Demo: BiFocus – Using Radio-Optical Beacons for An Augmented Reality Search Application

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ABSTRACT

Augmented Reality (AR) applications benefit from accurate detection of the objects that are within a person's view. Typically, it is not only desirable to identify what is currently within view, but also to navigate the users view to the item of interest - for example, finding a misplaced object. In this paper we demonstrate a low-power hybrid radio-optical beaconing system, where objects of interest are tagged with battery-powered RFID-like tags equipped with infrared light emitting diodes (LED) that emit periodic infrared beacons. These beacons are used for accurately estimating the angle and distance from the object to the receiver so as to locate it. The beacons are synchronized using the radio link that is also used to convey the object's unique ID.

Categories and Subject Descriptors

C.2.1 [**Computer-Communication Networks**]: Network Architecture and Design—*Wireless Communication*

Keywords

Augmented Reality, Radio, RFID, Optical, Infrared, Angular Estimation, Ranging

1. INTRODUCTION

We often need to find a specific item in a rather chaotic setting – for example, a toy in a house, items in a office room, or a product in the grocery store. In this application it is not only desirable to identify what is currently within view, but also to direct the users view to the item of interest. The problem can be reduced to determining the angle of the object from a persons direction of view as well as the distance of the object from the viewer.

Presumably, the object that is closest to the direction of view (smallest angle) and closest to the viewer (smallest distance) is the one the person is looking at. When the right object is within the user's concentrated view (human eye has a concentrated vision within its fovea [3]), it is important that the angular resolution is sufficient to discriminate among these objects. With 50cm spacing between objects and a 3m distance between the user and the objects, the angular resolution required is about 10 degrees; with 10cm spacing and a 1-3m distance, the angle resolution required can be as small as 2 degrees.

Radio–Optical Beaconing Approach: Current barcode tagging approaches for augmented reality are very limited in reading range, while active RFID tags suffer from imprecise angle of arrival estimates [2]. To fill this void, we designed a low-power hybrid radio-optical beaconing system, where active RFID-like tags enhanced with a IR LED, emit a high energy light beacon which is detected and sampled by the photodiode elements at a receiver IR unit. The received IR signal energy is used to estimate the angle and distance between the transmitter and receiver with high accuracy, while the RF link provides tag ID and receiver synchronization of the extremely short IR pulses to lower energy consumption.

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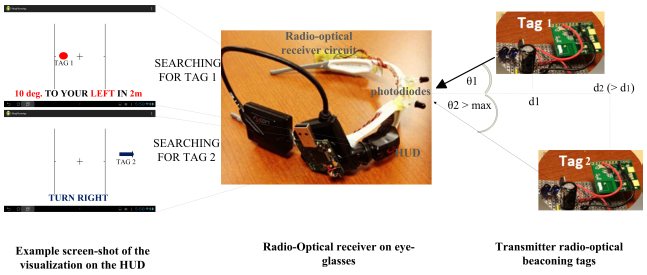

Figure 1: Illustration of the system demonstration

2. DEMONSTRATION SETUP

We will demonstrate our system using a receiver apparatus where the radio-IR receiver with two photodiodes is mounted onto eye-glasses along with a heads-up-display [1](HUD).

The radio transceiver also periodically uploads the object position data to a web-server. We will tag objects with our transmitter tags (each bearing a unique ID) and let the attendees find the object through the navigation aids we will provide through an app on the heads-up-display. We will also demonstrate the details of the system functions using a calibrated setup. Figure 1 shows an example screen-shot of the visualization along with the glasses and transmitter tags.

3. REFERENCES

[1] Recon mod-live heads-up-display. http://www.reconinstruments.com/products/snow-heads-up-display.

[2] Artag. http://www.artag.net/, 2009.

[3] C. Yuodelis and A. Hendrickson. A qualitative and quantitative analysis of the human fovea during development. *Vision Research*, 26(6):847 – 855, 1986.