NVNN: Non-visual Navigation and Notification

Special track along with VEHICULAR 2020 October 18, 2020 to October 22, 2020 - Porto, Portugal
https://www.iaria.org/conferences2020/VEHICULAR20.html

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***Abstract*—In this special session we introduce navigation or notification system without any visual devices. Communication with images can tell large amount of information at once, however, we may confuse in vehicular system because many systems adopt the visual notification and navigation. We will therefore focus on non-visual notification and navigation system. By combination with visual and non-visual system, more intuitive and real-time notification and navigation may be realized. Therefore, the non-visual system have possible to develop conventional notification.**

Keywords- GNSS, Infrared, Ultrasound, Geomagnetic, Radio waves, Sound, Vibro-tactile, Odor,Car navigation, Indicator, Alert.

I. Introduction

Recently, many systems are utilized with image sensors or display for vehicular systems due to treat much information at once. As conventional notifications, indicator such as blinker, parking brake shows alert not only a driver who activates himself / herself but also around the vehicle. Speed meter, fuel monitor and tachometer also notify by visual images. Around view monitors and car navigation shows the environments by a monitor. In the case of remote-control vehicles such as Unmanned Aerial Vehicle (UAV), information such as landscape and objects around the vehicle is shown by a display. By the visual image, people can intuitively understand the information. Moreover, in non-Global Navigation Satellite System (GNSS) environment, that is indoor, visual navigation system such as Simultaneous Localization and Mapping (SLAM)[1] is generally used.

Because of many systems utilize visual images, people such as driver, rider, and operator may confuse because they must check visual information from many displays and indicators at once. Several conventional systems also provide information to the drivers in the form of sounds (e.g., alerts by horn, car audio including radio, and alarms for reverse gear, pre-collision, and lane departure)[4][5][6][7]. Directions presented by a satellite navigation system are also expressed through the vehicle's sound system. To avoid confusing the driver, we considered creating a different sound, pitch and pattern for each type of obstacle; however, these would not be intuitive. Additionally, notifying the driver using speech would take too long. It is also difficult to apply the system by sound in the case of late-night bus with long distance, because passengers will concern to the alert.

On the other hand, in an environment such as dark plant, we cannot use visual navigation system. Therefore, the systems that use the infrastructure devices of such as pseudolites[2] or radio waves[3] have been also investigated.

We will therefore focus on non-visual notification and navigation system. By combination with visual and non-visual system, more intuitive and real-time notification and navigation may be realized. Therefore, the non-visual system have possible to develop conventional notification.

II. Submissions

First presentation is Proposal of Guidance Method in Car Navigation System by Akimasa Suzuki [8]. The car navigation system is popular and map applications, such as Google Map, are also popularly used. Such map applications on a smartphone sometimes are used as the car navigation system. They are so useful to drive a car in unfamiliar religion. However, drivers sometimes take wrong roads in case of the instruction, such as "turn right at XX meters ahead." We estimate that this wrong-driving is caused by the difference between a perceptual distance and true one. In this research, differences between perceptional values and true ones for the distance and elapsed time were studied. We propose a new guidance method that is "turning on the right/left blinker." As a result of evaluation experiments, this method effectively decreases mis-driving. This method would not annoy a driver and is superior in terms of safety driving. Since a driver surely turns on a blinker before turning in this method, a subsequent driver must notice a former automobile will turn immediately. We proposed a new guidance method that is "turning on the right/left blinker." As a result of evaluation experiments, this method effectively decreases mis-driving; and is superior in terms of safety driving.

Yuta Yamauchi presents entitled Vibro-tactile Notification in Different Environments for Motorcyclists[9]. This paper evaluates the effectiveness of vibro-tactile notification for motorcyclists under external factors. Although many car manufacturers provide side and rear collision warning systems with auditory or visual alarms, the notifications may confuse a motorcyclist because they already need to be aware of many visual targets such as mirrors and monitors, and environmental sounds. This paper proposes vibro-tactile notification system using a vibration speaker installed in a motorcycle helmet between the outer shell and the cushion. The proposed system should enable motorcyclists to correctly identify the directions of five vibrating motors, three level of risk, and three obstacle types (i.e., pedestrians, vehicles, and motorcycles). We evaluate the system under windy and engine vibration conditions and examine accuracy of notification via experiment. Our results indicate that motorcyclists can correctly detect four directions and three threat levels using this system.

Finally, Measurement Accuracy on Indoor Positioning System Using SS Ultrasonic Waves for Drone Applications is given by Tatsuki Okada [10]. This study develops a drone positioning system for use in indoor environments, including in dark places, inaccessible areas, and ordinary living environments where it is difficult to realize by any conventional methods. Various indoor applications using drones have been developed for applications such as drone communication systems and wall surface inspection, which require remote estimation of their position. For outdoor applications, a Global Navigation Satellite System (GNSS) is generally used to obtain the drone position. However, as the radiowaves of the GNSS cannot reach indoors or between buildings, camera-based methods, such as Simultaneous Localization And Sapping (SLAM), are applied to estimate the drone's position. The system uses a noise-resistant, code-division-multiplexed Spread Spectrum (SS) ultrasonic waves for three-dimensional positioning. We develop transmitter and receiver hardware using SS ultrasonic waves and evaluate the effect of wind and sound of the positioning system during drone operations on the SS ultrasonic positioning. The accuracy of the positioning system was verified through experiments, and the results showed that a positioning accuracy within 15 cm was possible despite the effects of downwash generated by the drone's wings.

III. CONCLUSION

The NVNN special track includes a broad range of topics related to automotive research and development for every kind of vehicle. It contains both academic research papers as well as studies from industry introducing interesting and unique ideas for future work in this thriving research domain.

ACKNOWLEDGMENT

I would like to thank the organizers of VEHICULAR 2020 for their tireless efforts and for accepting NVNN as a special track. I also thank the members of the program committee for their hard work with the reviews and feedback. Last, but not least, I am very thankful to the authors for their very interesting contributions.

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