PASSIVE LANGUAGE LEARNING APPLICATION DESIGN

BY

YINGHUA YANG

THESIS

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Master's Committee:

Professor Randall W Sadler, Chair
Lecturer Hugh Bishop

ABSTRACT

This thesis proposes the term “passive language learning” and presents four digital language learning products designed and collaboratively implemented by the author. All of the four applications promote learning a foreign language passively by using creative application design to naturally integrate language learning into people’s daily interaction with the rest of the world. This is an endeavor to make second language acquisition easier and more enjoyable. The thesis first includes a literature review and then presents the four passive language learning applications accordingly: a grammar mistake tracking system called Alang operating on any smartwatch paired with any mobile phone; a foreign accent visualization iOS application called NoAccent, an international traveling and learning web application called Fling, and a language learning platform called FlipWord which integrates language learning into people’s daily web browsing. At the end of the thesis, the author discusses the limitations of the four applications and future work in passive language learning.

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CHAPTER 1: INTRODUCTION

Learning a foreign language is generally hard for adults who are not living in the target-language environment. Since first language acquisition is easy, it is believed that the foreign language learning process for adults can be improved as well.

Starting from the Digital Revolution, people began to use digital technology to enhance language learning. On one hand, digital technology can enhance the effectiveness and efficiency of traditional classroom teaching; on the other hand, it brings automatic teaching solutions that can replace classroom teaching completely. Leading applications in the market include Rosetta Stone language learning software using Dynamic Immersion ("Rosetta Stone Immersion-Based Learning Method", n.d.), Duolingo language learning platform using gamification learning (Solis, 2015), Liulishuo mobile application using artificial intelligence adaptive learning ("Liulishuo at the Future of Go summit in Wuzhen", 2017) etc.

While all the top language applications are putting full force at making their teaching systems as intelligent as human teachers and "bragging" about their user base and their immersive, effective, or fun learning environments, they seldom talk about their user retention rate, which reflects how they maintain learners' motivation in such a pressure-free environment. Based on the only user retention graph Duolingo has released to the public ("Which Countries are the Best at Keeping Their New Year's Resolution", 2016), more than 50% of users on average will discontinue using the application within two weeks of use.

In contrast, traditional classroom learning guarantees a much longer learning period with a more motivating atmosphere. However, once the traditional course ends, students face a common decline in their foreign language skills. According to Caplan (2012), 97.5% of people

who passed foreign language courses in school claimed that they reached the level "Not Well" or below in foreign language competency.

Unfortunately, this disappointing long-term result might be inevitable if adults learn a foreign language through any traditional classroom teaching method or the major applications in the current market, because they all require people to switch part of their daily activity to language learning by "spending time in a closed environment with the main task of learning and no secondary task" (Reese, 2015), which is hard for adults to voluntarily repeat on a daily or weekly basis; otherwise, knowledge fades. If the adult learner is "forced" by pressure from an impending grade to learn and review on a daily or weekly basis, they will mostly likely drop the habit when the no more grades will be received. What makes the constant learning and reviewing even harder for adults is the impractical learning content, which they can rarely use in their daily life after closing the textbook, quitting the application, leaving the classroom, or graduating from the course. Therefore, the disappointing long-term result in adults' foreign language learning might be natural and inevitable due to the design flaws of any traditional classroom teaching and any of the major language applications in the current market.

Alternatively, a new teaching method - passive language learning - has the potential to change the disappointing long-term result. Unrelated to the widely used term "passive learning", "passive language learning" is a new term that is gradually introduced by the author throughout the development of FlipWord, a passive language learning platform that integrates language learning into people's daily web browsing co-founded by the author of this paper and Thomas Reese (Wood, 2017). Passive language learning is defined as a process whereby someone is unintentionally triggered by an event from their environment to actively or passively engage in a short language learning process that is either integrated into the current non-language-learning

activity or is short enough that the person does not think their current non-language-learning activity has been interrupted. In passive language learning, the learning is a secondary task on top of a non-language-learning activity which is the main task.

Part of the inspiration for passive language learning and FlipWord is how babies learn their first language. Different from adults, babies do not actively stop their current activity and switch to language learning completely. Their language learning "occurs within a shared environment" (Reese, 2015) as a side task in addition to the main activity, such as eating, playing with toys, listening to parents' conversation, etc. For adults, language learning activities that can be categorized as "passive language learning" include picking up a new language gradually through dating a foreigner, working with foreigners, watching foreign entertainment content, etc.

Passive language learning is similar to but distinct from two established learning methods: incidental vocabulary learning and diglot weave or code-switching narrative technique. Incidental vocabulary learning is generally defined as the acquisition of vocabulary as a "by-product of reading" (Ender, 2015). Diglot weave or the code-switching narrative technique involves teaching target language vocabulary by weaving them into stories written in the learners' native language (Nemati & Maleki, 2014). Passive language learning covers a much larger scope compared with the two methods. It happens in people's non-language-learning activities and creates a comprehensive language-skill learning experience. At the time of writing, there is no largely adopted passive language application in today's market.

In this thesis, the author first reviews relevant literature and then introduces the design, implementation, and development timeline of four passive language learning applications she created during her study at the University of Illinois at Urbana-Champaign. The four applications include a grammar mistake tracking system called Alang operating on any smartwatch and

mobile phone; a foreign accent visualization iOS application called NoAccent, an international traveling and learning web application called Fling, and a language learning platform called FlipWord which integrates language learning into people's daily web browsing. At the end of the thesis, the author discusses the limitations of the four applications and future work in passive language learning.

CHAPTER 2: LITERATURE REVIEW

Foreign language classes are required by most of the high schools in the United States; however, students' actual ability to speak the foreign language after several years of study is questionable. According to the Digest of Education Statistics 2015 released by the United States National Center for Education Statistics (Snyder et al., 2016), the "percentage of high school graduates who took foreign language courses in high school" in 2000, 2005, 2009 are respectively 84.0%, 85.7%, and 88.5%. Nevertheless, according to the General Social Survey 1972 – 2010 Cumulative Data released by the University of California, Berkeley, more than 97.5% of the people who learned a foreign language at school claimed that their foreign language competence only reaches the level "Not Well" or below (Caplan, 2012). This disappointing result calls into question the traditional foreign language teaching's long-term effectiveness.

Is the common incompetence after a traditional language education a simple learning loss or a reflection of the disturbing fact that most students never truly learn well through a traditional language course, even after completing the course requirements?

The loss of academic skills after the end of a semester was first mentioned by White in 1906 when he noticed "summer slides" among students' mathematical computation skills. More sophisticated research followed after White's discovery. A meta-analysis of data conducted by Cooper et al. (1996) quantified the average learning losses among students during their summer vacation time. Based on their research, students will lose about one month of learning on a grade-level equivalent scale during the summer and the learning loss becomes worse as students' grade-level increases. Summer learning loss also happens across various subjects (Alexander et al., 2007), which is specifically obvious in spelling skills and math computation.

According to Barber (2015), summer learning loss is related to the memory loss which is backed by the famous forgetting curve hypothesizes proposed by Ebbinghaus in 1913. According to Ebbinghaus (1913), information will be lost quickly if learners do not try to retain it, although the speed of forgetting will slow down after a certain point. Another famous study in human memory by Atkinson and Shiffrin (1968) explained the structure of human memory, which guides people to find solutions to the forgetting issue. According to Atkinson and Shiffrin (1968), there are three components of human memory: the sensory memory, the short-term memory and the long-term memory. Once the information is stored in the long-term memory, people can recall it over time. In 2006, Cepeda et al. (2006) proved that spaced learning and reviewing leads to better knowledge retention in long-term memory. Most language courses have designed spaced review and practice sessions into their curriculum. However, most review sessions' temporal distribution is solely structured around the school's academic calendar, specifically exam calendar. After completing each course and passing the final exam, there is no incentive for most students to methodically review outside the school's academic calendar (Lindsey et al, 2014).

The "closed learning environment" (Reese, 2015) with exam-oriented learning content is another reason that it is hard for students to revisit learned materials after they complete the course, which eventually leads to learning loss. The learning environment at school is designed for active learning (Meyers & Jones, 1993), which Faust (1998) defined as "any learning activity engaged in by students in a classroom" except for passively listening to a lecture. In school's active and intentional learning atmosphere, study is set as the primary task. No secondary tasks are allowed to happen simultaneously. However, in students' real life, it is difficult to define a pure time block or a learning environment that has no secondary tasks, which are considered

interruptions for active learning. In recent years, the most common interruption during students' self-studying time is media-induced activities, such as Facebook, Twitter, etc. Rosen et al. (2013) researched 253 students from 7th grade to university to see how technology distractions impacted their studying time outside a classroom environment. The average session length before students switch to a technological distractor is 6 minutes. One of the research's educational implications states that students should be allowed to have short "technology breaks" to reduce distractions. However, ending a "technology break" without academic pressure or monitoring is unlikely.

In addition, most learning materials are not practical for students who are living outside the target language immersion environment, because tasks involved in the learning materials are designed to simulate real-world tasks inside the target language immersion environment. In the 1980s, task-based language teaching (TBLT) became popular, which is heavily influenced by Krashen's Input Hypothesis (1985) and Long's Interaction Hypothesis (1996). Krashen (1985) thinks that second languages can only be acquired through comprehension. Long (1996) thinks that negotiation of meaning, especially when negative feedback happens, will increase the effectiveness of comprehension, which hence contributes to the second language acquisition. Therefore, TBLT attempts to help users acquire the language through interaction requiring the language with classmates to complete a comprehensible task that simulate real-world tasks (Mao, 2012; Seedhouse, 2017). Using a real-world task and a closed environment, such as classroom, to simulate a natural target language immersion environment may allow students to easy comprehend the knowledge; however, "there have been few attempts to employ TBLT in naturalistic settings outside the classroom" (Seedhouse, 2017). Ji (1999) criticized the common ignorance of creating a really meaningful textbook for communication language-teaching (CLT),

which TBLT derived from. He stated that few textbook writers ask themselves what kind of communication a foreign language learner really needs that matches their age and their non-target-language environment; therefore, most of the information gaps in an English as a Foreign language (EFL) classroom are not "worth filling" (Ji, 1999). For example, a typical communication task in a language classroom is asking for directions in the target language; whereas most of the learners will not have any chance to practice asking for directions using the target language in their native-language environment outside the classroom. Without being able to apply language knowledge outside the classroom naturally and repetitively, it is questionable how much students can retain over time.

