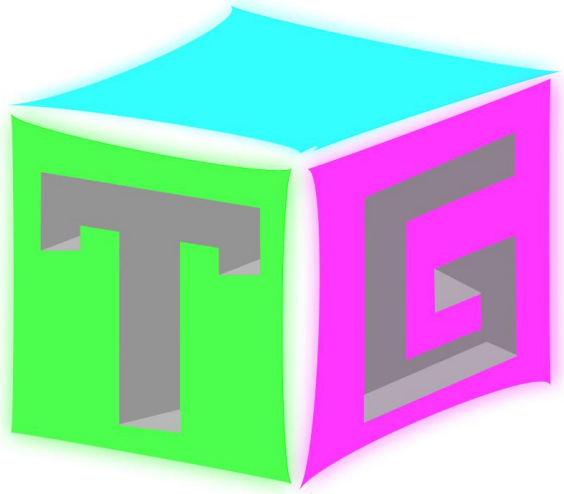

TangiGuru

Tangible Learning Solution for Early Childhood Development

2022-287

SLIIT
FACULTY OF COMPUTING

Team

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Background

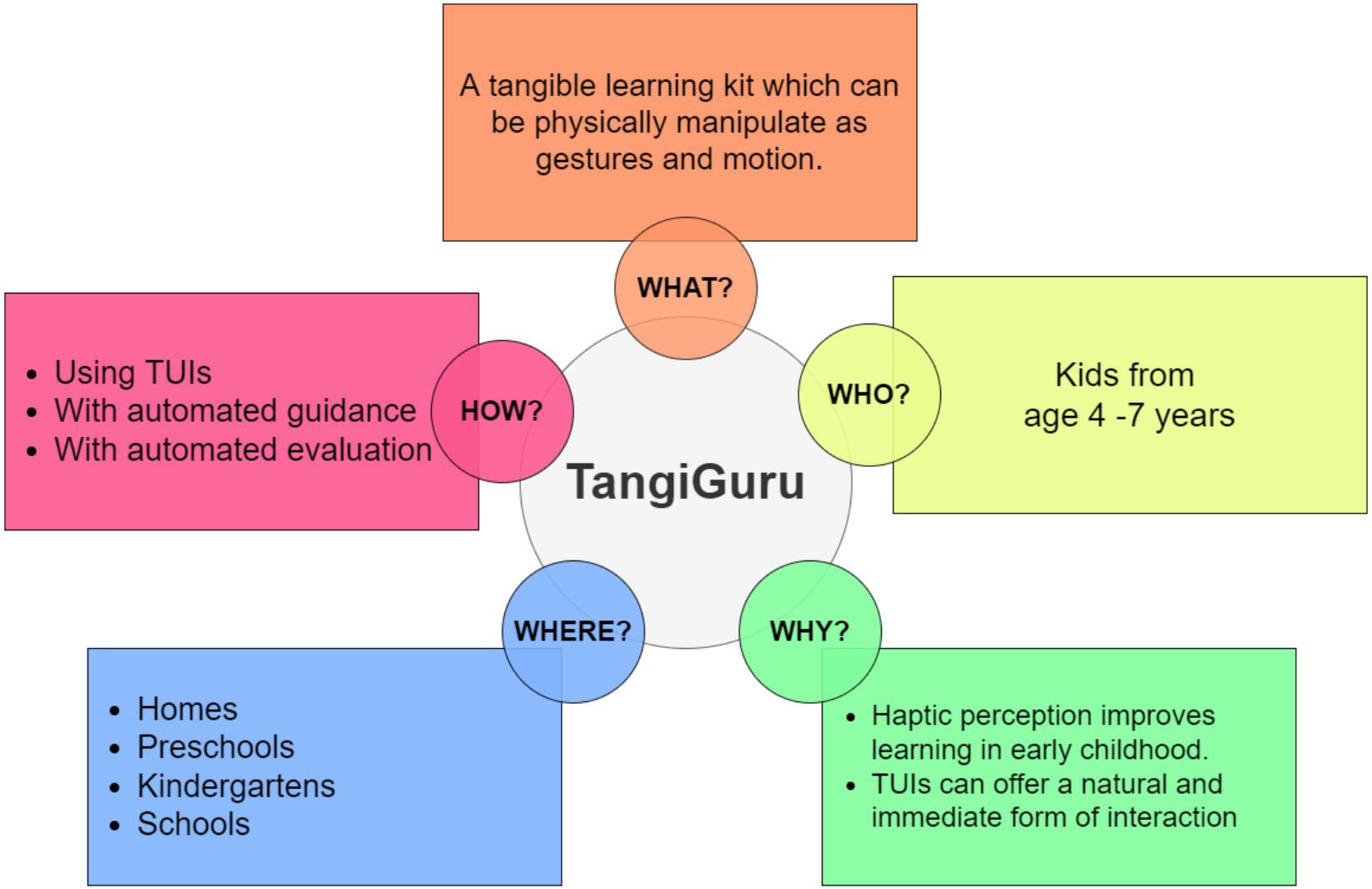
•Kids tend to interact with their surroundings to develop their cognitive skills.

•Therefore, tangible learning is used to teach children in early childhood.

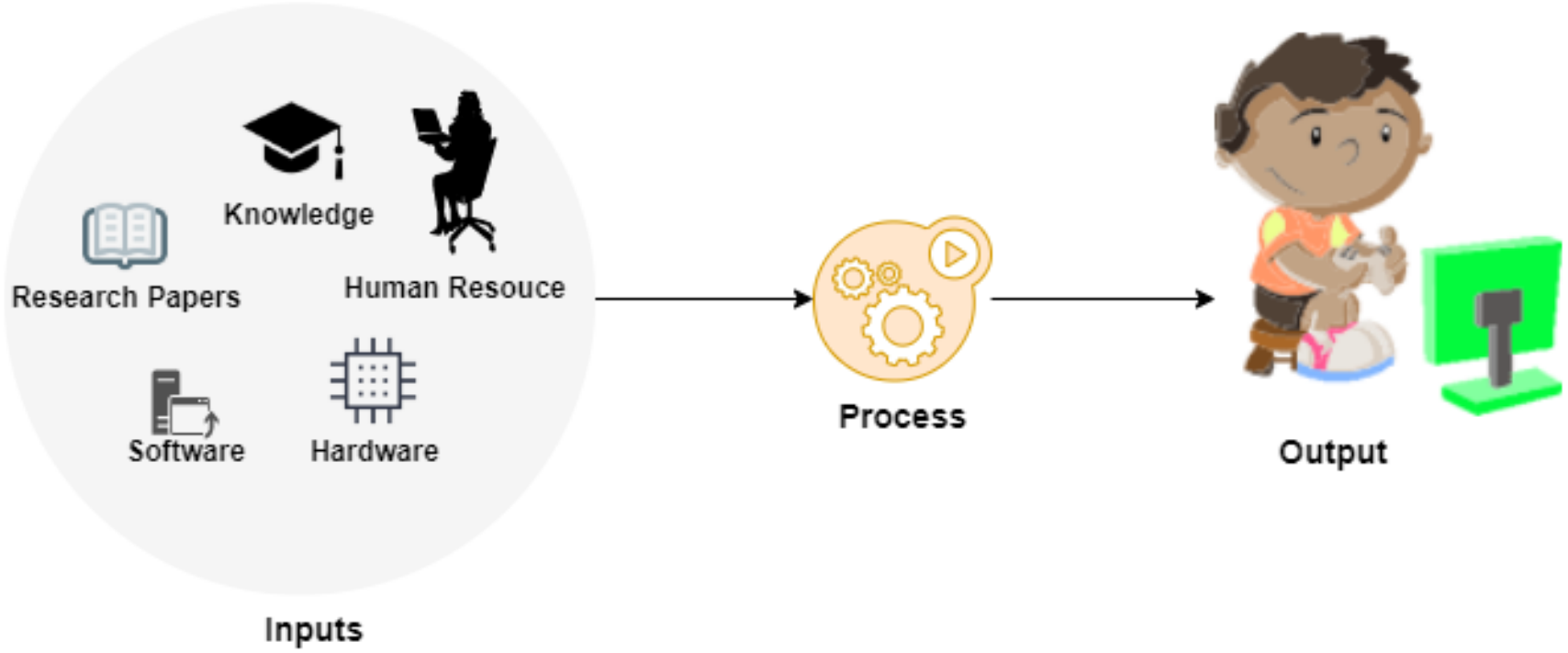
•Tangible learning has not improved a lot for decades.

•Early childhood education requires external guidance and supervision.

