**A Project Report on**

**TOURISM SIMPLIFIED THROUGH VOICE**

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**In partial fulfillment of requirements for the award of the degree of**

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**In**

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**CERTIFICATE**

This is to certify that the project entitled “**TOURISM SIMPLIFIED THROUGH VOICE”** being submitted by **Mr. THARUN KAUSHAL (16BD1A0594) Mr. NIHITH REDDY (16BD1A0596) Ms. CHANDANA POGULA (16BD1A059B)** students of **Keshav Memorial Institute of Technology, JNTUH** in partial fulfillment of requirements of the award of the Degree of **Bachelor of Technology in Computer Science and Engineering** as a specialization is a record of bonafide work carried out by them under my guidance and supervision in the academic year 2019 – 2020.

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**EXTERNAL EXAMINER**

**DECLARATION**

We hereby declare that the project report entitled **“TOURISM SIMPLIFIED THROUGH VOICE”** is done in the partial fulfillment for the award of the Degree of Bachelor of Technology in Computer Science and Engineering affiliated to Jawaharlal Nehru Technological University, Hyderabad. This project has not been submitted anywhere else.

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**ABSTRACT**

Alexa is Amazon’s cloud base voice service, that helps users interact with brands, data, and business logic through voice. Use Alexa to innovate and build the next generation of interfaces for tourists in India. Your solution should help solve pain points of tourists coming to India like - voice forums to crowd source destination reviews, GPS based voice navigators to guide tourists at historical sites, SOS and emergency support solutions for local and international travelers, travel guides with entry prerequisites, government policies, visa needs, and recommendations on seasons to visit. The Alexa based solution should be intuitive to use also cater to the physically challenged travelers in India.

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**CHAPTER-1**

**1. INTRODUCTION**

**1.1 Purpose of Project**

Amazon Alexa, simply known as Alexa, is a virtual assistant AI developed by Amazon, first used in the Amazon Echo and the Amazon Echo Dot smart speakers. It is capable of voice interaction, music playback, making to-do lists, setting alarms, streaming podcasts, playing audiobooks, and providing weather, traffic, sports, and other real-time information, such as news. Alexa can also control several smart devices using itself as a home automation system. Users are able to extend the Alexa capabilities by installing customized skills by using Alexa skills kit.

With the Alexa Skills Kit, we can experience an entirely custom voice experience or build a wide range of skills using our pre-built models. The Alexa Skills Kit offers pre-built interaction models which include predefined requests and utterances to help start building quickly. For custom skills, we must define the interaction model. Therefore, having flexibility and control over the skill design and code. For skill building, we must define the requests the skill can handle, define the name Alexa uses to identify your skill called the invocation name and write the code to fulfill the request.

The Basic working of Alexa skill starts with the invocation call mentioning the invocation name in the utterance. The Alexa-enabled device sends the utterance to the Alexa service in cloud. There, the utterance is processed via automatic speech recognition, for conversion to text, and natural language understanding to recognize the intent of the text then it sends a JavaScript Object Notation (JSON) request to handle the intent to an AWS Lambda function in the cloud. The Lambda function acts as the backend and executes code to handle the intent. The Alexa service receives the JSON response and converts the output text to an audio file and then the Alexa-enabled device receives and plays the audio.

We can use Alexa to innovate and build the next generation of interfaces for tourists in India. This solution can help solve the pain points of tourists coming to India like - voice forums to crowd source destination reviews, GPS based voice navigators to guide tourists at historical sites, SOS and emergency support solutions for local and international travelers, travel guides with entry prerequisites, government policies, visa needs, and recommendations on seasons to visit. The solution can be intuitive to use also cater to the physically challenged travelers in India.

**1.2 Problems with Existing System**

**1.3 Proposed System**

**1.4 Scope of the Project**

**1.5 Architecture Diagram**

A screenshot of a social media post

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*Figure 1: Architecture Diagram*

**CHAPTER-2**

**2. SYSTEM REQUIREMENT SPECIFICATIONS**

Software Requirement Specification (SRS) is the starting point of the software developing activity. As system grew more complex it became evident that the goal of the entire system cannot be easily comprehended. Hence the need for the requirement phase arose. The software project is initiated by the client needs. The SRS is the means of translating the ideas of the minds of clients (the input) into a formal document (the output of the requirement phase.) The SRS phase consists of two basic activities:

# 2.1 Problem/Requirement Analysis:

The process is order and more nebulous of the two, deals with understand the problem, the goal and constraints.

