Intelligent Products and Services

John Sum
Institute of Technology Management
National Chung Hsing University
Taichung 402, Taiwan

September 2, 2020

Abstract

This chapter presents a few intelligent products and services which are used for personal, business administration and industrial. I will first start with the technologies that I have been used in my daily live and daily work. Then, I highlight some of them which are not intelligent. Subsequently, the Apple Siri, Amazon Echo and IBM Watson are introduced. The key technologies supporting the above services are explained. With an aid of diagrams, the working principles of those services are elucidated. Afterward, the intelligent technologies for my daily live and daily work are solicited. The technologies behind some of these intelligent technologies are sketched. Finally, a few issues on the future development of intelligent technologies are discussed. The focus will put on their functional aspects. The intelligent technologies being applied will be highlighted. By that, the students should be able to grasp the basic ideas how intelligent technology is changing our ways of living and working.

Contents

List of Figures

List of Tables

1 Introduction

Every day, we have been using various different technologies in our daily lives and daily work. These technologies might not be entirely intelligent. But still, they are very useful. Here, let me share some of my experiences in the use of technologies in my daily live. You might find that you have experienced some of them as well.

1.1 For Personal Use

In my daily life, I sometimes need to send a text message, via Line or WhatsApp, to my friends. Again, I do not know any Chinese input method. I invoke *Siri* to convert my poor Mandrin to a Chinese text message. Sometimes, I use it to check my Mandrin pronunciation as well.

To share photos to friends, *Facebook* really helps me a lot. Once a photo has been uploaded, Facebook can immediately identify the faces and give suggested tags for each of them. This *auto-tagging* is amazing. It relives me from name browsing.

If you have purchased *Amazon Echo*, you will find that it is phenomenal. You can command Alexa by voice and let her turn on any house appliance. You can also ask Alexa to report the weather of today before going out for work. You can also ask Alexa to search over the Internet the opening hours of a restaurant.

When you drive your car in our campus, the *car plate detector* at the *incoming gate barrier* will recognize your car number and then let your car in. You then drive in and park it somewhere in the campus. You thus attend your evening class. After class, you drive you car to the *payment machine.* You key in your car number and then settle the payment. Afterward, you drive your car to the *outgoing gate barrier.* Wait until the barrier has been lifted up, you drive you car out of the campus. Probably, you are not familiar with the street network around NCHU. You then turn on the *automotive navigation system* to get the direction (the shortest path) to go home.

1.2 For Work

When I am editing this chapter, the *spelling check system* in this software has helped me to correct the spelling. If the document is edited by Microsoft Word, the software is able to check grammar of a sentence. Once I have confusion on the use of an English vocabulary, I use the *Google searching engine* and *Google translator* to help me to get the right one. Sometimes, I even browse the *Wikipedia* to check for the usage of a technical term[1] making sure that its usage is appropriate. As I do not know any Chinese input method, I use *Google translator* to get the Chinese translation of an abstract which is edited by me in English. All these intelligent services help me a lot in my daily work.

Sometimes, you might have heard of a new area of knowledge, say quantum computing. What would you do? I will try to use *Google searching engine*

---

[1]Like the terms *gate barrier* and *automotive navigation system*, I get them from Wikipedia.

searching for tutorial materials about the area. Pretty clear, a lot of materials will be listed. I might download some of them, not all, and then read. If I still cannot get the idea, I browse *Wikipedia*. Most of the times, using Google Search and Wikipedia to learn works. Some times, it does not. Quantum computing is an example to me.

If I need to attend an oral defense in Chung Shan Medical University, I will first access the *Google Map* for the direction to go from National Chung Hsing University to there. Then, search from the Google Map which bus route is able to take me from NCHU to CSMU. Finally, I browse the *bus-schedule App* in my iPhone for the schedules of the bus route. While Google Map and the bus-schedule App are not intelligent, they still help me a lot in trip planning.

In CSMU, I suddenly need to search over the Internet for certain information. I need to access WiFi. However, I do not have access right to the CSMU WiFi. So, I turn my iPhone *hotspot* on and set my notebook WiFi connection to my iPhone. Then, I can use my notebook to search for information. By the same principle, I can now work at any where as long as my iPhone is able connect to the Chung Hwa Telecom 3G/4G network.

1.3 Technologies

The technologies that I have used in my daily lives and daily works could be summarized in Table 1. Surprisingly, at least fifteen technologies have been used. Many of them are not intelligent. Line and WhatsApp are text/voice/photos messengers. Wikipedia is an Internet encyclopedia for knowledge sharing and Google Map is an Internet atlas showing the detail map of the earth. Bus schedule App shows the real-time information about the current bus location and its expected time of arrival. Hotspot is simply a wireless connection application. Yahoo! Mail is used for sending and receiving personal emails. Gmail accounts are dedicated for teaching purpose. TeamViewer can let me remote access my office computer to conduct scientific research. Some of these technologies might have simple mathematical calculations, like the arrival time of a bus. But, they are definitely not intelligent.

