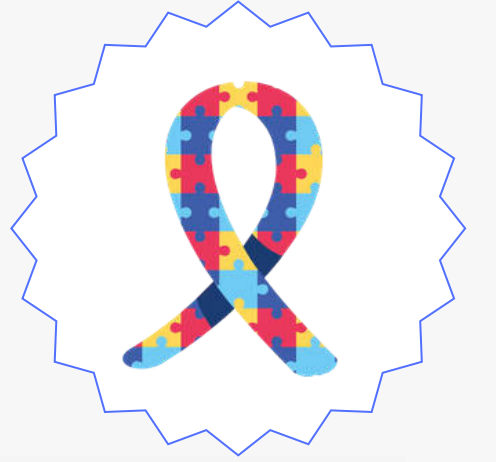




AURIVA

Adaptive English Language Learning
Platform for Autistic Children in Sri Lanka



Adapting Autism Education



	Panel Guidance Received	Improvements Made
SHARED	Define Functional and Non-Functional Requirements	Included a dedicated functional and non-functional requirements section under each component covering system behavior, performance, usability and security.
	Strengthen the Practical Aspect of Components	Each component is now linked to real-world teaching sessions and daily use cases for special education teachers and autistic children.
INDIVIDUAL	Address the Language Feasibility for the Target Users	Since the app teaches English to children whose first language is Sinhala, visual and audio translations in Sinhala have been incorporated.
	Address the order of introduction to the Sentence Construction and Conversation Builder Modules	After the vocabulary is taught the Sentence construction is introduced with the concept of SVO writing, then conversations are built according to the learner profile.
	Improve the research novelty	Introduced continuous ML-based learner clustering to periodically update child motor-learning profiles using ongoing handwriting activity data
	Improve the research novelty	Introduced to phoneme-aware pronunciation analysis using MFCC and DTW. The system now identifies weak sounds and uses them with learner history, score, and word difficulty to recommend the next adaptive practice word for Grade 3 autistic ESL learners.

PROBLEM AND IMPACT



9,000

Identified Children with
Autism Spectrum Disorder



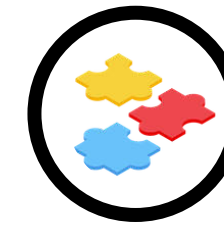
23.5 %

Excluded From Mainstream
Education



8.6 %

Schools Specialized For
Disabled Children



<15 %

In Genuine Inclusive
Educational Settings

English language acquisition is a core curriculum subject and ASD children receive no specialised support for it.

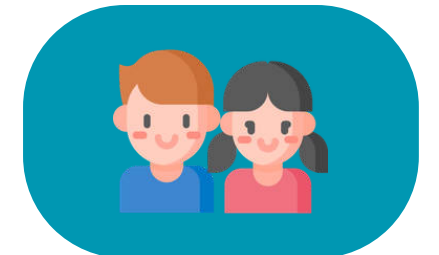
Traditional methods lack visual structure and adaptive scaffolding, leaving learners disengaged

Without progress data, schools cannot meet national inclusive education mandates or justify resource allocation

Teachers cannot monitor individual progress or personalise content across diverse cohorts

WHO IT AFFECTS

No adaptive, curriculum-aligned English learning modules suited to their cognitive profile



Cannot track individual progress or deliver differentiated content across diverse student cohorts

Lack of outcome data to demonstrate inclusive education compliance



OUR PROPOSED SOLUTION

USERS

Special Education Teacher

Sets up Sessions | Monitors Progress
Views scores, audio playbacks and trends



Autistic Child

Practices pronunciation, handwriting, vocabulary and dialogue on a tablet
Multimodal interface : Images | Audio | Lip-sync | Tap-to-select | Non-verbal fallback



APPLICATION

ROLE-BASED ACCESS

Teacher Workspace / Dashboard

Student Workspace

LEARNING MODULES

Pronunciation

Listens to student speech
Scores against reference audio
Adapts next word to difficulty
Flags phoneme weakness

Handwriting

Captures stylus strokes on tablet
Analyses line control and accuracy
Groups children by motor ability
Sequences letters by complexity

Concept Learning

Teaches words via 3 stage cycle
GNN detects confusion patterns
Personalized learning paths
Generates teacher insights

Dialogue

3 level conversational scaffold
Generated personalised turns
Speech assessed with tolerance
Non-verbal fallback

DATA LAYER

Database (PostgreSQL)

