WICHITA STATE UNIVERSITY

TIICH
Interactive Whiteboard

By:

Kevin Nguyen

Ashan Amaranayake

Jitendra Khadka

Mahesh Dalpathado

EE585/EE595
SENIOR DESIGN
Wichita State University

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1.0 Introduction

1.1 Purpose

Imagine having an interactive whiteboard in every single classroom. An interactive whiteboard sounds expensive, which they currently are. Our TIICH interactive whiteboard on the other hand, is very inexpensive compared to the current products that are being sold today. Costing only around $285 while SMART boards cost around $2000. Our system consists of a portable rear projection as well as an infrared sensor, infrared LED pen, and infrared glove.

2.0 Project Scope

Our TIICH system is based off of the SMART board. We are trying to compete with the SMART board by having our system being cheaper and portable.

2.1 Features and Benefits:

While a SMART board is going to cost around $2000 or even more, our TIICH system will only cost around $145. Including the projector, the system will cost around $285. Our TIICH system cost almost a tenth of the price of a SMART board. SMART boards are supposed to be mounted on a wall and stationary, our TIICH system is portable. By using a portable rear projection screen mount and projector, a user can easily pack up our system, pack it in their car, and take it anywhere they want to use it. We're targeting teachers with our product. We're trying to build a system that is inexpensive as well as an effective teaching aid for classrooms use. Our TIICH system will allow more schools to be able to afford interactive whiteboard, which allows teachers the ability to write notes for their students with ease. This would allow teachers to save their notes after the class is over and easily post them on blackboard, or any type of server over the Internet for their students.

2.2 Proof of Concept:

Our TIICH system operates by having an infrared camera tracking the movements of an infrared LED. This lets you use the LED as a mouse for your computer when you connect it to our system. For the LED, we designed an infrared pen. This will let teachers write, move items, etc. comfortably. We're going to use PowerPoint to let teachers write notes. We wrote a code for the macros on PowerPoint so teachers can easily switch to different color pens, use highlighters, erase, go to next slide, etc. Allowing to teachers to freely write notes for their students how they please.

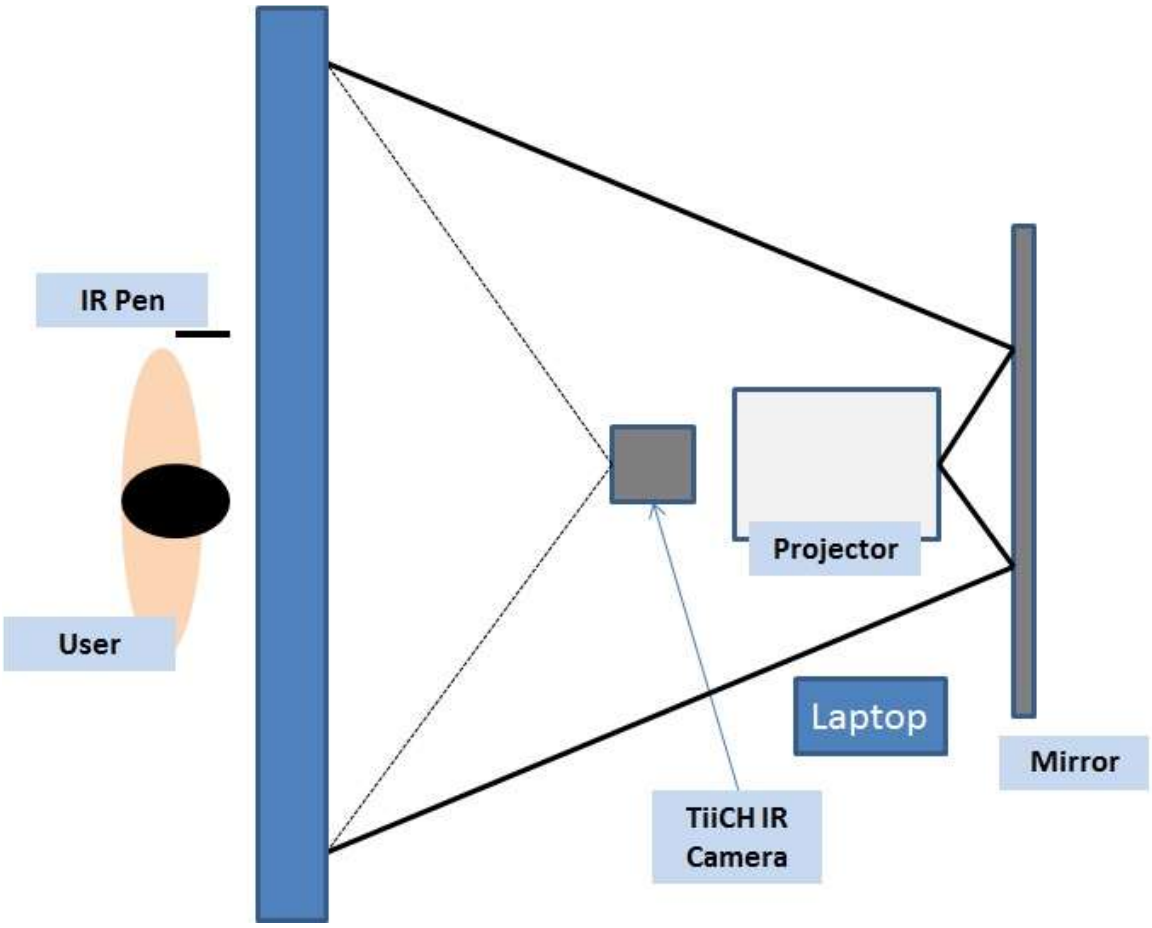


Figure 3.2.1

Figure 3.2.1 is to give just an idea of how our system would work. The user will set up the rear projection mount and place the items accordingly like figure 3.2.1 displays. The projector will bounce the image off of the mirror, eliminating half the space necessary to create a big image. The infrared camera will be pointed at the screen and connected to the user's laptop. Once that is done, the user may start TIICH, callibrate the software, and enjoy our TIICH system.

