

English School Mate

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Dissertation Submitted in Partial Fulfillment of The Requirements for the Bachelor of
Science Special (Hons) Degree in Information Technology

Department of Information Technology

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September 2019

DECLARATION

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ABSTRACT

A key policy of successive governments of Sri Lanka has been the teaching of English as a second language in schools. In the current context of globalization, technological advancement and the development of a modern and diversified labor market, the use of English language skills is recognized as essential. One of the main problems with the focus on the provision of English education for students in Sri Lanka, in general, is that this approach fails to consider how there is unequal access to English education across the country. The writing section of this project is focused on improving English grammar knowledge of students using typing keyboard, screen writing and some additional English lessons in an interactive way. We will be using the technology of image processing to do this. The grade wise English pupil books will be used to implement these lessons. We will be having exam papers for students to go through as well and the student learning progress reports will be implemented using machine learning algorithms.

Keywords: English, English Grammar, Rural Areas

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Moreover our special gratitude goes to all the banking officials who helped to collect information on the financial documents and their access permission. Special thank you goes to all the industry experts and the graduates who helped in determining the best technologies when designing the solution.

I am glad to mention something about all the volunteers who participated in answering the questionnaires during the testing phase of our solution. Their feedback gave us hope to do well in this worthy research.

Furthermore, we would like to thank our parents for their patience, time, and providing resources to acquire the needful and for other expenses. A special thanks to the fellow research members who worked alongside to make this research more effective and successful.

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List of abbreviations

API	Application Program Interface
CNN	Convolutional Neural Network
LD	Learning Disabilities
ND	Numeric Dysgraphia
ML	Mashing Learning
UI	User Interface

Table 1-List of abbreviations

1. INTRODUCTION

1.1 Background & Literature Survey

English is the biggest language spoken and third most communicated in local language on the earth after Chinese and Spanish. English is either the official language or one among the official languages in very nearly 60 sovereign states. The Global Economic Forum gauges 1.5 billion individuals around the globe communicate in English, but 400 million have it as their mother tongue. Further it is the foremost generally learned second language on the earth.

Absence of capability in English knowledge is one among the main reasons for joblessness. The main proof for this is that the lack of English knowledge has become one major boundary for graduates to seek job opportunities especially within the private sector. Henceforth, the private sector wants to use non-graduates with great language skills, contrasted with graduates. English language skills is an empowering influence for professional success and social relationships. Comparatively a very large portion of the undergraduates understand the importance of English language skills when they run behind jobs. It is frequently past the purpose of no return at that time. Enhancing English language skills is a huge commitment and a long lasting learning practice. The students must perceive the importance of English, build up a program to gain all the skills, and adequately utilize all the accessible assets.

In contrast, although the Importance of English language is discussed in many forums around Sri Lanka, the number of steps taken by state and non-state organizations to uplift the English proficiency level is minimal. Especially the students who are in rural areas are not met with the requirements to improve their English language skills. The main focus of this research is to present an integrated solution to improve all the main aspects of English Language while preserving the interest of students to learn. This also introduces an Instructor Dashboard to help mentors visualize results easily and to predict

student proficiency levels. This document is based on the Written English module which is one of the components of the above mentioned integrated solution.

1.2 Literature Survey

- N. Doghonadze, E. Pipia, A. Aliyev “THE DEVELOPMENT OF ENGLISH AS A FOREIGN LANGUAGE WRITING SKILLS THROUGH THE APPLICATION OF MOVIES SUPPORTED BY EDUCATIONAL TECHNOLOGIES”[1]

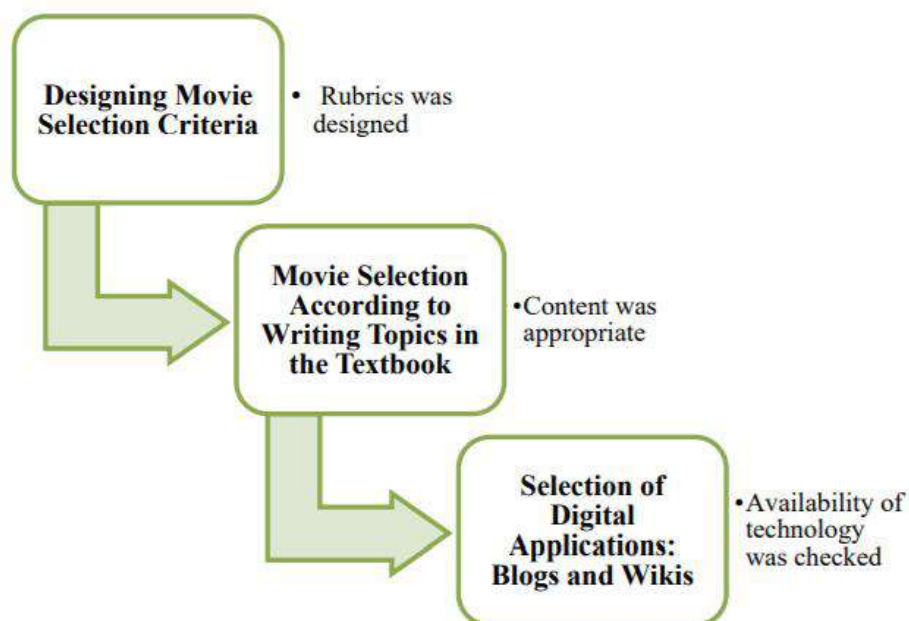


Figure 1. Designed Model for the Experiment- Step1.

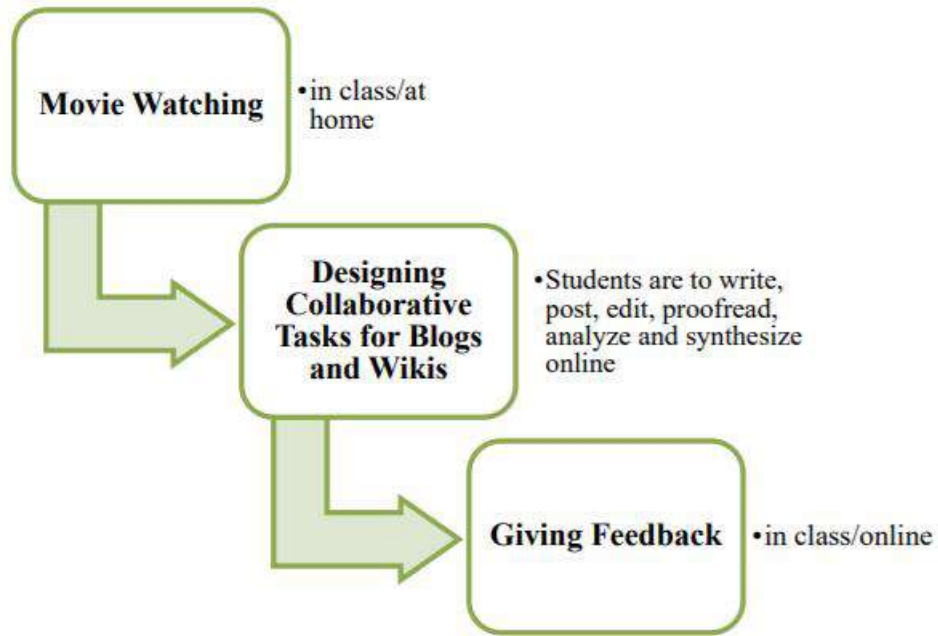


Figure 1 Designed Model for the Experiment- Step 2.

Table 1 Mean Tests Results (2015-2016 Spring).

	Pre-Test	While-test 1	While-test 2	Post test
Experimental group I	22.21	24.69	25	27.01
Control group I	22.18	22.78	24	24.68

Averages of Progress Tests (part I)

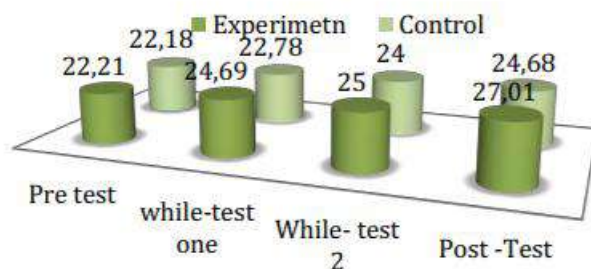


Figure 1. Average of Progress Test of Experiment and Control Group 1.

Table 2. Mean Tests Results (2016-2017 Fall).

	Pre-Test	While-test 1	While-test 2	Post test
Experimental group II	71.81	76.4	80.5	86.28
Control group II	71.34	74.28	75.56	77.31

Averages of Progress Tests (part II)

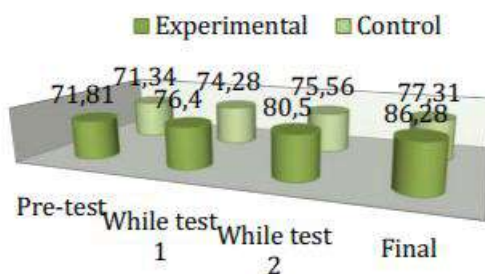


Figure 2. Average of Progress Test of Experiment and Control Group 2.

