Location Inference using Co-presence of multiple devices

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LOCATION INFECTION USING CO-PRESENCE OF MULTIPLE DEVICES

ABSTRACT

A system is disclosed for inferring physical or semantic location using co-presence of multiple mobile devices. The system gets the location reports from several nearby mobile devices and sends back an accurate location for all these devices. The location reports from each device’s sensors (such as Wi-Fi, cell tower, Bluetooth or GPS) that are close together are used to determine the semantic location for these devices. Each type of sensor is provided a reliability weightage when combining data from the multiple devices. The system then statistically combines the signals from the multiple devices to determine the semantic location more accurately than using just an individual device.

BACKGROUND

Current mobile devices have multiple forms of wireless connectivity to discover other mobile devices in their vicinity. In addition to this, mobile devices also have the capacity to determine their location using these technologies. Each device however gets a different combination of signals based on their relative location to GPS satellites, cell towers, Wi-Fi routers and other phones. The location indicated by these signals can be tens of meters away from the actual location of the user. These signals are used to determine the position of the device in terms of latitude and longitude. The latitude, longitude locations are then mapped into a semantic location e.g. restaurant, store, pharmacy, home, work etc. to build useful applications over this information. However, these location reports have high interference and are not always accurate enough to determine correct semantic location. All current efforts for solving the location inference problem are centered on finding a location for a user using location reports and data from that user only. However, most people are always around other people and each of those has location reports coming in as well. Thus there is a need for a better method to determine the semantic location using mobile devices more accurately.
DESCRIPTION

This disclosure presents a system for location inference using co-presence of multiple devices, such as mobile phones carried around by a group of people. The system includes a server for processing data connected through an application to the multiple mobile devices. The system combines the signals from the multiple devices known to be within a small distance of each other to determine the semantic location more accurately than using just an individual device.

The location reports from each device sensor such as Wi-Fi, cell tower, Bluetooth or GPS that are known to be together are used to determine the semantic location for these devices. Each type of sensor in a device is provided a reliability weightage when combining data from multiple devices.

The system envisages treating the following specific cases:

1. If one user confirms the location to be a specific place, the application extrapolates that confirmation to other users in the same location as well.

2. If one of the devices has a global positioning system (GPS) on, the application assumes its latitude, longitude report to be more accurate, or assigned a higher reliability than that from other sensors/devices and uses it for semantic location determination.

3. If one of the devices is connected to a wireless network of a specific point of interest which can be reliably confirmed, the application uses that information to determine the location for each of the other devices.

4. Even if none of the devices has a confirmed or highly reliable location report, the application combines the location reports from all the devices to come up with a derived signal canceling out some of the noise and increasing the possibility of determining an accurate semantic location.
5. The application in some cases uses a combination of personalization signals from all the users taken together to determine the location of all the users.

The system envisages that computations of location as indicated by the steps above are done either on the server side or on the individual devices, where the system gets the location reports from all the nearby mobile devices and sends back an accurate location for all these devices.

The application may require a user to explicitly agree to share their device location information as part of installation, or may prompt the user to provide specific permission to the application for that user’s location to be discovered. Alternatively, the application may be configured to share the location information with a known contact as established by another application on the user’s device. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is not accessible or removed.

The advantages of using this application include mitigating the communication of inaccurate location data report from a single person that has thus far led to incorrect location inference for the person. Use of statistical or machine learning approaches to combine data from multiple mobile phones provides a better way to solve the hard problem of determining semantic location.