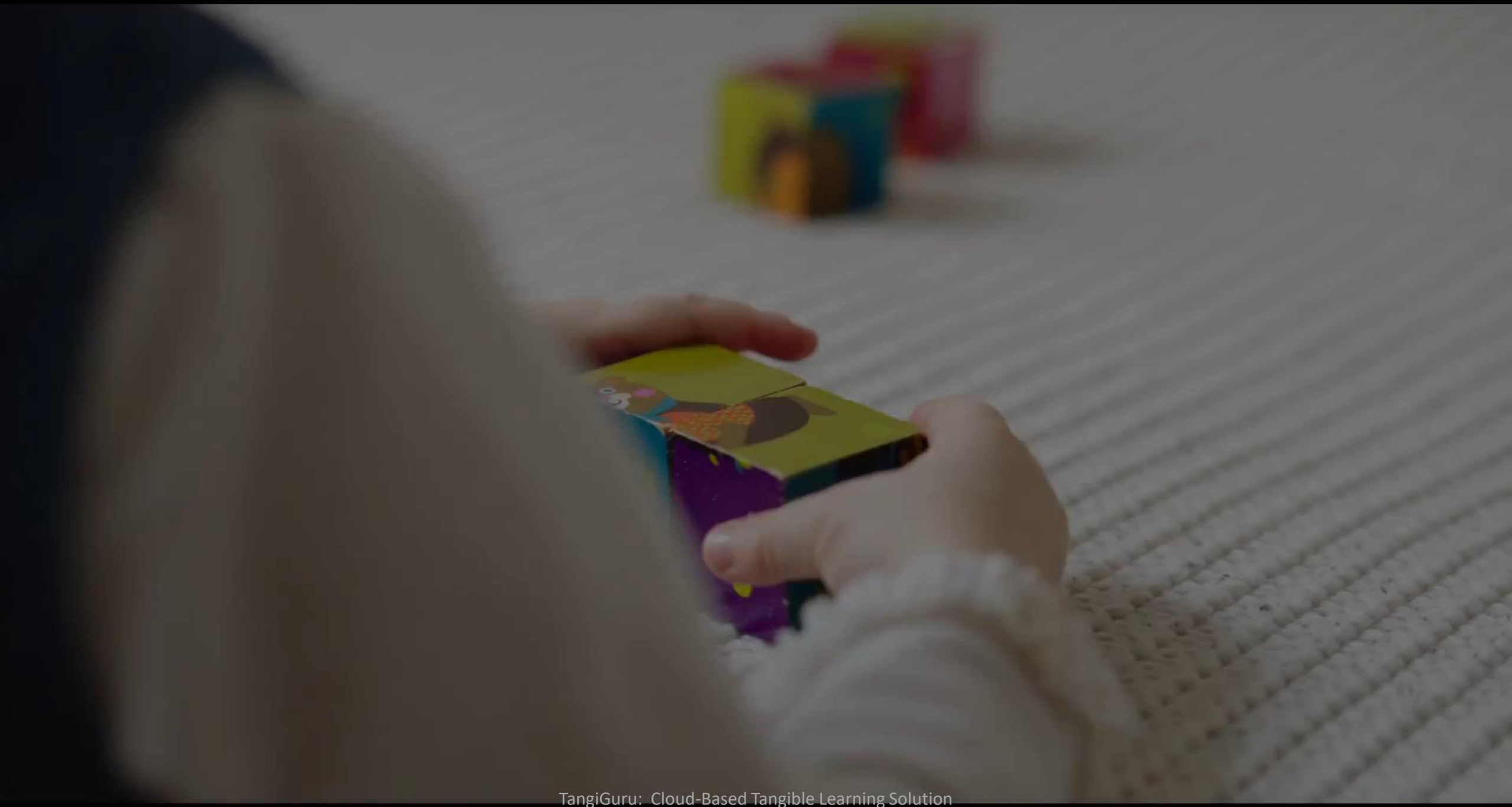

TangiGuru: Cloud-Based Tangible Learning Solution

TangiGuru

Tangible e-Learning Solution for Early Childhood Development

Team

Supervisor:
Ms. Shashika Lokuliyana

Co-Supervisor:
Ms. Narmada Gamage

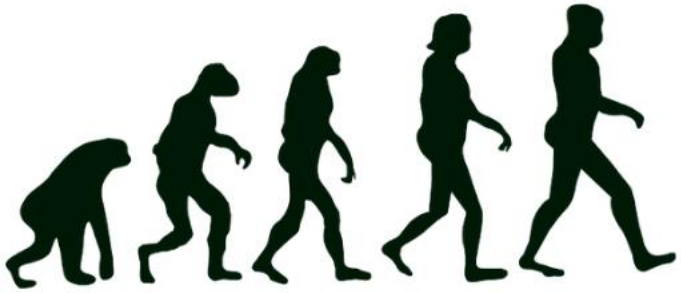
External Supervisor:
Mr. Rajitha de Silva

Thiwanka Cholitha
IT19206806

Lakisuru Semasinghe
IT19051130

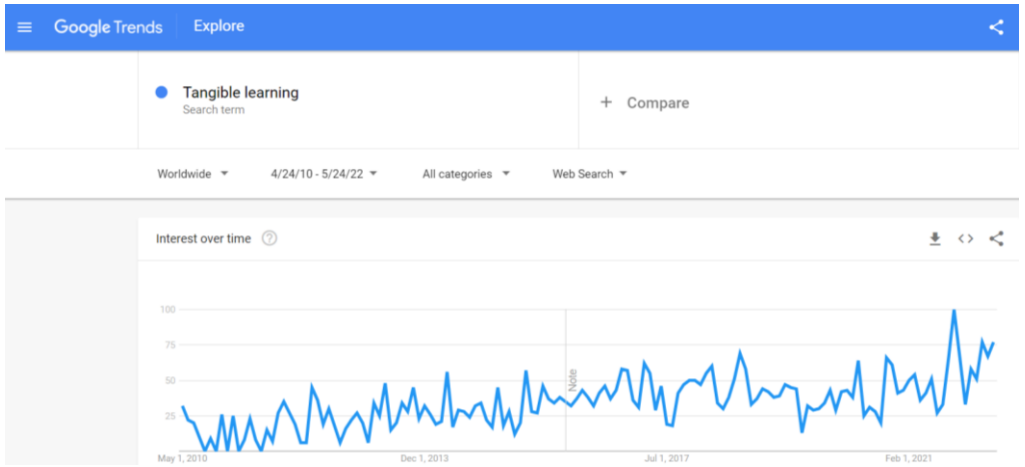
Manisha Ratnasuriya
IT19215716

Evolution



Introduction

- What is Tangible Learning?
- Why are we focusing on Tangible learning?

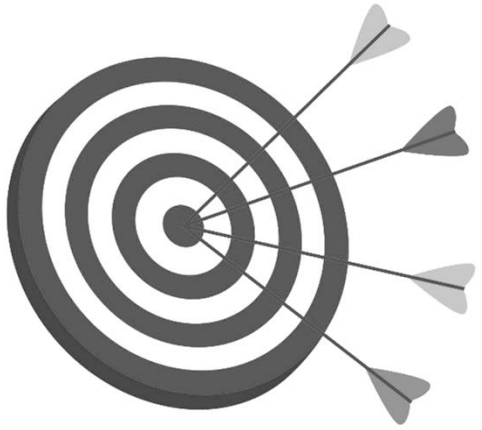


Research Problem?

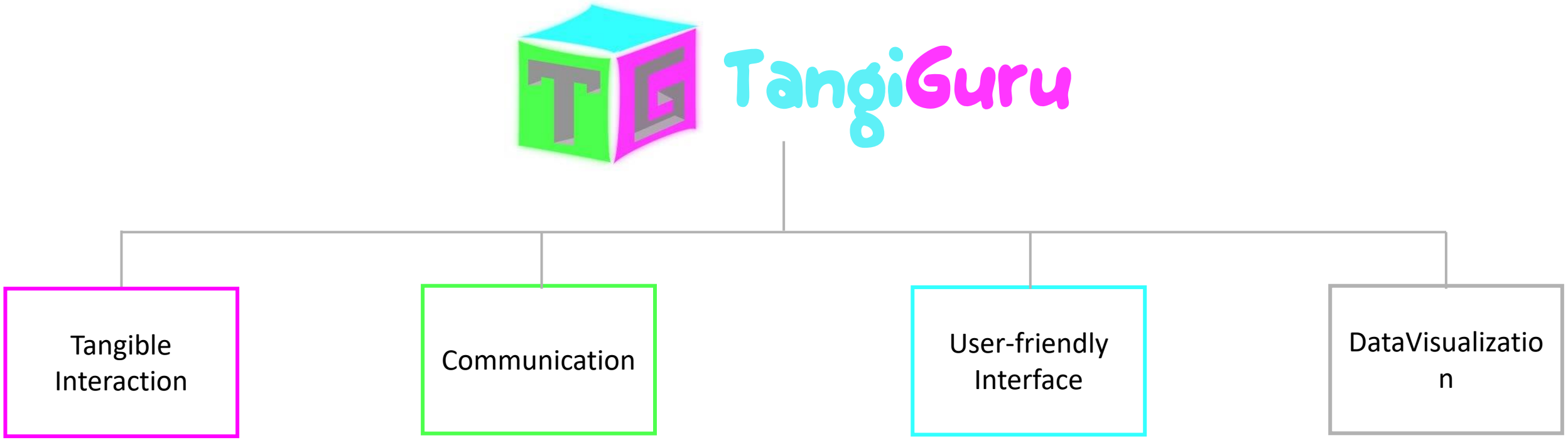
- Limited Activities
- Will not be used after a time.
- No guidance
- Not Interactive

