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Predicting Bus Arrival Time With Mobile Phone Based Participatory Sensing

RinorobinA, Thamaraimuthumani

Abstract— The bus arrival time is primary information to most city transport travelers. Excessively long waiting time at bus stops often discourages the travelers and makes them reluctant to take buses. In this paper, we present a bus arrival time prediction system based on bus passengers' participatory sensing. With commodity mobile phones, the bus passengers' surrounding environmental context is effectively collected and utilized to estimate the bus traveling routes and predict bus arrival time at various bus stops. The proposed system solely relies on the collaborative effort of the participating users and is independent from the bus operating companies, so it can be easily adopted to support universal bus service systems without requesting support from particular bus operating companies. Instead of referring to GPS-enabled location information, energy efficient sensing resources, including cell tower signals, movement statuses, audio recordings, etc., which bring less burden to the participatory party and encourage their participation.. The evaluation results suggest that the proposed system achieves outstanding prediction accuracy compared with those bus operator initiated and GPS supported solutions. To suggests the easy deployment of our system and promising system performance across cities. At the same time, the proposed solution is more generally available and energy friendly.

Keywords— Participatory Sensing, predicting, android

I. INTRODUCTION

Public transport, especially the bus transport, has been well developed in many parts of the world. The bus transport services reduce the private car usage and fuel consumption, and alleviate traffic congestion. As one of the most comprehensive and affordable means of public transport, in 2011 the bus system serves over 3.3 million bus rides every day on average in Singapore with around 5 million residents. When traveling with buses, the travelers usually want to know the accurate arrival time of the bus. Excessively long waiting time at bus stops may drive away the anxious travelers and make them reluctant to take buses.

Nowadays, most bus operating companies have been providing their timetables on the web freely available for the travelers. The bus timetables, however, only provide very limited information (e.g., operating hours, time intervals, etc.), which are typically not timely updated. Other than those official timetables, many public services (e.g., Google Maps) are provided for travelers. Although such services offer useful information, they are far from satisfactory to the bus travelers. For example, the schedule of a bus may be delayed due to many unpredictable factors (e.g., traffic conditions, harsh weather situation, etc). The accurate arrival time of next bus will allow travelers to take alternative transport choices instead, and thus mitigate their anxiety and improve their experience. Towards this aim, many commercial bus information providers offer the real-time bus arrival time to the public. Providing such services, however, usually requires the cooperation of the bus operating companies (e.g., installing special location tracking devices on the buses), and incurs substantial cost.

A. Bus detection

Since the sharing users may travel with diverse means of transport, we need to first let their mobile phones accurately detect whether or not the current user is on a bus and automatically collect useful data only on the bus. Without accurate bus detection, mobile phones may collect irrelevant information to the bus routes, leading to unnecessary energy consumption or even inaccuracy in prediction results.

B. Bus classification

We need to carefully classify the bus route information from the mixed reports of participatory users. Without users' manual indication, such automatic classification is non-trivial.

C. Information assembling

One sharing user may not stay on one bus to collect adequate time period of information. Insufficient amount of uploaded information may result in inaccuracy in predicting the bus route.

An effective information assembling strategy is required to solve the jigsaw puzzle of combining pieces of incomplete information from multiple users to picture the intact bus route status.

As we get location information, from the sharing users, this data is recorded into the server. The location from the clients from all the requesting clients who are waiting is received. This data is compared and the estimated time of arrival with respect to a client location is calculated.

In this paper, we develop practical solutions to cope with such challenges. In particular, we extract unique identifiable fingerprints of public transit buses and utilize the microphone on mobile phones to detect the audio indication signals of bus IC card reader.

RinorobinA, P.G Student, Department of Computer Science & Engineering, St. Michael College of Engineering.&Technology, Kalayarkoil,Sivanganga,India . (Email: rino.heaven@gmail.com.)

A.Thamaraimuthumani, Associate Professor, Department of Computer Science & Engineering , St. Michael College of Engineering.&Technology, (Email: rajathamarai234@gmail.com)

We further leverage the accelerometer of the phone to distinguish the travel pattern of buses to other transport means. Thus we trigger the data collection and transmission only when necessary. We let the mobile phone instantly sense and report the nearby cell tower IDs.

We then propose an efficient and robust top-k cell tower set sequence matching method to classify the reported cell tower sequences and associate with different bus routes.

We intellectually identify passengers on the same bus and propose a cell tower sequence concatenation approach to assemble their cell tower sequences so as to improve the sequence matching accuracy.

