ISS Chatbot

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1.0 Executive Summary

In this project, we aim to design and train a chatbot based on Google powered Dialogflow to automatically handle users' general enquiries about Institute of System Sciences (ISS) at National University of Singapore (NUS).The main objectives are to increase the efficiency of information retrieval and to provide more human-like conversational experiences.

2.0 Business Value

Chatbot, a piece of software designed to simulate how a human will behave as a conversational partner during information acquisition has the capability of creating personalised customer experiences at scale.

The application has many potential benefits, for example:
- Provide 24/7 instant response
- Answer simple questions
- Facilitate easy communication
- Manage multiple tasks
- Reduce costs as less manpower is required for repetitive tasks

Apply this technology to handle users' general enquiries about ISS helps in increasing the efficiency of information retrieval and user engagement.

3.0 Knowledge Specification

In this section, we specify how we collect and represent requirements.

3.1 Knowledge Acquisition

Our team used these approaches to gather requirements for system designs:
- Interviewed current students to better understand the school curriculums;
- Visited ISS official website https://www.iss.nus.edu.sg/ for general information.

3.2 Knowledge Representation

Project Scope

The bot is able to handle questions from these domains.
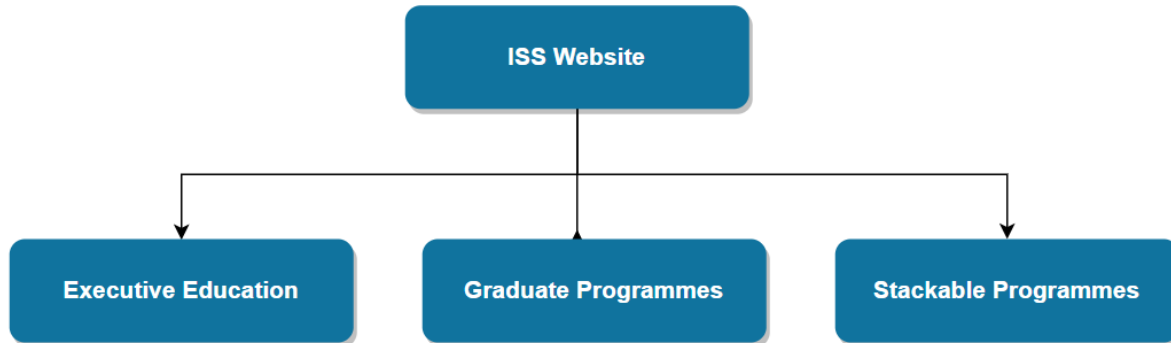
Diagram 1:Domain Scope

Sample Use Cases

The chatbot is powered to answer general enquiries or frequently asked questions in a user-friendly and interactive manner.

Scenario	Utterances
Information Session	Where is the next talk? When is the next preview talk? When is the next Info Session? When is the next Information Session?
Getting Around	Where are the classrooms? Where is ISS How can I find ISS? How to get to ISS building?
Curriculums	what is Master of Technology what are the programs available? what are the courses available? Is there a list of programs offered by ISS?

Sample Utterances

Utterances	Description
ISS offers, list of programs of ISS, what are the programs ISS offers?	Intent: iss.programs
Who is Jack?	Intent: iss.people
How can I contact ISS?	This is for the intent iss.contactInfo
Where is ISS?	This is for the intent "iss.location"
When is the next Information Session?	This is for the intent "iss.infoSession"
Does ISS have system analysis course?	Intent: ISSCourseIntent. This will reach webhook-ed API to fulfill the functionality.
How long is the EBAC program?	Intent: ISSCourseDurantion. This will reach webhook-ed API to provide course duration information
What is the total cost of IS program?	Intent: ISSCourseFee. This will reach webhook-ed API to provide course fee information

4.0 Solution

4.1 Framework

Dialogflow is chosen as the underlying platform for this project because of its simplicity to extend, capability to interface with many other applications and intelligence to understand user requests.