Main Objective

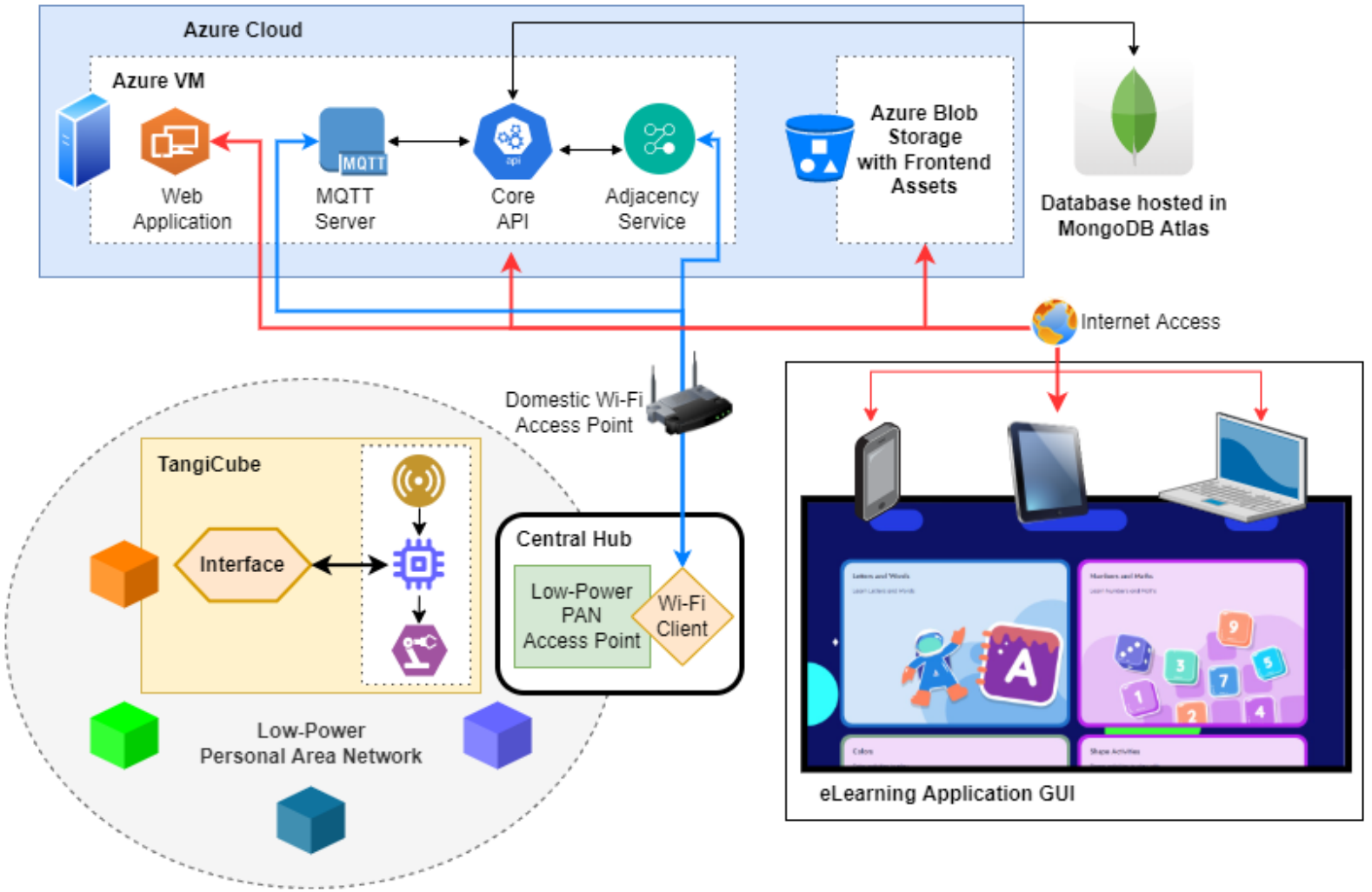
- To create a learning kit for the children to perform various activities with a single set of tangibles for developing the early childhood of children.



Sub Objectives



Overall System Diagram



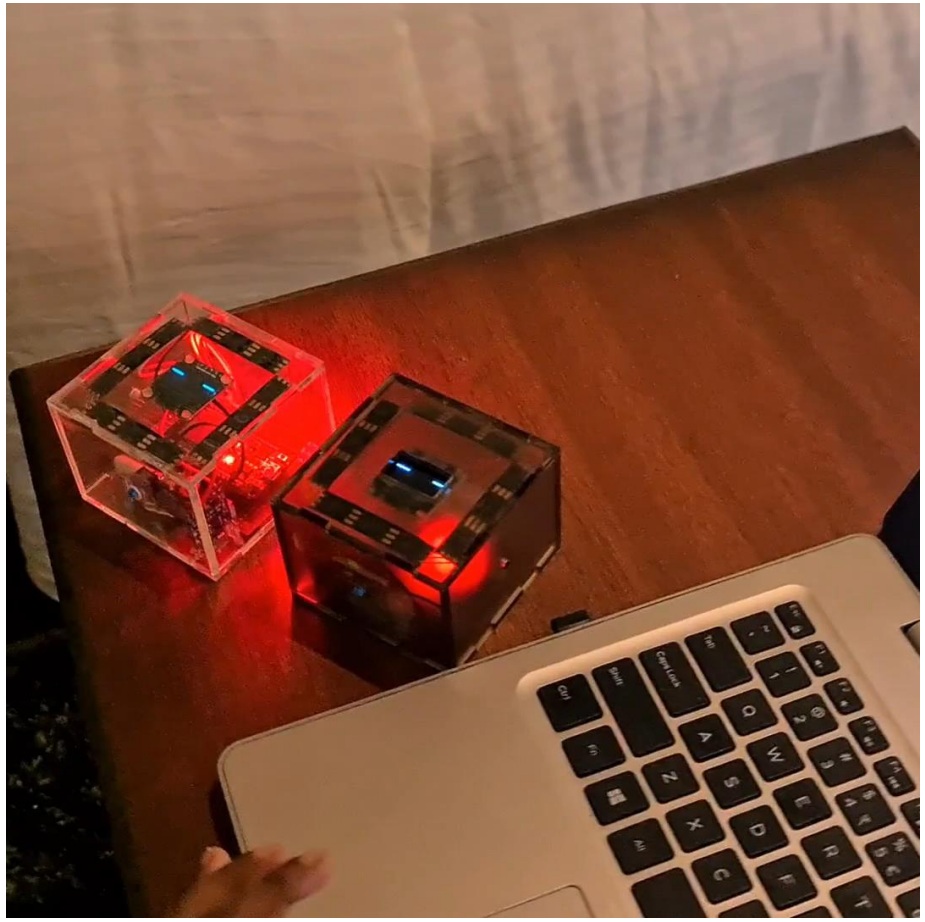
Tangible Interaction

Thiwanka Cholitha Hettiarachchi

IT19206806

Background

- What is Tangible Interaction ?
- How Tangible interaction works ?
- How does Tangible Interaction relate to ?[1]



Research Problem

- How to design a user-friendly tangible interface to interact with children?

- Does the tangible cubes will be interactive and develop the cognitive skills of the children?

Knowledge Areas

- How to design a user-friendly tangible interface to interact with children?

- Does the tangible cubes will be interactive and develop the cognitive skills of the children?

Specific and Sub Objectives

- Main Objective

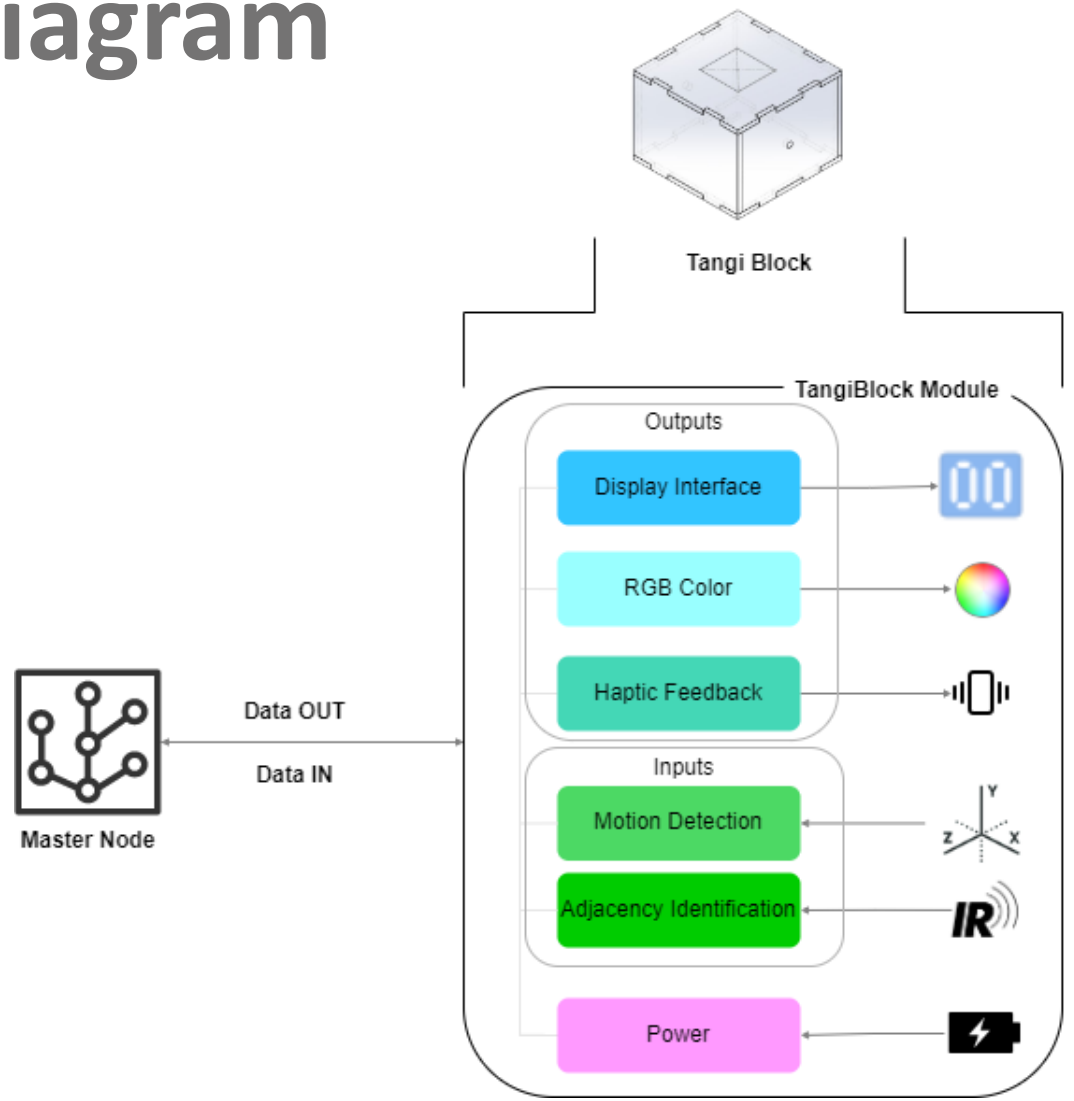
Develop objects that can actively interact with the Children and aid them to perform the learning activities.

- Sub-Objectives
  - Provide the interaction mechanisms to the cube (Color, Display, Feedback).
  - Provide a mechanism to capture the interaction from the child.

