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PROJECT REPORT

TOY DESIGN FOR COGNITIVE & LANGUAGE SKILLS OF CHILDREN WITH DOWNS SYNDROME

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TABLE OF CONTENTS

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1.ABSTRACT

This report highlights the design & detailing work done to solve the problems identified relating to children with Down Syndrome in order to create a learning aid cum toy for them by Group A.

The main objective has been to identify the root problem faced by the children who suffer from Down Syndrome. After intense research, a major problem identified which hasn't had a lot of intervention done is that of cognitive & language skills development. In the market, most toys help the children with motor skill development and the ones for cognitive & language skills are either very poorly designed or are extremely expensive & not adapted to the Indian scenario.

There is a huge gap in this sector in terms of toys to aid language and cognitive skills, hence the problem statement that is going to be tackled as a part of this project is to design a toy to aid cognitive & language skills of children affected by Down Syndrome, as well as to be inclusive enough to be used by able children. Through this statement, we are restricting ourselves to target a very specific problem & make life easier for the children as well as the teachers and the parents associated with them.

In this phase, we have brainstormed and generated 50+ ideas and finalised to two concepts that are split team wise. 2 reports have been submitted - one highlighting the work of Group A, and one highlighting that of Group B.

Through this project, the main aim of the team is to catalyse the learning of children with Down Syndrome through the use of fun & toys.

2.INTRODUCTION

This project is being done as an Engineering Design Project by 3rd year students of PDPM Indian Institute of Information Technology, Design & Manufacturing, Jabalpur. The main aim of this project is to cross collaborate across various fields of engineering & design in order to produce an all rounded product as an output.
The team consists of 11 people from different fields of engineering and one member from design from PDPM Indian Institute of Information Technology, Design & Manufacturing. The team of 11 is split into 2 teams - Group A and Group B with the design member leading both the teams.

The team is working on designing a toy for children with Down Syndrome to aid with their language and cognitive development skills. The members of the team have always been enthusiastic and have prior knowledge in working towards the betterment of disabled people.
The team has worked collaboratively in the research phase since the problem statement for Team A and Team B is the same. The teams have developed & prototyped 2 solutions which have been highlighted in these reports.

The team consists of members from Mechanical Engineering, Electronics & Communication Engineering, Computer Science Engineering & Design. This cross collaboration potentially led to a very concise, well designed & engineered toy that can be tested with the Downs Syndrome children & iterated forward to create a wonderful product.

3.OBJECTIVES

1. To delve deep into the lives of children with Down syndrome to truly understand their life & the problems that they face that can be tackled via an effective toy design.
2. To do desk research and benchmarking & understand what is happening in this field of toy design for these children & what problems faced by them are being tackled in the industry today.
3. To do field research, conduct interviews, spend time with & observe these children & interact with their ecosystem first hand in order to understand the root problem that can be tackled through toy design.
4. To design 2 toys for children with Down syndrome that can act as teaching aids in terms of language & cognitive development of the child as a primary goal.
5. To provide positive feedback in order to motivate children with Down syndrome to keep learning and using the toy.
6. As a secondary goal, the toys can help the child with motor skills enhancement too.
7. To bridge the gap between the inherent limit of teachers and parents in teaching and the slow learning ability and need for repetition in language & cognitive skills of children with Down syndrome.
8. To make life easier for the children as well as teachers, parents & anybody else involved in the ecosystem of children who suffer from Down Syndrome.
9. As a tertiary goal, the toys can be inclusive enough to be used by able children as well (to develop a well defined marketing plan so that the designed product can be sold & used well in the market by various primary, secondary & tertiary target audience).
10. To keep in mind the ranging economic status of certain families who have kids with Down syndrome as well as various non profit schools and organisations and the fact that they cannot afford to use expensive and high end toys & learning aids for the disabled children.
11. The concepts of the products would be designed in such a way that they entail work by mechanical, computer & electrical engineers.
12. To develop a prototype of each toy - total 2 - one by each team and test them at early stages to get effective feedback from the children in order to iterate the product & truly make it successful.

4.PROBLEM STATEMENT

The problem statement that has been tackled by the team is -
“How might we design a toy to aid the **cognitive & language development** skills of children with **Downs Syndrome**?
Simultaneously, it might also be **inclusive** enough to be used by able children”

5.METHODOLOGY

The first phase consisted of problem solving & the second phase consisted of design & development. This report highlights the details of design & development leading to a properly prototyped product i.e. the final solution.

Conceptualising, empathising & developing. In this phase, the problem identified has been tackled through rapid ideation and narrowing down of concepts. The designer has made sketches, renders & imbibed lots of creativity and wild thinking into the ideas. The engineers conceptualised and developed the engineering design of the concept as per their branch (Mechanical Engineering, Electronics & Communication Engineering or Computer Science Engineering). Along with this, the team has prototyped the concept. During this phase, the team of 11 has worked separately as Group A & Group B with the designer heading both the teams. The teams have been working on one concept each to tackle the same problem.

Details & a brief recap of the phases has been defined below -

Table 5.1

	Description of Work	**Start and End Dates**
Phase One	In depth immersion, user research & problem identification	11th August - 9th September 2018
Phase Two	Concept generation & basic electronic design, programming, sketches & mechanical design of two concepts	10th September - 10th October 2018
Phase Three	Working towards final prototypes of two concepts after generating feedback on the same from the target audience	10th October - 15th November 2018

6.BACKGROUND RESEARCH

People with mental and physiological disorders, have a difficult time in the society. The disorders affects the development of the brain and body parts of the children often making them unable to perform day to day activities and especially for children unable to learn like able children.

Literature Review

Children can suffer from the following mental disabilities:

1. **Anxiety disorders:** Children with anxiety disorders respond to certain things or situations with fear and dread, as well as with physical signs of anxiety (nervousness), such as a rapid heartbeat and sweating.
2. **Disruptive behaviour disorders:** Children with these disorders tend to defy rules and often are disruptive in structured environments, such as school.
3. **Eating disorders:** Eating disorders involve intense emotions and attitudes, as well as unusual behaviours, associated with weight and/or food.
4. **Elimination disorders:** These disorders affect behaviour related to the elimination of body wastes (feces and urine).
5. **Affective (mood) disorders:** These disorders, including depression, involve persistent feelings of sadness and/or rapidly changing moods.
6. **Schizophrenia :** This is a serious disorder that involves distorted perceptions and thoughts.
7. **Tic disorders :** These disorders cause a person to perform repeated, sudden, involuntary and often meaningless movements and sounds, called tics.
8. **ADHD** (Attention Deficit Hyperactivity Disorder): Children with this disorder are hyperactive and have trouble controlling their impulses and paying attention. ADHD is the most commonly diagnosed mental disorder in children.
9. **Down syndrome**:- a congenital disorder arising from a chromosome defect, causing intellectual impairment and physical abnormalities including short stature and a broad facial profile. It arises from a defect involving chromosome 21, usually an extra copy (trisomy-21).

On further examination, the research was narrowed down to children with ADHD and Down's syndrome as the toys that help these children are limited and have overlooked many of the problems the kids face.

ADHD:

Attention deficit hyperactivity disorder, or ADHD, is a commonly diagnosed childhood problem. ADHD is characterised by consistent demonstration of the following traits: decreased attention span, impulsive behaviour and excessive fidgeting or other non directed motor activity. All children, including children with Down syndrome, display these traits from time to time. But a child with Down syndrome may exhibit these traits more often than other children his or her age.

The frequency of ADHD in children with Down syndrome is not known with certainty. However, ADHD-like symptoms are more common in young children with Down syndrome than they are in children from the general population. Compounding symptoms such as stereotypy (repetitiveness), anxiety or extreme irritability in the presence of ADHD-like symptoms may indicate another disorder such as autism, bipolar disorder or obsessive compulsive disorder.

Uncomplicated ADHD is common in younger children with Down syndrome. However, many school age children with ADHD frequently have other behavioural conditions including oppositional defiant disorder, disruptive behaviour disorder or obsessive compulsive traits.

Problems with ADHD child

1. Self-focused behaviour

A common sign of ADHD is what looks like an inability to recognise other people's needs and desires. This can lead to the next two signs: interrupting and trouble waiting their turn.

2. Interrupting

Self-focused behaviour may cause a child with ADHD to interrupt others while they're talking or butt into conversations or games they're not part of.

3. Trouble waiting their turn

Kids with ADHD may have trouble waiting their turn during classroom activities or when playing games with other children.

4. Emotional turmoil

A child with ADHD may have trouble keeping their emotions in check. They may have outbursts of anger at inappropriate times. Younger children may have temper tantrums.

5. Fidgetiness

Children with ADHD often can't sit still. They may try to get up and run around, fidget, or squirm in their chair when forced to sit.

6. Problems playing quietly

Fidgetiness can make it difficult for kids with ADHD to play quietly or engage calmly in leisure activities.

7. Unfinished tasks

A child with ADHD may show interest in lots of different things, but they may have problems finishing them. For example, they may start projects, chores, or homework, but move on to the next thing that catches their interest before finishing.

8. Lack of focus

A child with ADHD may have trouble paying attention, even when someone is speaking directly to them. They'll say they heard you, but they won't be able to repeat back to you what you just said.

9. Avoidance of tasks needing extended mental effort

This same lack of focus can cause a child to avoid activities that require a sustained mental effort, such as paying attention in class or doing homework.

10. Mistakes

Children with ADHD can have trouble following instructions that require planning or executing a plan. This can then lead to careless mistakes — but it doesn't indicate laziness or a lack of intelligence.

Problems with Down syndrome children

Down syndrome (DS or DNS), also known as trisomy 21, is a genetic disorder caused by the presence of all or part of a third copy of chromosome 21. It is typically associated with physical growth delays, characteristic facial features, and mild to moderate intellectual disability.
In addition to intellectual and developmental disabilities, children with Down syndrome are at an increased risk for certain health problems.
However, each individual with Down syndrome is different, and not every person will have serious health problems. Many of these associated conditions can be treated with medication, surgery, or other interventions.

Some of the conditions that occur more often among children with Down syndrome include:

1. **Heart defects**. Almost one-half of babies with Down syndrome have congenital heart disease (CHD), the most common type of birth defect. CHD can lead to high blood pressure in the lungs, an inability of the heart to effectively and efficiently pump blood, and cyanosis (blue-tinted skin caused by reduced oxygen in the blood). For this reason, the American Academy of Paediatrics (AAP) Committee on Genetics recommends infants with Down syndrome receive an echocardiogram (a sound "picture" of the heart) and an evaluation from a paediatric cardiologist. Sometimes, the heart defect can be detected before birth, but testing after birth is more accurate. Some heart defects are minor and may be treated with medication, but others require immediate surgery.
2. **Vision problems**. More than half of children with Down syndrome have vision problems, including cataracts (clouding of the eye lens) that may be present at birth. The risk of cataract increases with age. Other eye problems that are more likely in children with Down syndrome are nearsightedness, "crossed" eyes, and rapid, involuntary eye movements. Glasses, surgery, or other treatments usually improve vision. The AAP recommends that infants with Down syndrome be examined by a paediatric eye specialist during the newborn period, and then have vision exams regularly as recommended.
3. **Hearing loss**. Up to three-quarters of children with Down syndrome have some hearing loss. Sometimes the hearing loss is related to structural problems with the ear. The AAP recommends that babies with Down syndrome be screened for hearing loss at birth and have regular follow-up hearing exams. Many inherited hearing problems can be corrected. Children with Down syndrome also tend to get a lot of ear infections. These should be treated quickly to prevent possible hearing loss.
4. **Infections**. People with Down syndrome are much more likely to die from untreated and unmonitored infections than other people. Down syndrome often causes problems in the

immune system that can make it difficult for the body to fight off infections, so even seemingly minor infections should be treated quickly and monitored continuously. Caregivers also should make sure that children with Down syndrome receive all recommended immunisations to help prevent certain infections. Infants with Down syndrome have a 62-fold higher rate of pneumonia, especially in the first year after birth, than do infants without Down syndrome, for example.

5. **Hypothyroidism**. The thyroid is a gland that makes hormones the body uses to regulate things such as temperature and energy. Hypothyroidism, when the thyroid makes little or no thyroid hormone, occurs more often in children with Down syndrome than in children without Down syndrome. Taking thyroid hormone by mouth, throughout life, can successfully treat the condition. A child may have thyroid problems at birth or may develop them later, so health care providers recommend a thyroid examination at birth, at 6 months, and annually throughout life. Routine newborn screening may detect hypothyroidism at birth. However, some state newborn screening programs only screen for hypothyroidism one way, by measuring free thyroxine (T4) in the blood. Because many infants with Down syndrome have normal T4, they should be screened for levels of thyroid stimulating hormone (TSH) in these states as well.
6. **Blood disorders**. Children with Down syndrome are much more likely than other children to develop leukaemia, which is cancer of the white blood cells. Children with leukaemia should receive appropriate cancer treatment, which may include chemotherapy.5 Those with Down syndrome are also more likely to have anaemia (low iron in the blood) and polycythemia (high red blood cell levels), among other blood disorders. These conditions may require additional treatment and monitoring.
7. **Hypotonia (poor muscle tone)**. Poor muscle tone and low strength contribute to the delays in rolling over, sitting up, crawling, and walking that are common in children with Down syndrome. Despite these delays, children with Down syndrome can learn to participate in physical activities like other children.

   Poor muscle tone, combined with a tendency for the tongue to stick out, can also make it difficult for an infant with Down syndrome to feed properly, regardless of whether they are breastfed or fed from a bottle. Infants may need nutritional supplements to ensure they are getting all the nutrients they need. Parents can work with breastfeeding experts and paediatric nutritionists to ensure proper nutrition.In some cases, the weak muscles can cause problems along the digestive tract, leading to various digestive problems, from difficulty swallowing to constipation. Families may need to work with a gastroenterologist to overcome these problems.
8. **Problems with the upper part of the spine**. Some children with Down syndrome have misshapen bones in the upper part of the spine, underneath the base of the skull. These misshapen bones can press on the spinal cord and increase the risk for injury. It is important to determine if these spinal problems (called atlantoaxial instability) are present before the child has any surgery because certain movements required for anaesthesia or surgery could

cause permanent injury. In addition, some sports have an increased risk of spinal injury, so possible precautions should be discussed with a child's health care provider.

9. **Disrupted sleep patterns and sleep disorders**. Many children with Down syndrome have disrupted sleep patterns and often have obstructive sleep apnea, which causes significant pauses in breathing during sleep. A child's health care provider may recommend a sleep study in a special sleep lab to detect problems and determine possible solutions.It might be necessary to remove the tonsils or to use a continuous positive airway pressure device to create airflow during sleep.
10. **Gum disease and dental problems**. Children with Down syndrome may develop teeth more slowly than other children, develop teeth in a different order, develop fewer teeth, or have misaligned teeth compared to children who do not have Down syndrome. Gum disease (periodontal disease), a more serious health issue, may develop for a number of reasons, including poor oral hygiene. Health care providers recommend visiting the dentist within 6 months of the appearance of the child's first tooth or by the time the child is 1 year old.
11. **Epilepsy**. Children with Down syndrome are more likely to have epilepsy, a condition characterised by seizures, than those without Down syndrome. The risk for epilepsy increases with age, but seizures usually occur either during the first 2 years of life or after the third decade of life. Almost one-half of people with Down syndrome who are older than age 50 have epilepsy. Seizures can usually be treated and controlled well with medication.
12. **Digestive problems**. Digestive problems range from structural defects in the digestive system or its organs, to problems digesting certain types of foods or food ingredients. Treatments for these problems vary based on the specific problem. Some structural defects require surgery. Some people with Down syndrome have to eat a special diet throughout their lifetime.
13. **Celiac disease**. People with celiac disease experience intestinal problems when they eat gluten, a protein in wheat, barley, and rye. Because children with Down syndrome are more likely to have celiac disease, health care providers recommend testing for it at age 2 or even younger if the child is having celiac symptoms.
14. **Mental health and emotional problems**. Children with Down syndrome may experience behavioural and emotional problems, including anxiety, depression, and Attention Deficit Hyperactivity Disorder. They might also display repetitive movements, aggression, autism, psychosis, or social withdrawal. Although they are not more likely to experience these problems, they are more likely to have difficulty coping with the problems in positive ways, especially during adolescence. Treatments may include working with a behavioural specialist and taking medications.

Treatment for down syndrome

Children, teens, and adults with Down syndrome also need the same regular medical care as those without the condition, from well-baby visits and routine vaccinations as infants to reproductive

counselling and cardiovascular care later in life. Like other people, they also benefit from regular physical activity and social activities.

1. Early Intervention and Educational Therapy
2. Treatment Therapies
3. Drugs and Supplements
4. Assistive Devices

Early Intervention and Educational Therapy

“Early intervention” refers to a range of specialised programs and resources that professionals provide to very young children with Down syndrome and their families. These professionals may include special educators, speech therapists, occupational therapists, physical therapists, and social workers.

Research indicates that early intervention improves outcomes for children with Down syndrome. This assistance can begin shortly after birth and often continues until a child reaches age 3.After that age, most children receive interventions and treatment through their local school district..

Treatment Therapies

A variety of therapies can be used in early intervention programs and throughout a person's life to promote the greatest possible development, independence, and productivity. Some of these therapies are listed below.

1. **Physical therapy** includes activities and exercises that help build motor skills, increase muscle strength, and improve posture and balance.

    1. Physical therapy is important, especially early in a child's life, because physical abilities lay the foundation for other skills. The ability to turn over, crawl, and reach helps infants learn about the world around them and how to interact with it.
    2. A physical therapist can also help a child with Down syndrome compensate for physical challenges, such as low muscle tone, in ways that avoid long-term problems. For example, a physical therapist might help a child establish an efficient walking pattern, rather than one that might lead to foot pain.

2. **Speech-language therapy** can help children with Down syndrome improve their communication skills and use language more effectively.

    1. Children with Down syndrome often learn to speak later than their peers. A speech-language therapist can help them develop the early skills necessary for communication, such as imitating sounds. The therapist also may help an infant breastfeed because breastfeeding can strengthen muscles that are used for speech.
    2. In many cases, children with Down syndrome understand language and want to communicate before they can speak. A speech-language therapist can help a child

use alternate means of communication, such as sign language and pictures, until he or she learns to speak.

3. Learning to communicate is an ongoing process, so a person with Down syndrome may benefit from speech and language therapy in school as well as later in life. The therapist may help with conversation skills, pronunciation skills, understanding what is read (called comprehension), and learning and remembering words.

3. **Occupational therapy** helps find ways to adjust everyday tasks and conditions to match a person's needs and abilities.

    1. This type of therapy teaches self-care skills such as eating, getting dressed, writing, and using a computer.
    2. An occupational therapist might offer special tools that can help improve everyday functioning, such as a pencil that is easier to grip.
    3. At the high school level, an occupational therapist could help teenagers identify jobs, careers, or skills that match their interests and strengths.

4. **Emotional and behavioural therapies** work to find useful responses to both desirable and undesirable behaviours. Children with Down syndrome may become frustrated because of difficulty communicating, may develop compulsive behaviours, and may have Attention Deficit Hyperactivity Disorder and other mental health issues. These types of therapists try to understand why a child is acting out, create ways and strategies for avoiding or preventing these situations from occurring, and teach better or more positive ways to respond to situations.

    1. A psychologist, counsellor, or other mental health professional can help a child deal with emotions and build coping and interpersonal skills.
    2. The changes in hormone levels that adolescents experience during puberty can cause them to become more aggressive. Behavioural therapists can help teenagers recognise their intense emotions and teach them healthy ways to reach a feeling of calmness.
    3. Parents may also benefit from guidance on how to help a child with Down syndrome manage day-to-day challenges and reach his or her full potential.

Drugs and Supplements

Some people with Down syndrome take amino acid supplements or drugs that affect their brain activity. However, many of the recent clinical trials of these treatments were poorly controlled and revealed adverse effects from these treatments. Since then, newer psychoactive drugs that are much more specific have been developed. No controlled clinical studies of these medications for Down syndrome have demonstrated their safety and efficacy, however.

Many studies of drugs to treat symptoms of dementia in Down syndrome have included only a few participants. The results of these studies have not shown clear benefits of these drugs, either. Similarly, studies of antioxidants for dementia in Down syndrome have shown that these supplements are safe, but not effective.

Assistive Devices

More and more often, interventions for children with Down syndrome involve assistive devices—any type of material, equipment, tool, or technology that enhances learning or makes tasks easier to complete. Examples include amplification devices for hearing problems, bands that help with movement, special pencils to make writing easier, touchscreen computers, and computers with large-letter keyboards.

Use of assistive devices seems to be the most effective solution to the problem.

After analysing the problem we narrowed down the area of research to teaching aids for Down syndrome children which can help them in improving their cognitive and communication skills. This narrowing down was aided by our field research.

Research on the development of communication in children with Down syndrome indicates that language is frequently delayed relative to cognitive, motor and social ability. There is also evidence for some specific and persistent delays in certain aspects of language, particularly grammatical components. However, there is now considerable evidence that the use of signed input, in combination with speech, can facilitate early language development: evidence for this coming from a substantial number of single case-studies and, more recently, from larger scale studies incorporating some experimental controls.

How to communicate :

Use open-ended questions.
Questions that lead to a story.
"Silence prompts the kids to talk more".
Give them time to process the question.
Comment on the conversation it encourages them to talk more.
Use games to bridge the communication gap.

Presenting information:

Illustrating text with graphics.
Support text and audio with graphics, photos, audio, and video.
Videos with closed captions help.
Using text to speech.
Teach in small groups.
Take a multi sensory approach, use real-life experiences, stories, physical activities (actions)

enhance the understanding.
Use visual timetables for the organisation.

For teaching the kids with down syndrome the methods/helping aids used should be:

1. Enthusiastic and encouraging.
2. Less distractive.
3. Provide consistent positive reinforcement immediately after the student produces a correct response.
4. Give clear signals about the end of one activity and the beginning of the next. Use picture cues or audio cues with young children.
5. Present only a few stimuli or objects at a time.

Children with Down syndrome have specific points associated with their learning development:

1. They are visual learners.
2. They understand a lot more than they can say.
3. They are able to follow classroom rules and routines.
4. They need help to remember instructions – use shorter phrases or visual clues.
5. Teacher's expectations of behaviour, attitude and ability should be high.

Research has shown that people with Down syndrome, with developmental levels of between five and six years, show similar patterns of response to typically developing children on tasks involving visual orientation.

Singing and making music as an activity

Benefits :

1. Auditory discrimination enhances due to this activity.
2. Important for imagination and ability to express ideas through words, gestures and so on.
3. Way to learn to construct phrases and sentences (words in songs are more memorable).
4. Singing and music provide vital tools in everyone's learning processes, and especially for children with Down syndrome.

Here are some practical examples:

1. Alphabet song - An Austrian went a-yodelling
2. Counting song - Five green speckled frogs

Benchmarking & Comparative Research

After studying about the children affected by Down Syndrome , the team did a study of existing solutions of toys for problems of children with Down Syndrome in order to understand what is going on in the market in the present date.

1. **Octobo - a toy that can actually respond to feedback from children and truly engage them in genuine interactive play.**

Octobo is a robot that encompasses the most innovative technology of today, while still being a soft and cuddly companion, thus, kids develop an emotional attachment to him. Octobo integrates physical books, play, cognitive puzzles, and family time into one activity. Parents can additionally unlock new features and personal meaningful content with Octobo's expanding app library as their children grow or their interests change.

Octobo creates an experience that captures the best of both physical and digital worlds - the interactive and stimulating social play experience of traditional toys together with the endless content of a digital library. It also aims to inspire kids to learn, imagine, and explore in a more engaging and safe learning environment.

Toys and learning tools today fail to engage young children to learn in a safe and enticing way. Although children develop rapidly, many times toys cannot keep up with a child's learning curve and have limited replay able value. Most toys that integrate technology today are actually detrimental to the amount of time a child spends with their family, with other children, or even reading a physical book. Octobo was created to fix these problems.

2. Camo Chameleon Bean Bag Toss

Kids with Down syndrome can have difficulty with fine motor skills, so games and puzzles with just a few large pieces to work with are often a hit. Especially good are games like this bag toss — its level of difficulty can be adjusted to custom-fit the child and her developmental stage. This game helps develop hand-eye coordination and gross motor skills.The toy is durably constructed for use either indoors or outside, the non-wobbling metal base is covered with strong polyester fabric. The whole things folds flat for easy storage.

Image 6.1 *(Ref: https://www.melissaanddoug.com/camo-chameleon-bean-bag-toss/6686.html)*

3. Vtech Tote & Go Laptop

For kids with autism & Down syndrome, cause-and-effect toys (push a button, get a response), especially those that promote interaction by encouraging a verbal reply are very useful. Vtech's Tote

& Go Laptop Plus does just that, teaching letters, words and more through fun games and friendly characters.It teaches 60+ words, spelling, shapes, logic, animals and more; plays 30 popular melodies in rock, country or jazz styles.It can be customised with the child's name, age, favourite food, avatar and more.Activities include progressive learning levels that gradually increase in difficulty. The attached mouse introduces basic mouse skills.

Image 6.2 *(Ref: https://www.amazon.com/VTech-Tote-and-Go-Laptop/dp/B00OC7VBI2//ref=as_li_ss_tl?ie=UTF8&linkCode=ll1&tag=mpanlifetoysgreatforkidswithspecialneeds-20&linkId=68c3e23f9b636d35f084af632a7bdd6d&language=en_US)*

4. Elefun

Juvenile arthritis can limit movement in certain parts of the body, so choose a toy that gently works the area that's compromised. Because slow and easy gestures are used to catch the cascading butterflies, Elefun is ideal for kids who have trouble with their upper joints & motor skills.

5. LEGO DUPLO All-in-One-Box-of-Fun

Children with cerebral palsy often have involuntary, spastic movements, so toys with big parts are better. At its heart the toy is a buildable wagon base with rounded edges and wheels that really turn. This comprehensive set also includes 2 opening window elements, a cute dog and numbered bricks with corresponding decorated bricks to help your child develop their counting skills. There are even extra classic DUPLO bricks for more creative fun. It includes a boy DUPLO figure. At twice the brand's normal size, LEGO's chunky DUPLO bricks fit the bill when it comes to awesome toys for kids with cerebral palsy.

Image 6.3 *(Ref: https://shop.lego.com/en-US/LEGO-DUPLO-All-in-One-Box-of-Fun-10572)*

6. Hide Me Tent & Tunnel

There are two sides to sensory integration impairment: It makes some kids feel overstimulated by the world and causes others to seek out more interaction. For those who like to escape, a tent-and tunnel combo is ideal.

Image 6.4 *(Ref: https://click.linksynergy.com/deeplink?id=93xLBvPhAeE&mid=38605&u1=MPANLIFEToysGreatForKidsWithSpecialNeeds&murl=https%3A%2F%2Fwww.kohls.com%2Fproduct%2Fprd-1502695%2Fspan-classtextpacific-play-tents-hide-me-tent-tunnel-combo.jsp%3FprdPV%3D47)*

7. Weighted Lizard

Weighted stuffed animals are great toys since they weigh almost 5 pounds and offer a sensory stimulation for children that is both physically & mentally soothing.

8. Rush Hour

Games that adapt to fit the developmental stage of a child with Down syndrome can be highly beneficial for the development of cognitive & motor skills of kids. Rush Hour is the classic traffic jam logic game and one of the all-time most popular STEM toys for boys and girls. The objective of

Rush Hour is to move vehicles out of your car's way to escape the gridlock. Players progress at their own pace, tackling four levels of difficulty.Playing through the challenges builds reasoning, cognitive and planning skills and provides a great stealth learning experience for young players.

Image 6.5 *(Ref: https://www.amazon.com/Think-Fun-Traffic-Logic-Girls/dp/B00000DMER/ref=as_li_ss_tl?ie=UTF8&linkCode=ll1&tag=mpanlifetoysgreatforkidswithspecialneeds-20&linkId=07d22aa9a172c1634b7f109b6aeeb379&language=en_US)*

9. Bilibo

The Bilibo child seat is great for kids with Down syndrome, autism or sensory processing disorders. It’s big enough for children of varying ages to sit comfortably, and helps stimulate senses, teach body awareness and encourage creative play. The rocking and spinning motions can also be especially soothing for children with special needs.Deceptively and elegantly simple and magically attractive, the Bilibo is immediately appealing. Its unique shape arouses curiosity, engages imagination and stimulates creativity. Infinitely adaptable, it is the ultimate open-ended, creative activity toy. Sit in it, stand on it, spin in it or stack it. Rock it, fill it, wear it or slide it. Surprisingly expressive, turn it over and it has 'eyes' and a smile. The imaginative uses of the Bilibo are limitless.

Image 6.6 *(Ref: https://goto.target.com/c/249354/81938/2092?subId1=MPANLIFEToysGreatForKidsWithSpecialNeeds&u=https%3A%2F%2Fwww.target.com%2Fp%2Fkid-o-bilibo-child-s-seat-blue%2F-%2FA-51249728)*

10. Move & Groove

Kids toss the plush cube, pick a matching coloured card, and perform the given move -- all while learning the basics of game play, balance, creativity, and movement without the pressure of competition.

11. Learning Piggy Bank

The child will learn about counting, colours, animals and sizes. The toy responds with songs, music, speech, and activities. 10 colourful coins have to be dropped into the slot. Then, the child has to open the door for put-and-take play. It makes learning more fun.

12.Go Baby Go Poppity Pop Musical Dino

Poppity Pop Musical Dino helps encourage and reward children. It includes an adorable Dinosaur character and 6 brightly coloured balls. When a ball pops up and out, the child will be encouraged to follow it. The child is rewarded with over 8 fun tunes and silly sound effects. This toy helps children to develop cognitively & start to understand cause and effect of actions.

Down syndrome (DS) is caused by trisomy of human chromosome 21 (HSA21) and results in a large number of phenotypes including learning difficulties, cardiac defects and distinguishing facial features. In this way, we identified that individuals with Down syndrome are able to learn new tasks, and that improvements can be enhanced via the use of repetition of same things they need to find a pattern in every logical learning.

It was concluded that individuals with Down syndrome respond positively and effectively, with improvements in sensory motor control, when stimulated with tasks that are complementary to conventional therapy, including therapy involving on speaking skills. So we are aiming to make

something that helps the child using some conventional therapy and learning path so that they learn things in a smooth way as well as they get a proper path of learning.

7.FIELD RESEARCH

Interviews

English Teacher at a School for Children with disabilities

Position of person interviewed -
English & Hindi teacher

Insights -

1. The children are very **stubborn** and need proper **positive feedback** in order to learn efficiently.
2. Toys like the **alphabet peg board** are used to motivate the children and push them towards the world of languages & alphabets.
3. All of the children have a problem in writing - not because of problems in grip, but **problems in controlling the writing instrument**.
4. The children **get scared easily** if they see even a slight amount of violence or hear any loud noise. In such cases, the primary method to get these children back to normal is through **poems & music.**
5. They like to sit in one place & position and do the **same task for a long time**. They get very **attached to people, places & objects** once they get used to them.
6. They love **music, dance & being around fellow human beings**.
7. They absolutely love **colourful, bright objects** & get very excited by the colour **red**.