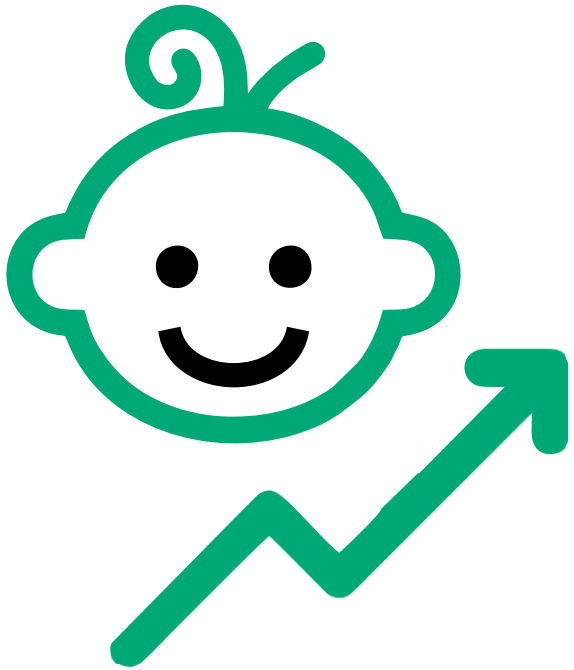
Introduction



Output


Knowledge
Research Papers
Human Resouce
Software
Hardware
Inputs
Process
Output

Outcome



- Improves children's,
  - Creativity
  - Self Learning
  - Adaptability
  - Improve Problem Solving
  - Cognitive Skills
  - Trial and Error

Research Question

- How to create an Interactive Tangible learning solution to develop the early childhood of children?

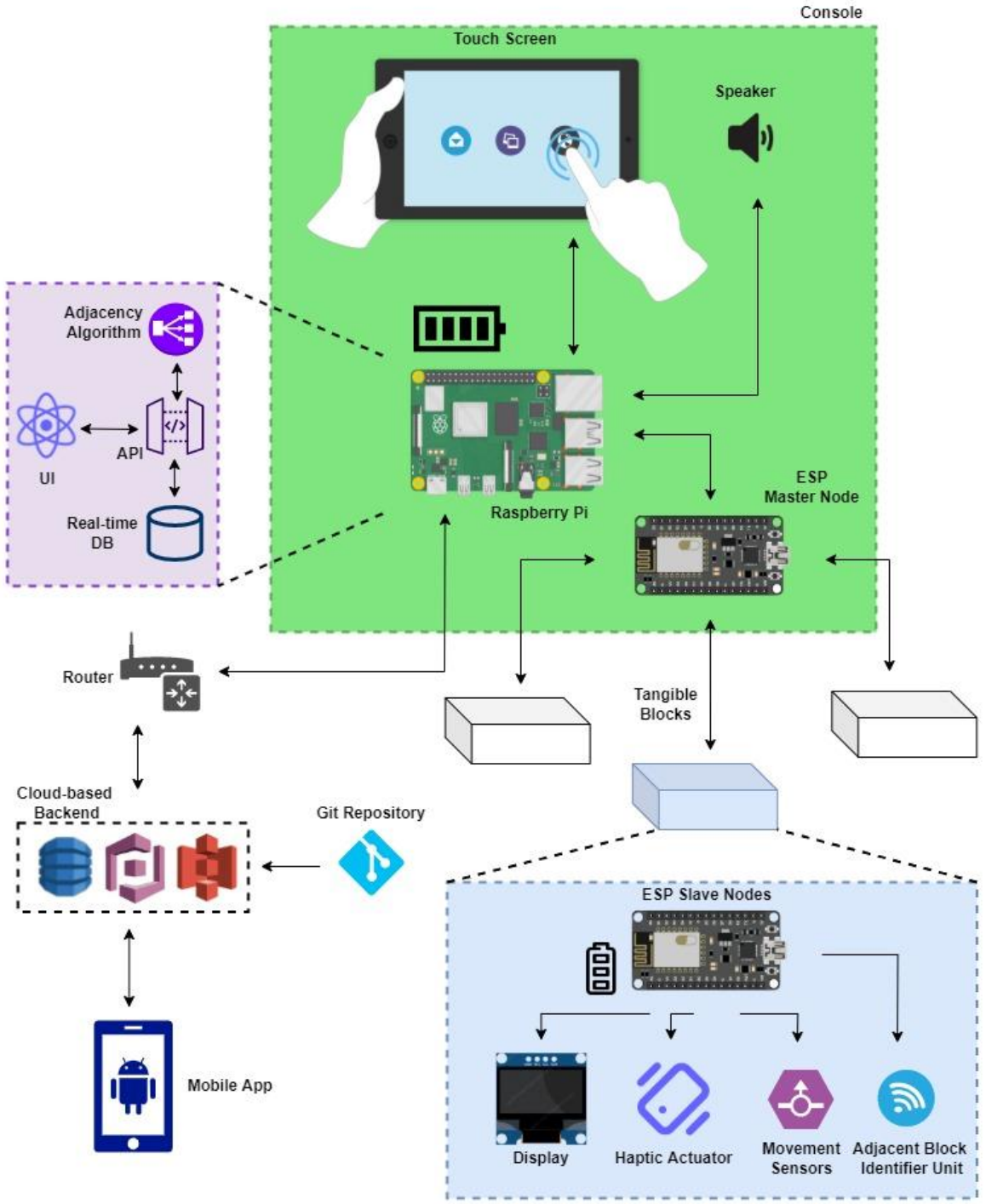
The main research question is followed by:

- How to develop tangible blocks with interactive features and components.
- How to develop a technology to identify the adjacent blocks, and method of communication between blocks and applications.
- 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.

Research Objectives

- To develop tangible blocks with interactive features and components.
- To develop an intermediary platform for communication among tangible blocks, learning activities with adjacent tangibles identification.
- To develop an interactive, child-friendly UI/UX which is easily understandable for children.
- To develop the learning activities suitable for required learning outcomes in early childhood development.

Overall System Diagram



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Hettiarachchi T.C.D.S.

Computer Systems and Network Engineering

INTRODUCTION

Background

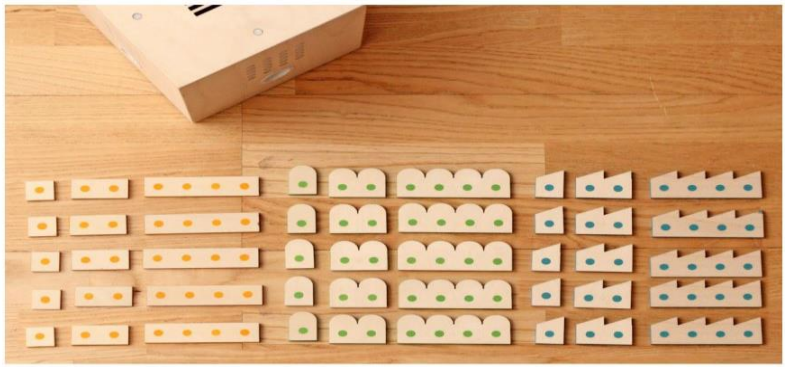
- TUI(Tangible User Interface)can enhance children's thinking and learning[1].
- TUIs benefits: Playfulness, Trial and Error, Sensory engagement, Spatial learning[2-5]
- Children's creativity can be improved by manipulations, and objects[6]

Implemented solutions:

Magic Buns

Story Blocks

Cyber Place



Superbleeper

Product	User-Level	Interaction	Application Domain	Skills
Story Blocks	Junior (7 - 12)	Audio, Blocks	Programming	Critical Thinking
Magic Buns	Junior (7 -12)	Color, Vibrate, and Sound	Constructive Play	Imagination, Creativity
Cyber Place	Junior (7 -12)	Color, Sound	Storytelling	Computational Thinking, Creativity
Superbleeper	Primary (4-6 years)	Blocks, Music	Mathematics	Creativity, Cognition

Research Gap

01

- Focused on age groups 7 years and older
- studies have been conducted for older children[1]

02

- Tangibles are static.
- Activities are Limited.
- Play area Is limited.

03

- Developed for a specific Application Domain.
- Cannot be used for another Application Domain.

Comparison

	Magic Buns	Story Blocks	Cyber place	Super Bleeper	TangiGuru
Mobility	✓	✗	✗	✓	✓
Dynamic use	✗	✗	✗	✗	✓
Interactive features	✓	✓	✓	✓	✓

Research Question

How to integrate hardware and make the tangibles dynamic to use in learning activities?

