Every Child is Special

LEXආදයා

AI-based Personalized Rehabilitation for Dyslexia and Dyscalculia Adolescents

Group ID: 24-25J-233

OUR TEAM

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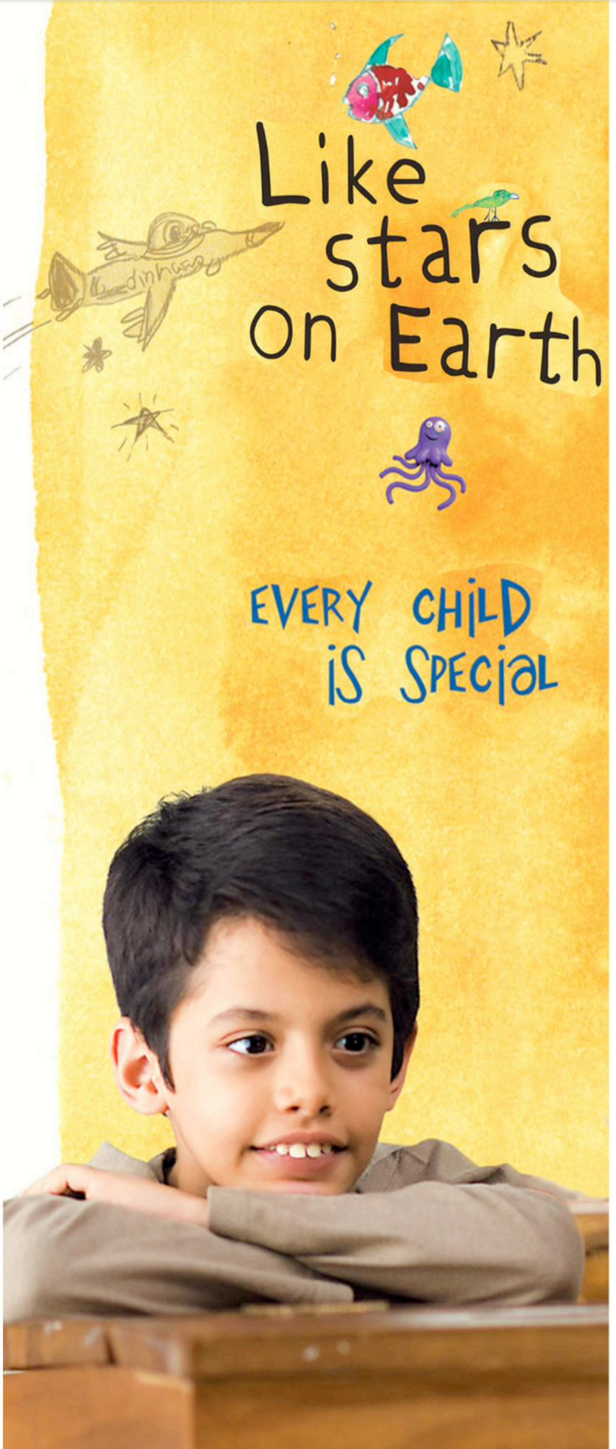

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1. Introduction
2. Research Question
3. Research Gap
4. Proposed System
5. Technologies
6. Domain Expertise and data requirement
7. Individual Components
8. Commercialization Aspects
9. Budget
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INTRODUCTION

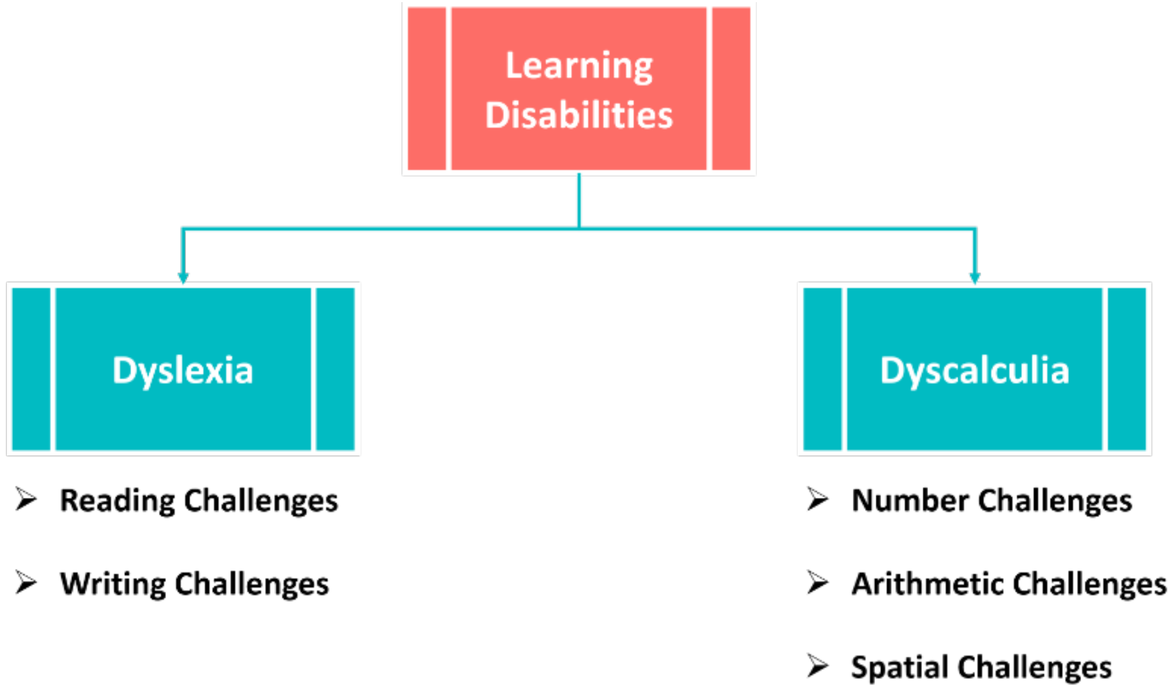
Most children have no idea

how they are supposed to see.

So when words look like this,

they assume everyone sees

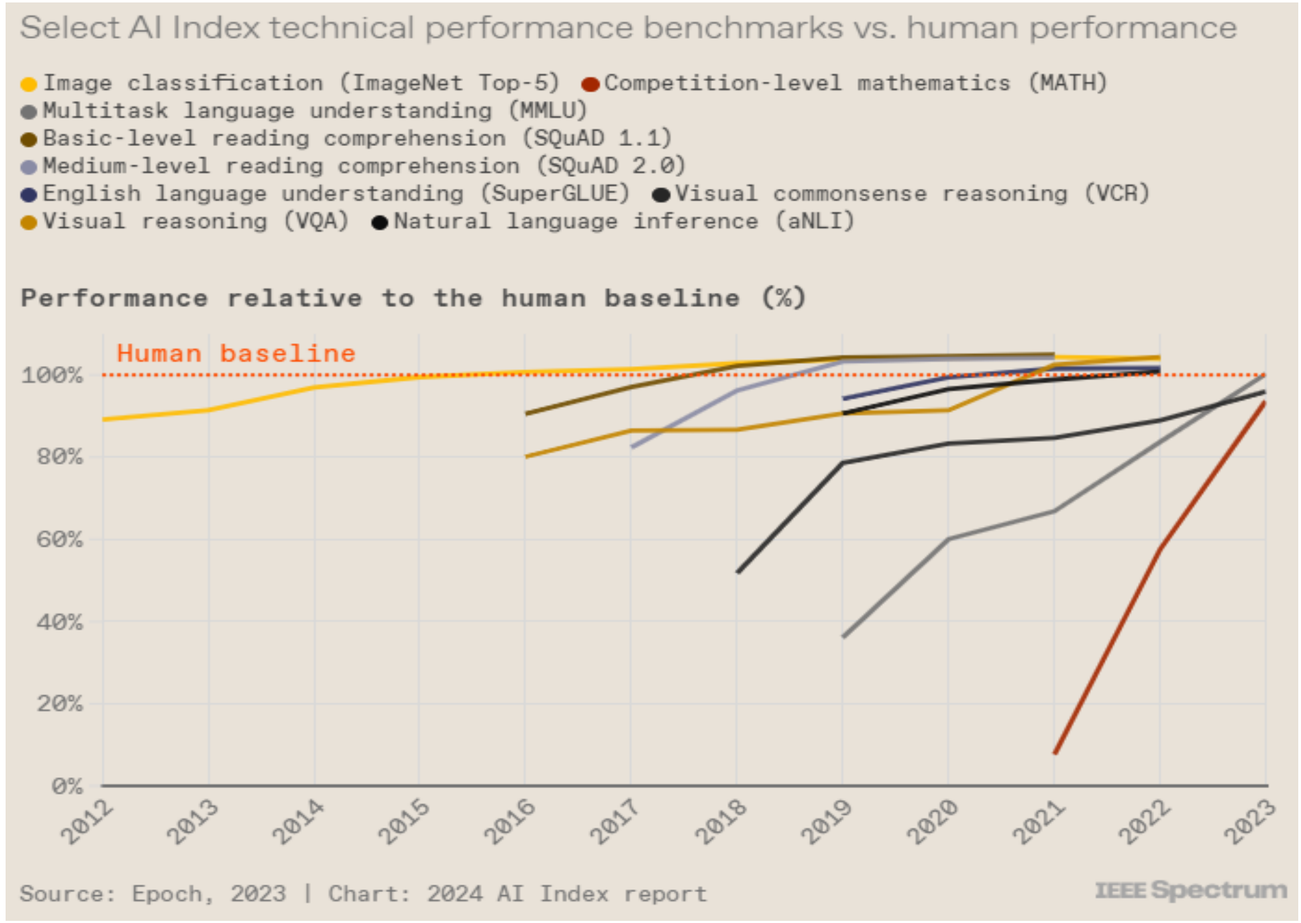
the same way.