Principal at a School for Children with Disabilities

Position of person interviewed -
Principal

Insights -

1. The children love **bright toys, toffees & playing games**.
2. Any kind of **physical activity** largely motivates the children - learning through sports, especially cricket is very useful for children with Downs Syndrome.
3. However, too much physical activity cannot be done by these children since they are more **prone to respiratory problems**.
4. They **get scared very easily** & do not like loud noises or too much sudden movement.
5. They take some time to calm down & get used to new environments & people as compared to able children.
6. They love **storytelling, narrations, poems** & listen very intently for hours on end to the above.
7. There is a huge need of **repetition** in order to explain concepts to the children & make them understand certain things.

8. For example, in order to make them learn how to use a certain toy or game - for example a peg board - they have to be shown how to use it multiple times & then they learn.
9. At some points, the students get very **stubborn** and hence the teachers, being human beings , tend to reach their breaking point & give up. As human beings, there's an inherent limit to how much the teachers can give to these students. Hence there's a major gap here where intervention through a toy can be done.

Physiotherapist and General Practitioner

Position of person interviewed -
Doctor

Insights -

1. Down syndrome is generally observed when the father's age (for the first child) is 35-40 or mother's age is greater than 30.
2. Children with Down's syndrome don't suffer from any physical disability or inability to control muscles. They are merely **slow learners** and have to be **taught the same task in multiple steps and multiple times.**
3. They have **cognitive problems and show slow development in motor, social and learning skills.**
4. These children aren't usually hyper, they are always smiling and don't get irritated easily.
5. They are **scared of violence**.
6. They also suffer from **respiratory problems, poor feeding, excessive sleepiness and have possibility of heart diseases, RTI** etc.

Shree Bhasha Vikas Kendra Head

Position of person interviewed -
Head of Bhasha Vikas Kendra & has several years of experience

Insights -

1. Their focus is to give the child proper attention and care at the same time imparting basic skills and knowledge. Therefore, they provide **personal attention** to each child. They use techniques such as **picture cards, blocks, imitating actions** to make them learn. Also they have maintained a record of what each chid can do or not, and they have made goals of what they want to achieve with and for the children.
2. In order to make the children with Down syndrome do something, they have to **motivated** and pushed a bit, but when they start doing it, they **get very involved**.
3. At home, parents spend as much as time they can to communicate with the children with the help of **sign language and sound** (eg. clapping). The **children imitate** whatever their parents do & this in turn helps in developing foundation skills in them. In order to motivate them parents **celebrate each small victory.**

4. Children love to do activities which they find intriguing, ie. playing with toys which have **lights, sound** and animation. In particular, the children **love animation & digital** things.
5. Development in **language and cognitive skills** can be done upto great extent, but it requires **patience** from both parents and teachers side. There are many cases, one is of a girl of age 13 who can now read from a book and can also write a bit. This was only possible after continuous working of 8-9 yrs. Currently, there are **no concise, affordable toys in the Indian scenario for cognitive & language development skills of children with Down Syndrome**.

Observation

The team visited and spent time with children who suffer from Down Syndrome in order to get a first hand glimpse into their life & problems. The team visited these children with a number of toys, balls of different radii, toys of different colours & textures, with & without lights in order to observe what excited the children and how the children were interacting with & reacting to various stimuli.

Image 7.1 *(A team member interacting & playing with children who have Down Syndrome)*

Place visited -
Navjyoti School for mentally challenged.

Observations & insights -

1. The children show **slow motor responses**.
2. They have short attention span.
3. They **love intricate things** and **puzzles** and solve such things without being prompted to do so and are **good at pattern recognition**. They enjoy putting things together. It wasn't a task for them to complete puzzles or peg boards and they did so willingly.
4. It is easier for them to **learn** with **visual aid** like pictures colours and **actions**. The teachers taught them different letters and sounds by attaching them to hand motions and pictures.

Often when the children couldn't remember the letter or word the would reply with hand motions.

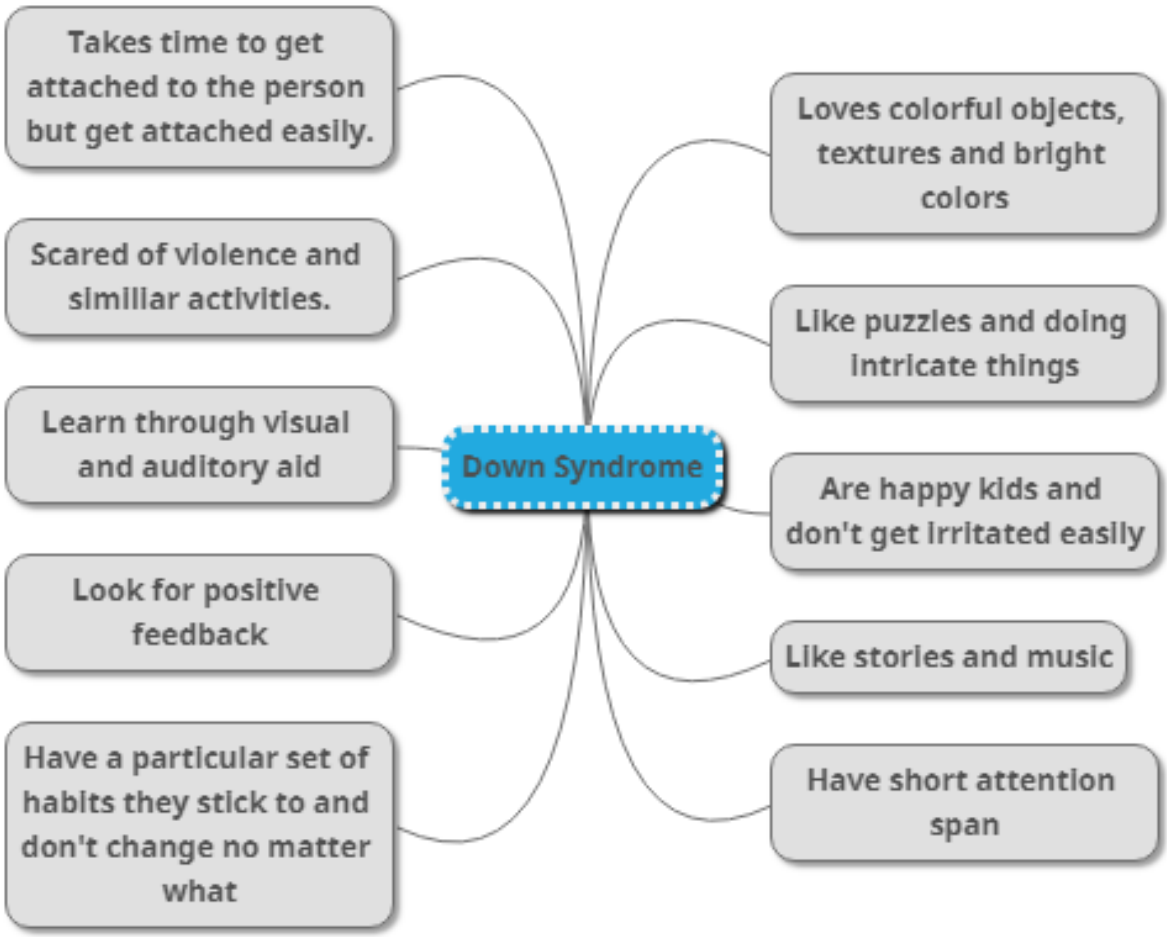
5. These children are **scared of violent activities or behaviour** and are not willing to accept any sudden changes in their daily life. If a child is used to sitting in one place then he/she would sit there for all 8 hours.
6. They are **fascinated by lights, squishy toys and interesting textures**. They kept playing with the texture on our bags and refused to leave the light lava ball they were playing with. They are also attached to certain objects and keep searching for them in the form of rewards.
7. Children suffer from **cognitive and language impairment**. They feel uneasy around new people but once they get use to them, they are extremely friendly.
8. They also suffer from **speech impairment**. They have difficulty pronouncing words or even forming words in some cases.
9. Learn through **repetition**. They had to be taught how to throw a ball multiple times and couldn't leave the ball. It took them around 10-12 tries to throw it and not place it on the floor.
10. **Stories and music** have a **positive impact** on their learning abilities. They really enjoy singing, dancing and listening to music.
11. It was **easier** for them to make **straight lines** and **curves than** complex shapes like **triangles, angles** and so on. They kept drawing spirals even when repeated attempts were made to make an angle, they were unable to stop and redraw. Connecting the starting point with the ending point.
12. They like **bright colours**, **sweets** and **crunchy** food.

Empathy Mapping

After spending time with & understanding the children affected by Down Syndrome first hand, the team was able to empathise with them and understand their needs, wants, motivations & fears.

Hence, the team mapped out the understanding in relation to the personality of the children specifically in the figure depicted below. This emphatic understanding will enable the team to come up with better solutions to the problem identified.

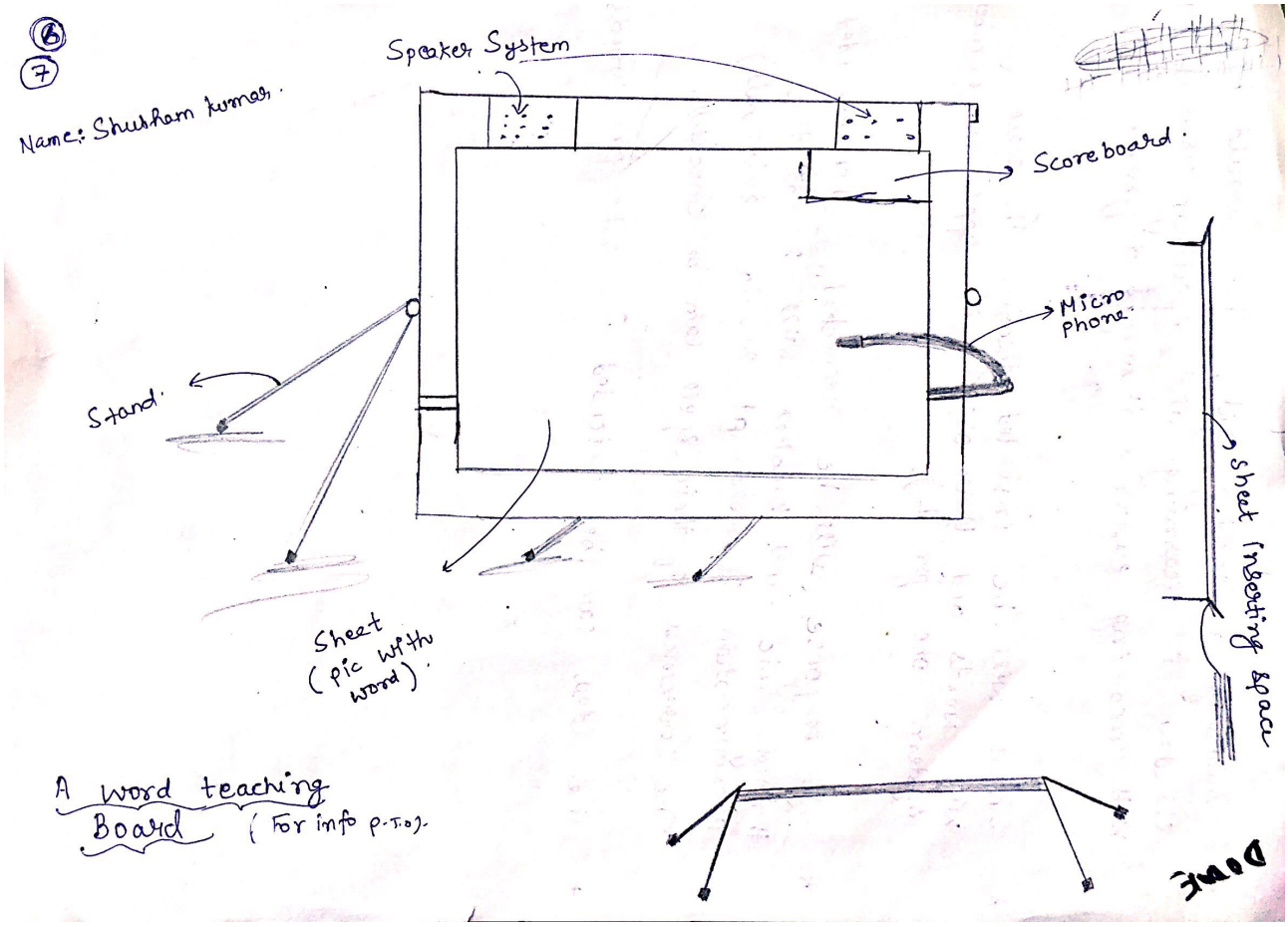
Figure 7.2


Takes time to get attached to the person but get attached easily.
Scared of violence and similiar activities.
Learn through visual and auditory aid
Look for positive feedback
Have a particular set of habits they stick to and don't change no matter what
Down Syndrome
Loves colorful objects, textures and bright colors
Like puzzles and doing intricate things
Are happy kids and don't get irritated easily
Like stories and music
Have short attention span

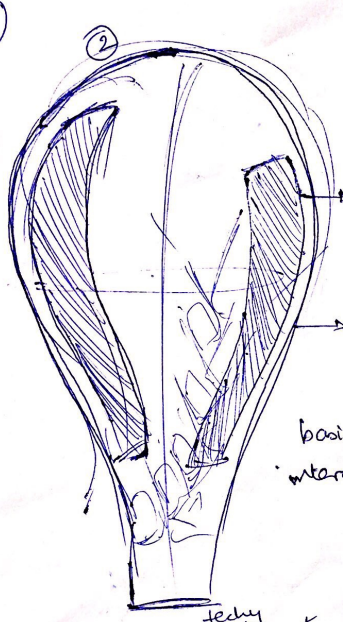
8.CONCEPT GENERATION

The team of 11 members (Group A + B) started this phase of the project by sitting together and generating various concepts to tackle the problems identified. Each team member came up with various ideas. Our main aim while generating these concepts was to stick to something which is affordable and creates some kind of attachment with the child.

Below are some images of the concepts generated by the team -
Note - Please excuse the poor drawings, these are rapid ideations have done by a team consisting of engineers and one designer.



(13)

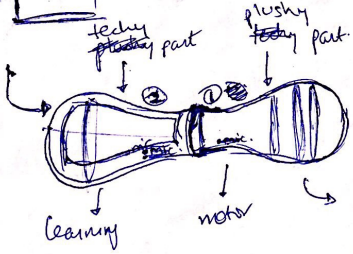


automatically shuts off after specific time of use.

- Balance of TECH & CUDDLES

→ this form made from plushy hands joined together.

basically soft plushy cuddly toy that lights up & talks on interaction & cuddling

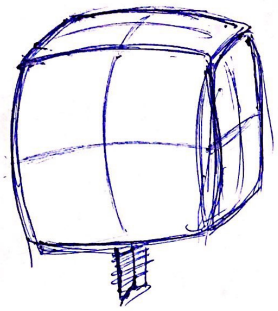


once ① is connected to ②, a techy toy gets created.

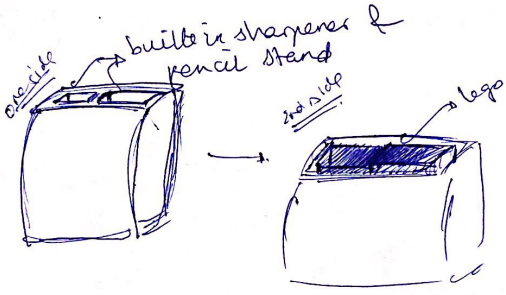
→ turn & join for puzzle type game

*on pressing, shows how to write a letter & nos on screen & child can learn through repitition

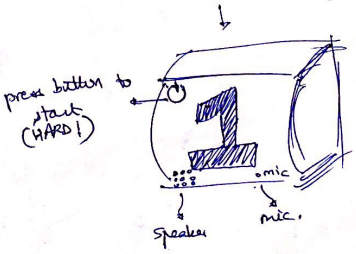
(14)



the cube (soft!)

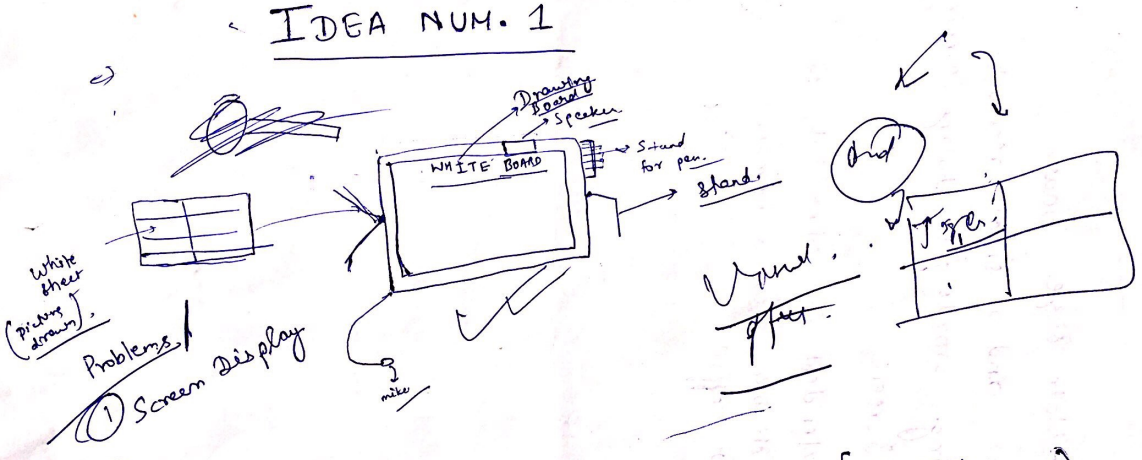


random feedback during the day.



roll like a dice, whichever side lands, (nos., letters etc.) the child has to study that on that day. repeated through speaker once turned on. mic records what child says. If correct, speaker applauds & ~~blue~~ Bubbles colorful.

IDEA NUM. 1



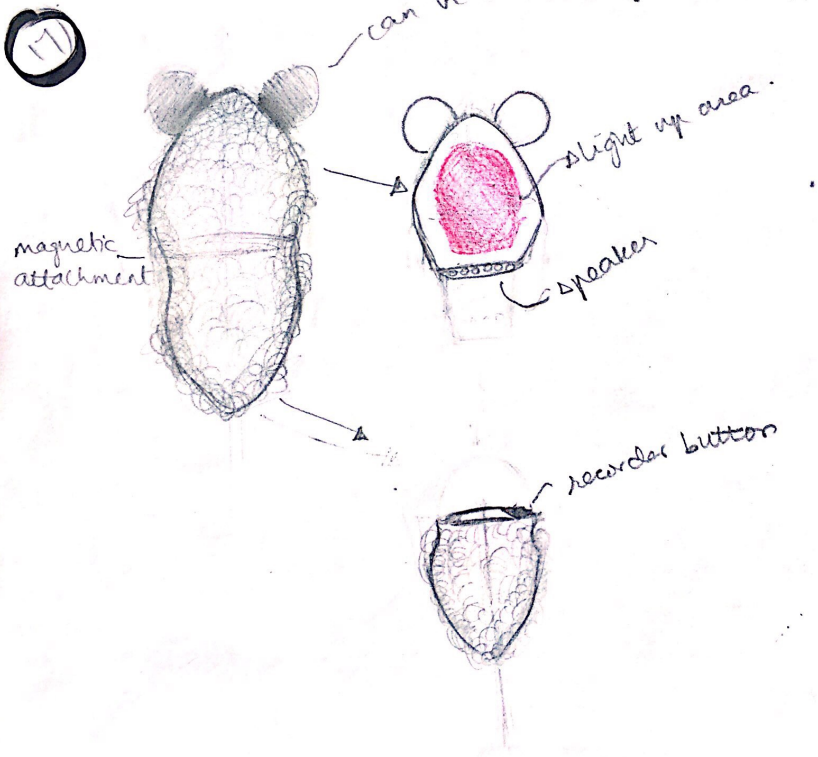
2

- NO SCREEN
- LOW COST-PAPER USED (TEMPLATE)
- CR TEACHING

feedback

{ P. T. O for description

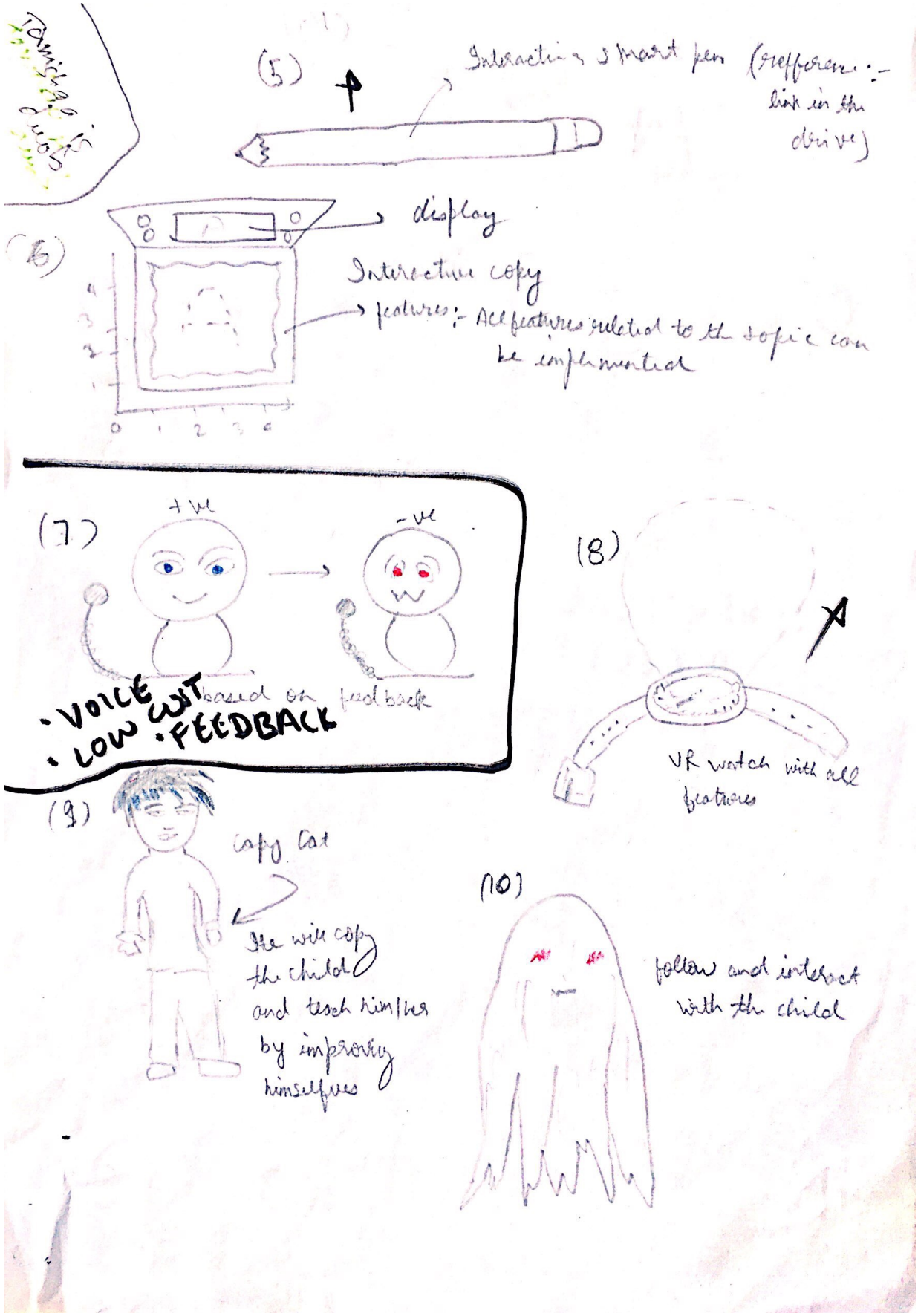
Name- Shubham kumar

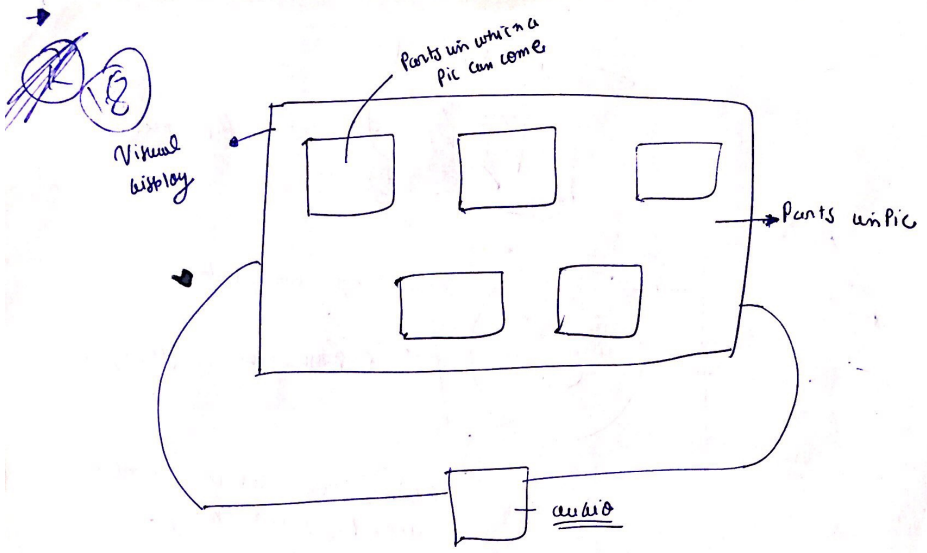


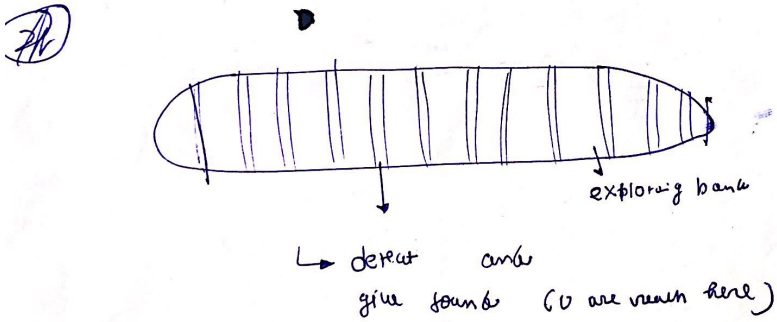
Tanishq

senses basic correct/incorrect pronunciation

human intervention reqd. for reading


(5)
Interactive smart pen (reference :- link in the drive)
(6)
display
Interactive copy
features :- All features related to the topic can be implemented
(7)
+ve
-ve
based on feedback
• VOICE
• LOW CUT
• FEEDBACK
(8)
VR watch with all features
(9)
copy cat
He will copy the child and teach him/her by improving himself/her
(10)
follow and interact with the child



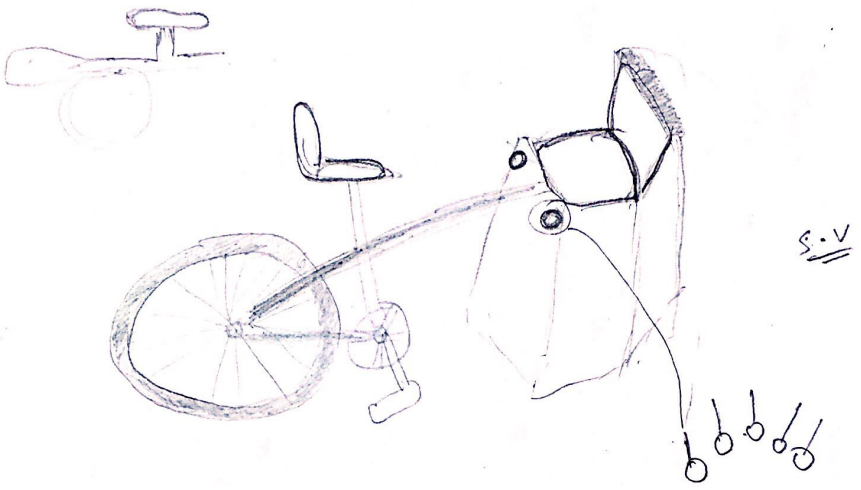


Shantanu S

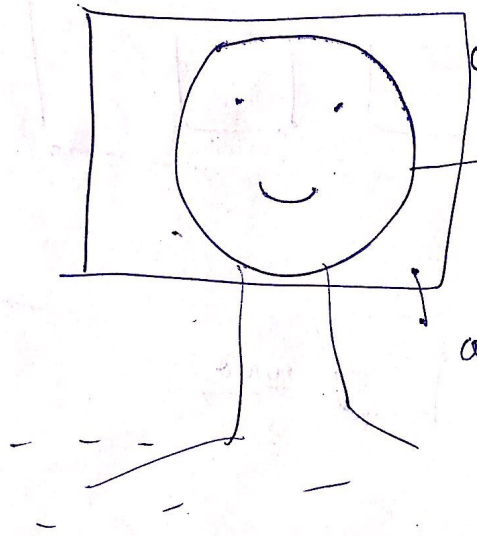
23

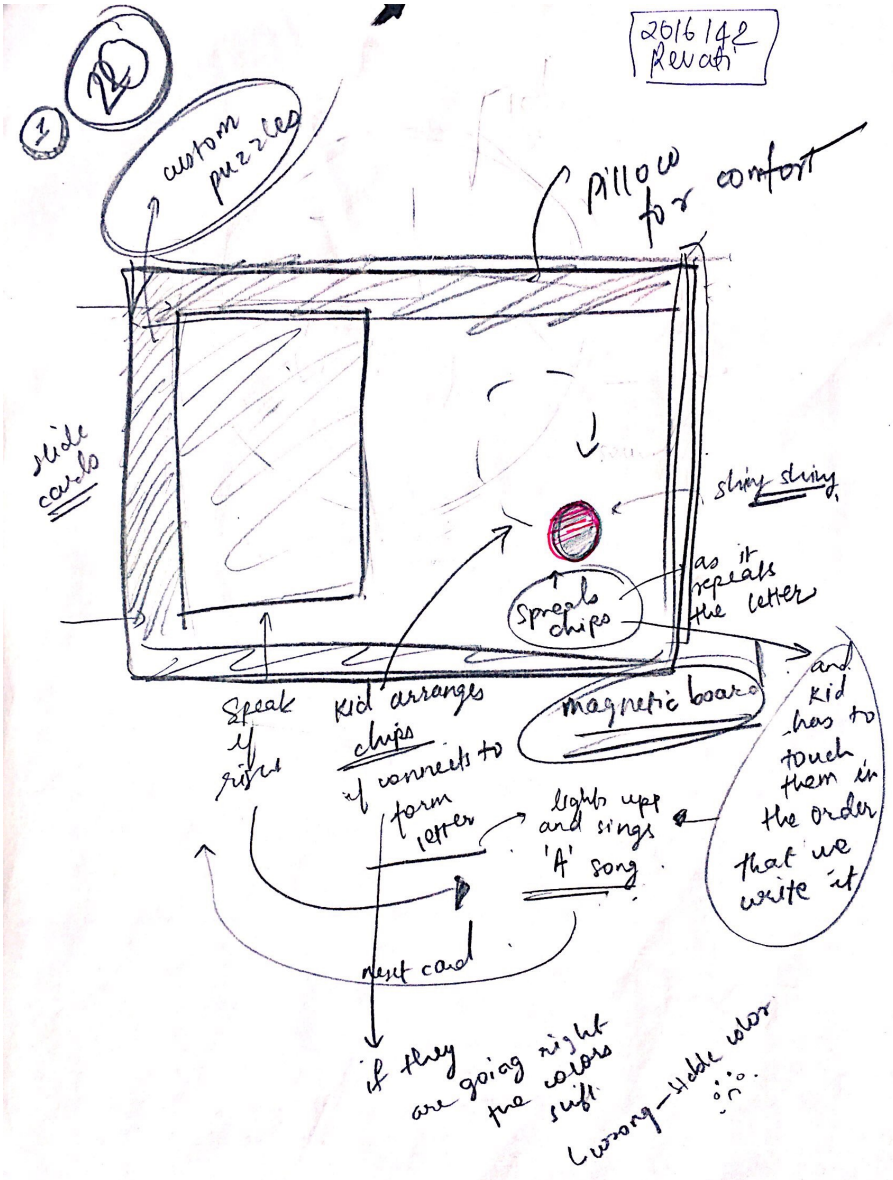
→ Effect of music on down syndrome children.

