Traceband: Locating Missing Items by Visual Remembrance

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ABSTRACT
Finding missing items has always been troublesome. To tackle the hassle, several systems have been suggested; yet they are inflexible due to excessive setup time, operational cost, and effectiveness. We present Traceband; a lightweight and portable bracelet, which keeps track of every targeted commonly used object that a user interacts with. Users can find the location of missing items via a web-based software portal.

Author Keywords
Finding missing items; bracelet; image matching; life logging; Traceband

ACM Classification Keywords
C.3 Special-purpose and application-based systems: Real-time and embedded systems.

INTRODUCTION
Locating daily used objects is a serious concern for both youth and elderly due to absentmindedness or perceptual problems [6]. We often lose objects, we forget where we keep or leave them. Looking for an object could get very frustrating especially if we have no lead on where to start.

Several systems introduced novel methods to tackle lost finding scenarios. Ueoka et al. [7] proposed a head mounted vision interface system that continuously records videos from the user viewpoint. The system searches through videos for predefined items and if there is a match, it assigns the portion of video to that item. WristSense is a wrist-worn device that utilizes an accelerometer to detect hand gestures and trigger a camera [2]. Hand gestures should be trained at a previous stage by wearing an additional head mounted camera, performing each desired gestures and labeling. A system by Nakada et al. [5] requires attaching RFID tags to commonly used objects. It then detects them using RFID readers and ultrasonic position detectors mounted at the environment. Another work utilizes a wearable RFID reader to detect the tagged objects [1]. Although many of these solutions were innovative and successful, they were not efficient (e.g. excessive trainings, memory usage, battery life constrains) [2, 7], or flexible (e.g. improper camera position for capturing placement of objects) [7], or visually desirable (e.g. multiple devices in every room, attaching active RFID tags to commonly used objects) [1, 5].

UIST '14, Oct 05-08 2014, Honolulu, HI, USA
ACM 978-1-4503-3068-8/14/10.
http://dx.doi.org/10.1145/2658779.2658800

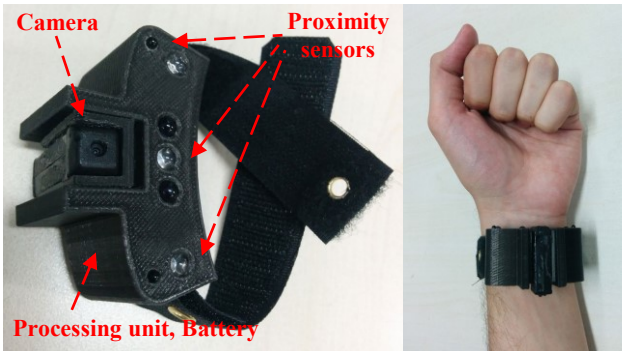

Figure 1. The bracelet consists of three proximity sensors, a camera, rechargeable Li-Ion batteries, a custom processing board, and transmission module.

While previous approaches were helpful, alternative methods can enhance the experience. To assist users in locating their missing items, we present Traceband.

SYSTEM DESIGN
Figure 1 shows the prototype. It consists of a proximity sensing module that detects status of wearer's hand with regards to any surface. Approaching or distancing a surface triggers the camera to capture frames of the front space for five seconds (up to 10 fps). We make sure that recorded photos are clear using a metric for blurriness [3]. Furthermore, we apply Chi-Square test on their histograms to filter near-duplicates.

Each set of photos is sent wirelessly to a server which compute their ASIFT keypoints [4, 8] and compares them with archived personal items. Personal items are archived at a previous setup stage using an independent web-based software (Figure 2). The server records an incoming log

photo only if it is related to a match among archived personal items. We consider a photo as 'related' if it is followed or preceded by a matching photo within a range of 15 frames. An unrelated photo could be a result of proximity changes to a surface without detecting any personal items. Each related set of photos is assigned to the personal item as the most recent matching group.

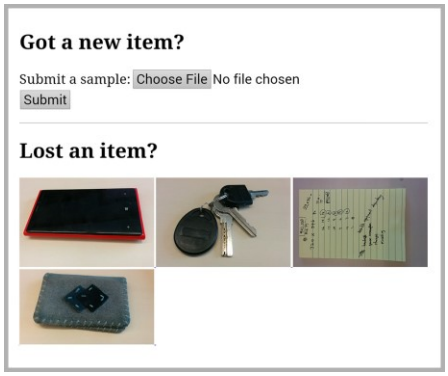

Figure 2. Traceband website. Users can archive new personal items, or search for lost ones.

Matching and visualization of archived photos

To find a lost object, the user can directly open the webpage (Figure 2) and click on the archived photo of that object. Once the user clicks on one of the archived photos, the server loads the most recent group of frames assigned to that item. The sequence is displayed in reverse time order with matches bolder than others; see Figure 3.

Figure 3. Results of searching the cup. The images containing the match are highlighted. Other images complement the matches to help in quick remembrance of missing object's location.

CONCLUSION AND FUTURE WORK

We introduced a novel system to facilitate object finding by picturing where it was left behind. It is a compact and lightweight design that can be embedded into the current smartwatches form-factor. We have tested our system in various daily scenarios, holding different objects. Since we only took distinct and related scenes, less processing and time were spent on computation of image feature. This also helped in effective usage of memory, faster retrieval and display of a concise sequence of scenes. The arrangement (Figure 3) helped testers to quickly identify the location of matched items.

This work will be further developed to increase the matching rate on objects with slight flat features. We also plan to add infrared capturing system to enhance the operation in poor lighting conditions and darkness.

ACKNOWLEDGMENTS

We thank all people who volunteered in the system testing and video production. Moreover, we thank Dr. Shendong Zhao and Dr. Taku Hachisu for providing constructive comments on previous versions of this document. The authors have no affiliation with brand names, logos, and products used for testing the system and video shooting.

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