Grade	Multiple Impairments		Hearing Impairments				Visual Impairments				Speech Language Difficulties		Dyslexia		Intellectual Impairments		Physical Disabilities		Epilepsy		Emotional Problems		Other		Total
			Complete		Half		Complete		Half																
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Grade 1	327	202	15	12	41	39	19	6	386	297	454	172	149	81	417	251	145	106	50	27	217	55	100	63	2320
Grade 2	258	170	16	14	58	55	24	11	485	394	410	179	172	86	510	271	148	111	50	36	263	65	84	69	2478
Grade 3	279	169	8	14	68	52	25	15	663	626	358	139	283	141	571	311	159	98	57	33	265	73	100	61	2836
Grade 4	256	135	9	13	80	47	37	13	736	652	304	149	291	141	609	356	173	95	60	34	224	72	97	65	2876
Grade 5	197	166	17	11	59	63	23	23	690	704	230	94	255	148	533	304	139	95	42	42	233	64	87	42	2505
Grade 6	138	108	10	12	88	52	25	15	600	745	155	46	303	133	403	196	127	83	48	30	212	54	92	62	2201
Grade 7	135	58	6	15	71	60	29	14	792	893	158	50	227	113	345	167	117	74	55	30	192	51	78	49	2205
Grade 8	107	59	11	11	60	78	23	16	904	942	128	54	203	68	323	159	120	70	53	39	239	59	71	40	2242
Grade 9	67	46	12	9	63	51	24	18	716	1020	96	44	226	102	294	132	106	77	40	31	184	52	71	35	1899
Grade 10	71	30	6	6	54	41	30	18	636	931	74	32	162	72	198	134	98	77	26	32	184	54	45	32	1584
Grade 11	42	25	12	12	44	36	10	18	613	736	54	29	120	52	170	114	64	74	19	24	135	36	33	23	1316
Grade 11 (Repeaters)	1	2	0	1	2	4	2	0	39	42	5	1	6	3	5	8	5	4	2	0	2	1	3	3	72
Total	1878	1170	122	130	688	578	271	167	7260	7982	2426	989	2397	1140	4378	2403	1401	964	502	358	2350	636	861	544	24534

Disability among Students in General Class and Government Schools, Recorded in the Year 2019

WHY NOT A TECH SOLUTION?



Select AI Index technical performance benchmarks vs. human performance

RESEARCH QUESTION

- Lack of adaptive educational lessons
- Need for systems that detect emotional and engagement cues.
- Need for personalized and multisensory teaching methods.
- Need for audio adjusting features.

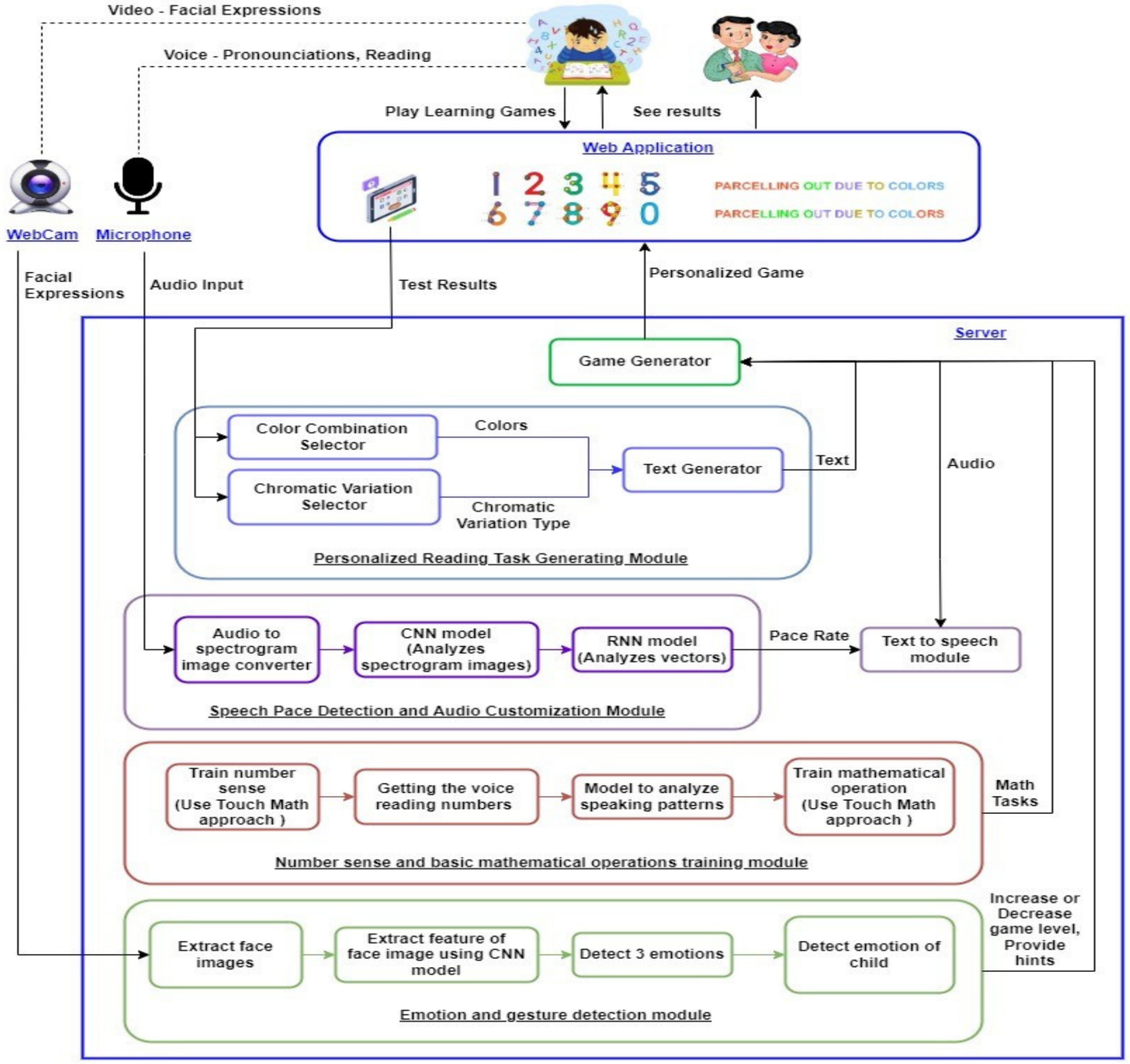
OBJECTIVES

Develop a personalized assistive learning platform for children with dyslexia and dyscalculia

Sub Objectives

- Enhance reading skills using color variations.
- Implement personalized audio output based on speech pace detection.
- Improve mathematical skills using the Touch Math approach.
- Use real-time emotion detection to adapt tasks dynamically and provide supportive guides.

SYSTEM OVERVIEW DIAGRAM


Video - Facial Expressions
Voice - Pronounciations, Reading
Play Learning Games
See results
Web Application
PARCELLING OUT DUE TO COLORS
PARCELLING OUT DUE TO COLORS
WebCam
Microphone
Facial Expressions
Audio Input
Test Results
Personalized Game
Server
Game Generator
Color Combination Selector
Chromatic Variation Selector
Colors
Chromatic Variation Type
Text Generator
Text
Audio
Personalized Reading Task Generating Module
Audio to spectrogram image converter
CNN model (Analyzes spectrogram images)
RNN model (Analyzes vectors)
Pace Rate
Text to speech module
Speech Pace Detection and Audio Customization Module
Train number sense (Use Touch Math approach)
Getting the voice reading numbers
Model to analyze speaking patterns
Train mathematical operation (Use Touch Math approach)
Math Tasks
Number sense and basic mathematical operations training module
Extract face images
Extract feature of face image using CNN model
Detect 3 emotions
Detect emotion of child
Increase or Decrease game level, Provide hints
Emotion and gesture detection module

AGILE SOFTWARE DEVELOPMENT

Software Development Life Cycle

3 Implementation

- Break down user stories into tasks
- Assign tasks to team members
- Develop code according to architecture
- Conduct unit tests and code reviews

2 Design

- Create wireframes and prototypes
- Develop system architecture
- Plan database schemas and data flow
- Design user interface specifications

4 Testing

- Perform functional testing
- Execute integration tests
- Conduct regression testing
- Gather feedback and adjust.

1 Requirement Gathering and Analysis

- Collect user stories and requirements
- Define acceptance criteria
- Analyze feasibility and risks
- Prioritize backlog items