# 2.2 Requirement Specification:

Here, the focus is on specifying what has been found giving analysis such as representation, specification languages and tools, and checking the specifications are addressed during this activity.

The Requirement phase terminates with the production of the validate SRS document.

Producing the SRS document is the basic goal of this phase.

# 2.3 Role of SRS

The purpose of the Software Requirement Specification is to reduce the communication gap between the clients and the developers. Software Requirement Specification is the medium though which the client and user needs are accurately specified. It forms the basis of software development. A good SRS should satisfy all the parties involved in the system.

# 2.4 Requirements Specification Document

A Software Requirements Specification (SRS) is a document that describes the nature of a project, software or application. In simple words, SRS document is a manual of a project provided it is prepared before you kick-start a project/application. This document is also known by the names SRS report, software document. A software document is primarily prepared for a project, software or any kind of application.

There are a set of guidelines to be followed while preparing the software requirement specification document. This includes the purpose, scope, functional and nonfunctional requirements, software and hardware requirements of the project. In addition to this, it also contains the information about environmental conditions required, safety and security requirements, software quality attributes of the project etc.

The purpose of SRS (Software Requirement Specification) document is to describe the external behaviour of the application developed or software. It defines the operations, performance and interfaces and quality assurance requirement of the application or software. The complete software requirements for the system are captured by the SRS.

This section introduces the requirement specification document for Facial Expression Detection using Deep Learning which enlists functional as well as non-functional requirements.

## 2.4.1 Functional Requirements

For documenting the functional requirements, the set of functionalities supported by the system are to be specified. A function can be specified by identifying the state at which data is to be input to the system, its input data domain, the output domain, and the type of processing to be carried on the input data to obtain the output data. Functional requirements define specific behavior or function of the application. Following are the functional requirements:

The input design is the link between the information system and user. It compromises the developing specification and procedures for data preparation and those steps are necessary to put transaction data into a useable form for processing can be achieved by inspecting the computer to read data from a written or printed documented or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input design considered for the following things:

⮚ What data should be given as input?

⮚ How the data should be arranged or coded?

⮚ The dialog to guide the operating personnel in providing input

⮚ Methods for preparing input validations and steps to follow when error occur.

* Input design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management correct information from the computerized system.

* It is achieved by creating user-friendly screens for data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulations can be performed. It also provides viewing facilities.

* When the data is entered, it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that user will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow.

## 2.4.2 Non-Functional Requirements

A non-functional requirement is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. Especially these are the constraints the system must work within. Following are the non-functional requirements:

**Performance:**

The performance of the developed applications can be calculated by using following methods: Measuring enables you to identify how the performance of your application stands in relation to your defined performance goals and helps you to identify the bottlenecks that affect your application performance. It helps you identify whether your application is moving toward or away from your performance goals. Defining what you will measure, that is, your metrics, and defining the objectives for each metric is a critical part of your testing plan.

Performance objectives include the following:

* Response time or latency
* Throughput
* Resource utilization

# 2.5 Software Requirements

* Alexa
* Alexa Skills Kit
* Amazon web services
* Node JS
* DynamoDB

# 2.6 Hardware Requirements

* Fluently working Laptop
* Alexa echo device
* Mobile phone with Alexa app

**CHAPTER-3**

**3. LITERATURE SURVEY**

In today’s growing world the technologies are evolving to make life easier, to make life better. One such new technology is human-machine interaction using voice. Many intelligent Voice assistants are available today: A popular application from Apple called Siri. Siri is a computer game program that works as an intelligent personal assistant and knowledge navigator, part of Apple iOS, watch OS, macOS, and tvOS operating systems. The feature uses a natural language user interface to answer questions make recommendations and perform actions by delegating requests to a set of Web services. The software, both in its original version and as an iOS feature, adapts to the user’s individual language usage and individual searches with continuing use, and returns results that are individualized. Siri was originally introduced as an iOS application available in the App Store which was acquired by Apple on April 28’ 2010. Siri Inc had announced that their software would be available for BlackBerry and for phones running Android, but all development effort for non-Apple platforms were cancelled after the acquisition by Apple. There are several accent and gender combinations for the voice of Siri. This application is very interesting, easy going and convenient, with wide real-world usage and large developing potential. Google Home is a smart speaker developed by Google as part of its “Made By Google” product line. The product stands as a rival to Amazon Echo in the smart speaker industry. Amazon Echo is a smart speaker developed by Amazon.com. The device connects to the voice –controlled intelligent personal assistant service Alexa, which responds to the name “Alexa”. The device is capable of voice interaction, music playback, making to-do lists, setting alarms, streaming podcasts, playing audiobooks, and providing weather, traffic and other real time information, such as news. Alexa can also control several smart devices using itself as a home automation system. Users are able to extend the Alexa capabilities by installing customized skills by using Alexa skills kit.

