Hidden Guardian

Project plan

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Table of Contents

List of Figures

List of Tables

List of Symbols

Not Applicable.

List of Definitions

UWP - Unified Windows Platform

1.1 Acknowledgement

Professor Swamy Ponpandi provided technical support and shall be acknowledged for assisting Team 9 in the development of Hidden Guardian. Similarly, Professor Zambreno and the SE, CPR E and EE departments provided financial support in the creation of this product.

1.2 Problem Statement

Kid's lives today involve online interactions more than ever. Their interactions with strangers invoke the risk of sharing unwanted personal information, password theft, receiving viruses, being cyberbullied and more. However, currently there is no practical parental monitoring system to keep track of these unwanted videogame interactions.

Our solution is Hidden Guardian. Hidden Guardian is a combination of a speaker/microphone for a gaming console. It will connect to the XBox Controller as well as the Hidden Guardian's mobile app and speaker. Through the mobile app the parent user will be able to input keywords, such as meet, phone number, address and will be notified if they are used in chats. The app will also provide live text streams of the child's conversations and specific text paragraphs of chats with those keywords. Hidden Guardian will only be able to be enabled or disabled by the parent.

Overall, our goal is to provide a system so that parents can have peace of mind that their kids videogame interactions are safe.

1.3 Operating Environment

The typical operating environment of Hidden Guardian is a household setting. Given that houses are typically well climate controlled the hardware component won't be subject to any extreme conditions. It will however be handled frequently and should be at least somewhat robust in order to withstand moderate impacts.

1.4 User Interface Description

The intended user for this project will be for 2 targets, parents and their children. The children will be able to use the bluetooth speaker for their gaming uses or listening to music. The speaker will provide immersive gaming experience by providing high quality audio. The device will also have a mic to enable children to communicate with other players online to improve gameplay.

Parents will be using it as a device to monitor their children's activities. By using the mic on board, the device will record all of the child's conversations while the device is turned on. Parents will be able to access logs of recordings using the app and search for keywords in the recording such as phone numbers, and addresses, to help improve the safety of their children.

1.5 Assumptions and Limitations

Assumptions:

- At the end of development, this product will not be commercially ready to consume
- The maximum amount of hours/week of data we will store is 15.
- We don't need to comply with licensing rights, since we are handling the data outside of the console.
- Hidden Guardian is used in a household

Limitations:

- For speech to text recognition we will only support one language (English).
- We are limited by the amount of audio data that can be stored in the local object.
- Our device won't be able to separate each voice and associate it with different users
- We won't be able to access text chat communications
- The device will require relatively large amounts of power for a battery powered device
- Hidden Guardian's Speaker can only be used in Parent Mode up to 30 feet away

1.6 Expected End Product and Other Deliverables

- Smartphone App

  The smartphone app will allow users to review and search through the data collected by the console app. It will have a user friendly interface and provide a variety of tools for filtering through the stored data. These tools include things like being able to search for keywords or users and having all relevant conversations pop up.

- Hardware Speaker

  The wireless speaker will have a rechargeable battery and a bluetooth receiver. The speaker will play audio data received via its bluetooth receiver, and will user a usb cable to recharge its battery.

- Hardware Controller Extension

  The controller extension will house a microphone and a set of controls for both the microphone and speaker. The controls will be buttons affecting microphone and

speaker volume, as well as muting the microphone. The extension will attach to the bottom of an Xbox one controller using the 3.5mm jack. The extension will also contain a 3.5mm jack itself to serve as a passthrough for any user wanting to use their own headset. The extension will also house a bluetooth and wifi transmitter for connecting to the speaker and database respectively.

The initial stages of each of the mobile app and Database will be delivered by May and the final versions of those components as well as the hardware will be delivered by the beginning of December.

2 Proposed Approach and Statement of Work

2.1 Objective of the Task

Our goal is to create a multifunctional speaker, XBox controller attachment that includes a microphone, and a mobile application. The controller attachment will include a microcontroller that gathers the 3.5mm headjack data and sends it to both the speaker and the mobile application.

Hardware

Multifunctional speaker - This hardware component has two functions.

Gaming Mode: Allows the user to interact with others in an online gaming environment. It projects the audio output and will have a series of basic controls for controlling the volume level of the speaker. Bluetooth will not be used in this mode.