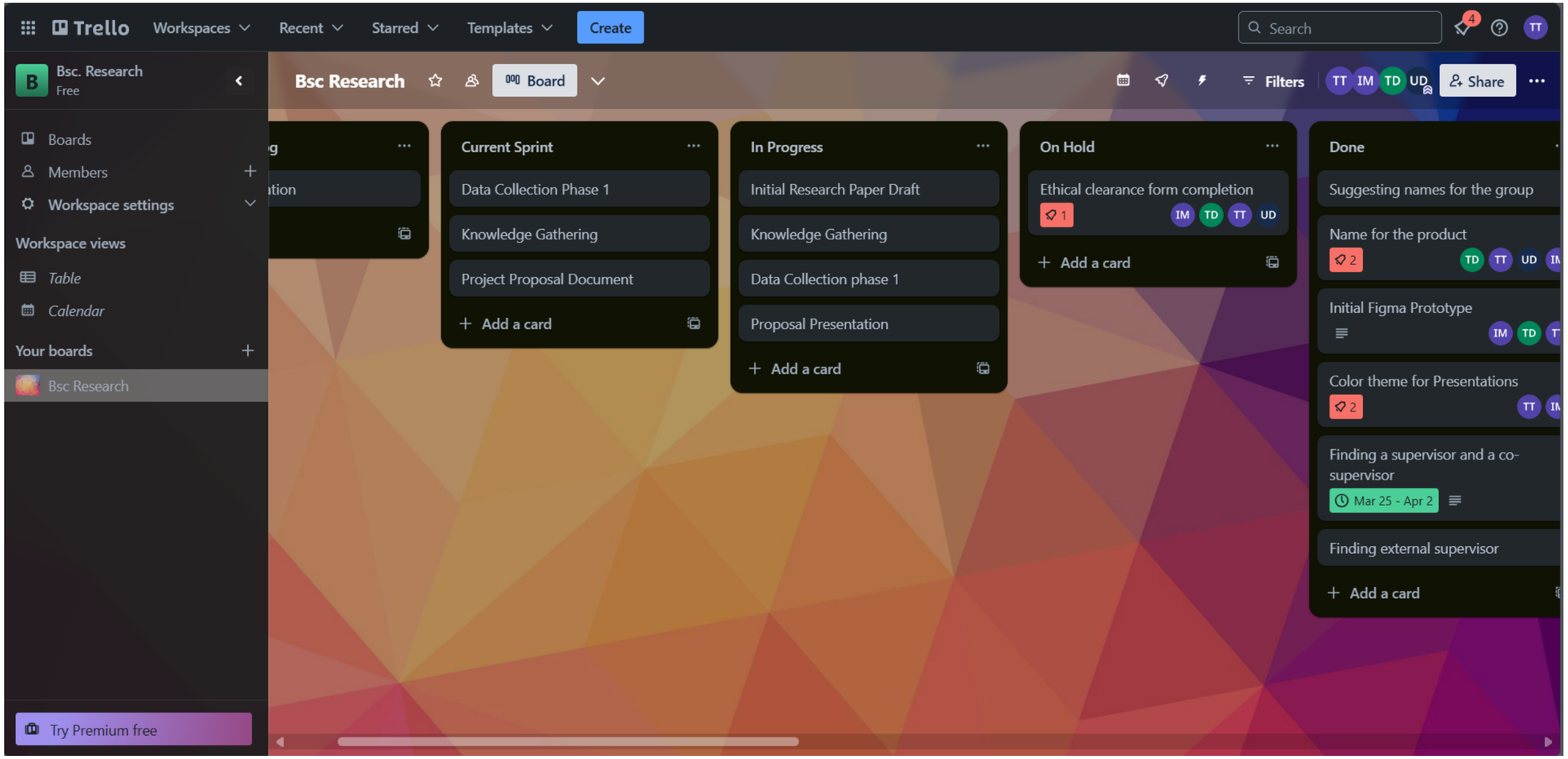
Deployment 5

- Prepare deployment plan
- Perform system deployment
- Monitor initial deployment issues.

6 Maintenance

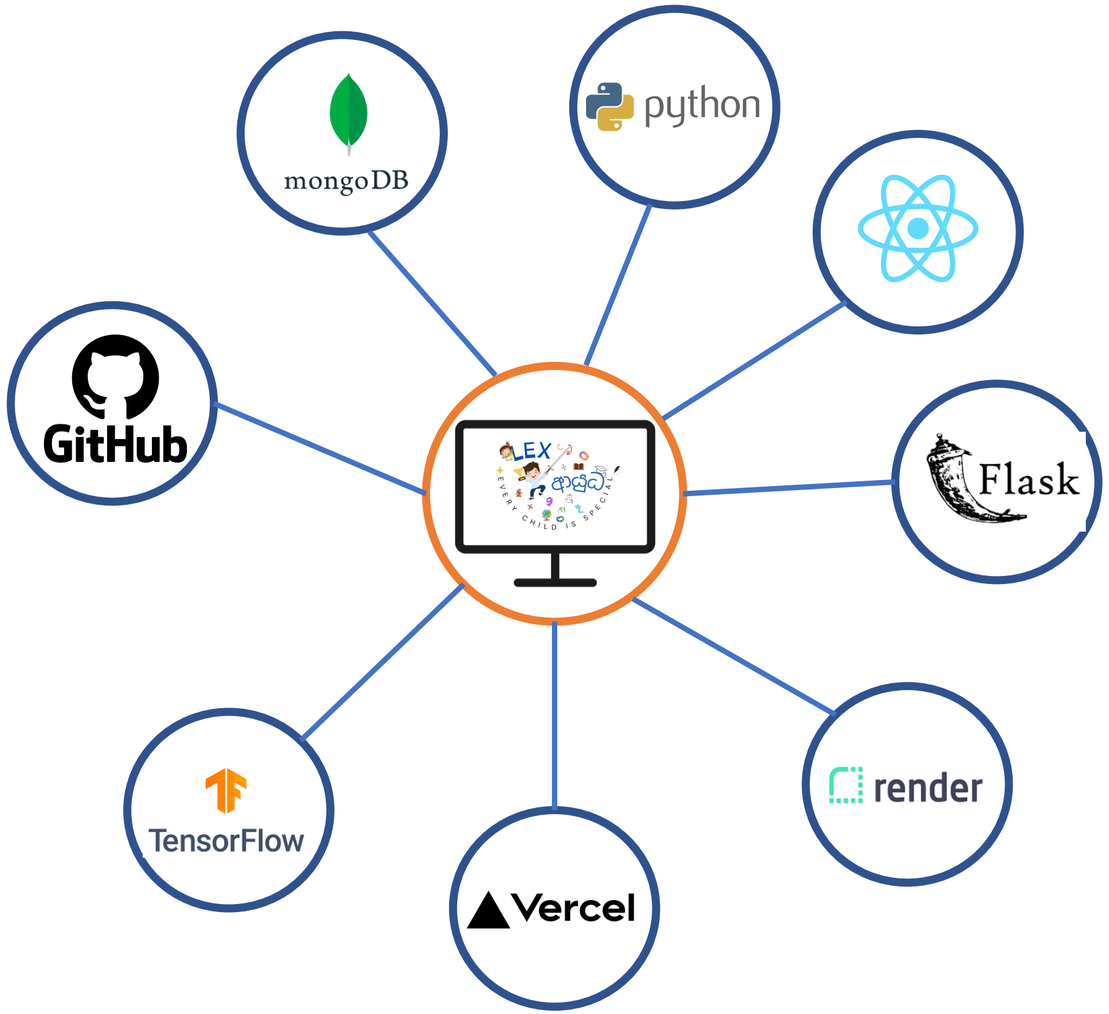
- Resolve issues and bugs
- Implement user feedback changes
- Ensure regular updates and improvements

Project Management Dashboard



Figma Prototype

TECHNOLOGIES



Frontend

- React
- Ant Design

Backend

- Flask
- Node Js

Machine Learning and Deep learning

- Python
- Jupyter Notebook
- TensorFlow
- Keras
- OpenCV
- Keggale

Version Control and Project Management

- Github
- Trello

Technical Concepts

- Machine Learning
- Image Processing
- Convolutional Neural Network (CNN)
- Recurrent Neural Network (RNN)
- Containerization
- Microservices

INDIVIDUAL COMPONENTS

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EMOTION RECOGNITION TO PROVIDE REAL-TIME ADAPTIVE FEEDBACK AND ADJUST GAME DIFFICULTY LEVEL

Research Gap

		A	B	C	D	E	LexAyudha
Personalized Rehabilitation	Rehabilitation Activities	✓	✓	✓	✓	✓	✓
	Report Generation	✓	✗	✗	✗	✗	✓
	Detect User's emotion	✗	✗	✗	✗	✗	✓
	Provide Personalized feedback to guardian	✗	✗	✗	✗	✗	✓
	Focus on Student's stress level	✗	✗	✗	✗	✗	✓
	Keep track of progress	✓	✓	✓	✗	✗	✓

a - A Mobile-Based Screening and Refinement System to Identify the Risk of Dyscalculia and Dysgraphia Learning Disabilities in Primary School Students[1]

b - Developing two game-based interventions for dyslexia therapeutic interventions using gamification and serious games approaches entertainment computing journal[2]

c - Effectiveness of digital game-based trainings in children with neurodevelopmental disorders[3]

Research Problem

How do we create A system that provide

- Real time emotion detection to reduce stress level
- Support student by dynamically changing the activity level
- Personalized Feedback to guardian with child's emotion status

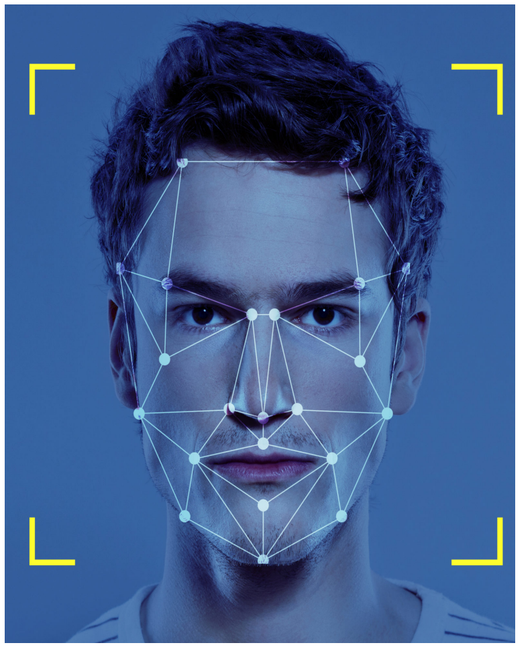
Objectives

SPECIFIC OBJECTIVE

Emotion Recognition to provide real-time adaptive feedback and adjust activity difficulty level

SUB OBJECTIVES

- Detect emotion and identify the emotion class
- Dynamically change acitivity difficulty level
- Keep track of student emotional records with relevet activity
- Generate Personalized feedback for guardian



Objectives Cont.

