Evolve

A PHYSICAL MEDIA TOOL FOR KIDS TO PLAY & LEARN

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COSMIC IDC IIT Bombay

NANYANG TECHNOLOGICAL UNIVERSITY

Declaration

The research work embodied in the written submission titled "Evolve- A Physical media tool for kids to play & learn" has been carried out as Project 3 by the undersigned as part of the post graduate program in the Industrial Design Centre, IIT Bombay, India under the supervision of Prof. Ravi Poovaiah and Dr. Ajanta Sen.

The undersigned hereby declares that this is an original work and has not been plagiarized in part or full from any source. Appropriate reference information or links have been provided wherever due. Furthermore, this work has not been submitted for any degree in this or any other university.

I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action if need arises.

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Approval Sheet

This Interaction Design project entitled “Evolve- A Physical media tool for kids to play & learn” by Debasish Biswas, 136330010, is approves in partial fulfillment of the requirement for Master of Design Degree in Interaction Design.

Project Guide

Chair Person

Internal Examiner

External Examiner

Date: 27/06/2015

Acknowledgement

I would like to express my sincere gratitude to Dr. Ajanta Sen and Professor Ravi Poovaiah for their support and guidance. Without their constant efforts of trying to push me to find a purpose, this would not have been the same.

Furthermore,I would like to thank Prof. Anirudha Joshi, Prof. Venkatesh Rajamanickam and Girish Dalvi for their valuable ideas and insights during the various stages of presentation of project.

I am obliged to many of my friends who supported me, at various stages during the process of making this happen. The project wouldn't have been the same without them. Thank you Riken "Patel" for your robotic expertise, without you the prototype would not have been possible. Trivikram, Sanket and Maharaj for their frequent discussion and motivation and Debakshi for her presence. I would like thank my parents and sister for their motivation and understanding.

I would also like to thank Industrial Design Centre, IIT Bombay for providing me with all the facilities and necessary materials and an environment that encourage me to work on such a challenging project.

Project Timeline

DEC

- Finalizing the topic
- Defining the need of the problem
- Secondary research

JAN

- Secondary research
- Understanding the current process

MAR

- User studies
- Analysis and personas
- Redefine the brief
- Concepts

MAY

- Analysis
- Concepts and ideation
- Prototyping

JUNE

- Report writing
- User feedback
- Finalizing the design
- Evaluation

Table of Content

Introduction

The motivation for the project was observing kids play and having fun. What if kids can learn while playing games? Can games be used to teach? Can we change the way video games are played with today? How would this new interactions be? I began this project with these questions. The project was sponsored by COSMIC. I finished primary and secondary study before going to NTU, Singapore for working on the project. This visit gave me a fresh perspective and I started my secondary study from scratch.

About COSMIC

The Centre of Social Media Innovations for Communities (COSMIC) is a collaborative initiative between three centers of excellence – two from Singapore, the NUS (National University of Singapore) and the NTU (Nanyang Technological University), and one from India, IITB (Indian Institute of Technology Bombay, Mumbai).

COSMIC aims to empower communities, through social media innovations that improve the way they live, work and play, specifically those in the informal economy who are typically under served by existing technology.

The initial project objective was to add new gestures and content to the Pubby platform, which is an intuitive platform for children (4-7year), to interact, learn and play in remote situation. Its important to note that this project or its details were not disclosed to me until the end. No work presented in this project is taken from Pubby project.

This project will be taken forward as an alternative to Pubby project as it is based on different technology and design research.

Abstract

Kids are playful and imaginative by nature. Digital media games has become very popular among kids these days and this trend is just going to peak as we get more depended on digital technology. How should kids interact with digital media?

Secondly, the current education system is like an industrial production line setup. Forcing kids to not grow at their own pace. Children need conducive learning environment to play and learn. Kids can learn best from experiential learning. The goal of this project is creation of a new play and learn environment, which is tightly interwoven with a child's everyday live through the objects and devices that surround him/her and the spaces they inhabit.

This project is attempt to provide a play and learn platform using physical toys from kid's world. I looked at using puppets as facilitators for learning. Physical toys such as puppets are from the realm of a child's imagination and therefore they relate to it. The platform will allow kids to participate in active role playing game-play and interact with their environment using a puppet glove. This play & learn platform consists of a multi-sensorial physical glove with gesture based input and a content module with different games .

The project contributed to study and classification of games/toys. It also contributed to classification of social gestures. A set of nine gestures were derived and implemented from these studies. These gestures were mapped on to a physical puppet, e.g. moving the hands of the puppet will move the virtual character's hand onscreen. The final set of gestures were arrived at after testing with kids for intuitiveness and ease of use. The project contributed to implementation of a working prototype. The prototype consists of the puppet glove and three working game modules with finalized set of gestures.

Scope & Objective

The project is targeted at group of children aged 7-10 years. These children are learning to read and have started to engage in structured team play. Seven year old and above prefer to engage in physical activities which lets them move around and develop social skills. The scope of the project would be to study kid's indoor play and study environment and get insights regarding factors that can influence intended play and learn environment. The focus is more on implementation of a working platform.

The objective is to create physical media tools for kid's play & learn environment. The platform would allow children to interact with virtual environments using physical interfaces. This would involve study of existing games and toys across various age group of kids. I will also study gestures and develop a new set gestures for the intended platform.

Figure 1. While playing with building blocks

Figure 2. Engaged in art activity

Primary Research

Aim of primary study was to Interact with children to get insights on their play behavior, learning behavior, dislikes, peer interactions, ways of developing soft skills etc.

Play is the way children learn. Through play, children learn about themselves, their environment, people and the world around them. As they play, children learn to solve problems and to get along with others. Theorist John Dewey suggests that children learn best by both physical and intellectual activity. [1]

Play is a necessary element of healthy development for children of all ages. Play influences all areas of development; it offers children the opportunity to learn about the self, others, and the physical environment [4].

For this project I am focussing only on indoor environments due to safety and moderation concerns raised by parents. Also, reducing number of playing spaces like parks in our urban neighborhood added to the decision.

User study 1

I visited an urban nuclear family, where both parents were working and interacted with their son. He is the only child and therefore often spends play time alone (Figure 1, Figure 2). Observation and shadowing is used to observe the kid during his play routine and activities over a period of one week. Following inferences were made from the study:

- Kids are physically very active. Even when there is no need for physical movement.
- They love to role play as adults and characters from cartoon show.
- They create their own content for different activities and make rules as they play along.
- They are very possessive about their belongings. And have an distinctive sense of identity about their likes and dislikes.

Feel

Cognitive and emotive factors

Age

Games and toys kids play with are age specific

Activity

Physical to non-physical

Behave

Roleplay, Identity, Influence, etc.

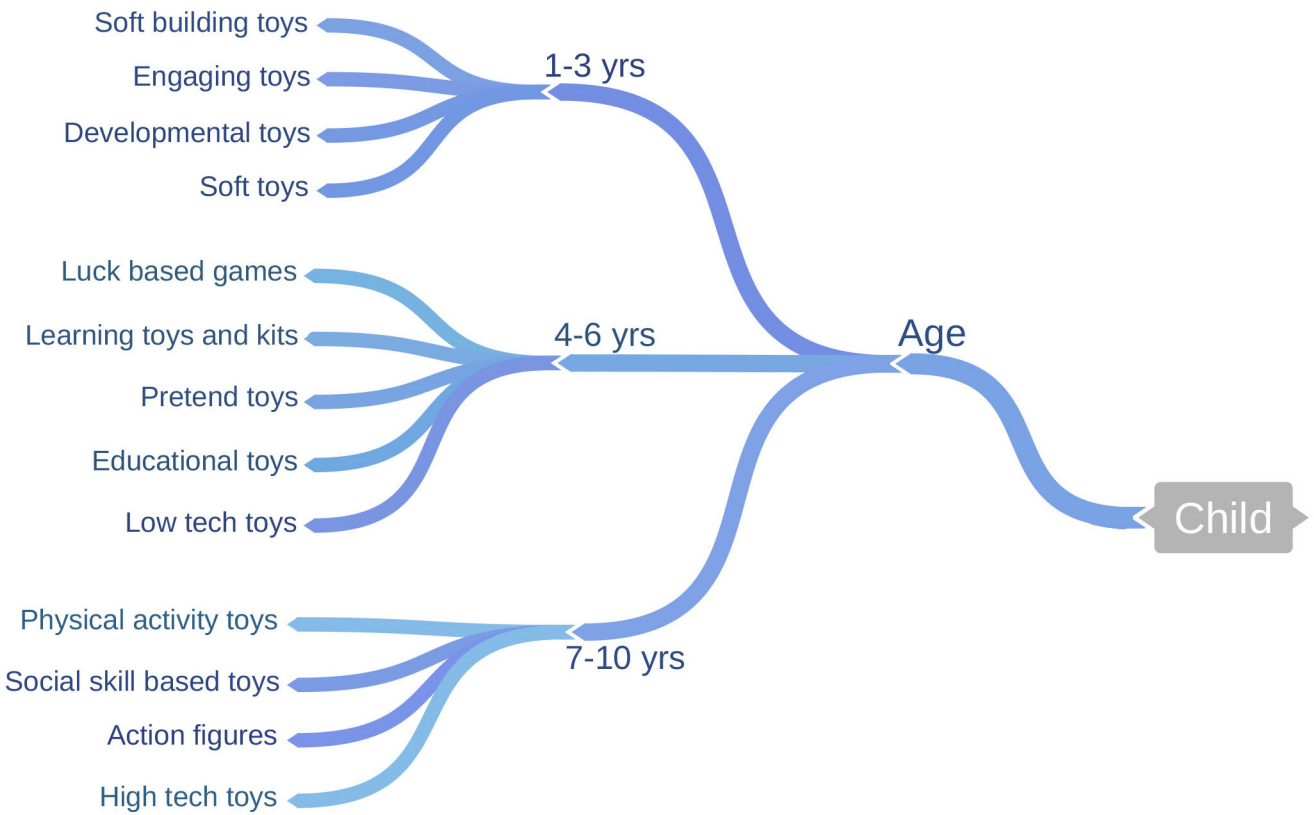
Nature of the user

During my user study 1 and going through relevant literature, I found that children's free play is a complex concept; but children's play typically is pleasurable, self-motivated, imaginative, non-goal directed, spontaneous, active, and free of adult-imposed rules[2]. Quality play involves the whole child: gross motor, fine motor, senses, emotion, intellect, individual growth and social interaction[3].

In times of confusion children invent their own game play and rules with group approvals. They devise fair play themselves to pick the captains and teams. [4] Well known example of a system that lets children create their own content is Scratch. Similarly, offerings such as LEGO Mindstorm allow children to create interactive systems.

The age group for this platform is 7-12 years. I have identified the following four factors that would help us understand about the nature of the kids. These factors are as follows:

- Age
- Feeling
- Activity
- Behavior



By the age of 7yrs children start developing social skills

Age

Age 1-3 years

- Things to build with- large soft blocks and wooden cubes
- Things to use their large muscles with- large balls, push and pull toys, and low, soft things to crawl over
- Engaging toys- Board books with simple illustrations or photographs of real objects
- Recordings with songs, rhymes, simple stories, and pictures

Age 4-6 years

After the age of 4 children begin to play actively with each other. They like to act out grown-up roles and enjoy costumes and props to help them bring their imaginations to life. Materials for arts and crafts are also popular with this age group, as they enjoy creating things with their hands.

- Things for pretending and building—transportation toys, construction sets, child-sized furniture ("apartment" sets, play food), dress-up clothes, dolls with accessories, puppets and simple puppet theaters, and sand and water play toys
- Low tech toys, educational toys, learning kits and luck based games

Age 7-10 years

School-age children enjoy play that requires strategy and skill.

- Board games, tabletop sports and classic toys like marbles and kites are favorites.

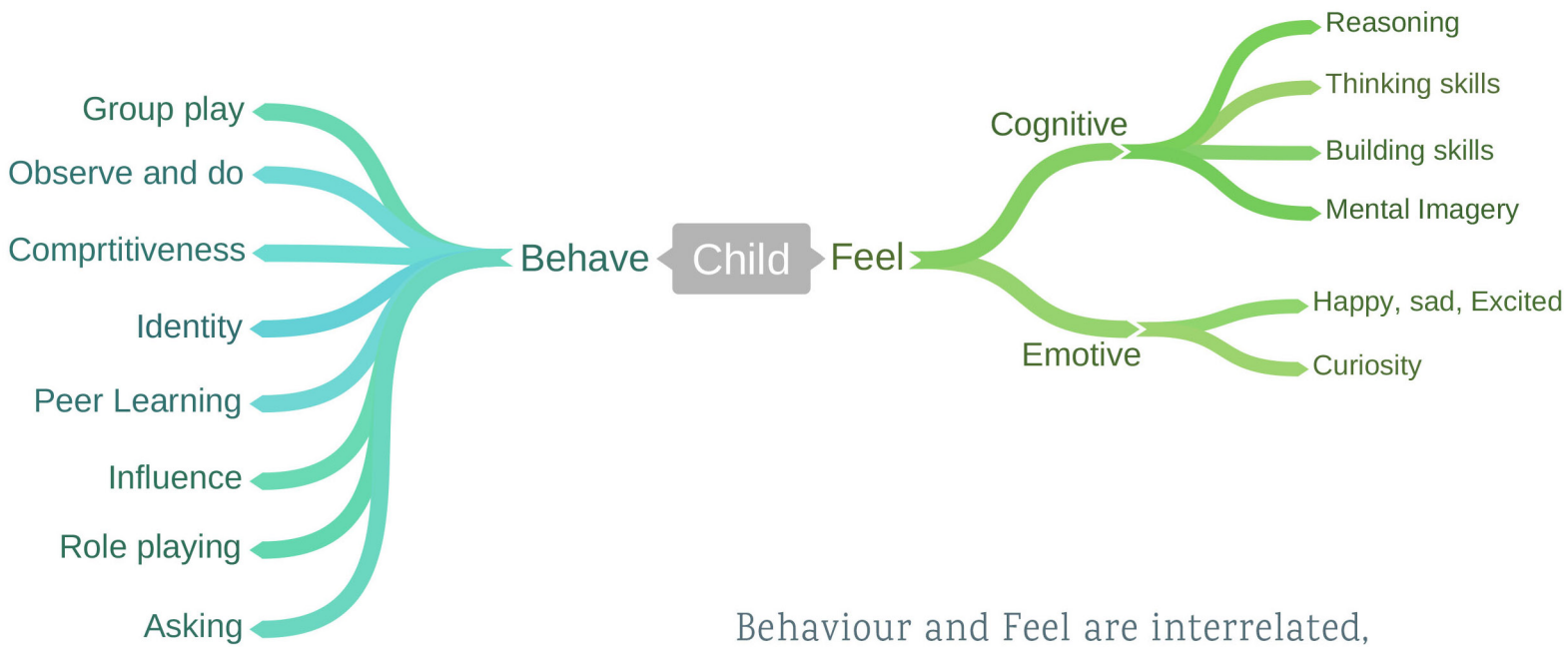
- kids also enjoy exploring different kinds of grown-up worlds and like fashion and career dolls and action figures.

- Children this age seek out new information and experiences through play and enjoy science, craft and magic kits.

Age 11-13 years

- Pre-teens begin to develop hobbies and life-long interests and enjoy crafts, model kits, magic sets, advanced construction sets, science kits and sophisticated jigsaw puzzles.

- Painting, sculpting, ceramics and other art projects continue to be of interest.



Behaviour and Feel are interrelated,
one influences the other.

Behavior and feeling

By the age of 7-12 years kids display various traits of behavior. They start engaging in group play, learn from observing and doing among various other traits like competitiveness, identity, peer learning, influence etc.

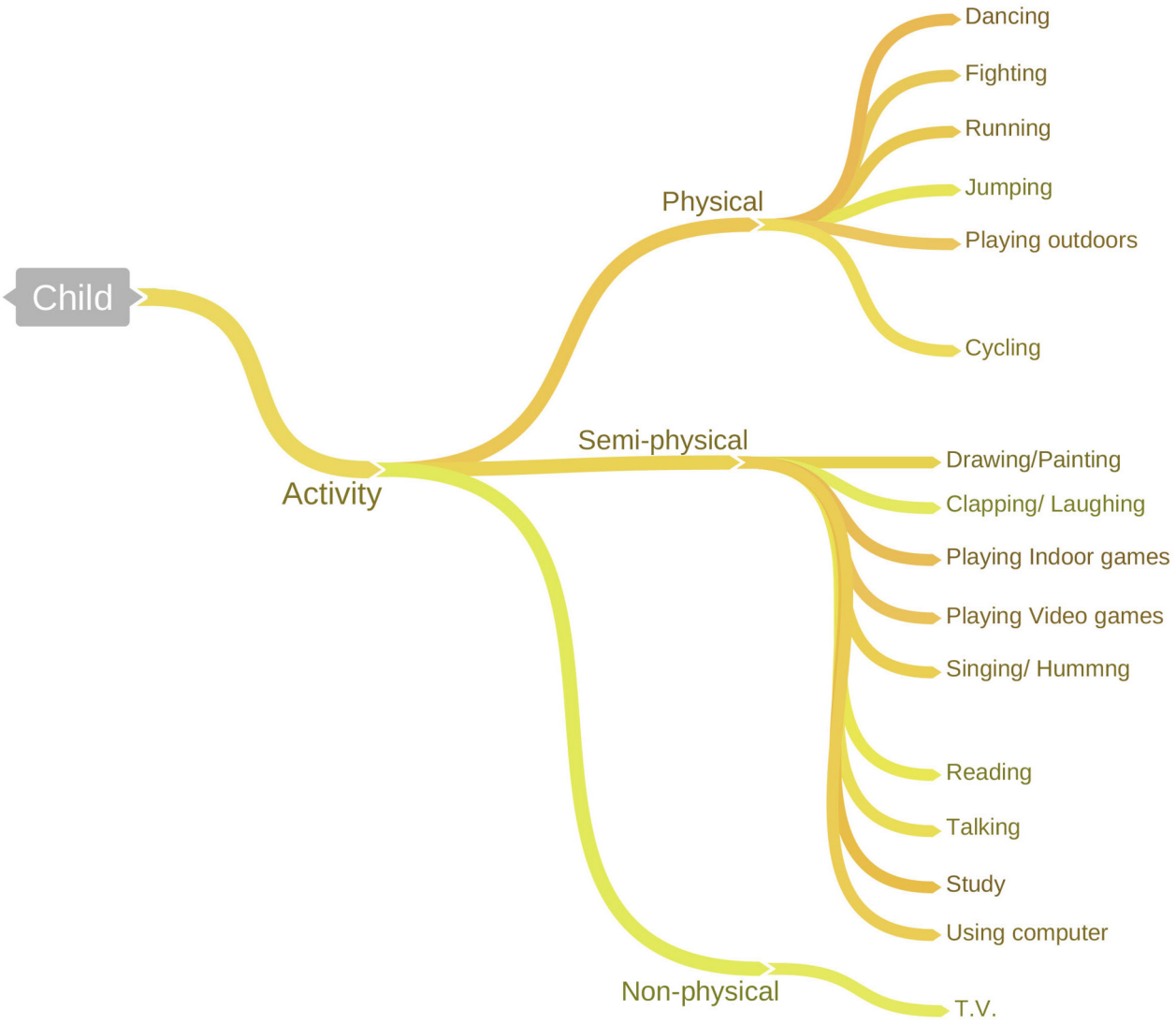
Researchers have distinguished three main categories of play in relation to children's development[5]. These are summarized below:

Play and physical/motor skill development- The desire to run, jump, crawl, climb and swing is the natural way through which children's bodies develop.

Play and social development- Play enables social and emotional development through activities where children must play with others, share and cooperate, respect other views, express their ideas, feelings and needs without the constant mediation of an adult.

Play and cognitive development- Through play children discover, explore and develop an understanding of the environment around them. Through their exploration and experience of the social, physical and natural environment they become familiar with the patterns and systems of life and the interconnectedness of these with themselves.

Activities like reading and study may not be physically intensive but they are highly cognitively loaded.



Activity

I mapped different activities of kids into physical, semi-physical and non-physical activities. The types of play activities characteristic of each of these developmental activities include:

Physical/motor skill activities-
Playing on fixed structures, participating in structured games, using free equipment (e.g., bats/balls).

Social/non-social play activities-
Talking with others, watching others, reading, daydreaming– this could include onlooker activities where children watch the activities of others but do not attempt to engage in the activity, and unoccupied behavior when children demonstrate a marked absence of focus or intent. This could include children staring blankly into space or wandering aimlessly.

Cognitive activities (including imaginative and creative play)-
building or making things with loose materials, observing and interacting with nature, exploring environment, engaging in imaginative activities (role plays, drama, fantasy).

As observed some activities such as studying are not physically intensive but are cognitively intensive. This congnitiveness is perceived in many cases. For Eg. Kids learning science from textbooks and the same activity taught using game and models.

Figure 3. Students from Jafrey School

Figure 4. Teacher using instructional techniques

User Study 2

After getting a basic understanding of kid's behavior in their play environment I wanted to study their learning environment. I went to Jafery School is located in Shivaji Nagar, Govandi. My friend is teaching in this school as a Teach for India fellow therefore it was convenient to get permission and sit through during classes. It is an english medium high school. The school is located in a low income Muslim Community. Whole day was spend to attend science classes and do analysis using observation and interviews. The same topic was taught in two sections during a span of two periods each.

36 students of 8th Class
Science periods- 2 of 35min each
English medium school
Topic being taught
Science chapter 17,
Topic17.4 – The solar system

Learning Objective – Set by teacher

Upon interviewing the teacher regarding the teaching principles practised by them, I got many valuable information. They used an objective setting format called Mager's format. [4]

Objective 1 (knowledge)
Students will be able to recall and list at least 2 properties of a planet accurately.

Objective 2 (analysis)
Given a list of two planets the students will be able to compare and contrast between them.

Higher order objective
Improve English vocabulary

Learning strategies used by teacher

I learnt about different learning strategies used in school for teaching kids. For e.g.

Outlining- The topic to be covered in class were outlined in the start of class and students were told to write down learning objective themselves.

Imagery- A hand drawn chart of the whole Solar system.

Imaginative Role playing- Transition from classroom to space.

Physical Examples- Use physical objects to explain revolution- differentiate rotation and revolution.

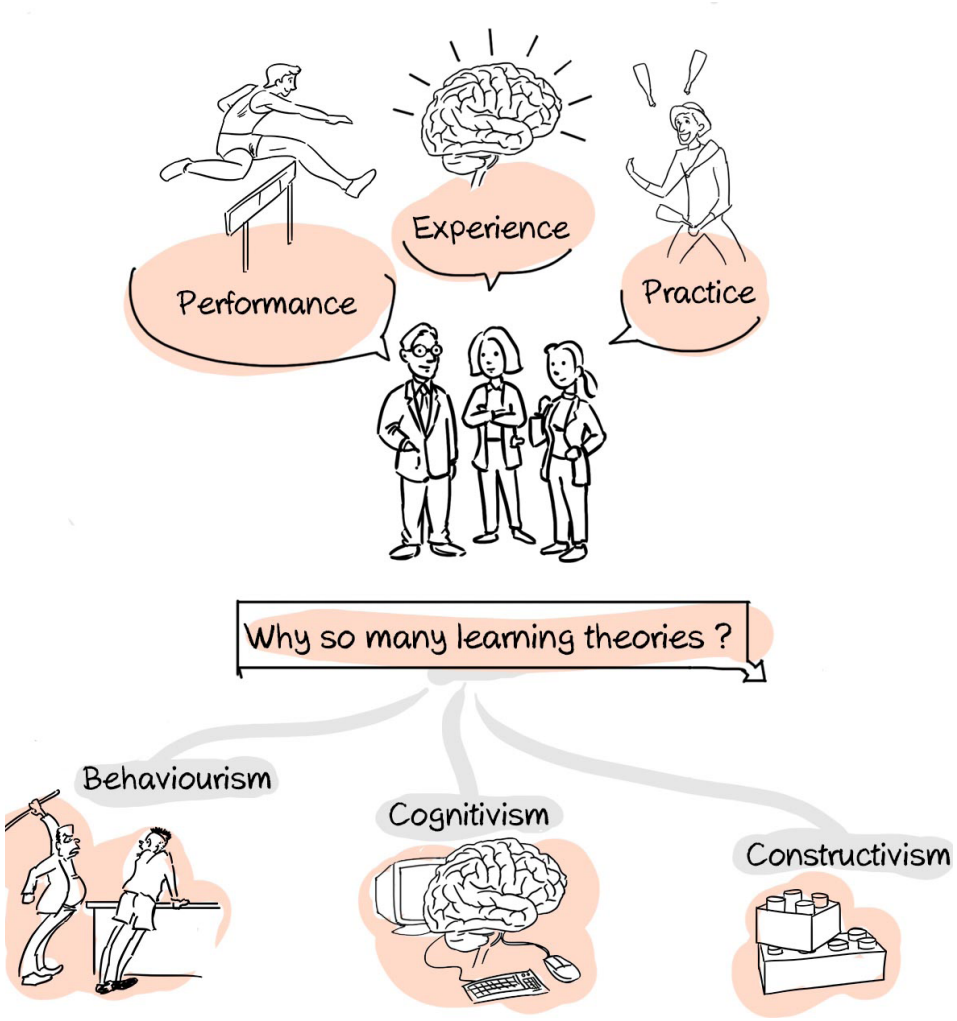


Figure 5. Learning theories

Mnemonics- (My Very Educated Mother Just Served Us Non veg). This maps to Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.

