**An AI based Chatbot for VMware Snapshot and Storage Troubleshooting**

Kiran Raj K  
Reva University, Karnataka, 560064, Bengaluru, India  
[Kiranraj.ba07@race.reva.edu.in](mailto:Kiranraj.ba07@race.reva.edu.in)

Amal Bhagat  
VMware Software Pvt Ltd., Bengaluru, 560076, Karnataka, India[abhagat@vmware.com](mailto:abhagat@vmware.com)Deepak Arora  
Reva University, Karnataka, 560064, Bengaluru, India  
[Deepakarora.ba07@race.reva.edu.in](mailto:Deepakarora.ba07@race.reva.edu.in)

Shinu Abhi  
Reva University, Karnataka, 560064, Bengaluru, India[Shinuabhi@reva.edu.in](mailto:Shinuabhi@reva.edu.in)

***Abstract*—** Chatbot **is an intelligent interactive platform that provides users with accessibility to important data they need through interactive dialogue. Chatbots have proven useful in various contexts to automate tasks, such as customer services, education, and e-commerce. Any business unit worldwide is challenged by need for information accessibility, reachability, and ease of conveyance because of widespread culture of working from home[1], and hence more users use chatbot virtual assistants to complete simple tasks in business-to-business (B2B) and business-to-consumer (B2C) environments. Chatbots have shown to be the ideal tool for e-learning, sales, customer support, information searching, and more. This paper describes integration of VMware troubleshooting techniques with IBM Watson Assistant chatbot on conceptual issues like Snapshot and Datastore categories. The virtualization technology that enables users to deploy multiple servers, known as Virtual Machines, on a single host is a key component of VMware's business model. Snapshots, which offer quicker ways to maintain virtual machine's memory state, represent the point-in-time state of machines. Datastores are the mounted storage locations on ESXi hosts that offer required platform for storing the data and Snapshot files for Virtual Machine. The main goal is to offer a 24/7 interactive, solution-based system that can quickly respond to end-user inquiries and find an immediate fix for problem categories identified for Snapshot and Datastore-related issues. IBM Watson powers the chatbot used in this project. The end-user is then given the most common errors as a sub-option after making appropriate issue category selection, followed by solutions.**

***Keywords*— *VMware Snapshot, Storage, Datastore, Chatbot, IBM Watson***

# Introduction

Since 1998, VMware has been a leader in cloud computing and virtualization. The business offers products like Network Virtualization NSX, Virtual Machine, vRealize, vCenter Server, ESXi Host, vMotion, Site Recovery Manager, vCloud Foundation, Virtual SAN, and vRealize Automation as part of its bundle of virtualization suites. Bots have already built a solid foundation in providing support services, application software, and user experiences that are redefining digital virtualization and cloud computing. Chatbots have further expanded their horizon toward providing a healthcare service using an AI-based chatbot. At the core of all chatbots lie the Natural Language Understanding platforms—referred hereafter simply as NLU. NLUs are essential for the chatbot’s ability to understand and act on the user’s input [2]. To address the massive demand for manpower in customer service, some companies have proposed automated customer service chatbots [3] that are intelligent, fast, and can substitute some human functions. However, artificial intelligence (AI) and natural language processing (NLP) technologies are still limited in replacing humans completely [4]. As a result, this project is inclined towards providing a system that enables end users to deal effectively and independently with both fundamental and current/hot challenges associated with VMware-specific related queries and issues. This paper aims to provide a user-friendly, interactive dialogue bot that can be accessed 24/7 to respond to user questions and assist in identifying and resolving issues with Snapshot and Datastore.

# Materials and Methodology

In this section, we will discuss various studies performed on the usage of chatbots in different business domains that in turn helped to build, enhance and optimize the chatbot created for this project.