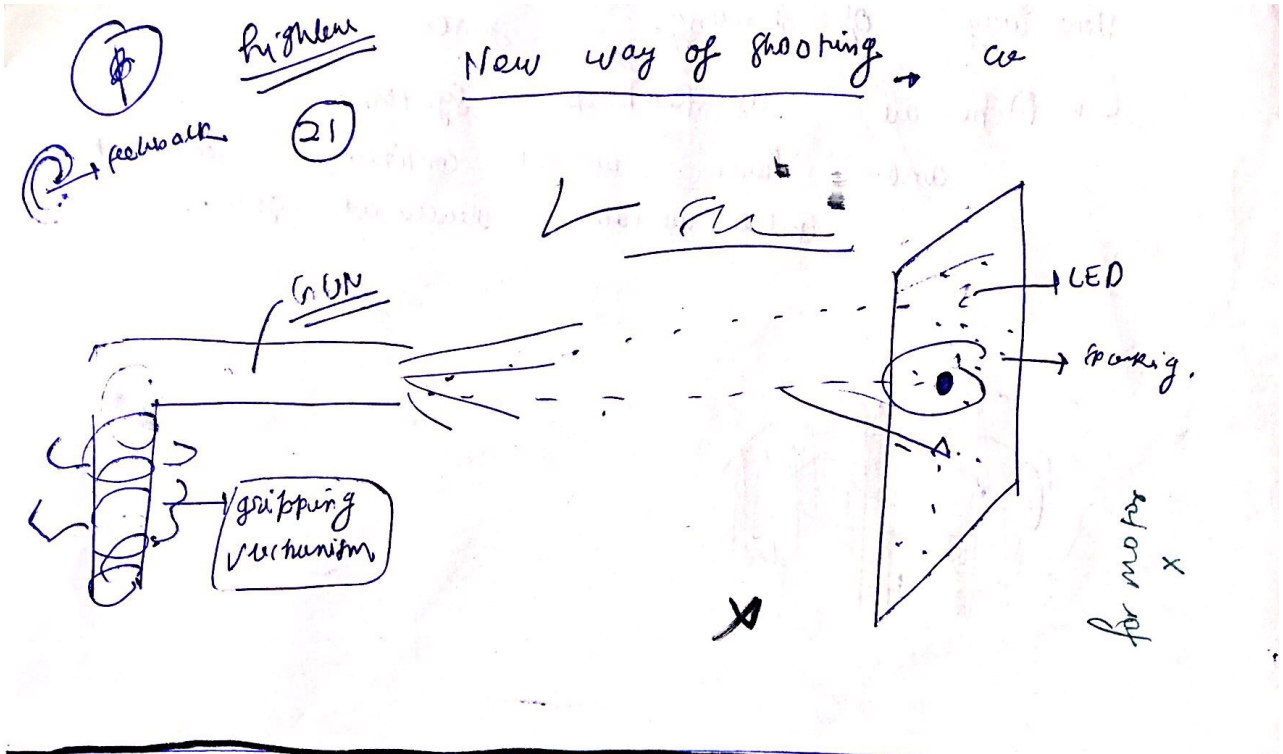
→ Effect of particular colours on minds of children.

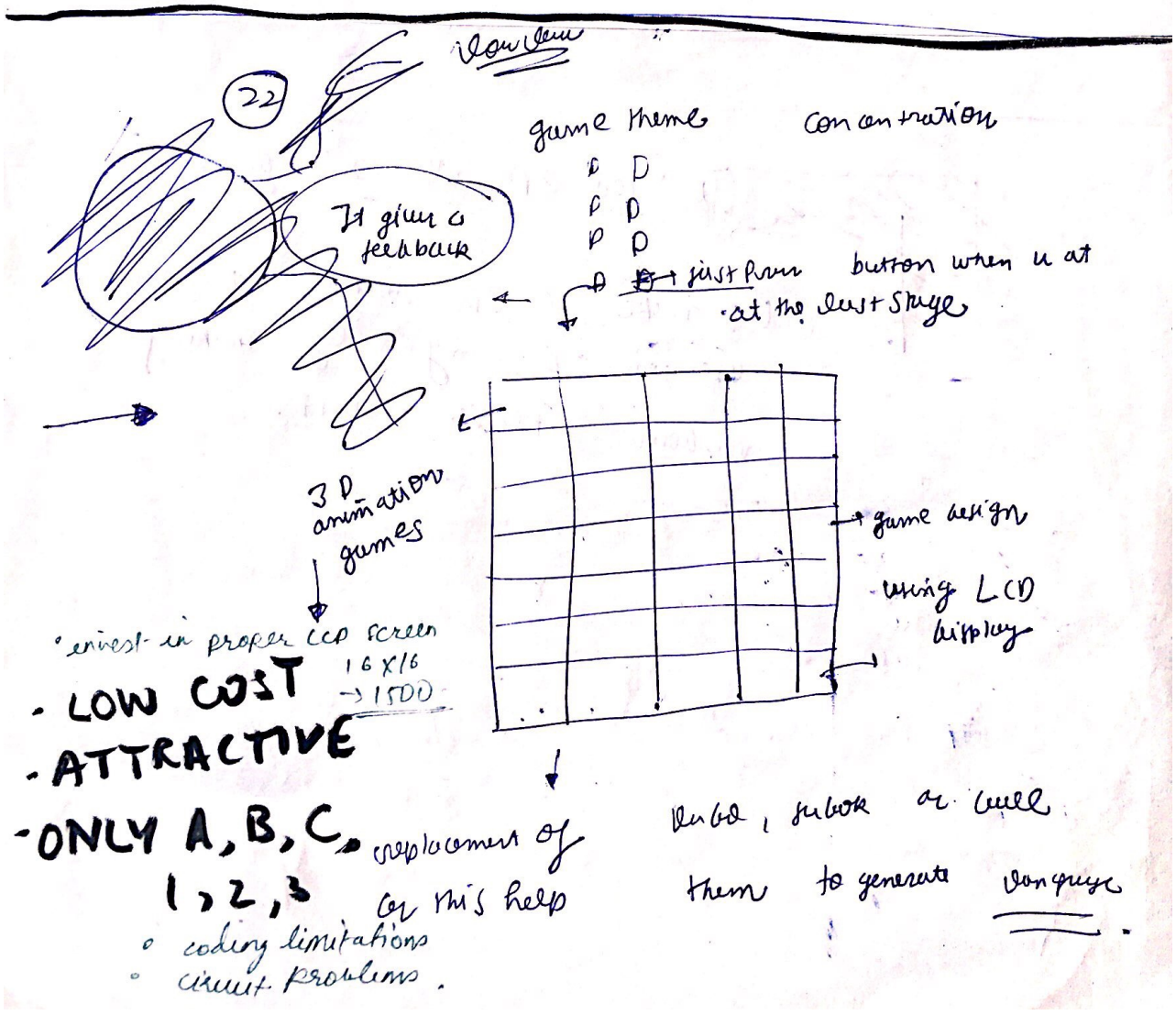


S.V

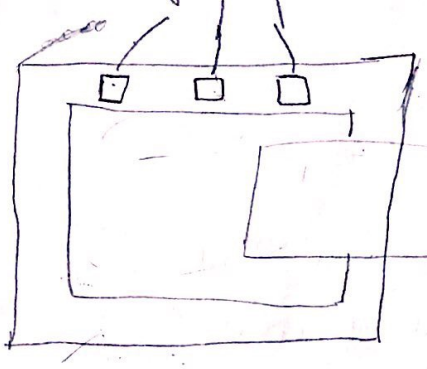

Changing mood Robot
express your feeling.
auto correction and
wired / wireless.


2016142
Revath
custom puzzles
pillow for comfort
slide cards
shiny string
Spreads chips
as it repeats the letter
Speak if right
kid arranges chips if connects to form letter
magnetic board
and kid has to touch them in the order that we write it
lights up and sings 'A' song
next card
if they are going right the colors switch
Lessons - Hide color

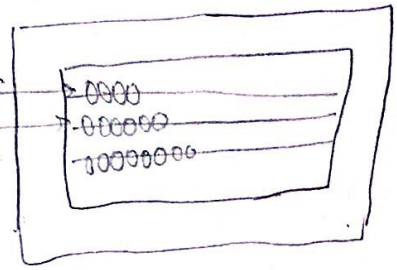

brighten
feedback
21
New way of shooting → ce
LED
sparking.
gripping mechanism
for motor


22
game theme
concentration
just press button when u at
at the last stage
It gives a feedback
3D animation games
game design
using LCD display
invest in proper LCD screen
16 X 16
→ 1500
- LOW COST
- ATTRACTIVE
- ONLY A, B, C, 1, 2, 3
replacement of
or this help
coding limitations
circuit problems.
them to generate

(11)



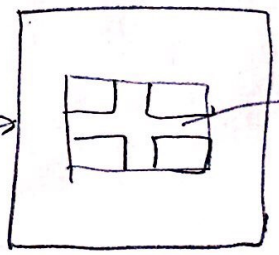
~~appearance &~~ → shape should be more appealing.



*MOBILE INTEGRATION FOR TEMP. SCREEN

(12)

Talking Teddy



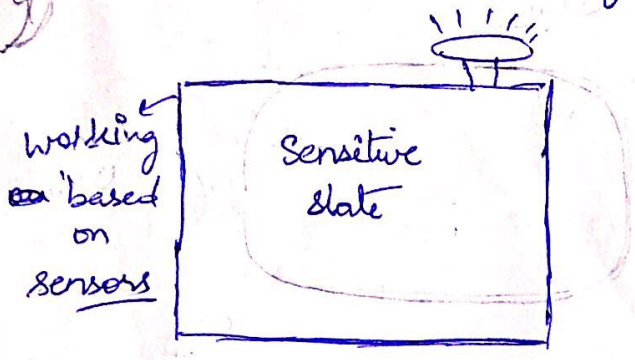
on pressing plays A,B,C,..
or 1,2,3,...
different points for different things.

Extra features
- may include listening and providing feedback

Shweta

(9)

Voice feedback

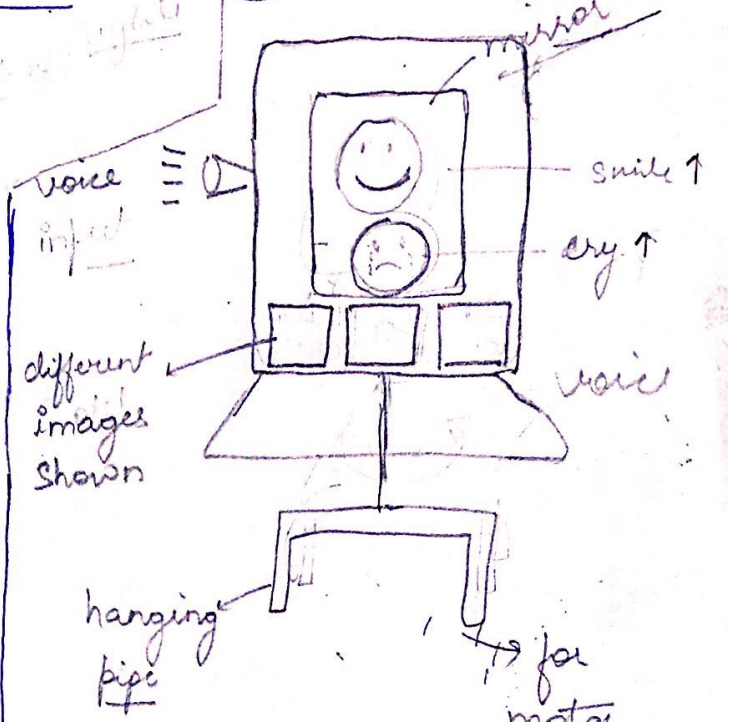


chalk

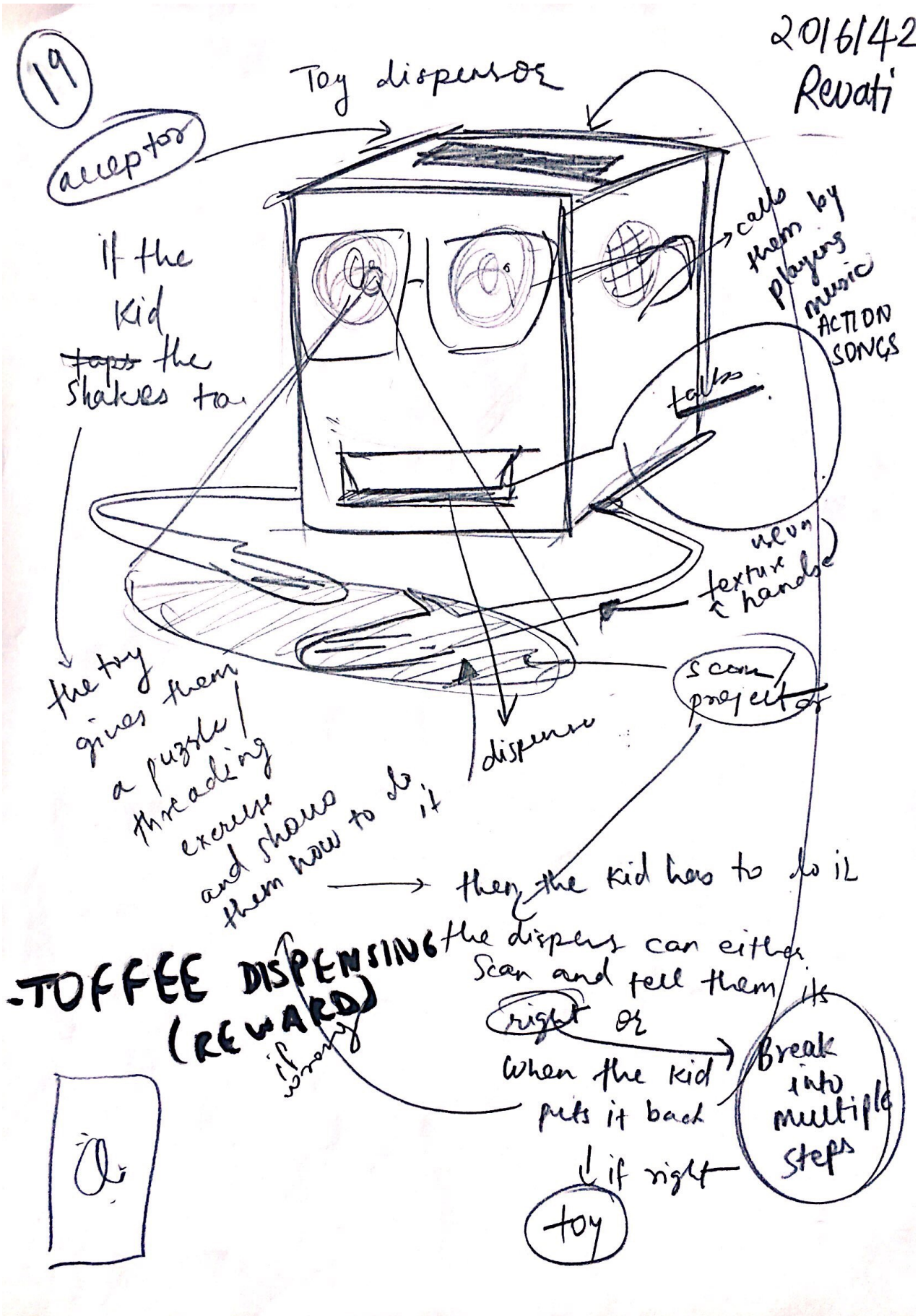
child
if ~~child~~ has made something that does not exist in this world → negative feedback

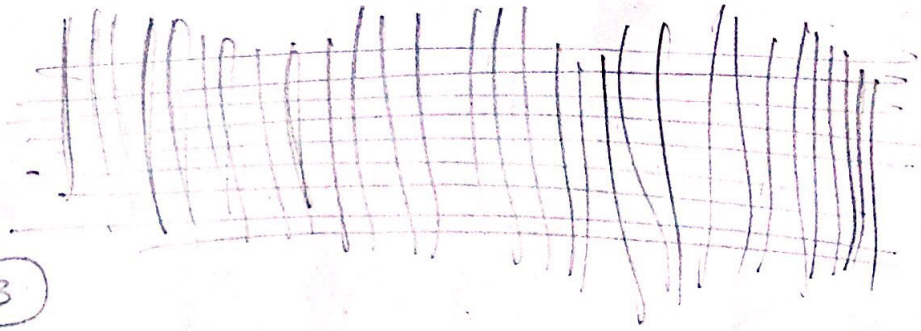
(8)

SHWETA GUPTA



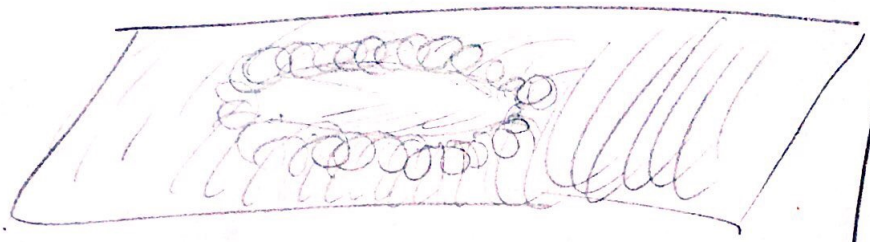
speaker → speaks something then child has to touch the correct fig in the screen.
if correct touch — ☺ with sound effect
if not ☹


19
2016142
Revati
Toy dispensor
accepts
If the
Kid
taps the
shakes toy
calls them by
plays
music
ACTION
SONGS
talks
uses
texture
& handle
the toy
gives them
a puzzle/
threading
exercise
and shows
them how to do it
dispenses
scans/
project
then the kid has to do it
TOFFEE DISPENSING
(REWARD)
the dispenser can either
Scan and tell them its
right or
When the kid
puts it back
if right
Break
into
multiple
steps
toy



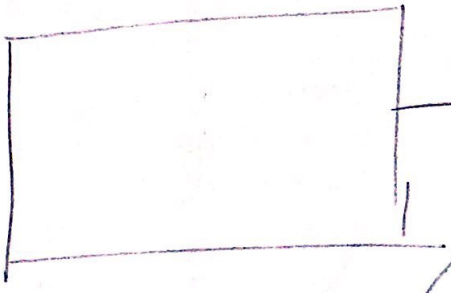
floor

(3)



[Cushion which is uncomfy and child cannot sit for a long time.]

(4)



→ blackboard

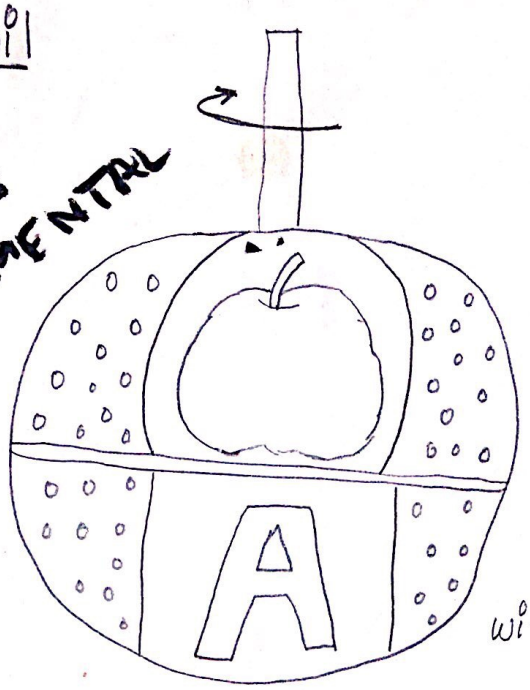
Trying to write a thing and it will guess all the things. or stuff about that word or thing.

[Blackboard, on which child writes anything or tries to write if it matches to the 40-50% of the standard thing feeded and the voice would come saying the same thing]

· BLACKBOARD (INDIAN MENTAL MODEL AESTHETICS)

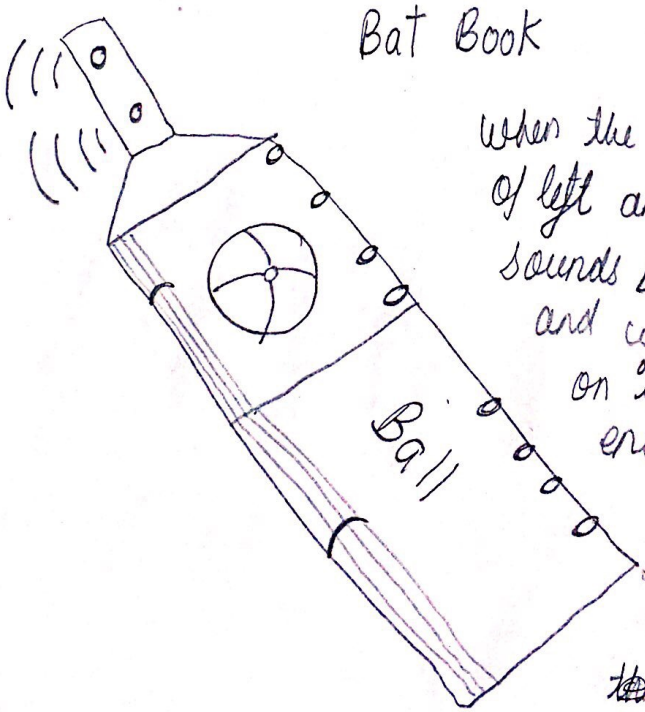
21 Sunil

'ROTATION
'DEVELOPMENTAL



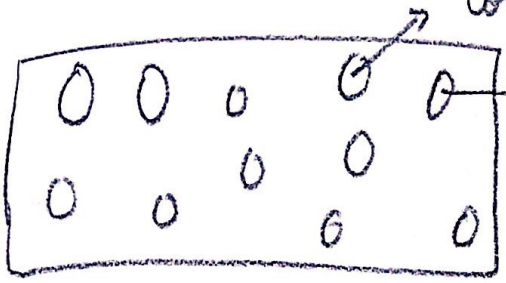
The ball with the LED glows continuously when it is stopped by the child it shows the first letter of the alphets and when ~~He~~ leaved started glowing again. Touched again the Next alphebet it displays with its picture.

22 Bat Book



When the wrong combination of left and right it sounds beep - beep. and when the correct on it makes an encourages sound which child likes. when correct order is matched ~~the~~ eg - B for Ball. Ball repeats and some animation of ball.

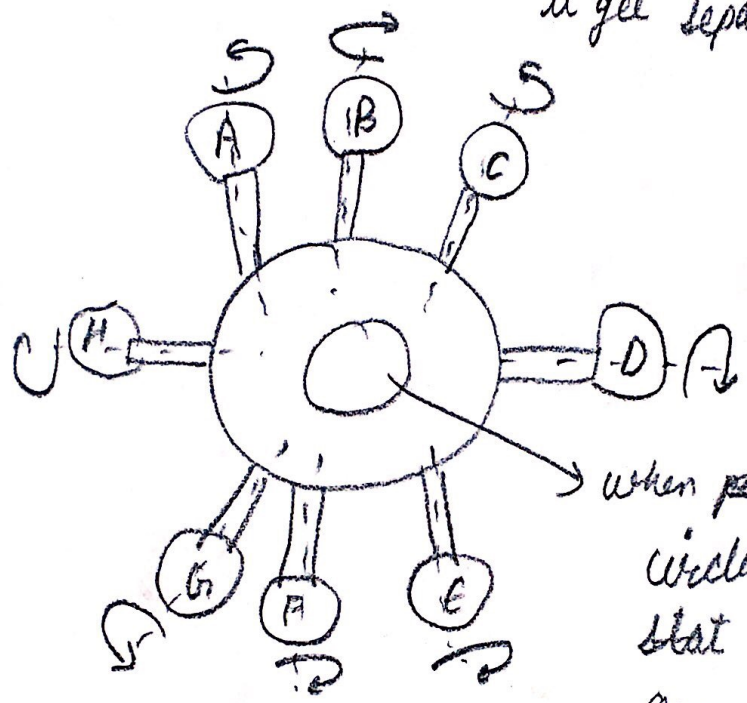
(29)



coloured finger sticker

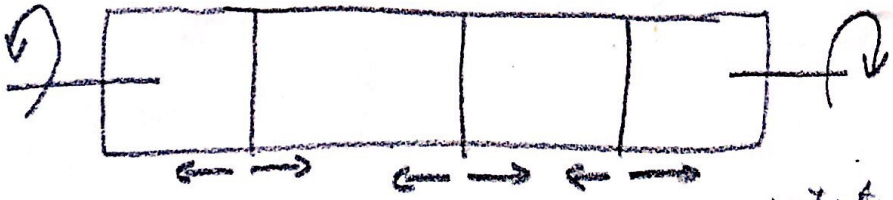
when put finger on it make the finger stick on it.
when put some force it get separated.

(30)

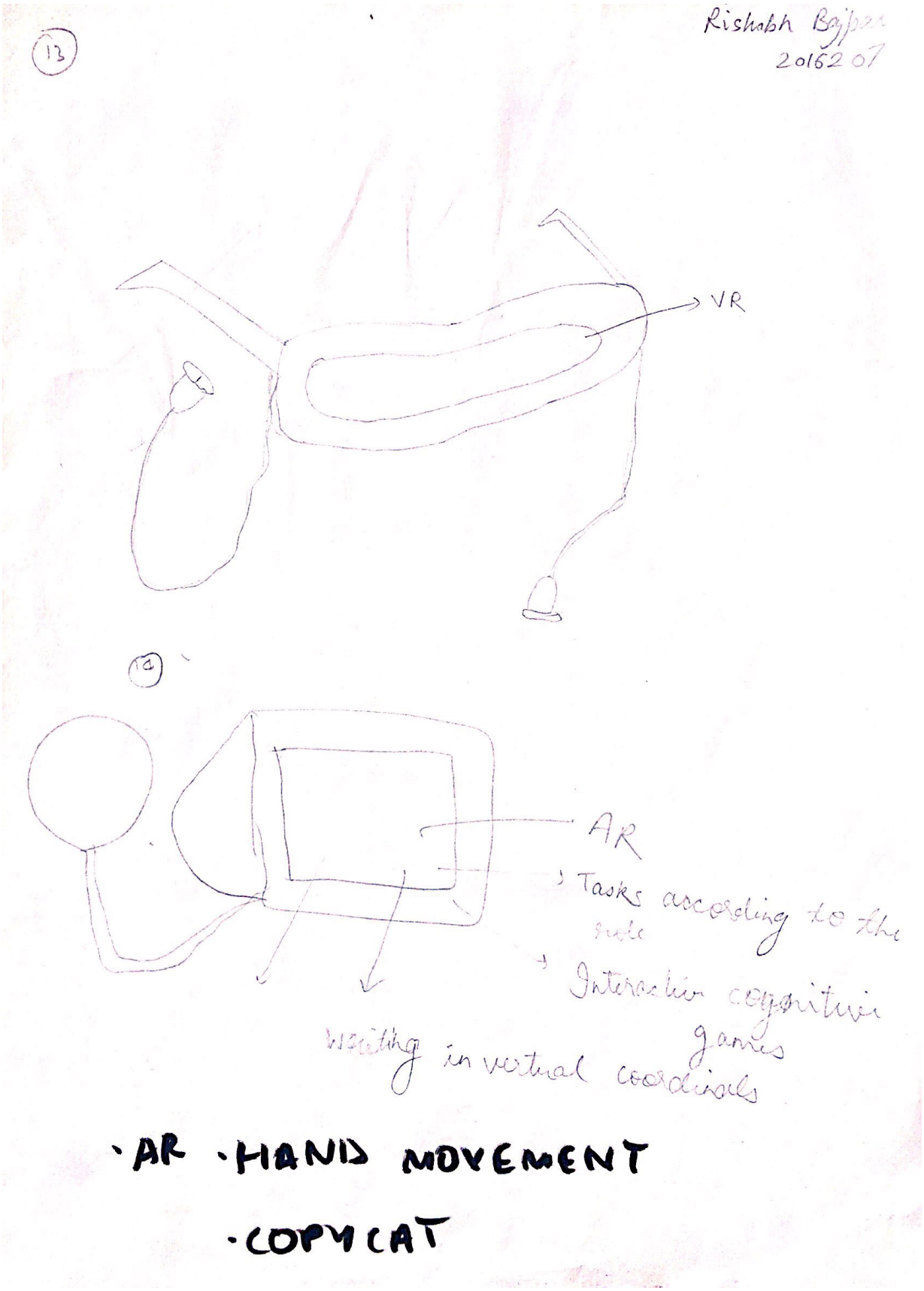


when ~~put~~ hit this circle all balls that start rotating one by one.

(31)



When the rectangle is forced or rotated it it makes sequence of alphabet in rep eated order.


Rishabh Bajpai
20162007
13
VR
14
AR
Tasks according to the rule
Interaction cognitive games
Working in virtual coordinates
·AR ·HANDS MOVEMENT
·COPYCAT

After generation of all these concepts, they were condensed down based on relevance to the problem; desirability; viability & feasibility.
The Pugh's matrix was used for comparison and final selection of 2 concepts.
The two concepts were selected based on one toy which is aimed at higher end customers and the other toy which will be a lower end model for people of the lower economic sector. The selection & splitting has also be done based on one toy which aids classroom cognitive & language skill development and one toy which is a personal cognitive development toy for the child. In this way, the toys created by both the teams will have their own unique selling point while tackling the same problem statement.

This report highlights the development & prototype done by Group A.

