

Initial Plan: Conversations with Mother

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Project Description

Collaboration between humans and computer systems has taken place in one form or another since computers were first invented. It can be almost universally agreed that there are certain areas in which humans excel and other areas in which we are thoroughly outmatched by automated systems^[1]. In the early days of computing this was most evident when computers were used to supplement humans in complex calculations, information storage, or analysis of very large data sets; a famous example of this being the Colossus machines which were used to aid cryptanalysis in the 1940's.

More recently computer systems have increased in complexity and capability to a point where they are able to more directly collaborate with us on certain tasks. This collaboration is important because it allows us to take advantage of the differing capabilities afforded by humans and machines. In most cases this results in the human being given the role of 'decision maker' and machines being used to support us, either through the use of automation or by providing relevant information (data to decision process)^[2]. The degree of automation is determined by the complexity of the tasks, the capability of the machine, and the cognitive workload required to carry out the task. In the SRK taxonomy^[1], tasks are broken down into skill-based, rule-based, and knowledge-based categories with automation being most easily applied to skill-based tasks while knowledge-based tasks lend themselves to human decision making.

The goal of this project is to allow users to interact with a smart home device, the "Sens.se Mother"^[3], to gather information about the state of their home as measured by the device's sensors, which are themselves "internet of things" devices; having a variety of sensing capabilities, with event feeds generated depending on the applications installed. While this would fall under a low level of automation, the collaboration between humans and machines is still important as it allows the machine to provide the human with the information needed to inform decision making.

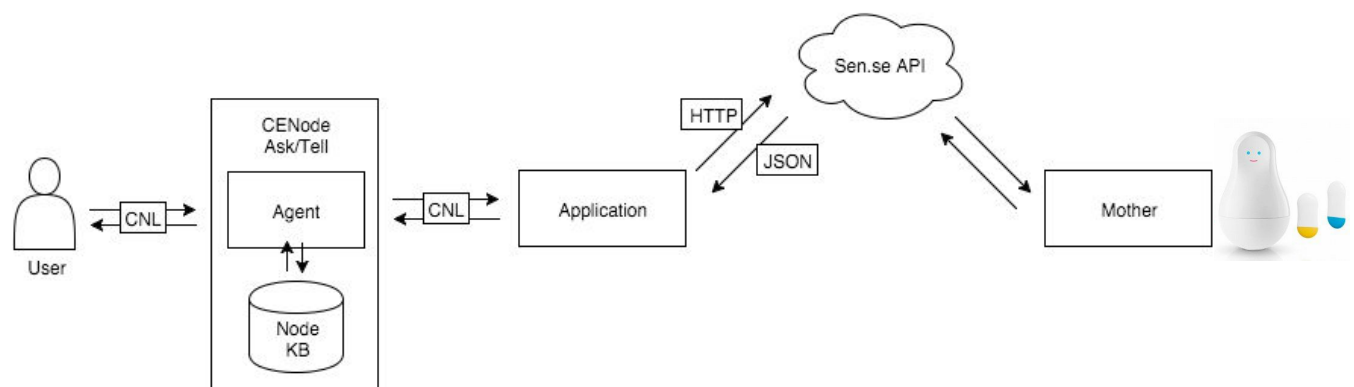
The interaction between the user, Mother, and the "Cookie" sensors is to take the form of controlled natural language (CNL)^[2]. This aspect is important, as it is an appealing method of interaction between humans and machines. Services such as Google Now, Siri, and Microsoft's Cortana make it clear that users prefer a method of interaction that is as natural as possible, and the personality imbued upon these services make it evident that users like interacting with "friendly things". The conversational interaction with these services allows users to get access to raw data in a more easily digestible form^[4].

Interactions with Mother and Cookies could also flow in the reverse direction, i.e. users telling mother things, allowing them to task the unit or sensors to measure or collect some data. This type of interaction could also include the passing of some previously unknown information to the device e.g. telling Mother "the person X has the Cookie named Y", this would in turn allow for queries making use of person X's name, "When did the person X leave the location home?".

Currently the only way users have of accessing data collected by the Mother hub and its sensors is a web service made available by the Sen.se platform or a mobile application which presents a pared-down version of the online dashboard. The conversational approach outlined above would allow users to ask Mother about things it is capable of measuring (e.g. temperature, house occupancy etc.). The queries and responses would be given in controlled natural language as this provides common ground for machine and human readability; and is a natural way for humans to interact^[5].

This is to be accomplished through the use of the CENode Javascript library^[6] in conjunction with Sense's API, to retrieve data from the Mother unit, and an application to be developed as outlined in this document.

