Sri Lanka Institute of Information Technology

TMP-22-218

Project Topic Assessment – 2022 (Regular)

Topic

Game-Based E-Learning System for Preschoolers - Brainy

Abstract (200 Words Max):

Today's children belong to a generation that is familiar with technologies, such as computers, tablets, and the internet. Nevertheless, over time, kids have an excessive tendency to watch television, play computer games, or access social networking sites such as YouTube or Facebook. As a result, there is a growing social discourse that kids, ought to be kept away from technology to some extent, especially due to the addiction and wastage of time. But it is a crucial as well as a negative step to take in a rapidly evolving world. Although many e-learning systems including game-based applications have been developed to strengthen children`s minds and education. E-learning games have become a popular in recent years and these solutions remained the same for decade based solely on technology. Therefore, there is a need for a design that can develop the mind of the child or enhance the education through a clear combination of technology and real-world activities.

Our purpose of this application is to provide children with such a comparable experience of wasting time on above mentioned events, but that it effectively devotes some of that time to education and enriches children's education. We intend to continue our e-learning application's research by incorporating advanced technologies such as natural language processing, augmented reality, object detection, and pose detection.

Research Group/Area: Select the area by referring to the document uploaded to the Course Web

Computing for Inclusive and Equitable Society (CIEC)

E-learning and Education (ELE)

Supervisor should fill this part

Supervisor and Co-Supervisor endorse the proposed project, and hence, guide the students to acquire required knowledge skills pertaining to above sub domains of their specializations.

Supervisor: **Ms. Kushnara Suriyawansa** Signature

Continuation of Previous Year Project? ☐

If yes, state the Project ID

and year

Co-Supervisor: **Dr. Nuwan Kodagoda** Signature

External Supervisor Name

Team Members:

Student Name	Student ID	Specialization
Leader: Fonseka D.W.L.K	IT19171234	SE
Member 2: Fernando S.M.J	IT19053592	SE
Member 3:Jayasundara J.M.I.S	IT19108582	SE
Member 4: Jayawardhana M.U.D	IT19063492	SE

Research Problem:

Today's kids are part of a generation that grew up with computers, tablets, and access to the internet. Marc Prensky [1] called this generation “digital natives”, acknowledging that digital language is an essential component of their life and that it has the potential to alter their thinking patterns. Game-based E-learning applications are one of the instances of the fascinating multimedia content that has been developed to support digital native’s educational necessities.

In terms of E-learning concept, there are typically three major components that directly influence the development of E-learning applications: kids, technology, and educators(guider). Design procedures, teaching-learning methodologies, and content are all conditioning aspects for learning in terms of technology [8]. In terms of design, pedagogical applications for children must use graphics and actions that provide context; they must use simple and clear instructions, based on images; they must have an intuitive interface and interactivity for independent use, but also a challenging approach with multiple opportunities for success, to maintain interest [7]. E-learning Games which are developed in accordance with above terms have been popular among kids for decades, relying solely on same technology.

However, these apps do not appear to be up to date with existing technical features. In addition, the homogeneity of the activities associated with these applications is now negatively highlighted. As a result, today's digital natives are heading back from these tedious apps, as well as tending to waste time of their on other platforms. Recent studies indicates that whatever the digital media content used should be age-appropriate and meaningful to children, allowing them to explore multiple areas: intellectual, physical, and emotional while providing opportunities to enhance learning with extra-curricular activities [6]. In fact, the question is to what extent this requirement is covered by existing game-based E-learning applications. The problems with existing applications are outlined below along with the latest technological features that allow kids to interact more and improve their skills with real-world objects and activities.

<u>Augmented Reality(AR) – To improve visual perceptual skills and memory</u>

Various game-based learning applications are available for concepts including sorting things, classifying, studying nature and shapes, listening to stories, and some other subject areas that are included and considered important in the preschool curriculum in any country [5]. Most of these products have been created by utilizing only 2D technology (Mostly Cartoons) [2].To accomplish the game's objective, the child may wait patiently for something to appear, listen to something, type, hit a button, or drag - and - drop, as we mentioned earlier this is with the older approach. There is no correlation between game content and the real world or physical nature of any objects.

