Detecting Changes in User Emotions During Bicycle Riding by Sampling Facial Images

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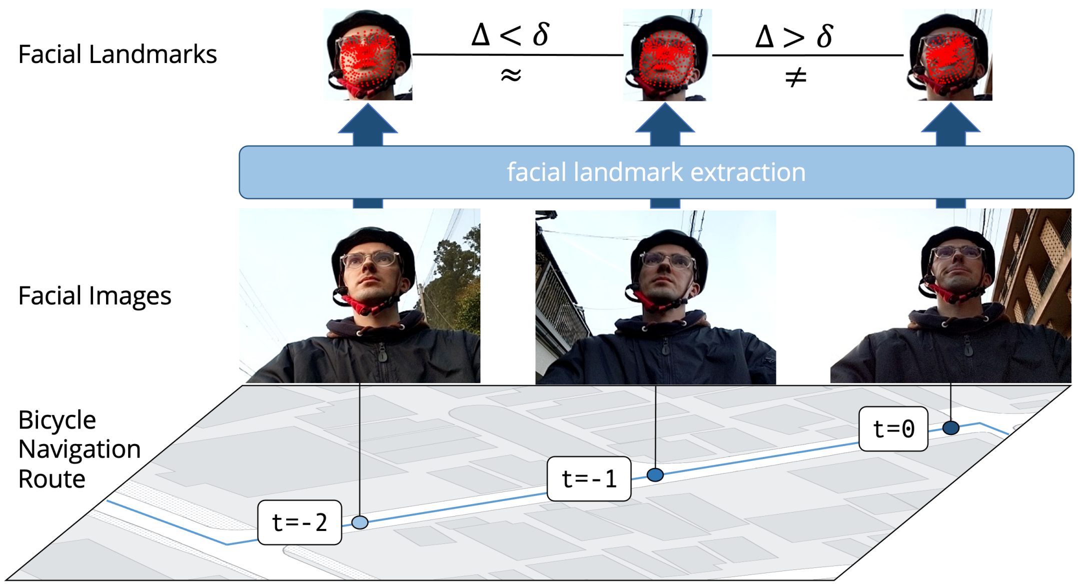

Figure 1: Facial images of the cyclist will be taken along a navigation route. Facial landmarks are extracted from the images and differences Δ between them are calculated. If the differences are greater than a threshold δ the current image along with the location and the change vector is stored.

ABSTRACT

In the context of mobility as a Service (MaaS), bicycles are an important mode of transport for the first and last mile between the home and other transport modalities. Also, due to covid-19 bicycle users such as food delivery drivers and commuters to work are increasing. To investigate driving experience of bicycle users in context and improve MaaS service quality, we propose and describe a method to automatically detect changes in user emotions during bicycle riding by sampling facial images using a smartphone. We describe the proposed method and how we plan to use it in the future.

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CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile computing systems and tools**.

KEYWORDS

emotion, bicycle navigation, machine learning, mobile computing

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1 INTRODUCTION

Mobility as a Service (MaaS) is a fundamental aspect for a smart city and provides seamless passenger experience using multiple modes of transport. Furthermore, since COVID-19, bicycles are the core transport modality of many recently booming food delivery services and for commuting of returnees to work all over the world [2]. Previous works have proposed crowd sourced bicycle navigation systems to improve the service provided to citizens and to improve the overall rider experience [7, 8]. Classical experience sampling methods (ESM) typically require the participant to interrupt the current activity to get an in-situ experience sample. A response in the moment is preferred in order to avoid retrospection bias and the effect of memory [5]. However, collecting user data and interrupting the participant while controlling a vehicle is a safety risk. Therefore, it is difficult to use classical experience sampling methods (ESM). In addition, it has been shown that retrospection bias can be reduced using visual records taken in the moment. Such visual records can lead to improved recall in post-study interviews [9]. To overcome the safety problem and support investigate the driving experience of cyclists, we propose a method to detect changes in user emotions during bicycle riding by sampling facial images and collect moments of interest for retrospective user rating using a smartphone.

