Design and Implementation of a Traveler Information Tool with Integrated Real-time Transit Information and Multi-modal Trip Planning

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ABSTRACT

The chief objective of the multi-modal traveler information application, PATH2Go, is to improve the accessibility and quality of real-time traveler information and to make transit a known and viable choice for travelers. It was developed for a field test on the US-101 corridor, in the San Francisco Bay Area, with a primary hypothesis that travelers will benefit from real-time multi-modal traveler information and would therefore be more likely to consider using transit. PATH2Go integrates a web-based multi-modal trip planning tool that uses real-time information of available transit, traffic and parking availability, a web-based search tool that finds real-time transit arrival and schedule information and a mobile application that provides personalized en route transit trip information. PATH2Go integrates these major components of traveler information into one platform and therefore makes it easier for travelers to access real-time information. The system architecture of PATH2Go and major design considerations are described in this paper. Enabling technologies including the GPS fusing algorithm and a framework of scenario parsing based on GPS location data are also introduced.

INTRODUCTION

Multi-modal Traveler Information System

As suggested by Adler et al in (1), Traveler Information Systems (TIS) can be categorized into two generations, with the first generation consisting of variable message signs, route guidance systems, and the second generation, termed Advanced Traveler Information System (ATIS), providing dynamic route guidance, real-time traffic conditions and traveler service information, in a more real-time and dynamic manner based on new technologies.

While the TIS technologies have been developed, there is still a deficit in the expected benefits from these systems. Several studies have addressed this issue, including one conducted at Seattle(2), which showed that the critical factor that prevented the ATIS from being effective is the availability, level of detail and accuracy and timeliness of information. Other critical factors include the awareness of the sources and nature of the trips.

To improve the availability of the information, state-of-the-art traveler information systems have adopted web and mobile phone platforms. The use of these technologies is considered to be cost-effective for the agencies operating the services and therefore the most preferred way of delivering the information. In 2008, Internet users in United States reached 230 million (3); also mobile phone users in the United States reached over 280 million at the end of 2009 (4). It is clear that a web-based and mobile traveler information system could significantly improve the accessibility of the information.

Improving data quality by providing real-time transit information is another means to appeal to users Real-time transit arrival time predictions based on automatic vehicle location (AVL) technology have significantly improved transit data quality. More accurate real-time data helps to relieve traveler stress and reduces the waiting time when provided priori to the travel. An increasing number of agencies are providing such information, including the Bay Area Rapid Transit (BART), Chicago Regional Transportation Authority (RTA) (5), and dozens of transit agencies and schools whose systems are powered by NextBus ®(6).

Travelers can benefit from better information quality by receiving real-time transit information. This is true even for infrequent or choice transit users, who are a key market for attracting more transit riders. A primary approach to encourage mode shift is to provide multiple travel options to these travelers. Kenyon and Lyons from Southampton University conducted a survey...
which showed that presenting a number of modal options for a journey would help travelers consider alternative modes (7). State-of-the-art traveler information systems, therefore, have provided multi-modal traveler information. Google® Transit is a convenient tool for travelers to compare driving, transit, walking and bicycling. Another well-known system is the Goroo system of Chicago RTA, which provides a multi-modal trip planner for the Chicago metropolitan area with real-time transit information.

**PATH2Go Background**

Research objective of this study is to learn via a field test how travelers along the US-101 corridor in the San Francisco Bay Area could benefit from integrated multi-modal traveler information combined with real-time transit and traffic information and how likely these travelers would consider transit as a viable option.

The US 101 corridor has many characteristics of a prototypical commute corridor that has many transportation options, including driving either on freeways and arterials, or riding commuter rail, transit rail, and buses. The freeway system along the corridor (US-101 and I-280) may be severely congested during peak commute hours.

Analyzing Census 2000 data showed that most commuters still consider driving as the primary option. Travelers in this corridor who commute to San Francisco typical travel via train (up to 17%), use buses (up to 10%) or travel by car (up to 82% by car, although this varies from city to city) (8). It is important to note that transit and parking facilities along the corridor have not been fully utilized.

