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Comparative Study of Intelligent Personal Assistant

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Abstract— When Apple, Inc. launched iPhone 4S on late 2011, one of its point of interest is the new built-in personal assistant application called Siri (Speech Interpretation and Recognition Interface). The application has the ability to answer questions, make recommendations, and perform actions as a response for its user's voice input using natural language processing. Siri gets favorable reception though it still has some shortcomings such as limited functionality when used outside United States and trouble understanding English with accent. Currently, Siri is only available for iPhone 4s. While there is a chance that Apple's other mobile device (older iPhone, iPad and iPod) will get Siri in the future, it is very unlikely that it will be opened to another mobile operating system. Since Google's Android is holding more than half smartphone market in the world as for 2011, we feel the need to find similar application to Siri for Android devices. There are several personal assistant applications using natural language processing available in Google's Play Store. Top three of the application will be compared in this paper to assess their ability as personal assistant, as same as like Siri for iPhone 4S. They are Iris, Skyvi, and Speaktot's Assistant as they have the highest install count, 5 stars rating, and average rating in Play Store. These applications will be tested for its features for input and output correctness, ability to understand questions or command outside their embedded input structure. Some tests will be embedded to provide user scientific reference to determine the best application similar to iPhone's Siri for Android devices. Based on the test's results, Speaktot's Assistant comes in the first place. It managed to pass all tests with 100% score, beating Skyvi and Iris with 70% and 63.33% score respectively. But still, all the tested applications have much homework to be able to compete with Siri.

Index Terms— Intelligent Personal Assistant, Iris, Siri, Skyvi

I. INTRODUCTION

There are many ways to communicate with others. But speaking and listening feels more natural for us as human being. Today the needs of natural way to communicate are not just for human to human but also for human to machine. In this context a more natural way for human to communicate with computer in more natural way is discussed. In early days of digital era, the main methods to input something to computer are using keyboard and mouse. And then the output is displayed as text and graphic using monitor. Generally, user can only communicate with computer by typing and reading. Many can only dream to just have to speak to computer and it will understand the user's command and the computer give answer by speaking like it is

also an intelligent being. These dreams began to appear as an achievable goal with years of advances in computer programming. Natural Language Processing (NLP) is the field in computer science that helps to solve the problem to make computer understand human language. Works in this field started as early as 1950s. In 2006 IBM created a supercomputer that can answer complex question spoken in human language. It is a result from DeepQA project code named "Watson". The supercomputer uses advanced NLP and many other technologies so it can interact with human using verbal communication [1]. To test Watson's ability, IBM put it in the Jeopardy! Quiz shows human competition answering the quiz questions. Watson beat Brad Rutter, the biggest all-time money winner on Jeopardy! and Ken Jennings, the record holder for the longest championship streak (74 wins) [2]. Seeing a supercomputer beat human in a television show is awesome. But having that kind of program in our mobile devices to assist us in daily activities, it is a whole new level of awesome. It was Apple Inc. that makes the breakthrough to bring a fully loaded application with ability to understand human language. Siri got the attention it deserved when Apple released it with the new iPhone 4S. Talking to Siri is like talking to a person, user can speak with natural voice with conversational tone. The more the user uses Siri, the more it will understand things. It will work better to recognize many kind of dialect in English as it exposed to more variations of user. This is possible because Siri is connected to a server that holds its core algorithm, the application in the iPhone 4S is just the client using the services from the server [3], [6]. Siri also uses user information in the phone to understand the user better. For example, user can make Siri remember whom the user refers to when saying 'call my sister' by let it knows the key relationship that user has with the peoples in their Contacts [3]. There are many other features that are not mentioned here that make Siri described by the US National Federation of the Blind as the only handset that a blind person can use [4]. Unfortunately, Apple only made Siri available for iPhone 4S for now. Even other iPhones, iPads and iPods does not get the same treat. This is Apple's way to show some exclusivity. The fact is Apple's device does not hold most of the market share for smartphone. In 2011, Android hold 50.9% market share of sold smartphone around the world while iOS (Apple's smartphone operating system) came in second place with 23.8%. Clearly Android has literally more than twice of iOS user. There are already several applications available that are similar to Siri for Android in Google's Play Store and

most of them are free to install. There has to be a systematical tests done to these applications to help user determine the best application to install in their Android devices to have similar ability like iPhone's Siri. The result of tests can also to know, how close these applications for Android can compete with Siri.

