

Tilly – A Tamil Learning Chatbot for Non-Native Tamil Speakers

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Abstract— Sri Lanka is a multi-ethnic, multilingual country, and Sinhalese, Tamils are considered the major ethnic groups in the country. These two ethnic communities maintain their mother languages, Sinhala and Tamil that are official languages in communication and for official purposes. As Sri Lankans, learning both official languages are essential and important to maintain harmony and peace among people. Although Sinhalese and Tamils have lived together for a long time, it is an unfortunate situation that they are unable to communicate with both official languages. This problem has severely affected the majority Sinhala community in the country due to their low level of Tamil language knowledge. To overcome this current situation, most people are trying to learn the Tamil language, and learning such as a new language has become a difficult and challenging task. As a solution, the Chatbot system can be introduced which is a very popular interactive communication media between humans and machines. This paper presents the design and implementation of a Tamil chatbot system named Tilly to learn the Tamil language. Using this system people can ask questions in Tamil language and the system responds to the user in the same language. The question base of the system has been implemented based on three categories of questions such as simple, moderate and advanced depending on the ability of each person in the Tamil language. Accordingly, any person with any level of Tamil language knowledge can use this system to improve the language fluency as a hobby in their day-to-day lives. This system has been designed using Dialogflow and Google cloud platforms. Finally, the system has been tested in a practical environment using human evaluators and successful results were obtained

Keywords— Chatbot, Tamil, Dialogflow, Google cloud platform

I. INTRODUCTION

Sinhalese, Tamils are the major ethnic groups in Sri Lanka and they have a long history that is going back more than 2000 years [1]. These two major linguistic communities maintain their mother languages such as Sinhala and Tamil in communication and also use them for official purposes in their territories. [2] In the face of this situation, the Government of Sri Lanka has paid special attention to these two languages and has adopted legislative policies for them. Accordingly, the 13th Amendment to the Constitution of Sri Lanka has made Sinhala and Tamil as official languages and in 1988, the 16th Amendment to the constitution corrected the position by stating, “Sinhala and Tamil shall be the languages of administration throughout Sri Lanka.” [3]

The pathetic problem of these two official languages in the country has arisen with the linguistic survey that was conducted in 2010. The survey mentioned that around 90% of Sinhala speaking people are unable to communicate in the Tamil language and 70% of Tamil speaking people are unable to communicate in the Sinhala Language [4]. Accordingly, this is a very serious and a pathetic problem because, although these Sinhalese and Tamils are living together for many centuries, learning both official languages were not achieved. Besides, learning Sinhala and Tamil languages is a very essential fact to maintain peace, harmony among two communities [24]. The report produced by the Lessons Learned and Reconciliation Commission (LLRC) in 2011, appointed by the Sri Lankan Government includes some recommendations regarding these languages as follows [5].

The learning of each other’s languages should be made a compulsory part of the school curriculum. This would be a primary tool to ensure attitudinal changes amongst the two communities. Teaching Tamil to Sinhala children and Sinhala to Tamil children will result in a greater understanding of each other’s cultures.

The proper implementation of the language policy and ensuring trilingual (Sinhala, Tamil, and English) fluency of future generations becomes vitally important. A trilingual education will allow children from very young days to get to understand each other.

Due to this situation, the Government of Sri Lanka recommends learning all three languages such as Sinhala, Tamil, English and make the learning of official languages is compulsory for all the public servants. Moreover, learning all three languages is included in the school curriculum also. However, this problem has severely affected the majority Sinhala community in Sri Lanka due to their low level of Tamil language knowledge. To overcome this problem, most of them are trying to learn the Tamil language and it has been in operation for some time now.

Generally, studying and learning such a new language is a difficult, challenging task and requires timely and practical methods. But, in a rapidly developing technological advanced world, these tasks can be solved very efficiently with the help of novel and emerging technologies. The Chatbot concept can be introduced to overcome this challenge practically and enjoyably which is one of the most emerging technologies in the 20th century [17].