Methodology

- System Diagram
- Technologies

System Diagram



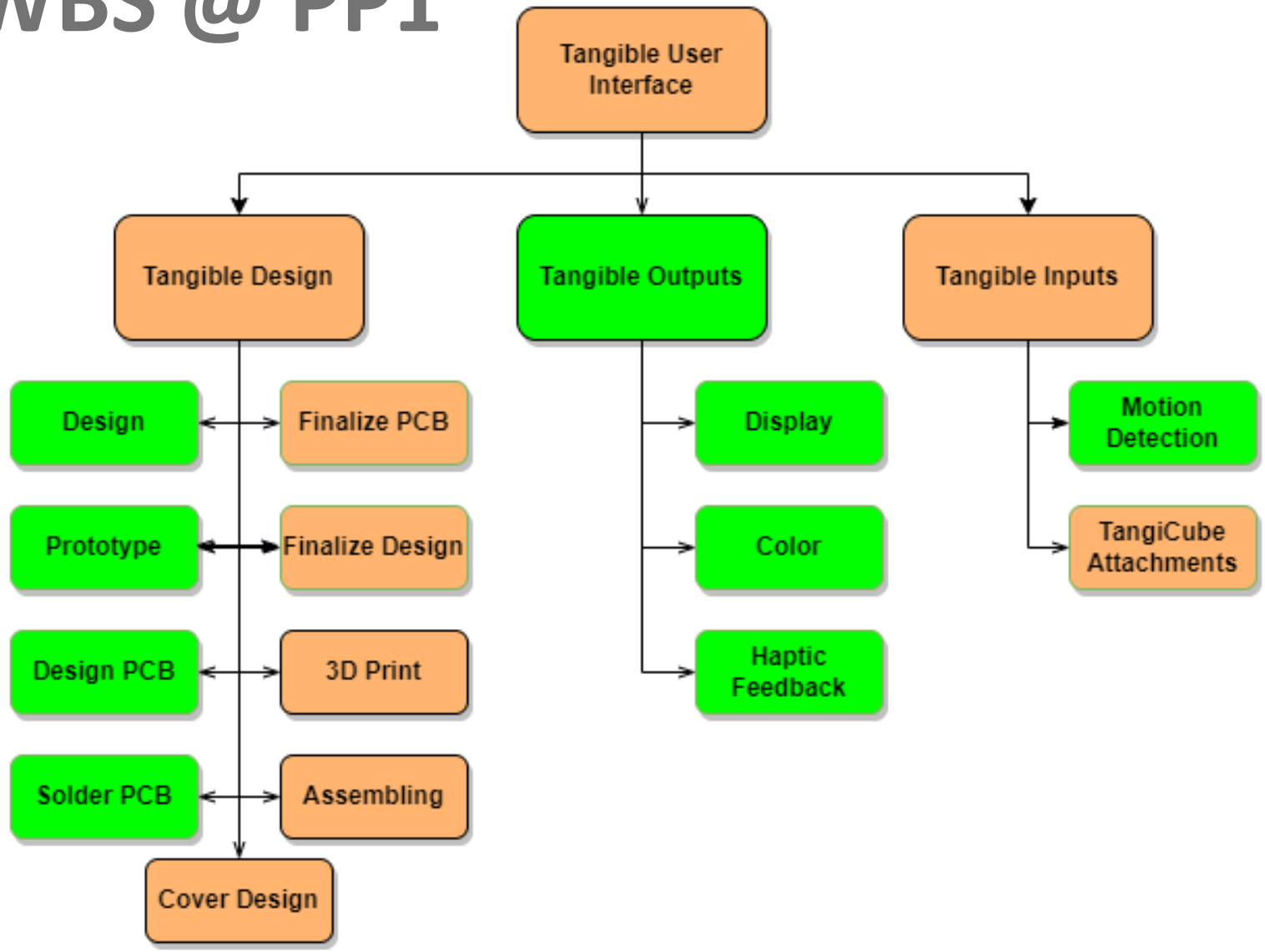
Technologies

- C++
- OLED
- KiCad
- Solid Works
- 3D Printing
- Spring
- Arduino

implementation

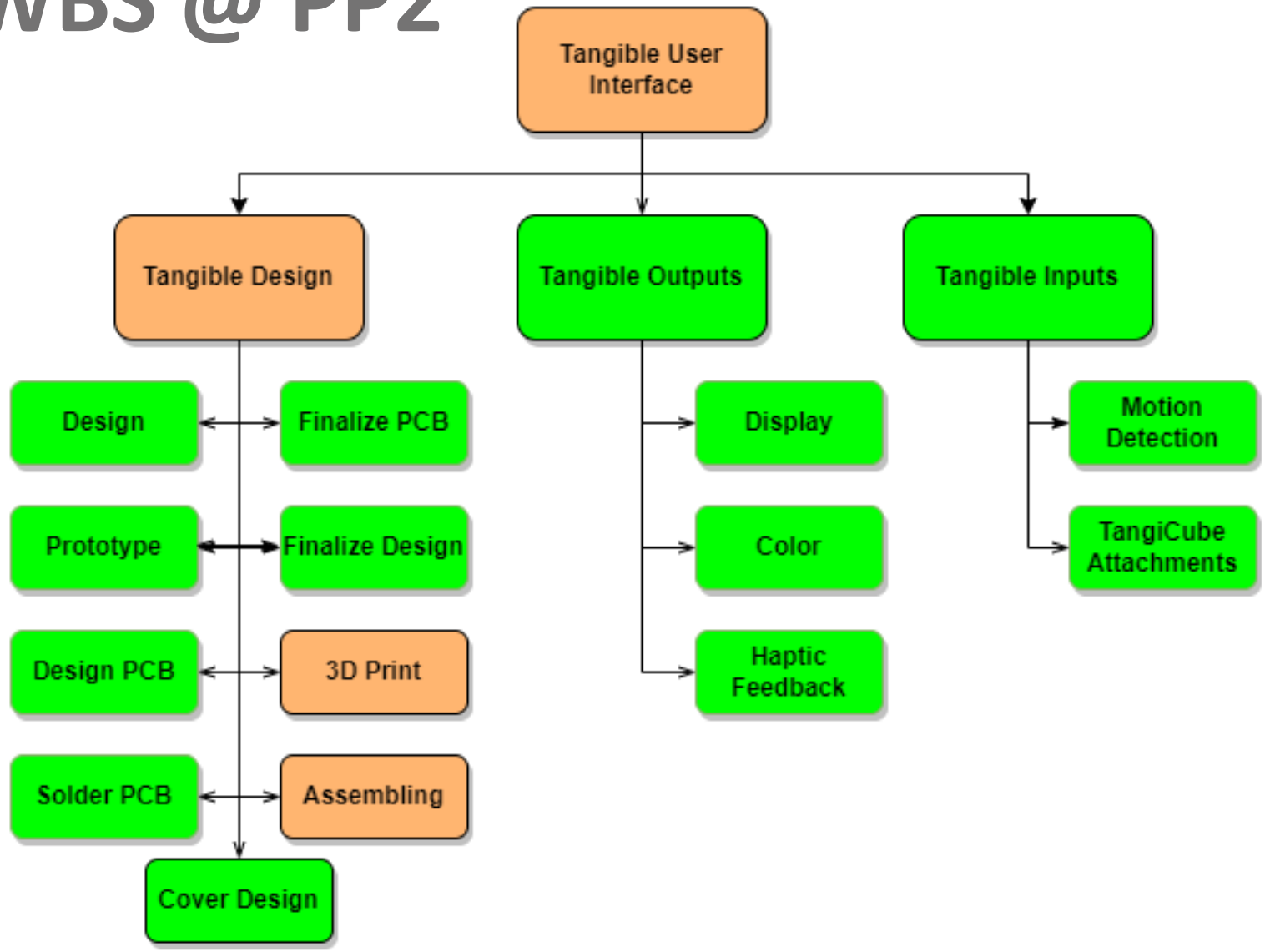
- WBS @ PP1
- WBS @ PP@
- Completion of the Project.
- Standards
- Best Practices
- Social and Legal Requirements
- Non-Functional Requirements

WBS @ PP1



- **Completed – 55%**
- To Be Completed – 45%

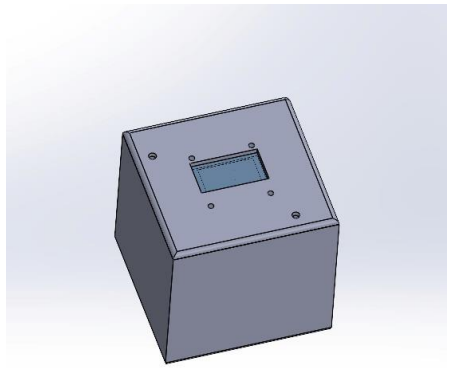
WBS @ PP2

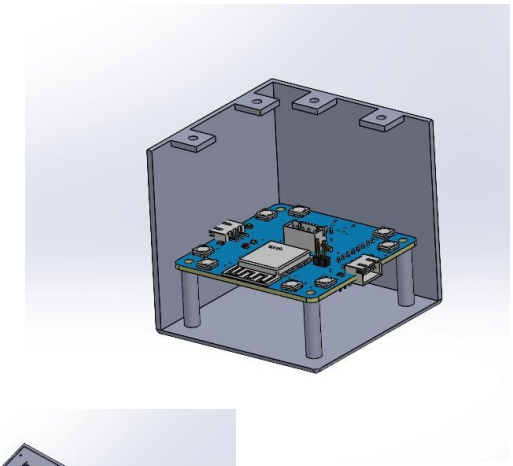


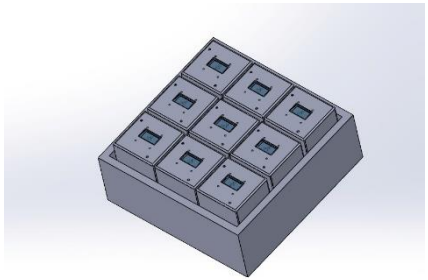
- **Completed – 90%**
- To Be Completed – 10%