Student Records : Scores | Attempts | Audio | History
Word Library : Reference Audios | Images | Pronunciation Score
Handwriting Data : Stroke Control | Motor Scores
Concept Graph : Master Levels | Confusion Flags
Dialogue Sessions : Vocab Used | Progress | Speech Score

Shared Student Profile

Vocabulary Mastery : Words the child knows | Drives LLM and concept path
Motor Profile : Current ability group | Shapes letter sequence
Pronunciation History : Phoneme weaknesses → Adaptive next word routing
Concept Graph State : Confusion nodes per child → Personalized path
Dialogue Progress : Phase per phrase (learn/practice/check/mastered)

DESIGN EXCELLENCE AND INNOVATION

Concept Learning

Graph Neural Network-driven Confusion Detection



- GNN over a knowledge base detects confusion nodes learner
- Learning path re-routed dynamically without teacher input
- LLM converts inferences into plain-language educator insights

Dialogue Module

Mastery-Gated Dialogue with Tolerant Speech Assessment



- LLM output constrained to each learner's mastery vocabulary
- Speech scored via fuzzy matching
- Mastery-gated progression with non-verbal fallback pathway

Handwriting Learning

Motor-informed Adaptive Letter Sequencing



- Stroke X-Y trajectories scored for control and accuracy
- K-Means clusters learners by motor ability profile
- Letter sequenced by complexity, not alphabetical order

Pronunciation Support

Phoneme-aware Adaptive Remediation



- MFCC + DTW scores pronunciation at phoneme level
- Recurring error patterns route learners to remediation words
- Adaptive selection considers phoneme level scores

IT22084590 | H H Jayasundera



Title of Individual Component :

Graph Neural Network-Enhanced Adaptive
Concept Learning Module

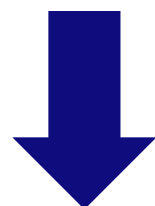
Specialization : IT

GNN-ENHANCED ADAPTIVE CONCEPT LEARNING MODULE

SUB-PROBLEM



Autistic children in Sri Lanka have no access to adaptive English learning tools suited to their individual cognitive profiles.



HOW IT IS ADDRESSED



Three-Tier Architecture (Visual Familiarization, Single Word Recognition and Attribute Introduction)