![FIGURE 1 Trip Travel Time Comparisons among Different Transportation Modes (morning peak from Palo Alto, CA to San Francisco, CA)](image)

Transit travel time is competitive to driving during peak hours along the US-101 corridor. Figure 1 shows a travel time comparison of a weekday morning commute along the US-101 corridor (driving time calculated using the PeMS data (9). The Baby-Bullet express train option shows competitive travel time with driving. Given complete and integrated information, travelers can potentially make smarter travel decisions, which motivates the development of the PATH2Go system.
DESIGN OF PATH2GO

Requirements of PATH2Go

The requirements of the PATH2Go system are derived from research objectives. The first requirement is to provide multi-modal traveler information with trip planning. The year 2000 San Francisco Bay Area Census data obtained from the Metropolitan Transportation Commission (MTC, SF Bay Area’s metropolitan planning organization) showed that both train and bus riders could be multi-modal users (8). It is obvious that provision of integrated multi-modal traveler information (IMTI) would have the most potential to affect travelers’ behavior (7, 11). Also pre-trip planning, compared to wayside or onboard information (11), is considered the most effective stage when IMTI should be provided.

Provision of real-time transit arrival information is another requirement for the system. As shown in (11), real-time transit information (which includes real-time delay info) is desired for the IMTI system by more than 90% of survey respondents.

Searching efforts using the online planning and transit information tools can be effectively reduced by an online exploration tool that searches the ITMI by name, address, etc. Google® Transit has very powerful point-of-interest exploration capabilities, which while not specifically designed for transit riders are still quite useful. OneBusAway, developed by the University of Washington, provides an easy-to-use search tool that allows users to find transit routes and stops by name or nearby address (12). Most other online tools only allow a step-by-step look up using transit agency, route and stop name. A search capability could be equally useful for frequent transit users who may need a quick update of the bus or train arrival time without having to enter an origin and destination to get trip plans.

On-the-go traveler information for wayside and onboard stages via mobile phones is another requirement of the PATH2Go tool. Mobile IMTI has been greatly facilitated by the development of smart phone platforms. These have proliferated: a search on the Apple iTunes® store using the keyword "bus" gives hundreds of applications for public transit worldwide, among which Google Maps and 511 mobile are two well known mobile tools.

State-of-the-art IMTI systems have incorporated some or all of the features above, including multi-modal information, real-time bus or train arrival, online search capabilities for transit information and design for use on mobile platforms. With the many data sources, travel modes and applications, it is clear that the integration of the IMTI will be the way to enhance the overall system. Table 1 shows the integration that could be achieved for IMTI systems at two different levels of integration: (1) by data; and (2) by mode.

The PATH2Go tool aims to improve the integration of IMTI at both levels. In addition to the implementation of the integrated features as described in TABLE 1, we have also included the following experimental features in PATH2Go:

Comparison of multi-modal trips at a glance. Based on the research in (7), we have designed a way of comparing different modal trip options based on travel time, fare and emissions savings for driving, driving to transit, transit and biking modes (biking mode trip planning result is powered by the Google® web service).

Integrated mobile and web-based application. The online tools such as a web-based trip planner and mobile based applications are usually considered as two different platforms for
TABLE 1 Integration of IMTI at different levels for public transportation

<table>
<thead>
<tr>
<th>Integration</th>
<th>Example Systems</th>
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<tbody>
<tr>
<td>Data integration</td>
<td></td>
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<td>Multiple transit agencies</td>
<td>511, Google Transit, Goroo, PATH2Go</td>
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<tr>
<td>Integration of real-time data with transit schedule</td>
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<tr>
<td>Traffic</td>
<td>511, Google, NAVTEQ ® traffic.com</td>
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<tr>
<td>Parking</td>
<td>511, PATH2Go</td>
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<tr>
<td>Modal integration</td>
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<tr>
<td>Multiple mode choices</td>
<td>Google (Transit, driving, walking, biking)</td>
</tr>
<tr>
<td>Driving-then-transit mode</td>
<td>PATH2Go (Transit, driving, driving to transit)</td>
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<tr>
<td>Integrated traffic in trip planning</td>
<td>Goroo (Transit, driving, driving to transit,</td>
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<td></td>
<td>walking, biking)</td>
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<tr>
<td>Integrated real-time parking in planning</td>
<td>Goroo, PATH2Go</td>
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<td>511, Google Maps, PATH2Go</td>
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IMTI. However, they can be further integrated to allow innovative features that travelers can benefit from, such as registering a trip planned on the website for later en route guidance using a cell phone.

