The Social Impact and Electronic Functionality Design Inspiration Brought by Application of Artificial Intelligence (AI): A Case Study of Google Assistant

1 Part 1: Writing Check-In

1.1 Investigation

1. *What writing strategy do you intend to employ to approach writing this?*
   For writing the case study report, I will use the following strategy:
   1) Identify the problem of the statement and the case to be studied from the literature review and case study proposal.
   2) Outline the bullet points for sections A B C and D based on my research.
   3) Revise my literature review content.
   4) Detail how each section is connected to my major idea.
   5) Make sure each section is evidence-based.
2. *What kind of time do you predict each section will take to complete? How will you plan for needing to revisit these stages throughout analysing your case and writing your report?*
   In my writing habits, I will probably spend one hour reviewing my literature review and case study proposal, then spend a few hours to research my topic and case, and answer the first two parts of the case study assignment in several hours. After that, I need some hours to revise my literature review a little bit and write the bullet form answers from the first two parts in complete sentences as a continuous document. I will leave it for another day to review my report to make sure it becomes fluent and reasonable. The time I'm planning to finish this assignment will be several days to make sure I have deep consideration about my topic during these days.
3. *Consider the resources available to you for writing, (i.e. librarian consultations, EASC, lecture and seminar content, coffee chats, forum posts, and Mohsen's office hours). Having read through all the previous instructions, what is your assistance plan for how to best make use of the resources available to you?*
   The available resources I am going to use are: review the lecture videos about case study; review the workshop video - research strategies for the case study; use the research result from the database - IEEE Xplore Digital Library; hold group meetings to discuss each group member's topics and technologies.
4. *How do other students understand the task? Is your understanding similar? If not, how does it differ?*
   While my group holds the meeting for reflection 3, my group mates have the similar understanding as mine. This assignment is helping us to combine the literature review and case technology step by step.
5. *What tools will you be using for your analysis? (i.e. mind map, reference tracker like Mendeley, template, etc.)*

Mind map will be used for my analysis, it helps me to organize the relationship between different components related to my topic. The Case Study Example provided on d2l will be used as the case study report template. The Checklist extension from google chrome will be used to keep track of my mean idea of each paragraph.

6. *How will you organize yourself to make sure you meet all the requirements?*
   I will be using the checklist tool to make sure I meet all the requirements. After finishing the report, I will leave it for another day to review it based on the rubric to make sure I meet all the requirements.
7. *Is there anything else you might need to know to complete this assignment?*
   I might need to do some research on similar types of technology, for example, Siri, Alexa, and so on.

1.2 Diagnosing

1. *You are about to draw a relationship between your technology and literature review problem statement. Reviewing your reverse outline and the details you've given so far; will that relationship seem believable to your audience? Why or why not? (note, asking a peer to read over your answers is a great way to determine this)*
   The technology I chose: Google Assistant.
   The problem statement of literature review: How the Discovery and Development of Artificial Intelligence (AI) and Machine Learning Has Impacted Society.
   The relationship between my technology and the literature review problem statement is Google Assistant bundles machine learning, speech recognition, and natural language processing (NLP), which is an application of AI. The impact of Google Assistant in the electronics industry is a specific branch topic of the impact that AI and machine learning brought to society.

1. *Consider the mind-map you did in your case study proposal. Mind maps can be useful to separate out a problem into its most important elements and relationships. With the new information gained from your research how can you update your mind map? Were your original relationships accurate given the new information? Is there anything you need to add or subtract? If you didn't update your mind map discuss why (i.e. where your assumptions were validated, etc)*
   The mind-map I designed in the case study proposal was fairly accurate, after further research, I can add one more significant element based on the mind-map, which is the applications of virtual assistants.
2. *The purpose of a case study is to help solve a problem – oftentimes large problems cannot be solved in a single case study, and thus an author will need to make a definitive statement to help advance the discussion for future work to build on. Definitive statements can be recommendations about potential solutions, courses of action, predictions about the future or claims about why something happened the way it did. Refer to your problem statement from your literature review. Is it stated in such a way that you could give a definitive statement to address it? For instance, if you wanted to recommend a course of action, is your problem stated in such a way that you could suggest a way to minimise, solve or remove the problem? Why or why not?*

My problem statement for the literature review is how the discovery and development of Artificial Intelligence (AI) and Machine Learning has impacted society. A definitive statement to address it (combining it with my technology) could be: As a typical application of AI, Google Assistant can bring functionality design inspiration for the electronics industry, which impacts society in the present and future.

