Product Design Project II

Cognitive toys for visually disabled children

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Contents

Introduction

Understanding medical Blindness

Visual impairment is the damage to any part of the eye that affects the normal functioning of the organ i.e. the eye. This disability can be measured with tests like the visual acuity test, color vision test, visual field test etc.

Visual Disability is the disability of a blind person to function normal everyday tasks and not the functoin of the eye organ.

Low Vision: Any bilateral loss of vision that cannot be corrected with eyeglasses or lenses that hinders the activity of the person.

Colour Blindness: The inability to differenciate various shades of colors, particularly green and red, that others can easily distinguish. (not a true form of blindness)

Night Blindness: The difficulty in seeing under low illumination , this defect in the eye is mostly acquired through genetic inheritance

Snow Blindness: loss of vision due to exposure to large aounts of UV light, this is a temporary form of blindness And can be recovered later with appropriate treatements.

Levels of visual impairment

20/30 to 20/60: near-normal vision
20/70 to 20/160: moderate low vision
20/200 to 20/400: severe low vision
20/500 to 20/1000: profound low vision
More than 20/1000: near total blindness
No light perception: total blindness

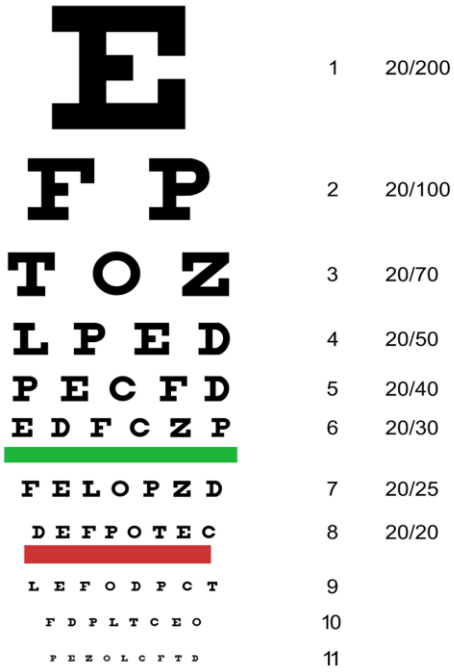


Fig.1 **Snellen Visual acuity test chart**

Literature case studies

Assessment of play behaviors and social interactions of 2 blind girls: Case studies in Japan
Authors : Darja Kobal Grum, Toshibumi Kakizawa, Marie Celeste
Play features of visually impaired children
Authors: Hale DERE ÇİFTÇİ
Play behaviours and social interactions of a child who is blind: In theory and practice. Journal of Visual Impairment and Blindness,
Celeste, M. (2006)., February , 75-90.

Previous Works in IDC

Visualisation for blind children**,** *Aneesha Pitale, VCPR 123, 1990*
Interactive arcade game for the blind and sighted, *NIKHIL karwall, MDP 333, 2007*
Playing aids for blind children, *Kumar Shilpi, MDP 259*,
Teaching aids for blind children, *Patrick John, 2014*
Indian Toys, D'Source

The literature case studies were done to understand the importance of playing in personal character development. The behavioral and socializing nature of children in general and also about the children with disabilities were also studied. And the inferences about the child persona from the literature case study was noted down and similar character traits were looked for in the live case studies conducted.
Projects done in the field of visually disabled in IDC was referred to see the similar and dissimilar projects to get a novel design direction.
The references helped hugely in understanding the needs for children with visual disability for their playtime. The toy or game design needed to be designed in such a way that it enhances the senses of the user, cognitive abilities as well as socializing with sighted and non sighted peers.

Need for multisensory learning

Children with visual disability can use their auditory and touch sense better through play by focusing their attention. *(MEB*--Milli Eğitim Bakanlığı*, 2013) Mary celeste* tells that since hand eye coordination is missing the hand-sound coordination takes a while to develop and this needs to be aimed at to develop the child's reflexes and fine motor skills. Other studies show that children with blindness prefer to play with audio and tactile toys, than stuffed toys which merely offer emotional support whereas audio and haptic toys stimulate their other senses. A study by *Özyürek and Koçak* claim that the toys should be easy to distinguish when touched, smelled or heard such that all the senses come to play together and the toy gives them a multisensory playing experience.

Inferences

The game should be designed in such a way as to increase the imagination and creative thinking of the visually disabled children. The game should help them break the barriers of solo play and parallel play and help them socialise with their parents, siblings and sighted peers. The game should increase their sensory experience by giving them a multisensory feedback experience. The game should teach them the concepts of way finding, cause-effect relation, weights, possible braille intervention to help them grasp braille letters through gaming.

User study and analysis

The user studies were done in 2 famous institutions dedicated to teaching the visually disabled children namely “National association for blind, worli sea face” and “Happy home school for the blind’ worli” . Upon visit the school environment was analyzed on how the place is set up to treat the blind users, the architectural practices to aid the visually disabled, the teaching syllabuses, and most importantly the special toys that are used to teach the blind children.

Observations

Environment & Comfort

The schools were seen to have a safe environment which was very comfortable for children. This was understood as lots of children were running around in corridors without fear of blockades or falling over.

Social interaction & game play behavior

Majorly indoor social games were played at school. group activities were done under supervision by a teacher. The group games seemed to be monotonous and less challenging and children seemed to be forced to mingle. Same games are tweaked by teachers to make new games and the games becomes boring due to lack of novelty. mThe students were encouraged to display talents in group activities such as singing or reciting poems. This was aimed at removing fear and boost their confidence. Mostly promotes muscle development and physiotherapy-less challenging. Some young children (4-5 yrs) had their parents assist them in school.

Sensory explorations

The children were highly observant with their hands. They touch and stroke to find out details and explore objects. Touching is an integral part of interaction and communication with others as they hold hands and fell the neck or face while talking to friends. While engaging in games they seem to be enjoy musical elements more than other elements. They like listening to music and play with electronic music equipment like the piano.

Game play behavior

Smaller children (<6) are relatively shy and engage in solitary or parallel play with peers. Small children (<6 yrs) are reluctant to play with sighted children. Children above 7 years however play with sighted children. Intellectual games (chess, puzzles) used for only high age group (10+) below 10 are not confident to play

7 users mostly below the age of 10 years were interviewed with the questionnaire prepared beforehand and their responses were written down and a cluster analysis was done to group similar responses to form design insights. The questions that were asked them are as follows.

1.what games are played frequently at school ?
2.what games are played frequently at home ?
3.Favourite game type: puzzle/ strategy/
4.buildingblocks/electronic games/ action figures / art based ?
5.Are you able to play without assistance?
6.Which are the most enjoyable elements while playing?
7.Which are the most challenging elements while playing ?
8.How do you spend free time at home? extra-curricular activities involved ?

A separate questionnaire was prepared for the teachers/parents who have a better understanding of the students learning and social skills.

1.what games are played frequently at school ?
2.How are the children grouped during play?
3.Do they interact with sighted children ?
4.Do you have to constantly monitor playtime for 5-8 yr olds, 8-10 yr olds ?
5.How do they treat shy and silent children?
6.Inputs and recommendations
7.Remarks on children

User	Age	sex	Level of blindness	Blind from	place
User 1	10	f	20/70 low vision	From birth	NAB*
User 2	7	m	20/70 moderate low vision	After 3 years	HHSB*
User 3	6	m	20/200 low vision	From birth	HHSB
User 4	6	m	20/1000 near blind	From birth	HHSB
User 5	9	m	20/1000 near blind	After 4 yrs	HHSB
User 6	7	m	**blind (NLP)**	From birth	HHSB
User 7	10	m	**blind (NLP)**	5 yrs of age	HHSB

Table showing the users, their age, sex and type of blindness

***NAB**- National Association for Blind,
HHSB- Happy Home School for Blind

User quotes and insights

User 7 " I no longer play the old games, they are very easy and boring. "
User 3 " When there is nothing to play I go and listen to TV or listen to music."

Insight : Elder children outgrow the old toys and turn to media entertainment to fill leisure time.

User 6 " It is fun when I win and beat my best friend.s "
User 4 " My friends and I always play together. "
User 6 " If like messing other's chances to win, it is very funny. "

Insight : Children are competitive and enjoy sabotaging others' game**.**
Interactive multiplayer game could teach them cause-effect relation and teach them to think in advance of moves and counter moves.

User 5 " I like electronic games and beeping sounds."
User 7 " When a game is over we all congratulate the winner and clap."

Insight: Blind children enjoy haptic feedbacks- vibration or rattling children like loud sounds and enjoy winning moments.

User 3 " My mother gives me toffees when I finish reading one braille page. "

Insight : Reward system gives children motive to finish difficult tasks and redo them.
" win moment" could be a combination of 'reward + sound rattle/vibration.'

User 1 " I like games like in which braille marking is there, I can learn also."
User 2 " Teacher has put braille marking in many things at school."
Insight : Braille can be picked up faster if the learning is gamified.

User 2 " Old games are changed (modified) by teacher to make new games."

Insight: Old games get repetitive and tend to be unused after long.

Market study: Market has many solutions regarding toys for blind toddlers but not many novel and challenging games for elder kids (8 yrs +).

Insight: Toys can grow with the child, modular parts may be added to increase complexity of toy as per the growing age of the child.

Senses of the visually impaired children

Vision

Visually impaired children live in a world with absence of color, light and visual stimulus. Hence they rely on auditory stimulus the most to understand their position in space and relative positions of other objects in the same environment. Inability to understand Shapes, patterns, contrasts at the early stages of development is a setback in learning and it takes more time compared to their sighted peers. Understanding of shapes comes from touch and feel of objects hence the touch sense plays a big role in understanding object constancy.

Hand-eye coordination is lacking hence the hand-ear coordination needs to be developed quickly to foster their reflexes.

The child cannot understand cause-effect-feedback relation during early development stages and is behind in this understanding compared to their sighted peers.

Sound

Sound stimuluses indicates source of activity or information and it helps the individual in orienting himself in space. Sound helps in identifying parents, siblings and friends. Infant has no control over the sound stimulus in his environment.

Object permanence, which is, the understanding that an object remains in existence even when it is not directly observed takes time to develop and this development is heavily reliant on auditory stimulus.

Touch

The touch sense helps a blind individual understand surfaces, contours, differentiate textures, skin, clothes, differentiate food, and feel temperature. Often communication is also depended on touch and feel as holding of hands and feeling people's faces are a part of interacting with their loved ones.

Smell & Taste

Often times the visually disabled differentiate objects based on their material smell/0odour and taste too. Differentiating food taste and texture with the tongue is always a pleasrueful way of enjoying food by both the sighted and the non sighted. Smell and taste are an often overlooked sense among the 5 senses.

Market study of toys for visually disabled children

The market study methodology was to investigate existing board games and toys for children by personal visit in toy shops and also detailed analisys over the internet online markets. The market study on games investigated the potential of the games by studying the skills imparted by the game to the children and also the age group for the children. Special toys for children with special needs have also been studied about.

Motor skills	2-3 yrs age
Texture sensing	2-4 yrs age
Shapes and size recognition	3-5 yrs age
Order & classification	4-6 yrs age
Counting and memory	6-8 yrs age
Logic games	6-15 yrs age

Image.1.1

Image.1.2

Motor skills game (2-3 yrs)

Description

Simple toy that requires toddlers to differentiate objects by color and size and drive them through stiff bent wires. Objects are usually geometric shapes and made in hard plastics like ABS or even wooden blocks.

Uses

Improving fine motor skills , understanding patterns, classifying objects based on size, weight etc, following a path.

Advantages

Easy to manufacture, safe materials, easy to store, helps grasping skills, transferring of objects become second nature.

Drawbacks

Lack of multiple textures make it difficult for children with visual disability to differentiate based on color.

Image.1.3

Image.1.4

Shapes and size recognition (2-4 yrs)

Description

Simple toy that requires toddlers to differentiate objects by color and size and stack them in order of their increasing or decreasing sizes.

Uses

Improving fine motor skills , understanding patterns, classifying objects based on size, weight etc, following increasing and decreasing size order.

Advantages

Easy to manufacture, safe materials, nested models make it easy to store the components one inside the other.

Drawbacks

Lack of multiple textures make it difficult for children with visual disability to differentiate based on color.

Image.1.5

Image.1.6

Texture sensing (2-4 yrs)

Description

Dedicated toy for visually disabled children that requires toddlers to differentiate cups by feeling the texture inside the cups and matching them with the corresponding texture on the recessed holes in a wooden base.

Uses

Improving fine motor skills , differentiate textures, learn arrangement skills.

Advantages

Easy to manufacture, safe materials, easy to play, easy to store, the game is a good entry level game for visually disabled toddlers.

Drawbacks

Lack of complexity, the game tends to get repetitive and boring because of lack of deeper levels in the game play. The game is a single player game and has less facilitation for parallel or group play.

Image.1.7

Texture sensing (2-4 yrs)

Description

Soft toys made from felt or similar soft textured material over 2D shapes. The shapes are assembled together to form simple planar 3D forms that becomes animals.

Uses

Improving fine motor skills , understanding textures, puzzle solving skills.

Advantages

Easy to manufacture, safe materials, easy to store, teaches visually disabled children about nature and helps create a mental picture of the animal world.

Drawbacks

Similar texture for all animals may make it difficult to differentiate between different animals' parts unless the child is assisted by a sighted helper. Creating gradient in textures for different animals will help them to categorize the parts of each animals.

Image.1.8

Image.1.9

Shapes and size recognition (2-4 yrs)

Description

Simple toy that requires toddlers to differentiate objects by color and size and put them through stiff similar shaped doorways or dies into a fun looking tumbler. Objects are soft and geometric shaped and made in hard ABS.

Uses

Improving fine motor skills , understanding patterns, classifying objects based on size, weight , understanding matching of shapes, understanding of object shape regardless of change in the object's orientation.

Advantages

Good colors make it attractive to parents and children, safe materials, easy to store.

Drawbacks

All surfaces are smooth, lack of multiple textures make it difficult for children with visual disability to differentiate based on just one level of smoothness. The game is not very complex in nature and it is for 2-4 year old children only.

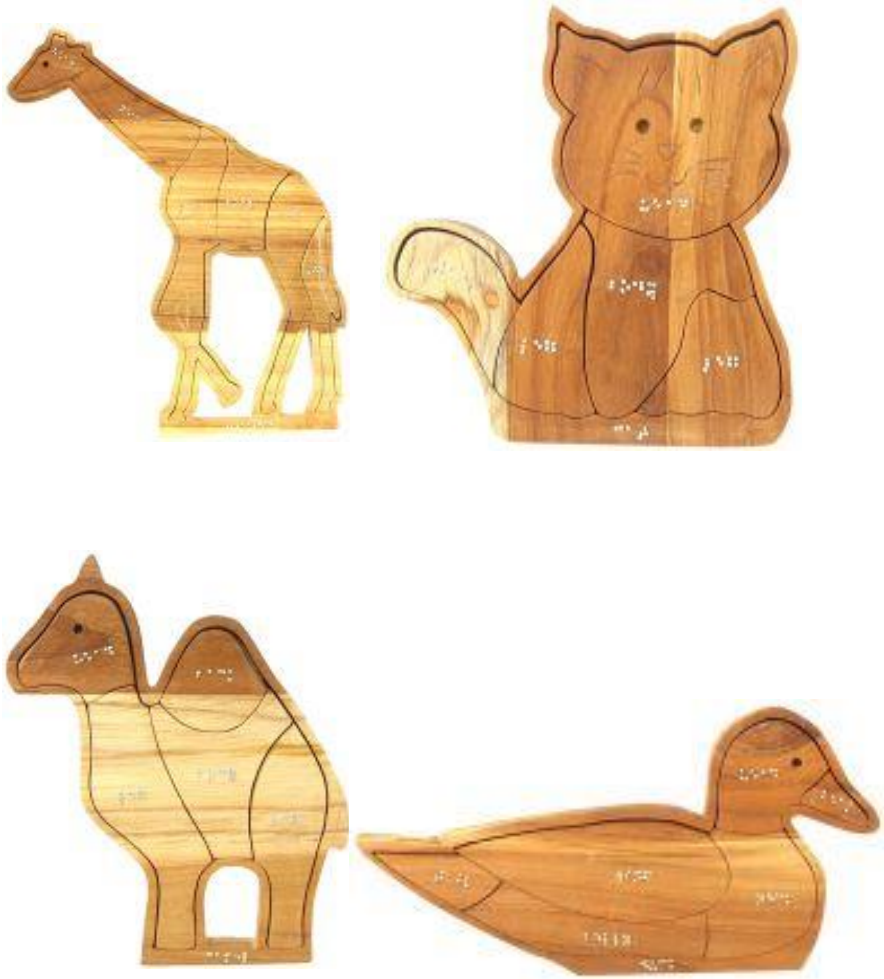


Image.1.10

Shapes and size recognition (2-4 yrs)

Description

Wooden puzzle toy with less than 5 puzzle parts that are felt with fingers to understand shape and assemble together to form 2 dimensional animal shapes. The formed animal is then placed in its own animal shaped wooden tray or receptacle. The puzzle parts have an add on braille lettering to understand which puzzle piece belongs to which animal.

Uses

Improving fine motor skills , understanding puzzle solving, learning and reading braille.

Advantages

Easy to manufacture, safe materials, easy to store.

