Primary Research: Toys R Us, Indianapolis

For our research on toys we visited a small store in Bloomington and Toys R' Us in Indianapolis. In Toys R Us we observed that a wide variety of toys were inspired from popular culture. Media and movies play an important role in defining the behaviour and psychology of children. Toy manufacturers have a moral responsibility analogous to teachers to fire the imagination of the children in the right way. They mediate the interaction of the child with the toy. The nature and functionality of the mediation dictates the learning and ludic experiences of the child interacting with the toy.

Primary Research: Toy Store, Bloomington

The goal of visiting the toy store in Bloomington was to get ourselves acquainted with a lot of analog toys. The store wasn't as commercial as Toys R Us, so we had the opportunity to analyze the toys, inspired from 'analog avenues' rather than through the more digital means (Television or movies).

Play can mimic and reinforce gender ideas, aptitude for, and acceptance of directed action. The themes were also derived from more nationalistic avenues like pro-war, pro- defence, etc. This led us to believe that that culturally guided play can be used to reinforce a political agenda. We also saw use of violence as a tool for imaginative engagement for boys.

Secondary Research

During our secondary research based on the analysis of the field work data, we found out that mediated interaction of the child through the toy results in a very directed ludic and educational experience. As the children spend a lot of time with their toys, it is a great opoortunity to foster their creative imagination from an early age.

Children are active learners who utilize all their senses while exploring the world around them. Direct physical interaction with the world is in critical role in their lives, affecting substantially the development of children's cognitive and motor skills [1]. Through research, it has become evident that the things that children appreciate are especially: **control, social experiences (collaboration), expressiveness and curiosity [2][3].**

We wanted to explore these themes with our hacked arduino toy.

Design: Rationale and User group

Research has shown that, in relation to young children's abilities and focuses of interests, traditional interface use is often developmentally inappropriate for children. Lack of fine motor skills and **lack of abstract representational skills** are just some examples of those difficulties, that children may face while dealing with traditional interfaces [7]. One important thing is also children's low patience which results in the child being distracted from the intended educational motive of the toy. **Children want to act, manipulate and modify things. They also want instant feedback for their actions due to their low attention span.**

Pic. Children have low attention span and patience [8]

Design: Goals and Inspiration

Tangible user interfaces have many advantages when compared to the use of traditional user interfaces.

First, they provide digital interactivity using real physical objects that are relevant to the task [7]. For example children's traditional toys can have new interactive functions which will support children's cognitive development.

Second, tangible user interfaces offer to a child an alternative way of interaction and control of the computing environment [4, 5]. This interaction can happen via body movements, touching, feeling, manipulating and building and include equipments that are already familiar to them (like toys).

Third, tangible user interfaces usually require little time to learn how to use them [4, 5]. Long instruction are not neccessary when children can learn how it works by trying and exploring.

Fourth, they support 'trial-and-error' activity by giving continuous presentation of the object and making it possible to use rapid incremental and reversible actions whose impact on the object can be seen immediately.

Fifth, they support more than one user. [4, 5] This is a very important thing in the context of children. Children like to do things together, co-operate, and imitate other's actions.

Pic. Child playing with legos [9]