Parallel to the development of traditional language teaching, technology is changing the field significantly by not only bringing "together novices and experts" (Sangeetha, 2016) but also replacing experts, making experts unnecessary. When a skill is too hard to learn, people turn to technology for help. Technology can lower the learning barriers or make the skill obsolete. As Google translation brings translation convenience to people's life, it took away freelance translators' job and translated "more words in 1 minute than all human translators in one year" ("What Does the Future Hold for Translators?", n.d.). In 2016, wearable translators began to emerge. Ili, the world's first wearable translator, launched at the 2016 Consumer Electronics Show in January (Valcarcel, 2016). In June, Pilot, "an earpiece which translates between languages", raised $3,465,958 on Indiegogo (Ochoa, 2016.). Other cutting-edge products, such as Amazon Echo, Google Home, etc., all have translation as a built-in capability (Wolverton, 2016). All of these inventions are trying hard to let people skip the painful language learning process but still communicate well with foreigners. These efforts have led to a contracting global language learning market. According to Adkins (2014), the global language learning market has

decreased from $56.3 billion in 2013 to $51.9 billion in 2015. Adkins (2014) forecasts that the market will keep shrinking in the next four years.

To buck the trend of eliminating foreign language skills, educators are using digital technology to make the learning process less difficult and more fun. According to Adkins (2014), the digital language learning market is surprisingly expanding given that the overall language learning market is shrinking. According to Adkins (2016), The digital language learning market will expand to $3.8 billion by 2020, which was $2.8 billion in 2015.

There are two common ways among the digital applications in the market attempt to make language learning easier. One is to break down language learning into a series of bite-sized lessons that are accessible at any time. By doing so, language learning is less intimidating and less time-consuming for learners. Mobile language applications have mastered this method due to its mobility attribute (Condruz-Bacescue, 2014). In Australia, English language learning applications alone occupied three slots out of the top ten selling applications in the Google Play Store (Adkins, 2014). Duolingo, a mobile language learning application, beat other types of mobile applications, becoming the iPhone App of the Year and the Best of the Best by Google in 2013 (Ranosa, 2015). Other top mobile language learning applications include Anki, Memrise, LiveMocha, Busuu, etc. (Henry, 2013).

However, the flexibly-paced language learning experience provided by mobile language learning applications also results in a much shorter learning session than what the inventors expected. According to Statista (2016), in the fourth quarter 2015, the average mobile application session length was 4.35 minutes across different application categories. The top five mobile application categories that have the longest session length are gaming (7.55 minutes), media and entertainment (5.59 minutes), travel and lifestyle (4.26 minutes), e-commerce and retail (2.85

minutes), and Technology (2.61 minutes). Language learning applications are categorized into the education category, which is not among the top five. Therefore, the average session length of language learning application is likely less than 2.61 minutes. None of the top-rated language applications design their lesson length shorter than 5 minutes. The fragmented attention and short session length of mobile learners was not well considered by mainstream language learning applications.

Another common way that digital technology makes language learning easy is to increase the efficiency of learning by creating an immersed environment, engaging and entertaining learning content, intelligent and personal feedback systems, etc. According to Konishe (2003), authentic materials from the Internet makes learners' comprehension of learning materials more effective. Rosetta Stone, the top digital language application in the market, creates a virtual but authentic target-language environment using Dynamic Immersion approach ("Rosetta Stone Immersion-Based Learning Method", n.d.). In the closed learning environment, users are "surrounded with words, images, and the voices of native speakers" without any translation or explanations, which is to simulate the language learning environment for a baby ("Rosetta Stone Immersion-Based Learning Method", n.d.).

However, only creating a closed environment with authentic content cannot completely reproduce the natural language learning environment that babies have, since babies' language learning occurs spontaneously during other activities, such as playing, listening to parents' conversations, etc. (Kuhl, 2015). According to Kuhl (2015), babies use statistical-learning to grasp language information through listening to parents' talk unintentionally. Their natural language learning also requires social immersion (Kuhl, 2015), such as playing with teachers on the floor. None of the activities are initiated by babies for the sake of learning. Language

learning simply happens as a "side effect" in "a shared environment" (Reese, 2015) with other activities happening at the same time. Therefore, language learning is never difficult for babies since they unintentionally learn and review the knowledge while doing other necessary activities in an open environment.

To simulate a natural learning setting that babies have for adults, the language learning process should be integrated into adults' natural interactions that they either have to do or intrinsically enjoy doing on a daily or weekly basis. When an application successfully does so, it truly creates a "natural critical learning environment", an ideal instruction method (Bain, 2004). According to Bain (2004), a "natural" learning environment embeds information that students need to learn into authentic tasks that they have to do or intrinsically enjoy doing. In this digital world, an authentic task can be posting a selfie, read a Yelp review, replying to an email, etc. In terms of a "critical learning environment", it needs to provide students space and freedom to critically think (Bain, 2014). When students are doing a real-world activity related to their own life and benefit, it is natural for them to critically think.

Thanks to the amazing speed that technology penetrates people's daily life, numerous opportunities are open for weaving language learning into people's digital life through passive language learning, which can be viewed as an evolved version of the deprecated language teaching approach diglot weave narrative technique (Blair, 1991). Diglot weave or code-switching narrative technique was first promoted by Burling (1968) as a way to teach French reading. Later, more and more educators, such as Morgan and Rinvolucri (1986), began to use stories that mix learner's target language and their native language to teach new vocabulary without denaturing the learning context inside a classroom. With code-switching, the common linguistic insecurity among learners can be easily reduced, the communication effectiveness can

be greatly enhanced, and a good comprehension of the learning content can be guaranteed (Pollard, 2002).

However, in recent decades, code-switching has been mostly viewed negatively as a linguistic deficit with the belief that it might interfere with learners' development of their first language (Hammink, 2000). As a result, "many classrooms or entire school districts discourage code-switching in academic settings" (Pollard, 2002).

Nevertheless, for an adult who has fully developed their first language, will the possible interference of code-switching be a real problem? What if the so-called "linguistic deficit" in a foreign language is good enough for adults, who value pragmatism more than perfectionism? Since technology has become so pervasive, is it possible to use technology to reduce the negative interference of code-switching? Those questions are beyond the scope of the thesis, but the author hopes her efforts in designing applications that integrate language learning into people's daily lives can drive more people to pay attention to those questions and bring new solutions to language learning with the aid of digital technology.

CHAPTER 3: PASSIVE LANGUAGE LEARNING APPLICATION DESIGN

Aiming at integrating language learning into people's daily life, the author designed and collaboratively implemented four language learning applications. The four applications are presented in the following order: Alang, NoAccent, Fling, and FlipWord.

Grammar Mistake Tracking System – Alang (Figure 1)

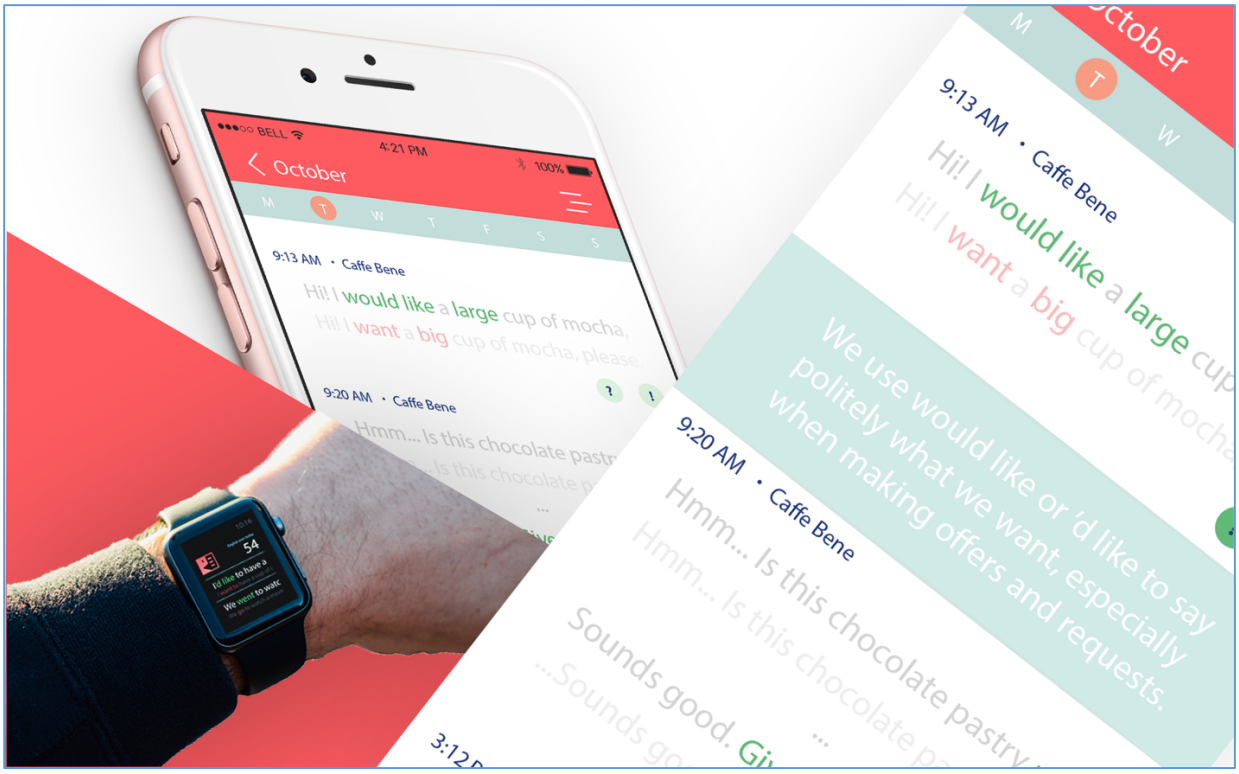

Figure 1. User interface of Alang on an Apple Watch and an iPhone

When people are living in a non-native environment, they need to use the local language (target language) more or less to interact with native speakers for daily tasks. In those interactions, many language mistakes made never get pointed out or corrected due to time constraints, politeness, etc. In many cases, learners do not need to complete a full sentence to be understood by native speakers. From a pragmatic point of view, as long as the learner gets things done, their language mistakes during any interaction can be ignored. However, those mistakes in

a natural setting is lost feedback that contains valuable information, like sleeping data, step count, or heart rate data before the birth of wearable technology.

Inspired by activity tracking devices that constantly monitor users' physiological parameters and provide daily reports on their mobile applications, Alang was ideated and designed by the author as a grammar mistake tracking system that contains a smart watch application to track users' grammar mistakes throughout the day; a web application or a mobile application to record their mistakes and give feedback on how to improve. It was collaboratively implemented on Pebble Time (Figure 2) by the author and two engineers within 48 hours at Hacking EDU - the world's largest education hackathon – in October 2015. Alang won the Coolest Pebble Hack prize at the event.



