

1. There are a hierarchy of stakeholders those are included in a project.
 - a) **Outside the developing organization:** There can be direct user, indirect user and beta tester.
 - b) **Developing organization:** In these category the possible stakeholders are Development Manager, Operational Support staff and Infrastructure support staff, information architect, sales staff, executive manager.
 - c) **c) Project team:** A project team members can be Project Manager, Business analyst, Developer, Tester, Data modeler, decision scientist, UI designer, machine learning engineer etc.
2. What aspect of the system is of particular importance to which stakeholder
 - a) **Outside the developing organization:**
 - Direct user: The end users who will use the application.
 - Beta Tester: The initial release of the application is targeted to beta tester only who are a group of friendly user from whom the developer will take feedback regarding the performance and improvement of the application.
 - b) **Developing organization:**
 - Development Manager: This person is responsible for managing the entire development team.
 - Operational Support staff: These people take care of the mishaps during daily operations
 - Infrastructure support staff: Any infrastructure relate problem is handled by them.
 - Many other people like information architect, sales staff, and executive manager also are developing organizations stakeholders.
 - c) **Project team:**
 - Project Manager: Manages the entire interaction between development team and business.
 - Business analyst: They are responsible for understanding and gathering all the business requirements from customers.
 - UI Designer: They are responsible for designing the user interface efficiently and user friendly manner.
 - Developer:- Understanding the business requirement, the developer implements the business logic .
 - Tester:- These people cross checks the implementation done by the developers and tests the model or business unit by various data set to check whether the system performs well.
 - Data modeler, decision scientist, machine learning engineer are responsible for training the system to learn the data in such a way that the system can provide contextual response to the user.
3. Our project is **An Approach to build Context Sensitive Intelligent Assistant**. In our project there are many constraints associated with it. Few important concerns are listed below:-

- **Privacy Constraint-** The assistant should start listening after listening a particular keyword like we say “Okay Google” to Google assistant. Or else it will automatically keep listening to all the conversation of the users. This privacy constraint should be taken into account.
 - **Time Constraint-** After end users ask the question to the voice assistance, the suggestion given by the assistance should be efficient enough to provide it in very less time.
 - **Data Constraint-** Voice assistant is based on supervised learning which required a lot of data to train the assistant. So, variety of data set is a basic constraint for this system.
 - **Legal Constraint-** The developer should implement some limitation where the system should restrict itself to provide some private or legal or confidential and sensitive data to end users
 - **System or Technical Constraint-** The developer should have a proper knowledge of what technology should be used to develop such assistant. Like which language can serve the purpose of supervised learning over another.
 - **Infrastructure Constraint:** - The assistant can perform online or it can be implemented as an offline application as well.
4. There are several functional and nonfunctional requirements for the design of the targeted assistant service. Those are listed below:-
- **Activation of application for taking user input:-** Our project will use only few particular wake words, such as "Alexa" or “Hey Google”. Our project will have a call-based wake word verification. The application will automatically activate its microphones without waiting for the wake word in multi-turn interactions and the system will not require the use of a wake word as part of the customer utterance while the customer will use it as touch initiated application and the microphone will be disabled until it listens to any wake word.
 - **Input from the Customer and Multi-iterative actions:-** It will enable customers to use voice to interrupt the system’s output (e.g. media playback and Alerts) as well as our application will automatically activate its microphones without waiting for a touch interaction in multi-turn situations. If the application is being used as touch initiated application then it enables customers to interrupt the output (e.g. media playback, Alexa voice responses, and Alerts) using the Action button.
 - **Deactivation of wake words:-** It will provide an always-available control to turn off the wake word or disable its microphones, putting the system into the Microphone Off state. It will provide audio cues to indicate when the Microphone Off attention state is activated and deactivated. It will use visual cues to convey clearly and continually to the customer that the Microphone Off attention state is active.
 - **Output from the application and the close the application:-** As the application will use both visual and audio cues ,the visual and audio cues will be synchronized to indicate when the A Listening state starts and when it stops. The system will support enabling/disabling microphones when internet connectivity is unavailable.

- **Human in the loop:** The assistant service is controlled by human feedback. Regarding this the assistant service should be able to handle also a certain amount of mistakenly wrong given feedback messages.

Nonfunctional Requirements:-

- **Minimum effort for the user:** - The goal of the integration of an assistant service is to make life easier for the user. A key requirement is that the service does not take much time from the user. The user need not to acquire any kind of technical knowledge about the system.
- **Supervision by the user:** It is very important that the user will have the control over the behavior of the system.
- **Adaptive:** The system has to adapt dynamically and quickly to the changing preferences of the user.
- **Evaluation time:** In our application context, the requests have to be processed in real time.
- **Management effort:** The assistant service should be scalable and applicable for many users in parallel, i.e., the system requirements per user and per request should be minimal.

5. Glossary:

- **Backend** - The back end handles the dynamic parts of the site, that your website visitors generally don't see or interact with such as a newsletter, an administration page, a registration database, a contact page or more complicated web applications
- **Benchmark**- A benchmark is a standard or guideline used to compare some aspect of a business to some objective or external standard measure
- **Features, advantages, benefits**- A FAB analysis explores the features, advantages, and benefits of a product or service offering.
- **Front end**- The front end is the appearance of website. It is the graphic design—some people call this the user interface or UI.
- **Product Definition**- A product definition is a stage in a new product development process in which concepts are translated into actual products for additional testing based on interactions with customers.
- **Product development**- Product development refers to expenses incurred in development of new products (salaries, laboratory equipment, test equipment, prototypes, research and development, and so on).
- **Product life cycle**- Product life cycle refers to the phases of the sales projections or history of a product or service category over time used to assist with marketing mix decisions and strategic options available and the four stages of the product life cycle include introduction, growth, maturity, and decline, and typically follow a predictable pattern based on sales volume over a period of time.