Key Emotions (5):

1. Happiness
2. Sadness
3. Surprise
4. Anger
5. Neutral

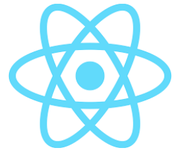
Main Classes (3):

1. Distraction (neutral, surprise)
2. Frustration (sadness, anger)
3. Engagement (happiness, neutral)

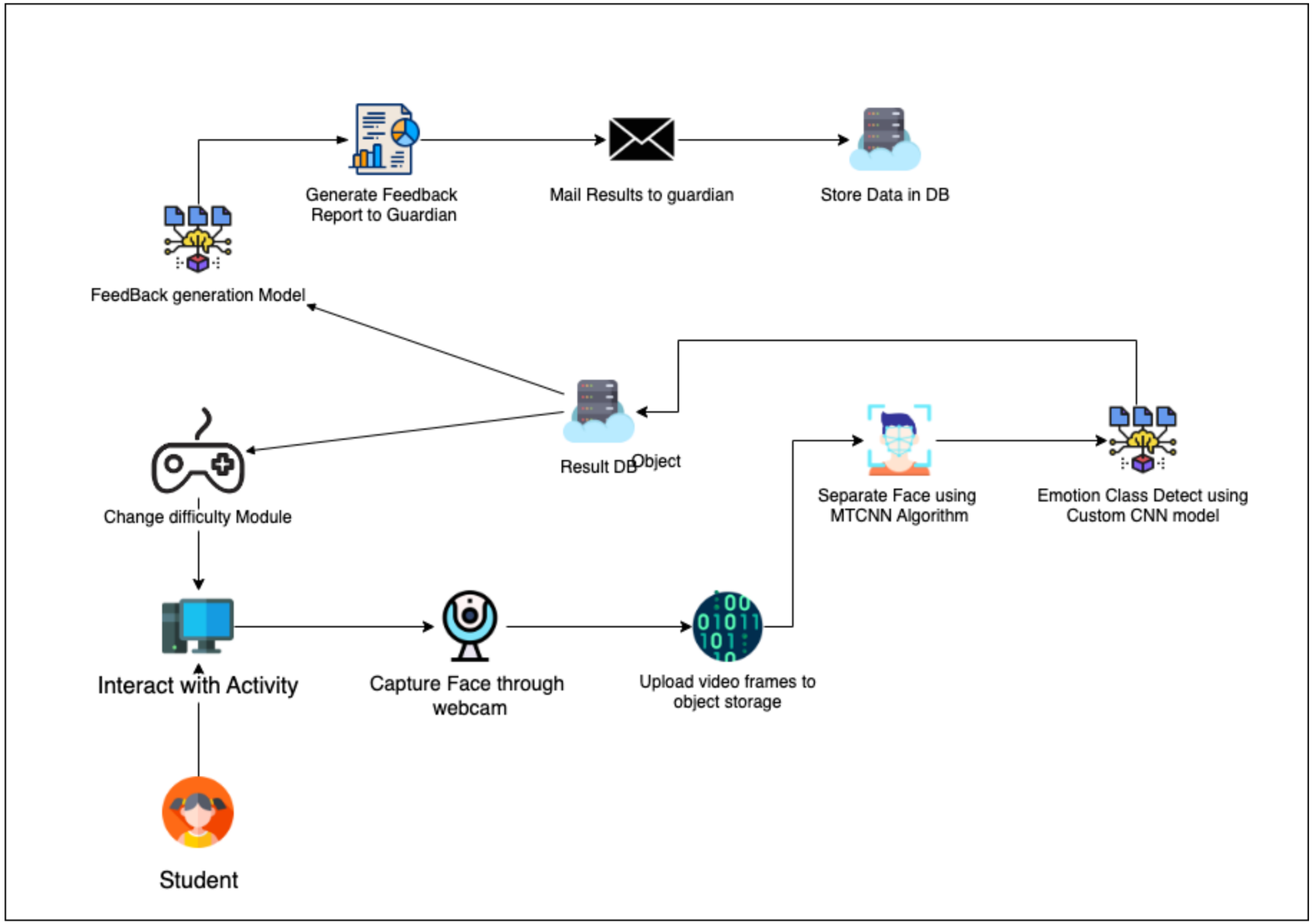
Technologies to be used

- Facial Emotion Recognition
  - TensorFlow
  - Keras
  - PyTorch
- Computer Vision
  - OpenCV
  - Dlib
- Backend Technologies
  - Flask
  - Node js
- Frontend Technologies
  - React js
  - Chart js

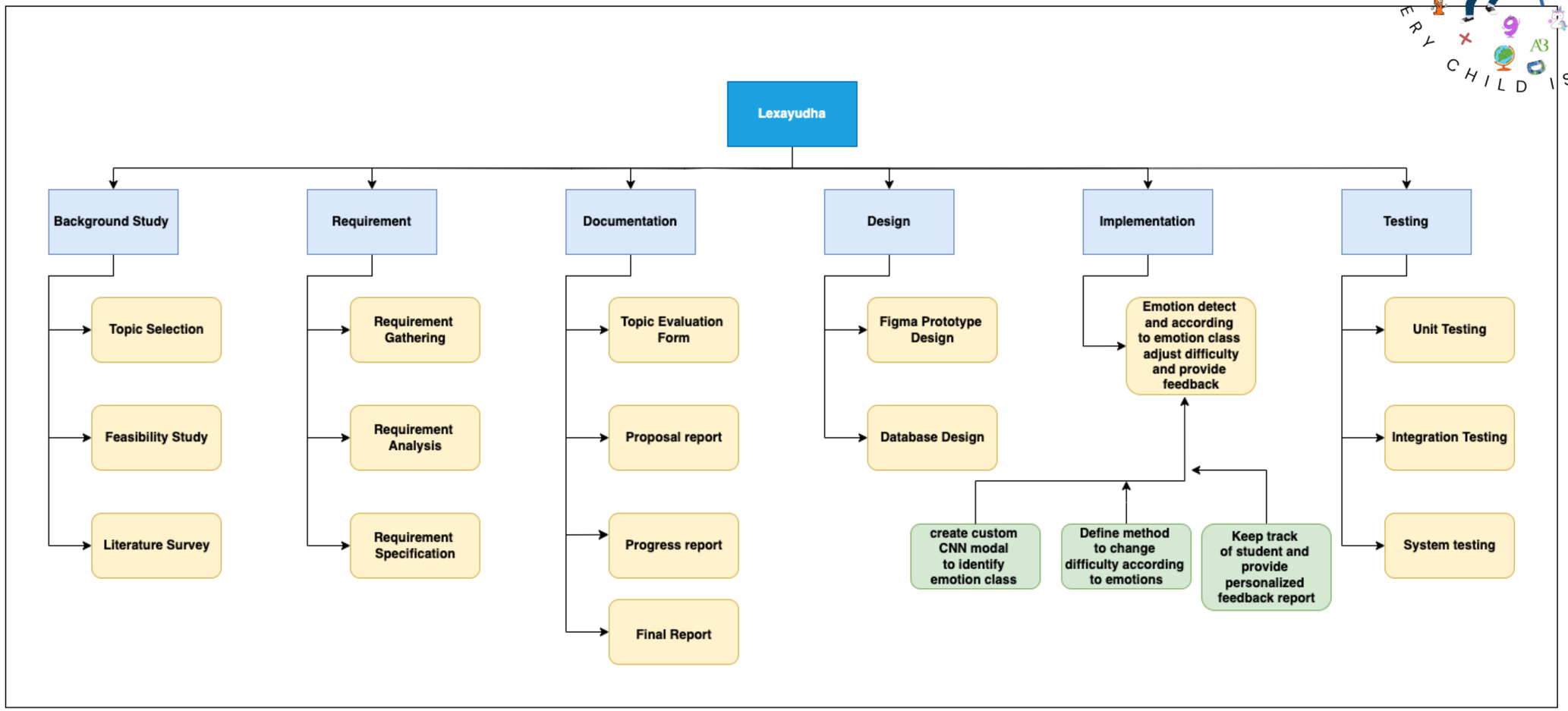
- Algorithms
  - MTCNN algorithm
  - Facial Landmark Algorithm



System Diagram



Work Breakdown Structure



Requirements

System Requirements

- Stable internet connection.
- High Definition Web Cam

Personal Requirements

- Consent to capture Video Data.
- Clear & Well lit environment.

Software Requirements

- Web browser with WebCam access.

Functional Requirements

- User Logs in to system.
- Capture Video Realtime.
- Recognize facial emotions
- Dynamically change difficulty level
- Generate Personalized feedback report

Gannt Chart

Task name	Progress	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Project Initiation																	
Study about research gaps	100%																
Deciding appropriate research area	100%																
Going through research papers	100%																
Finalizing a topic	100%																
Requirements Gathering & Analysis																	
Identifying functional requirements	100%																
Identifying non- functional requirements	100%																
Identifying data requirements	100%																
Identifying knowledge requirements	100%																
Design																	
Creating the figma prototype	100%																
Development																	
Model training	0%																
Backend Development	0%																
Frontend Development	0%																
Testing																	
Unit and API testing	0%																
Integration Testing	0%																
Load Testing	0%																
User Acceptance Testing	0%																
Deployment	0%																

References

[1] De Saram, E., Maduranga, A., Pathirage, G. P., Dewanmini, S., Thelijjagoda, S., & Krishara, J. (2023). WaliPilla: Mobile based screening and refinement system to identify the risk of reading weaknesses due to dyslexia. 2022 4th International Conference on Inventive Research in Computing Applications (ICIRCA). https://doi.org/10.1109/icacta58201.2023.10393657

[2] Manalu, H. V., & Rifai, A. P. (2024). Detection of human emotions through facial expressions using hybrid convolutional neural network-recurrent neural network algorithm. Intelligent Systems With Applications, 21, 200339. https://doi.org/10.1016/j.iswa.2024.200339

[3] Pan, Z., Wang, Y., & Zhang, S. (2022). Joint face detection and Facial Landmark Localization using graph match and pseudo label. Signal Processing. Image Communication, 102, 116587. https://doi.org/10.1016/j.image.2021.116587

[4] Agarwal, H., Mahajan, G., Shrotriya, A., & Shekhawat, D. (2024). Predictive data analysis: Leveraging RNN and LSTM techniques for time series dataset. Procedia Computer Science, 235, 979–989. https://doi.org/10.1016/j.procs.2024.04.093

