Team Final Report

Science and Technology Group

Ahmar Mirza, Dan Tattersall, Juana Nakfour, Thet Naing Oo

Contents

Introduction

In June 2015, the Amazon Echo became the first widely-released smart speaker. It utilized natural language processing to intelligently comprehend and respond to user voice commands, questions, and searches via the Alexa personal assistant platform. Many of the core abilities were developed by Amazon's Lab126 over the course of 5 years (Kim, 2016), but since its release two years ago, outside developers have created more than 7,000 "skills" on the Alexa platform (Marchick, 2017). To increase the capabilities and incentivize developers, Amazon simultaneously created the Alexa Fund, which is devoted to supporting "manufacturers, developers and entrepreneurs that are working to innovate on products and services that tap into the power of the human voice" (LeClaire, 2015). By offering opportunities for early third party development using the Alexa Skills Kit (ASK), Amazon helped the Echo become more than just the Alexa assistant platform: it provided a way for its hardware to be integrated with services outside of Amazon, thus increasing its feature-set and staying power.

While the Amazon Echo was the first broadly released smart speaker, competitors were not far behind in the form of hardware, such as Google Home and Mattel's Aristotle (Low, 2017). Additionally, the intelligent, personal assistant field is already crowded with big name competitors: Google's Assistant, Microsoft's Cortana, and Apple's Siri, along with possible international competition from Baidu's Xiaoyu Zaijia (Kleinman, 2017).

Only Google currently has both the hardware and platform to compete with the Amazon Echo, and, therefore, is considered its biggest competitor. Because the Google Home released in November 2016, over a year after the Amazon Echo, the Echo developed a strong foothold in the smart speaker market and has had more time to refine its product and platform offerings.

Despite the excitement and press surrounding their devices and platforms, both Amazon Echo and Google Home third party applications face obstacles in monetizing the ongoing use of services beyond existing streams of revenue such as subscriptions for music or video.

Hardware and Feature Comparison

Comparison

With growing competition, the Amazon Echo must find ways to differentiate itself in the market. While part of this strategy involves perception and marketing, which relates to consumer sentiment, a large piece of differentiation is making good hardware and a good platform that can support rapid development in an immature market. In Table 1, we can see how the hardware for the Echo and its biggest competitor, Google Home, measure up against each other.

Table 1. Hardware Technical Specification Comparison.

	Amazon Echo	Google Home

Main Processor	TI DM3725 ARM Cortex-A8 Core Digital Media Processor	Marvell 88DE3006 Armada 1500 Mini Plus dual-core ARM Cortex-A7 media processor
Microphone	7-mic circular array (far-field voice recognition)	Two Microphones (far-field voice recognition)
Speaker	2.5-inch woofer and a 2-inch tweeter	High excursion speaker with 2" driver + dual 2" passive radiators
Wireless	802.11a/b/g/n((2.4GHz/5Ghz), Bluetooth (A2DP, AVRCP)	802.11b/g/n/ac (2.4GHz/5Ghz) (Just announced Bluetooth)

While many features are comparable, Amazon makes sure to mention that its 7 microphones excel at picking up commands near and far, which Google Home claims to manages to do using software instead (Clark Estes, 2016).

Beyond the hardware, Amazon and Google boast strong feature sets on which their platforms are built. Compiled from product and industry sites, Table 2 shows a comparison of features across a range of attributes for each device.

Table 2. Feature Technical Specification Comparison.

	Amazon Echo	**Google Home**
Music Source	Amazon Music, Prime Music,Spotify, Pandora, iHeartRadio, TuneIn, more etc	Google Play Music, YouTube Music, Spotify, Pandora and TuneIn,iHeartRadio
Audio Books	Yes, Audible or Kindle	No
Calling and Messaging	Yes(Alexa to Alexa)	Yes (Just announced handsfree calling to mobile phones and landlines)
Audio	360º omni-directional audio	unidirectional
3rd Party Apps	Yes, Skills for Alexa (more than 10,000)	Yes, Actions for Google Assistant (less than 100)
Smart Home Control	Compatible with WeMo, Philips Hue, Samsung SmartThings, Nest, ecobee, Honeywell and others ([complete list](#))	Compatible with WeMo, Philips Hue, Samsung SmartThings, Honeywell, Nest, ecobee, and others

	Amazon Echo	Google Home
Order and Tracking package	Yes	Yes but not tracking
Always ON	Yes, "Alexa" wakes it up	Yes "OK Google" wakes it up
Cloud Natural Language Processing	Yes, Alexa	Yes, Google Assistant
Multiuser	No	Yes, can distinguish your voice from others for a personalized experience
Proactive Assistant	No	Yes (coming just announced)

Summary

To better understand how the Echo and Google Home products compare against each other, we have summarized key technical capabilities highlighted by CNET and PCMag. We focus on three main features: entertainment, personal assistant, and smart home. The data can be found in Table 3 below.