Finally, based on accumulated information, we are then able to utilize both historical knowledge and the real-time traffic conditions to accurately predict the bus arrival time of various route.

To present a novel bus arrival time prediction system based on crowd-participatory sensing. We interviewed bus passengers on acquiring the bus arrival time. Most passengers indicate that they want to instantly track the arrival time of the next buses and they are willing to contribute their location information on buses to help to establish a system to estimate the arrival time at various bus stops for the community. This motivates us to design a crowd participated service to bridge those who want to know bus arrival time (querying users) to those who are on the bus and able to share their instant bus route information (sharing users). To achieve such a goal, we let the bus passengers themselves cooperatively sense the bus route information using commodity mobile phones. In particular, the sharing passengers may anonymously upload their sensing data collected on buses to a processing server, which intelligently processes the data and distributes useful information to those querying users.

II. LITERATURE SURVEY

A. A Scalable Infrastructure For Track-Based Applications.

A Framework for Enabling Track-Based Applications by Ganesh Ananthanarayanan, Maya Haridasan, IqbalMohomed, Doug Terry and Chandramohan A Thekkath. Mobile devices are increasingly equipped with hardware and software services allowing them to determine their locations, but support for building location aware applications remains rudimentary. This paper proposes tracks of location coordinates as a high-level abstraction for a new class of mobile applications including ride sharing, location-based collaboration, and health monitoring. Each track is a sequence of entries recording a person's time, location, and application-specific data. Star Track provides applications with a comprehensive set of operations for recording, comparing, clustering and querying tracks. Star Track can efficiently operate on thousands of tracks.

Star Track is a system that provides the building blocks for developing track-based applications. A track is a time-ordered sequence of location readings, each of which is a track entry. A track is intended to capture the path taken by a mobile device or, more importantly, a person in possession of a mobile tracking device.

Tracks are recorded, under control of an application, and saved in a database along with previously recorded tracks from various users. Each track is owned by a particular person, and the owner of a track can specify who is allowed to access that track. Each track entry is a tuple consisting of a location, time, and optional application specific metadata in the form of an XML document with arbitrary contents. For instance, users may choose to attach photos, sticky notes, or location based advertising to particular track entries.

B. An In-Building Rf-Based User Location And Tracking System.

P.Bahl and V.N.Padmanabhan says in "RADAR: An In-Building RF-Based User Location and Tracking System" Infrared-based systems (e.g., Active Badge). Accurate due to short range and line of sight property. But scales poorly & requires specialized infrastructure Radio Frequency-based systems. Cell-level granularity using point of attachment. Duress Alarm Location System, Pinpoint. Alternative technologies: magnetic, optical acoustic. Very accurate (mm to cm resolution).But requires dedicated infrastructure. Targeted at specialized application, (e.g., head tracking).

C. Real-Time Trip Information Service For A Large Taxi Fleet.

Rajesh Krishna Balan, Nguyen XuanKhoa, and Lingxiao Jiang says in "Real-Time Trip Information Service for a Large Taxi Fleet". In this paper, they describe the design, analysis, implementation, and operational deployment of a real-time trip information system that provides passengers with the expected fare and trip duration of the taxi ride they are planning to take. This system was built in cooperation with a taxi operator that operates more than 15,000 taxis in Singapore. We first describe the overall system design and then explain the efficient algorithms used to achieve our predictions based on up to 21 months of historical data consisting of approximately 250 million paid taxi trips. We then describe various optimizations (involving region sizes, amount of history, and data mining techniques) and accuracy analysis (involving routes and weather) we performed to increase both the runtime performance and prediction accuracy. Our large scale evaluation demonstrates that our system is,

(a) accurate and the mean duration error under three minutes and (b) capable of real-time performance, processing thousands to millions of queries per second.

Finally, we describe the lessons learned during the process of deploying this system into a production environment. Taxi Fleets, Trip Information Service, Partition-based Predictions, Nearest Neighbor Queries, History-based Predictions.

D.Mobile Phone Based Video Highlights Via Collaborative Sensing.

