Embedded system for 3D-imaging (YD1-10)

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Overview

Introduction

The wireless control system is one of the most convenient aids for using computers. With the advance in Bluetooth technology and the processing power of the new PC, recognizing the gesture of an pen for controlling the system from the camera image has become more practical. The demand for system rise is due to its convenience, especially in presentations. By using this system, users can interactively present in front of a screen rather than standing in front of the computer without any interaction.

Since the trend of computer graphics is shifting from 2-D environment to 3-D environment, a device that to be used as mouse in 3-D environment is necessary.

Objectives

The aim of our project is to build a prototype product that can track a point source’s 3-D position, which involves its X, Y and Z coordinates and to produce a program for control purpose. We have 3 main objectives:

i. Low cost
ii. Fast response ability
iii. Accurate positioning

By comparison with the products on the market, we would like to produce a more functional controller, with basic functions such as a cursor control, a left right key.

Hardware Block Diagram

Software Block Diagram

Methodology

There are 4 stages in our projects:

The first stage (Hardware implementation and testing):
1) Methods of controlling IR camera
2) Embedded board kernel building
3) Communication library construction for accessing the hardware

The second stage (Software implementation and testing):
1) Main calculation program
2) Function for device actions transmission
3) Function for mouse actions handling
4) Use of Z-coordinates

The third stage (Whole system implementation and testing):
1) Testing the accessibility of the camera
2) Testing the calculations and wireless transmission part on embedded board
3) Interacting with a Linux PC
The final stage (Taking use of the embedded processor’s performance):
1) Simulating the 3-D environment
2) Controlling the 3-D model through the pointing device

Results

The outputs we have obtained are acceptable since we can make a system to replace the presenter with an accurate control.

Based on the testing results, we have made an accurate system. It shows that the data obtained only contains noise due to shifting of the FCD. A secured transmission protocol was chosen for the Bluetooth transmission, to avoid sending wrong messages.

The accuracy of camera, and the processing power and the Bluetooth transmission rate also proved that the product is fast enough to demonstrate a smooth control.

Conclusion

The largest limitation of the system is due to the relatively small view angle. This means the user must keep a suitable distance from the product in order to enable it to function normally. Since the IR camera is a part of a game controller, it is hard to find another replacement which has a high capturing frequency as this does. The immunity and the effective angle of the IR emitter also limited the gesture of using it. To solve this problem, we have to replace the existing part with a brighter and larger effective angle.

The extendibility of our product is very large. Its function is not only limited to act as a mouse pointer. It can be used to track an object’s outline, giving control in a 3-D environment and also used to provide an interactive 3D imaging. Since the trend of computer vision is shifting from 2-D to 3-D, we believe that our project can be used as a fundamental part of other future products.