2 Part 2: Scaffolding Your Case Study

2.1 Part A. Describing the situation

2. *What is the single technology you have chosen to discuss?*
   The single technology I have chosen to discuss is Google Assistant, which is an artificial intelligence–powered virtual assistant developed by Google.
3. *Discuss the details of your case (i.e. setting, environment, time period, major events, problems, conflict) to set the stage. What references are needed to adequately describe this technology? (note: engage a librarian for help if unsure by bringing your search record, mentioned in the first librarian workshop)*
   Google Assistant has launched on the Google Pixel smartphones, Google Home, and all modern Android devices. Users primarily interact with the Google Assistant through natural voice or keyboard. The related problem and conflict could be: The potential of machines to understand human language, and the positive and negative impact of virtual assistants to society. Google Assistant bundles machine learning, speech recognition, and natural language processing (NLP). The references of the above technologies are needed to adequately describe Google Assistant.
4. *Do you believe your technology makes a difference to society? In a sentence, describe this hypothesis (note: this is your initial understanding which you are about to test with evidence-based reasoning).*
   Yes, Google Assistant adds functionality design inspiration in the electronics industry so that embed virtual assistants to more electronics to bring convenience to human life.

2.2 Part B. Identifying the key issue

1. *Discuss the context of your case (i.e. discovery, development, application, implementation, impact, future)*
   Google Assistant was unveiled during Google's developer conference on May 18, 2016. In February 2017, Google announced that Google Assistant will be available on Android smartphones that run Android Marshmallow or Nougat. Now, Google Assistant has launched on the Google Pixel smartphones, Google Home, and all modern Android devices. Users use natural language to interact with Google Assistant to check the weather, play music, provide shopping service and so on. Considering the principle behind artificial intelligence, virtual assistants like Google Assistant can potentially do more for humans. In present, for example, an in-car virtual assistant helps people to look for the location and guide people to their destinations. In future, when the technology of natural language processing has been fully developed, virtual assistant can be a friend

of a person, parents of a child, or even a teacher of a student. Although this is morally debatable, it could still be a possible development direction in the future.

2. *Outline the specific pieces/aspects/characteristics of your case you intend to analyze*
   I intend to analyze three characteristics of Google Assistant: Talk with users with natural language, help users to finish simple tasks, and access information from users and analyze the information.
3. *Evaluate these aspects based on the evidence gained in your literature review body sections. For instance, if your body section question (i.e. heading) is "Environmental Impacts of EV Manufacturing and Supply Chain Production" then you might discuss: what is working in these areas, and what isn't working?*
   My literature review covered examples of virtual assistants in a body section, the implementation of the above characteristics are applications of AI. Therefore, it is reasonable to select Google Assistant as a case to study.
4. *Identify two to five challenges related to the aspects of your case, i.e. what are the inherent issues/risks to society in the case, what historical successes or failures occurred in relation to the case, what strengths or weaknesses does the case bring that could impact society?*
   1) Virtual assistants as customer service potentially increase the unemployment rate.
   2) Virtual assistants as a role in companionship is morally debatable.
   3) When humans ask virtual assistants to complete serious tasks, the unreliability of machines may cause fatal hidden trouble for safety.
5. *Why do you think these challenges exist?*
   Artificial intelligence is to make machines think like humans, but the way machines think can not be as reliable as the human self, especially in terms of emotion and judgment in emergencies.
6. *How do they impact and interact with the segments of society studied in your references? i.e. Who suffered negative outcomes due to these challenges? Who is responsible for them? Etc.*
   Today, pervasive applications of AI such as Google Assistant are reliable since they are fully tested and intended to complete simple tasks without potential hazard. More advanced artificial intelligence is still in the development stage, and many controversial issues need to be resolved in order to be widespread in the future. Customers who use the application of AI may suffer negative outcomes if the issues are not resolved, and the designer is responsible for them.

2.3 Part C. Analyzing the case using relevant concepts

1. *Consider the challenges you identified in Part 2, b. For each one, attempt to make a definitive statement (as defined in Part 1 – Diagnosing) and support with solid evidence.*
   1) Burnout is likely to occur when employees are overworked in some industries under strain such as the medical treatment, using virtual assistants reduces burdens of employees.
   2) For people who are living alone, being visually imparied or having dyslexia, virtual assistants are absolutely helpful for them.

3) Although the virtual assistant is not very reliable to deal with moral dilemmas, their reaction time and ability of attention focusing are better than human.