Parent Mode: The speaker will be bluetooth enabled. When a headset is in use the parents can move the speaker to another room in the household (within 30 feet uninterrupted) and listen to a live stream of the child's chat conversation.

Controller Attachment - This hardware component consists of a microcontroller and microphone. The attachment will send the audio data to the database at all times (so that it is constantly sending data to the mobile application). If the speaker is in "Parent Mode" it will also send the audio data to the speaker via bluetooth. The controller attachment will adjust where the audio comes through depending on what is connected to the 3.5 mm jack. If there isn't a headset plugged in it's microphone will pick up the user's audio and the speaker will output the chat. If there is a headset plugged in, the controller attachment will still be on to send data, but the microphone will not be on.

Software

Database - The SQL database will receive the audio data via Wifi from the microcontroller and use a tool to convert it into text within the database. It will also store the reference to the audio file. The mobile application will then access the database's text file and search for the stored keywords. It will continuously send text and voice chats to the mobile application.

Android Mobile application - This application will communicate with the database in order to search keywords and access the stored conversations. There will be a user interface for modifying the keywords and reviewing the conversations. A notification will be sent to the parent user via the mobile application to let them know when a keyword was flagged and it will direct them to the video and text chat to give them context. The mobile application text chat blurbs will also display confidence ratings of certain words due to speech to text errors. The mobile application will also include a help feature that lets the parent know how to navigate the application.

2.2 Functional Requirements

- The device will be able to record the conversations of a user while gaming online
- The conversations will be stored on a database which can only be accessed by an account tied to the device
- The database will be able to be searched for user-specified keywords using an app
- The speaker must be wireless and rechargeable
- The controller attachment must have a microphone
- The speaker will be optionally able to relay the live conversations of a user using a headset with the device

2.3 Constraints Considerations

We will want our product to be user friendly for parents who may not be very tech-savvy. We plan to assist with this by having thorough documentation for setting up the controller attachment and the speaker. We will also have a help menu in the mobile application that can take parents through our predicted FAQ.

We also have to consider the privacy of this product. Online members who participate in video game chat sign a release with XBox that they are willing to extend their privacy rights when using this product. This is meeting a standard, though may be considered unethical. The product is helping parents monitor unsafe actions, cyberbullying and avoiding password theft but it is also recording others so it is in a grey area.

There will also be a power constraint with the controller attachment's power consumption. An Xbox controller is powered by either two double A batteries or a rechargeable battery pack. Double A batteries are roughly 2500mAh, giving the controller roughly 25% more storage capacity than even larger smartphone batteries. There are no official sources on the expected battery life of the controller but users typically report between 10-30 hours of usage. Ideally we want to maintain as much of the controller's battery life as possible.

2.4 Previous Work And Literature

Android Application

We are using Android Studio to host the android application. We've connect our java application to a mysql database using JDBC (Vogella). We intend to store both a reference to the actual audio file and the text data of the chats on the sql database. We will also store usernames, encrypted passwords, keywords, and date and time of audio/text chat.

Activity Monitoring

There are a variety of spyware type applications for computers that will capture every aspect of a users online usage. Veriato Investigator is an enterprise level example of this, with other products offering similar capabilities, some of which are marketed at parents, like WebWatcher. However these products do not allow for recording or monitoring gaming console activity. There are products like Clean Router that work at the router level to monitor and logs all activity from any device accessing the internet, but this does not offer recording and search capabilities.

Console Activity Monitoring

Microsoft allows parents to set a variety of activity monitoring settings for their children's accounts. Using a feature called activity monitoring parents are able to get weekly reports about games and apps their child is using, search terms the child is using, and websites they are using, among other things. However they do not provide for a method to capture and filter through the child's online interactions.

Similar Devices

Currently, the only devices remotely similar are generic bluetooth speakers and a stereo headset adaptor for the xbox one controller. But none of these devices offer any kind of recording capabilities.

2.5 Proposed Design

Potential Approaches

Some potential solution we came up with included having a speaker that listened to the audio, adapted that audio to text and then sent that to the mobile application. The issue with this proposal was that clarity would most likely be very poor as the speaker may not be very closer to the user's mouth. It also posed for some issues with storage on the console application as it would require large amounts of storage. This may require a flash drive or micro-USB to transfer the data which is not user-friendly.