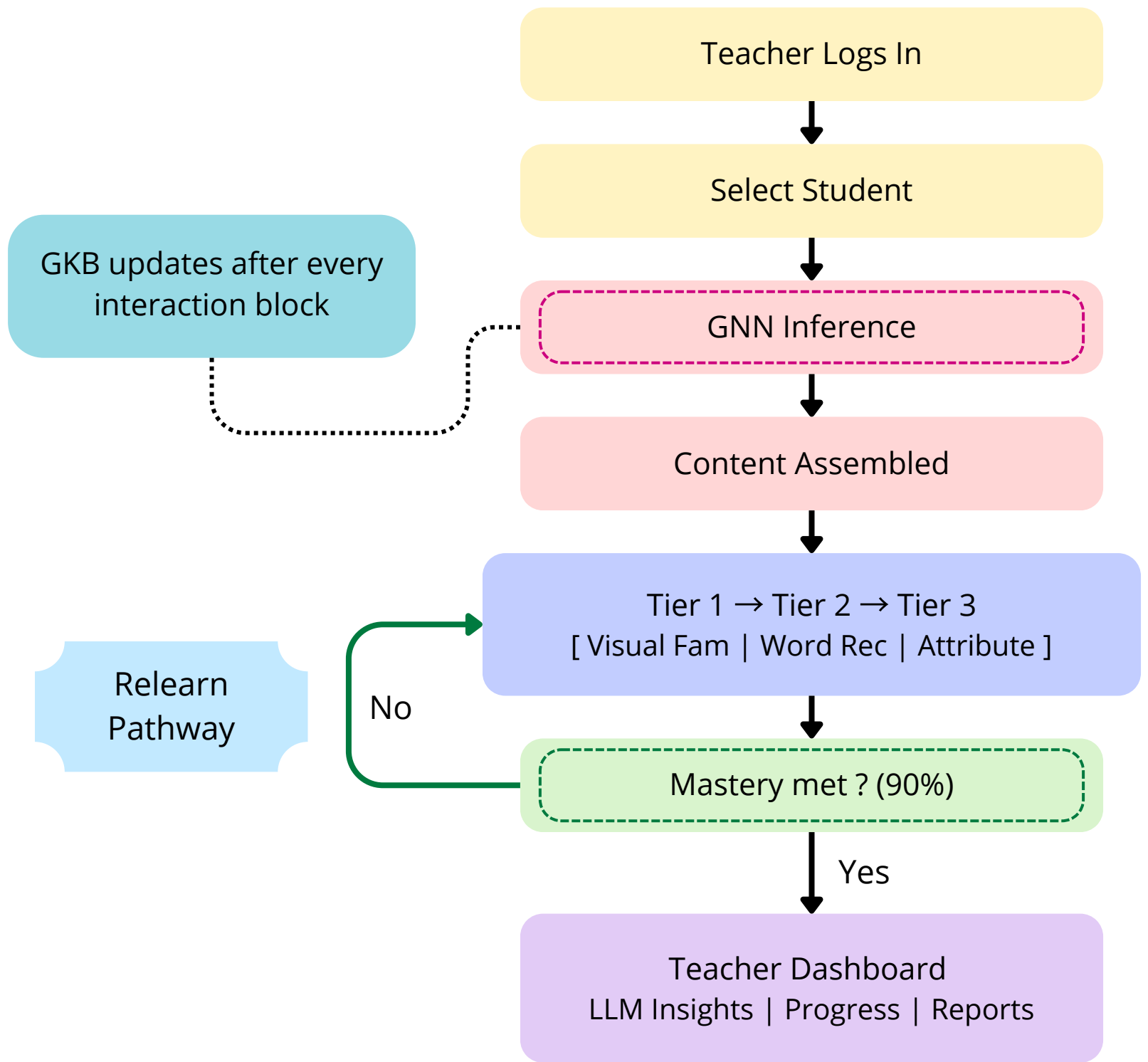


Graph Neural Network (Confusion Detection & Path Recommendation)



Teacher Insight Layer (Plain-language Summaries and On-demand Formal Reports)

FLOW DIAGRAM



GNN-ENHANCED ADAPTIVE CONCEPT LEARNING MODULE

FUNCTIONAL REQUIREMENTS

- Avatar & theme preference saved once, applied permanently
- 10 concept categories, NIE curriculum-aligned, attribute pre-classified
- Tier 1: audio, distractor adjustment, error handling & relearn pathway
- Tier 2: drag-and-drop, word-image matching, confusion detection
- Tier 3: colouring & attribute activities; teacher-handover on failure
- Post-concept evaluation every 5 concepts
- Inline LLM summaries, stats dashboard, on-demand reports
- Inline LLM summaries, stats dashboard, on-demand reports
- GNN confusion alerts & learning path on teacher dashboard

NON-FUNCTIONAL REQUIREMENTS

- Sensory-friendly, uncluttered interface with age-appropriate themes
- Multiple image formats; clear paced audio with replay
- Activities and LLM summaries render without delay
- Concurrent sessions without degradation
- All session data persisted with difficulty context
- No student Personally Identifiable Information sent to LLM API; accounts restricted to principal
- Curriculum and prompts configurable without code changes

GNN-ENHANCED ADAPTIVE CONCEPT LEARNING MODULE

TECHNICAL CONTRIBUTION

Graph Neural Network + Rule-based Applied Behavioral Analysis hybrid adaptive model

Dual-layer Graph Knowledge Base (static curriculum + live interaction)

Large Language Modal feedback enriched with GNN analytics

UNIQUE FEATURES

Three-tier mastery-gate architecture

Dynamic per-session content assembly

Personalised learning paths per student

USER FEEDBACK ON PROTOTYPE

United Kingdom standard spellings and pronunciations adopted throughout all learning content

Teacher given the option to intervene in the word selection phase to determine the order the concepts are taught

Allow children's coloured images from Tier 3 activities to be downloaded

IMPROVEMENTS TO BE MADE BASED ON FEEDBACK

All audio recordings need to be updated to use UK English pronunciation models.

Word sequencing interface need to be added to Student Workspace allowing Tier 2 manual reordering of concept queue before session start.

IT22166838 | M C Gunawardena



Title of Individual Component :
Adaptive Dialogue Learning And Progression Tracker

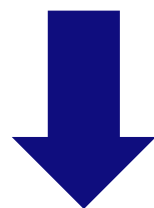
Specialization : IT

ADAPTIVE DIALOGUE LEARNING AND PROGRESSION TRACKER

SUB - PROBLEM



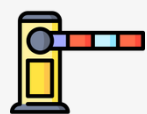
Autistic ESL learners in Sri Lanka lack a structured tool that teaches functional dialogue with pragmatic understanding and tolerant speech assessment.



