Science-Backed Timer for Building Lasting Study Habits and Improving Student Focus

James Scholz, Louis Vocatura
Computer Engineering Department,
University of Utah

***Abstract*—The ability to focus is something continually challenged in the modern era. Students, who are required to produce high-quality work, have felt the pressure of the attention crisis. Our group is focusing on building a device that helps students regain their focus by improving their ability to study. This device works to improve duration, consistency, and intensity through several scientifically proven techniques.**

I. Introduction

In the era of unprecedented information access, being a student is both rewarding and challenging. While students have an abundant supply of information on demand, they also have an unprecedented number of distractions constantly beguiling them with tailor-made content. Because of this, students are suffering from attention deficiencies, they are having trouble focusing on tasks that require periods of uninterrupted thought.

As students ourselves, it can be frustrating to constantly fall into distraction. It often feels as though we have no control over our behavior. This is in part because checking attention-seeking devices have become a large part of modern behavior. Provoking and enticing notifications constantly flood users until they consume them—only to be fed more. Checking our phones is something we do 344 times a day or every 4 minutes [1]. The average American uses their phone for 5-6 hours daily [2]. Our attention span has dropped by 4 seconds since 2000 [3], we are amid an attention crisis [4]. Imagine how much more could get done if that time was used productively.

One solution to help students regain their focus is a study timer that helps students improve several lead measures that result in better studying, such as intensity, consistency, and duration. The timer acts as a coach and a companion device that the user will interact with throughout their study routine. It will be implemented using multiple science-backed techniques for habit-forming to ensure the student will build long-lasting study habits [5]. The device will also measure useful statistics such that the student can model their improvement over time. From the device, it will be possible to measure general productivity, with the hope that this score will increase over time.

II. Background

This device will focus on cultivating three keystone skills for long-term success. These are duration—the amount studied, consistency—the number of times studied over an extended period, and intensity—the level of focus. The following section will outline how this device trains these skills.

A. Smart Studying

Equation 1 is often quoted in productivity literature:

$$\text{Total Work Done} = \text{Duration} \times \text{Intensity} \tag{1}$$

While this equation doesn't capture behavior over time, it's effective in describing two critical lead measures in producing results. To show productivity over time, consistency should also be considered, leading to equation 2:

$$\text{Productivity} = \text{Duration} \times \text{Intensity} \times \text{Consistency} \tag{2}$$

Focusing on improving these variables will lead to the desired output. Further, we can weigh each variable to produce a number representing one's productivity score. This formula hasn't been finalized yet.

1) Duration: Because there is a fixed amount of time in a day, the duration to which the student studies is arguably the least important of the lead measures. Focusing on maximizing intensity is far more efficient. Further, implementing new routines is much easier when starting small, and therefore likelier to reoccur [6]. Nonetheless, it is still necessary to train endurance. The timer will use Pomodoro time blocking, sectioning study sessions into manageable time chunks with breaks in between each chunk [7]. The study time for most students will be 25 or 50 minutes with 5 or

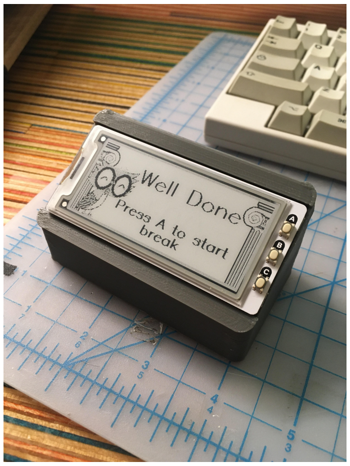

Fig. 1. A view of the final project

10-minute breaks after each study session, with an extended break after the fourth session. To combat the Planning Fallacy [8], over time the student will understand the required number of sessions required to complete their work. The student is expected to schedule these sessions into their daily routine. It is feasible that over time, the student will increase the number of working sessions as they become more accustomed to the workload.

2) Intensity: One of the most important qualities of effective studying is intensity [9]. Because the duration is limited by the amount of time someone has in a day, intensity is the variable to maximize. It is far more efficient to study less with greater intensity. The goal of studying should be to reach flow as often as possible, where flow is ”a state in which people are so involved in an activity that nothing else seems to matter” [10]. Individuals able to reach this state produce the highest quality work [11]. Thankfully, Pomodoro time blocking optimizes for intensity, as the student is to be completely focused on one task during the study session, and little distractions are ignored.

3) Consistency: To truly be consistent, the student must build strong habits that are isolated from the student's current temperament—meaning they shouldn't rely on motivation to study, rather they should build strong habits into systems that ensure the work gets done. There are several tactics for building consistency, this device primarily uses heat mapping, streaking, and Pomodoro time blocking.

III. Technical Details

After the completion of the timer, the overall result was a success with very little changes made to our original plan. For the screen, we ended up using a svelte 2.9” (296x128px) mono E Ink display from Pimoroni. This screen was around 18 dollars which was even cheaper than our original screen we planned on purchasing. The reason we changed screen was that the original screen we planned for had minor compatibility issues with the pico. We could display what we needed to on the screen but we were not able to refresh the screen at all. The Pimoroni screen has three built in buttons which allowed for easy configuration with the pico's GPIO pins. This gave the timer a more pleasing look that we would not be able to mimic manually. And on top of all that, its an even larger screen than the original!

