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Senior Design Proposal

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Pixie Power

1 Introduction

Picture this: you're a broke college student, it's 3 A.M., and the only thing you've written on your paper is your name. Your desk is a chaotic battlefield of notebooks, half-empty coffee cups, and procrastination-induced despair. Your dilemma has been brought about by your lack of experience juggling the numerous responsibilities dumped on you, which you now realize requires careful time management and prioritization – skills you have yet to develop. And the deadline? It's creeping closer with each passing second, and your motivation is on life support. But wait, despairing scholar, because salvation is at hand!

Introducing Pixie, the perfect desktop companion! Pixie is a pint-sized desk friend that combines both functionality and charm – helping you focus and manage your responsibilities while bringing some cheer to your study environment. Resembling a miniature computer, it brings the perfect touch of liveliness to bring back the pep in your step. Pixie can provide you with focus features such as study timers, critical notification syncing, day/night (wake/sleep) display modes, and more! Adding to the smart focus tool, Pixie is also a canvas for your creativity. Easily select your favorite pixel art to personalize your desktop buddy. Pixie also has a variety of other features that can rescue you from the clutches of procrastination and light up your late-night study session like never before!

2 Problem Description

Today's technological devices are more advanced than they have ever been, allowing quick access to the latest news, information, and trends within the swipe of your finger tip on your personal device. College students often find themselves distracted and procrastinating because of these devices. To make matters worse, students' tendency to become distracted is compounded by their inexperience handling real-world responsibilities due to their relatively young age. Furthermore, students may become stuck in a drab or an uninspiring workplace, often leading to unproductivity and decreased motivation. All of this makes it difficult for a large majority of students to successfully manage multiple deadlines and tasks – leading to the all too common all-nighters students use to finish their assignments.

3 Proposed Solution

To help prevent the temptation of becoming sidetracked by your phone during study sessions, we propose a device designed to provide you with necessary information independent from your phone. The Pixie Display aims to create a more conducive environment for students to work or study. Perhaps its most fundamental and prime feature, the Pixie's LED display serves as a smart desk light that automatically turns on and off based on the user's wake/sleep hours. Additionally, the LED display can be programmed to light up in response to sound queues, like clapping, providing visibility in the middle of the night without the need for reaching for your phone. This approach sets the stage for a productive day by promoting proper rest and discouraging late-night phone usage.

Pixie goes beyond just a conventional light source; it also serves as an enjoyable platform for showcasing pixel art. Through Pixie's website, you have the option to select from a handful of available designs to feature on your Pixie display and admire.

In the midst of active study sessions, Pixie can serve as a valuable study timer. Many contemporary students employ diverse study techniques, such as the Pomodoro method, advocating specific time blocks dedicated to focused work, followed by a 5 to 10 minute break. With Pixie, you can set timers to facilitate concentration during work and study sessions without the need to reach for your phone. Additionally, Pixie can showcase the date, time, weather, and synchronize critical email notifications, ensuring users remain connected to productivity-oriented applications while steering clear of distractions from media or gaming apps.

Lastly, Pixie doubles as a speaker, allowing you to play your preferred focus music. Whether it's classical tunes or lofi, having a tangible device like Pixie can help motivate students to successfully manage their time and complete any task at hand!

4 Demonstrated Features

The Pixie Display offers numerous features designed to enhance student focus during study sessions. The following is a list of the display's features, along with details on how each contributes to benefiting students.

- Pixel Art
    - This feature brightens the mood of studying while minimizing distractions from the user's phone and other personal devices.
    - There will be a handful of pixel art images to choose from, allowing a customizable feature for users.
- Sound activated light
    - From the clap of hands or possibly another sound activating feature, the screen of the device can be illuminated to provide light in the darkness of the night.

- Study Timer feature
    - The device has the ability to set timers. Setting a timer for study purposes will enhance focus, allowing study break time to take place after the timer goes off. Furthermore, just like all timers, this feature may be used as an alarm for sleeping as well.
- Date/Time/Weather info displayed.
    - To minimize reasons for the user to pick up their phone while studying, the device will display live date/time/weather information.
- Automatic day/night display modes
    - Day/Night modes adjust the lighting of the display based on the lighting of the user's study space.
- Sync phone notifications
    - It is still important to have some notifications available while studying, so we added a feature that allows important notifications to come through from the user's phone to the Pixie Display. Important notifications include phone calls from the user's favorite contacts list, school emails, school assignment notifications, etc.
- Music streaming (speaker)
    - Most students study with focus music, so we added a speaker to the device and the ability to connect music from a personal phone/computer to the display via bluetooth/wifi. One can also adjust the volume and skip songs using buttons on the device to prevent the user from picking up their phone!

5 Available Technologies

In order for the features previously described, key technologies and components need to be applied to the design of the device. The following list of technologies will adhere to the design of the Pixie Display, allowing full functionality as a study pal for students.

- Power: The device will have power provided via battery operation or AC electric power supply through a wall power port. The final decision between these two options will be made as seen best fit during the early stages of designing and building the product. We do not want to limit ourselves to a specific, singular form of power in the case that we find a better form of power fits the needs of our components used.
- Screen display: OLED/LCD/LED display options available. The choosing of a specific display will be based on screen dimensions and pricing. We want a larger display screen than what we have used in the lab, but we also want to stay within the budget. Realistically, the screen will most likely be LCD or LED over OLED as these types of screens are available in a wider range of sizes at much lower price points.
- Bluetooth module to allow access to phone notifications and music.