Drawbacks

Lack of multiple textures deprives children with visual disability to explore multiple textures and challenge their touch senses. Small part sizes may be a chocking hazard for toddlers. Lack of multisensory feedbacks to make the game interesting to play with.

Image.1.11

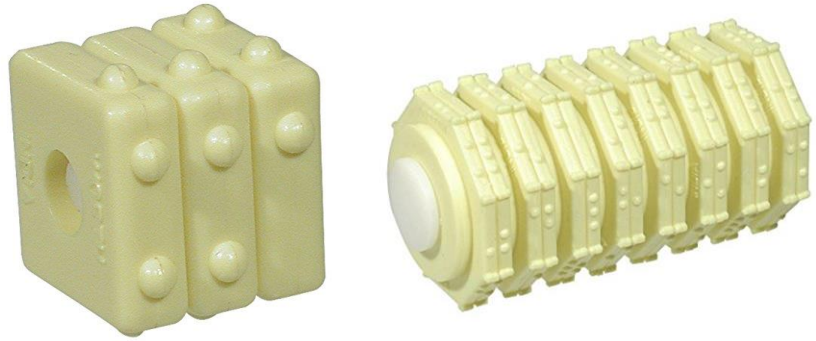


Image.1.12

Braille teaching (4-6 yrs)

Description

Cubical blocks that is usable for both the sighted and non sighted children. Used for stacking and learning numbers, alphabets in both English script as well as braille.

Cubical braille teaching device with 3 rotating faces containing raised dots in different arrangements that represent braille impressions. The faces can be rotated and new braille letters and alphabets be formed

Uses

Improving fine motor skills , teaches braille alphabets and letters.

Advantages

Easy to manufacture, safe materials, fun to play and builds imagination, teaches braille.

Drawbacks

Lack of multiple textures make it difficult for children with visual disability to easily differentiate based on texture. Difficult to store the toys easily. Lack of multisensory feedbacks to make the game interesting to play with.

Image.1.13

Cause and effect relation games (3-5 yrs)

Description

Fun toy that requires children to put objects into a top container and turn a knob situated at the joining belt of the toy. The turning of knob sends a small toy down to the bottom chamber from where the child can collect his toy.

Uses

Improving fine motor skills , transferring objects, understanding how a system works.

Advantages

Safe materials, fun and attractive colors, safe size of objects, teaches the child to understand the relation between cause and effect.

Drawbacks

Expensive toy and large size of the toy makes it harder to store. Lack of multisensory feedbacks to make the game interesting to play with.

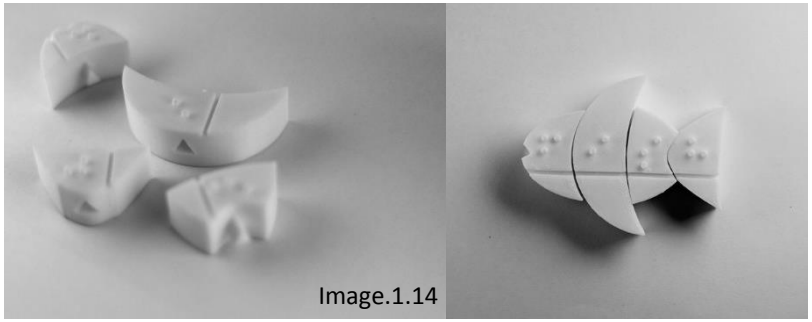


Image.1.14

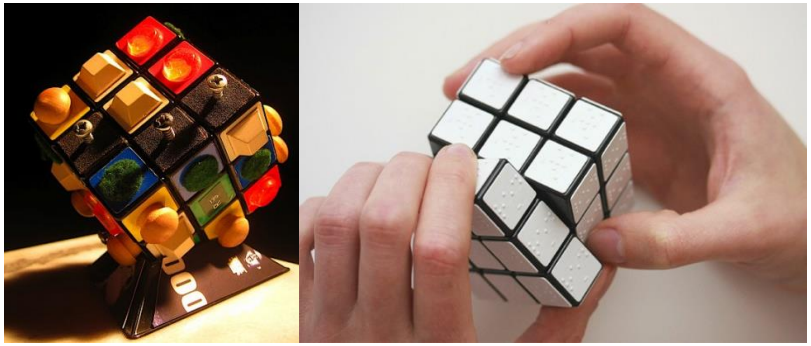


Image.1.15

Image.1.16

Counting, Memory & Logic (5 yrs & above)

Description

3D puzzle pieces with braille attachment that leads to forming of animal shapes.

Rubix cubes improvised with braille dots and other textures and small objects embedded onto the smaller cubes.

Uses

Improving fine motor skills , understanding puzzle solving, learning and reading braille.

Advantages

Easy to manufacture, safe materials, easy to store, aides ccognitive thinking and puzzle solving skills.

Drawbacks

Lack of multisensory feedbacks to make the game interesting to play with. Rubic cube may not be easily playable for toddlers and can become frustrating.

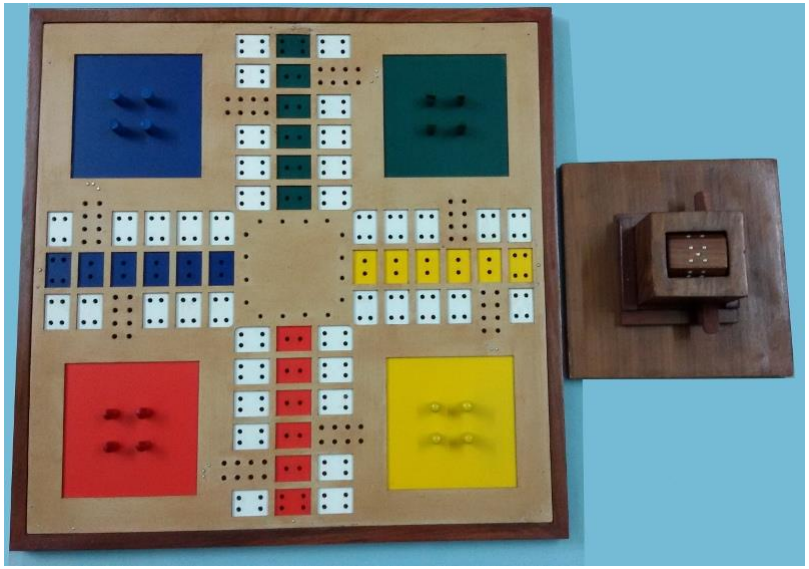


Image.1.17

Image.1.18

Adapted Games for visually disabled

Description

These games are the common board games and other similar toys which have been adapted to play for children with visual disability. The normal game play has been improved upon with the addition of textures and braille to make it easier for blind users to map and play the game.

Uses

Social gameplay, improves gaming skills like making strategy and winning moves and executing them with correct timing.

Advantages

Easy to manufacture, safe materials, easy to store, multiplayer, braille addition. Any game can be made into blind-friendly game by the addition of braille markings. This improvisation can be easily done by the parents.

Drawbacks

Lack of multisensory feedbacks like sound and smell to make the game interesting and sensuous to play with.

Inferences & Insights

Market has many solutions regarding toys for blind toddlers but not many novel and challenging games exclusively for visually impaired elder kids (6& above yrs). Most of the games for elder kids are adaptations of existing games for sighted children and do not offer much sensory explorations.

Multisensory toys require extra electronic parts that may tend to get expensive. So a need to design multisensory toy at a cheaper price is also vital. Another problem that is created by the toys that some of them take up storage space hence a packaging that can convert to an easy storage for the toys would be good.

Design Brief

“ To design and develop indoor toys for the visually impaired children **aged 6 & above** for teaching them cognitive thinking and problem solving. ”

Design Objectives

1. The major lacunae or the deficiencies addressed is that a lack of total sensory experience (low vision, sound, vibrations, textures, smell and possibly taste) is seen in most of the games/toys designed specifically for visually disabled children. This deficiency is being filled in the current product design.
2. Design for easy storage of the toys when not in use.
3. The user profile being targeted are children who are 6 years old and above with visual disability of 20/500 or poorer.
4. Quantity of manufacturing and up scaling of the product through injection moldable design of product parts. Design aimed at making assembly of electronic parts within the toy easy to install in an assembly line.
5. Target cost of the product ranges from 500-600 INR for Indian markets.
6. Adherence to safe product features such as chocking hazard part sizes (1.75 inch x 1.75 inch x 1.75 inch).
7. Adherence to international toy design safety standards such as
   - 7.1 EN 62115:2005 Safety of electric toys
   - 7.2 EN 71-1: Physical and mechanical properties
   - 7.3 EN 71-2: Flammability
   - 7.6 EN 71-8: Activity toys for domestic use
8. Design of product interiors and joinery to ease troubleshooting of the product by the user.

Design Direction

The design direction faced 3 dimensions namely cognitive, sensory and social aspects. The cognitive side of the design direction needed to tend to important aspects such as concentration power, memory power, logical reasoning, path finding, analyzing skills.
The sensory dimension needed to address important factors such as enhancing the 5 senses- touch, sound, smell, taste and low vision.
the social side of the game needed to look at expressing emotions, language skills, and education.

It was decided to merge all the dimensions together carefully and create a toy that addresses each dimension. Prime importance was given to the sensory experience of toy design and cognitive needs of the visually disabled child. The social side was thought to be given secondary importance, but still to be included in the toy design by having aids to learn language in some way while the core idea being braille letters.

Cognitive

concentration
memory
logical reasoning
analyzing skills
thinking skills

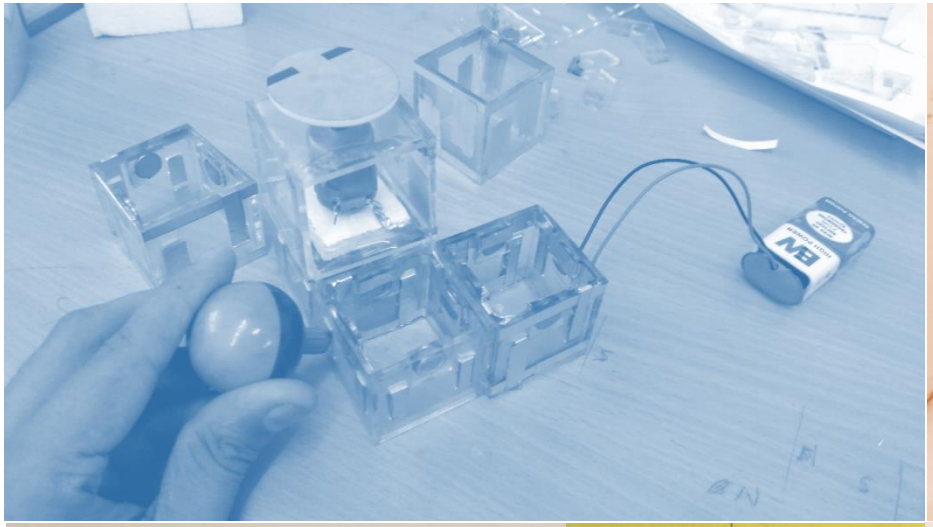
Sensory

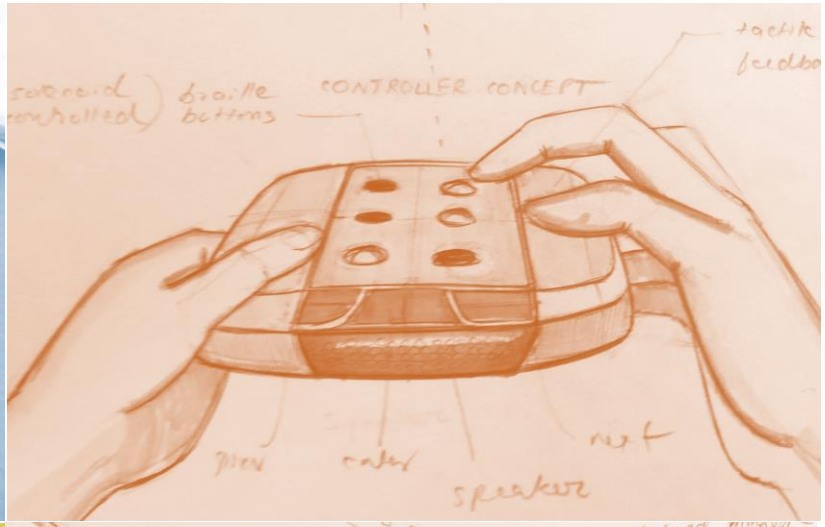
Enhance senses
Material
Movement/mechanics

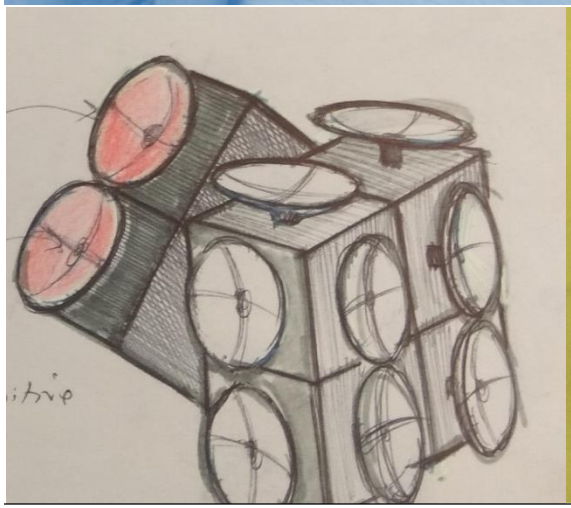
Social

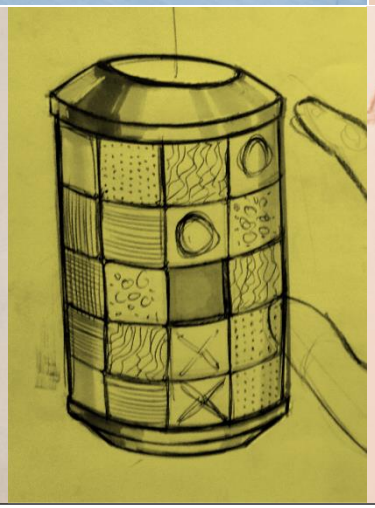
Expression emotions
Understanding emotions
Language skills
Verbal communication
Non verbal comm.
education

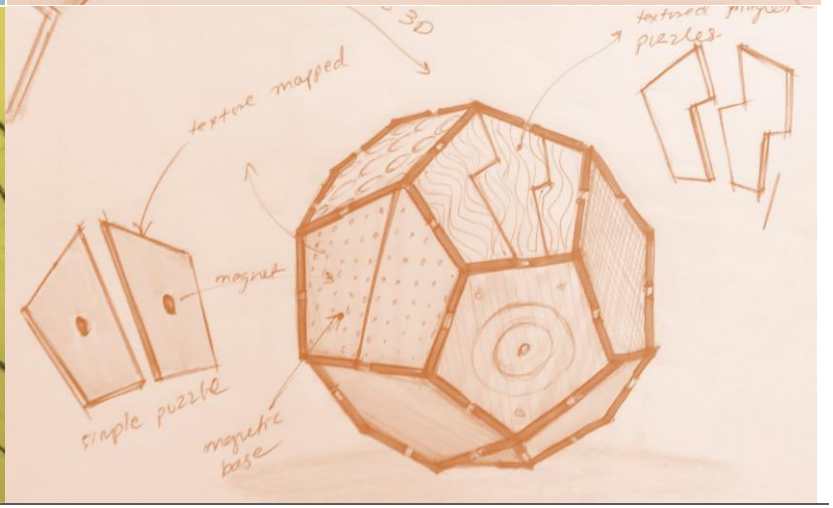
Design Concepts











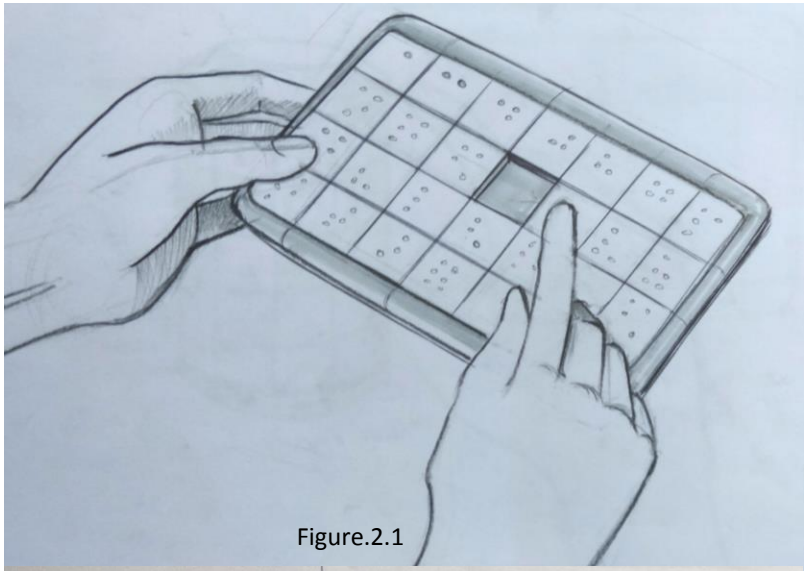


Figure.2.1

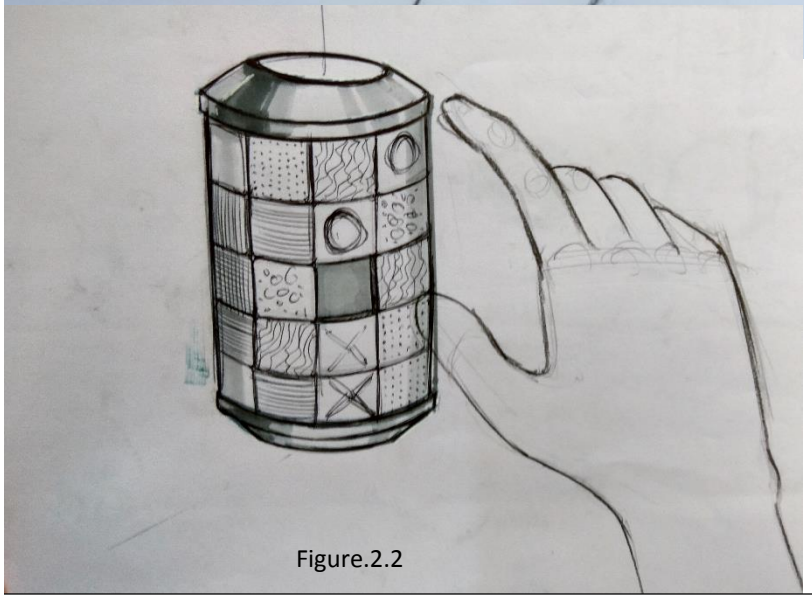


Figure.2.2

The toy concept is an improvisation upon the existing tile slider puzzle game, where a grid of interlocking slide able tiles are arranged with one tile removed so that the remaining slides can be moved around to find way and form the puzzle. This same concept is added with braille alphabet dots on the slide. The objective of the game is to arrange the tiles in alphabetical order through touch and feel of the braille alphabets.

