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Evaluation of Speech Processing Capability in Computer Games to Improve the Process of Learning English Pronunciation: An Action Research

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Original Article

Abstract

Introduction: Computer games are a proper approach for information transfer and education. Childhood is the best time to learn a second language and computer games are an attractive interactive tool for this purpose. The purpose of this study is to investigate the ability of speech processing in computer games to improve the process of English language learning and design a game in this regard.

Materials and Methods: This was a library-based study to retrieve English and Persian studies in this field and, on the basis of previous studies, a game was designed for children on android platform in the Unity environment using C # language. The child was able to choose a group of words based on color, object, and so on. The game was able to analyze the child' pronunciation and provide feedback to correct it.

Results: 50 popular smartphone-specific commercial language learning applications were comprehensively analyzed and three main characteristics were identified for them: the programs were designed to teach words independently, were tailored to the learner's least skill, and rarely provided learners with corrective feedback.

Conclusion: The proposed software seems to be able to be suggested for correcting English pronunciation of individual words in children aged 8 to 10 years in educational centers and language institutes and even at home.

Keywords: Speech processing; Computer games; Education; English language; Pronunciation

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Introduction

Speech is one of the easiest ways for humans to exchange information. For this reason, the creation of speech comprehension capabilities in the machine, also called speech processing, accelerates the information transfer process (1). With the expansion of technology infrastructure and increased use of smartphones, especially among children and adolescents, the use of applications is also increasing. Therefore, in addition to changes in social relations, the way of teaching and learning is also changing (2). Education means the transfer of useful knowledge that provides the ground for change and transformation in the learner (3). Computer games used in education are divided into three groups: simulation games, strategic games, and role play games (4). Educational games are a subset of serious games, most of which are aimed at educating preschoolers and beginners, allowing evaluation of children's responses in the game and their level of attention. The important point of the educational computer games is learning without dependence on specific time (5).

Computer educational games are known as a source of learning as well as a means of entertainment, and in recent years have been able to attract all special groups of children with special interactions and special effects (6-8). Educating children is difficult compared to adults because of differences in concentration; because they can focus on one topic for a short time. Therefore, interactive learning can attract their attention (9). Learning

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English as a second language has long been one of the main pillars of education; as in the present age in international societies, English knowledge is one of the characteristics of literacy, on the basis of which, many methods for teaching and learning foreign languages have been introduced (10). It is important to start learning this second language at an early age. However, early language learning may have negative impacts due to the lack of sufficient power of analysis in children (11). Speech processing refers to the perception of sound by a computer through a microphone, the conversion of speech into data, the analysis of data by statistical models, and the execution of various commands. Speech processing systems are based on learning by user or previous data, which increases performance by increasing the data in the machine learning method (12).

Due to the importance of word pronunciation in English language teaching, in the present study, a computer game was designed with the ability to receive and process user speech to help learn the pronunciation of English words. The other programs reviewed were often based on voice training and did not evaluate the user's pronunciation.

Materials and Methods

This study was conducted by the library review of English and Persian references and articles from Scopus and Scientific Information Database (SID) using Google Scholar and ScienceDirect search engines. Finally, the game was designed for children on the Android platform based on the study results in Unity environment (Unity® 2018.4.20 f1 <DX11>, Unity Technologies, 2018, San Francisco, California, USA) (13) and with C# programming language. The child could choose the group of words based on color, object, etc. In one part of the game, the correct pronunciation was executed for the child and in another part of the game, his/her pronunciation was received and assessed.

Results

Targeted diversity in language teaching can help increase the quality of learning. In this regard, language learning games with a communicative approach (14), for instance, using the augmented reality (AR) technology (9,15), mixed reality (16), or techniques to improve the graphic and visual quality of the game (17), can facilitate and strengthen language learning, including the second language in children. In various studies, computer games and virtual reality (VR) technology have been used with the aim of enhancing the child's pronunciation (18), language teaching in immigrant adults (19), or students (20). In the Netherlands, the Automatic Speech Recognition (ASR) language learning system was employed to teach Dutch students a second language, with the preliminary study suggesting that the use of this system could be expanded (21). In a review study, 50 popular smartphone-specific commercial language learning applications were examined and found that these applications tend to teach words individually, are tailored to the learner's minimum skill, and rarely provide corrective feedback to the language learners (20).

The Teacher software is an AR software (22) that, unlike other existing programs, has a speech recognition system based on a Microsoft platform (23).

Software design and implementation process: An important part of learning English is the correct pronunciation of words. For this purpose, a two-dimensional game with user speech processing capability was designed. The gameplay was such that the user had to guess the correct word from the displayed words step-by-step according to the image questioned and then pronounce the word by selecting the button designated for pronunciation. The user had the opportunity of 4 pronunciation errors in each stage, and these opportunities were both in terms of memorizing the word and pronouncing the word correctly. Figure 1 illustrates the educational part of the game where the user saw the shape of the element as well as the related English term and its meaning in Persian in text form and for correct pronunciation, using the Listen button, he could listen to the pronunciation of the word indefinitely.

Figure 1. Part of the game steps (educational part)

Figure 2 shows the competitive part of the game in which viewing the image as well as selecting the correct word from the displayed words, the user selects the Tell Me button to test their pronunciation.

The game was programmed in Unity software, which is one of the well-known game development engines, in C# language. The speech recognition task

was performed using the Speech Recognition in Unity: Light Buzz open text package (24). The designed training was categorized as a group, and the user, after entering the main page, chose the education of which group to go through (for example, colors or fruits) (Figure 3).

