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Development and Evaluation of a Service Bot in the e-Government Sector

Bachelor Thesis
am Fachgebiet Agententechnologien in betrieblichen Anwendungen und der Telekommunikation (AOT)
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Abstract

Though not a recent phenomenon, chatbots and voice assistants are gaining an increasing attention. While still emerging with no defined standards or set protocols, with their hype on the rise, tensions between industry giants with products like Amazon's Alexa, Apple's Siri, the Google Assistant or IBM's Watson unveil new examples in favour of providing an enriched user experience to the consumer. The surrounding ecosystem also plays a major role in widening the platforms available while exploring new horizons with alternative approaches and business models. Today voice assistance are already present around the house, in the car or on the go but are still a new terrain to discover and great potential to unleash.

One such use cases involves providing service bots in the public sector. In this work, we are going to explore Amazon's Alexa and respective platforms to develop a voice assistant for the local city council extending the chatbot's functionality available on service.berlin.de. We will touch on the technical challenges and possibilities in implementing a system for eGovernment inquiries and touch on its usability as well as effectiveness in replacing a traditional lookup service. We will then examine the goals we define for our use case to what we were able to achive with the available APIs and SDKs. With respect to these, we will also report on the limitations developers could face in the process.

Finally, we aim at analysing the current state for voice assistants and the future of this trend from a technical and a social point of view.

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Chapter 1

Introduction

talk about approaches (retrieval-based models / using ML / NLP...), modularization and Einteilung of the paper

1.1 Motivation

Human interaction with machines on an advanced level has always been an aspiration of the future. With evidence in fiction readings Sci-Fi films citation, societies have shown an increasing tendency to avail technologies that make computers present in most domains of our daily lives. And though we still are far from it, we have come a long way in the recent years. With the boom of artificial intelligence and devices making high processing power a tangible option statistic from graph about messenger surpassing social networks - Screen Shot 2017-11-19 at 17.15.18 More and more people ”trust” new technologies and the trends resulting from there, be it social media, alexa, selfies and no.. ripple effect - More use ’hey Siri’ -¿ results of data collected, what we know about people more than ever before

1.1.1 history of bots

- then: eliza psychoanalyzer
- now: Xiaoice: empathetic bot in china

1.1.2 Why Bots?

- den menschlichen Aspekt suggerieren(**?**)
- menschliches Verhalten immitieren
- smalltalk fähigkeiten

- imagination about ablitiy to react to everything
- how these are centralized at alexa somewhere -¿¿ SKILLS, amazon.com
- what are classic use cases for their use with prominent examples? Booking tickets (KLM bot),
- fun bots and more - unfortunately forums and FAQ pages are not as effective as talking to a human.
a- then again, as a customer, if i want assistance, I want the customer to tell me a model number etc.

1.1.3 Can they replace humans?

Although not impossible, it is a bit too far-fetched at this stage.
- Difference between bot and human in response
human says long sentences and there is a fluid transition between dialog and monologue
-con: the bot wants a sentence yesharra7a f 7etat soghayara w neshouf..nicht unendlich lang
- otherwise, error margin too large.
- this has to do with human language complexity.
Why can't robots understand us
- language is ambiguous, we need to understand context
–Syntactical: Homonyme
–Semantic: Methaphors, sarcasm, and puns

–dialects: enunciations
–underlying grammar
–underlying sentiment

-progress in NLP making bots great again
-neural networks: help understanding language patterns and get better over time
thought vectors: helps connect different words with related meaingns

chatbots as enablers in customer service industry
reply suggestions function - with the aforementioned techniques, such functionality becomes possible

- it would speak as an advantage for bots if they can determine these things automatically z.B.
- besides, I could be a bit more sure in customer support scenario that a bot won't trick me
- as a novice I am usually not sure if the help article / Kbase I am reading is the right one

- and forums have mostly Schrott anyway.
- what bots already achieved is at least not to give wrong answers.
- they could sometimes say idk, which is annoying, but at least it doesn't confuse the user.
- next step is to get around the user's frustration by making the bot at least more human.