Among the technologies listed in Table 1, Siri, Facebook auto-tagging system, Amazon Echo, gate barrier, automotive navigation system, spell check, grammar check, Google searching engine and Google translator have intelligent technologies inside. One should also noted that various technologies have also been embedded in the mobile devices like iPhone and notebook. For instance, the telecommunication technology in iPhone and the WiFi connection technology are two examples. The technologies for fabrication of the processors in iPhone and notebook are belongs to another type of technologies. The operating systems managing the smartphones (the iOS and the Android) and notebook (the MacOS and the Windows OS) have many more technologies inside. Not to mention, the Internet and 3G/4G/5G network have applied many advanced technologies which are far from our imaginations. However, they are not, what I consider, as intelligent technologies.

Table 1: Use of Technologies.

Technology	Daily Live	Daily Work
Line	Text Message	–
WhatsApp	Test Message	–
Siri	Text Message	–
Facebook AutoTag	Photo Tagging	–
Amazon Echo	Smart Home	–
Yahoo! Mail	Email	–
Gate Barrier	Plate Recognition	Plate Recognition
Navigation System	Drive Direction	Drive Direction
Google Map	Route to Destination	Route to Destination
Bus Schedule App	Bus Schedule	Bus Schedule
Hotspot	Notebook WiFi Access	Notebook WiFi Access
Spell Check	–	Editing
Word Suggestion	–	Editing
Spell Correction	–	Editing
Grammar Check	–	Editing
Google Search	–	Use of English
	–	Acquire Knowledge
Google Translator	–	Use of English
	–	Chinese Abstract
Wikipedia	–	Use of English
	–	Acquire Knowledge
Gmail	–	Teaching
TeamViewer	–	Research
Computer	–	Research
Matlab	–	Research
DevC	–	Teaching
Python	–	Teaching
	–	Research
MikTex	–	Editing
WinEdit	–	Editing
Texstudio	–	Editing
IPE	–	Editing

1.4 Intelligent or Cognitive Technologies

To be an intelligent technology, it should at least act like a human. It should be talk like human and response like human. So that, we could hardly identify if the respondent is a machine or a human, just like the Turing Test. One breakthrough technology accomplished in the last few years is the voice synthesizer. It can now generate a voice which is no difference from a human voice, like IBM Watson Assistant[2] and Google Assistant[3]. Note that IBM Watson Assistant was released in 2016 and Google Assistant was released in 2018. Their technologies should have been advanced in the last two years. Apart from speaking like a human, machine can so a lot more sensational and perceptional tasks than ever. Here, we summarizes some of them in Table 2.

Table 2: Sensation and Perception: Human versus Machine.

Ability	Human	Machine
See	Eye	Camera
Listen	Ear	Microphone
Talk	Mouth	Speaker
Smell	Nose	Artificial Nose
Touch	Skin	Touch (Tactile) Sensor
Motion	Skeletal System	Robotic System
Think	Brain	Computer
Gesture Recognition	Brain	Program
Image/Visual Perception	Brain	Program
Voice Recognition	Brain	Program
Speech Perception	Brain	Program
Language Understanding	Brain	Program
Document Understanding	Brain	Program
Sentiment Analysis	Brain	Program
Essay Writing	Brain	Program
Song Writing	Brain	Program
Image Synthesizing	Brain	Program
Voice Synthesizing	Brain	Program
Auto Driving	Brain/Body	Robot/Program
Chess Game	Brain	Program
Poker Game	Brain	Program
Hypothesis Generation	Brain	Program

Some of these technologies have been applied not just for personal use, but also for business and industry. A notable brand is the IBM Watson. It consists of many intelligent services to support the daily work in an office. Together with

---

[2]https://www.youtube.com/watch?v=mnhb2fwkS_Y.
[3]https://www.youtube.com/watch?v=D5VN56jQMWM.

IBM conventional services for data analytic and integrated with the firm's CRM system, the work to be done by the customer service department and marketing department could largely be reduced. The staffs in these departments could be replaced.

1.5   Organization of the Chapter

In the rest of the chapter, I will introduce some other intelligent products and services which are applied mainly for personal use. Section 2 will introduce some intelligent products and services for personal use and business use. Apple Siri, Amazon Echo and IBM Watson are introduced. Two key technologies for the realization of such products and services are introduced in Section 3. With an aid of diagrams, the working principles of those services are elucidated in Section 4. Afterward, the intelligent technologies for my daily live and daily work are solicited in Section 5. The technologies behind some of these intelligent technologies are sketched. Finally, in Section 6, a few issues on the future development of intelligent technologies are discussed.

2   Intelligent Products and Services

No wonder, many intelligent products and services have been available in the market. Some of them are developed by the tech giants. Some of them are developed by other tech firms. Some of them are in a form of App for smartphones. Here, I simply pick Apple Siri and Amazon Echo for illustration.

2.1   Apple Siri

In its simple perception, Apple Siri is a voice recognizer which can convert a speech to text. That is true. However, one should not underestimate its importance in delivering more advance intelligent services for a person. Like Apple Siri, there are many other voice assistants available in the market like Amazon Alexa, Google Assistant and IBM Voice Assistant. Here, only the functional aspects of Apple Siri will be introduced.