2 RELATED WORK

As one of the first publications in this context, and well before there was a bicycle mode in Google Maps, Priedhorsky et al [7] investigated how a personalized geowiki can be used to help cyclists share information more effectively. The authors formalized the notion of geowiki and the prerequisits for user contributions and how those could be met by cyclists. In order to provide a safe and comfortable route for electric bicycle users, [8], we developed a navigation system for data collection which can collect data from the bicycle rider and mobile user in real-time. In the context of driving, the experience of drivers was assessed at the end of a trip [4] and computerized ESM was performed to evaluate a parking assistant [3]. Moreover, the smartphone application EmoSnaps was validated for emotion recall from facial expressions [6].

3 DETECTING CHANGING USER EMOTIONS BY FACIAL LANDMARKS

To detect the user emotions from cyclist expression during riding by mobile phone, we should solve three issue. First one is the changing light condition, since the camera is facing upward the illumination of the face and the backlight vary. The other one is the computational efficiency. The method needs to run in real-time to capture visible emotional changes. Lastly, we need to be energy efficient to save the smartphones battery life. In this research, we propose to extract facial landmarks and postural markers to reduce the amount of computation necessary (feature dimension reduction) and be able to run efficiently on average consumer smartphones. The processing flow and exemplary output of the method is shown in figure 2. First, input to the proposed method are facial images taken during bicycle riding. The images are taken with a smartphone that is mounted at the handle bar of a bicycle. The front camera is adjusted to record the drivers upper body and head. In the facial images we detect the face region and extract 468 landmarks, as well as postural markers of shoulders, head and their location in three dimensional space using the Mediapipe framework [1]. We then apply Procrustes analyis to align the landmarks of the previous and current image. Next, we calculate temporal change, the difference Δ between two successive facial feature sets. The threshold δ determines if changes in facial features between frames are big enough to trigger a post-ride review. If the threshold is crossed we store the current image along with the location and the change vector for the review. A high level overview of the extraction method is shown in figure 1.

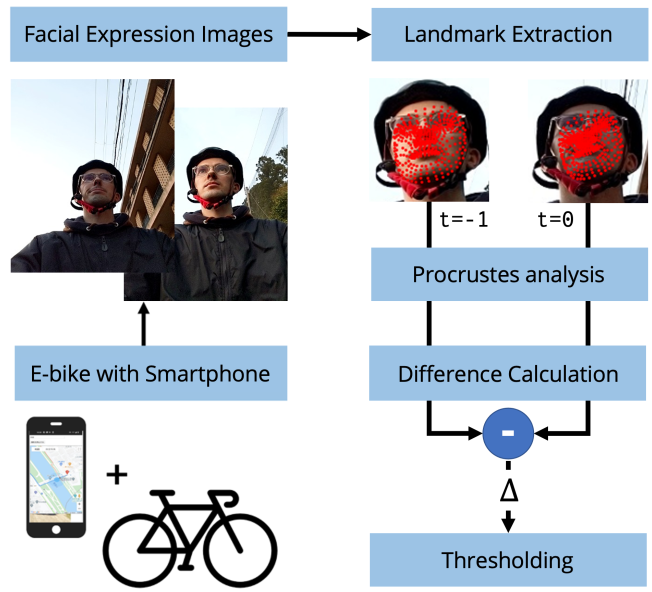

Figure 2: Overview of the proposed methods flow. The drivers face will be recorded with a smartphone camera during cycling. Facial landmarks, shoulder and head markers will be extracted in real-time using mediapipe. The extracted markers will be aligned between successive frames using Procrustes analyis and their difference calculated. A threshold comparison is made and, in case the threshold is crossed, the current image along with the location and differences are stored for post-ride review.

4 FUTURE WORK

In the near future, we will evaluate the proposed method for detecting changes in user emotions during bicycle riding by sampling facial images using a smartphone and integrate it with our existing system [8] to recommend comfortable and safe biking routes. Then, we are going to use this application to collect user data in Japanese metropolitan cities such as Kyoto, Osaka or Tokyo and improve the provided service using our method.

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