This paper is going to discuss a Tamil learning Chatbot named Tilly that was designed for Non-Native Tamil Speakers in Sri Lanka. This system operates in Tamil language and the user can maintain the communication in the Tamil language. This chat system contains more than 250 question types and is categorized into three domains as simple, general questions, moderate questions and advanced questions. Accordingly, a person having different levels of Tamil language abilities can use this system as an entertainment tool to improve the language fluency. A user with a week knowledge of Tamil language ability, can start the communication between the Tilly with simple questions and gradually move to the other two domains. This system allows any user to learn the Tamil language in a practical, enjoyable and effective way. Simply, this system acts as an assistant to learn the Tamil language in an enjoyable way. Accordingly, any person who is willing to learn Tamil can use this system to improve the language fluency as a hobby in their day-to-day lives.

The rest of this paper is organized as follows. Section 2 explains Chatbot systems and its importance. Then Section 3 gives details about existing Chatbots and Section 4 describes the Dialogflow technology that was used to develop the Tilly system. After that, Section 5 reports the design and the implementation of the developed Chatbot system and finally, Section 6 concludes the paper with a note on further works.

II. CHATBOT – AN EMERGING TECHNOLOGY OF THE 20TH CENTURY

Chatbots are considered to be an emerging technology in the world of the 20th century. It is an artificial intelligence software that is designed to conduct a conversation or a chat using several techniques including auditory and textual, especially over the internet [18]. To achieve this, the Chatbots provides an interface between the computer and the user with some intelligent features. A Chatbot can be also known as a smart bot, chatterbot, talkbot, IM bot, and interactive agent which is one of the most advanced and promising expressions of interaction between machines and humans [6]. When considering the history of Chatbots, it has been started in 1950 as a result of the Turing Test, and ideas of that test essentially laid the foundation for the revolution of Chatbots. Today Chatbots are often used in the field of business and many reasons were identified. Accordingly, many facts motivate people to interact with them as it increases productivity by providing facilities to access information quickly and efficiently. It gives entertainment when users have nothing to do as well as to avoid loneliness. Besides, it increases the curiosity of people.

There are many classifications in Chatbots. Among them, this paper focuses on two major classifications. The first classification depends on how the specific bots were programmed. Accordingly, they can be divided into two groups as simple Chatbots and smart or advanced Chatbots [8]. Simple Chatbots work according to pre-prepared commands which have been written by the developer using regular expressions while smart or advanced Chatbots are based on artificial intelligence when they communicate with users. The smart Chatbots are not based on pre-prepared answers like simple Chatbots, and they respond

with adequate suggestions. The second classification is standalone chat systems and web-based chat systems. Among computer-based or standalone chat systems is the most popular method used today. Not only that but also



Figure 1 Growth Rate of Chatbots

these chat systems can be again divided into two categories named human-computer dialogue systems and human-human dialogue systems [25]. Today, there are so many human-human chat systems available in the world such as MSN Messenger and Yahoo Messenger. They are the most popular chat systems in the world. Also, developing a human-computer chat system including natural language capabilities is a challenging task and it is as old as the field of Artificial Intelligence.

It is very interesting to discuss the importance and advantages of Chatbots. A Chatbot is a software program, powered by rules and Artificial intelligence. It provides a chat interface that simulates a real interaction with users [9]. Today Chatbots have become a very popular communication and business tool. Accordingly, the utilization of Chatbots has certainly gained momentum in the last five years. Figure 2 shows the growth rate of Chatbots in the last few years.

A. Customer Service.

When compared with other areas, Chatbots have become very popular in the business sector. As a result, most of the websites provide a small live chat tool that helps customers to find information. Besides, these customer service Chatbots are available in mobile phones for handling customers and help to save money of the customers and also to provide automation for repetitive work.

B. Education

The Chatbots can make education more accessible and more engaging as it is a very attractive tool. The students who are using educational Chatbots can send questions in-order to get answers for a particular subject area. Accordingly, it can also be used as a quiz game.

C. Mental Health

Chatbots can be used as entertainment tools to maintain balanced mental health. Generally, music Chatbots can help to create a more personalized playlist based on user preferences. Also, using Chatbots, online gambling operators can utilize smart assistants to manage live chats, analyze odds, or even distribute custom bonuses following the player status.

III. RELATED WORKS

In 1950, there was a generation with scientists, mathematicians, and philosophers with some concepts

including intelligent machines and artificial intelligence. Alan Turing, who was a young British polymath, explored the mathematical possibility of artificial intelligence. Not only that but also one of his papers named Computing Machinery and Intelligence has discussed how to build intelligent machines as well as how to test their intelligence. This is considered as the first idea of intelligent machines. Besides, Chatbot is also an intelligent system that includes intelligent interfaces [23].