One of the best approaches to teach preschoolers is to allow them to interact with real objects. Furthermore, there is no way to prevent memories from fading, even if it is done without using technology. However, with the use of augmented reality and technology, kids may relive the excitement and experience something they've never had before.

Augmented reality is a technology which introduces and replaces the existing world with a simulated one or virtual contents such as 3D computer-generated data (objects, texts and sound, onto real images and video), where computer graphics objects are blended into real world footages at real time [3] Augmented reality applications improve the attention skills, motivational skills or concept skills of preschool children [4].

Pose Detection – To improve gross motor skills and early mathematical concepts

"*Position estimation*" or "*Human pose detection*," means an artificial intelligence(AI) system that analyzes photos using machine learning methods. The concept is that using a camera and a little bit of magic, algorithms based on neural networks recognize human poses and monitor bodily motions in real time. That's a high-level summary of the computer vision algorithms used to track a person's stance at each given moment.

As aforementioned, various kids learning applications with different ideas had the same technology and human interaction methods for app development for decades [9]. Currently, there are no applications that use pose detection technology for game-based learning app development. Nevertheless, some other systems are using pose detection for some major tasks: Adobe character Animator. Pose detection has been shown to be effective in recent studies. A recent UNICEF web article shows an app which use pose detection with 2D technology to teach emotions [10]. This manual approach is incomparable with the capability of camera pose detection AI technology. Another case study demonstrates the usability of this pose detection technology for classroom activities, including assessing whether students understood the lessons [13]. Also, [11] research paper shows a successful story of a game with pose detection capabilities.

Voice Recognition – To improve Pre-Reading Skills or Other Auditory Perceptual Skills

Recent studies indicate that the existing educational applications do not use this fascinating technology properly and, the children do not get adequate education even in the other apps with voice recognition technology. What happens in most education game applications is that the child enters the word spoken by the system. A design model of a proposed gaming application for hearing impaired kids using the voice recognition feature was revealed upon further study [12].

There are no e-learning games made using voice recognition technology and the existing applications do not help children to learn properly. Furthermore, there have been no successful applications that has features like spelling recognition, lyrics recognition when a child sings a song, counting recognition in mathematics and pronunciation recognition.

"*Voice recognition*" is the process by which a machine identifies, understands, and responds to a statement or instruction made by a human. It uses voice as a research object and uses speech signal processing and pattern recognition to allow machines to automatically detect and understand words spoken by humans. Speech recognition technology is an advanced technology that allows a machine to convert vocal signals into appropriate text or instructions by identifying and interpreting that signal. Speech recognition is a multidisciplinary field that covers many topics. It is closely related to the fields of acoustics, phonetics, linguistics, information theory, pattern recognition theory, and neuroscience. Speech recognition technology is gradually becoming an important technology in computer information processing technology, thanks to the rapid development of computer hardware, software, and information technology [14].

Camera Object Detection and Recognition – To improve visual perceptual skills and Memory

Object detection is a visual technology that allows us to recognize and find items in a still or moving scene . Object detection may be used to count items in a scene, determine and monitor their precise positions, and precisely label them using this type of identification and localization. as an example: YOLO [15] [16].

Applications with object identification have already been developed for children. Nevertheless, numerous applications have utilized 2D technology to identify the object, but they've never shown any interaction with the real world. As aforementioned, most of the applications available today are homogeneous and limited to the capabilities of the device, also not associated with the materials in the real world. However, when designing a game-based e-learning application for kids, children's preferences and thoughts must be considered. For example, imagine of animals and other objects in the environment [17].

