Natural User Interface for Controlling and Operating Real Equipment (NUI CORE)

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Extended Abstract

Purpose

This paper discusses a possible alternative approach for human interaction with machines. The design project was undertaken to demonstrate that more natural methods of human interface can be developed between people and machines using currently existing touchscreen technologies. Additionally, the research attempts to establish that touchscreen input devices allow for easier, more efficient, and more intuitive control of machines and computers than do switches, keyboards, mice, joysticks, steering wheels and the array of other traditional methods of input and control historically used by humans for the same purpose.

This design project was conducted as the capstone electrical engineering project of a four-person team of undergraduate engineering students. The team had an array of talents and skills at its disposal, with team member possessing complementing technical abilities. The array of skills included software development, mechanical fabrication, electrical and electronic design, and an understanding of microcontrollers and photo-optic applications.

Method

In order to achieve the team's goals, a console was designed and built that has the capability to monitor multiple, simultaneous hand and finger touches from the human operator. Physical contact between the operator's hands and the console's touchscreen are detected and interpreted by a computer containing the machine's control software.

The touchscreen technology consists of an acrylic surface with peripheral edges surrounded by infrared light emitting diodes. The light is constrained within the acrylic until the panel's surface is touched by an operator, refracting the light from the acrylic into the console. The refracted light is observed by an infrared sensing webcam that communicates the position of finger touches on the acrylic glass to a desktop computer. This multi-touch sensing method is called Frustrated Total Internal Reflection (FTIR). The multi-touch events can be interpreted by the computer, through a set of software algorithms, as specific control commands. This allows the computer to generate the necessary commands to control a real world machine.

A commercial off the shelf radio controlled vehicle was chosen as the device to be controlled. Feedback from the controlled device to the operator is provided in the form of a video image from a wireless color camera mounted on the vehicle platform. The image from the wireless camera is projected onto the touchscreen display. This allows the operator to have situational awareness for the remotely controlled vehicle. Communication between the desktop computer at the FTIR console and the RC vehicle is established by wireless radio frequency communication. Essentially, on the touchscreen console the operator observes the video of the vehicle mounted camera, and is then be able to input control instructions to the vehicle based on the observed video, via the multi-touch display console. The multi-touch events are interpreted by computer software and control instructions are generated and sent to the vehicle platform by radio frequency communication.

Conclusion

Though multi-touch display has been constructed and is being currently used to remotely control the vehicle platform as described. Work is continuing to refine the touch interface to fully test the contention that such control is actual more natural in at least this one instance.