The history of Chatbots was started in 1950 as a result of the Turing Test, and ideas of that test essentially laid the foundation for the revolution of Chatbots. Then, many Chatbots have come to the stage such as Eliza (1966), Parry (1972), Jabberwacky (1988), Dr Sbaitso (1992), Alice (1995), Smarterchild (2001), IBM's Watson (2006), Siri (2010), Google Now (2012), Alexa (2015), Cortana (2015), Bots for Messenger (2016) and Tay (2016) [7]. A brief description of some of the common chatbots is given below.

A. Eliza

ELIZA has been created by Joseph Weizenbaum, during the period from 1964 to 1966. It is an early natural language processing computer program that has been created at the MIT Artificial Intelligence Laboratory. It was one of the first Chatbots as well as the first program capable of attempting the Turing Test. This Chatbot was created to simulate the communication between humans and machines by using a pattern matching [10].

B. Alice

Alice or simply Alicebot is a natural language processing Chatbot that holds a conversation with a human by applying a heuristical pattern matching technique to identify user input. Not only that but also, this algorithm used depth-first search techniques. ALICE stands for Artificial Linguistic Internet Computer Entity that was composed of Richard Wallace in 1995 [11]. In 1998 the program was written in Java and used an XML Schema called AIML (Artificial Intelligence Markup Language). Also, ALICE has passed the Turing test in two consecutive years.

C. Mitsuku

Mitsuku was created in 2012 by Steve Worswick. It was created using AIML technology and has won Loebner Prize in 2013, 2016, 2017, and 2018. Mitsuku contains most of Alice's AIML files [12].

D. Cleverbot

Cleverbot is also a Chatbot system that uses the Artificial Intelligence algorithm. It a web application and was created by Rollo Carpenter, a British AI scientist. Not only that but also Cleverbot is also available in several different operating systems such as iOS, Windows, and Android. Unlike some other chatterbots, Cleverbot's responses are not pre-programmed [13]. From 2014 Cleverbot has been upgraded to use GPU serving techniques and developers are attempting to build new versions using techniques of Machine Learning.

E. Octopus: A Multi-Agent Chatbot

Octopus is a multi-agent-based Sinhala chatbot system that was implemented through the MaSMT framework.

This chat system contains 8 sub-multi-agent systems namely core system, GUI system, Natural Language Processing system, communication system, learning system, action system, searching system and data access system to handle intelligent capabilities of the chatbot. Octopus has been implemented through Java and can run on two operating systems such as Windows and Linux [20].

F. Sinhala Chatbot

Hettige and Karunananda have developed a Sinhala Chatbot in 2006. This was developed using Prolog and based on Natural language processing modules. These modules are Sinhala parser and Sinhala Morphological analyzer. Besides the entire Chatbot system has been developed using SWI-PROLOG and JAVA that can run on both Windows and Linux operating systems [14].

G. POONGKUZHALI-An Intelligent Tamil Chatterbot

Kalaiyarasi and Parthasarathi have developed an intelligent Tamil Chatbot named POONGKUZHALI. The developed chatbot is a system that simulates human conversation through Artificial Intelligence using the Tamil language. A question or a statement from the user is taken as the input and the system generates an appropriate response as the output based on the context of the input. The response is formed using a set of reassembly rules that reside in the knowledge base. After that, the response is reframed to match how the user had framed his question. Also, using this system, the user can choose any existing topic for conversation. This chatbot system has been designed using a set of decomposition rules [19].

Human-Computer text conversation through NLP in Tamil using Intent Recognition

Shanmugam U and others have developed a chatbot that leverages NLP by using the Dialogflow API. This chatbot has been mainly aimed to bridge the gap between the parents and educational institutions. The developed chatbots can respond to the parent's queries in the Tamil native language thus assisting parents in keeping track of their students' performance at college. The significant components of this Chabot incorporate intent detection, routines for conversation management, dialogue design and slot fulfilment. Besides, it also uses Flask micro framework and Pusher Channels [21].