Solution proposed:

Pose Detection – To improve gross motor skills and early mathematical concepts

As explained in the problem part, children do not get to engage in much environmental activity with the existing Kids' learning applications. So, we decided to use pose detection as a solution to this problem in the game base is learning app we are making. First, we hope to create this application as a game with a story mode. So, the story of this game is mainly divided into several chapters. In each of these chapters, the children must engage in individual activities that cover all subjects. We hope to include pose detection-related activities along with these various activities: 1+1 show the answer with your fingers, jump up like a rabbit, bring a ball, and show it. Activities like this give the child good knowledge and good exercises for the body. The main target of our application is to keep children away from phone use, the specialty is that we hope to do that with an application. It is very important for us to use technology like pose detection inside our application to reach this target. We hope to use technologies like the ML kit from google developers as well as the face API to create activities related to pose detection.

Augmented Reality(AR) – To improve visual perceptual skills and memory

In this story mode e-learning game, which we have divided into chapters, we plan to deploy Augmented Reality technology as the speaker or presenter of the story.

Our objective is to continue to develop a sense of curiosity in kids by allowing them to interact directly with 3D characters and objects generated with AR technology. Also, this can give kids an artificially present experience, but they can experience it in real-time and in the real world, even if it's not available at their premises. This experience can assist preschoolers in the development of skills, especially visual perceptual skills, as well as memory and retention.

We're interesting to maximize our approach with the following AR game elements shown below [18]:

i. By merging real and virtual information and visualization, such a blended environment can enhance the perception of a studied topic.
ii. A player-oriented game with a dynamic environment that modifies according to the user and device orientation. i.e., physical interaction.
iii. point-and-click interface and a natural (gesture-based) human-computer interaction.
iv. So-called outdoor games which are context aware.
v. merges graphics and audio with the mobility.
vi. In online contexts, it directly supports social learning.
vii. content and stories based on multimedia
viii. Pervasive learning is supported by contextual and real learning contexts.

Throughout this approach, our augmented reality e-learning game application is intended to facilitate kids in learning complex geometric ideas and serve as a guide for self-learning, enabling learners to identify their strengths and weaknesses while having fun by completing chapters.

Voice Recognition – To improve Pre-Reading Skills or Other Auditory Perceptual Skills

In the field of voice recognition, this application provides a solution that considers four main functions: pronunciation, spelling, singing, and counting.