Another design idea we had is that once we gathered the data to directly send it to the mobile application without converting it to text. The issue with this idea was that it would require potentially 2.5 GB of data that would be hard to store on the speaker and also nearly impossible to feasibly store on a mobile device. We also considered having a device that would act as a blocker and would collect the audio data that was being sent to the headphones and send it to the mobile application, but the logistics of having that device/our speaker do that would get complicated for security reasons.

This research led us to our first proposed design, which was to have an XBox background application gather the user's audio data when communicating with other user and convert that data from audio to text on the console application. It would then send the text data to the database and inevitably the mobile application. The issue with this proposed design was the proprietary issues with accessing the audio data on the background application. We were able to get the background application to convert mic data from speech to text, however we struggled with gathering the audio data. Another issue with this approach was it only allowed us to have text data on the mobile application, not audio data.

After we ruled out this approach, we came up with two approaches that could still utilize the work we had completed with our first proposed approach. The first idea was to develop a game on the XBox development platform where we could create API's that allowed audio data to be spent from the game to the background application. This would work as a work-around to our inability to receive the audio data directly from the console, but would require our client to market to game developers to use our API's and we would have to sell our API's to them in order for our client to still make a profit. The second option was to create a "wire tap" that gathered the audio data from the 3.5mm headjack and sent it to the mobile application. The downfall of this idea was that it would make our background application unnecessary, and it would cause more power consumption on the controller.

After explaining these two approaches to our client, Ms. Rout chose the "wire tap" approach which brings us to our proposed design.

Proposed Approach

Our proposed design consists of four main parts. A controller attachment will contain a microphone and series of controls for both the microphone and wireless speaker. Additionally the attachment will have a Raspberry Pi with bluetooth and wifi capabilities to enable transmitting chat audio to the speaker, and both chat and microphone audio to a database after the audio is converted from analog to digital using the sound card adapter. The attachment will connect to the bottom of the console's controller via a 3.5mm audio jack, and will have its own 3.5mm audio jack if the user wants to connect their own headset. The wireless speaker will have a bluetooth receiver and adjustable volume. The speaker will also come with a code that will allow the user to associate the speaker with their personal account. The database will convert the audio into text and store both the audio file and the text transcription. An android application will provide a UI for interfacing with and retrieving data from the database. The user will have a username and password to connect to their data in the database. The app will have search tools which will allow the user to filter through the gamer's chat data via text transcripts and will notify the user/guardian based on specific keywords they have set up. Similarly, if the same user is being flagged for using the keywords marked as malicious it can notify the user/guardian of the flagged user.

2.6 Technology Considerations

- One of the main choices made was deciding which video game platform we should work with. We were deciding between Xbox and PS4 gaming devices. We chose Xbox because it has less development licenses rights that we'd need to work around and we capitalized on our background knowledge which aligned better with the Xbox platform
- For our database we decided on using an SQL database as microsoft has full SQL support for its universal windows platform. additionally. Additionally, an SQL database can easily be read with html which allows us room to build a web application
- Something we had to consider was mic sensitivity. If the mic is too sensitive, it will pick up audio from the speaker or other outside sources, but if we use a less sensitive mic we might risk not being able to record voices
- For the range of the Bluetooth, it is about 30 feet without any wall or interruptions

2.7 Safety Considerations

- Hardware needs to be safe to handle
    - no loose circuits
    - meets safety regulations of other speaker and microphone standards
- The information collected and stored must be encrypted as to not allow unauthorized access or tampering.
    - password encryption with database storage

- hidden ability to enable/disable Hidden Guardian if you are not the parental user

2.8 Task Approach

- **Speaker system**

We plan to use a TDA7266 Dual Bridge Amplifier. The speaker will require a Class-AB amplifier with a wide supply range of 3V- 18V that can provide 7W to two channels and a fixed gain of 20. Below includes a figure of our Speaker Diagram.

