Problem Identification: Adeel Ahmed

In many developed countries the public transportation that makes use of road infrastructure such as buses, is fully equipped with Global Positioning System Devices (GPS). This is kind of position aware service that relies on device's knowledge of its own location. However, we do not see such position aware information being conveyed and displayed to the passengers (able or elderly people in consideration) waiting at different bus stops, which can be highly useful. Had they access to it, either they may choose to wait for the bus, or look for an alternate transport like a Taxi/Cab (used interchangeably). The only way to have access to this information would be either if passengers explicitly check real time bus position information online using computer/mobile phones, OR make use of location-tracking service - which is based on relying on other parties to track the user's location and deliver the real time positions of bus information in form of notifications on their mobile phones. In this situation context-aware, location tracking service can be efficient but it has a major drawback associated with it, which is privacy concern, since user is being tracked continuously. Therefore the first motivation is to make real time information accessible to users at bus stop without any privacy concerned issues. The second motivation comes from the information obtained in the first phase about the real time positions of the buses at bus stops. What if there are no more buses on this route, or the waiting time at bus stop would be quite long, and passenger chooses to go for a cab, but he can not see any cab near by. This problem is resolved by providing an alternate interface at this bus stop for requesting a cab service. The three papers 'location based services for mobile telephony and privacy concerns', 'bus view a graphical transit information system' and 'public information kiosk system' combined together, addresses achieving this goal. The main benefits include: knowing the estimated waiting time for bus in advance, information on many other alternate buses and their current locations, lessening passenger's anxiety for unknown waiting time, allowing passenger to opt for the alternate mode of transportation, registering for taxi service and other relevant information.
Summary of Papers:

**location based services for mobile telephony and privacy concerns:** This paper discusses the context-aware computing applications for mobile devices that adapt to environmental sensor information and the associated privacy concerns. There are two types of location based services are discussed; first, 'location-tracking services that are based on other parties tracking the user's location' and second, 'position-aware services that rely on the device's knowledge of its own. The experimental case study findings measured the usefulness and level of concern in using the location based services, such as pushing a lunch service on mobile when user is around restaurant. The findings suggested that users were not overly concerned but had less concern for position-aware than location based services.

'bus view a graphical transit information system' : The paper discusses how to present the real-time transit information in graphical way to the public over world wide web. This is done using BusView, browser based interactive application program that allows users to navigate quickly to geographic area of interest via a variety of interactive gestures. The real time automatic vehicle location (AVL) data is streamed from server to the program for display. It discusses the mapping of static objects such as roads, water-spaces with dynamic graphical bus positions. Moreover, it displays the location and movement of large number of buses and the progress of a bus to particular destination. The findings have shown that it provides useful travel information in a timely manner.

'User Interface design guidelines for public information kiosk system' : The paper presents different guidelines on the user interface design while using kiosks - terminals that provide information and services to the general public places. The paper helps try to achieve 'interfaces for all'. The guidelines are based on the research of existing literature. It helps gain insight for different user needs considering different applications for the kiosk. The key guidelines presented in paper are categorized into: defining user requirements, location and encouraging use, physical access, introduction and instruction, language selection, privacy, help, input/output, structure and navigation, and customization.
Integration of Papers and Prototype:

**Hypothesis:** Access to real time transit information at bus-stops helps in planning journey.

To help plan journey in best way, we address two key questions, how do passenger get access to real time bus information and how do passenger request a cab service from bus stop.

The prototype is based on providing the real time position of the buses in the city limits at the bus stop. A centralized transit cell collects the real time position information of all buses in the city and disseminates the same using wireless communication infrastructure to all bus stops. The bus stops use electronic display screens and public information terminals (kiosks) to display this information. Passengers can interact with kiosk to have better interactive experience using touch or keypad.