Compare and contrast, Self Questioning and **Real life examples.**

Inferences

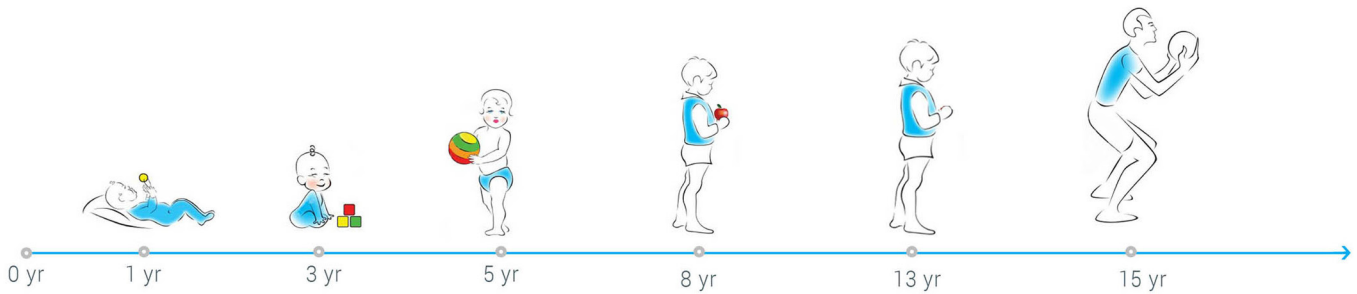
- Use of behaviorist and cognitivist approach of teaching. Learning objective method and strategies used were influenced from behaviorist and cognitivist principles.
- **Characteristics and individual difference** were observed among students. There were varied levels of performance among students.
- **Environmental arrangement** of class layout matters. Different room layouts in classes of different sections effected the teaching.
- Less focus on experiential learning

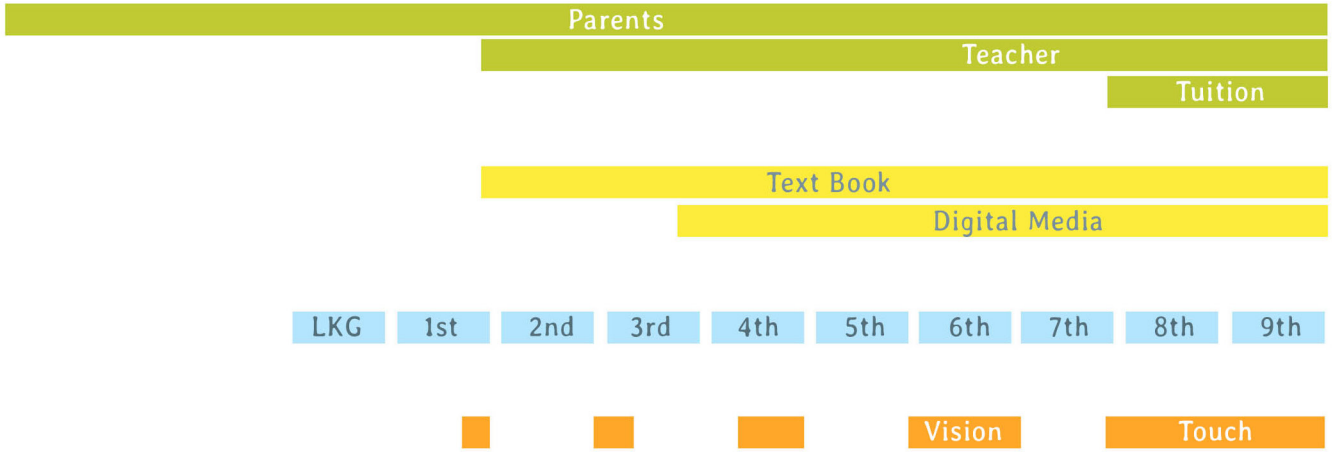
Constructivism

Upon seeing behaviorist and cognitivist methods being used in learning environments. I looked at constructivist principles (Figure 5). Several theories of child development and learning have influenced school's teaching approach. The constructivist perspective of child development was advanced by theorists such as Jean Piaget and Lev Vygotsky. Although their work varies greatly, each articulates a similar context of learning and development.

They are consistent in their belief that learning and development occur when young children interact with the environment and people around them. Constructivists view young children as active participants in the learning process. In addition, constructivists believe young children initiate most of the activities required for learning and development[5].

Currently, it is not widely used in schools as it does not work in the existing structure of education. Upon talking to teacher she told that the current educational system is not conducive to support constructivism in the mainstream classroom. Constructivist influenced schools and educators pay a lot of attention to the physical environment and the curriculum of the early childhood classroom.





Factors

Facilitator	Too many parallel facilitators
Media	Limited variety of media
Age	Industrial production line setup
Sensory Input	Poor sensory richness
Surroundings	No regard for learning environment

Figure 6. The world as it is today

The kid's world

Through constructivism, the main way of learning is the senses, causing the brain to build a full understanding of the surrounding world. This leads me to the understanding that each child is an individual creating unique responses and experiences.

From going through the concerned literature and discussions with my guide, I mapped the following five factors across the initial development stages of a child. These five factors are facilitator, media, age, sensory input and surrounding. Figure 6 demonstrates a child's world as it is today.

Facilitator
There are too many facilitators working in parallel to instruct the child. From parents to teachers and later tuition.

Media
A limited variety of media hampers a Childs development. We should try to move beyond text book and digital media.

Age
As discussed before, the current education system is like an industrial production line setup. Forcing kids to not grow at there own pace.

Sensory input
Range of sensories should move beyond vision and touch. Sensorial richness will improve the learning of a child.

Learning environment
Currently there is not much emphasis on creating learning environments for kids in mainstream schools or at home.

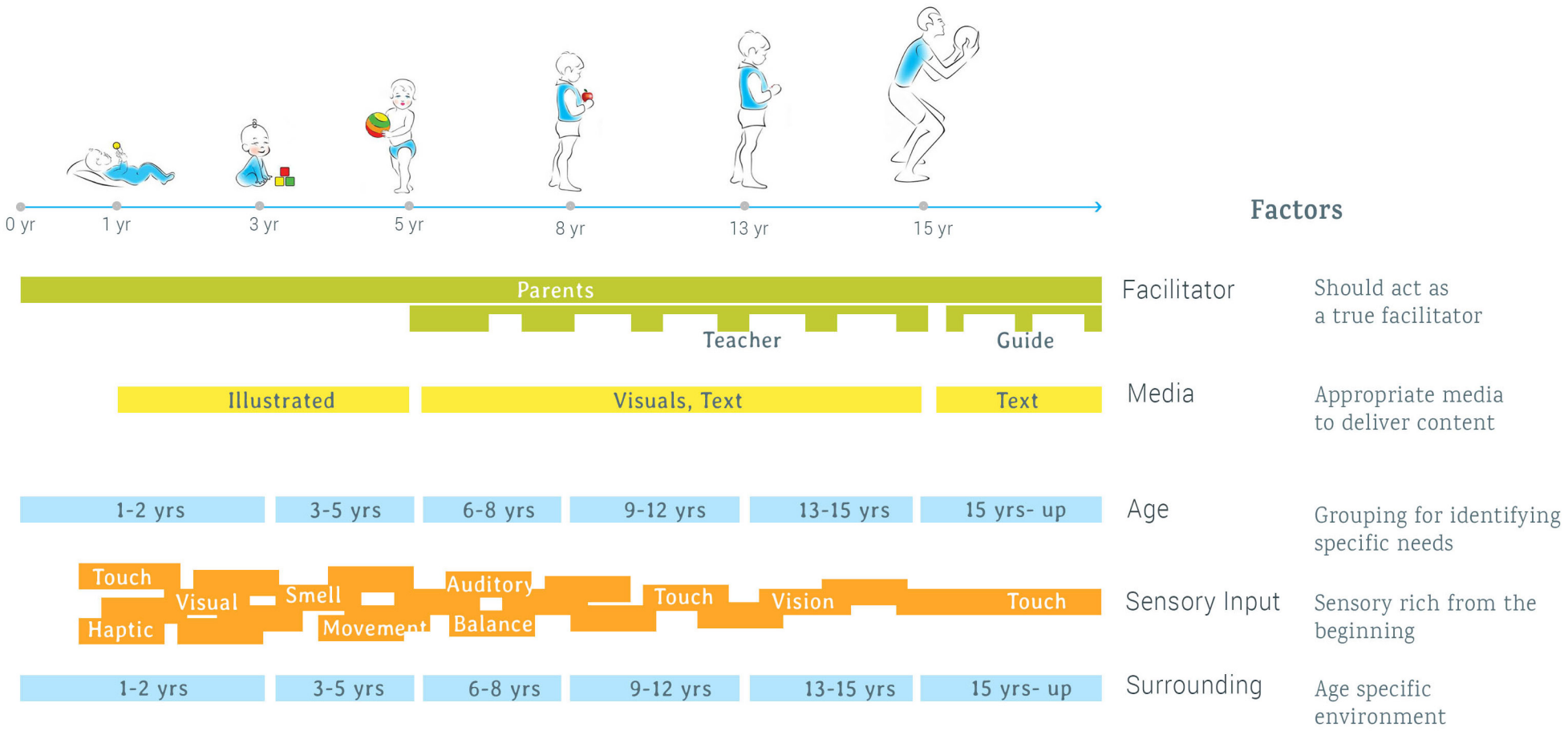


Figure 7. The world as it should be

Based on my study of constructivist theory of learning. In figure 7 I am showing how the kid's world should be. The aim is to make the world more sensorially rich for kids.

Facilitator
Constuctivist theory recognizes teachers as facilitators. The classroom is not a place where the teacher ("expert") gives knowledge to passive students. In the constructivist model, the students are urged to be actively involved in their own process of learning. The teacher functions more as a facilitator who coaches, mediates, prompts, and helps students develop and assess their understanding, and thereby their learning.

Media
Appropriate media to deliver content. Slowly moving from purely illustrated to visuals and text.

Age
Instead of having an industrial approach towards education. Focussing on age wise grouping for identifying specific needs.

Sensory input
Introducing a very sensory rich environment such auditory, smell, movement, haptic, touch, vision to kids. So they can have multi-channel association with experiences.

Learning environment
Creating age specific learning environments for kids. Starting from kinder garden to high school kids. Adding a variety of activities and physical spaces as well as a variety of sensory detail, adds richness to the environment. The environments that children experience in their early years of life are responsible for creating their understanding of many concepts, giving them spatial awareness, educating their senses, nourishing their curiosity, and encouraging their interaction.

In my final design I have used these five factors while developing the platform where facilitator is a hand puppet, media is digital and age appropriate for 7-12 years. The platform makes use of various sensory inputs like touch, haptic, visuals, movement and sound.

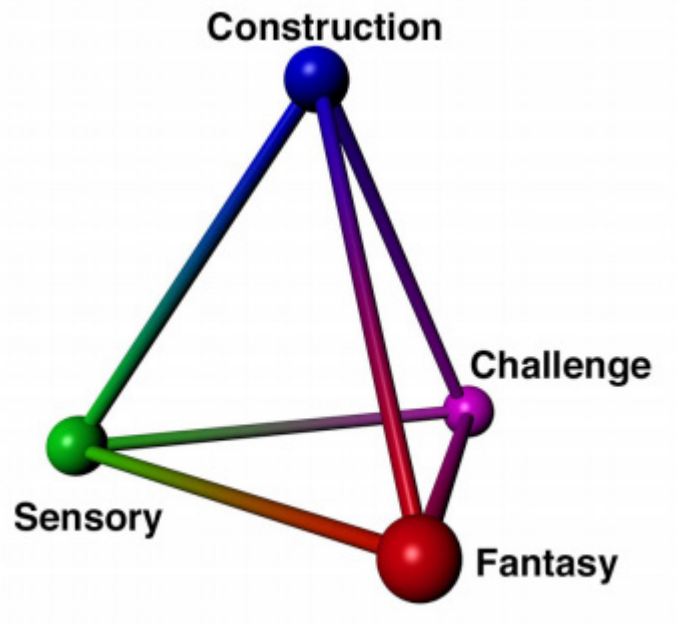


Figure 6. The Play Pyramid

Figure 7. The Edges of the Play Pyramid

Toys and play are listed as follows: Kaleidoscope, Whoopie Cushion, Furby, Teddy Bear, Disney World Amusement Park Rides, Movies, Television, GI Joe Action Figure, Finger Puppets, Tamagotchi, The Sims, Nintendo DS, Monopoly, Nerf Football, Playing Cards, Crossword Puzzle Jigsaw Puzzle, Taboo, Jenga, Origami, Balderdash, Stamp Collecting, Beading Necklaces, Crayola Crayons, Foam Blocks, Play-Doh, Sand Play, Play and Freeze Ice Cream Ball, Finger Paint, Toy Xylophone, Jack-in-the-Box, Slip and Slide, Jaw Breakers, Nickelodeon Slime, Magic Eye, Bop-It, Pogo Stick, Skip-It, Juggling Balls, Doll House, Play Make-Up Kit, Mr. Potato Head, Brio Train Set, Lego, Construction Blocks, Doodling

Secondary Research

After understanding the user I wanted to understand about the games/toys they play with.

Game and toy classification

Piaget's Stages are summarized as follows[6]:

• **Sensory-Motor Period** (0 - 18 Months) The child engages in sensory play and play involving moving objects to produce reactions.

• **Preoperational Stage** (18 Months - 6 Years) The child engages in symbolic play. Rules are not developed. (4 - 7 years) the child can perceive and imagine.

• **Period of Concrete Operations** (6 - 12) The child engages in more problem-solving play. Play involves classification and rules.

• **Period of Formal Operations** (12 - 15) Thought and play become more abstract. Play becomes more social and refined.

Barry et al. have defined four general categories of play that are loosely based on Piaget's four stages of development: Sensory (from Sensory-Motor), Fantasy (from Preoperational), Construction (from Concrete Operations), and Challenge (from Formal Operations).

These four categories as the vertices of a tetrahedron, where the edges consist of play that falls between two categories. The faces consist of play that falls between three categories. This classification system, as shown in Figure 6 is called the Play Pyramid[7].

Sensory: This play involves aesthetics and entertaining the senses.

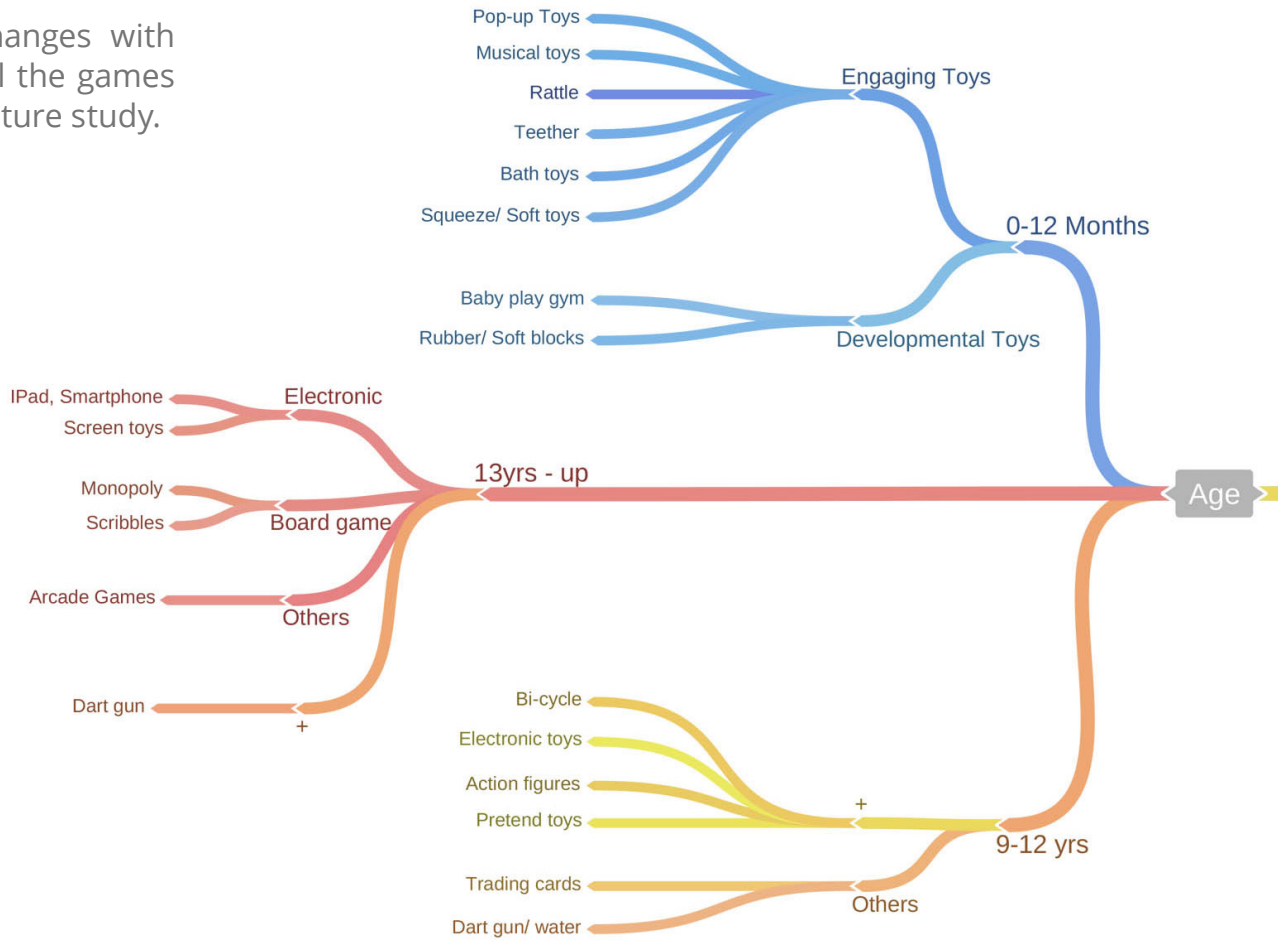
Fantasy: This play is about role-playing or it has a level of pretense.

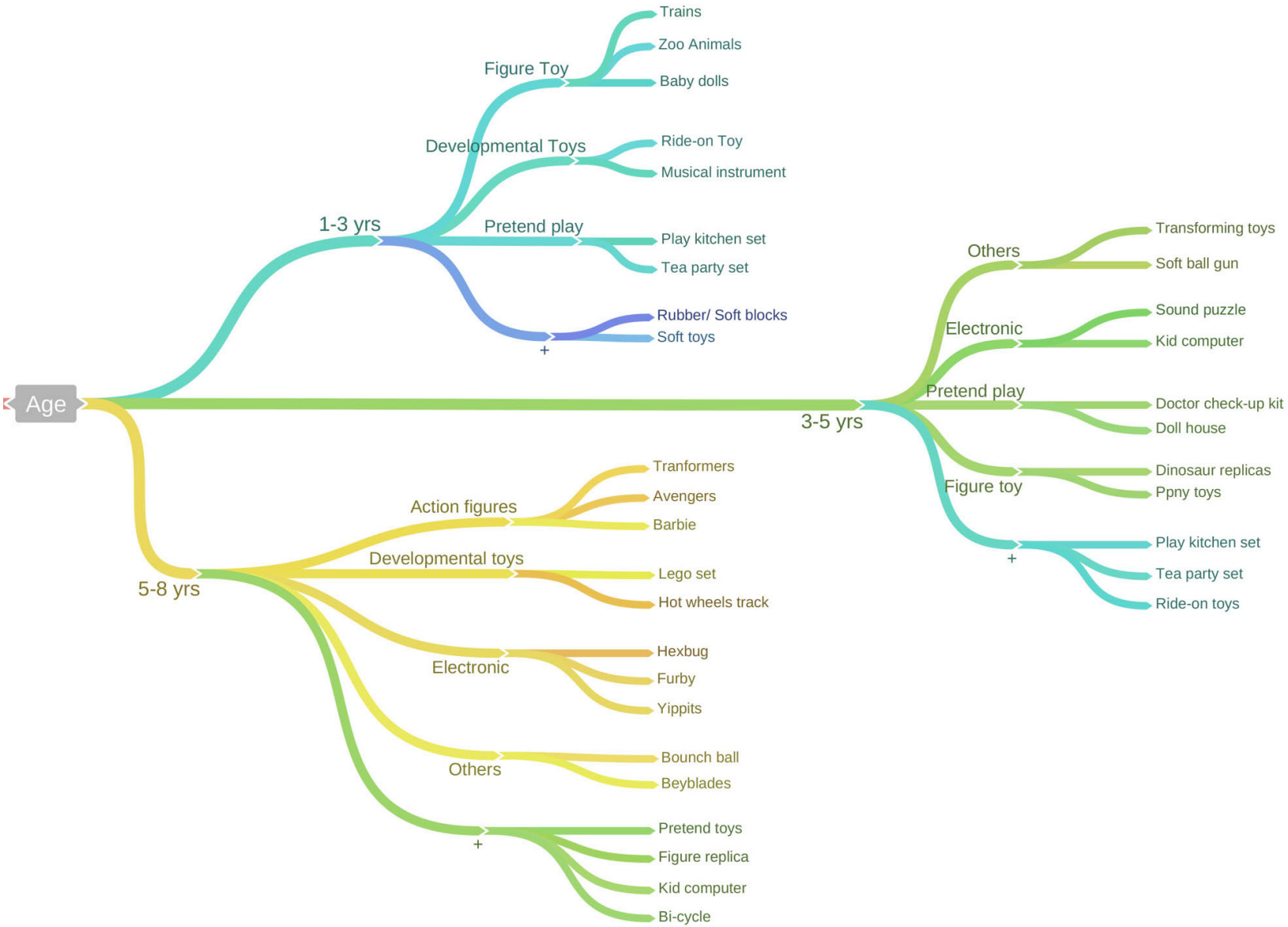
Construction: At the purest form, this play is about creating and not simply creativity as all play involves creativity.

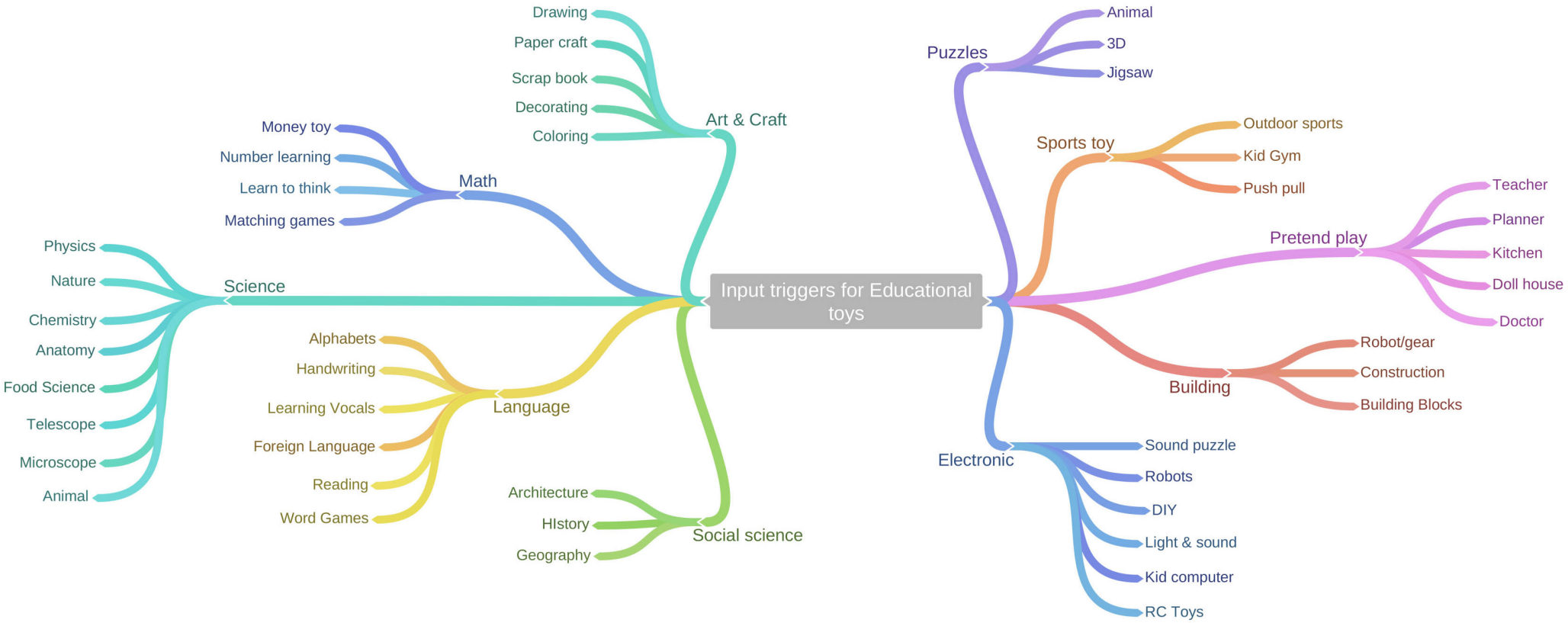
Challenge: Like all play types, this can be physical or mental. Physical challenges include both fine and gross motor skill development.

Age specific games/ toys

As discussed before games/toys changes with age. I created a mind map to map all the games and toys I read about during my literature study.



