



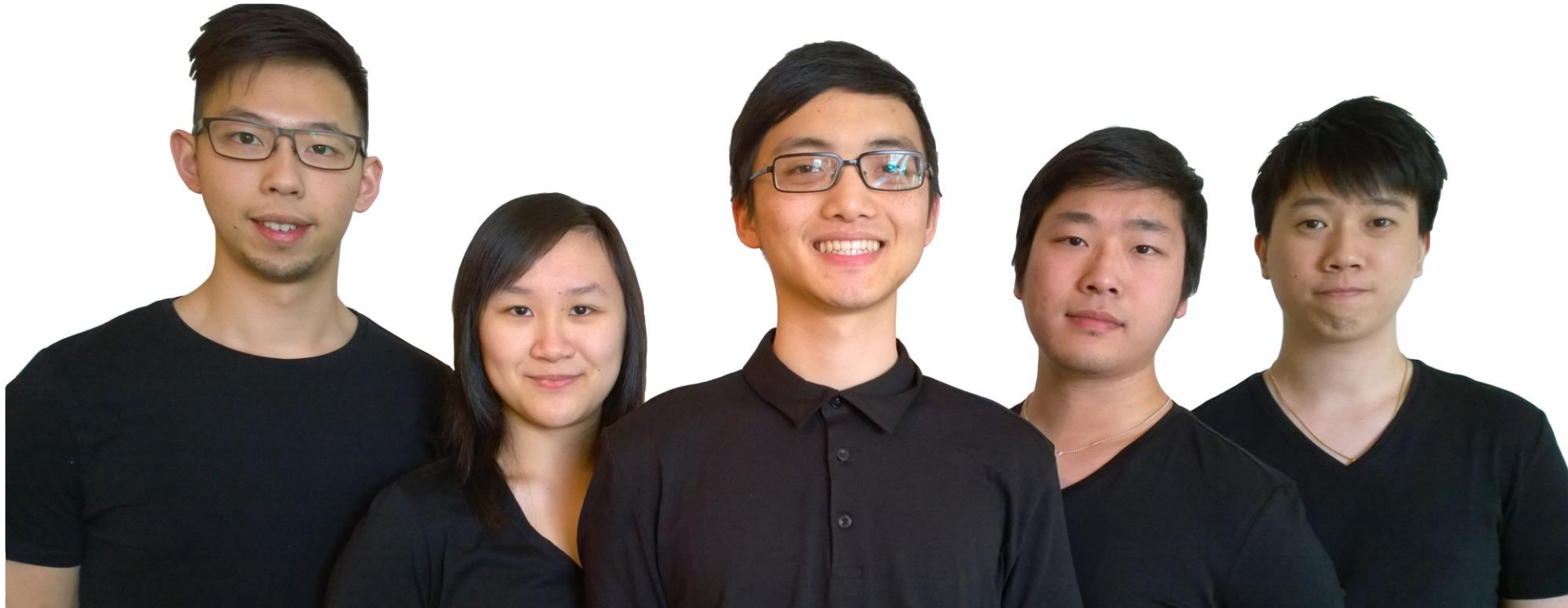
**LumenX<sup>3</sup>**

**Mobile Projected Computer**

**OBELXTECH**



# TEAM OBELXTECH



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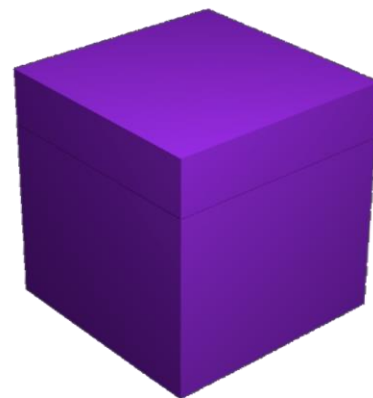
# Outline

- Overview
- Motivation and Market
- System Overview
- Scheduling
- Finances
- Project Summary
- Future Goals
- Challenges and Change in Scope
- Lessons Learned

# LumenX<sup>3</sup> Overview

The next addition to everyone's smart device portfolio

- Screen-less Projection
- Touch Gesture Recognition
- Windows 8.1
- Portability and Durability



# Motivation

## Disadvantages of current smart devices

- Screens fragile and easily crack
- Requires physical touch



# Motivation

## Disadvantages of current smart devices

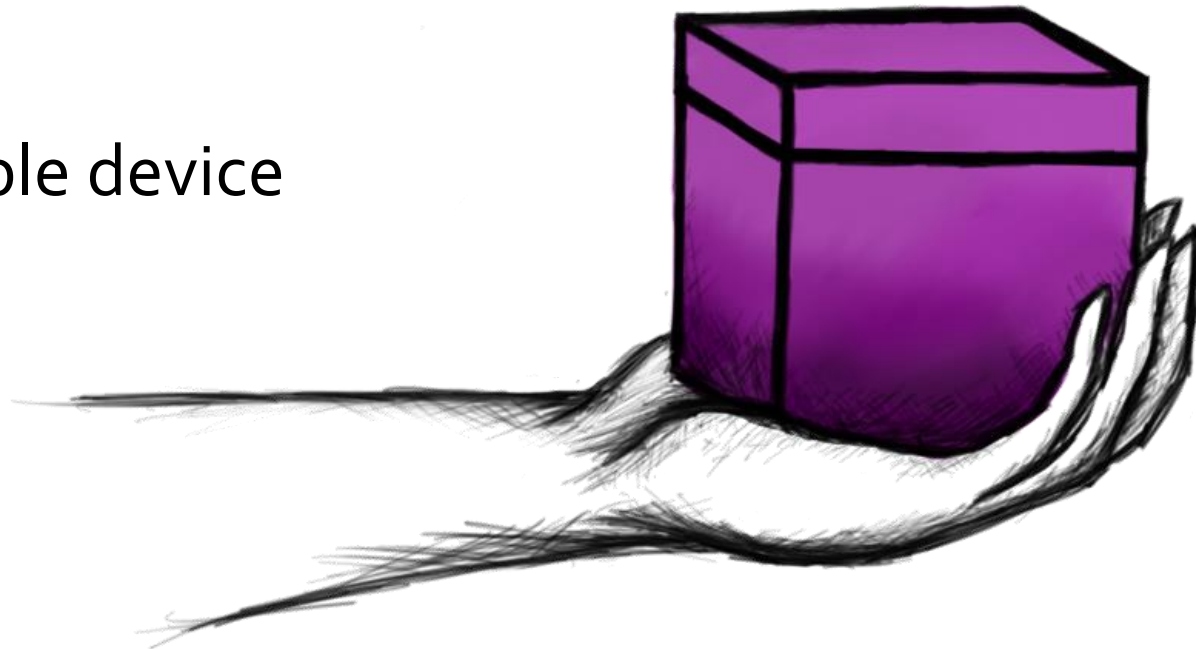
- Does not completely replace mouse
- Cannot be both portable and collaborative