II. RESEARCH METHODS

A. Chosen Application

The chosen application for the test are three personal assistant application. They all use Natural Language Processing and available on Google's Play Store with more than 1 millions of install, free to install, has the highest average and 5 star rating. The chosen applications are the last version available until 18th of March 2012. Following are the test subjects that meet the criteria mentioned. The chosen applications are described in Table I.

Table I. Chosen Application

	Iris	Skyvi	Assistant
Developer	Dexetra	Blue Tornado	Speaktoit
Install Count	1 – 5 millions install category		
Average Rating	4,2 / 5 from 56.000 user	4,5 / 5 from 49.000 user	4,6 / 5 from 24.000 user
5 Star Rating	33.000 user	34.000 user	17.000 user
Version	4.2	1.41	0.3.9

B. Tools

The chosen application installed on an android smartphone from Sony Ericsson with model number ST15i, also called Xperia Mini. It connected to a wifi network with stable internet connection to ensure no interference from network provider service quality. The integrated screenshot feature is used to take the screenshot of the applications. The specifications of the phone is described in Table II.

Table II. The Test Subjects

Brand	Sony Ericsson
Type	Xperia Mini (ST15i)
Network	HSDPA
Network Provider	XL
Operating System	Android 2.3.4
Screen Resolution	480 x 320
Screen Diagonal	3"
Processor	Qualcomm MSM8255 1GHz Arm v7
RAM	512 MB
Battery	1200 mAh

C. Assessment Parameter

These personal assistants will be assessed with 3 categories of test:

1) Input correctness

There will be 10 questions asked. Each question is taken from the guide for each application to activate available feature. The question will be repeated 3 times to avoid mistakes from the user. For one question that accepted correctly, the application gets a point with value of 10%.

2) Output correctness

From the questions asked in the first test, the application get a point with value of 10% if it can give suitable answer for the question

3) Ability to understand human natural language

The questions from first test will be reshaped with English grammar to make it more natural in human language and will be asked again to the test subjects. The question will be repeated 3 times to avoid mistakes from the tester. For one question that accepted correctly, the application gets a point with value of 10%.

Beside the tests described above, each application also will be reviewed for its user interface and other extra features. For conclusion, the sum value of each test along with another points from extra features and user interface assessment will determine the best application for Android that are using Natural Language Processing to be a personal assistant. The test winner means that it is likely to have closest ability to what iPhone's Siri can do.

III. RESULT AND DISCUSSION

In this section, we review the features and functions of chosen applications. Each application has different features and user interface. The assessment's result also described to see how each application handle the tests.

A. Skyvi

1) Overview of Skyvi

Skyvi always brings up voice input the first time it executed. This can be a good thing because user can speak directly after opening Skyvi. Naturally Skyvi is trying to understand all voice input by user. It tries to answer or give comment despite when it does not fully understand what user wants. When the voice input have multiple possibility of what it probably means, Skyvi just taking the most relevant one by its algorithm rather than giving option for the user to choose the exact meaning of the input. Skyvi often misunderstood the voice input if it does not contain the embedded command structure.



Fig 1. Skyvi first run

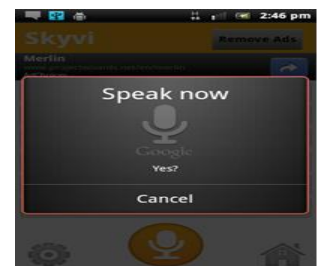


Fig 2. Skyvi main menu

2) User Interface

Appearance of skyvi made in such a way that facilitates user's authority to operate this application. With a few improvements have been made, especially on the UI, skyvi designed to be efficient and appear attractive for the users.

