# CarCast: A Framework for Situated In-car Conversation Sharing

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### ABSTRACT
In this paper, we propose a situated in-car conversation sharing framework. People often have conversations in the car. In those conversations, people talk about their points of interest that they have just passed. These conversations may contain valuable information because the conversations reflect situations such as seasons and passenger's own experiences. However, in-car conversations are transient and cannot be shared to others. We therefore aim to share these valuable in-car conversation with others. This paper describes a framework of our in-car conversation sharing system and discusses challenges to realize it.

### Author Keywords
in-car conversations; knowledge sharing; location-aware;

### ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

### INTRODUCTION
Car journeys are becoming an integral part of everyday life. According to the U.S. Transportation Statistics Annual Report, Americans spend 86 minutes per day in their cars on average[13] (the same as the U.K. [1]). This grows attention from the HCI community. In this paper, we propose a situated in-car conversation sharing system. Figure 1 shows the framework of our system. As shown in the figure, the system consists of following two processes. 1) Associating in-car conversation with the location and embedding the conversation in the location. 2)Sharing the embedded conversation to cars that pass the location. The aim of our system is to bring a new knowledge/findings to the people by sharing in-car conversations. We believe that in-car conversations are worth to share with others because they strongly related to the situation. Timely/up-to-date information of the location will be reflected to the situation. Thus, in-car conversation will have timely/up-to-date information about the location.

Adato observed that participants regularly make use of the occasion of conversation in generating topics [1]. The occasion includes known in common character and situation of conversation. On in-car conversation, the occasion corresponds to not only the situation in the car but also situation of the location and/or area of the car. This means that the topic of in-car conversation will be changed in accordance with the situation of the location. The situation includes season, time, weather and/or background knowledge of participants in the conversation.

Sacks argued that co-selection plays important role when the conversation transits the next topic [9]. He also argued that the co-selection structure consists of common sense and/or common subject among participants of conversation. That is, on in-car conversation, the location will be a common subject and the transition pattern of conversation depends on passengers' common sense.

We thus hypothesize that car passengers talk a lot about location-specific things and these conversations will be interesting for others because the conversations reflect situations such as seasons and passenger's own experiences.

However, in-car conversations are transient and cannot be shared to others. We therefore aim to share these valuable in-car conversation with others. In this paper, toward development of the in-car conversation sharing system, we discuss the requirements for the system.

### RELATED STUDY
Urban informatics, the use of information technology to understand urban needs and opportunities, explores these emerging digital layers of the city at the intersection of people, place and technology [4, 11]. Zheng et al. revealed flawed urban planning using the trajectories generated by 30,000 taxis traveling in urban areas in Beijing [14]. We not only use quantitative data such as GPS trajectories but also employ conversational recording generated in the car. Since in-car conversation handles timely information such as road information relating to the season (e.g. icy road in winter), it is possible to handle a qualitatively different information from former one and is worth to tackle in-car conversation sharing.

According to a survey [2], news, cartoons, weather and location-based information are the most popular types of con-

[1] `http://www.telegraph.co.uk/motoring/news/8287098/Britons-spend-more-time-driving-than-socialising.html`


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http://dx.doi.org/10.1145/2582051.2582068