**3.1 Software Test Life Cycle**

The process of testing a software in a well-planned and systematic way is known as software testing lifecycle (STLC). Different organizations have different phases in STLC however generic Software Test Life Cycle (STLC) for waterfall development model consists of the following phases.

* Requirements Analysis
* Test Planning
* Test Analysis
* Test Design
* Test Construction and Verification
* Test Execution and Bug Reporting
* Final Testing and Implementation
* Post Implementation

**3.1.1 Requirements Analysis**

In this phase testers analyse the customer requirements and work with developers during the design phase to see which requirements are testable and how they are going to test those requirements. It is very important to start testing activities from the requirements phase itself because the cost of fixing defect is very less if it is found in requirements phase rather than in future phases.

In this phase all the planning about testing is done like what needs to be tested, how the testing will be done, test strategy to be followed, what will be the test environment, what test methodologies will be followed, hardware and software availability, resources, risks etc. A high level test plan document is created which includes all the planning inputs mentioned above and circulated to the stakeholders.

Usually IEEE 829 test plan template is used for test planning.

A screen shot of a computer

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*Figure 2: IEEE 829 test plan template*

**3.1.2. Test Analysis**

After test planning phase is over test analysis phase starts, in this phase we need to dig deeper into project and figure out what testing needs to be carried out in each SDLC phase. Automation activities are also decided in this phase, if automation needs to be done for software product, how will the automation be done, how much time will it take to automate and which features need to be automated. Nonfunctional testing areas (Stress and performance testing) are also analyzed and defined in this phase.

**3.1.3. Test Design**

In this phase various black-box and white-box test design techniques are used to design the test cases for testing, testers start writing test cases by following those design techniques, if automation testing needs to be done then automation scripts also needs to written in this phase.

**3.1.4. Test Construction and Verification**

In this phase testers prepare more test cases by keeping in mind the positive and negative scenarios, end user scenarios etc. All the test cases and automation scripts need to be completed in this phase and got reviewed by the stakeholders. The test plan document should also be finalized and verified by reviewers.

**3.1.5. Test Execution and Bug Reporting**

Once the unit testing is done by the developers and test team gets the test build, The test cases are executed and defects are reported in bug tracking tool, after the test execution is complete and all the defects are reported. Test execution reports are created and circulated to project stakeholders. After developers fix the bugs raised by testers they give another build with fixes to testers, testers do re-testing and regression testing to ensure that the defect has been fixed and not affected any other areas of software.

Testing is an iterative process i.e. If defect is found and fixed, testing needs to be done after every defect fix.

After tester assures that defects have been fixed and no more critical defects remain in software the build is given for final testing.

**3.1.6. Final Testing and Implementation**

In this phase the final testing is done for the software, non functional testing like stress, load and performance testing are performed in this phase. The software is also verified in the production kind of environment. Final test execution reports and documents are prepared in this phase.

**3.1.7. Post Implementation**

In this phase the test environment is cleaned up and restored to default state, the process review meetings are done and lessons learnt are documented. A document is prepared to cope up similar problems in future releases.

**3.2 Technologies Used**

**3.2.1 Node JS**

Node.js is an open source, cross-platform runtime environment for developing server-side and networking applications. Node.js applications are written in JavaScript and can be run within the Node.js runtime on OS X, Microsoft Windows, and Linux. Node.js also provides a rich library of various JavaScript modules which simplifies the development of web applications using Node.js to a great extent.

**Features of Node.js**

Following are some of the important features that make Node.js the first choice of software architects.

* **Asynchronous and Event Driven** − All APIs of Node.js library are asynchronous, that is, non-blocking. It essentially means a Node.js based server never waits for an API to return data. The server moves to the next API after calling it and a notification mechanism of Events of Node.js helps the server to get a response from the previous API call.

* **Very Fast** − Being built on Google Chrome's V8 JavaScript Engine, Node.js library is very fast in code execution.

* **Single Threaded but Highly Scalable** − Node.js uses a single threaded model with event looping. Event mechanism helps the server to respond in a non-blocking way and makes the server highly scalable as opposed to traditional servers which create limited threads to handle requests. Node.js uses a single threaded program and the same program can provide service to a much larger number of requests than traditional servers like Apache HTTP Server.