IV. DIALOGFLOW

Dialogflow is a Google-owned framework that enables users to develop human-computer interaction technologies that can support Natural Language Processing (NLP) [15]. On the other hand, it is an end-to-end, build-once, and deploy-everywhere development platform that creates conversational interfaces for websites, mobile applications, messaging platforms, and IoT devices [16]. The architecture of the Dialogflow has 6 main components as Dialogflow console, agents, intents, entities, contexts, and events. These concepts are very essential when developing a chatbot or a voice bot.

A. Dialogflow Console

Dialogflow console is a web user interface that is used to create, build, and test agents. However, this Dialogflow Console is different from the Google Cloud Platform (GCP) Console as the Dialogflow Console is used to manage Dialogflow agents, while the GCP Console is used to manage GCP-specific Dialogflow settings. Generally, designers use the Dialogflow console to build agents but in advanced scenarios, Dialogflow API also can be used. Besides, using the console can perform several tasks.

Create agents, intents, and entities.

Control conversation paths with contexts.

Adding events that are triggered by occurrences outside the conversation.

Implement fulfilment to connect your service when using integrations.

Integrate with other conversational platforms.

Analyze agent performance.

The test developed the agent via the simulator.

B. Agents

A Dialogflow agent can be described as a virtual agent that handles conversations with users. The agent is very similar to a human call centre agent. It is a natural language understanding module that is capable of understanding the nuances of human language. When the user sends a text or audio during a conversation, Dialogflow translates that to structured data. Accordingly, the main purpose of agents of the Dialogflow is to handle many types of conversations required for the system. In Dialogflow, there are several types of agents such as prebuilt agents that are provided by Dialogflow for common use cases, multilingual agents that support many languages, and mega agents.

C. Intent

An intent categorizes the user's intention for one conversation turn. For one agent, designers can define many intents, and using combined intents can handle a complete conversation. When a user writes or something, it is referred to as "end-user expression". This expression will match the best intent of the voice bot by Dialogflow. This intent matching is known as intent classification. The basic intent contains four main parts as training phrases, action, parameters, and responses.

Training phrases – Training phrases are the example phrases for what a user might say. When a user's input expression resembles one of these training phrases, Dialogflow matches the intent. The advantage of this function is designer doesn't want to define every possible example.

Action: An action can be defined for each intent in the system. However, when an intent is matched, Dialogflow provides an action to the system. Besides, actions can be used to trigger certain actions that are defined in the system.

Parameters: Dialogflow provides extracted values from the user expression as parameters when an intent is matched at runtime. Each parameter has a type, named as [entity type](#) that dictates exactly how the data is

extracted. Unlike raw user input, these parameters are structured data that can easily be used to perform some logic or to generate responses.

Responses: Responses are the output that should be

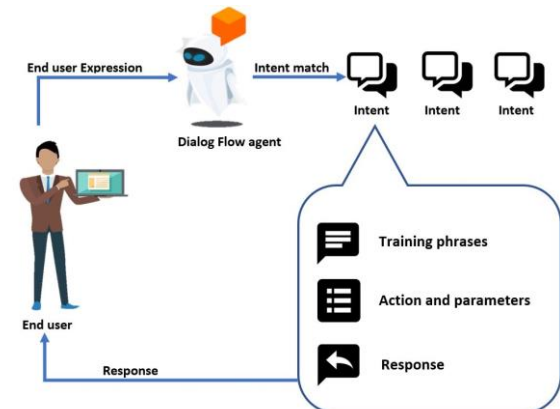


Figure 2 Basic Flow of the Intent Matching and Responding to the User

sent to the user as text, speech, or visual form. For every input that is sent by the user, the system has to send a response. These may provide the user with answers, ask the user for more information, or terminate the conversation.

D. Entities

Every intent parameter has a type named entity type. The entity type dictates exactly how data from user input or expression is extracted. Besides, Dialogflow already provides predefined entities that are named as system entities that match many common types of data. Therefore, there are system entities for matching colours, email addresses, dates, times, etc. Not only that but also, designers can create his/her custom entities to match custom data.

E. Contexts

Dialogflow contexts are similar to natural language contexts. For example, if a person says "they are apples", the system has to context to understand what "they" are referring to. Accordingly, to handle a user expression, it is essential to provide context to correctly match an intent. Also, using contexts, can control the flow of the conversation and can configure contexts for intent by setting input contexts and output contexts. These input and output contexts are identified by string names. When the contexts are active, Dialogflow matches intents that are configured with input contexts. Using contexts, you can control the flow of a conversation. You can configure contexts for intent by setting input and output contexts, which are identified by string names. When an intent is matched, any configured output contexts for that intent become active. While any contexts are active, Dialogflow is more likely to match intents that are configured with input contexts that correspond to the currently active contexts.