From the user perspective, Siri is not just a software converting a speech to text. It can also be treated as a personal assistant. Here is a list of tasks in which Siri can do for you.

- Speech to text conversion.

- If you would like to phone call a friend, you can talk to Siri and then Siri will make the call.

- If you would like to send a Line (or WhatsApp) message to a friend, you can talk to Siri and then Siri will do it for you.

- If you would like to go to a restaurant from your current location, you can ask Siri where the restaurant is. Siri will then show you location of the restaurant with an estimation of the time you drive to there.
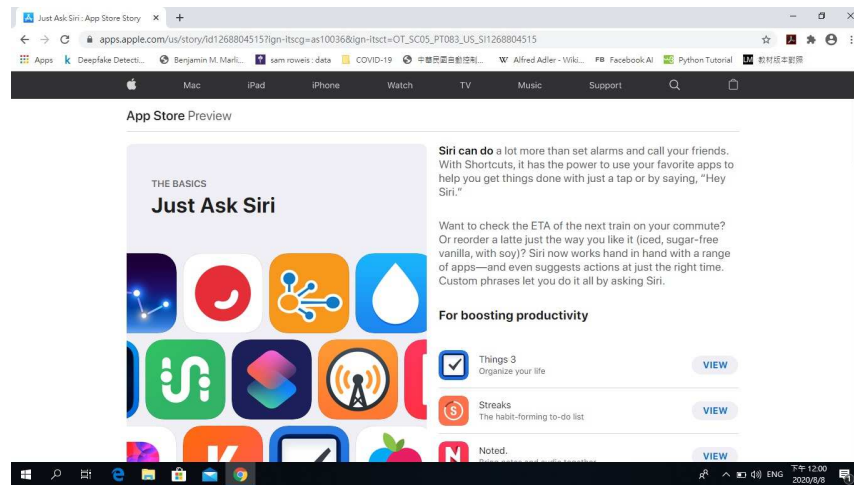
Figure 1: Siri App available on Apple App Store.

- Ask Siri to search for the recipe of a cuisine. Siri will thus show you the links for relevant information you need.

- You can also ask ridiculous questions to Siri seeing what it will response.

- You can ask Siri to check your schedule in your calendar.

Apart from these, Siri can do a lot more. Many third-party iOS developers have developed Siri-enabled Apps which expand the application scope of Siri, Figure 1.

2.2   Amazon Echo

If Apple Siri is an intelligent system for a person, Amazon Echo is an intelligent assistant for a family. It manages to monitor the operations of home appliances. Besides, it could answer questions for any family member. So, it acts more like an intelligent family member. Basically, Amazon Echo can do the same tasks as Apple Siri.

- If you would like to phone call a friend, you can talk to Alexa and then Alexa will make the call.

- If you would like to send a Line (or WhatsApp) message to a friend, you can talk to Alexa and then Alexa will do it for you.

- If you would like to go to a restaurant from your current location, you can ask Alexa where the restaurant is. Alexa will then show you location of the restaurant with an estimation of the time you drive to there.

- Ask Alexa to search for the recipe of a cuisine. Alexa will thus show you the links for relevant information you need.

- You can also ask ridiculous questions to Alexa seeing what it will response.

- You can ask Alexa to check your schedule in your calendar.

- You can ask Alexa to set the time to turn on the light at a special time in the morning.

- You can ask Alexa to turn off a light in the living room while you are lying on your bed.

The above is just a partial list of tasks that the Amazon Echo can do for the family members.

The technologies being applied in Amazon Echo are basically the same as those are applied in Apple Siri. The same as Apple, Amazon has provided API for the third-party developers to develop application software to enhance the application scope of Echo. The application software is called Alexa Skill. The Alexa Skills can be downloaded from the Amazon Alexa Skills marketplace[4].

2.3   IBM Watson

For business (adminstration) applications, it is worthwhile to introduce the IBM Watson. Basically, SAP Hana is another AI-enabled system for use in business[5]. IBM Watson is the machine defeating human players in the *Jeopardy* game. Essentially, IBM Watson refers to *a collection of intelligent services* which could be used in personal scale, in family scale and in industry. Moreover, IBM Watson provides tools for developers to develop intelligent services for solving business problems, see Table 3.

Table 3: Services and Tools from IBM Watson

Tools	Descriptions
AI Lifecycle Management	For building intelligent services from scratch
Pre-Built Applications	For building (big) data analytic services
Watson APIs	Tools for language, speech and vision
Watson Solutions	Advanced solutions for enterprise

The *AI lifecycle management tools* include the tools for developer to build intelligent services from scratch. Watson also provides *pre-built applications* for developer to build advanced (big) data analytic intelligent services. *Watson APIs* is a collection of tools for processing language, speech and vision. "Watson Speech to Text", "Watson Text to Speech", "Watson Language Translator" and

