Accelerometer Mouse

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Introduction

Since revolutionizing the PC’s user interface in the early 1980’s, the mouse has undergone a slow but steady evolution from a single-button ‘box’ into the multitude of sleek, digital, multi-button devices that we know today. In recent years, the availability of affordable low-g accelerometers has made possible a dramatic departure from conventional mouse operation. Using this technology, I propose the development of an accelerometer-based wireless mouse. Operable in midair with no external motion sensors, this mouse will free users from the traditional hassles of both cord and mousepad.

Preliminary Description

Physically, the accelerometer mouse will be comprised of two sections: a mouse and a receiver. The mouse assembly will be housed within a multi-button joystick grip. The only mechanical modification, besides removing the grip from the base, will be the addition of a scroll wheel. Internally, a single-chip accelerometer (the ADXL202 from Analog Devices) will track dual-axis tilt provided by the user’s hand movement. After signal conditioning, the two pulse-width modulated outputs from this device will be decoded by an onboard microcontroller. This motional data, along with the status of the mouse buttons, will be broadcast over a distance of at least ten feet via the 27MHz ISM (Industrial, Scientific, Medical) band commonly used by wireless peripherals. The receiver section, positioned on a desktop, will use a second microcontroller to perform additional signal processing upon the received signal. Finally, a USB interface IC will manage exchanges between the receiver section and the PC’s USB port.
Benefits

Through a comfortable and intuitive interface, the accelerometer mouse aims to increase productivity and provide the user with a more enjoyable computing experience. Admittedly, input device preference is largely subjective, and the accelerometer mouse is not expected to appeal to everyone. However, for many, the mouse will provide the aforementioned improvements, and may also reduce physical impact upon the wrist and fingers. This mouse is expected to appeal especially to those familiar with devices featuring similar biomechanics, i.e. PC joysticks and infrared ‘light guns’ commonly used in console gameplay. Although intended for use in all standard mouse applications, the accelerometer mouse would be ideal for various special applications, including computer presentations, multimedia control, and some games with a first-person perspective.

Market Comparison and Basic Specifications

Few commercial entries have reached the deskless mouse market, which belongs nearly exclusively to Gyration. Starting at $79.99, Gyration’s line of mice utilizes a specially developed solid-state gyrometer instead of an accelerometer. Other ‘deskless’ mice use dissimilar control methods, such as trackballs. The lack of commercial models
is somewhat surprising, as there are a considerable number of student projects (most using the ADXL202 accelerometer), that have been successfully developed and documented. In my preliminary research, I have yet to encounter such a project which uses a joystick style grip. So, while the basic concept of the accelerometer mouse has repeatedly proven feasible, there is still room for a degree of uniqueness in the details of implementation.

Quantitatively, the key parameters which will determine the effectiveness of the final product are: tracking precision and speed, wireless range, physical dimensions, battery life, and production cost. Research to this point has been limited, so the following target specifications are preliminary estimates.

- Resolution: 1 degree of tilt, each axis
- Range: at least 10 feet
- Battery Life: at least 18 hours of sustained use
- Prototype production cost (materials only): $100 or less
- Mouse Weight: less than ½ pound
- Receiver Weight: less than 1.5 pounds
- Transmission Band: 27MHz ISM

While further research will be conducted throughout the project to determine exact specifications and the tradeoffs necessary to achieve them, statistics comprise only half of the assessment. As mentioned previously, mouse effectiveness is a highly subjective matter. As such, feedback from volunteer testers will be considered more crucial than any numerical measurement.
Development and Demonstration

One simplifying factor in this project is the mouse’s modularity. The overall mouse design can be divided into the following 5 stages: input acquisition, onboard processing, wireless transmission, final processing, and PC interface. Using bench test equipment and portions of existing commercial hardware, these stages can be constructed and tuned independently, making it easier to troubleshoot problems and observe the effects of each stage upon overall performance. The vast majority of testing and construction will be conducted in the ET340 lab.

By nature, the accelerometer mouse will be ideal for demonstration. Being a familiar household device, users in an expository setting will be able to operate the mouse with no need for instruction, as well as immediately recognize the unique midair and wireless operation. The mouse will be equally suited for a presentation, as it was conceived, in part, with computer presentations in mind. While every attempt will be made to incorporate a forgiving learning curve, some personal practice will be required to demonstrate the mouse’s full capabilities.