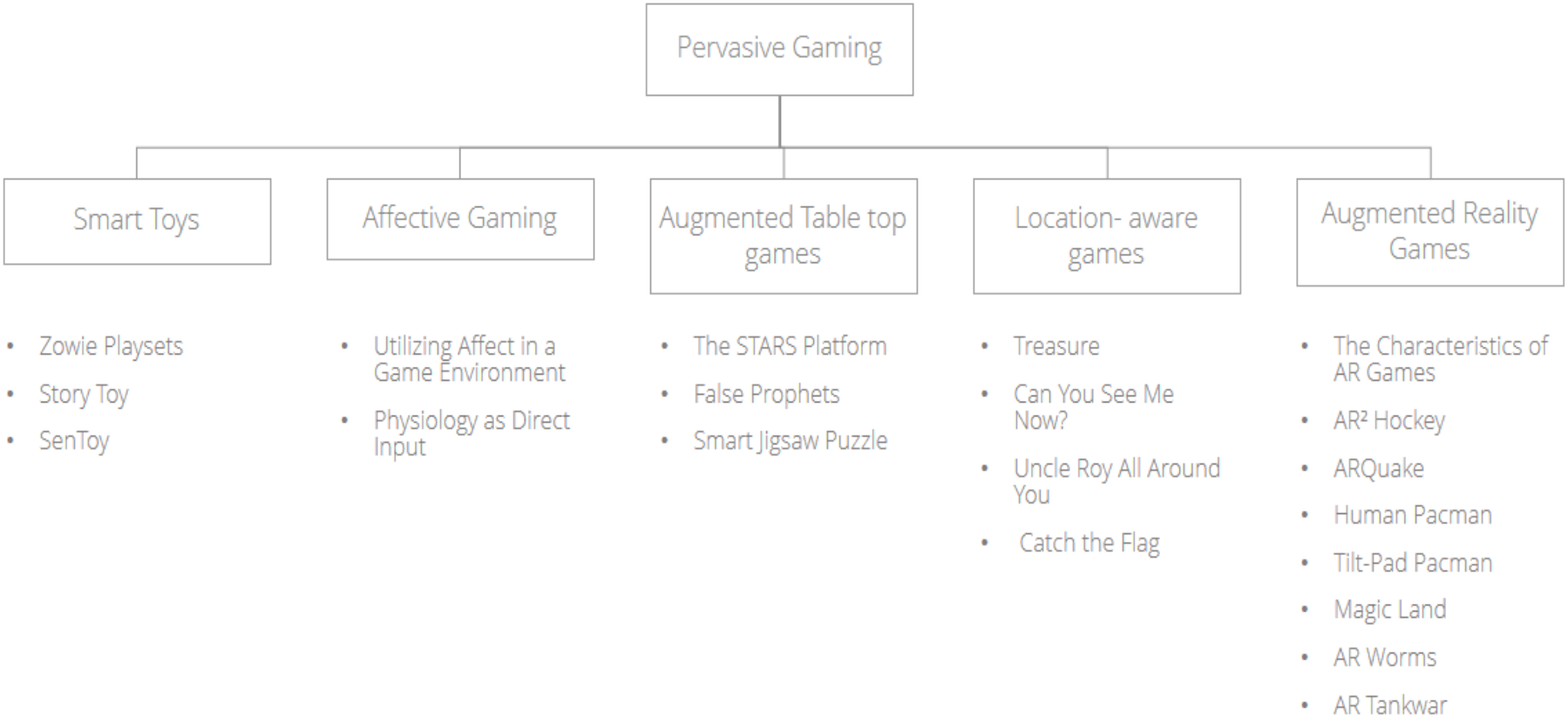

Age
1-3 yrs
Figure Toy
Trains
Zoo Animals
Baby dolls
Developmental Toys
Ride-on Toy
Musical instrument
Pretend play
Play kitchen set
Tea party set
+
Rubber/ Soft blocks
Soft toys
3-5 yrs
Others
Transforming toys
Soft ball gun
Electronic
Sound puzzle
Kid computer
Pretend play
Doctor check-up kit
Doll house
Figure toy
Dinosaur replicas
Ppny toys
+
Play kitchen set
Tea party set
Ride-on toys
5-8 yrs
Action figures
Tranformers
Avengers
Barbie
Developmental toys
Lego set
Hot wheels track
Electronic
Hexbug
Furby
Yippits
Others
Bounch ball
Beyblades
+
Pretend toys
Figure replica
Kid computer
Bi-cycle


Input triggers for Educational toys
Art & Craft
Drawing
Paper craft
Scrap book
Decorating
Coloring
Math
Money toy
Number learning
Learn to think
Matching games
Science
Physics
Nature
Chemistry
Anatomy
Food Science
Telescope
Microscope
Animal
Language
Alphabets
Handwriting
Learning Vocals
Foreign Language
Reading
Word Games
Social science
Architecture
HIstory
Geography
Puzzles
Animal
3D
Jigsaw
Sports toy
Outdoor sports
Kid Gym
Push pull
Pretend play
Teacher
Planner
Kitchen
Doll house
Doctor
Building
Robot/gear
Construction
Building Blocks
Electronic
Sound puzzle
Robots
DIY
Light & sound
Kid computer
RC Toys

Input triggers for educational games/toys

Educational games can be based on various input triggers. Toys may be used for a number of educational purposes. Some toys have incidental educational value. An educational toy should educate. It should instruct, promote intellectuality, emotional or physical development. An educational toy can teach a child about a particular subject or can help a child develop a particular skill. The key difference is the child's learning and development associated with interacting with the toy. Some of the subjects are:

- Science- Physics, nature, chemistry, anatomy, food science, telescope, microscope, animal world
- Language- alphabets, handwriting, learning vocals, foreign language, reading, word games
- Social science- Architecture, history, geography
- Maths- money toy, number learning, learn to think, matching games
- Art & craft- Drawing, paper craft, scrapbook, decorating, coloring
- Puzzles- Animal, 3D, jigsaw
- Sports toy- Outdoor sports, kit gym, push pull
- Pretend play- Teacher, planner, kitchen, doll house, doctor
- Construction- robot/gear, building block
- Electronic- sound puzzle, light & sound, kid computer, RC toys


Pervasive Gaming
Smart Toys
Zowie Playsets
Story Toy
SenToy
Affective Gaming
Utilizing Affect in a Game Environment
Physiology as Direct Input
Augmented Table top games
The STARS Platform
False Prophets
Smart Jigsaw Puzzle
Location- aware games
Treasure
Can You See Me Now?
Uncle Roy All Around You
Catch the Flag
Augmented Reality Games
The Characteristics of AR Games
AR² Hockey
ARQuake
Human Pacman
Tilt-Pad Pacman
Magic Land
AR Worms
AR Tankwar

Pervasive Games

After looking at games and toys, I wanted to look at video games. Digital media games have become very popular among kids these days and this trend is just going to peak with advancement in technology. The reason they are so popular among kids are:

- They provide illusion of being immersed in an imaginative virtual world with computer graphics and sound.
- Goals of video games are more interactive than traditional games, which brings players a stronger desire to win the game.
- Motivate players by bringing them more fantasy, challenge, and curiosity, which are the three main elements contributing to the fun in games.

Playing video games changes the brain's physical structure the same way as do learning to read, playing the piano, or navigating using a map. There are both positives and negatives impact on children who play video games. Some of the mental skills enhanced by video games include:

- Following instructions
- Problem solving and logic
- Hand-eye coordination, fine motor and spatial skills.
- Multitasking, simultaneous tracking of many shifting variables and managing multiple objectives.
- Quick thinking, making fast analysis and decisions.
- Accuracy, Strategy and anticipation.
- Situational awareness and pattern recognition.

Negative Impact of video games on Kids:

- Decrease in users' physical activities and social interactions.
- Both of which are important for child's self development.
- Computer games focus the users' attention mainly on the computer screen which can lead to medical problems.

I observed that kids use keyboard, mouse and glass screen to interact with digital media. The question to ask ourself is should kids continue to using such input devices which were designed primarily for adults ? Then how should kids interact with digital media? What are the alternative ways to play digital games? I started by looking at pervasive games.

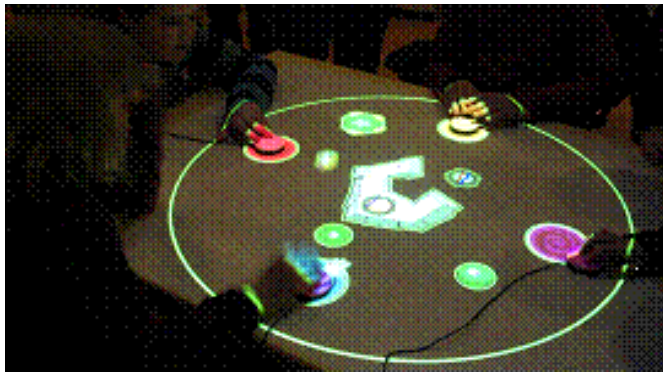


Image 4. pOwerball

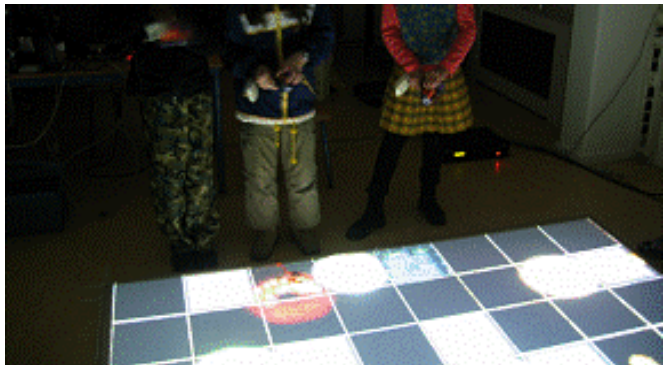


Image 5. Scorpiodrome

Image 6. Camelot, Resource collector (left) and resource zone (right)

Pervasive Games for Kids

A pervasive game is one where the gaming experience is extended out in the real world, or where the fictive world in which the game takes place blends with the physical world [8]. I looked at pervasive games for adults to get a basic understanding and then games made specifically for children. These are some of the pervasive games developed for kids which I studied:

pOwerball
It is an augmented reality computer game for children aged 8-14. It features a tangible user interface to tabletop augmented reality. It was designed to bring together children with and without a physical or learning disability and to encourage social interactions surrounding the play.

Scorpiodrome
It is a mixed reality game for groups of 3-4 children aged 11-14. It is designed for social gaming. The game includes a construction phase where children compose the racing landscape out of tiles that they place on a grid. Construction is followed by a high action phase, where they drive remote controlled cars around the circuit and combat with each other.

Camelot
It was designed to be a mobile outdoor game for small groups of children aged 7-10. Camelot was designed with the aim to encourage social interaction between the players and to encourage physical activity. The paper extends the research literature on design methodology for children, by recording and reflecting upon the lessons learnt by applying a range of techniques for involving children in the design of interactive systems. [1]

Few more examples of such games; Ely the Explorer, The Hunting of the Snark and Ambient wood. [6]

Inferences
- Most favored games in this category are rich in physical activity, e.g. running and chasing in Tag.
- The task of interacting with digital objects by interacting in the physical world is new and exciting for kids.
- Element of excitement, suspense- e.g. waiting while hiding in Hide and Seek.
- Role-play, pretend play- pretending to be somebody else or somewhere else allows one to act silly.

Image 7;. Sifteo Cubes

Image 7. Combiform

Image 8. Dance Dance Revolution

Physically co-located games

These games require the participants to be physically co-located in shared spaces. Co-located computer-supported games are also available commercially such as Kinect based games. I looked at some specific examples from pervasive games. For e.g.

Sifteo Cubes
The original Sifteo cubes are an interactive gaming platform developed by Sifteo, Inc. These motion-aware 1.5-inch blocks with full-color clickable screens interact with users and each other when they are shaken, tilted, rotated and placed adjacent to one another. They are designed for use by players ages six and up.

Combiform
It is a set of magnetic, combinable controllers. It gives user the freedom to interact face-to-face with opponents rather than focusing on a TV or monitor while gaming. Unlike other controllers, Combiform encourages social interaction by physically combining up to 4 individual controllers to work as a team or sabotage an opponent.

Arcade games like Konami's Dance Dance Revolution

The DanceDanceRevolution series is an interactive video game that combines real physical dancing with energetic music and visuals. DanceDanceRevolution also comes with a tailored workout mode that allows players to track how many calories they burn as they play.

Inferences
These games focuses on cooperative gameplay. The three main points to remember while developing co-op games are-

- Positive interdependence - Awareness that they are a team and group success also represents individual success.
- Social skills - The group demonstrates attitudes that foster positive social relationships skills such as leadership, decision-making, turn taking.
- Group processing - Team members analyze with each other the best way to tackle the problem and maintain an effective working relationship.

These points should be considered and incorporated in the gameplay while developing co-op games for the platform.

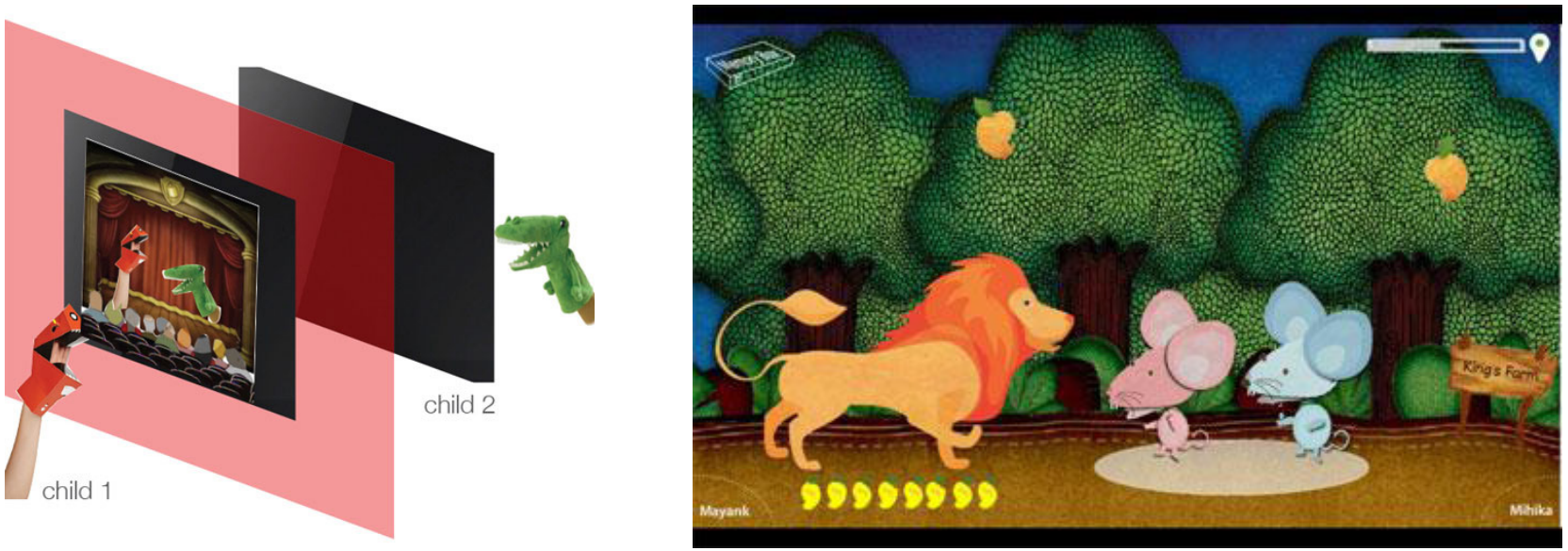


Figure 12. Pubby scenario

Pubby

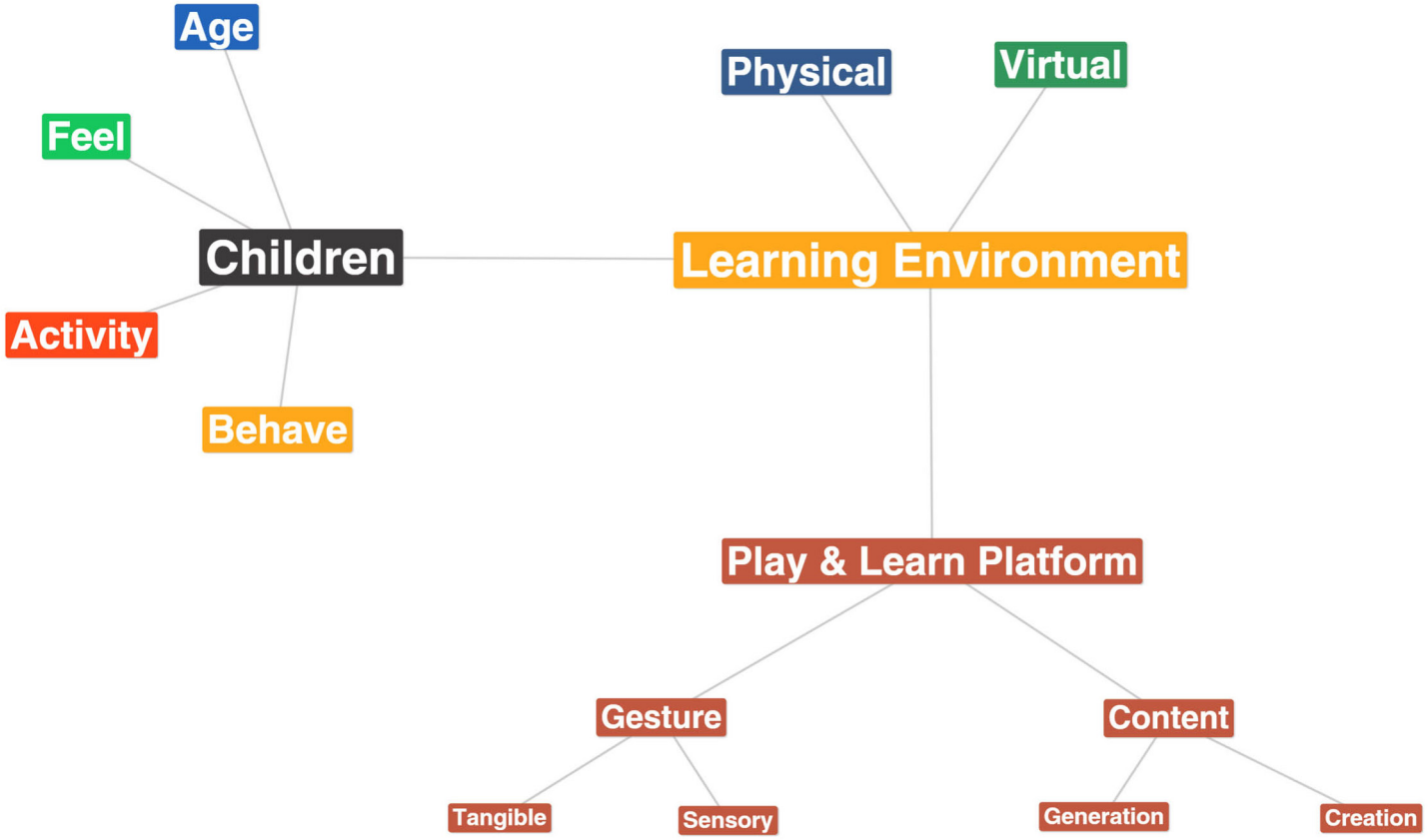
PUBBY (puppet buddy) is a project done under COSMIC labs. It is a social media platform for children to connect with peer and mentor's through role playing physical and virtual puppets. It is intended for children (4-7 year), to interact, learn and play in remote situation. Children through hand gestures make the virtual objects on screen, move, run, dance, walk, jump etc. Children can use puppets or toys to enact , role play and share stories and experiences. Two or more children can join the same story. Children from remote situation can do role-play, be part of a story, collaborate and perform activities and do storytelling.

The initial project objective was to add new gestures and content to the Pubby platform. Its important to note that this project or its details were not disclosed to me until the end. No work presented in this project is taken from Pubby project. Some key differences between both the projects are :-

- **Age group**- Evolve was targeted towards higher age group of children from 7-12 years as oppose to Pubby which was intended for 4-7 years old kids.

- **Puppet type-** Puppets are of different types. One of the project objective was to incorporate new gestures therefore I have used a five finger puppet rather than a two finger(4+1) puppet of pubby. This gave an opportunity to explore more gestures.

- **Technology used-** Pubby uses image recognition to identify gestures and take input from the puppet. Due to which the number of gestures actually used in the game were very limited. Since implementation was my one of my main focus therefore I reviewed their technology and discarded it in favour of sensor based wearable. This decision has helped in giving the project a more efficient and capable alternative as I was able to make a fully working prototype.


Age
Feel
Children
Activity
Behave
Physical
Virtual
Learning Environment
Play & Learn Platform
Gesture
Tangible
Sensory
Content
Generation
Creation

Project understanding so far

We learned about children and different factors that we need to consider to understand them. These are age, feelings, activity and behavior. We looked at current learning practices which puts more emphasis on behaviorist and cognitivist learning approach. But as shown in constructivist theory, learning is an active process in which the learner uses sensory input and constructs meaning out of it. This leads to the understanding that each child is an individual creating unique responses and experiences.

We looked at all games/toys suitable for 0-13 years of age and listed various input triggers for the content in these games/toys. We looked at pervasive games to understand how to merge virtual and physical gameplay.

The project is targeted at children from age group of 7-12 years. These children are learning to socially engage and have started to participate in structured team play. The design brief so far is to create a learning environment based on play & learn, that focuses on engaging kids using sensorially rich interactions based on auditory, visual, touch and kinesthetic.

This will be done by using physical toys from their everyday objects and spaces as facilitators for learning and developing a physical interface for kids to interact with digital media. The design decision to use physical toys as facilitator of learning was taken by COSMIC lab.

Games would be tailored to the skills of children. It will be an indoor game to take care of safety and moderation issues. The learning environment would have both virtual and physical elements based on gestures both tangible and sensory components. The platform should be open source for easy content generation.

Design goals

In this project I will be looking at using sensory input and media to create a play & learn platform. I will use physical toys as facilitators for learning. Going through the secondary and primary research and in consultation with COSMIC labs the following design goals were arrived at:

Higher level design goal

To create a learning environment based on play & learn, that focuses on engaging kids using sensorially rich interactions based on auditory, visual, touch and kinesthetic.

Primary (design) goal

- To create a new physical interface platform for children of 7-12 years using physical toys from their play environment.
- Create modules of educational content that will help kids learn about topics.

Secondary (project) goal

Create a working prototype of the design solution. Evaluate it for usability, engagement and market scalability .

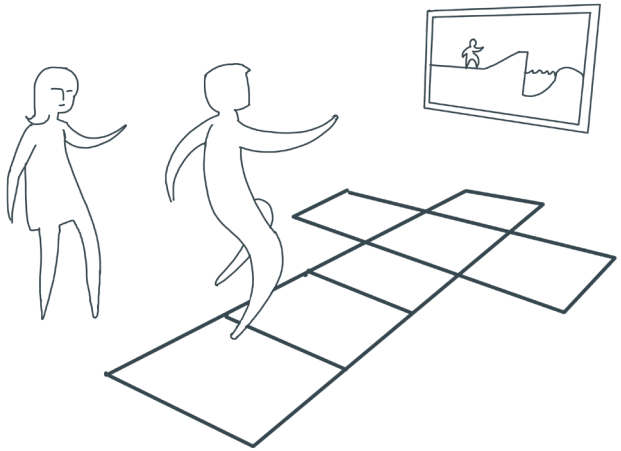


Figure 15. Pervasive hopscotch mat

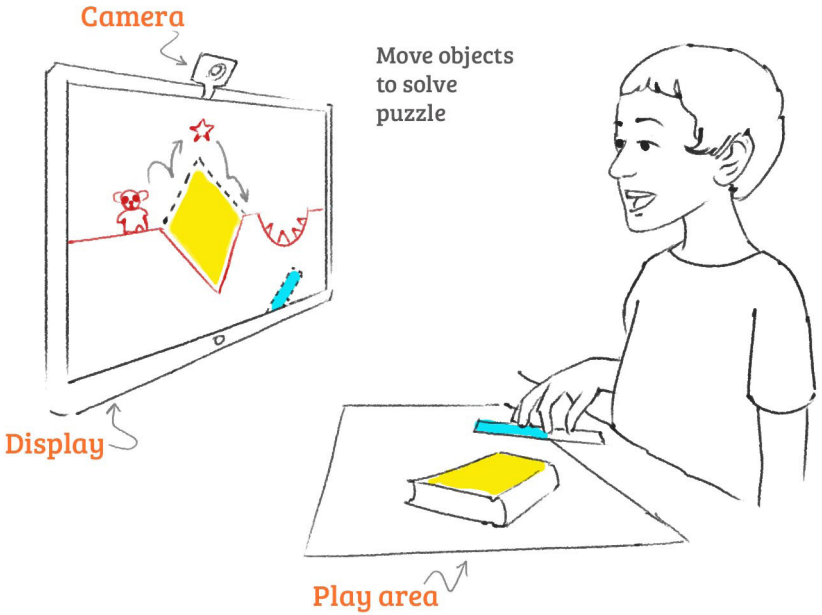


Figure 16. Shape hunting based Puzzle solving game

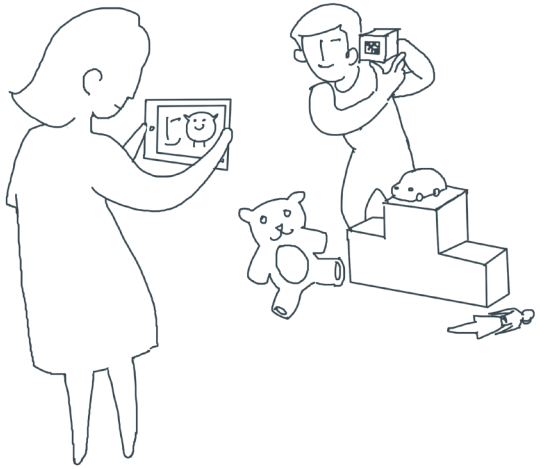


Figure 17. AR hide and seek

Platform ideation

Since this platform would consists of many elements therefore separate ideations were done for each part namely:-

- Gameplay ideation
- Physical toy ideation
- Gesture ideation
- Content ideation

Ideation for Gameplay

The early ideations were crude and in a sense forced modification of existing traditional games. Only the AR hide and seek (Figure17) was explored further in further explorations.