1.1.4 Topology of Bots

-use cases and purpose categories (leisure, productivity) - quick survey of respective 'AppStores' -platforms -physical locations (home, office, car, phone, in a business)

1.1.5 Information bots

- mention available service types (information system as a "webpage/database")
- vs an interactive bot that gives you customized information on demand hier soll der D115 Anwendungsfall "Beauskunftung" kurz erläutert werden

1.1.6 social bots

- with advantages / disadvantages
- fake news / online reviews

1.1.7 bot-type

- use of ML Handyversicherungsbeispiel
- from business perspective, the bot is aiming to sell more polices,
- the bot tries to determine if there is a nuance in the user's answer (machine acting as a judge!) - e.g. "how did the phone fall off" - MKTG - Aufwand

1.2 State of the Art

1.2.1 API.ai

1.2.2 Facebook Messenger Chatbots

1.2.3 wit.ai

1.2.4 motion.ai

1.2.5 Alexa Skills

1.2.6 Amazon Voice Service

1.2.7 Amazon Lex

1.3 Approach and Goals

- making the bot become something beyond a Q&A:
- Alexa Documentation
- retaining sessions (explain requests/responses - GET/POST)
- fullfilling intents
- nested handlers

- for facebook: implementing the three-answer suggestions

- internationalization / customization based on Locale - why is it important?
- many international users prefer a chatbot than a phone since the bot will commmunicate more accurately, will not have language probs if it understands the foreign lang etc.
- what are other approaches to localization? refer to IRS lecture notes
- use of translators, Stammsprache, etc., detecting the language and say it does not support it.

- Alexa Skill will work in germany in english and german -¿ add english after german
-AL: Anschließend soll das Ziel der Arbeit formuliert werden: Entwicklung und Evaluation eines Prototypen für den Anwendungsfall.

1.4 Structure of the Thesis

Chapter 2

Background

2.1 D115

- summarize infobroschuere_ BMI08324_screen_barrierefrei.pdf
-Use case im Detail
-Welche Daten gibt es?
-Was sind die Erwartungen?
- wie kann man die Güte des Systems beurteilen?
- Meist sollte man in diesem Kapitel die Lösung schon im Auge haben, um die Erwartungen so zu formulieren, dass die Lösung auch geeignet ist?

2.2 Frameworks and Data Structures (change title)

-AL: Ich würde erst etwas die Algorithmen und Datenstrukturen (Textanalyse, JSON, ggf. Graphen beschreiben. -AL: Anschließend die Frameworks vorstellen
-AL: Wichtig ist: Aus den Beschreibungen eine Schlussfolgerung ableiten, welche Art von Lösung entwickelt werden soll.
for current bot:
- Lucene **as the golden standard**: spell check, unscharfe suche, Tika / detect language / ...
- Solr - explain what's an intent, whats a slot `https://service.berlin.de/virtueller-assistent/virtueller-assistent-606279.php` `https://www.itdz-berlin.de/`

2.2.1 Intents and Slots

provided in JSON for value lookup, there are

explain json

- 616 Intents as `data`, each containing
  - `<string> responsibility` denoting in which city halls a service is available
  - `<boolean> responsibility_all` a flag set to true in case the service is available in all local authority offices / service points
  - `<HTML list string> description` not unified and includes text
  - `<string> not unified and might need to have an \lstinline`int— added to it and set to 0 in case service is free
  - `<int>residence`
  - `<int>id`
  - `representation`
  - `<long>leika`
  - `<string> process_time` need to derive minimum, average and maximum service times instead of a string, as well as conditions
  - `<string> name` the name of the service that would make sense to a human
  - `<node> appointment` with
    - `link` (Key value with URL to /terminveinbarung page) - check if orphan or if it is for each behörde and in that case how it gets the right one
  - `<node> locations`
    - `hint`
    - `<int> location` one of the 12 authorities
    - `url` of that service at that authority
    - `<node> appointment` (a second one)

      .
  - `<node> onlineprocessing`
  - `<node> prerequisites`
  - `<node> links`
  - `<node> relation`
  - `<node> legal`
  - `<node> requirements`
  - `<node> forms`
  - `<node> authorities`
  - `<node> meta`

missing variables e.g. are required papers, flag: persÃ¶nliche Vorsprache ja nein, ...