Events

Intents are matched when a user's input expression matches with an intent training phrase. Besides, can trigger intents using events and these events can be invoked in

several ways. There are two types of events such as platform events and custom events.

Platform Events: Platform events are built-in events that are provided by platform integrations. Generally, these events are invoked when platform-specific events occur.

Custom Events: Custom events are the events that are defined by the designer and can invoke them using fulfilment or the API.

V. DESIGN AND IMPLEMENTATION OF TILLY

Tilly chatbot has been designed using Dialogflow and Google cloud platforms. It is one of the natural language understanding platforms that makes it easy to design and also to integrate conversational user interfaces. Dialogflow helps to build Chatbots and conversational IVR that enable natural and rich interactions between users. Using Dialogflow as the development platform, designers and users can earn a lot of advantages such as 24x7 availability, can design customized chatbots for different areas, gives immediate responses for inputs, supports 20+ global languages, can be integrated easily with may devices, etc.

The developed Tamil Chatbot system has been established to fulfil a question-answering purpose. Mainly, there are two persons in this system. The first person is the user who is a human being and the second person is the agent in the Chatbot system who acts like a human. Simply, the user asks questions in the Tamil language while the agent answer to them using the same language and simulates a chat between two persons. This system works according to the client-server process and the agent

of the system works as the server. Figure 2 shows the basic architecture of the developed Tamil Chatbot system.

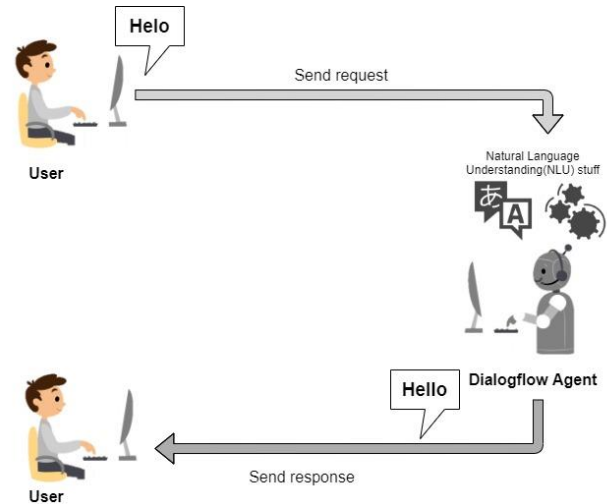


Figure 3 The Basic Architecture of the Tamil Chatbot

At first, the user of the system who is a human sends a text input message to the system using the Tamil language. After that this input will be taken by the system and apply NLU concepts and understands the received message. After that, it starts to generate a proper reply to the input and system sends that output text in the Tamil language to the user. As the final step, the user receives an output message from the system.