Table 3. Descriptive Statistics of the Variables (Both experiments).

Variable	Obs. No.	Mean	Maximum	Minimum	Std.Dev.
Panel 1: Experiment 1					
Final	64	25.29	30.00	15.00	3.795
Midterm	64	23.69	29.00	12.00	3.333
Progress2	64	23.98	30.00	12.00	3.970
Progress1	64	22.26	29.00	16.00	2.945
Gender	64	0.422	1	0	0.498
Dummy	64	0.500	1	0	0.504
Panel 1: Experiment 2					
Final	64	77.31	90.00	64.00	5.917
Midterm	64	49.17	88.00	12.00	27.28
Progress2	64	48.75	87.00	12.00	26.25
Progress1	64	71.34	82.00	52.00	7.405
Gender	64	0.484	1	0	0.504
Dummy	64	0.500	1	0	0.504

Table 4. Estimation Results.

	Model 1 ($y_i = \ln(\text{prog2})$)	Model 2 ($y_i = \ln(\text{midterm})$)	Model 1 ($y_i = \ln(\text{final})$)
Panel A: Sample 1			
Ln(prog1)	0.508***	0.078	0.179*
Female	0.034	0.020	0.027
Dummy	0.078**	0.030	0.101***
C	1.530***	2.915***	2.629***
No. Obs.	64	64	64
R^2	0.230	0.035	0.237
S.E.of Reg.	0.148	0.115	0.106
Panel B: Sample 2			
Ln(prog1)	0.404***	0.523***	0.360***
Female	0.014	0.038	-0.005
Dummy	0.026	0.061**	0.108***
C	2.576***	2.072***	2.813***
No. Obs.	64	64	64
R^2	0.337	0.365	0.557
S.E.of Reg.	0.071	0.098	0.062
Panel C: ALL TOGETHER			
Ln(prog1)	-0.017	-0.018	-0.033**
Female	0.045**	0.045**	0.025
Dummy	0.054**	0.048**	0.106***
C	4.355***	4.391***	4.484***
No. Obs.	128	128	128
R^2	0.073	0.081	0.279
S.E.of Reg.	0.128	0.114	0.093

Note: *, **, and *** denote significance level of 10%, 5%, and 1% levels, respectively;

- Nazlia Omar, Nur Asma Mohd Razali, Saadiyah Darus” AUTOMATED ESSAY MARKING TOOL FOR ESL WRITING BASED ON HEURISTICS”[2]

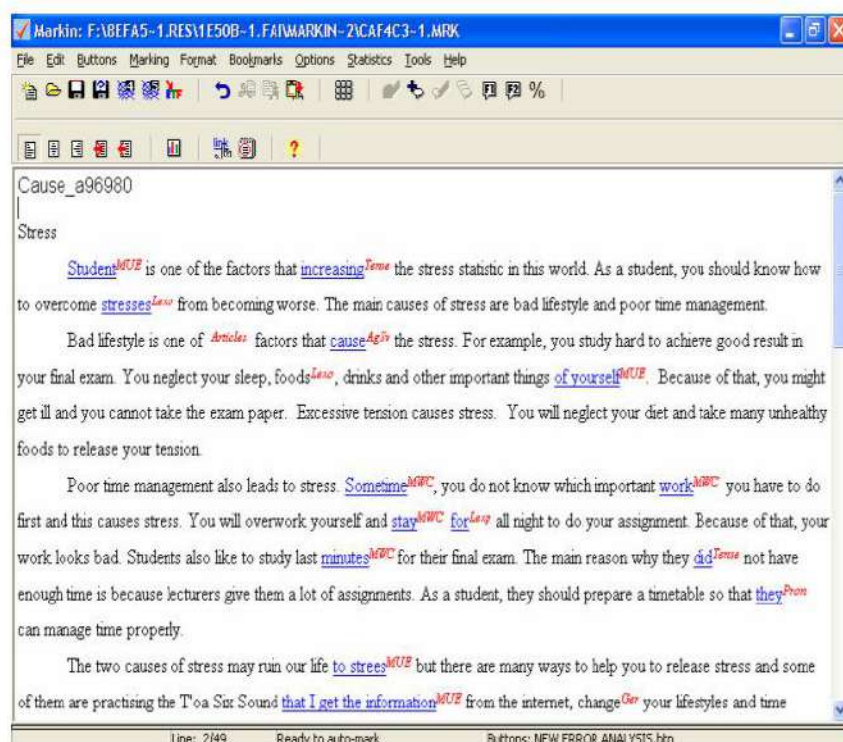


Fig. 1. Original marked essays using Markin 3.1

Errors	No. of errors	Average
1. Tense	1595	3.99
2. Articles	1204	3.01
3. Subject verb agreement	631	1.58
4. Other agreement errors	520	1.30
5. Infinitive	145	0.36
6. Gerunds	292	0.73
7. Pronouns	696	1.74
8. Possessive and attributive	232	0.58
9. Word order	194	0.49
10. Incomplete structures	253	0.63
11. Negative construction	56	0.14
12. Prepositions	1468	3.67
13. Mechanics	1105	2.76
14. Miscellaneous unclassifiable	1117	2.79
15. Word choice	1123	2.81
16. Word form	629	1.57
17. Verb to be	820	2.05

Table 2. Result of error analysis

Essays	Detect error in tenses		Percentage correctness
	Yes	No	
1	5	0	100%
2	4	2	67%
3	6	0	100%
4	2	0	100%
5	5	0	100%
6	3	0	100%
7	4	0	100%
8	3	0	100%
9	4	2	67%
10	3	3	50%
11	6	0	100%
12	3	1	75%
13	2	2	50%
14	3	1	75%
15	4	0	100%
16	5	1	83%
17	2	0	100%
18	2	0	100%
19	3	0	100%
20	3	2	60%
21	5	1	83%
22	4	1	80%
23	4	0	100%
24	6	2	75%
25	4	1	80%
26	5	0	100%
27	3	1	75%
28	4	2	67%
29	3	2	60%
30	4	1	80%
Average			84%

Table 3. Result on training dataset

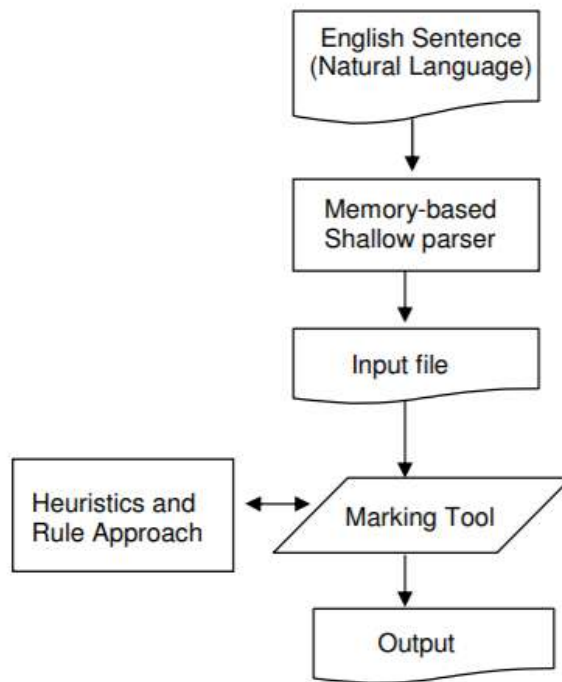


Fig. 2. Architecture of automated marking tool for ESL writing

```

1. FOR each sentence in parsed and tagged text file, DO;
2. FOR each sentence, DO;
  2.1 IF word is of type 'noun' DO;
    IF noun is in the set of heuristic Simple Present 1,
      IF noun is tagged as NNS, check the immediate verb after the noun.
      IF verb is tagged as VBP or VB, print the following sentence: The sentence has no
      grammatical error.
    IF noun is tagged as PRPplural, check the immediate verb after the noun.
    IF verb is tagged as VBP or VB, print the following sentence: The sentence has no
    grammatical error.
    IF noun is in the set of heuristic Simple Present 2,
      IF noun is tagged as NN, check the immediate verb after the noun.
      IF verb is tagged as VBZ, print the following sentence: The sentence has no
      grammatical error.
      IF noun is tagged as NNP, check the immediate verb after the noun.
      IF verb is tagged as VBZ, print the following sentence: The sentence has no
      grammatical error.
      IF noun is tagged as PRPsingular, check the immediate verb after the noun.
      IF verb is tagged as VBZ, print the following sentence: The sentence has no
      grammatical error.
    IF noun is in the set of heuristic Simple Present 3,
      IF noun is tagged as NNS followed by 'do' or 'do not', check the immediate verb after 'do' or
      'do not'.
      IF verb is tagged as VBP or VB, print the following sentence: The sentence has no
      grammatical error.

