FriendCluster: Group Based Spatial Alarms
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CS 4675/6675 - Project Proposal

Motivation and Objectives

An issue that people experience almost on a daily basis is trying to keep track of other people or groups in a large and/or crowded area. This is what drives our motivation for our project. Our group is proposing a project that is web-based application that utilizes geolocation to help a group meetup and to notify the group when a member deviates from the group. A few use cases for this application would be ensuring group safety, especially in large crowded spaces, making it easier to find others in large/crowded areas, helping parents keep track of their children when in public, and aiding teachers in keeping track of their students on field trips. This is an interesting project to our team because it utilizes localization. This project also applies ideas of spatial alarms in a different context.

Related work

Currently there is some research out there related to our project, however, there is no single publication that encompases our whole project. Therefore, we have combined many areas of research to construct the basis of the design of our projects. Here are some publications that we have found to help us formulate our plan of action:

GeoGrid: A Scalable Location Service Network [1]
Authors: Jianjun Zhang, Gong Zhang, Ling Liu

GeoGrid is a location overlay system that uses mobile nodes to provide location-based services. The aspect of flexibility within the system and tolerance to peers leaving, joining, and splitting regions could be useful when designing our system.

A Survey on Clustering Algorithms for Vehicular Ad-Hoc Networks [2]
Authors: Samo Vodopivec, Janez Bešter, and Andrej Kos

There has been work based on the vehicle ad-hoc networks and how they are clustered into a single node. This will guide us in creating a single location to base the spatial alarm around given mobile users with individual movements.

Energy-Efficient Processing of Spatial Alarms on Mobile Clients [3]
Authors: Anand Murugappan and Ling Liu

This paper examines spatial alarm processing in the context of a mobile device. The optimizations found for processing on mobile clients will create a guide for developing aspects such as distance measurement and polling intervals.

Effect of Location-Awareness on Rendezvous Behaviour [4]
Authors: David Dearman, Kirstie Hawkey and Kori M. Inkpen

This paper showed that having knowledge of your group members' locations affects your behavior when trying to rendezvous. Without communication through messages, some participants will leave the rendezvous spot to try and locate their delayed partner. Since our system uses a moving cluster of friends, any attempts to implement a meet up system will have to take into account the behavior of its users.

Proposed Work

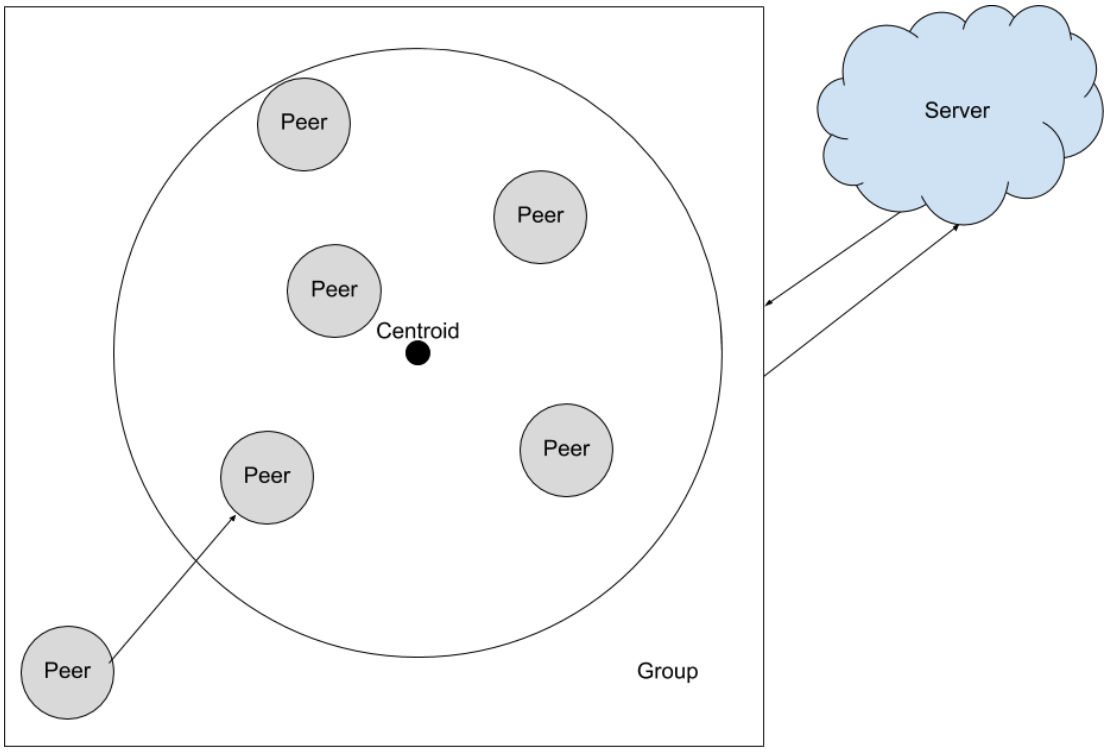

Figure 1. Architectural Design of FriendCluster

Our project will consist on creating a system design to create groups and cluster them. From there, we will expand using geolocation and the idea of spatial alarms to drive the location-based component of our project. In order to do this, the following tasks must be completed:

- Clustering of multiple users into a single location - by clustering multiple users into a single location, as depicted in Figure 1, to help build the spatial alarm
- Creating a spatial alarm around the location and alerting when a peer deviates from the spatial alarm - this is the space that is considered the "safe zone." If an individual leaves this safe zone, all other members in the group will be notified so they can reconvene.
- Map display - This will assist in locating your lost friend, child, etc.

- Navigation towards the center of the group - this will be utilized in helping a group converge to a single point
- An algorithm for updating the system in real time - this allowing the group to move around and recalculate the center/fence

Plan of action

Resources needed:
- Hardware: 3+ phones and a server
- Software: Web Application platform (potential candidates: Django, NodeJS, RubyOnRails, PHP)

Timeline (we are working in a agile environment with ~2 week sprints):

3/4: Find cluster center
3/18: Build geofence around cluster center
4/8: Create Simulation and run test on algorithms
4/15: Build server and client for mobile use

Evaluation and Testing Method

Once we implement the system, our project will be put under extensive testing. At this stage, we will test in the follow ways to assess accuracy, efficiency, and general usability of our system.
- Test simulation for accuracy of algorithm
    - Make sure centroid is in the center of the cluster of groups
    - Test if the safe zone circle is centered around the centroid and moves with the group
    - Ensure that the application reliably triggers an alert when a peer leaves the safe zone
    - Make sure algorithm is quick and efficient for large groups (up to 20 users)
- We will perform field testing with 3+ phones in both empty/small, empty/large, crowded/small, crowded/large areas.
    - Measure out the safe zone and have a group walk around within it. Test to make sure no alarms trigger.
    - Walk outside safe zone, and test for alarms.
    - Test cluster center by all moving together and having no alarms trigger
- To determine the efficiency of our system, we will be evaluating three components:
    - Ability to reconvene easily
    - Ability to find lost member easily
    - Reaction time between group member deviating from the safe zone and the notification trigger.

Bibliography

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[3] https://www.cc.gatech.edu/~lingliu/papers/2008/Anand-SEDE08.pdf
[4] http://www.dgp.toronto.edu/~dearman/papers/2005-Rendezvous-CHI.pdf