WISH 2024 DESIGN THINKING PROJECT

TOPIC : SMART TOY

SUBMITTED BY :

Nandini G WISH2430

Ishita Misra WISH2443

Rutuja Bidwai WISH2492

Gargey Pandey WISH2468

Serial no.	Topic	Page No.
1	Defining the problem statement	
2	Empathize with the end-user	
3	Ideation	
4	Prototype	
5	Testing	
6	Conclusion and reference	

TABLE OF CONTENTS

DEFINING THE PROBLEM STATEMENT:

Question given to be worked upon:

One of the earliest applications of the DSP was a solution called “Speak and Spell” which was a toy that helped children to learn how words are spelt. Can you think of a smart toy that can help people learn a new skill or a new language while also being a fun experience to use it? Think of how personal safety can be taught to children, or water / electricity conservation can be taught to children, etc.

Problem Statement we came up with:

In a world where children are increasingly attracted to electronic gadgets, parents are concerned about the adverse effects of excessive screen time. Traditional toys like wooden playthings and paper books are favoured for their developmental benefits but often fail to capture and maintain children's interest in the long term. There is a pressing need for an innovative solution that combines the best of both worlds: the engagement potential of electronic toys and the developmental benefits of traditional playthings. We aim to develop a smart toy that not only decreases screen time but also actively engages children through interactive, two-way experiences. This smart toy will help children understand environmental awareness, and grasp basic science concepts in a fun and engaging manner. Moreover, it will feature a unique smart code detector/generator, adding an educational layer that teaches children about Morse code and basic coding principles.

By addressing the limitations of both traditional and electronic toys, this smart toy will provide a holistic, engaging, and educational play experience, promoting balanced development and reducing dependency on screens.

Extensive user research was conducted to ensure our smart toy effectively meets the needs of children and their parents. We surveyed and interviewed parents to understand their concerns about screen time and their preferences for educational toys. Observations of children's play habits revealed a need for interactive and engaging toys that combine learning with fun. In addition to being cost-effective, the toy addresses parents' concerns about excessive screen time. Its engaging, interactive modes—Morse code detector/generator and house game for teaching energy and water conservation—provide stimulating alternatives to electronic gadgets.

Screen Time

Extensive user research informed the development of our smart toy by addressing parents' concerns about excessive screen time. Through surveys and interviews, we learned that many parents are apprehensive about the amount of time children spend on electronic devices. Our toy offers engaging alternatives to screen-based entertainment, encouraging active play and hands-on learning with interactive modes like the Morse code detector/generator and the house game for energy and water conservation.

Non-Interactive and Costly Toys

Observations of children's play habits highlighted a need for interactive and affordable educational toys. Many traditional toys lack ongoing engagement, leading to boredom. Our smart toy fills this gap by using durable, cost-effective materials and innovative technology, we ensure that the toy remains accessible without compromising on quality or educational value.

Working Parents' Time Constraints

Understanding the challenges faced by working parents, we designed our smart toy to support independent play and learning. With interactive features, children can engage with the toy effectively even when parents are occupied. This allows children to learn and play autonomously, fostering developmental skills throughout the day.

EMPATHIZE.

Empathize is to understand what the user is actually struggling with by being in the user's shoe. It was necessary to observe the lifestyles of parents first, for us to design a toy for their children.

When asked to Smita Mahajan primary school teacher and a mother of two it was sighted that both her and her partner are working professionals and thus the major challenge they have **is giving proper time and attention** to their children. She stated that, to stay at home and interact and **track weather her children are even watching appropriate content** is not easily possible for her and it became very **difficult for her to keep a balance between Education and Screen Interaction** of her children and she always had an **urge to find an alternatives** in the age of growing digitalization.

Akola based Housemaker Komal Patankar spoke to us on how the **day boarding schooling** for her children leads to them have a long time in school , so they **hate to study at home** even for a while, along with this their tuition classes add on to their studies thus they **constantly ask for mobile phones** . She wished if there was **device or toy which could engage, entertain and educate** at the same time it would be of great help to her.