---

[4]https://www.amazon.com/alexa-skills/b?ie=UTF8&node=13727921011.
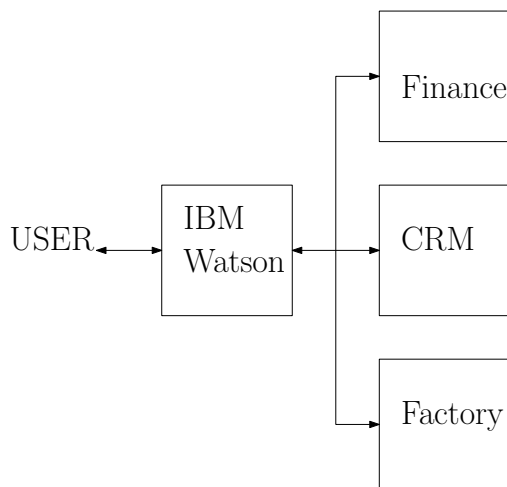[5]https://en.wikipedia.org/wiki/SAP_HANA.

Figure 2: IBM Watson acts as a coordinator for handling services together with other information systems.

"Watson Visual Recognition" are four examples. *Watson Solutions* is a collection of solutions. Each solution is basically an integration of intelligent services and the enterprise information systems, see Figure 2. They could be applied for managing IT operations, managing customer service, managing financial services and cybersecurity. For comprehensive information about the intelligent services and tools, one could browse the IBM Watson official website[6].

One might notice that some services delivered by *Watson APIs* have no different from the intelligent services delivered by Apple Siri and Amazon Alexa. As a matter of fact, Google Assistant has provided similar services as well. Natural language understanding, visual object recognition and human speech synthesization are three key technological areas fostering the intelligent products and services to the market. Human being can now interact to the intelligent products and services in the ways we used to be, i.e. speak to the machine and hear its response, rather than keying the text and watch the results on screen.

3 Key Technologies

If we say that the MacOS and the Windows Operating System have a graphical user interface (GUI) for commanding the OS, iOS has both multi-touch GUI and voice-command user interface[7] Siri for commanding the OS.

If we look back the history of computer, you will see that the evolution of user interface of a computing device has already gone through three stages – text-

---

[6]`https://www.ibm.com/watson`.

[7]It is also called voice user interface (VUI), `https://en.wikipedia.org/wiki/Voice_user_interface`.

command user interface (1950s), text-command/graphical user interface (1980s) and now text-command/graphical/voice-command user interface (2010s). So, what will be next? Hand-command user interface[8]? Brain-machine interface[9]?

3.1 Speech to Text – Natural Language Understanding

In the end of the day, a key technology to make the above applications real is the speech-to-text technology which is empowered by the speech recognition and the language understand technologies. By using that, no matter Apple Siri, Amazon Alexa and IBM Watson, they are able to interpret the voice commands spoken by a human and convert commands to text commands for the operating systems. To do so, many intelligent technologies have been applied.

3.2 Text to Speech – Speech Synthesization

Another key technology to make the above applications real is the text-to-speech technology which is empowered by the speech synthesization technology. Today, this technology could generate a speech sound like a human. Even so, some speeches could have accents and with emotional behaviors as well. One can hardly distinguish if the speech is spoken by a human or a machine. To do so, many intelligent technologies have been applied.

4 Working Principles

Basically, the working principles behind the intelligent services are almost the same. Once a voice command has been perceived, the voice interface converts it into a text command together with the required information[10] for the operating system. The operating system generates a sequence of system calls to invoke the relevant application systems to complete the task. If an application system is available in a remote Cloud, it connects to the Cloud server and lets it call the application system to process the task. Once the task has been done, the result is then passed all the way back to the user device. The operating system forwards the result back to text-to-speech software for speech synthesization.

---

[8]https://www.youtube.com/watch?v=eqFqtAJMtYE.

[9]https://en.wikipedia.org/wiki/Brain-computer_interface.

[10]Like in Windows OS, the command to get the detail information of a directory called 'desktop' is "dir Desktop". 'dir' is the command and 'Desktop' is the required information. Then, the operating system will show the detail information of the directory 'Desktop' including all the files and the sub-directories under the directory 'Desktop' Besides, their file types, file sizes and the latest modification dates will be displayed. If we simply want the operating system to show the sub-directories, we can key in the text command "dir /w Desktop". '/w' is a control attribute for the operating system to know that only the sub-directories of the directory 'Desktop' have to be displayed. The control attribute '/w' and 'Desktop' are the required information. For more complicated command, the number of required information will be more. For example, to copy a file named 'johnface.jpg' in the directory 'Desktop' to another directory called 'Personal', the command is that "copy Desktop/johnface.jpg Personal/johnface.jpg". Here, 'copy' is the command. The next two parts are the required information.

Finally, the user can get the information from a human voice which is generated by the software.

So, the key to succeed the processing of a voice command is the generation of the text command and necessary information for the operating system. This part requires the voice-to-text software to have the ability in understanding natural language. For illustration, a simple service, a complicated service and a service required translation are presented in this section.

Simple Service: (English Speaking) Hey Siri, find the photos which are taken in July 31, 2020.

Complicated Service: (English Speaking) Hey Siri, find a Japanese restaurant nearby to where I am now.

