MagicWatch: Interacting & Segueing

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Abstract

Seeking for more friendly, more efficient, and more effective human-computer interaction ways is an eternal hot topic. This video demonstrates a MagicWatch that can sense user's gestures, understand user's intensions, and achieve expected tasks with the underlying core techniques and the support of a back-end context aware smart system on a cloud platform. The MagicWatch can act as a pointer, a remote controller, and an information portal. Just using hand, you can point a building, a person, or a screen; you can control a device, for instance, changing TV channels, adjusting temperature, or switching slides; and you can get necessary information from the cloud. Moreover, this video highlights MagicWatch's seamless interactions with objects in its surrounding and easy segueing in cyber-physical spaces.

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ACM Classification Keywords

H.5.2. User Interfaces.

Introduction

In today's "wearable computing" era, with the emergence of various wearable devices, wristwatch has been receiving much attention and widely accepted not only as a classic watch but also as a gateway from the physical world to cyber worlds. Comparing to other wearable devices, it has significant advantages such as

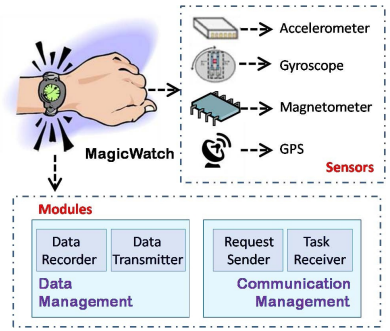

Figure 1. System Overview.

easy to use, getting used to wear, and suitable for any ages of people. In particular, it does not need to be taken out from pocket comparing with a mobile phone. Moreover, with embedded sensors, it can catch hand (including wrist) gestures which are of rich representations and expressions. It presents a promising future of input technology. As a hand-wear device, watch is incomparable among friendly and seamless interactions.

As it is fact that modern smart watches are featured with GPS, Bluetooth, Wi-Fi, camera, accelerometer and other sensors. The emergence of cloud computing enables all resources management and processing done at back-end cloud. Therefore, a smart watch can be light as a user front-end and become more and more important in Human-computing interaction.

This video presents our project, MagicWatch, which is a smart watch with efforts on HCI, cooperative work and seamless task immigration. MagicWatch can timely sense a user's gestures and understand the user's intention so as to provide the user services. With the supporting from a cloud platform, MagicWatch can control devices and systems remotely, share the data among users seamlessly, resume tasks among different devices actively. Briefly, it can easily segue in cyber-physical spaces.

MagicWatch: Components and Functionalities

The MagicWatch system as shown in Figure 1, is implemented on the GeakWatch platform with android operation system and enhanced by some Bluetooth sensors. The system has built-in 3-axis accelerometer, magnetometer, gyroscope, and other sensors, with which it can catch and record a user's gesture data. MagicWatch can connect to the Internet or other devices via Wi-Fi or Bluetooth. Build-in software modules, Data Management and Communication Management, enable data transferred to the cloud for storage and processing, and communications to and from the cloud and other external systems. MagicWatch has the following four functionalities, i.e., sensing user's gestures or pointing orientation, controlling devices or systems, and connecting user's physical space to cyber space. It acts as a pointer, a controller, and an information portal.

MagicWatch as a pointer

Pointing is a very common-used gesture in our daily life. It is natural for a user to point to an object such as a building, a person, or a device before some further performance or operations such as obtaining information about a building and making conversions with a person. MagicWatch can recognize the gesture of pointing and find out a target user, device or software system so as to manipulate it.

MagicWatch as a remote controller

With MagicWatch, a user can use a gesture to control a device or system. For example, a user can control temperature of a remote air conditioner by just pointing it and shaking hands to up or down with a MagicWatch. This function owe to the advanced IoT and cloud computing technologies which enable a MagicWatch to flexibly provide remote control to the connected devices and systems through the cloud.

MagicWatch as an information portal

MagicWatch acts like a bridge linking the physical space and cyber spaces and actively provides users online

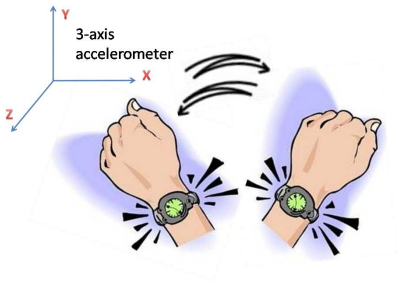

Figure 2. Illustration of how to recognize user's gestures.

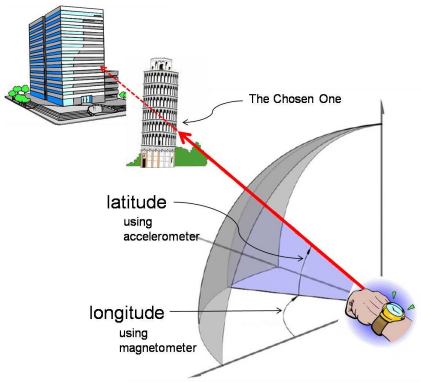

Figure 3. Illustration of how to sense what you point to.

services upon their needs and intentions through continuous sensing and understanding them. On the one hand, a user can access to the cloud through his/her MagicWatch, and seamlessly share data, tasks and other information in cloud. On the other hand , the services in cyber space will be continually provided to users through MagicWatch according to the context in the physical space. For example, when a user wearing a MagicWatch meets a group of visitors, once the user shakes hand with a visitor, the information about the visitor will be sent to his ears. When the user points a person in a meeting room, the person's self-introduction will be shown in a presentation screen.