Another possibility is to feed the GPS data from the travelers’ smart phones to the PATH2Go server to generate bus arrival time at downstream stops. Those predictive arrival times could then be accessed by other travelers even when the buses do not have AVL devices or when the GPS update rate on buses is very low (which is the current case for many transit agencies whose radio systems only accommodate GPS updates every 90 to 120 seconds).

PATH2Go Architecture

PATH2Go is comprised of the following modules:

**Multi-modal trip planning using real-time transit and traffic data.** A web-based multi-modal trip planning tool that uses real-time transit arrivals, real-time traffic and parking information. Transit, driving to transit and driving are supported by the trip planner. The driving time of any mode involving driving is calculated based on real-time traffic data and historical statistics. Different trip options can be displayed in tabular form with comparison of total travel time, fare and emission savings to make it easier for the users to choose a preferred trip.

**A web-based transit information exploration tool.** that supports searching real-time or scheduled information using either route name, stop name or a nearby address. User inputs are matched to the three different modes automatically using a best-effort match.
En route information update. The objective of this application is to build highly accurate and timely *en route* information for the user based on their location and itinerary. The location of the user traveling via a multi-modal trip is tracked and projected to the itinerary. We developed a scenario parsing algorithm to match the user GPS tracks with the multi-modal itinerary and GPS data from other sources (such as transit vehicles) to improve the situational awareness of the system. The information content generated to the users therefore becomes more personalized, accurate and timely. The location data from the mobile devices, however, are often seen to have poor quality due to bad reception in congested urban area. The fact that multiple transit routes could share a single station means that multiple relevant transit vehicles may be associated with user location. We applied a multi-hypothesis data association approach in the matching of user location with trip segments and transit vehicles to deal with the uncertainty issue, that resulted in more reliable matching. Results can be found in the section, "Fusion of Mobile Phone GPS from Users for Real-time Arrival Prediction". Information content is then generated for a certain user for any stage of a trip, either before the trip, driving to the train station, waiting at a bus stop or while on a transit vehicle. Information includes the "update of your bus / train arrival time", "update of alighting time" when onboard the bus, alert of "approaching the destination stop", "low number of parking spaces" while driving to train station.

**FIGURE 2 Architecture: PATH2Go Server**

*Figure 2* shows the components in the system. PATH2Go is currently online at [http://tlab.path.berkeley.edu/](http://tlab.path.berkeley.edu/) (10).
IMPLEMENTATION AND ALGORITHMS
PATH2Go aims to provide a set of tools that can make transit information along the US-101 corridor more easily accessible to both existing riders and those infrequent users. The approach adopted for PATH2Go and described in the previous section is to build an integrated system that makes the real-time IMTI easier to access at all stages of travel.

The application scenarios of PATH2Go components are illustrated in Figure 3.

FIGURE 3 PATH2Go Applications

Pre-Trip Multi-modal Trip Planning
The trip planner inherently implements the planning function along the US-101 corridor for driving, transit, driving to transit and walking as a necessary mode to make transfers. Users can choose either to compare all those modes, or plan a transit-only trip with the web interface.

As illustrated in Figure 4, the planner provides an all-modes-at-a-glance feature that allows a direct comparison of travel time, fare and emission savings.

Comparing multiple trips at a glance
Travel time comparison The total travel time for each mode is decomposed into two portions: the time spent on transit or waiting for transit versus the time spent on driving, whenever applicable. We differentiate the two different kinds of times spent on the trip to highlight the fact that time spent on transit could be used for working or relaxing, which in general is more productive and less stressful than driving. As pointed out in (11), both time savings and the saving of effort are most valued by travelers. Since usually travel time by transit is not competitive with driving, highlighting the effort saved could potentially encourage consideration by travelers to take transit.
- Color coding: In our design, blue is used to indicate "working/relax" time and gray is used for "driving" time.

- Overall transit time or time of driving to transit includes driving time to transit stops (when applicable), walking and waiting time at transfer stops, time on bus or train and any walking time needed to get to the destination.

