

TalkAR : Language Learning in Augmented Reality

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Abstract

In recent times, learning a foreign language proves to be useful in terms of career growth opportunities. In addition to this, with the advancement of mobile technology, learning using a mobile application opens the path to better results and a better learning experience as compared to the traditional classroom environment. In this paper, we present a mobile application which helps language-independent people to learn the basics of German language in an Augmented Reality (AR) environment. Based on the several studies that were conducted, it was found that Germany is one of the budding countries that requires learning the basics of this language. With this in mind, this application was implemented to initiate interactive learning with the help of a virtual tutor in AR.

Keywords: Augmented Reality, Basics of German, Language learning, Learn German, Mobile application, Virtual tutor.

1. Introduction

In recent years, the ability to speak more than one language is considered as a valuable skill in modern society. Many adults are seeking to learn a second language either to communicate with a new client base or to graduate from foreign universities. Meanwhile, it was found that Germany opens a gateway for both, job seekers and for those who would prefer to pursue higher education. Teaching German to people who do not come from a German-speaking background is considered as one of the most difficult task for educators. Students often face problems such as spending an excessive amount of money, time and also there is a need for the physical presence of the tutor just to learn the basics of this language which is not feasible if you are a full-time employee or a student. Most of the mobile application found a have a high launching cost making it infeasible for students.

TalkAR generally wants to create language learning experiences that will stimulate people to learn this language not only out of necessity, but because they genuinely enjoy it thus making the process of learning more enjoyable and interactive.

Researches show [1] that, the use of technology, especially mobile phones, play an important role in personalization and motivating students toward learning. Studies also show [2], that people especially children, enjoy using AR-based methods as it gives them a hands-on learning experience as opposed to traditional learning in a classroom. The purpose of using AR for language learning in TalkAR is that it not only increases the interaction of the user with the application but also shows 3D objects as coexisting in the real world. This creates an environment that encourages users to utilize this application because of its visual aesthetics and good content as well as helps them to memorize the lessons.

Currently, students belonging to the technology background prefer migrating to Germany as it is one of the most sought-after countries by many information technology giants. However, a necessary condition to migrate there is to know at least the basics of German which is the native language of Germany. This system thus aims to (1) Provide quality learning without the constant physical presence of a tutor. (2) Create an interactive learning environment using Augmented 3D models. (3) Provide a one-stop solution to all language learning needs. Using the TalkAR system, the result is a potentially better learning outcome in the convenience of the user's place and time to achieve the desired level of proficiency in German.

2. Related Work

Since the beginning of its development, AR technology has been widely known for its interactive nature and its visually appealing attribute. Because of this, it has been widely looked upon for teaching and learning because it helps in grasping different concepts in a better way. In Zainuddin, Nurkhamimi and Rozhan's work, they describe the process of development of an AR-enhanced flashcard for non-native students of Arabic language of the university of Sains Islam Malaysia (USIM), to help them in increasing their knowledge and memorization skills of basic Arabic Vocabulary [1]. An application namely Aurasma was used. Their study explains the procedures to develop AR-enhanced flashcards. To keep the students engaged, the addition of a variety of tasks and good audio quality was needed.

Teaching a language to young children who have less experience with technology is a very difficult task. The authors Dalim, Dey Piumsomboon, Billinghamurst and Sunar in their work present an Augmented Reality (AR) tool, TeachAR, for teaching basic English words [2]. They compared the effectiveness of using AR to a non-AR application. The Unity game engine with the ARToolkit for Unity plugin was used for the development of TeachAR. The user's speech was captured by using a microphone module of the Kinect sensor which was passed to Microsoft Speech API for recognition. The sensor had to be placed 30 cm apart from the students. This system required an improvement in the AR tracking system to avoid tracking interruption.

In the paper, Design and Implementation of an Augmented Reality Application with an English learning lesson [3], the authors discuss the use of an AR application based on the solar system for teaching English as a second language. By incorporating some different individual characteristics of students like self-efficacy and cognitive style in the research questions, the need for an extra training level that is required for the students can be avoided.

The combination of AR with lessons as stories prove to be particularly useful in keeping young children engaged. The authors Vate-U-Lan and Poonsri performed a research on AR curriculum materials [4]. Young children were taught English language with the help of an AR 3D pop-up book. The AR 3D pop-up book creation involved steps like sound, graphics and cartoon creating. The results indicated that this media can be used as teaching material. The system would have proved to be more efficient by being able to accept a variety of graphic objects.

