

# Virtual Assistant Chat-bot

Hiren Chaudhary  
201801438  
*Technology Analyst Intern at Morgan Stanley*  
Bangalore, India  
201801438@daiict.ac.in

**Abstract**—This document describes my experience and learning as a Technology Analyst Intern at Morgan Stanley. IT includes the things that I have worked upon and learnt over the course of 6 months and a brief summary of my intern project. In the starting of the internship we had to go through a two month long training program. We had to simultaneously work on our project as a part of the Blended Training Structure. My B.Tech project focuses on building a Virtual Assistant for the existing application in Morgan Stanley through which user can interact using chat-service.

**Index Terms**—Web development, front-end, back-end, Angular, Amelia, Virtual Assistant, Spring framework, REST API

## I. INTRODUCTION

Morgan Stanley is a major financial services company with offices all over the world. Investment management, wealth management, investment banking and securities are some of the services it offers. People, institutions, governments all are clients of Morgan Stanley's various services. To provide this services and manage this big firm, Morgan Stanley has technology as its backbone. Today, we are inclined to develop the application that are more user friendly and committed to provide the most optimum solution to various business problem.

Morgan Stanley is a Financial firm so it is very crucial and important aspect of its business to manage various regulations based on different jurisdictions. The application that I am working on is responsible for on-boarding new client to Morgan Stanley. This is one stop application for all non AML regulatory functions with enhances systematic controls and automation. My project is to make a Virtual Assistant which will give users best in class view to interact/communicate with application and get the real time help and retrieve the desired data. It will save users productive time and improve user satisfaction.

## II. TRAINING

My internship began with a two month long extensive training program which covered both financial and technical aspects of Morgan Stanley. The training was conducted by SMEs (subject matter expert)s of the firm. It was a blended training program which was combined of both training and project work. We covered the basics of various tools and technologies that might be helpful in our future projects. During the training, we had to go through various assigned tracks on Pluralsight. We also had regular assignments as a part of the learning process.

### A. Financial Domain Training

Within the first week, we had a two day session to understand the financial jargons. The session was conducted to give the overview of Morgan Stanley's stand in world finance. We get to know more about the firm and its various services. The session included various concepts such as GDP, interest rates, forward futures, inflation rates, derivatives, options, swap, role of Morgan Stanley in the financial world, etc. The session consisted of interactive activities to help us better understand.

### B. Generic Training

This training was conducted to brief us about ms environment, useful portals and developer tools used in the firm. We got to know about how the software development life cycles works in the firm.

### C. OOPs and JAVA Training

The mentors guided us through the OOPs topics such as abstract classes, inheritance, overloading, overriding, design patterns, etc. OOPS allows the programmer to think in terms of classes and objects which makes it easier to understand the problem and makes it easier to code. It gives a perspective of a software which is nothing but a set of interacting Objects. The Java training was conducted to explain concept of core java and give better understating of its fundamental and usage. Second part covered some important topics of Junit and Spring framework.

### D. WebTk Training

This training was conducted in two parts. The first part covered the basics of languages which are useful for angular development, like javascript and typescript. While the second part covered some important topics of angular framework that helped to develop an angular project using various angular properties such as components, communication between parent and child, observables, routing, forms, etc. I also covered some tracks on Pluralsight such as Javascript Fundamentals, Angular Fundamentals, Angular Best Practices. The tracks helped me to develop an Event listing application. At the end of the pluralsight course and training, we had made a demo e-commerce application which is shown in below fig 1.

DSA training was designed to understand about choosing the best possible data structure and algorithm to solve problem optimally. This was very interactive and problem solving session. The database training helped us understand the importance of database management and optimization.

The topics covered during this course were normalization, sql queries, tables, cursors, views, stored procedures. During the entire span of course, all interns were randomly divided into teams to design a database schema for a ecommerce website and exercise some complex queries on the same. The Operating System training helped us to understand basic OS fundamentals, CPU scheduling, process synchronization, processes and threads, memory management etc.

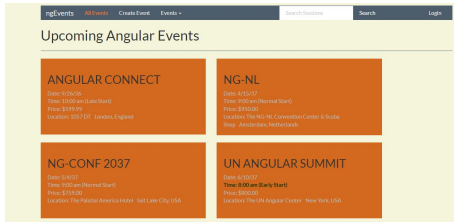


Fig. 1.

