VR Kerala
An Integrated Tourism Application

Amal Sebastian
Dept. of Computer Science and Engineering
St. Joseph's College of Engineering and Technology,
Palai Kottayam, India

Afthab Nihar
Dept. of Computer Science and Engineering
St. Joseph's College of Engineering and Technology,
Palai Kottayam, India

Remya Raju
Dept. of Computer Science and Engineering
St. Joseph's College of Engineering and Technology,
Palai Kottayam, India

S Nikhit
Dept. of Computer Science and Engineering
St. Joseph's College of Engineering and Technology,
Palai Kottayam, India

Lija Alex
Dept. of Computer Science and Engineering
St. Joseph's College of Engineering and Technology,
Palai Kottayam, India

Praseetha V M
Associate Professor
Dept. of Computer Science and Engineering
St. Joseph's College of Engineering and Technology,
Palai Kottayam, India

Sarju S
Assistant Professor
Dept. of Computer Science and Engineering
St. Joseph's College of Engineering and Technology,
Palai Kottayam, India

Abstract:- VR-Kerala is an interactive tourism application that offers an immersive experience to tourists who visit Kerala with the help of Augmented Reality and Artificial Intelligence. It offers an interactive virtual guide to tourists.

The AR guide will walk through different locations to guide tourists. The avatar facilitates both indoor and outdoor navigation as well. It also gives a 360-degree view of a multitude of places one would wish to travel, at the comfort of their home. The K'Lens feature included within the app identifies forts, monuments, etc that are unknown to them by pointing the camera at it when they reach a particular destination in Kerala. A multilingual chatbot to assist travellers, and a back to home feature to enable a tourist to trace back to home are additional features. The app notifies them about weather, disease, or any other cautionary alerts in their destinations. The app also shows nearby facilities like toilets, accommodations, restaurants, etc. The social impact would be that it promotes tourism, creates a welcoming, safe and helpful environment with a very interactive medium.

Keywords:- *Augmented Reality, AR guide, K'Lens, ChatBot, 360 Images, Multilingual.*

I. INTRODUCTION

We know that tourism is a rapidly growing industry and it has a lot of potential to be explored. Many people desire to visit Kerala every year for its rich nature and culture. Tourism helps in different areas like Increasing awareness about our culture and heritage. Provides jobs, Economic benefits, Infrastructural development, Cross-cultural connections. Promotional benefits: Tourism gives the locality a chance to show itself off and raise its profile in the world. Good travel experience requires an effective and trustworthy travel guide service. Using technology in this sector will make the whole process more efficient. Our Project aims to build an app that runs virtual assistance for travellers.

A. Background

Kerala is the first state in India to declare tourism as an industry. The tourism policy documents of the central and state governments claim that the Kerala tourism model is one of the most liberalized tourism models with the private sector leading tourism development. Tourism constitutes 10 percent of Kerala's GDP, as per official statistics, and reportedly contributes around 23.5 per cent to the total employment in the state. However, the truth is there is no reliable picture of the economic effects of tourism on Kerala.

B. Objective And Scope

The main objective of this proposed project is to create a user-friendly, multilingual mobile app that runs a virtual tour for travellers, which assists the travellers to explore unknown places and the facilities available. The virtual assistant would walk the tourist through the destinations which include travel spots, museums, parks, etc. The user would get details about the destination, its historical significance, and other facts which make the travel more informative. Many people prefer to travel alone and use the technology at hand while travelling, instead of having a human guide accompany them. So this app helps them to achieve that. The app can also be used to identify new places using its K'Lens feature and it also provides a 360- degree view of a place to the users wherever and whenever needed. This helps them to know a place more and make better decisions while choosing their destinations. The app would show them the nearest facilities like toilets, hotels, and restaurants and will provide them with the necessary helpline numbers. There is also a multilingual chatbot to assist tourists. The information about the tourist hotspots in Kerala is also offered by this app. The app also focuses on people of all age groups due to which it also has an audio assistant for the elderly (or visually impaired). The app also notifies them about weather, disease, or any other cautionary alerts in their destinations. The dynamic search bar keeps on updating the app using the searches made by people. This promotes tourism, creates a welcoming and safe environment, and gives a very interactive medium for the tourists, along with addressing a wide audience.

