Chapter 5
A Novel Design of Motion Detector Using Mouse Sensor

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ABSTRACT
This paper presents a novel design using a mouse sensor to construct a system for motion detection in normal vision environment. A mouse sensor is packed under an optical mouse for detecting the motion of mouse on desktop and sending out the data and parameters to a controller or a computer directly. This paper introduces this kind of sensor to vision motion detection field by designing and building a circuit system. The feasibility of the design is demonstrated and degree of reliability is measured by experiments performed on the designed system. Additionally the authors point out the advantages of this design in comparison with other traditional methods or devices in brief.

1. INTRODUCTION
Due to various demands and applications, motion detection has become an important field of digital and semiconductor technologies, which is attracting more and more attention. In traditional vision motion detection, CCD and CMOS sensors are widely used, mostly with a complex servo in background such as a server of a DSP (Digital Signal Processor) with a customized algorithm. Therefore, a new conception which is cheaper to build, easier to develop, more portable, and more reliable to use is desired by engineers and users.

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A number of de-interlacing algorithms are widely and commonly adopted in the motion detection field (Han, Shin, Choi, & Park, 1999; Lee, Chang, & Jen, 1991; Shahinfard, Sid-Ahmed, & Ahmadi, 2008) which are based on TV signal. However, the improved fabrication technology and architecture bring forward some other applications based on CMOS Image Sensors (CIS) directly (Ma & Chen, 1999; Sohn, Kim, Lee, Lee, & Kim, 2003). Lately, SOC replaced the foregoing techniques and became the dominate technology in motion detection area for its low power consuming and compatibility. But sometimes SOC costs a long development cycle because of the developer must grasp the overall situation of hardware and software.

During the past several years, the progress of the optical navigation area has leaded us to a new period of time that solid-state optical mouse has inevitability become a new standard. Inspired by the mouse devices and considering the situation of motion diction, we attempted to use the mouse CMOS sensor which is in low resolution ratio for motion detection. An experimental system was built tentatively to validate this idea. The feasibility of the design is demonstrated and degree of reliability is measured by experiments performed on the designed system.

In this paper, Section 2 will introduce what is mouse CMOS sensor, and explain the elements of it. Section 3 is the design of it that prototype is showed. In Section 4, we designed a series of experiments to test the system in resolution, color, texture, and luminance. Then advice is given for the application that needs the function with this module.

**MOUSE CMOS SENSOR**

The heart of an optical mouse is a mini camera in low-resolution. Just as Figure 1 showed that the navigation LED in the mouse illuminates a surface, and the light reflects off the surface to the lens. When the mouse is moved, the mini camera of the mouse (the sensor) takes continuous snapshots of the surface. The built-in digital signal processor (DSP) would process the data and determine the distance and direction of the movement. Then the micro-controller will send the result to the PC via the USB wire or other communication channel.

Figure 2 displays the algorithm of motion detection in the mouse DSP. When the mouse is moved, image A and B are captured by the CMOS sensor continuously. Ref is the same sub-image on both A and B, so that it can be a reference of image for A and B. In other words, it must be made sure that there is something on the image which is captured by the CMOS sensor. Then the DSP will figure out the vector of the movement based on the reference.

Because the resolution of CMOS of mouse sensor is very low (about 200 pixel in our prototype), and the DSP is making use of the algorithm for simple figure and point, the cost of the processor is low. So this is the reason of low power and high speed.

**2. DESIGN**

In this section, we presents a novel design taking full advantage of the mouse sensor introduced above to achieve motion detection with lower cost and faster response.
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