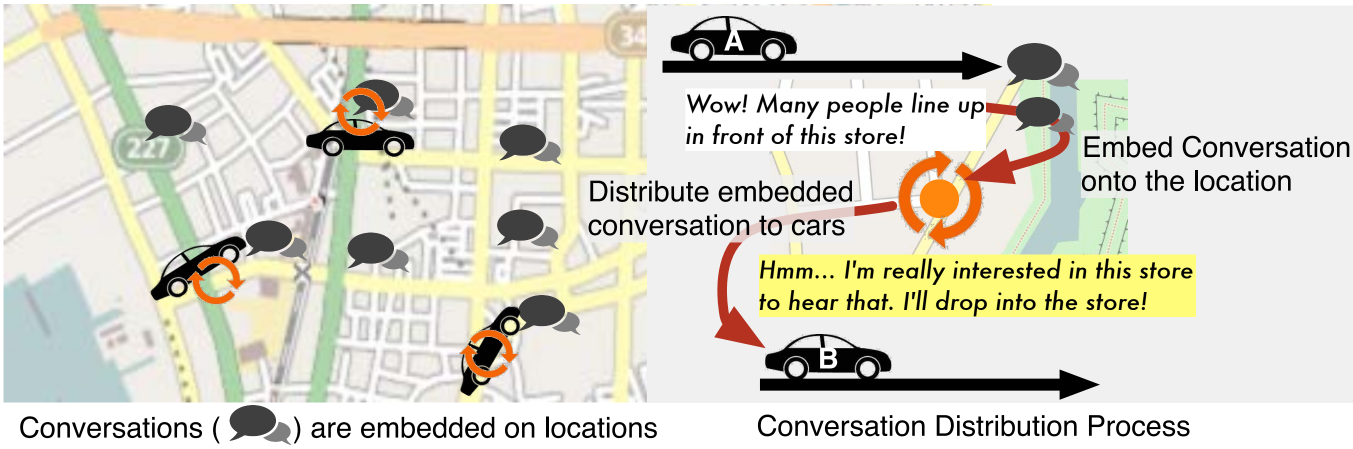


**Figure 1. Overview of our conversation sharing system. In-car conversations are embedded at the location and the system share them to the car that passes the location.**

tent for car entertainment/infotainment. Tester et al. proposed, "CommuterNews" , an in-car infotainment system [12]. The system provides daily news stories in the form of multiple-choice questions and short relevant sound clips; however, it cannot provide location-based information. Since our proposed system collects and shares *'fresh'* conversation associated with its location, our proposed system makes it possible to provide users with up-to-date location-based information without being operated as a car radio.

## IN-CAR CONVERSATION SHARING

We propose a framework to share in-car conversations. Figure 1 shows an overview of our conversation sharing framework. When people have a conversation in the car, the system embeds the in-car conversation into the location right by car and shares it as *"car radio"* to other cars passing the location. The system is able to provide valuable and up-to-date, information about the location to cars. This is because in-car conversations reflect both the knowledge of the occupants and up-to-date information about the location, the season (the date) and the time of day.

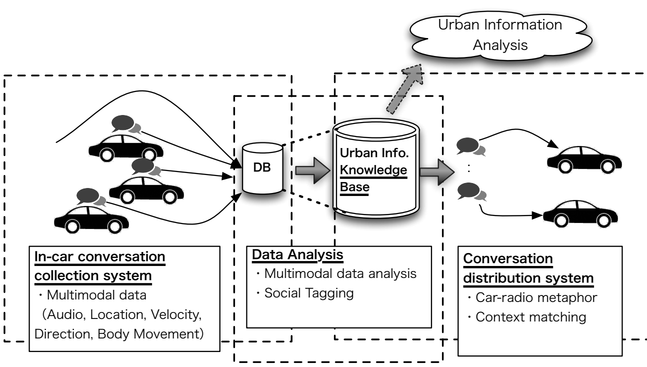


**Figure 2. Three challenges toward in-car conversation sharing.**

Figure 2 shows three challenges toward in-car conversation sharing. In the following three parts corresponding to each challenges, we describe the requirements for realizing the conversation sharing system and our current state of each challenge.

### Associate Conversations with Situations

In order to associate an in-car conversation with the location, the system needs to record both audio data and location data simultaneously. There are some commercial products which have a similar function. Several digital still cameras have a feature that records both still images and location data using GPS.

Recently, smartphones have started to include many sensors such as microphones, inertial sensors, and GPS, and are used as data loggers. Kawaguchi et al. provide a tool, HASC Logger[2], which can record audio, location, acceleration, rotation, etc... for both Apple iOS and Android Smartphones [5].

We have used HASC Logger and collected over 120 location enabled in-car conversations for over one year. We recorded in-car conversation with location, acceleration and rotation. The audio data was recorded as 16 bit/44.1kHz wav audio files. The locations were recorded by GPS using a 1Hz sampling rate. The accelerations and rotations (gyro) were recorded using a 100Hz sampling rate.

Smartphones provides not only location of the in-car conversation but also situation of the conversation. For example, using Bluetooth technology, the smartphone can detect other devices around the smartphone. That is, it is possible to recognize the situation where more than one person in the car. This allows automatic in-car conversation recording function that automatically start recording when it recognize more than one person. We plan to develop this function to ease data collection.