We asked 5 parents to list out 5 healthy and unhealthy habits of them and their children. Most of the parents defended their children when it came to unhealthy habits saying that they **watch Instagram reels** because we do. So, it was clear from that , that parent’s behaviour and habits too influence the activities their children do. Along with this we also collected most common issues and tried to work on them for our toy model

The parent who is not able to give time to their child tries to compensate them with all the luxuries and advanced technologies and It is mostly seen these days that **kids view their mobiles, i-pads, laptops and computers as their besties** instead of their parents.

Few parents also stated that kids do play games that is okay to some extent but they constantly **ask google or visit Youtube for the solutions and cheat codes** of those game as well , this the level at which they are being tech savvy.

In **schools as well digitization is anchoring** itself in the form for interactive and smart boards and further adds on to the pre-existing problems of increased screen-time, weak eye-sight, constant headaches and what not. When children are at home for summer , filling their day with fun activities feels daunting, so, in order to keep the child engaged and occupied , screen time is constantly increased.

It us very important for us to let the kids be kids. Mobile phones, video games and televisions were all invented to entertain children **but these advancements eliminate the need for children to use their own imagination.** With elementary children, behavioural problems and violence may arise due to excess screen time.

Games hurting children's studies, causing distractions, attention span problems, making their creativity suffer and above all **reducing their social interactions** are major concerns of parents these days. They expect that toys should be engaging and should promote learning, should develop spatial skills like building blocks do, improve problem solving abilities how puzzles, provide them with literary knowledge and be interactive.

When asked “What do parents exactly want from toys?”, in a survey by Mirror.com and American Society it was found that 68% parents want the toy to improve their kids fine motor skills and 67% parents want it to boost their imagination and creativity and to teach them collaboration and sharing.

Few of them also said that they want their child to develop important cognitive skills such as pattern recognition, attention to detail and sequential thinking.

Working parents often have to leave their child in daycare and the caretakers there often find it easy to play cartoons and videos on tv and engage the kids.

For stay-at-home mothers, the cost of advanced and smart toys is also of concern. Thus, if we could come up with something that can be used as a medium to teach children at home and even can be used as aid in day care in minimal cost and optimized size then it will be of great help.

In the world of digitization eyesight problems are arising and the imagination power of kids is killed by the preset images in their devices . Mobiles and VRs are doing that mostly. We always forget that these devices can provide us with the information but they can’t actually develop us in an all-round way. There is 30% less absorption and retention when children learn from virtual devices.

Thus it is a challenge for us to work on something which will keep the imagination of a child alive till a long time , something which could help kids visualize instead of auto-feeding them.

Based on the user research approach, some of the key challenges and pain points that parents may face, which the smart toy could potentially address would be:

1. Keeping Children Engaged and Entertained

2. Supporting Learning and Development

3. Balancing Screen Time and Digital Interactions:

4. Tailoring to Individual Needs and Preferences

5. Ease of Use and Integration into Daily Routines

6. Fostering Social-Emotional Skills

By addressing these key challenges and pain points through the smart toy's design and features, you can create a product that truly resonates with parents and enhances their children's learning and development.

IDEATION

Introduction:

From the very start, we aimed to create something that could entertain children and be beneficial or useful to them in the long term. We considered various ideas. One idea that emerged was to create something using a **Finite State Machine**, but we were initially unsure what to do. We wanted to implement an automatic dispenser that would generate a treat if the child gave the correct answer, keeping the child engaged and happy using a toy.

Initial Research and Ideas:

We watched many YouTube videos and thought about implementing something by learning about microcontrollers and DSP. Since we had no proper understanding of these courses, a new idea arose: creating something to reduce children's screen time, a major concern for parents nowadays. We thought of implementing speech recognition that would respond in a selected language or detecting signals for teaching guitar through signal processing. We even reviewed a research paper by Julie Doll that involved various sensors and interacted with humans.

Another idea was implementing a house game where children would learn about conservation of energy and water through questions. We also considered making something for Braille users. We explored various blogs and research papers about smart toys. One blog described a parent who created a toy that played their child's favourite song by touch, without interacting with a phone or iPad, helping to reduce screen time. We also thought of implementing Morse code based on touch sensors, which could be useful for children to learn communication in distress situations.

