Designing for Mixed Reality Play

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About me

- I’m an assistant professor in the Department of Informatics at UC Irvine
- I run a group called the Transformative Play Lab
- We’re multidisciplinary, combining:
  - design research methods
  - hermeneutic analysis of games
  - artistic practice and production
- Our work often bridges “digital” and “physical” systems: we use tangibles, props, costumes, and environments in our design practice.
- We design participatory narrative experiences inspired by performing arts practices.

I make playful XR* experiences

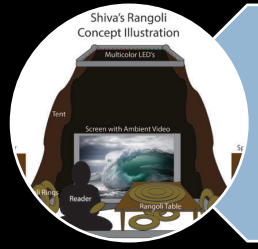
- I draw on techniques from the performing arts to inform my designs
- I'm interested in identity transformation, perspective taking, and role play
- I work in a "tech light" mode, focusing more on experience and less on prototyping

* XR combines AR, VR, and MR into one handy acronym!

Designing for Mixed Reality Play

The Reading Glove

Magia Transformo



Shiva's Rangoli

Mixed Reality?

from Milgram & Kishino (1994) *A Taxonomy of Mixed Visual Displays*

Prototyping as "Bricolage"

- Levi-Strauss contrasts the work of the "*bricoleur*" against that of the engineer
- Bricolage is "devious" – it is the art of **hacking** together clever solutions with the materials at hand, rather than the art of formally designing and building
- It is the fine art of "jury-rigging"

The Reading Glove

by

Theresa & Karen Tanenbaum

Narrative Objects

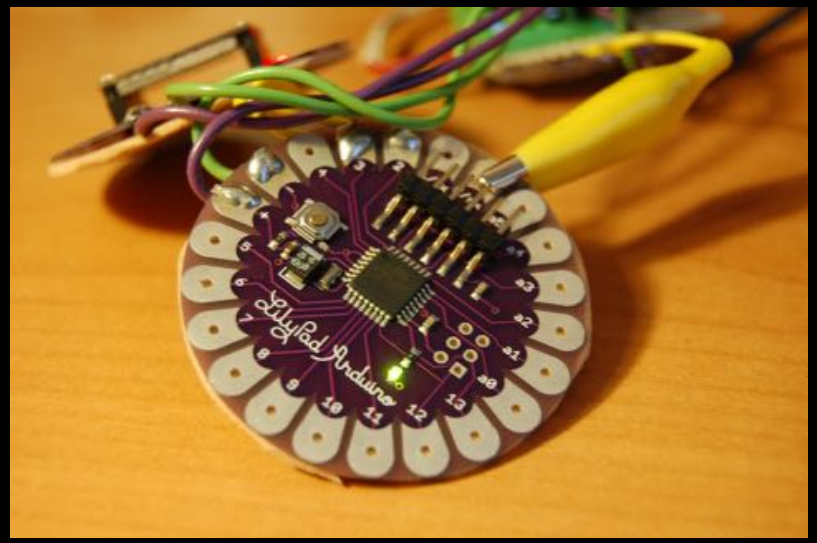


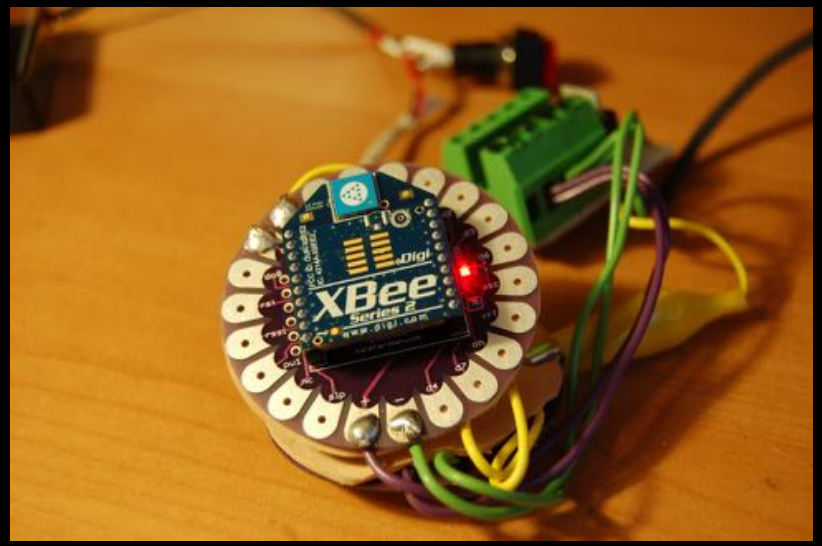


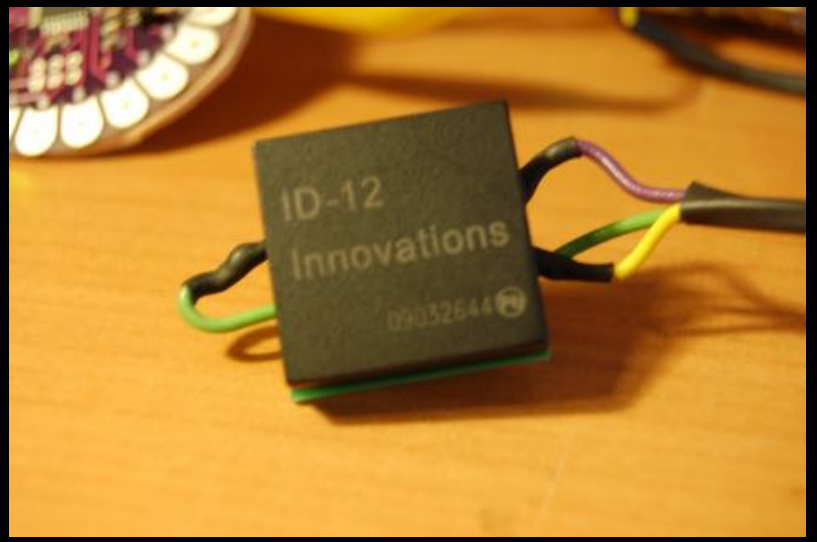





Glove Hardware



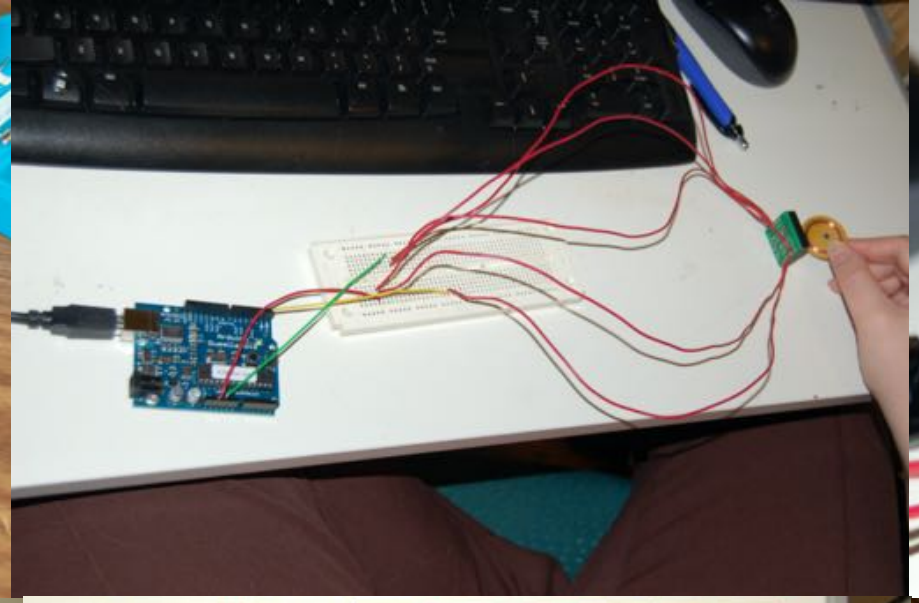
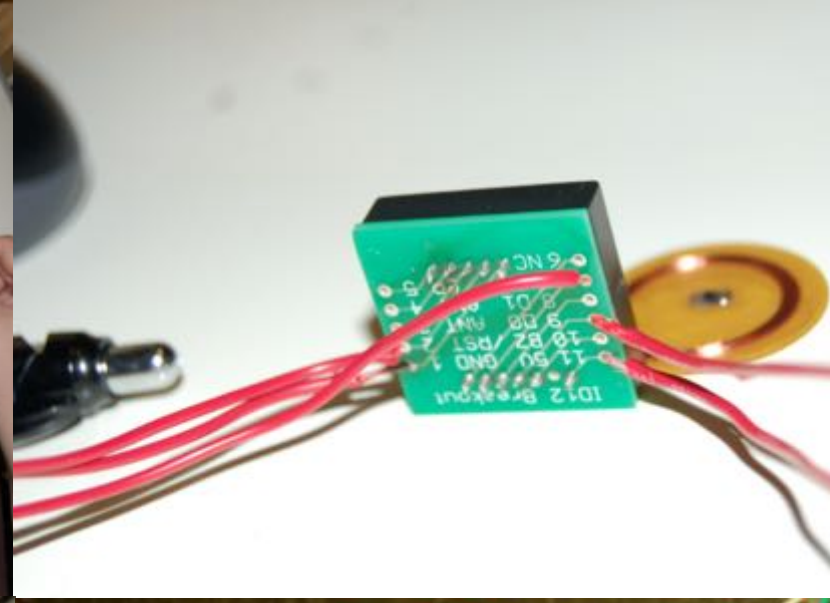
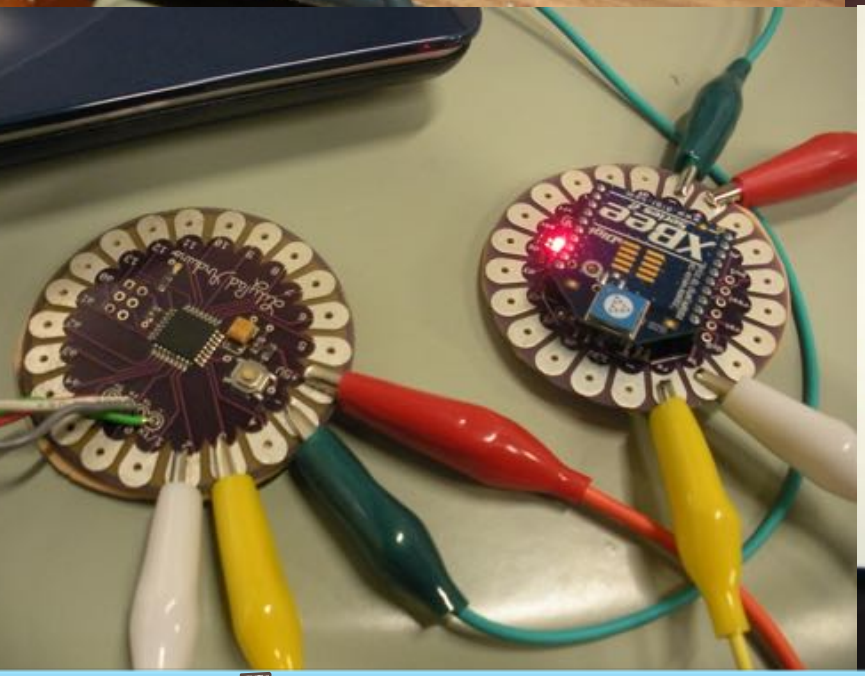