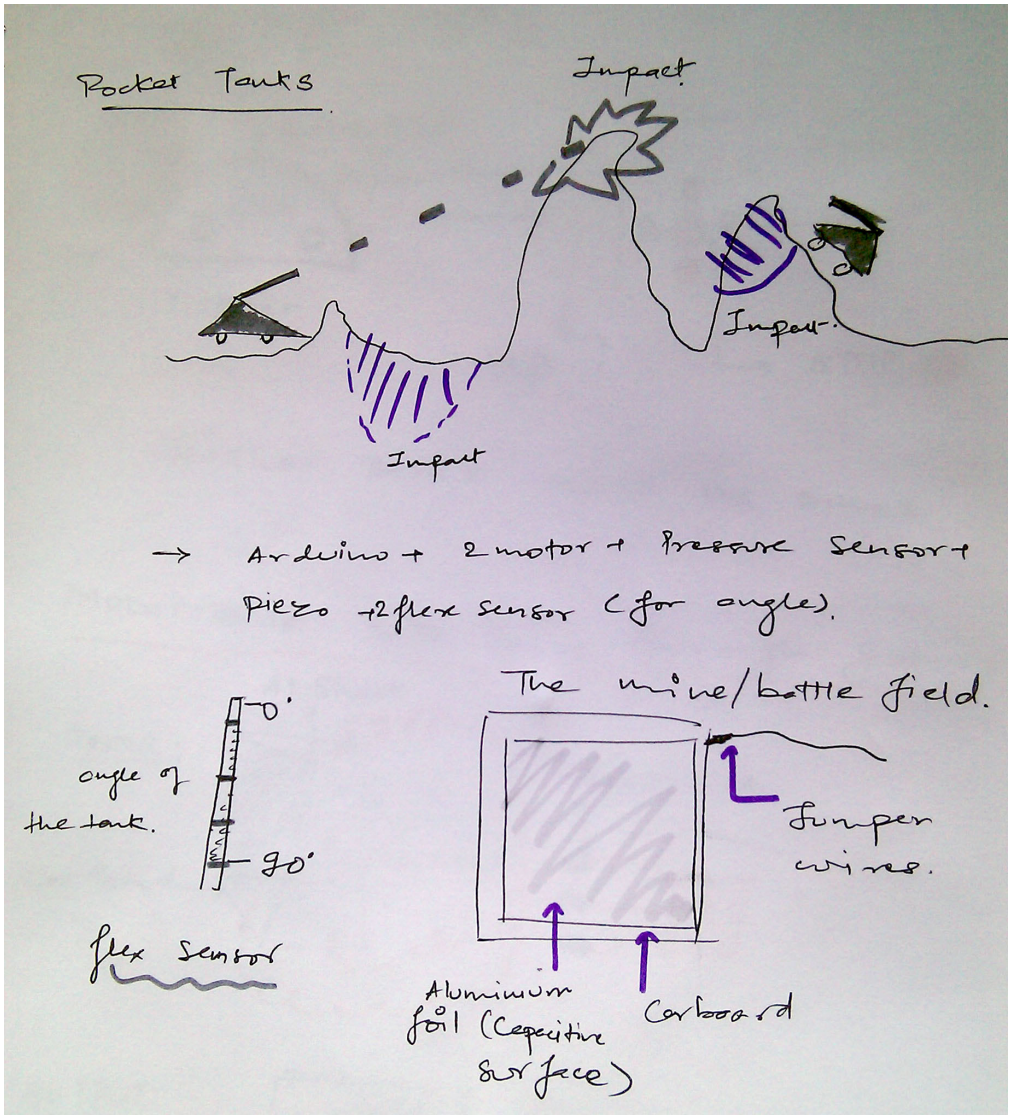
Design: Ideation

Exploration of the problem space led us to ideate different conceptual scenarios. The themes we were interested in where imagination, collaborative gameplay, tangible interaction, transportation and road safety, etc.

Some of our conceptual sketches are depicted in the document.

Concept 1:

We wanted to create Pocket Tanks game, which is a collaborative artillery based computer game. The idea was to integrate the tangible action of firing a tank to the digital war zone. The angle and force would determine the range and impact of the cannon fired.