HOW IT IS ADDRESSED



Three-Phase Word Acquisition : Familiarization, Speech Production, and Contextual Understanding Check

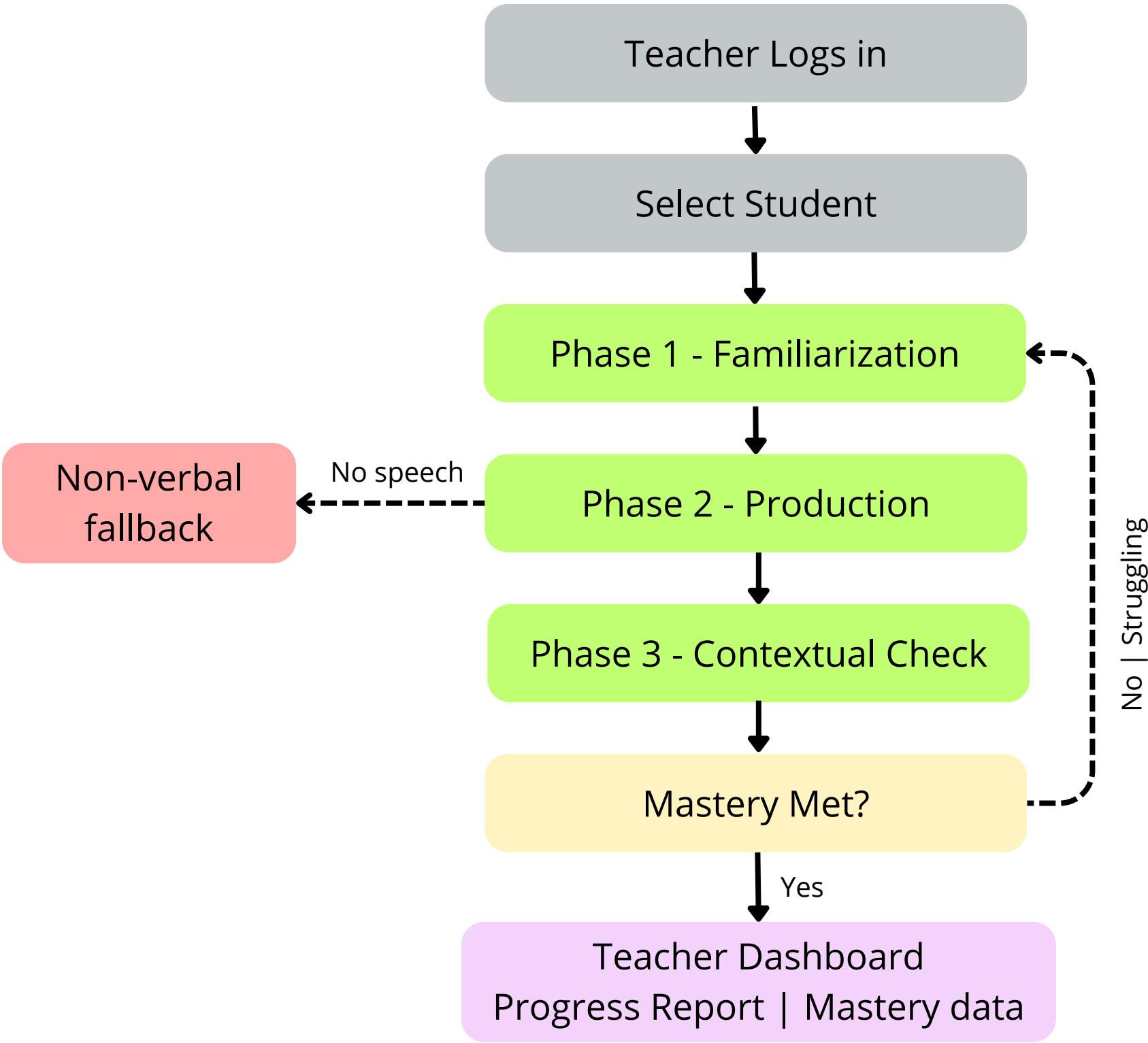


Mastery-Gated Progression Algorithm (Four-State Tracking and Adaptive Deferral for Struggling Learners)



Multi-Layer Speech Assessment Pipeline with keyword matching and fuzzy check and non verbal pathways