II.　EXISTING SOLUTIONS

These are some applications that currently exist for tourists to use.

A. Kerala Tourism App (OFFICIAL APP)[1]

The app provides information on the nearby attractions from the place of your stay, pictures, and videos of Kerala, a trip planner to help organize trips, and details on the major upcoming events in Kerala. Drawbacks - The performance of the app is poor and it is very slow.

B. Kerala Tourism and Tourist Places[2]

The app contains a good amount of data. The app provides information about the attractions and places in Kerala.

Drawbacks - The app is missing personalized recommendations as well as properly categorized data.

C. Antarctic Heritage Trust AR[3]

AntarcticAR is a mobile outdoor Augmented Reality (AR) application that provides a virtual tour of Antarctica. The AntarcticAR application was developed on the Google Android platform and it runs on tablet devices running Android OS version 3.1 or higher. The goal of the project was to develop an AR system that provides an immersive, interactive, and personal virtual tour experience for the public, so that they can discover new facts, gain new knowledge, and enjoy visiting Antarctica.

Drawbacks - Lack of information about how long the tour was expected to last. The app also required users to walk a long way between Points of Interest (POIs) that were placed far apart. The reflections on the screen were also a problem.

D. ViewAR[4]

All-in-One Augmented Reality System for Indoor Navigation, Remote Assistance, Product Visualization, Industry 4.0 & IoT with Multi-Platform Support. The ViewAR app lets user's access ViewAR apps and their own experiences created using the ViewAR system.

Drawbacks - It only provides indoor navigation. The user needs to feed the area beforehand for navigation. Also, it is not accessible for all.

III.　PROPOSED SYSTEM

The system is divided into eleven modules: (1) Authentication, (2) Dashboard, (3) Discover, (4) Explore, (5) Navigation, (6) Travel Packages, (7) Nearby facilities (8) Data Entry, (9) Analytics.

A. Authentication

Provides the user with sign-in and sign-up facilities to access the app. First time users must register with the required credentials to sign-up and then log in with their unique id and password.

B. Dashboard

The dashboard displays the different app functions and facilities that are provided to the user and also helps them to choose between the available travel destinations. It visually displays the available travel options.

C. Discover

Shows the user the nearest travel destinations and locations to choose from. The user can know what all his/her options are around their location.

D. Explore

Shows different destination options available for the tourists. They can search for different locations and choose the one that fits their needs.

E. Navigation

The navigation function helps the traveller to navigate to their desired location, know the routes of a place, the time it has taken to reach there, total distance, and clear their location queries, etc.

F. Travel Packages

This shows the user the different travel packages available for different rates which involve facilities available, number of days of the trip, accommodation details, the places to visit, and provisions of each trip.

G. Nearby Facilities

Informs the user of nearby accommodations, restaurants, toilets available to them in different tourist locations. Shows the nearby available facilities to the user at the click of a button based on their location.

H. Data Entry

It is accessible only to the admins to add, update or delete data from the database. Contains location and all other details required by the app.

I. Analytics

It is accessible only to the admins. Shows the analytics of the app and database. It Helps in identifying user preferences, frequently visited places, number of travellers, and improves app performance.

IV. TECHNOLOGIES USED

1. Flutter[5] - Flutter is an open source development kit. It is used to develop cross platform applications for Android, iOS. Flutter apps are written in the Dart language and make use of many of the language's more advanced features. The major components of Flutter include: Dart Platform, Flutter engine, Foundation library, Design-specific widgets, Flutter Development Tools

2. Google Cloud Platform[6] - Google Cloud Platform (GCP), offered by Google, is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-user products, such as google search. Alongside a set of management tools, it provides a series of modular cloud services including computing, data storage and analytics and machine learning. Google Cloud Platform provides infrastructure as a service and serverless computing environments.