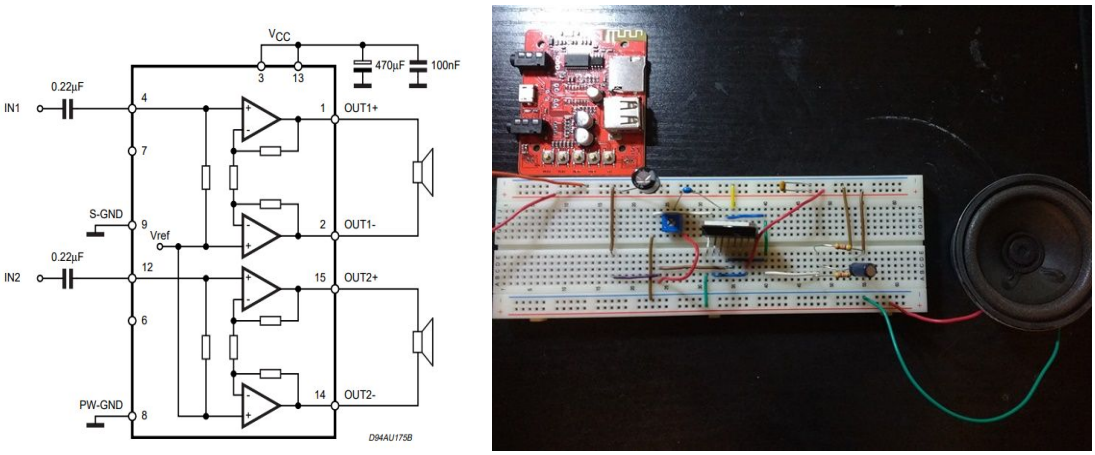

Figure 1 - Speaker Diagram

Our controller attachment will be similar to the figure below except it have a mic to pick up audio, a preamp to boost the signal and a microcontroller to transmit the signal to bluetooth speaker and the database.

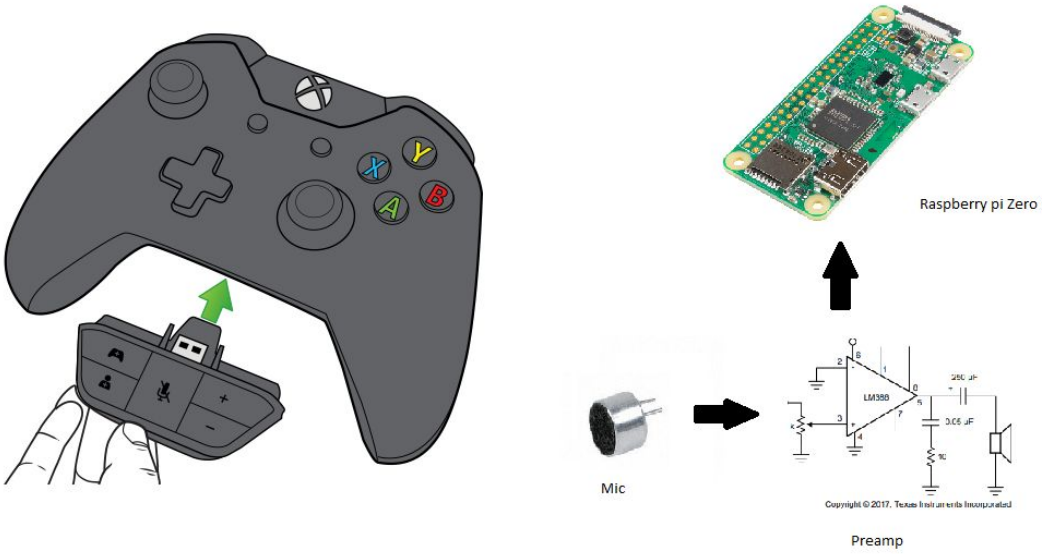

Figure 2 - Controller Attachment Diagram

The image below is a visualization of our complete system.