Table 3. Technical Capabilities Comparison (Sources: **(Gebhart, 2017) (Segan, 2017)**))

	Amazon Echo	**Google Home**
Entertainment **CNET winner:** Google Home **PCMag winner:** Google Home	**CNET:** • Sounds quality isn't comparable to High end speakers **PCMag:** • Able to control multiple speakers in sync	**CNET:** • Sounds quality isn't comparable to High end speakers • Able to control multiple speakers in sync **PCMag:** • Able to control multiple speakers in sync • Provide better sound than Echo

Personal Assistant	CNET:	CNET:
CNET winner: Google Home	• Ability to set events on calendar and make to do list	• Ability to understand contextual conversation
PCMag winner: Amazon Echo	**PCMag:**	• Able to provide step-by-step instruction of recipes from phone
	• Ability to set events on calendar and make to do list	**PCMag:**
	• Perform better at shopping related queries.	• Ability to provide more relevant information from the web (more conversational)
Smart Home	**CNET:**	**CNET:**
CNET winner: Amazon Echo	• Integration of large third party apps integration.	• Flexibility in understanding the user's command
PCMag winner: Amazon Echo	**PCMag:**	• Better TV integration with Chromecast
	• Integration of large third party apps	• Convenience multiple user integration
	• Ability to control bigger selection of smart-home devices.	**PCMag:**
		• Convenience multiple user integration
		• Better TV integration with Chromecast

Both products have their own advantages and weakness. In entertainment category, Google Home seems to be the clear winner with the ability to sync to many speakers at the same time. In personal assistant category, Google Home can handle flexible user command, but lacks the key functionalities such as adding event to calendar or making to do list. On the last note, Amazon Echo has a wide range of third party applications to choose from and better integration with smart-home products. It is a close call to say that one is better than the other.

Recommendation
As these products become more mature and find ways to differentiate themselves based on their natural advantages (Amazon: ecommerce, Google: search and knowledge), they may find core user groups based on these strengths or find ways to overcome their weaknesses in an attempt to appeal to the broadest market. However, during their current early development stage, neither is decidedly better than the other in hardware and features.

Product and Sales Analysis

Comparison

A 2017 report from Voicelabs, a Voice application analytics company, describes the "voice-first device" market as a "winner-take-entire-household market" (Marchick, 2017). Similar to smartphone ecosystems that users adopt and are resitant to leave, a Voicelabs survey found that only 11% of Echo and Home owners plan to buy a competing device.

The lack of consumers willing to own competing voice-first devices takes on more meaning when combined with the assessment of McKinsey & Company Partner Kabir Ahuja. In a video on the outlook for connected homes, Ahuja explains that people tend to add connected devices to their homes gradually over time and are usually prompted by a major life event, such as moving, marriage, or having children (Ahuja, 2016).

Summary

Strengths

Because this adoption is slow and consumers are reluctant to buy competing connected devices, Amazon should be able to hold on to consumers who have already purchased the device for a number of years.

The 2017 Voicelabs report estimated that, by January 2017, around 7 million Amazon Echos had been sold over the course of 2015 and 2016 whereas the Google Home only sold 400,000 to 500,000 in 2016 (Sharma, 2017). In addition to being the first-to-market for consumers to purchase, the Amazon Echo benefits from increased time for third party developers. Furthermore, the ability to order through the Amazon Store provides an opportunity to grow existing revenue streams that Google Home doesn't have.

An April 2017, eMarketer report confirms the strength of the Amazon Echo's position in the market and estimates that by the end of 2017, approximately 70% of voice-enabled speaker owners will have an Echo (eMarketer, 2017).