* **No Buffering** − Node.js applications never buffer any data. These applications simply output the data in chunks.

* **License** − Node.js is released under the MIT license.

**Who Uses Node.js?**

Following is the link on github wiki containing an exhaustive list of projects, application and companies which are using Node.js. This list includes eBay, General Electric, GoDaddy, Microsoft, PayPal, Uber, Wikipins, Yahoo!, and Yammer to name a few.

**Where to Use Node.js?**

Following are the areas where Node.js is proving itself as a perfect technology partner.

* I/O bound Applications
* Data Streaming Applications
* Data Intensive Real-time Applications (DIRT)
* JSON APIs based Applications
* Single Page Applications

**Where Not to Use Node.js?**

It is not advisable to use Node.js for CPU intensive applications.

* + 1. **Alexa**

Alexa is a virtual digital assistant developed by Amazon for its Amazon Echo and Echo Dot line of computing devices. Alexa's capabilities mimic those of other intelligent assistants such as Apple Siri, Microsoft Cortana, Google Assistant and Samsung Bixby.

Alexa responds to voice control by returning information on products (on Amazon of course), music, news, weather, sports and more. The back-end engine for Amazon's Alexa runs on Amazon Web Services in the cloud, enabling Alexa to learn an individual or family's preferences and expand its functionality over time.

In addition to the Echo products, Alexa is also supported by Amazon's Fire HD tablet and Fire TV set-top box products. A few select third-party products have started to support Alexa as well, including the Nucleus Intercom, Ford SYNC automobile infotainment systems and Invoxia's Triby speaker and message system.

Alexa gets its name from the ancient library of Alexandria, and it can be activated by first saying a trigger word (either "Alexa" by default or "Echo," "Amazon" or "Computer," based on your preferences), followed by your query or request. Alexa uses natural language interpretation to process and act upon requests.

In addition to returning information, Alexa also enables Echo devices to function as smart home hubs that can control Internet of Things connected devices like smart lights, thermostats and electronics.

Beyond its built-in capabilities, Alexa offers more than 3,000 "Skills" from Amazon and third-party developers that users can add to extend Alexa's functionality, including one for IFTTT, which can help coordinate and automate interaction between other connected devices.

* + 1. **Amazon Web Services**

In 2006, Amazon Web Services (AWS) began offering IT infrastructure services to businesses in the form of web services -- now commonly known as cloud computing. One of the key benefits of cloud computing is the opportunity to replace up-front capital infrastructure expenses with low variable costs that scale with your business. With the Cloud, businesses no longer need to plan for and procure servers and other IT infrastructure weeks or months in advance. Instead, they can instantly spin up hundreds or thousands of servers in minutes and deliver results faster.

Today, Amazon Web Services provides a highly reliable, scalable, low-cost infrastructure platform in the cloud that powers hundreds of thousands of businesses in 190 countries around the world. With data center locations in the U.S., Europe, Brazil, Singapore, Japan, and Australia, customers across all industries are taking advantage of the following benefits:

**Low Cost**

AWS offers low, pay-as-you-go pricing with no up-front expenses or long-term commitments. We are able to build and manage a global infrastructure at scale, and pass the cost saving benefits onto you in the form of lower prices. With the efficiencies of our scale and expertise, we have been able to lower our prices on 15 different occasions over the past four years.

**Agility and Instant Elasticity**

AWS provides a massive global cloud infrastructure that allows you to quickly innovate, experiment and iterate. Instead of waiting weeks or months for hardware, you can instantly deploy new applications, instantly scale up as your workload grows, and instantly scale down based on demand. Whether you need one virtual server or thousands, whether you need them for a few hours or 24/7, you still only pay for what you use.

**Open and Flexible**

AWS is a language and operating system agnostic platform. You choose the development platform or programming model that makes the most sense for your business. You can choose which services you use, one or several, and choose how you use them. This flexibility allows you to focus on innovation, not infrastructure.

**Secure**

AWS is a secure, durable technology platform with industry-recognized certifications and audits: PCI DSS Level 1, ISO 27001, FISMA Moderate, FedRAMP, HIPAA, and SOC 1 (formerly referred to as SAS 70 and/or SSAE 16) and SOC 2 audit reports. Our services and data centers have multiple layers of operational and physical security to ensure the integrity and safety of your data.