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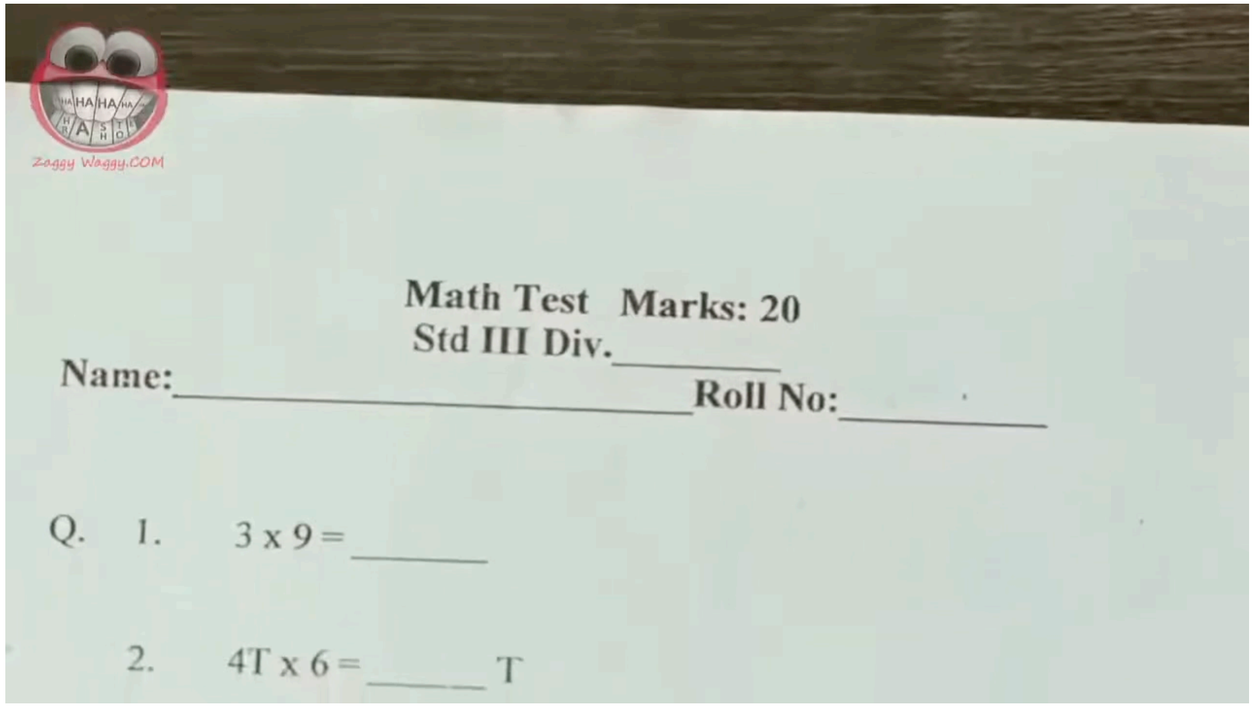
TOUCH MATH APPROACH FOR ENHANCING NUMBER SENSE AND MATHEMATICAL OPERATIONS

Background



What is the answer?

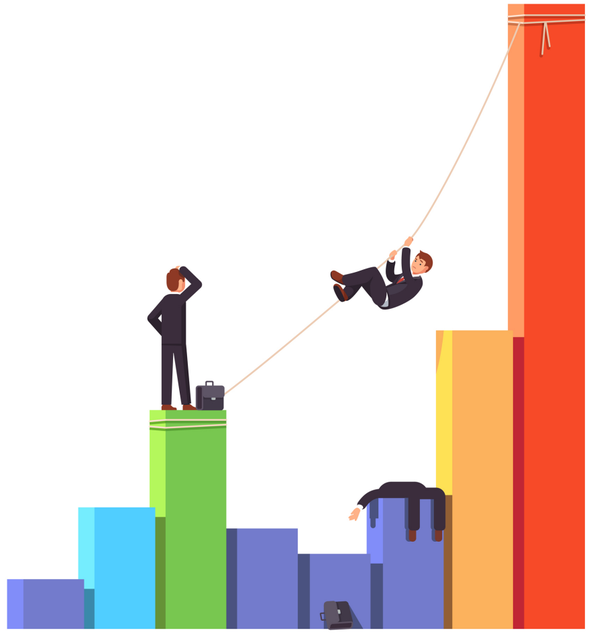
3 x 9 = ?

Research Problem

- Lack Analytical Skills
- Inadequancy of Traditional Methods
- Need Alternative Approches
- Need more personalized study process

Research Gap

- Limited technology integration with Touch Math approach
- Students less interactions with existing systems.
- Lack personalized platforms.



System Comparison

	A	B	C	D	Lexayudha
Use TouchMath Approach	✓	✓	✓	✗	✓
Technology Integration	✗	✓	✓	✓	✓
Personalized Activities	✗	✗	✗	✓	✓
Use Attractive interfaces (Multisensory)	✗	✗	✗	✓	✓
Voice Recognition Techniques	✗	✗	✗	✓	✓
Provide activities to improve the math concepts.	✗	✗	✗	✓	✓
Teaching Process	✗	✓	✓	✓	✓

A - A review of the articles about TouchMath [1]
C - TouchMath Tutor Kindergarten Demo[2]

B - Touch math pro[3]
D - Nanashilpa

Objectives

SPECIFIC OBJECTIVE

Touch math approach for enhancing number sense and mathematical operations

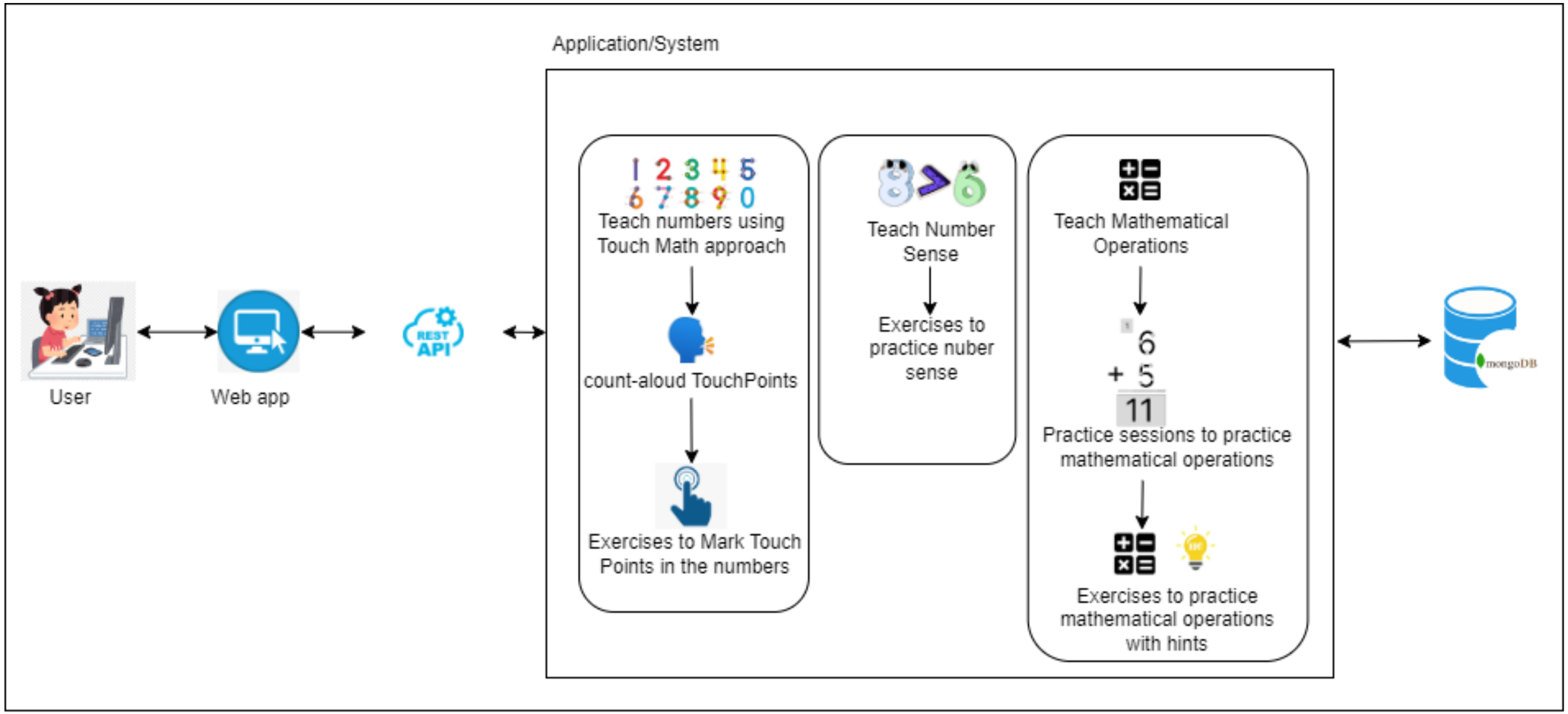
SUB OBJECTIVES

- Implement test to identify most difficult areas
- Providing learning and practice sessions, utilizing touch mach approach
- Integrate voice recognition to analyze number pronunction
- Generate performance report

Technologies to be used

- Natural Language Processing
  - TensorFlow
  - Keras
- Speech to text
  - Google Cloud Speech-to-Text API
- Backend Technologies
  - Flask
  - Node js
- Frontend Technologies
  - React js
  - Canvas API