Same idea of sliding tiles is made in another concept with a cylindrical form with the alphabets replaced with different textures. The objective of the game is to arrange similar textures in a vertical column.

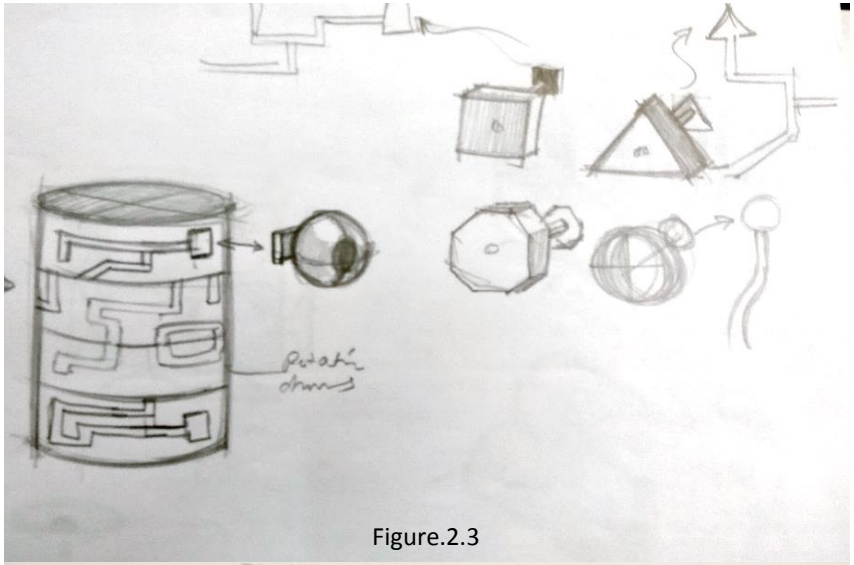


Figure.2.3

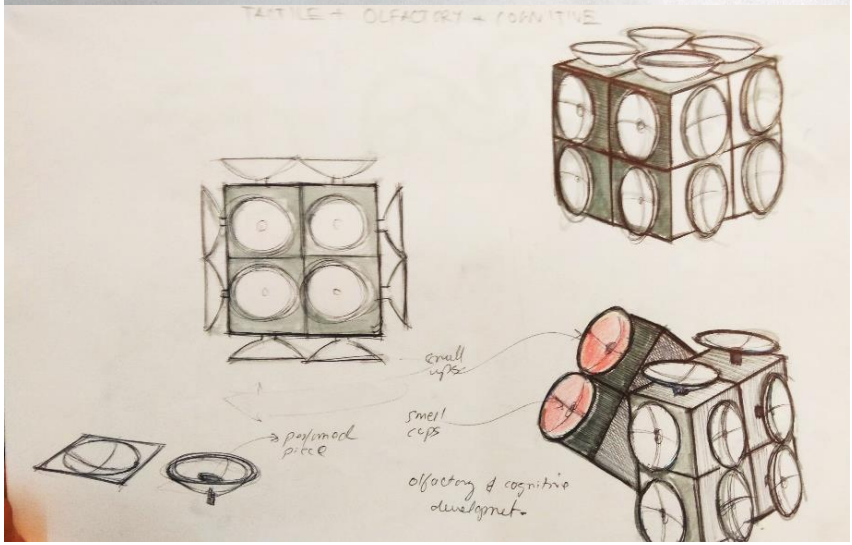


Figure.2.4

This toy concept is a way finding puzzle that requires the player to use geometric knobs or pieces to slide into slits and drag across changing pathways and arrive at their designated exit ports. Each different shaped knob can only exit its own designated exit hole.

The concept on the bottom is a 2x2 rubix cube inspired design that replaces colored tiles with smell cups. needs to be arranged back to its former self via smelling the scented cups and arrange the cube according to similar smelling cups.

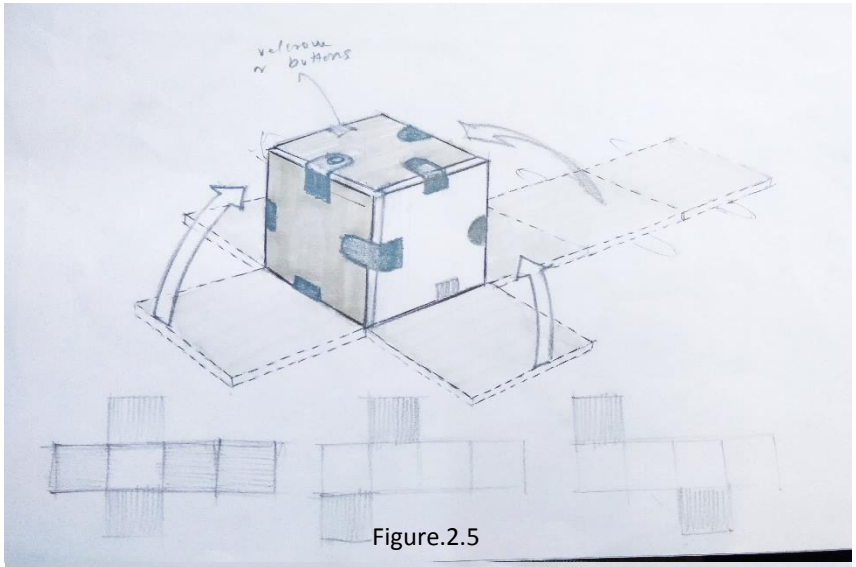


Figure.2.5

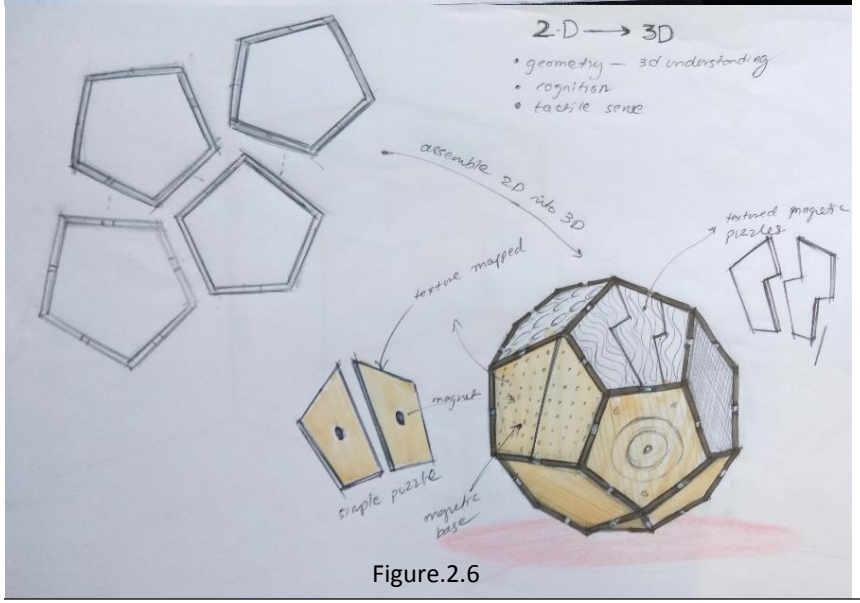


Figure.2.6

This concept aims at teaching visually disabled children the concepts of how development models of geometrical figures turn into actual 3D forms. The development patterns are felt by finger to understand how pieces come together and how 2D turns into 3d.

The developments could be made of acrylic that can be joined together with magnets or velcro or buttons.

Additionally the faces of the 3d geometrical faces could have added on textured puzzle pieces that go onto their corresponding faces.

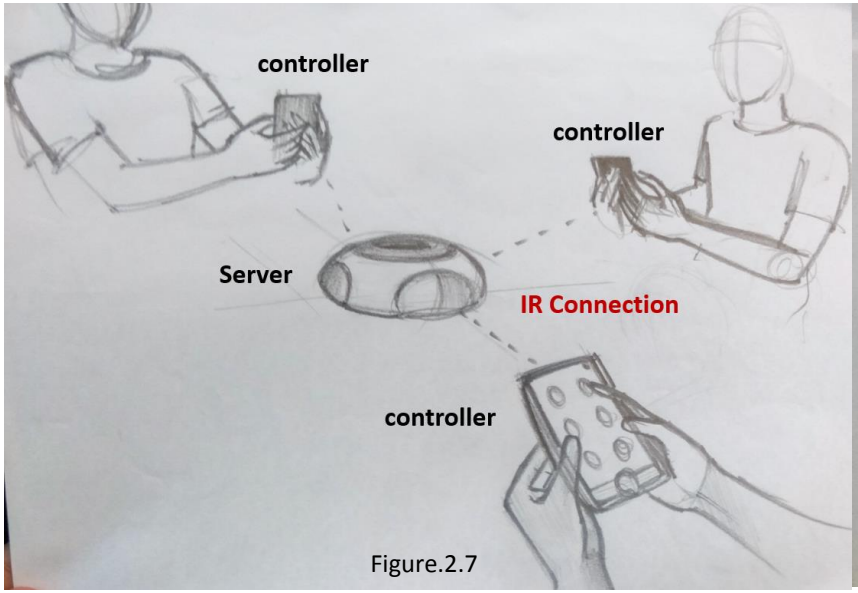


Figure.2.7

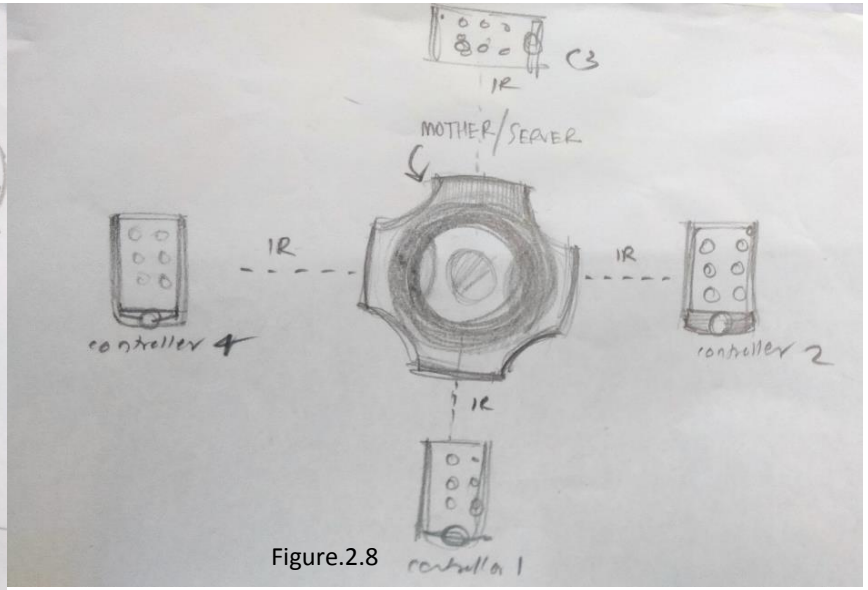


Figure.2.8

The controller was though to be an ergonomic handpiece with controllable dots in the middle row to form the braille alphabets. The dots could be made of electroactive polymer diaphragm similar to the functioning of the modern refreshable braille keyboards or could be controlled via electro active solenoids.
The controllers and the servers can be interconnected via infra red.

Ideations showing the server module , the controllers and connectivity.

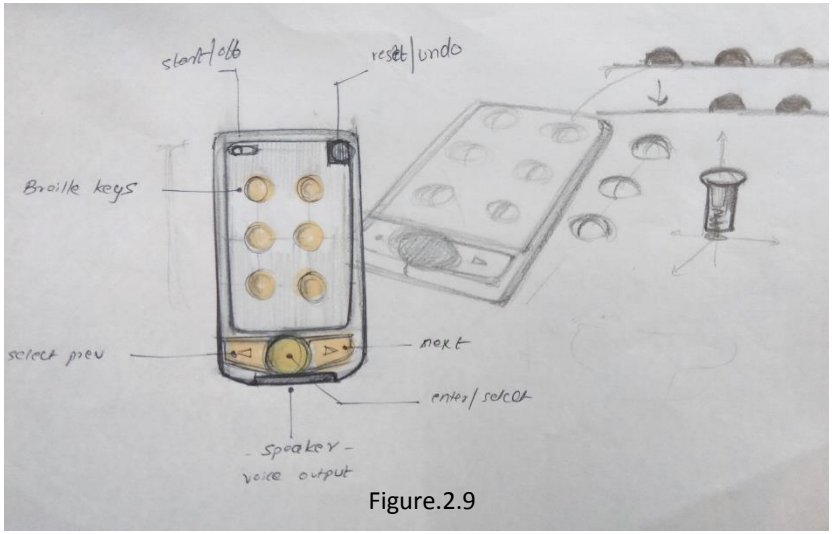


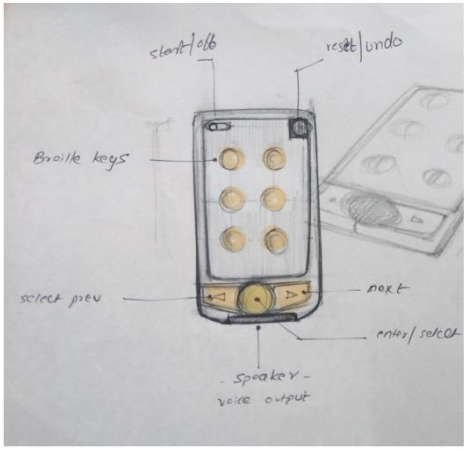
Figure.2.9

The multiplayer braille learning game is a 4 player game that teaches braille alphabets through fun gameplay. The game components are, 1 main server part, 4 braille entry controllers.

The server gives out instructions in the form of alphabets to the players devices. The players have to enter the coorect alphabet according to braille dot formations. Upon entering the alphabet the controller detects the right or wrong answer and corrects the player if a wrong answer is entered. Entering right answers moves on the gameplay to the next player.