Figure 2. User experience flow from Alang's Pebble Time application to its web application

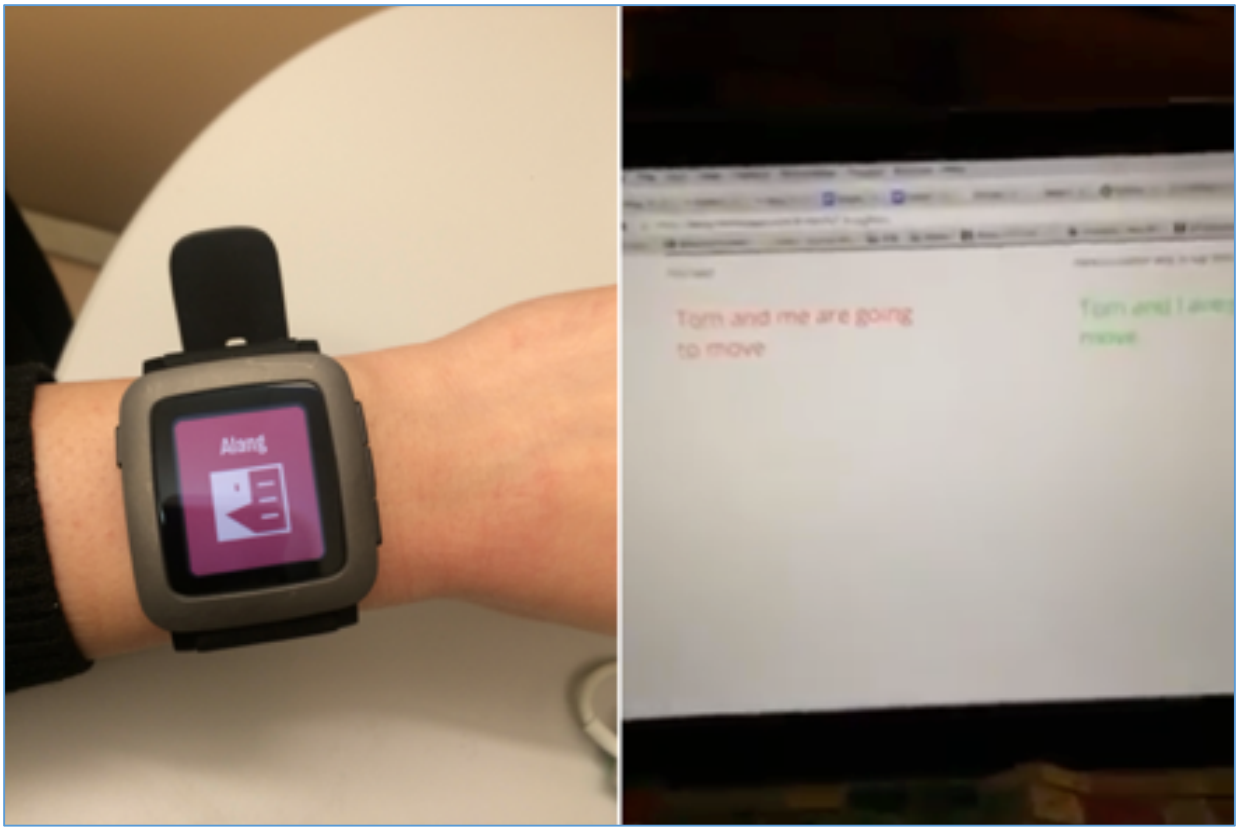

Figure 3. Demo of Alang's Pebble Time application activation interface and web application

Alang's smart watch application tracks users' grammar mistakes by monitoring their daily interactions in the target language with native speakers (Figure 3). It was originally designed to be an always-on listening application, like Echo, Google Home, etc. However, due to privacy issues and Pebble Time's hardware constraints, it was implemented as an application that users need to activate before it begins to track and analyze their conversation. By pushing the middle button of the Pebble Time, users can activate Alang's recording mode when they are ready to start a conversation. When audio is detected, Alang uses Pebble Time's native Nuance Dictation Application Programming Interface (API) to convert from speech to text. After the conversation is done, users confirm the speech-to-text result by pushing the middle button again (Figure 4). Alang then sends the speech-to-text result to Alang's web server.

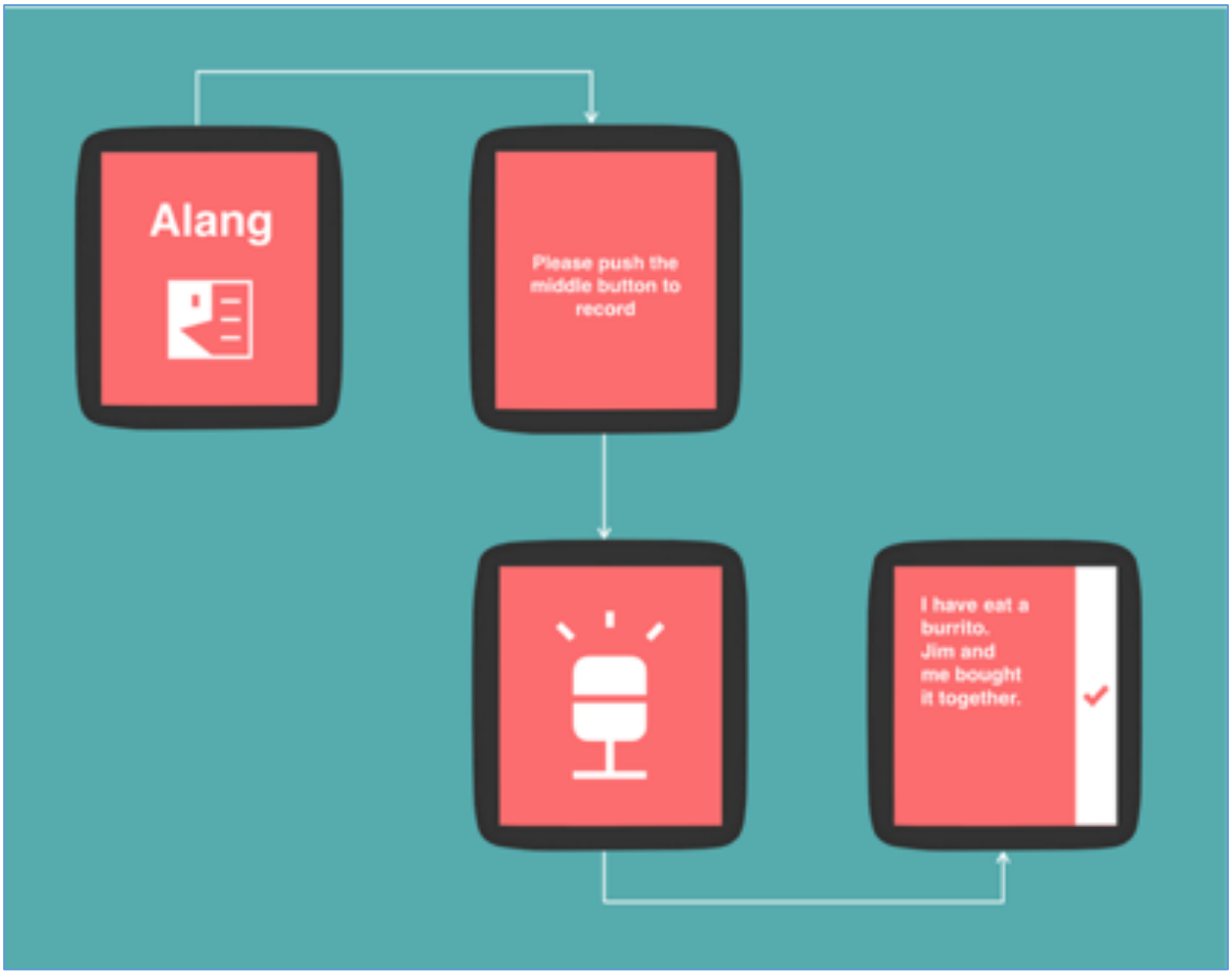

Figure 4. User experience flow of Alang's Pebble Time application

After receiving the speech-to-text result, Alang's web server users the Gingerbread wrapper of the grammar checking API Ginger to analyze the input and then display both of the original sentence and the correction suggestions on its web application or mobile application. The original sentence will be marked in red and the correction suggestions will be marked in green. Alang's web server will record all of the incorrect sentences as users' history. At the end of the day, users can access their grammar mistake summaries on Alang's web or mobile application.

Alang's smart watch application was written in C on Cloud Pebble collaboratively. The author wrote the front-end user interface for the Pebble Time. One engineer wrote the component

to trigger the Nuance dictation API and to send the speech-to-text result to the web server. Another engineer wrote the web server component including using the Gingerbread wrapper to analyze the speech-to-text result. After the initial development sprint, the author designed an Apple Watch version and refined the design of Alang's mobile application (Figure 5).



Figure 5. Alang's iOS application and Apple Watch application

Foreign Accent Visualization Application – NoAccent (Figure 6)

When taking selfies, people often make multiple attempts before they are finally satisfied with their photo. During these attempts, people try different facial expressions to make adjustments. If they use Snapchat lenses or Facebook Messenger filters (Figure 7), it will take them even longer to complete a selfie by trying different funny lenses and making various facial expressions to match the lens style. Inspired by this observation and a previous personal design project called Accent! (Figure 8) by the author, she ideated and designed an iOS application that prompts a foreign word for users to practice in the few seconds before a selfie is taken and provides accent visualization using an animated Space Cat filter as well as more pronunciation improvement tips at 2015 WildHack, the official intercollegiate hackathon hosted by the