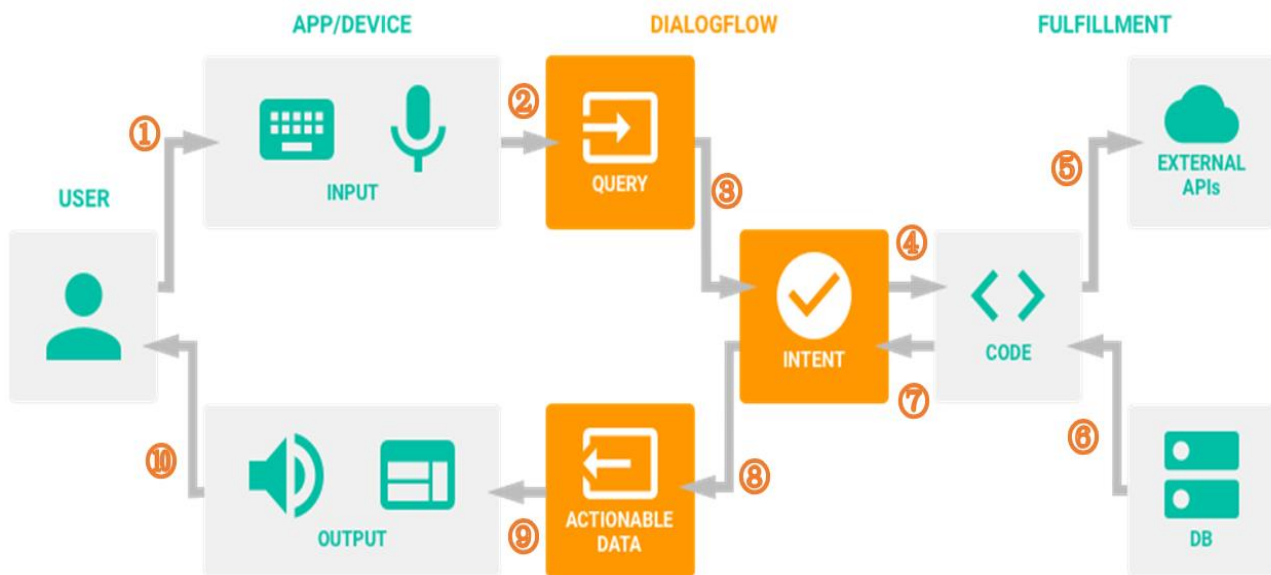


Figure 4 Design of the Tilly Chatbot

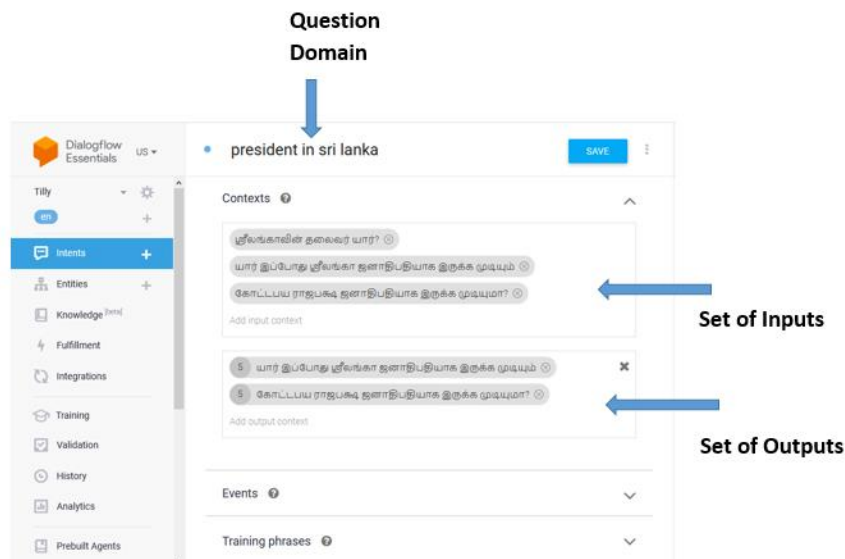


Figure 5 Declaration of Inputs and Outputs for Question Type

The system has been designed for any person having different levels of Tamil language ability. Based on the language ability, the question base of the system has been implemented for three types of questions such as simple questions, moderate questions, and advanced questions. Category 1 or simple question category has been designed with 100 question types for the people who have very low language ability. The questions of this category were limited to a maximum of two words. Secondly, category 2 has been designed with 100 question types and was designed for the people who have a moderate level of knowledge. The questions of this category were limited to a maximum of four words. At last, category three was developed with 50 advanced question types that are very useful for people who have very good language fluency. Accordingly, this chatbot supports 250 different question types and as a result, the system contains and has been trained for 250 different intents. Figure 3 shows the design of the system.

At first, the user sends a text message to the Chatbot agent named Tilly. This text message is the input of the system. In the second step, the text message will be taken by the Dialogflow agent named Tilly as a query. Then, the agent starts to categorize and match the received query with a corresponding intent that is already manually defined by the developer. The intent section has 250 different intents based on the question types. If the query is matched with an existing intent of the system, then the agent generates an actionable data which is an appropriate output and sends that to the user. However, when the query is not matched with one of the 250 existing intents of the system, the agent has to communicate with the fulfillment. This case will happen when the replies to the input are dynamic and the server of the system needs to retrieve data. Accordingly, Dialogflow provides webhook integration free of charge to allow Chatbot communication

with the server. That means a response can be retrieved from the database using a webhook to provide a better reply to the user to his input without dealing with existing intents in the Dialogflow system. Accordingly, Webhook sends a formatted response to the intent. After that intents generate actionable data according to different channels and send that response to the user as the output.