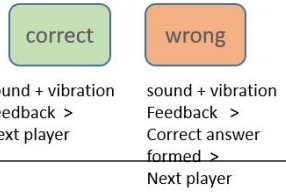
Teach mode

- On
- Select mode> enter
- Select alphabet > prev/next>enter
- Letter formed
- Touch and learn
- Ok> select new
- repeat



Play mode

- On
- Select mode> enter
- Server------ C1,C2,C3,C4---- prompt player ready ?
- C1,C2,C3,C4---- press enter>haptic + sound feedback
- Server assign random alphabet to C1
- C1 enters



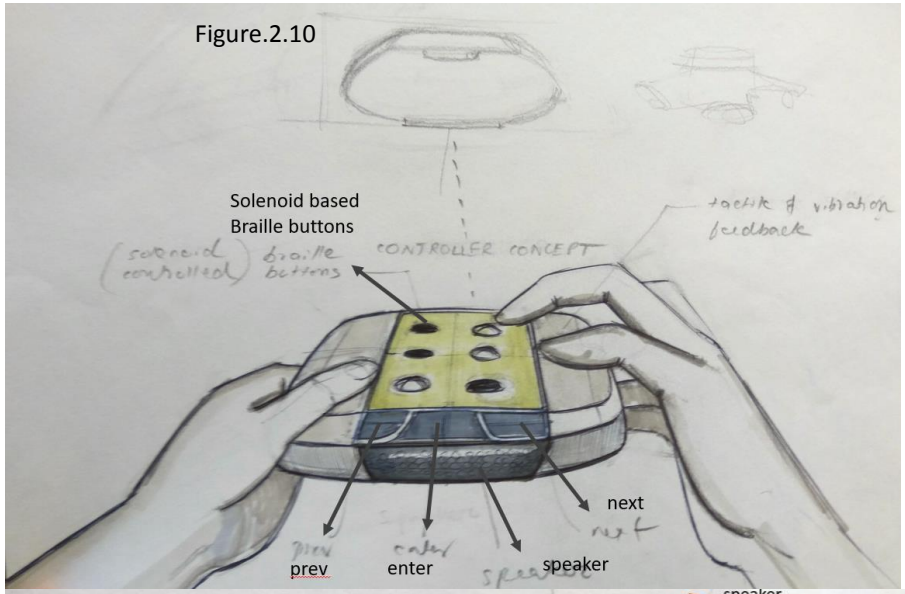


Figure.2.10

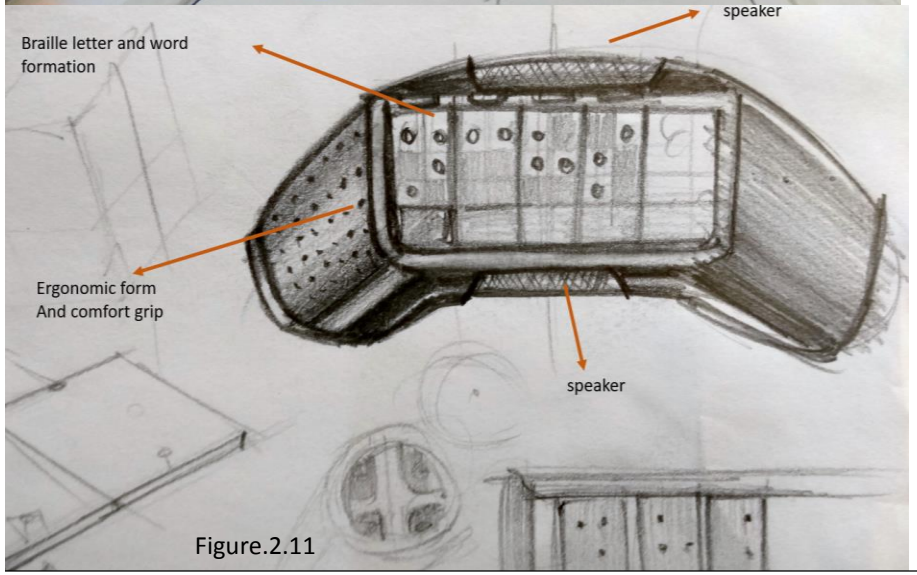


Figure.2.11

The controller was though to be an ergonomic handpiece with controllable dots in the middle row to form the braille alphabets. The dots could be made of electroactive polymer diaphragm similar to the functioning of the modern refreshable braille keyboards or could be controlled via electro active solenoids.
The controllers and the servers can be interconnected via infra red.

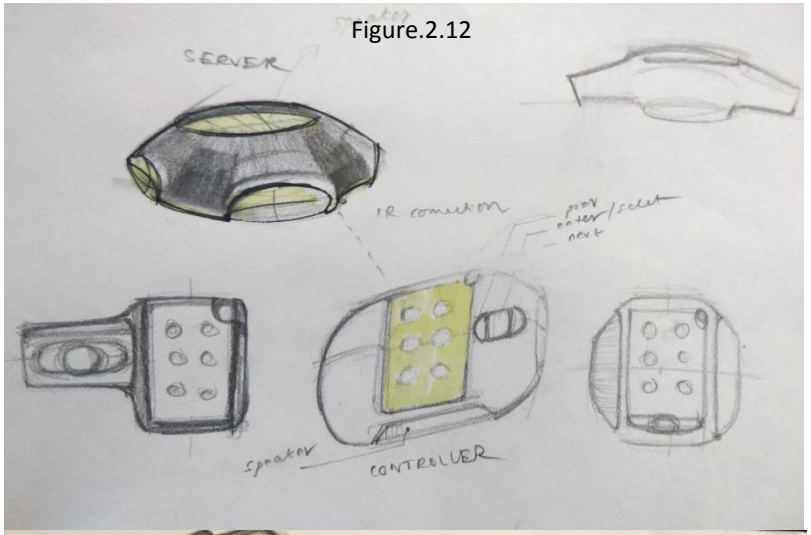


Figure.2.12

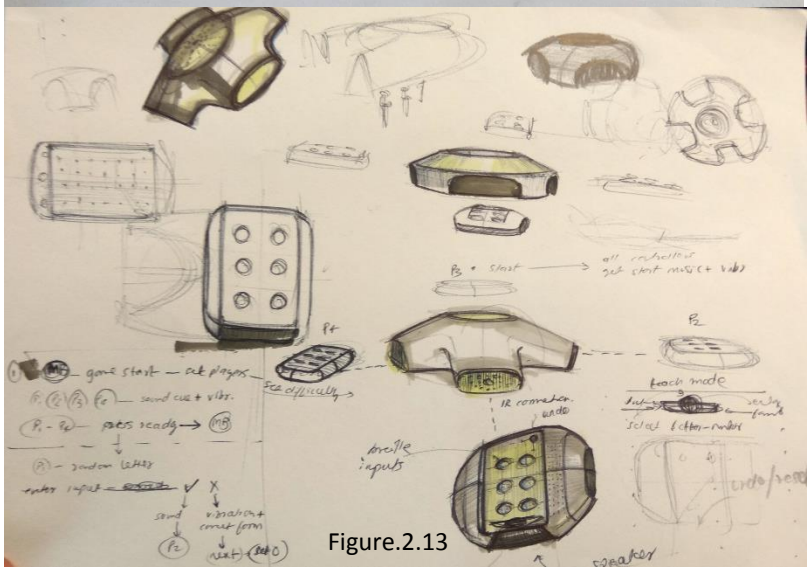


Figure.2.13

Modular electronic toys

- Figuring out electronic loops — cognitive intelligence
- Geometrical modules — shape recognition
- Action A → Reaction B — cause effect understanding
- Sound feedback
- Haptic feedback
- Smell differentiation

  → design for the senses
- Plug & play — fast game play

The toy concept comes with a lot of added benefits such as fun way to explore electronic game pieces. It improves the discovering skills and imagination of the children through electronic modular building block pieces. The children can imagine and build new shapes and structures and also test their discovering skills by trying to connect the interactive modules to the battery and figure out the circuit paths.

Multisensory feedback modules that give sound and haptic feedbacks when connected stimulates the senses of the user and enhances their understanding of cause and effect through the gameplay.

The plug and play design of modules avoids booting time which is commonly seen is electronic games and helps to play and get results instantly.

The modules are shaped ergonomically and in geometric forms teaching them 3d geometrical forms.

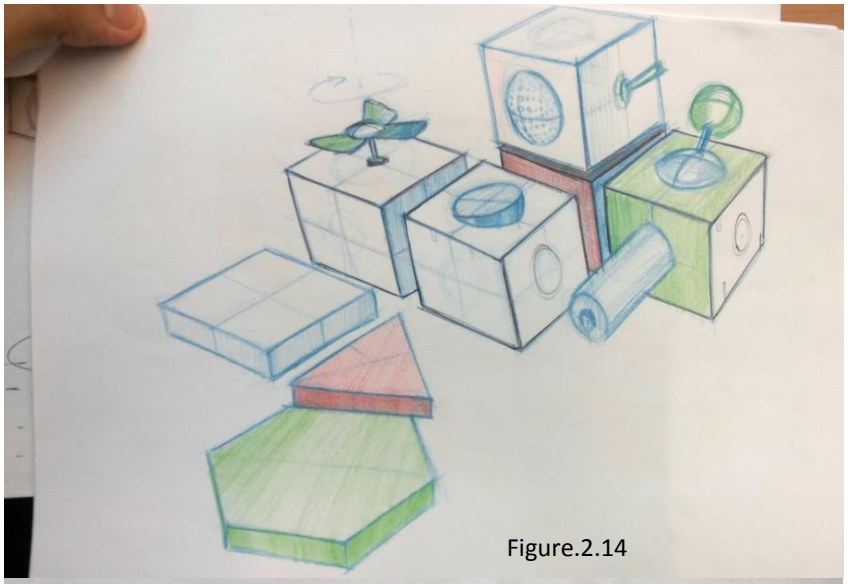


Figure.2.14

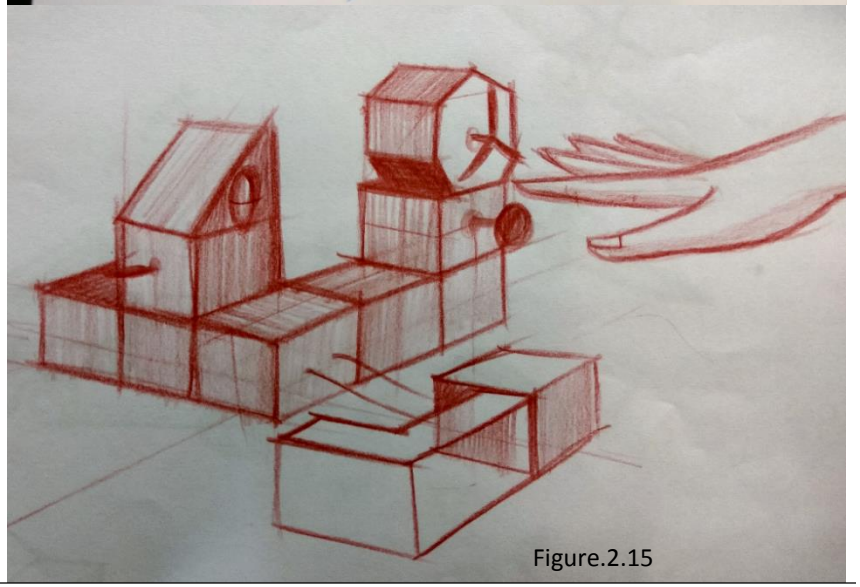
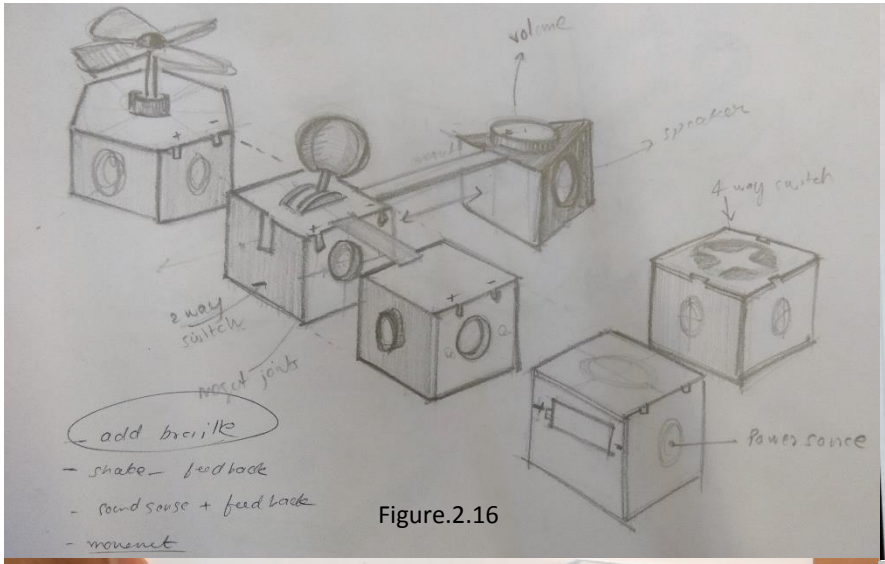


Figure.2.15



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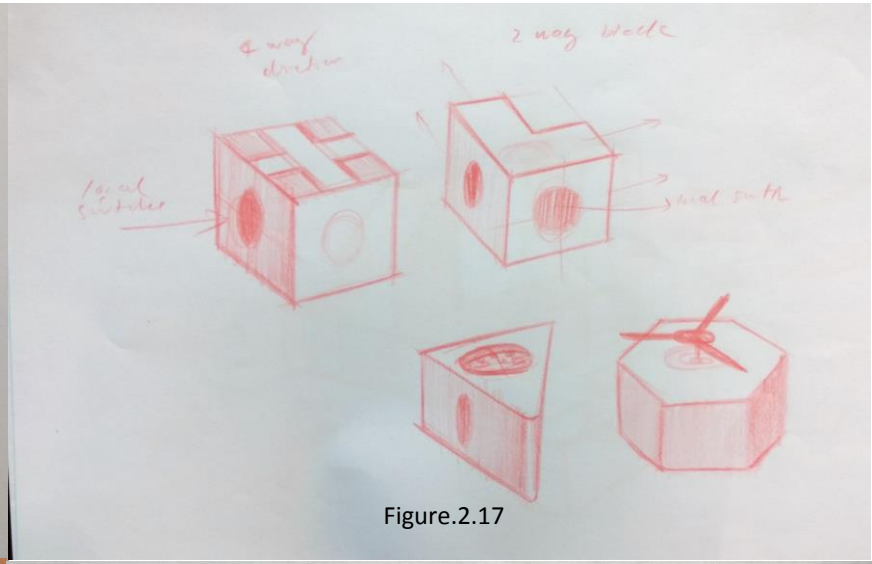

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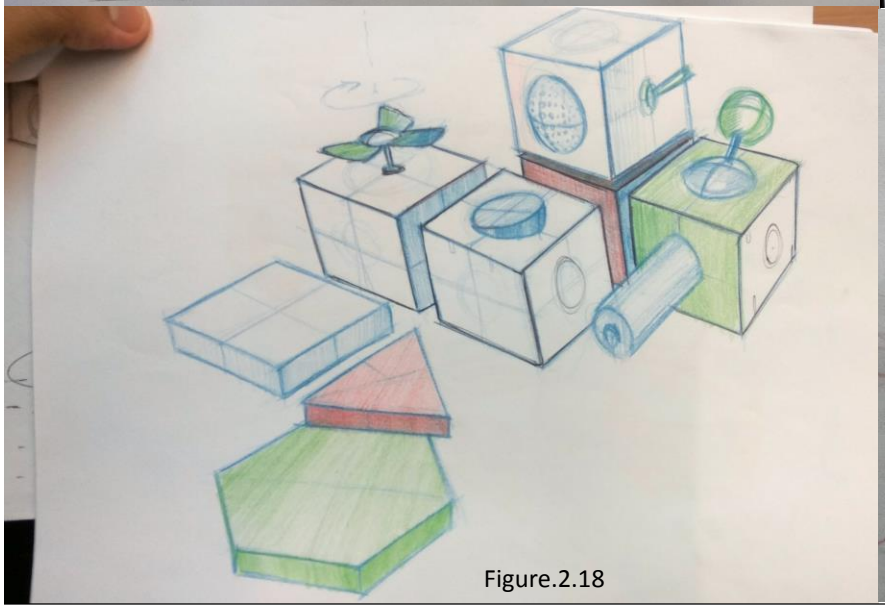
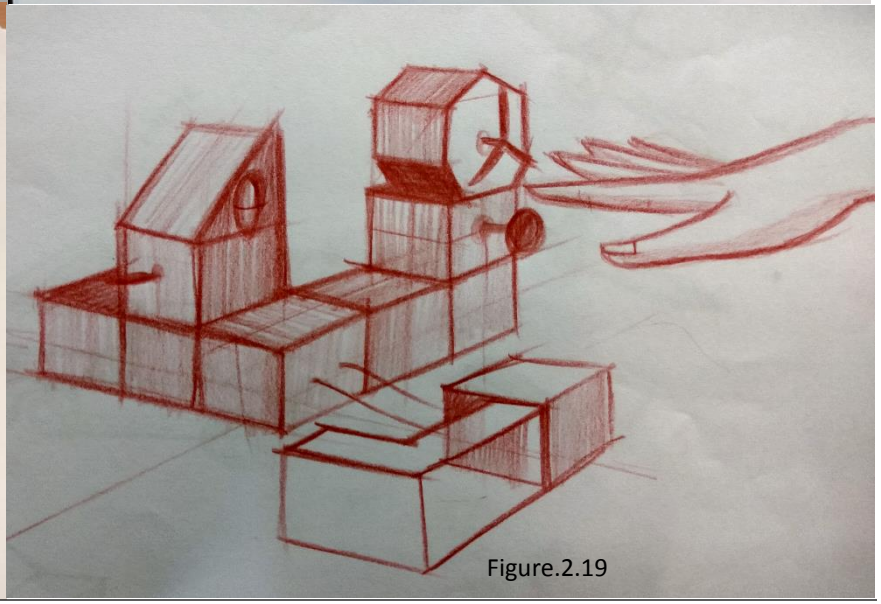


Figure.2.18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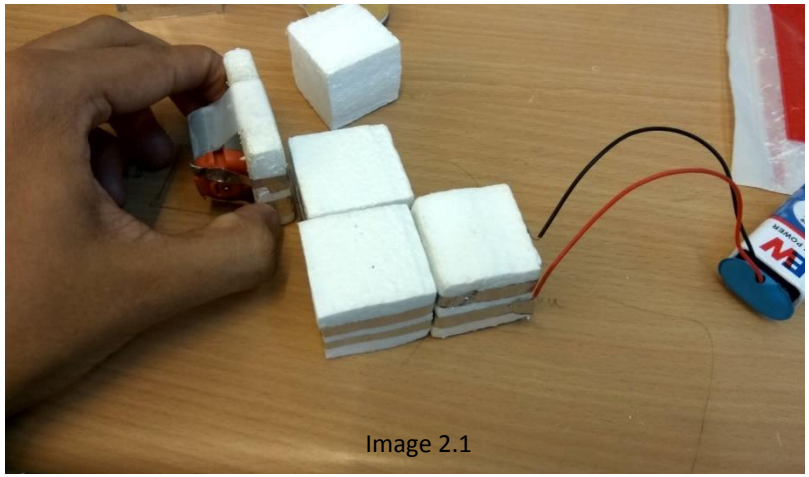