* + 1. **DynamoDB**

Amazon DynamoDB is a key-value and document database that delivers single-digit millisecond performance at any scale. It's a fully managed, multi-region, multi-master, durable database with built-in security, backup and restore, and in-memory caching for internet-scale applications. DynamoDB can handle more than 10 trillion requests per day and can support peaks of more than 20 million requests per second.

Many of the world's fastest growing businesses such as Lyft, Airbnb, and Redfin as well as enterprises such as Samsung, Toyota, and Capital One depend on the scale and performance of DynamoDB to support their mission-critical workloads.

Hundreds of thousands of AWS customers have chosen DynamoDB as their key-value and document database for mobile, web, gaming, ad tech, IoT, and other applications that need low-latency data access at any scale.

**Performance at scale**

DynamoDB supports some of the world’s largest scale applications by providing consistent, single-digit millisecond response times at any scale. You can build applications with virtually unlimited throughput and storage. DynamoDB global tables replicate your data across multiple AWS Regions to give you fast, local access to data for your globally distributed applications. For use cases that require even faster access with microsecond latency, DynamoDB Accelerator (DAX) provides a fully managed in-memory cache.

**No servers to manage**

DynamoDB is serverless with no servers to provision, patch, or manage and no software to install, maintain, or operate. DynamoDB automatically scales tables up and down to adjust for capacity and maintain performance. Availability and fault tolerance are built in, eliminating the need to architect your applications for these capabilities. DynamoDB provides both provisioned and on-demand capacity modes so that you can optimize costs by specifying capacity per workload, or paying for only the resources you consume.

**Enterprise ready**

DynamoDB supports ACID transactions to enable you to build business-critical applications at scale. DynamoDB encrypts all data by default and provides fine-grained identity and access control on all your tables. You can create full backups of hundreds of terabytes of data instantly with no performance impact to your tables, and recover to any point in time in the preceding 35 days with no downtime. DynamoDB is also backed by a service level agreement for guaranteed availability.

**CHAPTER-4**

1. **SYSTEM DESIGN**

**4.1 Introduction to UML**

The Unified Modelling Language allows the software engineer to express an analysis model using the modelling notation that is governed by a set of syntactic, semantic and pragmatic rules.A UML system is represented using five different views that describe the system from distinctly different perspective. Each view is defined by a set of diagram, which is as follows:

1. User Model View

* This view represents the system from the users’ perspective.
* The analysis representation describes a usage scenario from the end-user’s perspective.

1. Structural Model View

* In this model, the data and functionality are arrived from inside the system.
* This model view models the static structures.

1. Behavioural Model View

* It represents the dynamic of behavioural as parts of the system, depicting he interactions of collection between various structural elements described in the user model and structural model view.

1. Implementation Model View

* In this view, the structural and behavioural as parts of the system are represented as they are to be built.

1. Environmental Model View

* In this view, the structural and behavioural aspects of the environment in which the system is to be implemented are represented.

**4.2 UML Diagrams**

**4.2.1 Use Case Diagram**

To model a system, the most important aspect is to capture the dynamic behaviour. To clarify a bit in details, dynamic behaviour means the behaviour of the system when it is running /operating. So only static behaviour is not sufficient to model a system rather dynamic behaviour is more important than static behaviour. In UML there are five diagrams available to model dynamic nature and use case diagram is one of them. Now as we have to discuss that the use case diagram is dynamic in nature there should be some internal or external factors for making the interaction.

These internal and external agents are known as actors. So use case diagrams are consisting of actors, use cases and their relationships. The diagram is used to model the system/subsystem of an application. A single use case diagram captures a particular functionality of a system. So to model the entire system numbers of use case diagrams are used.

Use case diagrams are used to gather the requirements of a system including internal and external influences. These requirements are mostly design requirements. So when a system is analysed to gather its functionalities use cases are prepared and actors are identified.

In brief, the purposes of use case diagrams can be as follows:

* Used to gather requirements of a system.
* Used to get an outside view of a system.
* Identify external and internal factors influencing the system.
* Show the interacting among the requirements are actors.

A close up of a map

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*Figure 11: Use case Diagram for entire application functionality*

**4.2.2 Sequence Diagram**

Sequence diagrams describe interactions among classes in terms of an exchange of messages over time. They're also called event diagrams. A sequence diagram is a good way to visualize and validate various runtime scenarios. These can help to predict how a system will behave and to discover responsibilities a class may need to have in the process of modeling a new system.

The aim of a sequence diagram is to define event sequences, which would have a desired outcome. The focus is more on the order in which messages occur than on the message per se. However, the majority of sequence diagrams will communicate what messages are sent and the order in which they tend to occur.