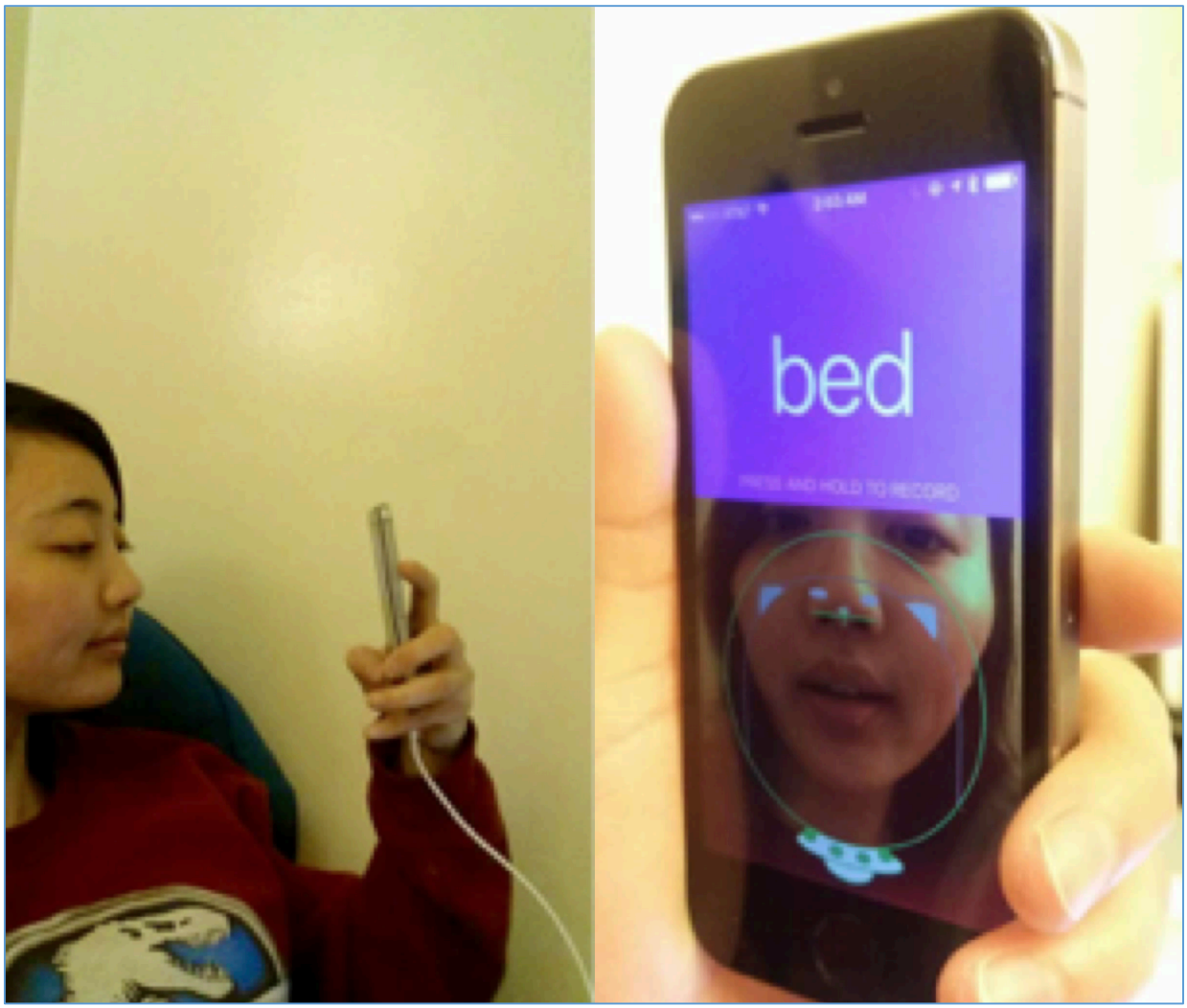

Figure 6. A user is using NoAccent before taking a selfie



Figure 7. Snapchat lenses (Carissa, 2017 ; Constine, 2015)

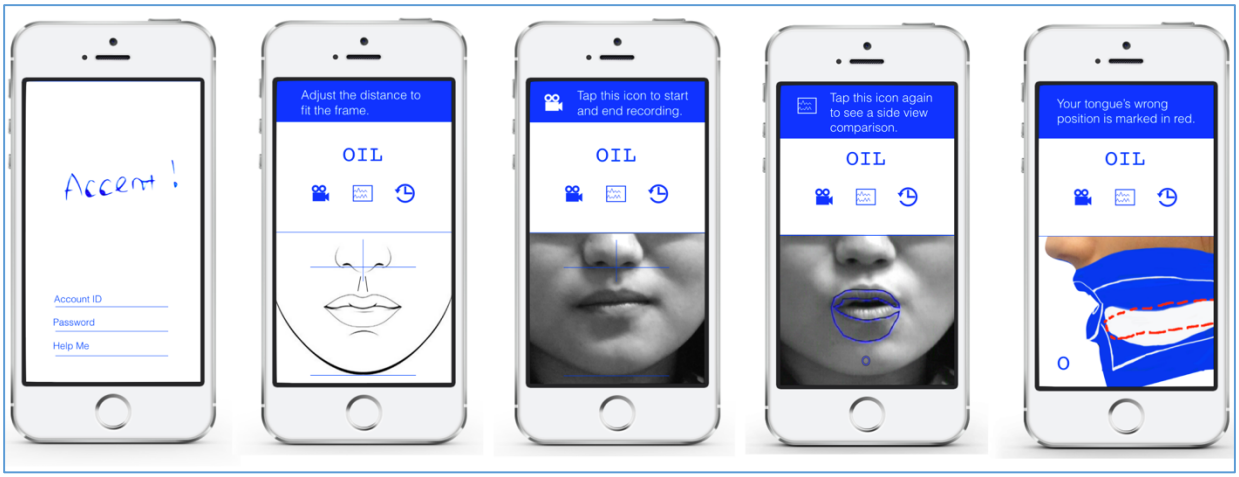

Figure 8. User experience flow of Accent!

Northwestern University. After onboarding two engineers at the event, they prototyped the application within 36 hours and re-named NoAccent. NoAccent eventually won the Most Out of This World Use of the Groupon Space Cat prize at the event.

NoAccent focuses on correcting users' foreign accent one word at a time while they are taking selfies. After signing up, NoAccent features a list of commonly mispronounced foreign words based on users' sign-up information, such as native language, region, education background, target language, etc. It then prompts one word each time when the users' camera enters front-facing mode. By superimposing a Space Cat contour with a crosshair over the camera screen, users can align their nose and mouth easily. Once their nose and mouth get aligned, they can begin to pronounce the word. NoAccent automatically stores users' speaking video for accent analysis in the backend. After users complete their selfie attempts, they can check their foreign accent visualization report from NoAccent.

In the accent report, NoAccent has two types of foreign accent visualization: a frontal view and a lateral view (Figure 9). In the frontal view, users will not only see their own mouth

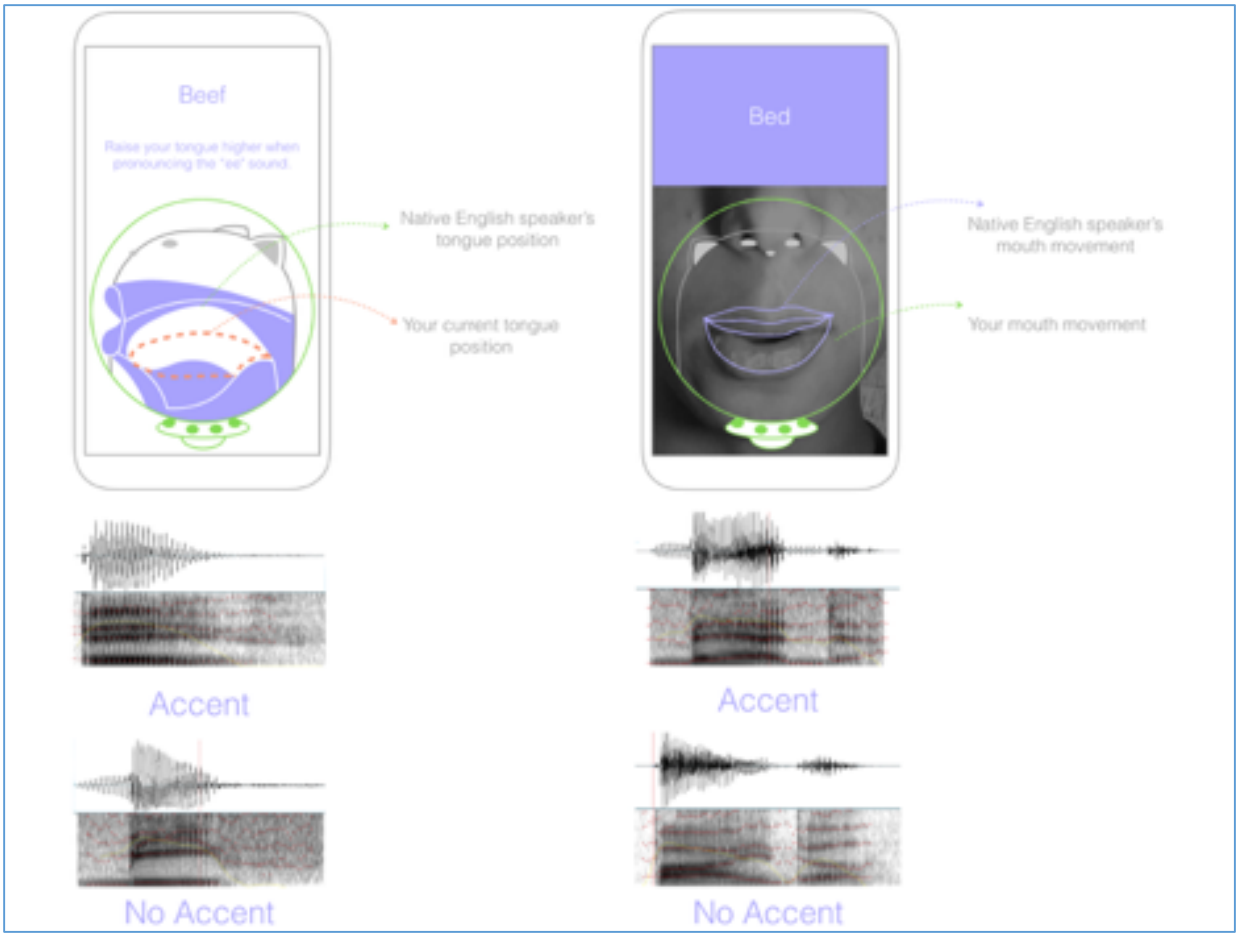

Figure 9. NoAccent frontal and lateral accent visualization

movement but also a superimposed animation of the mouth movement of Space Cat, who represents a native speaker of the target language who speaks the same word that the user practiced. By doing so, users are able to directly visualize the differences in mouth movement and hear the differences of pronunciation between themselves and a native speaker. In the lateral view, NoAccent compares positional differences inside of the mouth between users and Space Cat by approximating the side view of users' lip and tongue through analyzing users' audio recording's sound frequencies. Besides the two views, NoAccent also provides suggestions for users to improve their pronunciation.

The current prototype of NoAccent does not include all of the features and details mentioned above due to a shortage of resources and limited time. It was implemented as a prototype that aims at demonstrating the potentiality of the application. Ideally, the application should have a good database of commonly mispronounced words for different languages and normalized mouth movement recordings from authentic speakers in corresponding languages. Other techniques might also include machine learning, facial recognition, phonetic analyzing software support, etc. Last but not least, the final application should be able to function as an add-on whenever users open their camera, instead of only working when the application is opened.

At WildHack, one engineer wrote NoAccent's front-end user interface. Another engineer worked on a demonstration website for the hackathon event. Besides designing the application, the author also worked on compiling a sample of language data for the application to use. Unfortunately, the team did not have enough time to complete the back-end implementation of NoAccent.

International Travel Language Application – Fling (Figure 10)

Fling was inspired by people who get bored on long distance international flights. After booking an international flight through any online travel agency partnered with Fling, users get a language course offered by Fling that matches their destination country and flight duration. If the airline also cooperated with Fling, the language course will be available in the airplane's entertainment system. Once users board the flight, they can choose to learn a language course instead of watching a movie from the monitor in the back of the seat. If the airline did not cooperate with Fling, Fling will remind users to download the course before heading to the airport and start to learn once they board the plane. By the time they land, they will worry much

less about potential language issues and be able to experience many unique experiences without full reliance on guides.