In the paper, Arbis Pictus: A Study of Vocabulary Learning with Augmented Reality [5], the authors discuss a measurable benefit to learning vocabulary through AR labeling of real-world objects without the use of flashcards using two tools, one was an AR learning tool and the other a traditional flashcard tool. The AR tool made use of Microsoft HoloLens. The authors findings suggest that after the test most of the participants gave the feedback that learning via AR was better than learning through flashcards. The use of novelty effects might have made an impact as HoloLens is a new and interesting technology.

The use of notes and other cards to learn vocabulary has also been used in the past. However, the same idea when developed using technology can help in memorizing words and lessons effectively. The paper, Speaky Notes: Learn Language with augmented reality [6] describes a unique web-based mobile application that helps children in learning a new language by using Augmented Reality. In this system, the search for a word can be accomplished by using a category browser by the word's first letter. Then, teachers can build their card set by dragging items into a box. After this step, Speaky Notes are generated automatically using a personal e-dictionary. The QR code and the Speaky Notes are now available to the teachers in the form of a pdf. Given the advantages of this system, learning in the AR environment should not be limited by any pre-requisites for both teachers as well as students.

The ability to translate a foreign language into a language known by the user coupled with the use of technology like AR in real time can help to solve the language barriers. Arioputra, Dimas and Chang in their work [7], present a mobile application that translates Chinese menus into a 3D model of the menu. This system runs on an android platform. The authors try to find a solution for travelers who would prefer to see the images of the food items at the restaurant. The system captures a video stream and uses modified FAST corner detector. The camera frame from video stream is analyzed with the corner detector and matching points between the detected points in the frame. The system renders the 3D models up to five at a time and uses AR along with tracking of Chinese words using homography. The system is also dependent on how fast the mobile phone performs autofocus. The

application can also be extended to translate not only Chinese menus but also include different other foreign languages.

Along with different other languages, Augmented Reality has also found importance in the learning of traditional regional languages. Syahidi, Aulia, Herman, Ahmad and Kohei in their work [8] present an AR application “BandoAR” which translates Banjar to Indonesian with the help of AR. The BandoAR system makes use of Vuforia which uses Computer Vision technology to track planar images in real time. It makes the detection and tracking of text elements by performing a camera display scan called the Region of Interest (ROI). It uses two different ROI, one for detection and one for tracking when Vuforia tries to match the words found in ROI to the words in a set of databases called word lists. The outcome of this system suggested that the use of AR helped in the preservation of Indonesian as well as Banjar culture. However, there was a need for the analysis of the application’s accuracy.

The authors Medina-Carrión, A., et al. discuss [9], about Augmented Reality and they present an interactive application aimed at supporting both teaching and rescuing the heritage of Cañari and Inca indigenous cultures for children. The interface support layer of this system allows the user to interact with the system, through the web. It has two modules, the comic strip module and the text boxes. The augmented reality module validates the visual patterns captured by the app in order to provide the 3D interactive content. The system could be further expanded to include more information about the objects, thus expanding the database of the system on the archaeological remains.

3. Proposed System

After considering the difficulties faced by non-linguistic people it was found that, language acts as a very important component of communication which allows people to express their feelings, ideas, opinions and meanings. Due to these reasons, it plays a vital role in the lives of people especially students who wish to pursue their career in a foreign country.

Since the data found on the internet cannot be considered as well grounded and infallible, the study of several language learning applications was done and the curbs involved were found. To make the proposed system useful as well as beneficial in real time with the help of AR, a survey was conducted to analyze the language learning needs along with the identification of the language that has a more promising scope in terms of career advancement especially for students.

The study works toward designing and implementing an Augmented Reality application which is deeply integrated with interactive German lessons and a virtual tutor to guide users throughout the learning process.

3.1. Comparative study of applications

Currently, language learning applications are revolutionizing the process of language learning and have become very popular in different application stores worldwide. There are several discussions about how effective and accurate these applications can be particularly when it comes to reading, writing and speaking. The following study which concentrates on the comparison between different features offered by other language learning applications and TalkAR was carried out.