```

Fig. 2. Extract from the algorithm for heuristics to detect error in Simple Present Tense

- Ali Muftah ,Ben Omran ,Mohd Juzaidin Ab Aziz” AUTOMATIC ESSAY GRADING SYSTEM FOR SHORT ANSWERS IN ENGLISH LANGUAGE”[3]

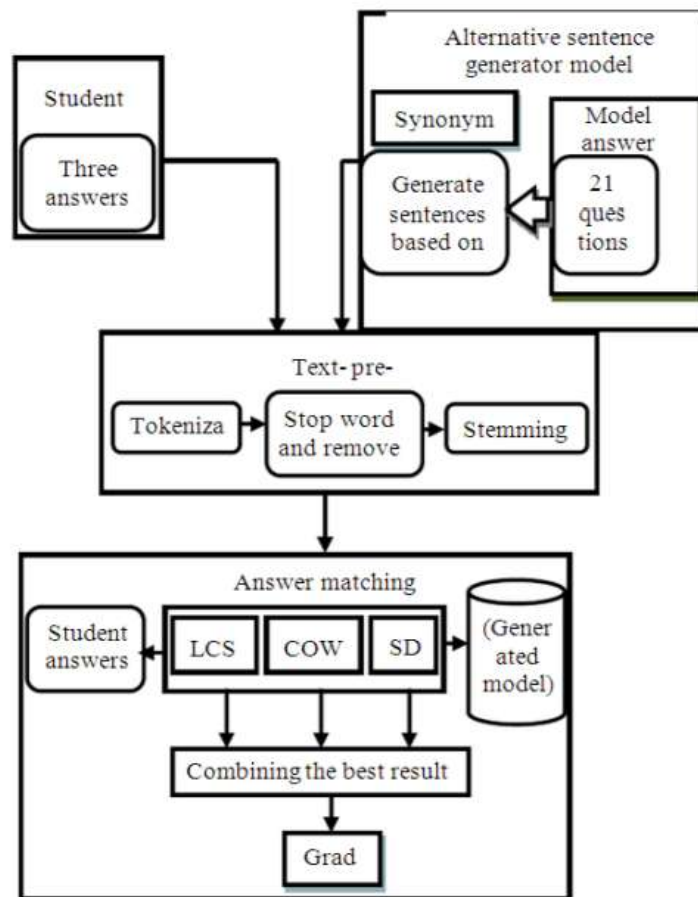


Fig. 1. Architecture of AEG system for short answer in English language

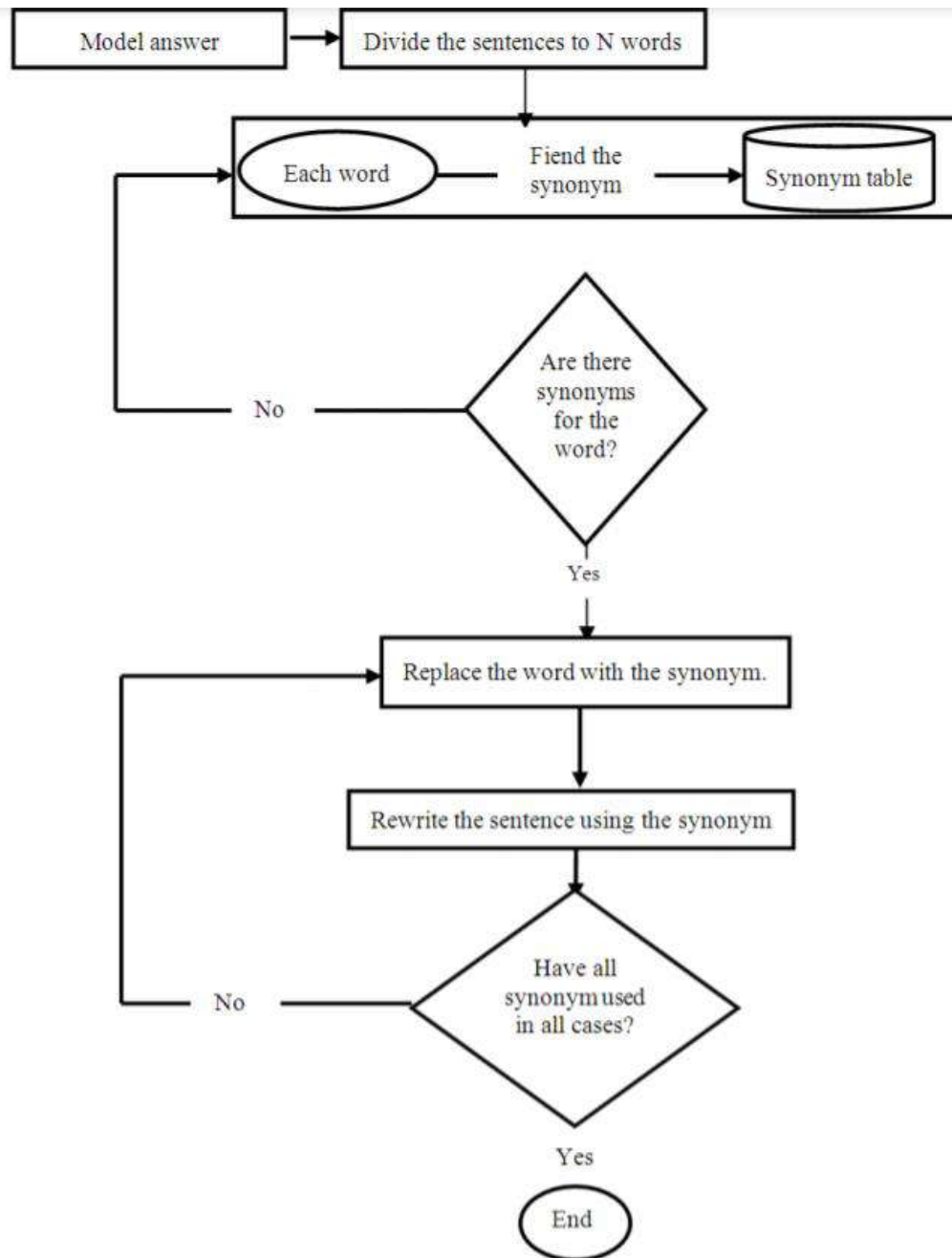


Fig. 2. Alternative sentence generator method process

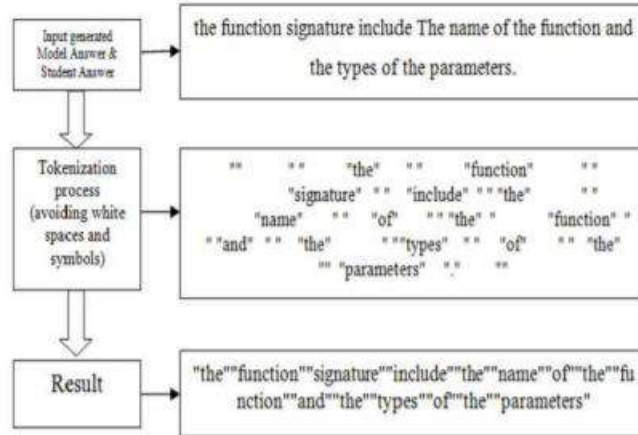


Fig. 3. Tokenization process

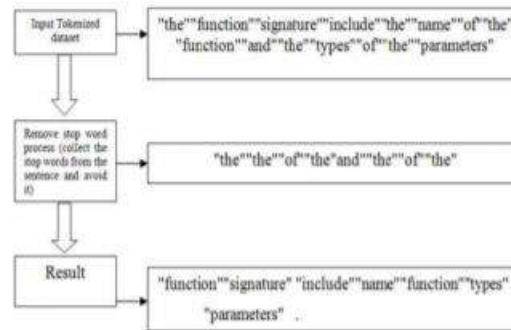


Fig. 4. Remove stop word processing

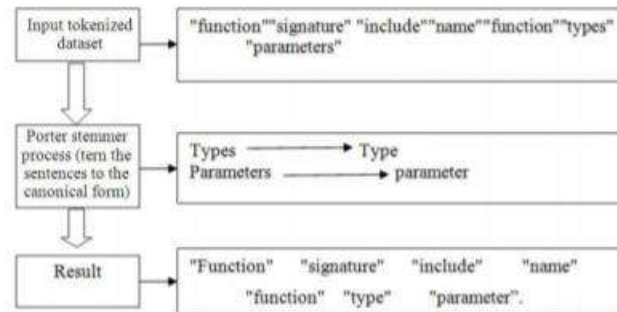


Fig. 5. Word stemming processing

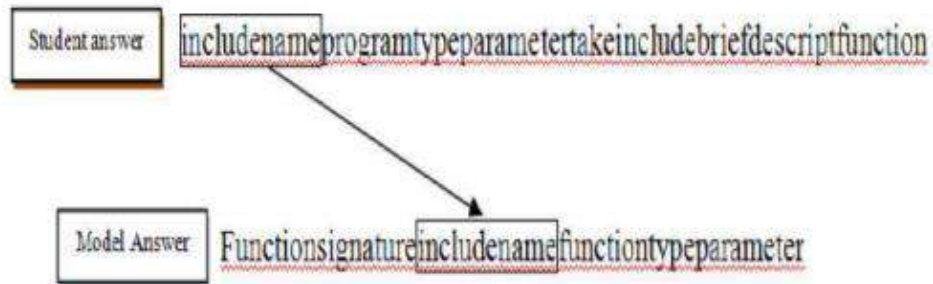


Fig. 6. Longest Common Subsequence similarity (LCS)