3. Firebase[7] - Firebase is a platform developed by Google for creating mobile and web applications. Developers were using Envolve (where firebase evolved) to sync application data such as game state in real-time across their users. This includes things like analytics, authentication, databases, configuration, file storage, push messaging, and the list goes on. The services are hosted in the cloud and scale with little to no effort on the part of the developer.

4. Blender[8] - Blender is a free and open source 3D creation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, video editing and 2D animation pipeline.

5. Unity3D[9] - Unity3D is a powerful cross-platform 3D engine and a user-friendly development environment. Easy enough for the beginner and powerful enough for the expert. The Unity application is a complete 3D environment, suitable for laying out levels, creating menus, doing animation, writing scripts, and organizing projects. The user interface is well organized and the panels can be fully customized by dragging and dropping.

6. TensorFlow - TensorFlow is an end-to-end open source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries and community resources[10]. Machine learning models could be built and trained using high-level APIs like Keras which makes for immediate model iteration and easy debugging. **tf.keras is** the Keras API that has been integrated into TensorFlow 2. Using tf.keras allows one to design, fit, evaluate, and use deep learning models to make predictions in a few lines of code [11]. It makes common deep learning tasks, such as classification and regression predictive modelling, easier.

7. TensorFlow Lite - TensorFlow Lite is an open source deep learning framework for on-device inference[12]. The steps involved in generating a Tensorflow Lite model includes picking a model, converting a TensorFlow model into a compressed flat buffer with the TensorFlow Lite Converter, taking the compressed .tflite file and loading it into a mobile or embedded device for deployment.

V. SYSTEM ARCHITECTURE

The system has three parts:
1. End-User Mobile/Web App
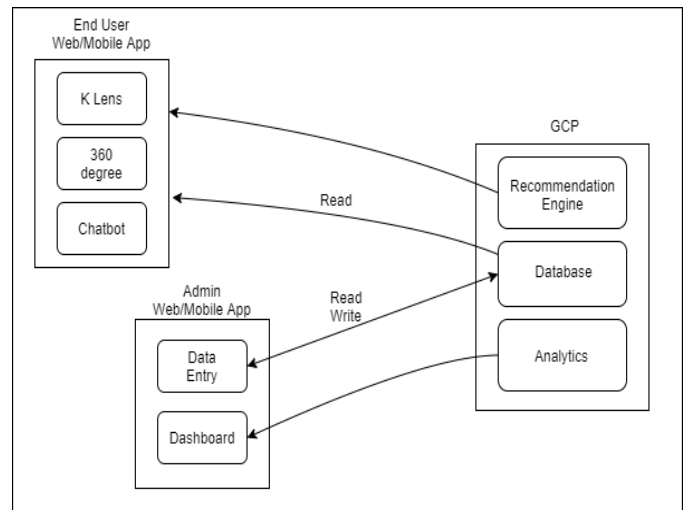2. Admin Mobile/Web App
3. App Backend

Fig-1: System Diagram

1) End-User Mobile/Web App

The end-user mobile/web app will be implemented in Flutter. The end-user Android app will be available on the Google Play Store and the iOS app on iOS App Store. The end-user web app will be deployed on the GCP. The K'Lens feature will be available only on mobile apps which will leverage the device camera and an on-device pre-trained machine learning model. The Multilingual Chatbot will also be available only on mobile and will work on the on-device pre-trained machine learning model. The 360-degree view of places will be available on both the mobile and web apps and when required will fetch the images from the database. The app will show recommendations based on the user's previous likeness which will be provided by the recommendation engine deployed on the GCP backend.

2) Admin Mobile/Web App

The admin mobile/web app is implemented in Flutter. Only a pre-allowed list of people will be able to access the admin portal. The admin web app is deployed on the GCP. The admin will do the data entry work of the app. The data for the app is stored on the database in GCP. The admin will also be able to view the database analytics provided by GCP in the dashboard.