Finalised Ideas:

1. Braille System Learning
2. Morse Code based on tapping patterns and sound beeping
3. House games for awareness on water and energy conservation or basic science facts
4. Learning languages or instruments based on speech recognition
5. Games to teach personal and internet safety

Rejected Ideas:

However, we had to reject a few ideas. Braille devices already exist, so we needed to create something new. Learning languages based on speech recognition was too monotonous, given the existence of tools like Google. Games for teaching personal and internet safety were also rejected because they required screens, which we wanted to avoid.

Focused Concepts:

We moved forward with **house games** and the **Morse code detector** idea. However, we faced many challenges with both ideas. For the treat dispenser, we considered implementing a door lock mechanism to dispense treats, but it became

too complicated. The Morse code concept already existed, so we needed to add a personal touch, like treasure hunts or decoding with Morse code. We also struggled with how to give input for the Morse code idea.

Practicality of Morse Code:

We considered that Morse code could be useful in harsh situations, like when a child is stranded on an island without internet. One of us created a block diagram for the house games idea, considering a customizable version where parents could add or delete their own questions. We reviewed other research papers involving smart toys for inspiration, such as:

- i-Companion (for child's overall development)
- FPGA-based vending machines
- Studies on children's modular toys
- Vending machine design using Verilog and HDL
- Multifactor authentication in IoT-based children's toys

Final Concept:

Finally, after much research, we concluded that we should incorporate both the automatic dispenser and Morse code into one device. The device would ask the child to type Morse code, and if correct, the dispenser would generate a treat. We faced the challenge of attaching a dispensing system to the Morse code mechanism, but ultimately decided on a device with two modes:

1. Morse Code mode
2. Question-answer mode

Both modes would incorporate a **dispensing mechanism**. For the question-answer mode, we wanted the device to ask questions and provide options via audio, with answers given via a hex keypad. We resolved the challenge of generating audio output with our mentors' help. We also addressed how to make our device customizable by allowing parents to delete old questions and add new ones by overwriting data in the RAM. For the Morse code mode, we considered generating random letters for the child to type.

We also thought about incorporating internet connectivity to update the device with daily questions, adding to the child's general knowledge. However, we realized that our target age group might not benefit from this, and there were concerns about why someone would need another internet-connected device. Our device could also help day centers and nannies entertain and educate children.

Conclusion:

After all these brainstorming sessions and overcoming challenges, our final idea was a device with two modes: a question-answer mode focused on environmental awareness and basic science facts, and a Morse code detector/generator mode. For the question-answer mode, we thought of recording questions in the parents' voices to add a personal touch, helping children of working parents feel close to them.

PROTOTYPE

Then, we have to show how we prototyped what we thought of. This can be a PPT, role-play with the end user, post-it notes, storyboard, etc.

First Draft:

Chalking out the data flow, using basic items like a hex keypad and a decoder to implement choosing questions, and coming up with the combinational logic using AND and OR gates to check answer combinations.

Challenges:

- Customization by making a way to record new questions and change the options accordingly.
- Controlling the powering up of the second keyboard only after the question is completely read out.
- Determining what kind of audio storage to use that can store a particular message corresponding to a data line and play it when that data line is activated.

Second Draft:

- Having a combinational logic block to check the answers.
- Using an audio device with a RAM where questions can be rewritten by recording and processing by ADC.
- Powering up the second keyboard at the end of the data in the audio RAM, or using some kind of counter in between to generate a delay between the question and answer checking message.
- For Morse code, having a random alphabet generator block for the child's practice, and another Morse code detector block for checking the answer.
- For learning Morse code, providing pre-recorded audio data in the ROM for each alphabet of the child's choice.

Challenges:

- The combinational block is unchangeable if options change upon entering a new question.
- Generating a random alphabet from A to Z.
- Replacing the data going to a speaker with new data that comes in the following stages.
- Ensuring that the answer is checked only after the child has given some option of their choice and not just when the answer entry block is active, else, the data line continuously returns a 0 when no answer is given.