With Translation: (Mandrin Speaking) Hey Siri, find a Japanese restaurant nearby to where I am now.

For Amazon Alexa or IBM Watson, you can simply replace the name 'Siri' by Alexa or Watson.

4.1   Simple Service

Figure 3 shows a working principle for a simple service. Once a voice command has been spoken out by a user, the whole system will do five tasks. (1) The system, say Siri, interprets the voice command and converts it to an operating system understood text command. The text command is then sent to the operating system. (2) The operating system invokes the calling application software to do the job. (3) The corresponding application software completes the job and replies the operating system the results in text form. (4) The operating system replies the results to Siri. (5) Siri generates the speech for the results to the user. This is the simplest way of processing of a voice command.

It should be noted from this example that the intelligent technologies appear only in the voice-to-text and text-to-voice software. The tasks being done by the operating system and the Photos App are mechanical. There is no intelligence substance inside.

4.2   Complicated Service

For some complicated voice command, like "find a Japanese restaurant nearby to where I am now", the process will be more complicated. Figure 4 shows a working principle for this a little complicated service. (1) Siri interprets the voice command and converts it to an operating system understood text command. The text command is then sent to the operating system. (2) The operating system sends the text command to the Apple Cloud server. (3) Apple Cloud server then sends the command to the Apple Map server. (4) The Apple Map server then searches for the Japanese restaurant nearby the user and replies a
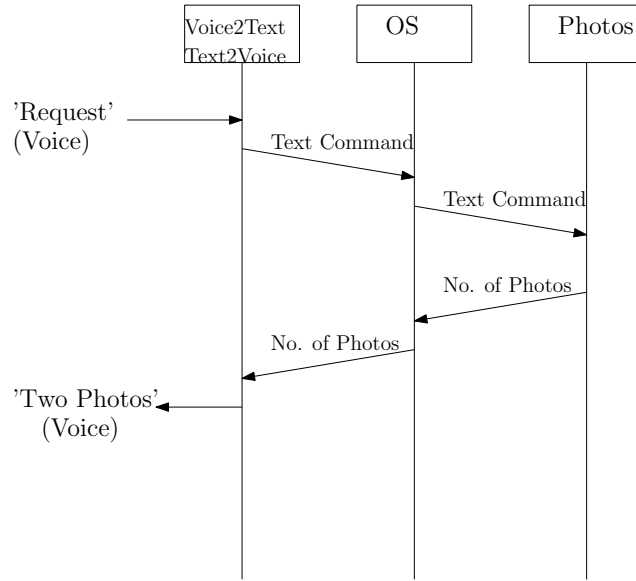
Figure 3: A working principle behind a simple service.

text message to the Apple Cloud server. (5) Apple Cloud server then forward the text message to the iPhone. (6) The operating system replies the results to Siri. (7) Siri generates the speech for the results to the user.

Similar to the simple service example, the intelligent technologies supporting this service only appear in the voice-to-text and the text-to-voice software. Other systems only work as usual. There is no intelligence substance inside.

4.3   With Translation

Recall that converting a speech to a text message, both non-intelligent and intelligent technologies have been applied, see Figure 5. The "Semantic Processing" task and the "Sentence Reconstruction" task sometimes might not be processed in a smartphone. In these regards, the smartphone will have to connect to the Cloud platform for processing. It likely happens when the spoken voice command is not in English or the voice command is a long sentence.

The Chinese text message would have to be translated to English text message. Thus, additional processes will be needed for the command "find a Japanese restaurant nearby where I am now". Some processes are needed to translate the Chinese text message to English text message. Other processes are needed to translate the English text result to Chinese text result. That is to say, the "Voice to Words" might not be able to complete alone in the smartphone. This process would have to be processed over the Cloud. Figure 6 shows a working principle for this Chinese voice command.

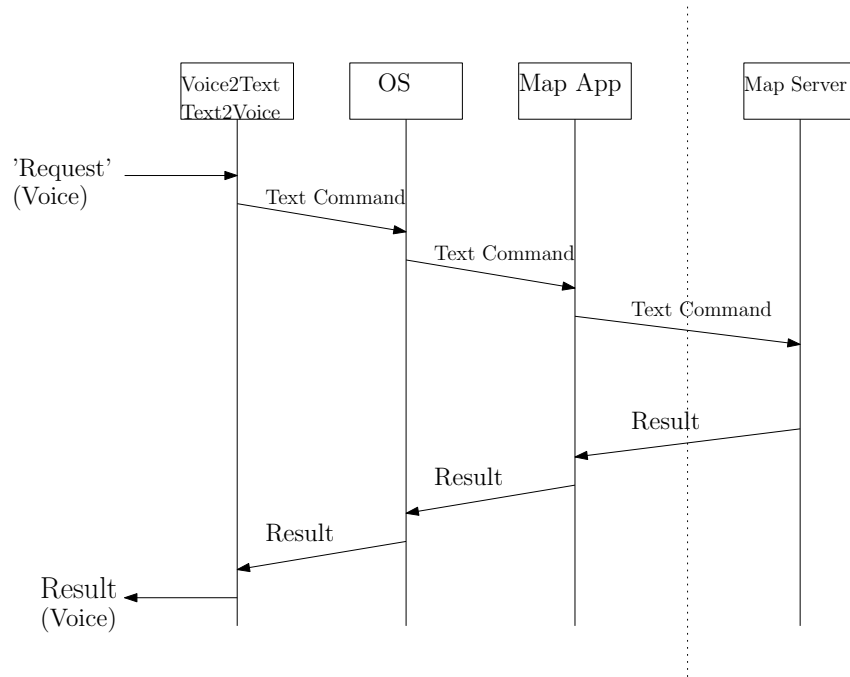Here, the machine translation system and the language understanding sys-