3) App Backend

GCP will be used as the backend for the app. Firebase provided by GCP will serve as a database for the app. It will also contain the recommendation engine which will provide recommendations to the end-users. The GCP provides analytics to the admin app.

VI.   MAIN MODULES

1. AR GUIDE

The AR[13] guide (Augmented Reality guide) was created using the following phases- First, the AR avatar was modelled using Blender software through low poly modelling and its texture and skin colour was added through the different features available in Blender.

Second, the model was given an armature (skeleton) to move its body parts and for animation. Then the model was given certain animations like breathing, waving, traditional Indian greeting and walking. After these cyclic animations, the model was imported as a package in the Unity software. Thirdly, Unity was used for AR+GPS navigation of the model made, through the maps of the destinations. For the map, Google Maps API was used. The main packages used in Unity are AR foundations, AR core (for android compatibility) and AR kit (for iOS compatibility). Now the Avatar can appear on the screen when the destination is reached and can lead you through the destination in an interactive way. It demonstrates the animations and gestures created and the audios added are played in suitable situations. The AR guide walks us exactly through the direction specified on the map. For getting maps/directions Google Maps Directions API is used.

2. K'LENS

K'Lens module, short for 'Kerala Lens', has been developed to enable a tourist to capture the picture of a place he/she visits and get an instantaneous description of the place without the assistance of a travel guide. In addition, the tourist can get a brief description of the place he/she visited years or months ago just by feeding the picture from his/her phone's gallery.

The identification process of a place is facilitated by a neural network. The neural network has been built with the help of transfer learning method. The intuition behind transfer learning for image classification is that if a model is trained on a large and general enough dataset, this model will effectively serve as a generic model of the visual world [14]. The learned feature maps can be used, without having to start from scratch, by training a large model on a large dataset.

Keras Applications are deep learning models that are made available alongside pre-trained weights. These models can be used for prediction, feature extraction, and fine-tuning. Weights are downloaded automatically when instantiating a model. Here we take a pre-trained neural network called MobileNetV2[15] which is a lightweight convolutional neural network architecture. The MobileNet function returns a Keras image classification model, optionally loaded with weights pre-trained on ImageNet[16]. It performs well on mobile devices and supports classification, detection and segmentation.

About ten class labels have been used which includes historically significant monuments and places in Kerala. We used categorical cross entropy[17] for loss function, adam[18] as optimiser and accuracy as metrics. The model has a validation accuracy of about 96.3 per cent. The accuracy and loss plots corresponding to training and validation sets are shown in Fig-2. The trained model has been converted into a TensorFlow Lite model and exported into the application to enable on-device machine learning.
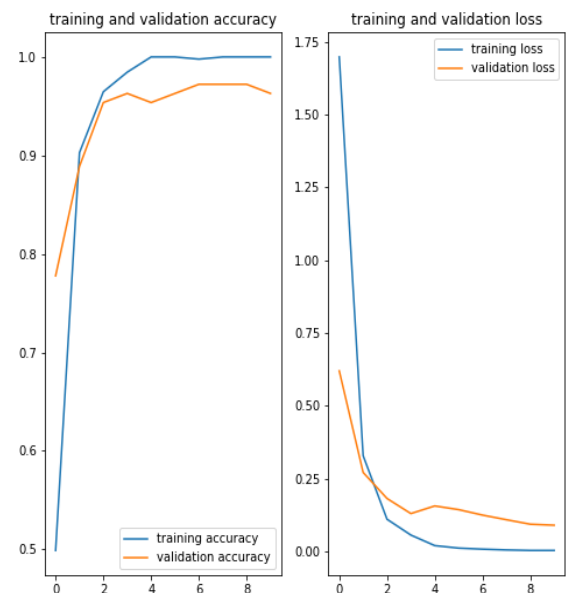