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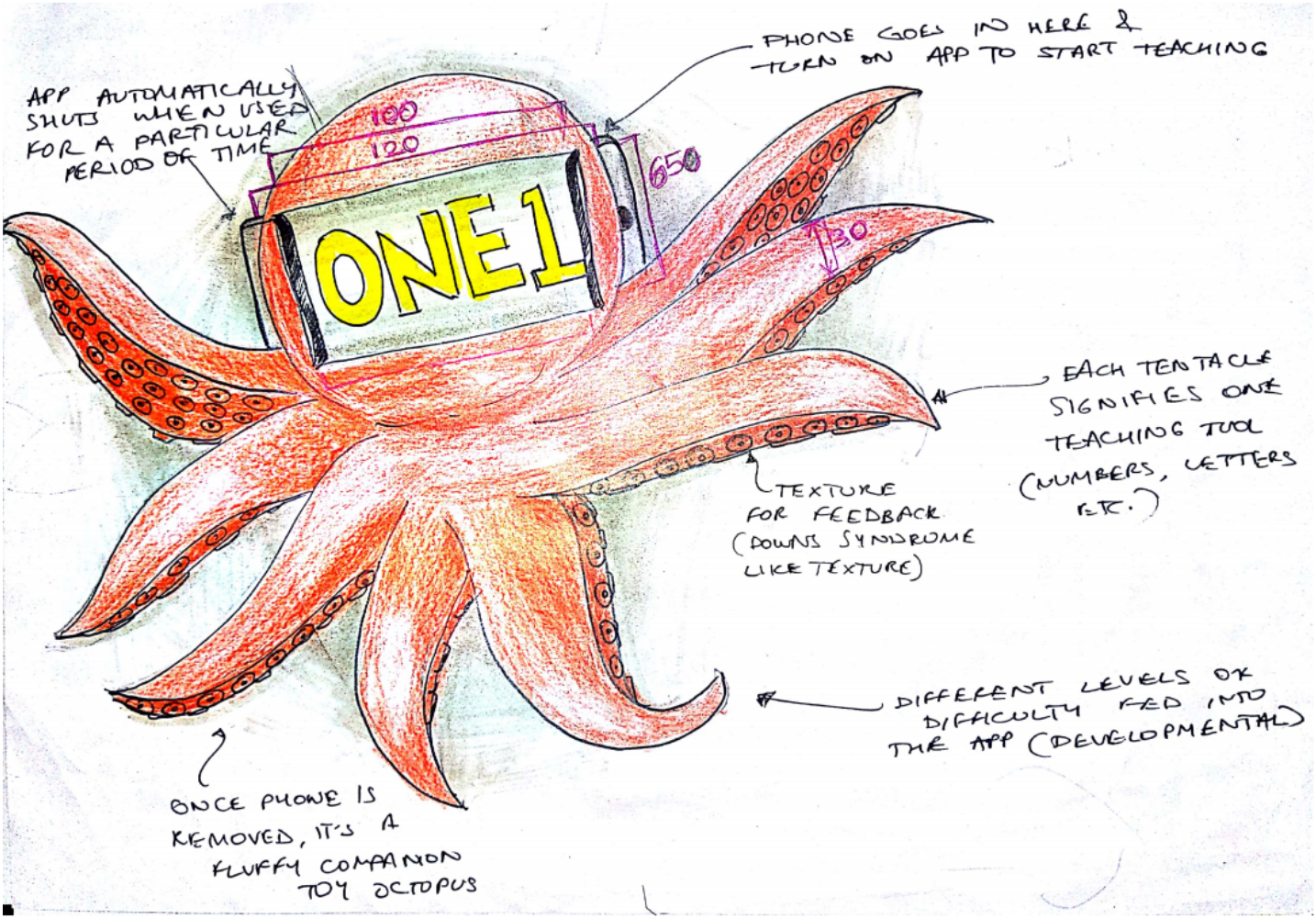
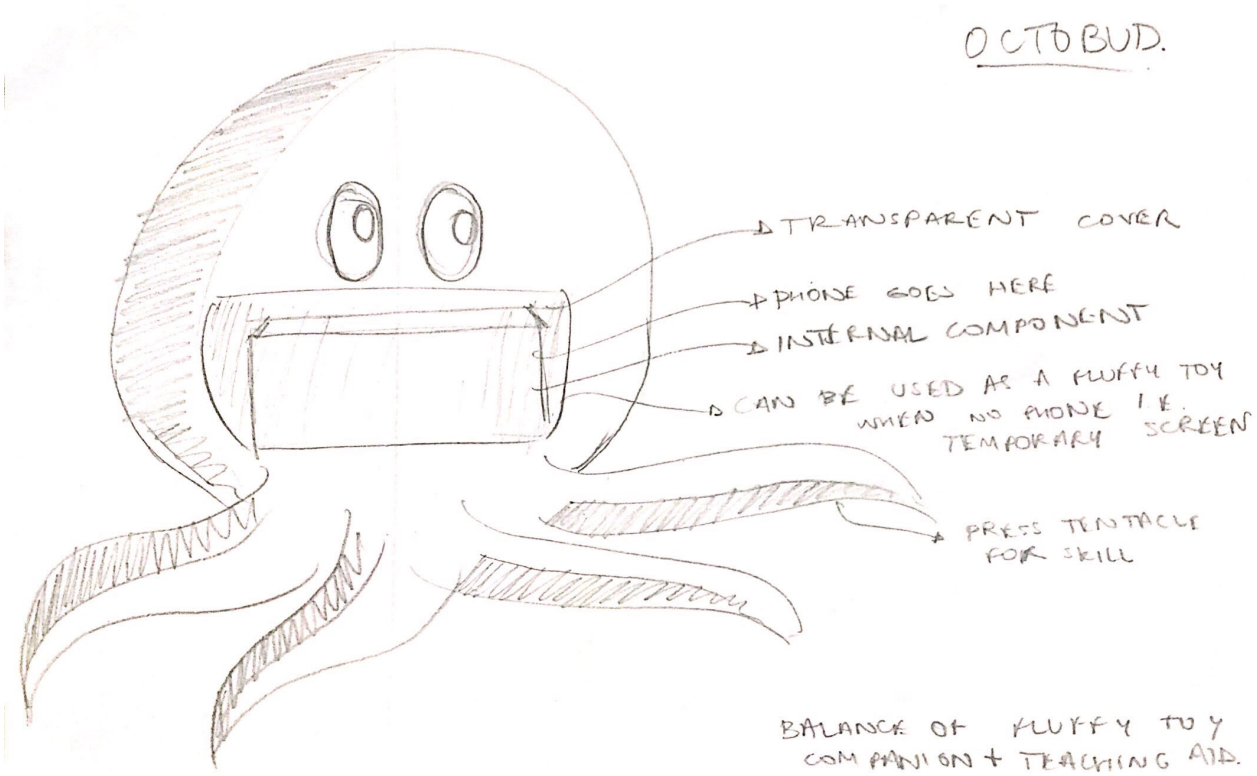
9.METHODOLOGY

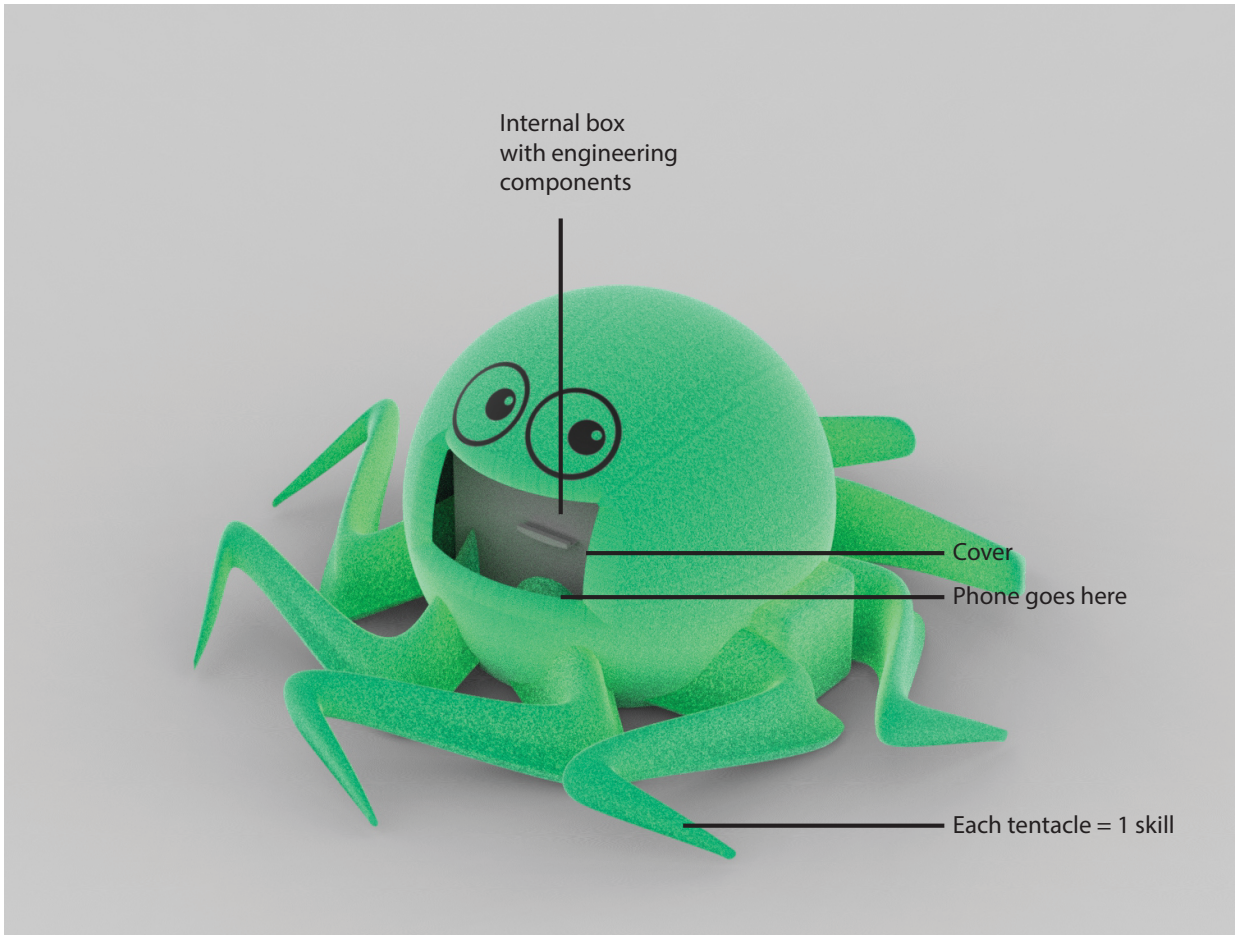
Group A's concept is the one aimed at customers of the higher end of the economic spectrum & for personal use i.e. teaching not done in the classroom. Specific care was taken to not completely wipe out or replace the human aspect of teaching the child since human relationships are an important aspect of the cognitive development of not just children affected by Down Syndrome, but all children in general. Hence, this toy involves interaction by people around the child as well.

The process involved selection of the concept, working on form & functionality, dimensioning & ergonomics, CAD, UI and programming for the app & the electronic simulation.

10.CONCEPT DESIGN




OCTOBUD.
TRANSPARENT COVER
PHONE GOES HERE
INTERNAL COMPONENT
CAN BE USED AS A FLUFFY TOY WHEN NO PHONE I.E. TEMPORARY SCREEN
PRESS TENTACLE FOR SKILL
BALANCE OF FLUFFY TOY COMPANION + TEACHING AID.

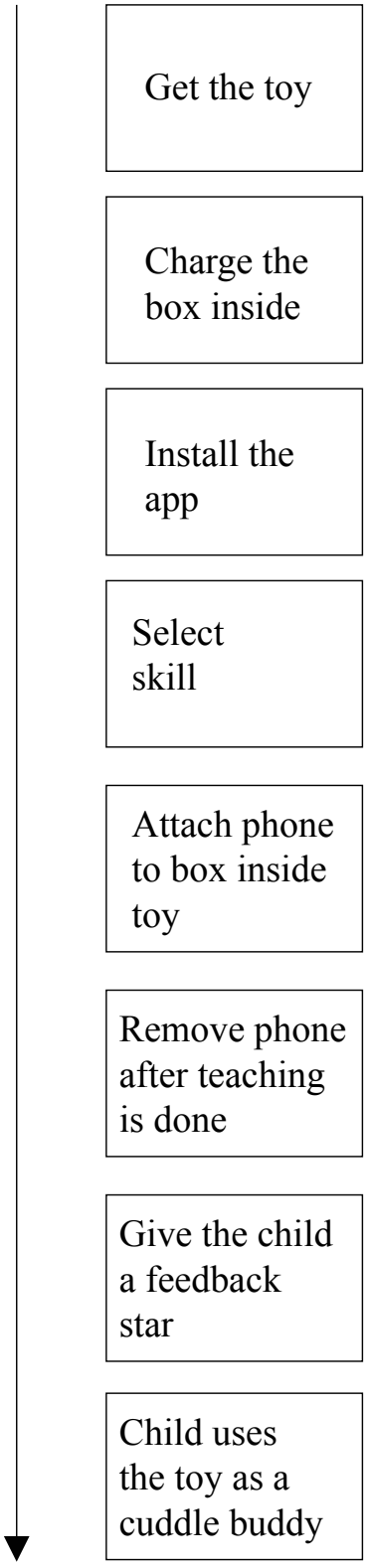

Internal box with engineering components
Cover
Phone goes here
Each tentacle = 1 skill

The name of this toy is Octobud. It consists of a toy linked with an app on the phone of the parents of the children with Down Syndrome. It is a balance between a cuddly companion for the child and teacher. Its relevance is as follows -

1) Targets the issue of lack of cognitive & language development that exists with the children suffering from Down Syndrome.
2) Children with Down syndrome love having companions & get very attached to toys that give feedback and develop constantly.
3) This toy has a place for a temporary screen (i.e. a phone screen) and is linked with an app that can be downloaded by the parents. This app is linked with the tentacles of the Octopus. Each tentacle is linked to one skill. Pressing the respective tentacle will trigger that skill when the phone is placed inside the phone holder of the toy. The app teaches the child the specific skill as per different levels of difficulty based on the ability of the child.
4) The skill is taught through audio visuals.
5) To prevent phone addiction & eye damage, once the skill to be taught is selected, the phone screen becomes unresponsive to touch & the app automatically shuts off after use for 20 minutes.
6) It cannot be reused unless there's a gap of at least 3 hours.
7) The toy has been ergonomically designed and the tentacles thickness has been formulated as per anthropometric dimensions measured of the children so that it is easy for them to press the toy.
8) The phone holder is attached to a box placed inside the toy which can be accessed by removing the strips below the toy.
9) This box contains all of the engineering components of the toy. The box can be removed & charged by the parents by removing the strip below the octopus.
10) The form of an octopus has been selected since it's 8 tentacles align well with the 8 skills being taught. Also, its a cute creature relevant to toys.
11) These skills are related to language development.
12) The skills being taught through this toy are as follows - Alphabets, words, sentences, poems, colours, manners, numbers and a specific special edition pack that gets updated with the app.
13) The toy records the voice of the child repeating after what is being said in the app and if the child says something correctly, feedback of clapping & colourful lights is given. The toy also comes with an attachment of starfish that light up on applying pressure. These can be given to the kids by the parents if the kids do a good job in learning and repeating correctly.
14) This feedback will ensure that the kid enjoys the toy & learns well.
15) The idea of using the phone for a screen was to reduce the cost a bit & to look at the phone not as an interactive interface for the child but as a temporary screen that can be removed from the phone to prevent any kind of addictions.
16) Children who have Down syndrome are very calm and do not throw toys around. However, in an extreme case, if a child does end up throwing the Octobud, the toy has enough

protection & the phone is placed very inside hence there will be no issue related to damage of parts.

TASK ANALYSIS



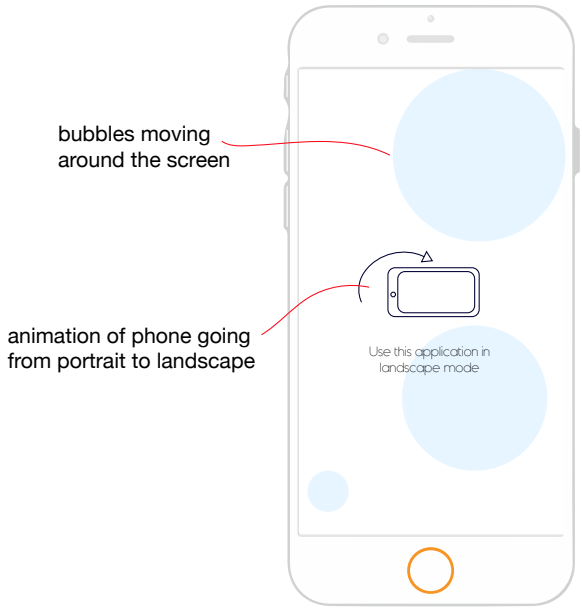
UI/UX DESIGN OF APP

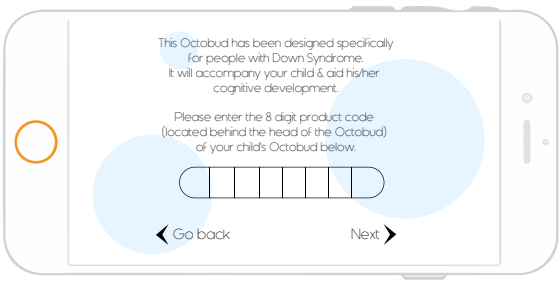
The UI design language of the application is displayed below as created by the designer. The layouts given below aren't of the entire app since it is too complex to portray & has been shown in the simulation video. The layouts here are to give an understanding of the visual language & flow of the application.

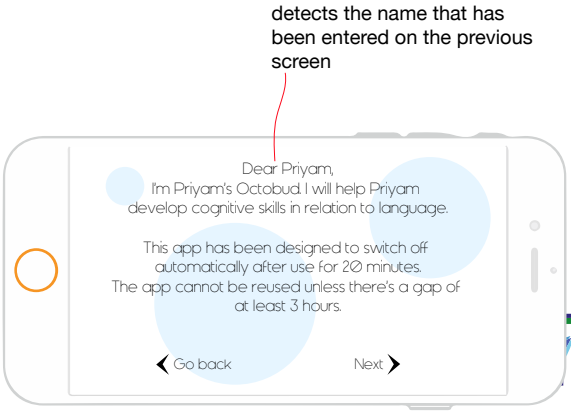
The CSE members have programmed this application & an interactive simulation of the entire application as coded by them & designed by the designer has been attached along with this document.

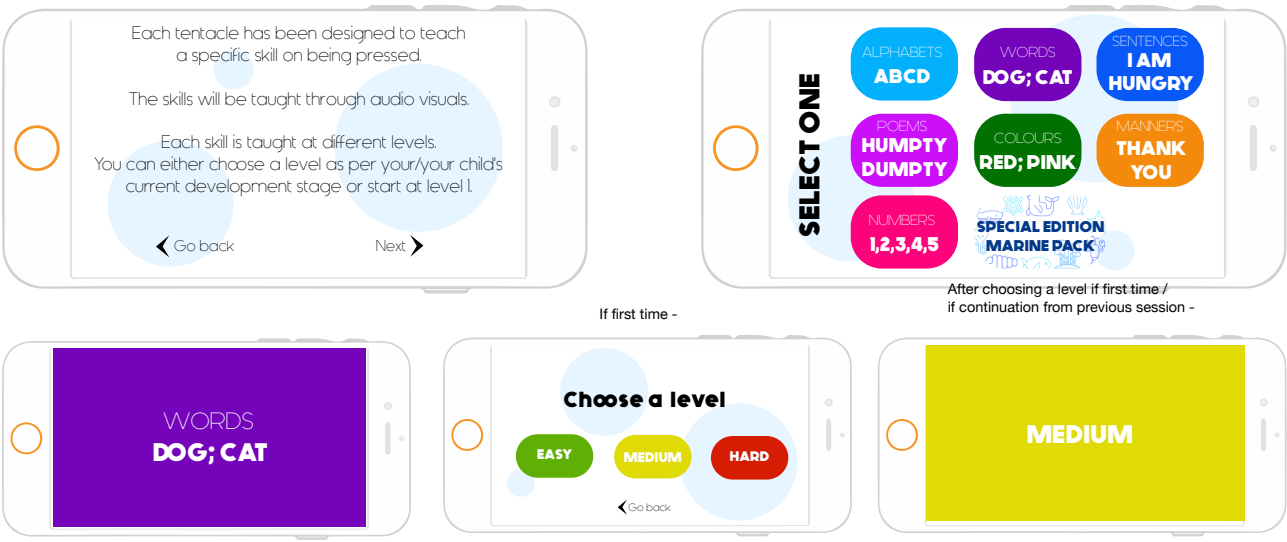
The UI is simple & there is a focus on readability. The blue bubbles have been used since they align with the marine nature of the October & add a hint of fun to the UI of the app.

1) When user launches the app for the first time -

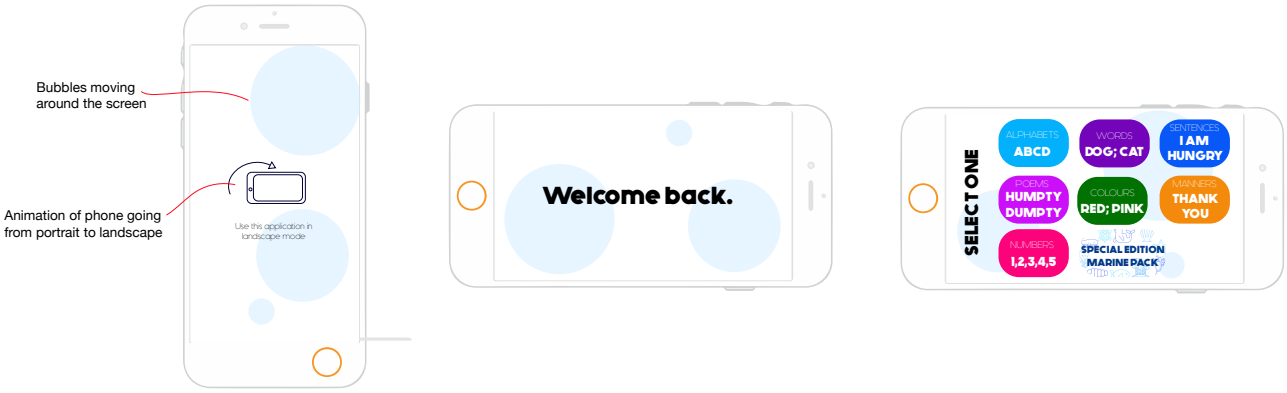




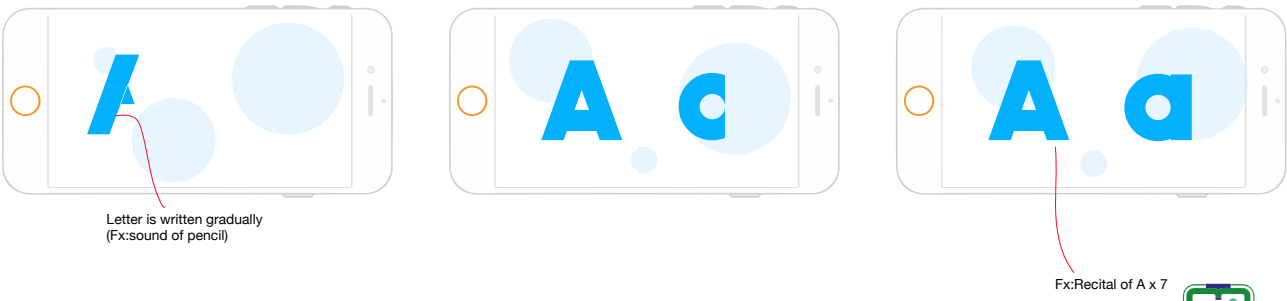




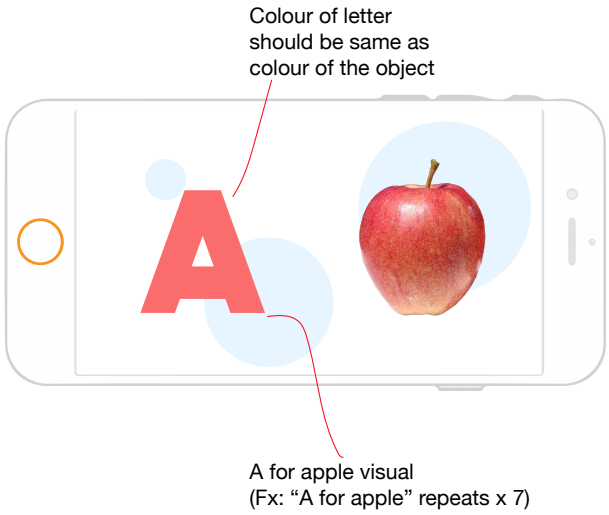
2) When user launches app for the second time -



3) Alphabets - Level Easy - Letters

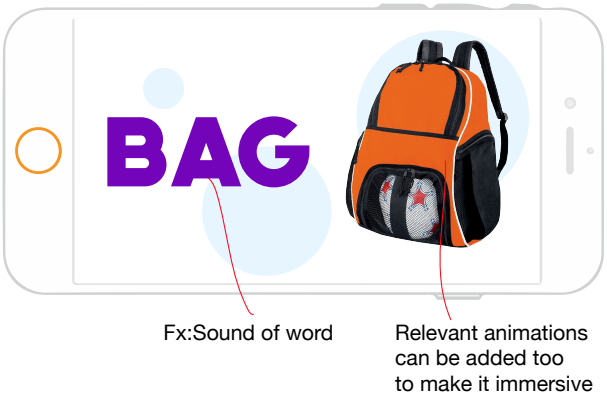


4) Alphabets - Level Medium - A for apple, B for ball etc.

