

Nihada Mithura - Interactive and Entertaining Model for Mute Sri Lankan Primary Students

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Abstract - Inclusive education is a core societal ideal aimed at giving equitable learning opportunities for all pupils, regardless of their specific circumstances or skills. The concept integrates technology, language, and entertainment to provide a comprehensive learning experience. It consists of four major components: A system for translating Sri Lankan Sign Language (SLiSL) into Sinhala natural language, complete with voice output and graphic representation, has been developed. An interactive 3D model that allows for bidirectional translation between Sinhala and SLiSL. Games designed specifically for deaf students, Quizzes designed to teach essential abilities such as the Sinhala alphabet and basic mathematical functions. The strategy is intended to boost academic performance, boost well-being and confidence, and empower marginalized kids. It makes an important contribution to the subject of inclusive education and has the potential to change the educational landscape.

Keywords: inclusive education, mute primary students, Sri Lanka, technology, language, entertainment, deaf, machine learning.

I. INTRODUCTION

Inclusive education is a core societal ideal aimed at giving equitable learning opportunities for all pupils, regardless of their specific circumstances or skills. Educational systems are always evolving in order to find novel approaches to ensure that no student is excluded. The purpose of this study is to solve the educational obstacles that mute/deaf Sri Lankan primary kids experience. These students face particular communication challenges and frequently do not have access to engaging and interactive learning activities. The fundamental goal of this research is to build an interactive and engaging model that is personalized to these students' individual needs, fostering an inclusive educational environment that supports their overall growth.

The study is divided into four interconnected domains, each of which aims to improve the learning path of mute Sri

Lankan primary students: The first domain seeks to bridge communication gaps by presenting a novel approach for transforming Sri Lankan Sign Language (SLiSL) into Sinhala natural language, including voice output and visual display. This method allows deaf kids and their peers to communicate more effectively.

In the second area, a novel interactive 3D model for bidirectional translation between Sinhala natural language and SLiSL is introduced. In addition to language acquisition, this paradigm promotes cognitive skills and social engagement.

The third domain is concerned with the educational value of entertainment. It entails creating entertaining games customized to the needs of deaf students. These games apply game-based learning techniques, captivating students' attention while increasing cognitive progress and establishing a good attitude toward learning.

The fourth domain focuses on the development of educational quizzes to teach basic skills such as the Sinhala alphabet and basic mathematical functions. These exams are precisely created to meet the unique learning needs of mute children, promoting a thorough and inclusive educational experience.

This study intends to improve not just academic progress but also the entire well-being and self-confidence of silent Sri Lankan primary kids by integrating these four dimensions. The proposed paradigm, which combines technology, language, entertainment, and education, has the potential to transform the educational environment and empower a deserving set of students.

II. LITERATURE REVIEW

Inclusive education, as a fundamental tenet of an equitable society, acknowledges the imperative of providing equitable educational opportunities to all students, transcending their diverse abilities and backgrounds. In this context, the endeavor to create an interactive and entertaining

educational model for mute Sri Lankan primary students holds profound significance. This literature review critically examines existing research and practices in the domains of converting deaf sign language to Sinhala natural language, employing interactive 3D models for bidirectional translation, utilizing entertainment games and game-based learning, and implementing educational quizzes to teach fundamental skills.

Efforts to bridge communication gaps for deaf students have witnessed advancements in sign language translation technologies. Johnston et al. [1] have explored the potential of real-time sign language translation systems. Our proposed approach, coupling voice output and visual display with the translation of Sri Lankan Sign Language to Sinhala, aligns with the broader trend of harnessing technology for inclusive education.

The transformative potential of technology in enhancing educational experiences for marginalized student groups is a burgeoning field of research. In the context of inclusive education, addressing the communication barriers faced by mute Sri Lankan primary students is of paramount importance. This literature review critically examines the application of computer vision to convert deaf sign language to Sinhala natural language, focusing on its role in creating an interactive and entertaining model for these students, an interactive way to teach alphabet to deaf students, convert natural language to sign language using 3D model, .