1. **Simplicity**
   - It has agents to transform natural language entered by users into actionable data, which behaves like a Natural Language Understanding (NLU) module in other bot applications.
   - It has intents and entities to identify users' requests. These features can be easily configured from frontend on the platform.
   - It has fulfilment and webhook for easy interfacing.

2. **Interfacing Capability (common ones)**
   - Google Assistant
   - Facebook Messenger
   - Slack
   - Skype
   - Twitter

3. **Intelligence**
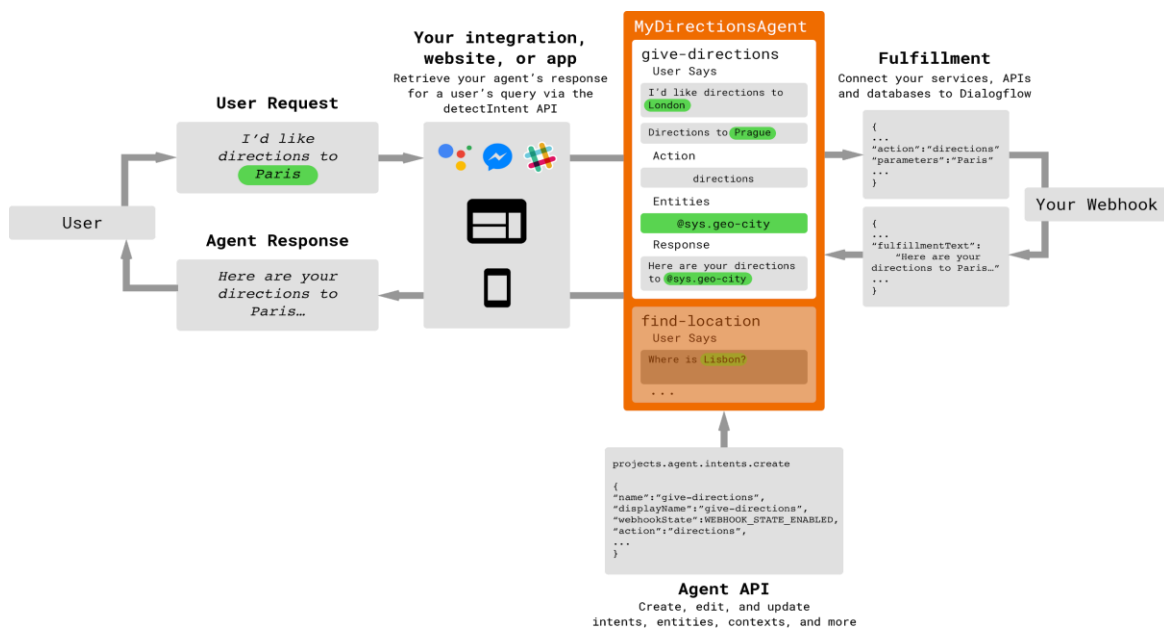   - Enables end-to-end dialogue with minimum coding required.

Diagram 2: Dialogflow Workflow (Extracted from Dialogflow Documentation)

4.2 Dialogflow Workflow

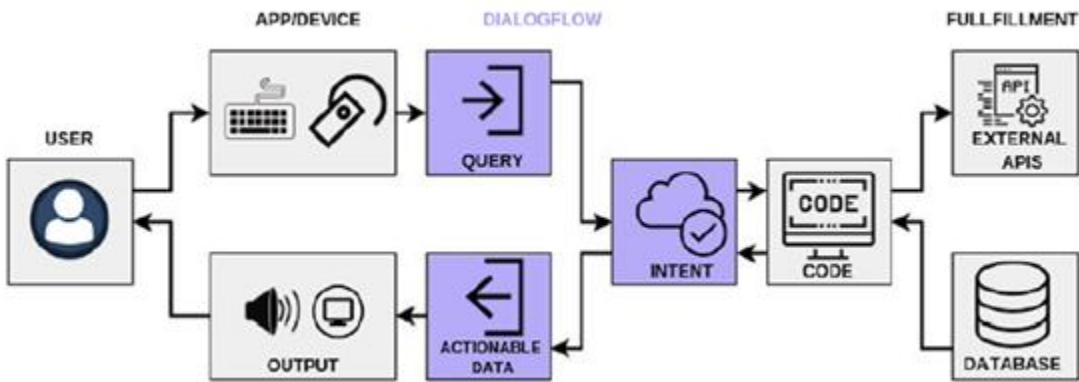The diagram below illustrates a Dialogflow conversational flow.