2.3 Serviceability:

Our product is easily serviceable considering there are minimum parts that are used in our TIICH system. Our infrared camera is in a box so the parts that make up the infrared camera shouldn't get loose or disconnected from user's everyday use. The rear projection mount is sturdy enough so the mount should survive any type of use the user puts the mount through.

Users may have check the infrared pen. Checking to see if the LED is working by using a camera to look at the LED, when turned on, to see if the batteries are not dead.

A user could also lose a part to the rear projection mount. This wouldn't be something the user couldn't service him or her self. Calling in for the part through the company would allow an easy way of reaplcing the part.

2.4 Reproducability:

Our design is simple enough where companies can reproduce our product with ease. Our rear projection is quite a simple design. Having a simple design makes the rear projection mount easily produced through a assembly line. The LED pen has a simple design as well. With a battery and a infrared LED that is connected with wires and controlled by a switch.

The hardest item to reproduce would be the infrared camera. We got our infrared camera from a broken Wii remote that we bought off of eBay because we found out that was the cheapest way of acquiring an infrared camera. If a company could get contracted by the same company that Wii gets their infrared camera from for a similar price, this would make reproducing the camera much easier and cheaper. Other then that, the circuit design for this infrared camera is simple, so it would be easily reproducable.

3.0 User Manual

3.1 Product Instruction

3.1.1 How To Set Up The Rear Projection

To setup our TIICH system, the user would have to set up their projector and projection screen so everything is projected right. Shown here:

Figure 3.1.1

First, the user must set up the base of the rear projection mount. The joints will be labeled, so the user must match the joints and the pipes to the right assigned spots. Be on the lookout for the letter and number on each side of the pipe before connecting a certain letter and number to the corresponding joint.

Figure 3.1.2

The user must place the pipes that are labels with a letter and number to the corresponding joint with same corresponding letter and number. As seen in Figure 3.1.2 which in this case all of the pipes labeled A2 will go to joint JA2. Follow the same procedure for the other side with the corresponding letter and number.

Figure 3.1.3

This is the top view of the same joint in figure 3.1.2.

Figure 3.1.4

Now the user will just follow the same procedure for the mirror section of the mount.

Figure 3.1.5

In this case, the user must place the pipe labeled A3 and C1 to JA3 and JC1. Follow the same procedure for the other side but with the corresponding letter and number.

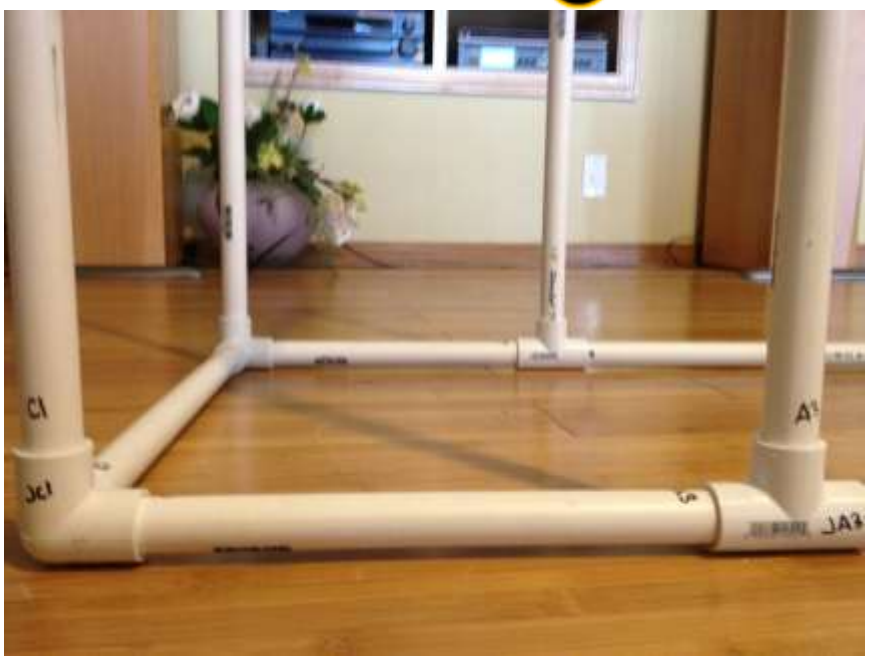


Figure 3.1.6

This is a side view of what the frame should look like for figure 3.1.5.

Figure 3.1.7

Now the user will add the mount for the projection screen that we will later install.

Figure 3.1.8

Follow the same procedure as before. Place the pipes in the corresponding joint with the same labeling. Figure 3.1.8 is what the mount should look like on one side of the mount.