- Wifi module to gain access to date/time/weather information.
- Microphone: to listen for sound, activating the night light feature.
- Speaker: (tweeter, subwoofer, or woofer) to play music from the device, receive information from a microprocessor that gets music info from bluetooth.
    - Audio cables to send audio signals from processor to speaker
    - full range drivers (transducers to convert energy as necessary, depending on power source used)
    - Possible amplifiers to amplify audio signals from cell phone to processor to speaker.
- Mini keypad : about 6 buttons to utilize for volume adjustments, light adjustments, skipping songs feature, etc.
- Microprocessor: the brain of the device, communicates information from bluetooth/wifi to the display monitor/speaker. We will be deciding between processors developed by Arduino or Raspberry (such as the Uno, or Pi Pico).
- 3D Printed housing: solidworks CAD as a simple rectangular display with character like appearances (animal ears, etc) to personalize the device. Accessible through ND EIH.
- Rubber feet for bottom of display to prevent slipping and damage to the desk.

6 Engineering Content

To be able to create the Pixie display, we will need to design, build, and test our product. The functionalities described in previous sections will be thought of in major functional blocks in the system and for the user.

<u>System functional blocks:</u>

- Wifi, bluetooth, microprocessor, screen. The wifi and bluetooth modules need to be able to communicate with the microprocessor in order to display the information on the screen.
- Microprocessor, keyboard, speaker, screen.

<u>Functional blocks between user:</u>

- They need to be able to connect to wifi and bluetooth in order to use the music functions, and connect their phones to see their notifications, day, time, etc.
- The keyboard and microprocessor need to have real time processing in order for the user to change between music, brightness, adjust volume
- The screen needs to be able to display the information being processed through the user's interaction with keyboard and bluetooth. This can also be conveyed in the form of widgets how the user can customize what they want on their Pixie Display
- Bluetooth and WiFi

    - This functional block is very similar to the respective bluetooth and WiFi system functional blocks. Instead of communicating between the bluetooth/wifi modules and the microcontroller, however, we will need to communicate to the user's cellphone. In order for the user to send data over bluetooth, we will need to learn how to develop an application or web server (similar to the one in our programming assignments) for the user to send information about display options, scheduling wake/sleep/focus modes, and syncing notifications. We will start from the most fundamental level and increase in complexity up to this point. For example, starting from a simple application/server that has binary state input buttons for the user to interact with. Once we are comfortable with this stage of the application, we will increase in complexity to improve functionality.
- Microphone
    - The user will interact with the microphone by sending audio queues (such as clapping) to turn the display on/off. We will need to configure the microphone to be sensitive to a very specific audio signature so as to not induce false display functions due to background noise. To determine this audio signature, we intend to record sample waveforms from students performing the same clapping pattern.
- Keyboard
    - This will be the primary interface for the user to directly alter the Pixie display without the need for bluetooth/WiFi connection. The configuration between the individual key functions and the microcontroller have already been described above in the system functional block. The primary engineering task needed on the user-side functional block is consideration for the ease/convenience of use. We will design multiple keyboard/key button housings using modeling software such as solidworks. Using the 3D printers in the EIH, we will fabricate our models and test each to determine the best option.

<u>What our team will need to work on/advance our knowledge on:</u>

- Display
- The microprocessor will need to relay relevant information to the chosen display to illuminate user defined patterns, widgets, and timers. This scope of this system also encompasses varying the screen brightness or loading stored displays to shift between wake/sleep/focus modes. Our team will need to research the communication protocols used for the specific display (whether it be LCD, LED, or OLED) and how to scale images and screensavers to fit the resolution and display dimensions. We will need to design multiple display layouts to partition the screen into different regions to be used for displaying widgets, notifications, timers, or background images.
- Speaker
- Our team will need to understand how our chosen microprocessor can be configured to send audio signals to the sound system. We will also need to determine whether the audio signals need amplification to be of any use to the speakers.

- Keyboard
- We will need to program several (about 6) GPIO pins on our chosen microprocessor to keep track of values and on/off states changed by the keyboard. We will most likely need to learn more about RTOS to create and use interrupt functions designated to each of the keys.
- Bluetooth
- The bluetooth module acts as a gateway between the user and the system. Once data from the user's phone is available inside our system at the bluetooth module, we will need to relay this information to the microcontroller so that it can be processed. We will need to learn how to use bluetooth communication protocols and understand how to differentiate/read different signals. Since we will be using the Pixie display as a notification forwarding device, we will need to know how to configure bluetooth for continuous communication. To develop our use of the bluetooth interface, we will design multiple test functions as we increase our complexity of communication. These test functions will simply print to the serial monitor or terminal, in text, the type of information we are receiving/sending. This will allow us to become more familiar with the communication protocol so that we can design a robust state machine in software to handle the data parsing.
- WiFi
    - Similar to the bluetooth module, this functional block acts as a gateway between the outside world and our system. We will design simple test functions as in the bluetooth functional block to assist our software development. We will need to learn how to pull information from web addresses to display updates on the weather, date, or time.

7 Conclusions

Pixie emerges as a desktop companion that mixes functionality and charm to address struggles faced by college students. These struggles include distractions, lack of motivation, and stagnant study environments. The key features of the device include pixel art, sound-activating lighting, study timer, display of the date/time/weather in the form of widgets, day/night mode, synced notifications, and music streaming. With these features, students can manage their time more effectively when they choose to study. Our team will need to choose technologies that are readily available and feasible for the power source, display monitor, bluetooth and wifi module, microphone, and speaker. The major functional tasks that our team will need to accomplish include configuring the microprocessor for audio signals, programming the keyboard, interfacing the display with the microprocessor, and implementing Bluetooth and Wi-Fi connectivity. With this device, the user should expect real time processing with control of music and brightness adjustment. The customization of the 3D printed housing and the pixelated art will enhance the user's experience as well. Pixie is a solution that can turn lifeless study spaces into productive sessions.