GROCS Proposal
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I. Project Name

M-Chat

II. Project Objective

M-Chat will enhance academic activity by facilitating collaboration among students, faculty, and staff in the University environment.

Technology companies have developed a wide array of applications that introduce individuals and facilitate communication for purposes ranging from dating to establishing new business relationships. There is a need for similar applications in the University environment to facilitate collaboration for academic purposes ranging from creating study groups on the fly to holding online office hours. It is unfortunate that instructors currently use commercial 3rd party services such as AOL Instant Messenger™, which contain no academic set of tools, to hold online office hours. It is unfortunate that students studying in the same library for the same exam currently have no way of meeting each other and studying together. These are only a small set of the many challenges M-Chat aims to conquer.

By building an infrastructure to introduce and connect individuals based on physical location, class registration, group membership, academic interests, and other relationships, we will lay the groundwork for the development of a multitude of next-generation collaborative learning and communication applications. Additionally, as part of the scope of this project, we will develop a proof of concept University-wide IM system that takes advantage of this underlying infrastructure.

The Internet2 Middleware Initiative sees the need for University-centric instant messaging services and created a working group (I2IM) in 2003 to further explore it (link provided in section IX). Unfortunately, participation in I2IM has fallen drastically over the last 12 months and the development of a solution by I2IM based on their findings does not seem likely at this time. If given this grant, we will base our solution in-part on the findings of the I2IM working group.

III. Participating Students

Ayush Agarwal is a junior pursuing Mathematics and Computer Science Engineering. He is passionate about designing software-enabled experiences that add simplicity to our life and allow for rich interactions. This summer Ayush worked at Microsoft as a Program Manager and successfully deployed a bug management tool, which is currently used to track the status of all Windows bugs. He is also the founder and CEO of Zinex, a design and innovation house focusing on intelligent products. Having grown up in Nepal and Singapore, Ayush brings a breadth of perspective on technology's relationship to people in the developing and developed world, and hopes to create technologies that directly impact quality of life in both developing and developed countries. In his free time Ayush enjoys dancing, photography, programming, solving puzzles and making gadgets.

Adam Herscher is a senior at the University of Michigan pursuing a B.S. in Computer Science with a minor in Near Eastern Languages and Cultures. His current coursework, projects, and interests include Location Based Services, Mobile and Handheld Devices, Search and Information Architectures, Security Architectures, and Recommender / Reputation Systems. Adam worked for the Computer Aided Engineering Network (CAEN Hotline) during his first two years at the University, and continues to work for the University as a member of the Information Technology Central Services (ITCS) Hostmaster group. Adam started a consulting business with a friend early in high school, and has since held intern and full-time positions with several software companies in his home state of California. As a hobby, Adam runs the University's Internet Relay Chat server, irc.umich.edu.

Jeff Powers is a senior at the University of Michigan, finishing a B.S. in Electrical Engineering. While in high school, Jeff independently developed a flight reservation system for Island Airways, an airline based in northern Michigan. He has a passion to push the edge of technology to improve the lives of others and make machines more intelligent. His passion for technology led him to map and publish the topography of 802.11b networks on Michigan's campus in his sophomore year. This past summer, Jeff was an intern at the National Security Agency. He currently acts as a student mentor, the Vice President of the University's Tau Beta Pi Chapter, and as a research assistant in digital communications. Following graduation, he hopes to transition to graduate school in the field of robotics.

IV. Participating Advisor

Dr. Elliot Soloway, a Professor affiliated with Electrical Engineering & Computer Science, School of Education, and School of Information, will act as a faculty advisor for this project. Through his significant knowledge of and experience with mobile, educational, and collaborative technologies, in addition to his award-winning teaching ability, Dr. Soloway will be an invaluable resource to the team throughout the semester.

V. Project Description

Synopsis

The project is to design and implement a network-based, relationship-driven infrastructure to facilitate personal interaction and academic collaboration. Users (clients) will interact with a server to obtain lists of other users with which they have relationships. Relationships may be geographical, for example connecting users studying or researching similar academic areas within a physical library. Relationships are not limited to geographical ones, however, and may include a wide range of metrics (axes) such as enrollment in courses or membership in campus and professional organizations. A basic information transmission mechanism will be provided between users, which will be utilized by plugin-style features that run alongside, and integrated into, the main framework. These plugins will allow interaction on a one-to-one or one-to-many basis. The most basic but crucial one-to-one communication will be instant messaging, of which we intend to complete a proof of concept by the end of the semester.