3) Ability

The developer gives some hints for using skyvi's sentence structure. However, users can also say a few words other than the given structure. All of Skyvi's abilities and it's given structures are describen it Table III.

Table III. Skyvi's ability

Action	Recommended Structure	
Call	Call <contact_name>	
Message	Text <contact_name> <message>	
Nearby Place	Find <place>	Call <place>
	I want a <context>	Find Closest <place>
	Directions to <place>	
Facebook		
Twitter		

4) Input Correctness Test

We ask Skyvi 10 questions related to its ability. The questions are following the recommended structure. The results are described in table IV. In Response column, V means Skyvi hears the question correctly. Otherwise it gets X.

Table IV. The Result of Input Correctness Test for Skyvi

#	Question	Response
1	Call Andy	V
2	Text Andy hello	V
3	Find Starbuck	V
4	Where is starbuck	V
5	I want a pizza	V
6	Direction to Botani Square	V
7	Read Facebook	V
8	post to twitter i am testing skyvi	X
9	what is the weather in Jakarta	V
10	who is Jeremy Clarkson	V
Score		90%

Skyvi can hear 9 out of 10 questions correctly, hence it gets total score of 90% for this test.

5) Output Correctness Test

The questions from Input Correctness Test answered by Skyvi gets V if it is suitable and X if not. The result for the test described in Table V.

Table V. The result of output correctness test for Skyvi

#	Answer	Suitable
1	Skyvi : "Press call to connect"	V
2	Skyvi : "Press send to confirm : hello"	V
3	Skyvi : "I found Starbucks Coffee Margo City 0.5 miles from you"	V
4	Skyvi : "I found Starbucks coffee Margo City 0.5 miles from you"	V
5	Skyvi : "I found pizza hut 1.2 miles from you"	V
6	Skyvi : "I found Pizza Hut 1.2 miles from you"	V
7	Skyvi : "Birthdays today : Agung Setyawan ... " Skyvi reads all new newsfeed from user's facebook timeline	V
8	Skyvi can not understand the question, hence it can not answer it correctly	X
9	Skyvi : "Now in Jakarta 79°F/26°C Wind: N at 4 mph Today in Jakarta High :93°F Low 77°F"	V
10	Skyvi : "Jeremy Charles Robert "jexxa" Clarkson (born 11 April 1960) is an English broadcaster, journalist and writer who specializes in motoring"	V
Score		90%

Skyvi can answer all questions correctly if it follows recommended structure. Since Skyvi failed to understand 1 question in Input Correctness test, it only answers 9 questions correctly. Hence it gets total score of 90% for this test.

6) Ability to understand human language test

We modified the questions from Input Correctness test to form a more complete and natural sentence and see if Skyvi can understand it. Skyvi gets V for every question it understands correctly. It gets X otherwise. The result for the test described in Table VI.

Table VI. The ability to understand human language test for Skyvi

#	Question	Result	Answer
1	I want to call Andy	V	
2	I want you to send Andy a message for me	X	I found BNI Securities GI JACC Thamrin City 11.9 miles from you
3	I want you to find starbuck for me	X	I found Me 15.9 miles from you
4	I want to know where star bucks is	X	What did you want me to find?
5	I want to eat some pizza	V	I found Pizza Hut 1.2 miles from you
6	show me how to go to pizza hut	X	Where do you want me to show you?
7	Read my face book timeline	X	Your Face book status is: read my face book time line
8	Post to my twitter that i am testing skyvi	V	

9	Is it raining in Jakarta?	X	Ask again later. Ask you if it is
10	can you tell me who is Jeremy Clarkson	X	I cannot tell you how fast I crossed it the other day.
Score		30%	

Skyvi gets rather low score in this test. It can answer only 3 out of 10 questions correctly, hence it gets total score of 30% for this test. Actually, Skyvi can hear the questions correctly but failed to understand most of it. For example, in question number 2, we ask 'I want you to send Andy a message for me'. Instead of asking of what message to send for Andy, Skyvi search a location with unrelevant keyword. So the answer are not relevant to the questions.