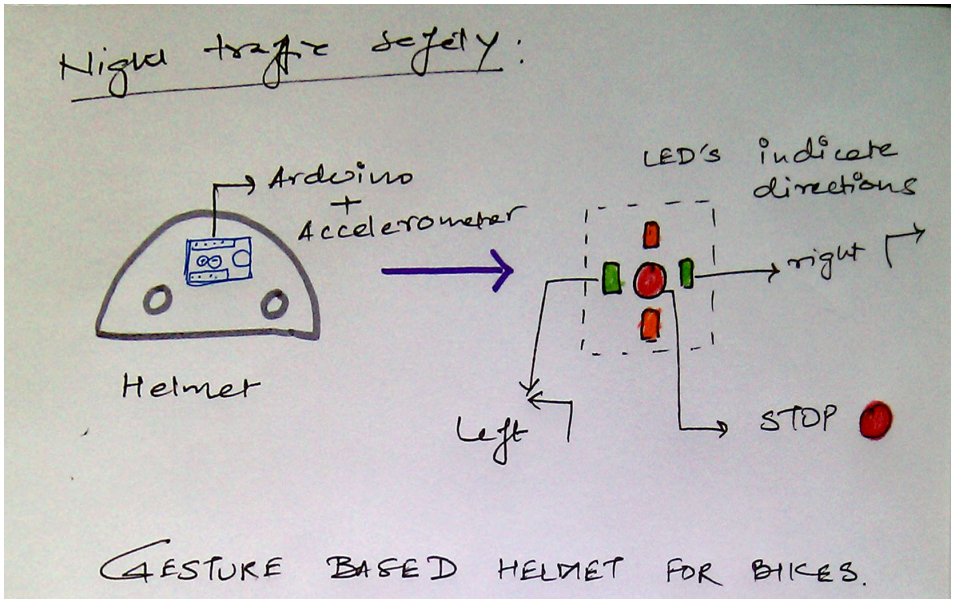


Pic. Concept sketch and exploration of technology for the Pocket Tanks game. Playing with varying capacitance as input.

Design: Ideation

Concept 2

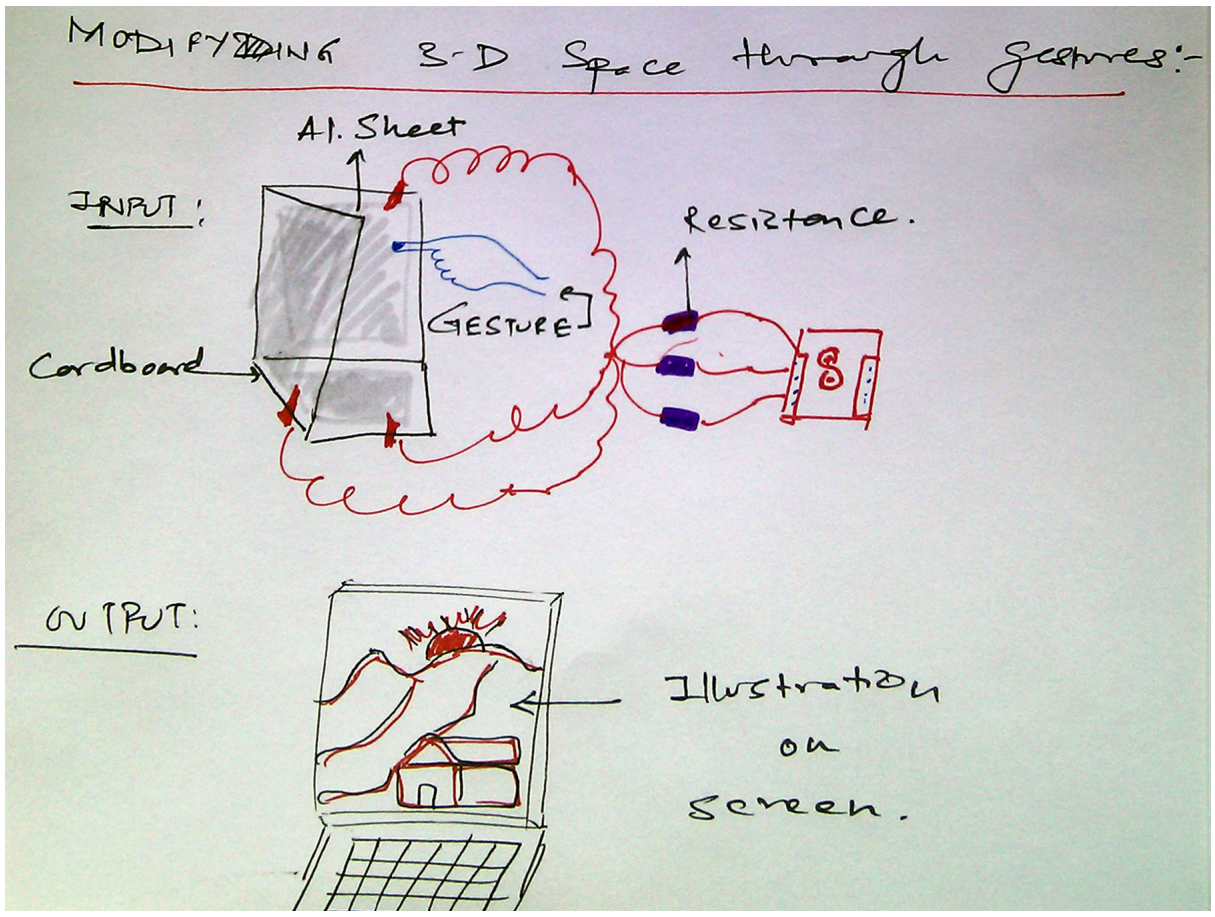
The second concept is that of a road safety helmet for bikers to be used during the night time. We thought of using an accelerometer, which would identify the specific head gestures while a bicyclist changes directions during night time. The input from the accelerometer would then feed into an array of LED's which is placed on the back of the helmet of the bicyclist. The LED signals will alert the vehicles tail gating that the biker is about to change his/her direction.