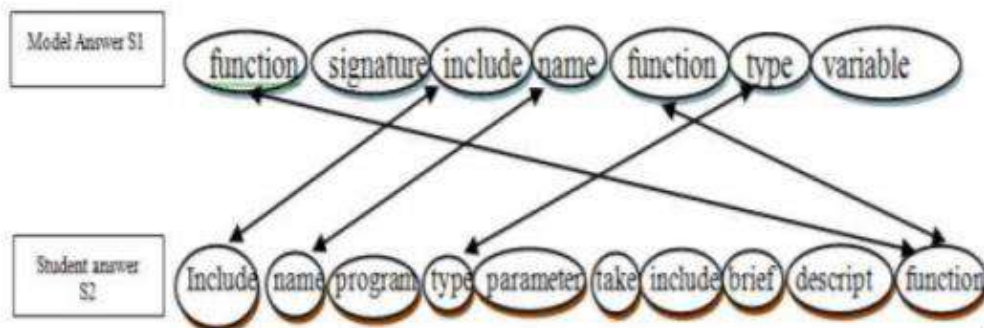


Fig. 7. Common Word Similarity (COW)

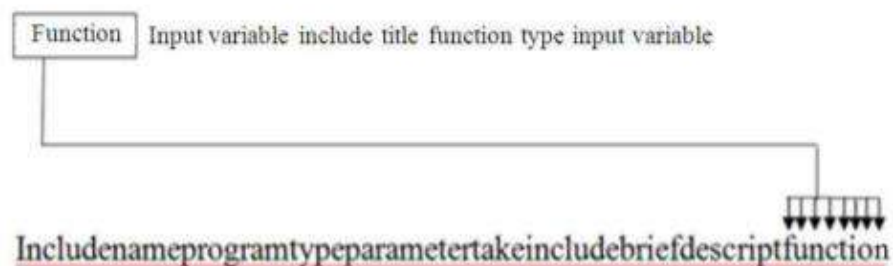


Fig. 8. SD from the SA to GMA

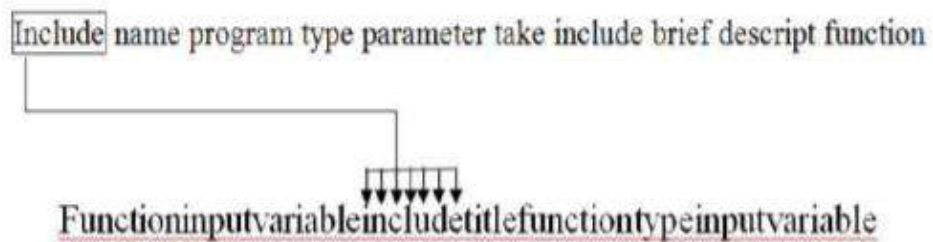


Fig. 9. SD from the GMA to SA

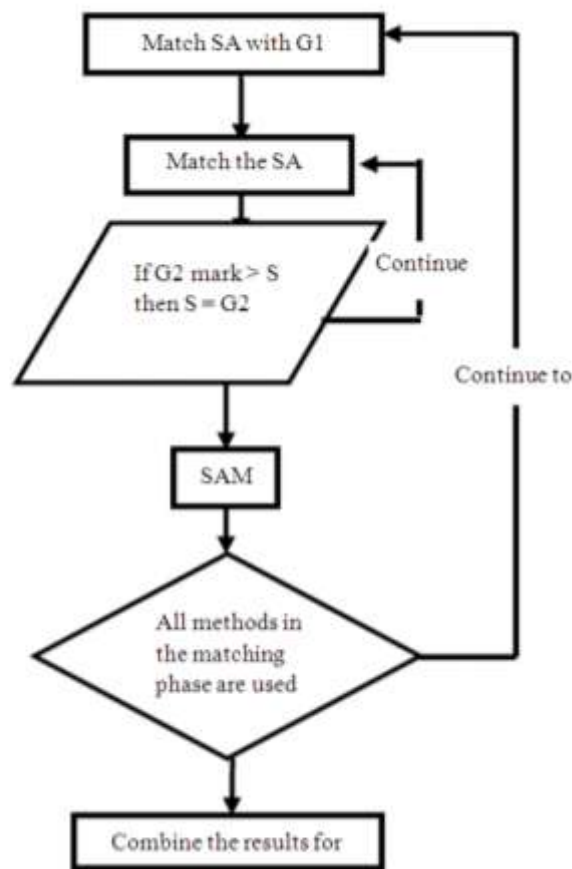


Fig. 10. Grade comparative method

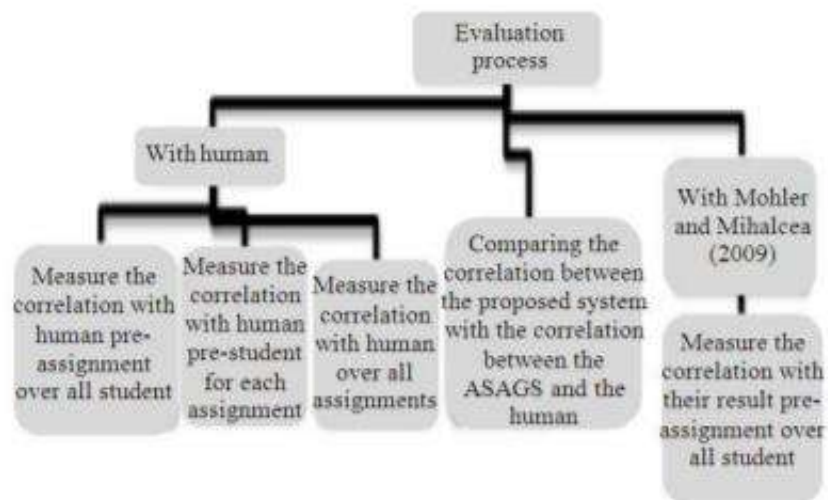


Fig. 11. Evaluation process

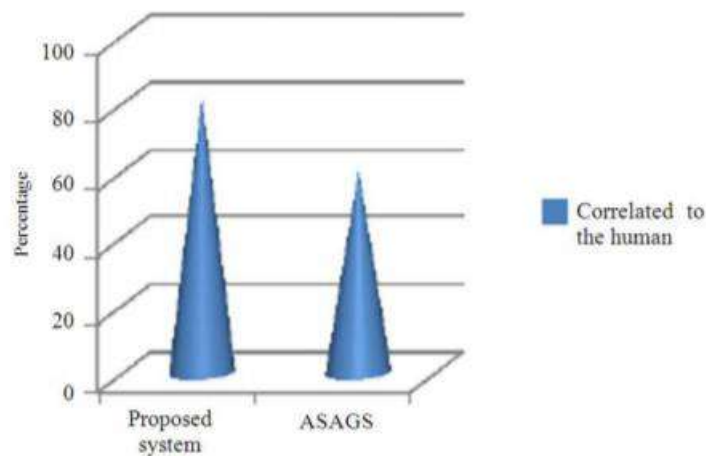


Fig. 12. Comparing the proposed system and ASAGS system with human grade

Identification of aspects in Written English

Practically every employment will require some level of Written English abilities, regardless of whether it is sending messages, composing updates or giving briefs and reports. The capacity to convey briefly and clearly using Written aspects guarantees that everybody you work with comprehends what you are going to express. Written English skills can be considered as those which are important to express what is on your mind using Written aspects such as letters and emails. Although it seems to be equal compared to the verbal language, written language differs a lot compared to verbal language rules. The verbal language utilizes body movements and tone while written language depends on syntax, punctuations and word decision. It is important to notice that to develop Written English skills, it requires practice, time and interest. Since Written English skills are so significant nowadays, it is also important to make an effort to improve them. The Written English language is composed of 5 major key elements as discussed below.

