Autonomous Navigation Guidance for Human through wearable light Stimuli

Sandeep Kumar Nayak NAYAK.SANDEEP@RM.IS.TOHOKU.AC.JP
Tohoku University

Kazunori Ohno KAZUNORI@RM.IS.TOHOKU.AC.JP
Tohoku University

Satoshi Tadokoro TADOKORO@RM.IS.TOHOKU.AC.JP
Tohoku University

Abstract

Recently, there has been a growing number of people using digital application for reading maps and navigating their way to their destination. Possible location for the usage include outdoor environments such as busy streets, roads, buildings and indoor environments such as shopping malls that adds a mental overhead to read and decipher the directions from the maps while moving or engaging in other activities such as walking while carrying luggage, doing work while navigating during construction sites etc. As a result, the likelihood of an additional risk of injuries due to accidents increases. In search and rescue operations, time and attention play a very crucial role and so, making device that could save time of reading and deciphering map is much needed.

Attempts have been made [1] to build a light guidance device either using a wearable glass with augmented reality features, head-mounted devices or hand-held devices. However, in real life scene, hand-held devices come with inconveniences like arm fatigue, regular switching [1] etc. Head-mounted device and AR have long time usage induced eye strain and wearing inconvenience for outdoor uses.

We address these problems by designing a wearable suit mounted with light guidance stimuli and data collection sensors like IMU.

Autonomous navigation by giving light control signals for the human to respond.

Human response to light time lag

Human behavior prediction of the tendency to follow the light and its degree for a better planning and control.

Fig 1 shows the concept description

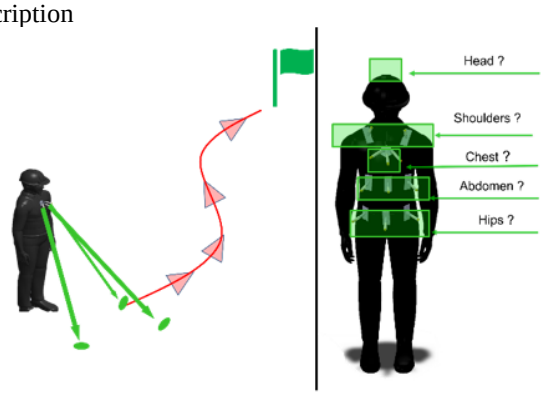


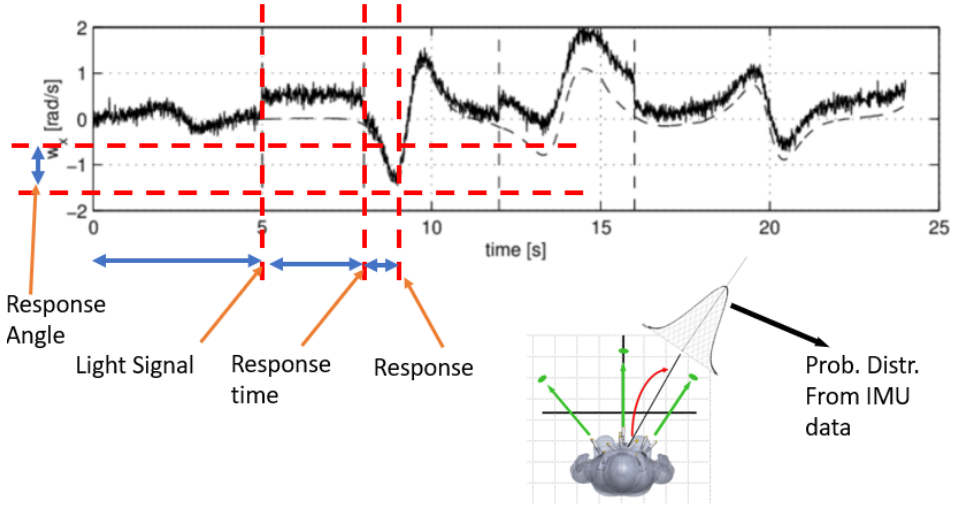
Fig. 1 *left*: Concept, *Right*: Problem Description

Designing a wearable suit mounted with light guidance stimuli and data collection sensors like IMU

For placement of light guidance, location on the human body with least variation is chosen by using data-driven analysis of CMU mocap dataset. We use standard deviation as a measure of variation. The standard deviation computed on the distance between the marker on human body and the average of trunk markers representing an average human body movement.

Data Collection

We decided on using IMU sensor for getting the relative orientation and GNSS sensor for getting the location. We use head-mounted camera as an additional data collection tool for getting the human view information. Fig2. shows the data input.



Challenges:

Stochastic behavior of human for following light signal.

Proposed solution 1:

Collection of data for human response angle to light stimuli angle and using this data to make a probability distribution of response.

Stochastic behavior of human as response time lag to light stimuli.

Also, in the future, we want to consider several external influencing factors for the human motion behavior as well.

Keywords: Autonomous Navigation, Wearable computing, light stimuli

References

[1] C. Winkler, M. Broscheit, and E. Rukzio, “NaviBeam: Indoor assistance and navigation for shopping malls through projector phones,” CHI 2011 Work. Mob. Pers. Proj., no. January 2011, 2011

[2] J. Chung, I. J. Kim, and C. Schmandt, “Guiding light: Navigation assistance system using projection based augmented reality,” Dig. Tech. Pap. - IEEE Int. Conf. Consum. Electron., no. May 2014, pp. 881–882, 2011.

[3] G. Glass, U. Rehman, and S. Cao, “Augmented Reality-based Indoor Navigation : A Comparative Analysis of Handheld Devices vs .,” vol. 47, pp. 140–151, 2017.