Fig-2: Accuracy and Loss plots (training and validation sets)

3. 360 DEGREE VIEW

360-degree videos, also known as immersive videos are video recordings where a view in every direction is recorded at the same time, shot using an omnidirectional camera or a collection of cameras. During playback on a normal flat display, the viewer has control of the viewing direction like a panorama. It can also be played on a display or projectors arranged in a sphere or some part of a sphere. 360-degree video is typically recorded using either a special rig of multiple cameras, or using a dedicated camera that contains multiple camera lenses embedded into the device, and filming overlapping angles simultaneously. Through a

method known as video stitching, this separate footage is merged into one spherical video piece, and the colour and contrast of each shot are calibrated to be consistent with the others. This process is done either by the camera itself or using specialized software that can analyze common visuals and audio to synchronize and link the different camera feeds together. Generally, the only area that cannot be viewed is the view toward the camera support.

4. CHATBOT

The users of the app can conduct an online chat conversation with the chatbot named Elena. The main objective behind the creation of the chatbot is to share relevant information about the place primarily based on the location of the user. The user can ask the bot for suggestions regarding the location of the nearest attractions, cafes, etc. through text as well as voice.

VII.   RESULTS

1. Authentication

Provides the user with sign-in facilities to access the app. First-time users must register with the required credentials to sign-up and then log in with their unique id and password. The authentication page is shown in "Fig-3".
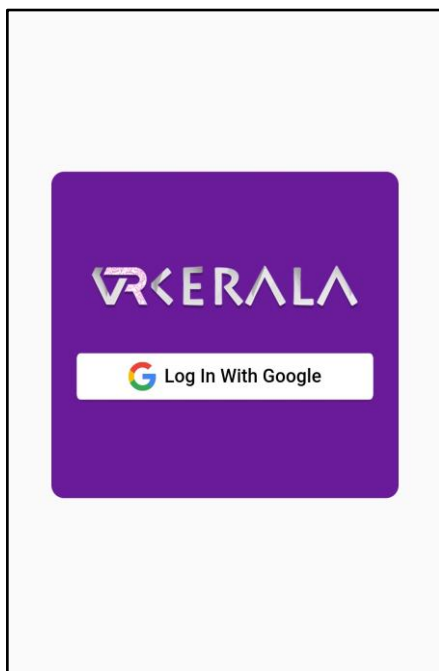
Fig-3: Authentication Page

2. Home Page

Shown in "Fig-4". Displays the functions and facilities that are provided to the user and also helps them to choose between the available travel destinations.
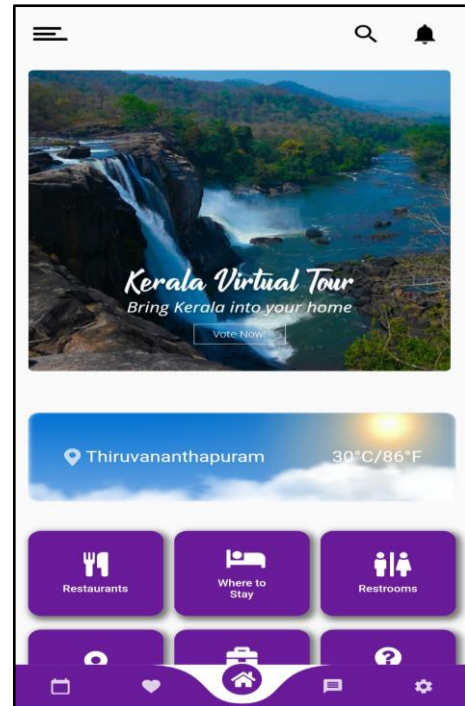