Third Draft:

- Replaced combinational logic for answer checking with RAM, which can be changed at the same address when the question is being changed. The

- checking is done by a bitwise comparator using XNOR gates and an AND gate.
- Introduced an Enter key in the keyboard, so the speaker is stimulated through a clock pulse at its enable port only when the Enter key is pressed.
- Using a random digit generator with a code between 0 and 25, mapping it to the 26 alphabets through the binary equivalent.
- For cutting down on the screen, we removed the OLED and simply have speaker output for verbally speaking out the alphabets.
- Added another feature to narrate some theoretical questions and/or thought-provoking stories for the child.

Challenges:

- Using the same keyboard makes the address pins driven all the time, consuming power. Also, the combination pattern changes when the option is input.
- The data coming out of the RAM has the problem of being altered or lost if we disable the block when giving option input.

Final Touches:

- We have a combinational logic for enabling the RAM addresses only when the question number is being entered, and it gets disabled when any of the options are given.
- We use a PIPO register for storing the data values so that it is not lost while disabling the RAM blocks, allowing us to check them with option bits entered later on.
- We also added an additional mode to engage the child in some entertaining and value-based theory sessions where the child can learn new concepts.

TEST

Challenge:

1.) Using the same keyboard for question number input and answer input.

A.) Introduced two inputs for enabling the audio ram and the combinational ram when question number is given as input and enabling the comparator and disabling the two rams when the answer input is given

2.) How to Power the Toy Sustainably?

A.) Use of solar cells.

3.) Repetition of questions?

A.) As of now enter the question number again and hit enter_qs.

4.) Usage of excess power by the RAMS

A.) Disabling the RAMS when not needed reduces the power intake by them.

5.) suggested by user - Morse code is played by the smart toy and the user has to guess the answer.

COST ESTIMATE OF THE PROJECT:

1. **16 to 4 Encoder (Keyboard of House Games)**
    - IC CD4532B CMOS 8-bit Priority Encoder
    - **Cost**: ₹60 approx.
2. **4 into 4 RAM (2 units)**
    - Storing option correct combination and for storing audio of questions and answers
    - **Cost**: ₹310 each, Total ₹620
3. **4-Bit PIPO Shift Register (2 units)**
    - 74194 BIT PIPO
    - **Cost**: ₹31 each, Total ₹62
4. **Microcontroller - Arduino Uno (1 unit)**
    - **Cost**: ₹273
5. **XOR Gates (16 units)**
    - CD4070 ICs
    - **Cost**: ₹19 each, Total ₹76
6. **AND Gates**
    - 4-input AND Gates (2 units) - 74HC21
    - **Cost**: ₹25 each, Total ₹50
    - 2-input AND Gates (2 units) - 74HC08
    - **Cost**: ₹10 each, Total ₹20
7. **ROM (3 units)**
    - AT25DF021 2Mb (2 units)
    - **Cost**: ₹41 each, Total ₹82
8. **Sandisk Micro SD Card (2Gb)**
    - **Cost**: ₹250
9. **DAC (Digital to Analog Converter)**
    - ADNet Digital to Analog Audio Converter
    - **Cost**: ₹176
10. **Speaker**
    - DFPlayer Mini MP3 Player Module
    - **Cost**: ₹200
11. **Servo Motor (For Treat Dispenser and Driver) (2 units)**
    - SG90 Mini Servo Motor
    - **Cost**: ₹80 each, Total ₹160
12. **Rechargeable Lithium-Ion Battery**
    - Portable 9V Lithium-Ion Battery Pack with USB Charge Port
    - **Cost**: ₹250
13. **OR Gates**
    - 7432 Quad OR Gate IC
    - **Cost**: ₹12
14. **Microphone (MIC)**
    - Analog Electret Microphone Module
    - **Cost**: ₹269
15. **Voice Recorder Module**
    - ISD1820 Voice Recorder Module
    - **Cost**: ₹147
16. **32 into 5 Encoder**
    - Simulated and reduced circuits

- **Cost**: ₹150

Total Cost Without Incorporating Solar Cell Charging Module: ₹2748

Unique Selling Points (USPs):

1. Morse Code Learning: Enhances communication skills and introduces a historical and practical coding system.
2. Environmental Education: Integrates lessons on water and energy conservation, addressing a crucial global issue.
3. Broader Educational Focus: Unlike competitors that focus on single aspects like STEM or Braille, our product offers a dual educational focus.
4. Sustainability Angle: Unique emphasis on environmental education sets our product apart in a market largely centred on STEM.
5. Cost-Effective: Designed to be affordable for a wide range of consumers, addressing the cost concerns of parents.

