Learning System Customer Service Chatbot

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ABSTRACT

Learning System Customer Service Chatbot is a computer application that interacts with users using natural language in a similar way to imitate a technical support representative using voice. This paper will develop a machine learning voice chatbot system for customer service based on Amazon Lex and Alexa Software Developer Kit (SDK) through extension of an Amazon text based chatbot. This system will gather questions and answers using a web administration interface. The voice chatbot will be based on natural language processing so we can improve human to machine interaction with learning systems customer services.

Author Keywords

Chatbot; customer service; learning systems; natural language processing.

ACM Classification Keywords

H.5.3 Information Interfaces and Presentation: Group and Organization Interfaces.

INTRODUCTION

Yellow Circle a free online learning platform for cloud computing is the subject of this paper. The company has reached more than 40,000 students that have signed onto the free platform since it launched in 2014. User growth has skyrocketed with greater demand for affordable tech education and a scarcity of affordable options to learn cloud skills. Like Codecademy and other coding sites, Yellow Circle provides a virtual learning environment for students in middle school and up to learn the complexities of cloud-based infrastructure, applications, servers and databases [1].

Limited by donated funding sources, the human resources to manage customer service at the educational not-for-profit Yellow Circle do not meet the requirements of 40,000 global users on a 24x7x365 basis. Currently, 4 part-time staff and up to 10 interns manage the questions as Yellow

Circles primary support as available. The problem is educational global students need personalized answers in real-time around the clock in a human voice as well as chat capabilities. What this project recognizes is the different learning and teaching styles of students as well as the technologies that can enable them such as chat or voice, hence the project name Learning Platform Customer Service Chatbot.

PRIOR WORK

This project builds on two prior papers.

In the project BuzzChat: Answers your OMSCS Questions set out to answer commonly asked OMSCS questions using an application developed with artificial intelligence [2].

In the project Evaluation of Modern Tools for an OMSCS Advisor Chatbot proposed an automated advisor for the OMSCS program in the form of a chatbot. A chatbot to answer student's questions immediately 24/7 [3].

This project extends these papers into voice technology using Amazon Alexa along with Lex Chatbot technology to provide advice to new and current students using a mock educational platform. Alexa Skills Kit (ASK) is used to build skills for use in the Alexa ecosystem and devices and lets developers take advantage of all Alexa capabilities. Amazon Lex bots support both voice and text and can be deployed across mobile and messaging platforms [4].

LEARNING PLATFORM

The Yellow Circle learning platform, the subject of this paper, is divided into a front and backend environment. The front end is built on WordPress. The backend uses OpenStack which is software controls large pools of computing, storage, and networking resources throughout a datacenter, managed through a dashboard or via the OpenStack API [5].

OBJECTIVE

This project simulates the interaction between student users of YellowCircle.net extending a text-based Amazon chatbot with a voice-based chatbot. The simulation front-end will include a simulated front-end YellowCircle.net environment that includes a text chatbot and a separate Alexa voice chatbot. The back-end will include question and answer content, natural language processing, ability to find answers to questions, and user authentication to enable the access.

CHATBOT TECHNOLOGY

Chatbots are computer programs that mimic conversation with people using artificial intelligence. They can transform the way you interact with the internet from a series of self-initiated tasks to a quasi-conversation [6].

A conversational chatbot is a tool that uses natural language processing (NLP) for human-machine interaction (HMI). Historically, chatbots were used for entertainment. With the goal of tricking a human into thinking they were talking to another human. Modern chatbots are tools used to convey information [3]. Kane D. (2016) noted that chatbots, with their pattern matching, natural language processing, and ability to connect multiple patterns to one response, are a natural fit for providing reference and instructional assistance [7].

Conversational Agents

Conversational agents, or chatbots, provide a natural language interface to their users [8]. Their use has been adopted to both education [9] and customer service (10).