2.3 currently deployed bot

- dienstleistungen.json structure (finding the info through hierarchical nodes)
- interpreting the nodes as intents - traversing the nodes (one level up then to next node)
- no session/no persistence

2.4 Implementation Possibilities

- structure of Hitlist on berlin.de is provided by ITDZ - as opposed to Versicherungsfirma z.B (ML tries to detect irregular patterns in case customer is lying). - unfortunately forums vs. FAQs did not work. if i want assistance, i want the customer to tell me the model number - and forums have mostly Schrott!
what the bot curently achieved is at least not give wrong answers, sometimes says idk but it doesnt confuse u. same attitude like in german shops (nur unpassende antworten sind frustrierend!

-Vorgehensweise: XML -¿ index über Lucene - ¿solr knoten...based on sth like when i say äm 10. augustït gets me masalan events..aha august ist ein monat, monat relates to calendar, calendar relates to events

Chapter 3

Implementation as Facebook Messenger Bot / Google Action

- as an example for text
- implementing the answer suggestions as buttons
- passing data to the BÃ¼rgeramt terminseite
https://console.dialogflow.com/api-client/
https://console.actions.google.com

Chapter 4

Implementation as Alexa Skill

- as an example for voice
-System Specifications
-System Structure
-UML Diagrams
-Design Choices
-scopes and granularity

4.1 All about Alexa

https://en.wikipedia.org/wiki/Amazon_
Alexa https://medium.com/@robinjewsbury/
how-to-create-bots-and-skills-for-facebook-messenger-and-amazon-echo-4
- Alexa Appstore had over 5,000 functions (”skills”) available for users to download,[18] up from 1,000 functions in June 2016. McLaughlin, Kevin (16 November 2016). ”Bezos Ordered Alexa App Push”Paid subscription required. The Information. Retrieved 20 November 2016.

Perez, Sarah (3 June 2016). ”Amazon Alexa now has over 1,000 Functions, up from 135 in January”. TechCrunch. Retrieved 5 August 2016.

4.2 Difference Between Lex and Alexa Skills

https://stackoverflow.com/questions/42982159/
differences-between-using-lex-and-alexa#URL
https://aws.amazon.com/lex/faqs/
https://aws.amazon.com/about-aws/whats-new/2017/09/
export-your-amazon-lex-chatbot-to-the-alexa-skills-kit/

Amazon Lex is a service for building conversational interfaces using voice and text. Powered by the same conversational engine as Alexa, Amazon Lex provides high quality speech recognition and language understanding capabilities, enabling addition of sophisticated, natural language ćhatbotsťo new and existing applications. Amazon Lex reduces multi-platform development effort, allowing you to easily publish your speech or text chatbots to mobile devices and multiple chat services, like Facebook Messenger, Slack, Kik, or Twilio SMS. Native interoperability with AWS Lambda, AWS MobileHub and Amazon CloudWatch and easy integration with many other services on the AWS platform including Amazon Cognito, and Amazon DynamoDB makes bot development effortless.