Diagram 3: Dialogflow Workflow

Process Description:
1. User to enter his request via text or speech.
2. User's query goes into the Dialogflow engine.
3. Dialogflow tries to understand the intent.
4. Based on the intent, a fulfillment is done by calling an Application Programming Interface (API) to retrieve relevant information from ISS website.
5. Response is returned to the intent.
6. Response is converted into actionable data.
7. User's request for information is returned to the output device.

4.3 Web API in JSON

The project uses lightweight JavaScript Object Notation (JSON) API to get interactive data for responses.

During a conversation, Dialog fulfillment allows users to use the information extracted by Dialogflow's natural language processing via API to generate dynamic responses or trigger actions.

4.4 Solution Intents and Entities

List of Intents

Intent	Description
iss.programs	ISS overall Programs: This will answer users' query regarding the programme that ISS offers: Graduate, Stackable, and Executive Education Programmes.
iss.programs.graduate	ISS graduate programs: This will answer users' query regarding the Graduate Programs that ISS offers. It gives user the summary of the graduate programs, and has follow up question regarding which specific program the user is interested in.
iss.programs.executive	ISS executive education programmes: This will answer users' query regarding the Executive Education Programmes that ISS offers. It gives user the summary of the executive education programmes, and has follow up question regarding which specific program the user is interested in.
iss.programs.stackable	ISS stackable certificate programmes: This will answer users' query regarding the Stackable Certificate Programmes that ISS offers. It gives user the summary of the Stackable Certificate Programmes, and has follow up question regarding which specific program the user is interested in.
iss.infoSession	Intent to capture Information Session queries
iss.infoSession.IS	Follow-up Intent for displaying information sessions for MTech Intelligent Systems
iss.infoSession.EBAC	Follow-up Intent for displaying information sessions for MTech Enterprise Business Analytics
iss.infoSession.SE	Follow-up Intent for displaying information sessions for MTech Software Engineering
iss.location	Intent to capture Location queries
iss.location.SFAH	Follow-up Intent for displaying location for Shaw Foundation Alumni House Campus
iss.location.OneNorth	Follow-up Intent for displaying location for One North Campus
iss.location.HMKT	Follow-up Intent for displaying location for Hui Mui Keng Terrace Campus
iss.location.all	Follow-up Intent for displaying all 3 locations of NUS

Intent	Description
iss.contactInfo	Intent to capture queries regarding ISS contact Information
iss.people	Intent to capture queries regarding specific human name
ISSCourseIntent	This intent Integrated with fulfillment API, handle general course level queries
ISSCourseFee	This intent Integrated with fulfillment API, handle query of course fee
ISSCourseDurantion	This intent Integrated with fulfillment API, handle query of course duration

There are also intents under various programmes to handle context-based questions. As there are too many of them, they are not listed here.

List of Entities

Entity	Description
coursename	Sys.any: The name of course that user has input for API to identify intent parameter.

5.0 Limitations and Future Enhancements

5.1 Limitations

1. **Short of good quality data**

   Although ISS official website provides comprehensive information about its background and programmes, there is still not enough data for chatbot training. Because the data available online, in its raw format (natural language), is not very friendly for machine reading comprehension.

   And unfortunately, data filtering and re-format was skipped in this project due to a short lead time. Therefore, intent matching and response provided in our chatbot is not optimal.