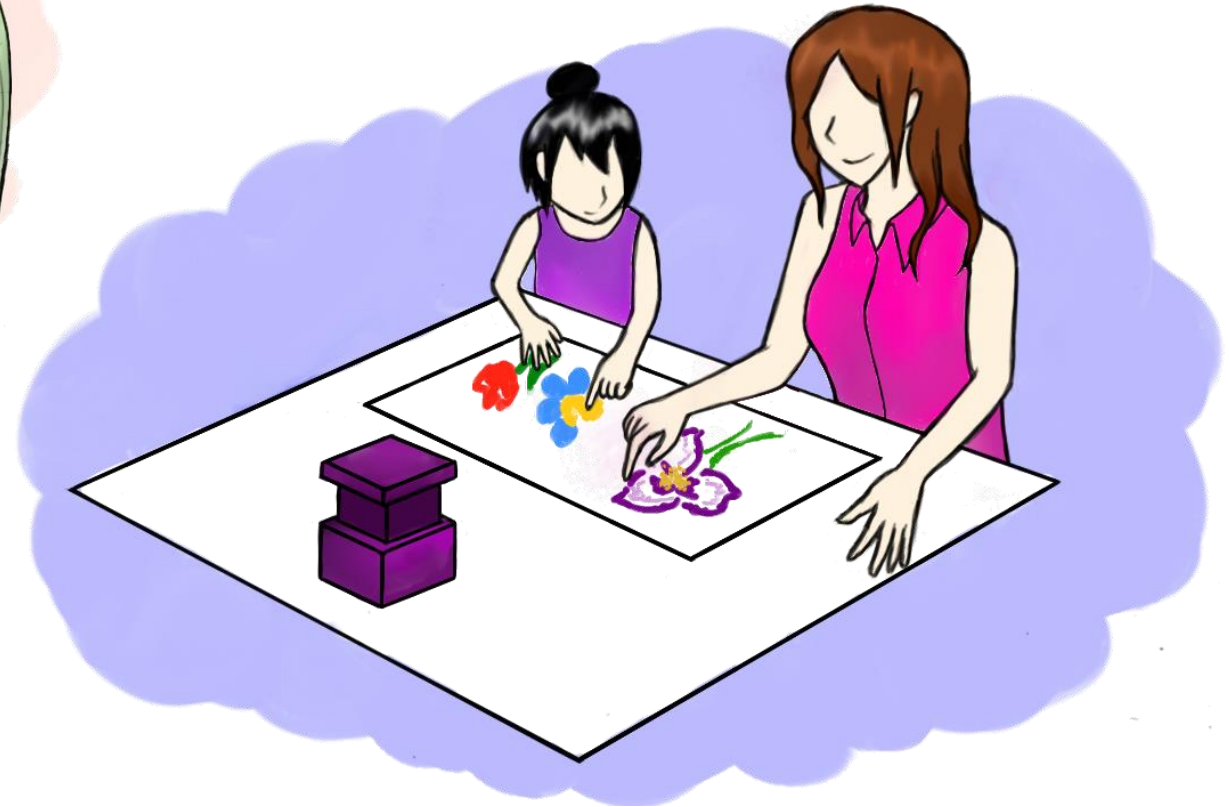
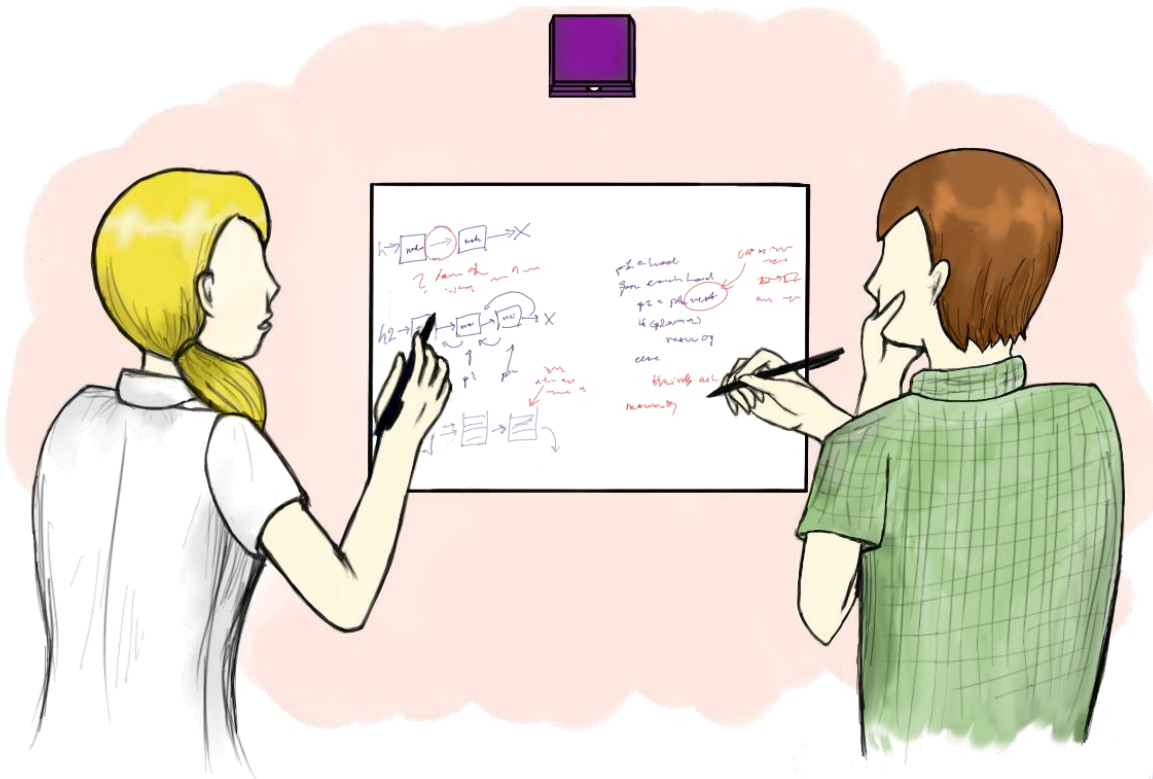
**Can we find a better way to interact with our devices?**



# LumenX<sup>3</sup> as the new Smart Device

- Entire 3D space under your control
- Removes screen size limitations and fragility
- Collaboration on a portable device



