Using Amazon Echo as a Framework to Communicate Patient Results from CASAS Smart Homes

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Abstract

CASAS smart homes, which monitor the activities of elderly populations, have provided large, reliable data samples over the past several years; the next step is finding a way to effectively present this data to nurses, healthcare professionals, and family members. Amazon Echo, a voice activated wireless speaker, fits well for this project because it is user friendly, making it an appealing option for users who want quick and simple updates about how their patients are doing. Using Echo, one can ask about a patient's current state of health and Echo will process and return a concise response to give an overview of the patient's condition across any time period. To implement this project, we will also design a prototypical data framework using RabbitMQ which will analyze sensor responses received from CASAS smart homes and prepare it to be used by potential clients (phones, websites, etc.) including Alexa. This processing framework will also serve as a basis for future projects such as smartphone integration, employing new data processing algorithms, and adding new types of sensors for expanded and improved monitoring. We predict that using Amazon Echo and our processing platform will make data more accessible and comprehensible, thus expanding our user base while making it easier for current caretakers to monitor patients.

Introduction

- Smart Homes developed by the Center for Advanced Study of Adaptive Systems (CASAS) under the smart home in a box program (SHIB) are designed with the purpose of finding a way to let elderly patients live independent lives as long as possible. Usually, these elderly patients have a nurse or relative who will occasionally check in to make sure they are safe and healthy. Our goal is to use the data we receive from the smart home to develop a remote monitoring system for caregivers to easily check in on their patient's activity anytime.

- Our objective was to develop a system which integrates Amazon Echo into the current SHIB environment. We hypothesized this would make it easy and intuitive for caretakers to use smart home data to monitor and understand the habits of their patients.

Related Work

Most commercial work related to smart homes is focused on controlling and securing the home, rather than focusing on monitoring the occupants like SHIB. When they do attempt to monitor, such as for a security system, they rely on cameras and simple sensors for monitoring rather than using machine learning with an array of sensors. Though sensors are not as accurate as cameras when it comes to certain activity monitoring, sensors are both cheaper and less invasive in the patient's lives, causing people with price and privacy concerns to be more likely to adopt our system rather than others on the market currently.

In addition, most conventional systems on the market use phone or tablet technologies to communicate data to their users. We chose to use Amazon Echo as our platform for now because we want to test if a voice activated system will interface well with users.

Implementation

- Initially, we used the work of Dr. Zulas and Dr. Crandall to identify the primary activities that caregivers wanted to monitor and how our system could be structured to track these. Some examples of the activities include time spent sleeping, number of times eating, and the amount of times the house was cleaned.

- We then grouped these activities into several broad categories: activity, medicine, hygiene, sleep, and nutrition.

- Due to technological and sociological limitations, the system needs to be able to go from question to answer in less than three seconds.

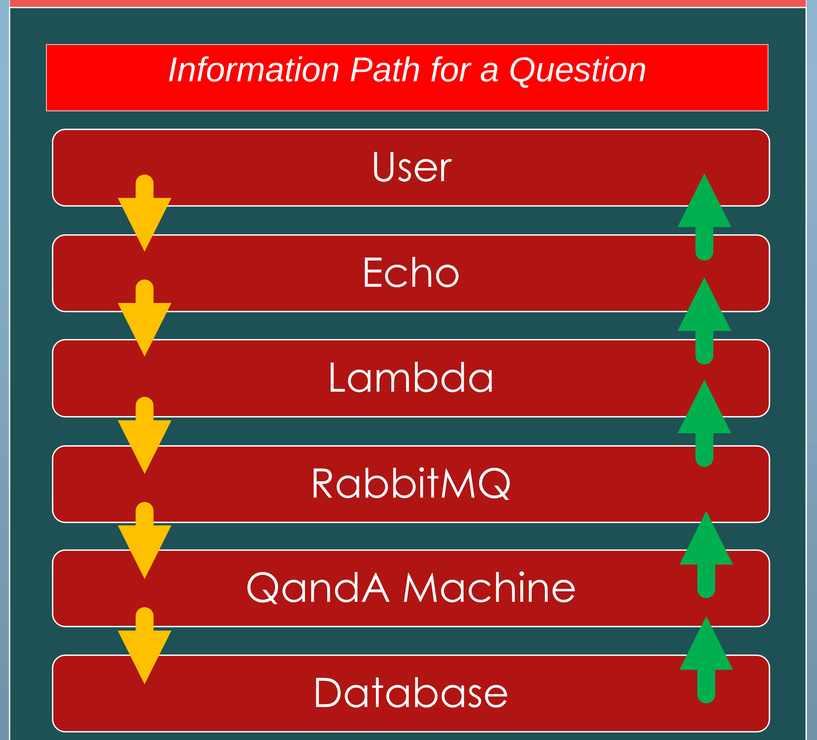
- Users ask their Amazon Echo unit a question regarding the activities of their patient. Their question is handed off to a remote Amazon Web Services Lambda program to be processed into a formatted JSON query.

- This question is then routed through a RabbitMQ messaging server to the Question Answering machine, a server we designed to be a general purpose scalable platform for quickly retrieving analyzed patient data.

- The Question Answering machine returns statistical data from a database pertaining to the requested topic and patient back to Alexa.

- The Lambda program then analyzes the statistics and converts them into a response for the Echo to say back to the user.

- Test users were asked to test the system out with some sample data we acquired by asking questions about a patient's health for a day, week, month and year.



Results

- The interface was able to successfully interpret questions and accurately relay answers in a format that was generally understandable.

- By using a data processor which calculates statistics as the data is being loaded into the database, our system cuts down on the requisite query time.

- People responded generally positive to a demonstration. Giving such comments as
  - "I believe that this app could help a lot of people better understand their loved one's conditions
  - "I like how easy it is to use"'
  - "It's neat what you've done with the concept"

- Due to the positivity of the user feedback and the resilience of the system under heavy testing, we confirmed its viability and effectiveness.

Future Work

- The project gave us many ideas for ways to upgrade our system and make it more accessible for all users:
  - Create an Android and IOS app using Amazon's Alexa Voice Services platform to increase the prospective number of homes and increase functionality.
  - Improve the QandA Machine so that it can give more complex answers and interface with multiple different CASAS systems.
  - Perform a full user experience study to determine the most effective way to deliver information and what people want more of from the system.
  - Create a 'story-telling' algorithm to have the processor dynamically create reports as data arrives.
  - Improve the machine learning algorithms which furnish the data to prevent errors.

References

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