According to Folstad's research study [1], chatbots with pragmatic attributes can lead to both favorable and unfavorable user experiences while also highlighting potential risks. Calversi's research [5] emphasizes the importance of personalized chatbot configuration and deployment to support users in multi-topic and multi-campaign behavioral change programs. Martin Hasal's work [6] emphasizes comprehensive insights into chatbot security measures and challenges. In Giancarlo's research [7], a micro-service architecture was designed to provide tourists with accessibility through a conversational agent based on the Seq2Seq model. The assessment framework showed that using GRU cells resulted in better outcomes in terms of accuracy and loss compared to LSTM. Guido Tascini's research [3] highlighted the need for chatbots to adequately describe complexity, interpret human language commands, and learn from interactions. Taejin Kim's research [9] demonstrated the ineffectiveness of constructing a fully functional and reliable information repository using a generic knowledge base. Instead, a substantial body of knowledge documentation and a finely calibrated encoder provided a more persuasive approach to constructing the COVID-19 database using the BERT pre-trained language model.

This section presents the precise steps required to understand the workflow of the Storage issue and Snapshot troubleshooting scenarios, along with the conceptual features and operation of the IBM Watson chatbot. The technique used to link the chatbot with the troubleshooting conversation for VMware snapshots and datastores is based on data point elements and their comprehension in the repository of VMware Knowledge-Base articles and documentation.

Diagram

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**Figure 1:** Basic Workflow of Snapshot Troubleshooting Chatbot

Pre-defined logical concepts and proper work process blueprints helped in the establishment of communicative discussions for chatbots. The discussion nodes were organized using grouped flowcharts, which determined the chatbot's responses to the questions posed by the users. To gain a thorough understanding of VMware Snapshots [8] and VMware Storage concepts [9] many documents and VMware KB articles were analysed. The entirety of the policies for mastering Watson Assistance was geared and gauged on the chatbot at its expert level, including the organized description of Entities and Intents and familiarisation with the Dialog boxes, as well as the appropriate relevant circumstances related to the queries and records created in Entities and Intents of Watson Assistance.

Along with the chat-theoretical bot's creation and viability, examination and verification of the Watson Chatbot integrated procedures for Snapshot troubleshooting and Datastore structural layout is very important. These processes rely on the essential elements to build a fully-fledged and functional chatbot and its accompanying parameters such as Intents, Dialogs, and Entities.

The vast majority of knowledge about Snapshot issues and Storage troubleshooting is derived from well-known VMware knowledge base articles [10].

Having a firm knowledge of storage and snapshot workflow, as well as their underlying conceptual ideas, is certainly required. The fundamentals of snapshot [11] can be understood in Figure 2 [12].

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**Figure 2:** Snapshot Disks Hierarchical Structure [12]

The ESXi Hypervisor uses a storage area called the Datastore to house all of the data, configurations, installation, and virtual machine-related files. The VMware storage architecture is shown in Figure 3.

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**Figure 3:** Storage Architecture [13]

A high-performance clustered file system called VMFS offers the Data stores reliable and effective storage virtualization.

The entire interactive chat workflow is depicted in Figure 4.

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**Figure 4:** The Chatbot interactive workflow

The project's next significant focus was on comprehending Watson Asistan's architectural design and conceptual operation. To begin building the bot, one must have an IBM Cloud account [14]. IBM Watson Assistant can be used to build customized branded live chatbots into any device, application, or channel [15]. An individual can interact with a chatbot via integration points, and the assistant will process their inputs to the dialogue skill layer which directs the flow of the conversation and responds to the user’s query. When the dialogue skill is unable to provide an answer, the search skill is invoked, which searches the company knowledge bases that are configured for the purpose to find pertinent responses [16].

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**Figure 5:** IBM Watson Architecture [16]

Additional components of Watson Assistant include these 3 key building blocks.

1. **Intents (prefixed with #):-** An intent is a collection of possible expressions that a user might use to convey a particular objective or notion [17].
2. **Entities  (prefixed with @):-** A component of the user's input known as an entity can be used to deliver a different response to a specific intent [18].
3. **Dialog Box:-** A dialogue is made up of nodes that define steps in the conversation that are chained in a tree structure to create an interactive conversation with the user [17].