Image 2.1

Mockups made of thermocol modules being tested for feedback and 3d buildability

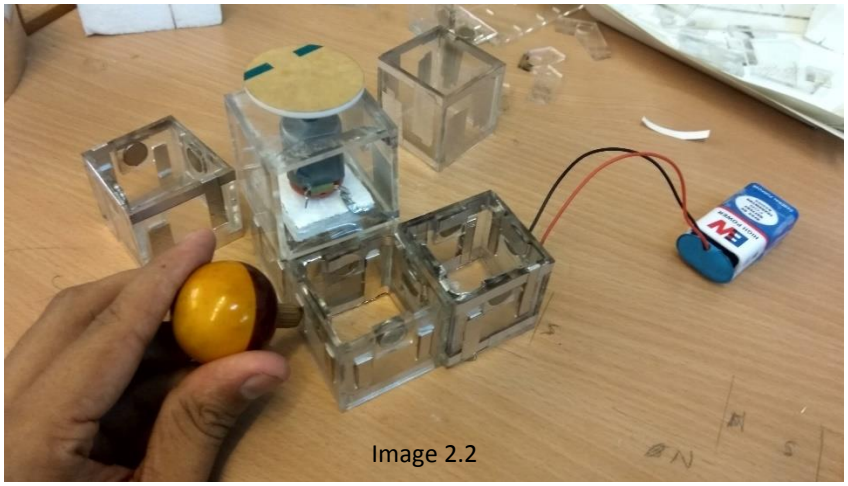

Image 2.2

Mockups made of acrylic modules being tested for magnetic inter connectivity

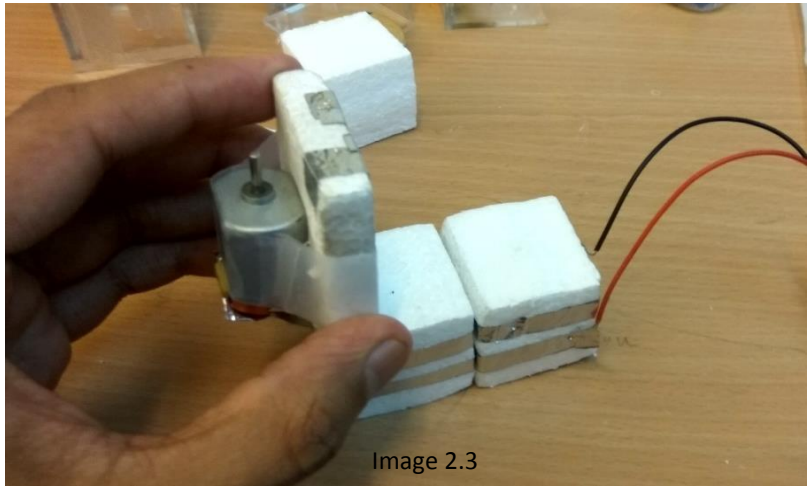

Image 2.3

Image 2.4

Image 2.5

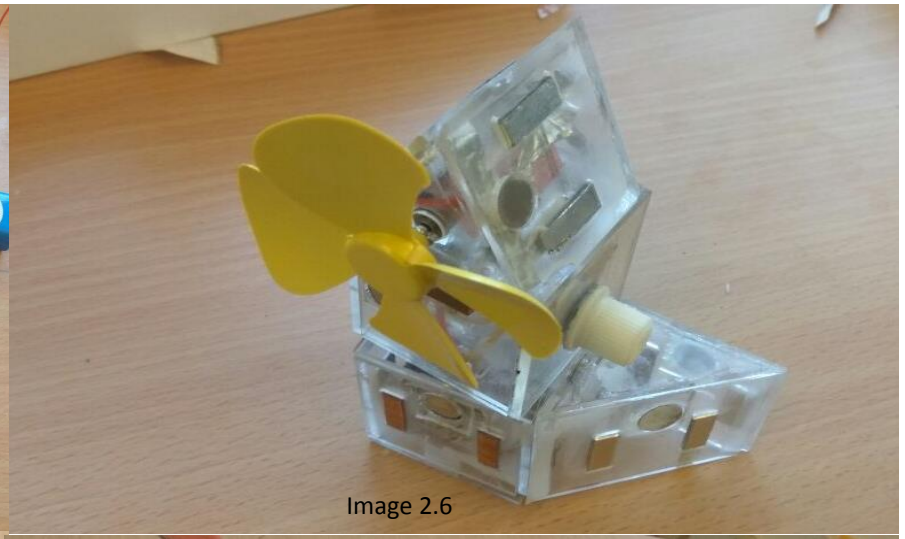

Image 2.6

Image 2.7

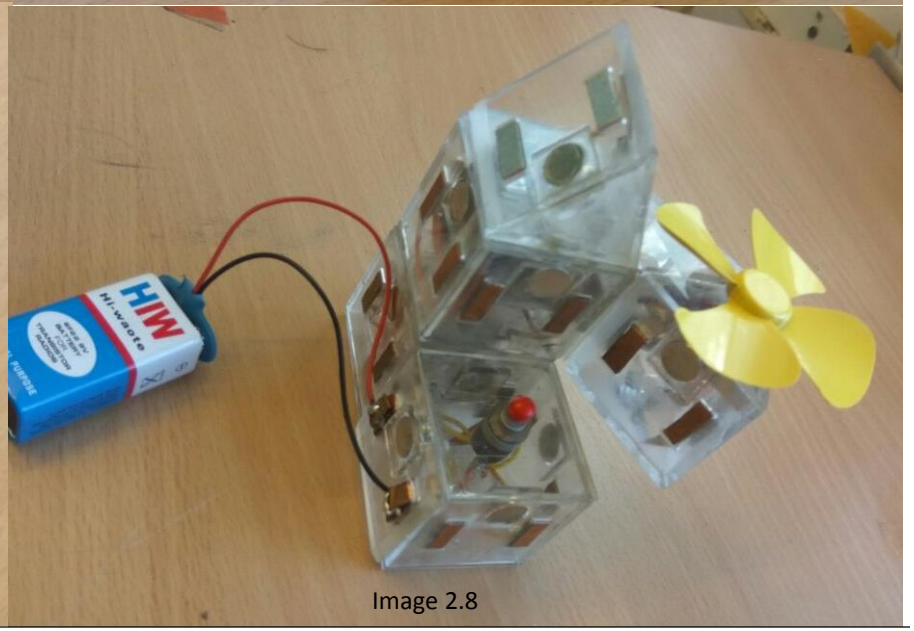

Image 2.8

Design Concepts

concept	multisensory					Fun factor	Gameplay duration	Play repeatability	Sighted/non sighted	Group play	Total /75
	Low vision	sound	touch	smell	cognition						
Simple cognitive	8	6	10	3	8	3	3	3	5	2	51
DIY geometry	8	1	10	3	7	3	2	2	5	3	44
Braille teacher	9	9	10	3	9	3.5	4.5	4	5	5	62
Electronic modular	9	9	10	3	10	4.5	4.5	4.5	5	4	64

The multiple concepts were evaluated to arrive at a final concept to proceed with. The concepts were evaluated with certain parameters associated with the context of the game play such as-

1.Appeal to multiple senses- low vision, sound, touch, smell and cognition.
2.Fun factor of the games .
3.How much the play can be repeated as the child grows up.
4.The duration span of the gameplay.
5.Playable to both the sighted and non sighted groups.
6.Whether the gameplay facilitates group play.

The parameters are evaluated on a scale of 0-10 (10 marked the highest) and the scores across all parameters tallied to find the resultant score. The concept that scored the maximum is identified to be the best concept among the lot.

User Testing I


Image 3.1


Image 3.2


Image 3.3

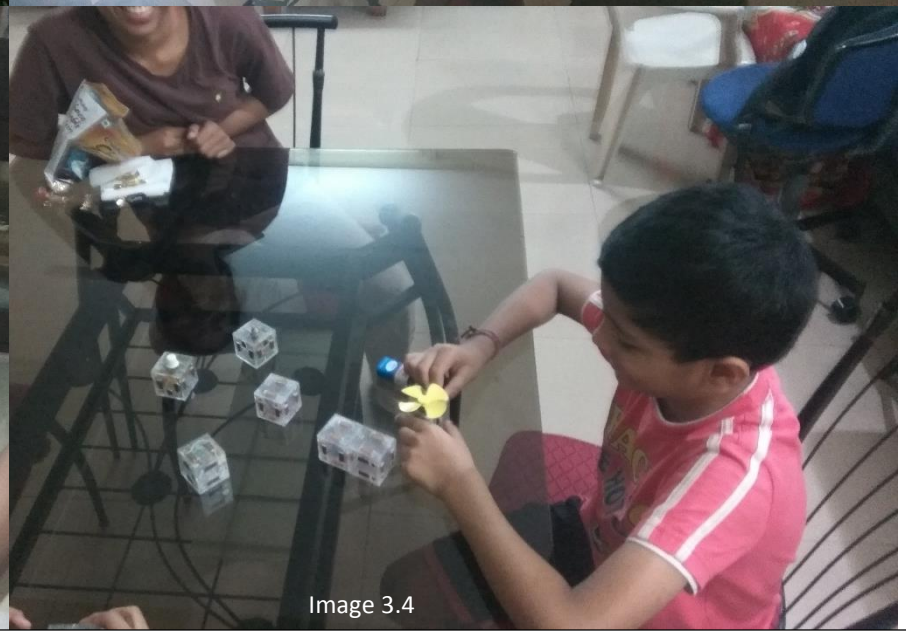
Image 3.4

Image 3.5

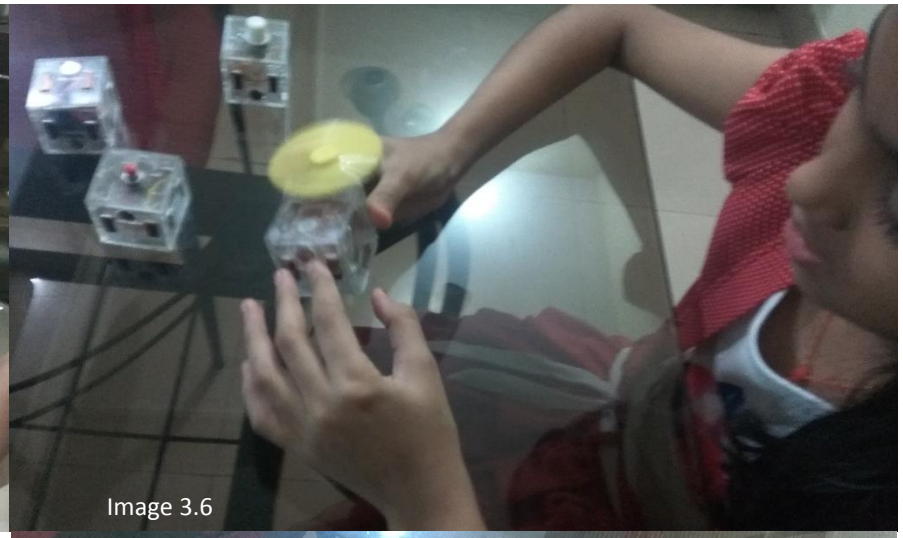

Image 3.6

Image 3.7

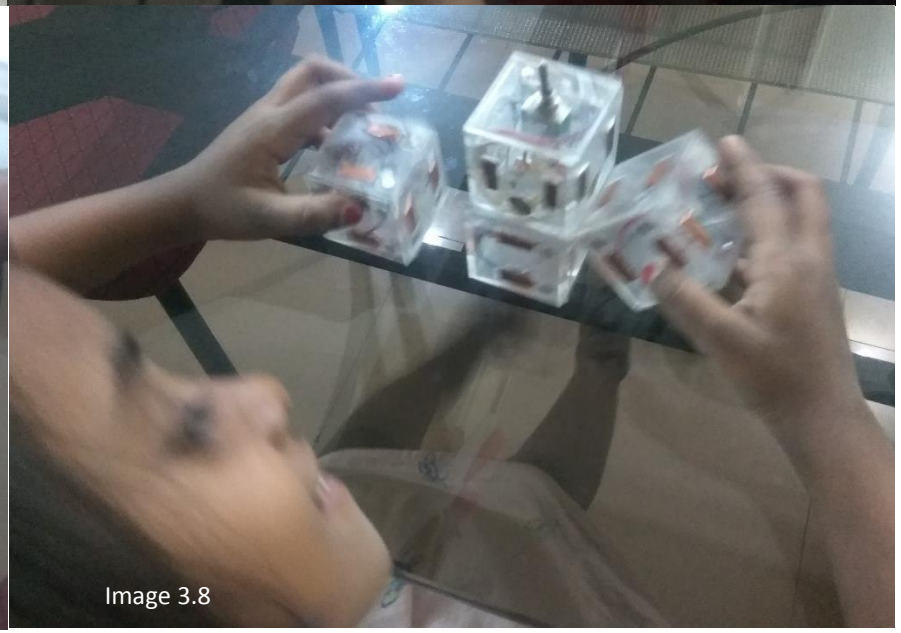

Image 3.8

User testing observation and user feedbacks

The user testing was done at NAB worli, three low vision children were asked to volunteer for the toy testing. Care was taken to see that children were playing in a safe environment . The toy modules were given to them in hand and were explained the function of each modules. They were encouraged to form 3D shapes and explore building blocks first to develop imaginative skills and object differentiation. Later the concept of simple electronics was explained to them and shown arrangement of functional modules with the power source. Then the development and extending of functional modules with the non functional extension blocks was also shown to them. The cause effect relation of power source-switches-and function modules were also shown to them. The children were then encouraged to explore the toys by themselves with little or no supervision. Their play behavior and discoverability skills were inspected. Also noted down were the failures in the current design regarding matters such as object differentiability based on textures and materials. Understanding of cause-effect phenomena.

Main feedbacks by the users were as follows-

1. Lack of modules. Users needed more number of building modules, they suggested around 15 modules so that the toys can be played by two people together hence more modules were needed.
2. Difficulty in differentiating objects. Some modules were found to feel similar while holding but had different functionalities.
3. Modules such as the press button switch module was found to be uninteresting and was confused between the toggle switch modules they had the same purpose. Users found more fun in using the toggle switch.
4. Addition of interesting textures or braille markings were missing as per the teachers.
5. Inability to open up the modules in case of trouble shooting.
6. More fun blocks were suggested by the users such as a module with wheels and add on wheels to play like a long train.
7. The fillets given to the module edges were felt to be little sharp hence more rounding off was required.
8. The nursery rhymes module was found to be difficult to understand how to use it.
9. Users mentioned they felt frustrated while identifying the correct magnetic faces as the faces often repelled each other making the users think that the modules were malfunctioning.