Figure 10. Fling home page

When there is a layover, such as San Francisco (America) – Seoul (Korea) – Shanghai (China), Fling first arranges a Korean crash course that teaches users airport language and then a Chinese crash course that matches the second flight duration. During the layover at Seoul, users can get around to practice their Korean immediately in the airport (Figure 11). Fling is currently implemented as a website to mock up the whole learning system.

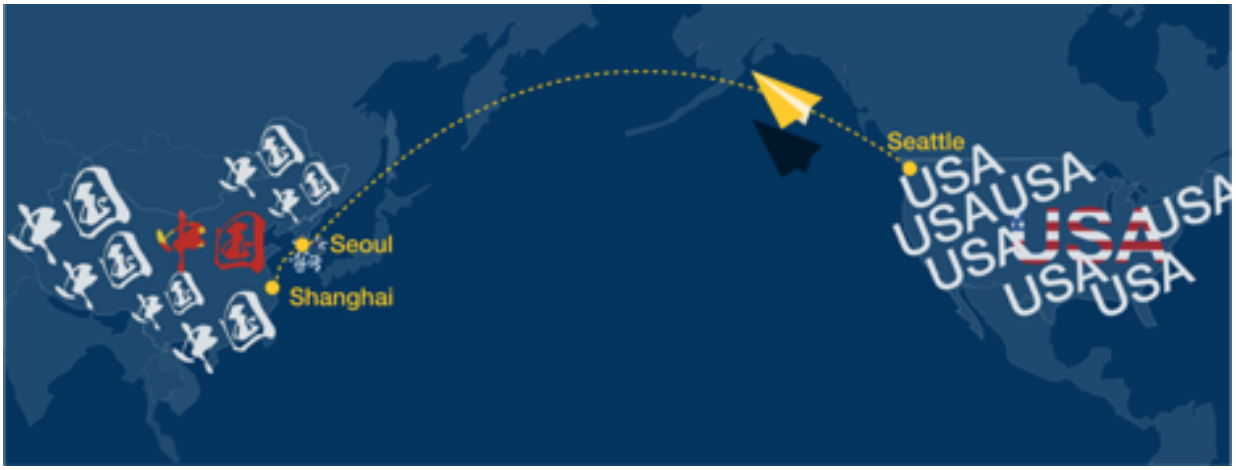

Figure 11. Fling layover

The learning experience of Fling starts from users boarding pass (Figure 12). It not only provides language knowledge but also knowledge about the destination city, such as main districts. Fling then teaches basic words, phrases and sentences with audio support that users need right after they arrive at the destination. Fling uses a point system (Figure 13) to keep users motivated. Ideally, Fling points can be exchanged for credits of airlines or travel agencies that partner with Fling. After completing the crash course, Fling will also suggest related services,



Figure 12. Fling boarding pass



Figure 13. Fling points

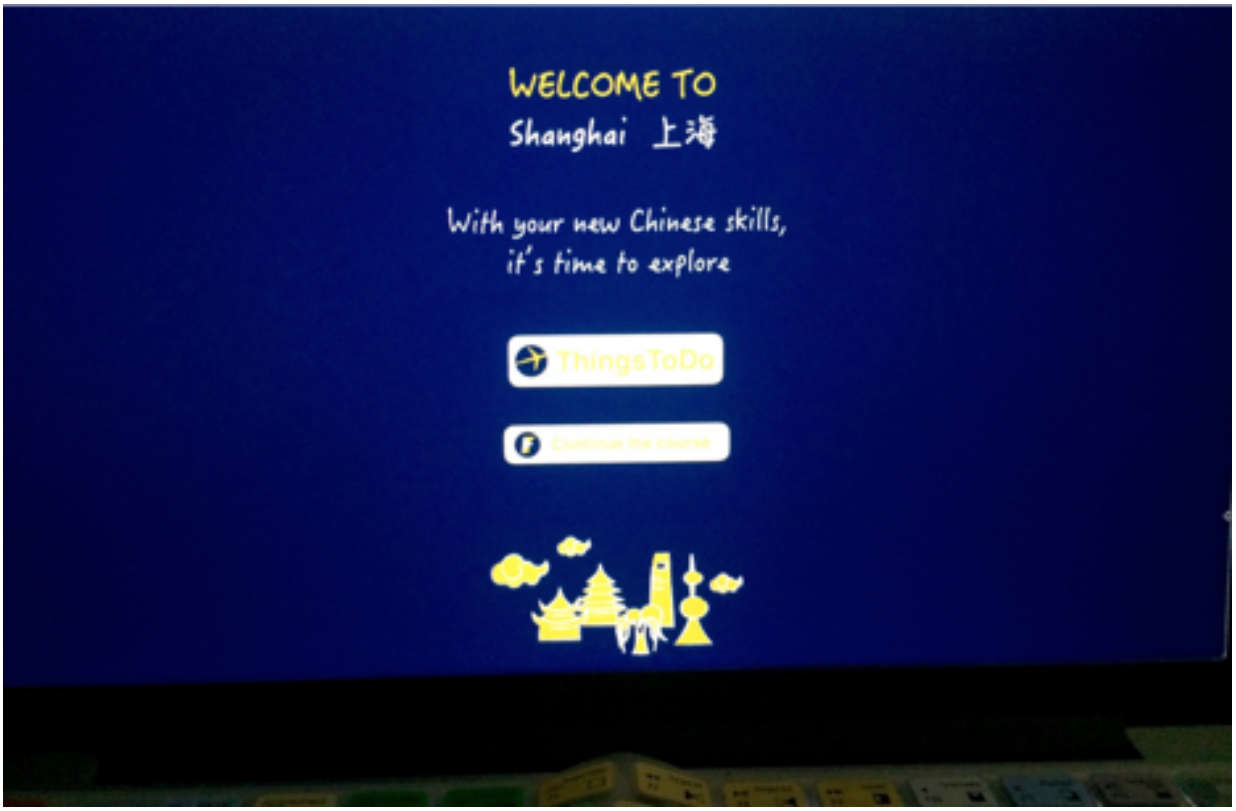

Figure 14. Fling landing page

such as Expedia's ThingsToDo, which will be helpful for users to explore the destination city (Figure 14).

Fling was a project the author did with another engineer at the 48-hr Expedia Hackathon in January 2016. The author came up with the idea, designed the website, and created one crash course. The engineer implemented Fling's website.

Compared with the other three applications, Fling does not completely use passive language learning, since one major part of the learning process is a crash course, instead of being broken down into small pieces and injected into one of the activities people have to do during a flight or at the airport. However, the author thinks the concept of Fling has a huge potential to integrate passive language learning experience in to one's traveling experience; therefore, Fling is included in this paper.

Passive Language Learning Application – FlipWord (Figure 15)



Figure 15. FlipWord poster image

FlipWord is a passive language learning system that weaves language learning into people's daily web browsing. It is a Chrome extension that automatically picks appropriate words for users to learn on any webpage they browse and replace them with users' target language. When any of the replaced words are hovered over with the cursor, a tooltip with information about the word will pop up for users to learn. Thomas Reese first came up with the original idea and prototyped the Chrome extension in 2015 for himself to refresh Chinese vocabulary. The author joined the startup later as a co-founder to expand the vocabulary-reviewing tool to a language-learning and test-preparation tool by adding features to support comprehensive language acquisition and language proficiency test preparation, creating a gamified quiz system, a community-oriented mobile application (under development), and a crowdsourcing marketplace (under development). The author's other responsibilities at the startup include user interface design, project management, team management, market campaign and investment opportunity discovery and coordination. At the time of writing, FlipWord has gained 10k user base with a 50% monthly user retention rate, has been featured as the daily Top 5 on Product Hunt, successfully raised $80k from the crowd, and filed a provisional patent.

After users install the FlipWord Chrome extension, target language words will be woven into their daily browsing by flipping the original native word to its counterpart in users' target language (Figure 16). Words to be flipped are not randomly chosen. FlipWord intelligently determine the appropriate words that fit the users' level and learning progress. Users can also customize the amount of words to be flipped on each page, which is called flip rate.

If users hover over a flipped word, they will have access to a bite-sized lesson on a tooltip that contains four tabs. The first tab contains detailed definition, example sentence,

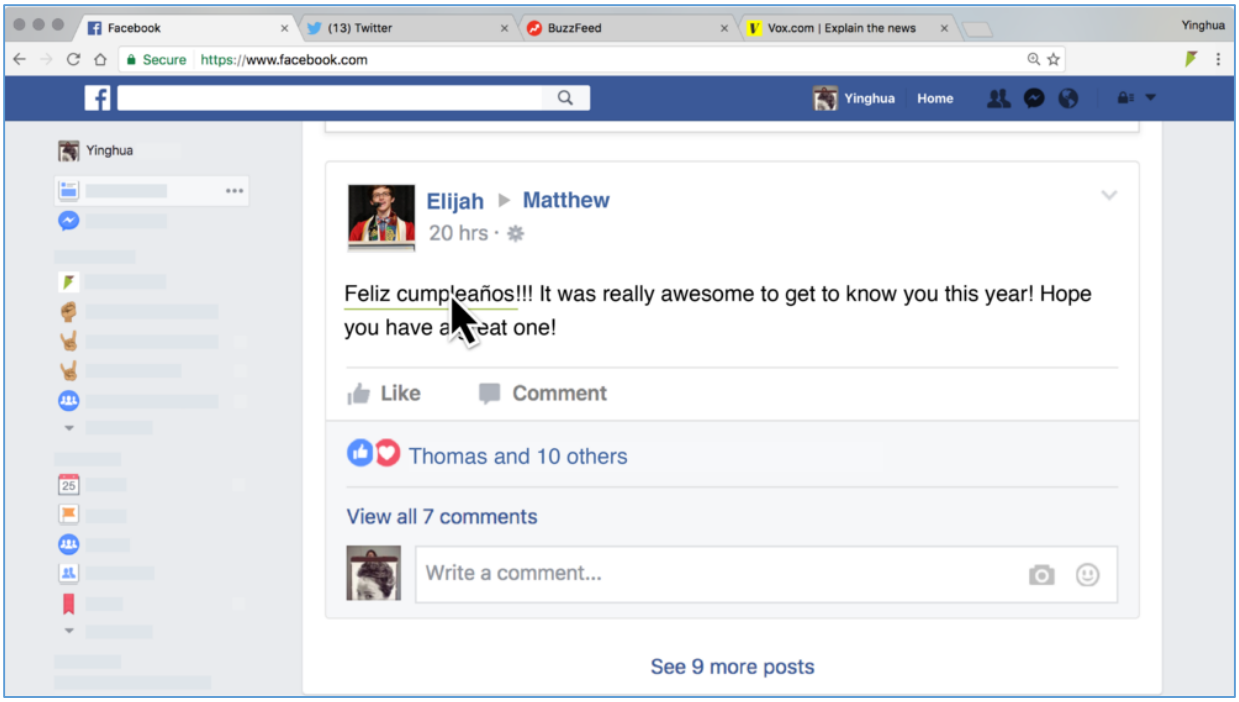

Figure 16. FlipWord weaves a Spanish phrase into a learner's Facebook News Feed page representation of pronunciation and audio support for users to learn how to say and use the target word. The second tab is for quick typing practice. Users reinforce their memorization by typing the word (Figure 18). The third tab is for speaking practice (Figure 19). Users can record their voice and receive feedback augmented using Google's speech recognition API. The fourth tab is for users to learn the target word within a real-world context (Figure 20). It contains a YouTube video, often music, that contains the target word spoken by a native speaker inside. If it's a music video, the specific lyric line containing the target word will be provided in the top of the tooltip. If users click the lyric line, the video will automatically jump to the point that the target word gets spoken. By doing so, users can not only learn the word in a real-world context but also learn the culture associated with the word.