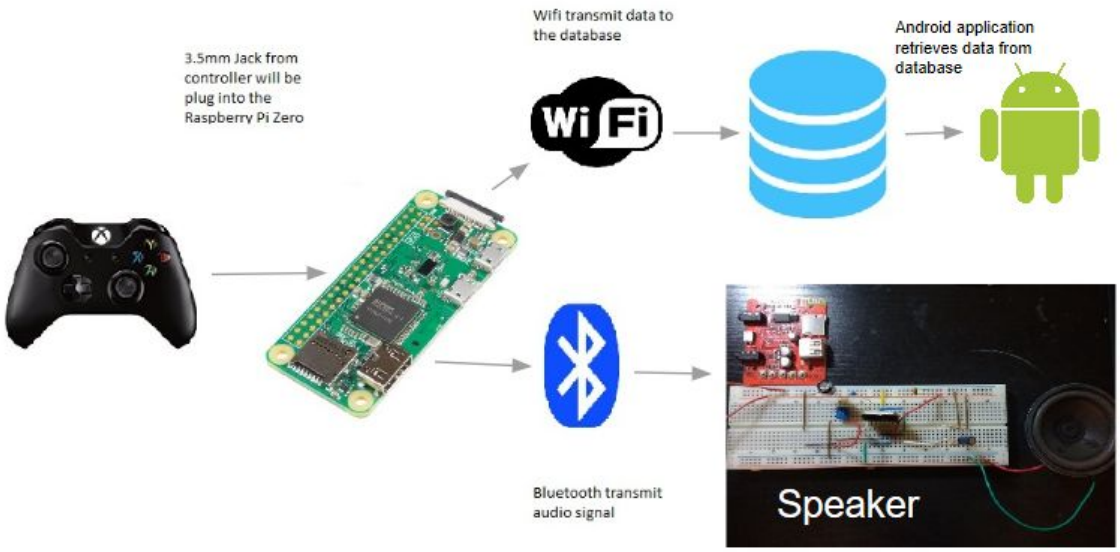

Figure 3: Complete system

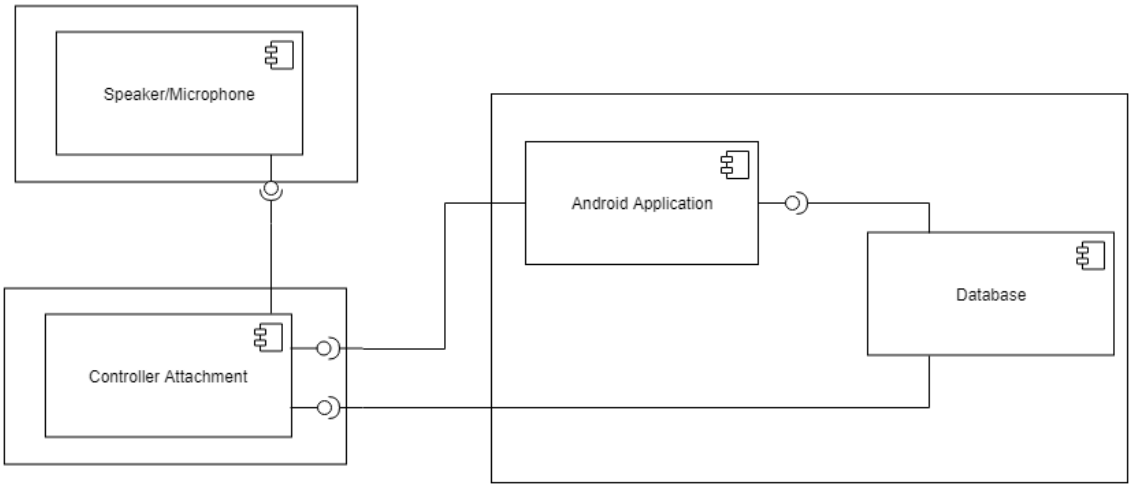

Figure 4: Block Diagram

The microcontroller will access the chat logs and store them in the database. The Android application will then be able to access the database including the recordings and the text chats.

User Interfaces

Login Page - login, password, enter button, create account text/link

Create Account Page - login, password (with certain credentials listed), enter button

Main Page - Widgets based on gaming sessions that triggered keywords and list of the keywords, username info, help settings

Specific Data Page - Lists text context of the keyword, audio context, full audio of that session

- Blue text -> Low confidence rating, **Red Bolded Text** -> Keywords

Other - notifications when a keyword is triggered that takes you to the link of the "specific data page"

2.9 Possible Risks And Risk Management

Strength

- Xbox One currently does not support wireless headset, our device will be able to enable wireless connectivity.
- By using a mobile app, we can access the recordings anywhere we want as long there is internet connectivity. we do not have to worry about not having a computer.
- Since we are not using the background application, we will have less licensing issues with directly getting the audio data from the console
- There is no controller attachment to XBox that gathers the audio data, so this is a new and inventive approach
- With this approach, the mobile application will be able to view text and audio data
- The ability to use the speaker as a listening device gives another option for parental monitoring that is live
- The speakers multifunctionality also allows users to still use the headset if they prefer without losing the ability to send the audio data to the mobile application

Weakness

- Inability to receive text conversations that are occuring on the console
- Potential expensive costs in purchasing an XBox One console, development license and hardware for the prototype
- Muffled voices, extreme volumes (quiet or loud), distance away from controller, music playing extremely loudly in the background and accents may affect the clarity of video recordings, false positives for keyword notifications and other accuracy issues