The intent matching is the core activity in this system. That means to generate the correct and appropriate answer or the output for the user's input. This activity is mainly based on Natural Language Processing principles. The system has been trained with sample question patterns and answers. For example, a question type can be declared for the asking name of the president of Sri Lanka. Accordingly, the user can ask the same question in different ways with the same meaning. However the user asks a question in different ways, the system matches the received input with existing intents and generate the correct answer. Figure 4 shows the sample intent matching scenario for a particular question type. The question type which was selected is asking the name of the president of Sri Lanka. At first, have to add a set of sample user input questions that the user might be asked. These inputs should be added with the same meaning but in different forms. Then, should add a set of appropriate answers for the input questions.

The Tamil Chatbot system has been designed using Dialogflow and Google cloud platforms. Dialogflow is originally named as api.ai which is a Google product used to develop Chatbots using the Natural Language Understanding (NLU) concepts. This means Dialogflow can convert the user input or query to intent by using NLP and NLU concepts. Therefore, it helps to integrate with many IM (Intelligent Machines) platforms such as Line, Twitter and Facebook.

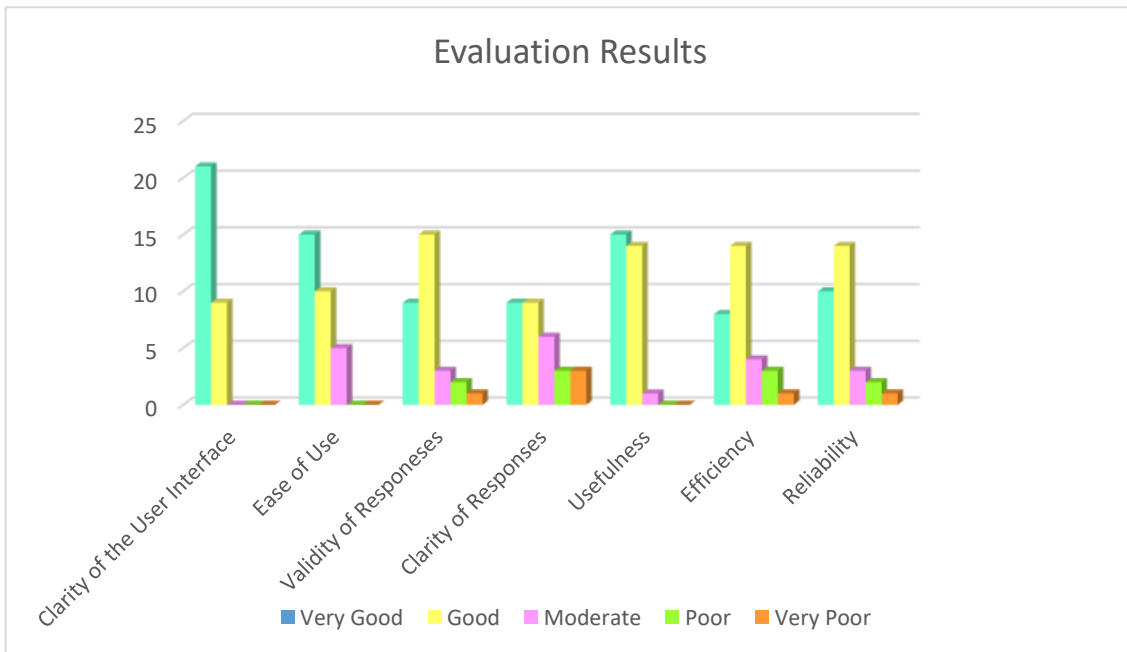


Figure 7 Evaluation Results of Test

The implementation process of this Chatbot takes several important steps. Among them, the first step is building a Firebase project at the Dialogflow console. Then, import the preconstructed agent named "Translate". When the designer imported the "Translate", some intents are automatically created and do not want to create any intents and entities. Then as the next step, initialize a new project with functions using the Firebase Command Line Interface. Then, select the Firebase project which was created earlier. After that, install the Actions on Google and Cloud Translate API libraries for the node using the below code.

```
cd functions
npm install actions-on-google @google-cloud/translate
```

Then, edit "functions/src/index.ts" and import the code in the project of the Dialogflow from index.ts with removing its contents. As the next step, deploy the "deploy-output" function with firebase and copy the below URL function.