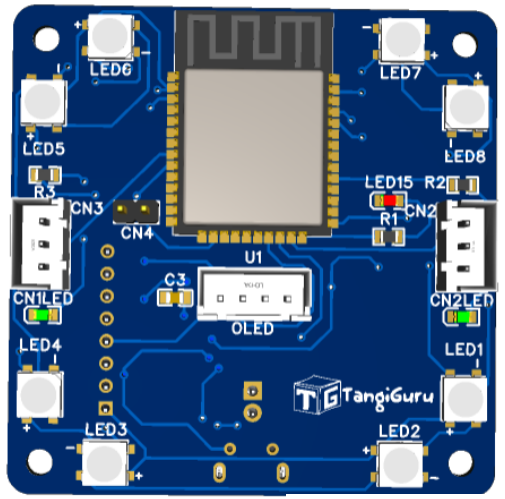
Completion of the Project

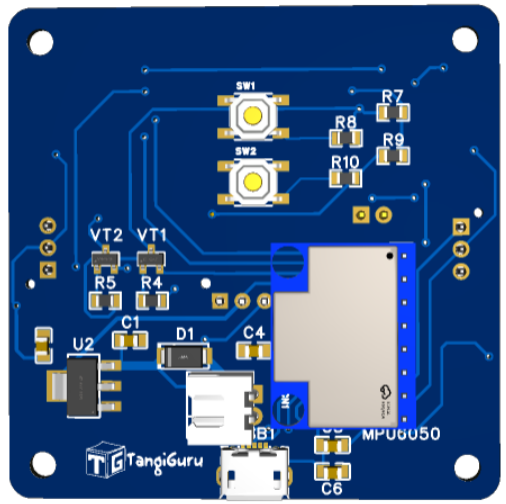
Design Excellence











Completion of the Project

294	**84.86**			**Machines and apparatus of a kind used solely or principally for the manufacture of semiconductor boules of wafers, semiconductor devices, electronic integrated circuits or flat panel displays; machines and apparatus specified in Note 9 (C) to this Chapter; parts and accessories.**	
		8486.10.00	-	Machines and apparatus for the manufacture of boules or wafers	**TS**
		8486.20.00	-	Machines and apparatus for the manufacture of semiconductor devices or of electronic integrated circuits	**TS**
		8486.30.00	-	Machines and apparatus for the manufacture of flat panel displays	**TS**
		8486.40.00	-	Machines and apparatus specified in Note 9 (C) to this Chapter	**TS**
		8486.90.00	-	Parts and accessories	**TS**
295	**84.87**			**Machinery parts, not containing electrical connectors, insulators, coils, contacts or other electrical features, not specified or included elsewhere in this Chapter**	
		8487.10.00	-	Ships' or boats' propellers and blades therefor	**TS**
		8487.90.00	-	Other	**TS**

Standards

- Followed the Arduino Coding Standards with the Comments, Defining Global Variables.
- Formatted variables and function names. In C++ according to the standards. [4]
- 3d Design was created to be used in multiple versions.
- Used SI measurement standards (mm)
- Used IPC (Institute for Printed Circuits) -IPC-2221 standard when designing the PCB.[5]

Best Practices

TangiGuru

Sharp edges and sharp points: Toys for older children may have sharp points or edges that can hurt a small child. Avoid toys made from thin plastic that can break easily. Also, avoid giving toys with metal parts to toddlers and babies.[2]

Toys with magnets: If magnets come off and your child swallows two or more of them, they can stick together inside your child's body. This can cause injury or death. Young children should not play with toys with magnets. If older children play with toys with magnets, warn them not to put any magnets in their mouths.[2]

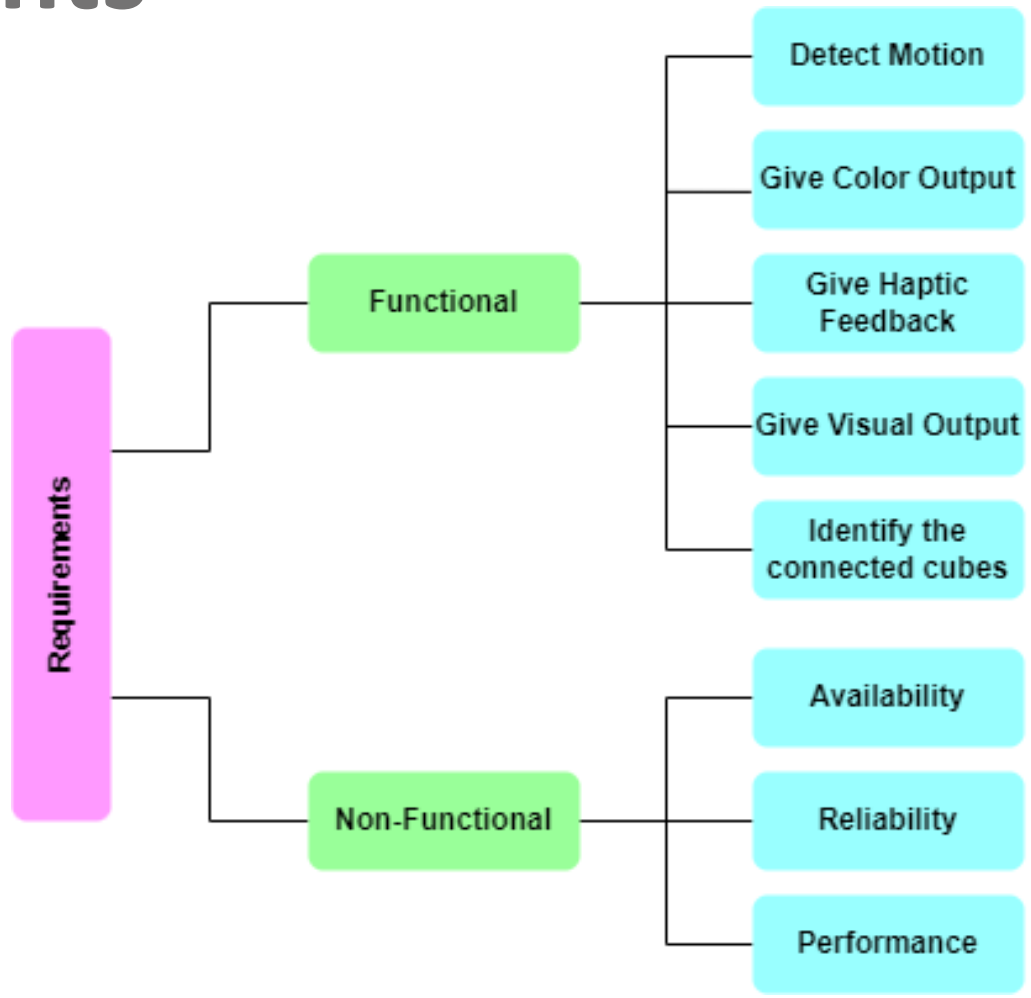
Small toys and toys with small parts: To prevent choking in kids 3 or younger, make sure that toys and parts cannot fit inside an empty toilet paper tube or a choke tube. Soft baby toys should be large enough that they can't be swallowed even when they are squished down. Check stuffed animals for eyes, noses, and parts that can come off. Put small toys and toys with small parts out of reach when young ones are around.[2]

Social and Legal Issues

- COPPA (Children's Online Privacy Protection Rule) applies to online services providers, *i.e.*, websites, directed to children, or any operator that has actual knowledge that it is collecting or maintaining personal information from a child.[3]

    - **Notice of Data Practices**. This requires operators to give direct notice to parents of their data collection practices.[3]
    - **Parental Consent (Verified)**. Verifiable parental consent must be given before an operator can collect personal information from a child.[3]
    - **No Conditional Participation**. Operators cannot condition a child to be allowed to play a game or be allowed to win a prize.[3]
    - **Required Reasonable Security**. Operators are also required to have and maintain reasonable security procedures to "protect the confidentiality, security, and integrity of the personal information collected from children."
    - **Data Collection**. Operators can only keep personal information collected online from a child as long as reasonably necessary to fulfill the purpose for which it was collected for.[3]

Requirements



Results

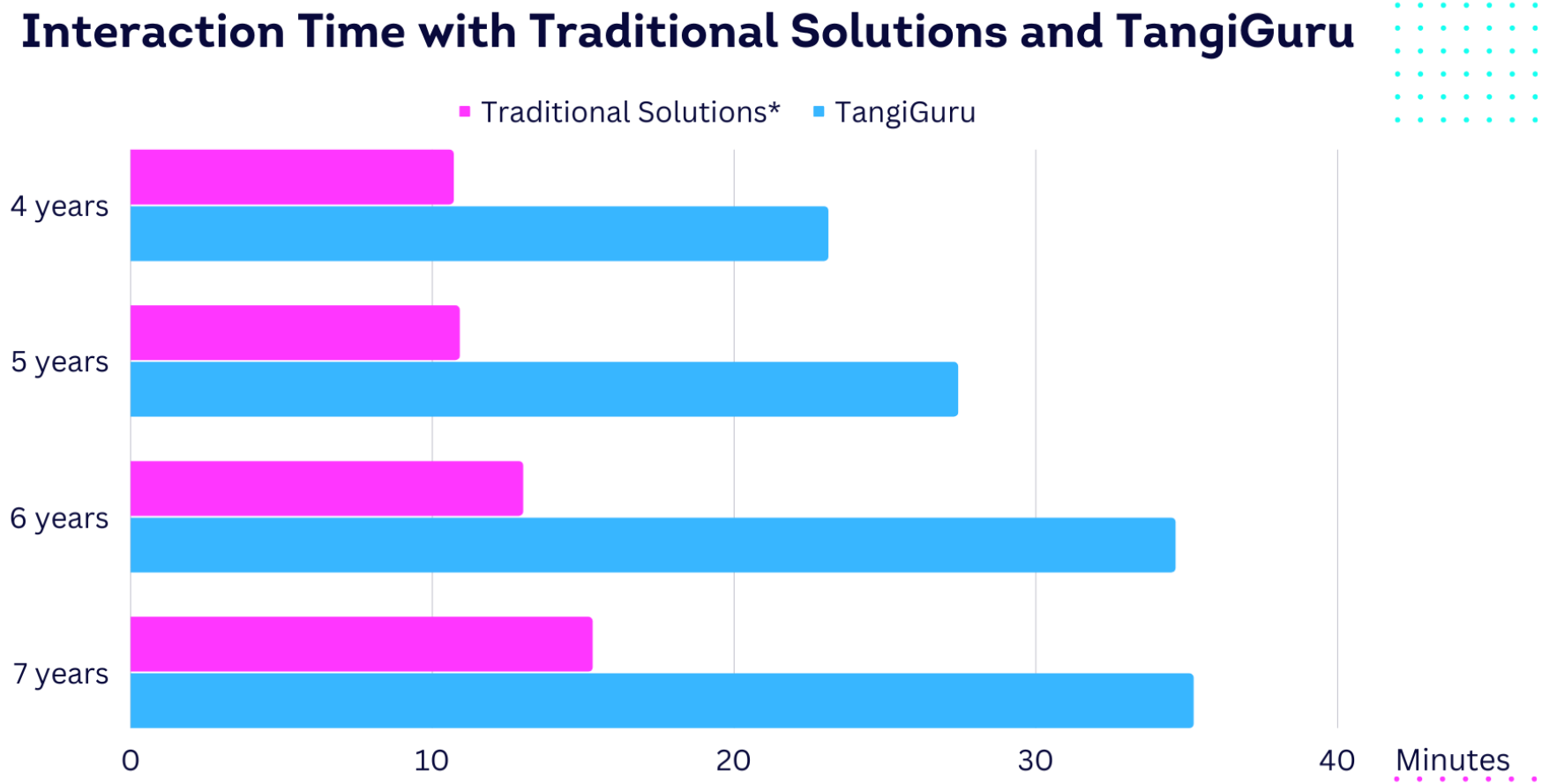


Figure 5: Interaction Time with Traditional Tangible Learning Solutions vs TangiGuru