OBJECTIVES

Specific Objective

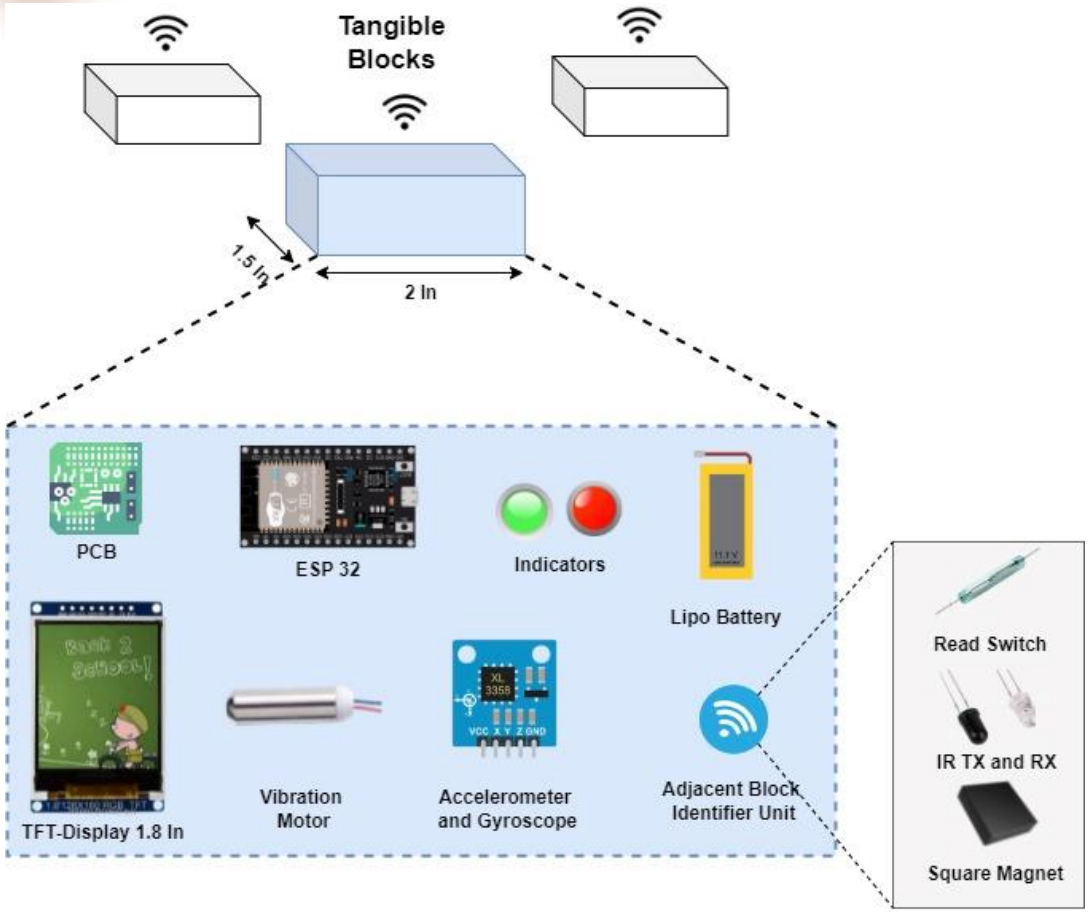
Development of tangible blocks to interact with children and develop the console considering the useability for children.

Sub Objectives

- Development of the tangible cubes and communication between blocks and console.
- Console development with required hardware.
- Power Management of blocks and console.

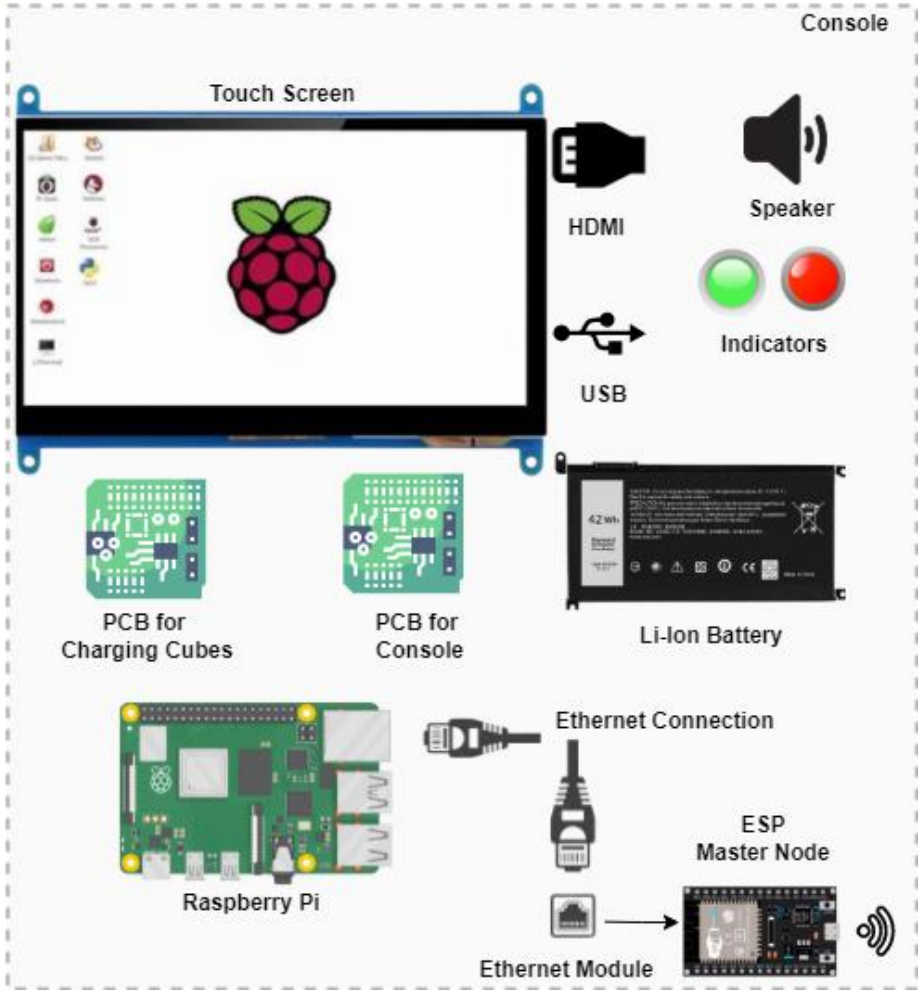
METHODOLOGY

Tangible Blocks



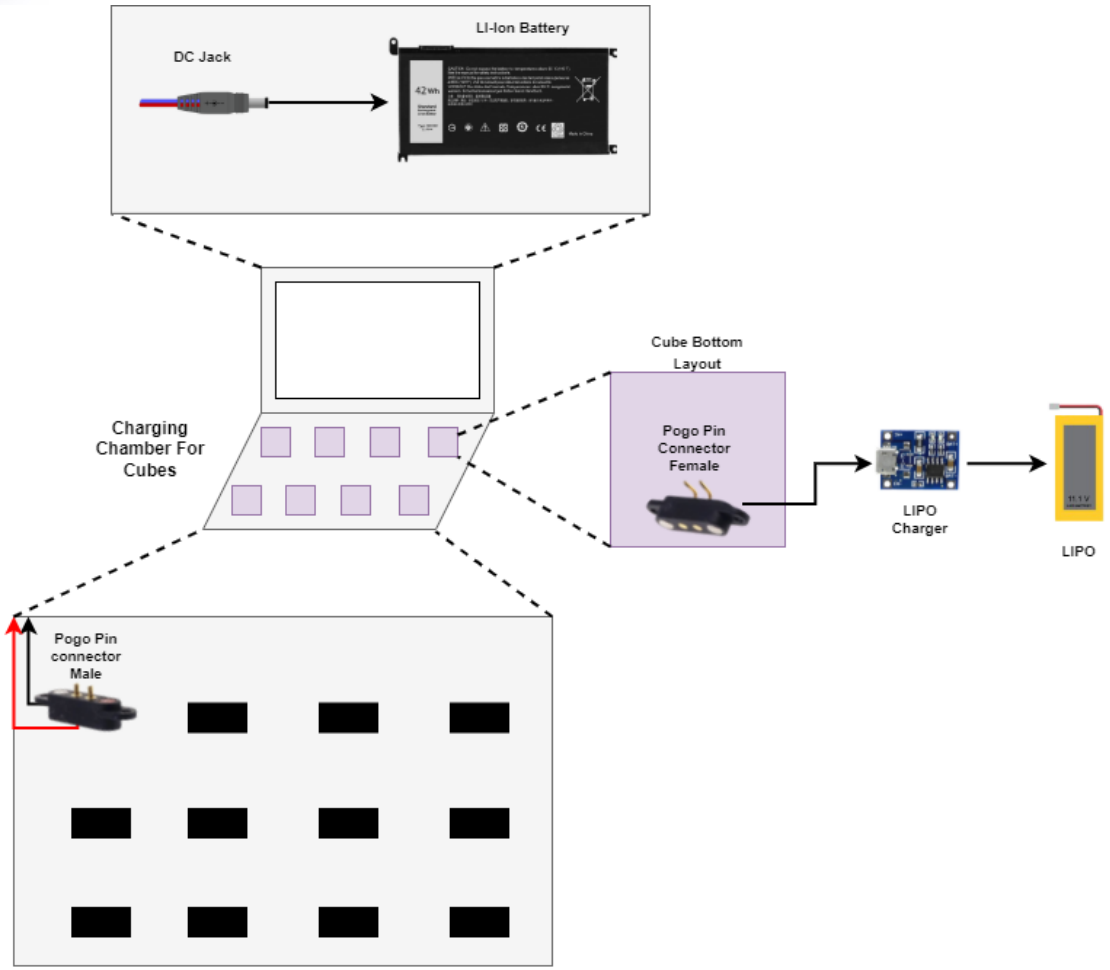
- ESP-32
- ESPNOW for communication.
- TFT display.
- MPU6050-accelerometer and gyroscope
- Lipo Battery – 300mah
- Vibration Motor
- Adjacent block identifier