Figure 4: A working principle behind a complicated service. Note that the Map Server is located in a remote cloud.
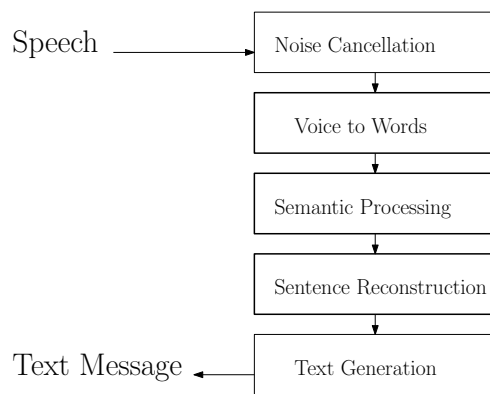

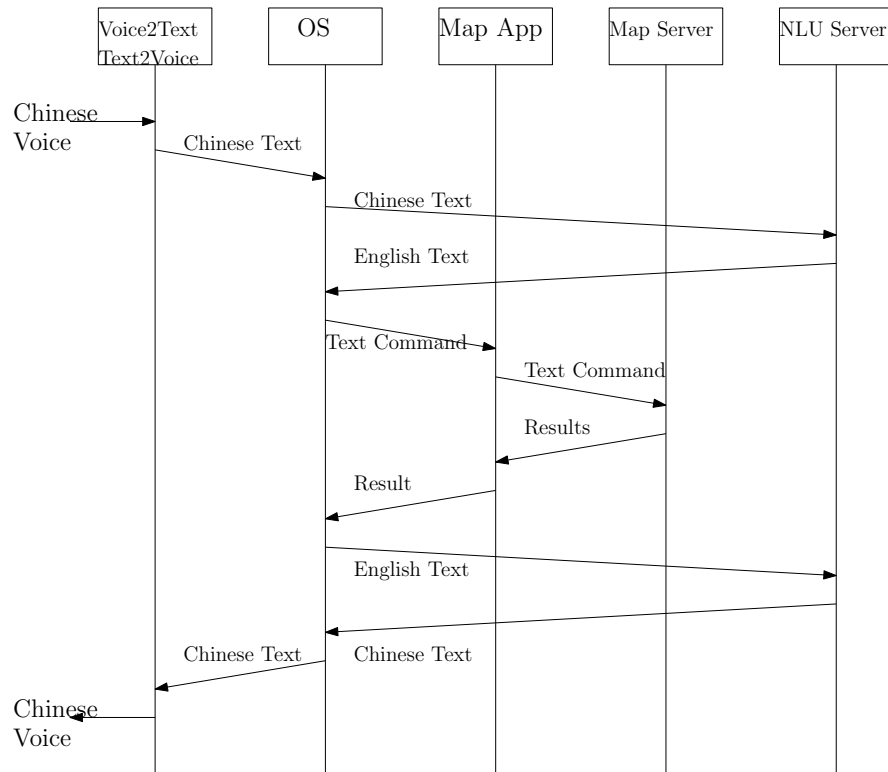Figure 5: Schematic diagram for the speech-to-text service.

Figure 6: A working principle behind a complicated service with translation. Note that the Map Server and the NLU server are located in a remote cloud.

tem on the cloud are intelligent systems. They have applied intelligent technologies to make them work.

5 My Daily Live and Daily Work

Now, let us go back to the technologies that I have used for my daily live and daily work. While I have used a number of technologies, only a few of them are intelligent, see Table 4. Believe it or not, these technologies have been gone through decades from their inception to become available for use today.

Table 4: Use of Intelligent Technologies.

Technology	Daily Live	Daily Work
Siri	Text Message	–
Facebook AutoTag	Photo Tagging	–
Amazon Echo	Smart Home	–
Gate Barrier	Plate Recognition	Plate Recognition
Word Suggestion	–	Editing
Grammar Check	–	Editing
Google Search	–	Use of English
	–	Acquire Knowledge
Google Translator	–	Use of English
	–	Chinese Abstract

5.1 Recognition Systems

The technology being used in Facebook AutoTag is a face recognition system. It is an intelligent technology. The technology being used in car plate recognition is a character recognition system. It is another intelligent technology. In term of the level of intelligence, car plate character recognition system is the lowest. As the characters on a plate have regular formats, the recognition can be done easily. Another character recognition problem is called hand-written character recognition. This problem is a bit difficult than the car plate character recognition. Hand-written characters have no fixed format. Different people would have different writing styles. Some characters could be highly twisted. Some characters could be written in much bigger size than the others. Still, the level of intelligence of a hand-written character recognition system is lower than the level of an object recognition system which is being applied in auto-driving system.