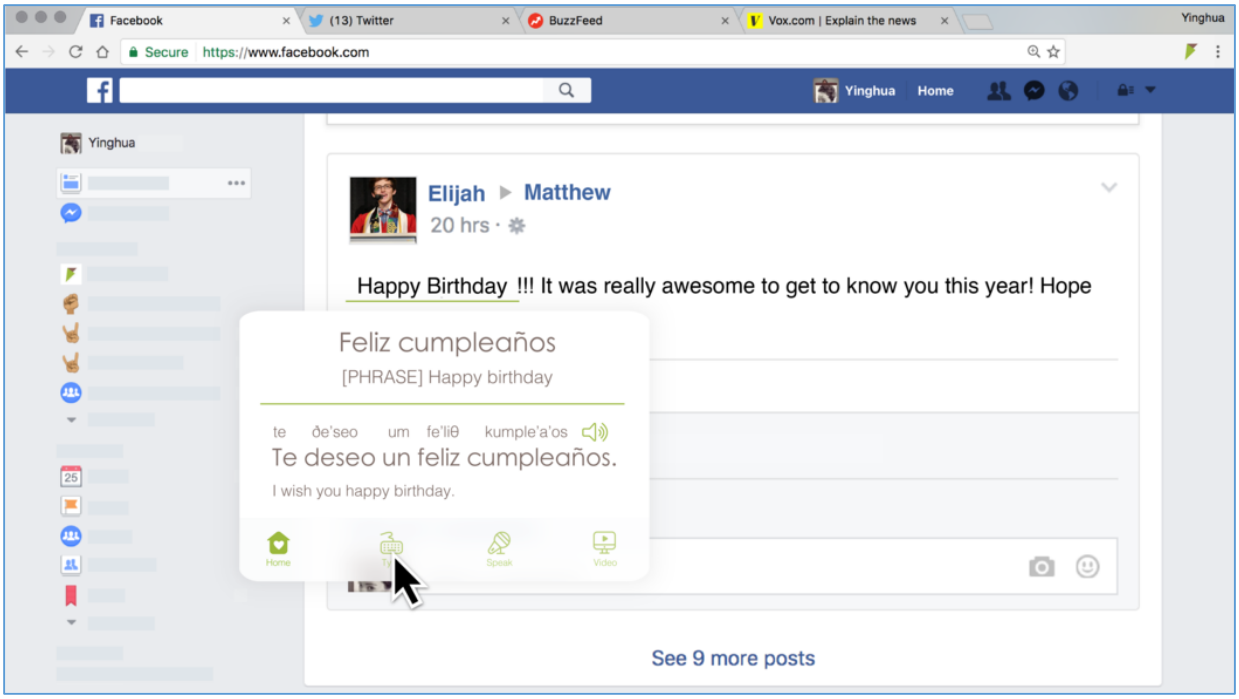

Figure 17. FlipWord tooltip's first tab – Word Details

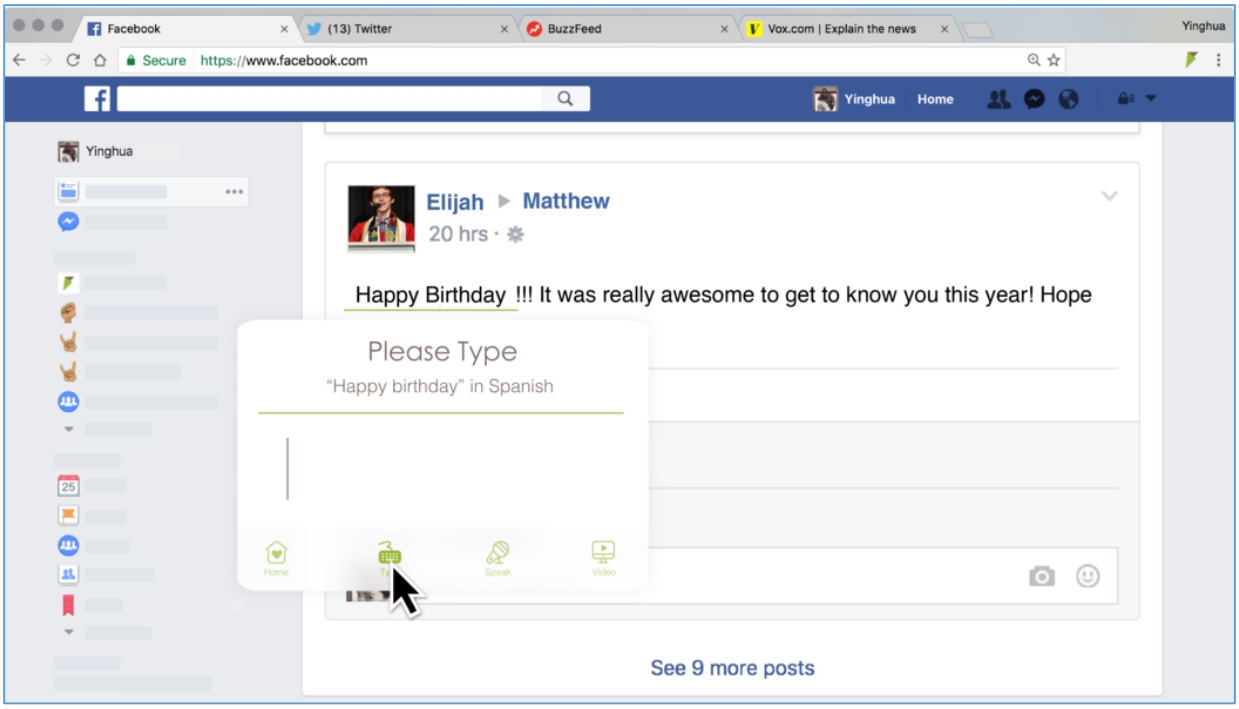

Figure 18. FlipWord tooltip's second tab – Typing Practice

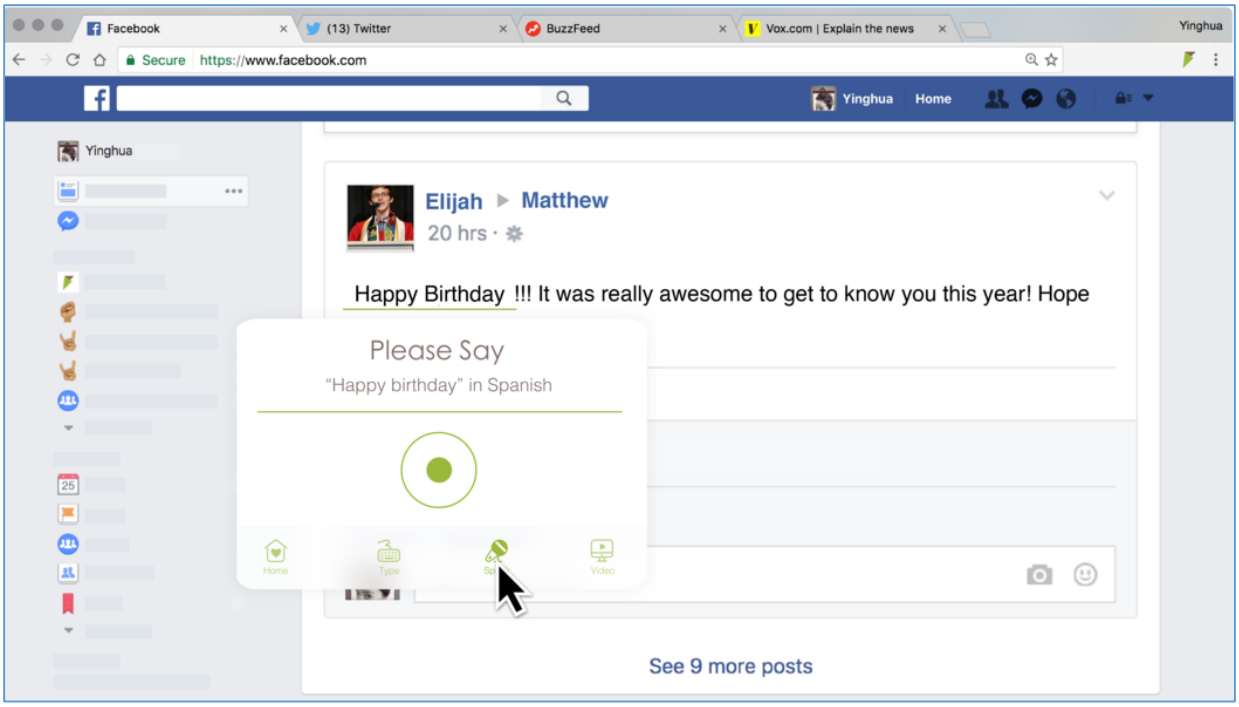

Figure 19. FlipWord tooltip's third tab – Speaking Practice

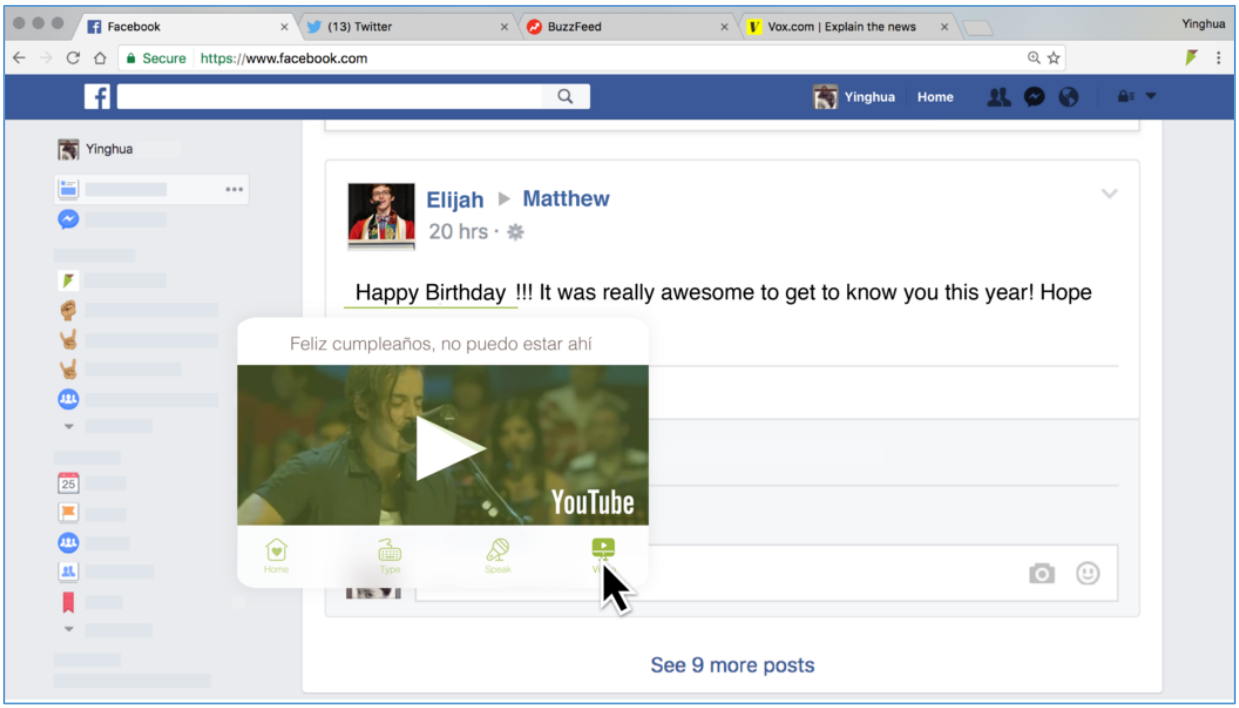

Figure 20. FlipWord tooltip's fourth tab – Video Tab

After one word is viewed multiple times, FlipWord starts to integrate appropriate quizzes into users' web browsing by flipping the original native word into a coin for people to collect (Figure 21). If users hover over the coin, the original native word will be flipped back and a tooltip that contains the corresponding quiz will pop up (Figure 22). If users complete the quiz correctly, they will gain points as a reward (Figure 23). There are more than 10 types