Pic. Concept sketch and exploration of technology for the Night safety bike helmet. Accelerometer was used to detct the change in the direction of the biker.

Design: Final Concept

Modern toys are others imagination made manifest. A proxy to a curated world built to be consumed and modeled. The imaginative interaction is limited to the ascribed patterns dictated by others. Often children are given toys in packaging and spend a considerable amount of time playing with the box itself. Some manufacturers have gone so far as to incorporate the box into the toys world, but most see the packaging as a means of transport. This is why we chose to open up the creative process and seek to empower the imagination through the repurposing of the toys container. Adding sensing and communication interfaces to the packaging can enable imaginative and exploratory interaction through directed but open ended play. The object contained by the packaging is an end, the container is the beginning.

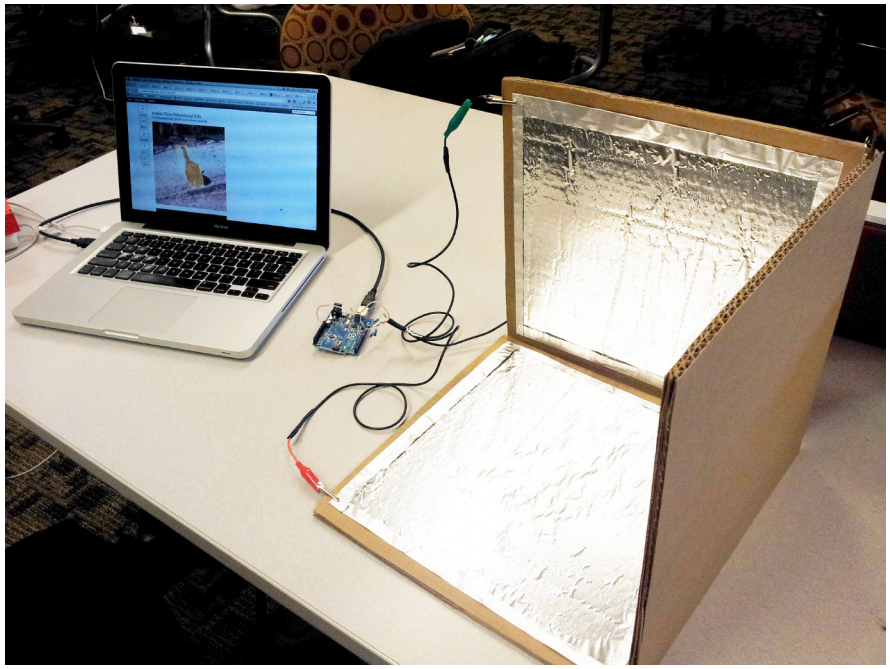