***Traditional Solutions: Tangible Learning Solutions without any digitalization involved**

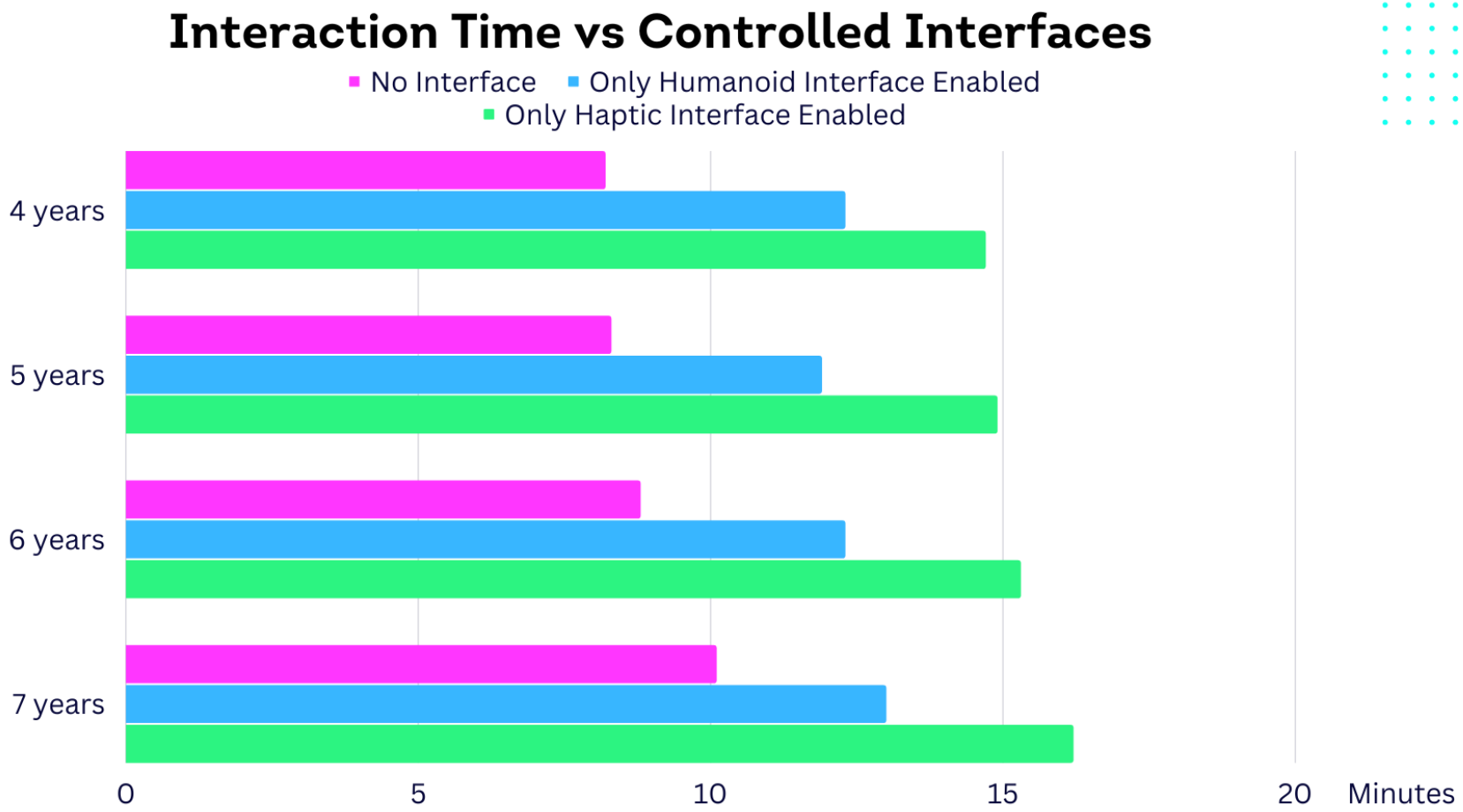


Figure 6: Interaction Time of TangiGuru vs Controlled Interfaces

1

TangiGuru

References

[1] M. Liang, Y. Li, T. Weber, and H. Hussmann, “Tangible interaction for children s creative learning: A review,” *ACM Int. Conf. Proceeding Ser.*, 2021, doi: 10.1145/3450741.3465262.

[2] https://www.seattlechildrens.org/health-safety/keeping-kids-healthy/prevention/toy-safety/

[3] https://www.dickinson-wright.com/news-alerts/legal-and-privacy-issues-with-connected-toys

[4] https://blog.wokwi.com/how-to-write-clean-arduino-code/

[5] https://resources.pcb.cadence.com/blog/2021-applying-ipc-standards-to-pcb-layout-design

Communication

Lakisuru Semasinghe

IT19051130

Research Problem

- How to **apply Modern Wireless & Cloud Technologies to Provide an Interactive Tangible Learning Experience** for Children?

Specific and Sub Objectives

- Main Objective

To **integrate modern Cloud and Wireless technologies to develop an Interactive Tangible e-Learning Solution**.

- Sub-Objectives
  - Wirelessly interconnect tangibles with minimal use of resources.
  - Provide a transparent, seamless connection between learning kit and the e-Learning application
  - Delivering e-Learning application interface to user equipment.