of quizzes to cover the comprehensive language skills - listening, writing, reading and speaking – at a word level and sentence level. For example, one type of quiz lets users type what they hear (Figure 24) to practice their listening skill. If they do not get it correct, they will receive a correction suggestion. Another type of quiz requires users to unscramble fragments of a target-language sentence to practice their reading and grammar skills (Figure 25). If they get partially correct, the correct parts will merge to decrease the difficulty when trying again (Figure 26, 27).

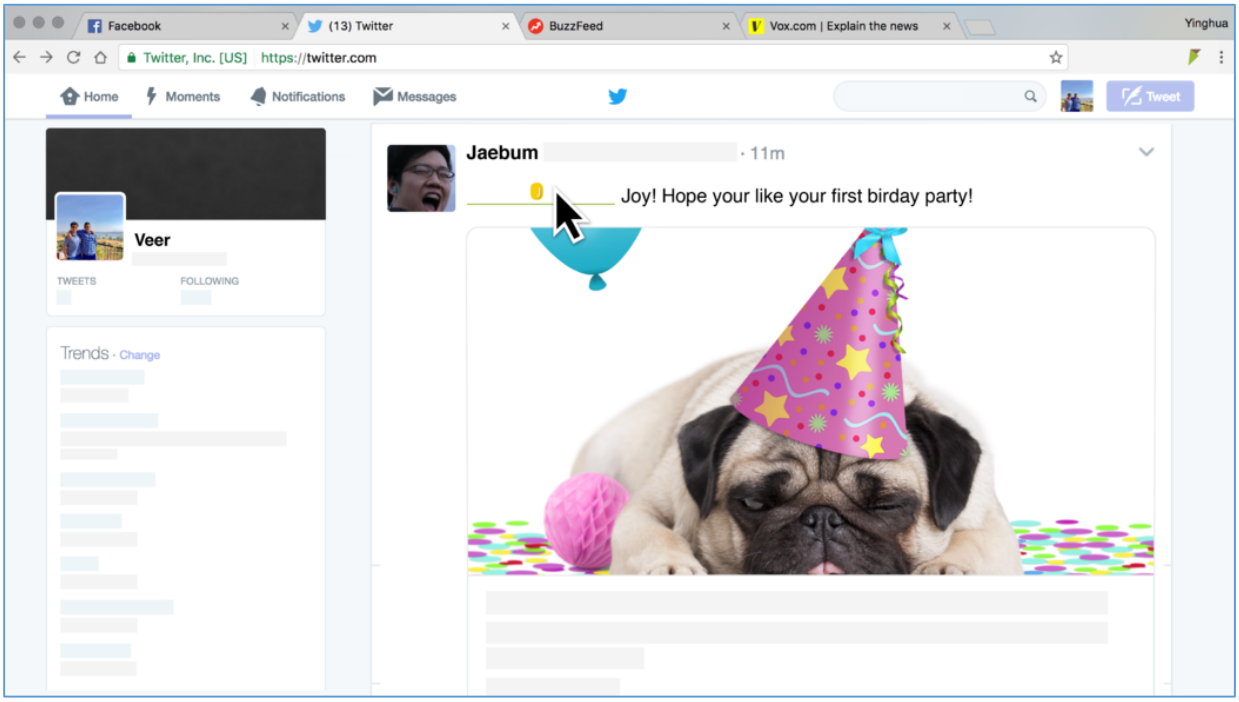

Figure 21. FlipWord quiz appears with a coin

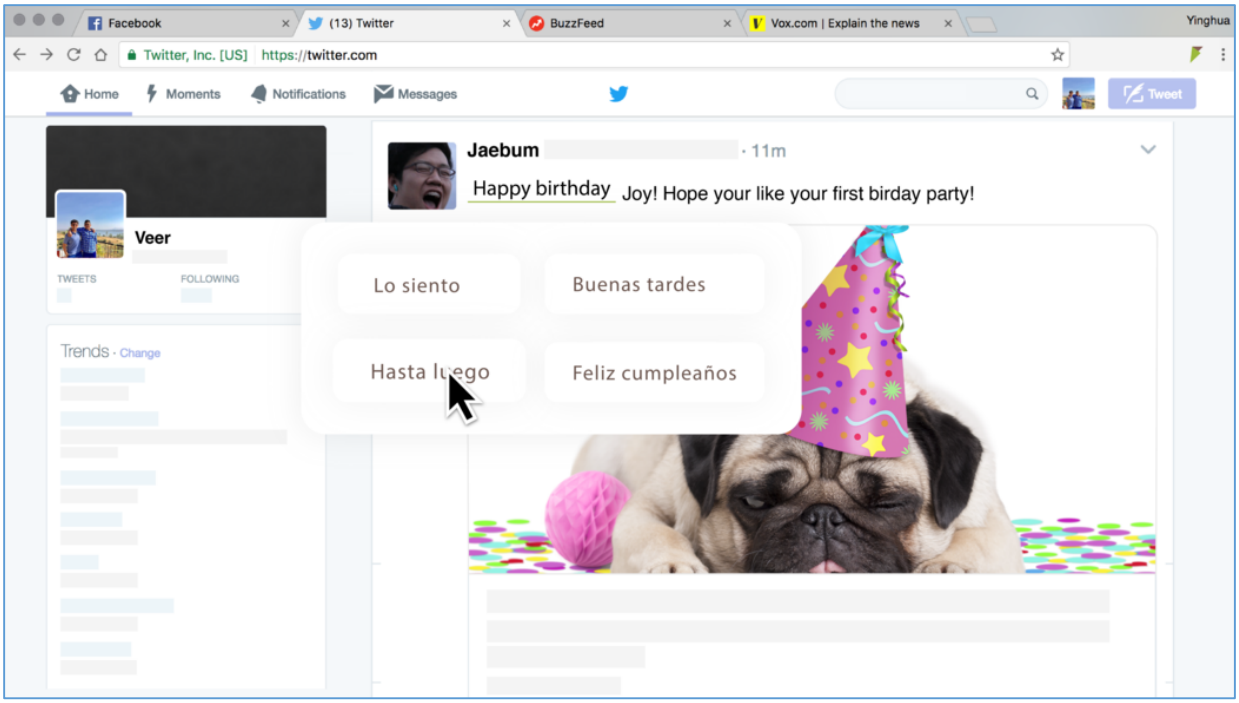

Figure 22. FlipWord multiple choice quiz

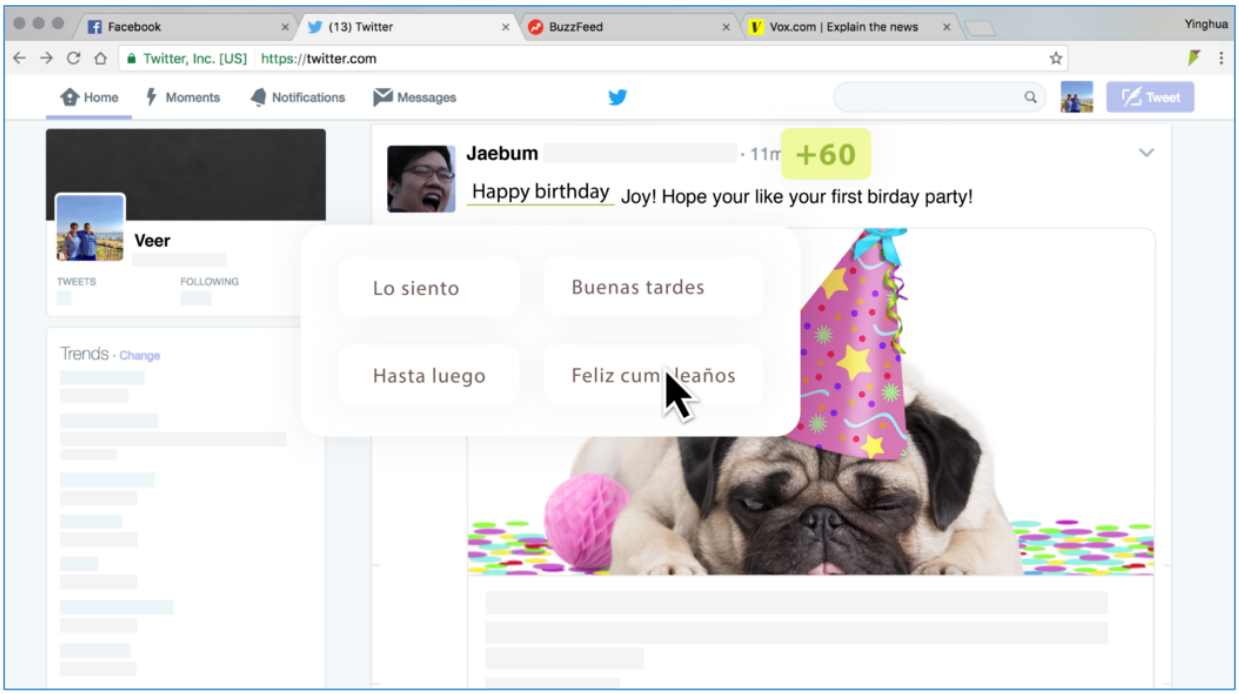

Figure 23. FlipWord multiple choice selection is correct.