Table 1. Comparison of the features of different applications with TalkAR

Feature	Duolingo	LingoDeer	TalkAR
Speech Recognition	Yes	No	Yes
Augmented Reality	No	No	Yes
3D models	No	Yes	Yes
Quiz	No	No	Yes
Images	Yes	Yes	Yes
Chatbot	No	Yes	No
Gif	No	No	Yes
Firebase	Yes	No	Yes
Animation	No	No	Yes
Progress Bar	Yes	Yes	Yes

It was found that TalkAR involves more interaction with the user as compared to other applications because of its novel usage of three-dimensional models and AR. As a gratuity, the speech recognition helps in attempting to improve the pronunciation of words making it more beneficial for the users.

3.2. Survey for language selection

People especially students nowadays, prefer migrating to foreign countries to pursue their education. However, a typical question that arises is about the choice of country and so the language learning requirements they may have.

To ensure that TalkAR caters to the needs of the language in demand among the users, a survey form was circulated to people belonging to different age groups. Most of these that participated in this survey were students studying in engineering colleges and had a positive attitude towards studying a new language to pursue further studies abroad. Different parameters were included in the conducted survey, like their interest in learning a new language, preferred language among Arabic, French, German, Spanish and Italian and whether or not AR should be incorporated within the application.

Figures shown below present pie charts showing results of the 264 responses received from the survey which was conducted.

Table 2. Results from survey

Parameters	User response(in Percentage)
Interest audience in language learning	84.5
People in favor of learning German	69.3
People interested in AR incorporation	78

Out of 264 responses received, it was found that more than 80 percent of the people are interested in learning new language because of different reasons and 12-13 percent were not sure about it.

More than half of the responses received supported the learning of German language and approximately 14 percent for French. One of the reasons students prefer to migrate to Germany for higher studies is that it costs about \$20,000 a year to get a decent education in the US, but it's nearly free in Germany.

The results from this survey suggested that majority of the masses were interested in learning German with the help of AR. Though Augmented Reality has been in trend since a long time now, this technology still remains new to people from a non-technology background. It thus creates a positive impact among people in peaking their interest for trying out this technology to learn a new language. This explains the interest of 78 percentage of the audience in learning more about AR.

On further research it became clearer that even the general statistics suggested that Germany had increasing opportunities for students who wished to pursue their studies over there as well as good exposure in terms of work experience. Keeping this in mind, it was decided to focus on learning German with the help of TalkAR system.

3.3. Architectural design

Learning any language requires a good command on speaking, writing, listening as well as reading skills of that particular language. Most of the language tests that evaluate an individual's proficiency in a given language requires the test attempter to be well prepared in all the above mentioned skills in order to clear the test.

So, keeping this in mind, the TalkAR system is designed in such a way that German enthusiasts who have no knowledge in German can achieve their desired level of proficiency.

The lessons in this application include learning alphabets, numbers, shapes, colors, things and greetings. Users have to begin with the lesson on alphabets at first. This is to ensure that they are well versed with the basics of the language before moving forward to the next lesson. As the lessons proceed, the users are also taught how to frame simple sentences in German.

The basic aim or goal of these lessons are to ensure that the users are able to memorize and learn German in a step by step manner which will help them to remember the language for a longer period of time, thus helping them build confidence and greater command over this language. The lessons not only ensure that users can write and understand German but also enables them to speak this language with a good control over the pronunciation of words.