FLOW DIAGRAM



ADAPTIVE DIALOGUE LEARNING AND PROGRESSION TRACKER

FUNCTIONAL REQUIREMENTS

- Avatar & theme preference saved once, applied permanently
- Three level instruction as Dialogue word learning, Sentence Construction and Conversation Builder.
- Three-phase instruction: Familiarization, Production, and Contextual Awareness per word
- Familiarization with concept videos and drag and drop activities.
- Production with practice audio, speech-to-text checking and non verbal activity pathway
- Contextual Awareness check to check when the word is used
- Speech captured and scored via STT + keyword match + fuzzy matching pipeline
- Mastery gated across two separate calendar days
- Teacher dashboard with mastery status and session history

NON-FUNCTIONAL REQUIREMENTS

- Sensory-friendly, uncluttered interface with age-appropriate themes
- High-contrast visuals and large touch targets for autistic learners
- Speech feedback delivered under 5 seconds
- Personal data stored separately from interaction data
- Non-verbal pathway activates if STT unavailable
- LLM turn generation completed within 10 seconds; seed library available if exceeded
- No personally identifiable information sent to external APIs

ADAPTIVE DIALOGUE LEARNING AND PROGRESSION TRACKER

TECHNICAL CONTRIBUTIONS

Three-layer speech assessment pipeline - Google Cloud Speech-to-Text combined with exact keyword matching and fuzzy matching

Four-state mastery-gated progression algorithm with calendar-day separation rule and automatic deferral

Text-to-speech for audio generation for sentence construction personalized according to student/teacher inputs

UNIQUE FEATURES

Three-phase instructional cycle per word: Familiarization, Production, and Contextual Awareness before marked as mastered

Non-verbal fallback pathway: image-based tap-to-select activities triggered automatically after three unanswered prompts

Adaptive pacing per child: exposure to phases are based on each child's demonstrated learning rate across sessions

USER FEEDBACK ON PROTOTYPE

Before introducing the days as words, explain the concept of each day through activities: weekdays are school days, while weekends are spent at home or outside school.

Sentence Construction Module – As the audio plays, animate and highlight each corresponding question and answer sentence to improve visual engagement during teaching.

IMPROVEMENTS TO BE MADE ACCORDING TO THE FEEDBACK

Add a introduction phase at Days of the Week module to teach the concept before introducing the days

Animate each sentence to pop up when displayed during the teaching phase and sync the animation with the audio output of the sentence

IT22216700 | Liluksha R.S



Title of Individual Component :
Motor-Informed Adaptive Handwriting Learning Module

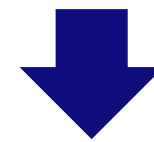
Specialization : IT

MOTOR-INFORMED ADAPTIVE HANDWRITING LEARNING MODULE

SUB-PROBLEM



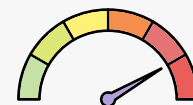
Existing handwriting learning systems do not adequately support children with autism, they provide static tracing activities without personalized adaptation or clear learner progress insights.



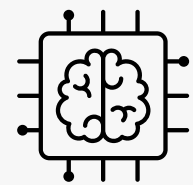
HOW IT IS ADDRESSED



Motor-Based Handwriting Assessment (Captures handwriting data, Extracts features)



Rule-Based Motor Analysis (Motor score calculation, difficulty pattern identification, and Motor-based categorization)