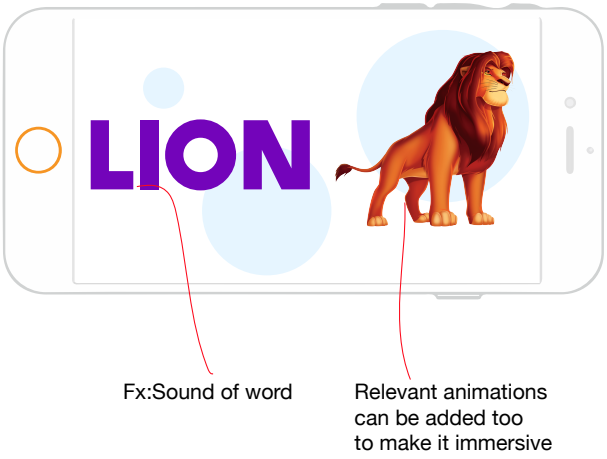


5) Alphabets - Level Hard- Alphabet poems

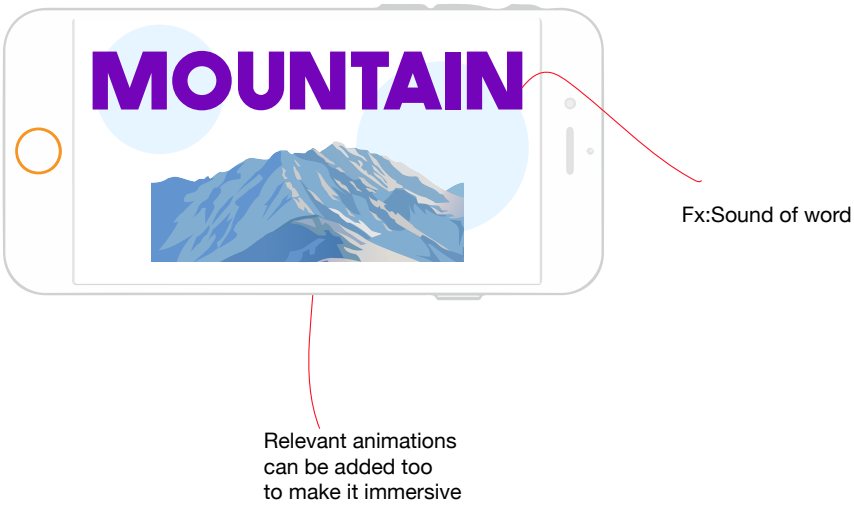
6) Words - Easy - Simple Objects



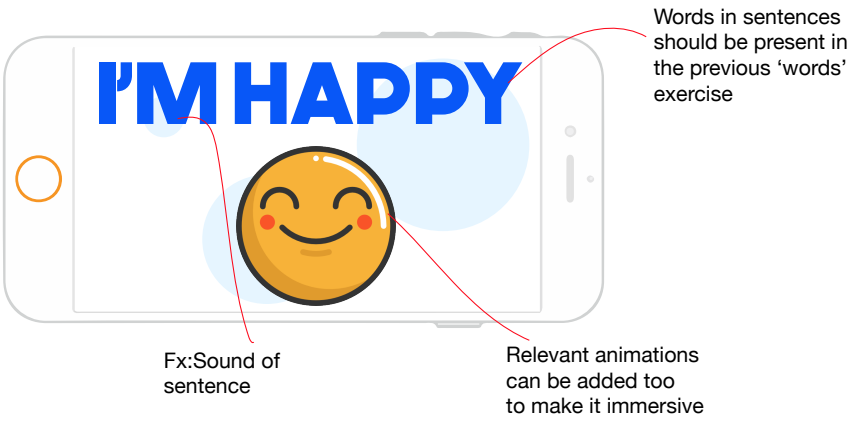
7) Words - Medium - Animals



8) Words - Hard - Complex Words

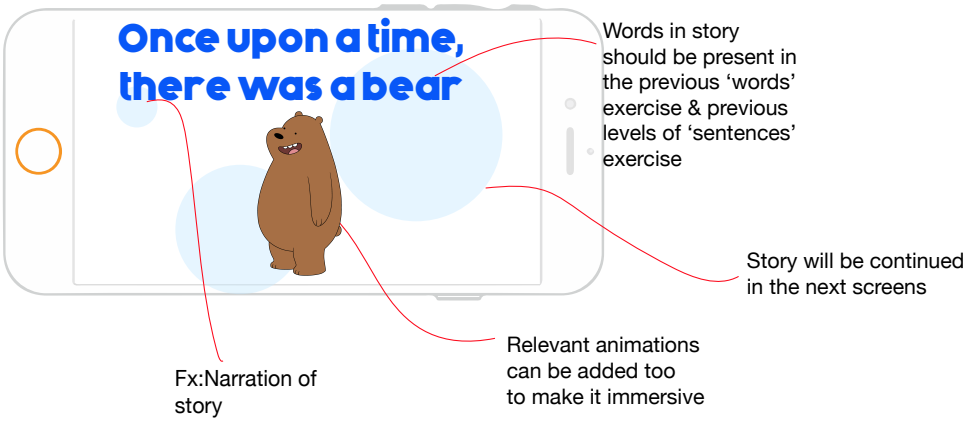


9) Sentences - Easy - Short sentences



10) Sentences - Medium - Long sentences

11) Sentences - Hard - Stories



12) Feedback page (Voice recognition) -

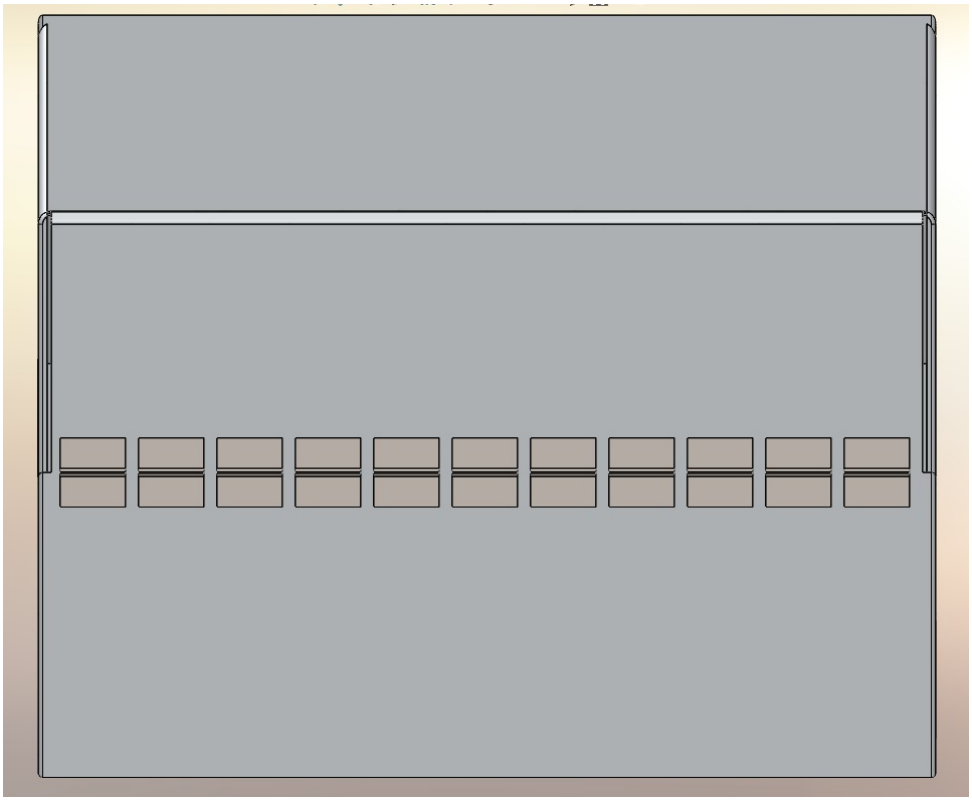
11.MECHANICAL DESIGN

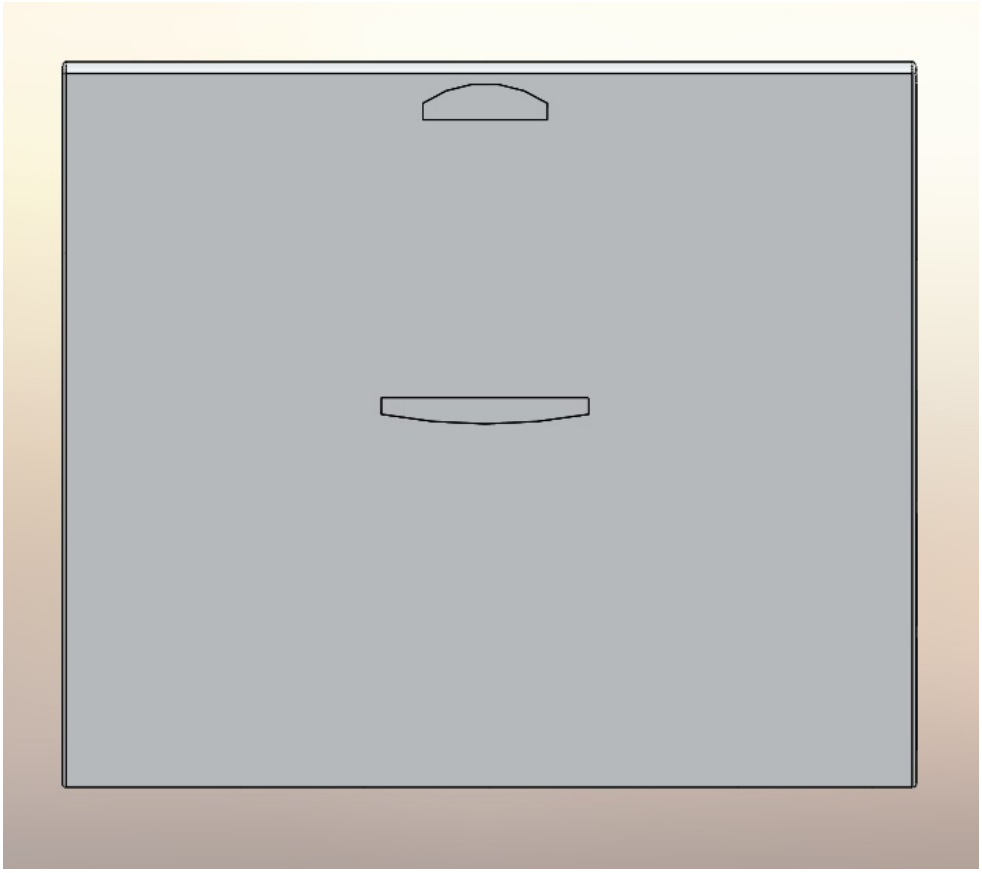
There are two parts of the toy

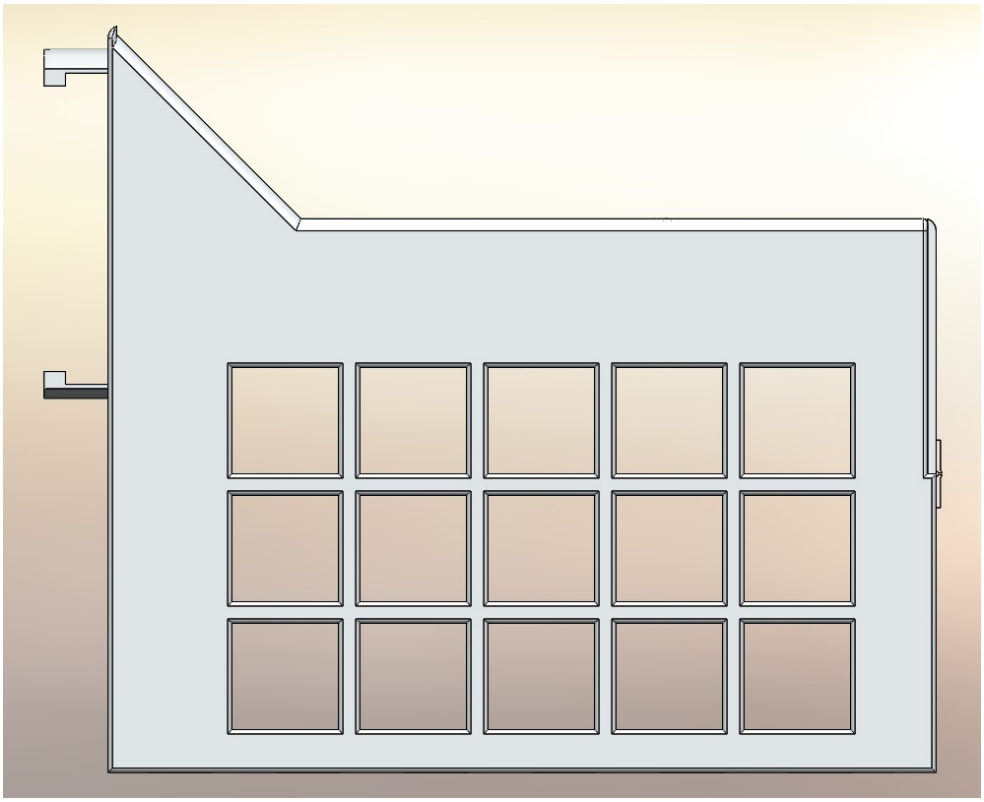
1. Inner

2. Outer

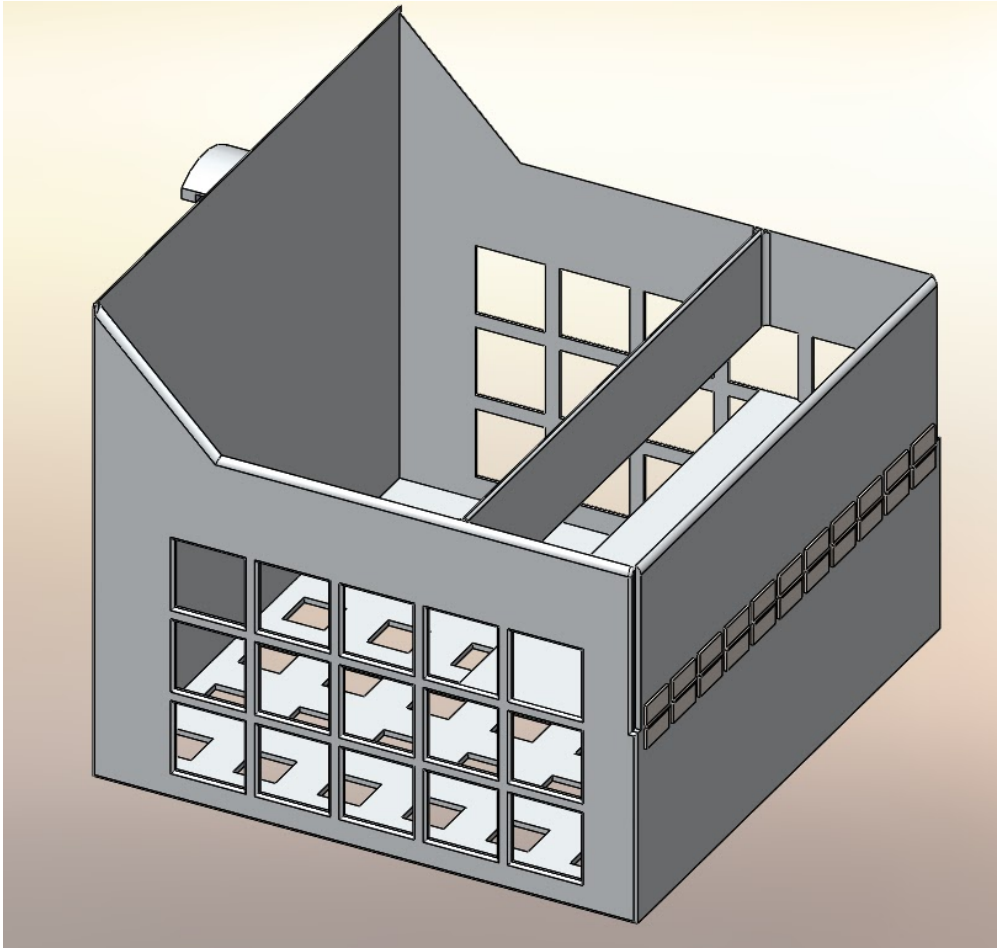
The orthographic views of the Inner part are shown below







The isometric view of the inner part.



The functions of the inner part:-

1. To provide sufficient stiffness.

2. To work as the base of the toy.

3. To hold the mobile phone.

4. To contain and protect the electrical devices.

5. Internal structure of the toy.

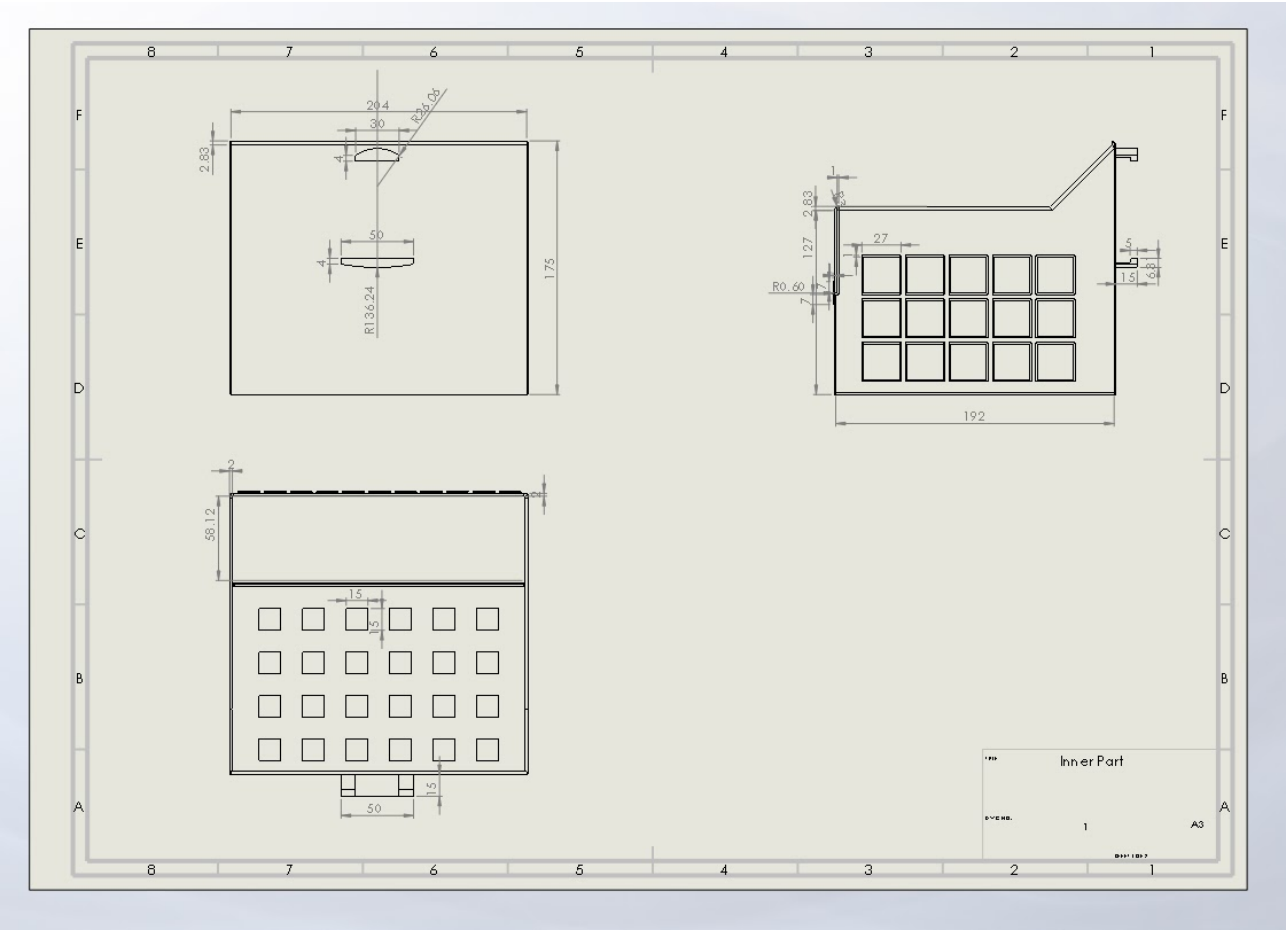
6. To increase the robustness.

7. To provide safety of the mobile.

Material used:- Aluminium alloy 6061

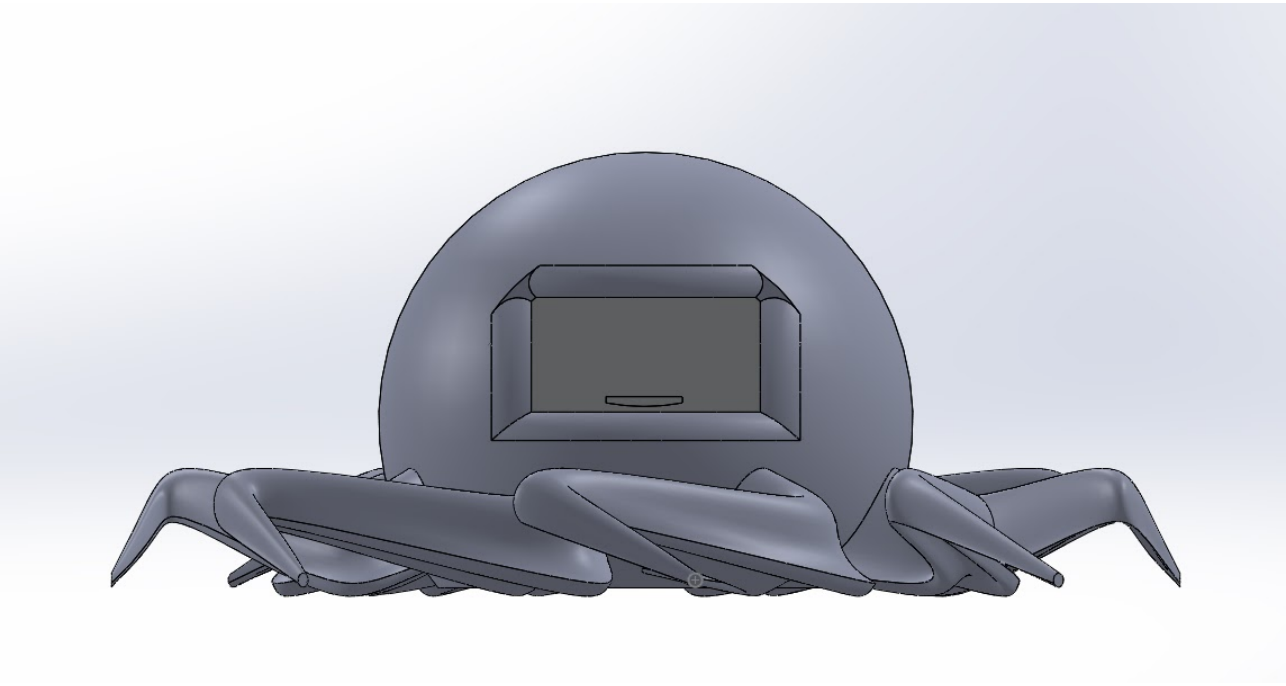
Reason:-Light weight, and stiff.

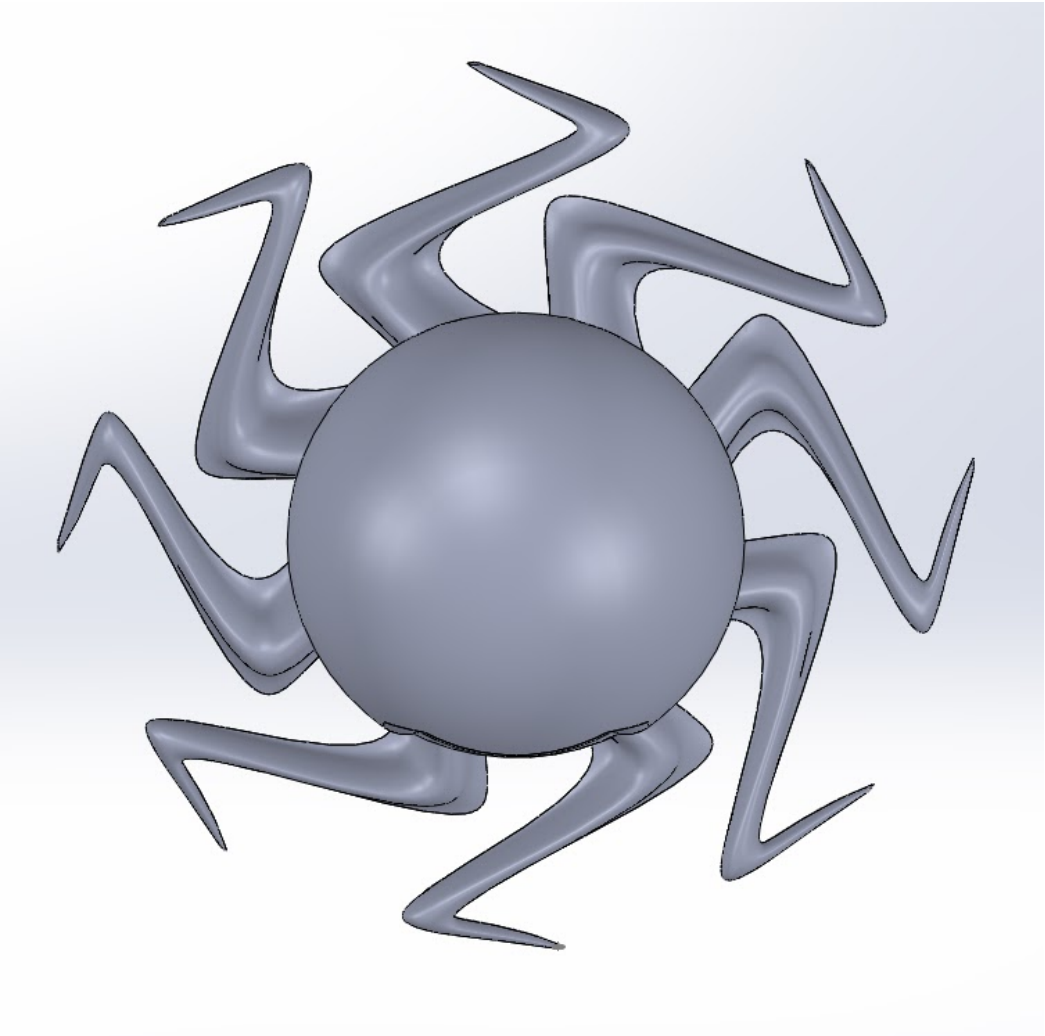
Drawing sheet for inner part:-

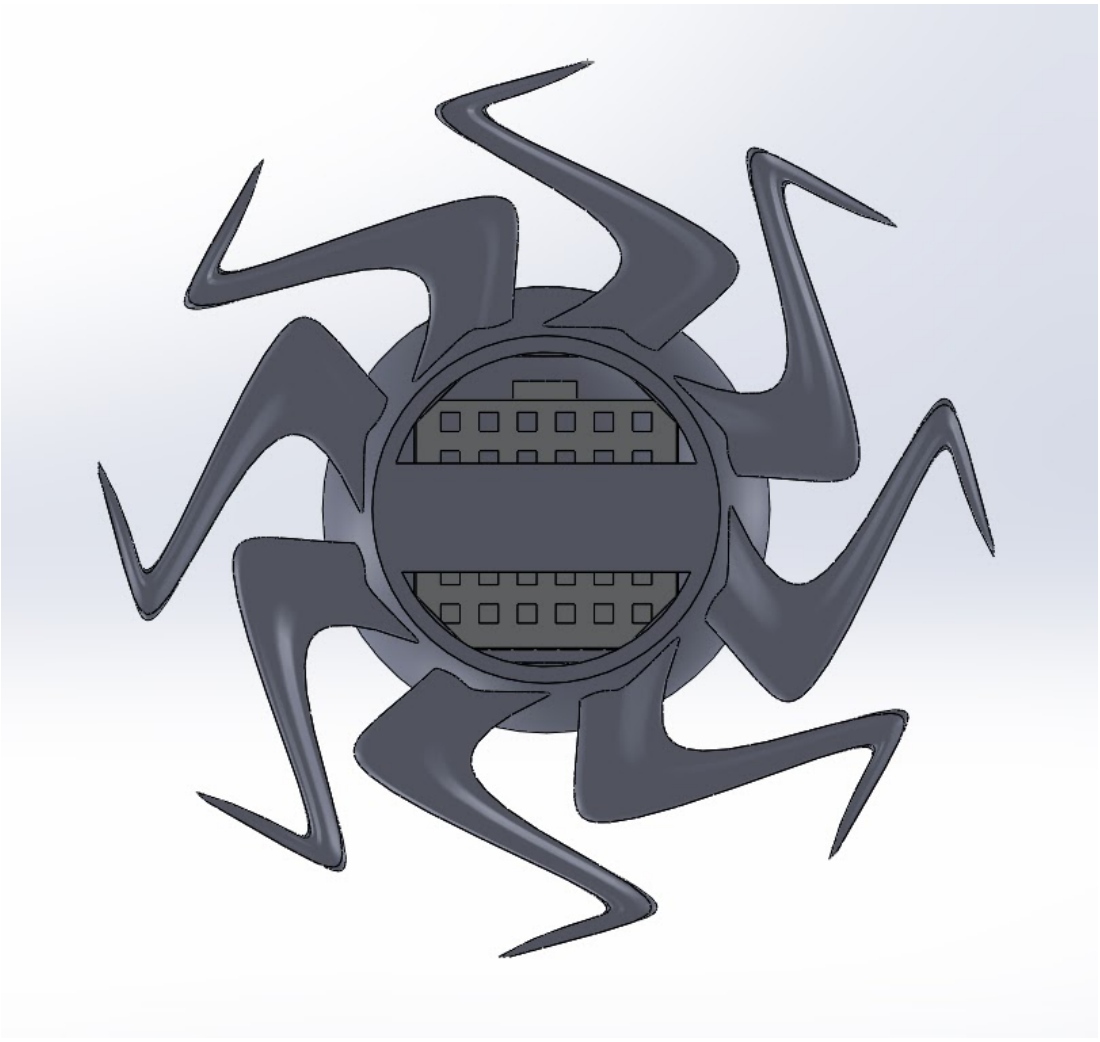


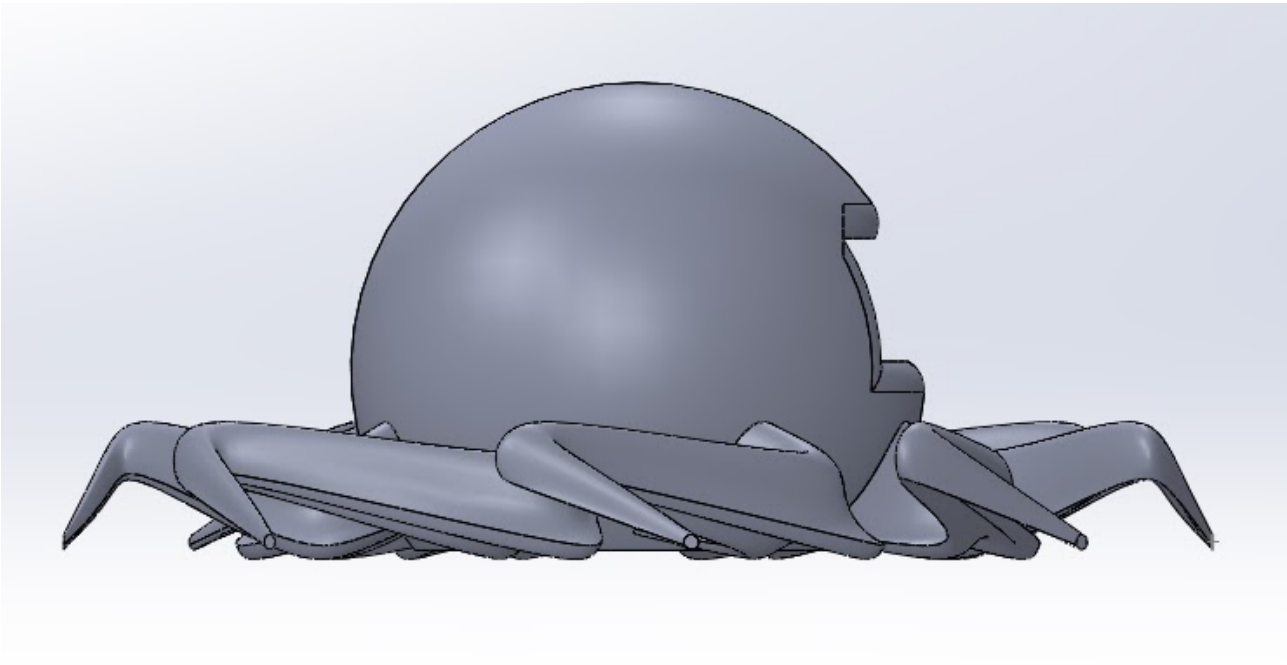
All dimensions are in mm.

The orthographic views of the assumably (Outer + inter part) are shown below.