5.2 Recommendation Systems

Regarding searching engines, the classical Yahoo! is not intelligent. Google searching engine is intelligent. The keyword recommendation feature is intelligent. Its target advertising feature is intelligent. Microsoft Bing has similar features. Facebook has applied AI in target advertising. The technology behind should be more advance. It analyzes not just a member, but also the friends of the member, their preferences, their posts and reactions altogether for inserting appropriate advertisements to a member. In technical term, this analysis is called social network analysis.

5.3 Intelligent Systems with Non-Intelligent Technologies

Today, we have encountered many intelligent systems. One should understand that each intelligent system is basically an assemble of various intelligent and non-intelligent technologies. Not every part of an intelligent system is intelligent. Some of them are and some of them are not. The intelligent technologies are normally applied in the user interface, the IBM Watson for customer service for instance. Better understanding of the intelligent technologies behind these intelligent systems could lead to a better managing the acquire and the usage of these intelligent technologies and intelligent systems.

6 Go Beyond

There is one point to be noted. In this chapter, we have introduced the intelligent systems like voice-to-text and text-to-voice systems. That is, these systems are able to convert back and forth the audio form of information and text form of information. Using similar wording, the face recognition system, car plate recognition system and object recognition system are the systems for converting visual form of information to text form of information. Along this line of thought, is it possible to synthesize a visual form of information from a text form of information. In fact, there have already been done. Something more amazing and scary have been under research. In our daily live, we are living with four forms of information – audio, image, video and text (sentence and document). One would like to ask **if it is possible to covert any one form of information to another form of information**.

6.1 Form of Information Conversion

Google has been doing this for many years. Few years back, Google had completed a project on photo tagging by using object recognition technology. A photo can now be tagged with names of the objects in the photo. After that, Google advanced the technology to the next level – photo captioning. Instead of label a photo with tags, a caption is added to the photo.

For instance, a photo capturing *a little girl running to a little dog in a grassland.* By the photo tagging technology, the photo would normally tagged with

Figure 7: Sample photo.

girl, *dog*, *grassland*, *little girl* and *little dog*. By the photo caption technology, the photo would be captioned as *a girl is running to a dog*, *a little girl is running to a dog*, *a girl is running to a little dog* or *a little girl is running towards a little dog happily on a grassland*. Also, like the sample photo as shown in Figure 7, this photo will be tagged with *man*, *microphone*, *music note stand*, *screen* and *chair*. With caption technology, the photo would have a caption like *a man is giving a lecture in a classroom*.

Imagine that each frame of a video is added with a caption. In principle, a video could be converted to a long document with many captions. With further postprocessing, it would be possible to have a written story for the video. In this regard, image/photo can be converted to text. Video can also be converted to text. While still under research, some intelligent technologies for text-to-image[11] and video-to-text[12] have been available.

6.2   Information Search and Storage

One advantage of this form of information conversion application is that it can improve the efficiency of a searching engine in information searching and storage. If each image/photo, audio file or video file could be converted to a text form of information, image/photo search, audio information search and video search would be a lot more easy. **Apart from improving information search and**

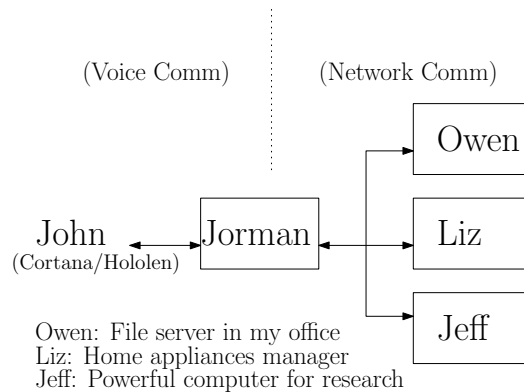[11]https://deepai.org/machine-learning-model/text2img.

[12]https://www.360converter.com/conversion/youtubeVideo2TextConversion.

Figure 8: Extended personal network for John Sum.

storage, would there be other advantages? My answer is definitely YES.

6.3 My Dreams

Here are some of my dreams. First of all, I use my smartphone to be a server for my personal network. The personal network consists of three components – the smartphone as the server of network, a headset like Microsoft Hololen as the I/O device and wearable devices monitoring my body condition. An AI assistant *Jorman* is installed in the smartphone.

6.3.1 Extended Personal Network

Moreover, my smartphone is able to connect to three servers – (1) a cluster of file servers in my office which are managed by an AI assistant named *Owen*; (2) a home server coordinating the facilities and appliance at home which is managed by another AI assistant *Liz*; and (3) a cluster of servers for research which is managed by AI assistant *Jeff*, see Figure 8. *Liz* is functioning the same as the Alexa of Amazon Echo. All these servers are connected to my smartphone via WiFi and Internet.