System Diagram



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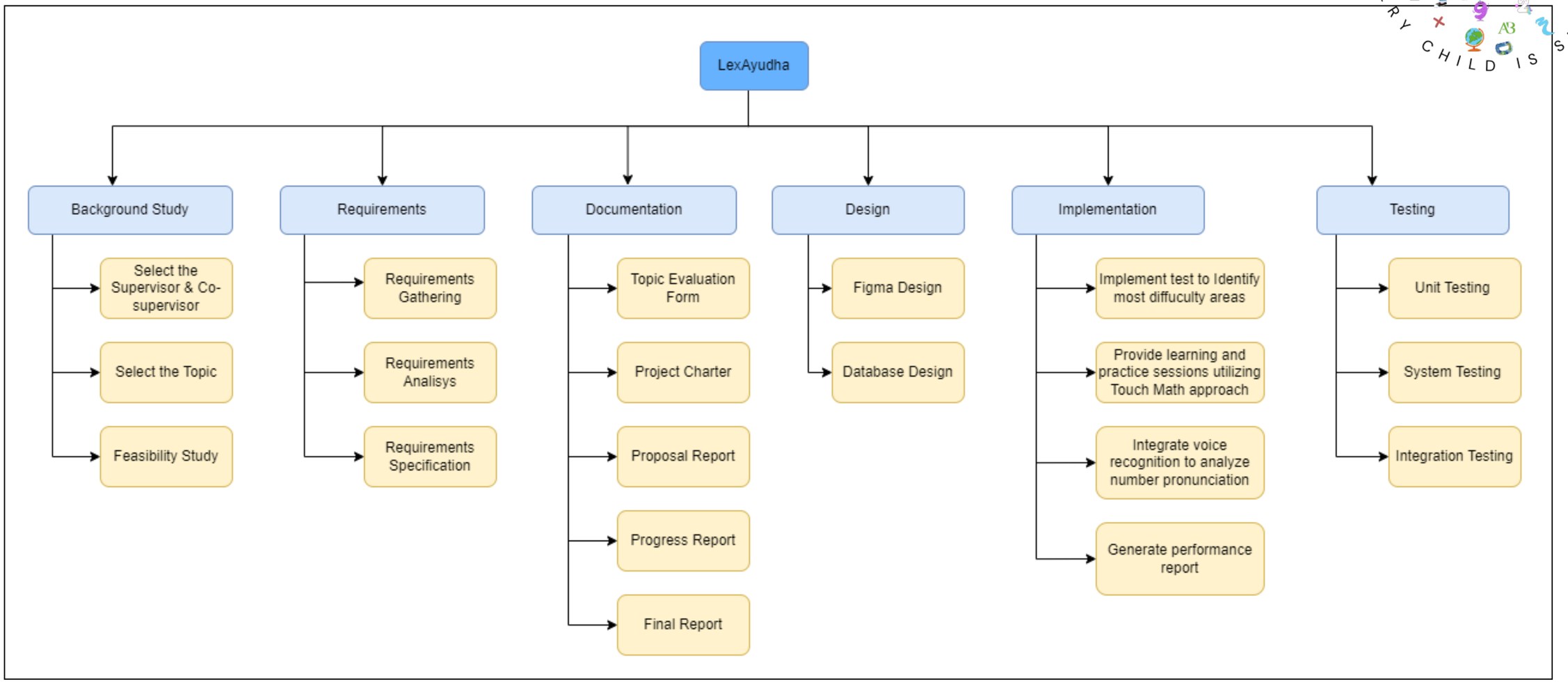

Requirements

Functional Requirements

- Create an account and login to the system
- Perform test to identify most difficult areas
- Perform learning and practice session

Non-Functional Requirements

- Reliability
- Accuracy
- Security

System Requirements

- User-friendly and accessible design.
- Enable touch points
- A microphone

Personal Requirements

- Concern to use touch points
- Concern about capturing speech audio data
- Clear voice volume

Software Requirements

- Web browser with microphone access

Gannt Chart

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References

[4]Aydemir, Tamer. “A Review of the Articles about TouchMath.” *Procedia - Social and Behavioral Sciences*, vol. 174, 12 Feb. 2015, pp. 1812–1819, www.sciencedirect.com/science/article/pii/S1877042815008940, https://doi.org/10.1016/j.sbspro.2015.01.842.

[5]Innovative Learning Concepts, Inc. *TouchMath Tutor Kindergarten Demo*, 14 Nov. 2023, touchmath-tutor-kindergarten-demo.software.informer.com/. Accessed 7 Aug. 2024.

[6]“TouchMath PRO.” *TouchMath Pro*, 2021, touchmath.com/pro/.

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ENHANCING READABILITY AND SPEAKING SKILLS IN DYSLEXIC ADOLESCENTS THROUGH PERSONALIZED SPEECH PACE

Background – Why Speech phase ?

For Dyslexic adolescents,

- Normal speech pace -> Hard to follow.
- Fast speech -> Confusing.
- Slower talking -> Easier to understand.
- Custom speed -> Better learning.

Research Problem

- Personalized speech pace needed.
- Current detection methods exist.
- Existing methods have limitations.
- New, accurate method required.

Research Gap

Research	Detect Spatial and temporal features in data	Analyses data for speech features	Utilizes hybrid model for improved accuracy	Generates a personalized speech pace	Utilizes the generated results for personalized speech
Human age estimation through audio utilising MFCC and RNN [7]	✗	✓	✗	✗	✗
An autonomous and intelligent hybrid CNN-RNN-LSTM based approach for the detection and classification of abnormalities in brain.[8]	✓	✗	✓	✗	✗
LexAyudha	✓	✓	✓	✓	✓

System Comparison

	A	B	C	D	Lexayudha
Use Deep Learning methods	✗	✗	✗	✓	✓
Detects speech pace	✓	✗	✗	✗	✓
Adjustable speech pace	✗	✓	✓	✗	✓
Automated speech pace adjustment	✗	✗	✗	✗	✓
Provides personalized speech pace	✗	✗	✗	✗	✓

A – Speechace B - Speechify

C - TextAid D - Nanashilpa

Objectives

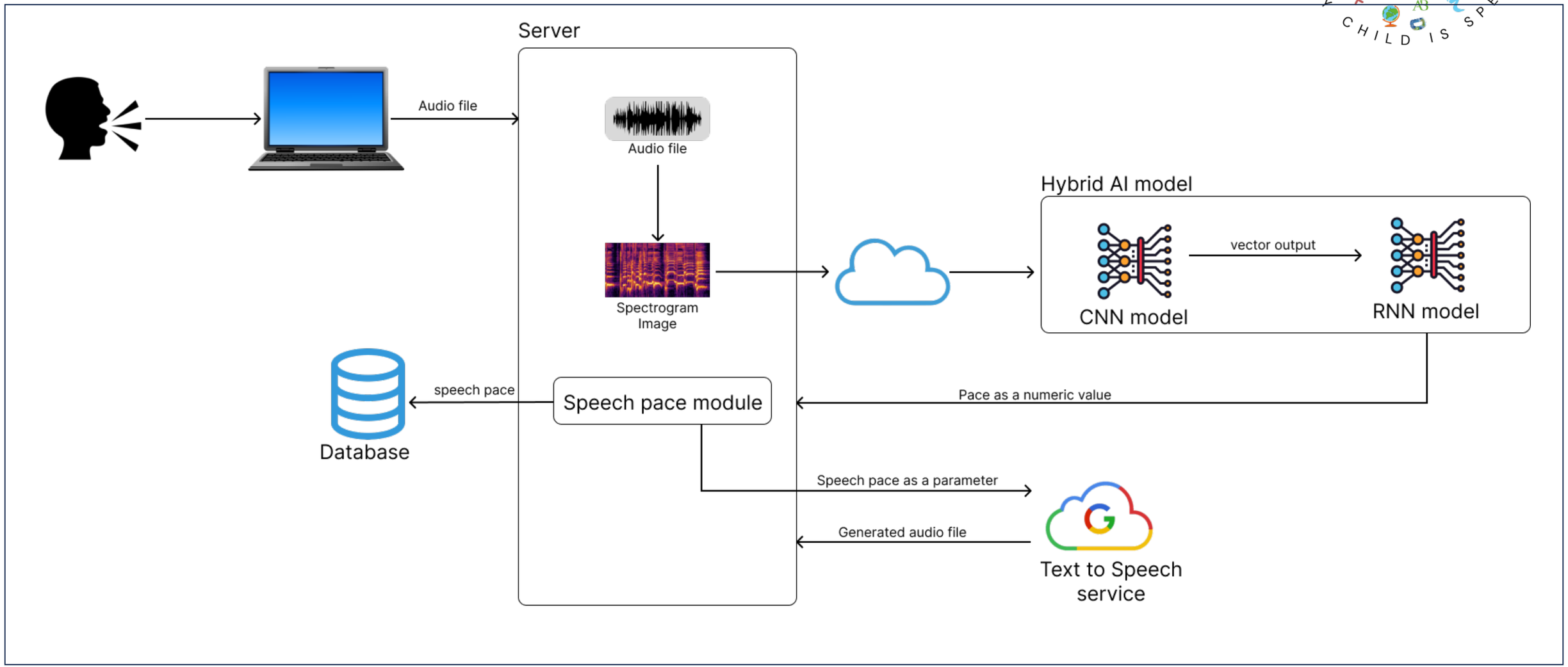
SPECIFIC OBJECTIVE

Develop AI speech pace system for personalized learning

SUB OBJECTIVES

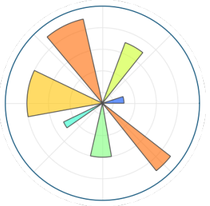
- Detect speech pace through voice data.
- Analyzing voice features.
- Integrating detected speech pace with text to speech(TTS) model
- System evaluation and validation.

Proposed Methodology



Technologies to be used

- Audio conversion to spectrogram images
  - Librosa python library
  - Matplotlib python library
- CNN-RNN hybrid model training –
  - TensorFlow
  - PyTorch
- Text to Speech model –
  - Google Cloud Text to Speech



Requirements

System Requirements

- ❖Stable internet connection.
- ❖A microphone.

Personal Requirements

- ❖Consent to capture speech audio data.
- ❖Clear & sufficient speech volume.

Software Requirements

- ❖Web browser with microphone access.