TangiGuru

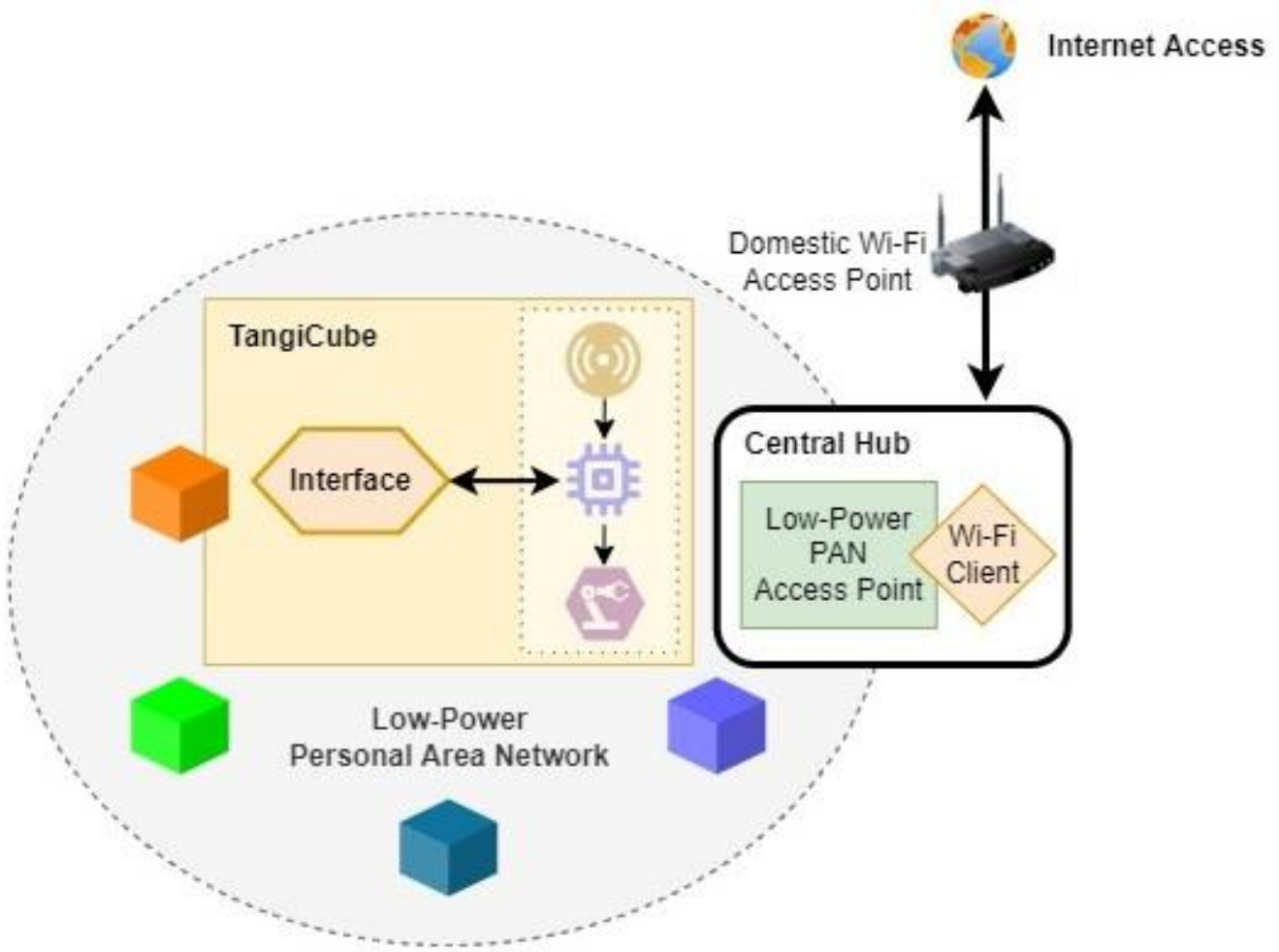
Methodology

- System Diagrams
- Technologies
- Requirements
- WBS

TangiGuru

Interconnecting Tangibles within the Tangible Learning Kit

System Diagram

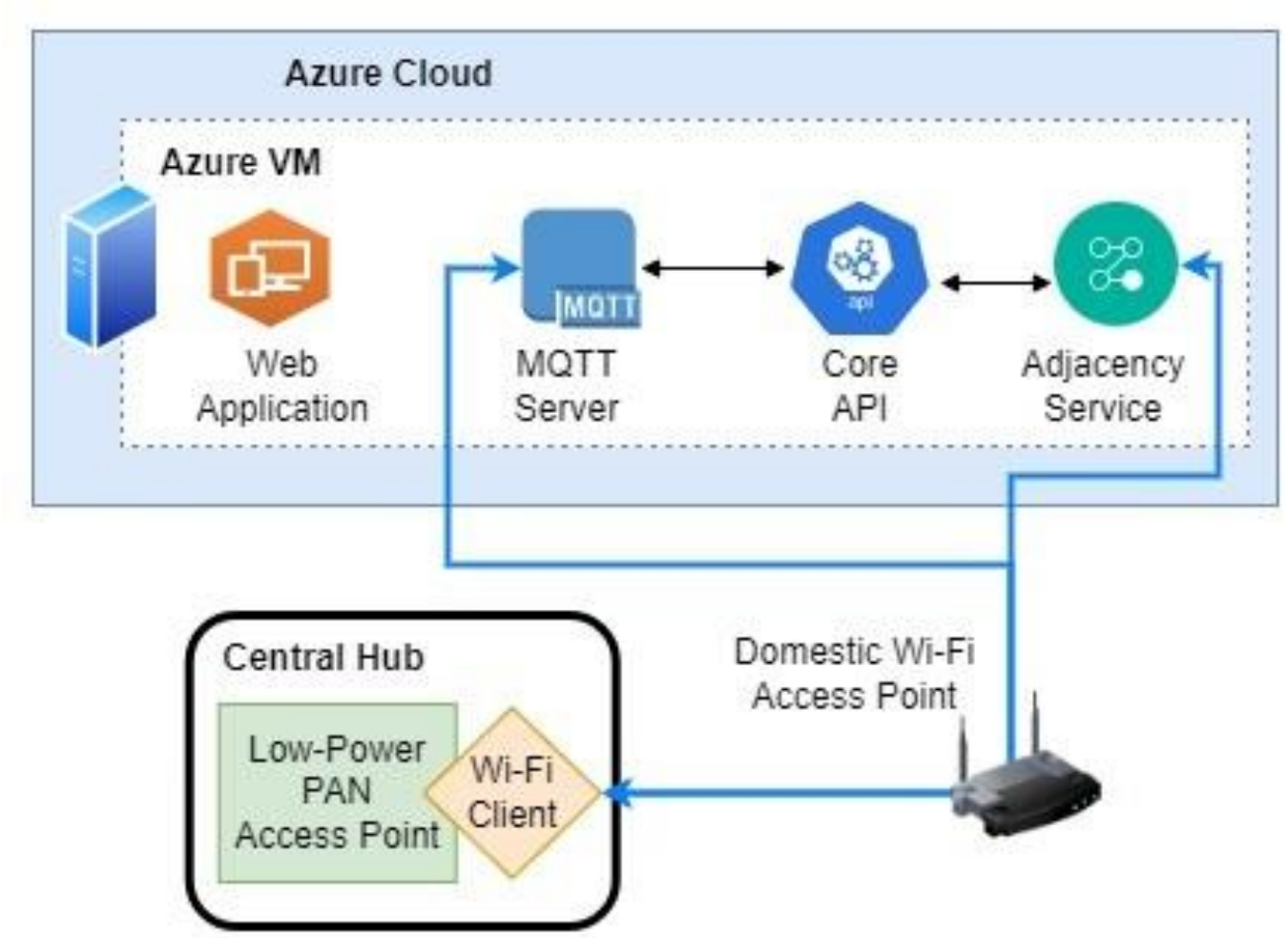


Semasinghe L.S IT19051130

TangiGuru

Connecting Tangible Learning Kit to e-Learning App Backend

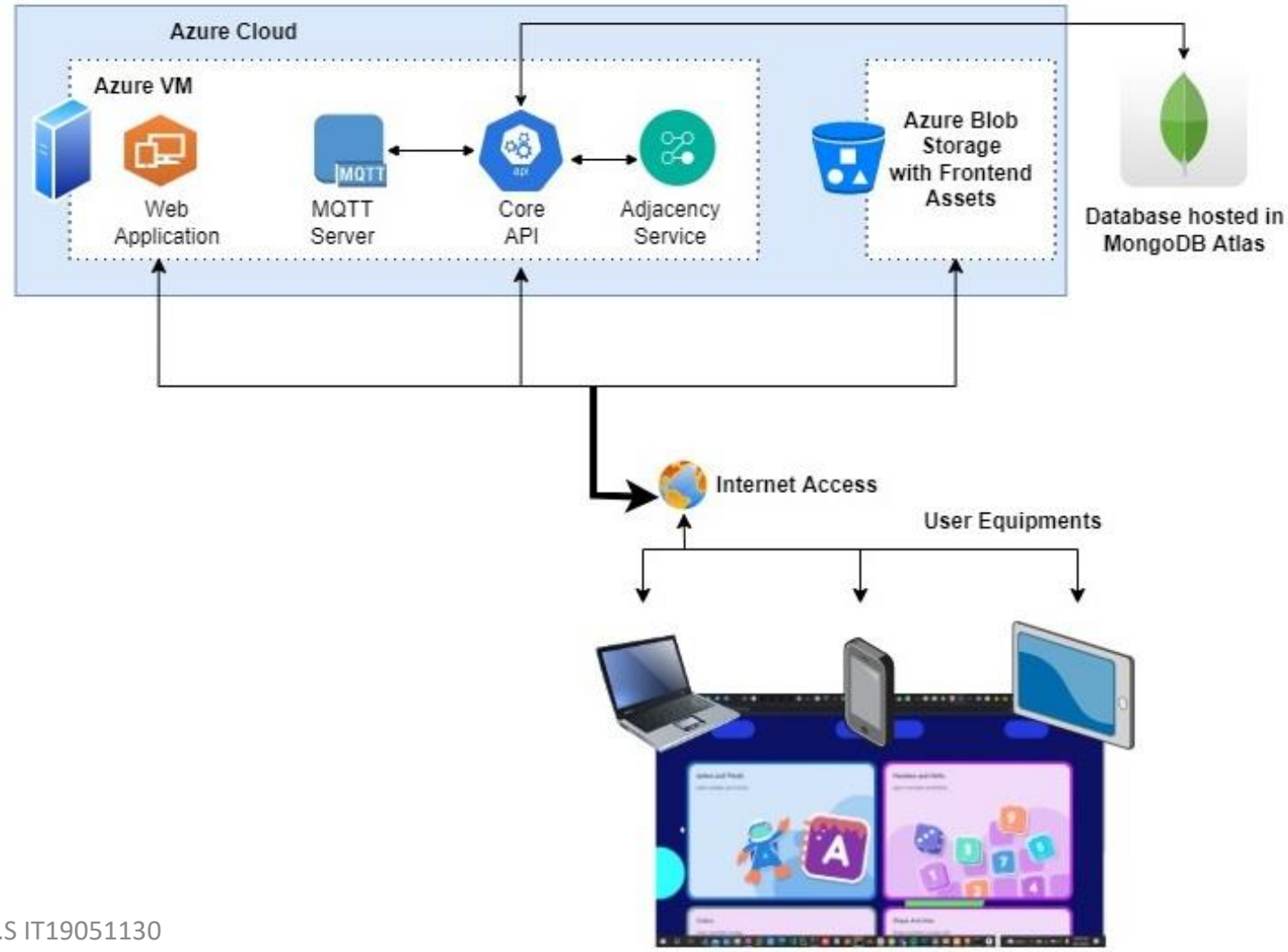
System Diagram



Semasinghe L.S IT19051130

Delivering e-Learning App to User Equipment

System Diagram



Technologies

- ESP32
- Azure Cloud Services
- MQTT, Wi-Fi
- MongoDB
- React Native
- C

Requirements

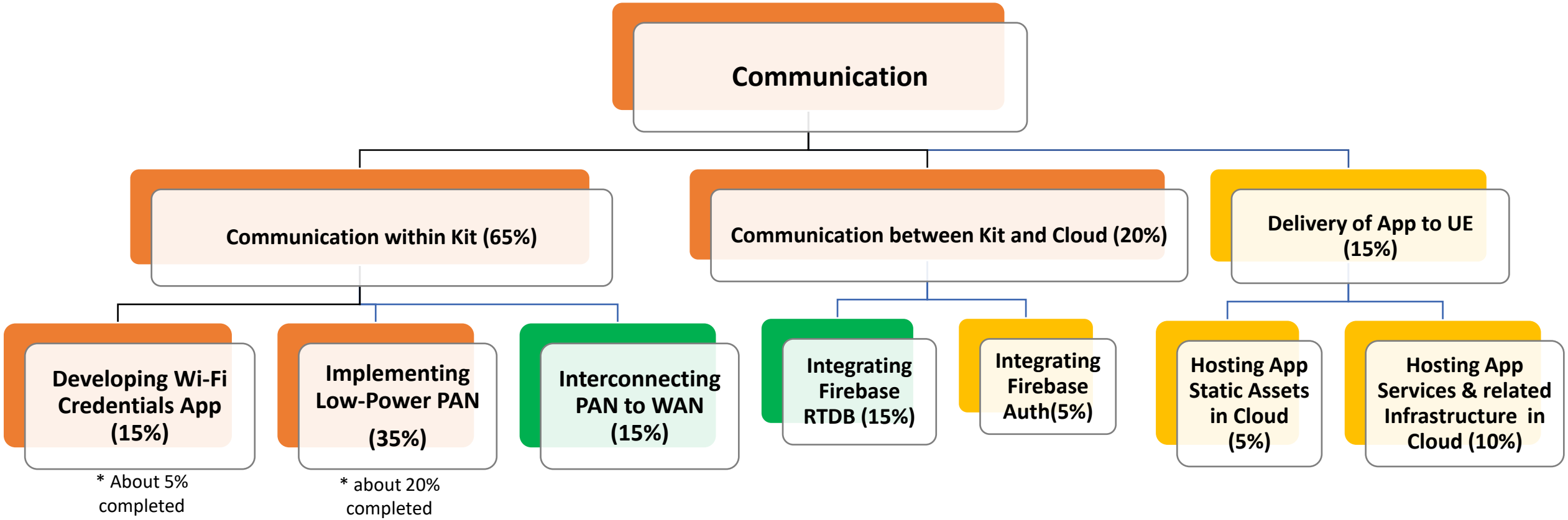
Functional

- ✓Real-time data transfer
- ✓Power efficiency
- ✓Compatibility with existing technologies and devices.
- ✓Small physical form factor