Fig-4: Home Page

3. Dashboard

It visually displays the available Travel and Guides options as shown in "Fig-5".
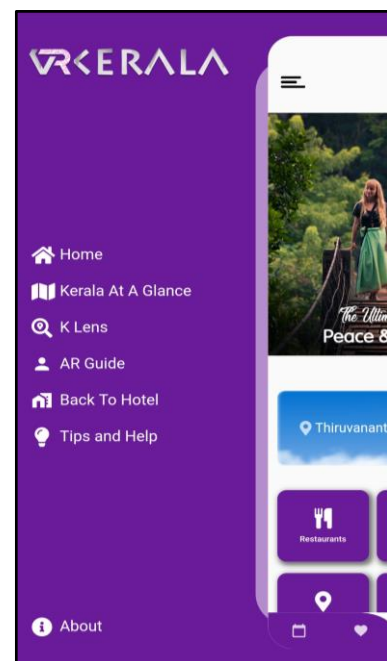

Fig-5: Dashboard

4. Discover

Shows the user the nearest travel destinations and locations to choose from. The user can know what all his/her options are around their location. Shown in "Fig-6".
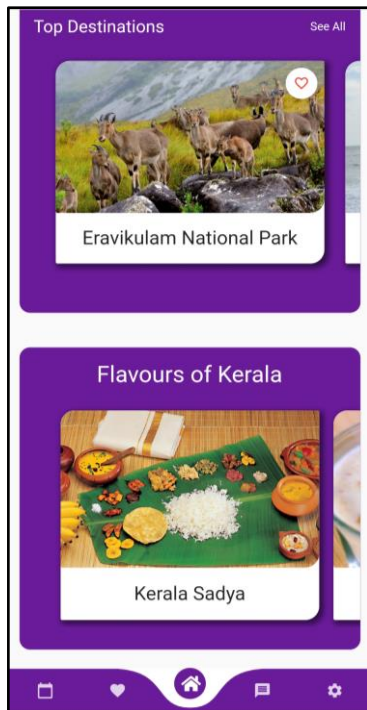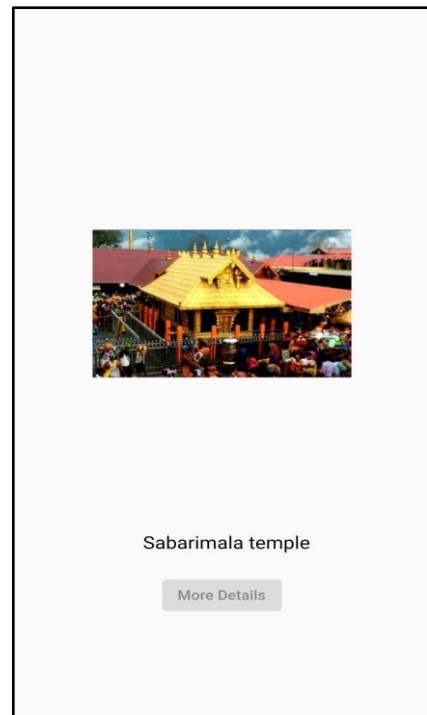
Fig-6: Explore

5. K'Lens

The K Lens interface and results are shown in "Fig-7" and "Fig-8". Here the user can pick an image from the gallery or directly capture a picture using the user's smartphone camera. The trained model integrated within the app will recognize the image and display the image label. On tapping the image so captured, the user will be directed to the description page containing a detailed image description.