Figure 3.1.9

Now, we will add the projection screen onto the rear projection mount. Follow the same procedure for building the projection screen.

Figure 3.1.10

Once the projection screen is built, the user will connect the projection screen to the mount with the joints JG1 and JG2 with a pipe labeled G2 on one side and G1 on the other side.

Figure 3.1.11

After building the rear projection mount, securely fasten the white cloth to the designated spots on the rear projection. Each side of the white cloth should be specified i.e. top, bottom, etc. Now place the Plexiglas securely on the middle section seen in figure 3.1.11. Then the user can place his or her projector and laptop on top of the rear projection mount. Once the projector is set up, the user may place the mirror onto the rear projection mount like in figure 3.1.11. Once mounted, the mirror must be adjusted accordingly so that the image displayed will fit appropriately on the projection screen seen in figure 3.1.12.

Figure 3.1.12

After setting the rear projection mount up and the projection screen should look figure 3.1.12,

3.1.2 How To Set Up TIICH System

Figure 3.1.13 Calibration Screen

The user must now point the infrared sensor right at the rear of the projection screen. Then the user can open up the TIICH program and press calibrate. Now use the infrared pen and calibrate the system by touching the targets like in figure 3.1.13 at each four corners of the screen. The TIICH system should now work and you may use your infrared pen just like a mouse would act.

3.2 Troubleshooting

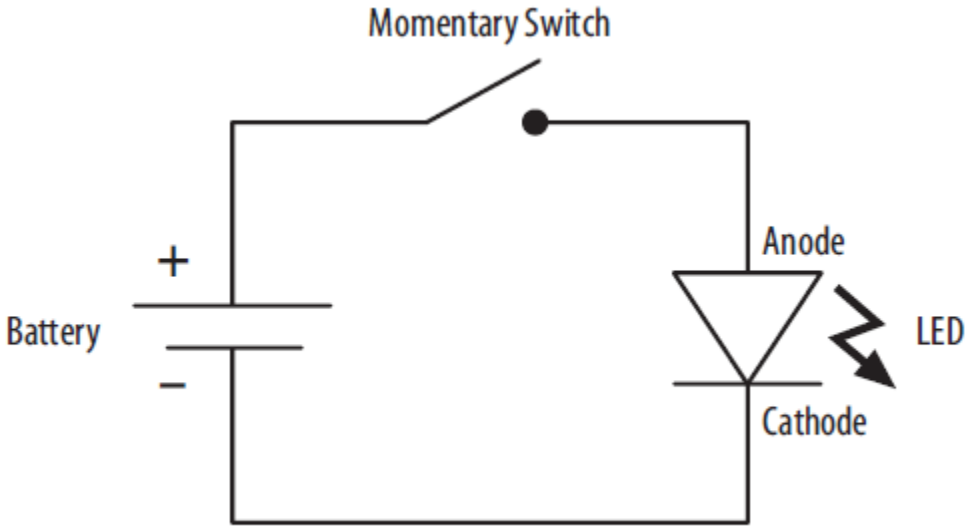
If the infrared LED pen tracking seems to be slightly off, the user would just have to recalibrate the system. This may happen if the infrared camera is slightly moved, mount got slightly bumped, or something in that nature where the calibration is slightly off. If the user finds that there is a continuous mouse click even when the LED pen isn't turned on, the user may have to end task or force quit the TIICH system depending if the user is using Mac or a Windows based laptop. If that doesn't work, a quick restart of the laptop will fix it.

We haven't been able to use our system for a long period of time so we have no idea how the system would work when used continually for like a year. But over our testing period, we found that our TIICH system works pretty well with just some minor bugs.

4.0 Product Information

4.1 Schematics:

4.1.1 Infrared Pen



Infrared LED Pen Schematic Drawing FIG 4.1.1

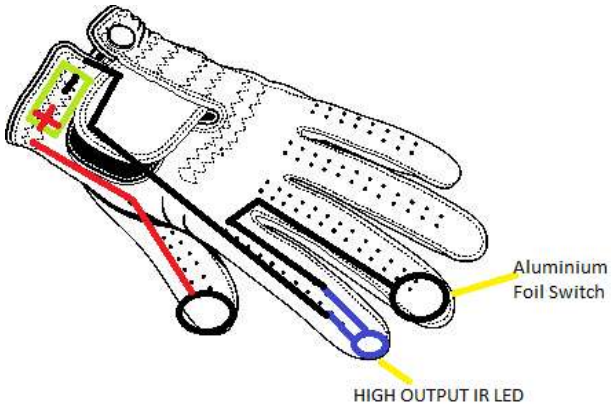
Directions to make the infrared pen:

1. Get any type of marker.
2. Wipe out the inside of the marker to remove any remaining ink.
3. Drill a quarter-inch hole for the pushbutton switch at the spot where your thumb naturally rests on the grip.
4. With a fine piece of sandpaper, scuff up the surface of the LED - this helps diffuse the light to improve tracking.
5. Solder an 8-inch length of red wire to the positive lead, which is the longer one (you can also tell by looking inside the bulb - the positive electrode is the smaller of the two).
6. Solder an 8-inch length of black wire to the negative lead.
7. Thread the wires through the body of the pen and use a set of pliers to screw the LED into the tip of the pen.
8. Fish the black wire through the hole for the pushbutton.
9. Snip the wire about an inch from the hole, and then solder that to one terminal of your pushbutton.