Market Research (Statistical Evidence):

1. Smart Toys Market: Expected to grow from USD 7.4 billion in 2021 to USD 15.5 billion by 2027, with a CAGR of 13.1%.
2. STEM Toys Market: Valued at USD 964.5 million in 2020 and projected to reach USD 2.5 billion by 2028, growing at a CAGR of 10.2%.
3. Educational Toys Market: Estimated to grow from USD 89.5 billion in 2020 to USD 132.1 billion by 2027, with a CAGR of 5.3%.

Profit Margin:
Here, we have broken down the components involved in calculating the profit margins and the assumptions/ considerations that impact them.

1. **Production Cost**

Material cost: Encompasses the cost of all the materials and components required to build one unit of the product.

Cost Estimate: ₹2,800 approx. per unit

2. **Manufacturing and R&D Cost**

This covers the labor and overhead costs of assembling the toy. This also includes quality control measures to ensure each unit meets safety and performance standards, in addition to cost of developing software for the product as well as ongoing maintenance and updates. While these costs can be considered fixed, a portion can be attributed to each unit produced.

Cost Estimate: ₹700 approx. per unit

3. **Overhead Costs**

This includes packaging, shipping and distribution, warehousing, marketing and sales costs and allowance for defective products and returns.

Cost Estimate: ₹500 approx. per unit

Total Cost of Production: ₹4,000 approx. per unit

Assuming a target profit margin of 15%, the retail price should be ₹4,700 approx. per unit.

Competitor Analysis:

1. Thinkerbell Labs (Annie)

- **Focus**: Braille literacy for visually impaired children.
- **Technology**: Interactive smart toy using tactile feedback and audio.
- **Target Demographic**: Visually impaired children.
- **Market Position**: Unique niche with high social impact.
- **Comparison**: Our product offers Morse code learning and environmental awareness, targeting a broader demographic. We can highlight our dual focus on education and sustainability.

2. LEGO Education

- **Focus**: STEM learning through building and programming.
- **Technology**: Modular kits with programmable components.
- **Target Demographic**: School-aged children interested in STEM.
- **Market Position**: Strong brand recognition and extensive product range.
- **Comparison**: While LEGO focuses on building and programming, our product emphasizes communication skills through Morse code and environmental conservation, providing a different educational angle.

3. Fisher-Price Think & Learn Code-a-pillar

- **Focus**: Basic coding concepts for young children.
- **Technology**: Modular, caterpillar-shaped toy that teaches sequencing and problem-solving.
- **Target Demographic**: Preschoolers.
- **Market Position**: Well-known brand with wide market reach.
- **Comparison**: Our product targets slightly older children with more complex learning objectives (Morse code and environmental education) compared to the introductory coding focus of Code-a-pillar.

4. Sphero

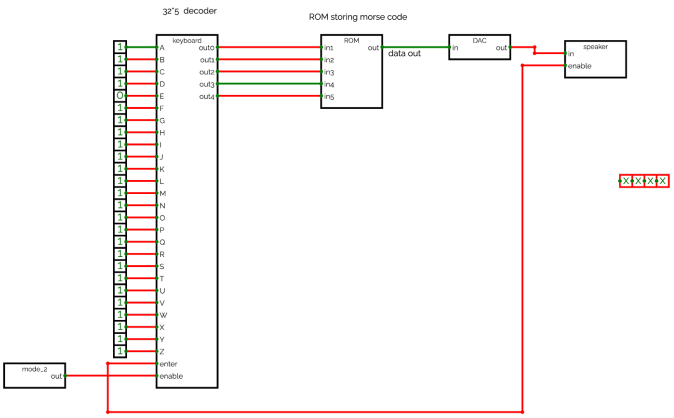
- **Focus**: Robotics and coding.
- **Technology**: Programmable robotic balls and devices.
- **Target Demographic**: Children interested in robotics and coding.