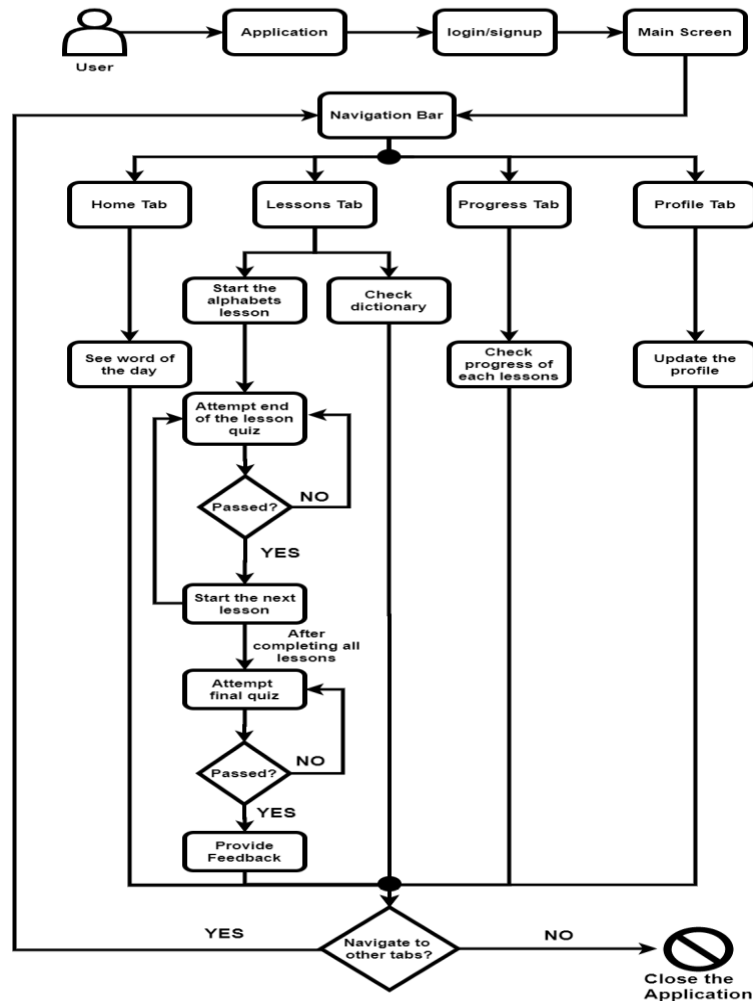


Figure 1. Flow of the application

The basic flow of this application is shown in Fig 4. Users on starting the application are first required to login. If they are a new user, they need to sign up to the application by providing the required details. Signing up is an essential step to use the application because it helps the application to keep a track of user’s progress. The user is then directed to the application’s home screen where the users are given a brief introduction about the application by a virtual tutor who guides the user throughout their journey of learning. Each day when the user opens the application, a new word pops up on the screen because of its ‘word of the day’ feature which helps in learning different words every day thus ensuring active learning and growth.

From the application screen, users can navigate to the Lessons, Progress and the Profile section. In the lessons section, before the beginning of every lesson, the virtual tutor guides the user on how to complete the lessons which are included in the application. For every lesson, users will be shown a 3D model which is displayed when a plane is detected by the camera. The word which corresponds to the model in German is shown on the screen to learn the lesson. On the AR screen, there are three

buttons. One is used to move to the next part, another to replay the audio of the word and the last one to record the user's speech. After completion of the first lesson which is on alphabets, users will have to answer to a short quiz to assess how much they have learnt. Likewise, a short quiz will be conducted at the end of every lesson namely numbers, shapes, colors, things, greetings and sentences. If the test results are positive, they can proceed to the next lesson.

In the sentences part, the application first displays the sentence in English along with model and then displays the German equivalent of the sentence with an audio that speaks out the pronunciation of the sentence. This helps the user to not only learn to write the sentence but also gives them an idea of its pronunciation, with the 3D model giving them a way to visually memorize the lesson.

After the completion of all the lessons, a final quiz is taken to assess if the user has learnt all the lessons properly. The benefit of this quiz is that it helps the user to understand the contents taught better as well as helps them know if they have mastered in speaking the language correctly. A dictionary is also included at the end where the users are given access to thousands of words that can be translated in German.

Furthermore, users can move to the progress section to check their progress and can access an inventory of the lessons, and in the profile section, they can update their details as well as see how much time they need to dedicate (in minutes) in order to complete all the remaining lessons.

4. Implementation and Results

Considering the results of the survey, TalkAR is created as an innovative augmented reality application using ARCore on Android Studio. In comparison with other application, users prefer personalization and interaction which is satisfied with the incorporation of a virtual tutor. The virtual tutor entices and guides the user making the process of learning an interesting and interactive one. Conversations of the tutor are played as audio and are displayed on the screen in text format to help the user to have clear understanding about the words.

The application makes use of the sceneform plugin in android studio. Sceneform is a three-dimensional framework which simplifies the process of building an augmented reality application. The plugin uses a physically based renderer that is optimized for mobile devices.