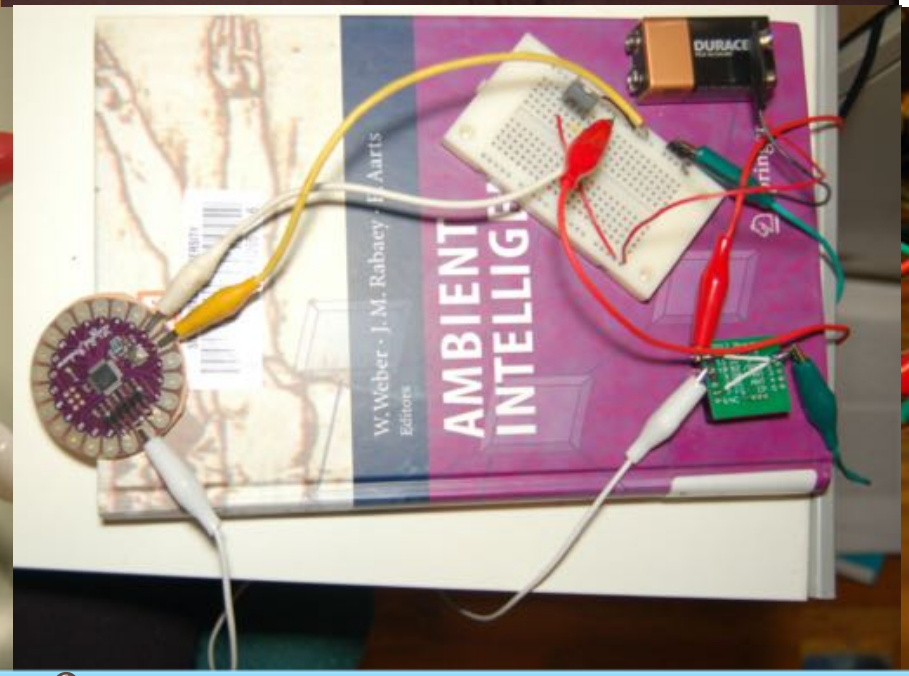


Off the shelf and hobbyist components (circa 2009)

Sourced on SparkFun.com

Highly unstable!



