \cdot \left(\left(\frac{m - p}{p} \cdot 0.0025\right) + 1\right)$$
  This will also tend positivity by motivation through the same principle

Environment

- A random factor is used to model the environment influence which adjusts the user's motivation 0.1% of the time.

- It is obtained from the Gaussian distribution $\mathcal{N}(\mu, \sigma)$, where μ is the mean and σ is the standard deviation.

- The new motivation will be
$$m_{new} = \mathcal{N}(m, 5)$$

- This is to account for any random scenarios effecting a users goal pursuit

Experiments

- Experiments are completed through 5000 steps and are repeated 10 times with the averages and standard deviations recorded

- Three variable are changed to obtain results
  - Average starting positivity and motivation of each user
  - The number of users with a biased average positivity and motivation
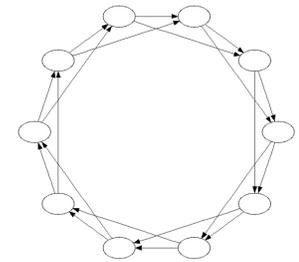 - Guardian Angel to Child ratio, as seen in figures 1, 2 and 3.

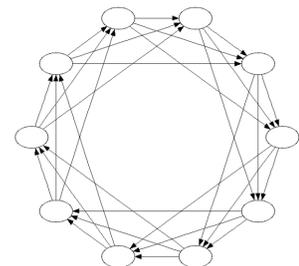*Figure 2. eGuardian Angel application with a guardian to child ratio of two to two*

Figure 3. eGuardian Angel application with a guardian to child ratio of three to three

Future Work

Field Studies

- Field studies can be completed on the eGuardian Angel mobile application to obtain statistics on the users and use of the application so the can be fed into the simulation and obtain more accurate results.

- This data can be used to more accurately set parameters in the simulation and define agent behaviour.

Network Structures

- Simulations could be carried out on different network types such as centralised and modular, and networks of different number of components.

References

[1] Doyle, J., Szolovits, P., Long, W. J., Kohane, I., & Pauker, S. G. (1994).Guardian Angel: Patient-centered health information systems. Massachusetts Institute of Technology, Laboratory for Computer Science.

[2] Westaby, J.D. 2012, Dynamic network theory: how social networks influence goal pursuit, American Psychological Association, Washington, D.C.