2. *Explain how this definitive statement fits with what we already know (i.e. your literature review and evidence based reasoning).*
   Since we know that AI is developed to simulate human brains, the product of AI is intended to replace some of the human power, this is inevitable and depending on how people use them.
3. *Explain why you believe it is realistic and specific. i.e. for a solution, explain why you think your solution will work. (note: we are evaluating your reasoning skills, i.e. how well can you put an argument together. We are not evaluating the quality of your solution in detail)*
   My solution will work because in large manpower demand industries and the population who needs daily care, using a virtual assistant is positive.

2.4 Part D. Evaluating and forming conclusions about a definitive argument

1. *Choose one of your definitive statements you think is most likely to be successful/accurate:*
   Burnout is likely to occur when employees are overworked in some industries under strain such as the medical treatment, using virtual assistants reduces burdens of employees.
2. *What limitations or roadblocks could prevent your definitive statement from being realized? (i.e. for a solution what could go wrong or keep it from being implemented)*
   The virtual assistant used in the medical treatment may cause fatal hidden trouble for safety.
3. *How could people use your analysis of your case to make better decisions in the future for other cases with similar features?*
   People can acquire inspiration after using my analysis when they design electronic products such as what functionality is required as safe for users to use, and what functionality can potentially cause the problems.
4. *What kinds of additional problems might people who want to address your problem statement come across? What kind of information could you provide to guide them or offer points for future discussion?*
   Additional problems may include what else electronic products can utilize the AI in the future. In my case study, I will provide some information about the potential development prospect of application of AI.
5. *Explain how your solution relates to your problem statement, and thus how your technology relates to society.*
   My problem statement is what kind of functionality design people could think of for the application of AI in the electronics industry after studying a specific technology: Google Assistant. My case study will provide the advantages of Google Assistant and how virtual assistants apply for present electronic products, and information about the potential development prospect of application of AI.

3 The Social Impact and Electronic Functionality Design Inspiration Brought by Application of Artificial Intelligence (AI): Google Assistant

Abstract

Artificial intelligence, abbreviated as AI. It is a new technology that studies the computation method and application used to simulate human intelligence. This report analyzes the research result of AI and machine learning, it introduces the discovery, development, and relationship between AI and machine learning, it also discusses many applications of AI, and explores how they influence different fields of society in present and future, such as the influence of virtual assistant in electronic industry, fingerprint recognition in biometrics, and chatbots in business. Furthermore, the report includes the study result of a specific application of AI: Google Assistant, and also discusses three different development directions of speech assistant.

Introduction

Machine learning is the study of how computers simulate human learning behavior so that they acquire new knowledge or skills, reorganize the existing knowledge to improve their performance. Artificial intelligence (abbreviated as AI in later sections) is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals, which involves consciousness and emotionality. [1] In general, the major goal of AI is to enable machines to perform complex tasks that would normally require human intelligence. Machine Learning is the core of AI, it is the fundamental way to make the computer intelligent. In recent years, more and more controversial topics have come up with the discovery and development of AI and machine learning. Human society has been impacted a lot in different fields, such as mathematics, science, medicine, industry, business, etc.

Google Assistant, as a typical virtual assistant application of AI, implements the speech interaction with users. The speech assistant is widely implemented on mobile devices and home automation devices, it is also accessible in electronic products in other industries. Therefore the development direction of virtual assistants is a topic that is worthy to be studied.

3.1 Discovery of AI

In the first half of the 20th century, there is a generation of scientists, mathematicians, and philosophers with the concept of AI culturally assimilated in their minds. Humans can acquire information and use their intelligence to make decisions, why can't machines do the same thing? [2] This brought the main idea of AI. Unlike the 20th century, computers have developed fastly, the cost of computers gets lower, memory and computing capacity of computers get increased. This allows computers to store a lot of information, and analyze that information to generate reasonable results by simulating human consciousness. There are more and more intellectualized machines in people's life. Therefore, AI has become significant in improving human's living standards.

3.2 Development of AI and Machine Learning

With the progress and development of human society, computers usually take the complicated science and engineering calculations that were supposed to be taken by humans. Today, computers not only complete these tasks, but also compute way faster and more accurately than human brains. Therefore, people no longer treat this kind of computation as "complex tasks that only depend on human intelligence to complete". It can be seen that the definition of complex tasks is changing with the development of technology. So, the objective of AI is also changing with the changes of time, it now turns into some more meaningful and significant objectives.