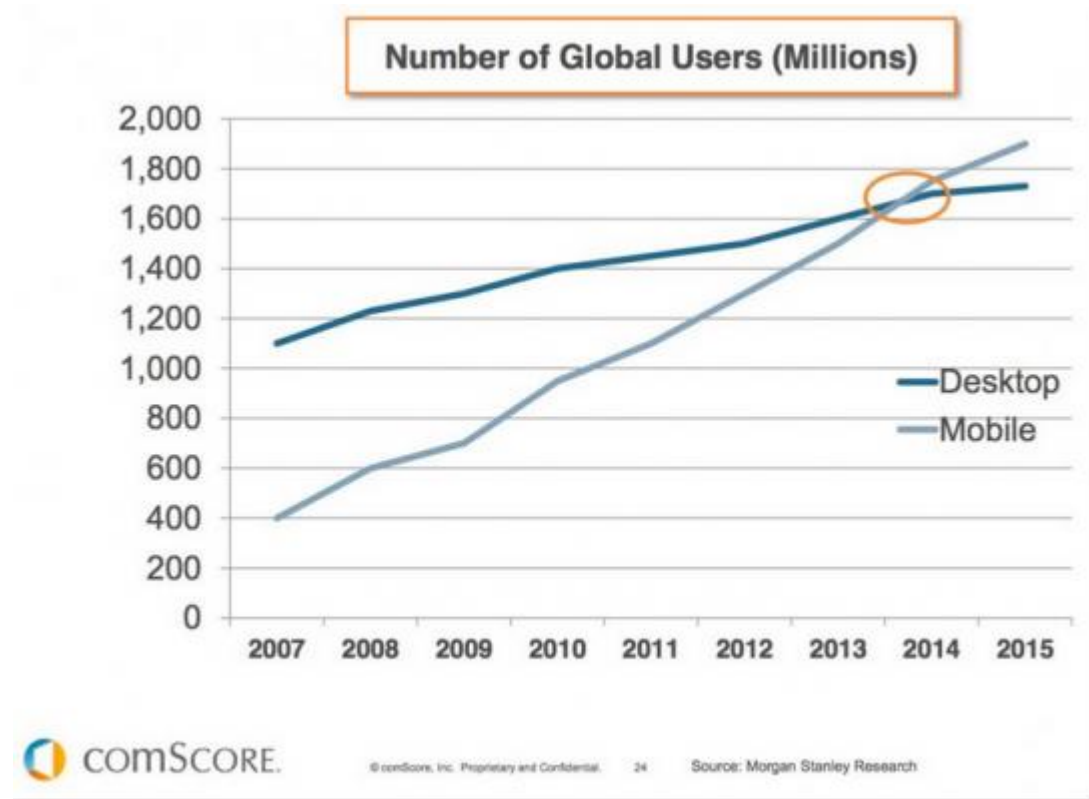


# User Scenarios



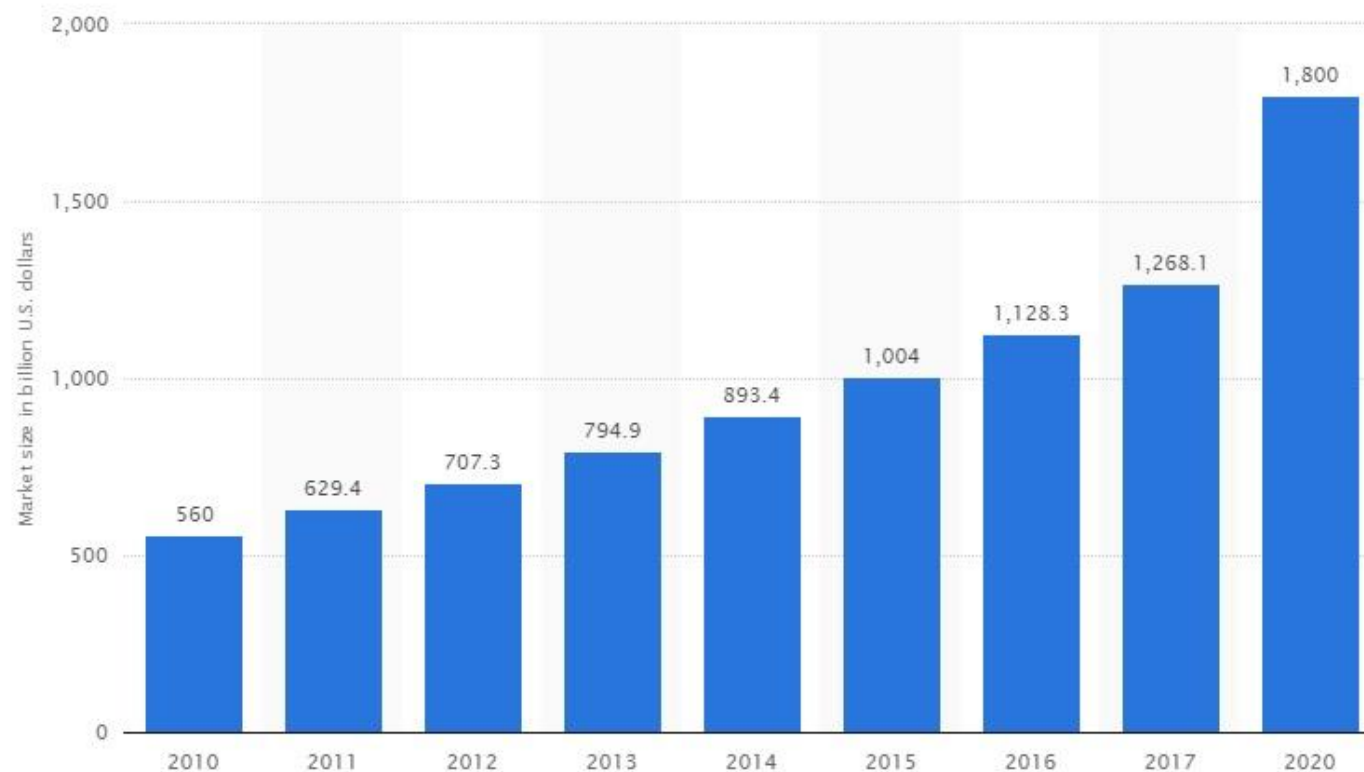
# Market Research

- 2014 was an extremely important shift in dominant platform
- Mobile devices are the preferred method for people to purchase, and consume content
- We spend more time on our mobile devices than the TV
- 80% projected growth in global market for connected devices by 2020



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# Target Market

- Groups and Individuals that embrace new technology
- Consumers who work/play in environments where touch screens don't work
- Those who value multi-user collaboration on a single device



# Competition



Promethean ActivTable	Apple iPad	Dos-Owls ODIN
\$6799 USD	\$500 - \$800 USD + Accessories	\$675 USD
<ul style="list-style-type: none"> <li>• Great for collaboration</li> <li>• Great Content consumption</li> <li>• Touch Input</li> </ul>	<ul style="list-style-type: none"> <li>• Very portable</li> <li>• Good content consumption</li> </ul>	<ul style="list-style-type: none"> <li>• Very portable</li> <li>• Good content consumption</li> </ul>
<p><b>Not portable</b> <b>Expensive</b></p>	<p><b>Tablets have fragile screens</b> <b>Physical collaboration is HARD</b></p>	<p><b>Requires keyboard and mouse</b></p>

# Cost and Financing

- Target price for production model \$800 - \$1100
- Cost of production model reduced significantly
  - Decrease in cost of parts
  - Production efficiencies
  - Economies of scale
- Plans for VC funding (Y-Combinator)
- Consider Crowd Funding (Kickstarter, Indiegogo)