   To address this issue, we can spend more time to gather data with below means to train our chatbot in the future:

   - Gather a list of sample questions (utterances) from current students and the public of how they will interact with an ISS Question and Answering system;
   - Filter and restructure the information crawled from ISS website before using them in the project;
   - Enable interactive learning to generate story data and train dialog management model.

2. **No perfect accuracy at this stage**

   Today's chatbot still requires a lot of handholding by writing business logic and rules.

   When setting up these logic and rules, we need to develop testing plans to detect possible flaws or limitations and update into knowledge base to improve overall performance.

   These are the possible testing areas:

   - Design conversation flows, from simple to complicated, to test ability of the chatbot in intent matching, small talk, fallbacks and navigation.
   - Design entity testing to examine the ability of the chatbot in slots identification, entity validation and variations.
   - Devise a fulfillment test plan to check integrations.
   - Conduct a user acceptance testing to assure the quality of chatbot.

   Even with all the trainings and testing, chatbot is still not at that stage that it can be self-trained with lots of data and perform with 100% accuracy.

5.2 Future Enhancements

1. **Use decision tree to facilitate flow management**
    Decision tree can be added to keep track of conditional code blocks and manage complex conversational flows. Furthermore, decision tree allows developers to create a full picture of the problem scope and debug faster as the chatbot expands.

    One example:
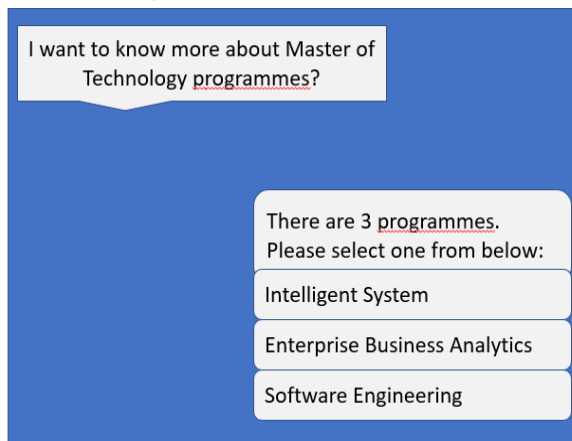
2. **Use Rasa Core to manage conversation flow**
    Cloud services like Dialogflow and Watson have their limitations as commercial off-the-shelf products although they are very easy to work with. (For example, setting up a conversation flow.) To address the control issue over system behaviours, we can use Rasa Core to train the bot and integrate with Dialogflow to achieve more ideal performance.

    One example:
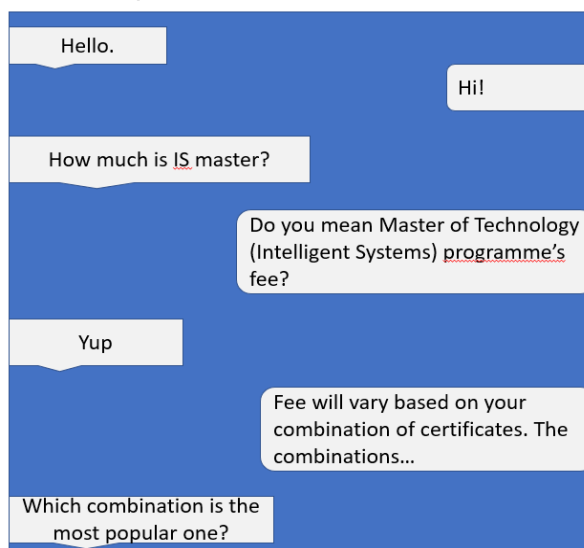
6.0 Conclusion

In this report, we have explained the designs and platforms employed to build our ISS question and answering chatbot to handle general enquiries and to stimulate human-like conversational experiences.

Furthermore, the benefits and limitations of chatbot are well-assessed to give a balanced view about the technology.

Lastly, some recommendations are given for future improvements of the chatbot.

In general, chatbot development still has many problems like high probability of intent mismatching at this stage but applying it in suitable contexts can still help organisations to save a lot of resources by reducing repetitive and trivial works.

7.0 Reference

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