Console



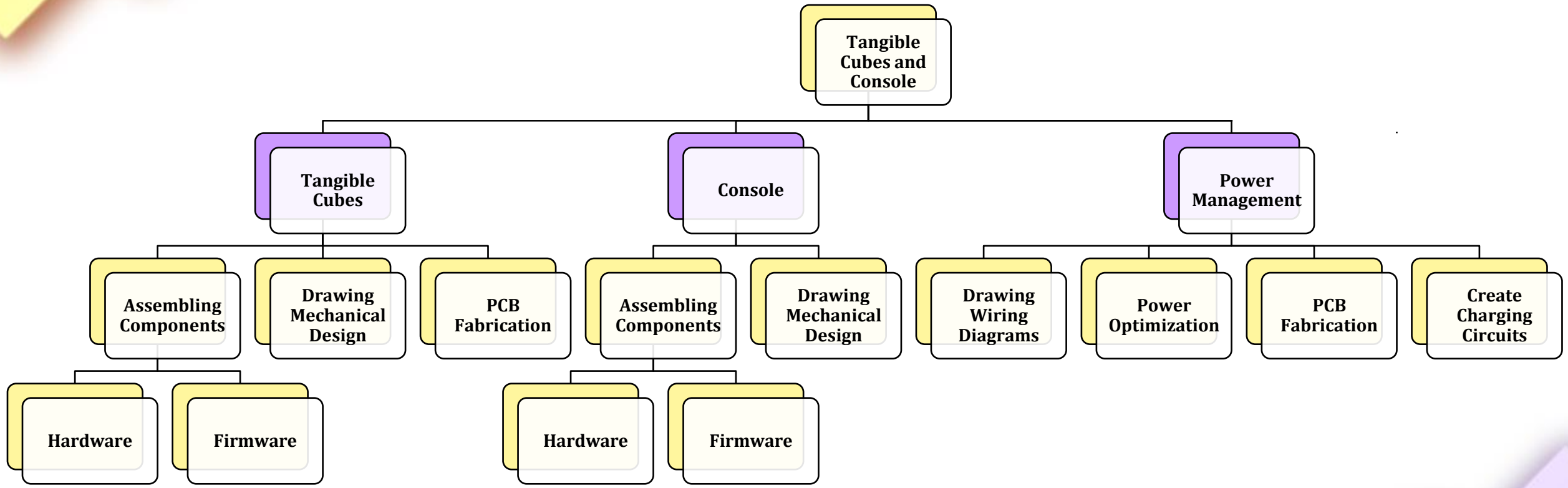
- Raspberry pi 4
- ESP 32
- 7-inch touch display
- PCB for console and charging.
- Li-Ion Battery
- Speaker
- Indicators

Power Management

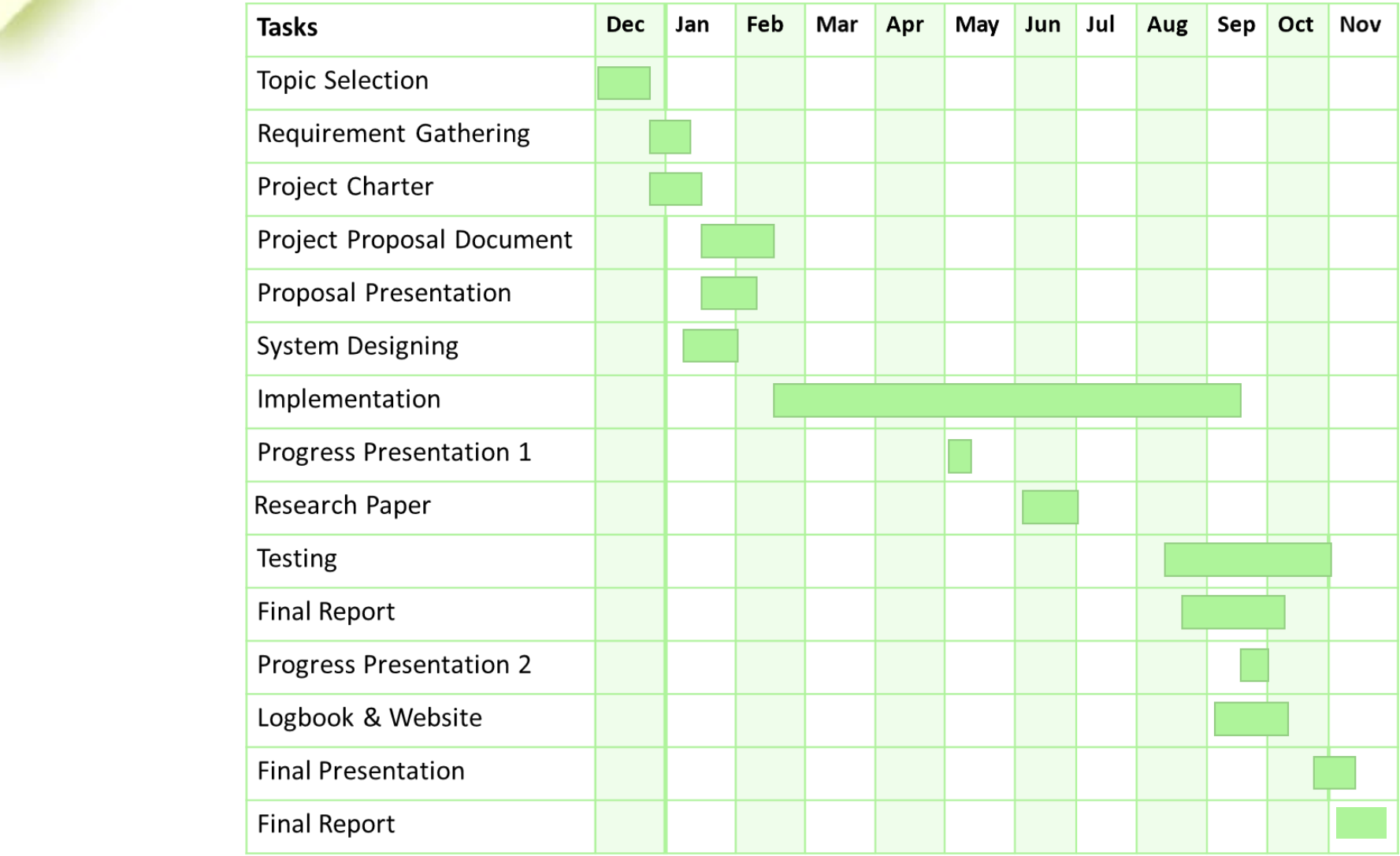


- Pogo pins will be used.
- Li-po charging circuit.
- DC barrel jack

Work Break Down Structure



Completion of the project



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[1] Claire O'Malley and Danae Stanton Fraser. 2004. Literature Review in Learning with Tangible Technologies. https://telearn.archives-ouvertes.fr/hal-00190328 A NESTA Futurelab Research report - report 12.

[2] Jerry Alan Fails, Allison Druin, Mona Leigh Guha, Gene Chipman, Sante Simms, and Wayne Churaman. 2005. Child's Play: A Comparison of Desktop and Physical Interactive Environments. In Proceedings of the 2005 Conference on Interaction Design and Children (Boulder, Colorado) (IDC '05). Association for Computing Machin.