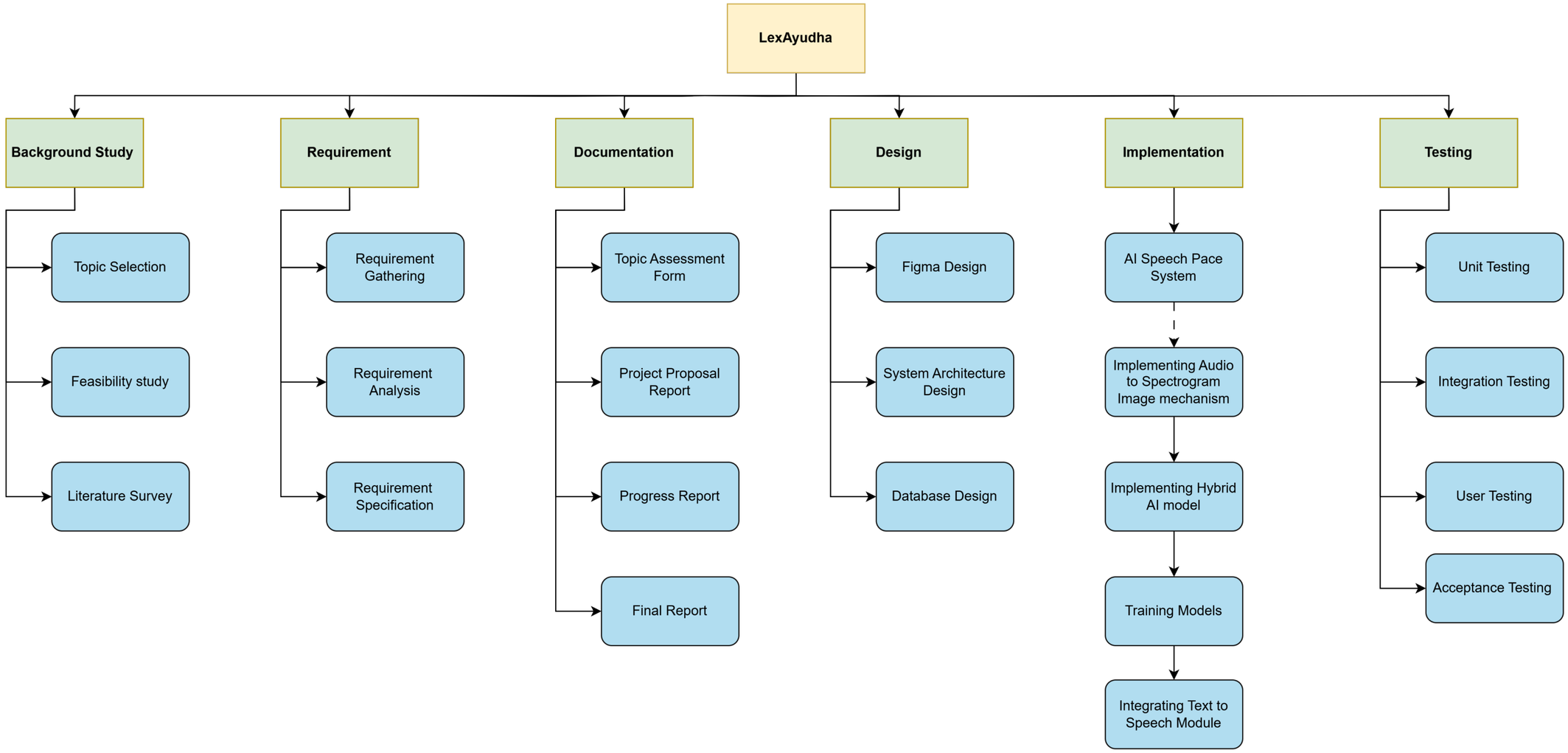
Functional Requirements

- ❖Automated speech pace detection.
- ❖Customized speech pace for each individual.

Non-functional Requirements

- ❖Speech pace accuracy.
- ❖Reliability & availability .

Work Breakdown Structure



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References

[7] Chandra, W., Ken, K., Quinn, O., & Pardosi, I. A. (2023). Human age estimation through audio utilising MFCC and RNN. Sinkron, 8(3), 1852–1862. https://doi.org/10.33395/sinkron.v8i3.12656

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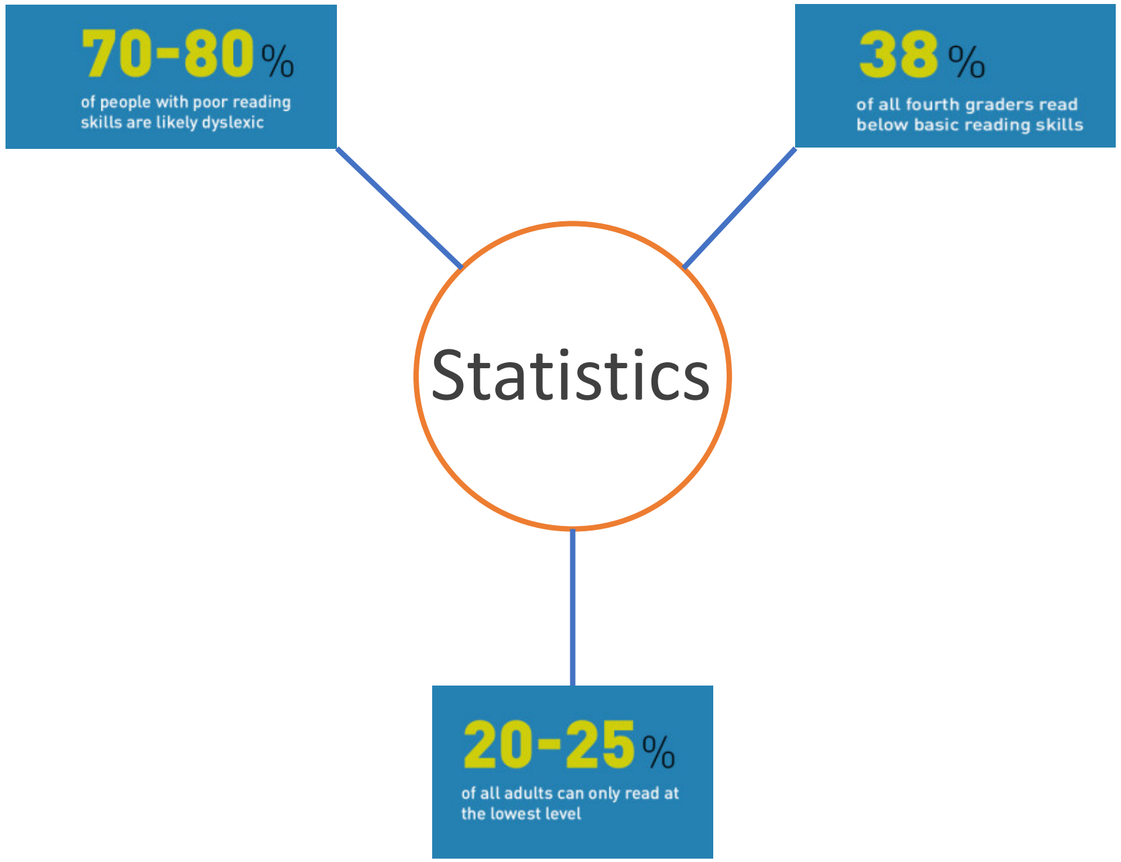
BSc (Hons) Degree in Information Technology (specialization in Software Engineering)

Teaching based on Chromatic Variations For Dyslexics to improve Reading Skills

Background



(a) PARCELLINGOUTDUETOCOLORS

(b) PARCELLING OUT DUE TO COLORS

(c) PARCELLINGOUTDUETOCOLORS

(d) PARCELLING OUT DUE TO COLORS

(e) PARCELLING OUT DUE TO COLORS

(f) PARCELLINGOUTDUETOCOLORS

(g) PARCELLINGOUTDUETOCOLORS

(h) PARCELLING OUT DUE TO COLORS

(i) PARCELLINGOUTDUETOCOLORS

Background

- Word recognition difficulties
- Poor spelling
- Problems decoding letters and words
- Reading below the expected level for age
- Slow and labor-intensive reading and writing
- Avoidance of activities that involve reading

Research Gap

Assistive Learning Environment for Students with Learning Disabilities

- Develop an Assistive Learning Environment (ALE) for students with learning disabilities.
- Provide a flexible environment allowing students to follow activities at their own pace.

Interactive Reading Tools for Dyslexic Students

- Develop interactive tools to aid reading for dyslexic students.
- Utilize multimedia elements like audio and visual aids to enhance reading comprehension.

AI-based systems for Dyslexic Students

- Develop AI-driven t systems to assist with reading difficulties
- Utilize natural language processing (NLP) to convert text into speech, making reading easier for dyslexic students.

System Comparison

	A	B	C	D	Lexayudha
Chromatic Variation approach	✓	✗	✗	✗	✓
Best suited chromatic variation detection	✗	✗	✗ ✗	✗ ✗	✓
Color variation effectiveness	✗	✓	✗	✗	✓
Best suited color variation detection	✗	✗	✗	✗	✓
Complexity adjustments	✗	✗	✗	✗	✓
Personalized Lessons	✗	✗	✗	✗	✓
Text to Speech	✗	✗	✗	✗	✓
Text Highlighting	✗	✗	✗	✓	✓
User Friendliness	✗	✗	✓	✗	✓
Possess a web/mobile app	✗	✗	✓	✓	✓

A - On the Role of Color in Reading and Comprehension Tasks in Dyslexic Children and Adults[11]

B - Chromatic visual evoked potentials: A review of physiology, methods and clinical applications[12]

C- Nessy

D – Claro Speek

Research Problem

- Identify the most suitable category of the chromatic variation
- Identify the appropriate complexity levels of the activities
- Generate personalized activities
- Monitor the recovery of the adolescents