Recent years have witnessed remarkable progress in sign language recognition through computer vision techniques. Starner et al. [2] pioneered the use of gloves equipped with sensors to capture sign language gestures. However, these approaches were restrictive and lacked scalability. Contemporary methods leverage computer vision algorithms, such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), to recognize and interpret sign language gestures from video input [3].

The integration of real-time translation and voice output in sign language recognition systems has the potential to revolutionize communication for the deaf. Li et al. [4] explore the conversion of American Sign Language (ASL) into natural language text accompanied by synthesized speech. This approach aligns with the proposed research component, where the conversion of Sri Lankan Sign Language (SLiSL) to Sinhala natural language, complete with voice output, holds promise in fostering effective communication.

Visual display is a critical component in enhancing communication experiences. Raspopoulos et al. [5] underscore the importance of visual feedback to facilitate effective sign language communication. The integration of computer vision techniques to display the translated text alongside the sign

language gestures augments the interactive and engaging nature of the learning model, catering to the unique needs of mute Sri Lankan primary students.

The integration of immersive technologies like 3D models in education has shown promise. Bujak et al. [6] illustrate the efficacy of interactive 3D environments for language learning. Our initiative to facilitate bidirectional translation between Sinhala and Sri Lankan Sign Language through an interactive 3D model echoes these findings, highlighting the potential to enhance language acquisition and cognitive skills.

The magnitude of this lookup challenge lies in addressing the educational and amusement wants of mute Sri Lankan most important students. Mute primary students face unique challenges in the classroom, including difficulties in communication, social interaction, and engagement with academic content. By developing amusement games mainly tailored to their needs, this study objectives to enhance their learning experience, promote inclusivity, and foster their basic development. The findings of this study have the conceivable to positively have an effect on the schooling system in Sri Lanka and make a contribution to the broader area of unique education.

This study will advance the field of special education by focusing on recreational games developed for Sri Lankan mute primary students. It will contribute to existing knowledge in several ways:

- Addressing the Needs of Mute Students: By appreciation, the specific wishes and challenges faced with the aid of mute students, this learns about will inform the design and improvement of entertainment games that cater to their communication, learning, and socialization requirements. This lookup will promote inclusivity and improve instructional effects for mute students.
- Innovative Educational Approaches: The find out about will explore innovative procedures to training through integrating leisure elements into the getting to know process. By leveraging the attractive nature of entertainment games, the learn about aims to create a superb and fun mastering journey for mute students, fostering their motivation and active participation in the educational activities.
- Culturally Relevant Design: The research will reflect on consideration on the cultural context of Sri Lanka to make certain that the amusement games developed are culturally relevant and meaningful for the target audience. By incorporating culturally fantastic content, aesthetics, and narratives, the learn about will beautify

the typical academic experience for mute Sri Lankan foremost students.

Practical Implementation and Evaluation: The study will not only focally point on game development however also provide insights into the implementation and evaluation of these leisure games in real-world educational settings. By assessing the effectiveness of the games in terms of mastering outcomes, engagement levels, and scholar satisfaction, this lookup will make contributions to evidence-based practices in the area of exceptional education.

Best Practices and Approaches for Developing Entertainment Games for Mute Students; Several first-rate practices and procedures have been proposed for creating leisure games that cater to the needs of mute students. Collaborative recreation design, involving educators, sport developers, and experts in assistive technology, can lead to the creation of innovative solutions. This interdisciplinary approach ensures that the games align with educational objectives and contain appropriate assistive technologies.

Adapting existing games to be inclusive for mute students is any other approach. Modifying gameplay mechanics, including visible cues, and imparting choice communication selections can make usual games greater accessible.

One factor emphasized in the literature is the importance of inclusive game design. Games that contain non-verbal conversation strategies such as sign language, facial expressions, and gestures enable mute students to categorical themselves, interact with others, and actively take part in gameplay. [7] An article through An and Zou (2020) discusses the format of accessible games for primary student with listening to impairments, highlighting the significance of visible cues and haptic remarks in developing inclusive recreation experiences. This research underscores the value of integrating choice skill of verbal exchange to make games handy to mute primary students as well.