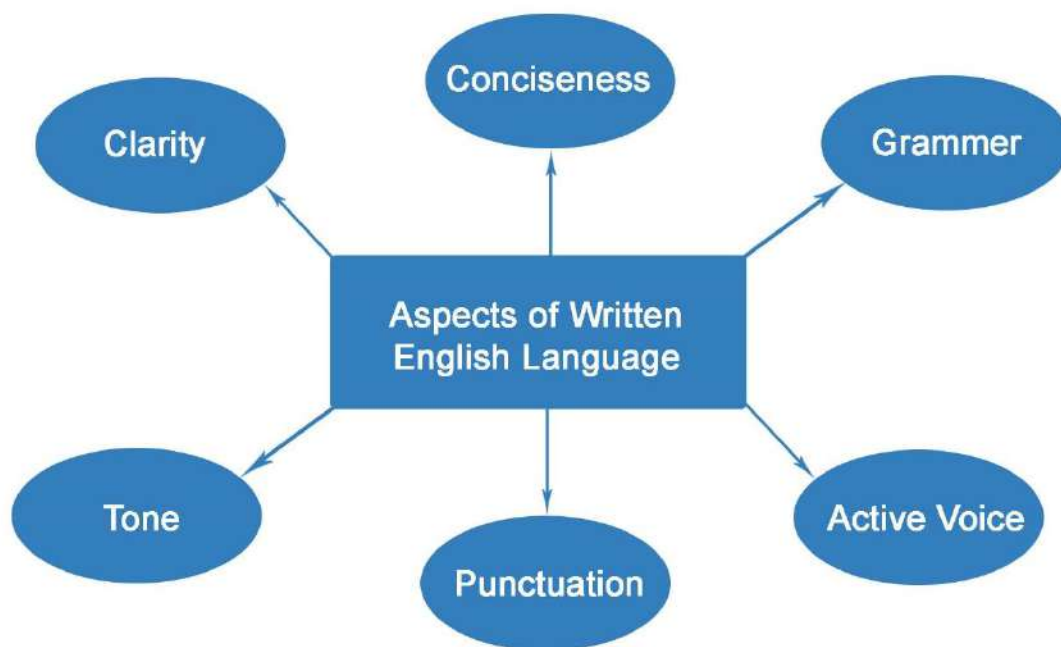


Figure 3 – 5 major key of Written English language

Evaluation of the question making process parallel to identified Written English aspects

The main focus of this research is to improve the English knowledge of rural students who are in grade 06. Therefore it is important to prepare questions to suit the rural society preserving the identified aspects of Written English. According to the above discussion there are 6 main areas in Written English language as clarity, conciseness, tone, active voice, grammar and punctuation. This section explains how the types of questions are selected to cater the mentioned areas.

There are various question types in the academic world including essay type questions, structured type questions, true or false questions, fill in the blank questions, multiple choice questions and matching questions. According to the English lessons allocated for the grade 06, the main focus is on structured type questions, multiple choice questions, fill

in the blank questions and true or false questions. On the other hand among the identified areas in Written English, grade 06 pupils book mainly focuses on grammar, punctuation and conciseness. Therefore by considering both consisting question types and consisting Written English areas, 10 exercises are created within the component.

1.2 Research Gap

Absence of capability in English knowledge is one among the main reasons for joblessness. The main proof for this is that the lack of English knowledge has become one major boundary for graduates to seek job opportunities especially within the private sector. Henceforth, the private sector wants to use non-graduates with great language skills, contrasted with graduates. English language skills is an empowering influence for professional success and social relationships. Comparatively a very large portion of the undergraduates understand the importance of English language skills when they run behind jobs. It is frequently past the purpose of no return at that time.

With the rapid enchantment of technology, the use of mobile phones has increased a lot. Therefore the modern society tend to use mobile phones to make their lives easier rather than sticking in to traditional methods. The most important fact is that this is followed not only by adults but also by teenagers and children. The best example is that most of the parents use online learning platforms such as Youtube to teach students using videos. Therefore generally students who are in grade 06 are not interested to study using books but by using online methods specifically related mobile technologies. When compared to the global academia most of the developed countries use this method which has brought them positive results when used within the limits. But in Sri Lanka the assets available for the students, specifically those who are starting there secondary education is very much limited.

Sri Lanka is one of the nations with the highest proficiency level in the world. Therefore without a debate the education system of Sri Lanka is at a higher level. But Sri Lanka is

still considered as one of the developing countries in the world. The main reason for this is the technological gap that keeps students away from reaching their targets especially in the rural areas. Most of the students learn to use e-learning when they start their higher education. Therefore it is clear that if the basic foundation to use the online assets in a right way is taught to the students during their secondary education, it is possible for us to reach the top levels as a nation.

On the other hand, although there are several solutions developed to fulfill different requirements of English in the world, there are some key elements missing in them. One main key element is that the complete composition of English language is missing when a single solution is selected. For an example 'Memrise' focuses only on Written English language. Therefore there is a huge gap in the local environment to deploy a compound solution catering all aspects of English. Further most of prevailing products are web based solutions or either organizational based products. In a situation where the solution is a complex web based application which cannot be operated with a mobile phone, the students without laptops or computers are automatically ejected from the list of possible users. Also if the product is an organizational based solution, the users who are not within the organization should pay to obtain the service. Also all the complex web applications and organizational products are less portable. This also makes a huge gap within the academic system keeping many students with less facilities away from using them.

Furthermore most of the prevailing mobile solutions which are acceptably standard are complex and highly advanced to be used by grade 06 students. Some solutions require training programs for even mentors to get used to them. Also most of them are highly resource consuming which is also another main problem for a mobile phone user in the storage perspective. It is clear that although there are several attempts carried out in this purpose, a solution which can address the above mentioned problems is still in need. Therefore the main focus of this research is to develop a solution which will cover all the required aspects and to make Smart Student the best among the list. The table below shows

the comparison of the proposed solution with the prevailing situations based on several important and key factors.

Application	English learning	Entertainment	Brain-improvement	Thinking ability
Dulingo	✓	✓	×	×
Magic Land	✓	×	×	✓
Vocab game	×	✓	×	×
Our proposed application	✓	✓	✓	✓

Table 2 – Research Gap

1.3 Research Problem

Proficiency of English is the most elementary factor to get into the private sector, and it's critical to advance within the public segment. Foreigners who move to English based nations like United Kingdom, USA, Canada and Australia can regularly struggle to accumulate occupations if their English language skills do not meet their professional qualifications. This regularly compels them to become independently employed or search for average positions. English language also helps to start interpersonal relationships with

different nationalities since it is the world's 'most widely used language', filling in as a typical language among individuals who communicate in various dialects. Moreover students who seek higher education or professional courses must have capabilities within English. Further, those who decide to search for foreign colleges are needed to fulfil their English language examination, most typically the IELTS (The International English Testing System) or TOEFL (Test of English as a far off Language). Therefore it is clear that English language is an important and essential factor to achieve advancement in society. But the problem is that although a sector of students who live closer to developed areas get enough chances to learn English, most of the students who are in rural areas do not get many opportunities.

English language skills is an empowering influence for professional success and social relationships. Comparatively a very large portion of the undergraduates understand the importance of English language skills when they run behind jobs. It is frequently past the purpose of no return at that time. Enhancing English language skills is a huge commitment and a long lasting learning practice. The students must perceive the importance of English, build up a program to gain all the skills, and adequately utilize all the accessible assets. But the main problem is that most of the organizations tend to develop English skills after focusing on professional skills.

With the rapid enchantment of technology, the use of mobile phones has increased a lot. Therefore the modern society tend to use mobile phones to make their lives easier rather than sticking into traditional methods. The most important fact is that this is followed not only by adults but also by teenagers and children. The best example is that most of the parents use online learning platforms such as Youtube to teach students using videos. Therefore generally students who are in grade 06 are not interested to study using books but by using online methods specifically related mobile technologies. When compared to the global academia most of the developed countries use this method which has brought them positive results when used within the limits. But in Sri Lanka the assets available for

the students, specifically those who are starting there secondary education is very much limited.

As discussed above in the Introduction section, English language has 3 main aspects as reading, speaking and writing. Most of available English based eLearning platforms in the world focus only on one single aspect of English which results producing students who are only comprehensive in one of the above mentioned areas. Moreover as a whole, the learning platforms available for reading and speaking are higher than writing. For an example there are platforms such as Reddit and Medium for reading and also platforms such as Duolingo and Hello English for speaking. Therefore developing a hybrid eLearning platform including English reading, writing and speaking aspects is one of the prime needs of the national academia.

The student evaluation and answer validation process is important as much as the question making process in a well structured learning management system. Although there solutions developed to fulfill the requirement of teaching for the convenience of students, a solution to fulfil the requirements for the convenience of teaching is not still developed. Therefore as a whole a mobile friendly hybrid solution which covers all the learning aspects of English along with an instructor dashboard is needed for the local academia.

1.3 Research Objectives

English language plays an important role in our lives because it makes communication between different countries the only common language across the globe. English books are the common available medium of literature and information that is accessible to everyone.

English in Sri Lanka is fluently spoken by approximately 23.8% of the population, and widely used for official and commercial purposes. It is the native language of approximately 74,000 people, mainly in urban areas. Nowadays English is one of the main

subjects of school syllabus in Sri Lanka. There are three categories of grammar, spoken and listening lessons in the school English pupils' book. So most of the time teaching methods are different from urban province schools than the rural province schools. According to that reason those students' knowledge was different.

With the rapid enchantment of technology, the use of mobile phones has increased a lot. Therefore the modern society tend to use mobile phones to make their lives easier rather than sticking in to traditional methods. The most important fact is that this is followed not only by adults but also by teenagers and children. The best example is that most of the parents use online learning platforms such as Youtube to teach students using videos. Therefore generally students who are in grade 06 are not interested to study using books but by using online methods specifically related mobile technologies. When compared to the global academia most of the developed countries use this method which has brought them positive results when used within the limits. But in Sri Lanka the assets available for the students, specifically those who are starting there secondary education is very much limited.