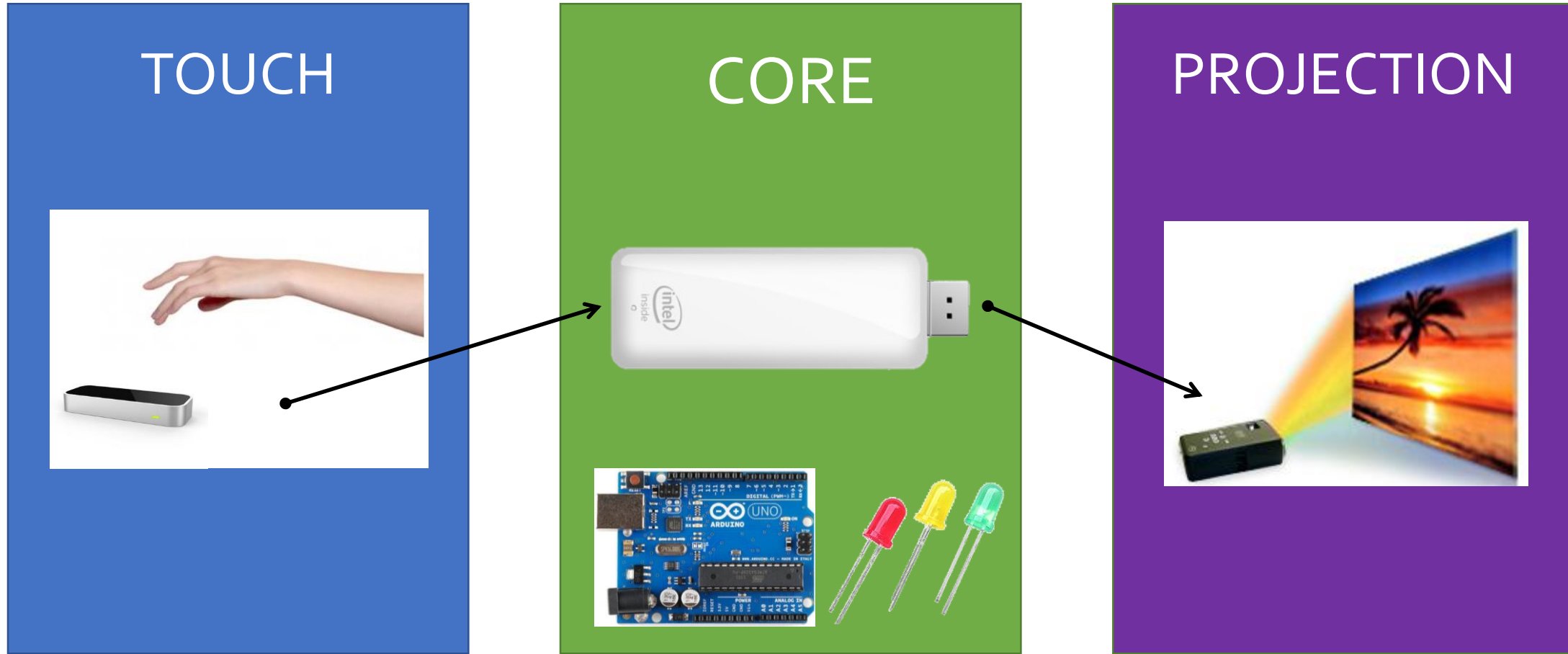


Combinator

KICKSTARTER

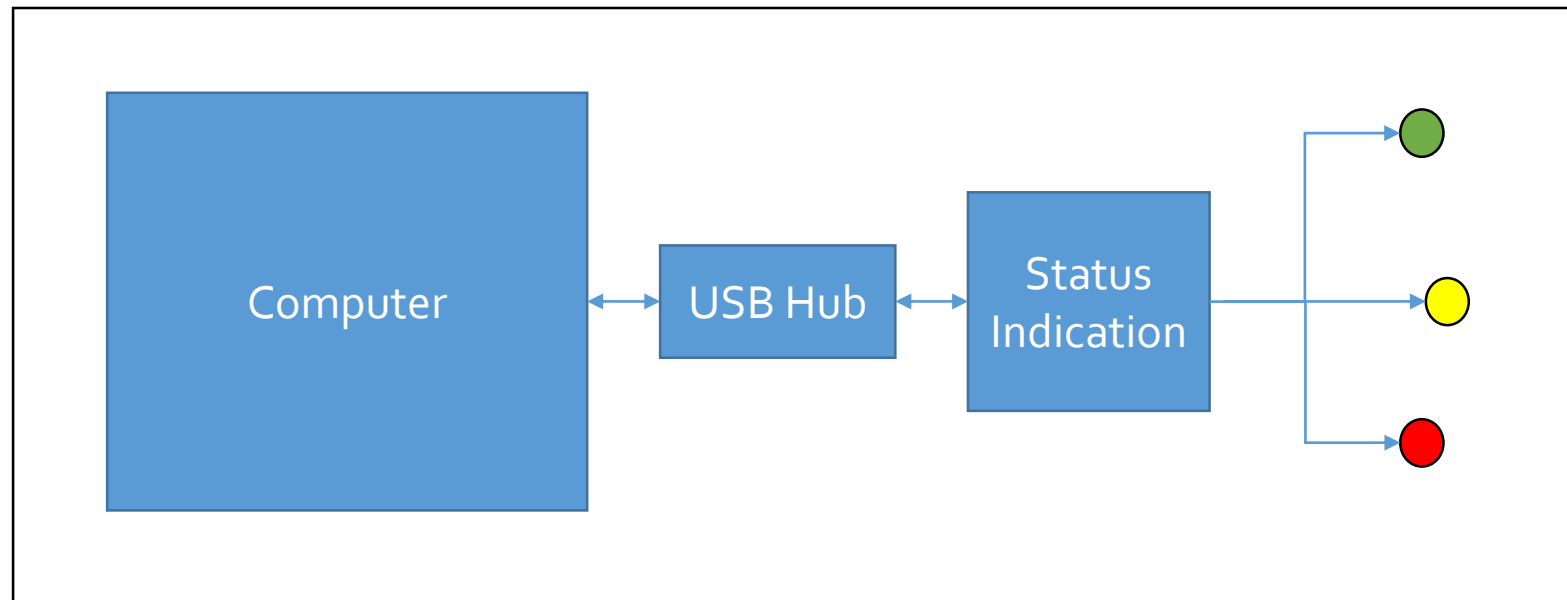
 indiegogo

# System Overview



# Core Subsystem

- Miniature computer that runs powerful desktop touch-friendly computer OS, Windows 8.1
- Combination of Windows Service and Microcontroller for status indication



# Core Subsystem

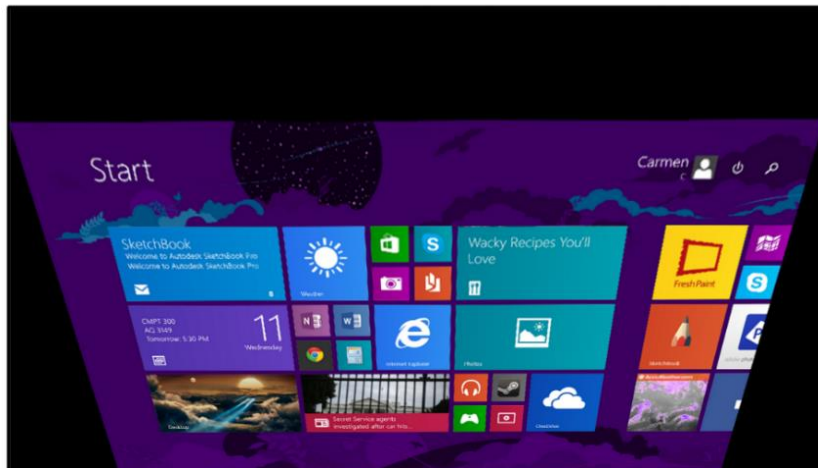
- MeegoPad T01
  - Intel Atom Processor x86 Instruction Set to run Windows
  - 2GB Ram/Quad Core to run our software algorithms
- Arduino Uno R3
  - Communicates with MeegoPad through serial interface
  - LED status according to IEEE
  - Automatic rising/falling of LumenX<sup>3</sup> using servo motors not yet implemented