### III. OVERVIEW OF TECHNOLOGIES USED

#### A. Amelia

Amelia is the leading intelligent virtual agent, powered by Conversational AI. It is a cognitive software agent who interacts with users to solve a problem. This tool is used to build AI powered virtual Assistants for the applications. Amelia consists of the following four major components.

- Intent detection: Identify what the user wants/is trying to achieve. It uses ML algorithms and BERT modal to detect intent from user utterance.
- Entity Recognition: getting relevant data from the user during the course of conversation. It collects the data to gather useful information and use it for making other integration.
- Business Process Networks: For anything non-trivial the chatbot will need a dialog flow to follow. It defines the process that needs to be followed once the intent is detected.
- Integration: to be helpful and efficient a chatbot needs integration with the relevant systems. To perform various actions and to connect with other systems, databases integration is required.

Using these major components, Amelia communicates with user, understand the need and request of the user. It calls the rest APIs through integration flows, retrieve the data and build the output. It provides various formatting components to display responses to the user. This make the application more interactive and user friendly.

#### B. Spring Framework

The Spring Framework (Spring) is an open-source application framework that supports the development of Java applications by providing infrastructure support. Spring is one of the most widely used Java Enterprise Edition (Java EE) frameworks, allowing developers to design high-performing

applications with simple Java objects (POJOs).It is very helpful in generating Web service endpoints and definitions based on Java classes.

IoC, also commonly known as dependency injection (DI) as the name suggests is a method of injecting or defining their dependencies, i.e. to define the objects it is going to use or depend on. These dependencies are passed through the constructor arguments in form of arguments to a factory method. These dependencies are then injected by the container into Spring beans. Basically, Spring beans are the objects managed by a Spring IoC. Multiple beans can be managed by the Spring IoC.

#### C. Swagger

Swagger is a suite of open-source tools for designing, building, documenting, and consuming REST APIs based on the OpenAPI Specification. REST APIs are used to retrieve data from back-end services. This tool is used to generate interactive API documentation that lets users try out the API calls directly in the browser. By using swagger we can embed the rest endpoints in out front-end framework to do API calls.

Swagger UI: It is a traditional npm module designed for use in single-page applications that can resolve dependencies.Swagger UI allows anybody to visualise and interact with an API's resources without having any of the implementation logic in place. It's created automatically from the OpenAPI Specification, and the visual documentation makes it simple to implement on the back end and consume on the client side.

#### D. Angular Framework

Angular is a component-based framework for developing UI which is built on TypeScript. The Angular framework includes various developer tools used for building, testing, and updating the UI code easily.

Angular also provides services which helps in sharing of data between components that are not related to each other in any other way. It also helps in making the code reusable as same service can be used by multiple components for doing similar work.

Angular Framework gives the ability to include a large variety of inbuilt features from various libraries including routing, client-server communication, reactive and template driven forms, form validation rules, Observables, creating dynamic child components and many more

- ngx-bootstrap modal: ngx-bootstrap modal component is a flexible and highly configurable dialog prompt and provides multiple defaults and can be used with minimum code. The chat-bot is developed as a chat-overlay, modal pop-up on top of the regular application. User will be able to use chat-service in this popup view and interact with application. It has bsModal as a selector and provides some useful function such as showModal(), closeModal(), showElement(), etc.
- Lazy Loading: The process of loading components, modules, or other elements of a website when they're needed is known as lazy loading. All of Angular's components

are loaded at the same time since it builds an SPA (Single Page Application). This implies that a large number of unneeded libraries or modules may also be loaded. This might suffice for a tiny application. However, if everything is loaded at once, the load time will increase as the application grows. Angular uses lazy loading to load components and modules only when they're needed.

#### IV. PROBLEM STATEMENT AND APPROACH

##### A. Problem Statement

The application developed by my team is used to onboard new clients to Morgan Stanley following various regulation from different jurisdictions. This app has a vision to enhance all existing regulatory functions and bring all feature under one umbrella for legal, operations to onboard non AML programs in client centric view. As of now application does not have systematic self service controls and effective communications tools. My project is to make a Virtual Assistant which will give users best in class view to interact/communicate with application and get the real time help and retrieve the desired data.

##### B. Agile software development

My team follows a Agile software development methodology. The Agile methodology is a way to manage a project by breaking it up into several phases. It involves constant engagement with stakeholders as well as continual development at every stage. Teams cycle through a process of planning, executing, and assessing once the work begins. This methodology uses various frameworks like Scrum, Kanban, Extreme Programming (XP), and Adaptive Project Framework (APF) to implementing them.

