

# MagicPhone: Pointing & Interacting

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## ABSTRACT

Mobile phones are becoming a kind of must-have portable devices for people. This video demonstrates a mobile phone that can sense what you are pointing to and can act as a physical ubiquitous interaction device in real world, called *MagicPhone*. If you want to interact with an appliance around you, you just simply point the MagicPhone to it and then operate. The MagicPhone uses both the built-in accelerometer and magnetometer to sense the pointing orientation. Using MagicPhone, you only need to point to a device and sliding your finger, to show a picture on a display, to send a document to a laptop, to share slides on a projector, and to print a photo. In addition, MagicPhone can control a selected device with accelerometer-based gestures, e.g. changing TV channels. It also can serve as a mouse to draw a picture or play clicking games.

**Author Keywords** mobile phone; magnetometer; pointing interaction; gestural control.

**ACM Classification Keywords** H.5.2 [ User Interfaces].

**General Terms** Design

## INTRODUCTION

Nowadays, electronic appliances become parts of our everyday life. They do facilitate our daily route and enrich our life, but the interaction between human and appliances is still not convenient. We expect an intuitive means of interacting with the appliances around. Borrowed from human society, gesture, including pointing, flinging, shaking, etc., is a natural way in HCI, representing some common commands towards appliances.

Mobile phones could be considering as the truly pervasive computing terminal. It is always with you to help you keep in touch with others. Many efforts have made to make mobile phone as a ubiquitous interaction device [1,2]. However, rapid and natural selection of an appliance using a phone for operation is still a challenging task. Laser pointer-based selection needs a light sensor attached on the appliance [1]; Camera-based phone selection should be supported by visual codes deployed in environments [2]. RFID-based selection requires the RFID reader-equipped phone approaching the appliance[6]; Joystick-based method needs a feedback mechanism or an on-phone GUI [4].

In this video, we develop a physical ubiquitous interaction device, *MagicPhone*, that supports the convenient direct selection of appliances by naturally pointing.

## WHAT MAGICPHONE CAN DO?

Our MagicPhone is a universal controller, a mini storage device, and a mouse. It interacts with appliances around us with a "*pointing&X*" manner. *X* could be displaying, projecting, printing, playing, drawing, controlling, and so on.

### Pointing & Printing

If you want to print a document or a picture, you firstly open/select the document/picture on MagicPhone, and then point the MagicPhone to a printer nearby and slide your finger on the phone screen towards the printer.

### Pointing & Projecting

Suppose that you are at a meeting or in discussions. If you point the MagicPhone to the projector and slide the finger on the phone, the slides or other documents stored in the phone will be shown on the screen.

### Pointing & Controlling

With help of a Bluetooth-to-Infrared module, MagicPhone can control most of home appliances by a few predefined gestures. For example, turn on TV and air conditioner, change TV channel, and switch the slides during presentation. We employ the accelerometer-based gesture recognition algorithm [4] for it is insensitive to lighting condition and viewpoint,

### Pointing & Displaying

MagicPhone is able to send media files to media player devices for playing, such as digital photo frame, TV, digital video player, and digital speaker, by the interaction of pointing & sliding. For example, send new pictures to show in digital photo frame, share pictures in TV, and play video from MagicPhone to TV.

### Pointing & Clicking

With capability of sensing the pointing position on a spherical surface in 3-dimensional space, MagicPhone can serve as a mouse to play the clicking games and to draw pictures. The left/right clicking operations are implemented by touching the MagicPhone Screen.

## HOW TO SENSE WHAT YOU POINT TO?

MagicPhone utilizes only two sensors – accelerometer and magnetometer – that are embedded in the mobile phone to sense the user's pointing orientation. Due to the

independency of any other equipment fixed in the environment, e.g. RFID reader, laser sensor, camera, MagicPhone is more usable and portable even when we move from one room to another.

The phone is like a baton. It can be pointed to any direction in the 3-dimensional space. Direction is described by the composite of longitude and latitude in a spherical surface, shown in Figure 1:

(Lon, Lat)

The longitude is equivalent to the direction in our daily life, e.g. east, south, west, north. This value of longitude can be calculated from the strength of magnetic field in a relative three orthogonal vector triad, which is given by the built-in magnetometer. The latitude is the angle between the plane of MagicPhone and the horizontal plane. Based on gravity, the value of latitude is calculated by the 3-dimensional orthogonal acceleration acquired from the built-in accelerometer.

With help of pointing orientation described above and location description of local devices [5], we can easily compute what the MagicPhone are pointing to.

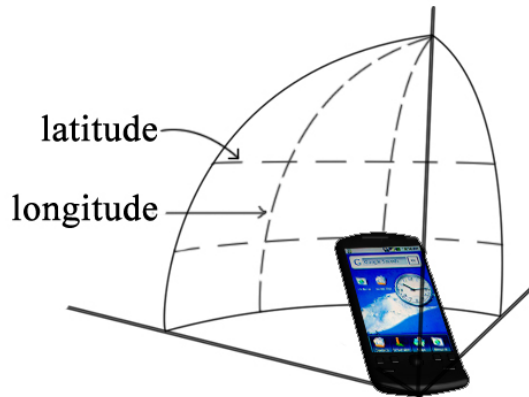


Figure 1. Illustration of Pointing Orientation.

#### IMPLEMENTATION

The MagicPhone is implemented based on the HTC Magic with Android 1.6, which has built-in 3-axis accelerometer and magnetometer. For those appliances compatible with Universal Plug and Play (UPnP), MagicPhone accesses the services they offer via UPnP, e.g. print files, share documents, display pictures.



Figure 2. Bluetooth-to-infrared Adaptor

In order to control home appliances, we developed a Bluetooth-to-infrared adaptor, shown in Figure 2, to convert the Bluetooth signals to infrared signals, since most of home appliances only support infrared controller. That would be unnecessary when they are able to communicate via Bluetooth or Wi-Fi.

Figure 3 shows screenshots of MagicPhone for some interactions. From left to right: sending pictures to the selected digital photo frame, MagicPhone as a mouse, and controlling the chosen air conditioner.



Figure 3. Screenshots of MagicPhone.

#### ACKNOWLEDGEMENTS

This work is supported in part by the 863 Program of China (2009AA011900, 2008AA01Z132), the HGJ Program (2009ZX01039-001-002-004), and Zhejiang Provincial NSF (No.Y1090690). The authors would thank to the volunteers participated in the performance. Gang Pan is the corresponding author.

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