Refined module design after feedback

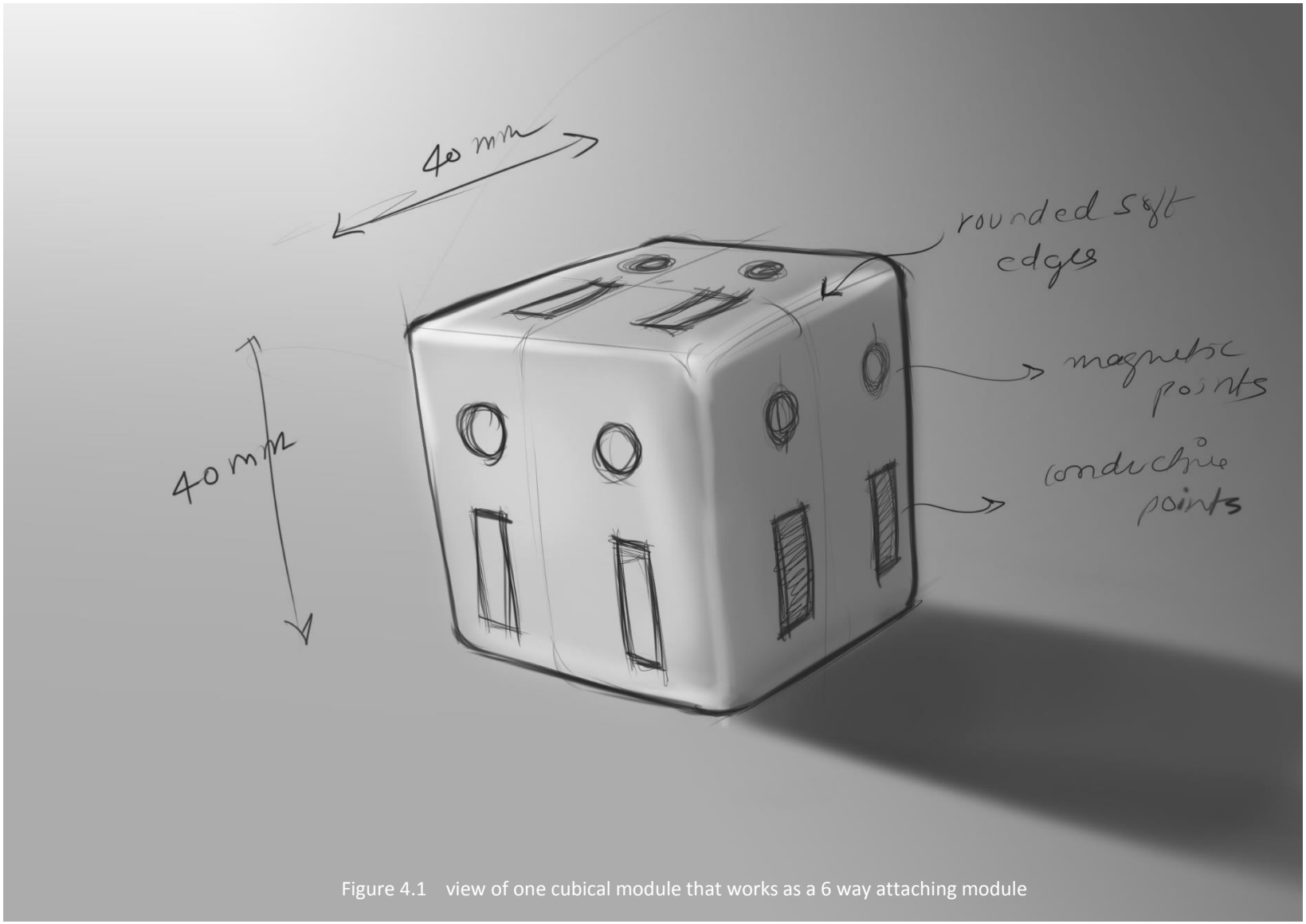

Figure 4.1 view of one cubical module that works as a 6 way attaching module

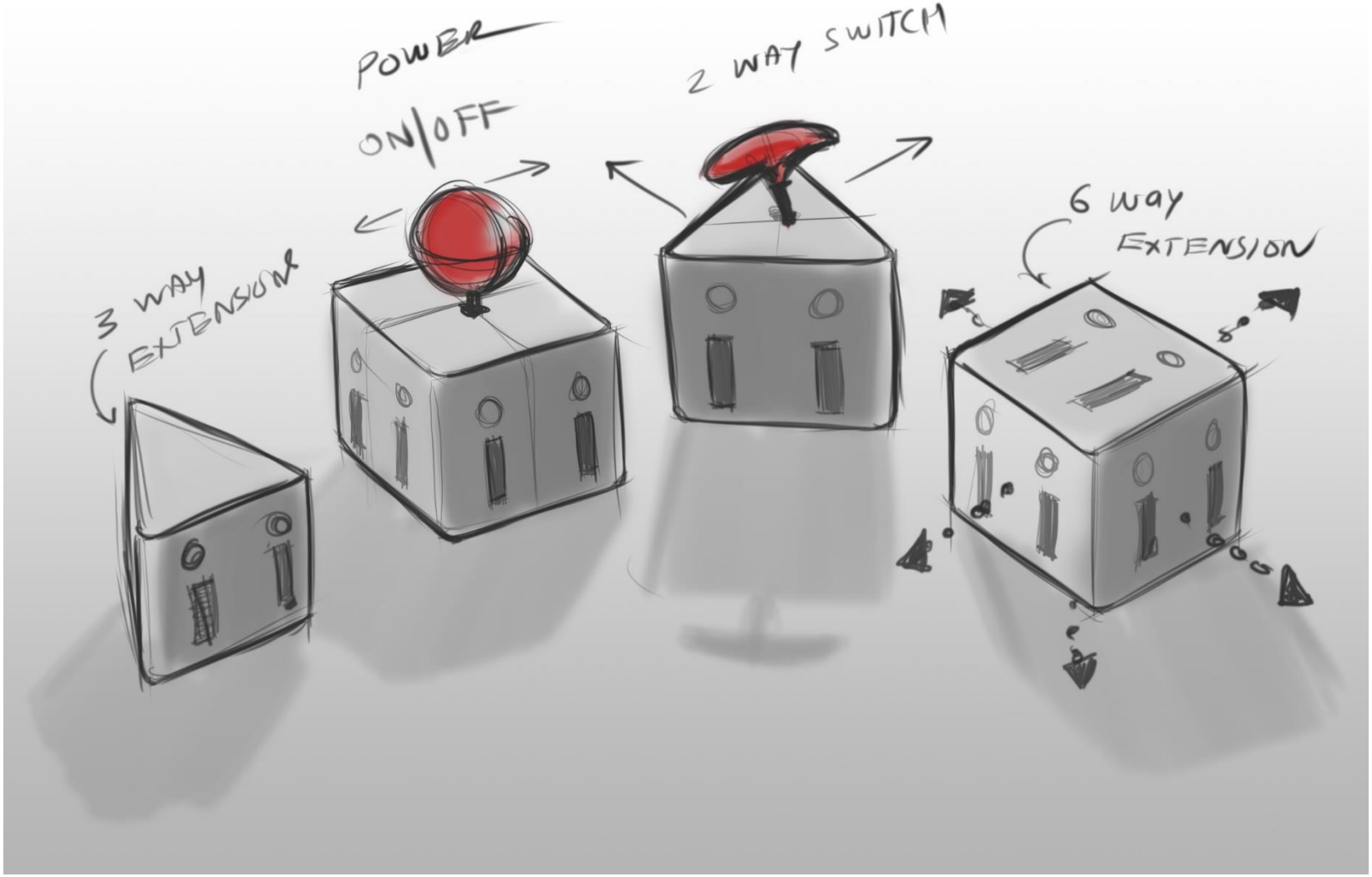

Figure 4.2 view of different play modules with different functions

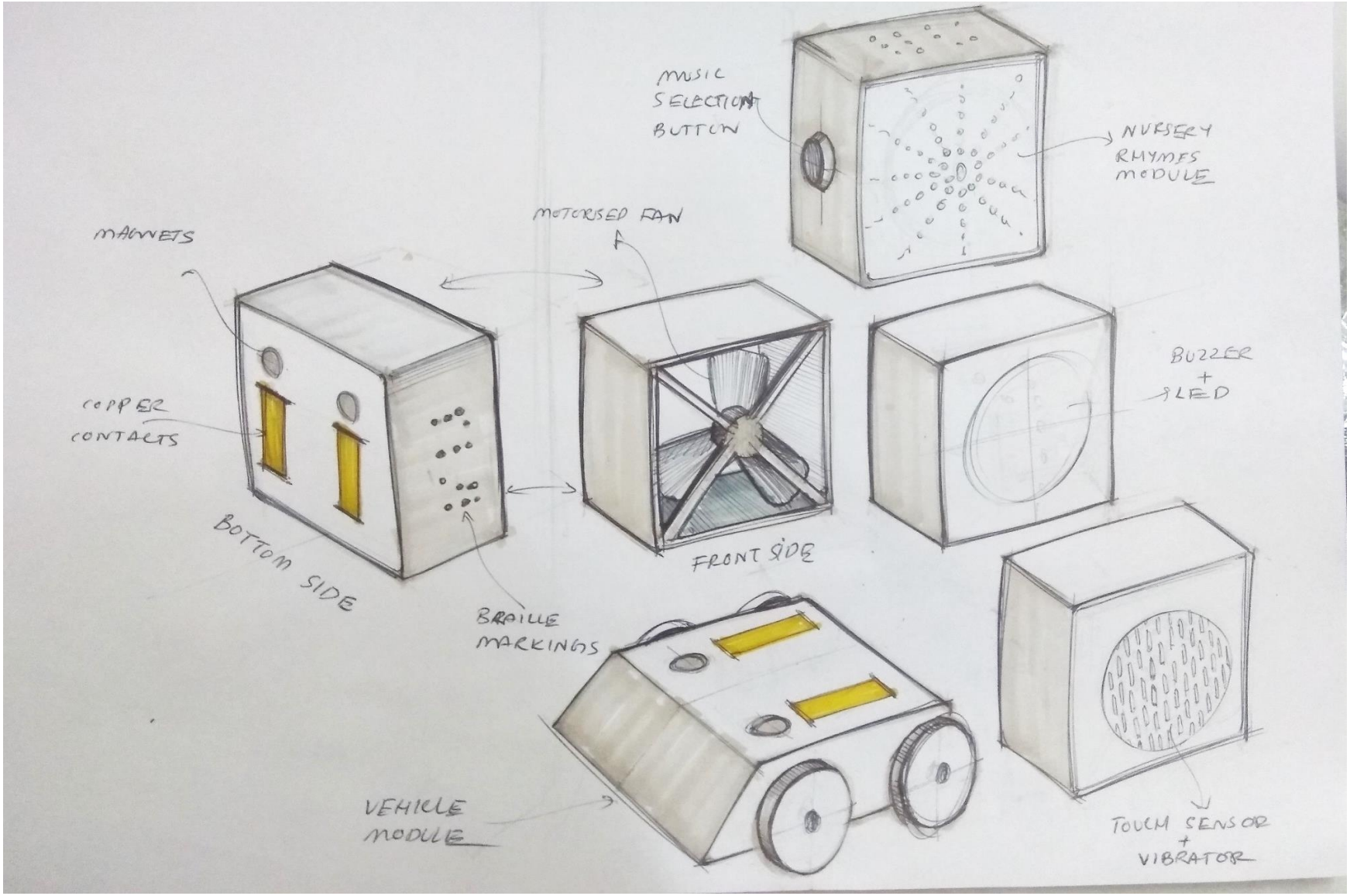

Figure 4.3 view of different play modules with different functions

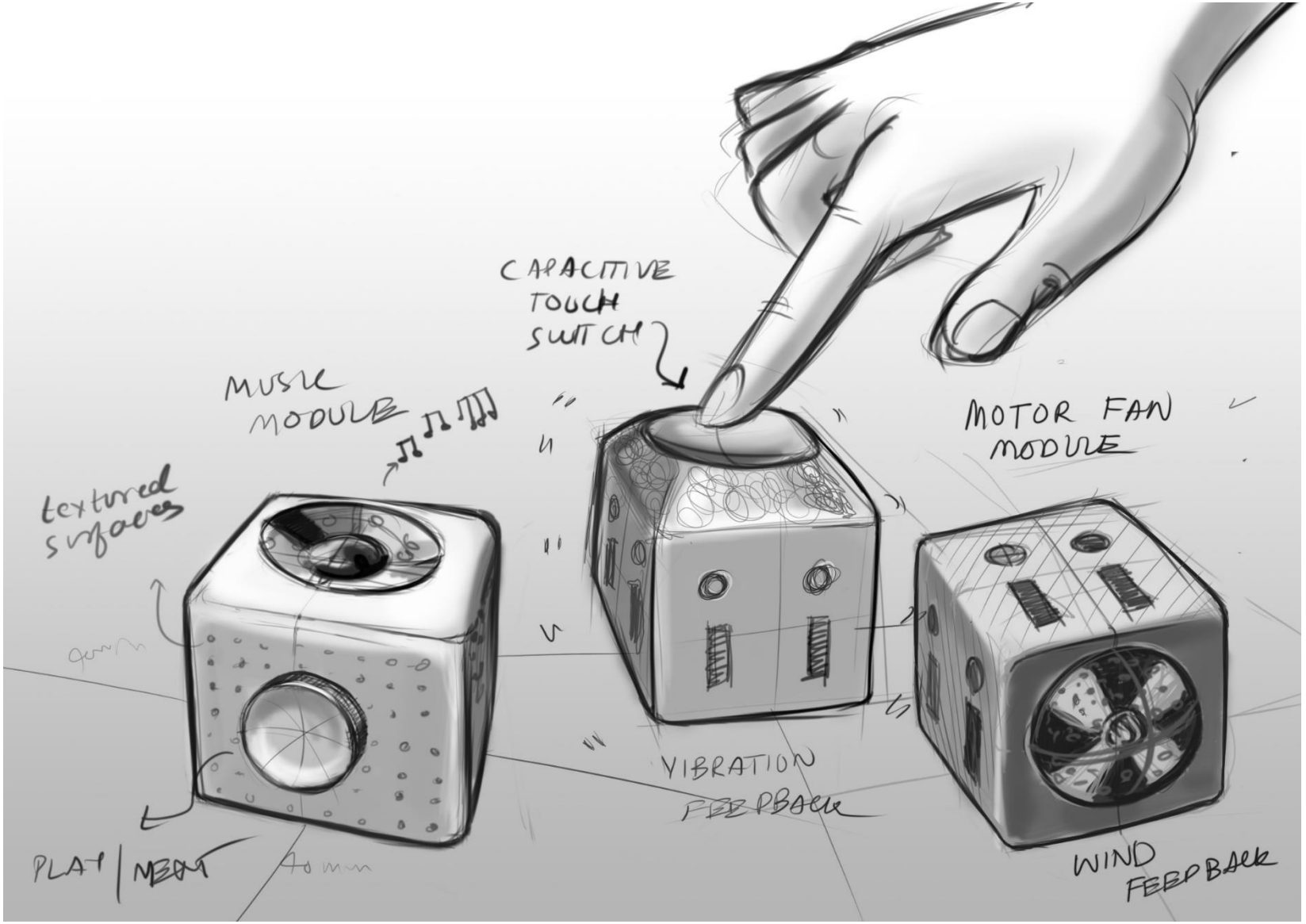

Figure 4.4 view of different play modules with different functions

Detail of manufacturing and assembly

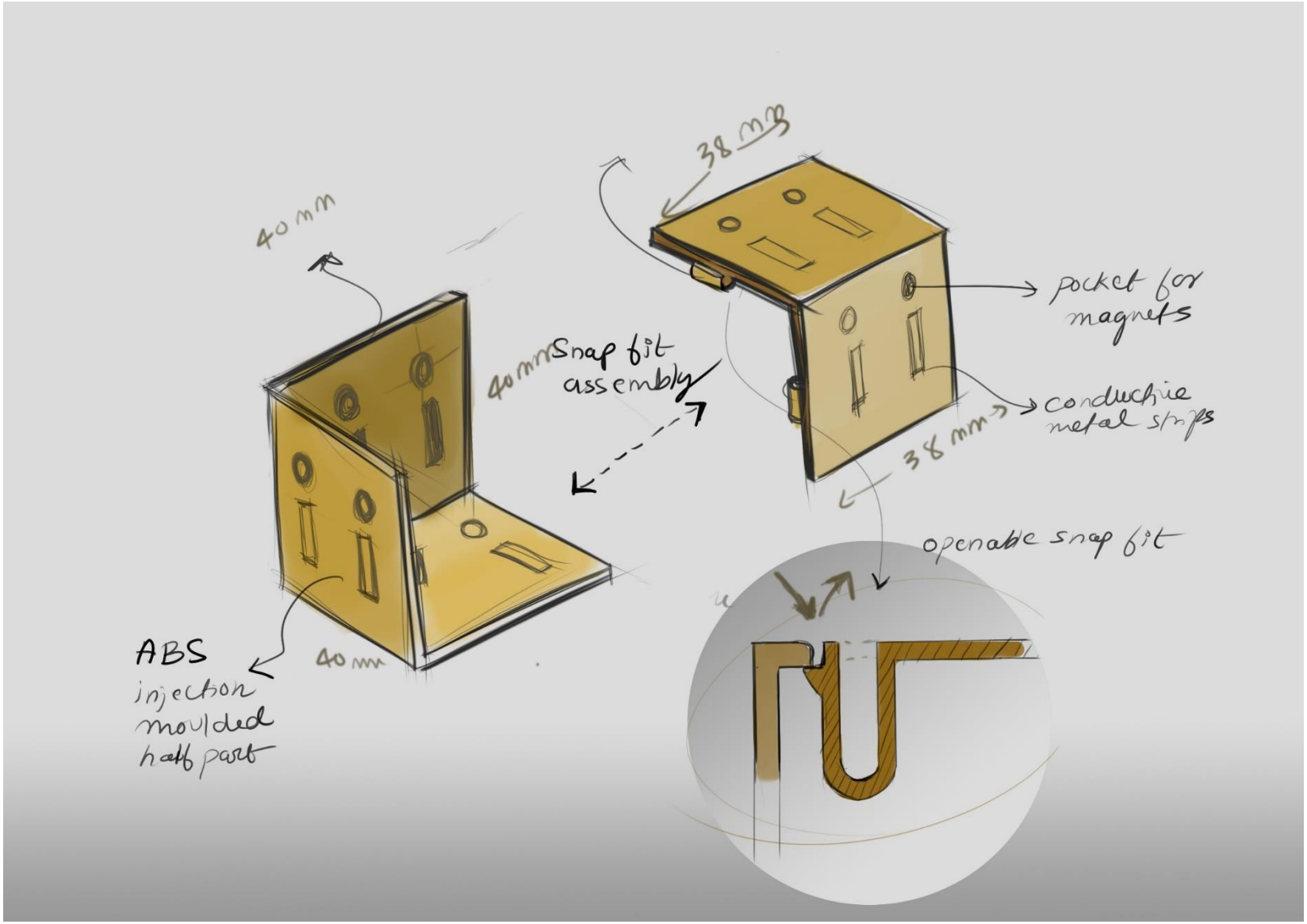

Figure 4.4 snap fit arrangement of assembling the modules

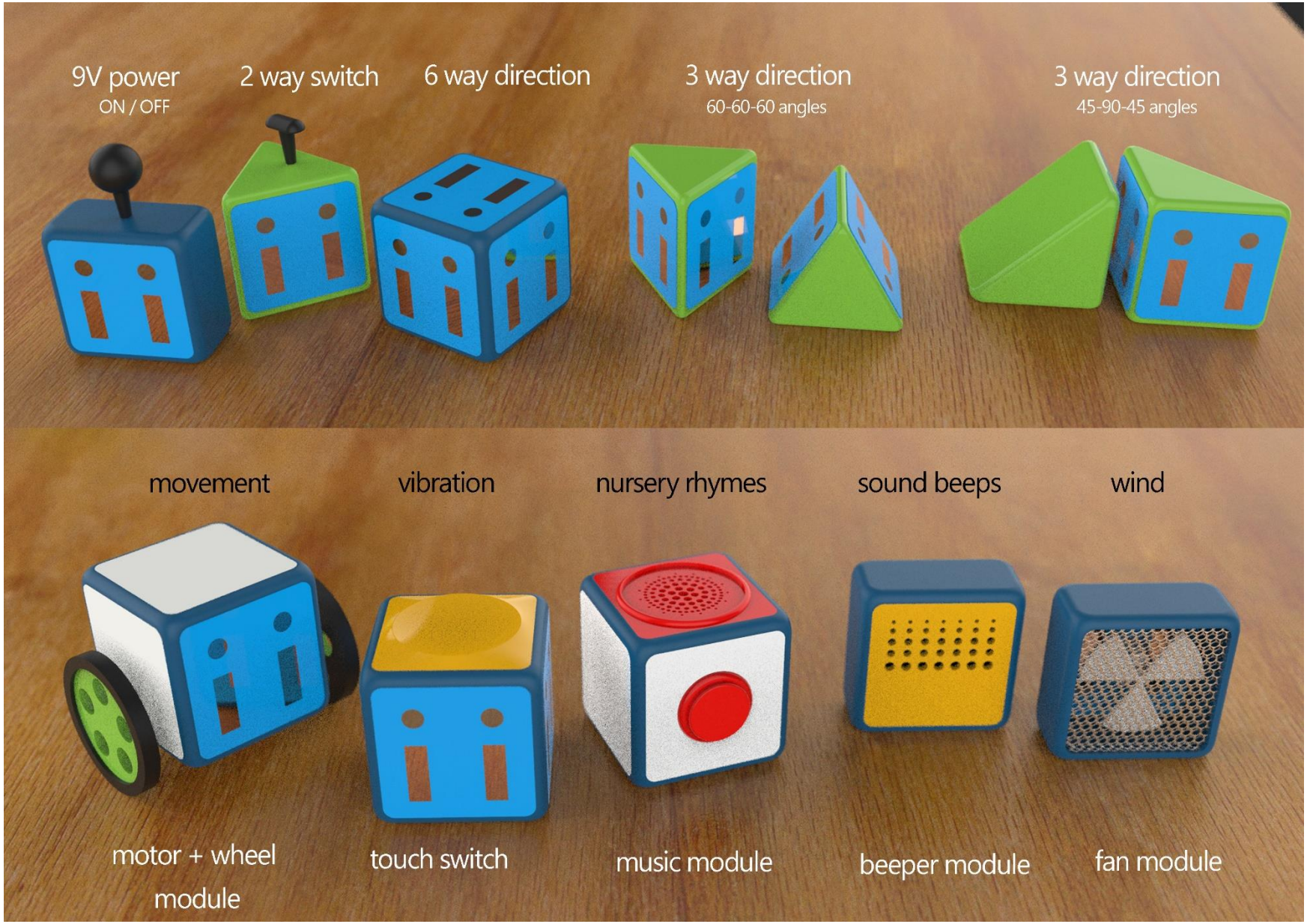

Figure 4.5 final colored rendering of the toys

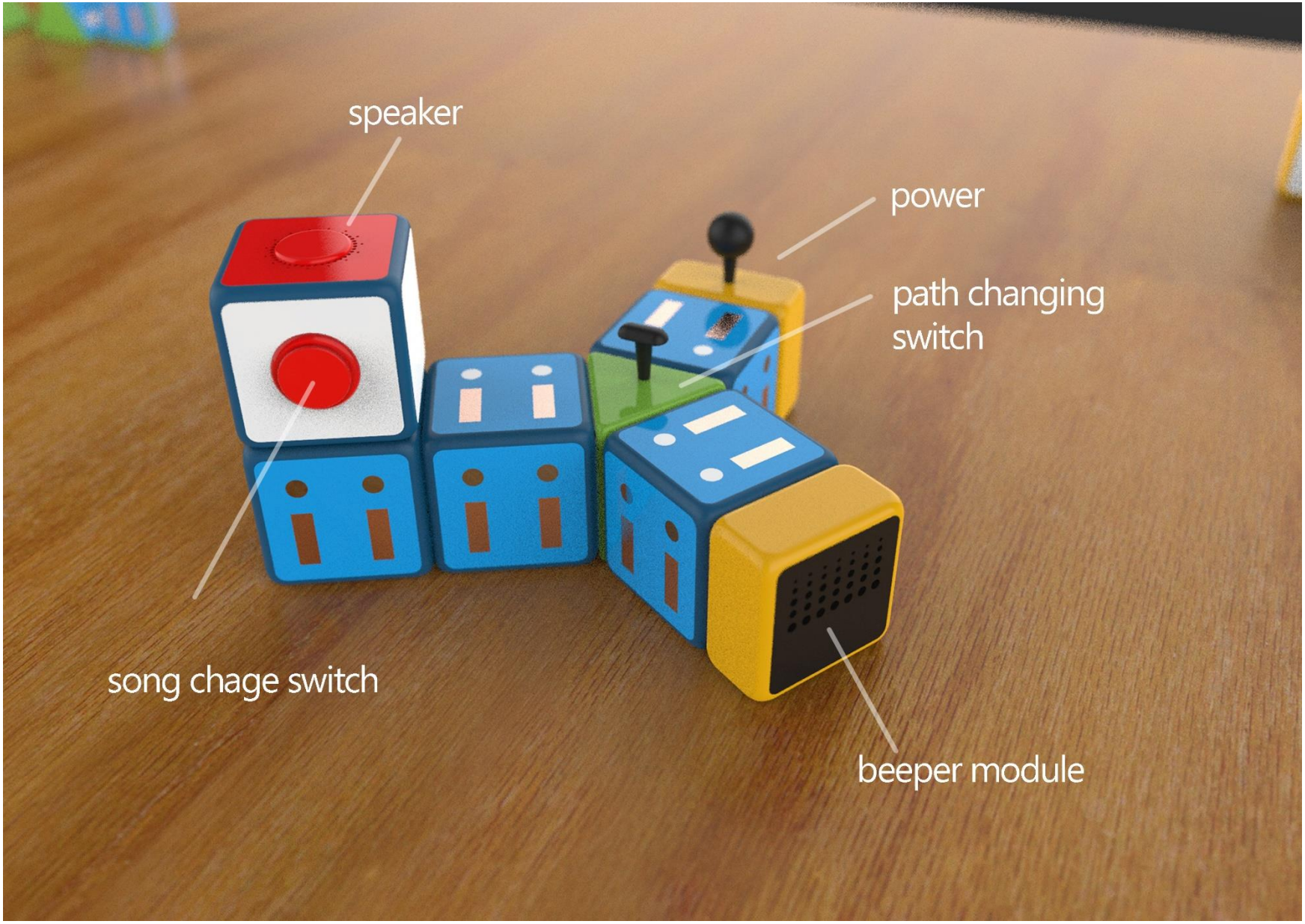