Early ideations

Aim- **Pervasive hopscotch mat**
About- This requires the users to take chance and play a pervasive game of hopscotch to help a game character finish levels. The one that finishes fast wins. Its inspired from dance dance revolution. The hopscotch mat can be folded, it will have pressure sensors to register input. Figure 15

Aim- **Shape hunting based Puzzle solving game**
About- An indoor based game that requires kids to bring objects of particular shape from their room to help the game character cross the levels. Kids can take part in collecting given shaped objects from their room. They can combine objects to get a desired shape. Figure 16

Aim- **AR hide and seek**
About- Kids will have tags which they can stick to their opponents items. The first part is to tag your opponents items and then search for these items. The one to finish first wins. This gives freedom to kids to modify their rules if required. The tag can send signals to a tablet. Using this tablet they can get augmented clues regarding the location of the items. Figure 16

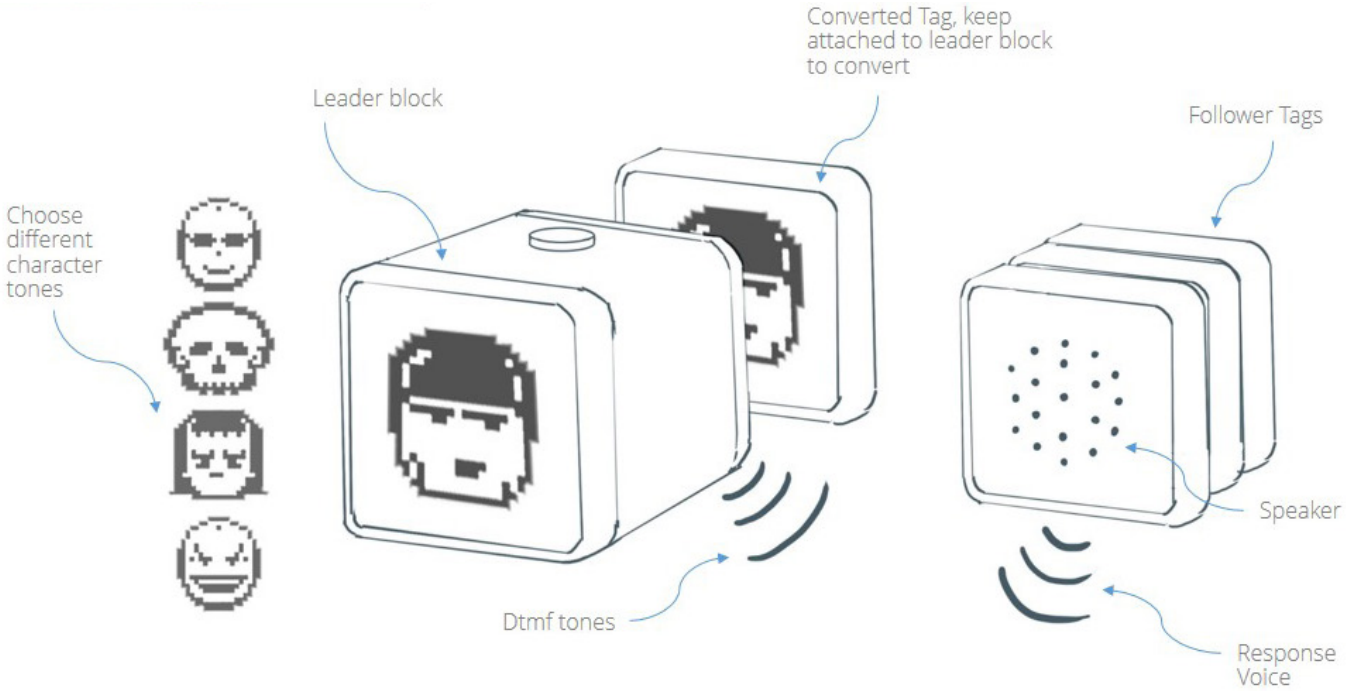


Figure 18. Low fidelity mock-up

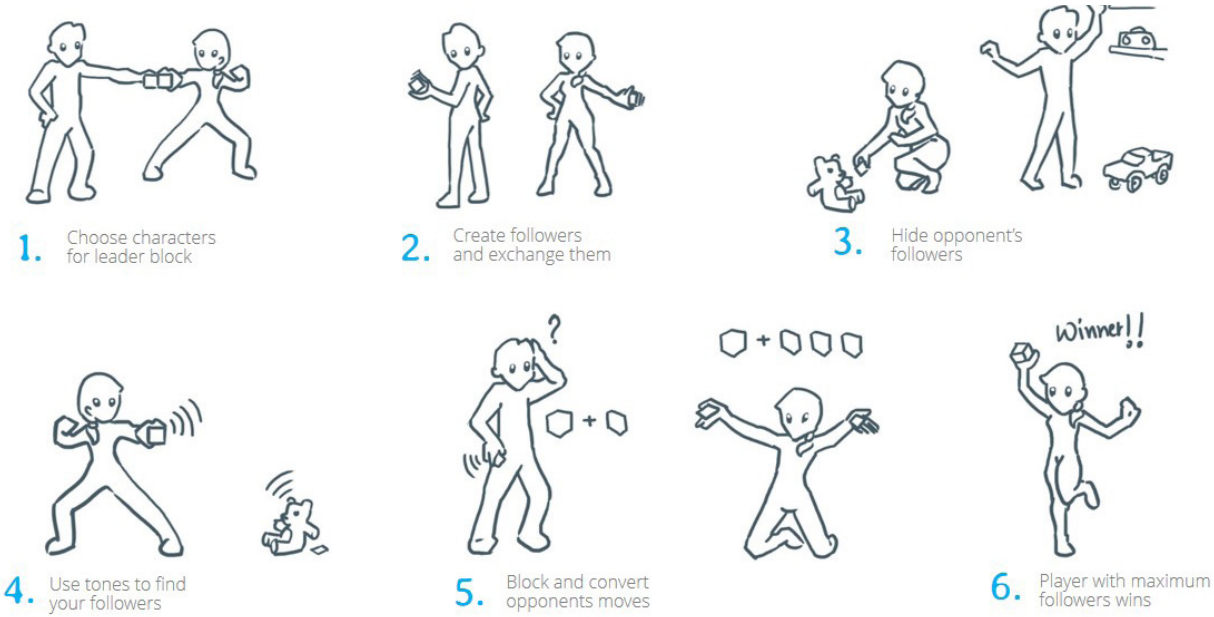
Concept 1

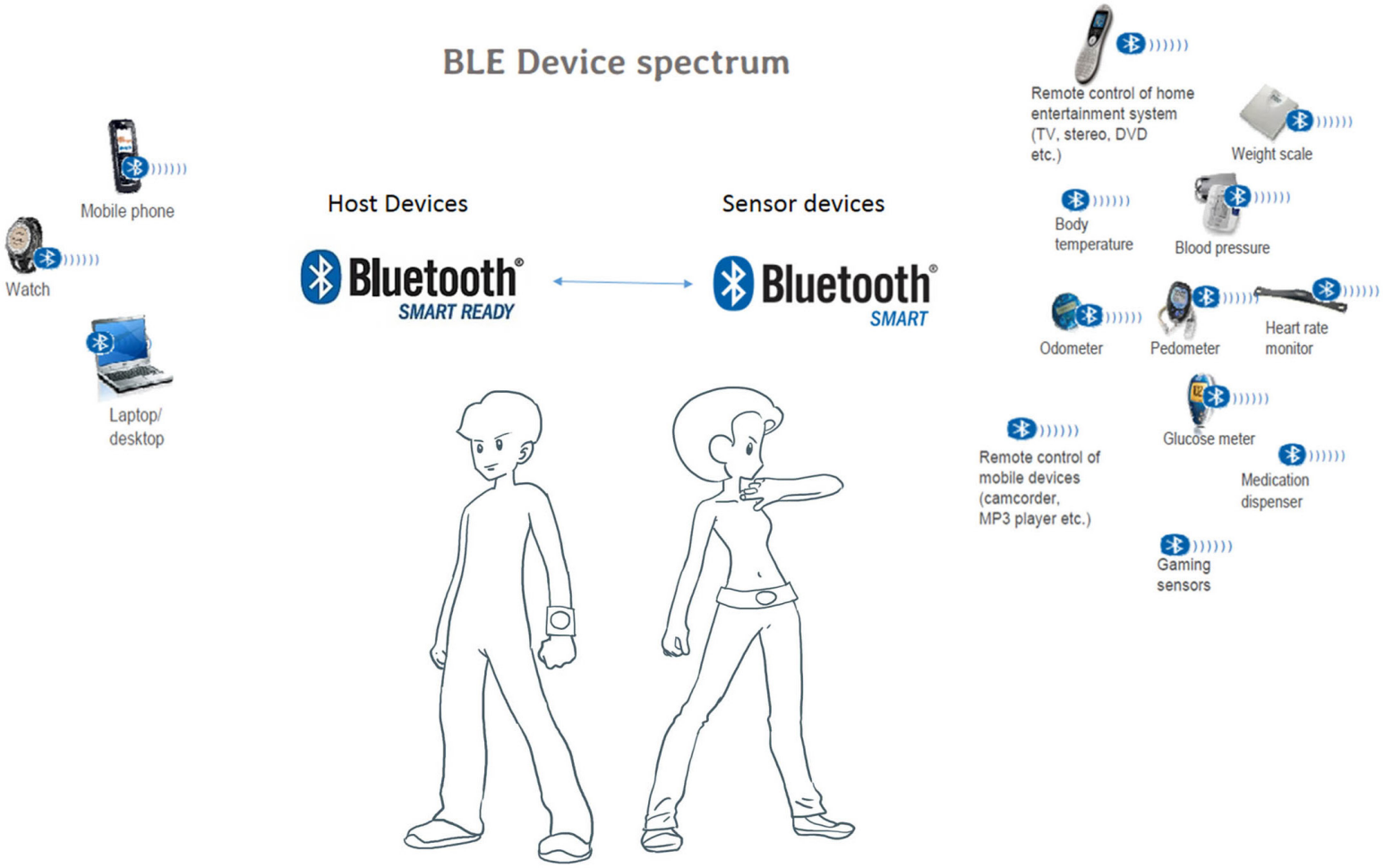
Based on hide and seek, this game consisted of physical blocks that interacted with each other when brought within close proximity of each other. The low fidelity mock-up was tested with two kids, Wizard of Oz method was used for simulating the gameplay.

Interactive cubes- A hide and seek based leader and follower game

The Game consists of leader block and follower tags. Players start with choosing their leader block character and creating equal number of follower tags. Then they exchange their tags and hide these tags around the play area. Each follower tag only responds to the Dtmf tone of its respective leader. Kids use these Dtmf tones to find their tags. The person who finds all his follower tags first wins the game.

The concept doesn't provide much scope as a platform for learning. The amount of technology required to make these blocks doesn't justify the gameplay value.




BLE Device spectrum
Host Devices
Sensor devices
Bluetooth SMART READY
Bluetooth SMART
Mobile phone
Watch
Laptop/ desktop
Remote control of home entertainment system (TV, stereo, DVD etc.)
Weight scale
Body temperature
Blood pressure
Odometer
Pedometer
Heart rate monitor
Glucose meter
Remote control of mobile devices (camcorder, MP3 player etc.)
Medication dispenser
Gaming sensors

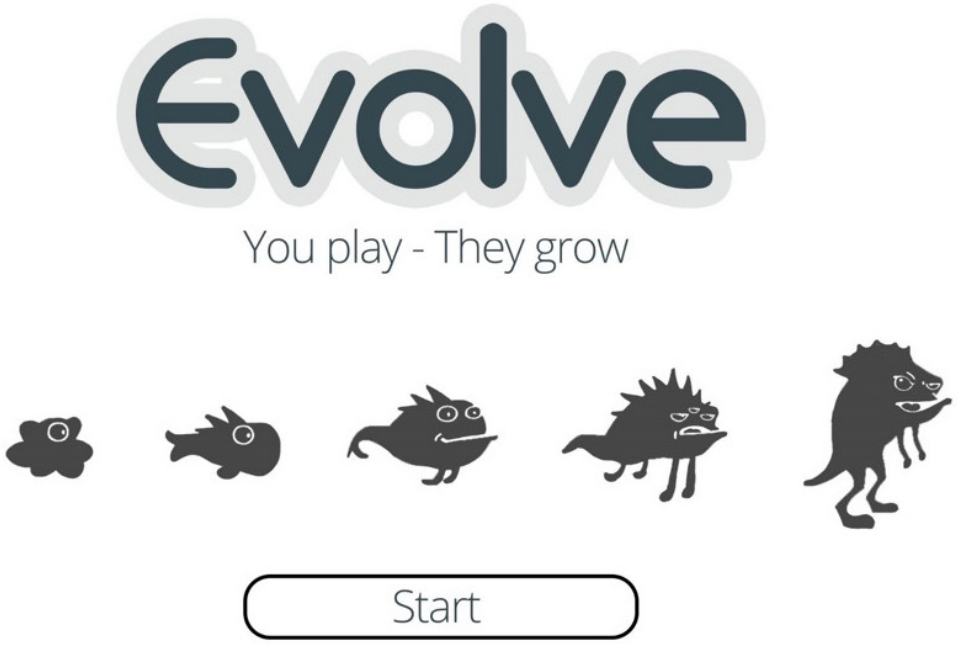
Concept 2

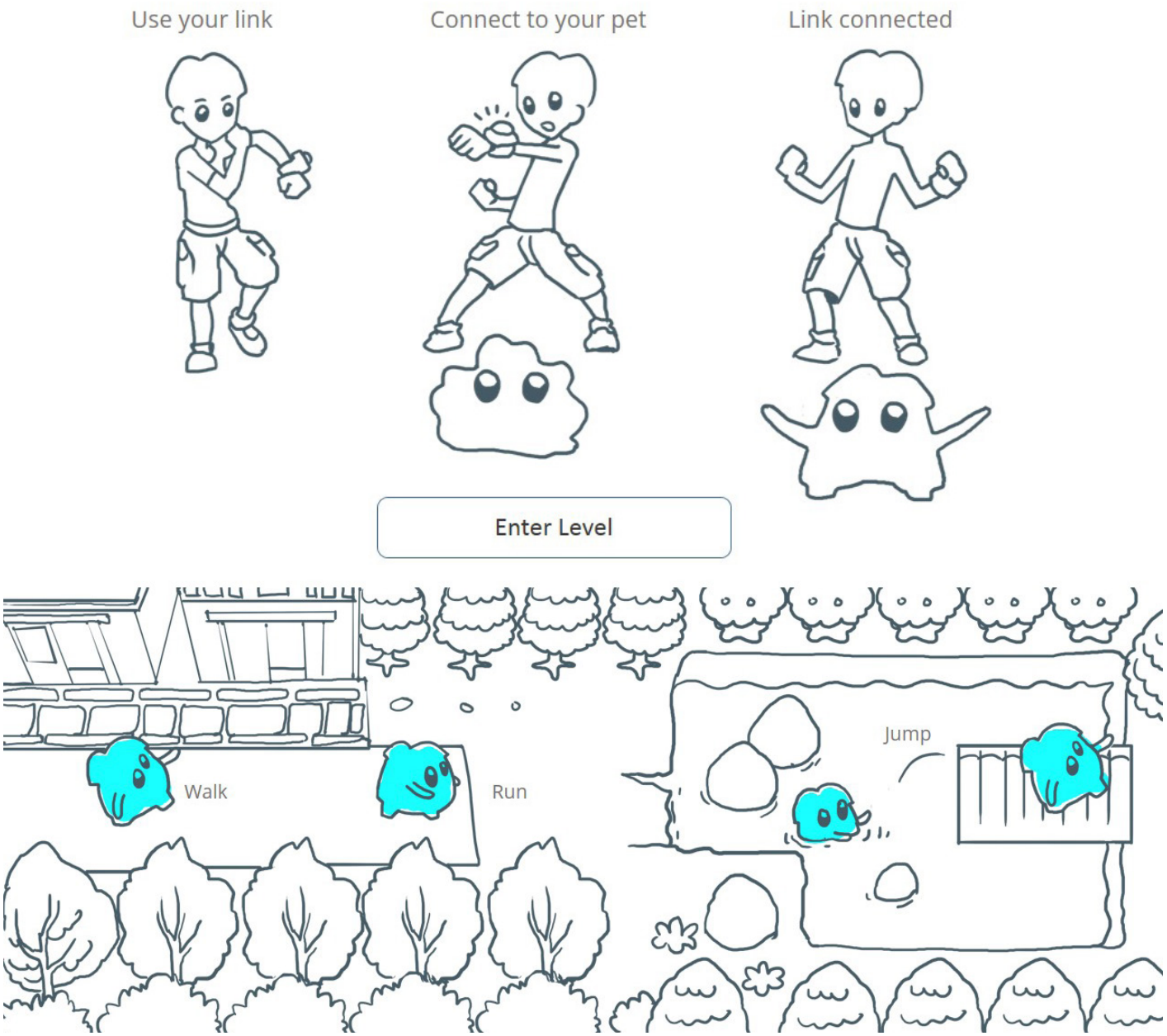
Evolve- A biometric based game

This was a fresh concept based on using biometric sensors in wearable to create a pervasive game for kids. Kids love to have pet animals, using virtual animals as facilitators, whom kids have to take care of in order to progress in game. This concept was further developed to arrive at current design solution. I gave it the name “Evolve” as the evolution of virtual characters was linked to that of children.

This would have:

- A wearable based interface for games.
- Data such as number of steps taken, distance walked, calories burned, can be used
- Accelerometer and gyroscope sensor can be used for gesture based navigation.
- The game would be ubiquitous in nature.




Use your link
Connect to your pet
Link connected
Enter Level
Walk
Run
Jump

Evolve- A biometric based game

The kid wears a wearable band as its been shown in the study that kids like wearing band and belts for gaming. The band is used like a link to control a virtual character on the screen. Different gesture are used to command different controls. Player get to evolve their character after every stage.

Early explorations (Figure 19) included using the actual walking and jumping the child to operate character on screen. In later study I have looked at micro (clapping) and macro (rotate) gestures that can be used for the platform.

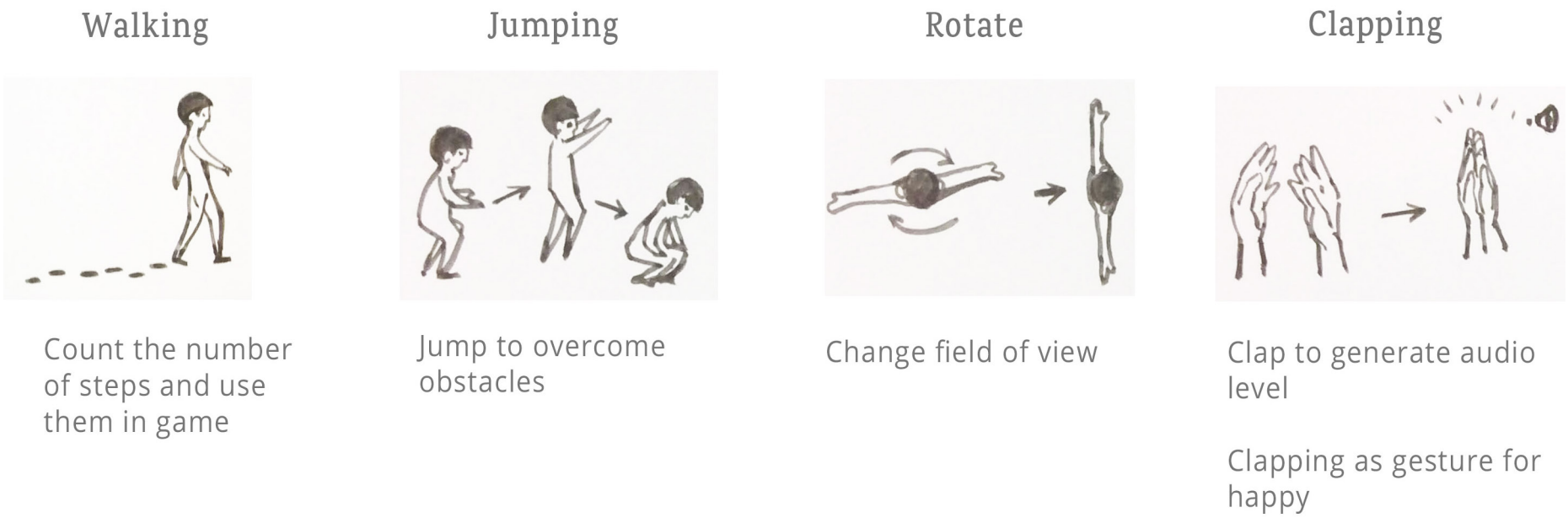


Figure 19. Early explorations of gestures

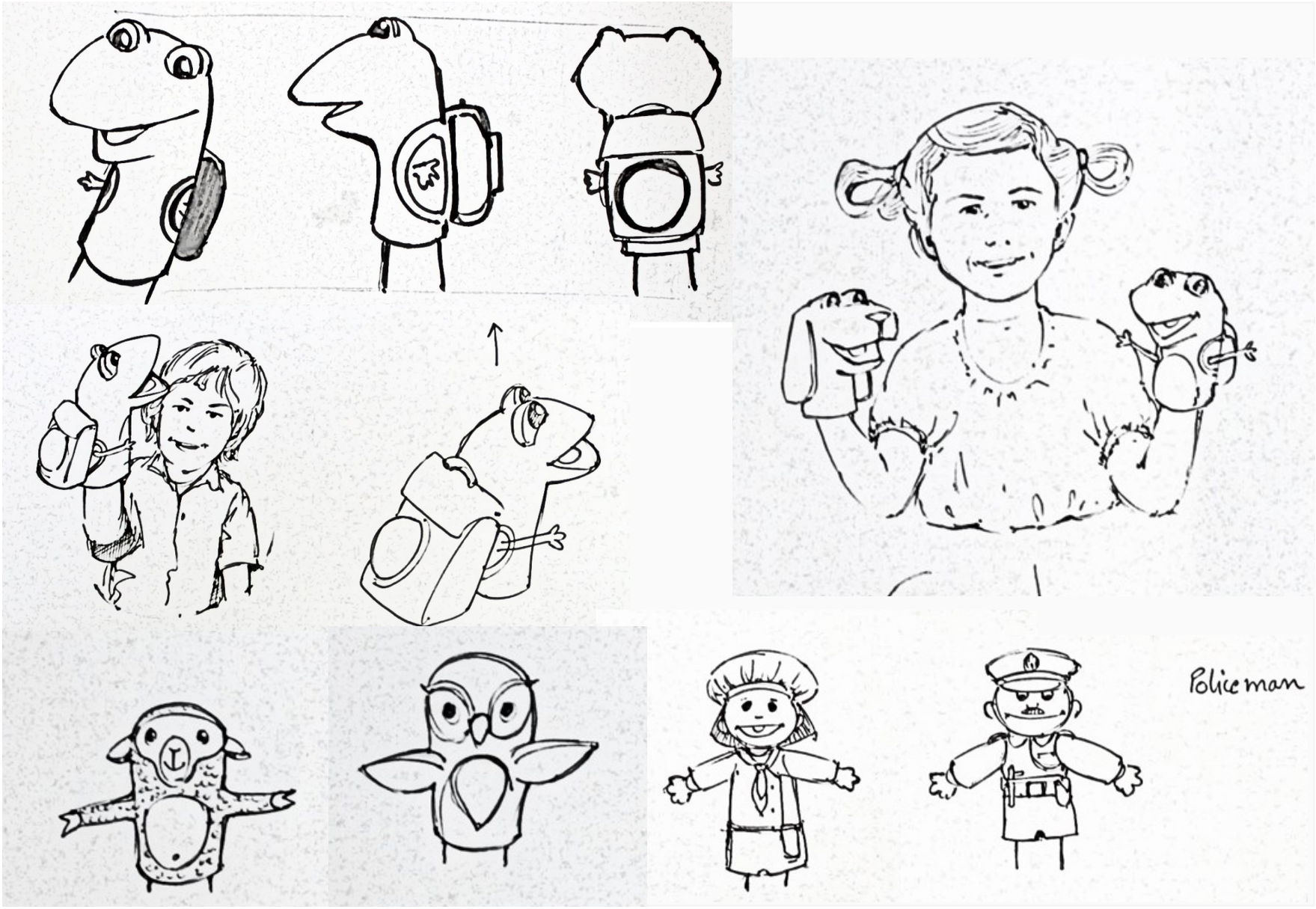


Figure 23. Frog puppet with his backpack as tangible accessory and other explorations

