A REAL-TIME INPUT DEVICE FOR KINETICALLY CHALLENGED PERSONS

Kyprianos PAPADEMETRIOU, Apostolos DOLLAS, Stamatios SOTIROPOULOS
Technical University of Crete, Microprocessors and Hardware Laboratory, Department of Electronic and Computer Engineering, University Campus, Kounoupidiana 73100, Chania, Greece
e-mail. kpapadim@mhl.tuc.gr

Keywords: Input Device, Embedded, Motion detection, Reconfigurable, Training

Abstract:

Input devices in general are based on the translation of a stimulus to some action. With the effect of computers today, a large selection of input devices for computer I/O is available for kinetically challenged persons such as large keyboards, eye-tracking devices etc. Essentially, all research and associated products to date have focused on making computers more accessible to kinetically challenged persons, or, in using computers to perform tasks (e.g. pick-up telephone, turn lights on/off, controlling appliances etc.).

The next step is to detach the input devices from the need to be connected to a personal computer, and by making them *embedded*, to associate such devices directly with desired tasks, such as direct device control (without the need of a general purpose computer). Furthermore, for kinetically challenged persons, it is desirable to decouple the input device functionality from the actual manipulation of physical entities (e.g. joysticks, trackballs, keyboards, mouse devices) and rather rely on *free motion* which may be more comfortable. Taking example from advances in virtual reality applications for scientific and entertainment purposes alike, which employ 3D input and manipulation devices, we consider that an input device which is based on free motion of kinetically challenged persons would be useful in real-world applications, if it is reliable in its results, robust in its operation, reasonable in its size, and inexpensive.

In this project we aim at the development of a low cost, embedded input device for impaired persons, which will be easily tunable to the specific motion characteristics of different persons without a re-compilation of the design but through *reconfiguration*, as needed. This device is based on solid-state accelerometers to sense motion in space, which are mounted on user's hand, a microcontroller to sample the data in real-time and an embedded reconfigurable device (e.g FPGA) to distinguish types of motion from programmable lists of motions. A Field Programmable Gate Array (FPGA) is an Integrated Circuit (IC) that can be programmed in the field after manufacture.

The FPGA computational model is an implementation of Finite State Machines (FSM) running in parallel that detect the individual's movements. A vocabulary of 16 predefined motions has been formed. Depending on the identified motion the system exits a predefined output. The device then could control external devices (e.g air-conditioning units, TV, appliances), in real-time, through a direct electronic interface.

A training methodology by which the device could be adapted to individual user's needs has also been developed. By using the PC as the user interface, we collect the acceleration data for the motions from individuals. In the standalone operation of the system the personal computer is not connected. In this way, the embedded system can recognize the motions that are similar to the initial patterns which the user provided.