Early Prototyping

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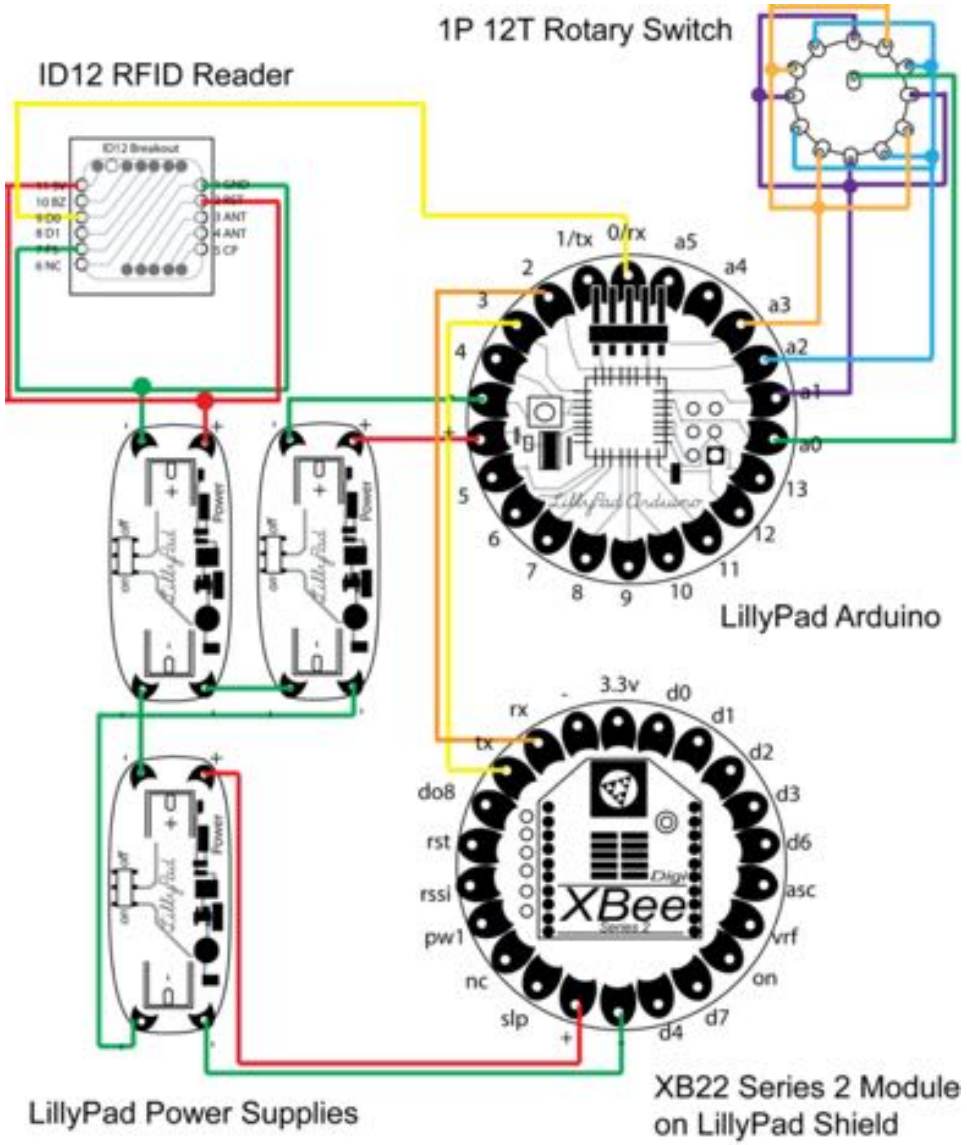
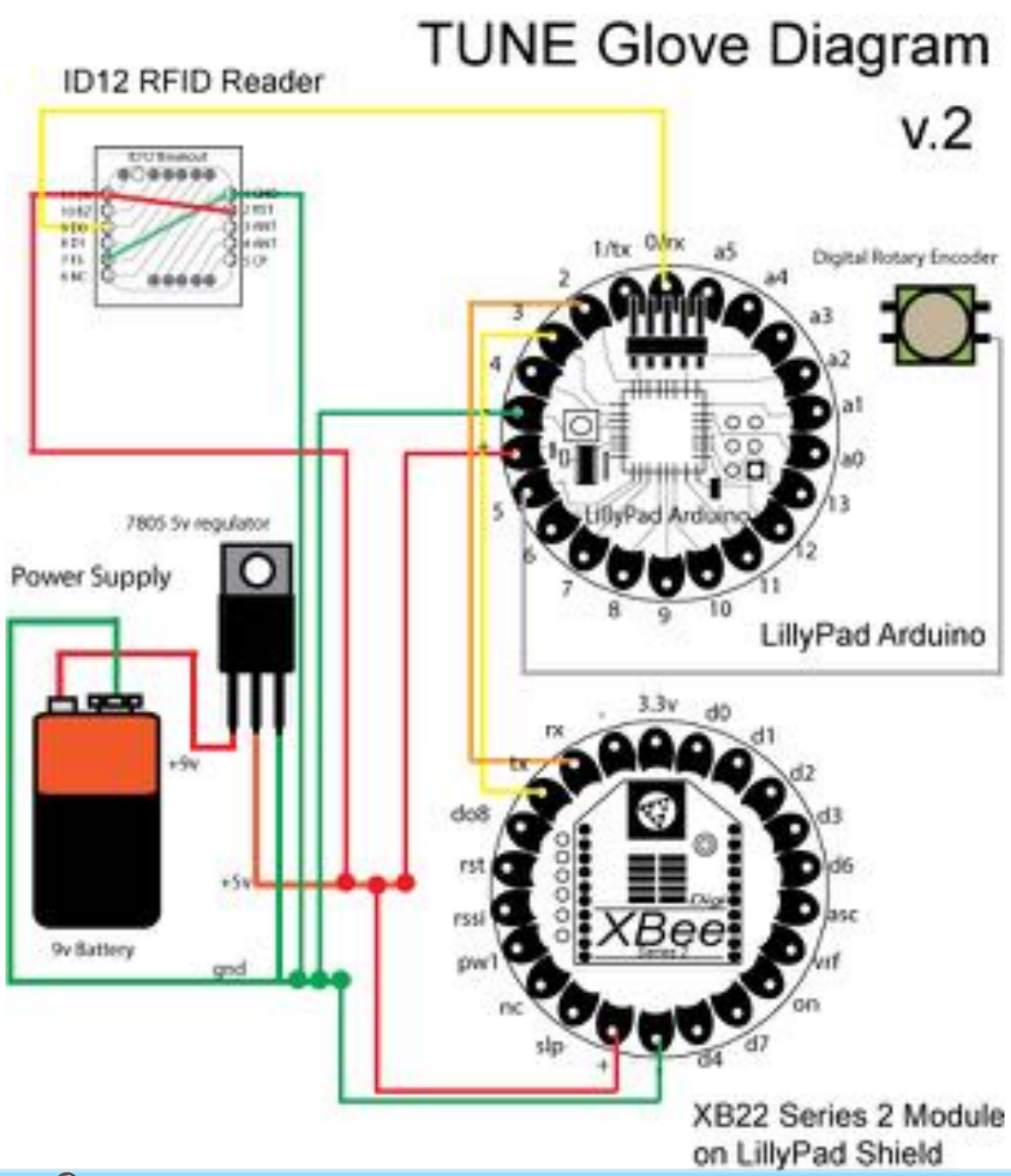
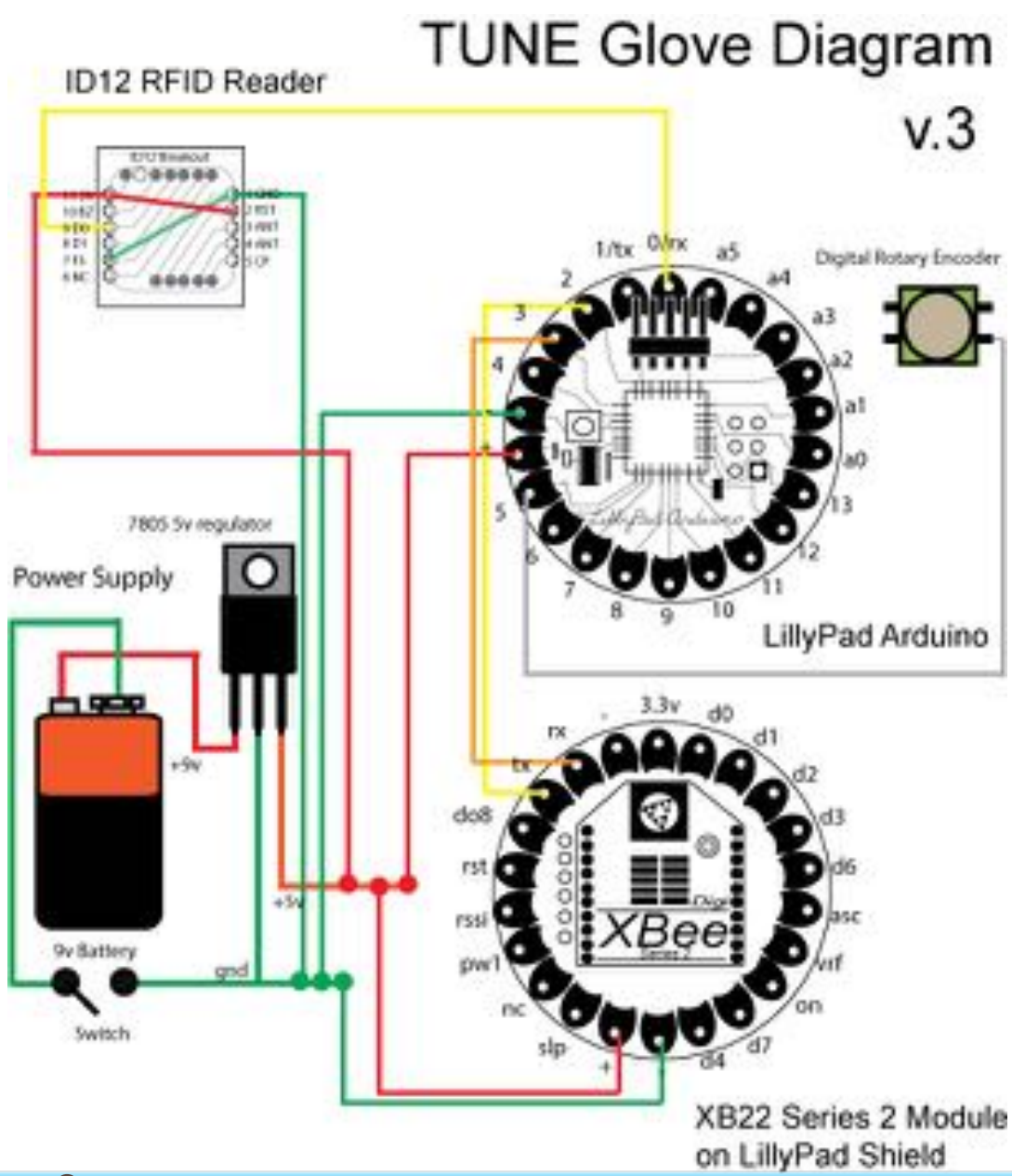