### Clip & Annotate a Conversation

Recorded in-car conversations must be clipped properly because recorded conversations are too long to listen to. It is also necessary to annotate (classify) clipped conversations with respect to characteristics of each conversation. We assume that detection of finger pointing and joint attention

[2] `http://hasc.jp/`

(shared focus of the eyes) will be key techniques required to clip/annotate a conversation because they both seem to be indicators of objects mentioned in the conversation [6]. As shown in Figure 3, during an in-car conversation, finger pointing will happen when the speaker talks about a location right by the car, as in "*this* (with finger pointing) building is... " or suggests looking a distant object to others as "*Look at that!* (with finger pointing)".

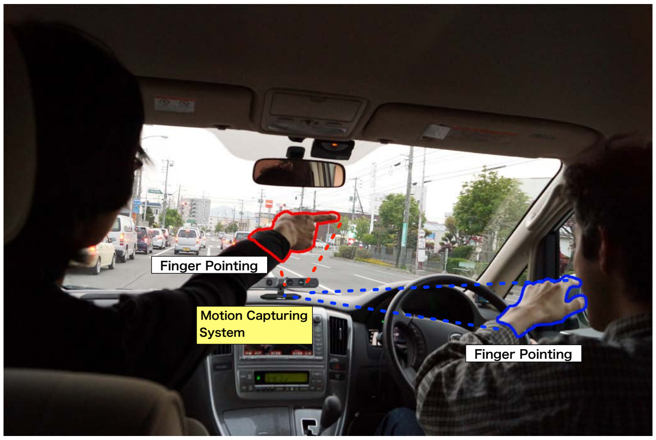


**Figure 3. Scene of finger pointing during in-car conversation.**

Annotating by finger pointing will be possible using a depth camera. Raheja et al. proposed a method to detect finger pointing using Microsoft Kinect [7]. Also Intel provides a feature to detect the direction of finger pointing in Perceptual Computing SDK, a programming framework for a depth camera[3]. Using depth camera, Rümelin tackled to use pointing gesture for identification with distant object from the inside of a car [8].

Also, eye tracking system have become cheaper in recent years. For example, The Eye Tribe[4] provides $99 eye tracking system. Using multiple eye trackers, it become possible to detect joint attention.

Before development of automatic annotation system, we clipped each in-car conversation manually. In order to clip in-car conversations, we firstly made a brief transcription of each screened in-car conversation. This is a basic procedure in conversation analysis [10]. In addition to the transcriptions, we noted the meta data of the conversations, including the number of occupants, their names, and a brief description of the trip. We then made clips of each in-car conversation manually according to the content of the conversation.

We also asked each subject to listen to about 10 in-car conversations and to annotate his/her points of interest on them. We developed in-house audio annotation software (Figure 4). Each subject could easily annotate his/her point of interest in an in-car conversation just by pushing a button and making a comment. We then associated the interesting point with the clipped in-car conversations.

[3] `http://software.intel.com/en-us/vcsouce/tools/perceptual-computing-sdk/`
[4] `http://theeyetribe.com`

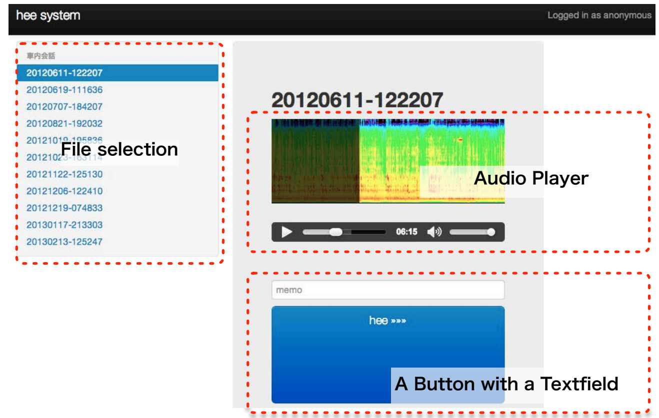


**Figure 4. In house interest annotation system**

We will analyze those clipped in-car conversation and annotation data to grasp the characteristics of in-car conversations and to develop automatic annotation system.

### Share Conversations

In order to share in-car conversations, it is necessary to address issues concerning the current location of the car receiving conversation clips from the system, and selection of conversations.

For the first issue, GPS technology is very appropriate. It can easily associate current location of the car and stored in-car conversations.