# Projection Subsystem

- AAXA P3 Pico Projector
  - Selected for its small size, bright and high resolution
- Windows 8.1 Display Driver
  - Performs perspective correction



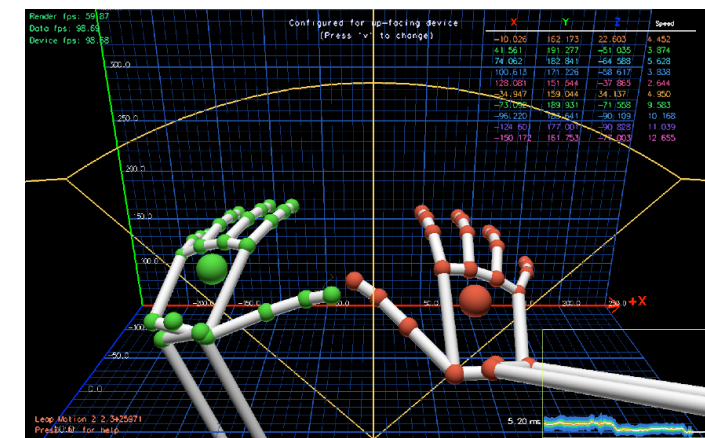
# Touch Gesture Recognition Subsystem

What is the Leap Motion Controller?

What is the Touch Software?

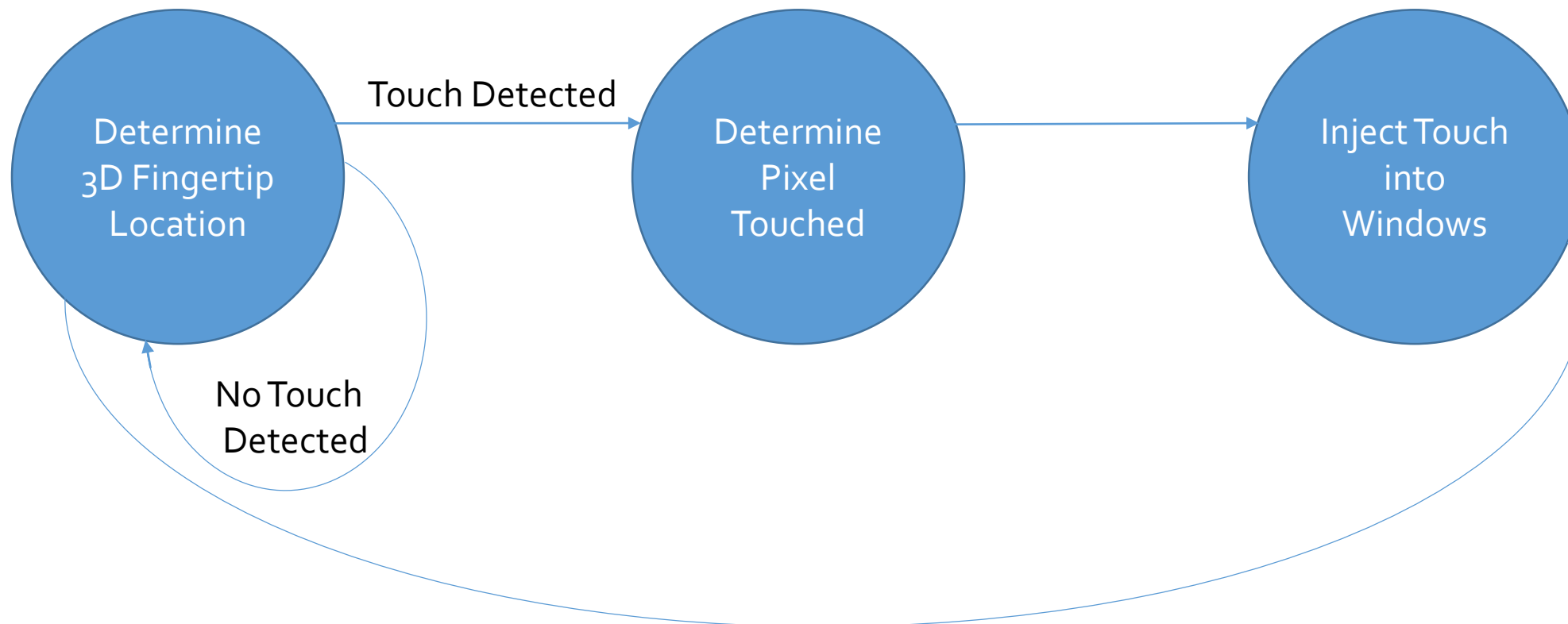


- Touch Software runs on 2 major algorithms:
  1. Touch Determination
  2. 2D Location Translation
- Both Algorithms utilize the Leap Motion SDK



# Touch Gesture Recognition Subsystem

How does the Touch Software work?