TUNE Glove Diagram

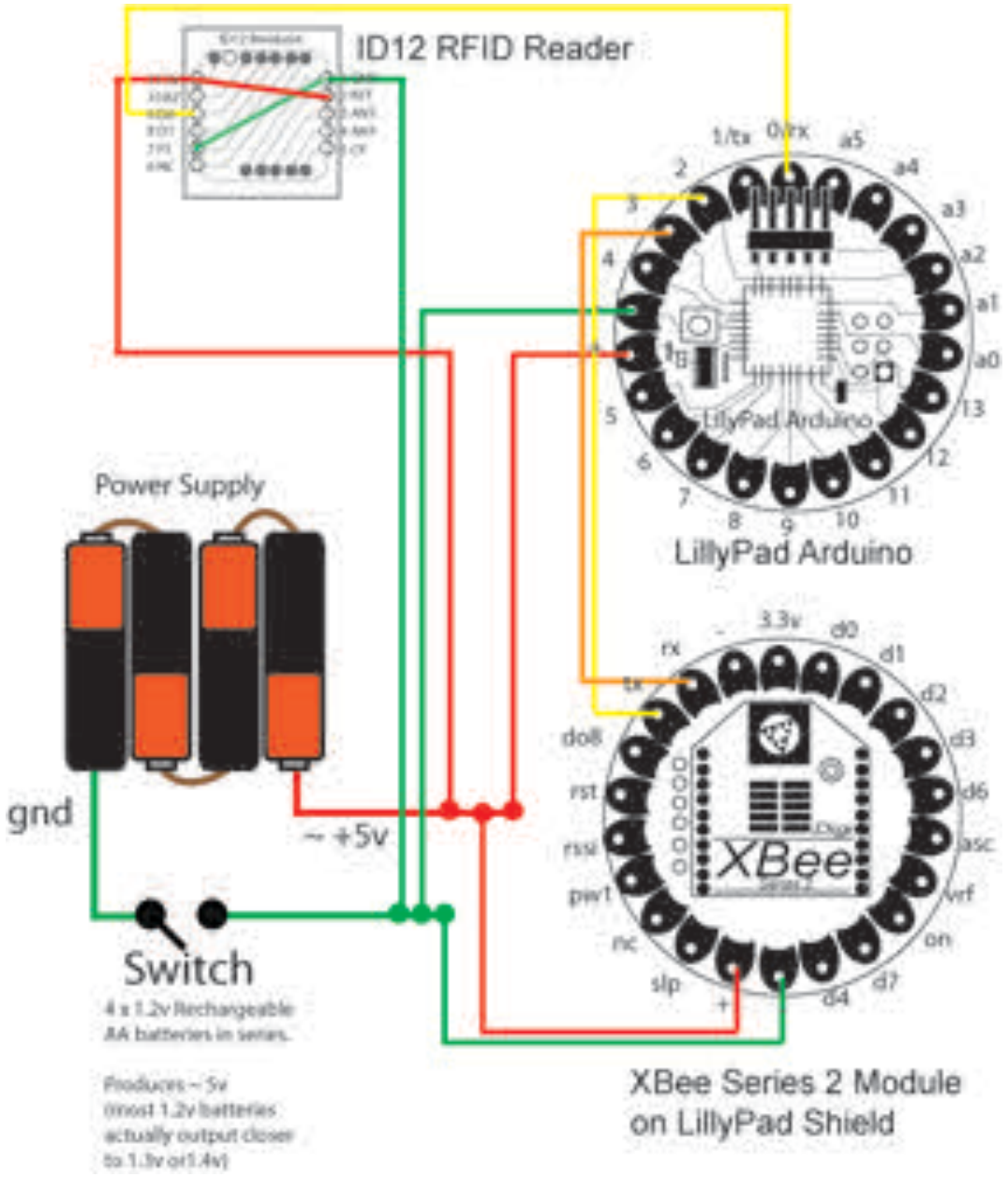
Iterative Design



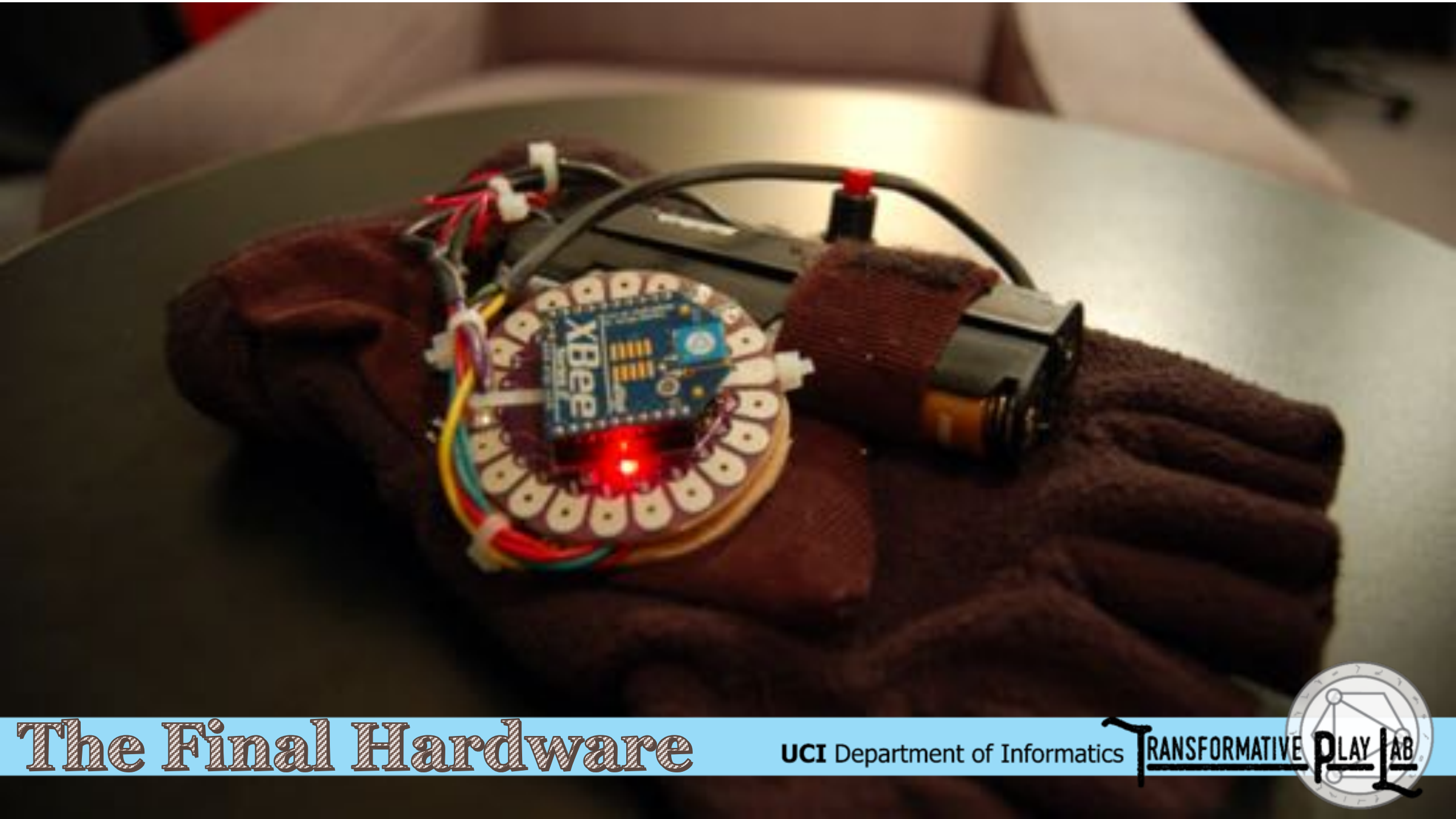
Iterative Design



Iterative Design



Iterative Design



The Final Hardware

Interaction Design Challenge:

- How would **you** solve this problem?
  - Each object has 2 lexia associated with it that you want to play alternately
    - Interactor picks up the object and Lexia A plays
    - Interactor puts down the object
    - Interactor picks up the object and Lexia B plays
    - Repeat…
  - The RFID reader sends continuous tag data so long as it is detecting a tag
    - Interactor picks up an object
    - RFID sends: “TAGID#, TAGID#,TAGID#” 5 times a second continuously until the object is set down.
  - Each lexia is a different length.
- How do you get the system to allow Lexia A to complete playing before triggering Lexia B without “hard coding” each lexia length/object interaction into the system?

Our (imperfect) solution:

- When a reader picks up an object, and the system reads its tag, Lexia A's playback is triggered
- The system then locks out any subsequent tag reads – the object is essentially dead, until…
- The reader picks up any other object and triggers any other lexia.
- This resets the lockout on the first object, and cues up Lexia B.
- This also can interrupt whatever lexia is currently playing.
- When the reader returns to the object, the new lexia plays.

Magia Transformo

-with Natalie Nygaard, Ke Jing, Mark Pareja, & Vincent Chang

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Core Concepts

Tanenbaum, T. J. (2015). *Identity Transformation and Agency in Digital Narratives and Story Based Games* (PhD Thesis, Simon Fraser University).

Tanenbaum, T. J., & Tanenbaum, K. (2015). Empathy and Identity in Digital Games: Towards a New Theory of Transformative Play. *Foundations of Digital Games, 2015*. Presented at the Foundations of Digital Games, 2015, Pacific Grove, CA.

CONCEPT #1:

OUTSIDE -> IN TRANSFORMATION VIA COSTUMED PLAY

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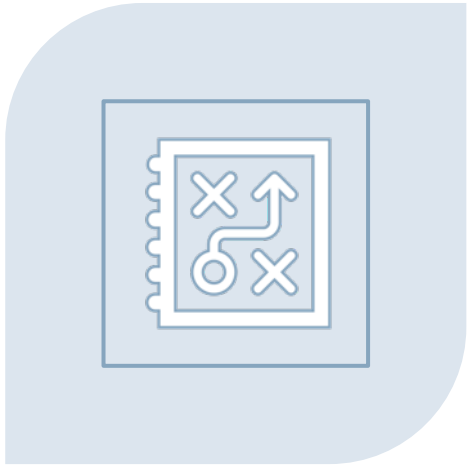

CONCEPT #2:

SCRIPTED ENACTMENTS AND BACKLEADING STRUCTURED BY GAME RULES

Core Concepts

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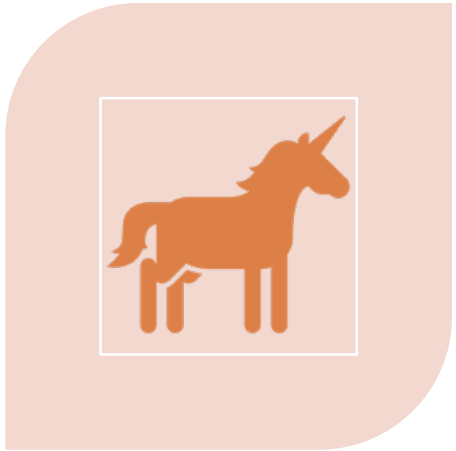


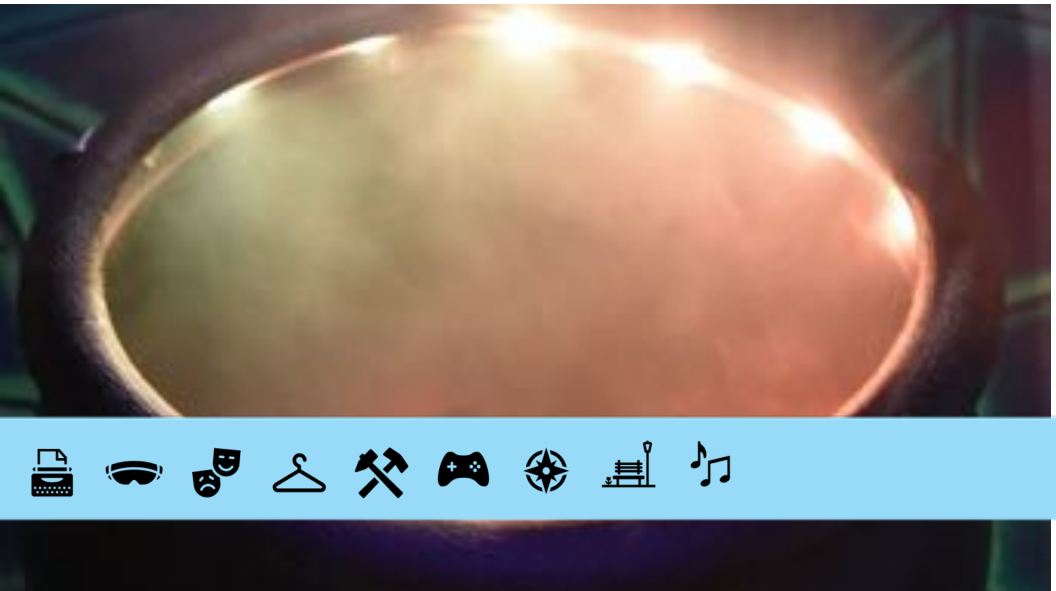
CONCEPT #3:

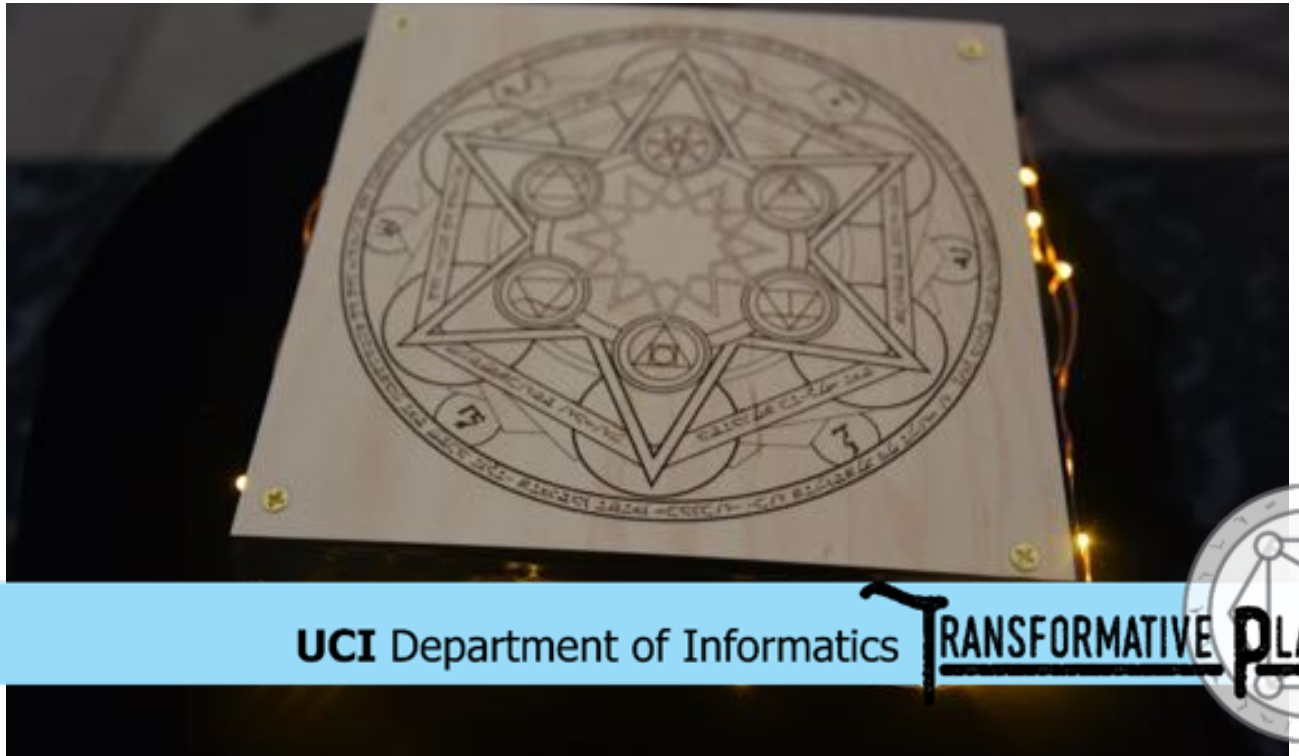
RITUAL SETTING AND SOCIAL CONTEXT PRODUCE
"CREATIVE STATE"


got fog?