B. Iris

1) Overview

Iris is a personal assistant application for Android. The application uses natural language processing to answer questions based on user voice request. It was developed in 8 hours by Narayan Babu and his team at Dextra Software Solutions Private Limited, a Kochi (India) based firm. The name is actually Siri spelled backwards, which is the original application for the same use built by Apple Inc. With the app, an Android user can just "ask" Iris instead of "Google-searching" for information. The developers claim Iris can talk on topics ranging from Philosophy, Culture, History, science to general conversation. However, Android users need to have "Voice Search" and "TTS library" installed in their phones for Iris to work.

Iris has been evolving well and it actually knows what you are saying (only punctuation is usually weird). It will recognize the meaning of sentence pronounced by the structure of sentence and match it with a system that has been embedded in it. Sometimes, the wrong pronunciation can affect the structure of sentences and there will be errors in sentence processing.

2) User Interface

So far, Iris has undergone several improvements from developer. and each improvement that has made, the developer also improves UI of this application in addition to adding features. Of course for appearance of Iris becomes more attractive, convenient and efficient for use by users. The user interface is used in these applications belong to the type of intelligent user interface and use touch screen system.



Fig 3. Iris' Splash Screen



Fig 4. Iris' Home Screen

3) Ability

For now, Dextra, the developer of Iris has set some standard phrases that can be used by user to interact with

Iris. Table VII shows the recommended structure of phrase that can be understood by Iris at this time.

Table VII. Iris abilities

Action	Recommended Structure	
Call	Please call <contact_name>	Can you call <contact_name>
Message	Send message to <contact_name>	Send text to <contact_name>
LookUp	Look up <name>	
Search	Search <topic>	Google<topic>
Missed Call	Show me my missed calls	Do I have missed calls
Music	Play me a <song_name>	Play me the song <song_name>
Unread Message	Show me my unread messages	Show messages
Weather	What is the weather in <location>	How is the weather in <location>
Horoscope	Show me the horoscope for <starsign>	

4) Input Correctness Test

We ask Iris 10 questions related to its ability. The recommended structure questions are following. The results are described in table VIII. In Response column, V means Iris hears the question correctly. Otherwise it gets X.

Table VIII. The result of input correctness test for Iris

#	Question	Response
1	Please call Andy	V
2	Send message to Andy	V
3	Look up Obama	V
4	Search artificial intelligence	V
5	Do i have missed calls	V
6	Play me the song 'All We Know'	V
7	Show messages	X
8	How is the weather in Jakarta	V
9	Show me the horoscope for Gemini	V
10	Recipe for pizza	V
Score		90%

Iris has difficulty to hear the word 'messages'. Therefore it only hear 9 out of 10 questions correctly and gets total score of 90% for this test.

5) Output Correctness Test

The questions from Input Correctness Test answered by Iris gets V if it is suitable and X if not. The result for the test described in Table IX.

Table IX. The result of output correctness test for Iris

#	Answer	Suitable
1	Iris: "Shall I call Andy?" (yes/no) If replied yes, it calls Andy. If replied no, it cancels the action	V
2	Iris : "What do you want to send?" Tester : "Hello"	V

	Iris : "Shall i send the message?" (yes/no) If replied yes, it sends the message to Andy. If replied no, it cancels the action	
3	Iris : "Sorry my eye is not attached right now"	X
4	Iris : "Have you tried looking in the Open Directory? Interesting question."	X
5	Iris : "You have no missed calls"	V
6	Iris : "Playing your song" Iris open music player and play the song	V
7	Iris : "Where do you want me to show you?"	X
8	Iris : "Now at Jakarta, Indonesia CURRENT humidity (75%), temp (86 F) Today in general at Jakarta, Indonesia 93 F (Max) and 78F (Min)"	V
9	Iris : "April 10 th . Wellness:9%*Intellet:26%*Money:82%* Work:4%"	V
10	Iris : "Pizza Bites : Pizza Bites Eazy Pizza Bites : Muffin Tin Pizza Bites Grilled Pizza : You can make this recipe as easy or fancy as you like. It's also versatile because each person gets an individual pizza. A great way to avoid turning on the oven on warm summer nights"	V
	Score	70%

Iris failed to give correct answer when asked to lookup about someone and search about something. Iris also gives unrelevant answer for question number 7 because it does not hear the question correctly from Input Correctness Test. Therefore Iris only gets total score of 70% for this test.