Objectives

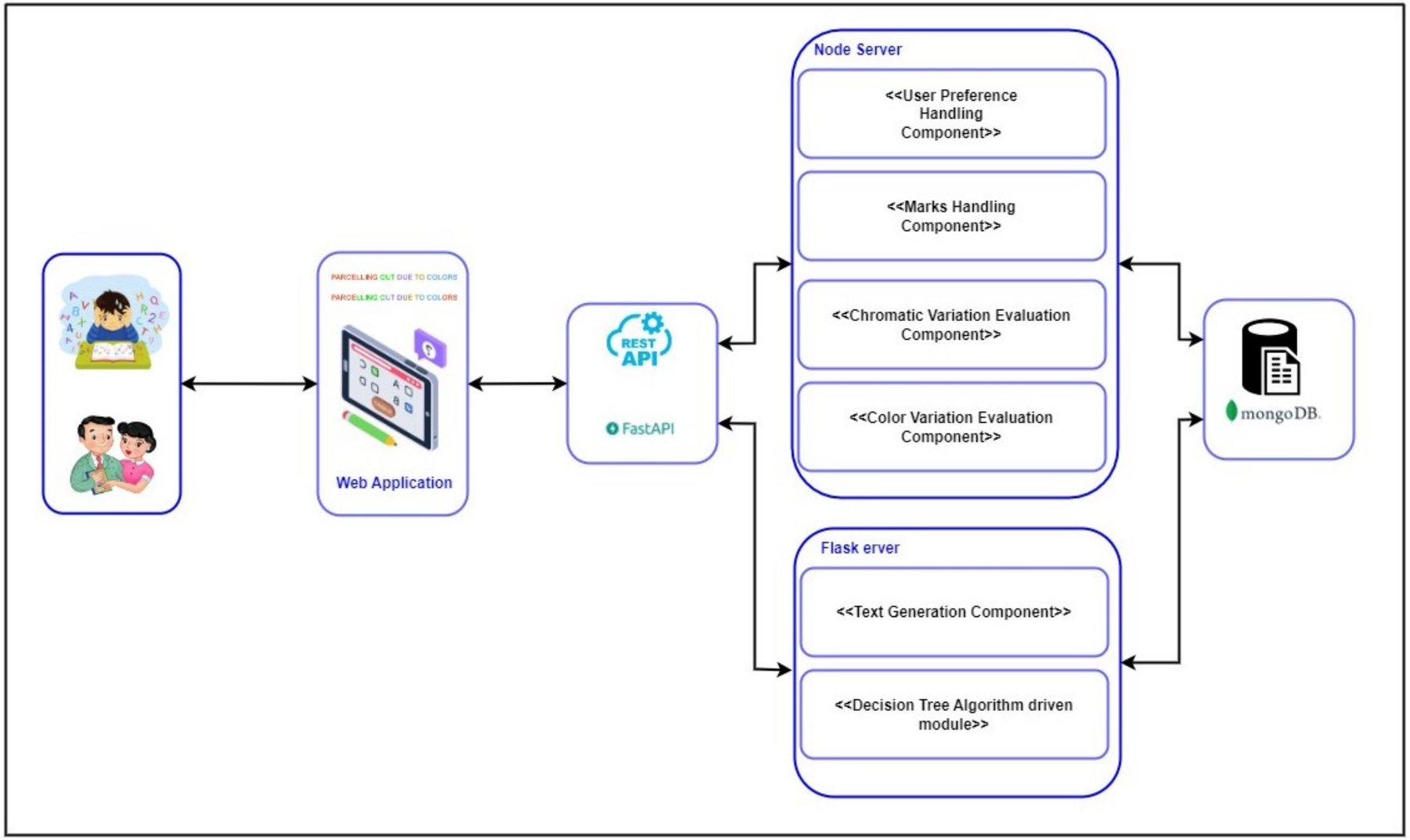
SPECIFIC OBJECTIVE

Identify the appropriate chromatic variation types and color combinations, provide a personalized activity plan.

SUB OBJECTIVES

- Sample test to identify the efficient color combinations
- Sample test to identify the most efficient chromatic variation type
- Test to check the reading skills to customize the complexity levels of the tasks
- Create personalized reading task plans

Methodology



Technologies to be used

- Natural Language Processing
  - TensorFlow
  - Keras
- Database
  - MongoDB
- Backend Technologies
  - Flask
  - Node js
- Frontend Technologies
  - React js
  - Canvas API
- Containerization and other technologies
  - Docker
  - Kubernetes
  - Fast API
- Algorithms
  - Decision Tree

Requirements

Functional Requirements

- ❖Create a personal account and access the application
- ❖Perform suited chromatic variation and color variation tests
- ❖View and learn personalized lessons
- ❖Perform quizzes and assess the performance

Non-Functional Requirements

- ❖Reliability
- ❖Accuracy
- ❖Security

System Requirements

- ❖Stable internet connection.
- ❖A microphone.

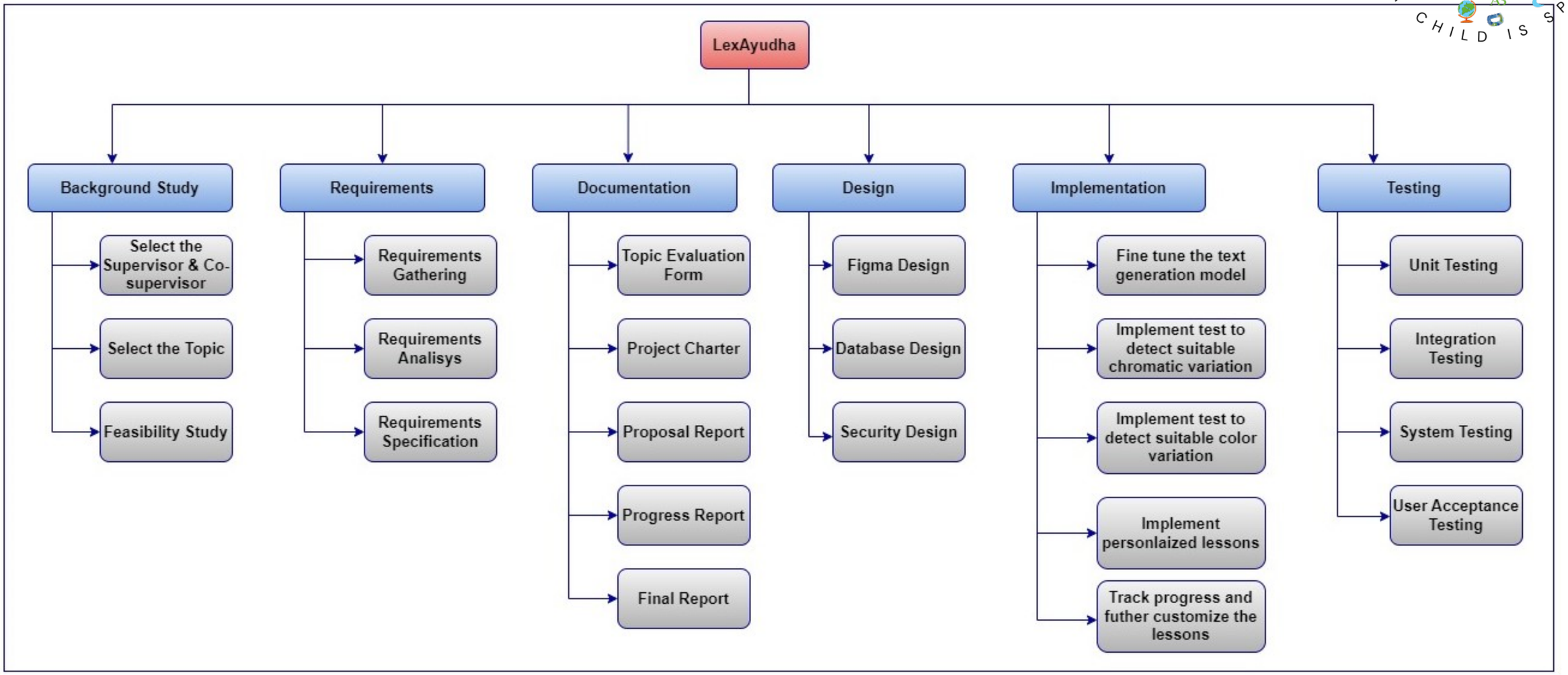
Personal Requirements

- ❖Consent to provide speech audio data.

Software Requirements

- ❖Web browser with microphone access.

Work Breakdown Chart



Gannt Chart

Task name	Progress	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Project Initiation																	
Study about research gaps	100%																
Deciding appropriate research area	100%																
Going through research papers	100%																
Finalizing a topic	100%																
Requirements Gathering & Analysis																	
Identifying functional requirements	100%																
Identifying non- functional requirements	100%																
Identifying data requirements	100%																
Identifying knowledge requirements	100%																
Design																	
Creating the figma prototype	100%																
Development																	
Model training	0%																
Backend Development	0%																
Frontend Development	0%																
Testing																	
Unit and API testing	0%																
Integration Testing	0%																
Load Testing	0%																
User Acceptance Testing	0%																
Deployment	0%																

References

[11] Alsobhi, A. Y., Khan, N., & Rahanu, H. (2014). Toward linking dyslexia types and symptoms to the available assistive technologies. 2014 IEEE 14th International Conference on Advanced Learning Technologies. https://doi.org/10.1109/icalt.2014.174

[12] Raghuram, A., Hunter, D. G., Gowrisankaran, S., & Waber, D. P. (2019). Self-reported visual symptoms in children with developmental dyslexia. Vision Research, 155, 11–16. https://doi.org/10.1016/j.visres.2018.11.007

[13] Pinna, B., & Deiana, K. (2018). On the Role of Color in Reading and Comprehension Tasks in Dyslexic Children and Adults. i-Perception, 9(3), 204166951877909. https://doi.org/10.1177/2041669518779098

COMMERCIALIZATION ASPECT

Monetizing Aspect

- Subscription based business model
- Donation enabled

Silver	Gold	Platinum
Free	$2	$3
Per Month	Per Month	Per Month
for individual use	for parents	for teachers
trial AI features	add up to 3 user accounts	add up to 15 user accounts
	enabled personalization	advanced personalization

Marketing Aspect

Primary Target Audience: The parents of learning divergent adolescents

Secondary Target Audience: Educators, Special education professionals

- Digital Marketing
  - Social media marketing
  - Blogs
  - Email marketing

- Partnerships
  - Collaboration with schools
  - Collaboration with dyslexic educational institutes

Budget

Description	Cost
Vercel – Frontend Deployment	Free Tier
Render – Backend Deployment	Free Tier
Azure Cosmos DB	Free Tier(25GB Lifetime)
Azure Blob Storage	$0.018 per GB (First 5GB Free)
Google speech to Text	1 hour free for month | $0.006 per 15 seconds over 60 mins up to 1 million mins
Azure App Services – Application Deployment	Free Tier
Google Colab Pro (If free tier not enough for Deep Learning Model Training)	$9.99

GANTT CHART

Gantt Chart

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THANK YOU

AI-based Personalized Rehabilitation for Dyslexia and Dyscalculia Adolescents

ANY QUESTIONS?