Customer service chatbots can be roughly categorized into two types: first-party and third-party. First-party chatbots refer to conversation engines developed by large enterprises for their own business to improve customer service quality and reduce overall customer service budget. This often happens in consumer-driven industries such as banking, telecoms, and e-commerce. Third-party chatbots refer to open source building blocks that help developers to build their conversation engines, such as Microsoft Bot Framework, Facebook Messenger, Google Assistant, and Amazon Lex (11). In this case, this chatbot is using Amazon Alexa Software Developer Kit (SDK) and Lex which are considered a third-party chatbot.

An important part of conversational chatbots is the building of dialogs. This can be viewed in the following Figure 1. In building a dialog, it is always assumed that there is an example of no response from the bot and then known answers.
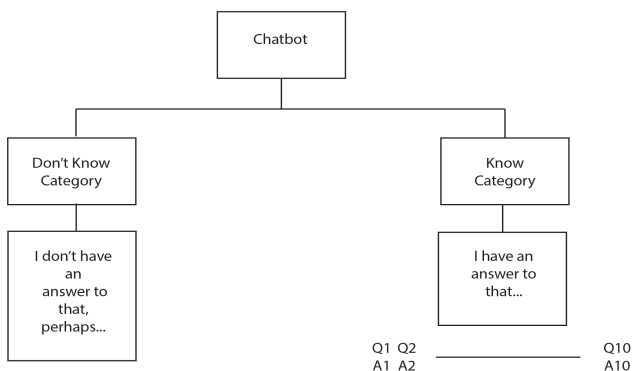

Figure 1: Categories of Responses

As an example dialog of a conversational agent, the following Figure 2 demonstrates the question and response. The dialog window can be embedded on the website.
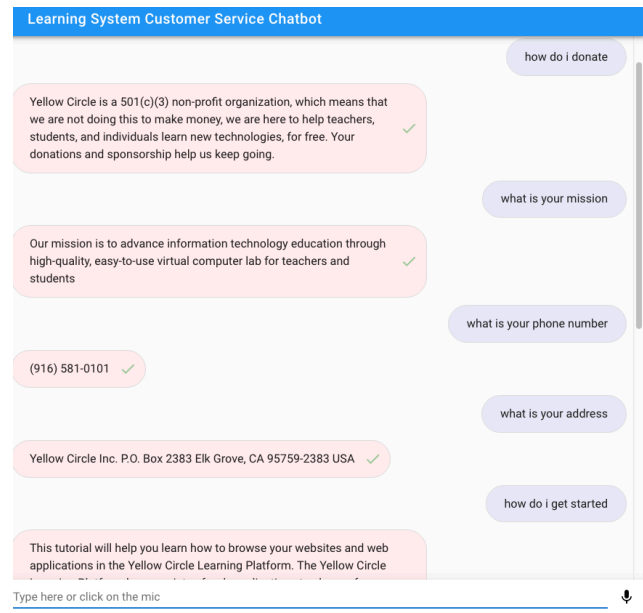

Figure 2: Example of Dialog

The voice-based chatbot is an extension of the conversational agent and uses an intelligent speaker connected to the cloud. The project uses an Amazon Echo. It is hands-free and always on—you can ask Echo for information, music, news, sports scores, and weather from across the room and get results or answers instantly. Echo leverages Amazon Web Services to continue to learn and add functionality over time [12]. In this project, the same set of questions and responses were utilized through a JSON file. The Amazon Echo used in this project is in Figure 3.