[3] Diana Xu. 2005. Tangible User Interface for Children - An Overview. In in Proceedings of the SIXTH Conference in the Department of Computing. 579–584

[4] Oren Zuckerman, Saeed Arida, and Mitchel Resnick. 2005. Extending Tangible Interfaces for Education: Digital Montessori-Inspired Manipulatives. CHI 2005: Technology, Safety, Community: Conference Proceedings - Conference on Human Factors in Computing Systems. https://doi.org/10.1145/1054972.1055093

[5]G.E. Baykal, I. Veryeri Alaca, A.E. Yantaç, and T. Göksun. 2018. A review on complementary natures of tangible user interfaces (TUIs) and early spatial learning. International Journal of Child-Computer Interaction 16 (June 2018), 104–113. https://doi.org/10.1016/j.ijcci.2018.01.003

[6] Klaus K. Urban. 1991. On the development of creativity in children. Creativity Research Journal 4, 2 (1991), 177–191. https://doi.org/10.1080/10400419109534384

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SEMASINGHE L.S.

Computer Systems and Network Engineering

INTRODUCTION

Background

- Most of the modern tangible learning solutions are consists of Hardware and Firmware, but not Software[1].
- Therefore, such solutions are subject specific and cannot be used dynamically for various learning activities.
- For children in early childhood, their learning should be more interactive and carried with external guidance and supervision[2].

Research Gap

- Less automated guidance and no evaluation.
- Less dynamic use of tangibles.
- Less mobility in more interactive solutions.
- Less interactive features in more mobile solutions.

Comparison

	Cyberplace	Superbleeper	Story Blocks	TangiGuru
Mobility	✗	✓	✗	✓
Positional Identity	✗	✗	✓	✓
Dynamic use	✗	✓	✗	✓
Interactive features	✓	✗	✓	✓
Guidance	✗	✓	✗	✓
Evaluation	✗	✗	✗	✓

Research Question

How to integrate software-based learning activities to the tangible learning components while maintaining the ability to guide and evaluate automatically?

OBJECTIVES

Specific Objective

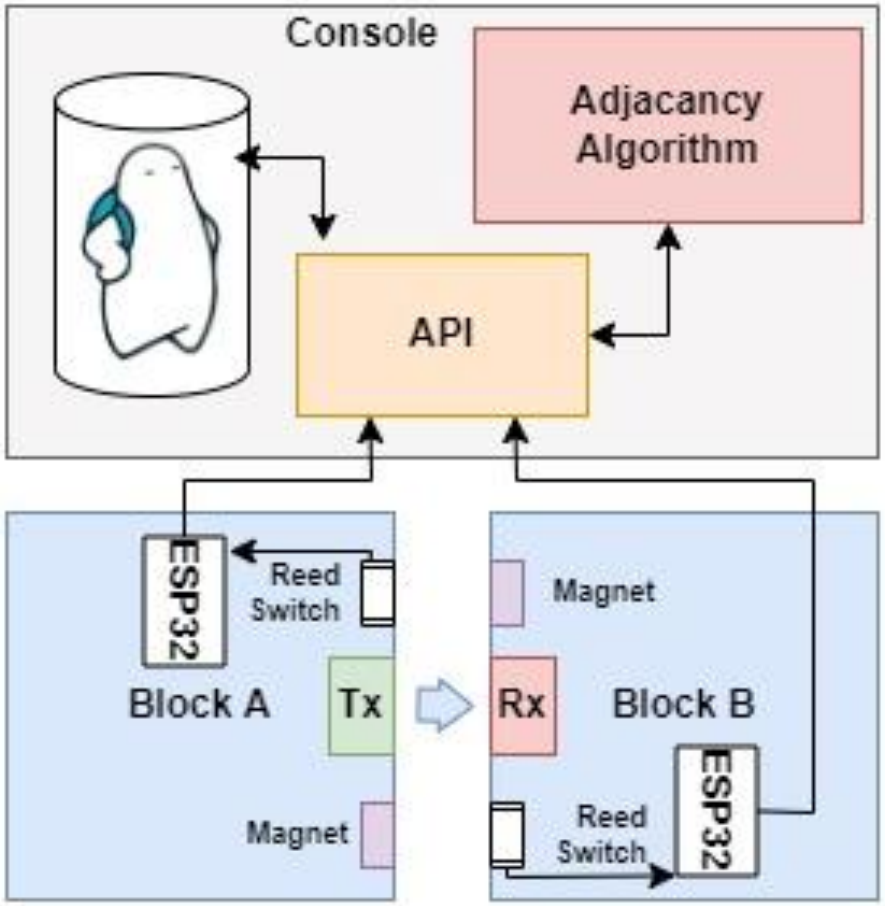
Development of an intermediary platform for communication among tangible blocks and learning activities with adjacent tangibles identification.

Sub Objectives

- Development of technology to identify adjacent blocks
- Development of system software as the tangible – virtual communication interface.
- Configuring cloud resources for backend services