Pic. The 3D space inside the capacitance is modified to form a exploratory drawing space. Children can create illustraions with the help of their hand gestures.

Prototyping: Implementation

Detecting the gesture in 3d space:

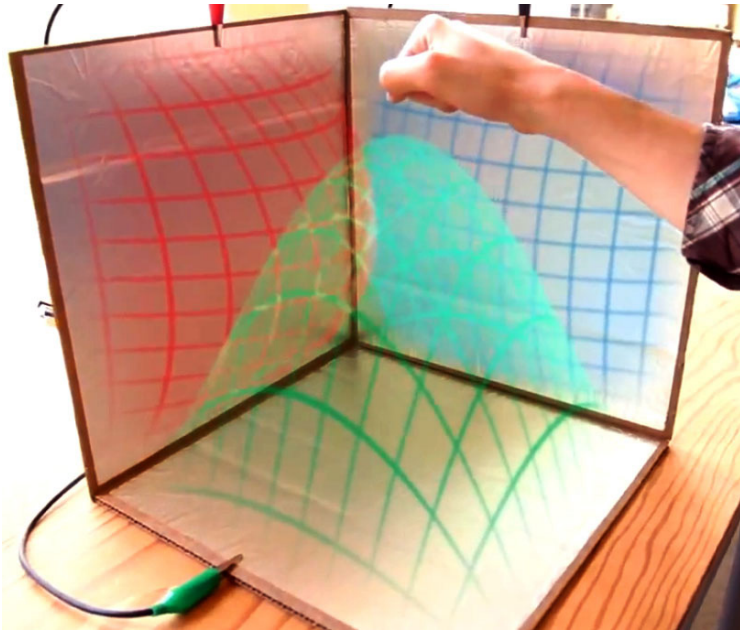
For detection of the gesture in the 3D space, we created a capacitance field which would vary based on the proximity of the finger/hand. The varying capacitance values accross the three axes would act as input for the arduino to detemine the location of the hand in the space.



Imagery using the gestures:

The input from the varying capacitance has algorithmic value and is mapped to the coordinates of the output software using map() function.

The user can also create sound or play piano nodes through gestural interaction. In this case the intensity of the capacitance field is mapped with the high and low nodes of the piano.



Prototyping: Concept evolution

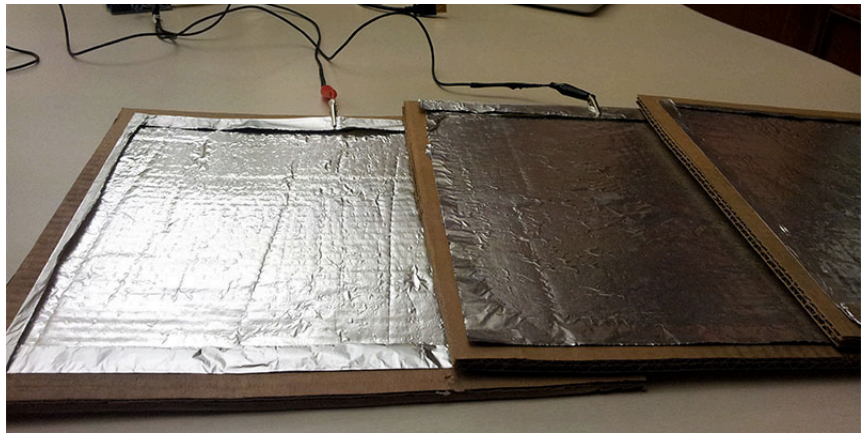
We wanted to create a space where the children can explore and use their creativity by interacting with the surface. We wanted little or no mediation so that the child can make their own boundaries and limitations.