Figure 24. FlipWord "type what you hear" quiz with the new user interface design

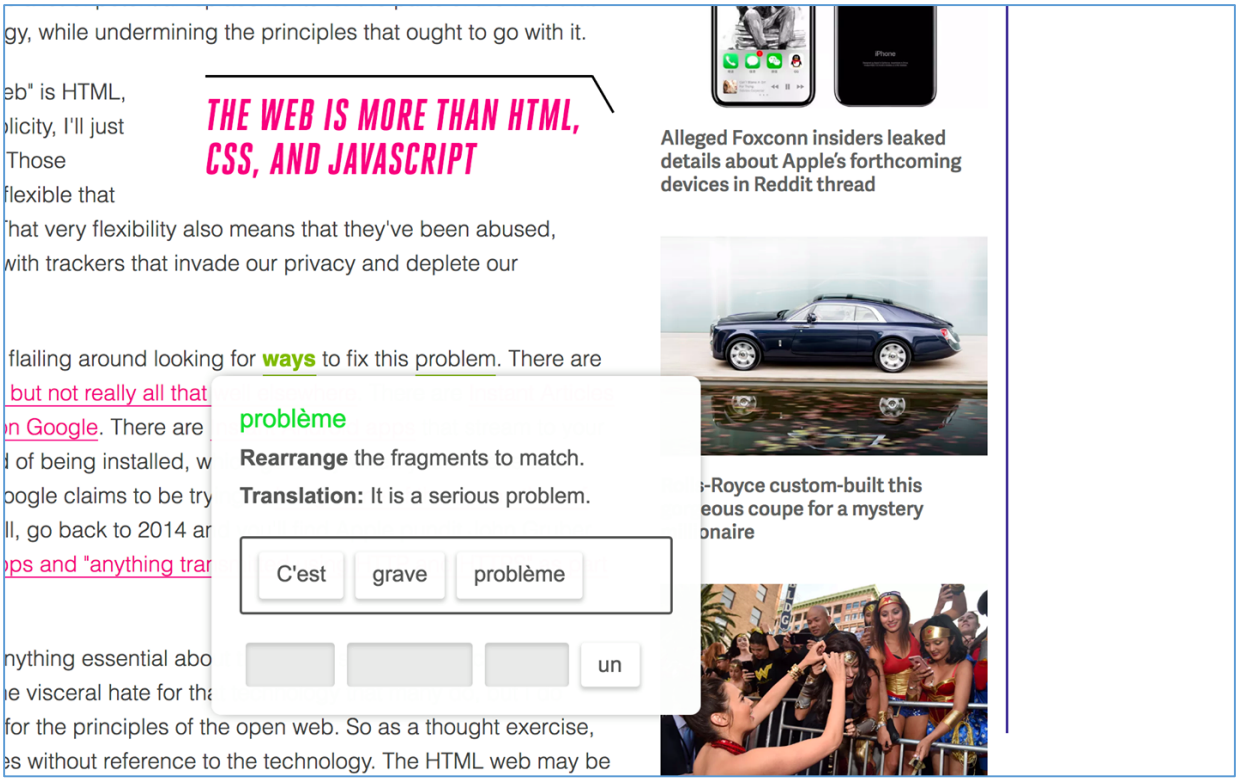

Figure 25. FlipWord sentence unscramble quiz (the user has moved 3 out of 4 fragments)

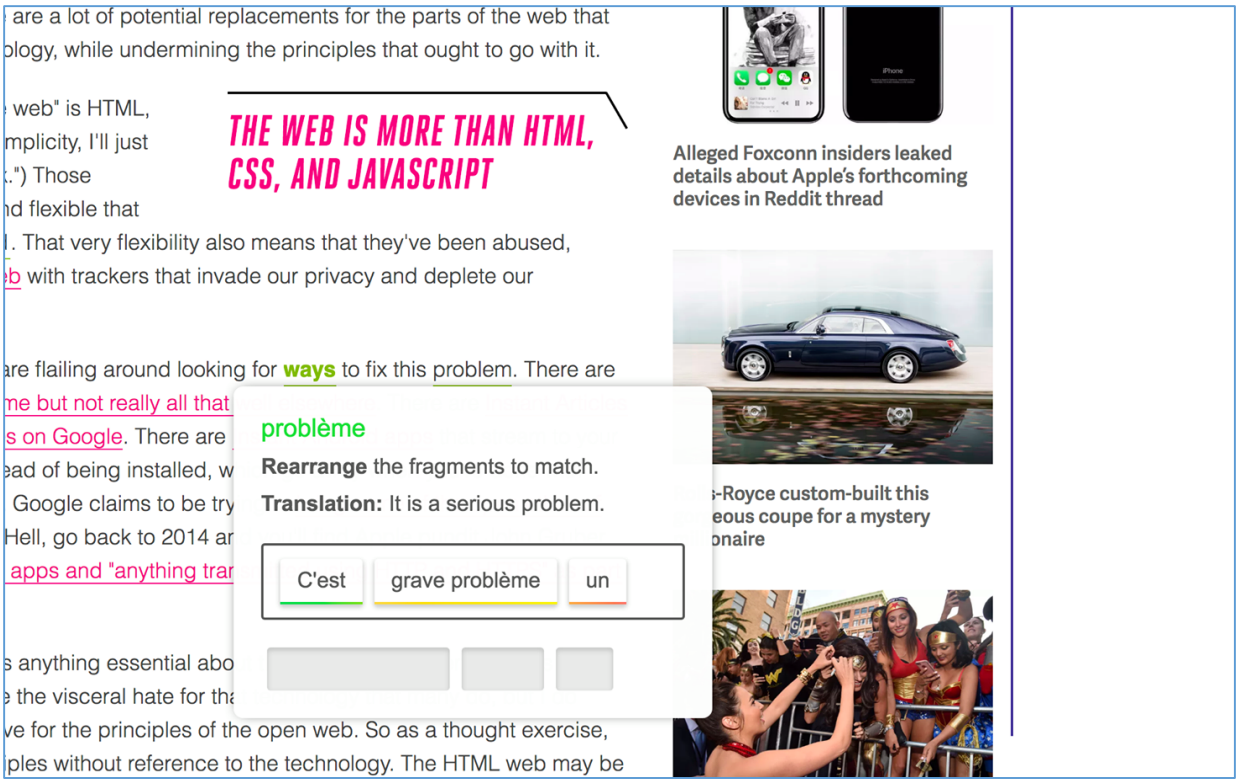

Figure 26. The partially correct parts are marked as yellow and merged into one fragment



Figure 27. When the user finally rearranged them into a correct sentence.

For language proficiency test preparation, FlipWord is currently targeting the Test of English as a Foreign Language (TOEFL) and the Test of English for International Communication (TOEIC). In addition to words carefully picked from the TOEFL high frequency word list, quizzes are also designed to resemble TOEFL sample tests released by Educational Testing Services (ETS) (Figure 28).



Figure 28. FlipWord English proficiency test preparation quiz tooltip

Besides the passive language learning function inside the Chrome extension, FlipWord also has a crowdsourcing marketplace and mobile application. Since both of them have not been released to the public yet at the time of writing, the author will not include them here.

CHAPTER 4: LIMITATION AND FUTURE WORK

Passive language learning in the digital environment of the 2010s is a new topic. Its limitations need to be explored, researched and validated in future works.

The author believes that there is a huge potential for passive language learning to disrupt the language learning industry. For a long time the traditional classroom has served as the most efficient and economical way to pass on knowledge because there are always limited teacher resources. Starting this decade, digital technology has gradually become a more valid replacement. Dozens of language-learning applications can be downloaded for free within seconds. However, failure to learn a foreign language through an application is still as common as learning through a traditional course. This result is not surprising at all. No fundamental change in language education can be made, if all applications do is digitalize a traditional classroom. Therefore, the novel approach presented – passive language learning – is a potentially viable option worth further study.

Where there is opportunity, there is risk. The first limitation for passive language learning is the high dependence on technology development. For example, all four passive language learning applications the author included need to use speech recognition technology to support speaking practice. However, at the time of writing, speech recognition still has plenty of room for improvement. This disappointing fact complicates the expansion of passive language learning that requires the technology, since during most passive language learning time, users are going to practice their speaking in an environment not designed for study, which means high noise. Therefore, it is really difficult for Alang and NoAccent to become a truly useful application that can be accepted by the market unless the speech recognition technology that they rely on significantly improves in accuracy.

Another main limitation of passive language learning the balance of interjection and interruption. One of the most common reasons for FlipWord uninstalls is a feeling of annoyance when seeing flipped words on a webpage while focusing on finishing a high priority task. To address this issue, FlipWord has added a pause feature that will temporarily deactivate and then automatically resume itself after a certain period of time selected by users. The automatic resume is to avoid FlipWord from being forgotten by users, as with most language applications. In the meanwhile, instead of directly resuming to users' preferred flip rate after the pause ends, FlipWord gradually increases the flip rate starting from zero, so that users will have time to adapt to the fact that FlipWord has been automatically resumed. In addition to the pause feature, FlipWord also lets users define their ideal FlipWord-deactivation-time based on their regular schedule. However, even with all these features, feedback on being annoyed is still a top complaint. Although NoAccent has not had a chance to be tested by real users yet, making the experience satisfying when taking a selfie is expected to be a key issue to address.

The third limitation of passive language learning is grammar instruction. It will not be a problem if the grammar is going to be taught independently, since it is easy to break down grammar lessons into mini sessions and inject them into people's daily relaxation time. However, for applications like FlipWord, when a Spanish word is woven into an English sentence, corresponding grammar rules such as conjugation needs to be considered based on the context. The hardest part for applications like FlipWord is not the core implementation but the time that is going to be spent in order to cover all kinds of grammar rules and contexts.

By documenting the design and prototype of four pioneering passive language learning applications, this thesis is an endeavor to push people to rethink traditional language teaching and new possible ways to take advantage of digital technology that can be used in the industry.

Future work is needed to validate their effectiveness and market opportunities, including rigorous research to evaluate and compare the long-term result of traditional language teaching and passive language teaching, innovative design to integrate language learning into people's daily life without distracting or disturbing them, exploration of more digital technology that can be utilized by passive language learning, and improvement of speech recognition and artificial intelligence that passive language learning relies on.

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