Figure 1. eMarketer Report, April 2017
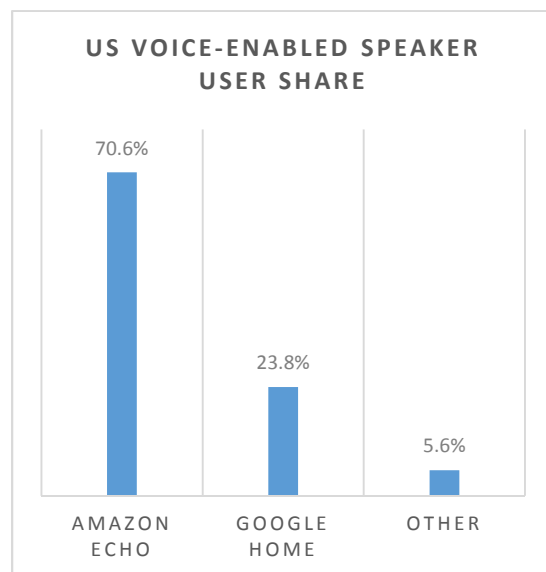
Weaknesses

The Amazon Echo is not without its challenges as it tries to maintain its dominant position in the voice-first device market. While it has the built-in advantage of access to Amazon's primary consumer-facing business, the Amazon Store, it lacks the search and assistant pedigree of Google which has been using its Google Assistant platform in Android phones for years and can leverage the interaction between the Google Home and Android phones.

Additionally, while Alexa has thousands of skills for use, "only 31% have more than one consumer review" and there is only a 3% chance that a user will be active the week after acquiring it (Marchick, 2017).

Opportunities

Industry analysts are enthusiastic about voice-first device sales. Analysts estimate that 24.5 million devices will ship in 2017 which is a large increase over the less than 10 million currently in consumers' hands. Considering the Amazon Echo's leading position, Amazon's development of related devices, and the slower than expected rate of adoption in homes, Amazon is both posed and needs to make 2017 a strong sales year as it starts to face stronger and more varied competition.

User and Sentiment Analysis

Method

Twitter

The method employed is to capture tweets on specific random dates every quarter. Currently, Twitter API only provides tweets published during the previous week. We wrote a python script that scrapes Twitter Advanced search results for specific date intervals and containing specific hashtags. For Amazon Echo tweets we used #AmazonEcho and for Google Home tweets we used #GoogleHome. The Python script utilizes the Selenium package that launches the Chrome browser with the Twitter Advanced Search URL and simulates page down events. The Python script then reads the browser page and parses tweet texts and dates. The data is saved in text files and used for sentiment analysis.

CNET

For CNET, one challenge that we faced was related to rendering of the pages. Reviews and some of the other information is rendered after a page is rendered (i.e., user/editor reviews and user information doesn't show in HTML code) so we utilized the Selenium webdriver to fully render the CNET review pages. Library lxml is utilized to scrape the HTML content and the user/editor reviews and review dates are stored in product specific files.

Facebook

Unlike Twitter, Facebook graph API does not allow user to query with the search term due to privacy setting. We can only collect data from public pages or from those to which we are given permission. Thus, the approach we take, in this case, is to collect all the status updates, the date they were published, and the number of likes that each status generated from respective official pages. The data are gathered in .csv files and a bar chart will be produced observe the general trend of each product. In second phase, we collected the comments that users have made for each status and the data are saved in a csv file to perform sentiment analysis.

Analysis

Some of the analysis we undertake here is of a qualitative nature or collects data via web-scraping to summarize the types of information currently describing comparison between Amazon Echo and Google Home and user sentiments around these two products. The sentiment analysis presented here follows the work of Hu & Liu (2004) who developed lists of positive and negative words from a larger set of product reviews where the meaning of the opinion could be measured.

In our research, we measure sentiment by building a corpus of the words used in each online data source and then classifying the words using the lexicon identified in Hu & Liu's research as either positive or negative. We then calculate the number of positive and negatives words used in available material about the brands of interest and calculate metrics to measure the sentiment in a simple way. In order to clean the data, we

eliminated stop words while building the corpus and also standardized the definitions of Amazon Echo and Google Home by replacing different words used to a standard token (for example, references of Amazon Alexa or Alexa are replaced with amazonecho). Once our data was properly cleaned and formatted, we considered the sentiment of words located near the standardized definitions.
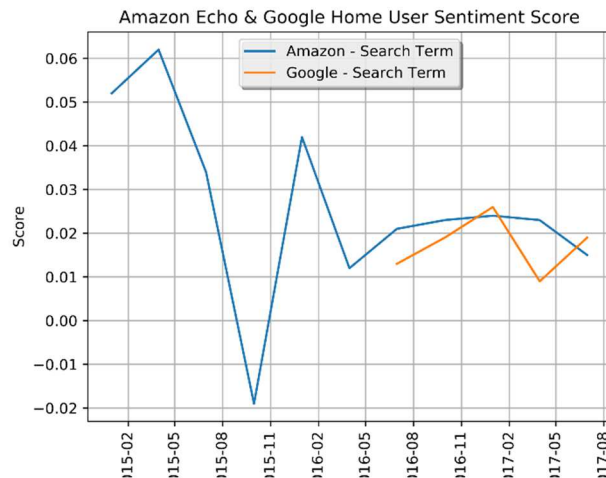

Figure 2. Echo and Home User Sentiment Scores.