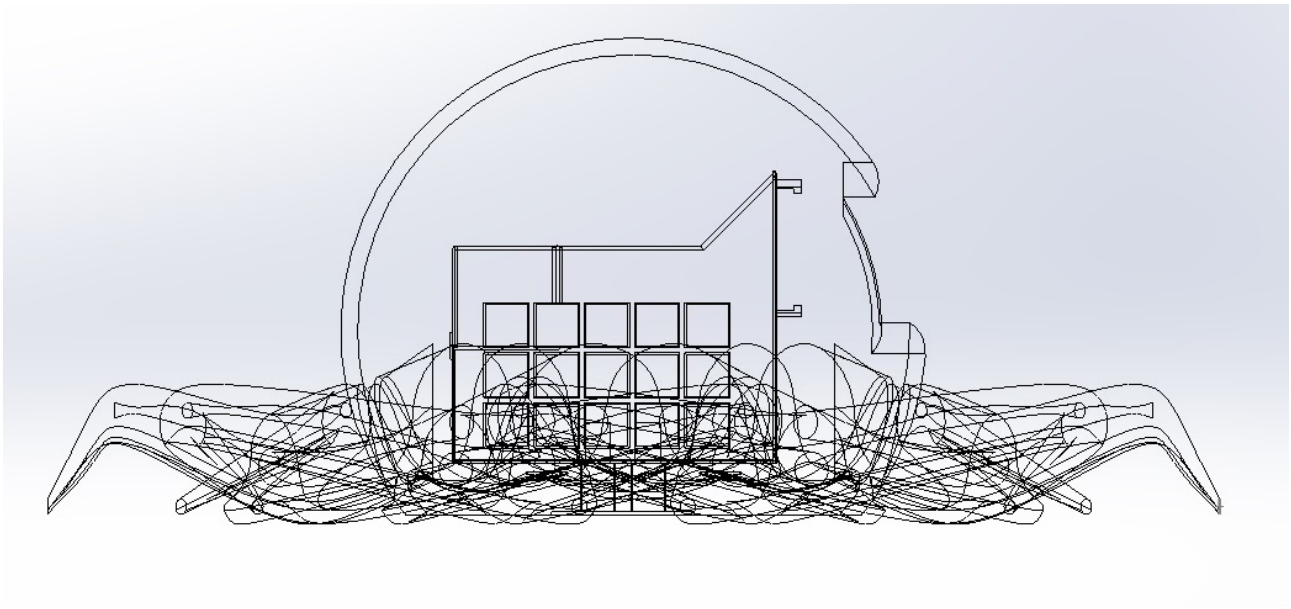


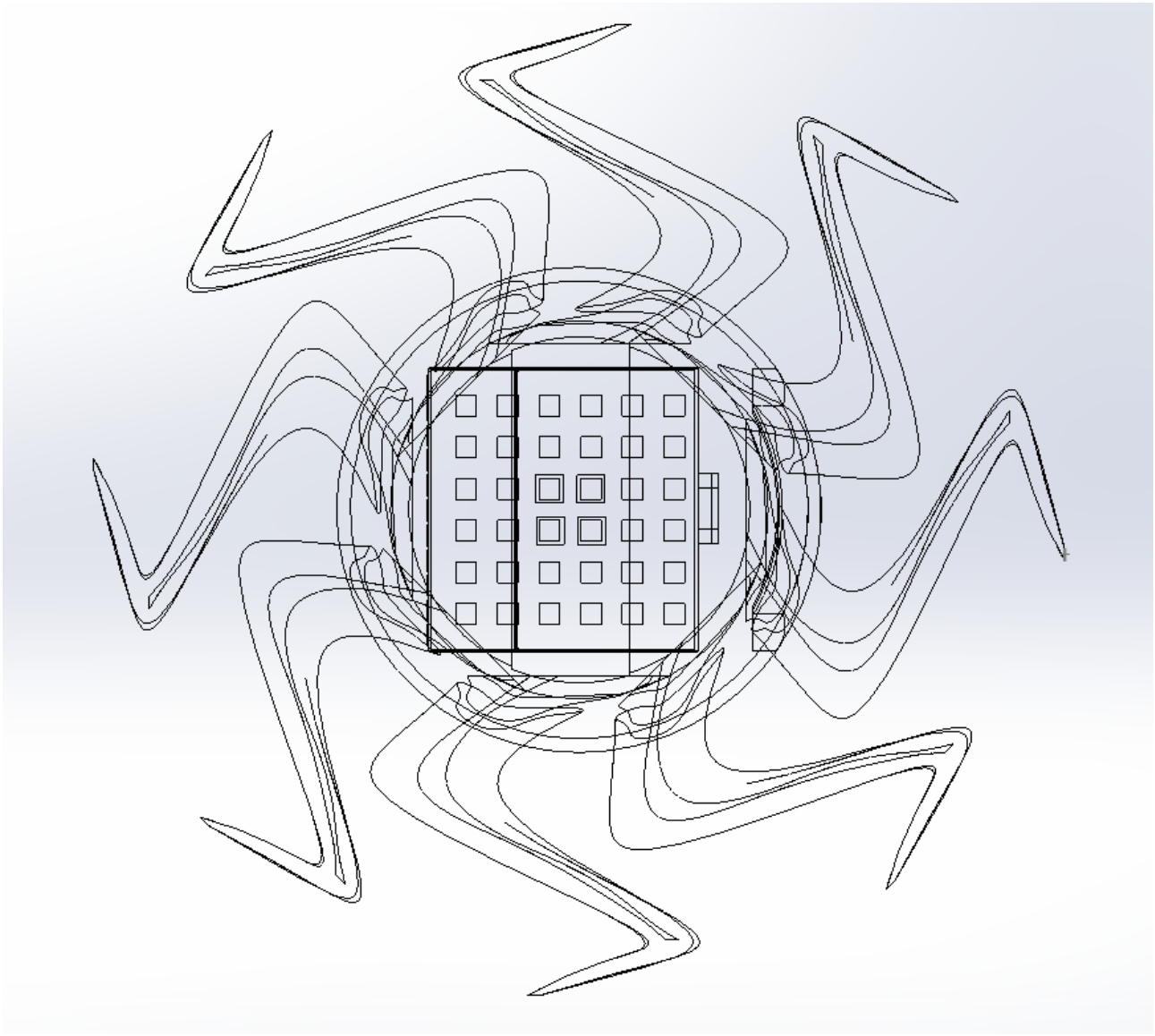


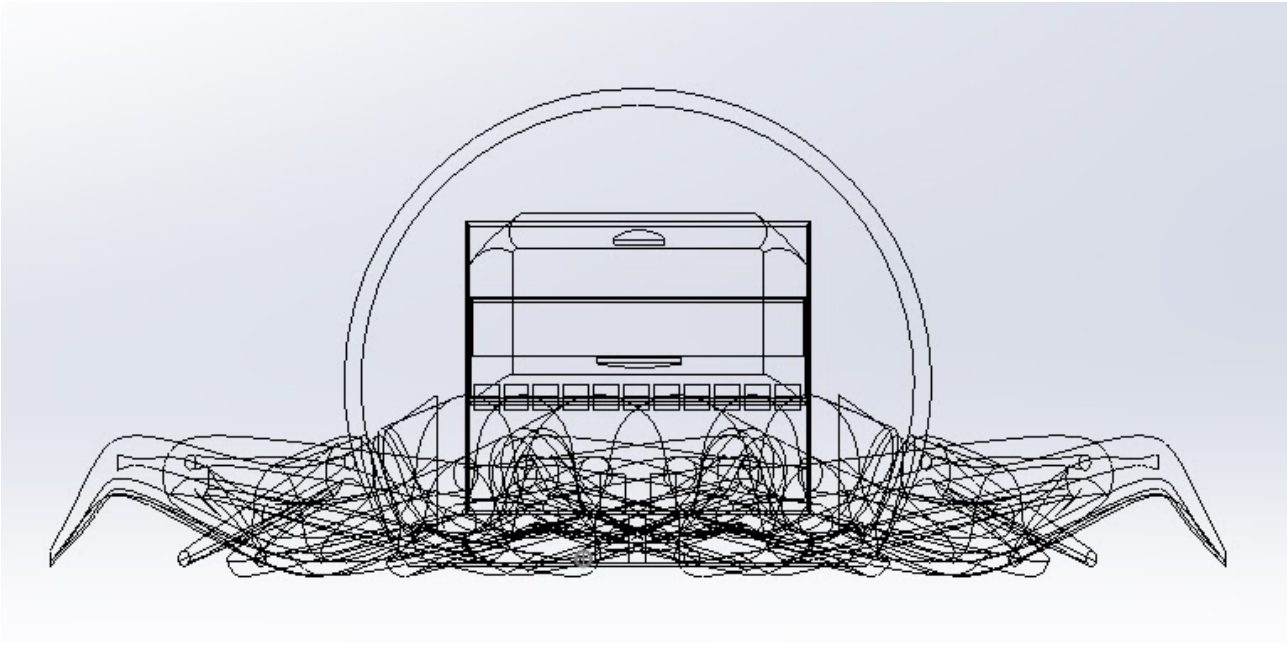




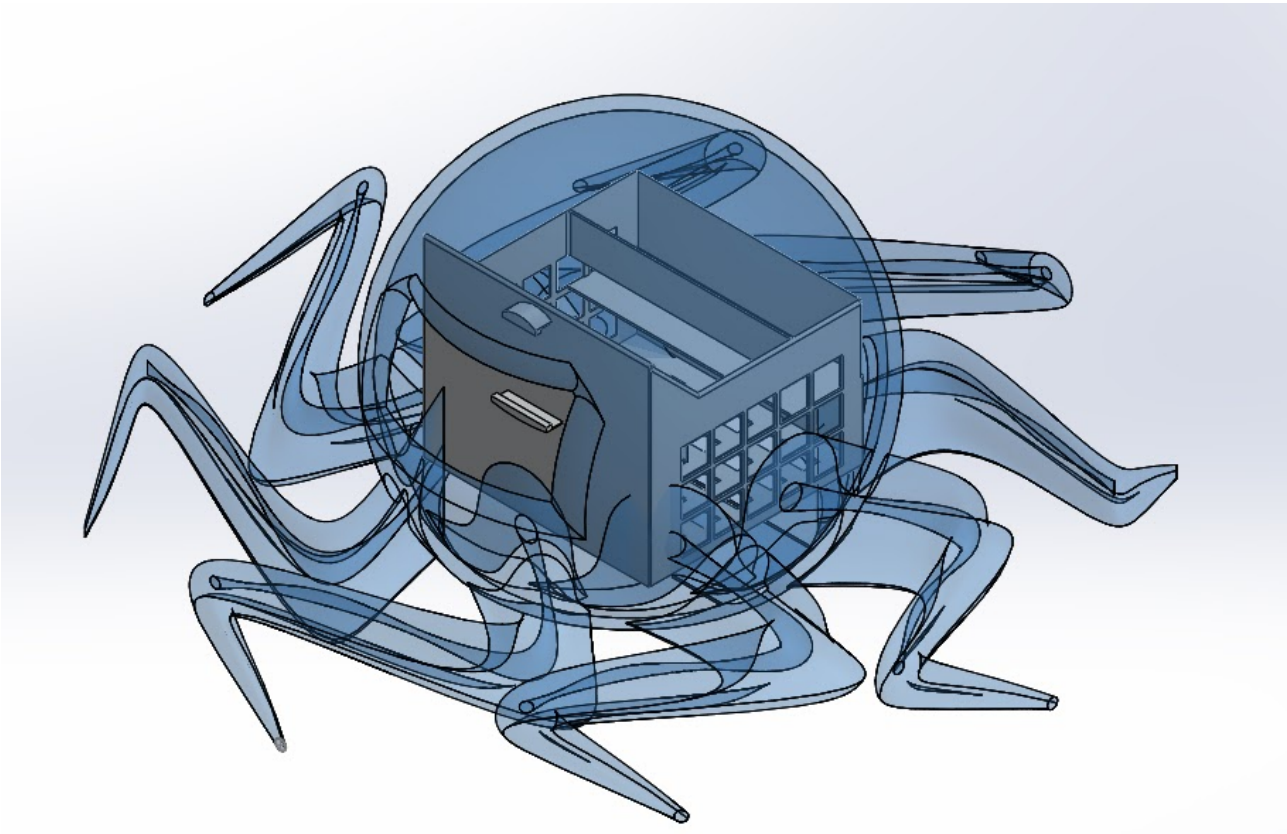
The orthographic views of the assumably (Outer + inter part) in wireframe are shown below.

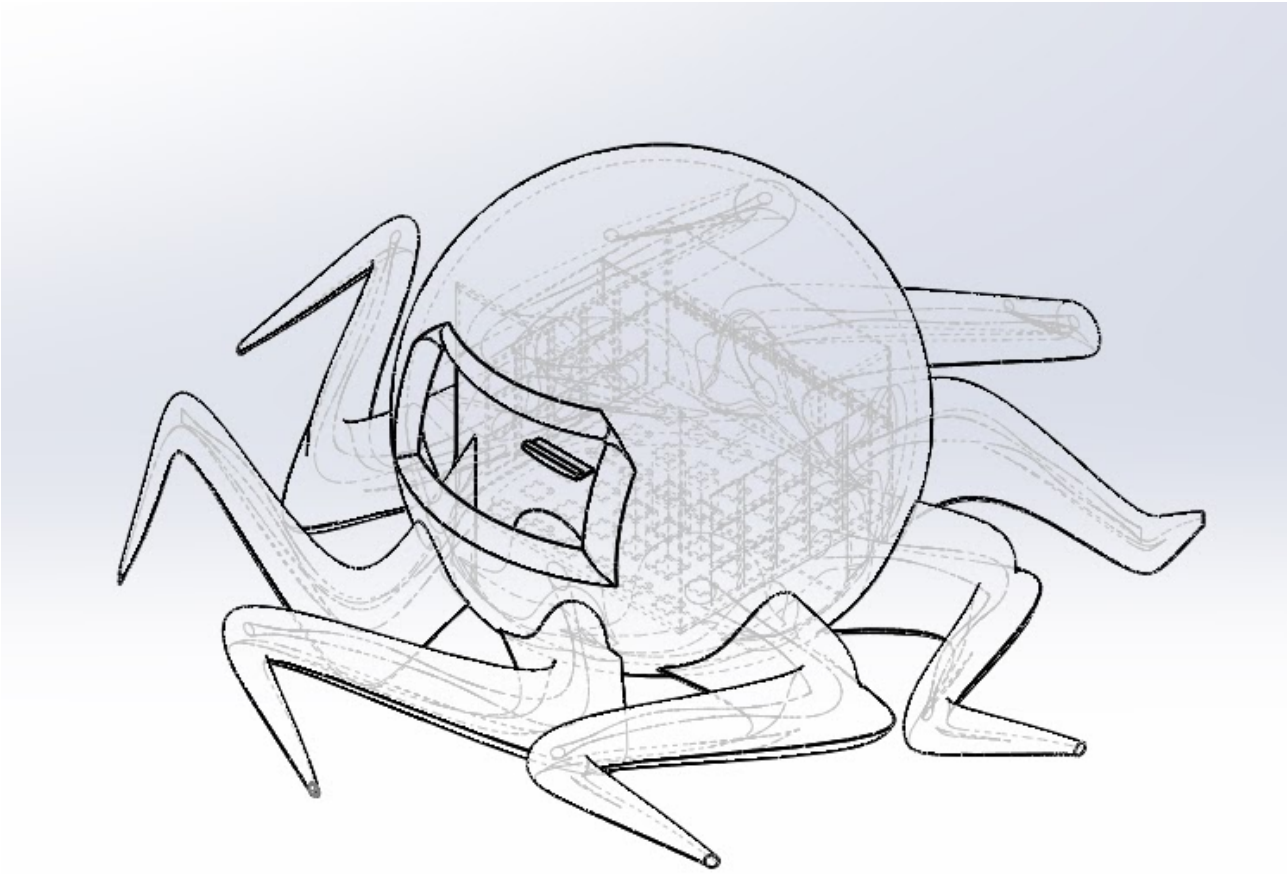


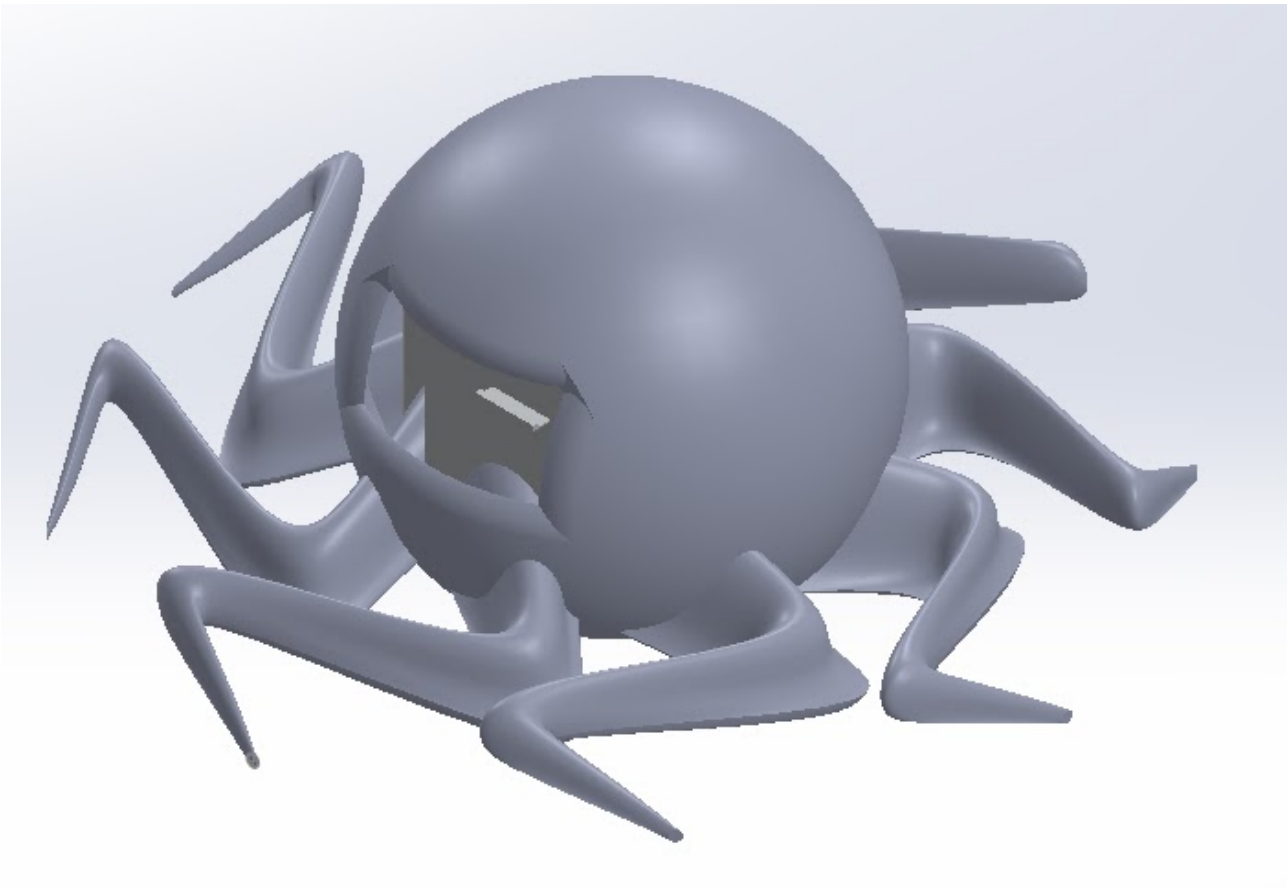


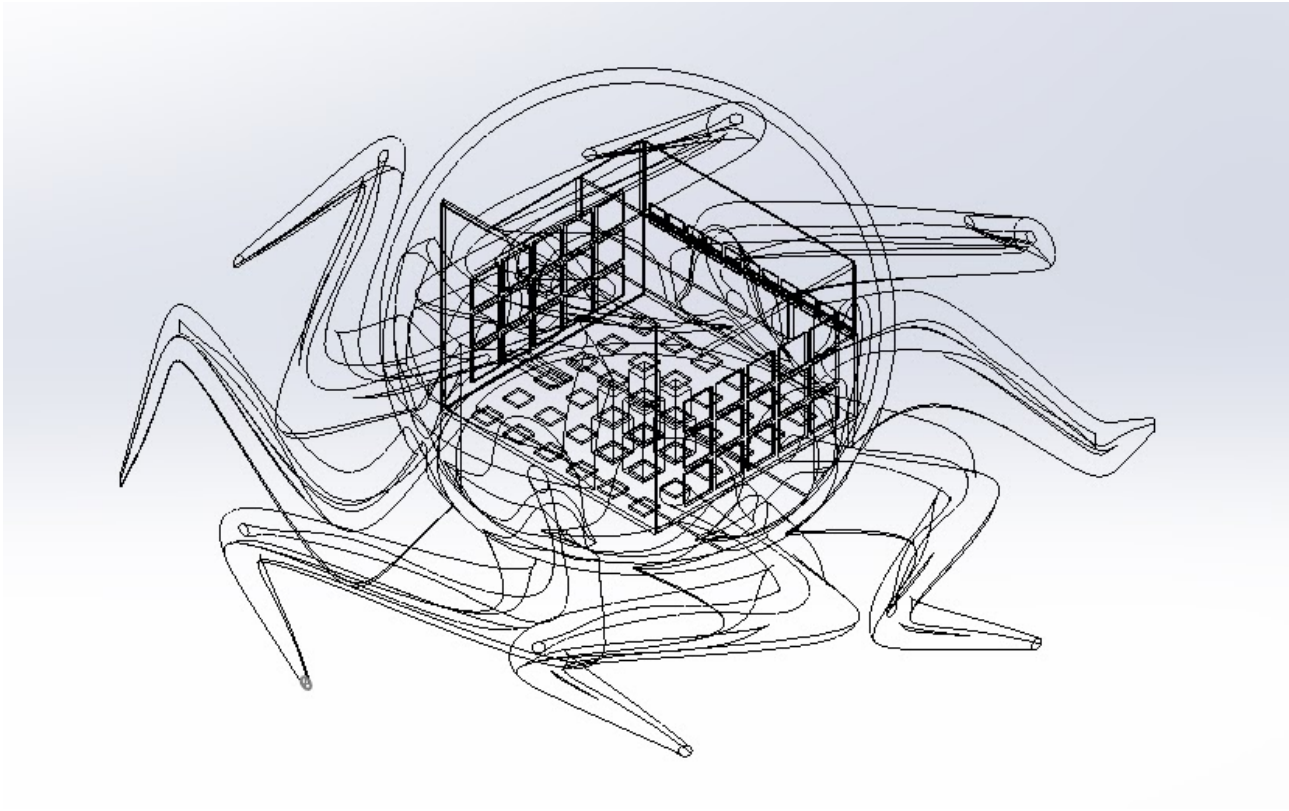


The isometric views of the assumably (Outer + inter part).

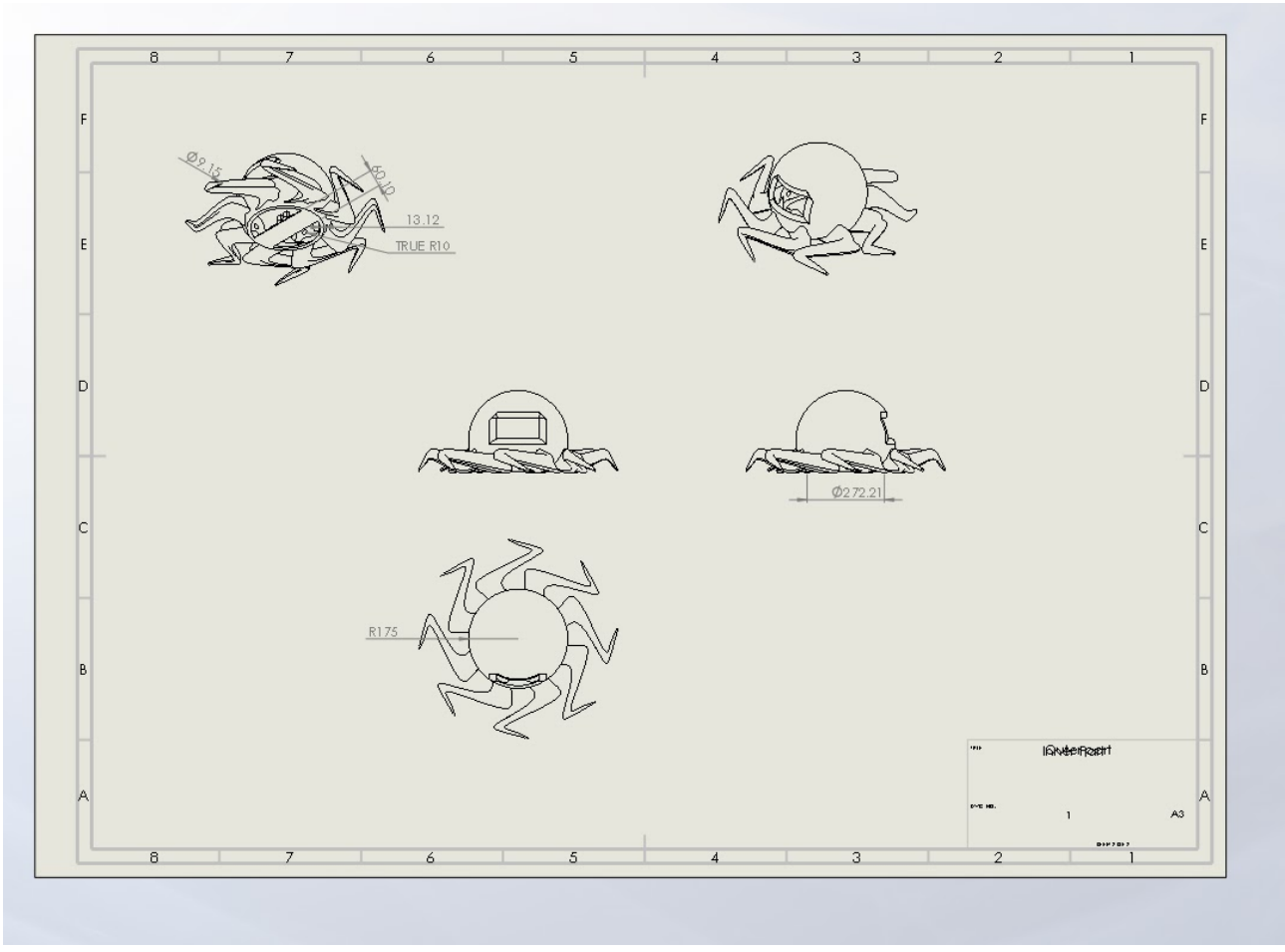








Drawing sheet for Outer part



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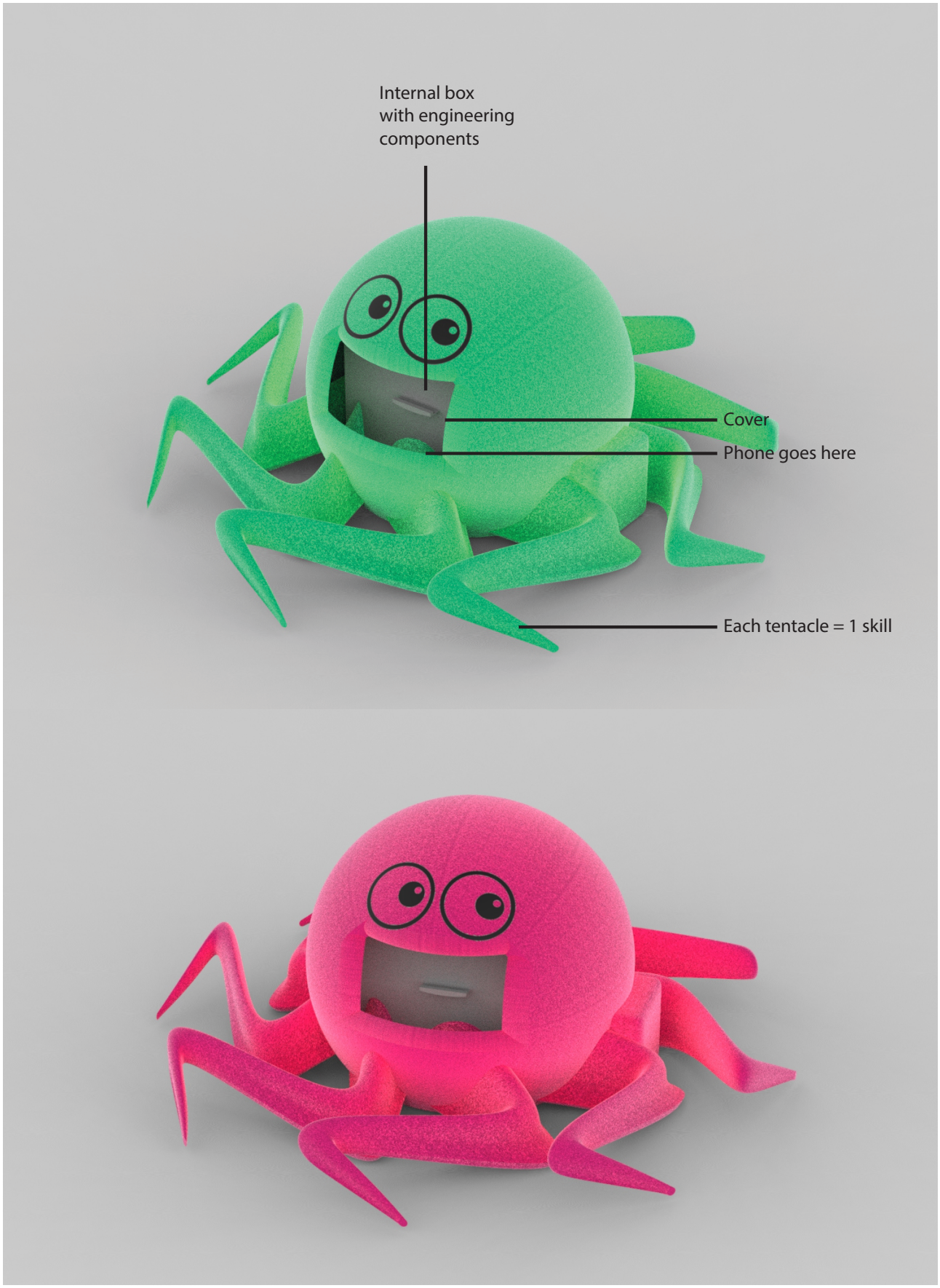
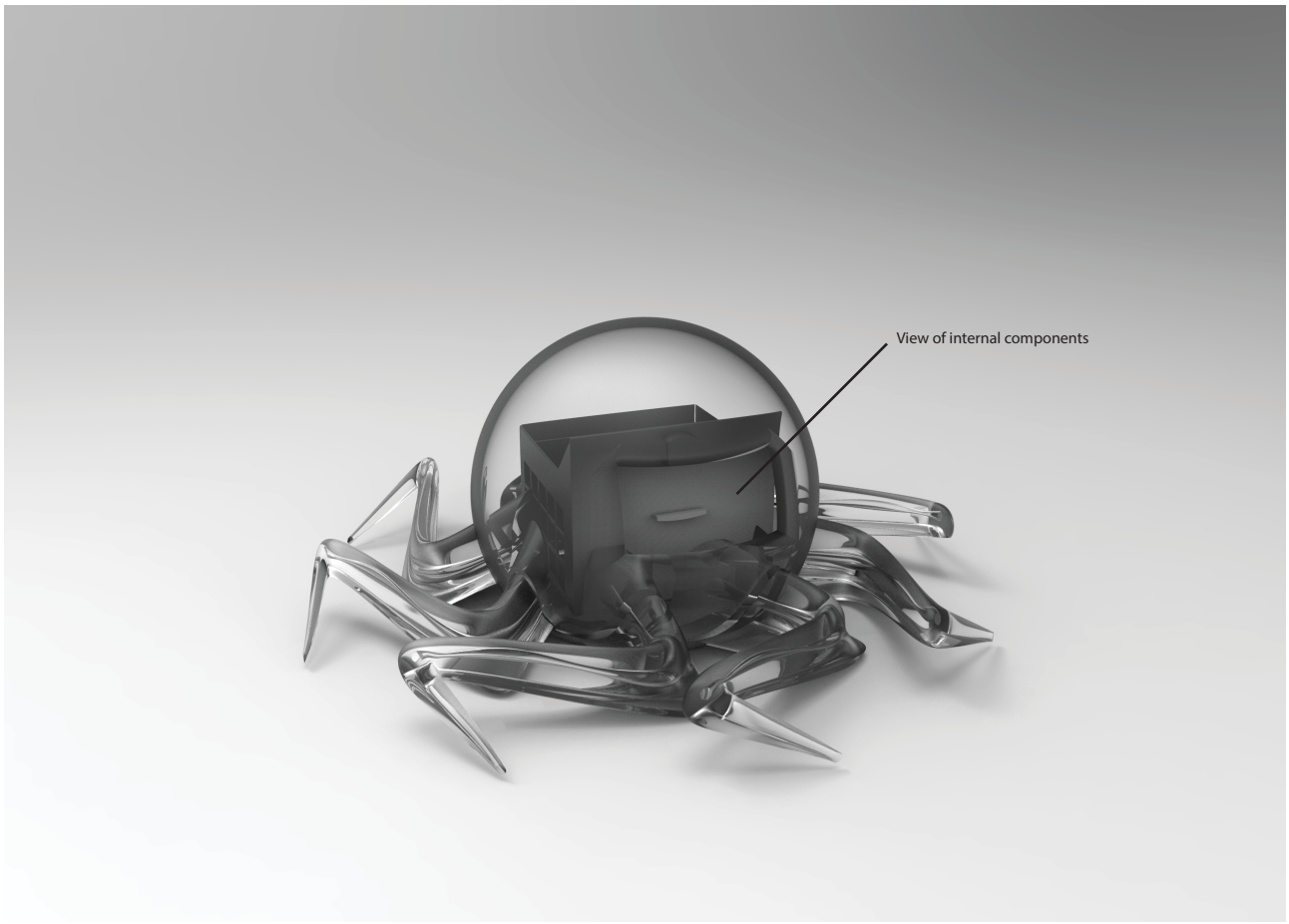
The functions of the outer part:-

1. For the softness of the toy.
2. Aesthetics of the toy.

Material used:- Felt and cotton.

CAD MODEL & RENDERS



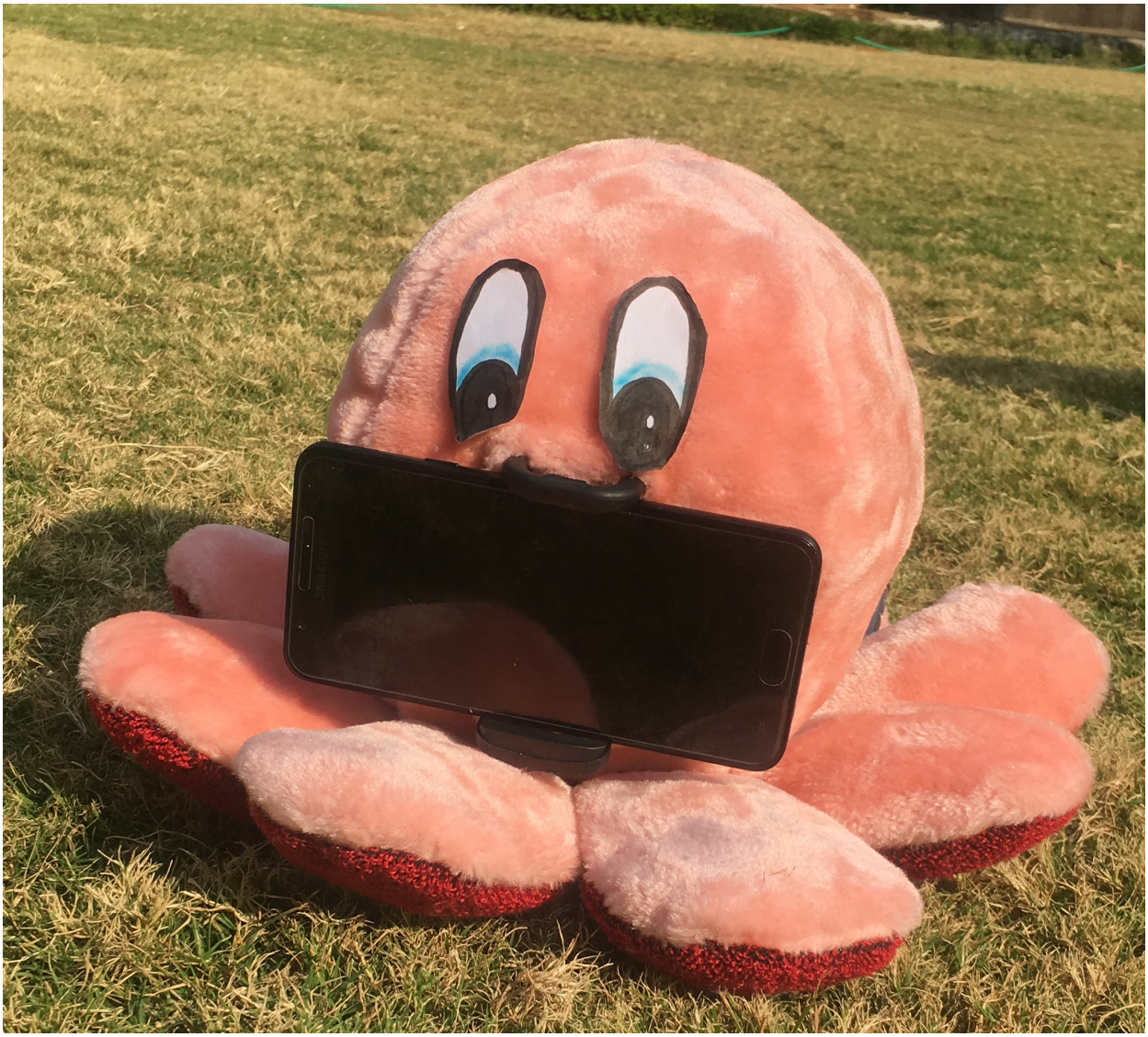


Prototype -

Material used:-

1. Fur cloth
2. Cotton
3. Plastic ball
4. Hardboard strips
5. Copper wires
6. Mobile holder
7. Arduino nano
8. Bluetooth module (HC-05)
9. Jumper wire

10.Perforated board



12.PROGRAMMING

Why an android app?