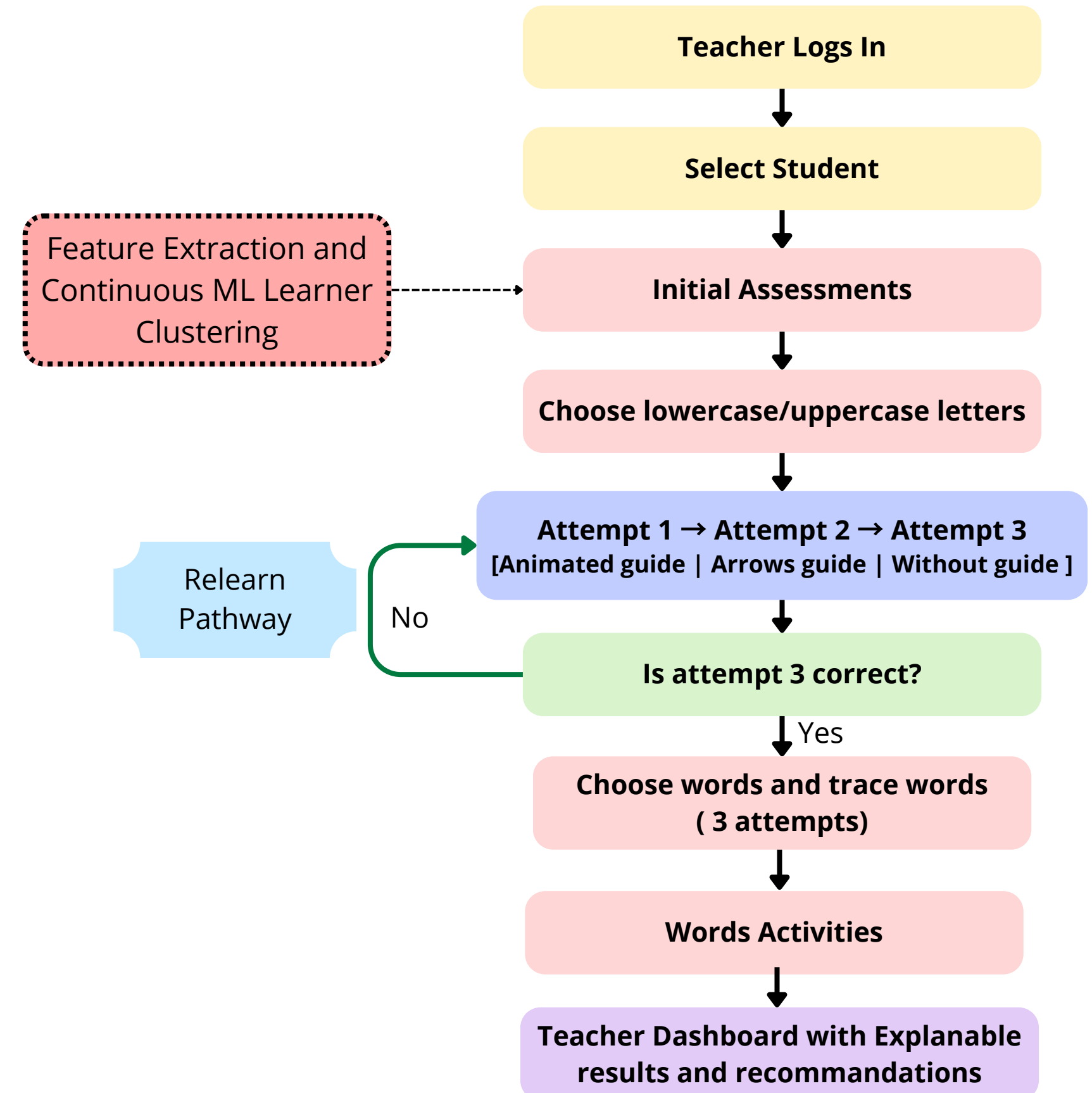


Continuous ML Learner Clustering (Initial learner clustering, and periodic profile updating)



Adaptive Learning & Teacher Analytics (Personalized letter sequencing, explainable teacher reporting and Progress recommendation insights)

FLOW DIAGRAM



MOTOR-INFORMED ADAPTIVE HANDWRITING LEARNING MODULE

FUNCTIONAL REQUIREMENTS

Initial handwriting motor assessment

Stroke-based handwriting feature extraction

Rule-based motor score calculation

Adaptive letter category sequencing

Continuous ML learner clustering

Personalized handwriting activities

Teacher analytics dashboard

Explainable feedback and recommendations

Progress tracking and learner profile updates

NON-FUNCTIONAL REQUIREMENTS

Child-friendly sensory-safe interface

Real-time handwriting data capture performance

Reliable continuous progress tracking

Maintainable adaptive learning architecture

Teacher-friendly report readability

Mobile tablet compatibility

Sinhala-friendly visual/audio guidance support

MOTOR-INFORMED ADAPTIVE HANDWRITING LEARNING MODULE

TECHNICAL CONTRIBUTION

Rule-based motor-informed adaptive learning architecture

Hybrid adaptive model combining motor analytics and ML clustering

Explainable AI-based teacher reporting framework

UNIQUE FEATURES

Motor-informed adaptive letter sequencing

Continuous ML-based learner re-clustering

Explainable recommendations for teachers

USER FEEDBACK ON PROTOTYPE

Activity instructions needed to be simpler for children

Some answer options did not properly match the activity question context

Teacher reports required clearer visual presentation

IMPROVEMENTS TO BE MADE BASED ON FEEDBACK

Teacher reports required clearer visual presentation and improved answer options to better match question context

Enhanced report visualization and feedback clarity and improved teacher-friendly progress analytics and explanations

IT22266378 | Samaranayake N G



Title of Individual Component :

Phoneme-aware adaptive pronunciation support module

Specialization : IT

PHONEME-AWARE ADAPTIVE PRONOUNCIATION SUPPORT MODULE

SUB-PROBLEM



Autistic Grade 3 ESL learners in Sri Lanka lack a structured pronunciation support tool that provides multimodal guidance, phoneme-level feedback, and adaptive pronunciation practice.