When the user signs up to the application, user's details are stored in a database where the lesson values are initialized with a zero value. Lesson values gives information about how many questions are completed in each lesson basically acting as the checkpoint. This is useful because next time when the user uses the application, they can resume learning from the point they last stopped and also helps in keeping a track of the user's progress. When the user is successfully authenticated, all the details of the user are stored in the shared preferences of the database. Shared preferences allow storing of data locally on the user's device. This makes it easier for the application to use the data provided by the user to perform any updates. It also helps the application to identify whether the application was opened for the first time on a particular day and if so, the word of the day is displayed on the screen. When the user updates any information on their profile, the information is also updated both in the database as well as in the shared preferences.



Figure 2. User details updated on profile

The lessons section consists of multiple lessons, quiz and a dictionary. Each lesson has multiple items to learn and each item has a corresponding 3D model associated to it. String Resources in android is used to store all the information. The 3D models are created using the Blender software which is open source that provides a path-tracing render engine and it is then converted to an object file. The object file of these models is then incorporated into android studio because of which the user can scale these models in the AR scene, thus providing them with the augmented reality. For augmenting the 3D models, we use some methods like create Model to provide the name of the model.

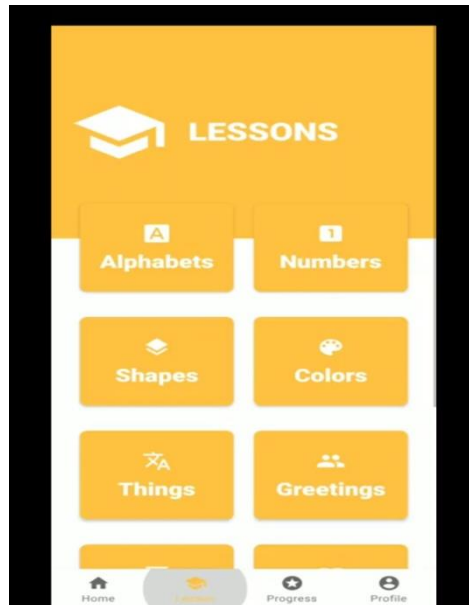


Figure 3. Selection of lesson



Figure 4. Lesson on Alphabets

For each lesson, the user is required to speak the alphabet, word or sentence displayed using the recorder button. The user's speech is recorded and converted to text with the help of speech-to-text library in android. The text is then matched with the correct output that is already stored. If the user answers correctly, it proceeds to the next part and if not, it asks the user to try again. As the user gives

correct answer, the lesson value is updated in the shared preference to accurately store the user's progress.

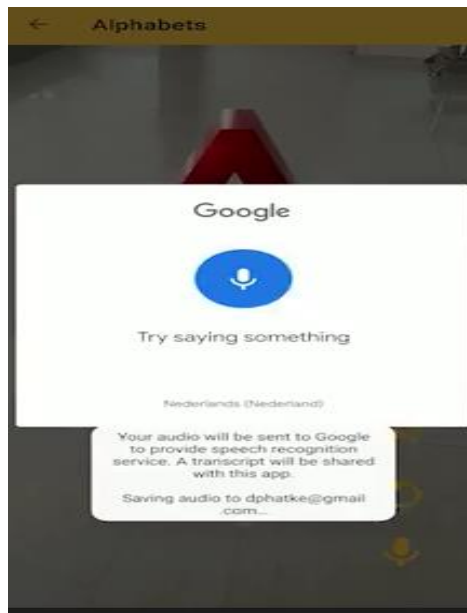


Figure 5. Speech of the user being recorded

The quiz section allows the user to check his understanding and learning obtained in each level. It consists of different models already taught during the learning phase. A quiz is taken after the completion of each lesson and it proceeds to the next lesson only when the user passes this quiz. After completion of all the lessons in the lesson section, there is a final quiz which consists of questions from all the lessons learnt. User's speech in these quiz is checked with the help of the same condition used in the lessons and points are awarded for correct answers. After the final quiz is completed, a brief feedback survey is taken to analyze if the user is satisfied with the application.

Users are also provided with a dictionary at the end of the lessons section. This dictionary is implemented with the help of Google Cloud Translate API which translates words into German.

In the progress section, when individual lessons are clicked, it opens an inventory of lessons that shows a list of items that have been completed and the ones that are yet to be completed have a lock on them. A condition that checks the lesson value is used to identify if the item is completed or not. It also shows how much time the user has spent in learning the completed modules within the inventory.