Figure 4.6 rendering showing play arrangement of the toy modules

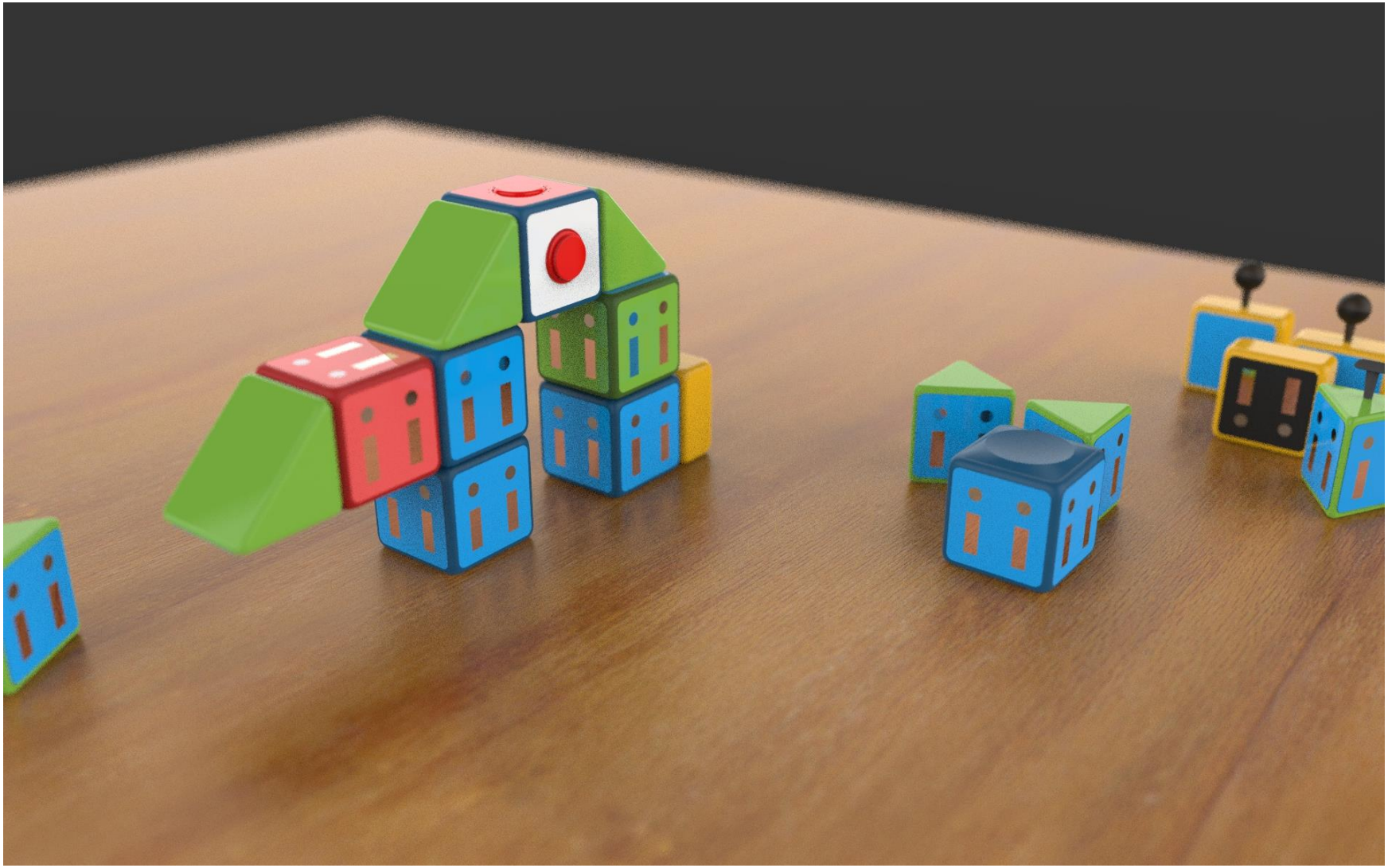

Figure 4.7 rendering showing toy modules arranged and imagined as an animal

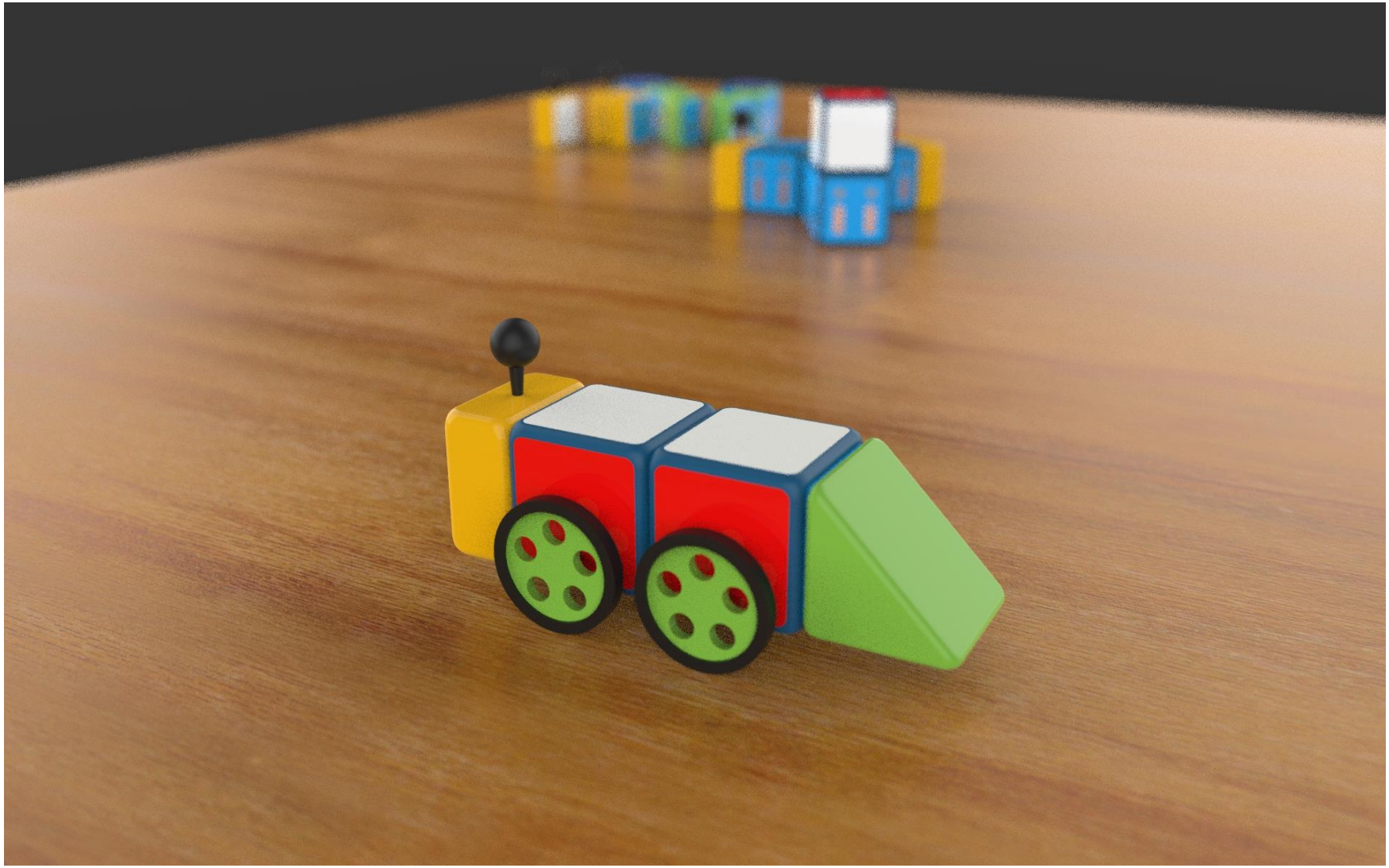

Figure 4.7 rendering showing the toys arranged as a working toy vehicle

image 4.1 step 1- joining modules to make simple tangible shapes

image 4.2 step 2- understanding basic connections of power to light/sound module

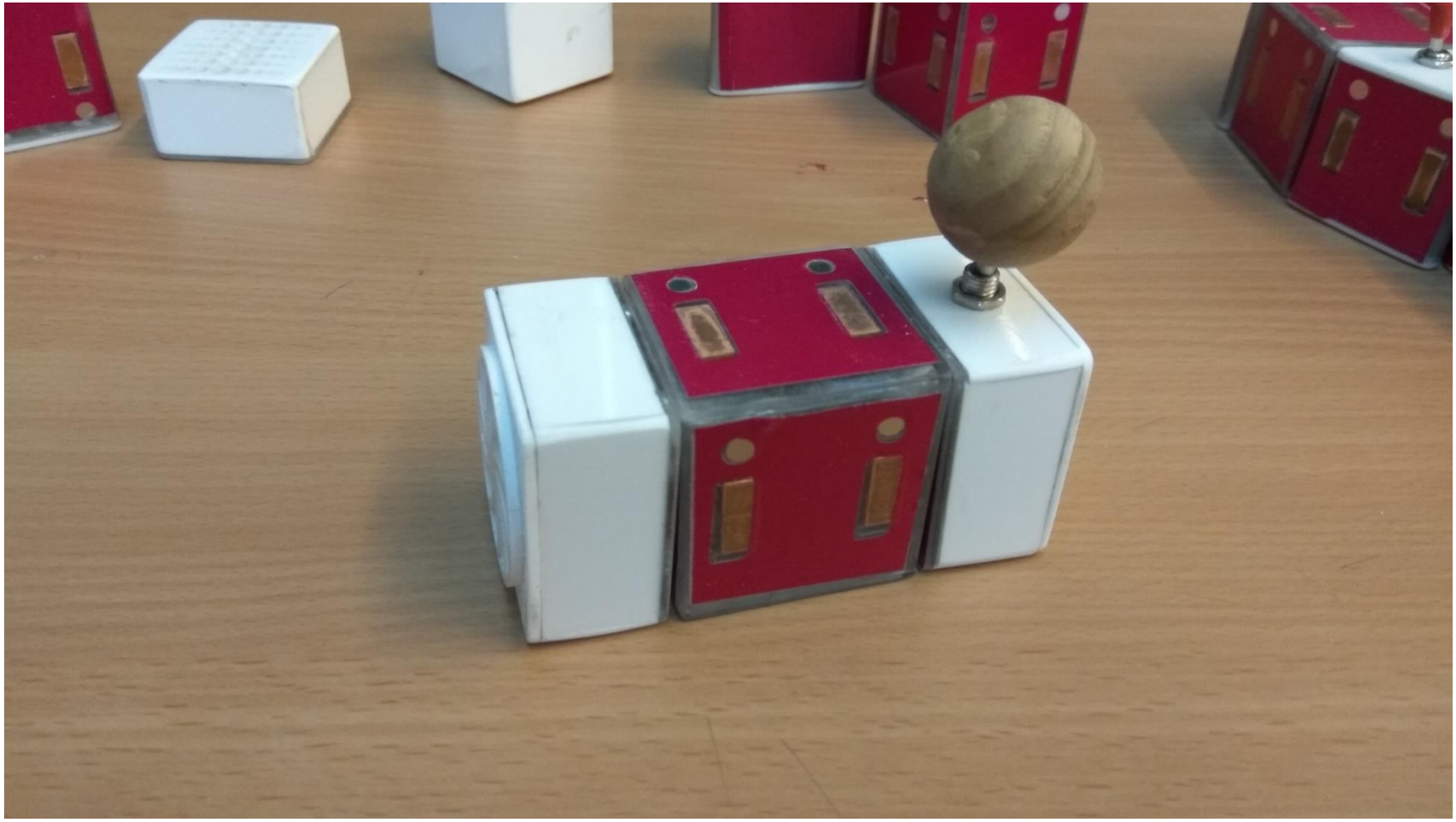

image 4.3 step 3- introducing intermediate extension pieces between power source and output module

image 4.4 step 3- introducing more extension modules between power source and output module

image 4.5 step 3- introducing more extension modules between power source and output module