Figure 1 shows a comparison of the Amazon Echo and Google Home related sentiment. Due to the release dates of the two products, we have much more data for the Echo. A quick glance at the Google Home sentiment analysis shows that after initially rising in sentiment up to its release, it quickly became more negative only to rebound in recent days as new Home features from Google IO have been released.

To do: More interpretation of Figure 1, interpretation of other two graphs

Conclusion

Appendix

References

Ahuja, K. (2016, August). The Promise of the Connected Home. Retrieved from McKinsey & Company: http://www.mckinsey.com/industries/high-tech/our-insights/the-promise-of-the-connected-home

Clark Estes, A. (2016, October 4). *Can Google Home Really Kill the Amazon Echo?* Retrieved from Gizmodo: http://gizmodo.com/can-google-home-really-kill-the-amazon-echo-1787371198

eMarketer. (2017, May 8). *Alexa, Say What?! Voice-Enabled Speaker Usage to Grow Nearly 130% This Year*. Retrieved from eMarketer: https://www.emarketer.com/Article/Alexa-Say-What-Voice-Enabled-Speaker-Usage-Grow-Nearly-130-This-Year/1015812

Gebhart, A. (2017, May 18). *Google Home vs. Amazon Echo, round 2: Google strikes back*. Retrieved from CNET: https://www.cnet.com/uk/news/google-home-vs-amazon-echo/

Hu, M., & Liu, B. (2004). Mining and Summarizing Customer Reviews. *Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery & Data Mining.* Retrieved from https://www.cs.uic.edu/~liub/publications/kdd04-revSummary.pdf

Kim, E. (2016, April 2). *The inside story of how Amazon created Echo, the next billion-dollar business no one saw coming*. Retrieved from Business Insider: http://www.businessinsider.com/the-inside-story-of-how-amazon-created-echo-2016-4

Kleinman, Z. (2017, January 5). *CES 2017: Baidu launches digital assistant with screen*. Retrieved from BBC News: http://www.bbc.com/news/technology-38515530

LeClaire, J. (2015, June 25). *Amazon Invests $100 Million in Alexa Voice Tech*. Retrieved from NewsFactor: http://www.newsfactor.com/story.xhtml?story_id=13200CZDTQUO

Low, E. (2017, January 1). *Mattel's Aristotle Connects Wired Child, Smart Home*. Retrieved from Investor's Business Daily: http://www.investors.com/research/industry-snapshot/mattel-aristotle-smart-home-product-snapshot/

Marchick, A. (2017, January 15). *The 2017 Voice Report by VoiceLabs*. Retrieved from VoiceLabs: http://voicelabs.co/2017/01/15/the-2017-voice-report/

Segan, S. (2017, May 18). *Amazon Echo vs. Google Home: Which Voice-Controlled Speaker Is Right for You?* Retrieved from PCMag: http://www.pcmag.com/article/348496/google-home-vs-amazon-echo-which-one-should-rule-your-smar

Sharma, R. (2017, January 24). *Amazon Has Sold 8.2 Million Echo Speakers So Far (AMZN, GOOG)*. Retrieved from Investopedia: http://www.investopedia.com/news/amazon-has-sold-82-million-echo-speakers-so-far-amzn-goog/

Github Folder structure

The GitHub repository can be found at https://github.com/dtatter/PREDICT-452-Spring-2017

The folder structure is the following:

src

Twitter(folder)

      Python program

CNET(folder)

      Python program

Facebook(folder)

      Python program

Sentiment(folder)

Python program

      Config files

            Bog of Words (+,-)

            StopWords

            CodeBook

Data

      Twitter-data-files (folder)

            Text/Data Google Home.txt

            Text/Data for Amazon Echo.txt

      facebook-data-files(folder)

            Text/Data Google Home.csv

            Text/Data for Amazon Echo.csv

      cnet-data-files(folder)

sentiment-data-files(folder)

      Combined text files for Google home

      Combined text files for Amazon Echo

Output

      Graphs.pdf

      ConText(folder)

Report

      Final Paper.pdf