For the second issue, a user interface to control the volume of the in-car conversation flow is needed. Each conversation not only contains location data but also meta data including the date, the time of day, number of occupants and ages/gender of occupants. It is possible to control the volume of the conversation using these meta data, for example, the user can adjust the date range, the range of the time of day and/or the range of occupants to control the number of playing conversations. However, user will confuse if there are a lot of volume knobs associating each meta data. Our solution is mapping multiple contexts into single volume knob as shown in Figure 5. Using this solution, the user can easily adjust number of in-car conversations to play using single volume knob.

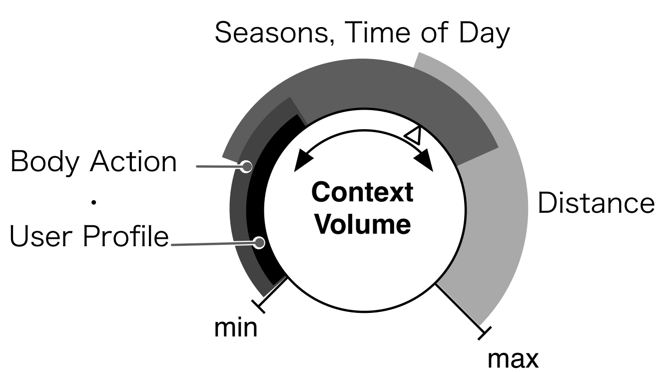


**Figure 5. Volume interface that is assigned multiple contexts into single dimension.**

We compare our in-car conversation sharing system to a car radio, so that means the user can tune the flow of playing in-car conversation like on a radio. One difference between the system and a car radio is the playing style. A car radio broadcasts one radio program at a time; however the system plays several conversations embedded in the location simultaneously. Since humans can distinguish a preferred conversation from simultaneously played conversations [3], the user of our proposed system will also distinguish a preferred one.

We plan to develop a simulation environment with three displays of street views as shown in Figure 6. Using this simulator, we can easily embed in-car conversations into the virtual environment and record subjects' reaction using a video camera. Also, this environment is preferable to evaluate our proposed system because of its stability.

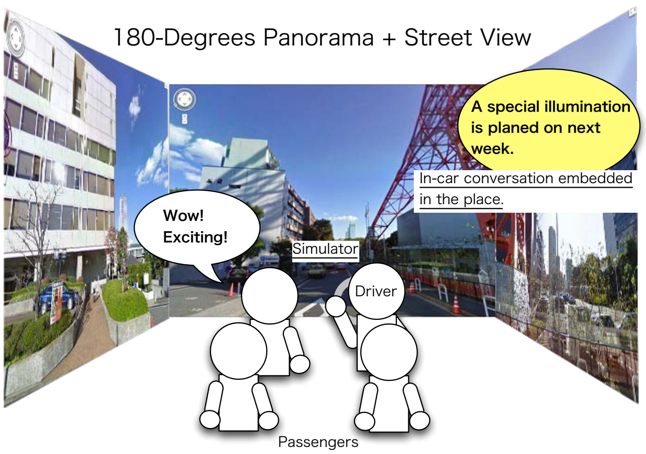


**Figure 6. Simulator using three displays.**

## CONCLUDING REMARKS

In this paper, we propose an in-car conversation sharing system that engages with the situation, and fully involves all car occupants, including the driver. In order to realize our proposed system, we discussed the requirements for the system. We formulated that there are three challenges to realize the situated in-car conversation system and proposed solutions to address the challenges. 1) In order to engage in-car conversation with its situation, we proposed to use smartphones for the purpose. Smartphones have many sensors and capable to collect in-car conversations with each of their situations. 2) We suggest that finger pointing action will be a key features to annotate in-car conversations. The action occurs when the speaker talks about a location right by car or suggests looking a distant object to others. 3) We propose a solution to control the number of playing conversations. The solution is simply mapping multiple context into single volume knob.

This paper also described our current state of the study. We collected over 120 location enabled in-car conversations for over one year and clipped each in-car conversation manually. Also, we developed in-house audio annotation software and asked each subject to listen to about 10 in-car conversations and to annotate his/her points of interest on them. We thus have over 830 clips of annotated in-car conversations. We plan to conduct a user study using a simulator and to assess our proposed system in the near future.

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