Inclusive recreation plan goes beyond verbal exchange techniques and focuses on promotion the cognitive and physical development of mute students. Chen, Chang, and Wang [8] discuss the development of an inclusive game gaining knowledge of surroundings for students with mental disabilities, demonstrating how games can foster problem-solving skills, necessary thinking, and motor coordination.

While particular lookup on enjoyment games for mute Sri Lankan students is limited, current initiatives and exceptional practices from other international locations can inform the development of inclusive games. The International Game Developers Association (IGDA) affords suggestions on

accessibility in games, emphasizing the want to reflect on consideration on various person needs, which include these with conversation difficulties. These guidelines stress the significance of incorporating customizable options, adjustable situation levels, and choice conversation strategies to make sure accessibility for all gamers (IGDA, 2020) [9].

In addition to enhancing communication, entertainment games designed for mute students can also promote the development of various skills [10]. Cognitive abilities, such as problem-solving, critical thinking, and decision-making, can be stimulated through gameplay mechanics that require strategic planning or logical reasoning. Moreover, games that incorporate educational content can support academic learning, helping mute students reinforce concepts in a fun and engaging manner.

When we consider deaf primary students, we interviewed teachers and students. Specially teachers mentioned that they should use sounds also when they teach to students. Because they want to grow the hearing ability from hearing impaired students.

III. METHODOLOGY

The proposed solution intends to provide a smart approach for teachers, deaf primary students, their parents, and their friends to communicate proper way though this platform and a creative method to learn some lessons creative way and make closer communication between deaf students, their friends, teachers.

A) Convert sign language to natural language (Sinhala Voice and text)

Our research employs an experimental research design to develop and evaluate an interactive and entertaining model that converts sign language (deaf language) to Sinhala language (natural language) for mute Sri Lankan primary students. The design integrates computer vision techniques, specifically Convolutional Neural Networks (CNN), to achieve accurate and real-time translation.

We adopt a CNN architecture for its effectiveness in image recognition tasks. The model comprises convolutional layers for feature extraction, followed by fully connected layers for classification.

The dataset is divided into training, validation, and testing subsets using stratified sampling to ensure representation across signing variations. The CNN model is trained using the training set, optimizing a loss function, such as categorical cross-entropy, through backpropagation. And trained CNN model is integrated into a real-time sign language

recognition system using computer vision libraries. Hand and gesture segmentation are performed to extract relevant features for translation. A mapping between recognized sign gestures and Sinhala phrases is established. A language generation module converts recognized gestures into coherent Sinhala text. An interactive user interface is designed to engage mute Sri Lankan primary students. The platform includes a visual display of the translated Sinhala text and voice output for enhanced comprehension. Upon successful gesture recognition, the system generates the corresponding Sinhala textual output. Subsequently, a text-to-speech (TTS) module is integrated to convert the generated text into spoken Sinhala. TTS technology, such as the Google Text-to-Speech API or other libraries, can be utilized for this purpose.

We imported necessary libraries, including OpenCV (cv2), NumPy (np), the matplotlib library for visualizations, the time module, the media pipe library for holistic detection, TensorFlow utilities for compatibility, Keras modules for building and training the model, and more.

By following this comprehensive methodology, we aim to develop an interactive and entertaining model that converts sign language (deaf language) to Sinhala language (natural language) using computer vision, contributing to the advancement of inclusive education for mute Sri Lankan primary students.

B) Convert natural language (sinhala) to sign language through 3D model

Our research employs a mixed-methods research design, combining experimental development and user evaluation, to create and assess an interactive and entertaining model for mute Sri Lankan primary students. The design integrates the Unity game development platform to develop a 3D model that converts Sinhala natural language to sign language.

The conceptual framework encompasses linguistic analysis of Sinhala natural language to identify relevant signs and gestures. 3D modeling techniques are employed to create lifelike virtual characters capable of expressive sign language communication. A diverse dataset of Sinhala phrases and sentences is compiled, covering a wide range of topics and contexts. A database of authentic Sri Lankan sign language gestures is collected, considering regional variations and cultural nuances. Interactive 3D scenes are created using Unity, incorporating virtual characters capable of sign language communication. Sign language gestures are mapped onto the virtual characters using animation techniques to ensure accurate and expressive representation. Computer vision algorithms within Unity are employed to track user hand movements and gestures through webcam input.