XuanBaoand Romit Roy Choudhury says inMobile phone based video highlights via collaborative sensing. Sensor networks have been conventionally defined as a network of sensor motes that collaboratively detect events and report them to a remote monitoring station. In this paper makes an attempt to extend this notion to the social context by using mobile phones as a replacement for motes. We envision a social application where mobile phones collaboratively sense their ambience and recognize socially "interesting" events. The phone with a good view of the event triggers a video recording, and later, the video-clips from different phones are "stitched" into a video highlights of the occasion. We observe that such a video highlights is akin to the notion of event coverage in conventional sensor networks, only the notion of "event" has changed from physical to social. We have built a Mobile Phone based Video Highlights system (MoVi) using Nokia phones and iPod Nanos, and have experimented in real-life social gatherings. Results show that MoVi-generated video highlights (created offline) are quite similar to those created manually, (i.e., by painstakingly editing the entire video of the occasion). In that sense, MoVi can be viewed as a collaborative information distillation tool capable of filtering events of social relevance.

E. Automatic Transit Tracking, Mapping, And Arrival Time Prediction Using Smartphones.

In Proceedings of ACM SenSys, pages 1–14, 2011.James Biagioni, Tomas Gerlich, Timothy Merrifield AndJakob Eriksson says in Automatic Transit Tracking, Mapping, and Arrival Time Prediction Using Smartphones. In order to facilitate the introduction of transit tracking and arrival time prediction in smaller transit agencies, we investigate an automatic, smartphone-based system which we call EasyTracker. To use EasyTracker, a transit agency must obtain smartphones, install an app, and place a phone in each transit vehicle. Our goal is to require no other input. This level of automation is possible through a set of algorithms that use GPS traces collected from instrumented transit vehicles to determine routes served, locate stops, and infer schedules. In addition, online algorithms automatically determine the route served by a given vehicle at a given time and predict its arrival time at upcoming stops. We evaluate our algorithms on real datasets from two existing transit services. We demonstrate our ability to accurately reconstruct routes and schedules, and compare the system's arrival time prediction performance with the current "state of the art" for smaller transit operators: the official schedule. Finally, we discuss our current prototype implementation and the steps required to take it from a research prototype to a real system.

III. EXISTING SYSTEM

There are many collaborative schemes for mobile networks. Mobile users, for example, can collectively build a map of an area. Collaboration is also needed when sharing content or resources (e.g., Internet access) with other mobile nodes.Various threats associated with sharing location information have been identified in the literature. For example, users can be identified even if they share their location sporadically. Knowing the social relations between users can help an adversary to better de-anonymize their location traces. Finally, location sharing of a user not only diminishes their own privacy, but also the privacy of others.

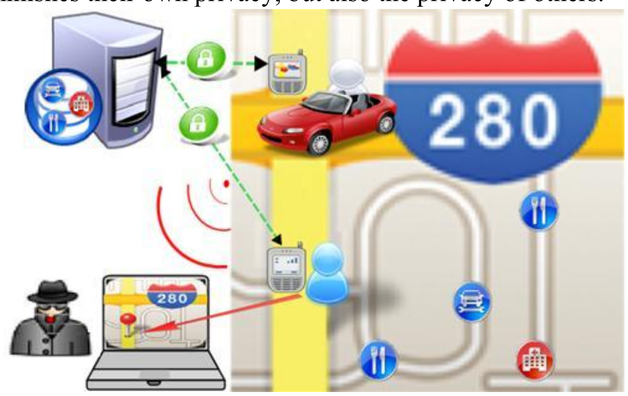

Figure No. 3.2.1. Existing System

IV. PROPOSED SYSTEM

Based on the stated design objectives, we propose a novel location-privacy preserving mechanism for LBSs. To take advantage of the high effectiveness of hiding user queries from the server, which minimizes the exposed information about the users' location to the server, we propose a mechanism in which a user can hide in the mobile crowd while using the service.

The rationale behind the scheme is that users who already have some location-specific information (originally given by the service provider) can pass it to other users who are seeking such information. They can do so in a wireless peer-to-peer manner. Simply put, information about a location can "remain" around the location it relates to and change hands several times before it expires. Our proposed collaborative scheme enables many users to get such location-specific information from each other without contacting the server, hence minimizing the disclosure of their location information to the adversary

The proposed system is a novel location privacy preserving system for LSBs which can provide high effectiveness of hiding user queries from the server and minimizing the exposed information about users' location to the server. The proposed mechanism comprises of hiding the user inside the mobile crowd while using it's services. Users already have some location-specific information (originally given by the service provider) can pass it to other users who are seeking such information through wireless- peer to peer communication method. Thus our proposed collaborative scheme enables many users to get such location-specific information from each other without contacting the server.