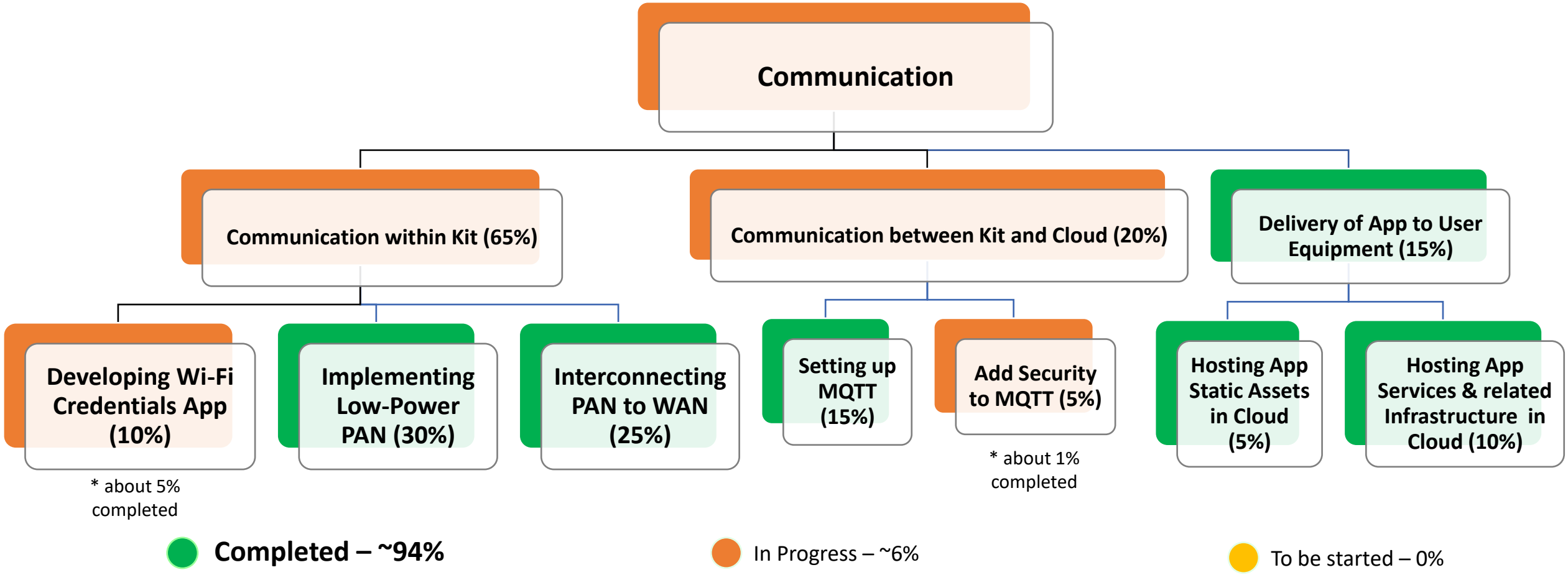
Non-Functional

- ✓Cost efficient (capital & operational costs)
- ✓Future-proof for 3-4 years

Work Breakdown Structure @ PP1



Work Breakdown Structure @ PP2



Evaluation

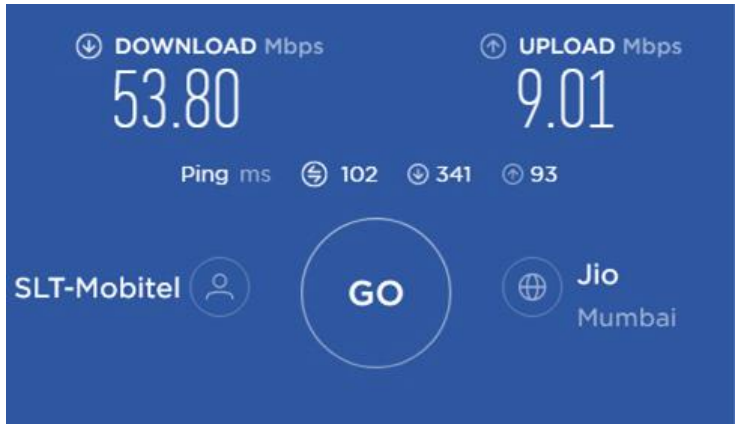
The following metrics are being measured and analyzed.

- **Reliability**
- **Transmission speed**
- **Transmission delay**
- Ease of use
- Power usage
- Operational costs

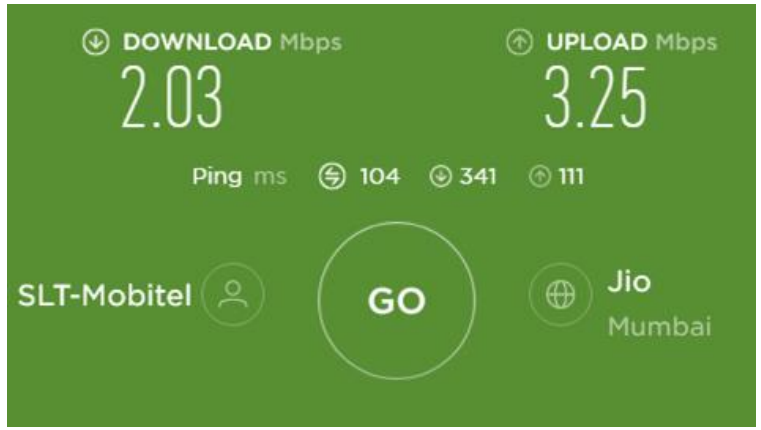
Evaluation

```
--- tangiguru.studio ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99298ms
rtt min/avg/max/mdev = 98.888/99.898/106.337/0.859 ms
```

```
--- tangiguru.studio ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99313ms
rtt min/avg/max/mdev = 101.188/103.164/113.480/1.873 ms
```



- Benchmark Network (Fiber Broadband powered Wi-Fi)
- TangiGuru Central Hub connected to Benchmark network



User-friendly Interface

Manisha Dilshani Ratnasuriya

IT19215716

Introduction

- Background
- Research Gap
- Research Problem
- Specific

Research Gap

- Children cannot perform learning without external supervision and guidance.

- Existing solutions are specific for narrow learning areas.

Research Problem

TangiGuru

- How to develop an interactive, child-friendly UI/UX which is easily understandable for children?

- How to develop the learning activities suitable for required learning outcomes in early childhood development?

Specific and Sub Objectives

- Main Objective

Development of child-friendly UI/UX and interactive learning activities for early childhood development.

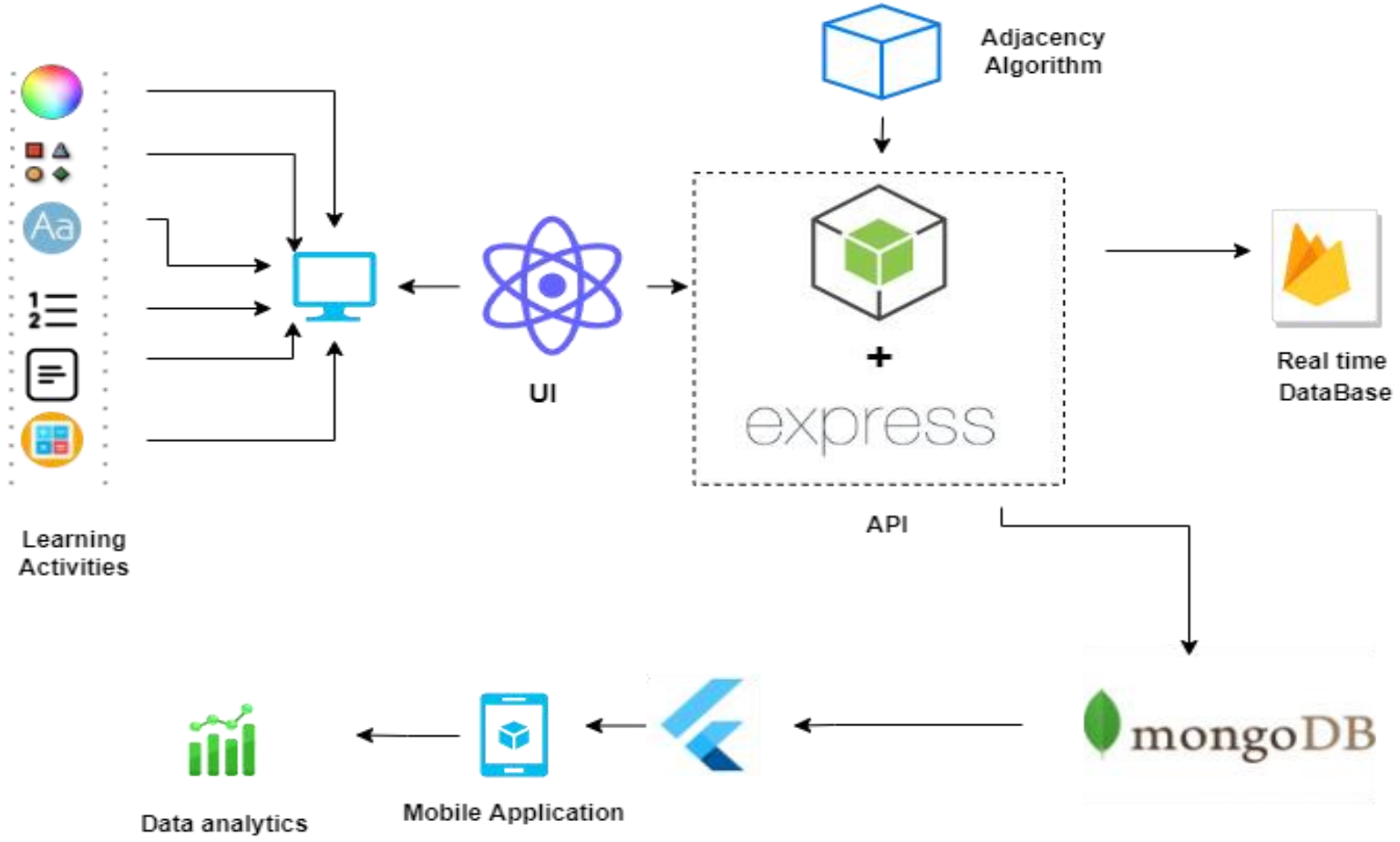
- Sub-Objectives
- UI/UX design for the web application .
- Implement the mobile application.
- Development of the learning activities suitable for required learning outcomes.

TangiGuru

Methodology

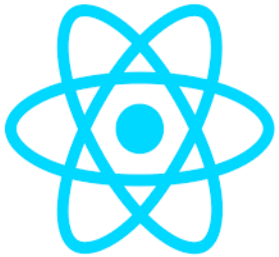
- System Diagram
- Technologies
- Requirements
- WBS