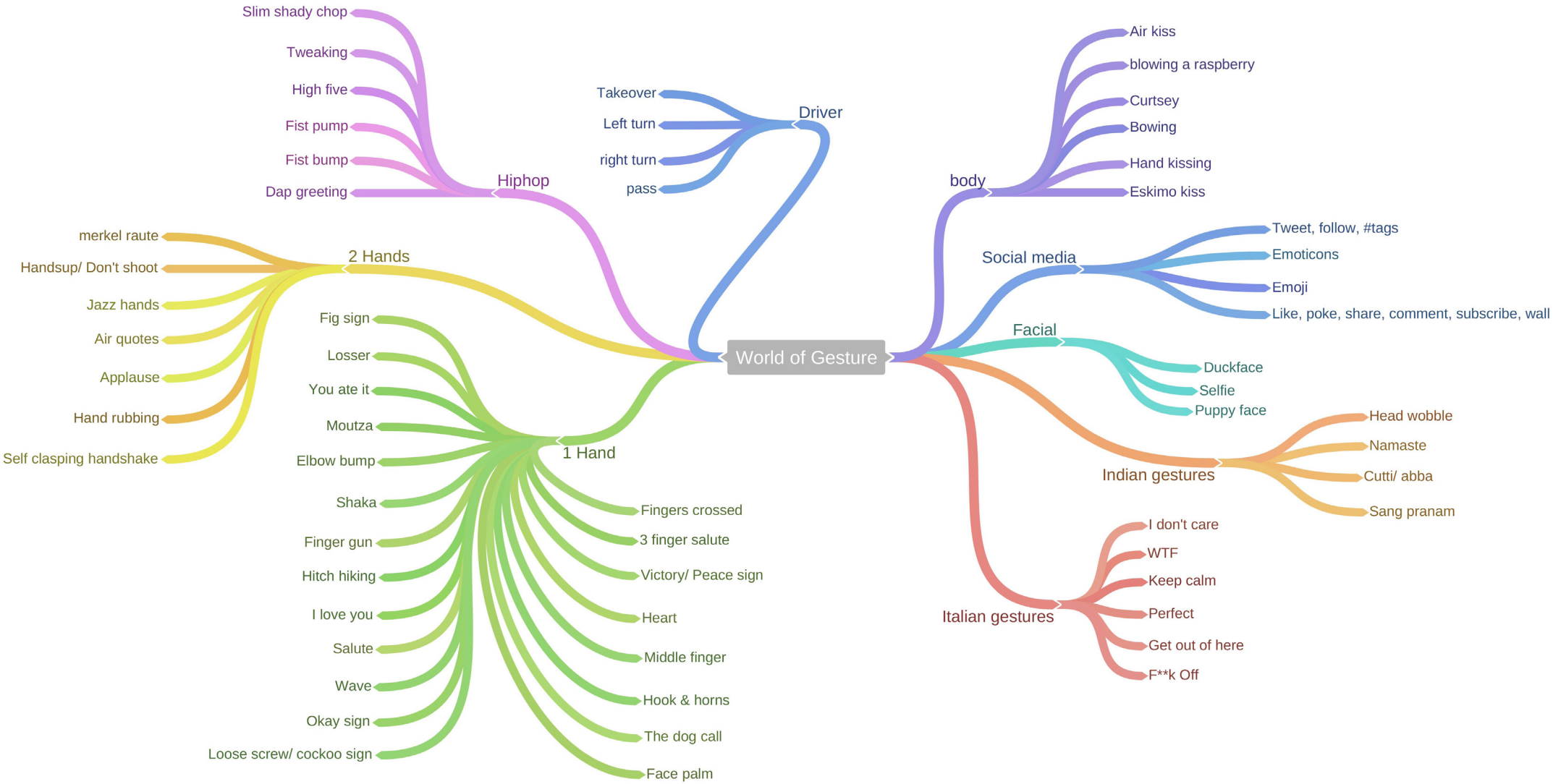
Ideation of physical tool

Puppet is an ideal medium for story telling. They can act as facilitators for learning[9]. Puppet is a toy children love playing with. A puppet can just as easily be replaced by other play things similar to puppets. Being an object a puppet is tangible and haptic, something within the realm of comprehension of a child. I am using a five finger puppet for the platform. These puppets would have more control. They can be based on either animals or professional identity such as Policeman and Chef (Figure 23).Another idea was to accessories these tools. Like the frog puppet can have tangible accessories like a backpack (figure 23). These accessories will provide opportunity for customizing and tangible artifact that can used for interaction.

Puppets by virtue of their keen imagination then allows kids to play around with sizes, styles, colors, shapes, and through the extremely haptic medium of the craft. Hence, while the puppet remains a primary and central point of interest for children, technology does not preoccupy their minds.

I created a five finger fox puppet gloves of my own to understand the process of puppet creation (figure 24). This is a fun activity which in itself can teach kids about arts and craft. Kids can create their own puppet which will make it more valuable for them.

Figure 23. Five finger fox puppet making


World of Gesture
Driver
Takeover
Left turn
right turn
pass
Hiphop
Slim shady chop
Tweaking
High five
Fist pump
Fist bump
Dap greeting
2 Hands
merkel raute
Handsup/ Don't shoot
Jazz hands
Air quotes
Applause
Hand rubbing
Self clasping handshake
1 Hand
Fig sign
Losser
You ate it
Moutza
Elbow bump
Shaka
Finger gun
Hitch hiking
I love you
Salute
Wave
Okay sign
Loose screw/ cockoo sign
Fingers crossed
3 finger salute
Victory/ Peace sign
Heart
Middle finger
Hook & horns
The dog call
Face palm
body
Air kiss
blowing a raspberry
Curtsey
Bowing
Hand kissing
Eskimo kiss
Social media
Tweet, follow, #tags
Emoticons
Emoji
Like, poke, share, comment, subscribe, wall
Facial
Duckface
Selfie
Puppy face
Indian gestures
Head wobble
Namaste
Cutti/ abba
Sang pranam
Italian gestures
I don't care
WTF
Keep calm
Perfect
Get out of here
F**k Off

Ideation of gesture

I studied the gestures from different contexts like social media, culture based (indian, Italian), body part based (one hand, two hand, facial) and profession based (driver, cheerleader); to understand the value of gesture not only as inputs but as a communication medium. I wanted to explore the world of gesture and if we can take inspiration from them to create new gestures that could be used as input for interacting with digital media.

From this, I made an appropriated list of gestures taking into consideration the children (Figure 20). I neglected gestures with sexual and negative connotation attached to them.

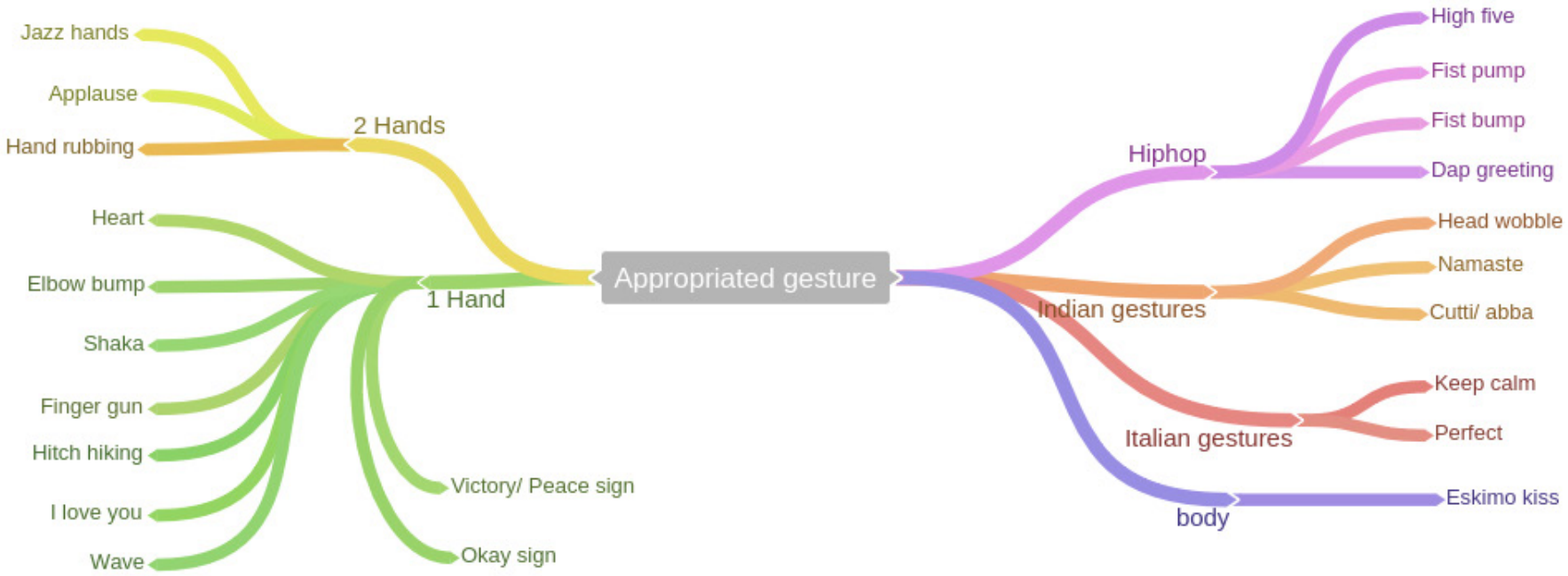


Figure 20. Appropriated list of gestures

Micro gestures

Macro gestures

Mix of both micro & macro gestures

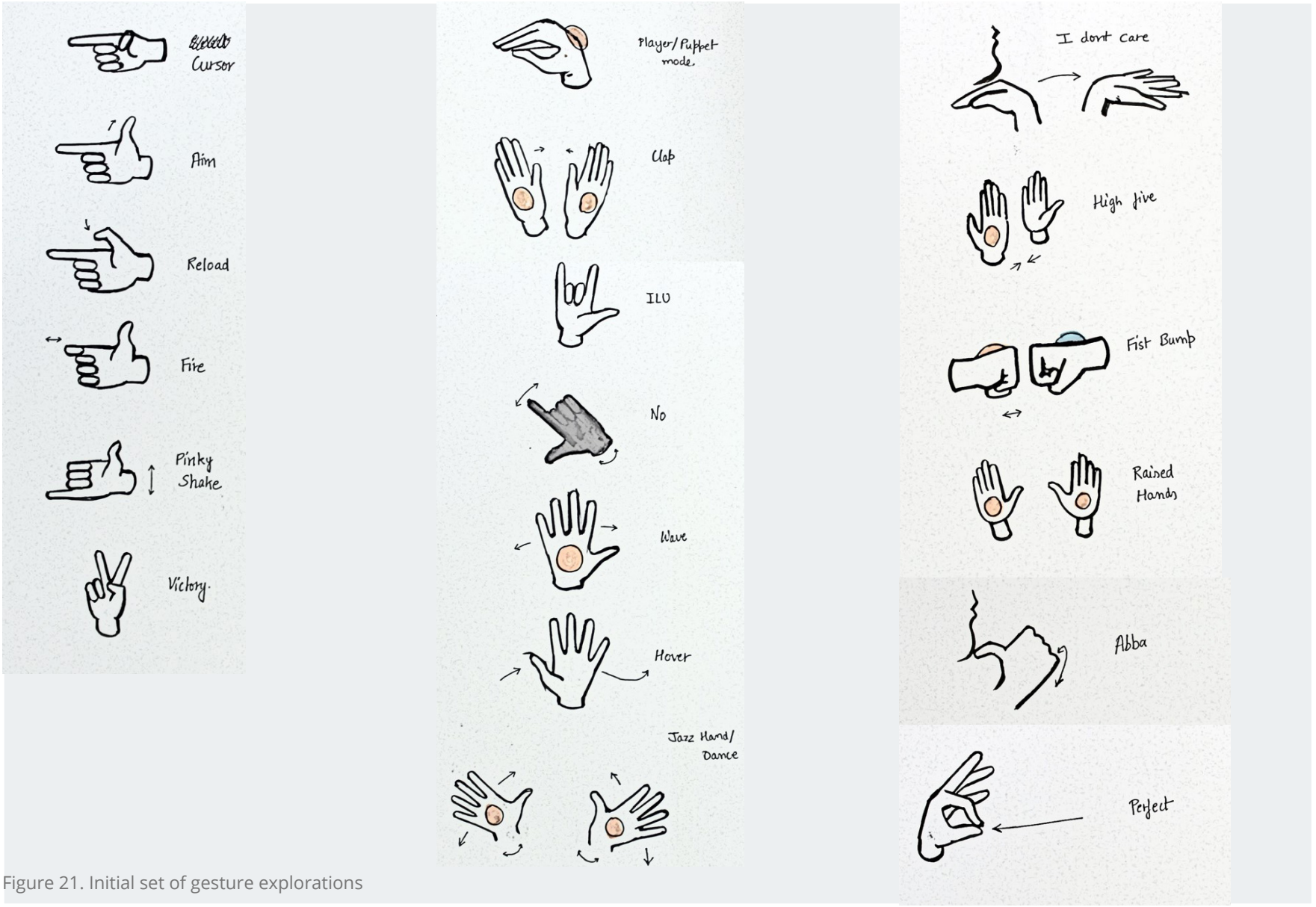


Figure 21. Initial set of gesture explorations

Refined set of gestures inspirations

After going through the appropriated list of gestures, I made further classification based on the number of movements (Figure 22) and the idea they communicate to find groupings in the gesture vocabulary.

The initial exploration of the use of some of these gestures is shown in figure 21. For example, the finger gun gesture can be used for inputs like shoot and point. The hover gesture with waving can be used for navigation. Items can be shared between players using fist bump. I observed that gestures consist of micro, macro or mix of both.

I identified the micro and macro components in these gestures. These micro and macro movement would form the basis for my further explorations of gesture language.

Since its quite difficult to implement gestures. This research can be used to add more gesture to the platform later as it grows.

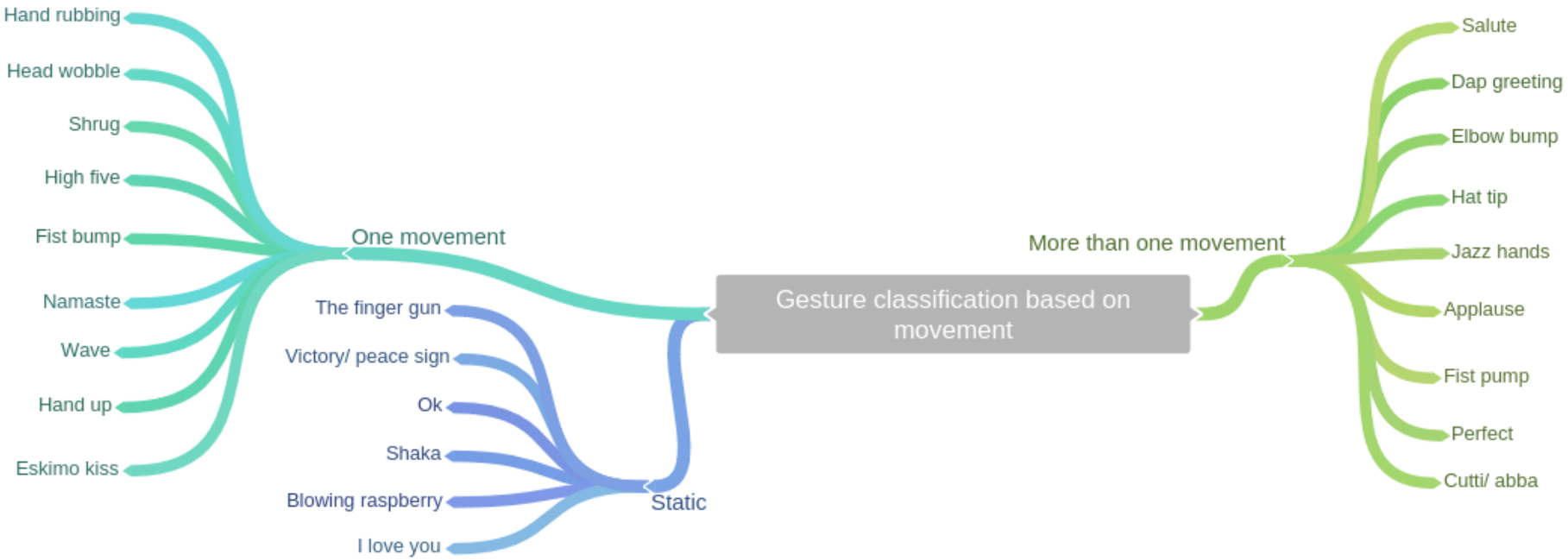
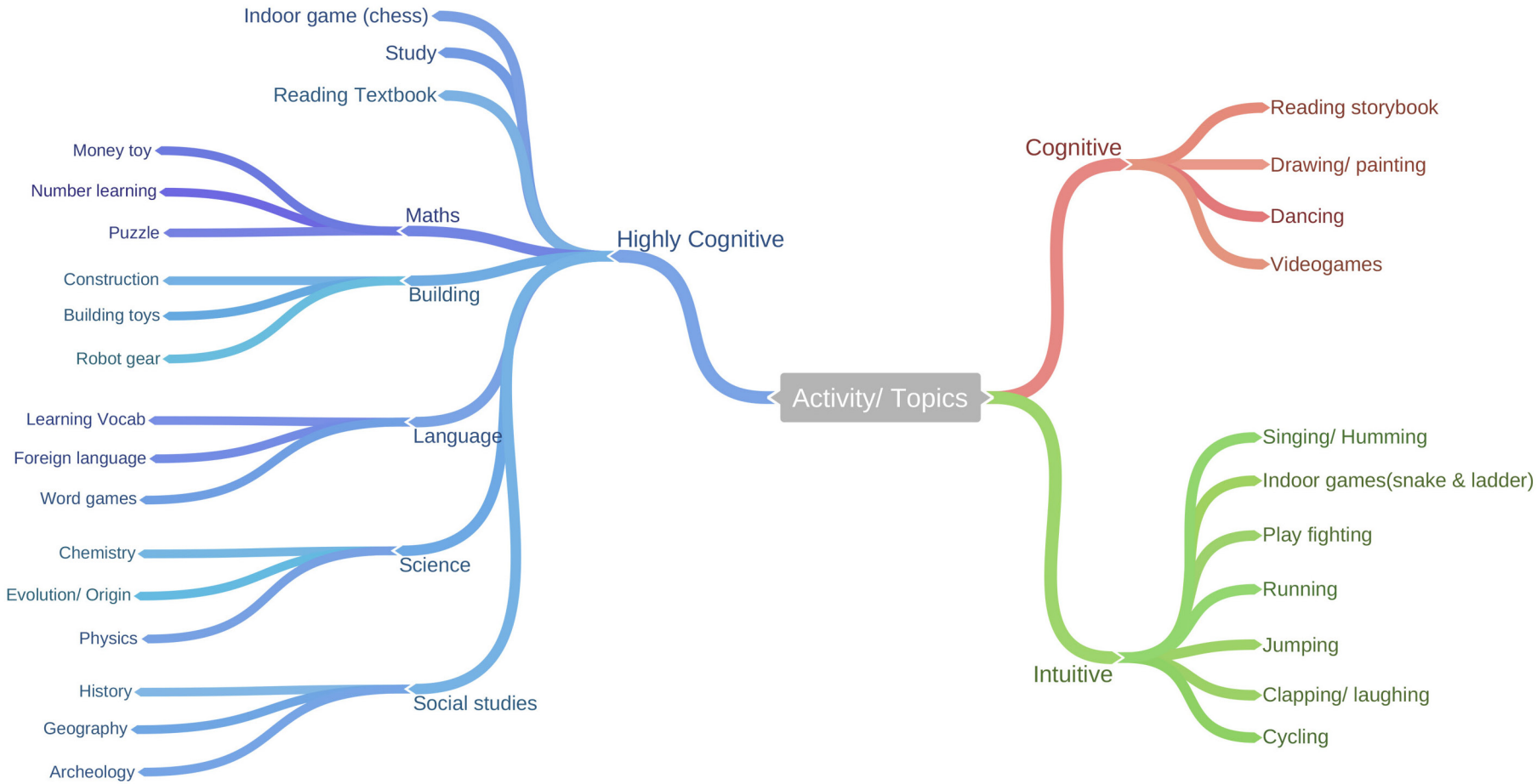


Figure 22. Gesture classification based on movement

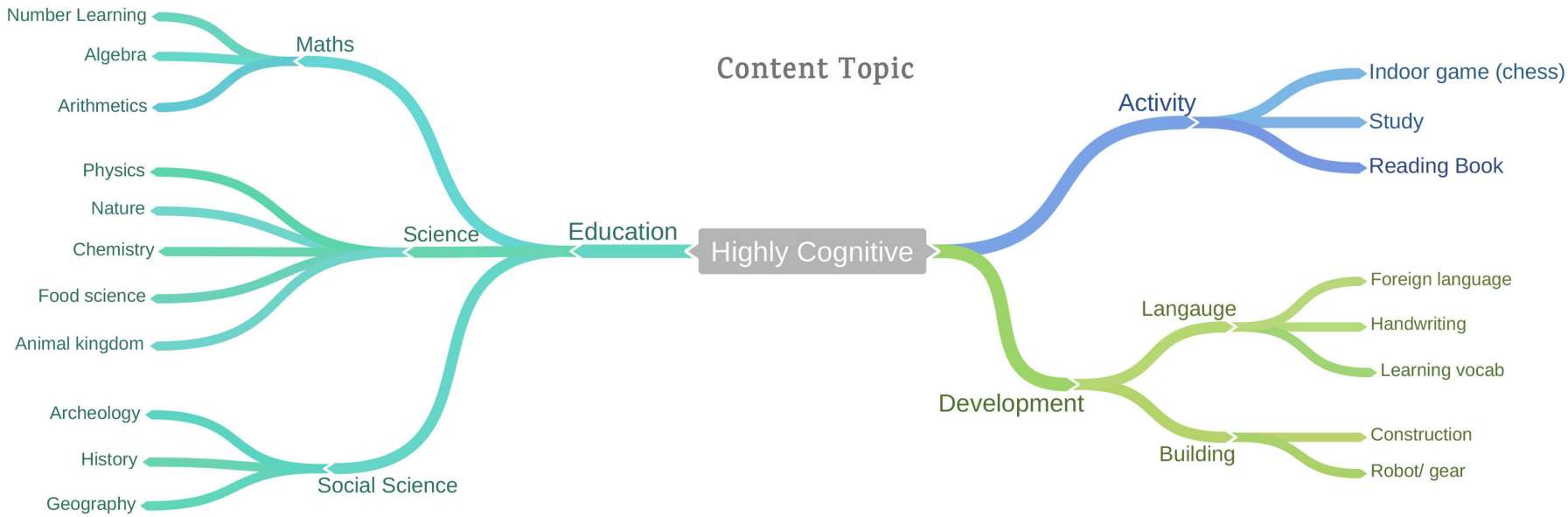

Activity/ Topics
Highly Cognitive
Indoor game (chess)
Study
Reading Textbook
Maths
Money toy
Number learning
Puzzle
Building
Construction
Building toys
Robot gear
Language
Learning Vocab
Foreign language
Word games
Science
Chemistry
Evolution/ Origin
Physics
Social studies
History
Geography
Archeology
Cognitive
Reading storybook
Drawing/ painting
Dancing
Videogames
Intuitive
Singing/ Humming
Indoor games(snake & ladder)
Play fighting
Running
Jumping
Clapping/ laughing
Cycling

Ideation for content

Children's activities are either intuitive, cognitive or highly cognitive. Kids love to perform activities such as running, jumping, singing, clapping as its comes naturally to them. Activities such as reading storybook, drawing, dancing are cognitive and requires child's focus.

Ideation for content

Subject such as math, language, science and social science are highly cognitive along with activities such as chess, studying textbook etc. These are often boring for kids as these require constant focus and concentration. I looked at various sub-topic that can be used to develop content for the play & learn platform. Topics from mathematics such as algebra and arithmetic which children have difficulty understanding due to its abstractness. Science topics such as physics and chemistry. I have as a personal choice decided to take social science with archeology, history and geography as my sub-topics, as it involves factual data which are difficult for kids to retain after studying.



A Magical adventure to monuments of India

Find eco points inside the golkonda forts

Color pick and trace
Fill in color to blank motives

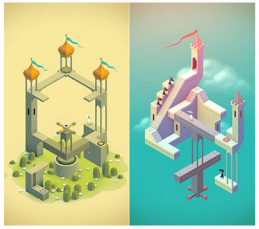
Discover ajanta murals in the darness of the cave

Content possibilities

Find Precious gem stone located inside Taj Mahal

Discover different influences in Indian Architecture

Dance with the king and queen



Build your own Monuments

Monuments/ Archeology/ Architecture

Archeology and Architecture are major part of history. There are very few games/toys that are based on Indian monuments and architecture. Every monument is known for some sensory experience, what if we can provide that through this play & learn platform.

Possible scenario for game

- Finding eco points inside the Golkonda forts.
- Color picking from the motif and painting the monument.
- Discover Ajanta cave murals in the darkness of the cave.
- Building your own monument using different architectural styles from India.

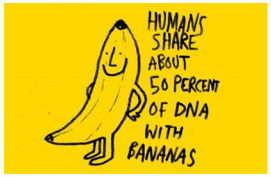
Need gap

- It is not possible for everyone to visit the monuments around the world. But it is possible to bring few experiences from these monuments to kids.
- Textual description in books does not justify the history and significance of monuments.
- History lesson have always been factual and without any experiential learning are forgotten quickly.