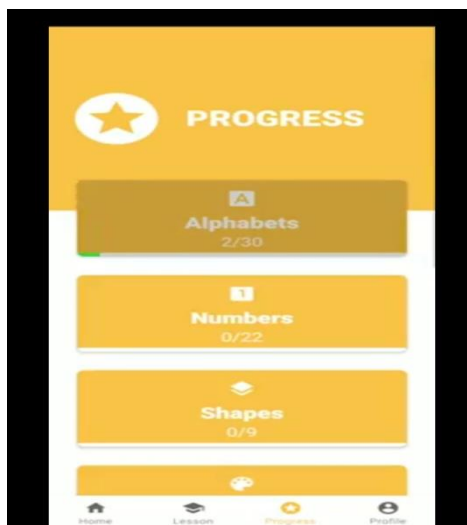


Figure 6. Completed items shown in the progress section



Figure 7. Inventory of alphabets lesson

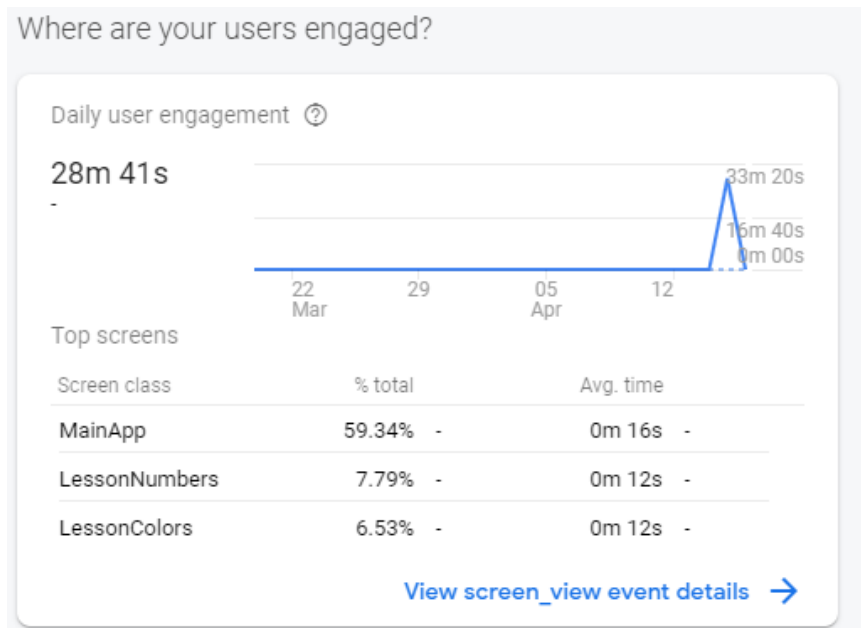


Figure 8. Graph showing average user engagement with the application

The application consists of analytics to track and analyze the various aspects of the application such as adaption of changes by the user, the number of active users, areas that require modification and so on. Figure 12. shows the graphical representation of user’s involvement per lesson which helps in gaining a better understanding of the user’s requirement which is a prerequisite in building a scalable and interactive application. The stability of the application can also be viewed. This helps in understanding if there is an issue in the application thereby helping in addressing the problem as early as possible. It pinpoints the exact location of error thereby helping in troubleshooting problems.

These analytics taken helped in drawing the conclusion that users found learning with 3D models in real time to be very useful, interactive and a unique feature as compared to traditional learning applications. This data also shows that the speech input from the users worked well therefore helping the user with their pronunciation and they were satisfied with the overall performance of this application.

5. Conclusion

Advancement in technology has allowed augmented reality to be a beguiling way to learn a language. TalkAR is one of the best examples of a mobile based application which helps in the learning of German language in an Augmented Reality environment embodying different lessons and features that contribute to interactive and active learning. The models were created and rendered using the blender software and then converted into object file. The use of ARCore proved to be an edge for the application. The results also showed that the virtual tutor was very helpful in understanding and interacting better and also averted the absence of a physical tutor.

Augmented Reality combined with the aspect of interactive language learning showed a positive inclination in usage of this application for a long run among the users. User of all age groups were able to use the application efficiently evading the issues of noise. The user interactivity and the ability to learn with the help of 3D model was considered as the favorable part of this application. The integration and the building of the complete application using android studio enabled users to have a compatible application which is easily available to them on their android devices. The application thus proved to be beneficial in learning German effectively in real time.

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