Figure 3: Amazon Echo

Chatbot Design

Amazon Lex uses AWS Lambda functions to implement the business logic for a chatbot. At the conceptual level, it includes six logical functions:

1. Bot – A bot contains all of the components of a conversation.
2. Intent – An intent represents a goal that the bot's user wants to achieve (buying a plane ticket, scheduling an appointment, or getting a weather forecast, and so forth).
3. Utterance – An utterance is a spoken or typed phrase that invokes an intent. "I want to book a hotel" or "I want to order flowers" are two simple utterances.
4. Slots – Each slot is a piece of data that the user must supply in order to fulfill the intent. Slots are typed; a travel bot could have slots for cities, states or airports.
5. Prompt – A prompt is a question that asks the user to supply some data (for a slot) that is needed to fulfill an intent.
6. Fulfillment – Fulfillment is the business logic that carries out the user's intent. Lex supports the use of Lambda functions for fulfillment [13].

Implementation of the Learning System Customer Chatbot is as shown in Figure 4. This figure displays 12 components of the implementation as described:

1. User – The end-user or an administrator of the system.
2. Echo – A smart speaker created by Amazon.
3. Learning System Website- A mock site to simulate the front page of Learning Circles website.
4. Alexa Skill- An intelligent voice service using Amazon Alexa Skills Kit. The Alexa Skills Kit (ASK) is a collection of self-service APIs, tools, documentation, and code samples that makes it fast and easy for you to add skills to Alexa. ASK enables designers, developers, and brands to build engaging skills and reach customers through tens of millions of Alexa-enabled devices [14].
5. User Interface (UI) and Content Website- SDK provides the ability to interface with the Bot through a website.
6. Fulfillment- The Lamda interface for the application that provides a response back to the user based on their input.
7. ElasticSearch Knowledge Base- An distributed search and analytics engine built on Apache Lucene [15].
8. Bot- An Amazon Lex Bot that provides natural language processing [16].
9. Cloud Front- Amazon CloudFront is a global content delivery network (CDN) service that securely delivers data, videos, applications, and APIs to your viewers with low latency and high transfer speeds [17].
10. Cognito- Amazon Cognito provides solutions to control access to AWS resources from your app. With this tool, an administrator can define roles

Figure 4: Design Diagram

and map users to different roles so your app can access only the resources that are authorized for each user [18].

11. Content Designer- SDK based web administrator interface to input questions and potential responses.
12. Content Designer API Gateway- Provides Rest-API for the web user interfaces.

RESEARCH CHALLENGES

As other researchers have reported, challenges remain in building a chatbot. While the idea of composing server-less functions is quite appealing, it lacks certain aspects that would hinder its long-term wide adoption and smoother composition of services. We broadly classify these aspects into four major categories: Programming & Debugging, Performance, Monitoring, and Security [19].

Programming & Debugging

During development and debugging several problems were encountered. As a serverless architecture, debugging relies on logs and monitoring tools. This required using additional services and disk space to accommodate the logs. For example, it was determinable that some characters were acceptable for text response, yet not acceptable for voice response through reviewing logs.

Monitoring

During the testing phase of our research, we logged over one million transactions on the server-less architecture. This is critical to realize from a cost perspective. In a server-based environment, the billing is based on the time the CPU instance is active along with other factors such as disk and memory [19]. Whereas in the server-less environment the billing is based on the execution time of the code. This required additional logging as well as alerts of billing.

Security

The initial environment required the use of a security role using Identity and Access Management. This allowed for a separation from the root account used to control the entire account. It also lowered the security risk of running an application but providing only the access level needed.

On extending the environment to use an Amazon Alexa Skill, it was discovered that bi-directional security between the existing chatbot and the Alexa Skill were a best practice.

To extend the environment to 3rd parties Facebook or Slack application APIs were available with the additional configuration on both Amazon and with the 3rd party.

CONCLUSION

In this work, we presented a learning system customer service voice chatbot using the Amazon Alexa SDK along with several services. The chatbot was used a SDK serverless architecture and presented itself both in text and voice to the end-user.

Our on-going research work is pursued along the following dimensions. First, we plan to extend the question set beyond ten to better support the customers of Yellow Circle. Second, we plan to extend to localized languages as Amazon extends its languages available globally. Third, we would extend the chatbot to 3rd party social media sites.

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