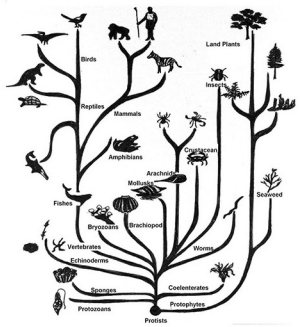
Scalability opportunity

- This content can be used on global scale to teach about Indian monuments to children outside India.
- This can be used in tourism industry to create virtual tours of monuments and museums.

The magical origin of life on earth



- How are we related to other Species



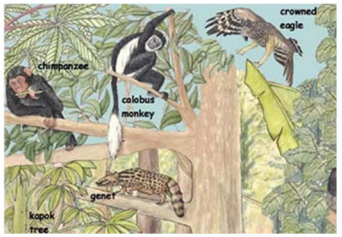
- Understanding family tree

Content Opportunities

Evolve

You play - They grow

- Evolve your own species



- Buid habitat for animals

- Understanding environment for evolution

Evolution/ Ecology/ Biology

Evolution and ecology are subjects that are abstract in nature. There is a need to create greater empathy towards other species. I have taken this topic to explore the content for my platform. The scenarios will be used to make games for the working prototype.

Possible scenario for game

- Recognizing and building animal habitats, their food habits and location.
- Understanding the different stages of evolution of life on earth.
- How are we related to other species
- Understanding other cultures like Mayan, Aztec, Inca civilization from rain forest.

Need gap

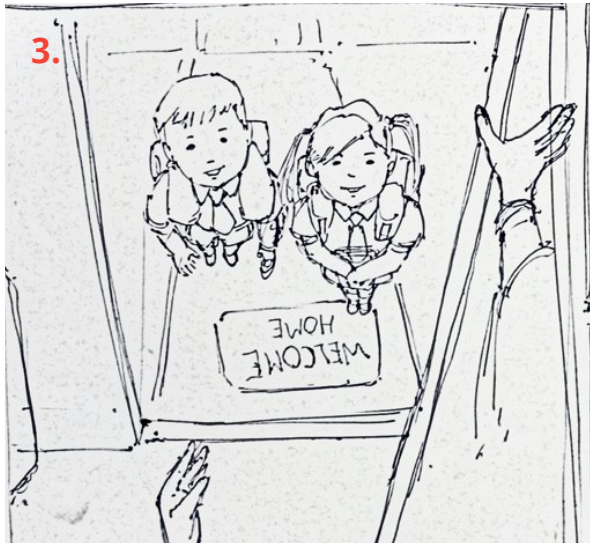
- Evolution is an important concept that deals with interdependency and relation among different species.
- Textual description in books is not sufficient to explain the importance and repercussions of disturbing the animal habitat.
- Need to develop empathy for other species and environment.

Scalability opportunity

- We can scale up to include endangered species including flora and fauna
- Use in Museums to educate visitors


1.


2.


3.
WELCOME
HOME


4.


5.

Initial Scenario

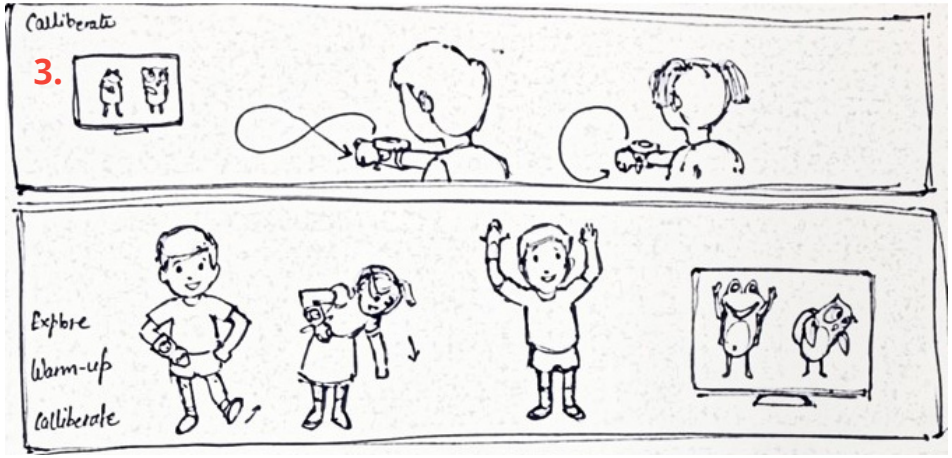
These scenarios are made to understand the potential of this platform. Scenarios are refined and finalized later implementation and evaluation.

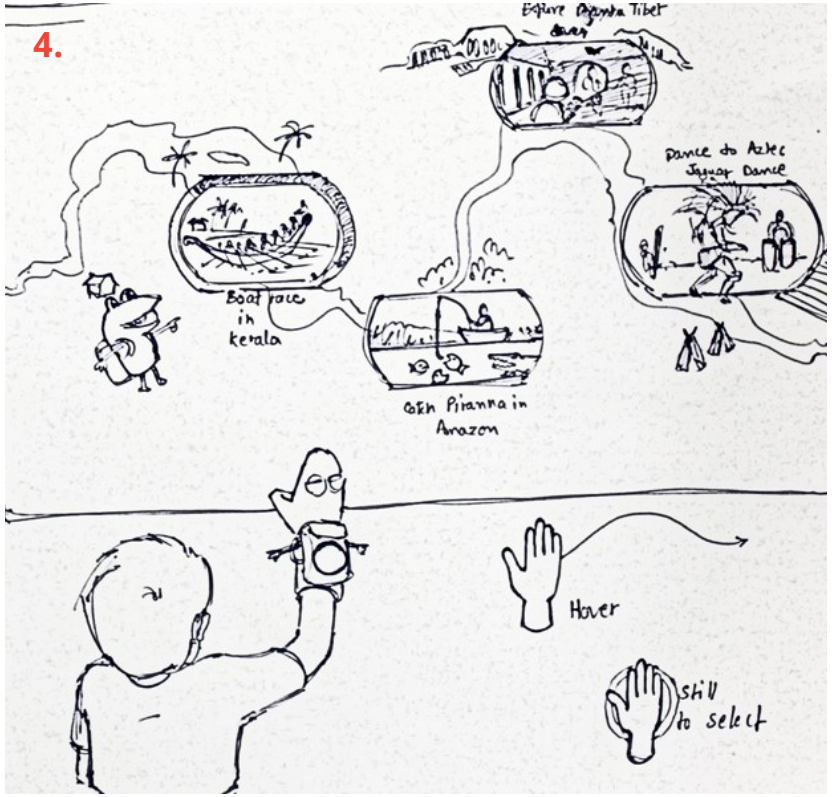
Kids are introduced to Evolve

1. Rahul and Swati are bored from the regular geography class.
2. They can wait for lunch break to start when they can play and have fun with their friends.
3. They are so happy to back home. Their mother greets them at the door.
4. Swati and Rahul can't sit and study for more than 15 Min. They are soon lost in their world of imagination.
5. They love to paint and wish they had more such activities.
6. Their mother brings 'Evolve- A magical journey' for them. They are excited to try it.


1.
FRONT
BACK
Buzzer
LED Display
Eskimo
Kiss
Clapping
Ready
Tap
buzzer
to
equip


2.
12:00


Calliberate
3.
Explore
Warm-up
Calliberate


4.
Explore Ogenda Tibet
Dance do Aztec
Jaguar Dance
Boat race
in
Kerala
60ft Piranna in
Amazon
Hover
Still
to select

Starting up the evolve puppet-

1. Both of them take out the puppet glove from the Evolve kit. Rahul takes the frog puppet while Swati takes the owl puppet. The puppet has sensor LED display at the back. Rahul wakes up his puppet by giving it an Eskimo kiss. Swati wakes up her puppet by clapping to generate noise. They tap on then LED buzzer when ready.

2. The LED display at the back acts as a secondary notification screen. Which tells them information about their puppets status, yes or no, how much time is remaining, etc.

3. On First startup they had to calibrate their puppets.

4. Hover gesture is used to navigate across the screen and still to select options. This gesture was later changed to fist gesture after evaluation. Different topics are taken based on their sub-context. There are four game levels with different sub-text in this scenario-

- Backwaters of Kerala- Geography, Exercise
- Swimming with river giants in Amazon- Ecology, Geography, Species
- Exploring Tibetan palaces- Archeology, Culture
- Jaguar dancing with Aztecs- history, Civilization, music

- **Gestures used-** Hover to navigate, Still to select. There are other gestures such as tapping on the bagpack display of the puppet.


1.
Backwaters ride
Snake water race
Elephant ride
Hover
Still
2.
Back Rowers
Main Rowers
Muthukuda
Beat givers
Hover
Still
UPGRADE BOAT
1800 XP
• Colour
• Capacity
• Accesories
10 Countdown
Red, yellow
Green
3.
Reset
Raw strength
Haptic feedback
Input
indicator motivator
Main Rower
Beat Giver
4.
Haptic feedback
Input
Red
Orange
Green
Sync feedback
Tap
Collect xp points
Are you ready!
Wipe sweat
Fist Bump
fist drab
drink coconut
5.
Attack / Collect coconuts
Steer / Hover Avoid obstruction
CO-OP

Module 1. Back waters of Kerala-

This will help kids learn about Kerala and its back waters. Their custom of boat racing along with physical exercise.

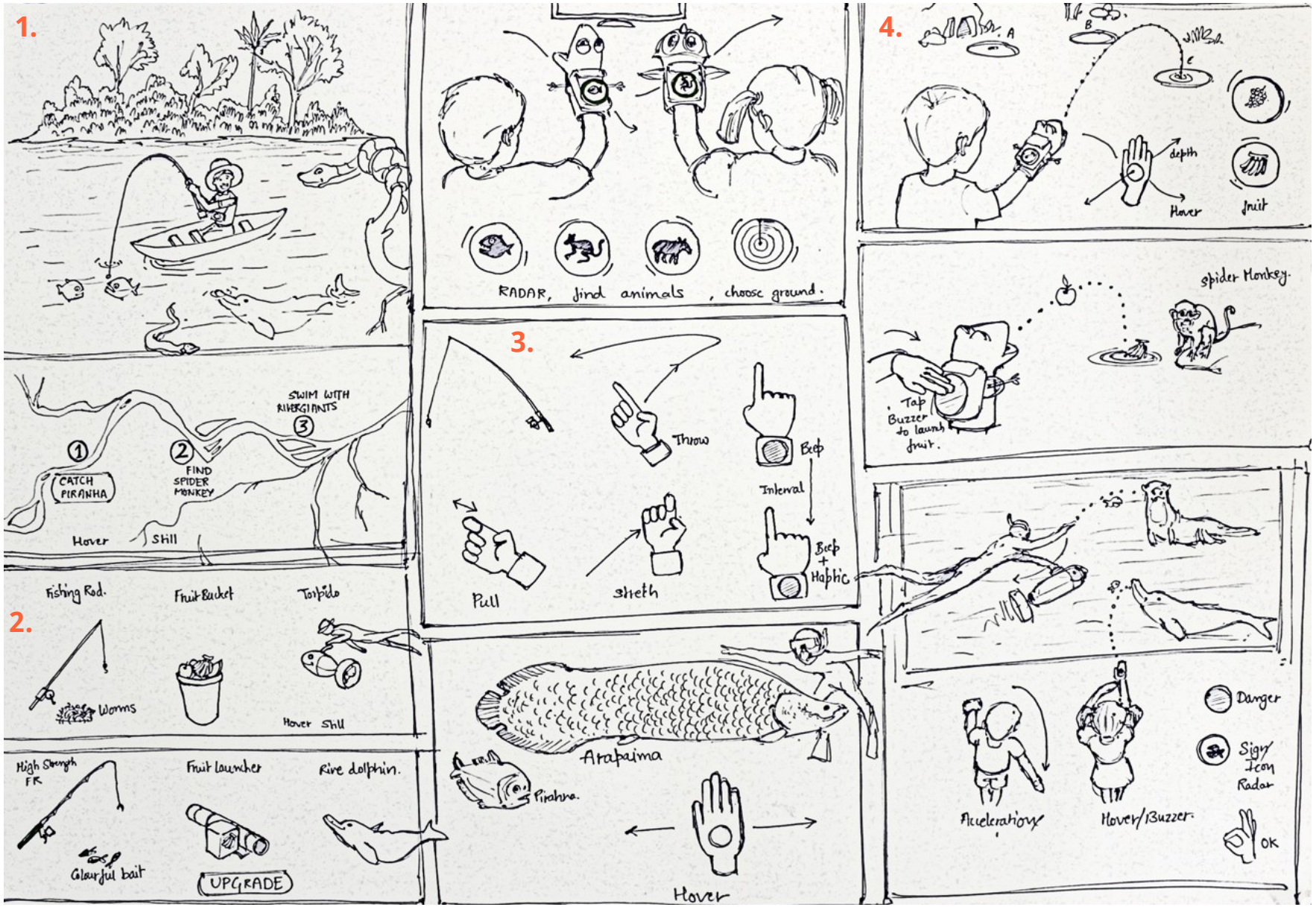
1. The game starts with intro-scene from Kerala showing all visual elements from Kerala. The player has to choose between different sub-games like elephant ride and snake water race.

2. Rahul and Swati choose snake boat racing. They can choose different position to play from in the snake boat. From the point of replayability, they can upgrade their boat speed, capacity.

3. Rahul closes his fist and moving it up and down for rowing the boat.

4. Swati has taken the position of beat givers, she has to move her hand in synch with the beat.

5. This is the elephant ride stage. It is a co-op round where, Rahul is using horn gesture to remove obstacles and Swati is navigating the elephant.


1.
2.
3.
4.
RADAR, find animals, choose ground.
SWIM WITH RIVERGIANTS
CATCH PIRANHA
FIND SPIDER MONKEY
Hover
Still
Fishing Rod.
Fruit Bucket
Torpido
Worms
Hover Still
High Strength FR
Fruit Launcher
River dolphin.
Colourful bait
UPGRADE
Throw
Beep
Interval
Beep + Haptic
Pull
Stretch
Arapaima
Piranha.
Hover
depth
Hover
fruit
spider Monkey.
Tap Buzzer to launch fruit.
Danger
Sign/ Icon Radar
Accelerations
Hover/Buzzer.
OK

Module 2. Swimming with the river giants of Amazon-

This will help kids learn about Amazon river and its biodiversity. This will teach them about ecology, species and habitat.

1. The game starts with intro-scene from Amazon showing all visual elements from Amazon. An abstract geographical map of the river will be used for level selection. The player has to choose between different sub-games like catching piranha fish, finding spider monkey.

2. Rahul and Swati choose atching piranha fish. From the point of replayability, they can upgrade their accessories used in different level of the game.

3. Rahul and Swati use their LED display to find animals around them. They make finger gun gesture to throw the fishing hook in water. In swimming with the giants level they swim using hover gesture.

4. Rahul throws projectile of food to respective animal habitats to feed them and bring them out of their hiding spots. Push the buzzer to throw items. This interaction was later implemented in the final prototype.


1.
2.
up down
Hover
Direction
Run
Horse capacity
limit
dist close
stop
stop.
Hourse Race.
3.
Painting/ Palace.
Paint /Hurry
Torch Light
Red.
Picked colour
TIBET
CHINA
INDIA
4.
Mountains
Top
Hover
Mountain Spot.
climb diffs
Horn
black boulders.
Jazz Hand
freezing Hands.
Jump
fist
palm

Module 3. Exploring the Tibetan caves-

This will help kids learn about Tibet and its geography. This will teach them about archeology and culture.

1. The game starts with intro-scene from Tibetan mountains showing all visual elements from Tibet. An abstract geographical map of the region will be used for level selection. The player has to choose between different sub-games like horse racing in Tibet, exploring cave paintings, climbing mountains.

2. Rahul does a gangnam style gesture to ride horses. The LED disply notifies the speed and capacity of the horse. It gives haptic feedback.

3. Rahul uses his hands as torch light to explore cave paintings, while Swati uses her finger to pick color and paint inside the cave.

4. Rahul uses grab gesture to hold on to rocks and climb the mountain. The horn gesture to avoid falling rocks. And jump to cross cliffs.


1.
2.
Drumming.
3.
No sound.
Tune1
Tune2
Tune3 + Tune4
Tune1
Tune2
Tune3
Tune4
Rattle
4.
Hover
Hover
Red.
Move.
Tiger Dance
Animal Inspired.
Hand Bump
Raised Hands
Fist bump.

Module 4. Jaguar dancing with Aztecs-

This will help kids learn about ancient Aztec civilization and its customs. This will teach them about history, culture and music.

1. The game starts with intro-scene from mythical Aztec civilization showing all visual elements from aztec. The player has to choose between different sub-games like playing drums or flute or dancing in sync with the jaguar dance.

2. Swati uses finger gun gesture to play drums.

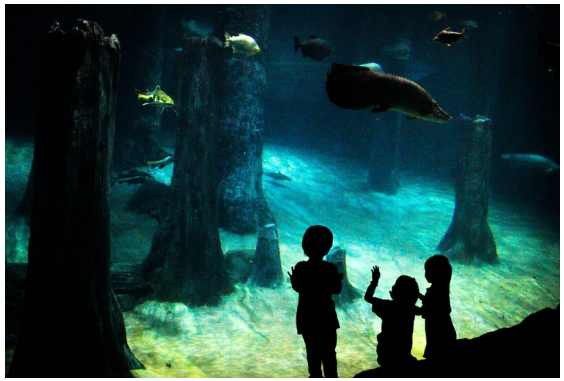
3. Rahul uses his fingers to play flutes. Aztec flutes makes the noise of the animal it is shaped like. For example, snake flute makes noises like the snake. Explore these flutes and identify the animal noise it makes

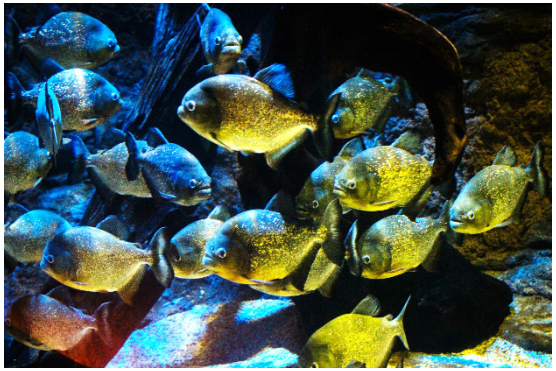
4. Hover to incoming beat and select. Stay in sync to earn more points

Initial scenario feedback

The initial feedback was that there is a lack of connection between puppet and the character on screen in the game. The gestures being used are not do directly mapped on to the puppet. One observation from evaluation is that kids don't focus on which character the are wearing during active gameplay.

From this initial scenario exploration and feedback I have taken forward the Amazon and Aztec scenario to cover all sub-context. This will cover ecology, animal habitat, culture and music. The game level are inspired from visit to Singapore zoo and river safari.





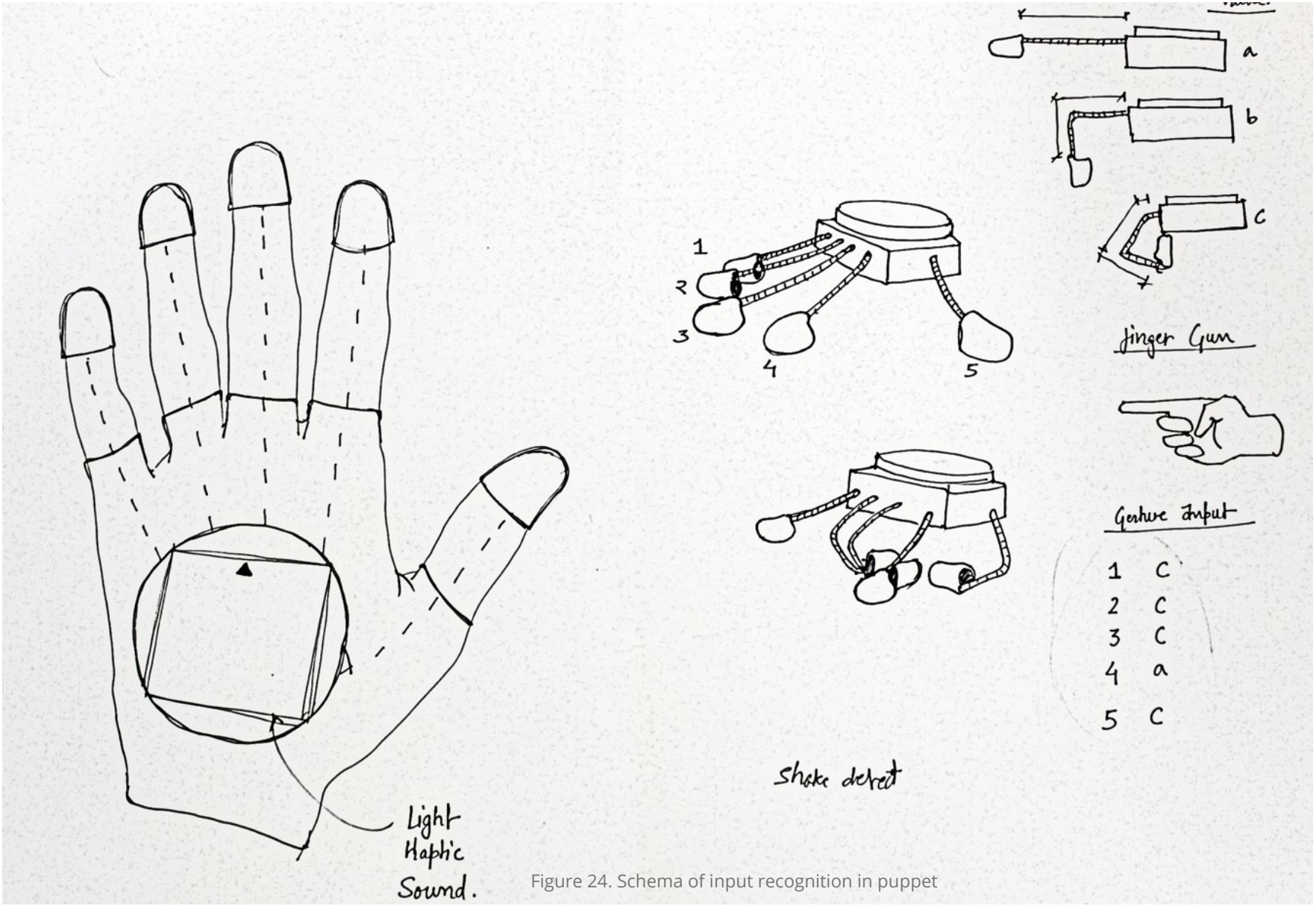


Figure 24. Schema of input recognition in puppet

Implementation

Schema for input recognition in glove

The puppet will use a flex sensor input for each finger. This can later be replaced with touch sensitive fabric. The values will be recorded for each finger(Figure 24). If the finger is open the value is 0, otherwise if its close the value is 1. This give a combination of number (Eg. 0,1,0,0,0) for corresponding gesture.

In the final glove I used a sixth sensor for recording the flick of the wrist as well. The position of the character on the screen was recorded by using the accelerometer and gyroscope sensor on the smartphone. By using this system the number of gestures that can be implemented is limited only to the permutation and combination of values(0,0,0,0,0,0) and the ergonomics of use.

Making a five finger puppet

I went to national library of Singapore to refer books on puppet making and created a five finger puppet glove (Figure 25). Another glove was created for the final prototype.

Figure 25. First try-out with a five finger puppet

Figure 26. Other puppet options

Proposed technology

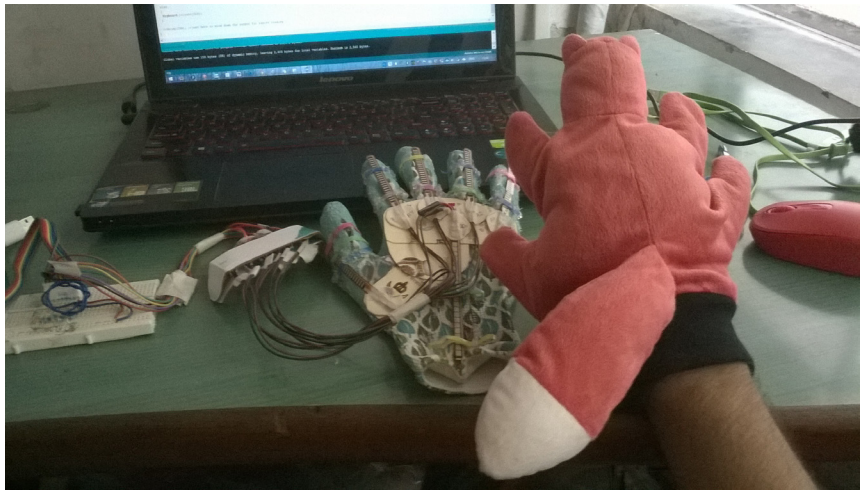
There are two ways the glove can be developed Fisrt one is that this will be a smartphone powered glove. Modern day smartphone have very powerful processors and come with all sorts of sensors. The smartphone will be attached to a port in the backpack of the puppet. Smartphone will take the inputs from the glove and can stream the video content to any T.V., P.C., Tablet, etc.

Secondly, the glove can be a standalone device with all the necessary sensors built into the device.