System Diagram



Technologies

- React JS
- Node JS
- Express JS
- Firebase
- MongoDB
- Flutter



Requirements

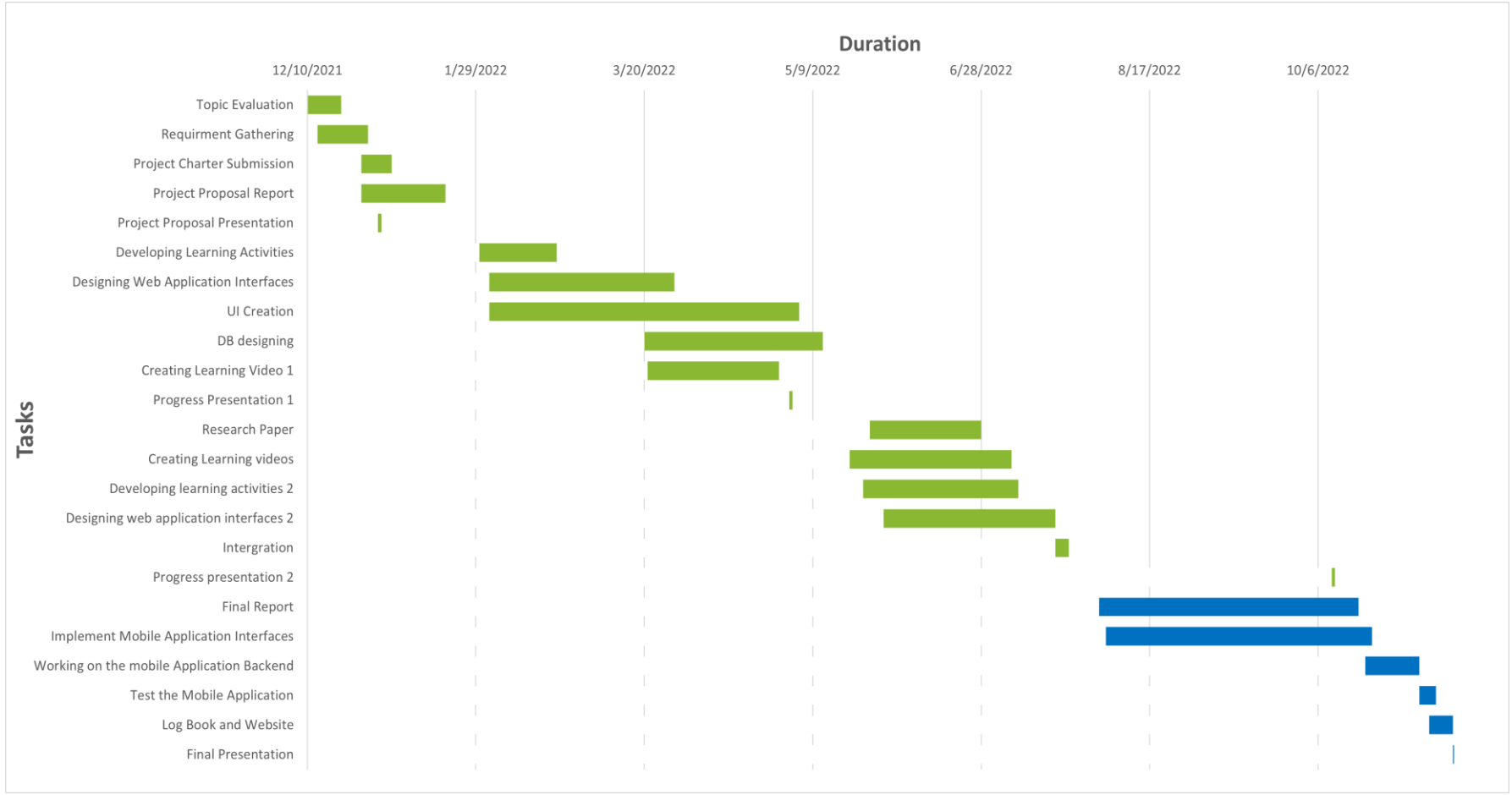
Functional

- Real-time data transfer
- Quick Feedback
- Automated guidance
- Automated evaluation

Non - Functional

- Enhanced the capability to recognize colors
- Ex- Learning videos
  - Child friendly UI
  - Intractive Q & A
  - Drag & Drop

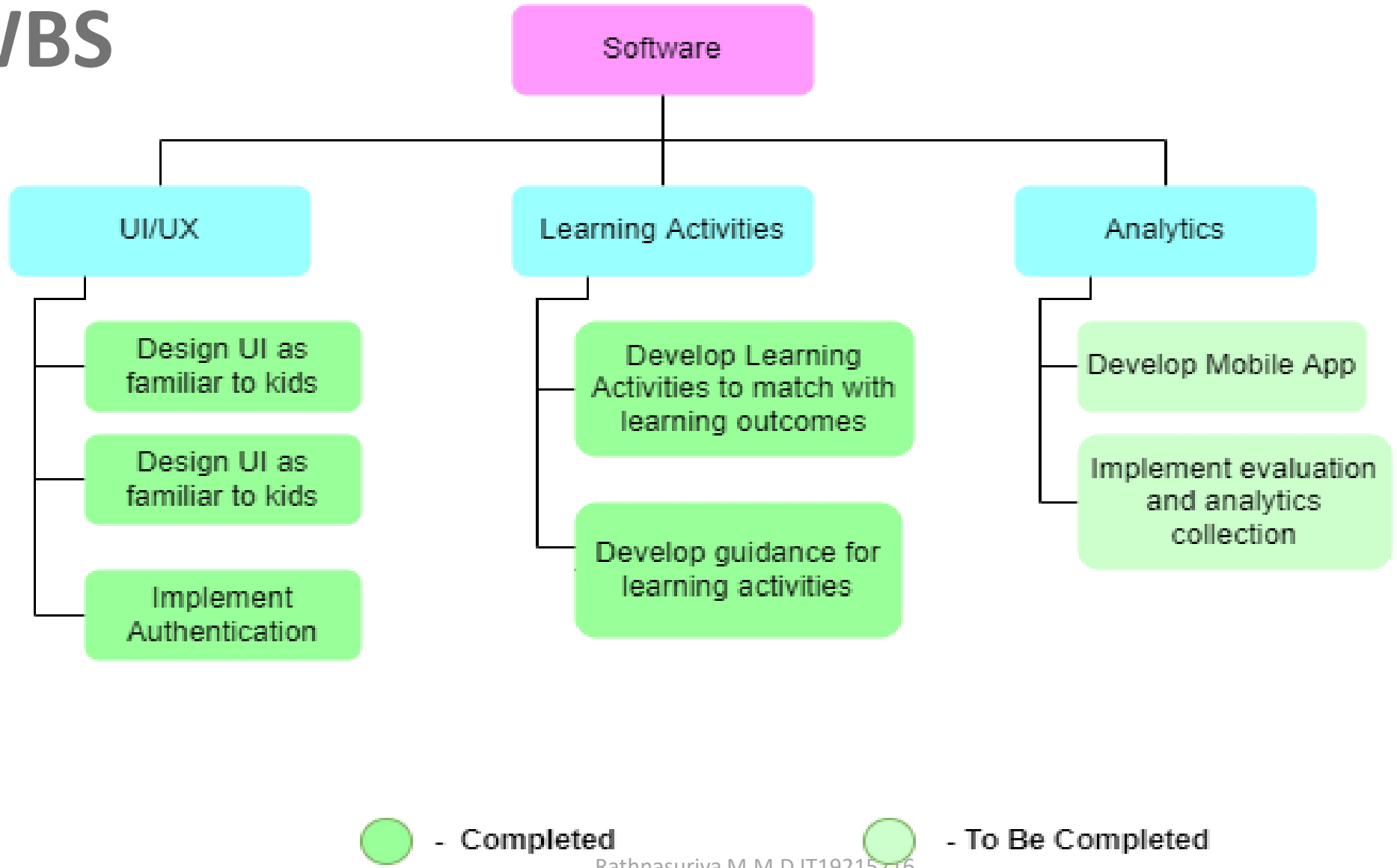
Gantt Chart



- Completed

- To Be Completed

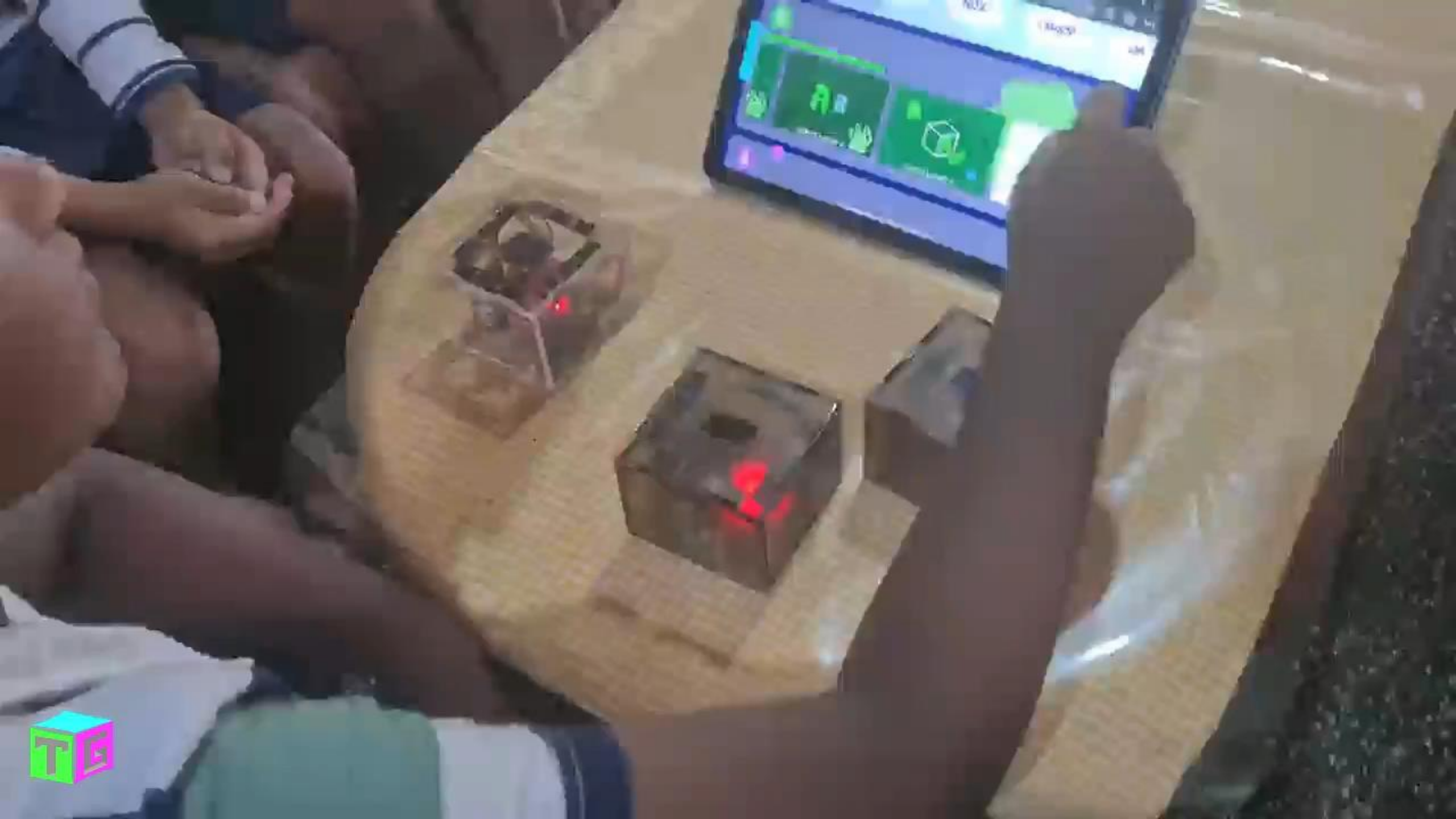
WBS


Software
UI/UX
Learning Activities
Analytics
Design UI as familiar to kids
Design UI as familiar to kids
Implement Authentication
Develop Learning Activities to match with learning outcomes
Develop guidance for learning activities
Develop Mobile App
Implement evaluation and analytics collection
- Completed
- To Be Completed

Evaluation

- Develop Marking Systems in UI which capable to allocate marks for every learning activity.
- Evaluate how they performed and how many activities they have completed and incomplete
- Evaluate whether the expected learning outcomes have been reached or not
- Identify activities that are suitable for relevant age gaps

Demonstration



TangiGuru

Thank You!

TangiGuru

Questions?