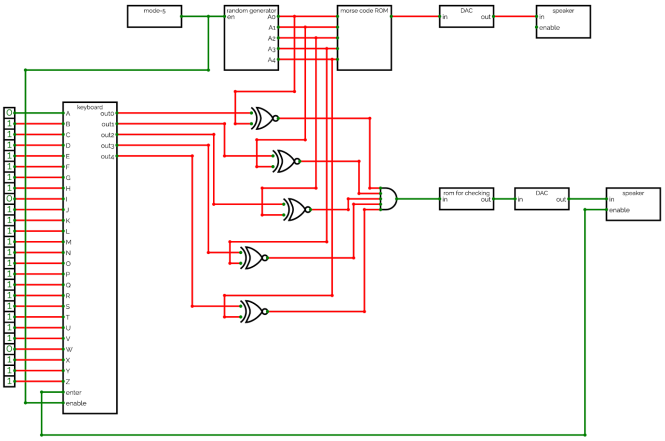
- **Market Position**: Popular in educational and consumer markets for interactive STEM toys.
- **Comparison**: Sphero excels in robotics and coding, while our product adds value in teaching Morse code and promoting environmental consciousness, filling a unique educational niche.

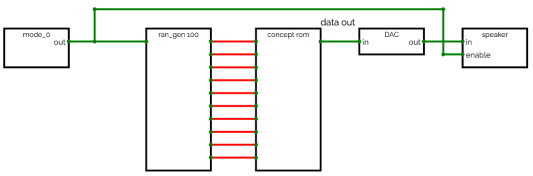
5. LeapFrog

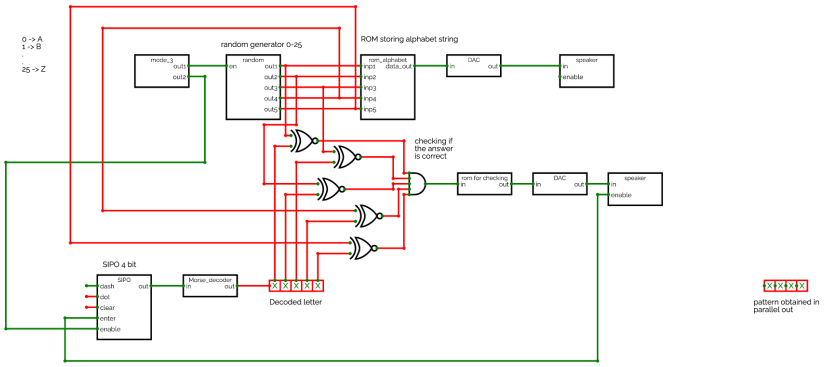
- **Focus**: Educational toys and tablets covering various subjects.
- **Technology**: Interactive tablets, books, and toys with a digital focus.
- **Target Demographic**: Early learners and elementary-aged children.
- **Market Position**: Leader in educational toys with a strong emphasis on digital learning.
- **Comparison**: LeapFrog's strength lies in digital learning across a wide range of subjects. Our product, by contrast, provides a tactile learning experience with a focus on Morse code and sustainability, offering an alternative to screen-based learning

BLOCK DIAGRAMS :




mode-5
random generator
en
A0
A1
A2
A3
A4
morse code ROM
DAC
in
out
speaker
in
enable
keyboard
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z
out0
out1
out2
out3
out4
enter
enable
rom for checking
in
out
DAC
in
out
speaker
in
enable


data out
mode_0
out
ran_gen 100
concept rom
DAC
in
out
speaker
in
enable



- **cloud connectivity for updated content and parental controls.**

Discover fun facts on a go

Observation is the key to grow

Relate to topics like never before

Achievement will make you happy to the core

Kid can learn morse for case of emergency

Pattern recognition is a skill to fancy

Parents can record their own question

Or a fun story to relieve some tention

This way parent can connect to the kid more

This friendship is something to adore

For visually impaired we introduce beep and sound

Because they too deserve development all-round

Piezoelectric charging module adds to the functionality

Energy conservation leads to sustainability

We've put some thought for the kid to enjoy

To develop and learn with our Smart toy.

-