1.3.1 Main Objective

The main objective of this research is to develop a hybrid solution to improve and evaluate the Spoken English, Written English, English Listening and English Reading abilities of the grade 06 students. To bring out this main objective in a more creative and an effective manner, the complete solution is divided into four major components. The first component focuses on improving and evaluating the Written English knowledge of students while the second component focuses on improving and evaluating the Spoken English knowledge of the students. The third component is for the convenience of the mentor where the mentor can view the results in an organized dashboard and also it is possible for the mentor to predict the marks for each exercise depending on external factors. The fourth component is a hybrid game which includes a brain development and an interactive

vocabulary development game. As a whole the product was developed by taking the above mentioned four research areas as the main objectives. In addition to the main objective several specific objectives were designed to increase the productivity and efficiency of the product while maintaining the commercial quality.

1.4.2 Specific Objectives

The main focus of this document is on Written English module which covers one specific and special aspect of English language. The other components are built assuming that the Written English module works correctly. Therefore to ensure that the made assumption is correct and to increase the quality of this component several specific objectives were designed based on the Written English module.

- Collection of lessons relevant to the grade 06 English syllabus.
- Categorization of lessons based on the identified aspects of Written English language.
- Selection of relevant types of questions and Construction of exercises based on the identified criterias.
- Maintaining the functional independence of the component to make sure that the final product can be switched accordingly.
- Implementation of a user-friendly environment to allow the users to operate the system with minimum knowledge to gain maximum Performance.
- Ensure that the designed solution will not make any difference to the cost estimation of the final product.
- Development of the Written English component to function based on minimum resources consumption but maximum efficiency.
- Ensure that the solution is easily accessible and portable while maintaining the security.
- Adoption of a commercially valuable development structure and a sustainable outcome.

Audience

The factors that are explained in the previous sections prove that one of the major reasons for not using eLearning in the educational system of Sri Lanka is the lack of focus on developing a solution that is fixed to a specific user group. As an example Duolingo application which is a vocabulary development solution is useful only to those who are keen on speaking irrespective to the objective they use it. Therefore this research is developed with the objective of expanding the audience to motivate the users to use these types of solutions. As a result the solution mainly focuses the development and evaluation of English language of grade 06 students.

2. METHODOLOGY

2.1 Methodology

The solution proposed under the research topic is broken down into 4 major components in order to fulfill all the objectives required to cover the prevailing research problems.

1. Written English Module
2. Spoken English Module
3. Prediction and Visualization mentor Dashboard
4. Brain Development and Vocabulary Improvement Game

Nowadays knowing English language increases your chances of getting a good job in a multinational company within your home country or for finding work abroad. It is also the language of international communication, the media, and the internet, so learning English is important for socializing and entertainment as well as work. So for that reason, English learning can be considered so important.

Language is one of the mediums of expressing our ideas, feelings, and emotions. And if we think about language in the present world then English is one of the most used languages in the world and also English is used as a second language in Sri Lanka. English is introduced here at the primary level and it's inclusion continues till the tertiary level of education. Most of the students in rural areas are weak in English language due to a lack of skilled and trained teachers who are familiar with the modern methods and approaches of teaching and lack of materials for teaching in the classroom. Further primary level English curriculum implementation is essential to achieve the English language competency in rural areas since students in rural areas are performing poorly in English compared to the urban counterparts.

Based on the above collected facts it is clear that the solution should cover every aspect of English to fulfill the requirements needed to the society. Therefore the main focus of

this research is to develop a hybrid solution to improve and evaluate the Spoken English, Written English, English Listening and English Reading abilities of the grade 06 students. To bring out this in a more creative and an effective manner, the complete solution is divided into four major components as shown above. The first component focuses on improving and evaluating the Written English knowledge of students while the second component focuses on improving and evaluating the Spoken English knowledge of the students. The third component is for the convenience of the mentor where the mentor can view the results in an organized dashboard and also it is possible for the mentor to predict the marks for each exercise depending on external factors. The fourth component is a hybrid game which includes a brain development and an interactive vocabulary development game.

The above introduction on the complete mechanism of the solution explains how the 04 major components collaboratively function together. The main focus of this document is on the Written English component which is the initial sector of the Smart Student Application. All the other components are developed parallel to this component while covering all the discussed objectives. The diagram below shows the overall workflow of the Smart Student system.

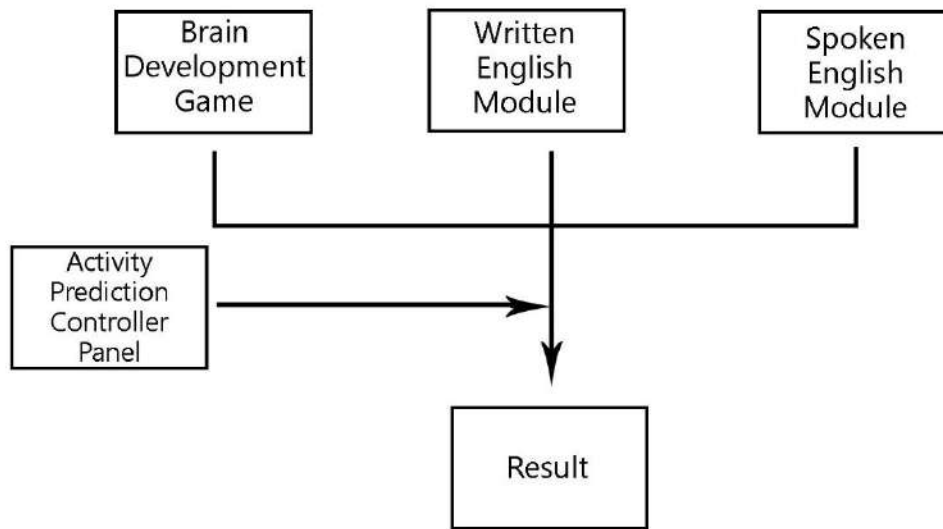


Figure 4 - Workflow Diagram

The Written English module is implemented based on several advanced logics. Initially, the product component has various types of exercises built within it covering most of the learning techniques including questions to underline, questions to mark true or false, and questions to fill in the blanks. Further, it is important to note that in some instances the questions are organized into lessons where a lesson contains questions of all the types.

The Written English module follows a unique method to load the questions into the front end which is known as fetched HTTP calls. The Hypertext Transfer Protocol (HTTP) is designed to enable communications between clients and servers. HTTP works as a request-response protocol between a client and a server. Here the questions are stored on a remote database and fetched through HTTP calls [10]. The Fetch API is a modern replacement for XHR; it was introduced in browsers recently to make asynchronous HTTP requests easier to do in JavaScript, both for developers and other APIs that build on top of Fetch[11].

The Written module also allows the users to see their progress, rank, scores, and other statistics for written quizzes which will provide the user as well as the mentor a productive environment to work with. The user-friendly interfaces further make the system more usable to children making the product more interesting. The answer validation process of the Written English module is implemented using Firebase ML vision and a custom drawing canvas. Firebase ML Kit is a mobile SDK that makes it easier for mobile developers to include machine learning capabilities in their applications. ML Kit is a wrapper over the complexities of including and using machine learning capabilities in your mobile app [7][8]. The complete mechanism of the Written English module can be divided into 6 main phases.

- The user draws on custom canvas
- If the user does not draw for 1s recognize it as break
- Get the bitmap from canvas
- Provide bitmap as input to the detector
- Display text
- Compare the recognized text with the correct answer of the question

The diagram below illustrates the system overview of the Written Module.

