New Approaches in sensing for tracking foot input devices

Salvador Barrera, Hiroki Takahashi and Masayuki Nakajima

Graduate School of Information Science and Engineering
Tokyo Institute of Technology
E-mail: {salvador, rocky, nakajima}@img.cs.titech.ac.jp

Introduction

Electronic sensors have been incorporated into footwear for several different applications over the last several years. Employing force-sensing resistor arrays or pixilated capacitive sensing, insoles with very dense pressure sampling have been developed for research at the laboratories of footwear manufacturers and pediatric treatment facilities (Cavanaugh, et. al., 1992). As sensors and associated processing systems decrease in cost and bulk, they also begin to adorn athletic footwear. Examples are a pressure-sensing insole for golfers to improve their balance during a swing (www.pro-balance. com) and inertial sensors (accelerometers and/or gyros) to perform pedometry measurements in jogging shoes (Hutchings, 1998). Although most interfaces for virtual reality applications concentrate on the hands, fingers, and head, some have been extended to the feet. Examples are NCSA's Cyber Boots (Choi and Ricci, 1997), which used an array of pressure sensors mounted in an overshoe to drive interaction when walking in CAVE (Cave Automatic Virtual Reality Environment) installations, and the "Fantastic Phantom Slipper" (Shirai, et. al., 1998), where a pair of infrared-emitting shoes are tracked over a limited area and haptic feedback applied by driving vibrators in the sole.

1 Proposed Method

The goal of our system is to make many different kinds of measurements at a movement's foot (e.g., pressures, positions, angles, inertial quantities), and transmit the data continually to a base station, directly from the foot's sensors. By measuring many different kinds of dynamic parameters, we capture much of the expression. By mounting all required sensors, circuitry, batteries, and transmitters directly on the lower part of the human legs, there are no constricting cables or tethers involved. Our applications therefore have explored possibilities between interactive sports and improvisational walking, where the wealth of sensor data streaming from the user's feet is interpreted in a computer and used to launch and modify different events at a time.

Human motion capture techniques were categorized according to the intended degree of abstraction imposed between the human actor and the virtual counterpart. Highly abstracted application of motion capture data analogous to puppetry, are primarily concerned with motion character, and only secondarily concerned with fidelity or accuracy. Human motion depends on limiting the degree of abstraction to a feasible minimum.

2 User's feet-Mounted Sensors and Electronics

In Figure 1 we show the physical layout of our current feet-Mounted Sensors system, including all sensors positions. As a next step, the hardware development is nearly completed; all sensors are working and integration of the algorithms. Future work will concentrate on applications of our new system. As these interface devices proliferate and begin to interfere with each other's data transmissions, an acute need for very low-power, minimal-overhead, overate-bandwidth channel-sharing quickly arises. We are currently researching available spread-spectrum transmitters to replace the fixed frequency FM transmitters used with the current device.

Figure 1: Electronic device picture.

3 Conclusions

References

[1] Choi), I., C. Ricci (1997). "Foot-mounted gesture detection and its application in virtual environments." 1997 IEEE International Conference on Systems, Man, and Cybernetics. Computational Cybernetics and Simulation, Vol. 5, 12-15 Oct. 1997, pp. 4248-53.