- Added lack of user friendliness as the user will need to get their microcontroller set up to their Wifi
- There will be a power drainage on the controller due to the controller attachment
- Added real estate is being attached to the controller which may not be preferred by the user

2.10 Project Proposed Milestones and Evaluation Criteria

- Create login set up on the mobile application
- Storing collected data as a reference in a database from the microcontroller
    - Attempt to store test data in the database
- Accessing data from the database on the mobile application
    - Attempt to read back test data that is stored
- Speech to Text conversion in the database
    - Getting Javoix to convert speech to text in the database
- Accessing both text and audio data from the database and displaying it on the mobile application successfully
- Making stored data searchable for keywords
    - Search through data with known characteristics
    - Ensure all relevant data appears when those characteristics are filtered for
    - Implement dynamic list of keywords and identify conversations from the database containing those keywords
- Creating a rechargeable bluetooth speaker circuit
    - Ensure volume is adjustable over a reasonable range
    - Connect to the speaker with a bluetooth capable device (e.g. smartphone)
- Creating a microphone and bluetooth transmitter circuit
    - Ensure playback of the microphone through the bluetooth speaker
- Interfacing a wireless speaker with the microcontroller from the console
    - Play a known sound file from the console and ensure it sounds correct from the speaker via the bluetooth connection from the microcontroller
- Interfacing a wireless microphone with the console
    - Use an existing console app with voice chat capabilities and use it to verify correct audio

2.11 Project Tracking Procedures

Our project tracking procedures will be done through gitLab issues. We will have an agile board where we assign tasks and are able to comment about the issues and tasks via this platform. Gitlab issues allows us to tag items to certain milestones and goals, assign due dates, and add certain “weights” so we all know the priority. We have just started using GitLab Issues as our Project Tracking Platform, but with time we will start utilizing their features and filling up our task board. An example of our current board is shown in Figure 3.

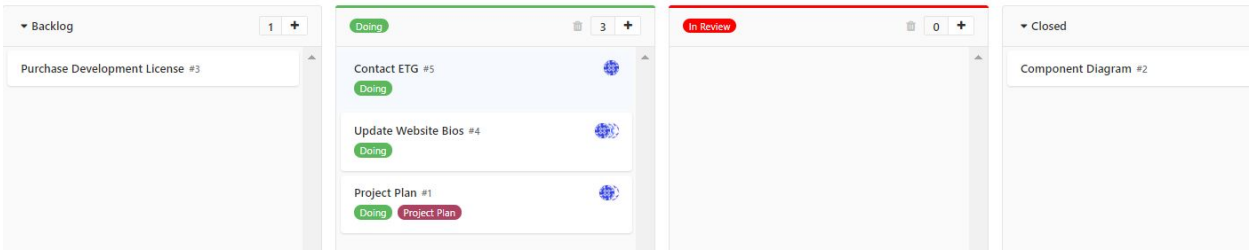

Figure 5 - GitLab Issues Board

2.12 Expected Results and Validation

Our desired outcome of this project is a working speaker and microphone, a console app with the ability to log and transfer audio and chat communications, and a computer/smartphone app that provides a variety of tools for quickly and intuitively navigating the logged data. To ensure that the components each accomplish their task sufficiently we plan to focus on testing the functionality of each component individually before combining them into a single functioning system.

2.13 Standards

For standards relating to privacy and security of data we will meet general standards of encryption of data being sent to and from the database and applications. However, before this product is able to go into production it will need a firewall system and further more intensive privacy and security implementations that will be handled by our client.

One thing that we've considered with ethical standards is whether it is ethical to distribute a chat record of audio conversations between one's child and potential other children or strangers. Though this is of concern, it falls under the same category as other gaming streaming services. Those who sign XBox's privacy license are willingly consenting to a potential distribution. I also think it is worth considering that this product's main consumers will be parents of children whose main intent behind purchasing is to keep their kids safe.

2.13 Test Plan

Functional Testing:

We plan to test whether the speaker can receive a bluetooth signal and amplify it based on the volume setting. We will also plan to test the distance the bluetooth speaker can withstand before losing signal so that we can record that for our consumers. We will test whether the controller extension can pair with the speaker and test transmitting an audio signal and receiving microphone data through the controller extension. We also plan on manually sending a message on the console to test whether it can be read into the application. We will test dumping all data on app into database. We plan to use unit tests on the database server to make sure querying works. We also plan to use unit testing to

test the keyword functionality on the mobile application. Sound testing will be done by simulating gameplay and having someone on the team speaking into the headset.