**Cost** We have used the average fuel cost as the cost of driving. This is different from the way used by Google Maps and other applications where driving cost is calculated based on the average rate that an employee can get reimbursed. This "reimbursement rate" is considered to be overestimation of the cost because it also includes insurance and depreciation of the car value, which occurs anyway even if the traveler shifts from driving to transit (7). Therefore using the fuel cost only for driving will result in a more credible result when driving is compared to transit. We use the average fuel efficiency value of a passenger car in the U.S. (22.5 average miles per gallon (mpg), 2007 data (13)) to calculate the driving cost.

\[
\text{Driving Cost} = \frac{\text{Mileage}}{22.5 (\text{mpg})} \times \text{(gas price)}. \tag{1}
\]

**Emissions (savings)** Emissions savings is another major benefit of taking transit in addition to the potentially more productive time on transit when compared to driving. Emissions are measured using the amount of CO\(_2\) in pounds.

- Emissions for driving

\[
\text{Emissions Driving} = 19.4 \times \frac{\text{Mileage}}{\text{mpg}}, \tag{2}
\]
where 19.4 is the average CO\textsubscript{2} emissions per gallon gas measured in pounds (14) and mpg is chosen to be between 20 and 32 for an average passenger car.

- Emission savings for transit

\[
\text{Emissions Savings} = \text{Emissions of driving} - \text{Incremental emissions with transit}, \quad (3)
\]

where "Incremental emissions with transit" is the additional amount of emissions caused by one more passenger on the bus (or train). This is nevertheless a negligibly small value and may be omitted while calculating the emission savings (c.f. (15) wherein experimental data showed that emissions of fully loaded heavy-duty diesel buses were increased by less than 10% when compared to being empty loaded. The added weight when fully loaded was approximately 9000 – 10000 lbs. Therefore the additional emissions caused by a 200-pound passenger would be less than 0.2% of the bus emissions, assuming that the extra emissions caused by passengers is a linear function of the load).

Real-time data in trip planner

Real-time transit arrival time is an integrated portion of the PATH2Go system.

For the traditional transit trip planner, the transit network of the trip planner is a time-dependent network with schedule data used for each bus stop. To include the real-time transit data into the trip planner, the transit network was constructed as a dynamic network that varies with the predictive bus/train arrival times. The transit network now has the following dynamic parameters:

- **Arrival time at each stop.** For each stop, schedule data are replaced with the predictive bus or train arrival times when they are available.

- **Travel time between stops.** Travel time between stops are also dynamic in the PATH2Go system. AVL data from multiple buses running along the same route are fed into one program which uses leading vehicles as traffic probes on the arterial road and feeds back the traffic conditions to the predictive model.

As illustrated in Figure 2, in the trip planning engine there is a dedicated thread which periodically updates the transit network, while other threads of the planning engine still handles requests from web and mobile phone users concurrently (16).

Real-time transit data are matched to the schedule via the running route, route direction, service date, trip pattern and for most of the agencies the daily trip sequence. As shown in the left bottom corner of Figure 4, when available the real-time transit data is used in the trip planner and displayed to the user.

Real-time traffic data is similarly used in the planner. The travel time on the road "links" are updated by real-time traffic data from third party sources (including NAVTEQ®traffic.com, PeMS data, etc) and historical data from the PATH2Go database. A dedicated thread in the planning engine updates the road network periodically using the real-time traffic data (16).

Real-time Transit Information

**Fusion of Mobile Phone GPS from Users for Real-time Arrival Prediction**

As illustrated in Figure 2, PATH2Go features a predictive real-time transit arrival time data algorithm that is based on the fusion of two data sources:
- GPS data from transit vehicles, and
- GPS data from en route users onboard the bus or train.

This fusion, described earlier, allows the prediction module to collect GPS data utilizing the communication channel of mobile users, which usually has a higher bandwidth than the dedicated radio of the transit agencies’ communication system. Depending on the fleet size, the radio system usually allows an update rate at one minute level only, while mobile phone users can send GPS data to the PATH2Go server at a second level data rate over a commercial wireless network.

We denote the GPS traces of the user and the transit vehicles as

\[ G_u(t) \]  
\[ G_v(t, j) \]

respectively. The objective of GPS matching is to associate \( G_u(t) \) with a transit vehicle \( j \). The successful matching of two traces enables "selective GPS usage", and a better situational awareness of the user.

For each burst of data (GPS traces), a user is associated with each relevant vehicle \( j \), using the condition that

\[ d_{u,j} = \| G_u(t_u) - G_v(t_v, j) \|_{\infty} < G_0, \]

where \( \{t_u, t_v\} = \text{arg min}_{t_u, t_v} |t_u - t_v|, \)

where \( d_{u,j} \) denotes the distance between a user and a transit vehicle at the most recent closely matched times, \( t_u \) and \( t_v \) which are found to be the most recent matched time for the user and the vehicle and \( G_0 \) is a preset threshold for association, respectively.