3.3 Application and Impact of AI and Machine Learning

Today, people use intellectualized machines everywhere. AI and machine learning brought enlightenment to the electronic industry. Many electronic products support virtual assistants, such as Siri, Google Assistant, Cortana, etc.[3] They process and store users' requests in the cloud storage when users call out the wake word and command. For instance, virtual assistants collect the map data and the user's current location information to provide the nearby restaurant's location; Virtual assistants look up the users' information, make calls and reply messages for people when people are driving. Thus, AI and machine learning have influenced the electronic industry and provided great convenience for human life. Virtual assistants require massive amounts of data to improve their performance, which also builds the momentum for AI, machine learning, and speech recognition fields.[4]

The technology of fingerprint and face recognition are also a typical application of AI in biometrics. This technology allows machines to collect human's unique traits of a particular part of the body such as fingerprint and face to classify and compare different identities. Fingerprint recognition has developed rapidly in recent years. It is a relatively mature identification method among many biological identification technologies. It has been widely used in many fields of society: mobile phone unlocks, payment information, message confirmation, airport security, law enforcement, etc.

AI and machine learning is also impacting business. An obvious example can be online customer service chatbots. Many business websites now offer a window for users to chat with customer service remotely. Customers are usually assigned to a chatbot first, which solves some basic problems for customers. This chatbot is like an automatic responder, a lot of common solutions are predefined in the storage. It can also connect the customer to an agent when the customer's request cannot be solved by the robot. Unlike the communication between computers, communicating with humans is way more complicated, these chatbots must be good

at understanding natural language. Therefore, this application relies on natural language processing (abbreviated as NLP), and once these chatbots collect enough natural language data so that they understand the most purpose involved in different languages, they could be used to mostly replace human services. So, there are a lot of advantages to using customer service chatbots. First, customers will get faster service, the robot usually keeps listening to the user's request every time, they do not need weekends, holidays, vacations, or sick days off. Then, using chatbots gives companies an advantage when they are trying to keep labor costs down since it may cost less than paying many employees. Although using chatbots brings advantages, they aren't perfect. Chatbots only work for a limited database, this may not satisfy customers, sometimes customers could get confused, and the conversation could run in a circle.[5] It can be seen that AI and machine learning also impact business. With the development of machine learning, it is also a meaningful topic whether chatbots can completely replace humans in the future.

3.4 Case under investigation: Google Assistant

Google Assistant is an artificial intelligence-powered virtual assistant developed by Google, which is one specific application from the previous section. Today, there are a whole bunch of internet users. According to data reports, over 1 billion people actively use Google's product and service, such as Google search engine, Google Chrome, Gmail, Google Drive, and so on. This not only shows that Google as a big technology company is reliable, but also reveals Google has these user's accounts and data. This means Google's products are more receptive than products from a company that has fewer users. As a virtual assistant, users primarily interact with the Google Assistant through natural voice. It offers voice commands, voice searching, and voice-activated device control, and helps users to complete different tasks after users have spoken "OK Google" or "Hey Google" wake words [6][7].

Google Assistant bundles automatic speech recognition (abbreviated as ASR in later sections), natural language processing (abbreviated as NLP in later sections), and text to speech (abbreviated as TTS in later sections). ASR refers to the transformation from human speech into machine language that can be read by computers. NLP studies how machines understand human language based on the transformed machine language and make relevant responses, then output feedback. NLP is the core of speech interaction. TTS is assistive technology in which computers read the feedback generated in the last step, so that implements the speech communication between human and machine [8]. Once machines understand human language and respond to humans correctly, almost all functionality of machines can be controlled through natural voice. This leads to a problem, as the development of Google Assistant, what functionality design inspiration of electronic products can Google Assistant bring?

3.5 Evidence-based reasoning

3.5.1 The development of application of Google Assistant

Google Assistant was unveiled during Google's developer conference on May 18, 2016. In February 2017, Google announced that Google Assistant will be available on Android smartphones that run Android Marshmallow or Nougat. Now, Google Assistant has launched on Google Pixel smartphones, Google Home, and all modern Android devices.
Users use natural language to interact with Google Assistant to record notes, check the weather, play music, set reminders, and so on. More complicated tasks such as home appliances control and message processing can be done with Google Assistant as well.

3.5.2 Inherent issues to society of Virtual Assistant

Considering the technology behind AI, virtual assistants like Google Assistant can potentially do more for humans. However, innovations have huge opportunities for further success but face challenges.

3.5.2.1 Customer service products

Google service can be used for customer service products. For example, robot waiters embedded with Google Assistant could be used in restaurants. They greet guests, guide customers, and monitor the buffet. When people say the wake words, the robot waiters make responses such as order dishes, ask for drinks, pay for the bill, and so on. Some questions from customers can also be answered through natural voice. The robot waiters could mostly replace human services, this means customers get instant service and employers do not have to worry about hiring, sick time, vacations, or human error. The cost of starting well-developed robot waiters outweighs the traditional service model of a restaurant, but labor costs are reduced with robot waiters in the long-term. Robot waiters used in China are reportedly less expensive than human waiter's annual salary [9]. However, it troubles people who depend on these jobs. The researchers found that for every robot added per 1000 workers in the U.S., wages decline by 0.42% and the employment-to-population ratio goes down by 0.2 percentage points[10]. This means the unemployment rate will increase on this innovation.