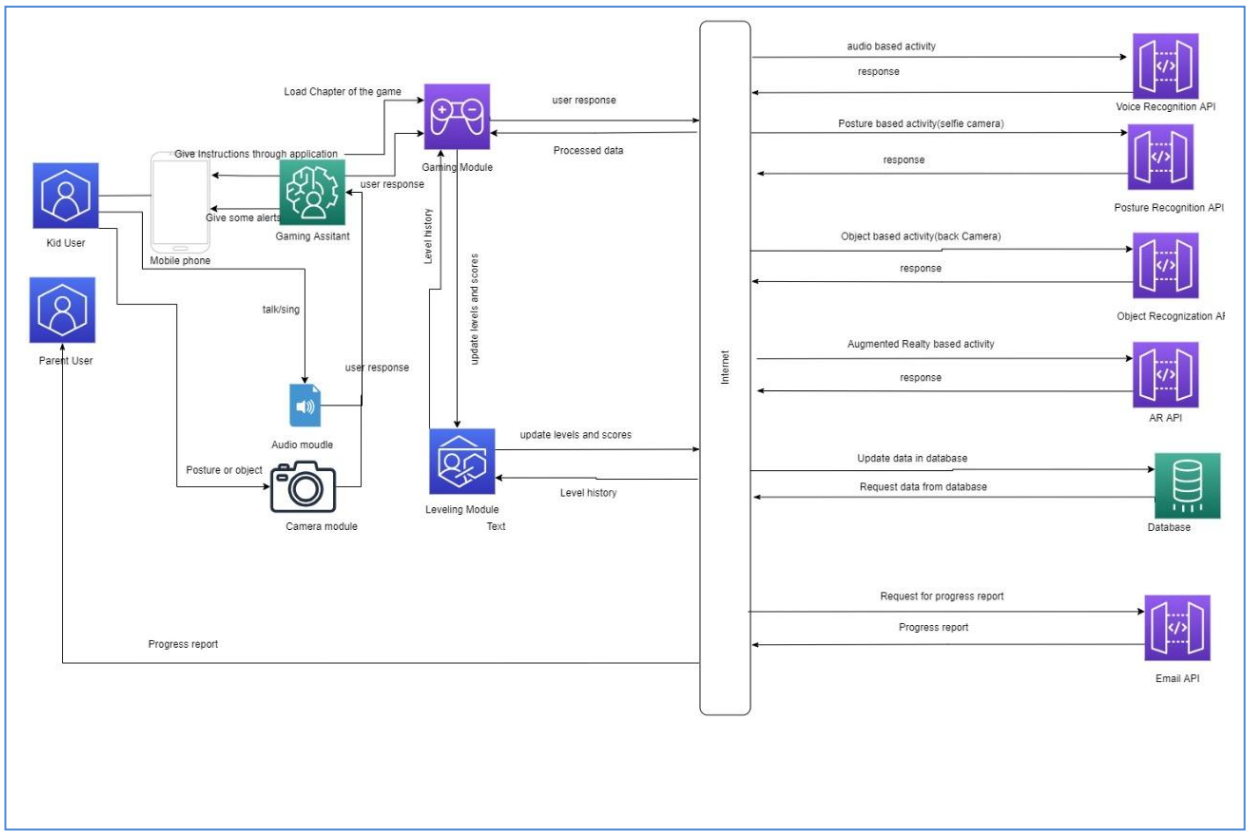
The pronunciation function mainly checks whether the child's words are correct. For that, the child pronounces what the system is showing or saying, thereby confirming the accuracy, letting the child proceed with the next task. In the Spelling function, the system says or shows a word or an image on the screen, then the child must read the word aloud, then voice AI checks the spellings of the word. Again, if the child can spell the word correctly, they can move on game. In the third part which is about the singing function, shows on the screen, then the child must sing the song correctly, the system will recognize the song and allow the child to continue playing. Finally, in the counting function, the system allows the child to read the numbers. For example, consider the child counting from 1 to 10. Here the system checks whether the child reads these numbers correctly and must answer the math problems provided by the system.

Camera Object Detection and Recognition – To improve visual perceptual skills and Memory

Existing game-based e-learning applications use 2D technology to perform functions. These applications display images on the screen to present and showcase an image or thing and make it usable by the user. but these systems were limited to what was displayed on the screen. users cannot think about these limits. So, as a solution to these limitations, we introduced object detection and object recognition technology to our kids' learning app. By using this material recognition technology, we can provide an unlimited user experience in real-time. We decided to develop our educational game with object recognition technology so that we can use object detection and recognition technology instead of old 2D technology to detect any 3D object any in the environment. It helps children understand the environment, objects, and animals around them.

System Overview Diagram for the solution proposed. Recommended to draw using draw.io. Note: This is not an activity/flow (UML) diagram

1. **Man components including the data sources, stakeholders, interaction among the stakeholders, etc.**
2. **Interconnection among the components**
3. **Major SW and HW components**



Objectives (1 main objective and 4 sub objectives):

Main Objective: Implement a game-base e-learning application for kids(preschoolers)

Sub Objective 1: Camera based activities on the child – pose detection

Sub Objective 2: Augmented reality and generating unique activities

Sub Objective 3: Camera based activities - Object detection and general recognition

Sub Objective 4: Recognizing voice to do various voice activated activities

Task divided among the members

Member 1

Every system that exists so far has been designed the same way it only deals with the child and the device, but we want to create a different system for it. We want to give the child a quality education by involving him in outdoor activities as well. For that we suggested using a technology called pose detection. Here we get the child to do some activity and the camera on the child's phone detects it and shows the child whether it is right or wrong and we try to give them a quality education though the activity. This will reduce the child's phone addiction and give the child a different kind of experience than the usual educational system.