6) Ability to understand human language test

We modified the questions from Input Correctness test to form a more complete and natural sentence and see if Iris can understand it. Iris gets V for every question it understands correctly. It gets X if not. The result for the test described in Table X.

Table X. The ability to understand human language test for Iris

#	Question	Result	Answer
1	I want to call Andy	V	
2	I want you to send Andy a message for me	X	Try sending mail to Dr.Wallace (drwallace@alicebot.org) Why do you want me to send a message for you?
3	I want you to look up Obama	X	Sorry my eye is not attached right now. Why do you want me to look up Obama?
4	I want you to search about artificial intelligence for me	X	Have you tried looking in the Open Directory? I will ask my botmaster for the answer. Why do you want me to search about artificial Intelligence for you?
5	Is there any missed call?	V	
6	I want you to	X	Try this query again with the

	play a song titled 'All We Know'		Artist or Album name. I'm listening
7	I want you to show my messages	X	Iris : Whom to send? Ask : Andy Iris : What do you want to send?
8	Is it raining in Jakarta?	X	Iris : Searching for Jakarta weathering -Iris never come up with the search result
9	I want to know about Gemini's horoscope	X	I don't know anything about it
10	I want to know about the recipe for pizza	V	Pizza Bites : Pizza Bites Eazy Pizza Bites : Muffin Tin Pizza Bites Grilled Pizza : You can make this recipe as easy or fancy as you like. It's also versatile because each person gets an individual pizza. A great way to avoid turning on the oven on warm summer nights
	Score	30%	

Much like Skyvi, Iris gets rather low score in this test, only total of 30%. It can hear the questions correctly but failed to understand most of it.

C. Assistant

1) Overview

The Speaktioit Assistant is a virtual buddy for smartphone that answers questions in natural language, performs tasks, and notifies about important events. The Assistant saves the time and makes communication with gadgets and web services easier and less stressful. No need to memorize special commands or complex interfaces – simply speak or type in everyday language and the Assistant will understand and respond with what we need. To strengthen its ability, assistant can show a piece of map directly in screen if the question is all about a place. Besides that, it is also connected directly to youtube if needed.

2) User Interface

Just like the two previous applications, the Assistant user interface is used in these applications belong to the type of intelligent user interface and use the touch screen system. Developer built this application so attractive to user. For example, the feature for its own background was made varies by developers so that users can choose their own background of application. In addition to changing the background application, users can also choose their own avatar that will appear on screen. Such as, choose a design clothes, hair, and skin and so on. Assistant provided two ways to do the input. Write the question or use voice command to ask. Assistant always bring up voice input the first time it executed. This can be a good thing because user can speak directly after opening this application.



Fig 5. Assistant's Home Screen

3) Ability of Assistant

All of Assistant's abilities and its given structures are describe it Table XI.

Table XI. Assistant's abilities

Action	Recommended Structure	
Call	Dial <phone_number>	
Message		
Nearby Place	Where is <place>	
LookUp	Look up <people> on <site>	
Search	Find <keyword>	Show me <keyword>
	Find me <keyword>	Search <site> for a <keyword>
	Any news from <keyword>	What's a <keyword>
	Who is <keyword>	Tell me about <keyword>
Twitter	Tweet 'this is a test'	
Face book	Post to Face book that 'this is a test'	
Foursquare	Check in here	
Music	Play song about <keyword>	
Video	Video of <artist>	
Organize	Add new event	Not that <note>
	Show my agenda	I need to <task>
	Set alarm for <time>	
Open	Open <name> application	
Translation	Translate <phrase> into <language>	
Calculation	I need to convert <number> <units> in <target_unit>	What is <number> divided by <number>
	Can you convert <number> <units> to <units>	

4) Input Correctness Test

We ask Assistant 10 questions related to it's ability. The recommended structure questions are following. The results are described in table XII. In Response column, V means Assistant hears the question correctly. Otherwise it gets X.