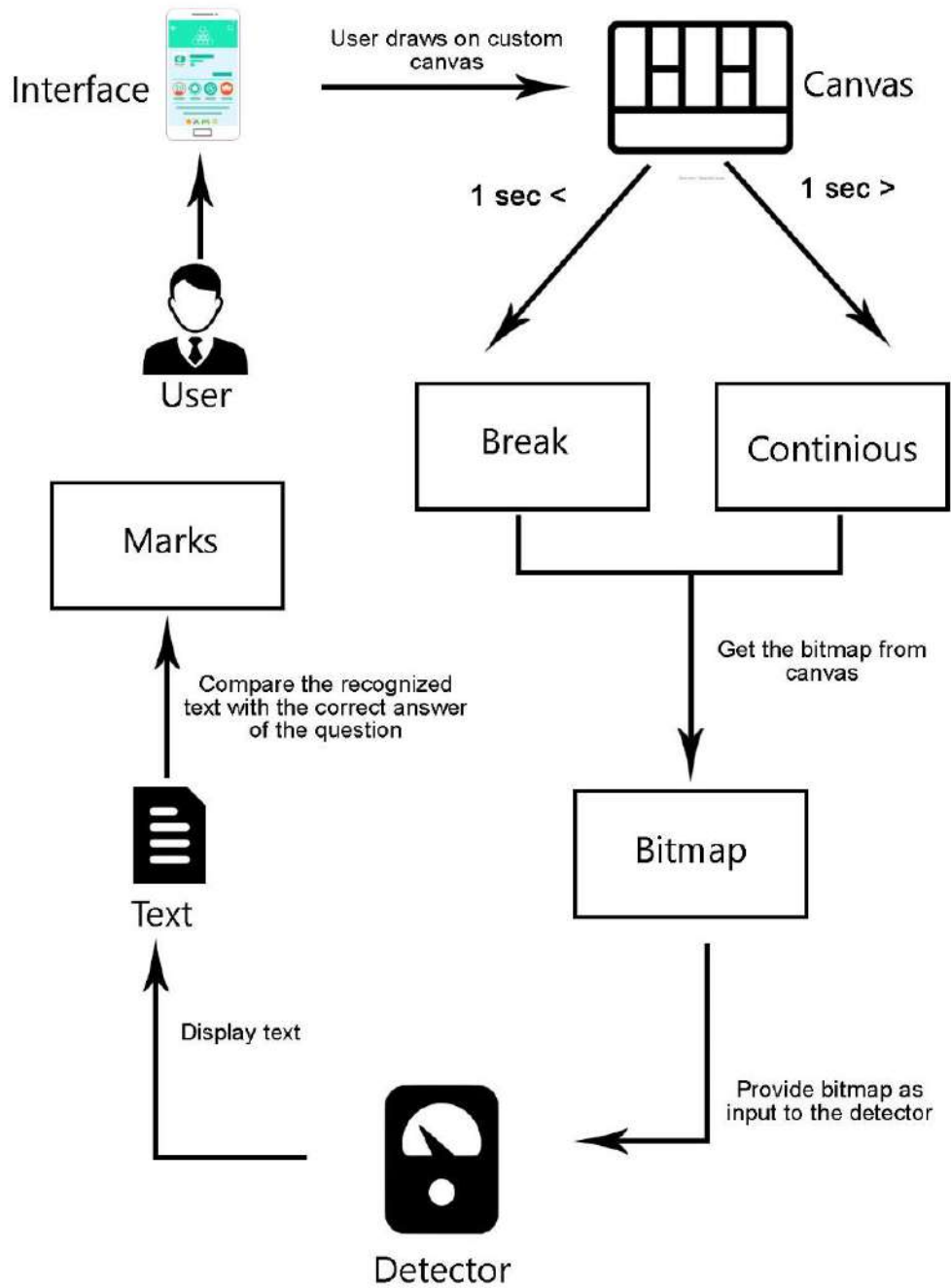


Figure 5 - Written English Architecture

2.2 Commercialization Aspect of the Product

Commercialization Factor	Previous Solution	English School Mate
Academic relavance	Acceptable	High
Audience	Not Specific	Specific
Lower resource Consumption	No	Yes
Portable	No	Yes
Cast effective	No	Yes
Evaluatable	No	Yes
Vishualizable	No	Yes
Covers every Subject areas	No	Yes
Low operational knowlage	No	Yes

Table 3 – Commercialization

2.3 Testing and Implementation

The main implementation of the Smart Student system has 2 major aspects as the Authentication segment and the Backend and Database. The Authentication segment is implemented using Firebase Authentication as a service. This is composed of a Sign-in screen and a Sign-Up functionality. Further, a Navigation Drawer update option and a user profile picture functionality are added to make the Authentication process complete. The backend and the database are implemented as a REST API using Java Spring-Boot and MongoDB as the database. Moreover, CRUD endpoints for written and spoken questions are also implemented. All the analyses of the question results will be performed here.

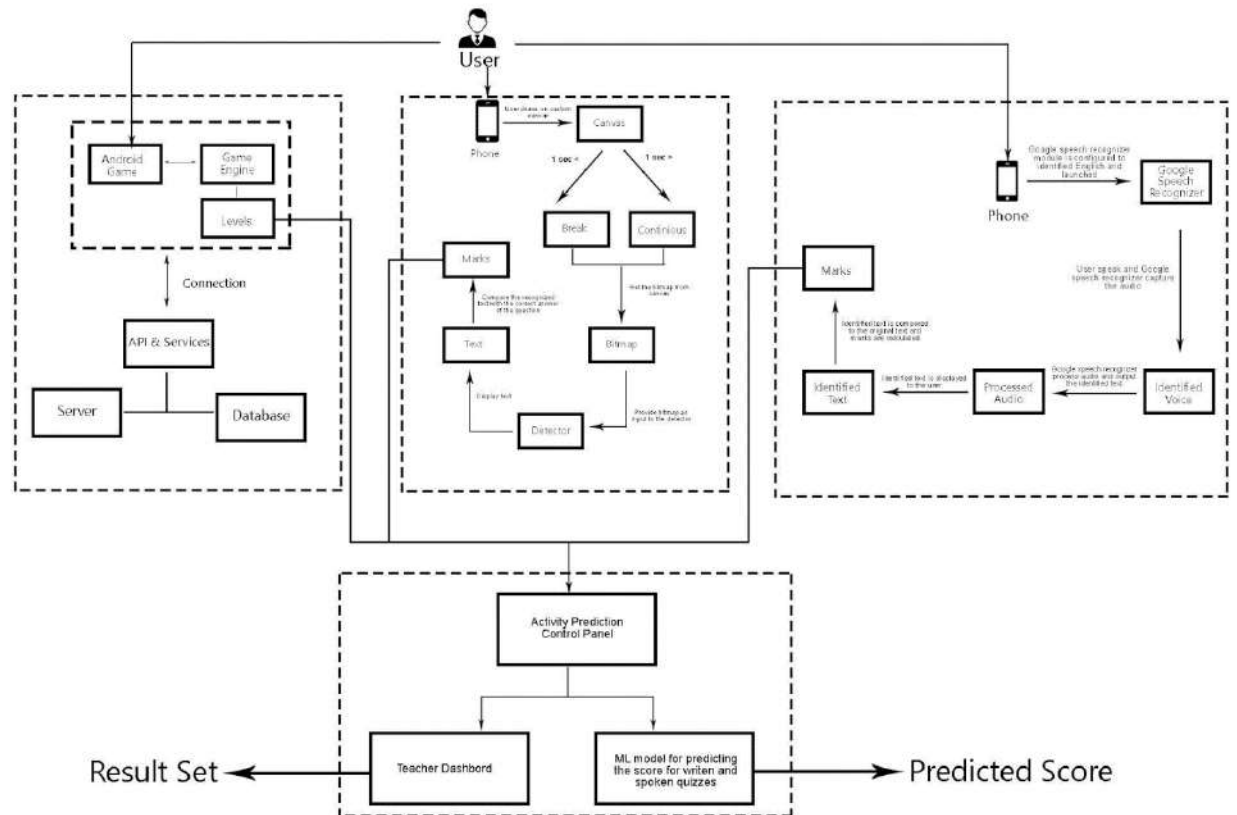


Figure 6 - High Level Architecture

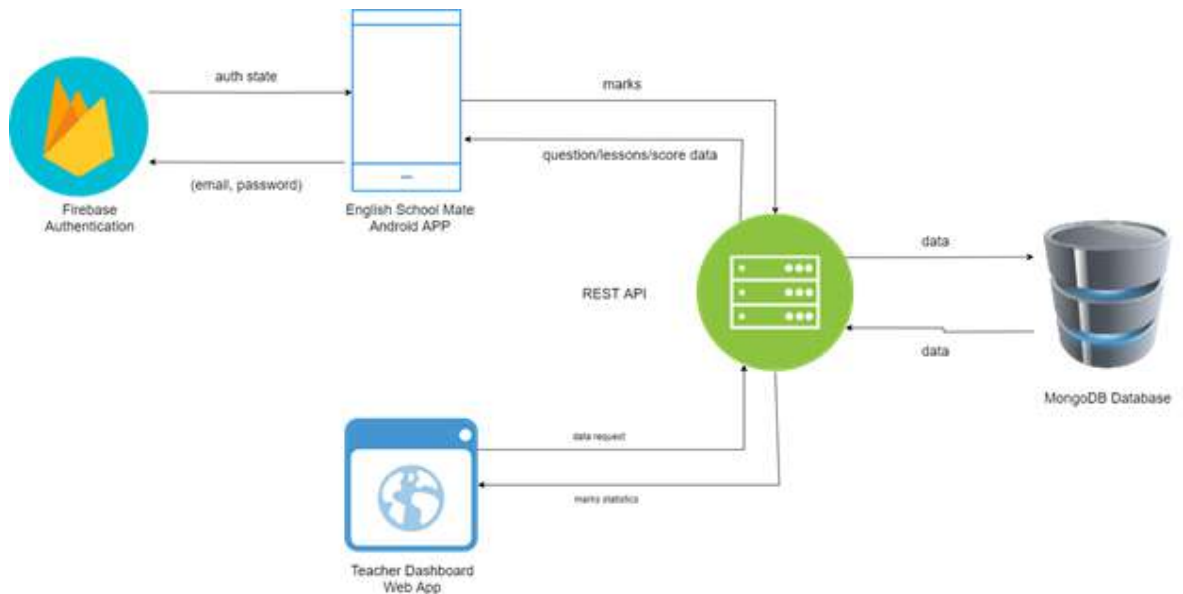


Figure 7 - tier System Architecture

Activity: Handles UI and rendering logic

View Model: Handles business logic and change states of live data based on results from operations