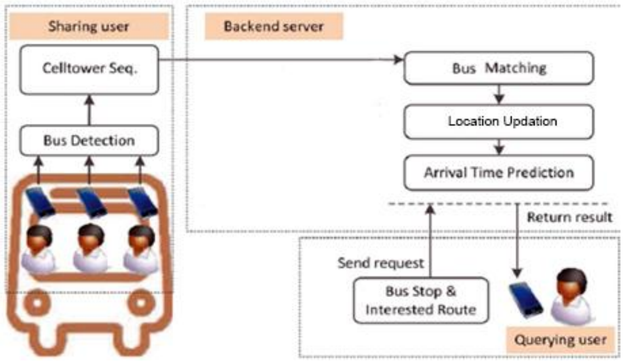

Fig 4.1 System Architecture

A. IDENTIFICATION (QR)

The main process of the concept is to register the details of the users. Every user in the cloud can enroll their details. According to the registered information's they have to move onto the next stage in the cloud. Here, we login to the cloud with the help of registered details. After the authentication process performed successfully we can select the files to upload into the cloud. In the process we have to choose different domains file for uploading. In this stage we protect the privacy by restricting the access to the data such as adding certification or access control to the data entries, so sensitive information access to the group of authenticated users. Second, we prevent the pinpointed sensitive information in individual data.such that no sensitive information can be mis-conducted by unauthorized individuals. For data anonymization, the main objective is to inject randomness into the data to ensure a number of privacy goals.One of the major benefits of the data annomization-based information sharing approaches is that, once anonymized, data can be freely shared across different parties without involving restrictive access controls. This naturally leads to another research area namely privacy preserving data mining, where multiple parties, each holding some sensitive data, are trying to achieve a common data mining goal without sharing any sensitive information inside the Data. We providing authentication the user have the rights to access, alter, and delete their own data.

B. LOCATION SEARCH (Network Based)

While the QR code is scanned the current location is probed. The current location is obtained from the cell tower location. The location thus obtained is sent over the internet to the main database server.

C. SYNCHRONIZATION

The synchronization modules sync the data between the client at the server end and the client waiting for the bus. This code, sends all data collected from the bus user and sends to the server. All clients listening to the server receive the data from the server database. Thus clients get an updated status on the position & schedule of the bus.

D. ARRIVAL TIME PREDICTION.

As we get location information, from the sharing users, this data is recorded into the server. The location from the clients from all the requesting clients who are waiting is received. This data is compared and theestimated time of arrival with respect to a client location is calculated.

V. IMPLEMENTATION &RESULTS

A crowd-participated bus arrival time prediction system using commodity mobile phones. The proposed system efficiently utilizes lightweight onboard sensors which encourages and attracts participatory users. Primarily relying on inexpensive and widely available cellular signals, the proposed system provides cost-efficient solutions to the problem. We comprehensively evaluate the system through a prototype system deployed on the Android platform with two types of mobile phones. Over a 7-week experiment period, the evaluation results demonstrate that our system can accurately predict the bus arrival time. Being independent of any support from transit agencies and location services, the proposed scheme provides a flexible framework for participatory contribution of the community.

Fig 5.1 Home Page

Fig 5.2 QR Code Scanning

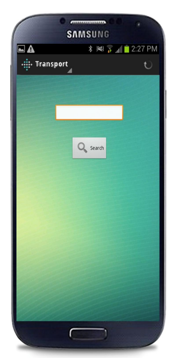

Fig 5.3 Search

Fig 5.4 Map View

VI. CONCLUSION

In this Proposed system, we present a crowd-participated bus arrival time prediction system using commodity mobile phones. Our system efficiently utilizes lightweight onboard sensors which encourages and attracts participatory users. Primarily relying on inexpensive and widely available cellular signals, the proposed system provides cost-efficient solutions to the problem. We comprehensively evaluate the system through a prototype system deployed on the Android platform with two types of mobile phones. Over a 7-week experiment period, the evaluation results demonstrate that our system can accurately predict the bus arrival time. Being independent of any support from transit agencies and location services, the proposed scheme provides a flexible framework for participatory contribution of the community.

VII. FUTURE ENHANCEMENT

"Predicting Bus Arrival Time with Mobile Phone Based Participatory Sensing", We think that not a single project is ever considered as complete forever because our mind is always thinking new and the necessities also are growing. The application also, if you see at the first glance that you find it to be complete but we want to make it still mature and fully automatic. As system is flexible you can generate more report and screen as and when required. The system is modified in future as to get the current status of the bus such as now running, breakdown fault and still at station.

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