Technology used in prototype

Six flex sensors are used to get input for the glove gesture. Accelerometer and Gyroscope sensor on the smartphone help navigate on screen.

Currently the prototype is wired due to time constrains. Using an integrated chip with wireless sensor it can be made to communicate wirelessly. The laptop interprets the input using Arduino. The games engine triggers the required action based on the pressed gesture.



	Kinect	LeapMotion	Evolve
Aim	Motion Tracking System, Macro gestures only	Micro gesture, extremely precise.	Both micro and macro gesture based detection
Price	₹ 25,000	₹ 7,199	About ₹ 4,000
Recognition	Recognize voice commands and facial recognition	Can recognize very subtle movement and translate it on the screen	Micro and macro gesture recognition,
Player	Multiplayer upto 4	3 hands (15 fingers)	Implemented 2 hands, Can be 4
Support	Open Source, SDK available	Open Source, SDK available	Open Source platform
Range	1.2m to 3.5m	Above the device (1 inch to 2 feet)	Wireless range

Final design solution

Existing technology comparison

When compared to the existing technology in the market, this platform can provide significant advantages over the other options. Other platform use camera recognition technology to detect gestures. Which creates its own advantages and disadvantages.

Kinect can only detect macro gestures. Micro gestures made with hand are difficult to detect through kinect. LeapMotion can detect micro gestures very accurately but the user has to keep his hands in front of the device at all point. Evolve is based on wireless technology just like a wireless mouse or keyboard therefore the range of using it depends on the wi-fi range. It is independent of the camera.

Secondly, manufacturing such a device will cost a lot lesser than the existing devices. Where devices like kinect cost about Rs 25,000. This device will not cost more than Rs 4000. This puts it in reach of more households, schools and children.

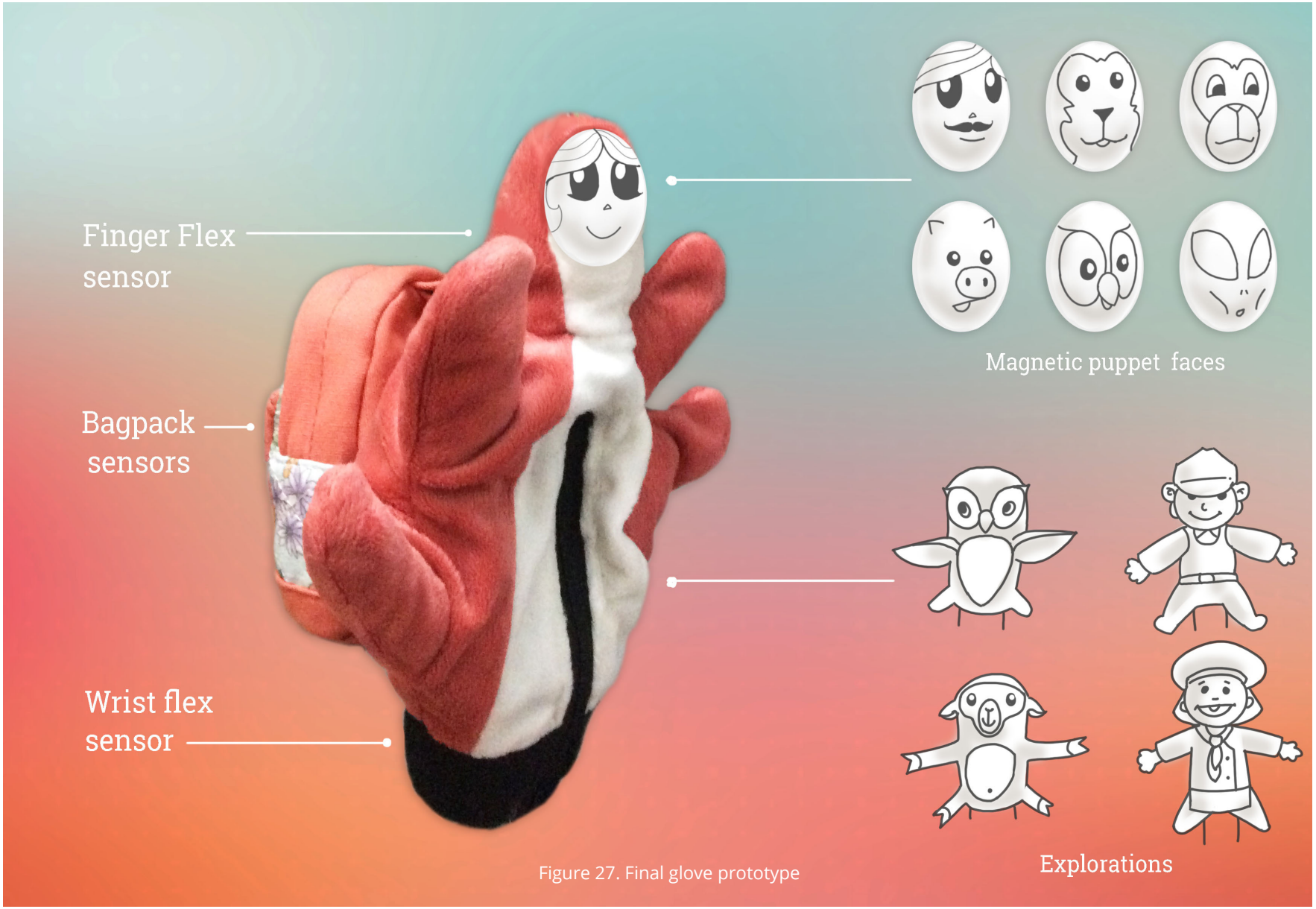


Figure 27. Final glove prototype

Final evolve glove

Puppets are diverse and vibrant, but for consistency during game play and avoiding hassle of changing gloves every time. I have introduced magnetic puppet faces, these swapable faces will allow players to switch puppet character during game play. The backpack hold all the sensors and the LED display (figure 27).

First implemented list of gesture

The implemented gestures used in first testing of the final game scenario are shown in figure 28. These gesture need to be tested further with kids and modified based on ergonomics.

Hover- to move left/right and top/bottom.

- Select- Fist gesture
- Throw- Flick of wrist gesture
- Pause- Shaka gesture
- Point- Finger gun gesture

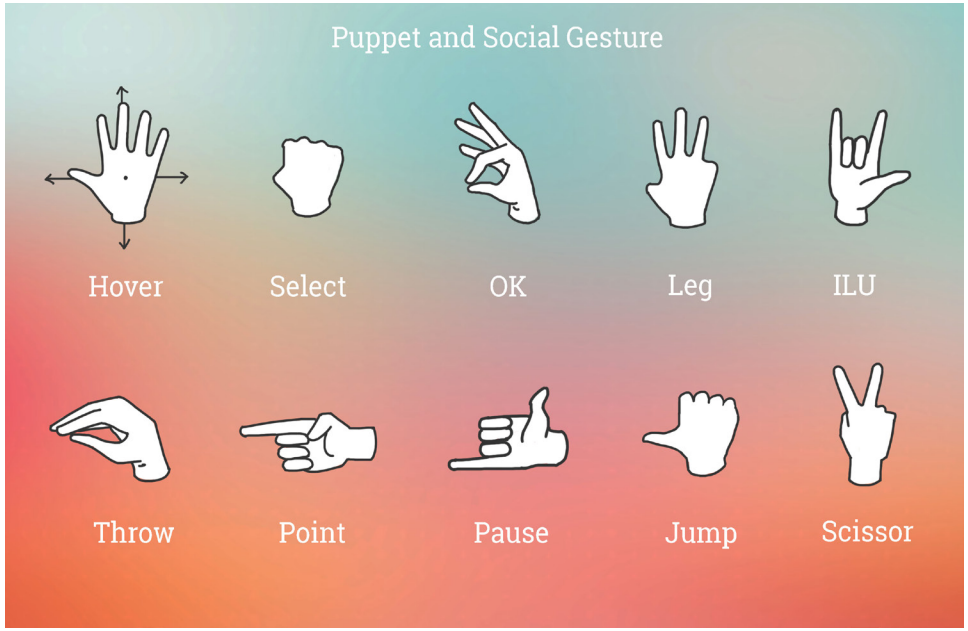


Figure 28. Initial implemented list of gesture

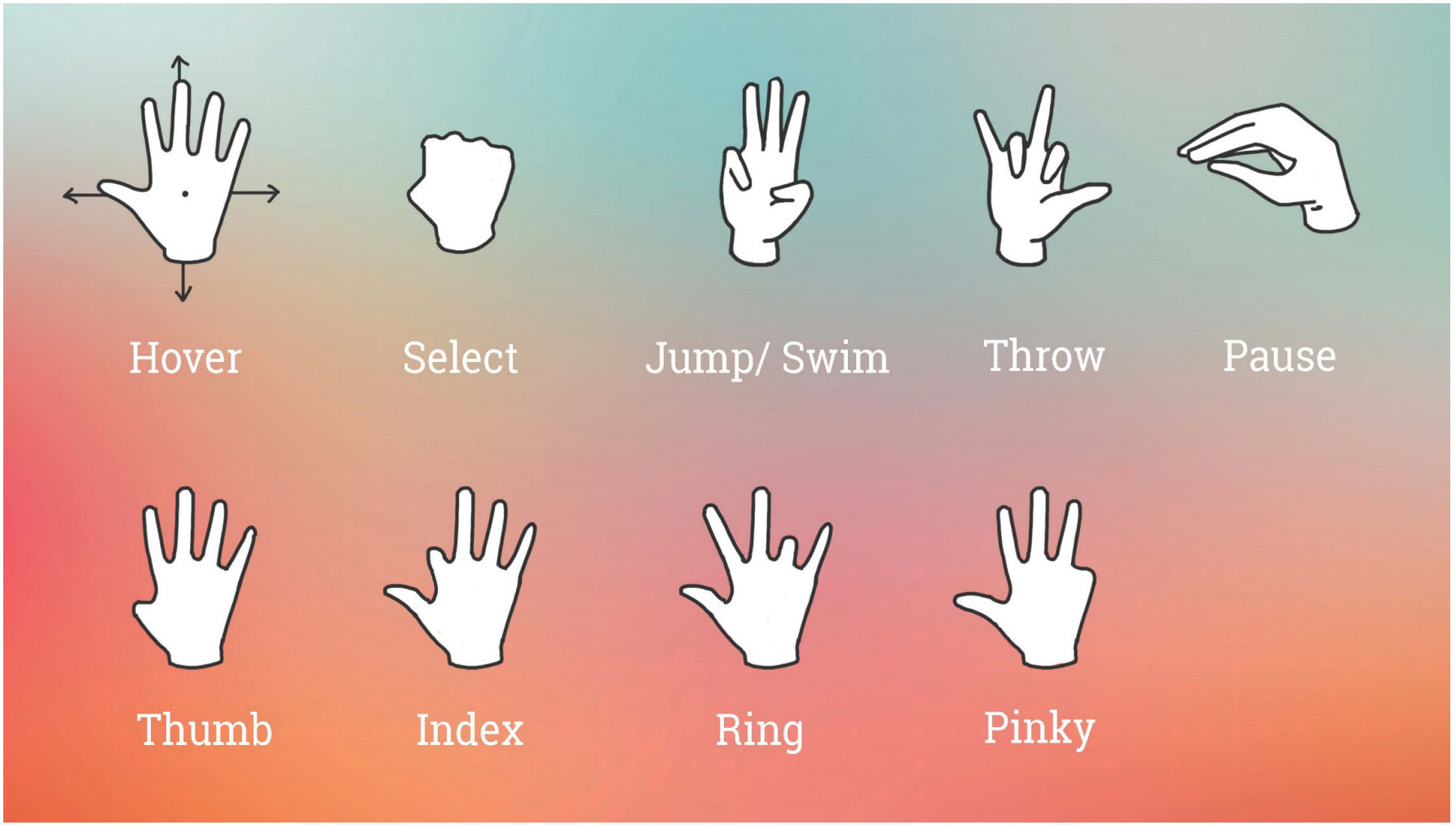


Figure 27. Final gesture set

Final gesture set

The initial implemented list of gesture was tested with kids to check for ease of use and ergonomics. Upon which it was found that some gestures worked well for other inputs. For e.g. The flick gesture was actually good for pausing the game instead of giving throwing command. These gestures are mapped for only the right hand at the moment. Finally, I have arrived at this final set of gestures namely:-

- **Hover-** Keep your hand as shown in figure 29. Move your hand left/right to move the virtual character left/right. Similarly, move top/ bottom for up and down.

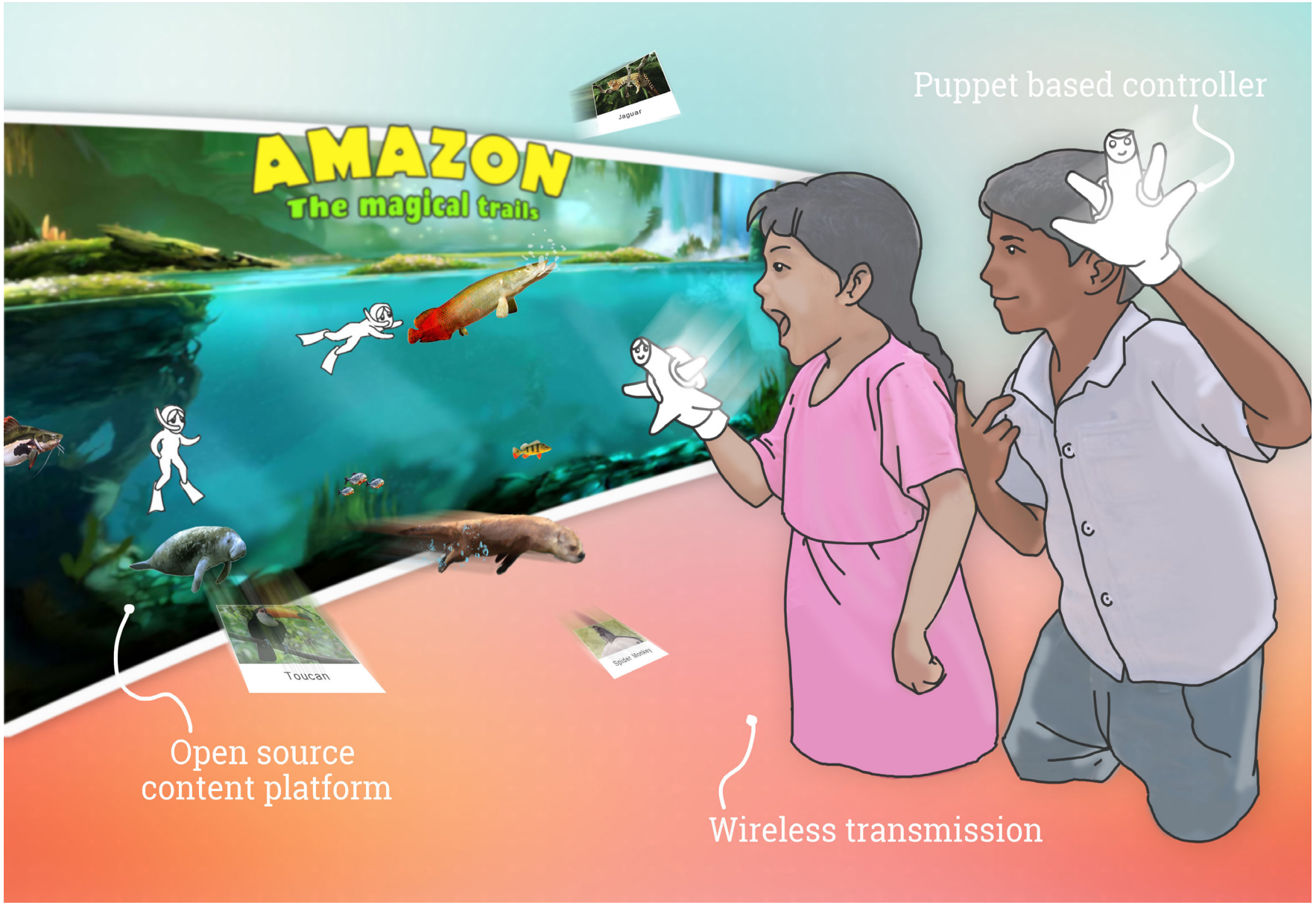
- **Select-** Keep your hand open initially and the make a fist to perform the select gesture.

- **Jump/ Swim-** We jump with our feet. To use the feet of the virtual character on screen bend your thumb and pinky finger as shown.

- **Throw-** We throw using our hands. To use the hands of the virtual character bend your ring and index finger as shown.

- **Pause-** To pause the game in between flick the wrist as shown in the figure. To unpause the game flick again.

- **Individual ginger based-** It recognizes individual finger bending to register different input. For example in this case, musical notes are assigned to each finger. When a particular finger is bent, the corresponding note mapped to that finger is played. This was kids can create melody in air by moving there fingers.


Puppet based controller
AMAZON
The magical trails
Jaguar
Toucan
Spider Monkey
Open source
content platform
Wireless transmission

Evolve- A physical puppet glove

Based on all the ideations that I did for gameplay, physical toy, gesture and content; I arrived at my final concept. The aim of the project was to create a new physical interface platform for children of 7-12 years using physical toys from their play environment. And then create modules of educational content that will help kids learn about various topics.

Puppet is a toy children love playing with. A puppet can just as easily be replaced by other play things similar to puppets. Being an object a puppet is tangible and haptic, something within the realm of comprehension of a child. This by virtue of their keen imagination then allows them to play around with sizes, styles, colors, shapes, and through the extremely haptic medium of the craft. Hence, while the puppet remains a primary and central point of interest for children, technology does not preoccupy their minds.

Final concept

The puppet based controller will be cheaper than traditional image recognition based gaming consoles. Its focussed more on micro-gesture for fine motor skills, rather than macro gestures.

The game application will run on the smartphone and the video feed will be streamed to wireless enabled devices. The game can be played from anywhere in the room giving the kids greater mobility.

The content is developed on Construct 2. I have taken amazon as my final scenario to develop for the platform as it covers all major sub-text such as geography, ecology, habitat, culture and music. The game will have three different stages:

- Rain forest
- River giants
- Jaguar dance

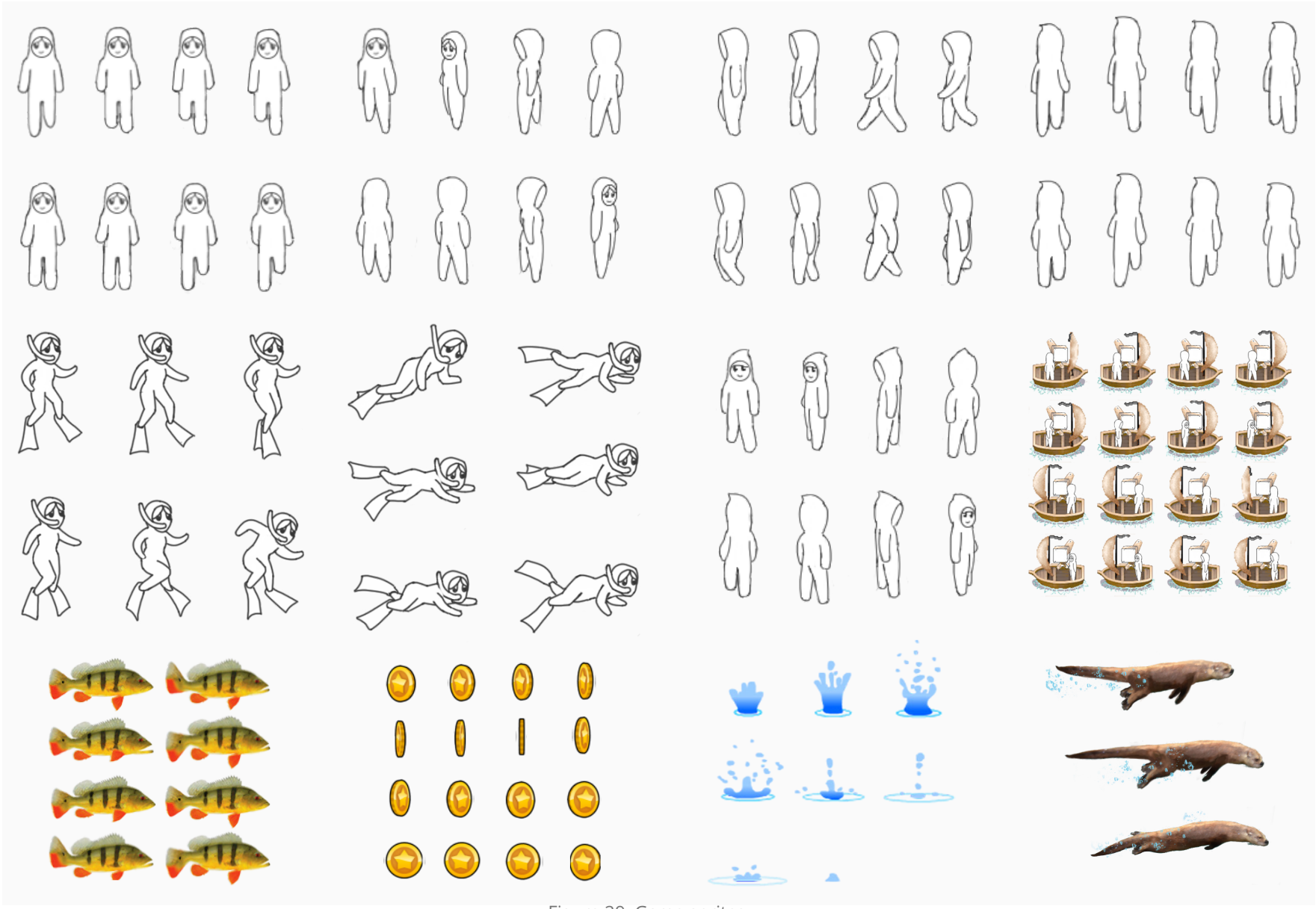


Figure 29. Game sprites

Game development

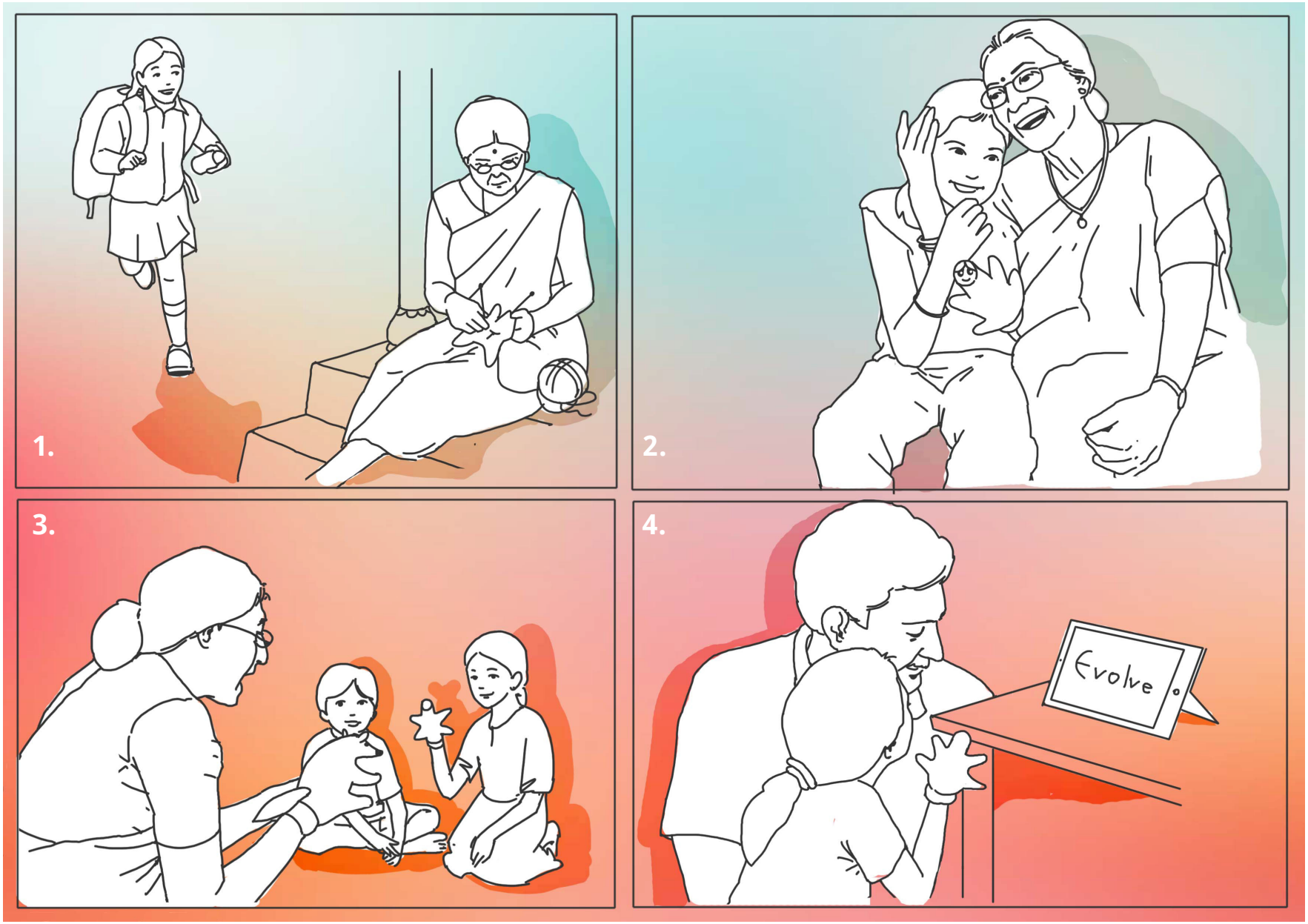
I have used Construct 2 game engine to create level for this game. Its useful for making 2D games. It is a GUI based game engine. Hence, I was able to write logic for three separate games even though I don't know coding. I wanted to test the gesture input in game therefore it was important for me to create working games. The game input triggers were mapped to the mouse and keyboard keys. Which would get feedback from the glove via separately written arduino program.