The software we embedded onto the pico was relatively complex, but proved to be extremely malleable once we got the basics down. Most of the code is a large FSM that controls what the user is currently doing. The state is checked every millisecond for updates and the buttons will change the state based on the current state. For example, if the user is currently in the main menu, state zero, button A will update the state to state one. The state update will be seen a millisecond later and tell the board to display something else. That state will persist meaning the buttons will now do something else because their functionally is state dependent. The great thing about this software design is its highly extendable. Any amount of states can be added for additional functionality.

A pico board has a special property that allows files to be booted upon powering up. When powered up, the pico will automatically run any file named ”boot.py”. This handy property gave us a lot of control over the power usage for the board. Our software is contained in a single file named boot.py which will start immediately after the reset button on the back of the board is pressed. We coded a special state that will intentionally terminate the program when the C button is pressed. This means the user has the ability to completely shut of the power to the board when its not in use, drastically increasing the battery life.

One issue that we ran into and couldn't fix was being able to transfer study data to an external computer. We originally thought that we could access the pico like a pen drive and create an XML file that could be dragged onto a computer. But it turns out we would need an external computer application that could physically access the pico's file system. It would be possible if we advertised a third party program that we tell the user about. It was a consideration but we eventually dropped the idea because we wouldn't be able to bring that to market. Instead, the timer will

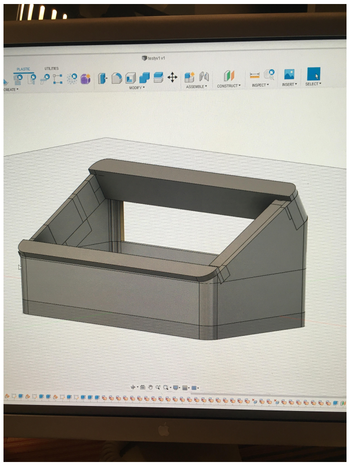

Fig. 2. A render of our 3D printed case design

store study data and simply display information about it to the timer screen when requested. Its essentially the same functionality because a large part of the design is that the user can see their study streak, which you can still do, it is just much less appealing to the eye.

For the battery power, the pico attached directly to the back of the eink screen. This made it a bit difficult to solder anything else to the board because each pin was utilised and we would need to make a parallel connection. Luckily, all we had to do was solder the hot and ground wire of really any battery pack to the VSYS and ground pins on the pico to have full battery power. We ended up changing the type of battery to lithium ion because of how easy it would be to do (we would just buy a lithium ion battery case which would also have two wires).

The device's chassis was designed to enclose the screen and battery compartment in a compact way that minimizes overall footprint but also emphasises the e-ink screen. With the hopes of eventually creating a mold that would allow injection molding, the design remained a single piece that contains straight lines and slight tapers. The preliminary design was sketched on paper then drafted within Autodesk Fusion 360. Knowing that the chassis would be 3D-printed for the demonstration, a slight amount of variance was allowed for inconsistencies within the final print. After modeling the case within Fusion 360, the STL file was exported to Ultimaker Cura to be sliced. Using standard grade PLA with support and adhesion enabled, the printer was able to create the design in approximately 2 hours.

Our stretch goal was adding animation to the screen. Adding an image was relatively straight forward as the screen uses bit maps to update pixels. All we had to do was convert any 296 X 128 image into a bitmap and store it on the pico. To make an animation would just be stringing images together one after another. This was entirely doable if we had the means of actually drawing the animations. We tried to draw images that could be framed together for animation, but it ended up being entirely too difficult. What we ended up doing was using an image of Owly the study owl instead who congratulates you for finishing a study session.

Fig. 3. Owly the Study Owl.

IV. Conclusion

Overall, the creation of our study timer was a success. Almost everything we planned to do worked out, and the problems we ran into were avoided easily. Our timer does what it was intended to do without being over budget. Our demonstration went smooth with no critical issues that prevented us from showing people everything we had done. We used our presentation for added effect since the timer is really small. The people we talked to were impressed with the projects scope and execution.

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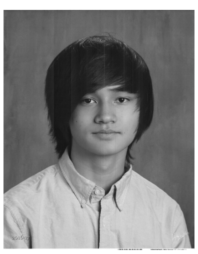

James Scholz is a Senior computer engineering student attending the University of Utah. He works as a researcher under Dr. Chris Myers at Genetic Logic Lab, based out of the University of Colorado, Boulder. The lab researches synthetic biology through computer science. Here, James works primarily on coding and developing tests and testing structures for SynBioHub, the chief product of the lab. He also programmed and produced its API documentation. His latest efforts are in overseeing a Google Season of Docs student who is writing the user documentation for SynBioHub. James is interested in pursuing entrepreneurship in consumer electronics later in his career.

Louis Vocatura Is a Senior computer engineering student attending the University Of Utah. He has multiple years of experience with the Department of Technology Services at the State of Utah. Specializing in database architecture and management, the Department of Technology Services at the State of Utah utilizes Oracle SQL and Forms to construct and manage the State healthcare database. After graduation, Louis plans to move to Chicago and join a team of engineers to help develop revolutionizing 3D printing technology.