HOW IT IS ADDRESSED

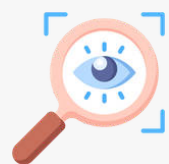


Phoneme-Aware Pronunciation Assessment

(Captures learner speech, preprocesses audio, and extracts MFCC features)

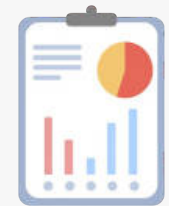
Similarity-Based Speech Analysis

(Compares learner pronunciation with reference audio using DTW and generates word-level and phoneme-level scores)



Weak Phoneme Identification

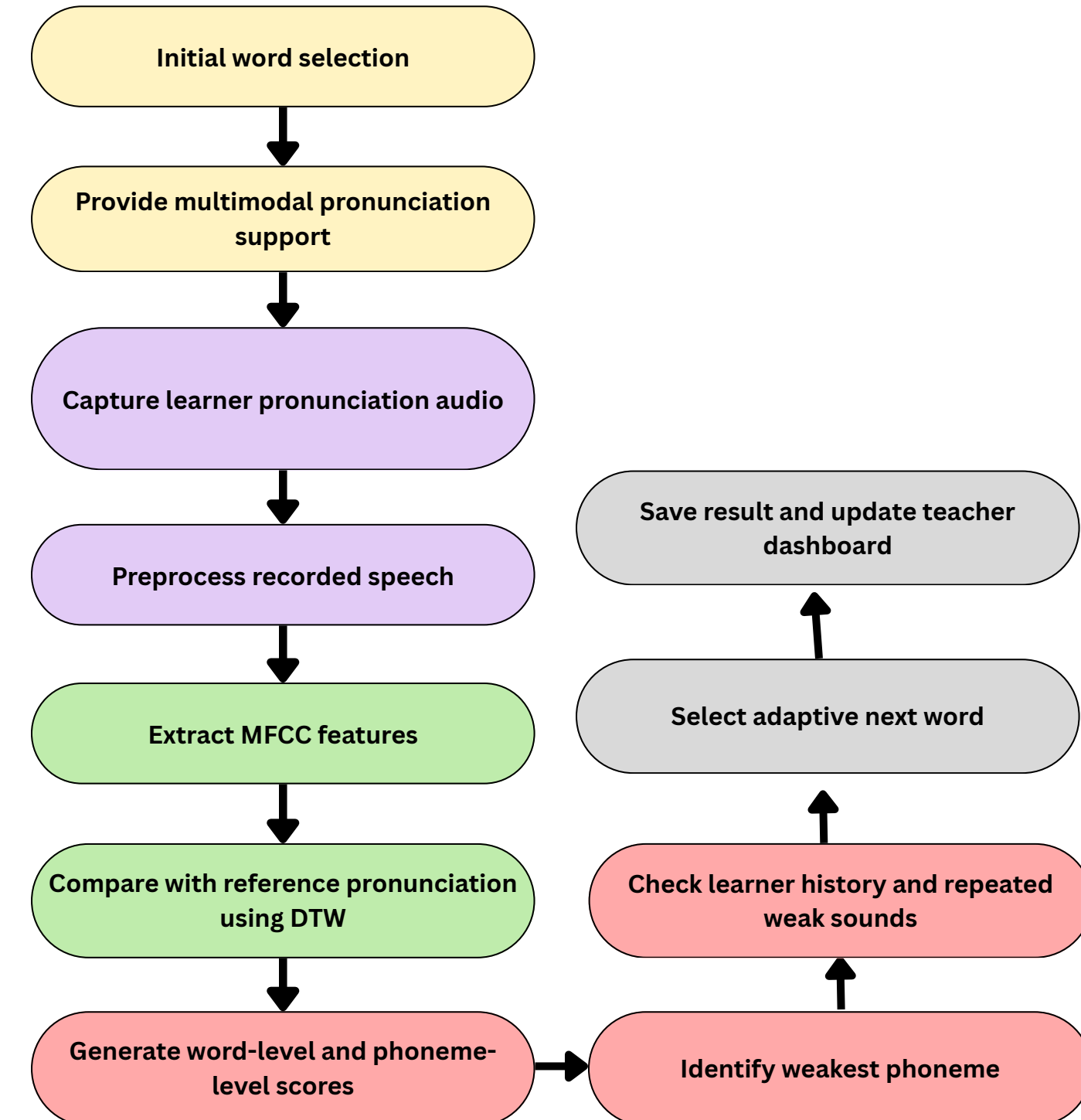
(Detects the lowest-scoring phoneme and tracks repeated pronunciation difficulties through learner history)