Fig-7: K'lens Interface

Fig-8: K'lens Results

6. AR guide

The AR guide will lead the tourist through the destination and inform them about the significance of the place whether it be an aesthetic destination or a place of historical significance like a Museum. The guide will pop in on the screen when the user activates it and it will walk through the place and have interactive gestures. Shown in "Fig-9".
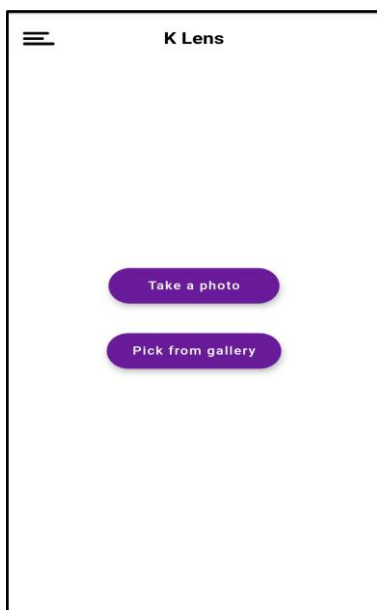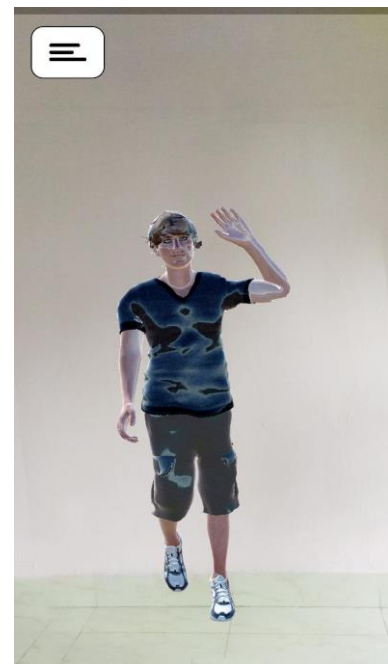

Fig-9: AR guide

7. Elena The Chatbot

Elena, the chatbot has been integrated into the app to provide quick chat assistance to the users. The chatbot interface is shown in "Fig-10". The user can ask questions related to the location of nearby attractions, restaurants, etc. The bot will guide the users to the respective pages based on the user chat input and the user location.
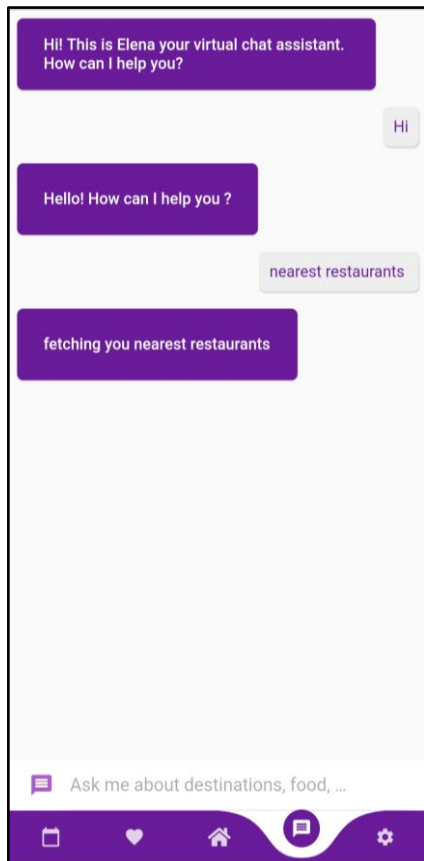

Fig-10: Elena the Chatbot

8. Multilingual Support

The app will detect the language of the device and set the app language accordingly. The user also has the option to change the app language from the app settings. "Fig-11" shows the app in the Italian language.
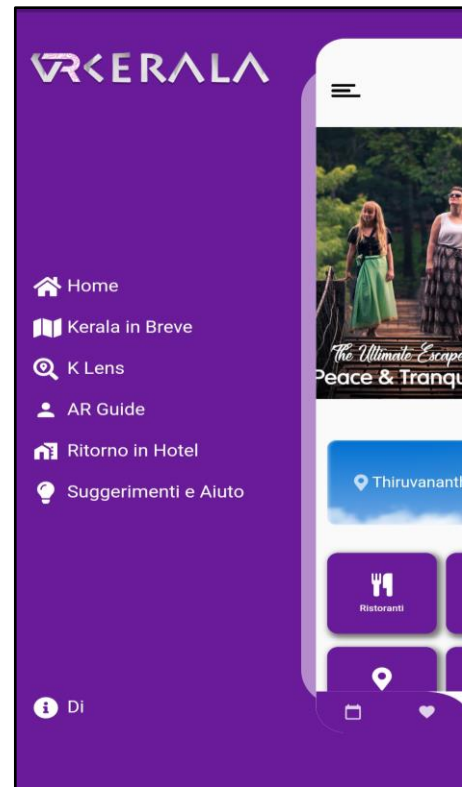

Fig-11: Multilingual Support

VIII. CONCLUSIONS

VRKerala mobile application behaves like a true virtual travel companion by providing an immersive experience with the help of augmented reality and machine learning.