**Basic Sequence Diagram Notations**

* **Class Roles or Participants**

Class roles describe the way an object will behave in context. Use the UML object symbol to illustrate class roles, but don't list object attributes.

* **Activation or Execution Occurrence**

Activation boxes represent the time an object needs to complete a task. When an object is busy executing a process or waiting for a reply message, use a thin gray rectangle placed vertically on its lifeline.

* **Messages**

Messages are arrows that represent communication between objects. Use half-arrowed lines to represent asynchronous messages.

Asynchronous messages are sent from an object that will not wait for a response from the receiver before continuing its tasks.

* **Lifelines**

Lifelines are vertical dashed lines that indicate the object's presence over time.

* **Destroying Objects**

Objects can be terminated early using an arrow labeled "<< destroy >>" that points to an X. This object is removed from memory. When that object's lifeline ends, you can place an X at the end of its lifeline to denote a destruction occurrence.

* **Loops**

A repetition or loop within a sequence diagram is depicted as a rectangle. Place the condition for exiting the loop at the bottom left corner in square brackets [].

* **Guards**

When modelling object interactions, there will be times when a condition must be met for a message to be sent to an object. Guards are conditions that need to be used throughout UML diagrams to control flow.

![A close up of a map

Description automatically 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vMrZVfzrToAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKxrHS5bbxBql8zL5V0kCL/e+Tf/APFVs1g6feTTeKNZgaQvDDHb+Wv93dv3fyoA3qKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAI5l8yN1/vLWZ4b02XR/Dul6fMyvNa2kUDMv3dyoFrSmbbEzD+7WP4PupbzwnotzcSGWeayglkdv4mZFOaAN2iiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAjb7rfT+lfj94y/5HDXv+v+4/9GvX7At91vp/SvyG8Zabd/8ACZa7/o0//IRuP+WT/wDPV6/POLk3TpW8z7/hFpVat/7pz/8ACK+7P+Ce/wDyIvib/sJL/wCihXw39hucAfZpv+/T190f8E/beWHwD4l8yNkP9pLjcm3/AJZJXzfDMJrMYtrufRcTVE8BJX/lPq2iiiv2c/HgooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooA5/xZBJcw6Z5UTS7NQt3baPuLv8AvV0FZOu6o2lR2RVVf7RdxW/zfw72rWoAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKzbe6tJNWv4Ik2XMSxec23727dt/rWlWRY6XJba/qd87KY7pIUUdxs3df++qANeiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigCN9qq277tUdFuLa80awmsI/KspIVeBSu3YhX5fl+lXpl8yN1/vLWZ4b02TR/DulWE7K81paxQMyfd3KgWgDXooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACm+Wv8AdH5U6ilZPcDA8M2Mlr/aomiKGW/llTcOqfLg1vBQvQYrI0HVJdTF/wCaqp9nvJbddv8AdWtiiyWw7sKKKKYgooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAzdWsLa+jtvtL+X5VzHKnzbcsrfKK0q5/wAWQSXMOmeVE0uzULd22j7i7/vV0FABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABWDp91PN4n1mB5C8MUdv5af3d2/d/St6s23urSTVr+CJNlzEsXnNt+9u3bf60AaVFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAEUzbYmYf3ax/B91LeeEtFuZ5DLPNZQSyO38TMinNbL7VVt33ao6LcW15o1hNYR+VZSQq8ClduxCvy/L9KANKiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAM3SraztvtZtHVvMuXkm+bdtkP3q0qwfDNrNa/2sJkZDLqEsqbu6HbzW9QAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAGTruqNpUdkVVX+0XcVv838O9q1qzdWsba+jtVun8vyrmOWP5tuWVvlFaVABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABWRY6XJba/qd87KY7pIUUdxs3df++q16wdOu5pvFGswPIXhijtzGn93dv3f0oA3qKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAI5l8yN1/vLWZ4b02TR/DulWE7K81paxQMyfd3KgWtKZtsLN/s1j+D7qW68I6Jc3EhlnmsoHkdv4mZFyaAN2iiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAMfQdUl1MX/AJqqn2e8lt12/wB1a2KzdJt7O3+2GzcN5lw7zfNu2y/xCtKgAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAOf8VQSXMWmeVE0u3UIHbaPurv+9XQVk69qbaXHZGNVbz7yK3O7/aatagAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigArNtry0k1a+giXZcxLF5zbfvBt23+taVZFjpctrr2p3rspjukiVVH3vk3f/FUAa9FFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAEb7UVmb7tUNFubW+0ewuLBPJs5YElgXbt2Iy5X5avzL5kbr/eWszw3psmj+HdLsJWV5rS1igZk+7uVAtAGvRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAGD4Zs57Q6p5yMnm38sqbv4lPSt6iigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAKOpaXFqi24lZh5E6XC7f7y9KvUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFZdnDeR6xfyTSb7KRIvIXP3T82/8A9lrUooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAIpm2ws3+zWP4PupbrwjolzcSGWeaygeR2/iZkXJrZfaiszfdqhotza32j2FxYJ5NnLAksC7duxGXK/LQBp0UUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQBHIvmRsv95azPDemyaP4d0qwmdXltLWKBnX7rMqBf6Vr0UAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFF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*Figure 12: Sequence Diagram for entire application functionality*

