Brian Hansen
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Stephen Travis Pope
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Design Considerations of the 200C Multi Touch Table

It was truly a team effort in constructing a multi touch table for our 200C project. The team did well at coming together to unify a vision for table design and functionality and then separating to contribute as individuals to its construction. The aspects of the table construction were divided between software and hardware design. This paper overview's the design considerations that went into hardware construction of the multi-touch table.

The table's design was modeled after an elegant tutorial featured online by Maximum PC titled "Build Your Own Multi touch Surface Computer." This tutorial focuses specifically on the construction of an FTIR (Frustrated Total Internal Reflection) based table. It outlines step by step the construction of the table. In each step it clearly documents all the components needed (LEDs, framing materials, wiring, tools, etc.), important measurements, and instructions on what and how to use tools to construct certain components of the table.

Upon reviewing this tutorial, there was consideration as to whether the team should pursue an FTIR or a DI (Diffused Illumination) based table. With an FTIR table, infrared light is shined into the side of acrylic panel by infrared LEDs. The light gets trapped inside the acrylic by internal reflection, and when a finger touches the surface the light becomes "frustrated" and is scattered downwards, orthogonally to the surface where it is picked up by a camera. With a DI setup, infrared light is projected through glass or acrylic from underneath. When an object touches the transparent surface, light is reflected back and sensed by a camera.

DI tables have some advantages over FTIR tables, but those advantages mainly lie in ease of construction. For example, one can use other surfaces besides an acrylic surface, like glass. Also, there is no need to solder and mount numerous LEDs, as all one needs are IR-illuminators, which are ready to go at

purchase. Ultimately, the team decided that the benefits of FTIR performance were worth the cost of a more involved construction process. A major benefit of FTIR design is that clearer signals are produced when touching the table. Because of this, smaller objects like pens can be used in addition to fingers. Another major benefit is the infrared illumination does not need to be recalibrated at setup, as once LEDs are soldered and mounted, the infrared illumination is the same every time. This aspect is especially attractive when considering table transport and setup in different locations. Finally, FTIR tables are more popular. This is a very beneficial aspect as there are more applications, design ideas, tutorials, and trouble shooting documents relating to the design.

After deciding to pursue the FTIR design, the team moved towards deciding and planning the construction of the table frame and base. There are numerous approaches to designing a frame and base. Most tables seem to embrace the box approach. Some examples of this are the table constructed in the tutorial "Build Your Own Multi touch Surface Computer" done by MaximumPC and the MT-50 table produced by Ideum. In this design, a large box is constructed, where the projection surface acts as the top of the box and all components such as the projector, camera, and computer are placed inside. This is nice design because of the cleanliness of presentation and fixed calibration. The dimensions of the box are determined based on throw distance of the projector and image capture width of the camera. With the dimensions fixed, the projector and camera can be permanently mounted inside and thus need not be recalibrated for different setups. The major drawbacks to this design are the size of the finished product and that the benefit of fixed setup sacrifices presentation flexibility. The box design produces a very large object that is very difficult to transport. It requires numerous bodies to move it and a large vehicle like a van or truck to transport it in. In addition, the box design drastically limits how the table can be presented. One may want to display the touch surface at a horizontal, vertical, or at an intermediary angle, and this is not possible with the box design. Thus, knowing that the table may need to accommodate multiple transports and presentation styles, the team decided to abandon the box idea, or any design

that would fix the projection surface. Ultimately the team decided to simply construct a sturdy frame that would house the acrylic and LEDs. Creating just a frame allows for ease of transport and presentation style. In addition, in would be easy to mount the frame to any fixed base, should one decide to construct one.

As we decided to only construct a frame for the FTIR setup, we wanted to focus on designing something sturdy, durable, and portable. The bottom of the frame consisted of four 1"x4" wood boards, two of 36" in length and the other two 22". The wood was bracketed together, forming a 22 by 28 inch window for projection to pass through. The acrylic rested on top of this with an overlap of about 1 inch on all sides. We then fastened thin balsa wood shims in place (1 inch wide on all sides) to hold the acrylic in place and to also allow the LEDs to be raised up and centered when shining into the sides of the acrylic. The LEDs were fastened using two-sided tape. The tape itself was about 1/16" thick. This thickness was perfect for sticking the LEDs to, as they are somewhat fragile and the tape acted as a cushion for them to rest on. Then, thin 1" wide strips that were 3/4" thick were fastened around the perimeter to enclose the LEDS and acrylic. Finally a cosmetic top was constructed by creating a picture frame that covered the perimeter. Inside the perimeter of the picture frame, a piece of mat was placed to hide the rest of the wiring and inner mounting of the acrylic. This mat had a 22" by 28" window cut out of the center to allow for projection to pass through.

All in all, we constructed a very sturdy frame that served our needs. Foremost, it is very sturdy and serves as a permanent fixture for the LEDs and acrylic. Secondly, it is easy to disassemble in the event that LEDS need to be replaced or the acrylic needs attention. Finally, its sturdiness allows for it to be transported without the concern of damage to it.