Cricking: Browsing Physical Space with Smart Glass

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Abstract
We are so used to surfing the web, clicking on links and getting instant feedback, that we often wonder why we cannot do the same on physical surfaces. We have coined crick as a portmanteau term blending click and brick (and mortar) to describe the action of selecting a point on a physical surface and receiving digital information about its content. In this paper we are presenting a browsable physical space with clicking solution. Our target space is a shelf equipped with Radio Frequency Identification (RFID) containing changing number of DVDs and books. The mouse is replaced by a smartphone acting as a touch pad, the cursor is replaced by a controllable moving head beam light that projects a spot on the shelf and the information about the products near the cursor’s position is then shown on a heads-up display (HUD) such as Google Glass. The items can be localized and visualized at HUD with an accuracy of 99%. The system is developed in context to independent living i.e. wheelchair users.

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Human Computer Interaction; Mobile Computing; Contextualization; RFID; Ubiquitous Computing

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H.5.m [Human-centered computing (HCC)]; Ubiquitous and mobile computing.
Introduction and Related Work

Online browsing is possible for people having physical disabilities but not physical browsing at retail or in libraries. Physical browsing is lacking in the context of independent living scenarios, e.g., where users need to retrieve the items (e.g., on shelf) present beyond their arm length. Examples include wheelchair users in which they are unable to touch or reach the items present beyond their arm’s length. Currently 1% of world population is using wheelchair [1]. A system enabling interaction with items without reaching them physically with online contents is required.

HUD can give more realistic application to the browsing reality. Nowadays more advanced head up displays are coming to the industry and are simply referred as Smart Glasses. The interaction of smart glasses and additionally carried smart devices can be much fruitful and beneficial in providing intuitive information to users. Smart glasses in relation with the devices that are considered to be highly personal and familiar will have a positive impact on the acceptance of technology in regard to specific population group.

Browsing physical space [3, 4] in context with retrieving online information related to physical objects is underway. Some of the major research contributions that enables browsing physical spaces with different technologies like augmented reality, wearable devices and RFID are proposed in [6, 2]. The concept of Cricking [5] allows clicking the physical spaces using pervasive technologies.

We have developed a system comprised of smart glass, smart space, head beam light and smartphone that enables the user to browse the physical space. Figure 1 shows the system overview. Our target space in current scenario is a shelf. The shelf is equipped with the RFID system and adjusted with head beam light. RFID turns the shelf into smart space by which all the items present on the shelf can be inventoried and localized. Head beam is used to have a cursor effect, user can move the head beam light focus on the shelf at particular location with the help of a smartphone and can click at particular location on the shelf. The information about the items present on the user’s clicked location on the shelf will be displayed on the HUD or smart glass as smart interfaces. Once the items are presented at smart glass users are bridged from offline world to online. From the smart glass interface user can access online information about the items including price, size, user comments, etc.

![Figure 1: System Overview. User interacts with the manager application that sends cartesian coordinates and angular coordinates to smart glass and head beam, respectively. Head beam lit up the smart space using angular coordinates and smart glass retrieve the user’s requested data from server using cartesian coordinates.](image-url)
Methods and Procedure

In the proposed project different components of systems are communicating with each other via WiFi LAN. The main components of system are explained below.

Manager Device

The mouse is replaced by a smartphone acting as a touchpad, and performs cricking. We termed this smartphone as Manager Device, as the main processing algorithms are implemented and executed in this device. Smartphone touch screen can be used for cricking. Cricking can be described as the position where the user stops moving the light. That particular area of shelf will be considered as the click area or user’s point of interest.

Physical Smart Space

It has the capability of providing real time inventory and location of items by using the RFID system. The shelf is equipped with the RFID antennas that are connected to the RFID reader through multiplexers and the items present in the shelf are RFID-tagged. The RFID system dynamically tracks the RFID-tagged items, measures their location with an accuracy of 20cm, and populates the database.

Head Beam Light

The head beam light is mounted in front of the shelf and act as cursor and to highlight the user’s area of interest. It moves to change the light focus on the shelf with the relative movement of user scrolling on the smart phone. Figure 2 shows the shelf mounted with head beam light.

Smart Glass

Vuzix M100 Smart Glass in used in the current case. It receives shelf coordinates from the Manager Device and connects to the database for retrieving inventory from a particular location. Once the particular inventory is received, smart glass constructs the interface. Figure 3 shows one screenshot of the smart glass interface.

Internal System Design

The proposed system is comprised of sub modules that run on different devices. The main module executes in smartphone which is developed in android that controls the whole system. It captures the finger movement, converts it to the spherical coordinates through the implemented algorithm and sends them to the head beam light via UDP datagram channel. It also converts spherical coordinates to 3D shelf coordinates through designed and implemented algorithms based on trigonometric functions and sends them to smart glass. For the head beam light there is an application developed in java that runs on a normal PC. It receives the spherical coordinates and moves the light to a particular position. Smart glass executes an android application that receives 3D coordinates and connects to the server for inventory. The RFID system automatically inventories and localizes the items present on the shelf and updates the server. All the communication between different components of systems is done through WiFi LAN. Figure 4 shows conceptualization of different devices coordinates synchronization.

General System Usage

User is provided with the smart glass and smartphone. Now, the user can use the smartphone as a touchpad to move the head beam light and lit the particular area on the shelf. All the items present under the lit area of the shelf will automatically be presented to the smart glass interface. From where the user can interact with them. If some items are removed, added or location has been changed, this can be detected by the system and user will always get the real time results with updated location.
Results and Future Work
The proposed system is tested and validated with a shelf that contains CDs and DVDs at different locations and we are able to locate and browse them with smart glass. Number of random tests has been conducted for browsing items present at shelf and the system has demonstrated an accuracy of 99% for visualizing the right item at the right location. Figure 5 shows the working system. The system has demonstrated a way to bridge the gap between the physical and the virtual world, since objects on a shelf automatically appear on the smart glass, and from there, all the common functionalities of the on-line world can be accessed. It has been shown how the system can be used to help handicapped people to live more independently, or to help retail stores create omnichannel shopping experiences, in which the physical shelves and the on-line catalogs merge.

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