Input:

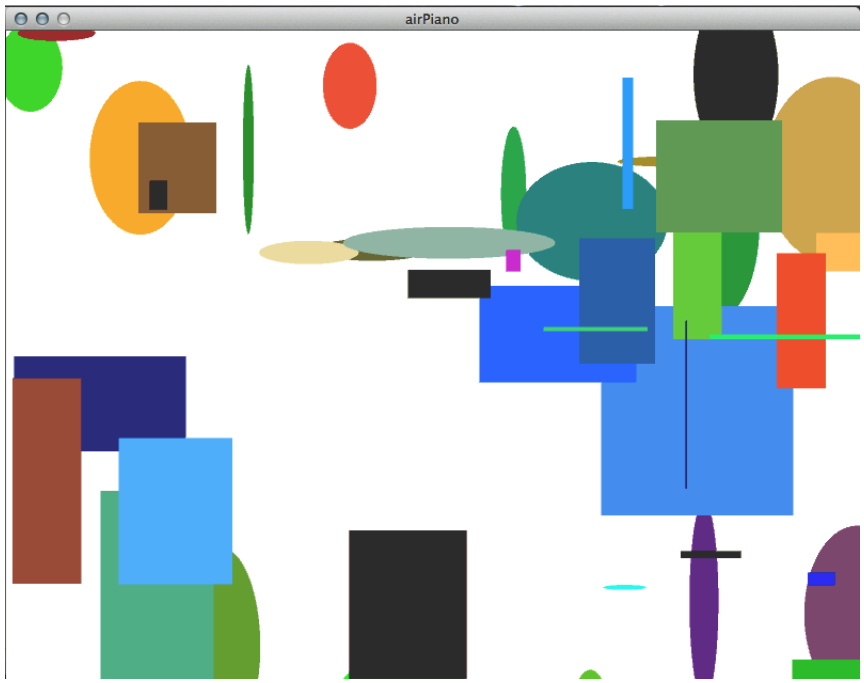
We used 3 cardboard pieces as input as they loosely signify the boundness of space. This volume indicates the interaction space of the toy.

Output:

The output was determined by the location of hand geasture in the space. The output could ne in form of a drawing or music along with random geometrical shapes. The user can interact with the space to draw illustrations. This space can be used collaboratively as well to form a shared illustration space for children.



Pic. The cardboard box with the aluminium sheets act as inputs of varying capacitance.



Pic. User can play piano nodes by interating with the tangibl;e surface.

Prototyping: The how to guide

Components used:

pieces of cardboard (3)
10KΩ resistors (3) from RadioShack.
220KΩ resistors (3) from RadioShack.
Alligator clips (3) from RadioShack.
Arduino from RadioShack.
Shielded cable , cut off the ends, cut into (3) 2' lengths from RadioShack.
Aluminum foil
Masking tape
Computer with Processing and Arduino software installed

[10] Image credit

How to guide:

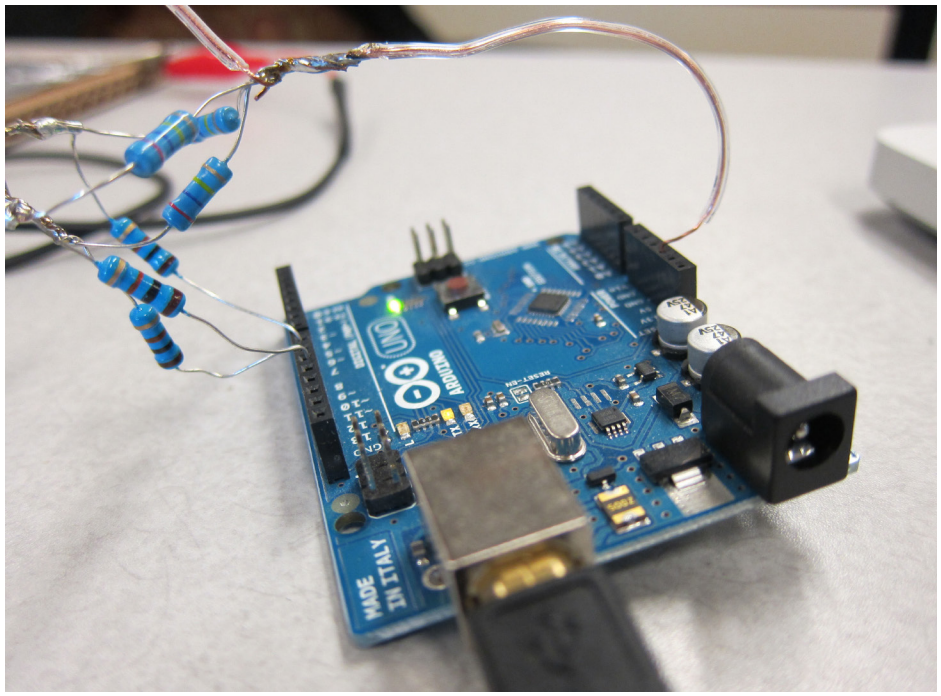
Step 1 — Making the sensor cube.

Spray the glue onto the cardboard and smooth the foil onto one side. Work slowly and try to leave a small gap around the edge of the foil. It is important that the foil plates do not touch each other when we tape the three sides together. Using tape, assemble the plates to form one half of a cube.

Prototyping: The how to guide

Step 2 — Adding the resistors.

On the other non-alligator end of the cables, twist together the 3 shield wires and solder them. The shield will be connected to the 5V pin on the Arduino. This will minimize the antenna effect of the cable on the circuit.



Connect the resistors to the three inner wires of the cables as shown and connect this to the ends of the three wires. The 220KΩ resistors all connect between the inner wire of the cable and 5V. The 10KΩ resistors will each be connected between the end of the cable and a pin on the Arduino.

Use a small piece of jumper wire to make the connection between the shield wires and the 5V output pin on the Arduino.