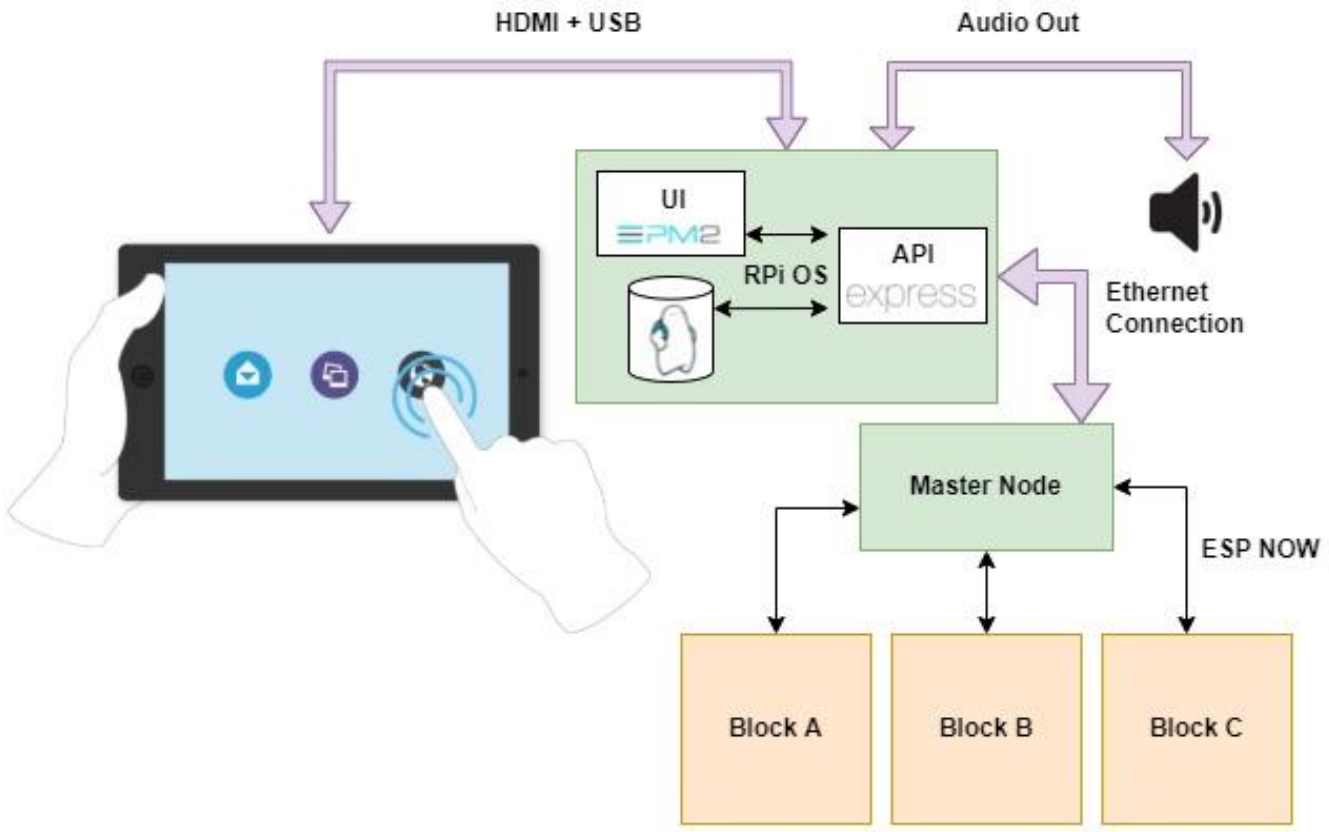
METHODOLOGY

Adjacent Block Identification



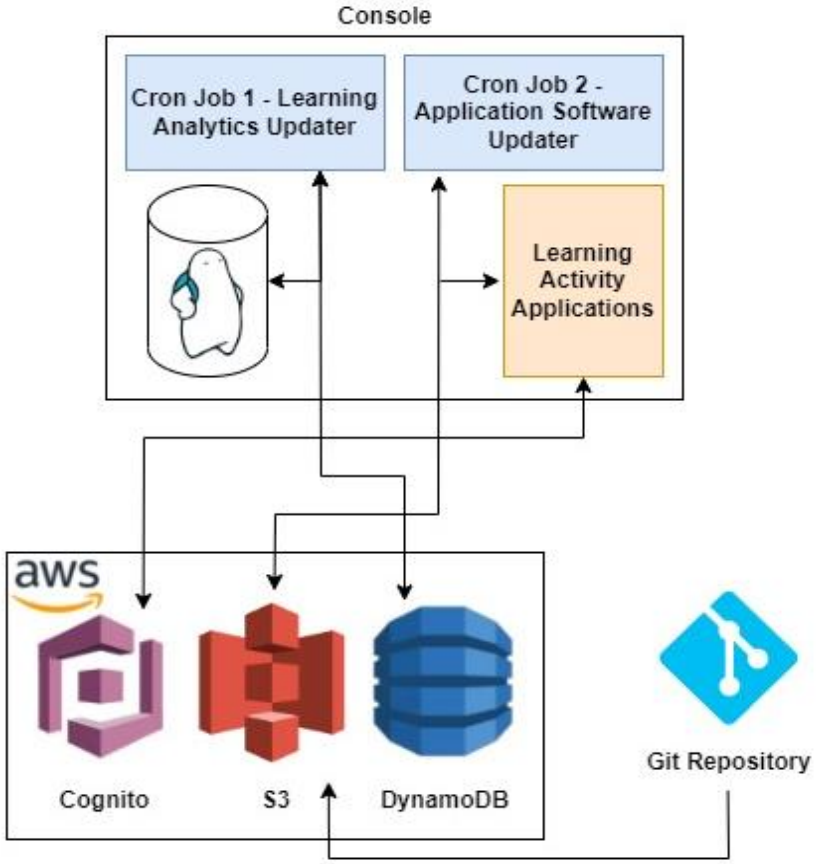
- A new technology based on legacy IR data transmission will be used.
- An algorithm will be developed for sorting the positional values of tangible blocks.
- Positional data will be updated at each new block adjacency.
- RethinkDB will be used as internal data storage for positional data.

Tangible – Virtual Communication Interface



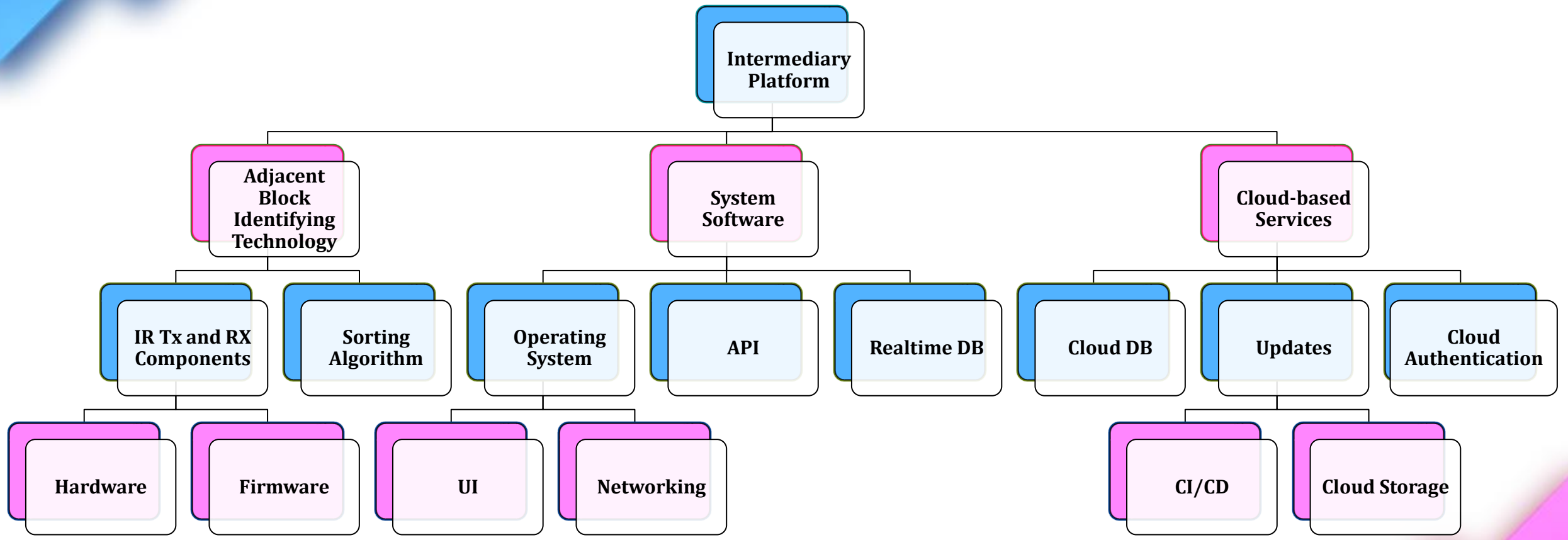
- A ReST API will be developed as the core intermediary among tangible blocks and software learning activities.
- All components will use RethinkDB as the reference point of data.
- Learning activities will be presented to user through a PM2 NodeJS runtime process manager.
- Tangibles will be connecting to the Raspberry Pi motherboard via an ESP master node.

Cloud-based Backend Services

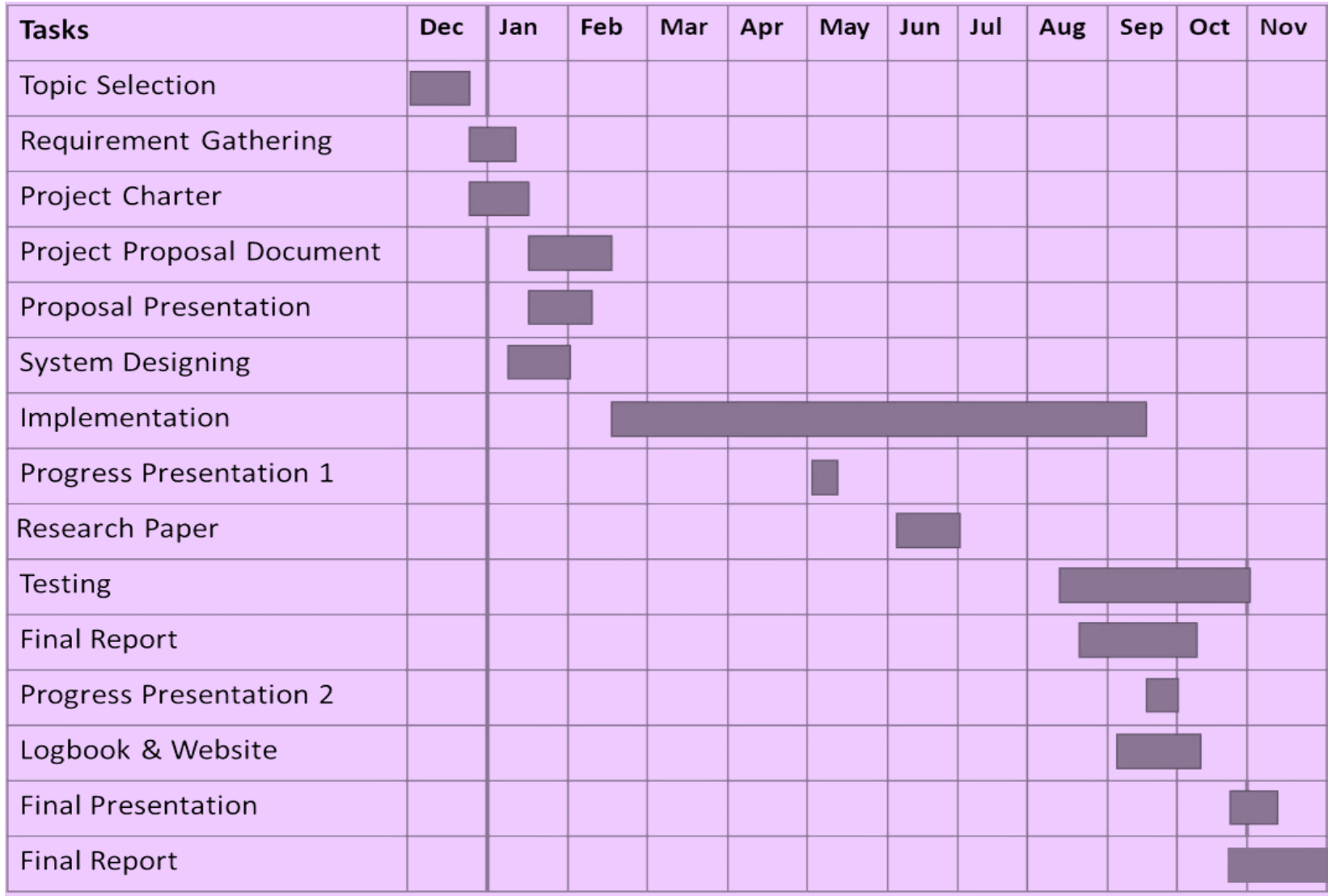


- Software updates will be carried out as CI/CD. For storage, a cloud storage service will be used. User equipment will be update periodically.
- Software authentication will be done using a cloud-based authentication service.
- Analytical data related to learning activities will be stored in a cloud database for mobile app access.