My team uses scrumaban methodology that is a hybrid of Scrum and Kanban. Scrum is a project management approach in which a small team is led by a Scrum master, whose primary role is to eliminate any roadblocks to task completion. Work is done in short cycles called sprints. The team meets regularly to discuss current objectives and barriers. It includes Sprint planning, daily scrum and sprint retrospective cycles. Kanban is a visual method to project management in which teams create physical representations of their activities. Tasks are moved through predetermined stages to track progress. The stages include To do, Ready for development, In progress, In testing and Done.

##### C. Backend REST APIs

REST is an abbreviation for REpresentational State Transfer. When a client uses a RESTful API (Get, Post, Put, etc.) to save, fetch, or update data, it transmits the current state of the resource to the endpoint. JSON, HTML, PHP, or plain text are the formats in which this data or information is transmitted.

REST endpoints are used for communication between applications. Virtual Assistant needs to pull data from backend services based on different user requests. For that, I created various REST endpoints to our service which can be called from front-end web application and also using Amelia's BPN

flow. Which latter be used by Virtual Assistant which gets lazy loaded in app and uses this endpoints to pull the data and display it to the user. Our app is working on the highly-restricted data so user authentication must be there for endpoints of the back-end services. Moreover, this endpoints are exposed to Amelia tool which is a third-party app and some PII information may get compromised. To prevent that I have to implement data-masking in the REST endpoints.

PII information is Personal Identifiable Information which is defined as data that can identify a person directly or indirectly. Exposing this information outside this application is not permissible so this information need to be masked for any third party apps. For masking I used inbuilt ms libraries. Any user or third party app who is not authorized under this application the data will be masked in specific format before sending the response from rest endpoints and for authorized user it will be visible.

##### D. Virtual Assistant UI

Our main application is using Angular framework for its frontend development. Our requirement was to integrate the Virtual Assistant chat-bot as a modal popup in the web app. For this I used ngx-bootstrap modal component. All the functionality and service for the chat-service will be available in this pop-up. Also I used module lazy-loading to load all the Virtual Assistant components, so the complete module for this chat-bot will get lazy loaded in app once the Virtual Assistant button is clicked, which is placed in the main UI. The button is added on top of the main app web page.

Before using Amelia I manually created a chat-service that serves all the basic use-cases of this Virtual Assistant Project. The UI for this chat-bot is displayed in fig.2. I used this manual chat-bot to test my REST endpoints. It detects specific keywords from user input messages and calls respective endpoint based on detected intent. Then, it reformats the JSON response and display it to users. In some use-cases, it also asks for specific attributes to user that are needed to pull data from services.

I also build the Amelia custom UI for the Virtual Assistant. It uses AI/ML algorithm to detect user intents. Once the intent is detected it triggers appropriate BPN flows for the next steps. This BPN flows are need to be generated in Amelia tool separately for each use-case. It collect attribute values needed to call REST services in form of entities by analyzing the conversation and asking questions to user if needed. This whole process is handled by the triggered BPN flow. I haven't keep the images and the figure of the Amelia as well as angular UI of Virtual Assistant, because it is embedded to the main app of MS and hence I can't display that in this report according to firm's policy.

#### V. FUTURE WORK

Currently My all work is done under dev instance. In coming months, I will be testing my work using some frameworks like Junit, Mockito for backend services that are developed in JAVA. My work will also go through automation testing. Then,

all the work will be migrated to QA and UAT environment. After tested by users it will be ready to deploy in Prod. For Amelia, new domain for prod environment will be crated and I need to integrate it with backend service and move my work to this new domain. After testing it will be onboarded in our main app and deployed in prod environment.

#### CONCLUSION

My intern project provided me an exposure to completely new field, Virtual Assistant. I got deeper understanding of front-end development and technologies like Typescript, Angular, Rxjs, bootstrap, Swagger UI etc. I explored the back-end development using technologies like JAVA, Spring Framework, etc. and also connecting this front-end and back-end development and making it full-stack. I got a chance to learn about completely new tool Amelia for developing conversational AI. Key part of this project was to bring all this components and technologies together and implementing a complete Virtul Assistant for the firm's app. While implementing this project I got deeper understanding of the key concepts of Software Engineering such as Requirements analysis, Development, Testing, Implementation and Integration of the Software and got good experience of enterprise level application development. This internship also provided me a great exposure to Agile methodology of software development. Being interactive with my managers, buddy and other team members, their support and guidance helped me to overcome obstacles during my project development. I realised that working in a firm is more about process than a code.

#### ACKNOWLEDGMENT

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