Course 7001 Mini Project
Demo for Privacy Preserving Networks

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1. Introduction

Recent years, privacy-preserving searches and query processing has become a hot topic. Privacy preserving search could prevent personal sensitive information from leaking, while still provide search capabilities. This is especially in dire need for health record sharing applications. In this report, we make demo of a grid-based searchable network, called privacy preserving network (or PPN). We design and implement of a demo system for visualizing typical usecases of PPN. We model the general usecases of PPN: Clients contact their closest network node (namely the gateway node), and search for multiple keyword queries. For example, user could pose queries about their own names in the wish to find out all medical organizations that hold their health records. A two-phase scheme is then used: first search a distributed index for a list of providers/nodes that relate to the queried keywords; clients then further use their own credentials to access these providers and to get matched records as final results. During the latter process, clients could be rejected by providers, due to lack of credential.

In the rest of dicussion, we decomposed the whole demo into three small parts, which respectively focus on basic search framework, search on a map, search in a dynamic network setting.

2. Demo 1: Basic Search Framework

In this demo, we can first fill in patients' personal information (say names or ids). The system will return a list of providers documents/tables on which have related health record. Then by choosing one provider from that list, the system show on the grid how PPN route the message to a destination, starting from searcher's gateway node (as shown in green line in Figure 1). On implementation, we developed an independent module that relies and interacts (heavily) with the GeoCast/Grid project[1].

3. Demo 2: Search on Real Maps

To give audience real senses, we also developed a demo based on real-world maps. Besides previous activities, we can now zoom in and zoom out for a specific region, and can change between aerial and road map. Figure 2 shows demo with background of an aerial map bounded around GaTech.

Figure 1

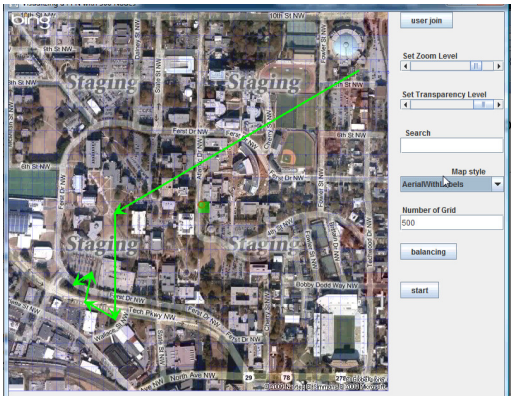

Figure 2

To implement the part, we adopt the Bing Maps web services[2], which provide us three interfaces to translate postal address to <latitude, longitude>, to render images of a local map and to search for keywords. We find some performance problems in using Bing Maps. When zooming in/out at different granularity, the time to retrieve new image from Bing Maps web server become noticeable, harming user experiences. We now adopt the cache method to hide the latency. However, as cache can't eliminate the compulsive miss, users still need to wait a long period of time for the first access. For the future work, we plan to address this problem, and to use a prefetch technique to further hide latency.

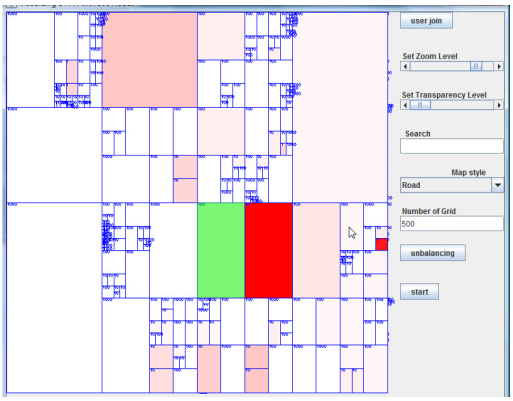

Figure 3

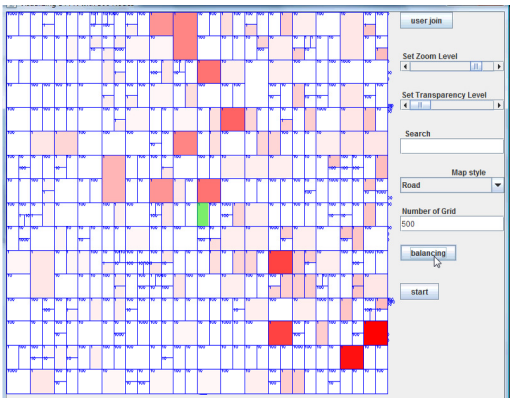

Figure 4

4. Demo 3: Search in Dynamic Networks

This section shows how grid adapts to dynamic network while still providing searching capabilities. Specifically, in the demo, we can respectively change the size of grid network, use different balancing strategy, and use time-evolving workload. The demo shows how the network can scale well and adapt to different conditions while still providing searching facilities. Figure 3 and 4 respectively illustrates workload distribution under balanced and unbalanced grid mapping. On implementation, we take care of the multi-thread issue in swing environment. Because java gui, swing, use single thread to render display, it is noteworthy to not write blocking code in this swing thread. We usually start a new thread/runnable to run blocking code, for example, when start a new frame, it would be better off starting a new thread to do this.

5. Conclusion

In this mini-project, we developed a demo for illustrating how PPN could work in real world. We identify several implementation issues and tackled them in a way. As future work, we plan to deploy the demo on multi-node networks.

References

[1] J. Zhang, G. Zhang, and L. Liu, "Geogrid: A scalable location service network," in *ICDCS*, 2007, p. 60.

[2] [Online]. Available: http://www.bing.com/maps/