10. Slip the remaining black wire back into the pen body and solder it to the other pushbutton terminal.
11. Gently set your pushbutton into place.
12. Solder the battery holder wires to those of the pen (red-to-red).
13. Slide the battery and wire into the back of the pen and push the end cap back on as far as it'll go comfortably.
14. Test out the pen. Note that the IR LED is invisible to the eye but it IS visible to the CCD of digital cameras. Point your camera at the light, press the button and you should be able to see it light up on the camera's screen.

Infrared Pen Fig 4.1.2

4.1.2 Infrared Glove



Infrared Glove Schematic Fig 4.1.3

Our first goal was to make an infrared glove, which would be one of the input devices in our system (Shown in the Current System Diagram). We used a regular golf glove for this task. For the switch, we used two Aluminum pieces as our switch.

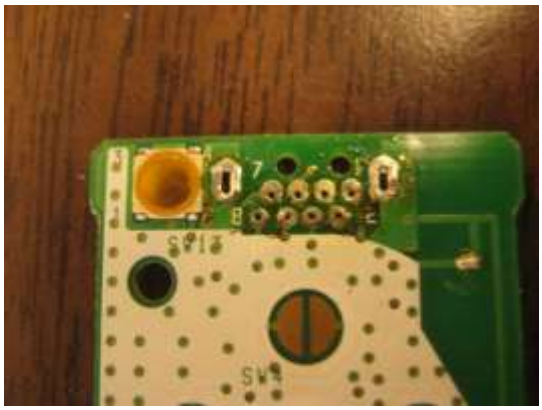
How the glove works: This glove runs on a battery with a switch to turn the infrared LED on and off. This switch is turned on when you touch your middle finger and thumb together, and turning it off when you release. Your middle finger and thumb has wires running up the glove where we have aluminum foil for easier connectivity. You can see how this glove was made from the schematic Fig 4.1.3.

Infrared Glove Fig 4.1.4

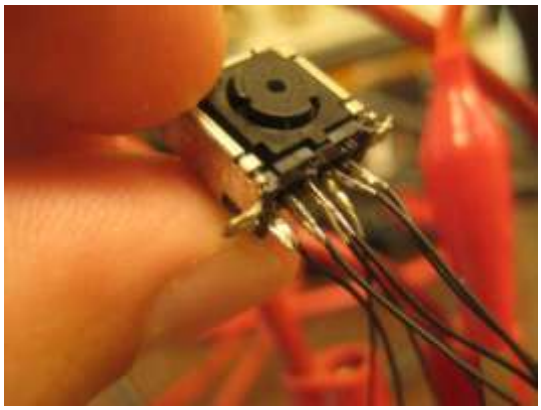
4.1.3 Infrared Camera With 4-Pin Oscillator

We got our infrared camera from a broken used Wii remote from eBay. We disassembled the Wii remote to gain access to the infrared camera. After getting the circuit board for the Wii remote, we desoldered the infrared camera from the board by heating the solder at a moderately high temperature and melt away the solder that was holding the infrared camera in place. Once the solder was melted, we just pulled the infrared camera right off. Then we soldered our own wires to the camera in order to hook the camera up to the breadboard for our arduino shield.