Work Breakdown Structure



Gantt Chart


Tasks
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Topic Selection
Requirement Gathering
Project Charter
Project Proposal Document
Proposal Presentation
System Designing
Implementation
Progress Presentation 1
Research Paper
Testing
Final Report
Progress Presentation 2
Logbook & Website
Final Presentation
Final Report

References

1. Tangible interfaces in early years' education: a systematic review
2. https://www.nap.edu/read/19401/chapter/8

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RATNASURIYA M.M.D.

Computer Systems and Network Engineering

INTRODUCTION

Background

- Children should develop their cognitive skills such as critical thinking, creativity during their early childhood phase.
- Usually, they gain that skills by interacting with their surrounding as they prefer more feedback [1][2].
- Children in early childhood cannot read and understand text. Therefore, they cannot be guided with textual instructions [3].
- As they lack knowledge and experience, they cannot self evaluate their work[3]

Research Gap

- Children cannot perform learning without external supervision and guidance.

- Existing solutions are specific for narrow learning areas.

Existing researches	Guidance	Evaluation	Analytics
1.A Tangible Approach to Interactive Wearable Creation for Children.	✗	✓	✗
2.Supporting Cultural Learning through a Lukasa-Inspired Tangible Tabletop Museum Exhibit	✓	✗	✗
3.Designing the User Interface of an Interactive Software Environment for Children	✗	✓	✗
4.A comparison of desktop and physical interactive environments	✗	✓	✗
5.Tangible Technologies for Childhood Education	✓	✓	✗
6.Tangible Learning Solution for Early Childhood Development.(TangiGuru)	✓	✓	✓

Research Question

- 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?

OBJECTIVES

Specific 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.

METHODOLOGY

- The web application will be developed using React JS using Bootstrap CSS library.

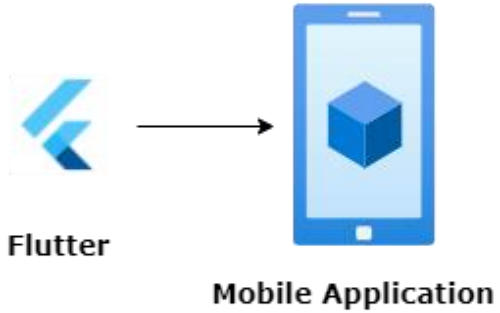
React

Color Palette

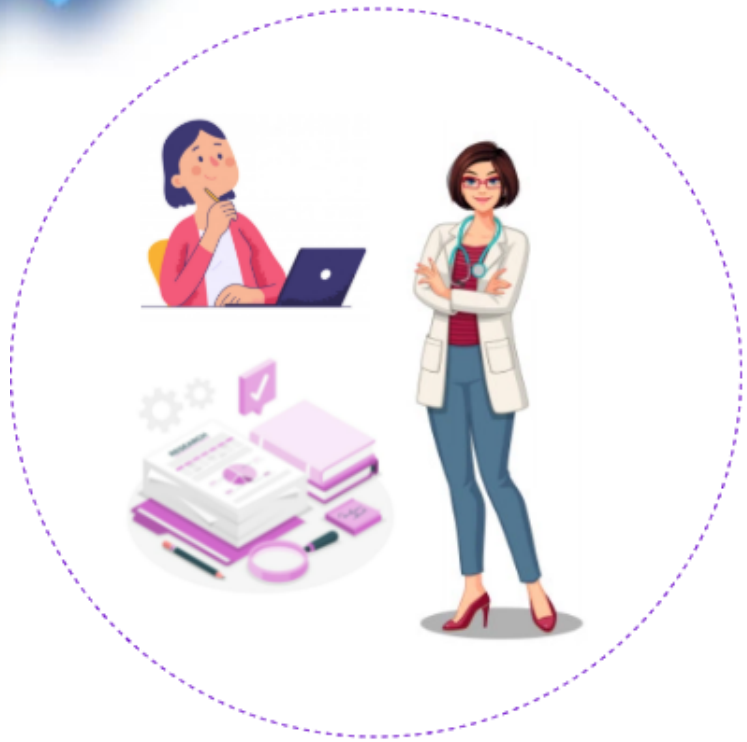
1.User Interface

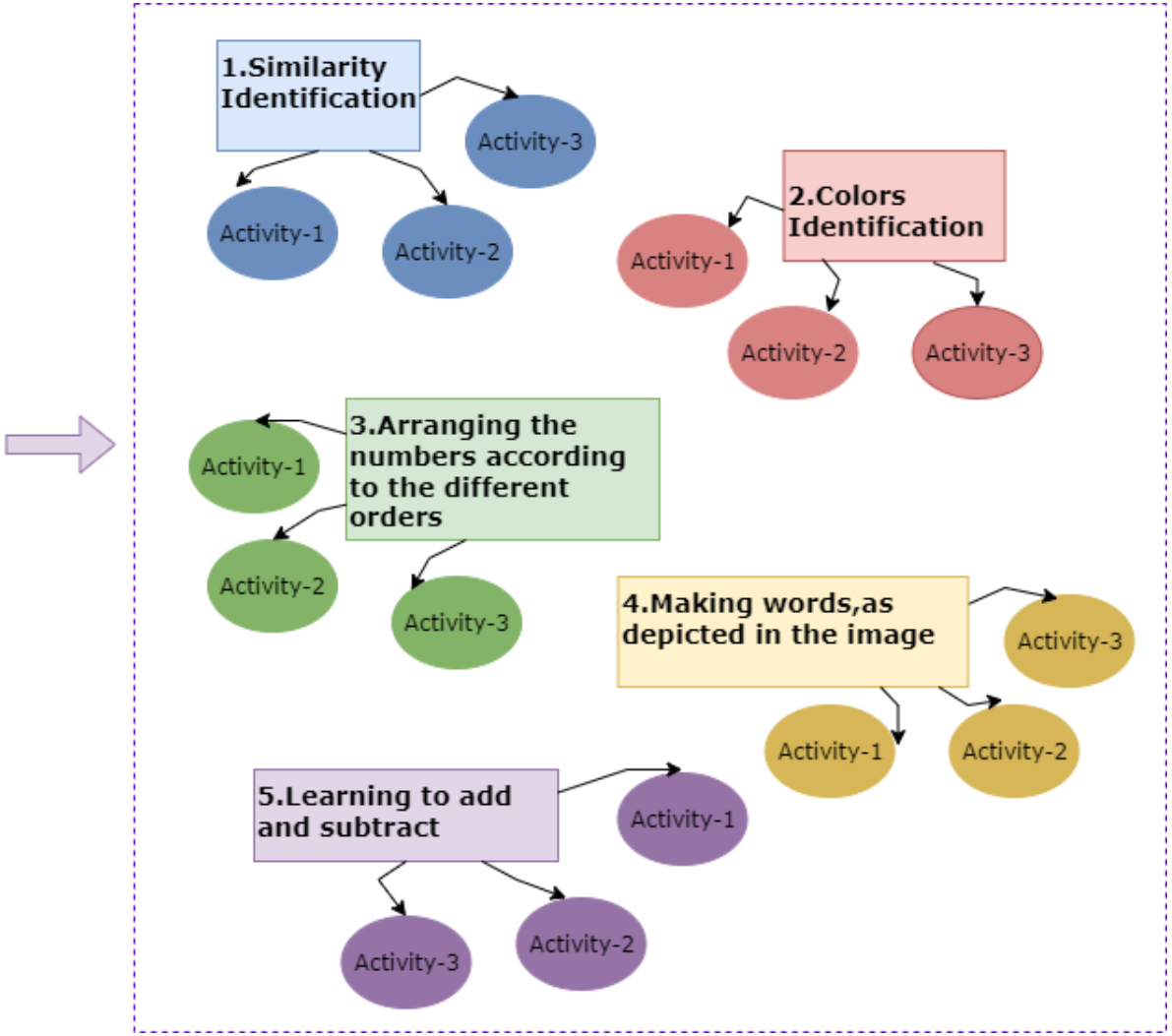
UI

- Flutter will be used to develop the mobile application.
- Amazon DynamoDB database will be used for the mobile application.
- Implement the mobile application to view the statistics of the child .