The AR guide, K'Lens, 360 view, chatbot and additional features like back to home and nearby facilities make VRKerala a perfect application a tourist can carry with them when they visit Kerala.

REFERENCES

[1]. Kerala Tourism Apps on Google Playstore - "Kerala Tourism – Apps on Google Play." https://play.google.com/store/apps/details?id=org.ke ralatourism.travelkerala&hl=en_GB&gl=IN} (accessed Jul. 13, 2021).

[2]. "Kerala Tourism & Tourist Places – Apps on Google Play." https://play.google.com/store/apps/details?id=com.a pp.keralatourism&hl=en_GB&gl=US} (accessed Jul. 13, 2021).

[3]. G. A. Lee, A. Dunser, A. Nassani, and M. Billinghurst, "AntarcticAR: An outdoor AR experience of a virtual tour to Antarctica," in 2013 IEEE International Symposium on Mixed and Augmented Reality - Arts, Media, and Humanities (ISMAR-AMH), Adelaide, Australia, Oct. 2013, pp. 29–38, doi: 10.1109/ISMAR AMH.2013.6671264.

[4]. ViewAR - https://www.viewar.com/

[5]. Flutter official documentation - https://flutter.dev/docs

[6]. Google Cloud Platform official documentation - https://cloud.google.com/docs

[7]. Firebase official documentation - https://firebase.google.com/docs

[8]. Blender Official Documentation - https://docs.blender.org/manual/en/latest/

[9]. Unity Official Documentation - https://docs.unity3d.com/Manual/index.html

[10]. TensorFlow Official Documentation - https://www.tensorflow.org/

[11]. J. Brownlee, "TensorFlow 2 Tutorial: Get Started in Deep Learning With tf.keras," Machine Learning Mastery, Dec. 18, 2019. https://machinelearningmastery.com/tensorflow-tutorial-deep-learning-with-tf-keras/ (accessed Jul. 13, 2021).

[12]. "TensorFlow Lite | ML for Mobile and Edge Devices," TensorFlow. https://www.tensorflow.org/lite (accessed Jul. 13, 2021).

[13]. A. Arusoaie, A. I. Cristei, C. Chircu, M. A. Livadariu, V. Manea and A. Iftene, "Augmented Reality," 2010 12th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing, 2010, pp. 502-509, doi: 10.1109/SYNASC.2010.53.

[14]. Transfer Learning - https://www.tensorflow.org/tutorials/images/transfer_learning

[15]. M. Sandler, A. Howard, M. Zhu, A. Zhmoginov, and L.-C. Chen, "MobileNetV2: Inverted Residuals and Linear Bottlenecks," ArXiv180104381 Cs, Mar. 2019, Accessed: Jul. 13, 2021. [Online]. Available: http://arxiv.org/abs/1801.04381

[16]. K. Team, "Keras documentation: MobileNet and MobileNetV2." https://keras.io/api/applications/mobilenet/ (accessed Jul. 13, 2021).

[17]. V. Martinek, "Cross-entropy for classification," Medium, Jun. 19, 2020. https://towardsdatascience.com/cross-entropy-for-classification-d98e7f974451 (accessed Jul. 13, 2021).

[18]. D. P. Kingma and J. Ba, "Adam: A Method for Stochastic Optimization," ArXiv14126980 Cs, Jan. 2017, Accessed: Jul. 13, 2021. [Online]. Available: http://arxiv.org/abs/1412.6980