By following this comprehensive methodology, we aim to develop an interactive and entertaining model that converts Sinhala natural language to sign language using a Unity-based 3D model.

C) Innovative approaches for teaching sinhala alphabet to deaf primary students

Contributing to an inclusive educational environment for mute Sri Lankan primary students. Educational quizzes will be developed in collaboration with subject matter experts, distinctive schooling teachers, and speech therapists. The quizzes will be aligned with the important school curriculum in Sri Lanka and designed to cater to the conversation wishes of mute students. Visual aids, simplified text-based questions, and choice communication methods such as sign language will be included into the quiz design. The quizzes will be pilot tested and refined based totally on remarks received from students and experts.

And also designed a way to teach Sinhala alphabet to deaf students using special educational theories and psychological methods for deaf students. Because some deaf students can hear some small sounds so we want to try to enhance their hearing ability also as they can learn to try to speak by hearing. Computer vision technologies are integrated to enable gesture-based interaction within the game. The OpenCV library is utilized for real-time hand detection and recognition. By analyzing the video feed from the user's webcam, the game identifies hand signs made by players as responses to the presented alphabet characters. For hand sign recognition, the captured video frames are processed using image processing techniques provided by OpenCV. Hand landmarks and contours are extracted to identify distinct hand gestures corresponding to each Sinhala alphabet character. A machine learning model is trained to classify and recognize the hand signs associated with each alphabet character. Convolutional Neural Networks (CNNs) are commonly employed for image classification tasks, and a similar architecture can be utilized in this context. Training data consists of a dataset of hand sign images corresponding to different alphabet characters. And also used Unity to game development process.

During the game, users are prompted to select the correct answer by displaying the corresponding hand sign in front of the webcam. The computer vision system processes the hand sign, and the machine learning model predicts the selected alphabet character. While studies have established the benefits of educational quizzes for inclusive education, there is a dearth of research specifically focusing on the impact of quizzes on mute Sri Lankan most important students' mastering outcomes. Further investigation is imperative to

investigate the effectiveness of educational quizzes in bettering information acquisition, necessary questioning skills, problem-solving abilities, and standard academic performance among mute students.

D) Interactive and entertainment games for deaf primary students

The developed leisure pc games will be carried out in the lecture room settings of the collaborating schools. The games will be hooked up on pc devices, and teachers will be supplied with training and support in using the games effectively. The game's user interface is designed to be visually appealing and intuitive, catering to the specific needs of deaf primary students. Unity's UI components allow for the creation of

interactive buttons, animations, and visual elements that effectively convey emotions and expressions. Animated characters are utilized to teach emotions through visual cues. Unity's animation system enables the creation of lifelike character movements and facial expressions. Characters can display different emotions, such as happiness, sadness, surprise, and more, enhancing the understanding and recognition of emotions among players.

Gamification elements are incorporated to enhance engagement and learning retention. Unity's scripting capabilities allow for the implementation of scoring systems, rewards, and progression tracking, motivating players to actively participate in the learning process.