The objective of the project is to design and fabricate a toy which helps enhance the learning and cognitive skills of a child with Down's syndrome. Taking into consideration their attraction to soft toys, round objects and textures, the Octobud was proposed.

The Octobud is a constant companion for the child. Adding a permanent screen would not only make it costly but also reduce the soft toy factor from the Octobud. Since the Octobud can be thrown around, cuddled with etc, a removable screen was the next best option.
Keeping in mind the feasibility and as an attempt to make the toy economical, mobile screens were an appropriate solution as a replacement for the permanently, potentially breakable screen.

An android application that can be installed in the parent/guardian's phone and can be plugged in for 15-20 minutes so the child to learn. Android phones are common in most households and the application runs on API 21 and higher thus targeting more than 96 per cent of Android users. The phone can be removed from the toy and used as usual.

About the application:

The main objective of the application is to provide visual and audio aid.Android studio IDE is used for developing the whole application.

The application can be used for multiple children as well. Since internet connection in schools is not always available, this application is offline and needs the internet only once, while installing it. It contains a login page which takes username and password as input to provide an authentication to the app that is only the registered users or the parents/guardians can access the features of the app and also kids should not access the app. There is a registration page also for the first time users to register themselves for starting the app for their kids. This page takes the name, email address and password as input and store these in the database and later they are used in the login page to check whether the user is registered or not.

Hardware Interfaces

• Arduino microcontroller along bluetooth module for connectivity with the app.

• Development supports Android version 4.0 and above.

Database: SQLite database is used for storing the data. Database model contains an ID column, a name column, an email address column, a column for a password, one for child's name, one for product serial number and seven for storing the level kid reached in each of the learning feature provided by pressing the tentacles of the Octobud.

Relation Tables:

Table 1:

name	email_id	child_name	password	product_id

Email_id is the primary for this table.

Table 2:

set	level	email_id

Email_id is a foreign key from table 1 and set is foreign key from table 3.

Table 3:

set	level_def	sr.no.	inf_name	video	level

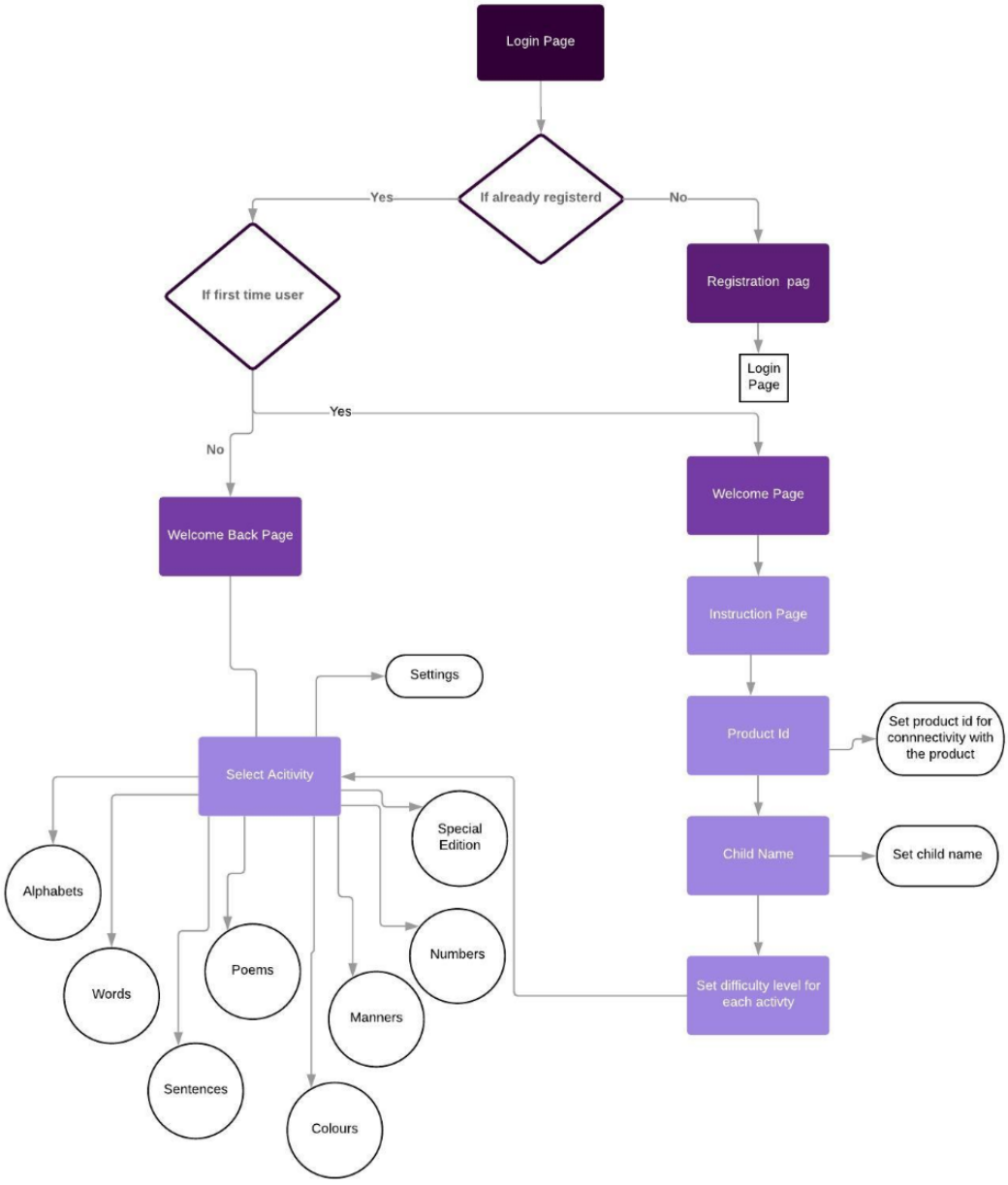
Set and sr.no.(Serial Number) are primary keys for this table.

Different java classes are used for each activity like activity_alphabets, activity_colors, activity_manners etc. and corresponding xml layouts are made with colors and fonts based on our research with down syndrome kids. Suitable java classes and xml layout files are made for instructions pages, pages to set difficulty for each learning activity, login page and register page. Also, android tools like AppCompatActivity, RelativeLayout, etc. are used to make the application visually appealing and easy to use.

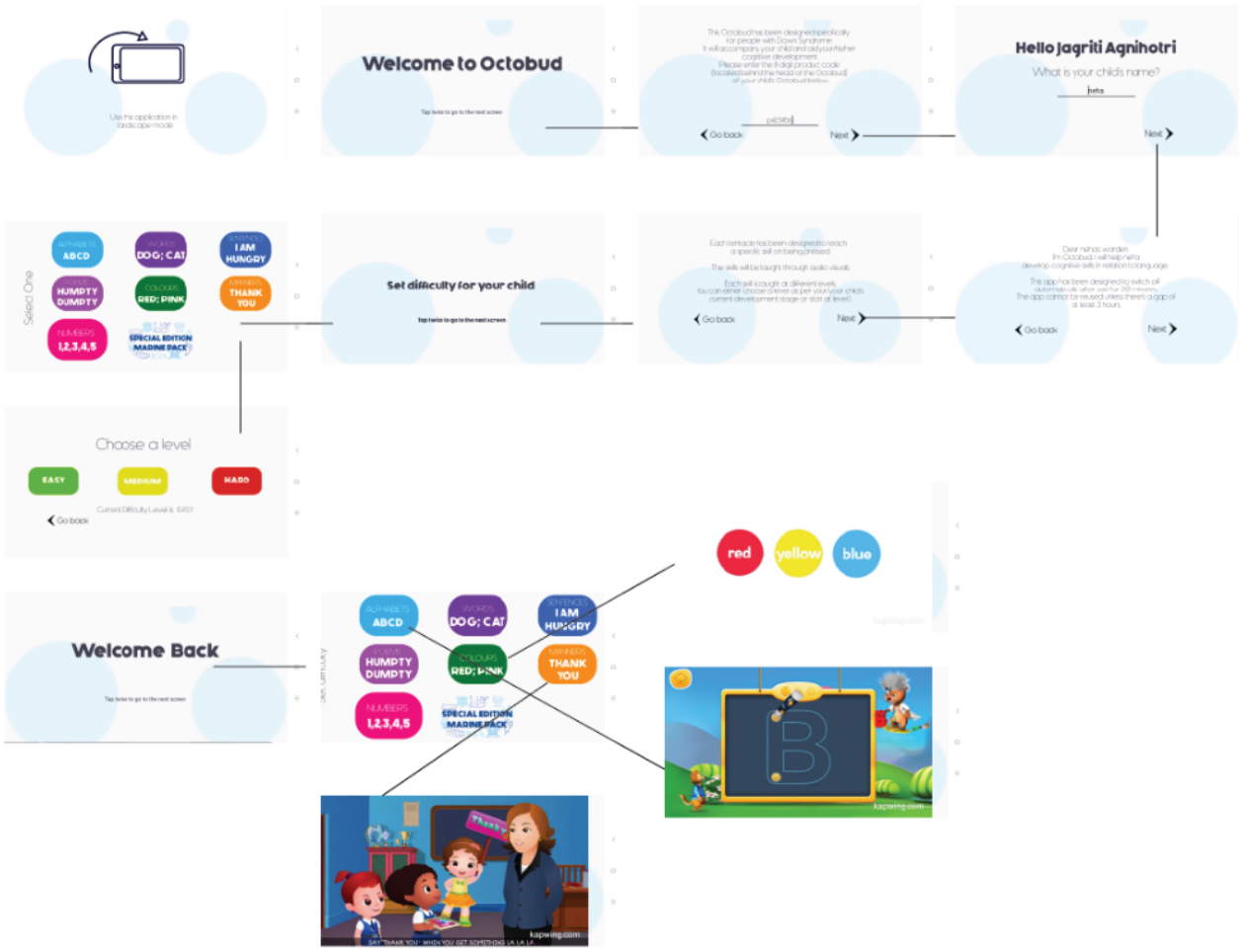
Child's name is asked once the login is done and used in later stages of the app to address the kid. Levels are initialised to one and continuously updated as the kid proceed to higher levels by learning.

Once this is done, a page appears showing seven options each for an activity for learning alphabets, words, sentences, poems, colours, manners or numbers and an extra option for the special edition marine package. On applying pressure on a tentacle, an activity will start corresponding to that

tentacle. Some videos and study material is shown to the child. Each material corresponds to a certain difficulty level. The level that can be perceived by the child is to be determined by the warden and the default setting will be EASY. With the help of videos and quirky animations, the app will have a visual impact on the child thus enabling him/her to retain information and have fun exploring new content and singing along to fun activities. There is a time limit, after which the user or child cannot use the app so that kids do not get addicted to the mobile.



An example of the flow of the app -


Welcome to Octobud
Hello Jagriti Agnihotri
What is your child's name?
Next
Go back
Select One
ALPHABETS
ABCD
WORDS
DOG; CAT
SENTENCE
I AM HUNGRY
RHYMES
HUMPTY DUMPTY
COLOURS
RED; PINK
MARINES
THANK YOU
NUMBERS
1,2,3,4,5
SPECIAL EDITION MARINE PACK
Set difficulty for your child
Choose a level
EASY
MEDIUM
HARD
Welcome Back
red
yellow
blue
B
kapaing.com

13.ELECTRONICS DESIGN

Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

Each of the 14 digital pins on the Nano can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialised functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Nano has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the analogReference() function. Additionally, some pins have specialised functionality:

I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website).

There are a couple of other pins on the board:

AREF. Reference voltage for the analog inputs. Used with analogReference().

Reset. Bring this line LOW to reset the micro controller. Typically used to add a reset button to shields which block the one on the board.

Communication

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other micro controllers. The ATmega168 and ATmega328 provide UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino software) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the FTDI chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A SoftwareSerial library allows for serial communication on any of the Nano's digital pins. The ATmega168 and ATmega328 also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. To use the SPI communication, please see the ATmega168 or ATmega328 data sheet.

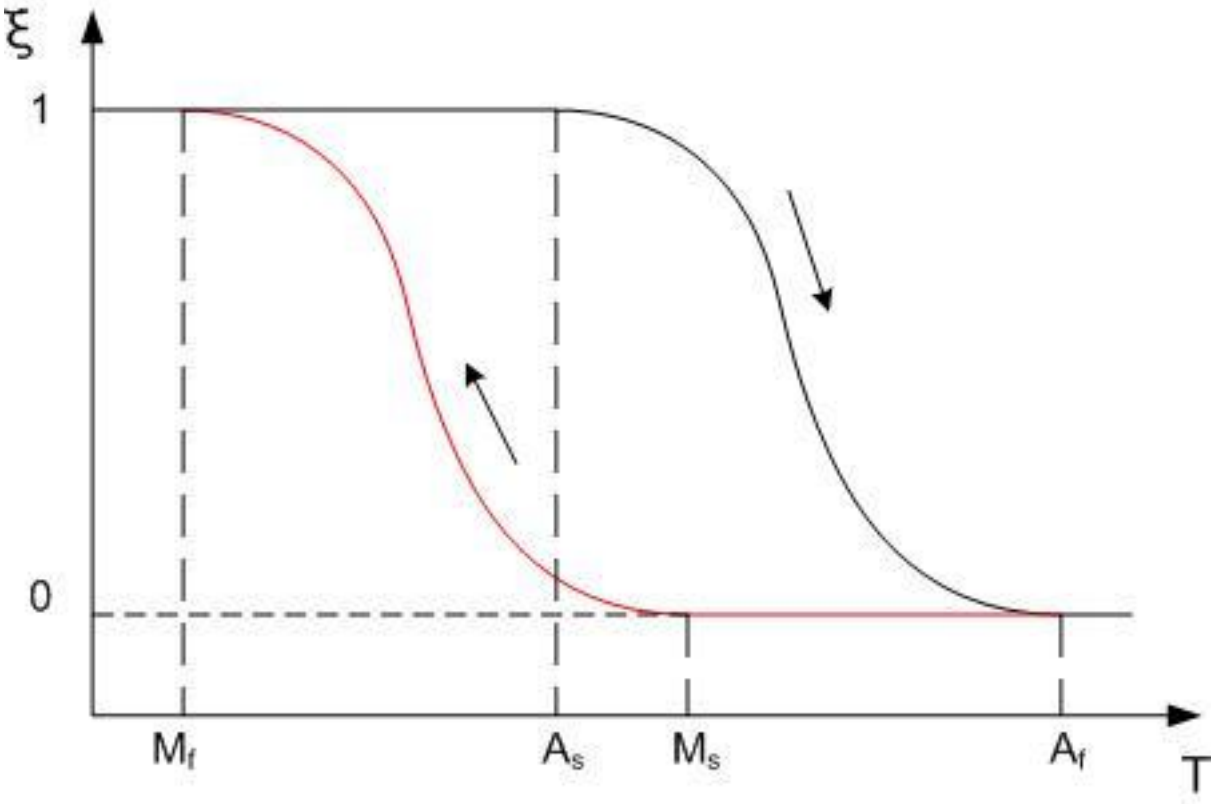
Muscle Wire

Muscle Wires are thin, highly processed strands of a nickel-titanium alloy called **Nitinol** – a type of **Shape Memory Alloy** that can assume radically different forms or "phases" at distinct temperatures. Below are some questions and answers to some commonly asked questions about Muscle Wire.

The two most prevalent shape-memory alloys are copper-aluminium-nickel, and nickel-titanium (NiTi) alloys but SMAs can also be created by alloying zinc, copper, gold and iron. Although iron-based and copper-based SMAs, such as Fe-Mn-Si, Cu-Zn-Al and Cu-Al-Ni, are commercially available and cheaper than NiTi, NiTi based SMAs are preferable for most applications due to their stability, practicability and superior thermo-mechanic performance. SMAs can exist in two different phases, with three different crystal structures (i.e. twinned martensite, detwinned martensite and austenite) and six possible transformations

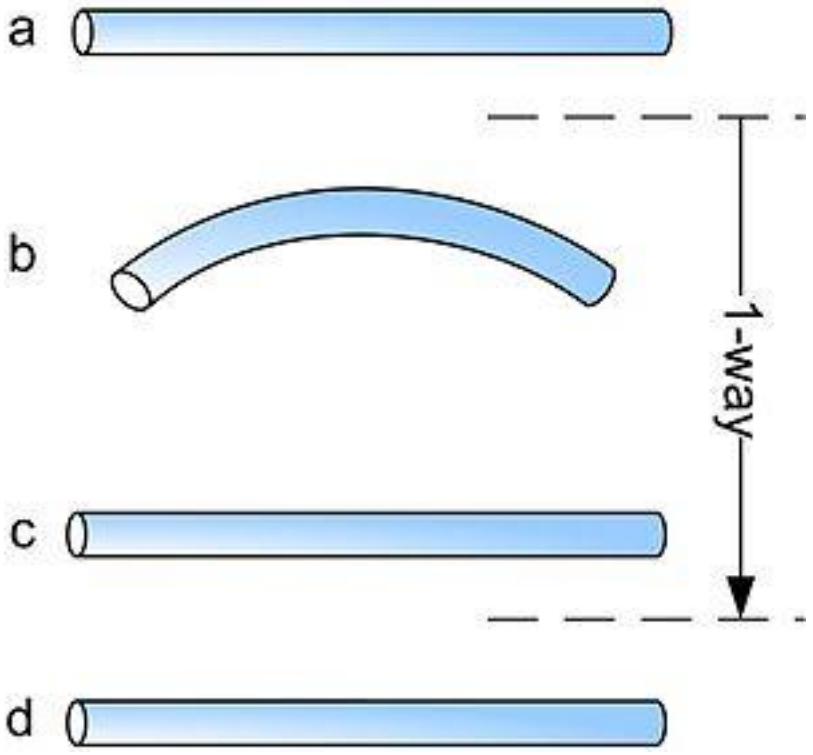
NiTi alloys change from austenite to martensite upon cooling; M_f is the temperature at which the transition to martensite completes upon cooling. Accordingly, during heating A_s and A_f are the temperatures at which the transformation from martensite to austenite starts and finishes. Repeated use of the shape-memory effect may lead to a shift of the characteristic transformation temperatures (this effect is known as functional fatigue, as it is closely related with a change of macrostructural and functional properties of the material). The maximum temperature at which SMAs can no longer be stress induced is called M_d, where the SMAs are permanently deformed.

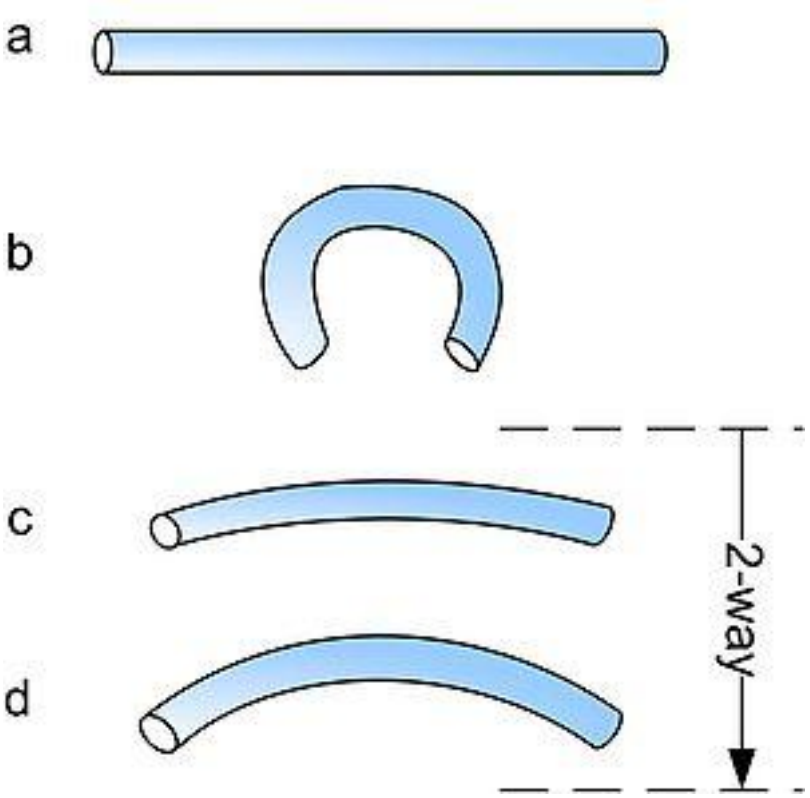
The transition from the martensite phase to the austenite phase is only dependent on temperature and stress, not time, as most phase changes are, as there is no diffusion involved. Similarly, the austenite structure receives its name from steel alloys of a similar structure. It is the reversible diffusion less transition between these two phases that results in special properties. While martensite can be formed from austenite by rapidly cooling carbon-steel, this process is not reversible, so steel does not have shape-memory properties.



One-way vs. two-way shape memory

Shape-memory alloys have different shape-memory effects. Two common effects are one-way and two-way shape memory. A schematic of the effects is shown below.





The procedures are very similar: starting from martensite (a), adding a reversible deformation for the one-way effect or severe deformation with an irreversible amount for the two-way (b), heating the sample (c) and cooling it again (d).

One-way memory effect

When a shape-memory alloy is in its cold state (below A_s), the metal can be bent or stretched and will hold those shapes until heated above the transition temperature. Upon heating, the shape changes to its original. When the metal cools again it will remain in the hot shape, until deformed again.

With the one-way effect, cooling from high temperatures does not cause a macroscopic shape change. A deformation is necessary to create the low-temperature shape. On heating, transformation starts at A_s and is completed at A_f (typically 2 to 20 °C or hotter, depending on the alloy or the loading conditions). A_s is determined by the alloy type and composition and can vary between −150 °C and 200 °C.

Two-way memory effect

The two-way shape-memory effect is the effect that the material remembers two different shapes: one at low temperatures, and one at the high-temperature shape. A material that shows a shape-memory effect during both heating and cooling is said to have two-way shape memory. This can also be obtained without the application of an external force (intrinsic two-way effect). The reason the material behaves so differently in these situations lies in training. Training implies that a shape memory can "learn" to behave in a certain way. Under normal circumstances, a shape-memory alloy "remembers" its low-temperature shape, but upon heating to recover the high-temperature shape, immediately "forgets" the low-temperature shape. However, it can be "trained" to "remember" to leave some reminders of the deformed low-temperature condition in the high-temperature phases.

There are several ways of doing this. A shaped, trained object heated beyond a certain point will lose the two-way memory effect.

Bluetooth Module

HC-05 Bluetooth Module

HC−05 module is an easy to use **Bluetooth SPP (Serial Port Protocol) module**,designed for transparent wireless serial connection setup.The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication.This serial port bluetooth module is fully qualified **Bluetooth V2.0+EDR (Enhanced Data Rate)**3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses **CSR Bluecore 04−** External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

Bluetooth Module HC-05

The Bluetooth module HC-05 is a MASTER/SLAVE module.By default the factory setting is SLAVE.The Role of the module (Master or Slave) can be configured only by AT COMMANDS.The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections.Master module can initiate a connection to other devices.The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.

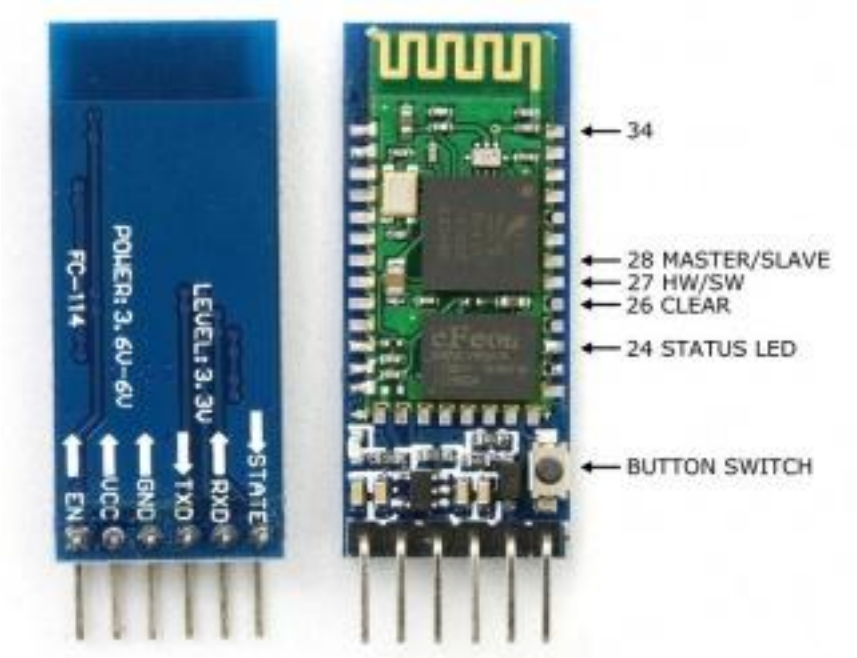
Hardware Features

- Typical −80dBm sensitivity.
- Up to +4dBm RF transmit power.

- 3.3 to 5 V I/O.
- PIO(Programmable Input/Output) control.
- UART interface with programmable baud rate.
- With integrated antenna.
- With edge connector.

Software Features

- Slave default Baud rate: 9600, Data bits:8, Stop bit:1,Parity:No parity.
- Auto−connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto−pairing PINCODE:”1234” as default.



Pin Description

The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

When enable is pulled **LOW**, the module is disabled which means the module will **not turn on** and it **fails to communicate**.When enable is **left open or connected to 3.3V**, the module is enabled i.e the module **remains on** and **communication also takes place**.

Vcc:

Supply Voltage 3.3V to 5V

GND:

Ground pin

TXD & RXD:

These two pins acts as an UART interface for communication

STATE:

It acts as a status indicator. When the module is **not connected to / paired** with any other bluetooth device, signal goes **Low**.At this **low state**, the **led flashes continuously** which denotes that the module is **not paired** with other device. When this module is **connected to/paired** with any other bluetooth device, the signal goes **High**. At this **high state**, the **led blinks with a constant delay** say for example 2s delay which indicates that the module is **paired**.

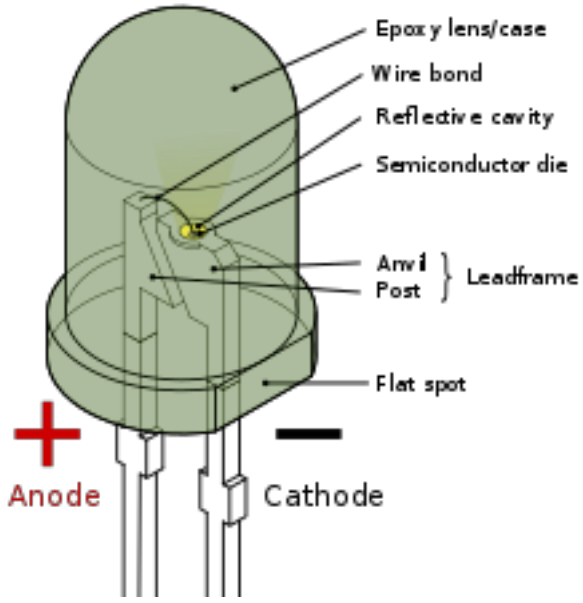
BUTTON SWITCH:

This is used to switch the module into AT command mode.To enable AT command mode press the button switch for a second.With the help of AT commands the user can change the parameters of this module but only when the module is not paired with any other BT device.If the module is connected to any other bluetooth device, it starts to communicate with that device and fails to work in AT command mode.

Push Button

A **push-button** (also spelled **pushbutton**) or simply **button** is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, although many un-biased buttons (due to their physical nature) still require a spring to return to their un-pushed state. Terms for the "pushing" of a button include **pressing**, **depressing**, **mashing**, **hitting**, and **punching**.

LED



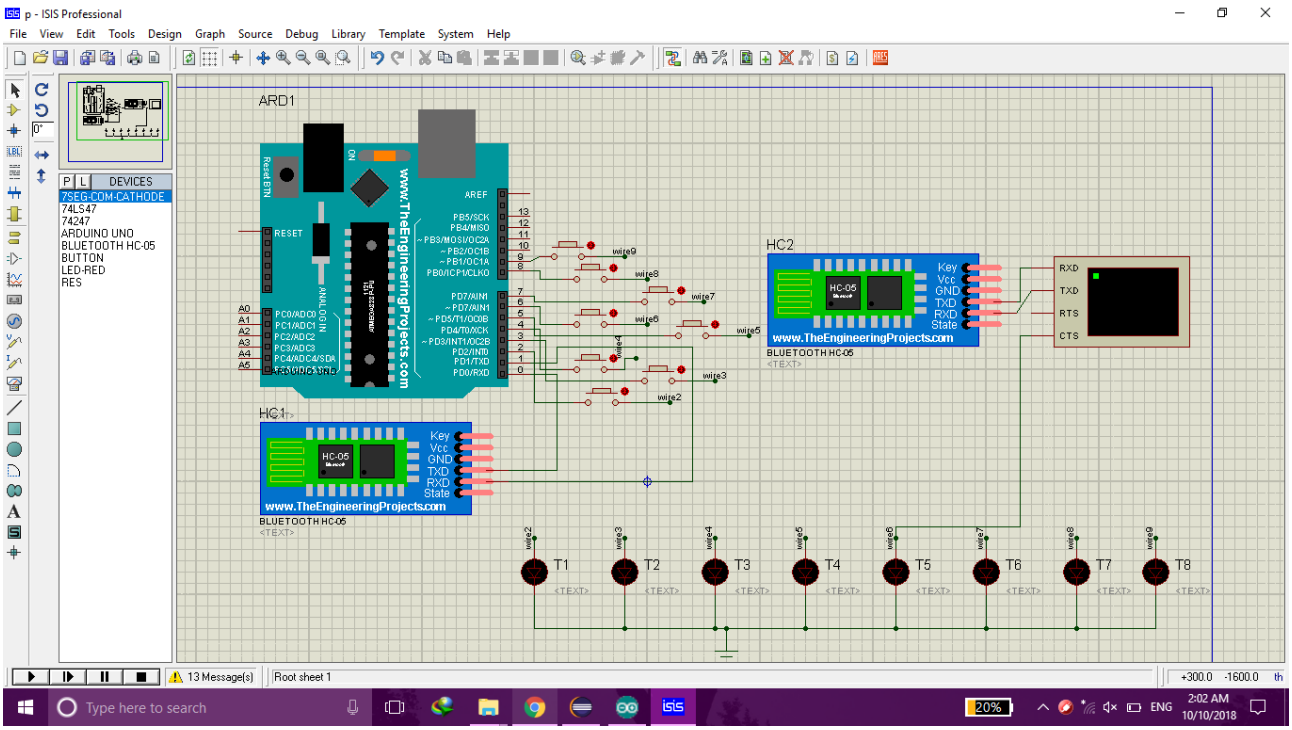
A **light-emitting diode** (**LED**) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated. When a suitable current is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm^2) and integrated optical components may be used to shape the radiation pattern.