Pose detection is used to detect postural things in real-time from a continuous video or static image. In kids learning, pose detection can be used to describe body positions at one moment in time and can be used to distinguish one pose from another. We hope to accomplish the tasks outlined above by the following:

- Gestured based activities
- Exercises
- Showing thing by hand
- Activities involved movement

Member 2

Augmented reality(AR) is a new technology for game-based e-learning applications because by now there are lesser attempts to develop AR-based kid's games. We have planned to use augmented reality for our application to generate digital objects and real-time objects. Another feature of the AR experience is that it combines 25% digital reality with 75% real-world reality. It means that virtual items are integrated into the actual world rather than replacing the entire environment. It indicates that AR allows seeing a computer-generated item on a screen by moving the smartphone camera into space. Everything happens in real-time as the user sees it through the camera. This technique allows kids to learn in a more interactive environment. We've planned to implement a story-based e-learning application using this technology. we expect to provide a real-time experience for the users using this technology.

Below outlined our expectations to generate unique actives and tasks for kids' games such as,

- Generate a story line based on items that are available on a scene, so kids may use those items available to solve a puzzle
- Generating and using unique images and 3d objects to be used.

Member 03

In this section, we mainly focused on object detection and object recognition technology. This is a new technology for game-based e-learning. This technology is used to interact with the real world. Most of the available educational applications show uniformity which means that they are never in contact without the real world because there is no defined approach to interact with it. Therefore, users are less inclined to use those applications.

We hope to implement this pedagogical game that allows kids to interact with objects that exists in the real world. Therefore, we've planned to include object detection and object recognition features for kids' learning applications to improve child activeness.

Camera based activities for detecting real world object and recognize them;

- Add on knowledge base for kids to understand and relate what they are seeing
- Using curiosity in kids for them to explore their surroundings
- Getting students to do various activities to do where they need to select items in the real world to solve these tasks

e.g., Problem solving, where they are toys, and they get to

Member 04

Voice recognition, often known as speech-to-text or voice recognition, is a type of modern technology that recognizes speech and uses it as the "primary interface between the person and the mobile application". This info brief examines how current speech recognition technology aids student learning, as well as how the technology may evolve in the future to help students learn more effectively.

Here we hope to create a mobile application for children to get a quality education. There we give the child the opportunity to learn through this voice recognition technology. This system will give activities to children such as singing, reading aloud, and then those are tested to see if they are correct. Although voice recognition technology has been used for a variety of purposes and has not yet been used for game-based e-learning applications. We hope to invent this technology for e-learning games.

Voice recognition can be used to recognize voice and do various vice-based activities.

- Identify correct pronunciation
- To detect spelling correctness
- To identify number count
- Recognize song while kids are singing

Technologies to be used:

Technologies

Game engine

Unity

Languages

Python

Java

C#

Other technologies

Yolo algorithm

Voice recognition

Open CV libraries

If supervisor States that this year is a continuation of previous work, state the further work the students should do compared to the previous years.
(NOTE: This part must be filled by the supervisor)

<u>This part will be filled by the Topic Screening Panel members</u>

Acceptable: Mark/select as necessary

Acceptance/ Rejection	Correction State	
	Minor Correction	Major Corrections
Accepted	☐	☐
Resubmit	☐	☐
Rejected	☐	

Corrections (if necessary)

Any other Comments:

_____

_____

_____

Approved by the review panel:

Member's Name	**Signature**

Important:

1. According to the comments given by the panel, do the necessary modifications and get the approval by the **same panel**.
2. If the project topic is rejected, find out a new topic and inform the CDAP Group for a new topic pre-assessment.
3. A form approved by the panel must be attached to the **Project Charter Form**.