Figure 2. Part of the game stages (user pronunciation test)

Phonetic practice of a language is efficient in teaching it (11). On the other hand, the most appropriate period for learning the correct pronunciation of a second language is childhood; In particular, hearing sensitivity in children up to 10 and up to 12 years old is very high (11).

Figure 3. Part of the game steps (selecting the education group)

This game was designed for the age group of 8 to 10 years with the help of audio training and speech scoring. In the first stage, the user had no time limit for submitting a response, and these restrictions were applied in the later stages of the game. After selecting each group, the user locks the next projects and to access the other groups, he must be able to earn points for the current stage. In other words, he must pronounce the words correctly. Figure 4 demonstrates the gameplay process.

Discussion

In addition to being entertaining, games are a good tool for educational purposes due to their interactive and immersive environment (15). Given the importance of pronunciation in learning English, finding a way to solve the pronunciation problem intelligently from the very beginning of learning is of a high value. In the present study, it was assumed that using the user's speech to progress in the game and scoring could be effective in better education. Additionally, the program designed had no space restrictions for use due to implementation on the Android platform. Thus, by designing a computer game in order to teach pronunciation using the user's speech, the promotion of the English pronunciation teaching process was considered in order to develop the learning process along with entertainment.

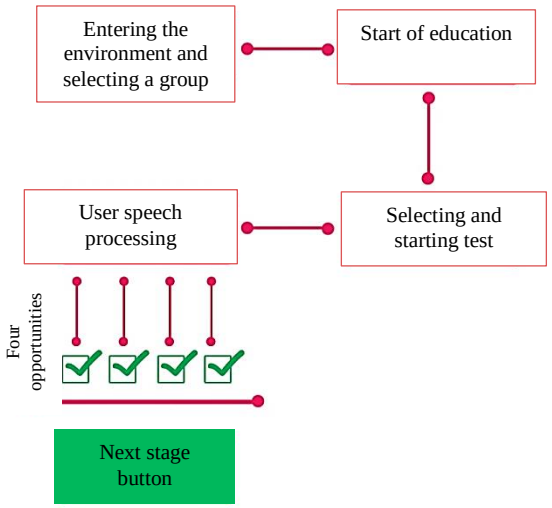

Figure 4. Gameplay process

It seems that using the user's speech to advance the game steps can motivate the user to pronounce the words correctly. Accordingly, using the user's speech processing, which was the distinguishing feature of the present game from other existing games and systems (18,22,25), the pronunciation of words was corrected. The present study focused on children's learning as well as measuring the pronunciation of words individually. The Teacher software is an AR platform-based environment that performs color change for children with both signs and speech recognition and has no process for measuring or improving the user's speech (22). In general, the difference between the software designed in the present study and other existing language teaching software was in its program structure. In the program designed in the present study, due to the attractiveness of entering the next stage and earning points, the user is encouraged to continue the game

and correct their pronunciation; Whereas in previous software, user pronunciation was not measured (26,27). Moreover, due to the ease of working with smartphones compared to personal computers (PCs), the user can use the program in any environment, and it seems that this is the strength of the program designed in this study.

Although the game in the present study was designed to teach a second language to children, but the same system can be applied to teach the correct pronunciation of words in the mother tongue to children, including ones who have lost the ability to pronounce words correctly or suffer from the naming disorder due to birth defects, injuries, accidents, or illnesses. The rehabilitation process of these individuals is often complex and time consuming, and the game designed in the present study can improve the motivation of the person to pursue treatment and achieve the desired result by creating attractiveness, in addition to reducing the frequency of his visits to medical centers.

Limitations

Currently, the designed software does not have the ability to communicate with computers and measure the quality of sentences. Furthermore, due to the differences between the pronunciation of pronunciation in children and adults, this collection is not adapted for adults.

Recommendations

Optimizing the package specifically for children in different age groups using children's audio educational examples can increase the accuracy of recognition and processing for their pronunciation. Software optimization to teach speech correctly with different English accents will also be valuable for adults. It is also recommended to use the machine learning power to develop computer games to measure the pronunciation of user words. Besides, by creating an interactive environment with the computer and communicating in a conversation with the computer, it is also recommended to measure the quality of sentences and corrections for both children and adults in the more advanced stages of language learning. Measuring the effectiveness of the software designed in real learners from different age groups in the target community can be useful in promoting software and helping to enhance the quality of language teaching in educational centers. It is recommended that this software be used in people with speech or communication problems such as stuttering, naming disorder, and stroke and report the results.

Conclusion

It seems that the proposed software can be utilized to improve the pronunciation of English words in children aged 8 to 10 in educational centers and language institutes and even at home.

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Authors' Contribution

Saba Abbasinia: Study design and ideation, providing study equipment and samples, analysis and interpretation of results, manuscript preparation, specialized evaluation of the manuscript in terms of scientific concepts, approval of the final manuscript to be submitted to the journal office, the responsibility of maintaining the integrity of the study process from the beginning to the publication, and responding to the referees' comments; Kazem Pouralvar: supportive, executive, and scientific services of the study, analysis and interpretation of results, manuscript preparation, specialized evaluation of the manuscript in terms of scientific concepts, approval of the final manuscript to be submitted to the journal office, the responsibility of maintaining the integrity of the study process from the beginning to the publication, and responding to the referees' comments.

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contribute to the designing, compiling, and reporting this study.

Conflict of Interest

The authors declare no conflict of interest. Dr. Pouralvar has been working as a faculty member at Tabriz Islamic Art University since 2007. Saba Abbasinia has been an MSc student in computer arts, intelligent simulation at the School of Multimedia, Tabriz Islamic Art University since 2017.

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