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light. Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays and were commonly seen in digital clocks. Recent developments have produced LEDs suitable for environmental and task lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

Unlike a laser, the colour of light emitted from an LED is neither coherent nor monochromatic, but the spectrum is narrow with respect to human vision, and for most purposes the light from a simple diode element can be regarded as functionally monochromatic.

Image of the circuit



Code

```
void setup() {

Serial.begin(9600);

pinMode(2, OUTPUT);
```

pinMode(3, OUTPUT);

pinMode(4, OUTPUT);

pinMode(5, OUTPUT);

pinMode(6, OUTPUT);

pinMode(7, OUTPUT);

pinMode(8, OUTPUT);

pinMode(9, OUTPUT);

}

void loop() {

Serial.println("Please enter 'a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', ");

while(Serial.available()==0){ }

motion=Serial.readString();

if(motion=="a"){

digitalWrite(2,HIGH);

}

if(motion=="b"){

digitalWrite(3, HIGH);

}

}

if(motion=="c"){

digitalWrite(4, HIGH);

}

}

if(motion=="d"){

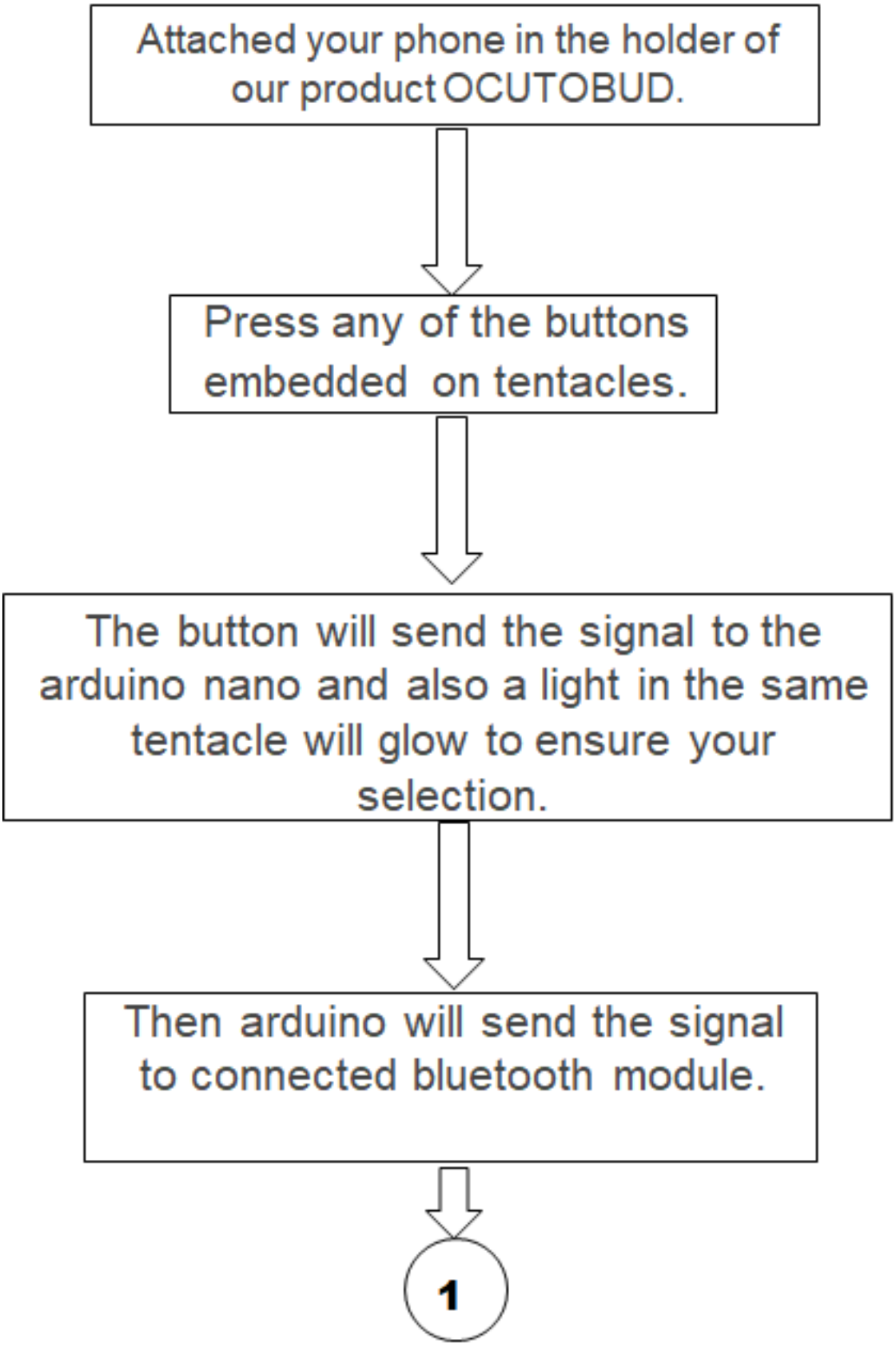
digitalWrite(5, HIGH);

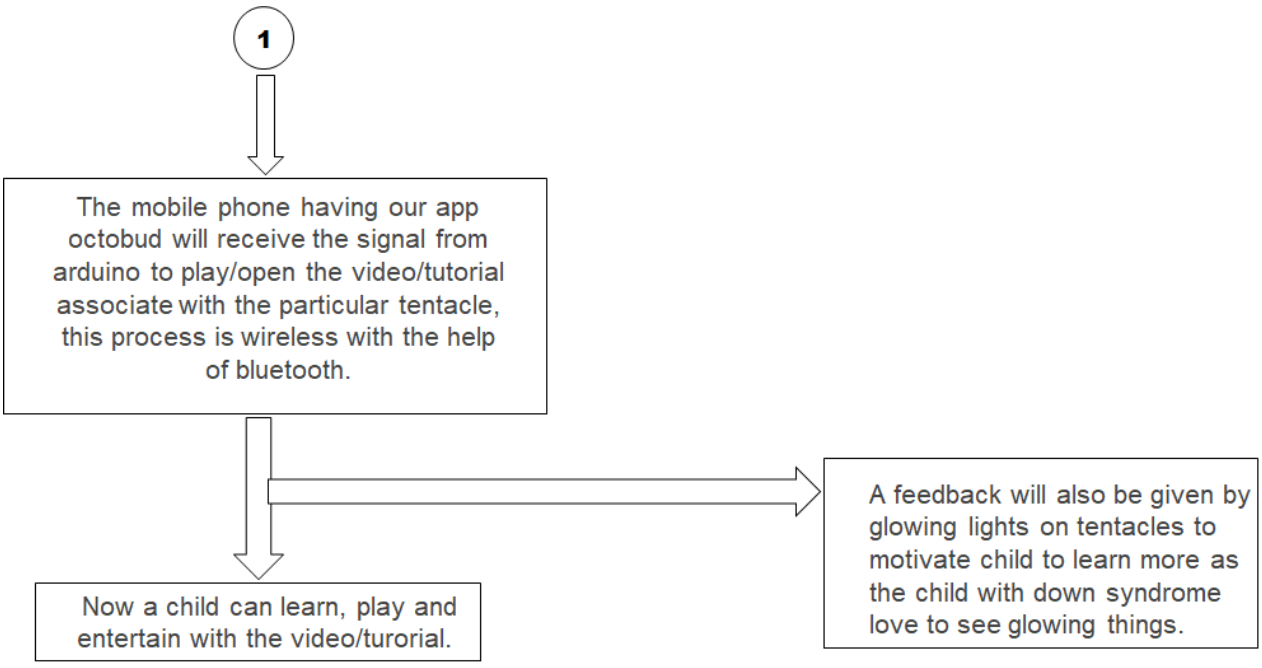
}

```
}
if(motion==&amp;quot;e&amp;quot;){
digitalWrite(6, HIGH);
}
}
if(motion==&amp;quot;f&amp;quot;){
digitalWrite(7, HIGH);
}
}
if(motion==&amp;quot;g&amp;quot;){
digitalWrite(8, HIGH);
}
}
if(motion==&amp;quot;h&amp;quot;){
digitalWrite(9, HIGH);
```


Signal Flow In Circuit

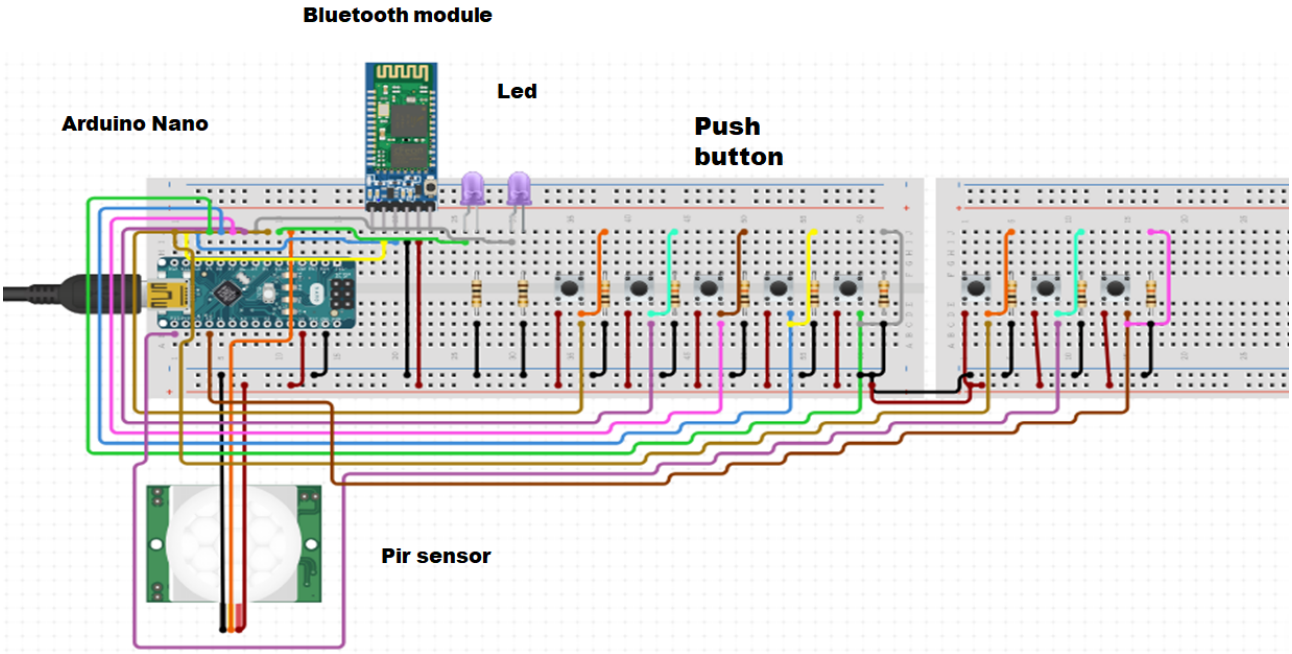
(flowchart)



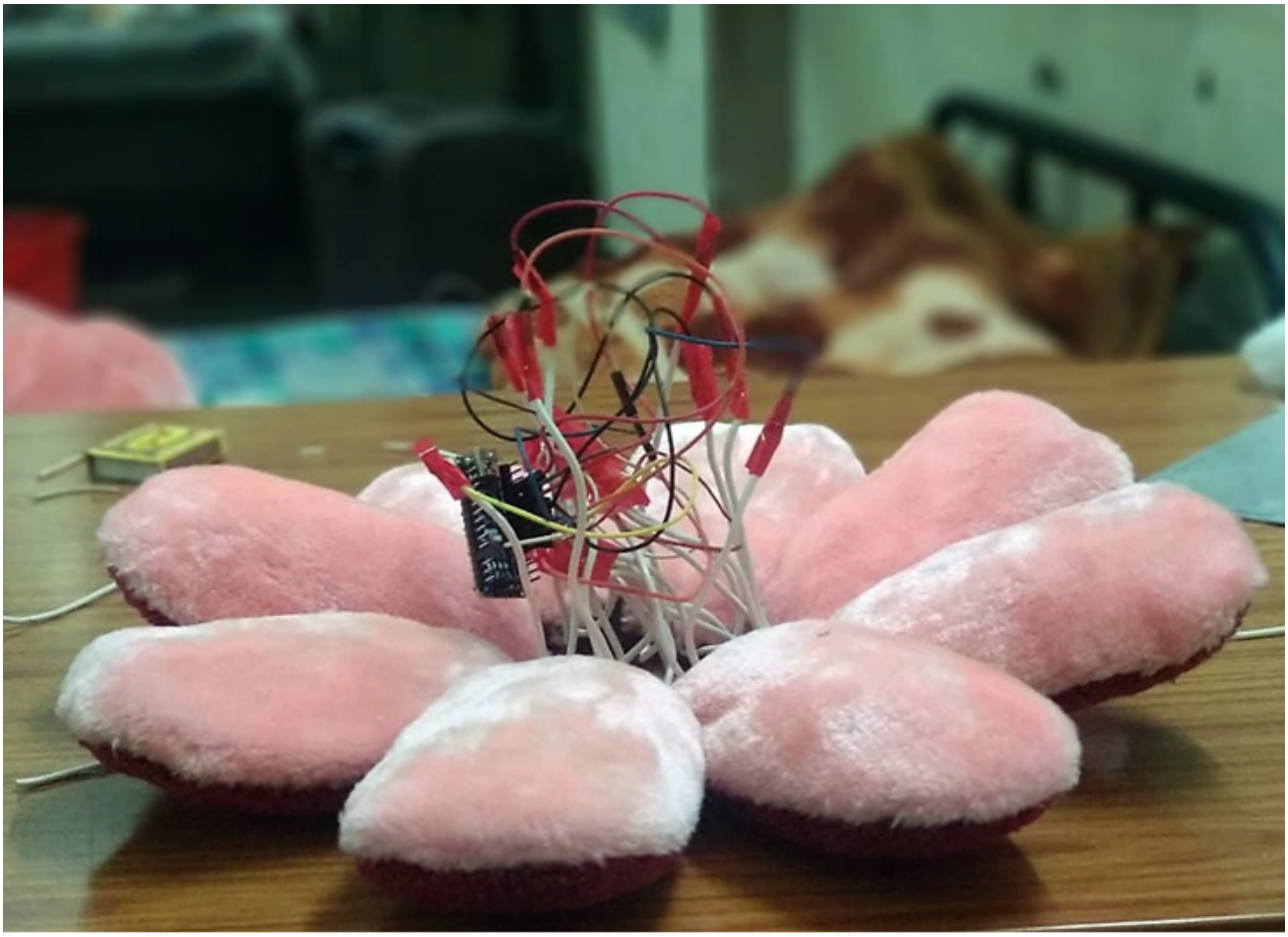


Circuit Diagram (designed in circuitio.io)

Circuit setup inside the toy



Circuit Inside Tentacle



Tentacles collectively grouped

Final Arduino Codes

```
void setup() {
  // put your setup code here, to run once:
  pinMode(1,INPUT);
  pinMode(2,INPUT);
  pinMode(3,INPUT);
  pinMode(4,INPUT);
  pinMode(5,INPUT);
  pinMode(6,INPUT);
  pinMode(7,INPUT);
  pinMode(8,INPUT);

  Serial.begin(9600);
  Serial.print(1);
  delay(2000);
  Serial.print(2);
}

void loop() {
  // put your main code here, to run repeatedly:
  if(digitalRead(1)){
      Serial.print("1");
      exit(0);
  }
  else if(digitalRead(2)){
      Serial.print("2");
```


```
    exit(0);
}
else if(digitalRead(3)){
    Serial.print("3");
    exit(0);
}
else if(digitalRead(4)){
    Serial.print("4");
    exit(0);
}
else if(digitalRead(5)){
    Serial.print("5");
    exit(0);
}
else if(digitalRead(6)){
    Serial.print("6");
    exit(0);
}
else if(digitalRead(7)){
    Serial.print("7");
    exit(0);
}
else if(digitalRead(8)){
    Serial.print("8");
    exit(0);
}
```

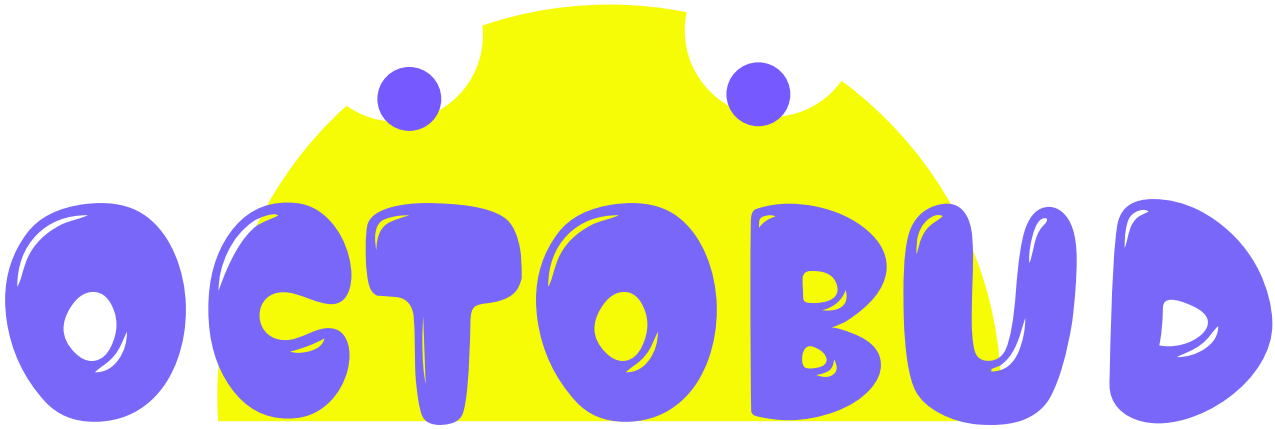

}

Scope of the product from ECE point of view

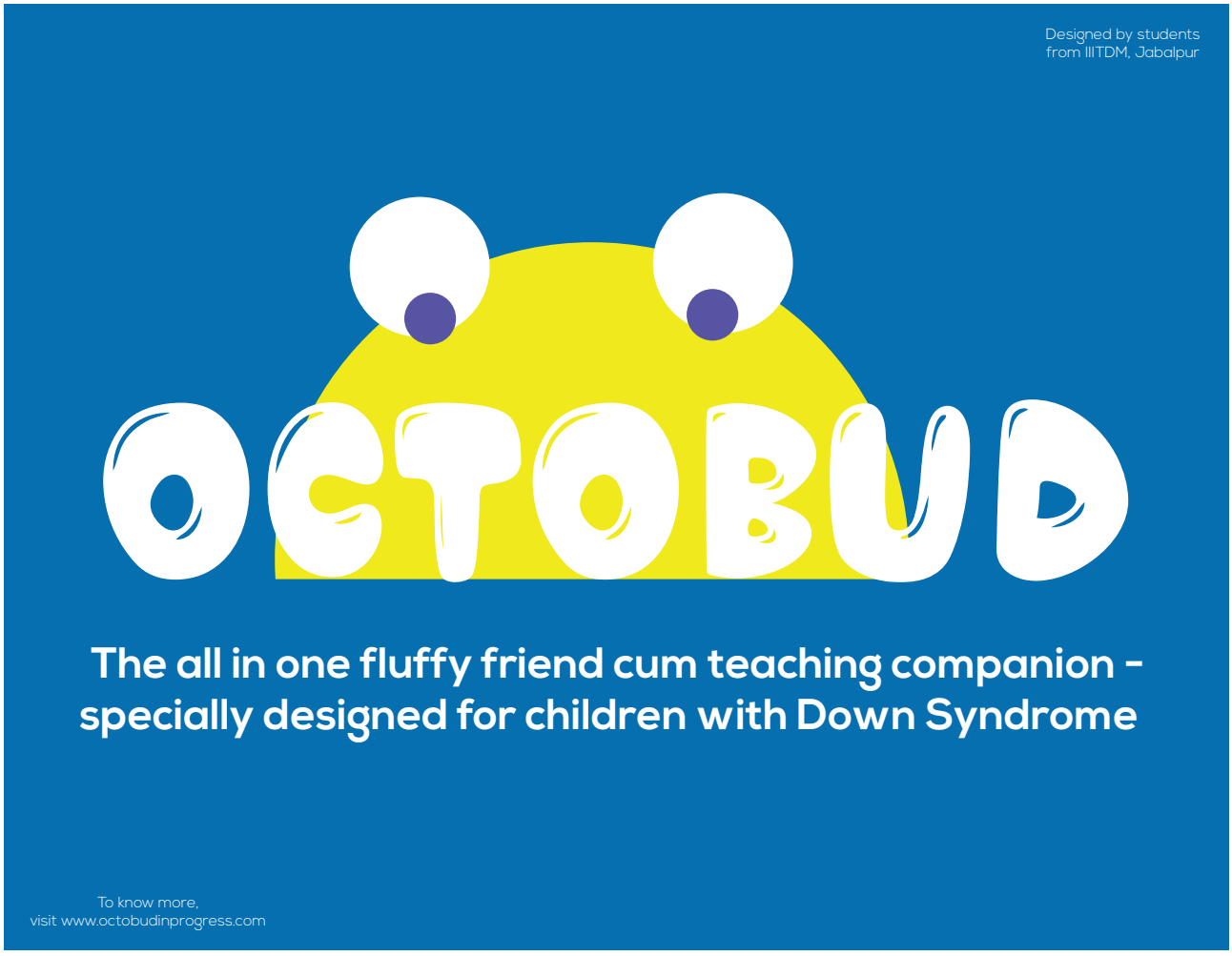
Here we are using Arduino nano and bluetooth module in our product Octobud as it is a prototype only. On the mass production we will use ICs in the place of Arduino and will connect the mobile phone with the ICs through AUX or mini USB cable to eliminate bluetooth module and this will exponentially decrease the manufacturing cost of our product.

14.LOGO & BROCHURE DESIGN

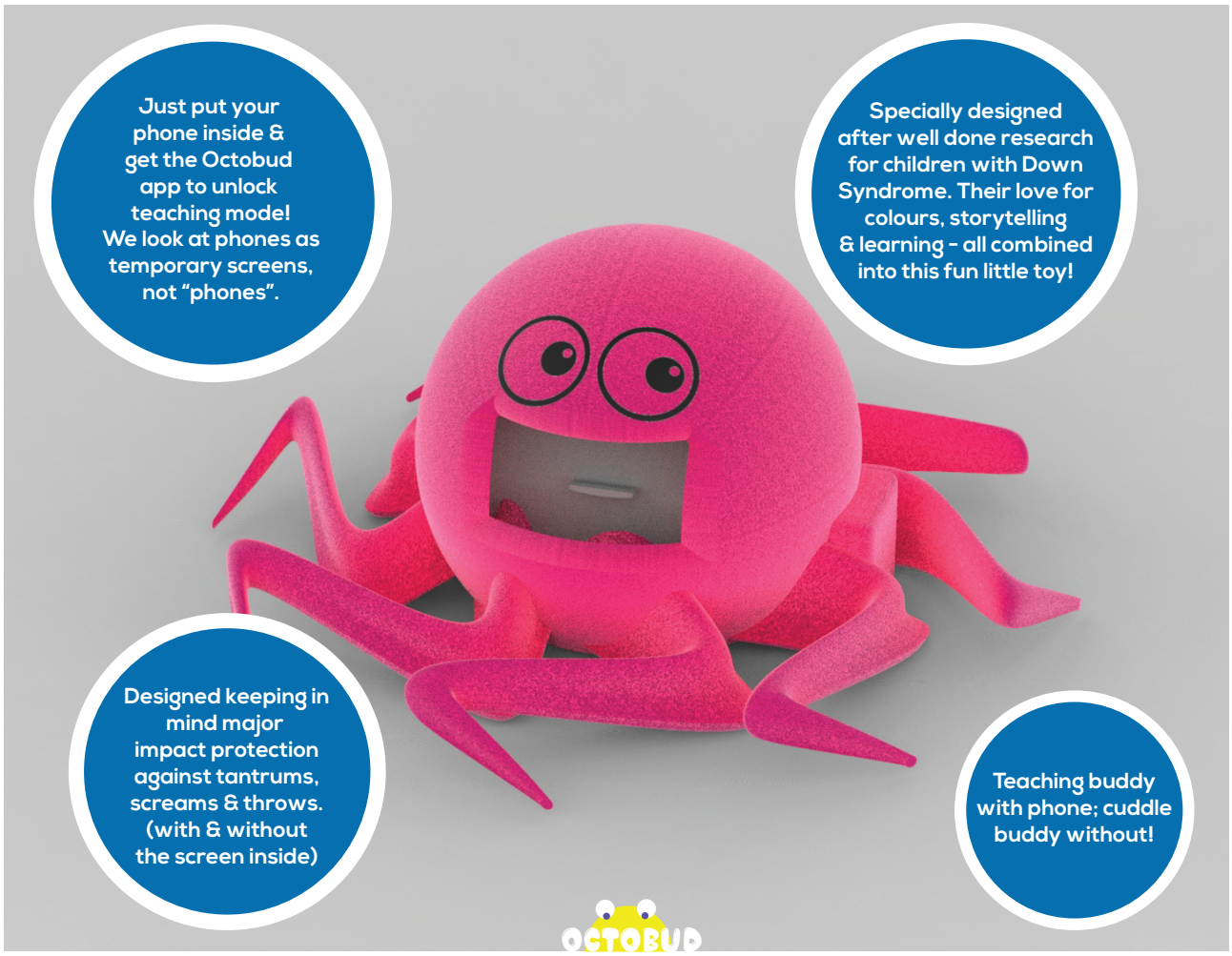
Logo -



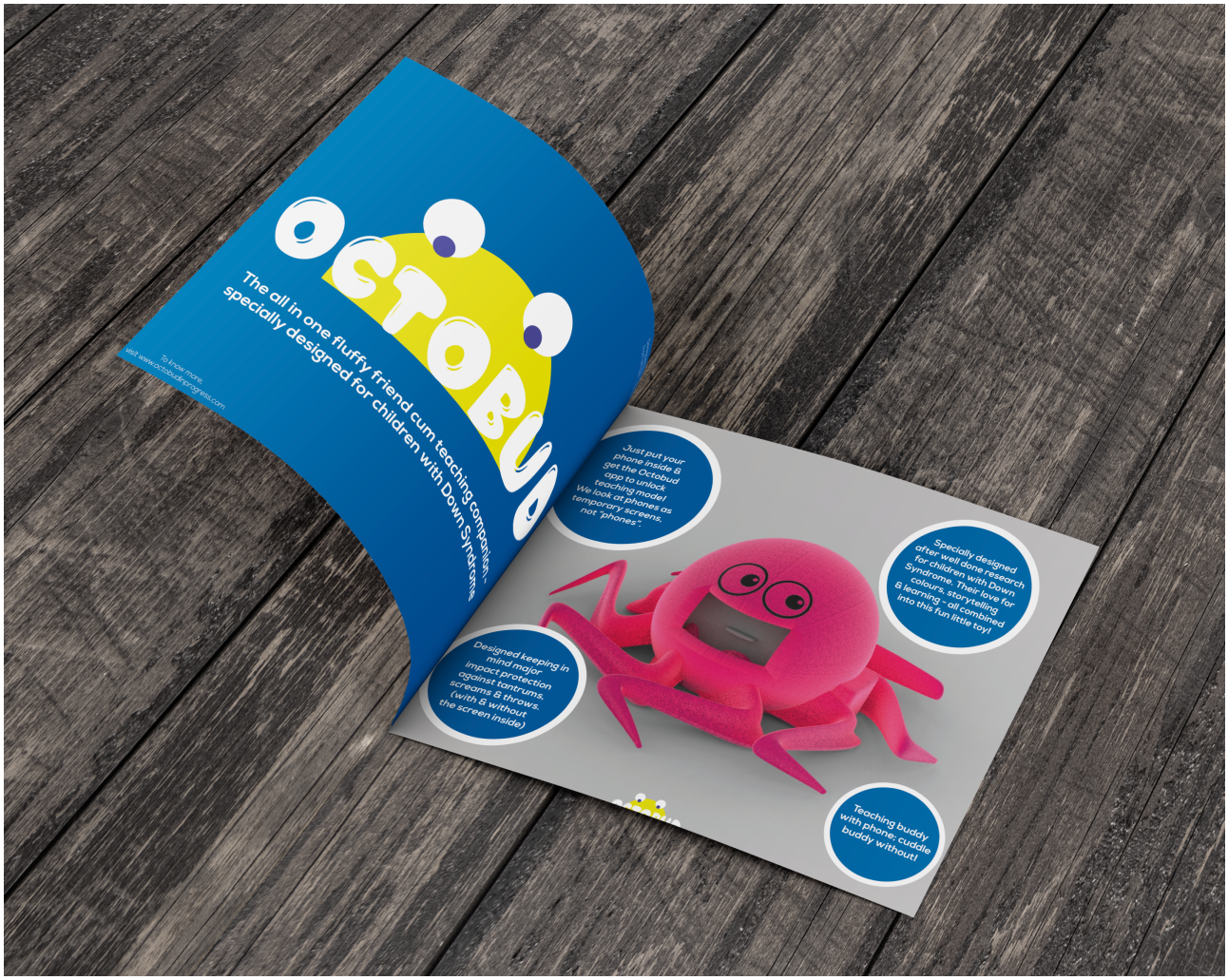
Brochure Front -



Brochure Back -



Brochure Mockup -



15.CONCLUSION

We would like to conclude by stating that this toy created by Group 6A would lead to a very well rounded learning & experience for children with Down Syndrome. The learnings that we gained in this project are mainly related to teamwork & cross collaboration.

Managing various team members, disciplines & meetings; collaborating across different disciplines & learnings from each other were major inputs to our growth as engineers & designers. The engineers got to learn a lot about how design influences a product & what the design process is - from design thinking, design research, iterations & a problem oriented approach. They also learnt about prototyping in relation to design. The designer learnt how to manage 2 teams and diverse team members along with learnings from the field of engineering in relation to Mechanical Engineering, Electronics & Communication Engineering & Computer Science Engineering. These learnings ended up giving each member a very wholesome development & skillset - which is extremely necessary for engineers & designers of today.

We hope to take this project forward by patenting it, & talking to various schools of Jabalpur & toy companies regarding the manufacturing & implementation.

This project taught us a lot about the importance of engineers & designers working together & the engineering design process. We hope to do more projects like this in the future,