References

[1] Prensky, Marc, "Digital Natives, Digital Immigrants Part 1," *On The Horizon,* vol. 9, pp. 1-6, 2001.

[2] "5 Great Online Visual Perceptual Games," [Online]. Available: https://thesensorytoolbox.com/online-visual-perceptual-games/.

[3] Contero, Manuel and Cascales-Martínez, Antonia and Laguna, Isabel and López, David and Perona, Pascual, "Augmented Reality for Preschoolers: An Experience around Natural Sciences Educational Contents," in *SPEDECE*, Alicante, Spain, 2012.

[4] Joshi, Abhijit and Mendjoge, Neha and Neogi, Omkar and Patil, Sidhhant and Prabhu, Chiquitha, "E-learning System using Augmented Reality," in *ICCUBEA*, Pimpri-Chinchwad, 2016.

[5] Tanja Mcilroy, "16 Things Kids Learn in Preschool," 2021. [Online]. Available: https://empoweredparents.co/what-do-kids-learn-in-preschool/.

[6] Hillman, Margy and Marshall, James, "Evaluation of Digital Media for Emergent Literac," *Computers in the Schools,* vol. 26, pp. 256-270, 2009.

[7] Clements, Douglas and Sarama, Julie, "Teaching with computers in early childhood education: Strategies and professional development," *Journal of Early Childhood Teacher Education,* vol. 23, pp. 215-226, 2002.

[8] Hsin, Ching-Ting and Li, Ming-Chaun and Tsai, Chin-Chung, "The Influence of Young Children's Use of Technology on Their Learning: A Review," *Educational Technology and Society,* vol. 17, pp. 85-89, 2014.

[9] "27 Best Free Educational Apps for Kids | Top Education Apps," 28 August 2020. [Online]. Available: https://www.edsys.in/educational-apps-for-kids/.

[10] "Play based learning activities for children aged 3 to 10," UNICEF, [Online]. Available: https://www.unicef.org/northmacedonia/play-based-learning-activities-children-aged-3-10.

[11] Y. a. P. T. Ploengpit, "2016 International Computer Science and Engineering Conference (ICSEC)," in *Mahidol University*, Nakhon Pathom, Thailand, 2016.

[12] Wong Seng Yue and Nor Azan Mat Zin, "Voice Recognition and Visualization Mobile Apps Game for Training and Teaching Hearing Handicaps Children," *Procedia Technology,* vol. 11, pp. 479-486, 2013.

[13] Lin, Feng-Cheng and Ngo, Huu-Huy and Dow, Chyi-Ren and Lam, Ka-Hou and Le, Hung Linh, "Student Behavior Recognition System for the Classroom Environment Based on Skeleton Pose Estimation and Person Detection," *Sensors,* vol. 21, no. 1424-8220, 2021.

[14] Meng, Jianliang and Zhang, Junwei and Zhao, Haoquan, "Overview of the Speech Recognition Technology," in *2012 Fourth International Conference on Computational and Information Sciences*, Chongqing, China , 2012.

[15] Lorna Yen, "Real time object detection with YOLO," 04 January 2019. [Online]. Available: https://towardsdatascience.com/hands-on-machine-learning-example-real-time-object-detection-with-yolo-v2-ebdd8441c12a.

[16] "YOLO: Real-Time Object Detection," [Online]. Available: https://pjreddie.com/darknet/yolo/.

[17] Jung, Minji and Yang, Heekyung and Min, Kyungha, "Improving Deep Object Detection Algorithms for Game Scenes," *Electronics,* vol. 10, no. 2079-9292, 2021.

[18] Ştefan, Livia and Moldoveanu, Florica, "Game-based Learning with Augmented Reality – From Technology's Affordances to Game Design and Educational Scenarios," in *ELSE 2013*, Bucharest, Romania, 2013.

.