<https://us-central1-your-project.cloudfunctions.net/fulfill>

Then, select "Fulfillment" trigger the webhook and insert the feature URL into the URL field in the Dialogflow console. After that choose "Properties" and select it. After selecting "Properties" check the "Use webhook" under "Fulfillment" for any purpose that was imported and also save it. Then, enable the Cloud Translate API in the Google Cloud console for the Firebase project. If you don't enable this API, then the first time the translate API is called by your function and it will leave an error in the Functions log with a URL to follow to enable the Google Cloud Translate API. Copy that URL and load it into your browser to enable the API.

Figure 5 shows the User Interface of the developed Tamil Chatbot system. At the first user can starts with simple question collection and then moves to moderate and advance question types gradually.

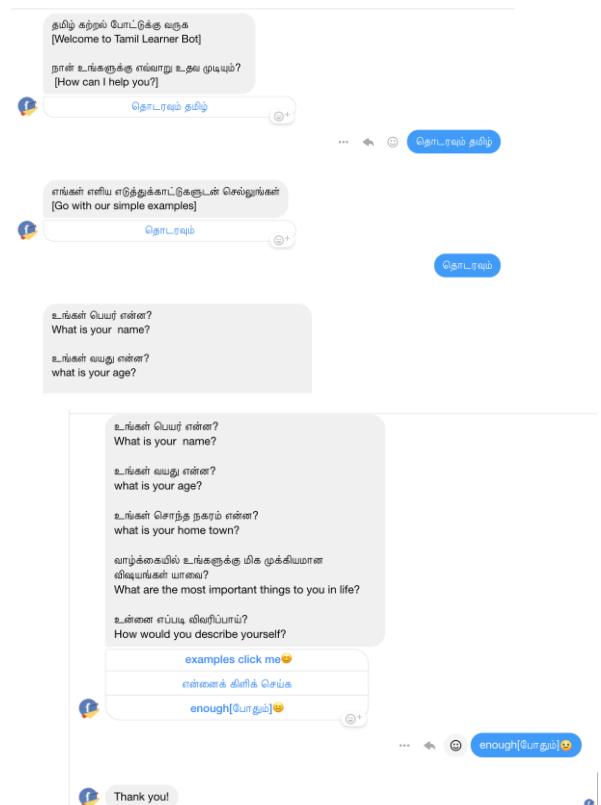


Figure 6 User Interface of the Developed Tamil Chatbot

Table I shows the results obtained from the test

Parameter	Very Good (5)	Good (4)	Moderate (3)	Poor (2)	Very Poor (1)
The clarity of the User Interface	21	9	0	0	0
Ease of Use	15	10	5	0	0
Validity of responses	9	15	3	2	1
Clarity of responses	9	9	6	3	3
Usefulness	15	14	1	0	0
Efficiency	8	14	4	3	1
Reliability	10	14	3	2	1

VI. TESTING AND EVALUATION

The Tilly chatbot has been tested using human evaluators in a practical environment. At first, people have been selected with different levels of Tamil language literacy and they were divided into three groups of 10 each such as poor Tamil literacy level, moderate level and advanced level respectively, As the next step, the system was freely distributed among them and asked them to chat with Tilly. After that, they were asked to score for some parameters.

VII. CONCLUSION & FURTHER WORKS

Sinhalese and Tamils have a long history in Sri Lanka that is going back more than 2000 years. These two major linguistic communities maintain their mother languages such as Sinhala and Tamil in communication and also use them for official purposes in their territories. However, unfortunately, both Sinhalese and Tamils can't communicate with both languages while they are living together for many years. Besides, the government of Sri Lanka also has ordered to learn both Sinhala and Tamil languages. Accordingly, a practicable solution can be introduced combined with new technologies to overcome this problem. This paper presented the design and the implementation of a Tamil learning Chatbot system named Tilly that can be used as an entertainment tool for non-native Tamil. This system has been successfully developed using Dialogflow, Google cloud platforms and tested using human evaluators in a practical environment and encouraging results were obtained. As further work can improve this developed system as a trilingual learning chatbot to learn the Tamil language.

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