Multiple candidate vehicles might be associated with one user at a certain time (especially when the user is waiting at a station). To address this ambiguity, we applied a multiple-hypotheses data association (MHDA) algorithm with a probabilistic model (17). Location data for the user could be assigned to a nearby vehicle with an \( a \ priori \) probability. Whenever a new burst of GPS data is reported by the user, it can be associated with (assigned to) any previously associated vehicles or other vehicles, thus forming a set of new hypotheses. The MHDA algorithm then calculates the evolving probability of each new hypothesis. Usually only several of the most likely hypotheses are kept for further calculation. Due to the exponential nature of this propagation, the right hypothesis will come up as the one with the highest probability and be accepted.

To evaluate the probability of hypothesis \( i \) (the probability of which is denoted as \( P_i^k \)) for a measurement \( G_u(t) \) based on the original hypothesis \( g \) (the probability of which is denoted as \( P_g^{k-1} \)), we have

\[ P_i^k = \bar{L}(G_u(t)) \cdot P_g^{k-1}, \]  

where
\[
L(G_u(t)) = \begin{cases} 
\frac{1}{l} & \text{"Vehicle association probability", when } G_u(t) \text{ is from vehicle } j, \\
\frac{1}{l} & \text{"None of the current but a new vehicle,}
\end{cases}
\] (8)

is the likelihood function of the measurement \(G_u(t)\) being either from a known vehicle \(j\) or a new vehicle and \(l\) is the normalization factor ensuring the probabilities sum to 1.

For the case \((G_u(t)\text{ is from vehicle } j)\), the probability is

\[
\bar{L}(G_u(t)|G_u(t) \text{ is on } j) = \frac{1}{c} \mathcal{N}(d_{u,j}, \sigma^2),
\] (9)

where \(\mathcal{N}(d_{u,j}, \sigma^2)\) is the normal probability density function and the variance \(\sigma^2\) can be estimated using empirical data. With new data arriving, the probabilities are updated using (8) and the association results from the hypothesis with the highest probability.

A system testing of the association algorithm was carried out for Caltrain and the VTA Rapid Bus Line 522, on October 1st and 2nd, 2009. In total, 24 trips were taken by testers, and the correct association rate was over 95\%, which accounts for 23 correct matches out of the 24 trips.

As illustrated in Figure 2, fused GPS data from transit vehicles and mobile phone users are fed into an arrival time prediction module, which is implemented as a combined short-term prediction with focus on vehicle movement and a long-term prediction which considers both vehicle movement, traffic conditions, historical conditions and data from other vehicles.

**Presentation of the Real-time Transit Information**

PATH2Go provides a web-based user interface which allows the user to do a "keyword" search of real-time transit information.

The search text is processed to extract the following information:

- transit agency name,
- route name , partially or in full,
- name of transit station, and
- address of nearby stops that should be displayed.

To minimize the user’s efforts in entering the information, a keyword can be entered freely with different combinations of the listed items in any order. A dynamic programming algorithm is implemented on the server to match user input with the listed items.

Figure 5 shows the user interface for the presentation of real-time transit information. We note that in this example, only the next CalTrain locomotive to San Francisco is real-time (since it has already left the starting station). GPS locations of the locomotives are also shown on the map.

**En Route Transit Application**

The timeliness and perceived usefulness of en route information relies on the level of situational awareness by the system. One possible way is to identify the traveler’s situation by matching the location traces to his/her itinerary. This, however is a difficult task due to the complexity of traffic movement, low resolution of location data and the ambiguity caused by the combination of transit, driving and pedestrian traffic on the road.
FIGURE 5 Real-time Transit Information: User Interface

En Route Transit Information Generation

Based on the GPS fusion algorithm, we built a reliable method to identify the mode and situation of the traveler via their GPS data, itinerary and AVL GPS traces from the buses and trains.

The activity recognition algorithm is an iterative procedure that is applied to each user with a multi-layer matching algorithm.

Map Matching With map matching, the "mapped location" helps to identify on the "link" of the road, or "transit route". We note that since cars and buses usually share the same road, the mapped location would not identify the mode by itself. Since the rail network could very well be separated from the road network it could therefore be identified using GPS location only.

