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Volvo intelligent news: A context aware multi modal proactive recommender system for in-vehicle use

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ABSTRACT

Keeping up to date with the world outside while driving is currently only possible through the impersonal car radio or the distracting features of a smart phone. In-vehicle infotainment systems exist today that attempt to tackle this challenge but few are sensitive to the current driving state. This paper describes the development of a multi-modal proactive recommendation system featuring personalized content combined with the use of car sensors to determine when to present information. A prototype is implemented in a car simulator and trained through user tests. The final system shows a 19% deviation from baseline driving and thereby performs better than comparable systems. This is backed up by user experience data which reports drivers having a positive experience with the system.

1. Introduction

"*The way we interact with our cars in the future will have a huge impact on people's lives and mobility*" [1].

Today people have a strong need to be connected to the world around them. This need is to a large extent taken care of by their smartphones; these devices are however less useful when driving due to the risk of jeopardizing safety.

Ubiquitous computing is becoming a reality. In particular, one sees cars being equipped with technologies that provide connections to the outside world [2]. The need to be connected is ever growing, together with it the problem of distraction for the driver.

The services for connecting people are typically designed to capture as much of the user's attention as possible. The cost of immersion (interaction with such services) can be a distraction, and when it comes to driving a car, safety comes first as explained by [1]: "*The challenge that arises from the proliferation of in-car devices is that they may distract drivers from the primary task of driving, with possibly disastrous results*".

Modern cars are equipped with technologies that make the car more and more intelligent, which can help the driver. To fulfill people's need for a connection to the outside world while driving, the car can take over responsibilities from the phone. This is achieved by moving the interaction with the phone to the car. The car is equipped with sensors that allow for collection of information on the state of the vehicle, its surrounding environment and, more recently, the condition of the driver. This information can be used to enhance the experience of safely driving a car while staying connected with the world outside it.

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The above described issues are inspired by a challenge set forth by the company Volvo regarding how to solve the problem of safe driving in a connected world. This paper describes our attempt at tackling this challenge through the development of a system named Volvo Intelligent News (VIN). We propose a multi-modal proactive recommendation system featuring personalized content combined with the use of car sensors to determine when to present information. The paper includes the development of a car simulator and three iterations of developments of VIN. It should be noted that the VIN system described here could be applied for any brand of cars.

2. Previous work

The research in general will be related to In-Vehicle Infotainment (IVI) as this is a broad term covering any kind of media system integrated into a car. IVI systems provide either radio, entertainment, navigational help or an all-in-one solution. IVI systems are designed specifically for in-car use and typically feature driver-friendly displays and controls while complying with laws and regulations governing driver distraction and traffic safety.

This section will be divided into three parts: *what* to present, *when* to present it, and finally *how* to present it. This is based on the logical deduction that interactive car systems generally will have to deal with these three aspects.

In order to find out *what* information drivers want, previous work in the field of recommendation systems will be investigated, but also what content people prefer while on the move in the increasing market of smartphones.

Choosing *when* to present the content is possibly even more relevant, as disturbing the driver at inappropriate times might not only be annoying but in worst case also have an impact on safety. This section concerns methods currently available in modern vehicles for monitoring mental state, focusing on possibilities of monitoring the driver, the driving situation, and the environment.

The *how* part of this chapter will investigate how information is currently presented to the driver in modern cars. The focus will be on the multimodal interaction capabilities of current car interfaces and research in future or experimental car interfaces.

The goal is to combine the knowledge attained in the sections what and when with the multimodal interaction capabilities to design a system, that considers both the type of content (*what*) and the driver state (*when*) in the process of deciding which mediums (*how*) to present the content to the driver.

2.1. What: IVI relevant content

There are several ways to decide on what content to deliver to a user. In recent decades, due to an overload of information stemming from the growth of the Internet, the development of recommendation systems has become increasingly relevant.

With the advent of smartphones and social networks, another market, such as check-in services, has opened up for recommendation systems.[1] Utilizing common smartphone functionality like global positioning system (GPS), check-in services give efficient and non-intrusive updates about locations and venues in easy, user-friendly ways.

In this paper the IVI content was divided into four different categories: efficiency, entertainment, information and social. The first category, efficiency, contains anything related to helping the user perform tasks such as handling emails or punch in coordinates for a GPS. Entertained is primarily music and movies while informed typically is news. The last category, social, covers social networks such as Facebook. Facebook claims to be the largest online social network worldwide [3].

Most car manufacturers have plans to embed a method of connecting to the Internet in their cars [4–7]. This opens up for a variety of options within all these categories. This movement stems from research such as [8], which shows an increasing demand for in-vehicle information about the outside world. As an example, one third of the German 18–25 year old population would like to receive and send emails while driving.

Verkasalo [9] has looked at the contextual patterns of mobile service usage, that is which aspects of a smartphone people are using while *on the move* compared to *home* and *office*. The survey finds that the average user uses his smartphone for 18.6 min while *on the move* per day. They find that in particular browsing, radio and music playback is used on the move. Gaming is the least popular activity while on the move despite it being the most popular activity at home.

In [10] it is reported that users are increasingly shifting to apps instead of using traditional web browsers for Internet services and it is observed that 20% of popular apps are local content, news and radio apps. The demand for information differs from the time of day and action according to [10]. News apps are used more frequently in the morning while sports apps are used in the evening. Social networking apps are more frequently used when users are moving around.

2.1.1. Recommendation systems

Recommendation systems help users find items or content that meet their specific needs [11]. These systems usually compare a user with a reference, and then try to predict the "rating" a user would give to an item they had not yet considered. These references are usually from either the item itself (content-based) or the user's social environment (collaborative filtering (CF))[12].

[1] http://techcrunch.com/2010/01/15/yelp-iphone-app-4-check-ins/.