Adaptive Learning & Teacher Analytics

(Recommends the next practice word based on weak phoneme, learner score, difficulty level, and provides teacher progress insights)

Simple flow diagram



PHONEME-AWARE ADAPTIVE PRONOUNCIATION SUPPORT MODULE

FUNCTIONAL REQUIREMENTS

- Initial pronunciation word/category selection
- Multimodal pronunciation guidance with images, audio, and mouth-shape cues
- Learner speech recording during pronunciation activities
- Audio preprocessing for pronunciation analysis
- MFCC-based speech feature extraction and DTW-based pronunciation similarity comparison
- Phoneme-level score generation
- Weak phoneme identification
- Adaptive next-word recommendation based on weak phoneme, score, difficulty, and learner history
- Pronunciation progress tracking and learner profile updates

NON-FUNCTIONAL REQUIREMENTS

- Child-friendly and sensory-safe interface
- Sinhala-friendly visual/audio guidance for autistic Grade 3 ESL learners
- Reliable speech recording and audio processing performance
- Accurate and consistent pronunciation similarity scoring
- Maintainable adaptive learning architecture
- Secure storage of learner audio, scores, and progress records
- Mobile and tablet compatibility with Teacher-friendly dashboard readability

PHONEME-AWARE ADAPTIVE PRONOUNCIATION SUPPORT MODULE

TECHNICAL CONTRIBUTIONS

Phoneme-aware adaptive English pronunciation learning approach

MFCC and DTW-based pronunciation similarity assessment and phoneme-level pronunciation feedback generation

Adaptive next-word selection based on weak phonemes and learner history

UNIQUE FEATURES

Phoneme-aware pronunciation analysis using reference word pronunciation.
Integration of multimodal learning support, speech analysis, adaptive remediation, and teacher monitoring in one component

Similarity-based speech comparison using MFCC feature extraction and DTW alignment.
Weak phoneme identification from learner pronunciation.

Adaptive next-word recommendation based on pronunciation score, weak phoneme, difficulty level, and learner history

USER FEEDBACK ON PROTOTYPE

Some children needed clearer visual and audio guidance before attempting pronunciation.
Repeated pronunciation attempts were needed because learners had different speech confidence levels

Word-level scores alone were not enough for teachers to understand specific pronunciation difficulties.
Teachers needed clearer records of weak sounds, previous attempts, and learner progress

IMPROVEMENTS TO BE MADE ACCORDING TO THE FEEDBACK

Added clearer flashcard, image, audio, and visual mouth-shape guidance before pronunciation practice

Improved pronunciation practice flow with repeated attempts and supportive feedback
Added phoneme-level feedback to identify specific weak sounds instead of only showing word-level scores

Improved pronunciation practice flow with repeated attempts and supportive feedback

ADAPTIVE ENGLISH LANGUAGE LEARNING PLATFORM FOR AUTISTIC CHILDREN IN SRI LANKA

CUSTOMER PERSONA

Autistic Child

ASD Learner (Estimated age between 5-15)

Challenges

- Limited verbal and non-verbal communication
- English as a second language
- Difficulty with abstract or unsupported instruction
- Fine motor difficulties with handwriting

Learning Needs

- Structured, visual and repetitive content
- Clear feedback and consistent pacing
- Non-verbal participation pathway when needed

Special Educator

Special Education Teacher (Estimated age between 21-60)

Challenges

- No data driven tools to track individual progress
- Difficult to identify specific learning gaps manually
- Needs curriculum-aligned, ready to use content

Goals

- Monitor each child's scores and trends at a glance
- Identify which children need additional support
- Deliver structured lessons without technical expertise

MARKET SIZE

27

Special Education Schools

704

Special Education Institutes

REVENUE MODEL

Freemium Trail

Free Trial - to evaluate before commitment

Tier I - Up to 30 students

Small Special Education Units

Tier II - 30 – 120 students

Mid-Scale Schools, Larger Special Education Units