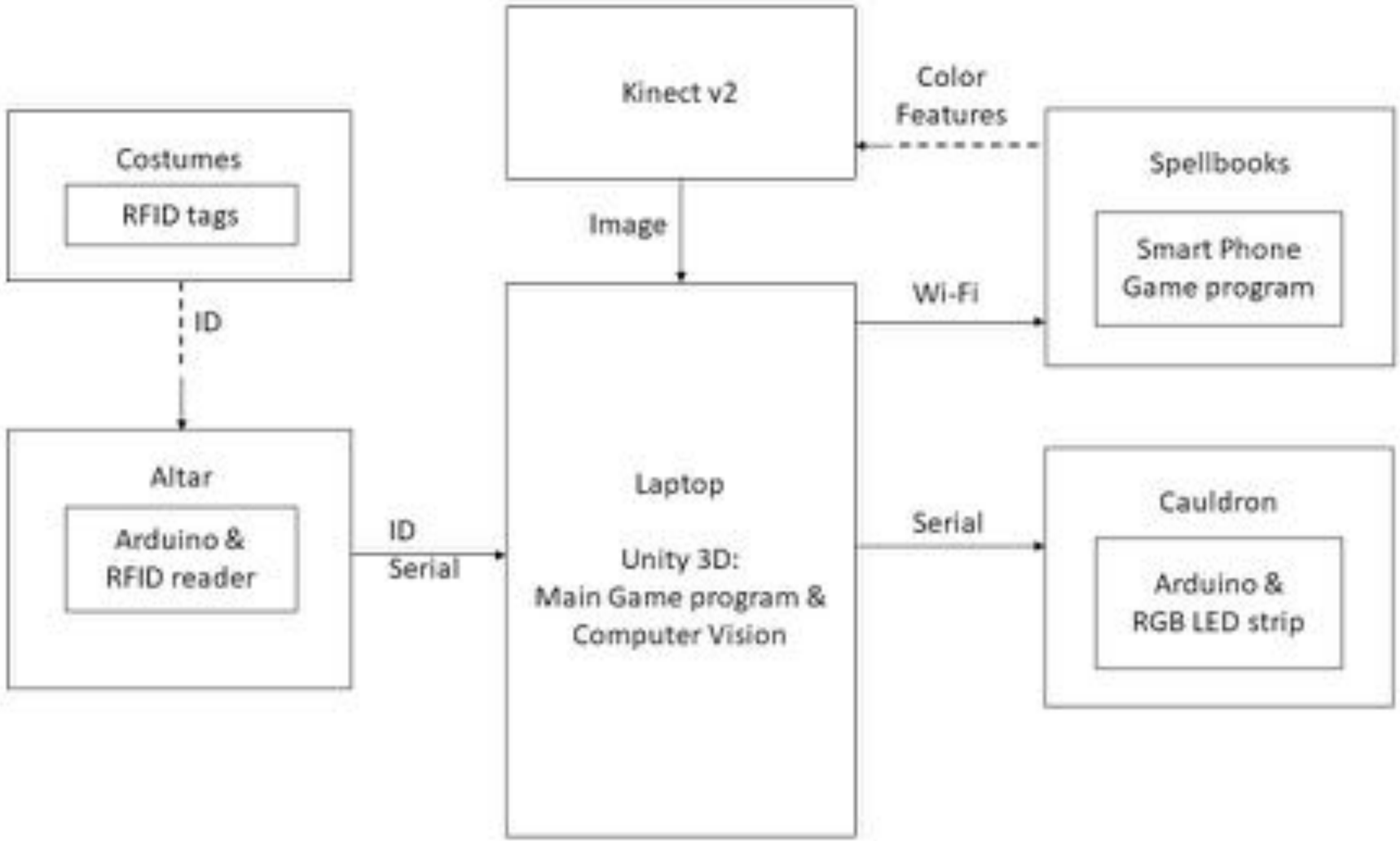

INDIECADE
SELECTION
2017


INDIECADE
SELECTION
2017

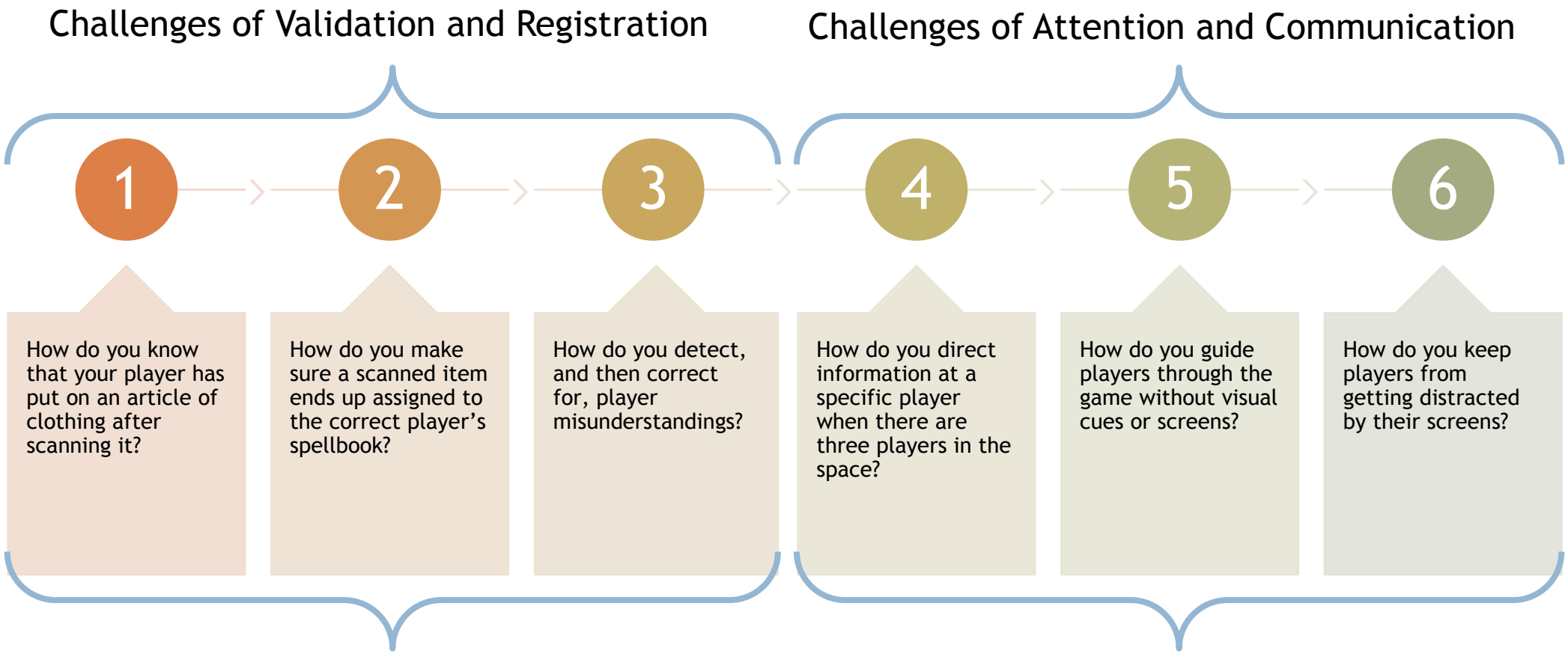




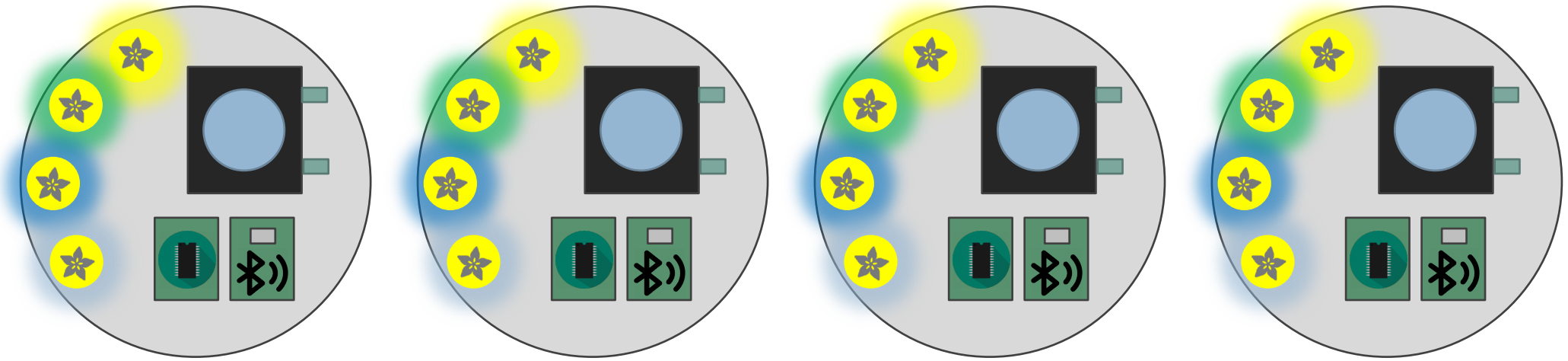

Let the dance of
transformation
begin!


Kinect v2
Color
Features
Costumes
RFID tags
Spellbooks
Smart Phone
Game program
Image
Wi-Fi
ID
Laptop
Unity 3D:
Main Game program &
Computer Vision
Altar
Arduino &
RFID reader
ID
Serial
Serial
Cauldron
Arduino &
RGB LED strip

Interaction Design Challenges



New Project: MarRker



Small attention management beacons for Mixed Reality Game Design

Adafruit NeoPixel

Push Button Switch

Atmel Microcontroller

BLE Radio

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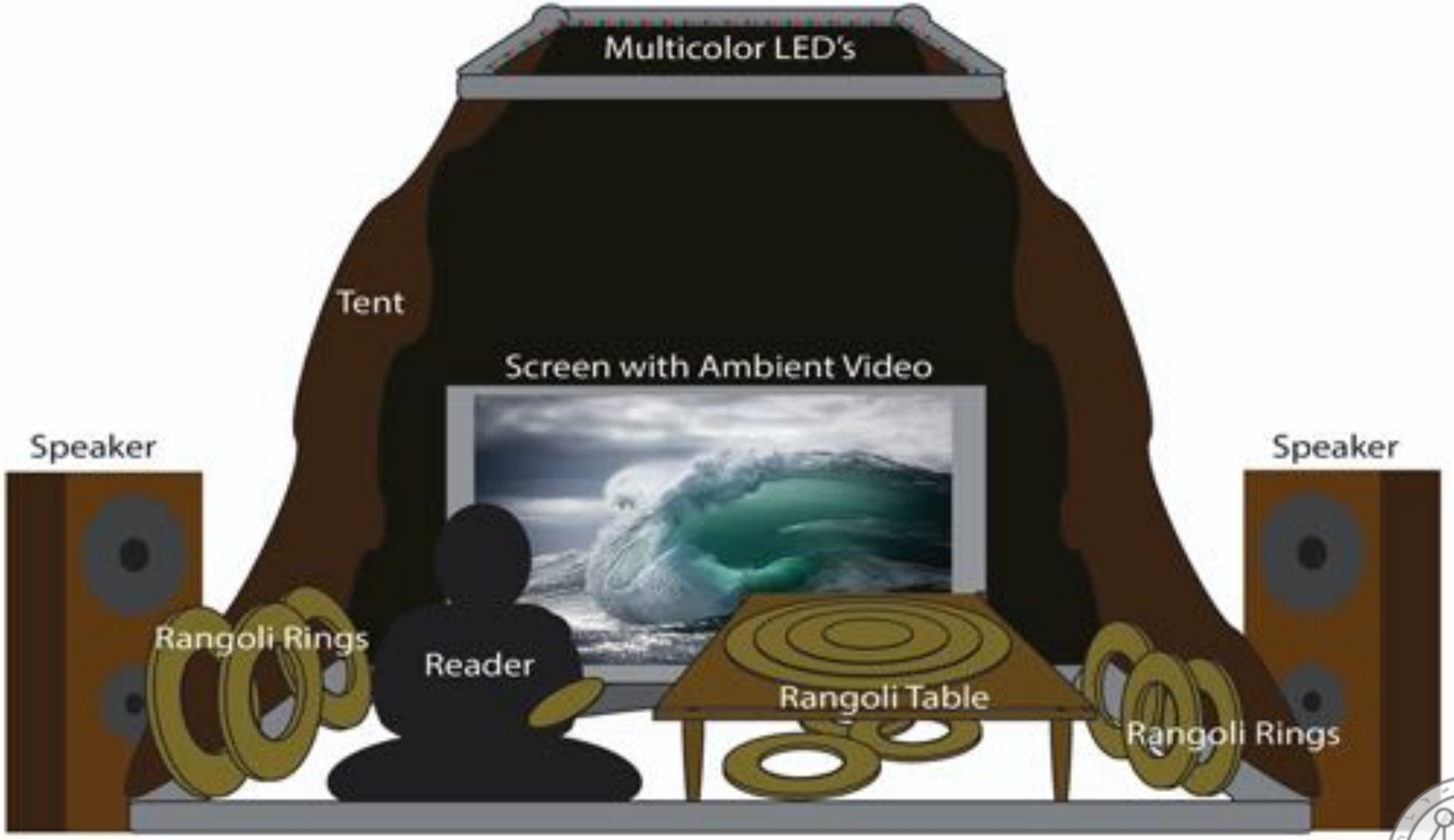
Shiva's Rangoli