**4.2.3 Class Diagram**

Class diagrams are the main building blocks of every object oriented methods. The class diagram can be used to show the classes, relationships, interface, association, and collaboration. UML is standardized in class diagrams. Since classes are the building block of an application that is based on OOPs, so as the class diagram has appropriate structure to represent the classes, inheritance, relationships, and everything that OOPs have in its context. It describes various kinds of objects and the static relationship in between them.

The main purpose to use class diagrams are:

* This is the only UML which can appropriately depict various aspects of OOPs concept.
* Proper design and analysis of application can be faster and efficient.
* It is base for deployment and component diagram.

Each class is represented by a rectangle having a subdivision of three compartments name, attributes and operation.

There are three types of modifiers which are used to decide the visibility of attributes and operations.

* + is used for public visibility (for everyone)
* # is used for protected visibility (for friend and derived)
* – is used for private visibility (for only me)

A screenshot of a cell phone

Description automatically generated

*Figure 13: Class Diagram for entire application functionality*

**4.2.4 Activity diagram**

We use Activity Diagrams to illustrate the flow of control in a system and refer to the steps involved in the execution of a use case. We model sequential and concurrent activities using activity diagrams. So, we basically depict workflows visually using an activity diagram. An activity diagram focuses on condition of flow and the sequence in which it happens. We describe or depict what causes a particular event using an activity diagram.

UML models basically three types of diagrams, namely, structure diagrams, interaction diagrams, and behavior diagrams. An activity diagram is a behavioral diagram i.e. it depicts the behavior of a system.

An activity diagram portrays the control flow from a start point to a finish point showing the various decision paths that exist while the activity is being executed. We can depict both sequential processing and concurrent processing of activities using an activity diagram. They are used in business and process modelling where their primary use is to depict the dynamic aspects of a system.

**Components of Activity Diagram**

* **Activities**

It is a behavior that is divided into one or more actions. Activities are a network of nodes connected by edges. There can be action nodes, control nodes, or object nodes. Action nodes represent some action. Control nodes represent the control flow of an activity. Object nodes are used to describe objects used inside an activity. Edges are used to show a path or a flow of execution. Activities start at an initial node and terminate at a final node.

* **Activity partition/swimlane**

An activity partition or a swimlane is a high-level grouping of a set of related actions. A single partition can refer to many things, such as classes, use cases, components, or interfaces. If a partition cannot be shown clearly, then the name of a partition is written on top of the name of an activity.

* **Fork and Join nodes**

Using a fork and join nodes, concurrent flows within an activity can be generated. A fork node has one incoming edge and numerous outgoing edges. It is similar to one too many decision parameters. When data arrives at an incoming edge, it is duplicated and split across numerous outgoing edges simultaneously. A single incoming flow is divided into multiple parallel flows.

A join node is opposite of a fork node as It has many incoming edges and a single outgoing edge. It performs logical AND operation on all the incoming edges. This helps you to synchronize the input flow across a single output edge.

* **Pins**

An activity diagram that has a lot of flows gets very complicated and messy. Pins are used to clearing up the things. It provides a way to manage the execution flow of activity by sorting all the flows and cleaning up messy thins. It is an object node that represents one input to or an output from an action. Both input and output pins have precisely one edge.

A close up of a sign

Description automatically generated

*Figure 14: Activity Diagram for entire application functionality*

**4.2.5 Collaboration diagram**

A collaboration diagram is required to identify how various objects make up the entire system. They are used to understand the object architecture within a system rather than the flow of a message in a sequence diagram. An object an entity that has various attributes associated with it. It is a concept of object-oriented programming. There are multiple objects present inside an object-oriented system where each object can be associated with any other object inside the system. Collaboration or communication diagrams are used to explore the architecture of objects inside the system. The message flow between the objects can be represented using a collaboration diagram.