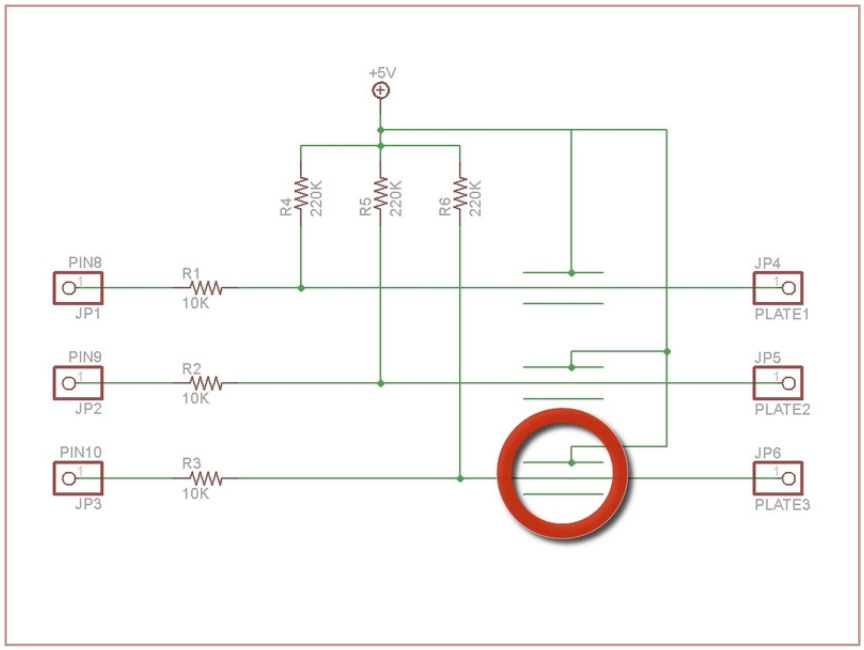
Prototyping: The how to guide

Step 3 — Connecting the arduino

On the other non-alligator end of the cables, twist together the 3 shield wires and solder them. The shield will be connected to the 5V pin on the Arduino. This will minimize the antenna effect of the cable on the circuit.

Connect the resistors to the three inner wires of the cables as shown and connect this to the ends of the three wires. The 220KΩ resistors all connect between the inner wire of the cable and 5V. The 10KΩ resistors will each be connected between the end of the cable and a pin on the Arduino. The circled area indicates that this wire should be shielded, with the shield connected to +5V.

Use a small piece of jumper wire to make the connection between the shield wires and the 5V output pin on the Arduino, as shown in the third photo.



Pic. Circuit diagram [10]

Lessons Learned

Capacitance is measured in time lapse currently which is not accurate, we want to measure absolute values of capacitance. The absolute values of the capacitance will give us better input and we can modify the output data better accordingly.

In future, we would want to make it more collaborative so that people can create illustrations and music together.

This could be used to detect different kinds of touches and generate different outputs based on multitouch interaction.

As people have varied degrees of capacitance, the capacitance values have to be adjusted for every user. We want to get rid of this constraint by use of better technology and software.

References

[1] Antle, A. N. (2007). The CTI Framework: Informing the design of tangible systems for children. Proceedings of the 1st international conference on Tangible and embedded interaction TEI '07, Baton Rouge, Louisiana. 195-202.

Available (17.12.2007): http://doi.acm.org/10.1145/1226969.1227010

[2] Druin, A. and C. Solomon (1996). Designing multimedia environments for children, John Wiley & Sons, Inc. According to Xu, Dianne (2005). Tangible User Interface for Children An Overview.

Available (17.12.2007): http://www.uclan.ac.uk/facs/destech/compute/research /conference/may2005/Xu.pdf

[3] Druin, A., L. Hanna, et al. (1999). The Design of Children's Technology, Moran Kaufmann Publishers, Inc. According to Xu, Dianne (2005). Tangible User Interface for Children An Overview.

Available (17.12.2007): http://www.uclan.ac.uk/facs/destech/compute/research /conference/may2005/Xu.pdf

[4] Xu, D., Mazzone, E. and MacFarlane, S. (2005). Informant design with children - designing children's tangible technology. 1st International Workshop "Re-Thinking Technology in Museums", Limerick, Ireland.

Available (17.12.2007): http://www.uclan.ac.uk/facs/destech/compute/staff/read/ Publish/ChiCi/references/informant_design_with_children.pdf

[5] Xu, Dianne (2005). Tangible User Interface for Children An Overview.

Available (17.12.2007): http://www.uclan.ac.uk/facs/destech/compute/research /conference/may2005/Xu.pdf

[6] http://www.uta.fi/~pp78517/NIT/children.html#link7

[7] Bolas, M., Druin, A., Revelle, G. & Zuckerman, O. (2005). Tangible User Interfaces for Children. CHI '05 extended abstracts on Human factors in computing systems, Portland, Oregon. 2051-2052.

Available (17.12.2007): http://doi.acm.org/10.1145/1056808.1057095

[8] Geoffrey Wiseman, Flickr, cc license, http://www.flickr.com/photos/diathesis/5870706594/

[9] Squiggle, flickr, cc license, http://www.flickr.com/photos/stephenr/2330850025/sizes/o/in/photostream/

[10] makezine: http://guide-images.makeprojects.org/igi/EafjJlFJuEyWBFeA.large