- Live data: notifies observers (activities/fragments) when state changes

Repository: Connect backend and android application

- Fetch and submit data from and to backend

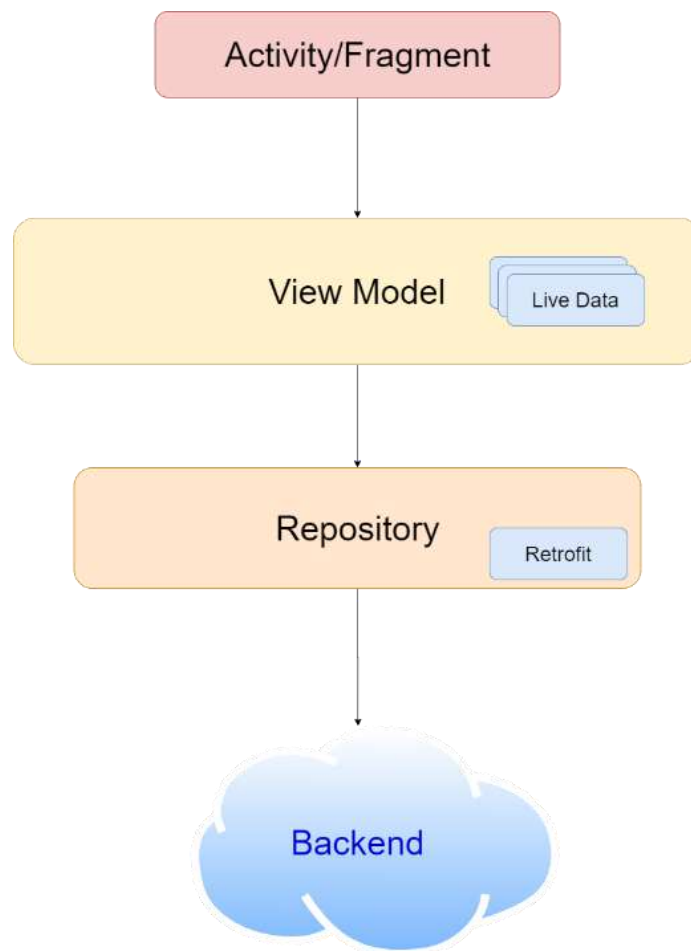


Figure 8 - Android Application Architecture

Based on the above developed test data the testing process of the Written English module was carried out based on 2 major aspects as,

1. Comparison of Mechanisms and Accuracy Calculation `
2. Evaluating the user experience of the interfaces

Comparison of Mechanisms and Accuracy Calculation

Written English module was implemented using all 3 major classification models namely K-nearest neighbor algorithm, Naïve Bayesian algorithm and Support Vector Machine algorithm (SVM). In order to select the best algorithm for our purpose while fulfilling all the objectives designed, it was required to calculate the 'Precision', 'Recall rate' and 'F-Measure' of all 3 algorithms. In general, the precision and recall rate are contradictory, so the results can be evaluated by the F-measure, which is the weighted average of precision and recall rate of the model. Since our research problem is completely based on accuracy, it was required to consider cost and resource consumption while selecting the algorithm.

The accuracy calculation testing process was carried out by inserting all the 20 documents to all 3 developed classification models. The 'Precision', 'Recall rate' and 'F-Measure' of each algorithm was then calculated based on the classification results obtained by each of the algorithms. The obtained results were then analyzed in parallel with the objectives of the research in order to select the most suitable algorithm. It was clear that different algorithms have different and specific characteristics based on our purpose. The obtained results and how they were analyzed to create the conditions which were used to select the classification algorithm is discussed more comprehensively under the Results and Discussion section below.

Evaluating the User Experience of the Interfaces

It was required to test the functionality and user experience of the user Interfaces related to the Writing English Module component prior to everything. The main reason behind

this was that the solution was developed to operate with minimum operational knowledge. After analyzing the fact of how to test the user experience of the web interfaces, 2 important testing perspectives were identified. They are as follows.

1. Internal Testing - Testing the functionality of interfaces by assigning a group member as a user who has a basic understanding about the solution.
2. 3rd party testing - Testing the functionality of the user Interfaces by assigning an external person as a user who is not aware about the technical background of the product.

3. RESULT AND DISCUSSION

3.1 Results

As discussed in the testing section the testing process of the Written English module was carried out based on 2 major aspects as,

1. Accuracy calculation and Selection of the mechanism
2. Evaluating the user experience of the interfaces

Based on the above 2 aspects the result analysis of text classification is divided into 4 main parts for decision making.

Evaluating the test results of user Interfaces related to Written English Module

Testing process for user experience of the Interfaces related to the Written English module was carried out by 2 testing parties as internal testing and 3rd party testing. Each testing party was given 2 testing approaches as free flowing attempt and time specified attempt. The testing mechanism of each testing party and each approach was discussed in detail under the testing section above. The results obtained after the testing phase is illustrated in the Table given below.

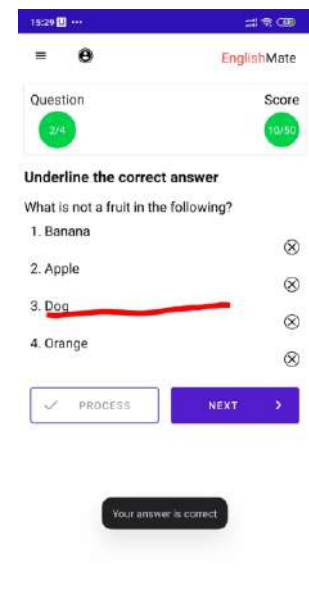
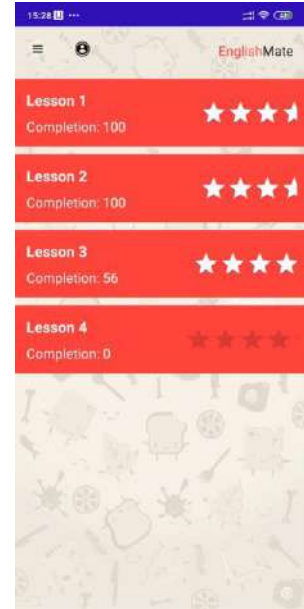
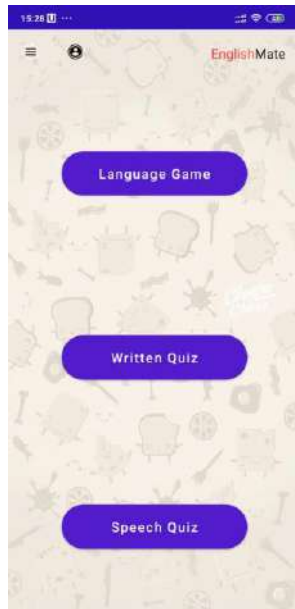


Figure 9 – App interfaces

Comparison of Mechanisms and Accuracy Calculation

Test Case#	Expected Result	Actual Results	Accuracy
1	Apple	Apppe	80%
2	elephnat	Elephant	100%
3	Car	Car	100%
4	Bat	Bad	66.60%
5	Cut	Cur	66.60%
6	Mat	Mat	100%
7	van	van	100%
8	ball	ball	100%
9	vass	vass	100%
10	pick	pick	100%
11	ant	ant	100%
12	monkey	monkey	100%
13	iron	iren	75%
14	is	is	100%
15	am	ar	50%
16	are	ara	66.66%
17	you	you	100%
18	has	has	100%
19	have	have	100%
20	but	but	100%

Table 4 – Accuracy Calculation

3.3 DISCUSSION

Writing session implemented using Firebase ML vision and a custom drawing canvas and questions stored on a remote database and fetched through HTTP calls. whole module lessons broke into three question types. Those are the true-false questions, underline, and fill in the blank questions. So users can see their progress, rank, scores, and other statistics for written quizzes. The handwriting recognition and answer validation flow are users

draw on the custom canvas, If the user does not draw for 1s recognize it as break, then get the bitmap from canvas, provide bitmap as input to the detector, display text and finally compare the recognized text with the correct answer of the question. So in this case the section covered written English exercises and correction models. Here it has a user-friendly interface and cost-effectiveness. Those are the several objectives achieved.

4. CONCLUSION

The overall objective of this research is to develop an integrated hybrid solution to English language learning application for the students of Sri Lanka to overcome their difficulties of learning the English language in their secondary school education. This also provides a solution for the mentor to analyze individual performances of students individually along with a prediction function to check how many marks a student can obtain before doing the quiz. With this, the mentor can get an idea about the status of the student.

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APPENDICES