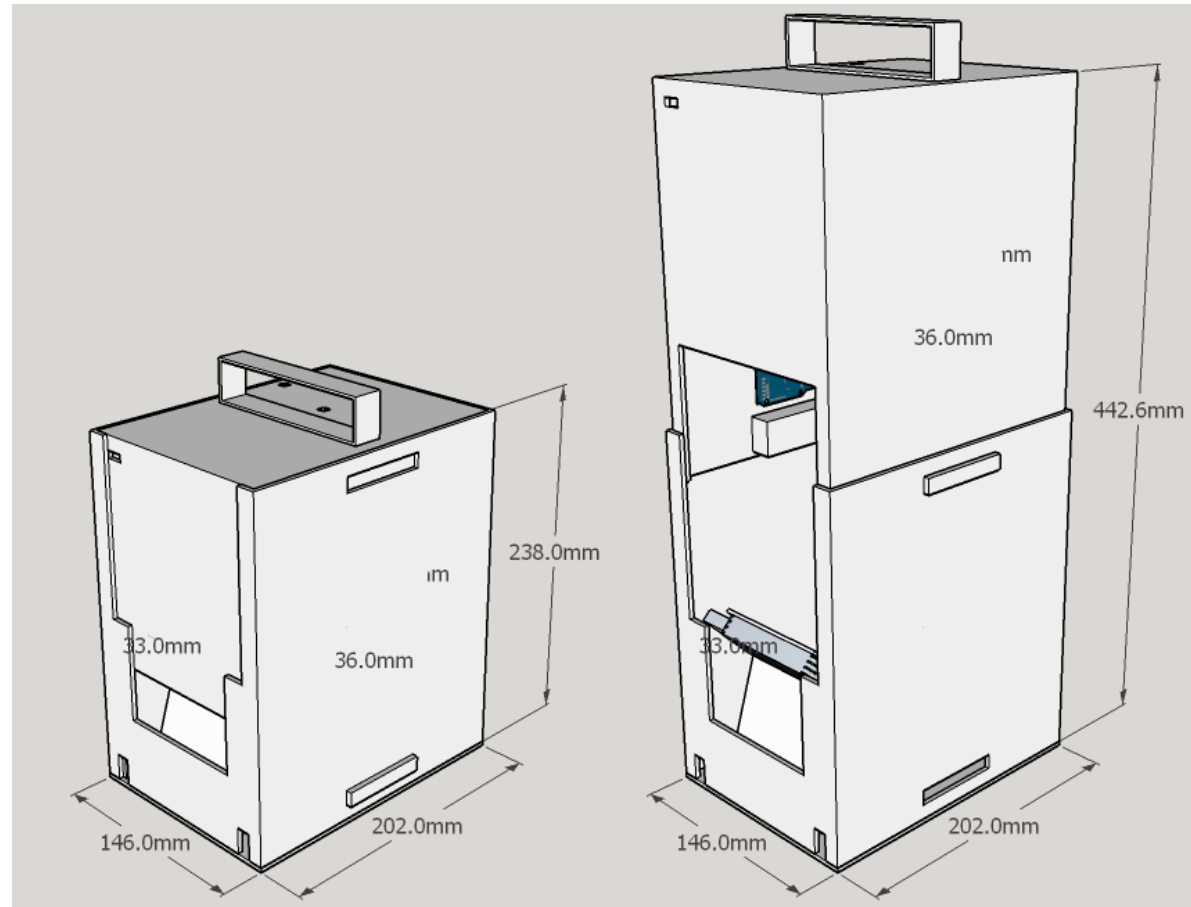
# Mechanical Case

- Robust and aesthetically pleasing
- Portable
- Height and placement requirements
  - Pico Projector: 29 cm @ 60°
  - Leap Motion Controller: 10 cm @ 45°
- Openings for Pico Projector and Leap Motion



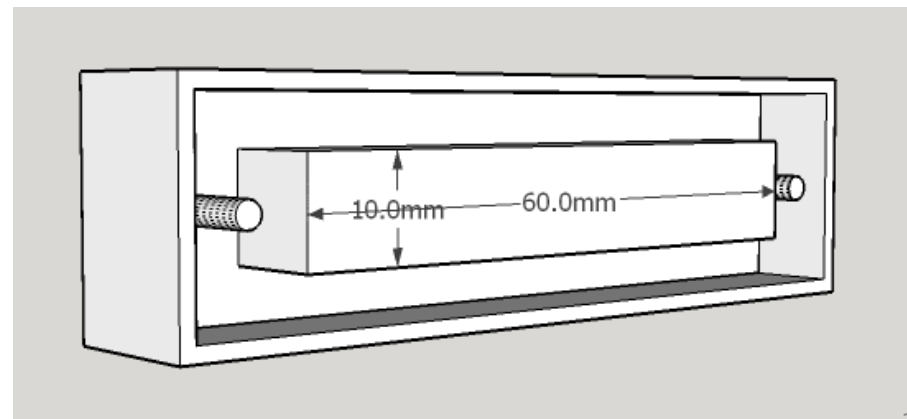
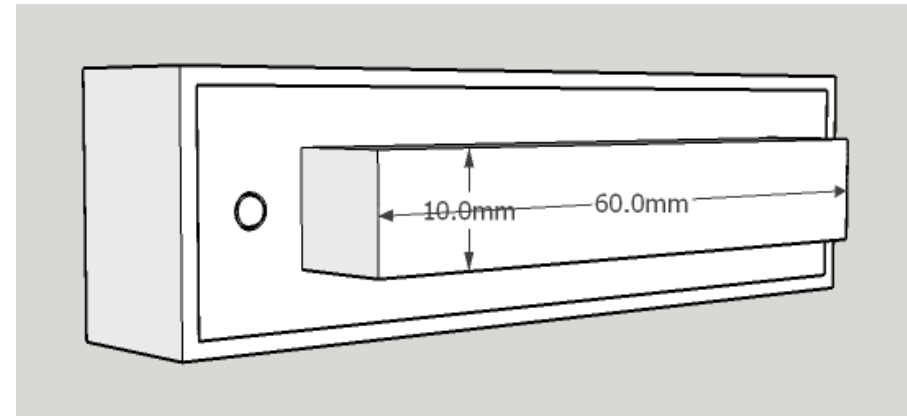
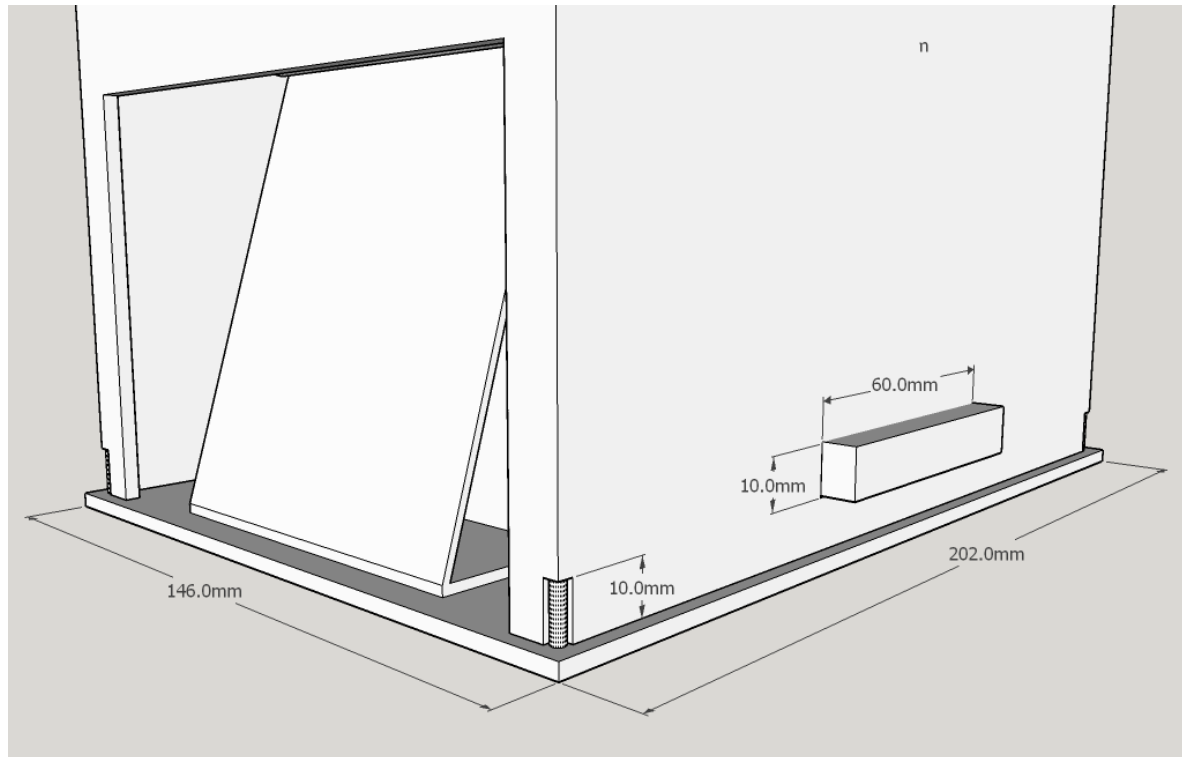
# Two-shell Design