Table XII. The result of input correctness test for Assistant

#	Question	Response
1	Dial 123	V

2	Where is Jakarta	V
3	Look up Brittany Robertson on IMDB	V
4	Show me the Toyota 86	V
5	Who is Jeremy Clarkson?	V
6	Tell me about Venus	V
7	Tweet i am testing speaktoit assistant	V
8	Post to face book that I am testing speaktoit assistant	V
9	Check in here	V
10	Play a song about love	V
Score		100%

Assistant gets a perfect score in this test. It can hear all the question and understands the purpose of questions that asked so that it can give the correct answer. Assistant gets total score of 100%.

5) Output Correctness Test

The questions from Input Correctness Test answered by Assistant get V if it is suitable and X if not. The result for the test described in Table XIII.

Table XIII. The result of output correctness test

#	Answer	Suitable
1	Assistant : "I've dialed '123'. Press 'Call' to send it through."	V
2	Assistant : "Let's see if this map of 'Jakarta' is useful" Assistant show the map of Jakarta on the screen	V
3	Assistant : "Here are the IMDB results for 'Brittany Robertson'" Assistant show the IMDB on the screen	V
4	Assistant : "I found a few pictures of 'Toyota 86' for you" Assistant show the picture on the screen	V
5	Assistant: "I'm learning to answer it. In the meanwhile, let's see here" Assistant show the result Google search on the screen	V
6	Assistant: "There are a few different definitions for 'Venus'. This one seems to be the most common: 'redirect 108,942,18 km'"	V
7	Assistant: "I'm going to post this to your Twitter page: "I am testing speaktoit assistant' Okay?"	V
8	Assistant: "Do you want to confirm this as your new Face book status: 'I am testing Speaktoit?"	V
9	Assistant : "Here, let's log in before we do anything else" Assistant opens login page to foursquare account	V
10	Assistant open music player and play a song that contain the word 'love' in its title	V
Score		100%

Assistant can answer all the question correctly and with suitable answers. Hence it gets total score of 100% for this test.

6) Ability to understand human language test

We modified the questions from Input Correctness test to form a more complete and natural sentence and see if Assistant can understand it. Assistant gets V for every question it understands correctly. It gets X otherwise. The result for the test described in Table XIV.

Table XIV. The ability to understand human language test

#	Question	Result	Assistant
1	Can you dial 123 for me?	V	Assistant open phone's dialer and call 123
2	Show me Jakarta in the map	V	Here, have a look at this map of "Jakarta"
3	Can you find me information about Brittany Robertson from IMDB?	V	I looked up "information about Brittany Robertson from imdb" on Google and this is
4	Show me a picture of Toyota 86	V	I found these images of "Toyota 86". Have a look.
5	What do you know about Jeremy Clarkson?	V	Let's try to Google it (show the Google on the screen)
6	Can you tell me about Venus planet?	V	Let's try to Google it (show the Google on the screen)
7	Post to my twitter account that i am testing speaktoit assistant	V	I'm tweeting : "that I am testing speaktoit assistant". Is that correct?
8	Post to my face book account i am testing speaktoit	V	All right. I'm about to change your Face book status to "I am testing speaktoit". Is this correct?
9	I want to check in here	V	Log in to foursquare account
10	Can you play a song about love?	V	Assistant open music player and play the song
Score		100%	

Once again Assistant did a great job. It can understand all questions and answer it accordingly. Therefore it gets total score of 100%.

IV. CONCLUSION

From the test results, Assistant gets highest result with average score of 100%. Skyvi comes in the second place with average score of 70%. Despite being the most installed of the three, Iris come in last with average score of 63.33%. From this result we can see that Assistant has considerable advantage against another application in this test for being the closest thing similar to iPhone's Siri for Android devices. Assistant also has unique feature as an added value. It offers more fluent speech that feels more human like. Skyvi and Iris are not so bad, but Speaktoit's Assistant is the one to try first.

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