4.3 APIs and SDKs

- swagger for handling JSON requests?
- `https://github.com/alexa/alexa-skills-kit-sdk-for-nodejs`

4.4 challenges

- und Lösungen dafür
- eine Überführung in Alexa, not writing everything new in alexa. such that when you want to do it in another system what do u want to integrate?
- use external web service maybe? in case that helps instead of alexa doing everything..
- konten hosting to be on alexa
- wo hilft mir alexa, was mach ich lieber woanders?
- Ähnlichkeitsmaße -levenstein-distanz, IFTTT

Chapter 5

Evaluation

-benchmarks
-strengths and weaknesses
-challenges
-performance
-usability
-feasibility of using the studied agents
- node.js?
- amazon's system testing options (incl. Betas)

- system usability scales (ISO, DIN)
- Con: Alexa skills are listed in the amazon shop page. Sehr unübersichtlich
just like prime
- impression: Amazon collects data and makes something "intuitive out of it for you". e.g. fire stick setup already had account linked before connecting to the internet! scary/funny/ but then it could be counterintuitive at some point if u want to do ur own customizations.
- removing bias in recriutment of participants (diversify based on what categories?)

- EVAL: AUC/ROC, true positives, false...no of utterances to text
- compare with Wiener Stadportal as a benchmark for a bot
https://www.wien.gv.at/bot/ http://www.vienna.at/wienbot-chatbot-der-stadt-wien-informiert-als-virtueller-beamter/5590853 https://digitalcity.wien/wienbot-auszeichnung-fuer-chatbot-der-stadt-wien/ singaporebot

5.1 Results

usability metrics: - heuristic eval - guidelines **(jakob nielsen, ralf molich whitepaper)**
– biggest usability flaw
- cognitive walkthrough
– step-by-step approach
– questions..wil the user tr and achive
- pluralistic walkthrough
– panel method
- hallway testing
- A/B Test
- speed and Bottlnecks

- clientele: census / SOEP, who can use the bot
- make a small prediction (Bus Analytics)
- this Hassloch thing from MKTG

5.2 Discussions

- Evaluate the system:
- is it trivial to build such a bot or not / what is the aufwand
- how does it react with longer sentences? some service names are long
- what does levenstein distanz cause
- wie leicht kann ich eine antwort finden auf das was ich suche?
- how am i going to classify my tests?

- are chatbots being pushed on the market or is there a demand? (kleine Umfrage basteln?)
- how easy or difficult it is to make a bot: planing poker - varianz anschauen zw. leicht und schwer und iterativ darÃ¼ber sprechen
- wo kann der Kunde (Sawa2 kan el end user or the senat in our case) help optimize the bot masalan bÃ¼rgeramt beyektebo, welche Rechtsgrundlage k̈eine-̈ auffällige Probleme masalan zay Perso, PA, personalausweis, how to introduce ëxpert modeš̈o that if u add it with a special character it knows what u want, just like alexa knows when u rename the lamp - refer again to use cases and exper vs personal field

Chapter 6

Conclusion and Future Work

6.1 Summary

6.2 Conclusion

6.3 Future Work

- use machine learning to rank higher demands for more popular services.
- matkhoshesh fel 7etta di awi - for now hitlist already given.
- future of bots. deren Einsatz. roles (As judges, catereres in hotels (that hotel botler)

Bibliography

[1] Hostname. PresName - Radio Replay: I, Robot. Hidden brain podcast. https://www.npr.org/player/embed/577622555/577666380 (25 January 2018).

Appendices

Appendix A: Abbreviations

AWS	Amazon Web Serivces
ASK	Alexa Skills Kit
AVS	Alexa Voice Service
ARN	Amazon Resource Name
MVP	Minimum Viable Product

Appendix B: Glossary

Intent	erklärung
Slot	erklärung
Utterance	erklärung
Alexa	erklärung
Alexa Skill	erklärung
Lambda Function	erklärung
Alexa Skills Kit	erklärung
Amazon Developer Console	erklärung
AWS Lambda	erklärung
Amazon Lex	erklärung
Amazon Polly	erklärung
ElasticSearch	erklärung
node.js	Framework built on top of JavaScript
Interaction Model	erklärung
Service	bot, AWS, Berlin.de
https://docs.aws.amazon.com/general/latest/gr/glos-chap.html	
Application ID	erklärung
Skill ID	erklärung
Bot	Unless otherwise mentioned, yeb2a Cha
Hitlist	erklärung