- Use case itself as rising mechanism



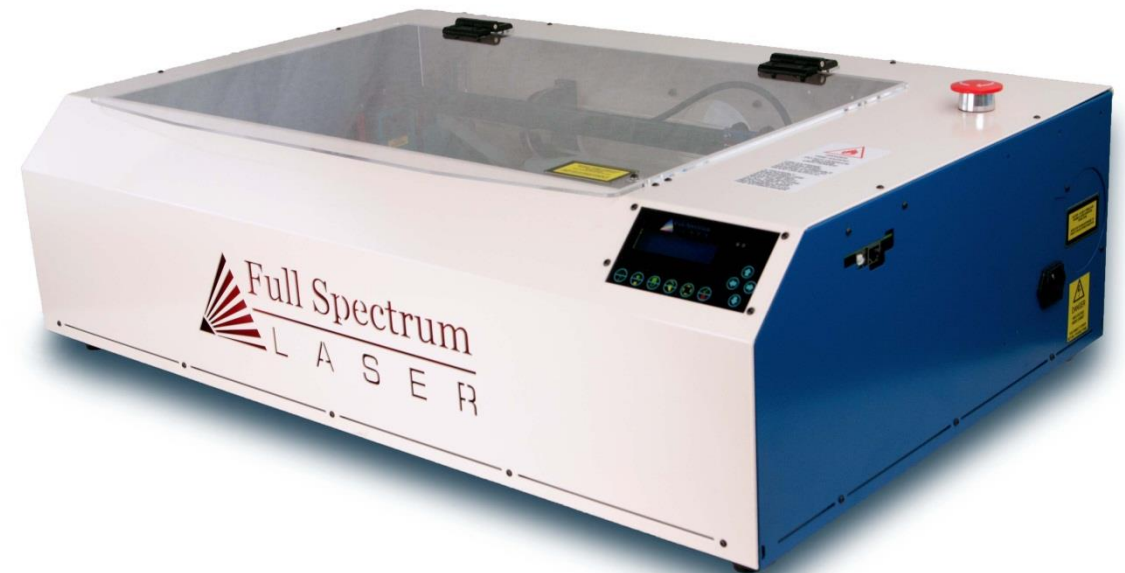
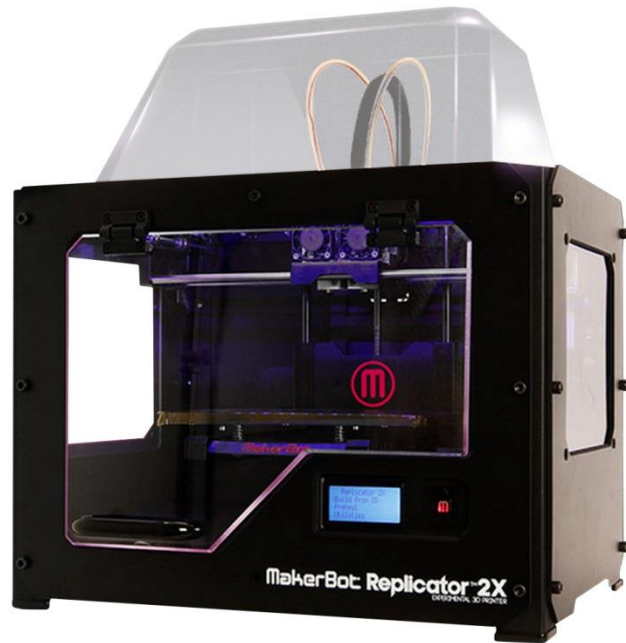
# Locking Mechanism

- Self-locking buttons on top and bottom (add pic of other part of button)



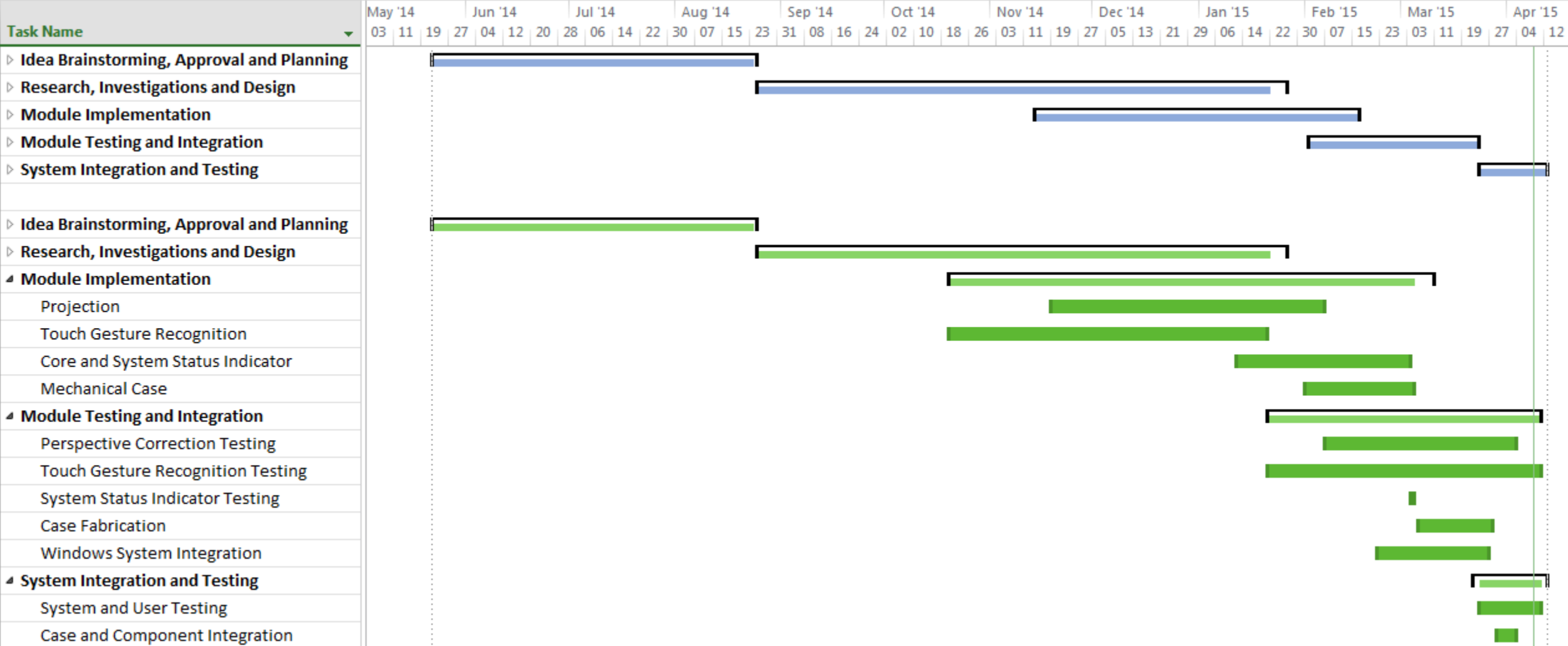
# Manufacturing

- 3D printed small parts
- Too expensive for larger shells
- Acrylic sheets traced with laser cutter
- Meld panels together