Non Functional Testing:

We will test the best location to put the speaker and the switches (for easy usability). We will test different ways to set up the controller extension so that it fits in the space between the controller handles. We will use unit tests to test our login feature to guarantee security. We will test compatibility between database and both applications and usability with be tested by making sure that the app fully runs in the background (we will use a lot of corner cases to test this with a simple gaming application). We will also do stress tests to make sure the console application can send a continuous stream of data.

3 Project Timeline, Estimated Resources, and Challenges

3.1 Project Timeline

Week 4 1/27 - 2/2	Create schedule, come up with unique ideas, write down research notes on voice recognition api, what is accessible in XBox dev mode, hardware, systems that currently do something similar
Week 5 2/3 - 2/9	Practice using git, get our “board of tasks” up and running, finalize development first draft decisions (this matches up with our task to finish the project plan). (UML Diagram - component), write requirements (functional and nonfunctional)
Week 6 2/10 - 2/16	Continue testing software implementation, and researching the same topics as in week 4.
Week 7 2/17 - 2/23	Begin development testing on console while simultaneously continuing research
Week 8 2/24 - 3/2	Continue development testing on gathering console audio data while simultaneously continuing research

Week 9 3/3 - 3/9	Work on database connection from xbox console, getting Speech to Text to work and gathering audio data from the console application
Week 10 3/10 - 3/16	Spring Break
Week 11 3/17 - 3/23	Focus on speech to text, gathering audio data from the console application, mobile app creation and database connection/ front end functionality
Week 12 3/24 - 3/30	Focus on speech to text, gathering audio data from the console application, mobile app creation and database connection/ front end functionality
Week 13 3/31 - 4/6	Finish speech to text and work on confidence ratings, focus on database connections and mobile application front end Note: This week we decided that our ability to gather audio data from the console was not realistic and we started brainstorming alternative paths.
Week 14 4/7 - 4/13	In complete development mode at this point. Working on both mobile app and hardware. Team will stop introducing new work/ features and focus on producing a proof of concept and fixing bugs. Note: This week we chose the hardware “wire tap” route after discussing the options with our client.
Week 15 4/14 - 4/20	Focus on producing a proof of concept and fixing bugs and preparing for presentation
Week 16 **4/21 -** **4/27**	Dead Week - presentation.

Table 1

Project Tasks	Week 6	Week 7	Week 8	Week 9	Spring Break	Week 11	Week 12	Week 13	Week 14	Week 15
Finalize project plan										
Purchase Dev Liscence and XBox										
Learn UWP/Start editting background application code										
Work on design document										
Focus on console background application speech to text										
Set up database										
Continuous development of android app back and front end										
Continuous development of console app										
Research new approach and update all documentation										
Get a speaker prototype up and running										
Focus on final presentation										

Figure 6 - Semester 1 Gaant Chart

Project Tasks	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
Database is recieving text from microcontroller														
Get hardware set up and communicating														
Get Javoix speech to text working														
Android app's keyword feature is succesfully working														
Implement a way to have confidence flags for text data														
Work on mobile application front end														
Write documentation for users														
Focuson testing														
Spend extra time for new ideas (implement website on VM)														
Prepare for final presentation														