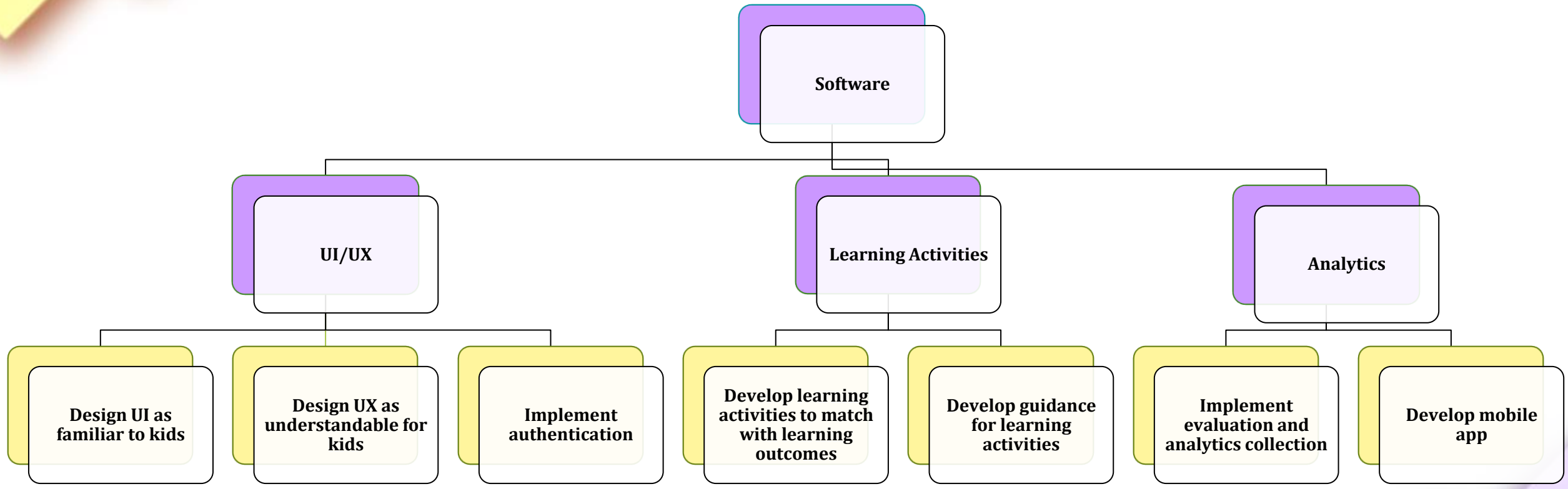
2.Mobile Application



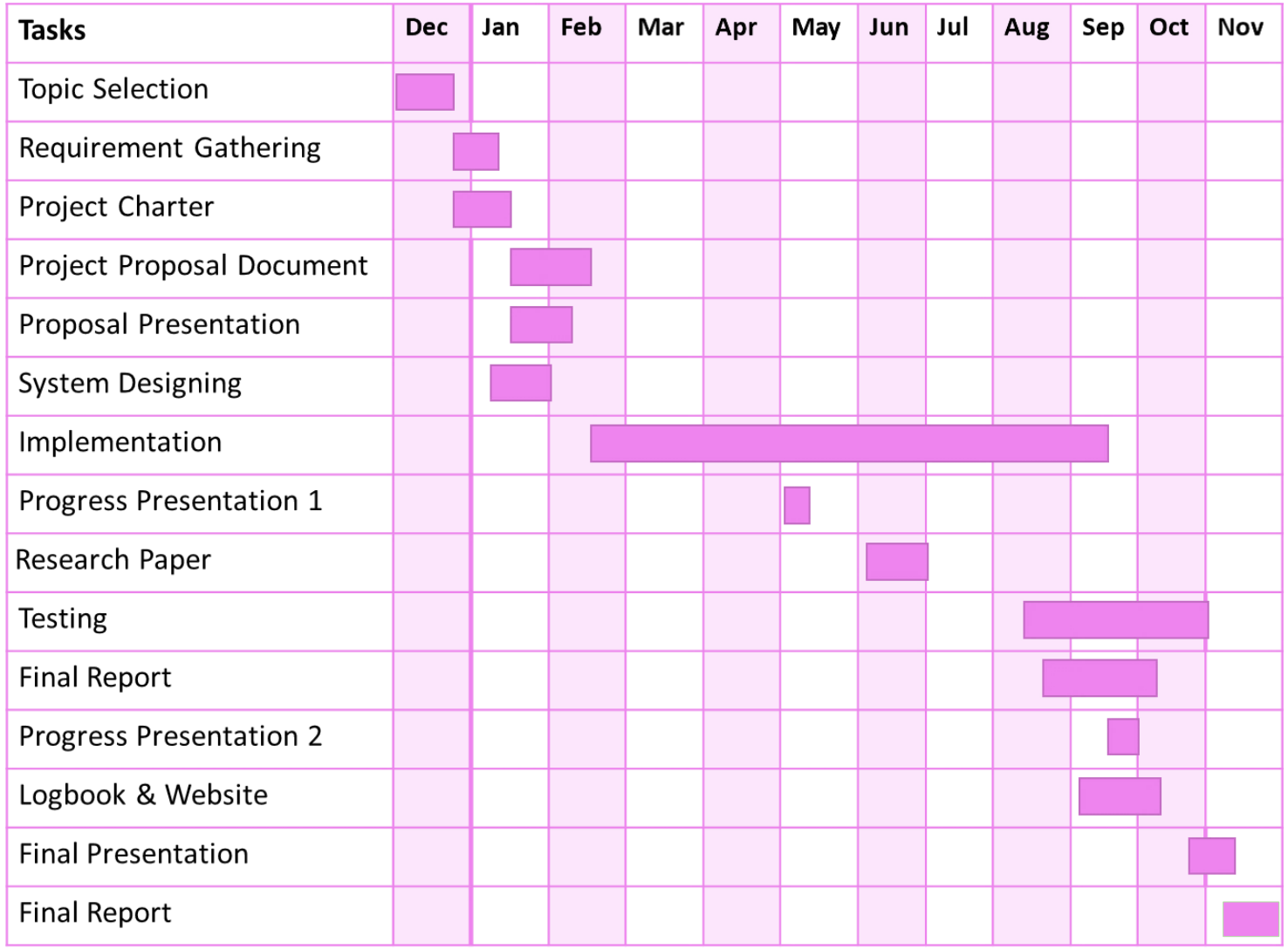


3.Learning Activities

Work Breakdown Structure



Completion of the project



References

- [1]https://www.researchgate.net/publication/303692608_Ergonomics_for_Children_Designing_Products_and_Places_for_Toddler_to_Teens
- [2]https://www.researchgate.net/publication/282234133_Mapping_Place_Supporting_Cultural_Learning_through_a_Lukasa-inspired_Tangible_Tabletop_Museum_Exhibit
- [3]https://www.medien.ifi.lmu.de/pubdb/publications/pub/liyanhong2021cc/liyanhong2021cc.pdf

Impact

- A generation having a developed mindset.

Budget

Item	Amount (LKR)
Raspberry Pi 4 Model B 2GB	10,000
ESP-32 chip (13pcs)	10,400
TFT color display (12pcs)	7,200
MPU-6050 Accelerometer and Gyroscope (12)	5,880
3.7V 250mAh 25C Li-Po Battery (12)	5,160
Micro DC vibration motor (12pcs)	504
12V 42Wh Li-ion Battery	10,500
Design and Fabrication Costs for Hardware	15,000
AWS Costs	2,500
PCB Fabrication	5,000
7-inch IPS LCD touch screen	14,750
Total	**71,894**

Commercialization

- Niche Marketing – (4 -7 years children).
- Brand Awareness – (Facebook, Instagram, Website).
- Tangi Guru Subscription.
  - 1-year Hardware Warranty
  - Software updates for 4 years.
  - Access for Cloud-based services for 4 years.

THANK YOU!

Q&A