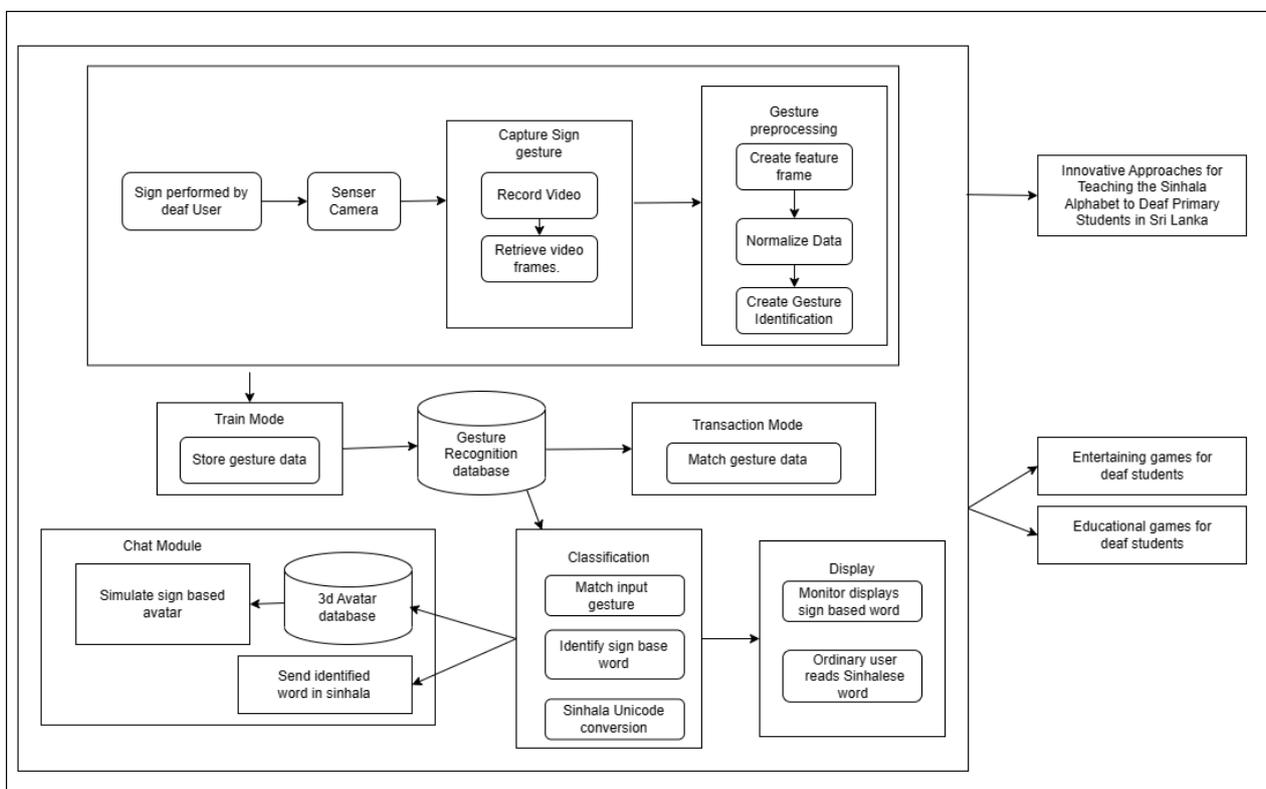


Figure 1: System Overview

IV. RESULTS AND DISCUSSION

The study investigated the effectiveness of entertainment computer games and educational quizzes as educational tools for mute Sri Lankan primary students. The findings showed that both types of interventions had a positive impact on learning outcomes, engagement levels, and social interaction.

- Entertainment computer games were found to be effective in improving academic performance, language skills, cognitive abilities, and subject-specific knowledge. The games were also found to be engaging

and motivating, and they helped to promote social interaction among the students.

- Educational quizzes were also found to be effective in improving learning outcomes. The quizzes were found to be engaging and user-friendly, and they helped to promote active participation and understanding among the students.

The study also found that the use of technology was beneficial for both types of interventions. The visual and auditory elements of technology-based learning made the experience more engaging and interactive for the students.

The findings of the study suggest that entertainment computer games and educational quizzes can be effective tools for inclusive education for mute Sri Lankan primary students. These interventions can help to address the special needs and challenges of mute students, and they can help to foster their academic and social development.

- Entertainment computer games and educational quizzes can be effective tools for inclusive education for mute Sri Lankan primary students.
- These interventions can help to improve academic performance, language skills, cognitive abilities, and subject-specific knowledge.
- They can also help to promote engagement levels, social interaction, and self-confidence.
- The use of technology can be beneficial for both types of interventions.

V. CONCLUSION

The successful implementation and evaluation of our interactive and entertaining model substantiate its potential to bridge communication barriers and enrich the educational journey of mute Sri Lankan primary students. The conversion of Sinhala natural language to sign language and vice versa through a 3D model, complemented by voice output and text generation, holds promise in fostering inclusive education, empowering students, and creating a more equitable and engaging learning environment. This research advances our understanding of technology's role in enhancing the lives of marginalized students and underscores the significance of a holistic approach to education.

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