How does MagicWatch work?

MagicWatch as three roles mentioned above can make users to perform some amazing tasks. This section will explain its underlying core techniques.

How to recognize user's gestures?

MagicWatch uses an acceleration-based as shown in Figure 2 gesture recognition approach, called FDSVM(Frame-based Descriptor and multi-class SVM)[1]. Firstly, the data from accelerometer referring to a gesture is collected and represented in a frame-base descriptor, for extracting discriminative information. Secondly, a SVM-based multi-class gesture classifier is built for the gesture recognition in the nonlinear gesture feature space. The recognition results can reach more than 95% accuracy in experiments.

How to sense what you point to?

MagicWatch utilizes two build-in sensors, accelerometer and magnetometer, to sense where a user points to[2]. As shown in Figure 3, the pointing direction is described by a pair of the longitude and latitude values in a spherical surface. The longitude value measuring the direction of earth magnetic field, is calculated using the magnetometer. And the latitude value is the angle of the MagicWatch plane and the horizontal plane. Based on gravity, the latitude value is calculated by the 3-dimentional orthogonal acceleration acquired from the built-in accelerometer. Along the direction, the first object encountered is regarded as the object MagicWatch is pointing to.

How to control?

A cloud platform is built for storing and managing users' data and task. The controllable devices and systems are virtually connected to the cloud platform via wireless or wired networks as shown in Figure 4. Their physical locations are computable via GPS values and indoor location labels [3]. MagicWatch can identify which object its user is pointing with its pointing functionality described above.

Further, a sequence of recognized gestures are transformed into a sequence of operations so as to control devices or systems connected to the cloud.

How to work as an information portal?

As an information portal, MagicWatch connects the cyber space and physical space as shown in Figure 5. Through MagicWatch, the two spaces smoothly interface and interact each other, users receive continuous and dynamic services and interact with cyber spaces unconsciously.

Some efforts are made to achieve this goal based on our previous work [3]. 1) We use a unified semantic description for describing smart environments, including the location, the abstraction capabilities, and

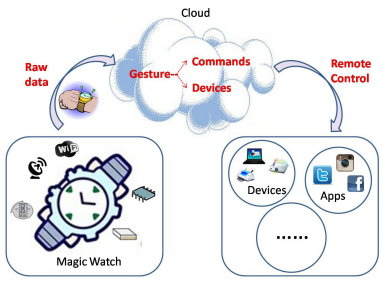

Figure 4. Illustration of how to control.

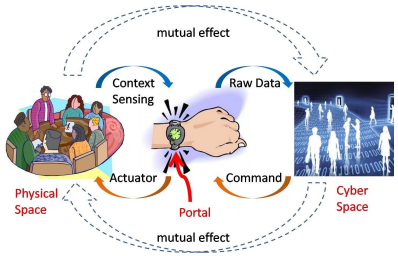

Figure 5. Illustration of how to work as an information portal.

the dynamic situations of users and devices in a smart environment. 2) Based on a rule-based context aware mechanism, a framework named Taskshadow is built for recording, sharing, and resuming tasks among different devices.

Typical Scenarios

MagicWatch is easy to deploy, and can function well in different situations, such as meeting room presentation, personal assistant, cooperation work.

MagicWatch for meeting room presentation

With MagicWatch, a presenter can control slides by his gesture. And the presenter can get tips by simply pointing to other users, or control devices by pointing to them.

MagicWatch for personal assistant

MagicWatch can serve as a user's personal assistant. It can remind a user when detecting a specific gesture. For example, when a user stretches himself, MagicWatch will remind him to have a rest. Moreover, MagicWatch can also find a user in a difficult situation by detecting his a particular gesture and inform his friend to lend a hand.

MagicWatch for cooperation work

In many situations, users need to cooperate with others. With MagicWatch, a user can easily "grab a document" from his laptop to other's laptop; a user can also "fling a document" to a projector to be shown; a user can exchange contact info or other data by just shaking hands with others; Moreover, different users can add marks or draw figures to a same document.

Conclusions

The era of "wearable computing" has brought wristwatches a great chance to take some advantages over mobile phones. MagicWatch, far beyond the classic watches, can function as a pointer, a controller, and an information portal. To achieve its functionality, the MagicWatch system makes best use of human hand gestures for understanding their intentions so as to serve or assist them with the following underlying core techniques: A gesture is recognized by FDSVM (Frame-based Descriptor and multi-class SVM); Data from accelerometer and magnetometer are used together with GPS or Wi-Fi for deriving what a user is pointing; a cloud platform is built for controlling remote devices and sharing data; and a framework named Taskshadow is built for recording, sharing, and resuming tasks among different devices. This video shows MagicWatch's two significant features: seamless interactions and easy segueing in cyber-physical spaces.

Acknowledgements

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