HAL: A Conversational Al Agent For Smart-Home Automation (Live Demo)

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WHAT IS HAL?

- HAL is a voice enabled conversational AI agent
- It brings natural language understanding to industrial-scale IoT
- It leverages machine learning, intent recognition and Natural Language Understanding (NLU) to think, act and respond to user queries
- Thus, HAL provides a human-like interface to Smart Home devices



BACKGROUND

- IoT devices have diverse purposes and help solve problems in multiple domains like energy, healthcare, retail, etc.
- Due to this, these devices communicate data in different formats, syntax, and semantics, depending on specific industry standards
- This heterogenous representation of data prevents interoperability
- And makes it difficult for users to find the required information



MOTIVATION

- Other problems with smart-home devices include:
 - the need to issue precise commands
 - use smaller voice commands
 - being limited to pressing a button or gesturing in order to get a response from an IoT device
- We need to unify experiences across multiple connected things and provide an improved intelligent user experience
- Conversational AI bridges that gap by conveying data about the various interconnected devices back to the user in a simple humanly understandable way

SMART HOME AUTOMATION

- Consider a smart home with multiple IoT devices, such as sensors embedded in (or in close proximity to) appliances like sump pumps, motion and temperature sensors
- HAL is a proof of concept designed to monitor, control and query these IoT devices via a natural language interface
- It also supports advanced services like:
 - conferencing in a plumber, if the sump pump stopped working
 - setting up SMS alerts, when temperature in the house reached a certain level
 - predicting the life of the pump, by dynamically executing models based on sump pump usage



High Level architecture of HAL

 HAL microservices can be classified into 3 categories: Telephony System, Conversational AI Agent and Smart Home

 FreeClimb by Vail, allows users to integrate telephony technologies into software with a simple API



LIVE DEMO

HIGHLIGHTS

- The assistant has an understanding of context in the conversation
 - It has the ability to remember what the user has said before
 - It can understand and respond to new and unexpected inputs, regardless of whether this input was in the training data, or not

- When was the pump installed? -> What is it's life expectancy?
 - It understands that the 'it' refers to the pump
- What is the temperature in the kitchen? -> What about the living room?
 - It understands that we are asking about the temperature of the living room

DEEP DIVE INTO AI ASSISTANTS

- Al assistants have to fulfill two tasks:
 - understand the user
 - give the correct response
- HAL is based on Rasa, an open source machine learning framework, used to build contextual AI assistants and chatbots
- Rasa comprises of 2 parts:
 - NLU: to understand user messages
 - Core: to hold conversations and decide what to do next



DIALOG MANAGEMENT

- Rasa NLU is a Natural Language processing tool for intent classification and entity extraction
 - Intents: describe how user messages should be categorized
 - Entities: relevant information in a user message, like dates and addresses
 - The NLU is trained on multiple ways a user could ask something

NLU turns free-form text into structured data

DIALOG MANAGEMENT

- Rasa Core is a dialog engine for building AI assistants
 - It decides what to do next,
 - based on machine learning models, trained on example conversations
- Things run by the bot in response to user input are called actions
- Actions include a simple text response, making an external API call, or querying a device, etc.
- **Policies** based on neural networks predict the next action, with a certain confidence score
 - The policy with the highest confidence is used to make the decision

HOW DOES IT WORK?



How an AI assistant responds to a message

- I. A message is received and passed to the Interpreter, that extracts intents and entities from it (NLU)
- 2. The Tracker object keeps track of the conversation state. It receives the incoming message
- 3. Policy get current state of the tracker
- 4. Policy decides which action to take next
- 5. Chosen action is logged
- 6. A response message is sent to the user

CONCLUSION

- The idea behind HAL is to bring natural language understanding to industrial-scale IoT
- Through a general-purpose, AI/ML powered, communications platform
- Other areas of application include automation of clean rooms, laboratories, monitoring of smart buildings, and pretty much anyplace that has IoT devices
- Also, HAL is multi-modal, i.e. the same assistant can be used via channels of communication, other than voice, including Facebook Messenger, Slack, SMS, or your own website

Thank You Open to Questions!