**Notations of Collaboration Diagram**

**Objects**

An object is represented by an object symbol showing the name of the object and its class underlined, separated by a colon:

Object\_name : class\_name

You can use objects in collaboration diagrams in the following ways:

* Each object in the collaboration is named and has its class specified
* Not all classes need to appear
* There may be more than one object of a class
* An object’s class can be unspecified. Normally you create a collaboration diagram with objects first and specify their classes later.
* The objects can be unnamed, but you should name them if you want to discriminate different objects of the same class.

**Actors**

Normally an actor instance occurs in the collaboration diagram, as the invoker of the interaction. If you have several actor instances in the same diagram, try keeping them in the periphery of the diagram.

* Each Actor is named and has a role
* One actor will be the initiator of the use case

**Links**

Links connect objects and actors and are instances of associations and each link corresponds to an association in the class diagram

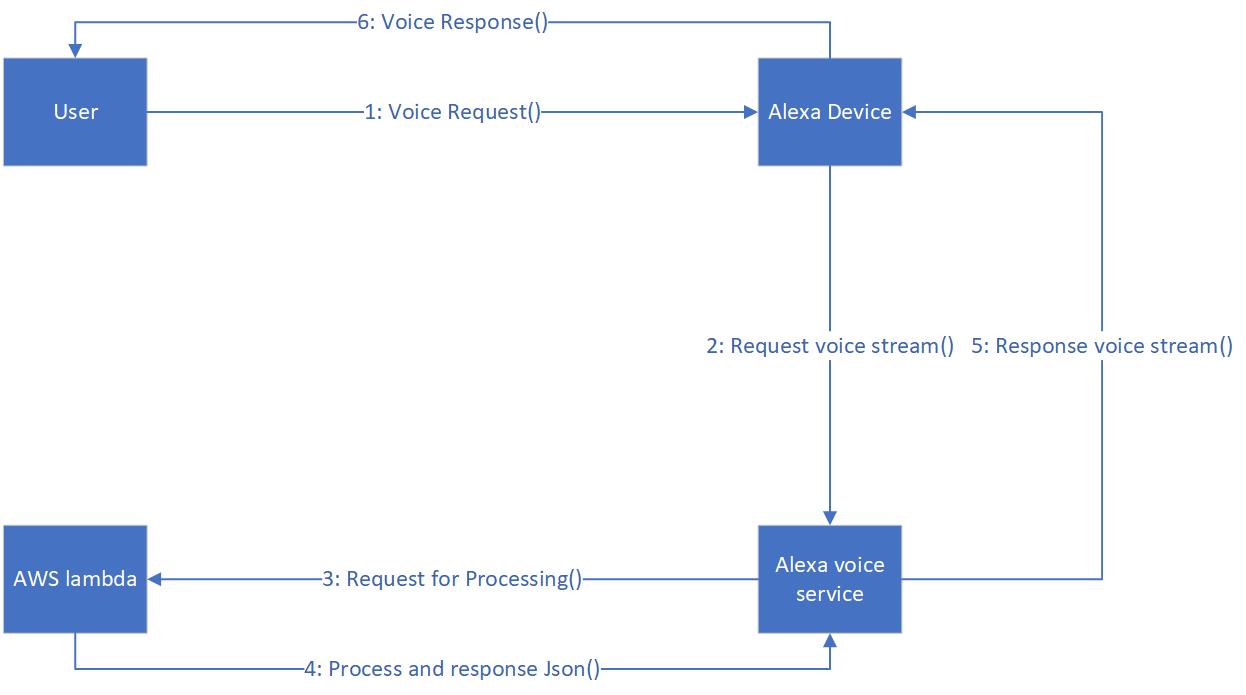
Links are defined as follows:

* A link is a relationship among objects across which messages can be sent. In collaboration diagrams, a link is shown as a solid line between two objects.
* An object interacts with, or navigates to, other objects through its links to these objects.
* A link can be an instance of an association, or it can be anonymous, meaning that its association is unspecified.
* Message flows are attached to links, see Messages.

**Messages**

A message is a communication between objects that conveys information with the expectation that activity will ensue. In collaboration diagrams, a message is shown as a labeled arrow placed near a link.

* The message is directed from sender to receiver
* The receiver must understand the message
* The association must be navigable in that direction



*Figure 15: Collaboration Diagram for entire application functionality*