by

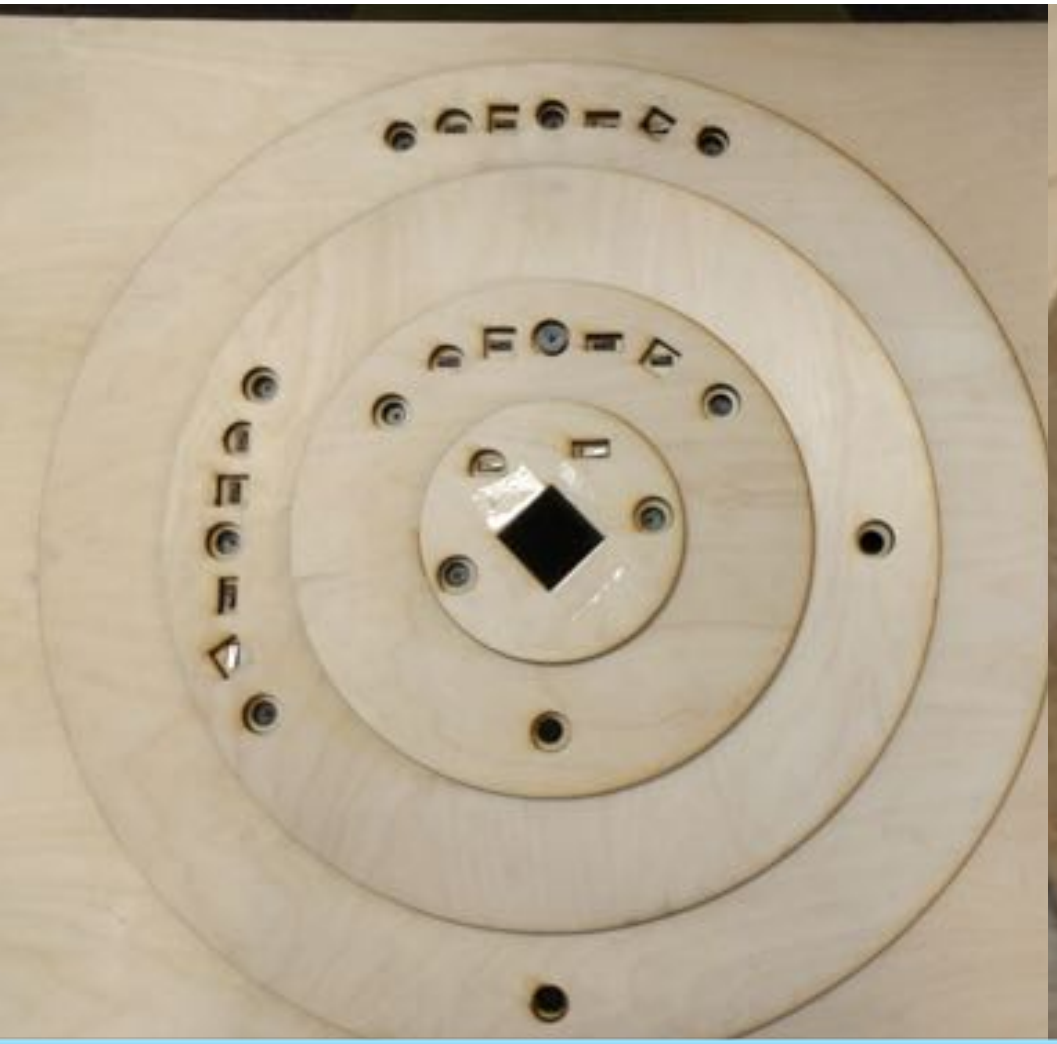
Saumya Gupta & Theresa Tanenbaum

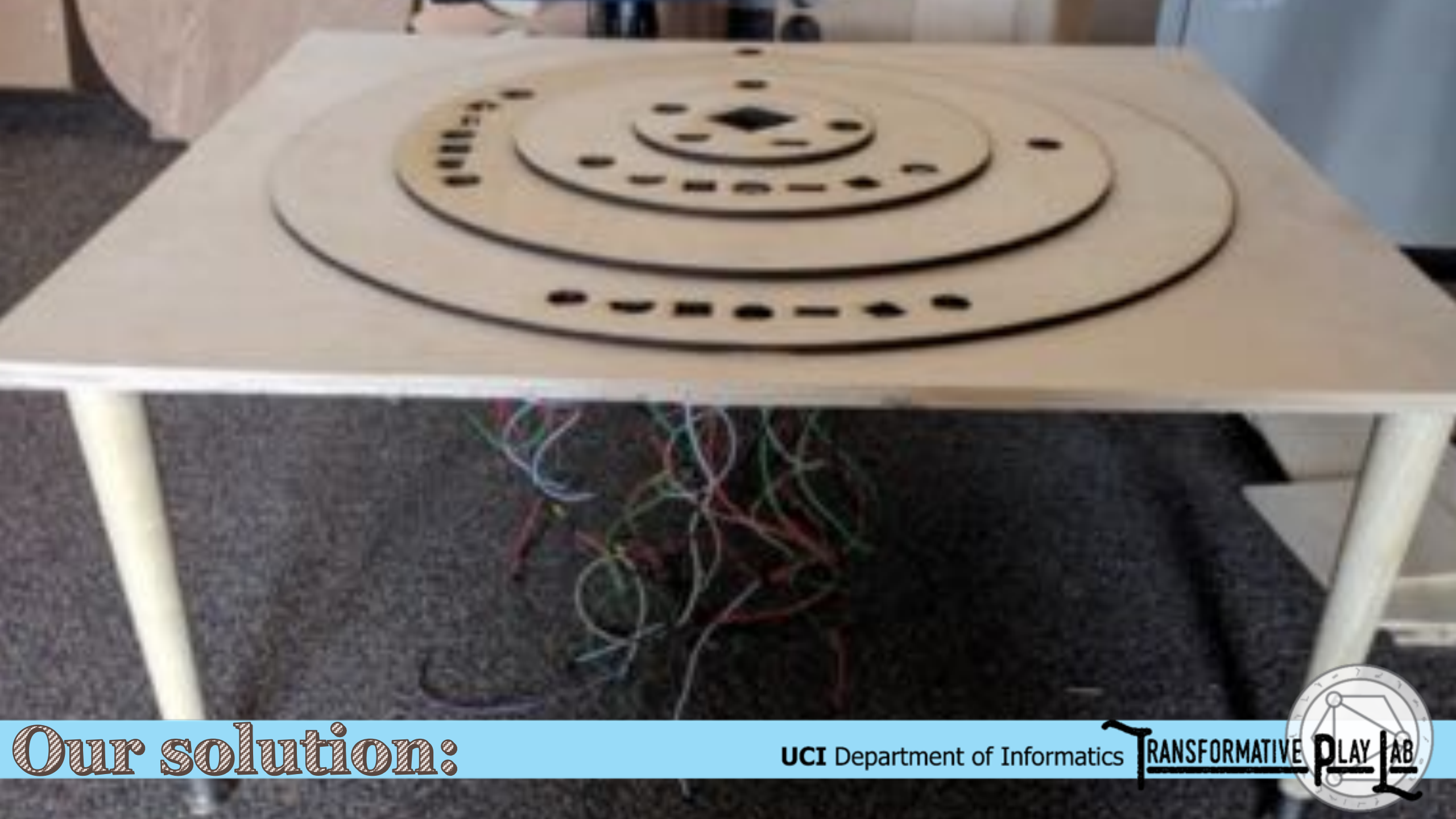

Multicolor LED's
Tent
Screen with Ambient Video
Speaker
Speaker
Rangoli Rings
Reader
Rangoli Table
Rangoli Rings

Implementation Challenge:

- For Shiva's Rangoli, we wanted the tangible tabletop to be able to detect when different rings were placed upon it in different combinations
- We had 12 rings, and 2 centerpieces to detect, for a total of 14 things that needed to be detected
- The rings needed to nest together tightly, meaning that RFID wasn't an optimal solution this time
  - Would have required 4 RFID readers, which would have been costly, and complicated to engineer
  - Rings were close together, so it would be tough to keep RFID readers from interfering with each other, or detecting adjacent rings
- To further complicate things, we needed the rings to be easily removed and replaced, but internally nested rings were hard to remove

Our solution:



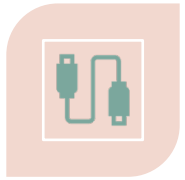


Our solution:

1. LOCATION SENSING

2. ACTIVITY VALIDATION

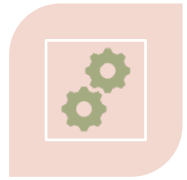
3. SIGNPOSTING AND ATTENTION MANAGEMENT



4. TRANSMEDIA INTEGRATION

5. ACCESSIBILITY

6. DISTRIBUTION

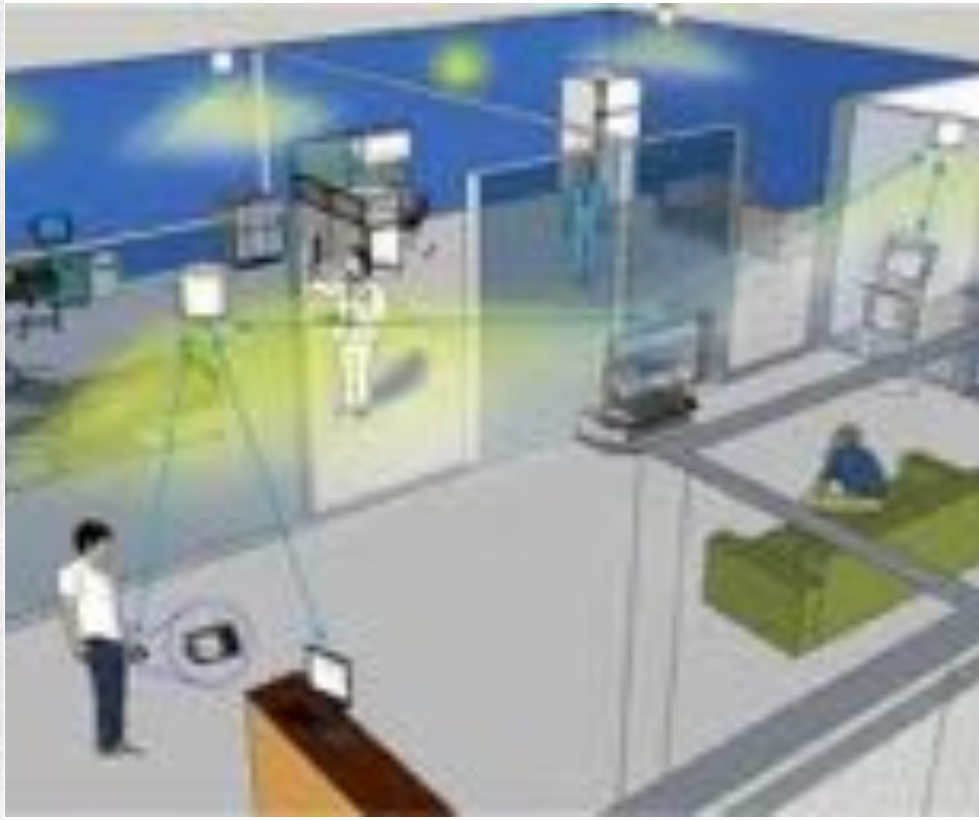


7. UPKEEP AND ROBUSTNESS

Seven Challenges for Mixed Reality Design

Challenge #1: Location sensing

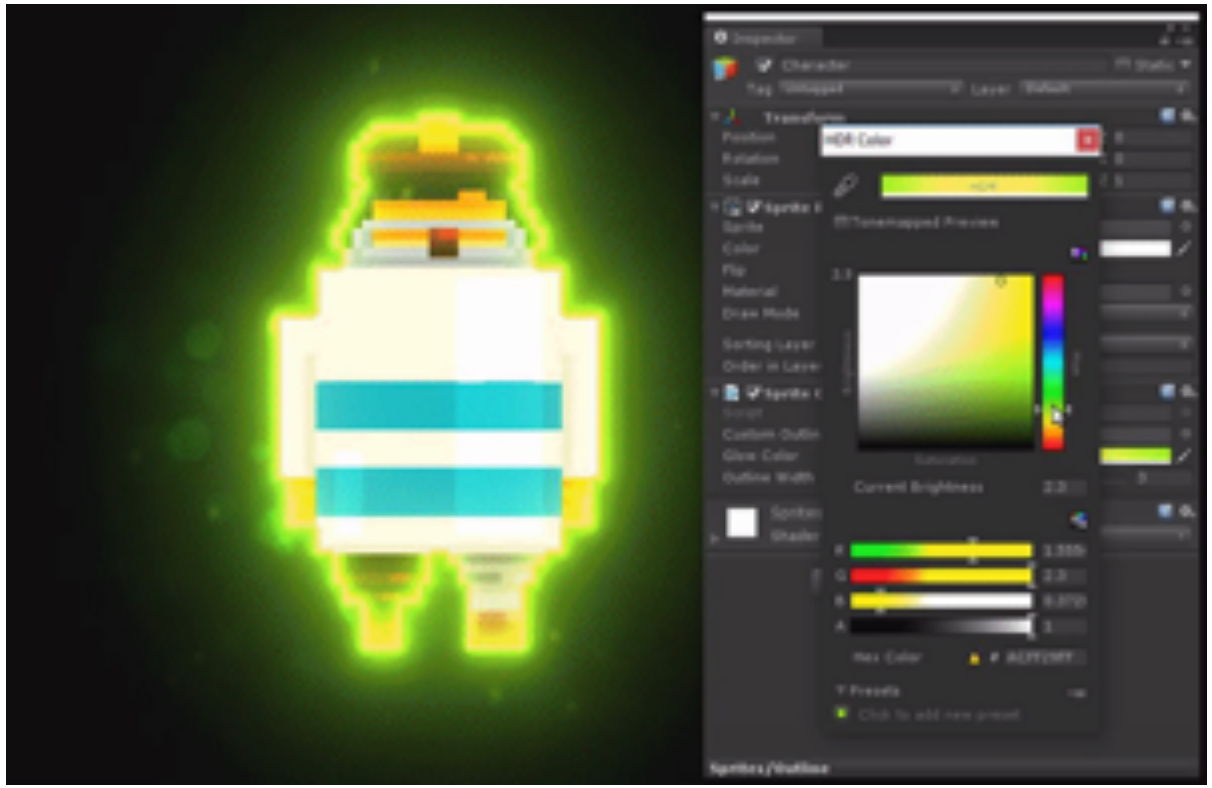
- Technologies for tracking and identifying people in space remain inaccessible.
- Solutions include:
  - Camera Vision (Kinect, blob detection, skeleton detection, etc.):
    - Strengths: fairly reliable, does not encumber users, allows for gesture detection
    - Weaknesses: limited field of view, highly sensitive to lighting conditions, doesn't differentiate well
  - Pulsed IR Beacon Triangulation
    - Strengths: allows unique identification, can be deployed over large scales
    - Weaknesses: high maintenance costs, easily occluded, cannot track fine body movements
  - RSSI Triangulation
    - Strengths: allows unique identification, can be deployed over large scales
    - Weaknesses: high maintenance costs, cannot track fine body movements, imprecise



Challenge #2: Activity Validation

- How do we know that people are doing any specific activity?
- In a software environment, we can easily verify if a user has done a desired thing, because we completely define the possibility space for interaction
- In the physical world, the possibility space for behavior greatly exceeds our ability to anticipate and respond

Challenge #3: Signposting and Attention Management



- The physical world lacks many of the affordances that we use in software to manage and direct user attention
- How do we call attention to opportunities for interaction?
- How do we guide a user through a structured experience without visual cues?
- If we are reliant upon audio cues, how do we manage distractions, interruptions, overlaps, and other environmental factors?

Challenge #4: Transmedia Integration

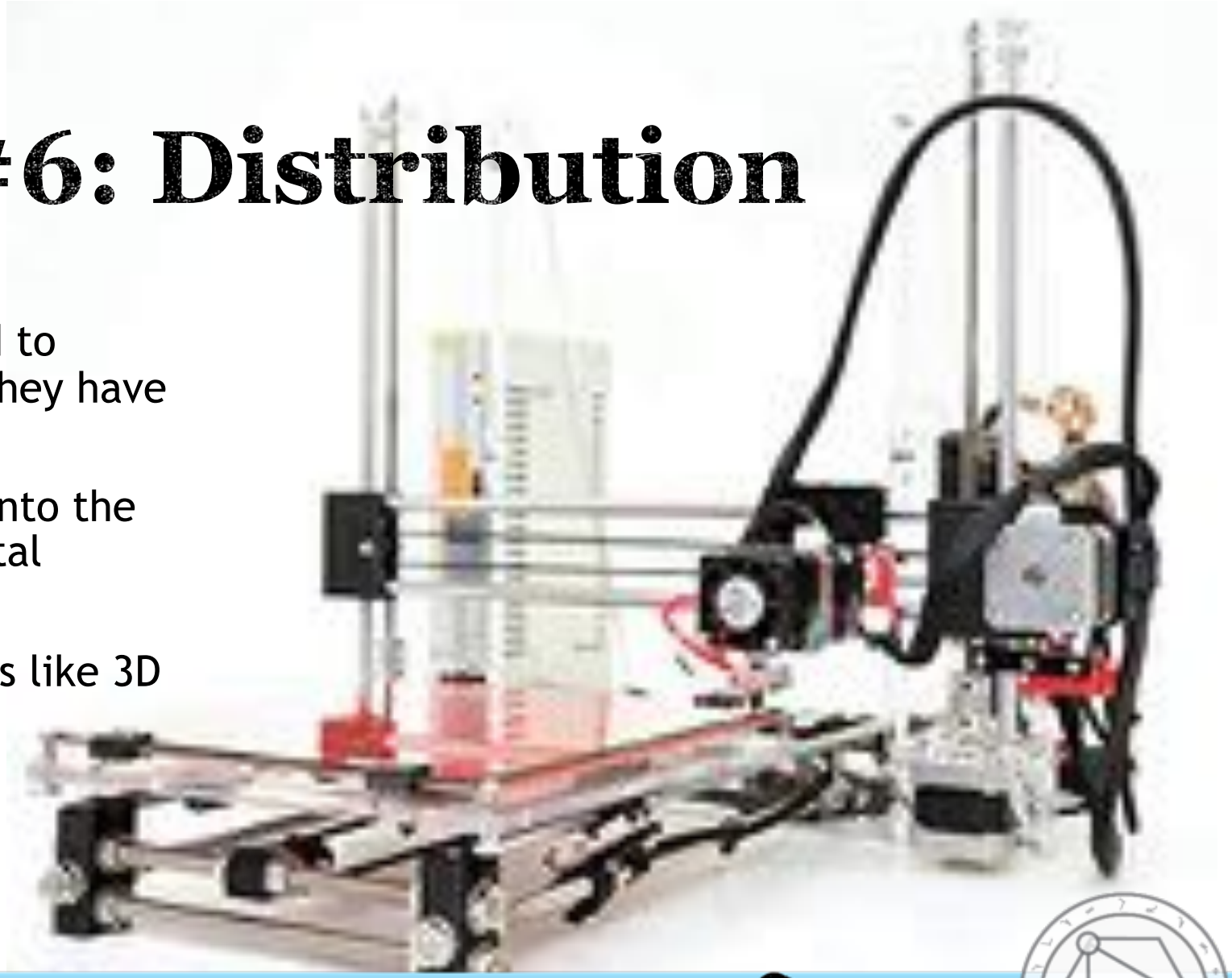
- Mixed reality design often requires us to combine various technologies and media in new and unique ways.
- How do we get different generations of technology to play well together?
- How do we manage all of the different drivers, platforms, connections, and data types needed to work these systems?
- How many USB connections are too many?

Challenge #5: Accessibility

- Mixed reality design is often more physically demanding than screen-based design
- How do we support users with diverse levels of ability?
- How can we learn from accessible design to improve mixed reality design (e.g: audio-only interfaces)?
- How do socioeconomic factors impact accessibility (e.g.: why build anything for a $3000 HoloLens?)

Challenge #6: Distribution

- Mixed reality designs are hard to digitally distribute, because they have physical elements
- How do we get out work out into the world when we can't use digital distribution methods?
- Can access to fabrication tools like 3D printers offset some of these challenges?



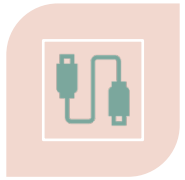
Challenge #7: Upkeep and Robustness

- Most of these systems require significant ongoing maintenance in order to function
- Regular use is enough to cause significant wear and tear:
  - Solder joins snap
  - Batteries lose their charge
  - Cables fray
  - Drivers become outdated
  - Replacement parts become obsolete
  - Students with expertise graduate
  - APIs are retired or changed
- How do we design systems to withstand regular use, and the vagaries of time?

1. LOCATION SENSING

2. ACTIVITY VALIDATION

3. SIGNPOSTING AND ATTENTION MANAGEMENT



4. TRANSMEDIA INTEGRATION

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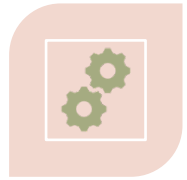

7. UPKEEP AND ROBUSTNESS

I don't have all the answers!
Thank you for your time!
Any questions?