Disassembled Wii Remote Fig 4.1.5



Desoldered Infrared Camera Fig 4.1.6



Rewired Infrared Camera Fig 4.1.7

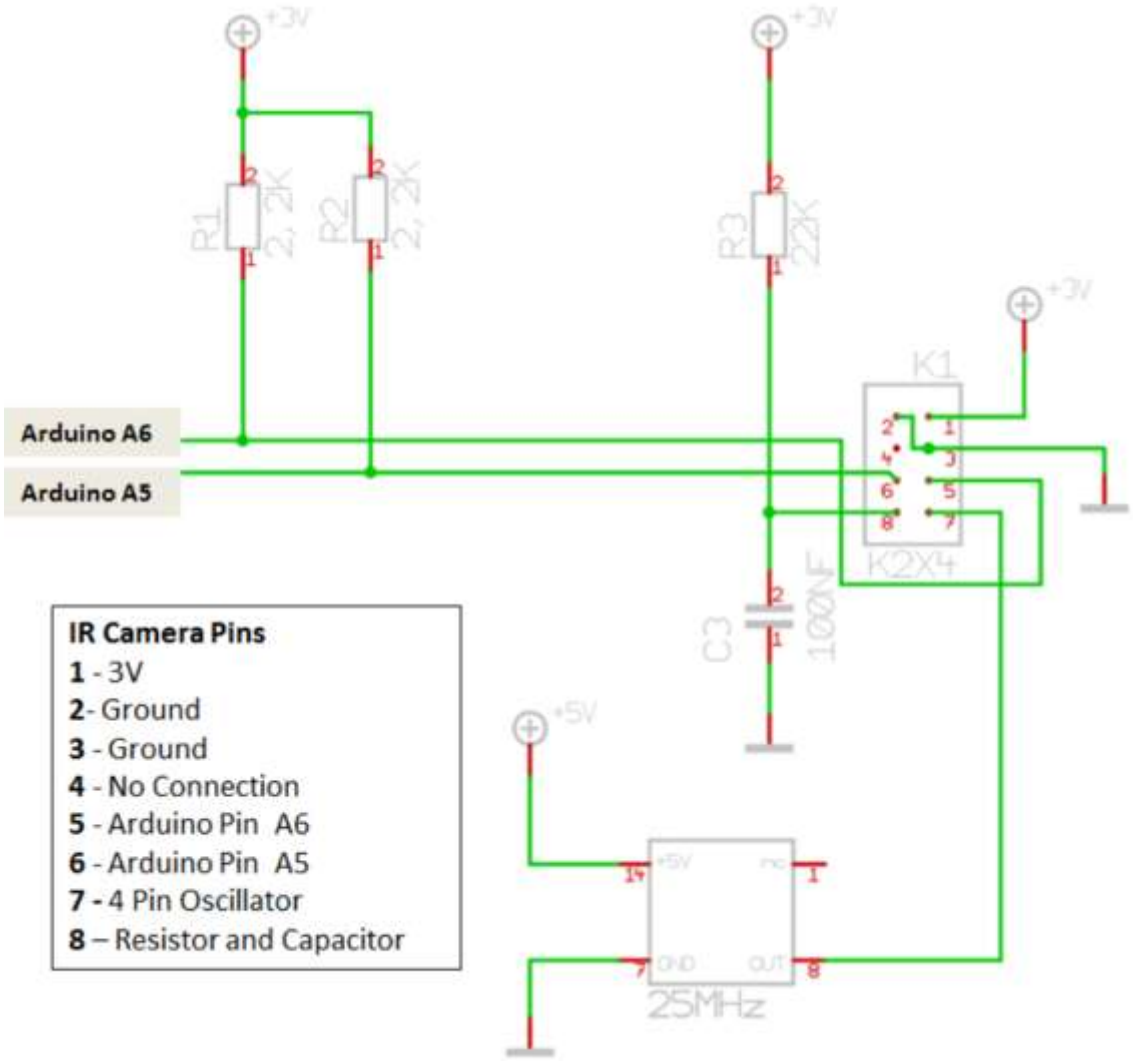
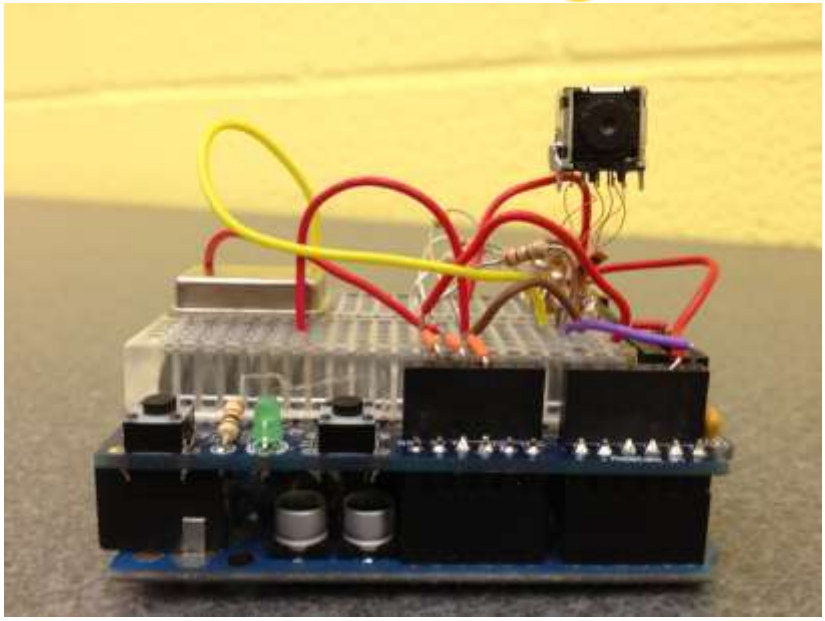


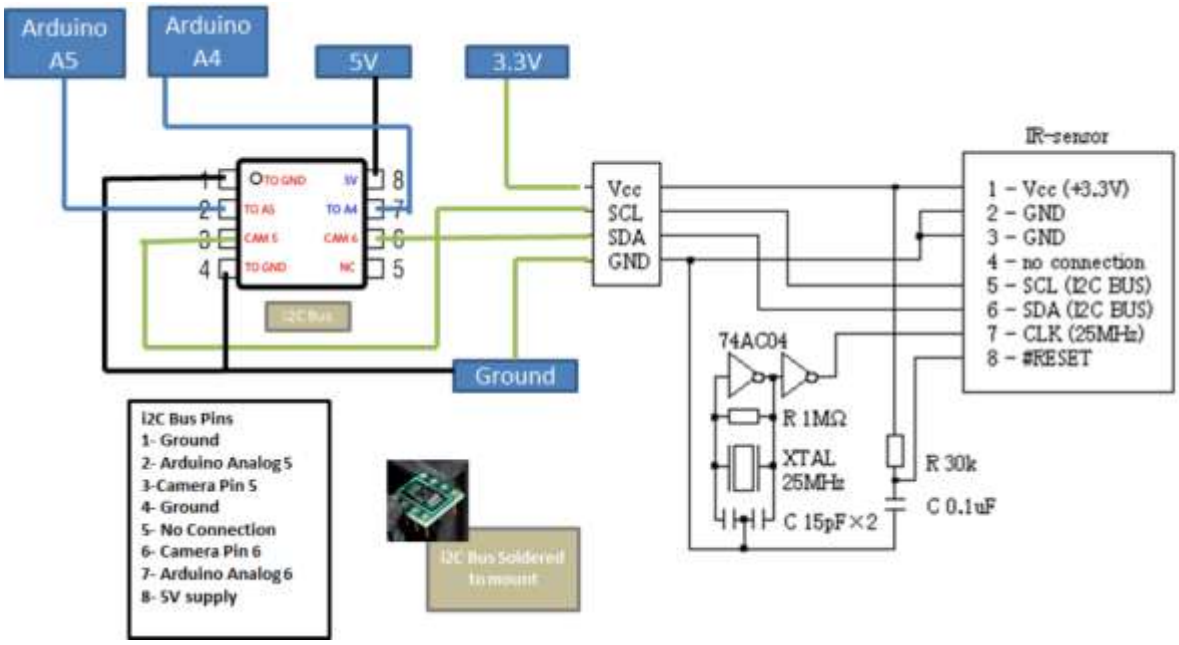
Figure 4.1.8 Four-Pin Oscillator Schematic