# Project Schedule





# Finances – Proof-of-Concept Model

Item	Estimated	Actual	Difference
Microsoft Windows 8.1	\$119.99	\$0.00	+\$119.99
AAXA P3 Pico Projector	\$184.91	\$184.91	\$0.00
MeegoPad T01	\$138.03	\$138.03	\$0.00
Leap Motion Controller	\$89.59	\$79.68	+\$9.91
Arduino Uno	\$30.00	\$35.00	-\$5.00
Minor Electronics and other Accessories	\$55.60	\$72.82	-\$17.22
Plastic Enclosure	\$30.00	\$41.43	-\$11.43
Contingency (15%)	\$100.00	\$131.43	-\$31.43
<b>Total Cost</b>	<b>\$748.12</b>	<b>\$683.30</b>	<b>+\$64.82</b>
ESSEF Funding		\$705.00	
IEEE Funding		\$622.85	
<b>Total Funding</b>		<b>\$1327.85</b>	
<b>Net Cash</b>		<b>\$644.55</b>	

# Project Summary

- Fully integrated and packaged device
- Working driver and projection
- Single tap and drag detection in hand tracking
- Compressed and Expanded mode



# Future Development

- Wide angle projection via lens and filters
- Fully custom circuit
- Integrated battery
- Unibody casing
- Improved hand tracking via point cloud
- More computational resources
- Super compact form factor



# Challenges Faced Along the Way

- Perspective Correction using OpenCV
- Compatibility between MeegoPad and Projector hardware
- LeapMotion not meant to be used with current orientation
- 3D printing the case
- Connecting everything and fitting in the case was difficult

# Changes in Scope

- Stereo vision with IR emitter and receiver
- Android OS for touch friendly
- Jetson TK1 for more powerful computational hardware
- Raspberry Pi for data routing and resource distributing between Jetson and other hardware

# Practical Lessons Learned

- Development may take longer than expected
- Sometimes things do fall in place
- Should have been constantly looking for alternatives and researching other things in the early investigation stages
- Going out and de-stressing with each other often helps bonds

# Technical Knowledge Acquired

How to:

- Write a Windows display driver
- Use the Leap Motion SDK
- Touch Inject actions into Windows
- Write a Windows service
- Make a physical case
- Work around hardware limitations

# Acknowledgements

- Andrew Rawicz and Steve Whitmore
- ENSC 305/440 TAs
- All our families for their support
- Dr. Bonnie Gray and the Micro-Instrumentation Lab
- Industrial Plastics and Paints
- Lakshman One, Dr. Michael Hayden, Dr. Ash Parameswaran, Sergiy Baidachniy, Kenneth Koothrappali



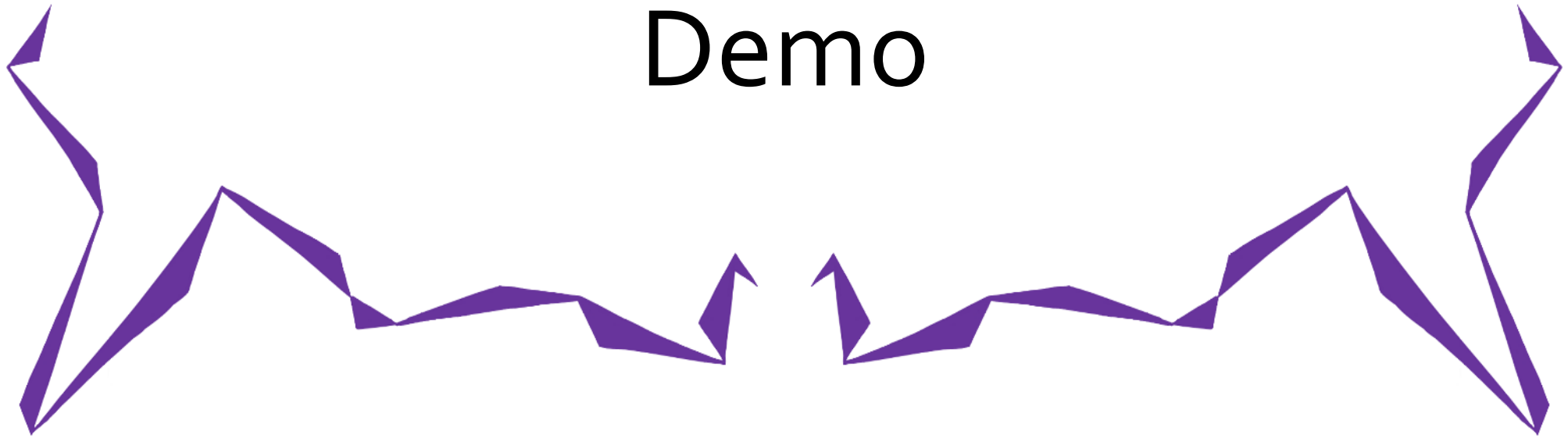
# References

- [1] C. Tang, H. Mak, H. W. Ng, D. Mok and G. Yu, "Design Specification – LumenX3: Projected Mobile Computer," 2015.
- [2] Bosomworth and Danyl, "Statistics on mobile usage and adoption to inform your mobile marketing strategy," [Online]. Available: <http://www.smartinsights.com/mobile-marketing/mobile-marketing-analytics/mobile-marketing-statistics/>. [Accessed 2 April 2015].
- [3] Hepburn and Aden, "Infographic: 2013 Mobile Growth Statistics," 1 October 2013. [Online]. Available: <http://www.digitalbuzzblog.com/infographic-2013-mobile-growth-statistics/>. [Accessed 2 April 2015].
- [4] Trenholm and Rich, "Quarter of iPhones have a broken screen, says new poll," 7 February 2013. [Online]. Available: <http://www.cnet.com/news/quarter-of-iphones-have-a-broken-screen-says-new-poll/>. [Accessed 2 April 2015].
- [5] "MeeGoPad To1 Microsoft Windows 8.1 OS TV Stick - Quad-Core CPU, 2GB RAM, 32GB Internal Memory, Bluetooth, HDMI Interface (White)," Q. C. Factories, 2015. [Online]. Available: <http://www.amazon.com/MeeGoPad-To1-Microsoft-Windows-Stick/dp/BooRVCGNEC>. [Accessed 20 January 2015].
- [6] Arduino, "Arduino Uno," 2015. [Online]. Available: <http://arduino.cc/en/Main/arduinoBoardUno>. [Accessed 22 January 2015].
- [7] Microsoft Corporation, "Windows 8.1 tutorial," [Online]. Available: <http://windows.microsoft.com/en-ca/windows/tutorial>. [Accessed 20 January 2015].
- [8] AAXA TECHNOLOGIES INC., "P3 Pico Projector," 2015. [Online]. Available: [http://www.aaxatech.com/products/p3\\_pico\\_projector.htm](http://www.aaxatech.com/products/p3_pico_projector.htm). [Accessed 23 January 2015].
- [9] E. Dubrofsky, "Homography Estimation," THE UNIVERSITY OF BRITISH COLUMBIA, Vancouver, 2009.
- [10] Leap Motion, Inc, "Leap Motion Controller," 2014. [Online]. Available: <https://www.leapmotion.com/>. [Accessed 10 January 2015].

Questions?



# Demo



# Videos

- Touch Demonstration:

<https://www.dropbox.com/s/afj3zi861gpmg51/Hand%20Gestures.mp4?dl=0>