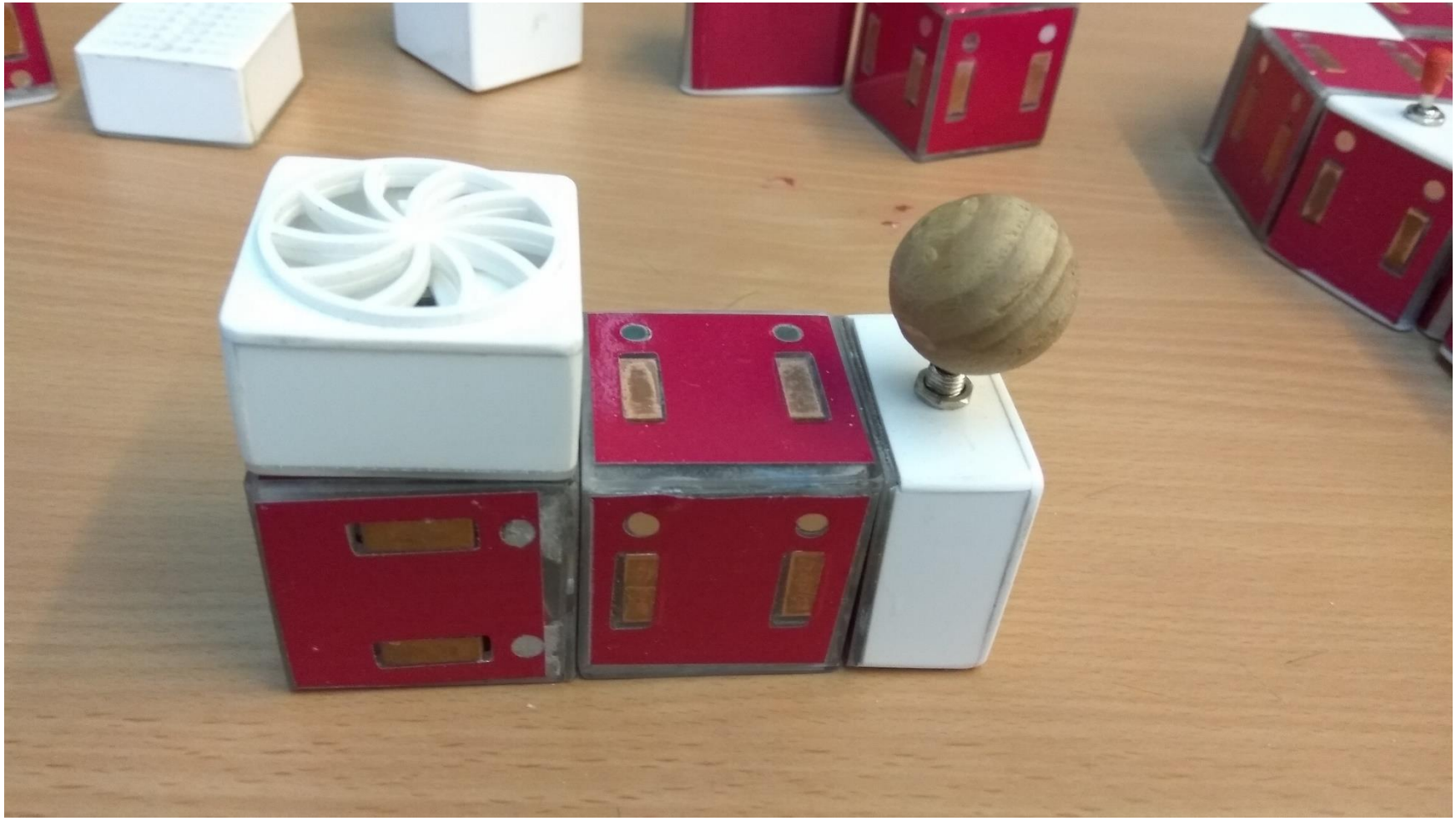

image 4.6 step 3- introducing more extension modules between power source and output module

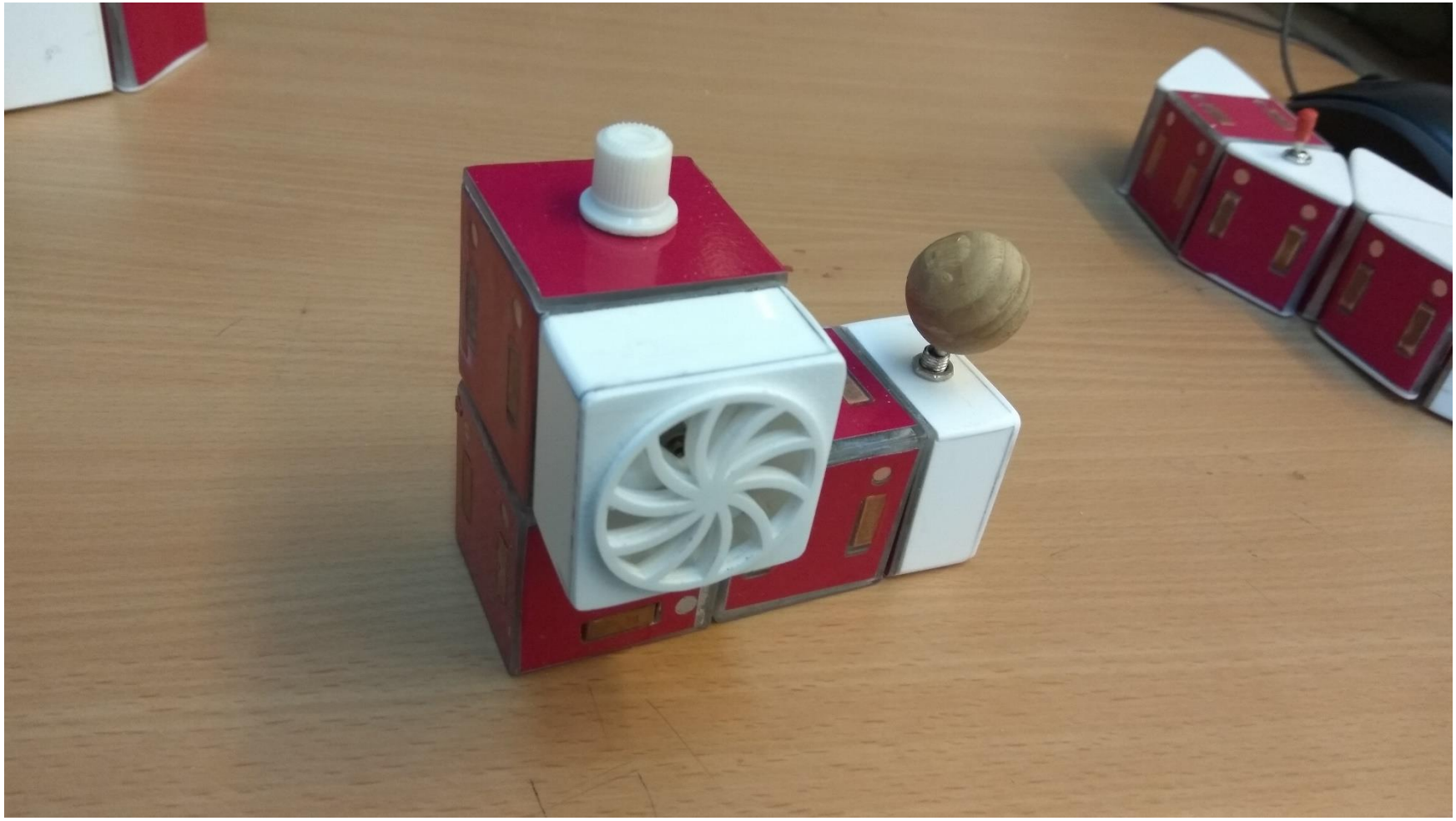

image 4.7 step 3- introducing more functional-extension modules between power source and output module

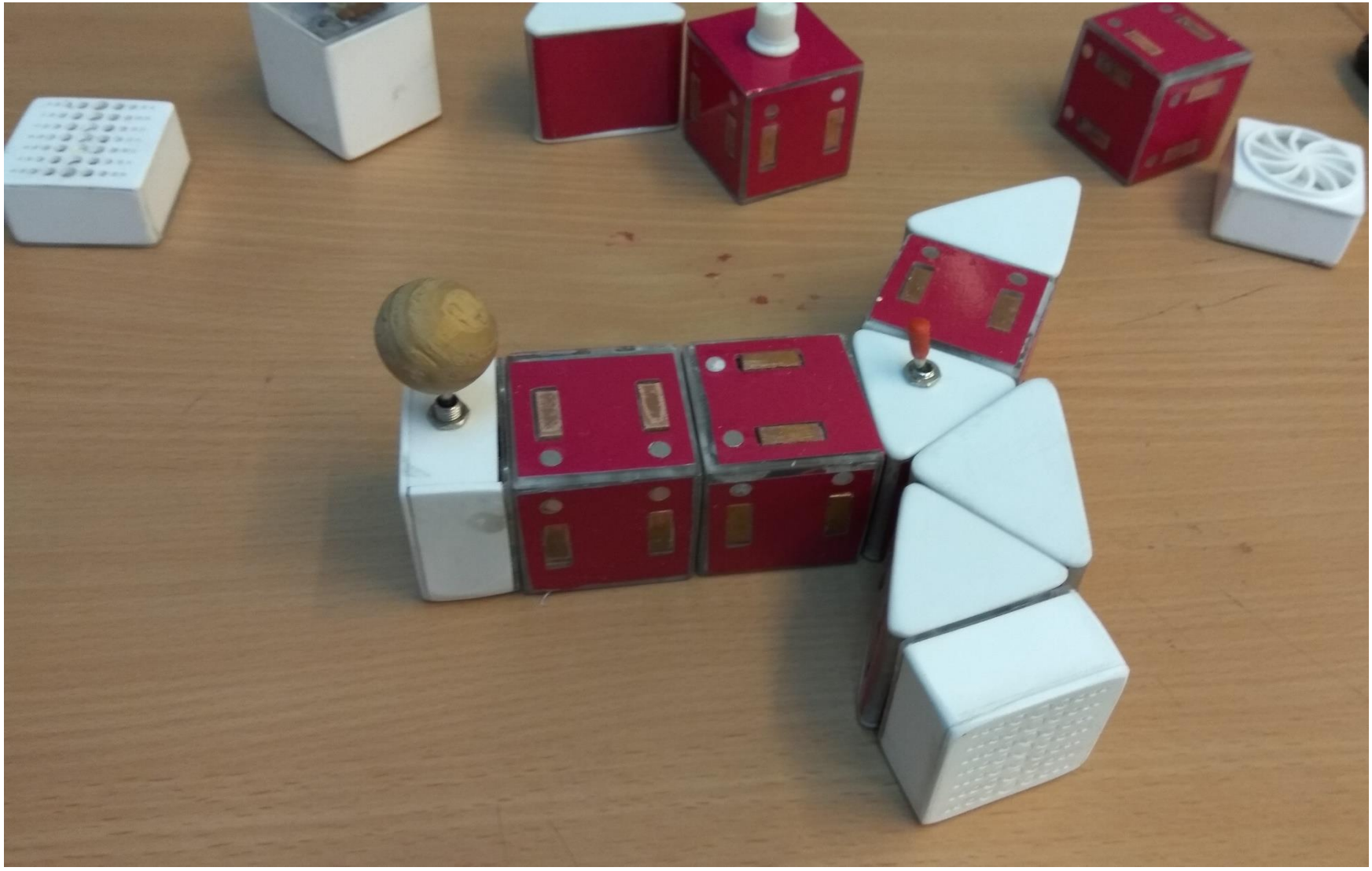

image 4.7 more dimensions and functional modules brought into the gameplay

Conclusion

Through this project I learned the problems that visual disability can cause to a child's daily life activities. I understood that these problems of visual disability can be overcome through will power and training. This training to understand and control your surroundings should be given from the childhood itself and the medium of administering this teaching is best done through playing. Playing and comparing skills with their peers can be fun as well as helps grow their confidence and self esteem

The product was tested with the users and found to be confusing at first to the users but later they picked up the knack of the toy usage. The final jury members of the P2 defense suggested that there be some sort of catalogue with the toy package that showcases the various possible combinations that create working toys. This catalogue has to be tactile in nature so as to impart proper information to the visually disabled users. Further comments from the jury was the detail designed to ease the assembly of the toy parts. It was suggested that conductive tapes need not be used as the electrical connections within the modules as it may tangle and slow down assembly, but rather use metal clips that lock together upon closing the modules. The usage of magnets to join the modules could also be changed to mechanical or physical fits as seen in the Lego toy blocks.

Through this project I learned how to empathize with my user group and involve them in the design process (participatory design). Through their participation and suggested improvements I was able to arrive at the successful conclusion of this product design project.

References

Online journals and studies

Celeste, M. (2006). Play behaviours and social interactions of a child who is blind: In theory and practice. Journal of Visual Impairment and Blindness.

Celeste, M. & Grum, D. K. (2010). Social integration of children with visual impairment: A developmental model

Allen, K. E. & Cowdery, G. E. (2005). The exceptional child inclusion in early childhood education (5th Ed.)

Liberman, L. J. & MacVibar, J. M. (2003). Play and recreational habits of youths who are deaf-blind. Journal of Visual Impairment and Blindness.

Assessment of play behaviors and social interactions of 2 blind girls: Case studies in Japan
Authors : Darja Kobal Grum, Toshibumi Kakizawa, Marie Celeste

Play features of visually impaired children
Authors: Hale DERE ÇİFTÇİ

IDC reports

Visualisation for blind children**,** *Aneesha Pitale, VCPR 123, 1990*

Interactive arcade game for the blind and sighted, *NIKHIL karwall, MDP 333, 2007*

Playing aids for blind children, *Kumar Shilpi, MDP 259*,

Teaching aids for blind children, *Patrick John, 2014*
Indian Toys, D'Source

Perception of tactile sensation through cutaneous path, INSPL, Meera Singh, 2011

Image References

Image 1.1 https://i0.wp.com/www.ikea.com/ie/en/images/products/mula-bead-roller-coaster__0341685_pe547789_s5.jpg
Image 1.2 http://www.echtkind.de/media/catalog/product/g/r/grimms_holzspielzeug_faedelspiel.jpg
Image 1.3 http://www.happyhomeschoolfortheblind.org
Image 1.4 http://www.happyhomeschoolfortheblind.org
Image 1.5 https://www.amazon.com/Excellerations-Touch-Match-Board-TM/dp/B01I0E3EGE
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Image 1.7 https://www.jigsawexplorer.com/categories/
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Image 1.9 https:// www.cefns.nau.edu
Image 1.10 http://www.braillebookstore.com/Braille-Animal-Puzzle.1
Image 1.11 http://www.wonderbaby.org/articles/braille-toys
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Image 1.13 https://www.ebay.com/p/Fisher-Roll-a-rounds-Swirlin-Surprise-Gumballs-2day-Ship/2255922244
Image 1.14 https://inhabitat.com/inhabitots/fittle-toy-puzzles-teach-blind-children-to-read-via-interactive-play/
Image 1.15 http://project-ray.com/10-rubiks-cubes-specially-designed-for-the-blind/
Image 1.16 https://direcaodeartedesign.wordpress.com/2011/12/09/braile-em-cubo-eduardo-de-boni/
Image 1.17 http://www.advancebrailleproducts.com/creative-puzzle-game-for-blind.htm
Image 1.18 https://www.amazon.com/MaxiAids-4-Row-Game-Tactile/
Image 2.1-2.8 self clicked photos
Image 3.1-3.8 self clicked photos