This is the schematic that we used in order to build are infrared camera on our arduino shield breadboard. The final product should look like figure 4.1.9.



Infrared Camera w/ Arduino Shield Using Four-Pin Oscillator Fig 4.1.9

4.1.4 Infrared Camera With 2-Pin Oscillator



Two-Pin Oscillator w/ i2c Bus Schematic Fig 4.1.10

On our initial try, we attempted to make our infrared camera using a two-pin oscillator with an i2c bus, which you can find the schematic for it in fig 4.1.10. We couldn't get the right 25Mhz oscillating so we had to find a four-pin oscillator for our infrared camera.

4.1.5 Rear Projection Mount

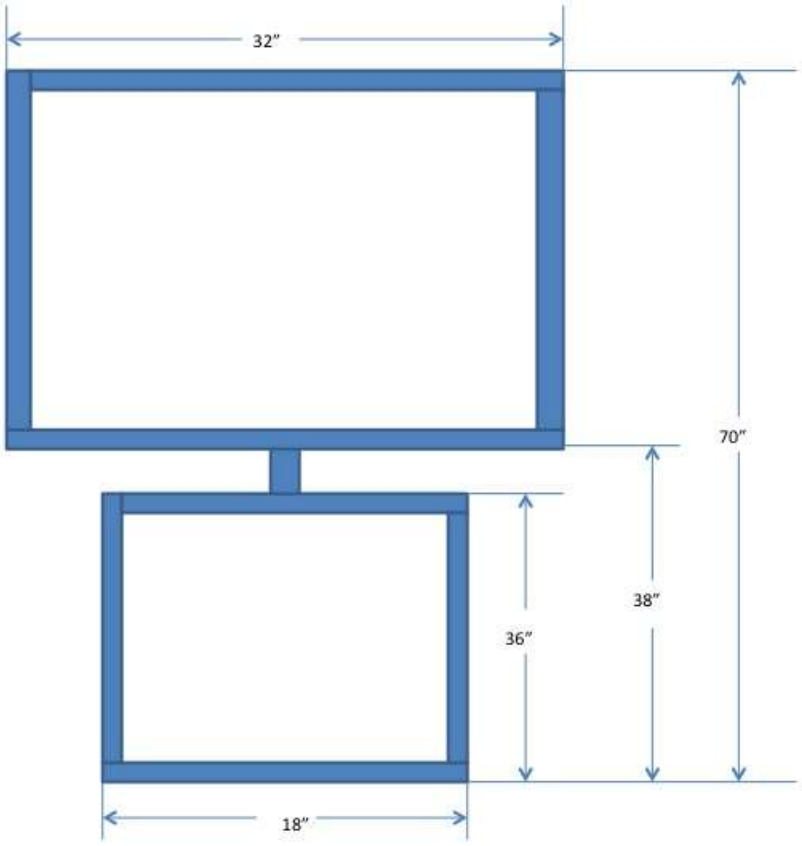


Figure 4.1.11 Front View Rear Projection Dimensions

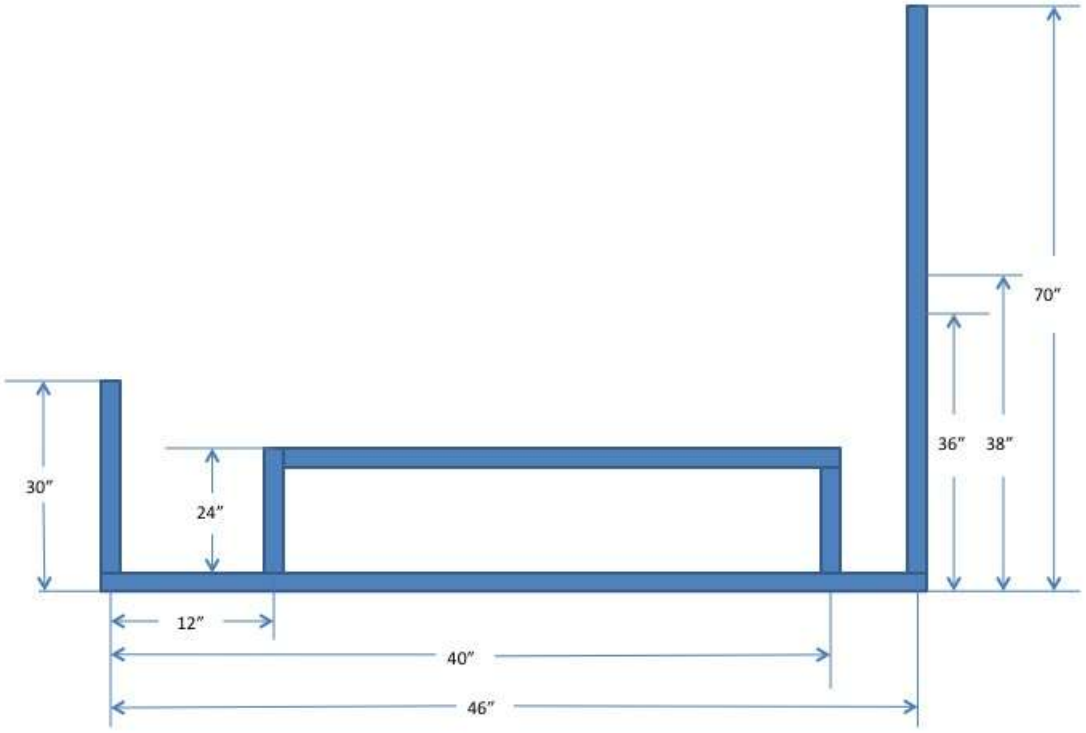


Figure 4.1.12 Side View Rear Projection Dimensions

4.1.6 Product Enclosure Box

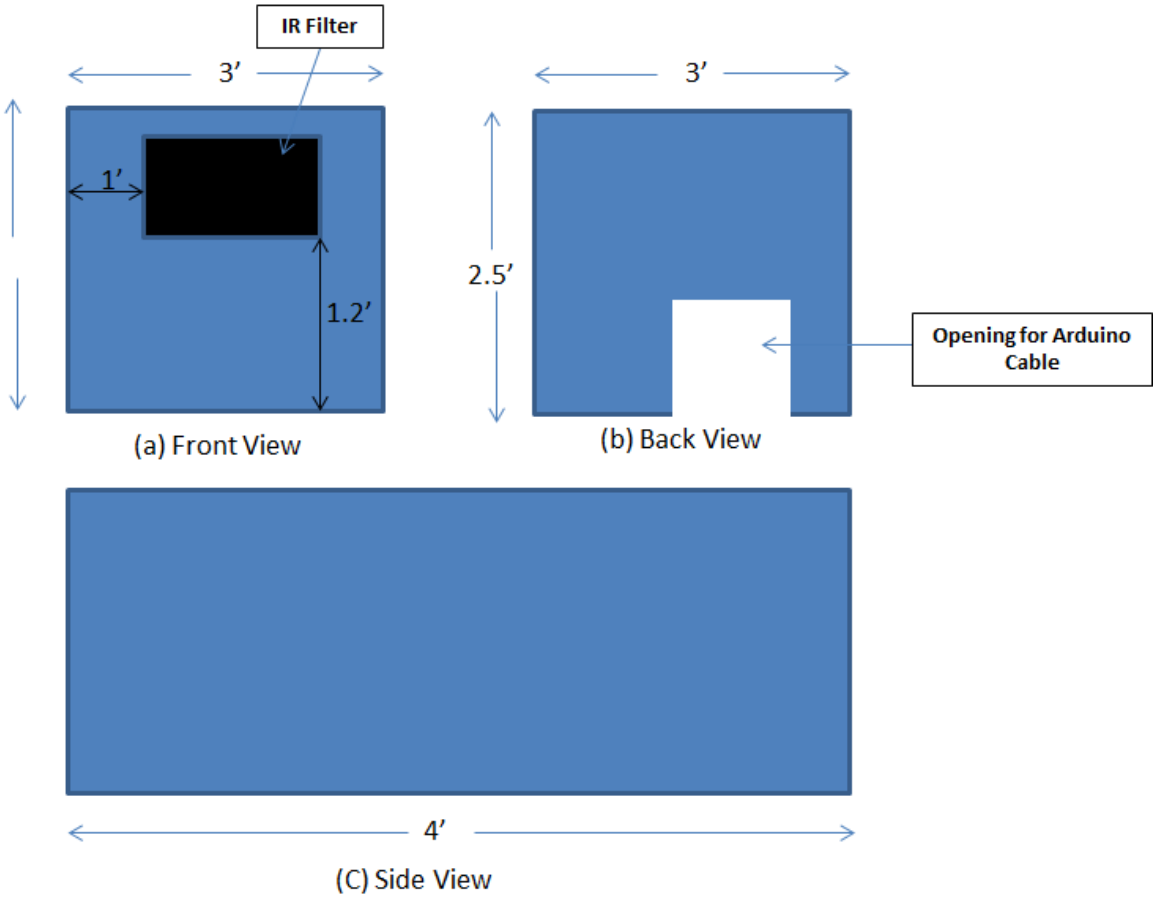


Figure 4.1.13 Enclosure Box Dimensions

We took a regular black product enclosure box from radio shack and cut out the necessary details so that our infrared camera would rest promptly in the box while being full functional.