3.5.2.2 Automatic driving

Embedding Google Assistant in automatic driving is feasible, which allows users to drive a car through natural voice. It combines speech AI technologies and machine learning to enable hands-free, which sounds attractive and convenient for users. However, the judgment that automatic driving is not better than human although it takes less reaction time, it may still cause fatal hidden trouble for safety. Furthermore, the virtual assistant is not very reliable to deal with

moral dilemmas. For example, a car going straight causes 4 dogs and a cat to die or crashes into the roadblock on the right and kills 5 passengers. Therefore, how the system deals with ethical issues is even harder to solve than the technical problem.

3.5.2.3 Role of companionship

Virtual assistant as a role in companionship is a potential direction of development. Life expectancy is increasing all over the world since the improvement of modern medicine and strong public health measures. Life expectancy is now nearly 20 years longer than it was in the 1960s. However, it has also led to increased demand for elderly people living alone and in need of daily assistance. Due to the shortage of skilled caregivers, virtual assistants such as Google Assistant provide complementary support for elderly patients. This is not only aimed at the elderly group of people, but also at people who are visually impaired or have dyslexia. Therefore, the functionality that Google Assistant can implement becomes varied. Many researchers are working on this. ElliQ is a successful smart robot and personal voice assistant for the elderly, it is friendly, intelligent, and inquisitive. It uses the similar technology that Google Assistant used so that ElliQ has features such as conversation, music streaming, calendar appointments, wellness keeping, and so on [12]. However, the companion robot can not replace adult children based on ethical concerns, the mental health of patients is a factor to consider.

3.6 Critical analysis

3.6.1 Customer service products

The uncertainty and decreasing unemployment rate of using assistant robots in restaurant customer service are controversial since many people depend on these jobs. But in medical treatment, burnout is likely to occur when employees are overworked. Using virtual assistants reduces the burdens of employees. Such as virtual assistants offer hands-free documentation

features during the surgery. When patients want to add notes, they can use the speech equipment in the room. And the digital consulting applications simplify the consultation according to the notes recorded. For instance, the AI platform of Ada Health supports clinical decision making, it allows doctors to pre-identify and categorize symptoms before patients suffering from pain or illness [13].

3.6.2 Automatic driving

Automatic driving is a very complex task that an AI can do. Self-driving cars are not available in most countries to date. But the idea and the functionality design are very concrete. The auto manufacturers design automatic driving as auxiliary functions. It asks the driver to touch the steering wheel after an amount of time in order to help the driver to preserve attention. So that the significant decision will still be made by humans. Furthermore, for the issue of dealing with moral dilemmas, in 2016, two students of MIT: Edmond Awad and Sohan Dsouzza launched a website called the Moral Machine, which aims to find out what the public thinks about how machines make decisions in moral dilemmas. And they have collected 40 million human decisions on ethical dilemmas of autonomous vehicles within 18 months, which provided great support for the development of automatic driving. Today, more investigations are still processing to make automatic driving more comprehensive in the future.

3.6.3 Role of companionship

For people who are living alone, being visually impaired, or having dyslexia, or for children who are living without parents, a great voice-activated personal assistant such as Google Assistant is absolutely helpful for them. This requires the assistant to not only have functional features, but also have emotion recognition. Such as voice and face expression. The MIT Media Lab Affective Computing Group[1] was the first to conduct research on emotion recognition of

[1] The Massachusetts Institute of Technology Affective Computing group creates and evaluates new ways of bringing together Emotion AI and other affective technologies in order to make people's lives better.

physiological signals, and also proved that it is feasible to apply physiological signals to emotion recognition [14].

Recommendations and Conclusions

The most accessible development direction from the examples given in the previous sections is related to the customer service for the industry that can easily lead to burnout. Using speech assistants as support helps employees to reduce pressure. Other than medical treatment, education and marketing can also be the target area that speech assistants like Google Assistant help.

Artificial intelligence(AI) is a broad and challenging subject, which consists of different fields. With the development of technologies, the expectation and attitude that people have on AI are changing, more controversial topics come with it. The applications of AI have great potential in different areas of society. It is clear that Google Assistant brought inspiration for electronic functionality design in customer service. The implementation of AI in customer service will enormously change human being's life in the future.

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