Activity Identification We divide the activities into "driving", "bus (onboard)", "rail (onboard)", "walking (transferring)", "at station", and "n/a". We note the activity as $M$, and the likelihood function of $M$ as

$$L_M^t = L_M\left(G_u(t), L_M(t-1), \text{road network}, \right.$$

$$\{d_{u,j} \text{for each transit vehicle j}\}, P_M\left(G_u(t)\right),$$

which is a function of the user GPS trace $G_u(t)$, the previous identification result $L_M(t-1)$, road network information, empirical probability of the user GPS trace belonging to a mode $M$ (the probability of which is $P_M\left(G_u(t)\right)$) and the fusion result with the transit vehicles. A state machine needs to be maintained for each user to iteratively update the activity identification results. Due to ambiguities and GPS errors, multiple hypotheses also need to be
kept and iteratively evaluated using the multi-hypothesis association algorithm. The output is the hypothesis with the highest likelihood. The recognition algorithm is implemented as a Markov Chain model with each hypothesis independently tracked as a Markov Chain (18).

**Generate Information** Based on the identified activity of the user obtained from layer 2, the system can further generate information for specific scenarios such as "waiting at a certain bus stop", "walking towards train station platform", "parking the car at a train station", or "driving towards a train station", etc.

The model of the activity identification is illustrated in Figure 6.

A system testing was carried out in Palo Alto, CA along the VTA BRT Line 522 and CalTrain. During the test’s 25 trips the correct identification rate of the user activity by the server was 95%.

**Mobile Phone Application**
Native applications for iPhone, Android and Windows Mobile platforms have been developed for the PATH2Go system. On the iPhone and Android platforms, Google Maps canvas is used to visualize the locations of transit stations, an upcoming bus or train, current location of the traveler and the itinerary route.

PATH2Go mobile application implemented the following three major functions:

**search for real-time transit information** Traveler can select a transit stop from a list of nearby stops, or search by their on street names.
FIGURE 7 Screen shots of the Mobile Phone Application (iPhone)

mobile transit planning  The mobile application also allows the user to start from his/her current location (or a selected transit station) to an entered destination.

en route transit navigator  The client software gets a real-time update of the transit trip status from the server based on the user’s current location. When the cell phone application is on, it will periodically send an update of the current GPS location to the server, and the server will identify the user’s current situation based on the scenario parsing algorithm described in the previous section.

CONCLUSIONS AND FIELD TEST PLAN

We have outlined the design and implementation of the PATH2Go multi-modal traveler information system. This system has been implemented for a field study along the US-101 corridor in the San Francisco Bay Area investigating how multi-modal real-time traveler information could encourage travelers to consider transit as a more viable travel option.

PATH2Go was implemented with three major components, a multi-modal trip planning tool using real-time traffic and transit data for the US-101 corridor, a real-time transit information viewer and a mobile application that provides en route transit information. The system has been designed in an integrated fashion such that data from various sources, including schedule-based and real-time transit data, plus traffic and parking data, are all integrated into one system and which enable PATH2Go to provide travelers with more accurate and timely information.

We have also discussed several core algorithms and implementation details used in the system. The design of the multi-modal trip planner with the feature of comparing all modes at a glance has been introduced. The algorithm of fusing GPS data sources from transit vehicles and mobile phone users was also discussed. This algorithm is a critical part of the system that helps to increase the quality of real-time transit arrival time prediction capability when the update rate of
the AVL data from transit buses is low. We have also developed a framework to reliably identify
the activity of the traveler for the mobile en route transit application.

In October 2009, we conducted a pilot test with a small group of participants who were
California PATH employees and UC Berkeley students with a portion of the results shown in the
paper. A follow-up survey also showed that a large majority of the participants (over 75%) thought
the information provided by the system was accurate, timely and useful.

A field test by to-be-recruited commuters from the San Francisco Bay Area (and in partic-
ular along the US-101 corridor) will be conducted starting August 2010. Data will be collected for
system performance analysis, including accuracy, and performance of algorithms (GPS matching,
scenario parsing, etc). Test participants will also be asked to take an online survey to evaluate the
usefulness, timeliness and accuracy of the multi-modal information and the results of which will
be reviewed by an independent evaluator.

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