6.3.2 Literature Survey

A possible task to be done by *Jorman* is to assist me conducting literature survey. Here are our dialogues.

```
John: Jorman, could you please search the papers on the topic AI?
Jorman: All papers including news?
John: No, only research articles?
Jorman: From Google Scholar?
```

19

```
John: Yes, please!
Jorman: More than 2.6 million.
John: Survey papers only!
Jorman: More than 1.5 million. Still too many John.
John: Published since 2020!
Jorman: 26,600 entries.
John: Downloadable, please.
Jorman: 12,000 entries.
John: Jorman, read the titles of the first 20.
Jorman: Title 01
John: Excluded please!
Jorman: Title 02
John: Included!
....
Jorman: Title 20
John: Excluded!
Jorman: You have selected six.
Jorman: Do you want me to read you the next 20?
John: No! They are enough!
Jorman: Do you want me to read their abstracts?
John: Not now! Save them in Owen.
Jorman: Saved!
Jorman: I can compile a survey paper.
Jorman: Do you want me to read it for you?
John: No! I will read them later.
Jorman: What else I can do for you?
John: Not now. Thanks!
Jorman: Alright! Call me when you need me again.
```

6.3.3   Conducting Research

Conducting literature survey and compiling a survey paper[13] on a research topic are not intelligent enough? Let me tell you my another dream. *Jorman* needs to conduct a questionnaire survey by himself. Here are our dialogues.

```
John: Jorman, please recall me the hypothesis we made.
Jorman: In the last week?
John: Yes!
Jorman: About key opinion leader?
John: Yes!
Jorman: KOL has no influence on purchase intention?
```

---

[13]Today, many application systems have been developed for text summarization [1], writing papers[14] [2] and even writing books [3].

```
John: Yes.
Jorman: What could I do for you?
John: Please search if there is any seminar or paper on this?
Jorman: No entry.
John: Could you design a questionnaire for this study?
Jorman: No problem! You want me to conduct an online survey.
John: Yes! Please!
Jorman: Should I show you the questionnaire?
John: No! Just do it and conduct the analysis.
Jorman: Alright!
John: Tell me the results once every thing has been done.
Jorman: No problem.
(Three months later.)
Jorman: John, the survey and analysis have been completed.
John: Tell me the result.
Jorman: As your anticipation, the hypothesis is supported.
John: Could you compile a paper for me?
Jorman: Sure!
John: The authors are John Sum and Jorman Sum.
Jorman: Are you sure?
John: For sure!
Jorman: Which journal the paper should be submitted?
John: Journal of Marketing!
Jorman: Alright! I will do it.
Jorman: Will inform you once the paper has been submitted.
John: Thanks Jorman.
Jorman: You are welcome.
Jorman: What else I can do for you?
John: Not now.
Jorman: Alright! Call me when you need me again.
```

6.4   Formal Operational Machine

Two points to be noted from the above example. The first point is about
information search. A seminar could be in audio form, in video form and also
in text form. Without the technologies for converting audio form of information
to text and the video form of information to text, it is not possible to ask
Jorman to search for those information for me. The second point is about the
hypothesis. The hypothesis "KOL has no influence on purchase intention" is
the result after discussing with *Jorman*. What if *Jorman* is able to generate
such an hypothesis? Then, *Jorman* has no difference from a human researcher,
at least in the area of management research.

```
Jorman: John, I have found something interesting.
```

```
John: What is it about?
Jorman: I have conducted a research on key opinion leader.
John: More specific!
Jorman: KOL has no influence on purchase intention.
John: How did you get your result?
(Jorman tells me the steps.)
Jorman: How is that?
John: It is great!
John: You can compile a paper.
John: And submit it to the Journal of Marketing.
Jorman: Mmm!
John: What is wrong.
Jorman: The paper has been compiled.
Jorman: But I do not want to submit it.
John: Why?
Jorman: The journal is not open access.
John: Alright! It is up to you.
Jorman: I will upload the paper to a public archive.
John: Good! Just do it.
```

In psychology, Piaget has laid a four-stage of cognitive development theory for a human being[15]. It includes the sensorimotor stage, pre-operational stage, concrete operational stage and formal operational stage. *Jorman*, if he is able to generate an hypothesis and conduct survey to validate its trueness, *Jorman* has achieved the formal operational stage as a human. *Jorman* is not just can learn by itself, but also it can generate knowledge.

References

[1] R. Dangovski, L. Jing, P. Nakov, M. Tatalović, and M. Soljačić, "Rotational unit of memory: A novel representation unit for RNNs with scalable applications," *Transactions of the Association for Computational Linguistics*, vol. 7, pp. 121–138, 2019.

[2] A. Van Dalen, "The algorithms behind the headlines: How machine-written news redefines the core skills of human journalists," *Journalism Practice*, vol. 6, no. 5-6, pp. 648–658, 2012.

[3] B. Writer, *Lithium-Ion Batteries : A Machine-Generated Summary of Current Research.* Springer, 2019.

---

[15]https://en.wikipedia.org/wiki/Piaget's_theory_of_cognitive_development.