An overview of the application's proposed structure is outlined in the figure below:



The proposed solution takes the form of an application intended to serve as a layer between CENode and the Sense API in order to respond to user requests. In the proposed scenario users would interact with the CENode agent using controlled natural language, the agent would check the node's knowledge base for relevant information or forward the request to the application via controlled natural language. The application would then query the Sense API for the appropriate information and respond to the agent's request with controlled natural language. The agent would then update the node's knowledge base and respond to the user's query with the new information. This interaction would need to be asynchronous in nature to accommodate the API request.

The goal of the project is to determine if a conversational interface using controlled natural language provides a feasible, effective, and user-friendly way of interacting with "internet of things" devices such as Mother and the Cookie sensors, as contrasted with the current web/mobile applications. The project aims, through the use of techniques outlined above, to assess whether there is merit in allowing users to have a conversation with an environment that talks back.

Project Aims & Objectives

The following is a list of broad requirements the project will attempt to fulfill, these objectives are to be used as a measure of success following evaluation of the project:

- As a user I can submit queries using controlled english via text input
- As a user I can receive output from the application in the form of controlled english text
- As a user I am able to issue queries about the data Mother is capable of collecting
- As a user I receive up-to-date information when submitting a query
- Invalid queries should be handled gracefully
- Loss of connectivity should be handled gracefully
- Data delivered to should be accurate

Work Plan

During this project I intend to adopt an agile approach, with work being divided into two week segments (sprints), each focused on a particular area of development. The reason for this is two-fold; firstly it provides focus and clear direction for each area of work, and secondly the agile approach allows for changes to be made as necessary to accommodate previously unforeseen problems. In addition to the scheduled supervisory meetings mentioned below, there will be continuous interaction with the supervisor via a Slack team.

- 31/01/16 - Submission of initial plan
- 01/02/16 - 15/02/16 Sprint 1: Initial development
Setup up development environment, initial testing with API and external libraries. Initial development involving querying data from Sense API and investigating support for asynchronous requests in the CENode library. Able to submit and retrieve simple controlled english statements from the CENode library, interact with the Sense API, and parse response JSON.

Deliverable: A simple application which can issue requests to and parse responses from the Sense API, and interact at a basic level with the CENode library.

- 16/02/16 - 29/02/16 Sprint 2: Word recognition
Investigate word recognition solutions for the querying of the Sense API based on submitted controlled english statements. Select word recognition approach and commence development on solution. Ability to derive selected attributes for querying the Sense API based on controlled english input.
 - 23/02/16 Second FYP meeting with supervisor
Second FYP meeting with supervisor to discuss progress and potential problems/solutions.

Deliverable: The ability to take controlled english statements as input and derive a meaningful query to the Sense API based on that input.

- 01/03/16 - 15/03/16 Sprint 3: Functional prototype
Able to submit controlled english queries, extract meaningful words from controlled english input and submit appropriate requests to the Sense API based on the extracted words.
 - 08/03/16 Third FYP meeting with supervisor
Third FYP meeting with supervisor to discuss progress and potential problems/solutions.
 - An evaluation of the functional prototype will take place in early March. The exact form that the evaluation will take is to be determined nearer the time. If necessary the proposed evaluation will be presented to the School Ethics Committee for approval. It is likely that the evaluation will involve a selection of users interacting with the prototype to issue queries and getting responses, giving feedback on the application's effectiveness.

Deliverable: A functional prototype of the application, representing the minimum viable product.

- 16/03/16 - 29/03/16 Sprint 4: Finalised prototype
Able to submit and queries and receive output using controlled english. Data is retrieved from the Sense API based on the input and returned to the user.
 - 18/03/16 Fourth FYP meeting with supervisor
Third FYP meeting with supervisor to discuss progress and potential problems/solutions.
 - 19/03/16 - 10/04/16 Easter Recess

Deliverable: A finalised prototype of the application, with changes made based on the evaluation conducted as well as feedback from supervisor meetings.

- 06/05/16 - Submission of final report

References

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- [4] O'Leary, Nick. *Technical Report, International Technology Alliance in Network and Information Sciences*. 2016.
- [5] Libov, Jonathan. "Futures of Text." *Whoops by Jonathan Libov*. Web. 22 Jan. 2016. <<http://whoo.ps/2015/02/23/futures-of-text>>.
- [6] Webberley, W. M., and A. Preece. "CENode.js." *CENode*. Web. 22 Jan. 2016. <<http://cenode.io/>>.