The prototype is extended to accommodate the passengers who wish to request a cab service at this bus point by extending the kiosk functionality. User registers on the kiosk by inserting his destination address or landmark and system asks user to pay through smart card. This billing and payment functionality is often part of the kiosk terminal. On completion of the user's request, the request is propagated to central bus monitoring cell. Considering the previous research, it shows that though cab agencies don't really want to work under the centralized public transport cell, but provided they get access to more passengers and thereby more revenue, so they don't hesitate sharing real time taxi information. Hence the request for cab service by the passenger gets propagated by the central transport cell to the nearest available taxi in that location in form of mobile based notification. This is an example of *location-tracking service*, and keeping track of a taxi is not a matter of privacy concern for taxis in this case. Later based on this information, driver picks up the passenger from that location.

The key advantage is that users do not rely any more on *location-tracking* services to get notified when they enter bus premises. It saves them from being tracked continuously and the privacy is no more at stake. Besides this, there are many other advantages that make this prototype more useful for passengers, which include, getting better informed on the real time automated vehicle location, alternate routes, key traveling alerts, information on navigating to popular destinations inside the city.
Use of Papers for Integration:

Location based services for mobile telephony and privacy concerns:

The literature and the findings from this paper has encouraged to use the location based services. The two types of such cited services; location-tracking and position-aware have been employed in the prototype. Buses and taxis both use the global position aware service, that uses global positioning system (GPS) device to track the bus position. However taxis also use the location-(based)-tracking services for mobile telephony to receive notifications from the central transit cell for the passenger who has requested a taxi service. The suggested prototype eliminates any chances of privacy concern for the users, since location tracking is only employed by taxis but not users.

Bus view a graphical transit information system:

The proposed prototype has made use of the cited bus view application that represents the real time transit information in graphical way using mapping between the static and dynamic objects. This graphical information can be viewed on the display screens at the bus stop and with an interactive gesture based experience on the kiosk as well. Passengers can zoom into different geographic locations of interest, and manipulate each bus icon to see the destination, starting and ending positions on route, the entire route map and other such features. This approach would help provide highly useful travel information to users and plan their journey accordingly.

User Interface design guidelines for public information kiosk system:

The proposed prototype has made use of the public information terminal based on the key guidelines suggested in this paper to try to aim for an 'interface-for-all'. The kiosk used in the prototype contains touch and standard keypad interface. Its display screen is steep fitted, large enough to see the mappings appropriately and small enough so that if someone passes behind or around the kiosk cannot see the information on screen since users might be paying using smart card. It is physically kept at the back corners of the bus stop to protect for privacy reasons. Text or graphic content is the only output displayed on kiosk.
Evaluation:

Hypothesis: Access to real time transit information at bus-stops helps in planning journey.
Null Hypothesis: Access to real time transit information at bus-stops does not help.

Population: I will consider doing a study on at least 20 or more people to give me These will can be regular daily bus passengers, visitors, students , elderly, people affording taxi (both males and females).

Type of Study: Across Subjects – same group will perform both tasks.

Independent Variable: Interaction, Dependent Variable: Ease of use

Metrics: Ease of use (for kiosk, ranked on 1 to 5 scale). Other possible measures that can be tested : accuracy for time of arrival for bus, accuracy for time of arrival for taxi, privacy for using kiosk.

External Validity: By comparing results with location-tracking services for Mobile Telephony.

Power and Generalization: Based on findings, power and generalization of study can be anticipated.

Task: To evaluate a prototype of real time transit information at bus-stop and whether it would be beneficial to passengers at bus stop. This would be done based on sample questionnaire.

Procedure: After taking participants' consent, a sample questionnaire is given to evaluate the design.

Biases: Maximum care is taken to ensure, no biases occur, else on occurrence would be reported.

Data Analysis: Based on the user evaluation of the study, data would be analyzed to

Conclusion: A prototype to provide access to real time transit information at the bus station has been proposed. Passengers can view the actual positions of buses on both electronic display screens and kiosk terminals. In addition to that passengers can also request a taxi service using kiosk terminal.

This prototype has great potential to be extended by interlinking all different bus stops across a study, to help passenger plan his entire journey in advance. Furthermore, this can be extended to include other modes of public transport such as train and sea. Many additional features such as information on blending routes for optimal path, fastest means to travel, organizing entire daily travel routes and saving it for later viewing purposes can be highly beneficial. Most importantly, gathering real time transit information would help better understand the traffic flow and passenger traveling patterns.
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