- Product development strategy- A product development strategy is a product-market strategy whereby an organization creates new offerings for existing markets innovation, product augmentation, or product line extensions.
- Product line pricing- Product line pricing refers to setting of prices for all items in a product line involving the lowest-priced product price, the highest price product, and price differentials for all other products in the line.
- User Interface- User interface is the graphic design and appearance of a website, its function as seen and used by the person on the user end, at the website in a browser.

6. For an Intelligent/Virtual Assistant below are the business capabilities:

- Managing Infrastructure
- Development of Smart Offices/Home
- Entertainment/Infotainment
- Appointment/Schedule Management
- Search/Query Processing
- Handling of everyday errands
- Advertisement Tech
- Collection of precious user data for optimizing the learning model
- Education Tech Systems

7. We can answer this in 2 levels:

A. Conceptual Level Decisions:

- I. Learning Algorithms (Reinforcement, Supervised, Variable Decision Model) – Highest risk
- II. Context Extraction & Evaluation

B. Technology Level Decisions: (Choice of Technology, Mapping of architectural elements)

- I. Infrastructure or Environment Dependency
- II. Programming Language to use
- III. Development Approaches (Agile, Waterfall)

8. Please find 8th answer at last!

9. The Forces are:

- The learning model should not take too much time to process
- Wait times for the response must be low
- Feedback collected from the user should be minimal
- The model should not depend on too much data to improve accuracy
- System should adhere to privacy regulations
- Contextual system must collect user consent
- Keep implementation effort low
- Provide configuration ease to end users

10. Specification (ISO standard 42010) of 2 most risky architectural decisions:

A. Choosing the Learning Algorithm

- **Description:** As an Architect/Decision Scientist, this is one of the toughest step of designing an Intelligent System. If there is a mistake in this phase, the overall implementation and end product might be a major disaster. Usually, the selection of a learning model takes a lot of time and comprehensive research effort before finalizing an appropriate one.
- **Alternatives:** There are 3 popular learning technique alternatives, namely Reinforcement Learning, Supervised Learning & Variable Decision Model. Every option has their own respective consequences/concern.
- **Concern:** Let's understand the concern for every alternative we have:
 - Reinforcement Learning: In this project we use this method and it is usually slow and depends too much on user feedback to tweak its response. Until the model converges to a decision, the user might be frustrated in providing it with feedback for very mistake it has made. Also, the feedback provided by the user might not be coherent as well as correct all the time.
 - Supervised Learning: Here, the learning model depends on a huge dataset to learn important inferences between the user input and expected output. But, the drawback is, it is always not possible to supply it with a magnitude of data covering every aspect it has been designed to be used for. Thus, the accuracy of the results would suffer badly, if there is a lack of sufficient training data.
 - Variable Decision Model: In an ideal intelligent assistant, this is the learning technique that is used. But, implementation of this model is too time consuming and is supremely complex with multiple interdependencies. Which in turn is less feasible & also degrades the performance of the system in real world applications.
- **Rationale:** If we choose Reinforcement learning technique over others, we can train the learning model without huge datasets & also there is scope to bypass the higher dependency on user feedbacks to arrive at a discussion rapidly. Also, connecting it with a context-parser will work wonders in its responses.
- **Outcome:** The outcome of making this decision is, we can train our assistant without actually replying too much on a huge dataset and provide response/assistance to user queries utilizing the underlying context rapidly.

C. Context Extraction & Parsing

- **Description:** For any researcher/NLP scientist, this is one of the hardest nut to crack till day. Where, we design the system to provide response to user's queries depending on the context of the discussion.
- **Alternatives:** To build a system which can respond based on the context of the discussion, we have to store the conversation between the user and the system (say last 10 sentences of a discussion). To do this either we can store the information on the respective device or store all the conversational info on a remote compute node.
- **Concerns:** Let's understand the concern for every alternative we have:
 - Storing the data locally/hybrid: Firstly, This is the safest way to oblige to user's privacy concerns. But, Depending on the growing scale of this data, we might not

be able to store all the generated context information in the local device (maybe a smartphone/embedded digital assistant).

- Storing the data remotely: In this approach, the generated contextual information is stored in a remote compute/NLP node, where all the parse operations on the data is done and only the intelligence is sent back to the local device. Here, there is a major concern for user's personal privacy and in cases we might not get regulatory permission for this approach.
- **Rationale:** In this project we consider Storing the data locally as it complies with regulatory policies and also a hybrid approach is followed, where only some of the data which cannot be evaluated in a local device is sent to a remote compute node. Thus, preventing from jeopardizing the entire user conversations to an attacker.
- **Outcome:** Safe, fast and secure processing of user contextual data. Which can be supplied to the learning model to intelligently answer to user's queries.

After all this, if the need arises to find/evaluate new alternatives, we can follow the below steps: Select reference models, Develop Baseline Application Architecture Description, Target Application Architecture Description, Perform analysis, Resolve impacts across the Architecture Landscape, Conduct formal stakeholder review

Given a preliminary understanding of the system, we can arrive at the following outcome and rationale:

Rationale: We choose Reinforcement learning technique & consider storing the data locally as we can train the learning model without huge datasets & also there is scope to bypass the higher dependency on user feedbacks to arrive at a discussion rapidly also it complies with regulatory policies thus preventing from jeopardizing the entire user conversations to an attacker

Outcome: The outcome of making these decisions is, we can train our assistant without actually replying too much on a huge dataset and provide response/assistance to user queries utilizing the underlying context rapidly and securely.