Homework 6 – Interactive Table

CPE-322

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I pledge my honor that I have abided by the Stevens Honor System

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Black Box Functional Diagram

Power

The objective of this table is to register touch screen inputs made by the user into inputs into the computer software. This enables the computer to emulate mouse events without the need of a physical mouse and/or keyboard. The power supply connects to the touch screen table which in turn produces heat which is negligible. The heat is not directed towards the direction of the user; it is dispersed through the sides of the tables.

LED Array

The LED array is responsible for relaying user input into software. It beams out infrared through the acrylic. When a user touches the acrylic screen, the infrared beams bend and cause the input to be registered by the camera.

Human Input

The user simply touches the acrylic screen to send events to the computer, which displays the final image to a projector. Afterwards, the projector outputs the image on the acrylic screen.

Functional-Means Tree Diagram

The touch screen table uses FTIR (Frustrated Total Internal Reflection) as the backbone for its user inputs and outputs. The user touches the acrylic screen in the position where he or she chooses. It is important to note that the touch screen table is a multi-touch interface; that is, the user can make selections with both hands and the screen would register the inputs. Our design does not implement special touch screen pens, such as styluses for the touch screen table; our notion is that the camera is concise enough to register multiple finger inputs. This technology requires the use of an LED array surrounding the acrylic sheet. The LED array beams infrared light through the acrylic. When a finger is pressed against the acrylic screen, it causes the infrared lights to be reflected down through the acrylic and into the cabinet where it is detected by the camera. This entire effect is called frustrated internal reflection. It is necessary for the LED arrays to be parallel to the acrylic sheet for this effect to work.
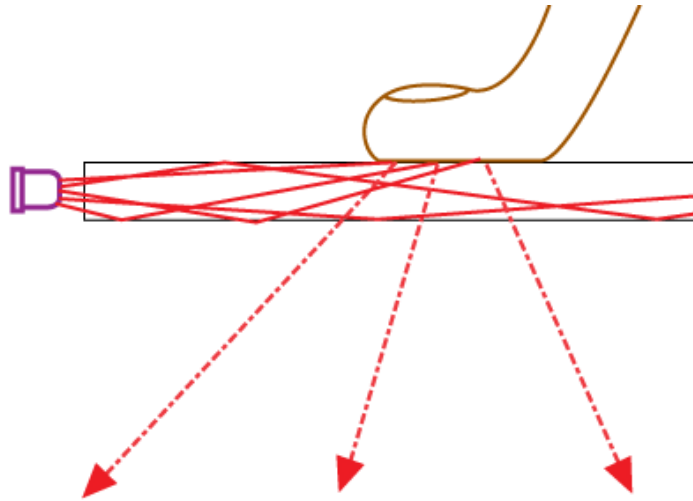
Acrylic Screen

For this technology to work, we must use an acrylic screen. If we do not use an acrylic screen, the infrared light would not reflect properly. For instance, if we used another type of screen, like glass, the light would not bend downwards when a user touches the screen. If the light does not bend downwards, there is no way for the software to know where the user touched. The acrylic screen is transparent, which enables us to project images to the screen and have the user see the image. This ability is important because we must project the computer screen onto the acrylic. The projector would be at the bottom of the table, pointing up at the acrylic. If the acrylic was not transparent, the projector would be useless since the user would not be able to see the computer image. Furthermore, one major benefit of acrylic is that the surface is touch-friendly and it allows the user to touch it with ease of use.

Camera

The acrylic screen, along with the infrared LEDs, transmits the user touch inputs to the infrared camera located at the bottom of the cabinet. The infrared camera is a special camera specifically designed to detect only infrared light. The ability for the camera to detect only infrared light is important because we only want the infrared light that gets bent downwards. The image the camera would see would be white blobs where the infrared light hits the camera and everywhere else would be black. This feature allows the software to easily detect where the touch inputs were made. If a regular camera was used, there would be too much information for the software to process; information such as various background, objects, etc. Any regular camera can be used as long as the camera has an infrared filter which enables the camera to only see infrared light. The camera would send the raw image feed to the computer software for processing. Since the camera has no built in processing capabilities, the image feed must be passed into the computer.

Computer

Because of that, the camera is connected to the computer. The computer powers the camera and also has software which processes the image feed. The operating system that the computer would run will be Microsoft Windows 7. The reason for this choice is simple; there are existing multi-touch software's for the Windows platform. There is also an open-source library called Touchlib which allows us to create custom applications using the library. The owner of the touch-screen table can also choose to implement security restrictions. The owner can disable any internet connectivity and have the computer completely isolated which in turn allows the computer to be very secure. On the flipside, the owner can opt to enable internet connectivity at his or her discretion. This enables the users to connect to popular third-party services such as Twitter, Facebook and Foursquare. The user can also look up nutritional information as well as personal calorie tracking.

Software within the Computer

The computer will incorporate the necessary software to process the touch screen inputs. The software is responsible for fine-tuning the inputs from the infrared camera. This step is needed because the "blobs" that the infrared camera feeds into the computer is not ideal for pin-point accuracy. In addition, the software would also install drivers into the computer so that the software can send mouse commands such as mouse clicks and drags to the Windows operating system. If the software did not install drivers then the touch screen functionality would only work within the software. Another software would need to be implemented to provide the user with a clean, touch-friendly user interface. This interface would have to have big buttons and bigger UI elements (buttons, images, and text) in order to be touch-friendly. There is existing software from Nuiteq which demos the computer's touch screen capabilities.

Projector

The computer is connected to a projector which projects the computer's display to the acrylic sheet. The projector is critical to this table because the user would not be able to see where to touch. The computer would still be able to recognize touch events made by the user, but the user would not be able to see where he or she touches. The projector would be underneath the acrylic sheet. The projector would be facing upwards so that it can project to the screen properly. Initial calibration must be done so that the projector projects an image that fills the entire acrylic sheet.

Power Supply

All the electrical components of this table need to be powered by a power supply. There is a power strip inside the table. The computer and the projector would be plugged into the power strip. With this power strip, there would only be one electrical cord to plug in from the outside. The infrared camera would be powered by the computer since the camera would always be plugged into the computer. The camera would be powered by the USB ports of the computer. The added benefit for this is that the camera would only take power when the computer is on. The LED arrays would need to have a power supply that is separate from the power strip. This has to be separate because the LEDs array would have to be powered by a direct current power

source (whereas the power strip is alternative current). The LED arrays would not need a huge power supply; it can be run off of a couple of AA batteries.

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Power		Heat

| LED Array | | **Relay to touch screen input to software** | | Touch screen interfernce |

| Human Input | | | | Projected output on screen |

Functional-Means Tree Diagram