The first step in creating a chatbot is to plan its objectives, processes, and business requirement. Next comes the infrastructure and resources utilized to develop and design the chatbot, hence, at this point, an effective chatbot application platform is very crucial and this project is designed on the IBM Watson Assistant chatbot [19]. Creating a chatbot includes the workflow of defining intents and entities to help NLU processing and designing structural dialogue nodes for the ease of conversational workflow to make the user sessions more interactive [17]. The intents and entities defined for this project can be accessed via the GitHub link [20].

# Results

Prior to the Watson chatbot assistant going live, IBM Watson offers a "Preview" capability feature that allows users to test the conversational dialogues and interaction responses.

In this option, a user can test the skills that are added to the assistant by entering text into the chat window and initiating a preliminary interactive session with the chatbot [21].

After building and testing the Watson Assitant, the chatbot is ready for deployment.

Depending on users’ preferences, various deployment modes are available in IBM Watson. To properly deploy a chatbot, it is integrated with an interface adapter that enables the assistant to communicate through a channel accessed by the end user [22].

In most cases, an assistant is deployed using one of these integrations.

* **Web chat integration**: This allows adding a safe and incredibly customizable widget to the website that can be modified per users’ preference and further customizable towards the theming to match per customer’s branding and website layout [22].
* **Phone integration**: The phone integration enables the assistant to converse with customers on the phone, using the IBM Watson Text to Speech and Speech to Text services [22].

# Discussion

With comparatively tiny data sets, IBM Watson Assistant employs machine learning and deep learning approaches to learn how to correctly respond to user questions. The Watson Assistant's artificial intelligence is built to recognize all possible combinations of intent as per real-world conversations. Watson Assistant has a new and improved intent detection algorithm, which is more accurate than commercial and open-source solutions in a recently published benchmark [23].

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**Figure 6:** IBM Watson’s improved intent detection algorithm [23]

To further enhance and optimize the Chabot created in this project, analysis is performed on a detailed conversation evaluation, chat dialogue functionality, and interactive responses to the “Issue & Error Selections” made by the end-users. The evaluation of the chatbot is performed depending on the end users’ feedback who were given access to the prototype demo version of the chatbot. And, after a month’s use, every participant’s feedback was recorded and worked upon to further improve the user interactive sessions and the ease of conversation dialogues to provide an accurate response. Based on the feedback, further enhancements were included as listed.

1. Included the Error not Listed option for unknown queries
2. Added “Go-To-Main-Menu” option to ensure the end users can navigate to and for at any given point in time
3. Provided options to toggle through various error categories

Enabled fuzzy match to round up and auto-correct the most relevant words, errors, and sentences

# Conclusion

The use of the IBM Watson assistant chatbot to troubleshoot issues relating to VMware concepts like snapshots and datastore was covered in this study. End users highlighted positive feedback after using the chatbot, especially on the ease of profound and clear interactive defined dialogues, and sessions were proven to be favorable towards finding quick resolutions and responses. Going through the preliminary studies and research papers helped to gauge the functioning of a chatbot and the resources required to build the platform to design, develop and implement a chatbot. The usage of Watson Assistant is very convenient as it has self-designed and integrated NLU-based algorithms and AI services [24].

Additionally, the chatbot is built on an IBM cloud-based platform that is easily scalable, secure in terms of security measures, and capable of ingesting, analyzing, and referencing updated documents. With each new intent, entity, and dialogue box created/modified, IBM Watson automatically trains and self-learns to update more sophisticated machine learning models. Because of these improvements and features included, the accuracy of Watson Assistant in the most recent model is **79%** [23].

Future updates will add more "Error categories," enabling customers to communicate with the chatbot and inquire about a wider range of VMware-related issues and concerns.

In the future, we want to equip the chatbot to detect an image as input data and deliver the user response by decoding the image using the AI-powered IBM Watson tool. Emojis, emoticons, and gifs may also be included as choices to enhance the interactions' creativity to provide human-like conversations. NLP techniques and algorithms can also be used to implement IBM Watson's Text-to-Speech and Speech-to-Text mechanisms, enabling chatbots to offer interactive sessions using both text and voice based[25].

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