Figure 7 - Semester 2 Gaant Chart

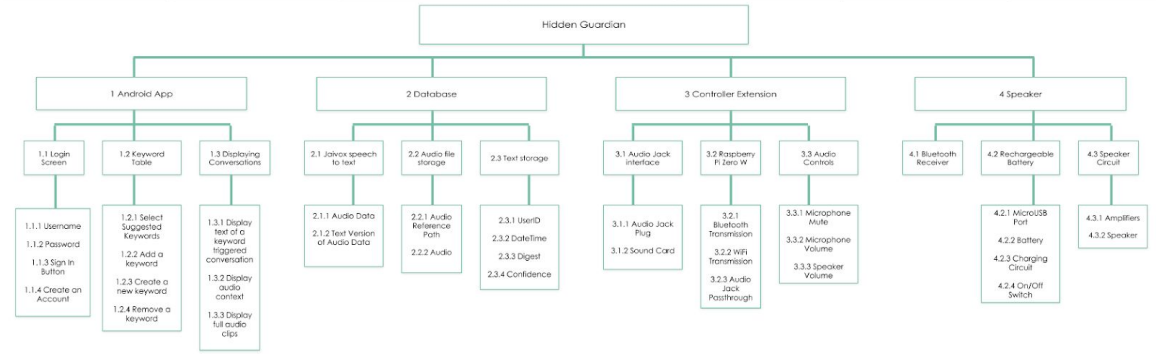

Figure 8 - Work Breakdown Structure

Our project timeline for the first semester reflects a breakdown of what happened. If you look at previous timelines you can see that it has changed due to our inability to get audio data from the console and required adjustments for our new approach. This means that our first semester deliverables were less developed than originally planned.

In the Fall semester we plan to implement as much as we possibly can. Our first goal will be to get our microcontroller and mobile application communicating via the database. We will then spend a lot of time working on Javoix speech to text. From there we will focus on making the keyword features as smooth and efficient as possible as well as improving on mobile application front end, documentation for the user to make it user friendly and other features that enhance our product.

3.2 Feasibility Assessment

The final product includes a wireless rechargeable speaker, controller attachment with bluetooth and wifi capabilities, database implementation of speech to text, and an android application for the end user to query the database. It is believed that each of these items are feasible and should not pose technical difficulties. The only foreseeable challenge is simply the interoperability of the hardware to the xbox app as well as making sure the database can be safely accessed by the software without anyone getting access to records they should not be viewing.

We know that gathering the data from the 3.5 mm headjack is feasible using a USB sound card. We will connect the Raspberry Pi through the USB sound card so that it is able to transmit the audio data to the bluetooth speaker. This will be feasible as we have forum guides that will assist in setting this up. This fixes our earlier feasibility issue of not being able to get the audio data from the console application.

We also know the speaker is feasible because we have created a prototype, tested it's bluetooth range and have the amplifier functioning.

Finally, we feel that getting the speech to text conversion within the database is feasible because we were able to implement speech to text in the Xbox background application so we are already familiar with how that works. We also have a platform we plan on using called Jaivox that will implement our speech to text conversion in the database. We also plan to store audio reference files in our database, so in the event the Jaivox implementation doesn't work we could have the speech to text conversion occur outside of the database.

3.3 Personnel Effort Requirements

Create speaker
Create Database structure
Develop DB interfacing
Develop DB Javoix Speech to Text
Create app front end
Create app back end
connect app to DB
connect speaker to microcontroller
connect DB to microcontroller
get button functionality working on the controller attachment
get button functionality working on the speaker

3.4 Financial Requirements

XBox One - **$450**

XBox Development License - **$19.99**

Speaker - $15

Controller attachment Microcontroller (Raspberry Pi Zero W) - $25

4 Closure Materials

4.1 Conclusion

Our goal for Hidden Guardian is to create a platform where parents can have their minds at ease about their child's video game play. We plan to have a speaker and a controller attachment with a microphone and microcontroller that could potentially replace the gamers headset, and a mobile application. Between the communication of these components the parental user will be able to listen for keywords, listen to chats, and effectively monitor their child's video game play on a user-friendly mobile app.

4.2 References

Speaker Amplifier

http://www.st.com/resource/en/datasheet/tda7266.pdf

Raspberry Pi Zero W

https://www.raspberrypi.org/products/raspberry-pi-zero-w/

Android Application

https://www.androidauthority.com/android-app-development-complete-beginners-658469/v
http://www.vogella.com/tutorials/MySQLJava/article.html
Financial Resources
https://www.gamestop.com/browse/consoles/xbox-one?nav=28-xu0,13ffff2412-1e0
https://www.xbox.com/en-US/developers
Speaker Research
https://www.parts-express.com/cat/midrange-midbass-drivers-full-range-speakers/16

https://www.digikey.com/
Battery Life Research
https://www.neogaf.com/threads/how-does-the-xbox-one-controllers-battery-life-compare-to-the-dualshock-4s.759677/
IEEE Ethical Code
https://www.ieee.org/about/corporate/governance/p7-8.html
Microsoft Windows UWP Forums

https://docs.microsoft.com/en-us/windows/uwp/

Previous work

https://support.microsoft.com/en-us/help/12441/microsoft-account-see-child-device-activity

https://www.veriato.com/products/veriato-investigator

https://webwatcher.com/pc-monitoring

https://cleanrouter.com/features/