4.2 Bill of Materials

Bill of Materials For Infrared Camera					
Quanitity	Part Description	MFG.	Part Number	Source	Price Per Unit
1	**Four-Pin 25MHz Crystal Oscillator**	**CTS**	**MX045-25M0000**	http://www.arrownac.com/	**$3.35**
1	**Infrared Camera**	**Pixart**	**T-H1-F2-4**	**www.ebay.com**	**$12.00**
1	**Arduino Shield**	**Adafruit**	**N/A**	**www.adafruit.com**	**$15.00**
1	**Arduino UNO**	**Smart Prrojects**	**Atmega 328**	**www.adafruit.com**	**$29.99**
1	**Project Enclosure Box**	**Radio Shack**	**270-1802**	**Radio Shack**	**$4.50**
2	**2.2k Ohm Resistor**	**Radio Shack**	**271-1325**	**Radio Shack**	**$0.10**
1	**22K Ohm Resistor**	**Radio Shack**	**271-1339**	**Radio Shack**	**$0.10**
1	**100nF Capacitor**	**Radio Shack**	**272-1053**	**Radio Shack**	**$0.28**
				Total:	**$65.32**

Bill Of Materials For Infrared Glove					
Quantity	Part Description	MFG.	Part Number	Source	Price Per Unit
1	**Glove**	**Nike**	**N/A**	**Tallgrass Pro Shop**	**$5.99**
1	**Infrared LED**	**Radio Shack**	**276-143**	**Radio Shack**	**$1.99**
1	**N-Size Battery**	**Enercell**	**N**	**Radio Shack**	**$2.50**
1	**N-Size Battery Holder**	**Radio Shack**	**270-405**	**Radio Shack**	**$1.99**
				Total:	**$12.47**

Bill Of Materials For Rear Projection Mount					
Quantity	Part Description	MFG.	Part Number	Source	Price Per Unit
10	**½" PVC Pipe**		**N/A**	**Lowes**	**$1.11**
6	**½" Corner Joint**		**N/A**	**Lowes**	**$0.28**
12	**½" Elbow Joint**		**N/A**	**Lowes**	**$1.18**
4	**½" T Joint**		**N/A**	**Lowes**	**$0.28**
1	**White Cloth**		**N/A**	**Walmart**	**$2.99**
1	**Mirror**		**N/A**	**Walmart**	**$5.32**
1	**12 Pack 3M Velcro**		**N/A**	**Target**	**$4.95**
1	**24"x48" Plexiglas**		**N/A**	**www.eplastics.com**	**$21.32**
1	**32" String**		**N/A**	**Target**	**$0.05**
				Total:	**$62.69**

Bill Of Materials For Infrared Pen					
Quantity	Part Description	MFG.	Part Number	Source	Price Per Unit
1	**Infrared LED**	**Radio Shack**	**276-143**	**Radio Shack**	**$1.99**
1	**Pushbutton Switch**	**Radio Shack**	**275-1548**	**Radio Shack**	**$1.60**
1	**Highlighter**		**N/A**	**Walmart**	**$0.30**
2	**N-Size Battery**	**Enercell**	**N**	**Radio Shack**	**$2.50**
1	**N-Size Battery Holder**	**Radio Shack**	**270-405**	**Radio Shack**	**$1.19**
				Total:	**$7.58**

Final Total of TIICH: 148.06

4.3 Code

You can find the code for our TIICH system here: https://skydrive.live.com/?cid=21C05BE685F8FE5B&id=21C05BE685F8FE5B%21103

4.4 Revision History:

Revision	Description	Date
Infrared laser sensors to ultrasonic sensor system.	Figured that the system would use too many infrared lasers and it would be too expensive.	**March 10, 2011**
Ultrasonic sensor to infrared sensor and LED system.	Found this system will be even less expensive and more accurate.	**April 2, 2011**

4.5 Industry Standards:

Our product has not been tested for industry standards yet. But our system shouldn't interfere with any systems that are near it; nor should the system harm your operating system on your laptop when being used. From the normal testing usage that we have done with TIICH, we haven't had any problems when using the software for TIICH on our laptops nor has the infrared camera cause and problems with and other systems around it. This is just observations during our testing phases. More testing needs to be done when the system if fully functional to make sure it fits the industry standards.

4.6 Patent Research:

A significant amount of research has been done on patents for our product on (http://www.google.com/patents). There is currently nothing that is exactly what our system has to offer.

There are many products that are similar to our TIICH system but they're not accounting for the scenarios our TIICH system aims to fill. A product called SMOOTH board gives only the software for users to buy and install on their laptops. Other companies offer similar software but add a Wii remote, mount for the Wii remote, and an infrared pen. There currently isn't and product our there that has made their own infrared camera and includes a rear projection mount like TIICH has to offer.

4.7 Liability:

The user is reliable for setting up the rear projection mount properly. Users are reliable for securely fastening the joints and connecting each piece of the rear projection mount securely. TIICH is not reliable for any accidents that are caused neither from our system nor from the user. TIICH does not guarantee that the rear projection mount will hold for a long period of time if the user does not secure the pieces properly. Throughout testing our system, there were no problems with our system when everything was properly set up.

5.0 Product Summary

This TIICH system is designed to eliminate the use of chalkboards and whiteboards. Letting teachers fully enter the electronic world but at a minimal cost. We wanted to let teachers teach their class, write their notes, and at the end of the day, post those notes if teachers wanted to. Allowing students to focus more in class rather than just focusing on writing their notes. TIICH has an unlimited possibility with the software that could be coded for this system. Potentially allowing teachers in elementary school levels, teach with a more visual and appealing way where they grab the attention of his or her students.