Server Infrastructure

For each axis, a database table will indicate relative distances between properties. Each user has a set of properties, which are largely self-defined. An example is the 'geographical location' properties, which are defined on 2 axes, latitude and longitude. Another example is the 'Courses' property, which is defined on a similarity scale. A user may occupy multiple points on the course axis, but will only occupy one point on the latitude axis, for example. The server component is designed to maintain distance information and essentially provide a list of neighbors for each axis to the clients. One server-decided coordinate is the user's 'Online/Offline' status.

Client Infrastructure

The client will not be merely a list of properties. Based on a combination of user and external-input, the client should calculate its coordinate(s) on the axes that the user has chosen to monitor. If the client happened to be connected to a GPS unit, it would periodically update latitude and longitude information on the server automatically. If the client happened to be accessing the network via a physical or wireless network on campus, its location information would be updated in a similar fashion.

Distances and Locations

Some axes have distances which are easy to compute. If a client transmits a geographical coordinate, it is trivial to calculate its distance from all other clients. If this information is unavailable, the network subnet may be mapped to a particular geographical coordinate. The server will notify the client that it is unaware of where, geographically, the user is located. The user will then have an opportunity to select his or her location, whereby giving the server the needed mapping of subnet-location, which it can use to infer the geographical location of future users who logon to the same subnet. Other coordinates, such as academic areas of interest, for instance, are not easily quantified in terms of distance. To solve this problem, a user will be asked to choose a number of related interests from the existing list. A transitive-closure-like operation will be then performed to find all interests which are more indirectly related. Numerous applications of graph theory and artificial intelligence could help determine the similarity between users' properties on a given axis with a large number of points. We may leverage other data sources, with the user's permission, to determine properties. An example would be the user's class list from a university website.

Performance and Efficiency

Efficiency is important to the success of such a system. The server must monitor changes in the coordinates of users on all dimensions, and 'fix' existing proximity lists, rather than re-computing all neighbors of all users when a change occurs on an axis. The most efficient solutions to this problem may involve complex graph theory. Also, as a practical matter, only one list of neighbors should be kept and updated for users in the same location – to save calculation time and memory.

Technologies

An adaptation of an instant messaging platform would be well-suited to this application. Both the actual interaction and the proximity information should be sent over the same framework. Further, platform-independence is a worthwhile goal, but may not be practical for a short development cycle.

Future Information Display

Hardware devices could enhance the interactivity of such a system. Existing information display technologies such as color-changing globes could indicate the arrival of system users in a coffee shop or library, or their level of interaction. In essence, the globe might be an invisible client which monitors the state of one or more coordinates that it shares with users. A professor could use something similar to monitor the interaction of students in a particular class.

Privacy

With encouraged interaction comes increased information sharing, which can hinder privacy. One solution would be to warn users that their privacies will be given up when using the system, but a better solution is to design the system such that anonymity is optional, and that interaction can first take place without exchanging personal information such as user names or email addresses. For many types of properties, it is sufficient to show those who share the property, and it is in the interest of privacy to avoid showing all other properties of a user.

Timeline

A prototype system will be developed over the course of the winter semester 2005.

VI. Equipment and Resource Requirements

We will require a Linux-based server to be used as a development environment and to host the proof of concept application once completed. We may be able to provide this hardware ourselves through connections at ITCS and other organizations.

VII. Missing pieces

It may be beneficial to include an additional person with significant graphical user interface and HCI (human-computer interaction) knowledge and experience. However, we have made a calculated decision at this time to limit the group size to three persons in order to maximize efficiency and limit communication overhead. The majority of the design and implementation work in this project lies in the dynamic location-based server infrastructure, whereas the client communications application can be adapted from the code-bases of existing open-source software projects.

VIII. Contact information

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IX. References

Should our team be given the GROCS grant, we will maintain a project web site that will act as a reference. In the meantime, the following references may be relevant:

- Internet2 I2IM Working Group - http://middleware.internet2.edu/i2im/
- Cohn, E. R. 2002, Instant Messaging in Higher Education: A New Faculty Development Challenge - http://www.ipfw.edu/as/tohe/2002/Papers/cohn2.htm
- Frand, J. L. 2000, The Information Age Mindset, EDUCAUSE Review, September/October 2000, 15-24. - http://www.educause.edu/pub/er/erm00/articles005/erm0051.pdf
- Farmer, Robert, Instant Messaging – Collaborative Tool or Educator's nightmare! - http://naweb.unb.ca/proceedings/2003/PaperFarmer.html
- Patch, Kimberly, Messenger taps social nets - http://www.trnmag.com/Stories/2004/071404/Messenger_taps_social_nets_071404.html

X. How did you hear about GROCS?

Ayush Agarwal heard about GROCS through word of mouth.