Game character and sprite sheet

I created two player character, one male and one female (figure 29). Then their sprite sheet were made based on the gesture animation. This process was repeated for all elements in game with animation for e.g. fishes, animals, coins etc.

A lot of inspiration for the art work and visuals was taken from my visit to the Singapore river safari, which had a section on amazon river (figure 30).

Figure 30. Getting inspired from trip to the Singapore river safari


1.
2.
3.
4.
Evolve

Final game- scenario

I have taken amazon river as my final content to develop for the platform as it covers all major sub-text such as geography, ecology, habitat, culture and music. The game will have three stages:

- **Rain forest-** In this module kids will learn about the wild-life that lives in the rainforests of amazon.
- **River giants-** In this module kids will learn about the aquatic life forms such as fishes, and mammals.
- **Jaguar dance-** In this module kids will learn about the percussion instruments used by Aztec civilization and learn how make music with them.

The complexity and number of gestures used will increase with each stage.

Intro scence

1. Divya is 8 years old and lives with her parents and grand mother in Mumbai. Her grandmother has promised to make a new puppet for her. She is very excited to return from school as her grand mother has told her that she will finish the puppet today.

2. Divya is also interested in making dolls and has made few of her own puppets. She is very happy to see the new puppet glove. She gives her granny a big hug.

3. Her grand mother tells them stories using the five finger puppet glove. Divya's younger brother is fascinated by the puppet show. They wear puppet gloves of their own to take part in the story.

4. Divya is excited to play with evolve. Her father had promised to take her to Amazon river and introduce her to strange animals and music. When her father returns at night, he downloads the amazon module from internet and opens it on his tablet. Then Divya starts playing the game using Evlove glove. Her father is happy that she is not stuck with the screen anymore.


1.
AMAZON
The magical trails
Select Player
Speed: 4
Strength: 3
Speed: 2
Strength: 4
2.
Close hand to skip
3.
Select Trial
River Giants
Jaguar Dance
Forest

Stage selection scenario

1. Divya is on the title screen which reads “Amazon- The magical trials”. She has to choose between the male and the female character. Divya choose the female character by taking the cursor over the female character and doing select gesture.

Gesture used- Hover gesture will be used to move the cursor on the screen and select gesture to choose player (see page 82).

2. She lands on the tutorial screen. Here she can freely move around and interact with the character. This screen will be used for teaching new gestures. They can skip this page when they want to by using select gesture.

Gesture used- Hover gesture will be used to move the character up/down or left/right. Select gesture will used to skip to select stage level.

3. After this she lands on the select stage screen. She can choose to play from three levels. **Rain forest** is a mix and match game, where she has to match the correct animal clues to reveal hidden animal flash cards. **River giants** is an exploratory game where she collect fish cards and survive the round to unlock all the aquatic life form. Lastly **Jaguar dance** will teach her to play musical instruments using her fingers and make a character dance using her puppet controller.

Gesture used- Hover gesture will be used to move over the levels and select gesture will used to go to that level.

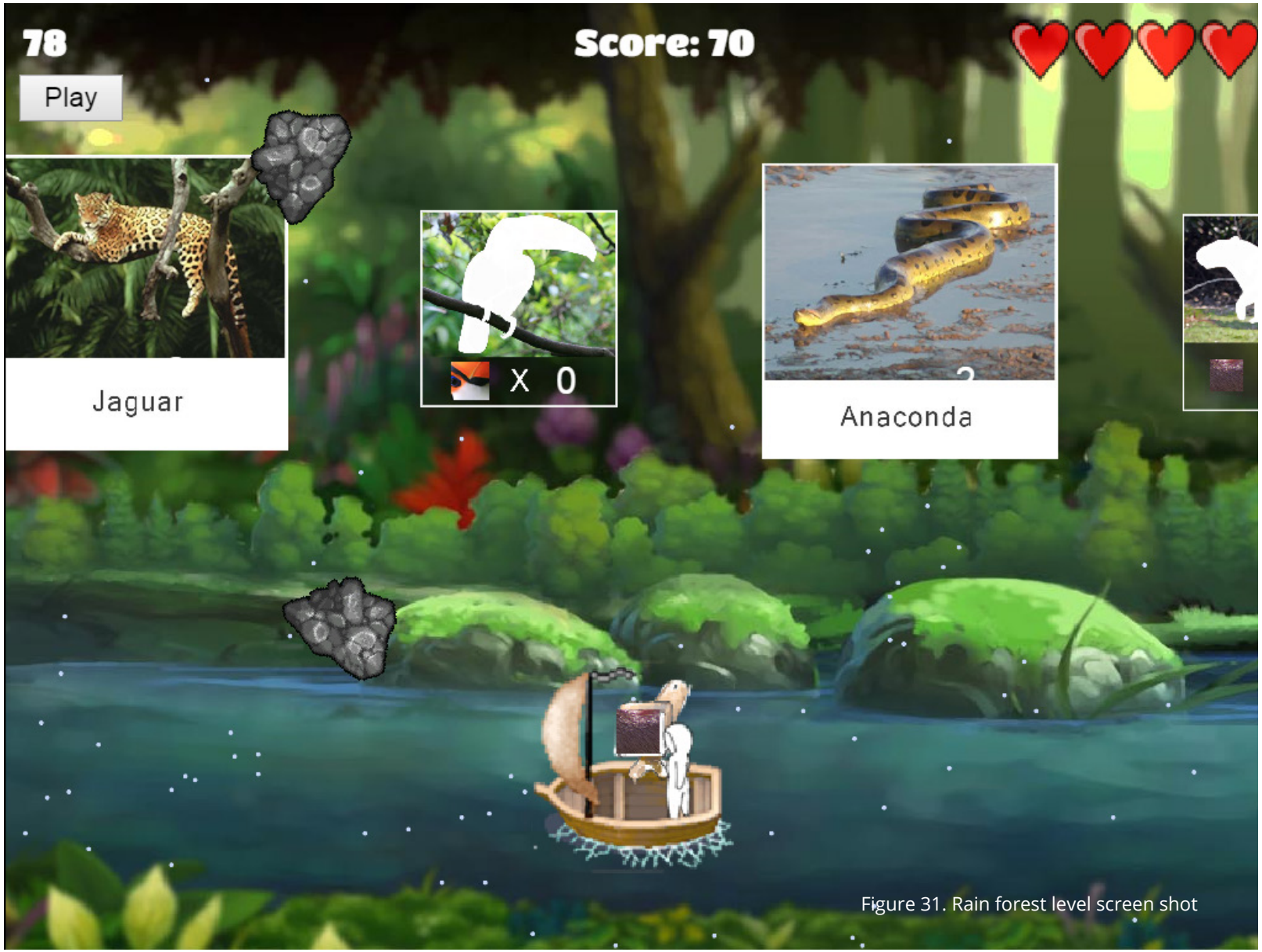


Figure 31. Rain forest level screen shot

Rain forest

Divya selects the rainforest game. Her character is riding a boat along the amazon river. She has a texture gun on the boat that fires textures of animal found in the amazon rainforest.

Objective

The game objective is to match the correct animal texture clues to their corresponding texture flash card with hidden animals.

Divya has to match correct animal textures to reveal all the animals. Upon sufficient collection of correct clues the animal reveals itself and an interactive video will be played telling her more about he animal. The first person to reveal all the hidden animals win the game.

Difficulty

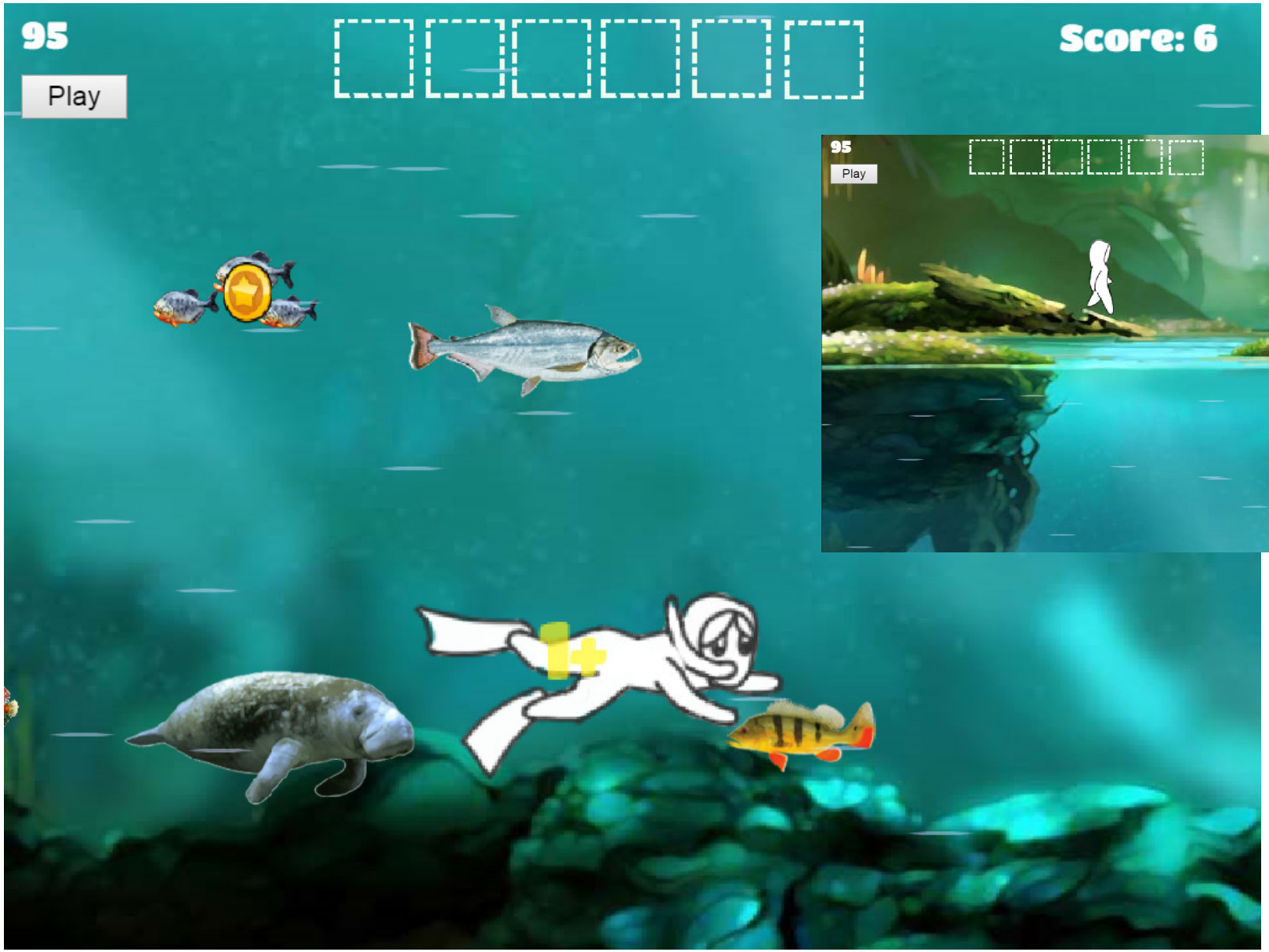
Divya has to avoid getting hit by rocks, that will reduce one health. She will lose the game when her health becomes zero. She has to reveal all flash card within set time which is 2 minutes in this case.

Controls

Hover gesture is used to move the boat left and right. Throw gesture is used to throw the texture clues at the hidden animals(figure 28). Player can pause the game using pause gesture.

Learning

After playing this level kids will have knowledge about different rain forest animal living in amazon. They will know there name and how they look. They will learn about their sound, behavior and habitat via revealed video.


95
Play
Score: 6
95
Play
Score: 5

River Giants

Then Divya selects the River giants game level. Her character starts on ground. She can jump and swim to move around the level. She has to collect coins from fishes in the amazon river. For that she must dive into the river.

Objective

The game objective is to interact with fishes in amazon river to collect point. Collection of coins add points to the scoreboard. With increasing score points, the game will reveal various flash cards about the fishes. Player have to collect all the flash cards to win the game. Higher the score the more rarer the flash card will be. After sufficient collection of flash cards in a given period of time player wins the game.

Difficulty

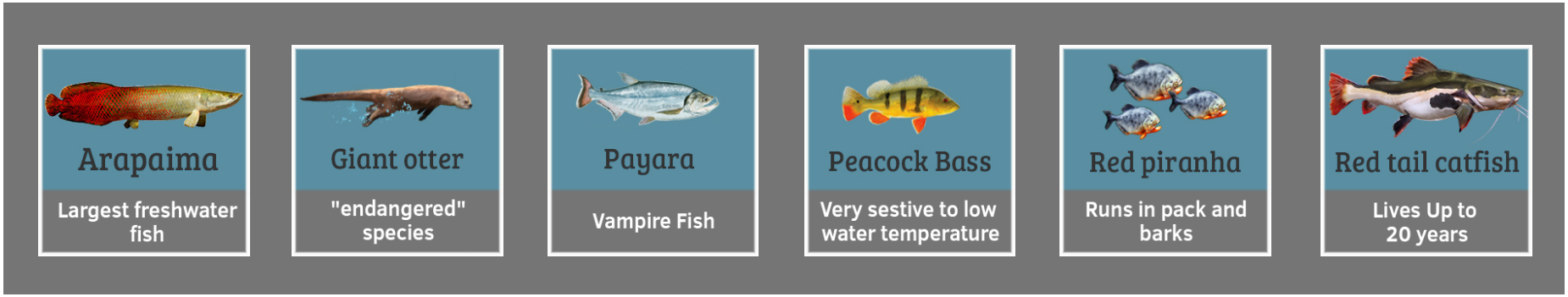
Divya has to collect all flash cards before the time is up. She has to collect coins from rarer fishes as they give more points using which see can can quickly make more points and unlock all flash cards of animals.

Controls

Hover gesture to move left ad right when on land. When under water then hover gesture to swim left and right. And swim/jump gesture is used to swim up or jump up based on players position on land and water. Player can pause the game using pause gesture.

Learning

After playing this level kids will have knowledge about different aquatic life form living in amazon river, their names and how they look. They will get to know about their habitat and behavior by unlocking the flash cards.




Score:40
Ti To Ko Ti To Ko Ti To Ko Ti
Ko
To
Ti
Ki

Jaguar Dance

At last, Divya selects the jaguar dance level. This level she gets to learn about different percussion instruments. She can choose instruments like flute shaped like birds, snakes and tortoise and drum. She chooses Aztec drum. This drum has four simple notes “To”, “Ko”, “Ti” and “Ki”, Using these four notes she can learn to play play various Aztec compositions and create compositions of her own. The current running composition is shown at the top of the screen. And the music is played in the background.

Objective

The game objective is play the right notes at the right tempo to create music. This game is based on guitar hero, where players match notes that scroll on-screen to colored fret buttons on the controller, pushing the controller in time to the music in order to score points.

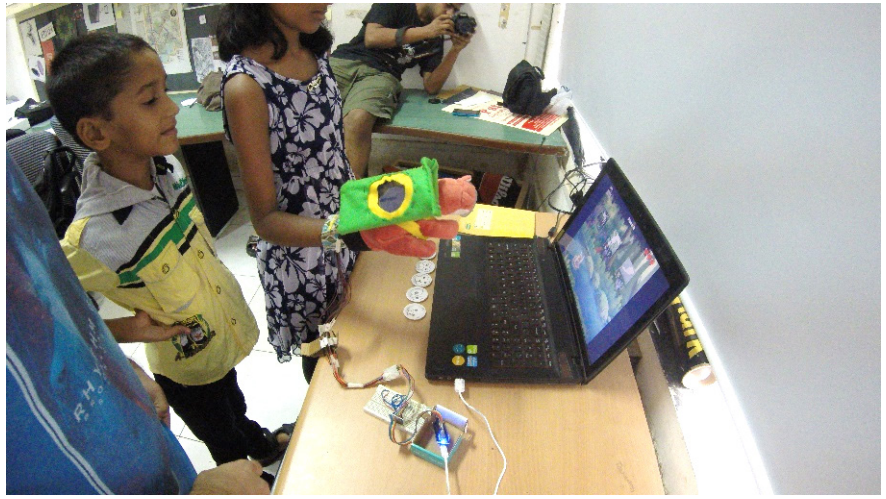
Controls

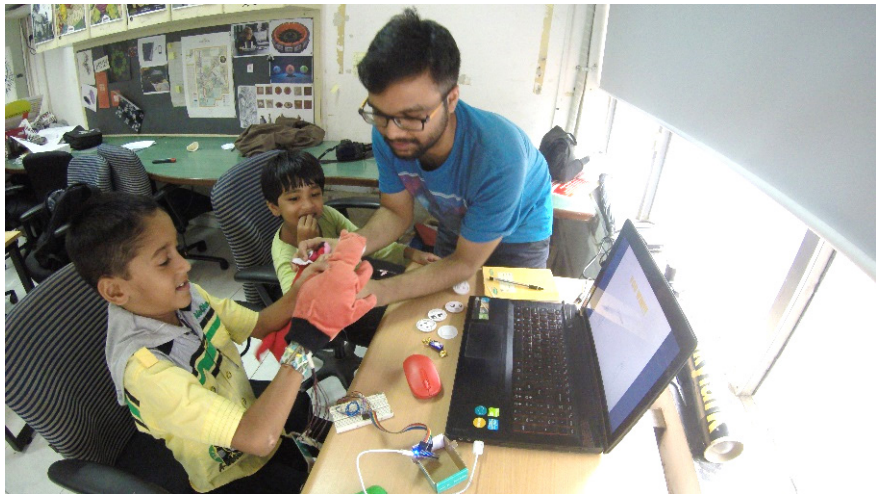
The various notes of the instruments are mapped on to the fingers of the player’s hand. “Ko” is mapped to the thumb, “To” is mapped to the index finger, “Ti” is mapped to the ring finger and “ki” is mapped to the pinky. Divya has to move corresponding fingers to play the music in tune.

Learning

After playing this level kids will have knowledge about different Aztec instruments and how to play them. They will have understanding of notes and how to compose them.

All these games are meant to give a flavour of what are the possibilities of for the content. Any game can be mapped on the puppet glove using this system.





Evaluation Plan

Goals of Evaluation

The project will be successful if kids are able to use the physical tool intuitively and learn the intended topics from the game.

From user's perspective the goals of evaluation is to examine the:-

- Usability of newly proposed puppet gesture glove
- The engagement level of kids with the game.
- The learning from playing the game.

Key Questions

- Is new play & learn environment an effective approach for teaching 7-12 years age of children educational topics.
- Do kids prefer playing this game using the puppet glove over using the keyboard, mouse or other input devices?
- Do kids retain the information they learn from games and how much do they retain?
- Do kids find the gesture based puppet controller intuitive and easy to use.

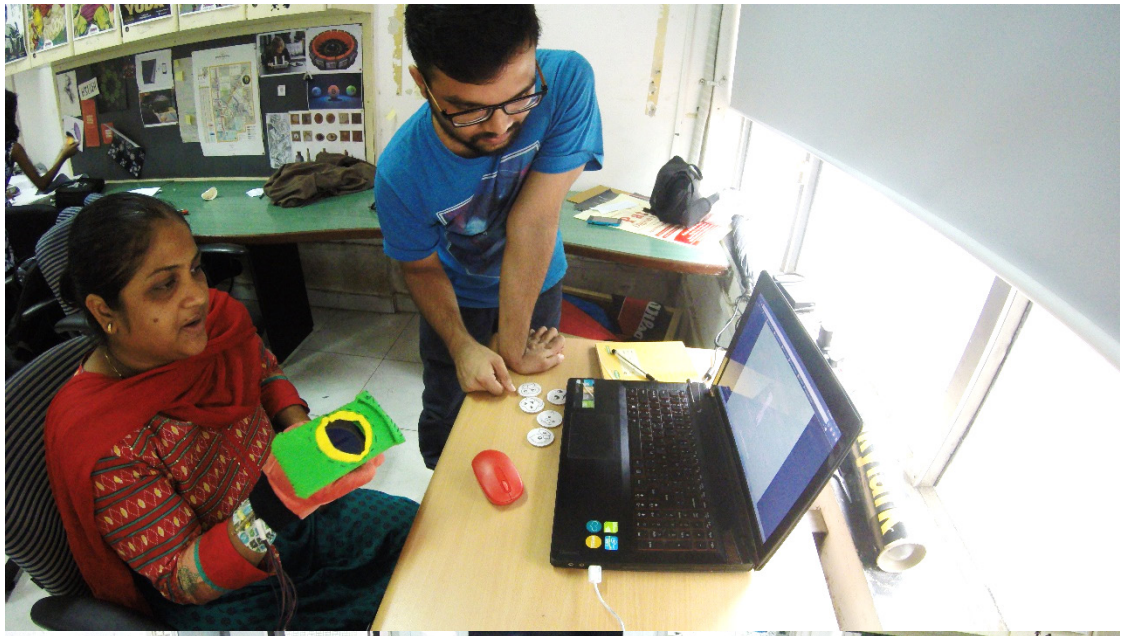
User Test Plan

Protocol

The project needs to be assessed for user and an evaluation test has been designed for them. Each assessment will contain an evaluation test and post-test.

Before conducting evaluation, participants will be given an short introduction to the platform and what it does. After introduction, ticipant will be given goals to accomplish using the puppet glove provided to them. While conducting evaluation test, participants will be observed to collect data about evaluation criteria.

After evaluation test, participation will be asked to give post-test which will record their conceptual understanding, reaction, likes and dislikes about the platform.



Criteria for recruiting kids

Required participants: 7 people (3 boys, 2 girls, 2 adults)

- Age range: 7-12 years old
- Are exposed to computer games
- Don't have prior knowledge about Amazon river and Aztecs.

Evaluation test

Introduction

A brief will be given to introduce the platform to the participants. They will be told about the puppet glove and its different gestures. They will told to try on the gloves to see how it fits them. They will be told about the Amazon game and its different levels. They will be told to test the glove on tutorial level in game. They can use this level until they are comfortable with he gestures, Parents also played the game and gave feedback during post-test.

Evaluation Test

1. The user will be asked to use an unfamiliar gesture to perform a task.

Scenario Description: The user should perform one unfamiliar gesture from the list of gesture.

Evaluation Criteria: Completed or not, no of tries required to complete the task, time required to complete the task.

2. The user will be asked to complete different stages of game.

Scenario Description: The user will be asked to play different stages of game and complete the level.

Evaluation Criteria: Completed or not, no of tries required to complete the task, time required to complete the task.

3. The user will be asked to recall their learnings 15min after the gameplay.

Scenario Description: The user will be asked to recall and give answers to questions regarding the learnings from the game.

Evaluation Criteria: If answers are correct or not, number os answers correct, time required to complete the task.

While conducting these test I will check for engagement and replayablity of the game.

Post-test

The user will be asked to recall information from played level of games.

Scenario Description: The user will be asked to answer question about Amazon river and its wildlife.

Evaluation Criteria: Correct or not, no of tries required to recall, time required to complete the task.

Results

Test 1

Task 1. Perform hover gesture
100% completion rate

Task 2. Perform select gesture
50% completion rate, Ergonomics issue

Task 3. Perform Pause gesture
100% completion rate

Task 4. Perform throw gesture
80% completion rate

Task 5. Perform jump gesture
50% completion rate, Game bug

Task 6. Perform thumb gesture
80% completion rate

Task 7. Perform index gesture
100% completion rate

Task 8. Perform ring gesture
100% completion rate

Task 9. Perform pinky gesture
100% completion rate

Test 2

Kids were able to complete the game in 2-3 tries. Younger kids had more difficulty completing tasks they took more time to understand the working of the game. Overall, Kids enjoyed playing the first level “rain forest” most. Other two games may not have worked due to bugs that interrupted the gameplay. These bugs were fixed after the evaluation.

Test 3

I conducted a post-test after 15 min break. All kids were able to recall the gesture functions of the game. They were able to recall the number of animals they saw but could not recall the exact names for the animal. Kids were able to classify if giant Otter is a land or aquatic animal. They didn’t not retain the composition but were able to recall the four notes of music from the game and which note corresponds to which finger.

Future scope

This project was well received by the COSMIC labs and they have decided to take forward as an alternative way to approach Pubby project. This platform can be researched on further to see its application as a input device for tasks other than gaming. For e.g. This can be used as a input method to interact with computers, This can be used by elderly to perform exercises that helps them improve their motor-skills.

Conclusion

This will be an ongoing project. Due to time constraints I was not able to focus more on developing the content. Focus was given more on implementation and therefore ideas were limited due to technology. For e.g. Right now the macro and micro gestures work separately, gestures that require both micro and macro gestures to perform action were therefore not included in the final prototype. This can be implemented with further work.

The platform was in my opinion able to answer one question. This can provide a viable alternative to traditional input devices for kids to interact with digital media. This input device is something kids can relate to.

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Table of Images

The end is only the beginning