Embedded Systems Project Document

YOUR NAME: Oliver Hansen

1. Initial Project Idea

PROJECT TITLE: Smart Dial
PROJECT DESCRIPTION: The smart dial is a haptic feedback twisting dial with a screen in the middle. Different features can be programmed into the dial, but the main purpose is to be a desk study tool that runs timers or connects to a computer to control volume. The basic hardware implementation involves some form of electromagnetic induction motor that is programmed to resist a turning motion until a certain point and then releases allowing the user to progress one “step” of the dial. An easier implementation would be a static system using a rotary encoder to track the twisting. The screen in the middle is what provides visual feedback for the dial, and is also what makes the dial fully stand alone if need be. Internally, the system will need a motor driving module of some sort, and a display driving IC that is interfaced with the microcontroller. other features could be added like a speaker for alarms, or a vibrating motor.

2. Finding Comparable Products

1. Scott Bezek's Smart Knob - https://www.youtube.com/watch?app=desktop&v=Q76dMggUH1M
   https://github.com/scottbez1/smartknob/

This DIY knob is very similar to what I am thinking of with a couple key differences. One big one is that the Microcontroller is embedded in the PCB permanently where I am hoping to make mine removable with female and male headers. I like how simple the design is for this one, there are only a couple components he is using, the motor, some leds, and the display panel. There are some additional features I would like to add like a vibration motor embedded in the knob so it can act as a sort of alarm while it is sitting on my desk. This is running on an ESP32, which I really like so I might draw some inspiration from this design when implementing my own.

2. HAPTICORE Smart Knob
   https://www.xeeltech.com/smart-knob/

This has the same core features that I would expect from a smart knob, mainly the display on the front and the custom haptic feedback. This is a good example of this idea being implemented as a full commercial product. The code for this device is not public, but there is an app to configure and use the device.

3. S3XY Knob - Tesla smart dial

https://enhauto.com/product/s3xy-knob

This is a little different than the desk model I was envisioning, but the same ideas are implemented for a tesla center panel modification.

4. Google Nest Thermostat - https://store.google.com/us/product/nest_thermostat?hl=en-US&pli=1

The google nest is a very practical use of a smart knob. Having a dial with a screen to display information is perfect for this kind of application because the main thing you do with a thermostat is twist the dial. This device also has a suite of other smart features, but it highlights its energy saving capabilities by perfectly tailoring your heating and cooling to your needs.

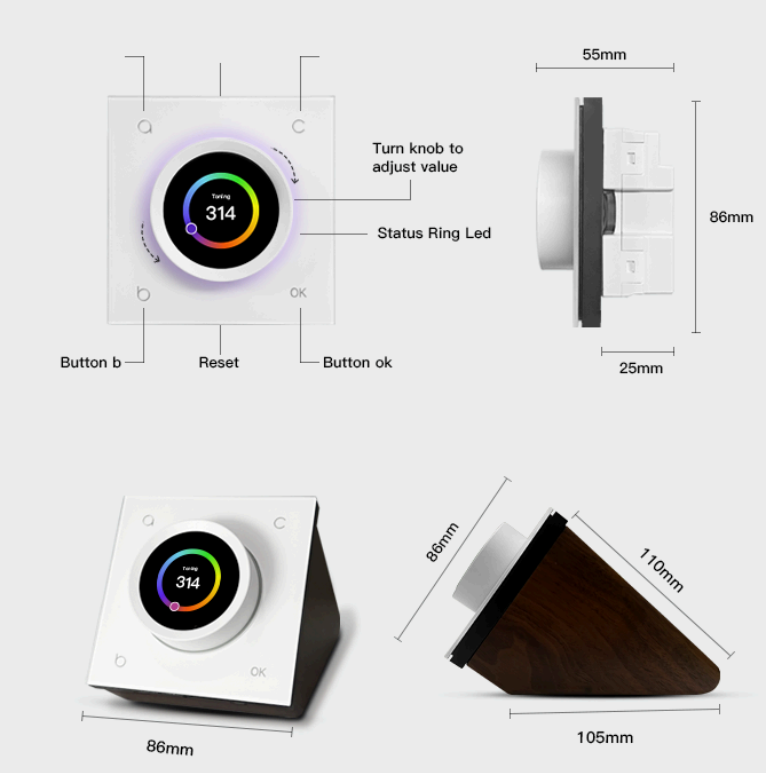
5. DROK USB Volume Control Knobs - https://www.amazon.com/DROK-Adjuster-Controller-Adjusting-Computer/dp/B016U2KXCG

This one keeps it super simple and does away with any and all smart features. I personally don't plan on making anything like this, but it is a good device to show the desired functionality. The usb connection is a key feature, I am not sure if mine should be wireless or wired but the good old usb connection is a safe bet.

6. Ome Smart Knob 2.0 - https://www.omekitchen.com/products/ome-smart-knob

This one is a very interesting product that takes a completely different direction in creating a smart knob. This smart knob has automatic turning capabilities to allow a user to control their stove remotely. It is a very niche product, but I can see it being useful for making sure you turn off your stove when you leave for work or even heating water just before you get home.

7. G-Knob - https://www.kickstarter.com/projects/g-knob/g-knob-all-in-one-smart-knob-controller



Another smart knob tailored towards home system control and smart home use.

8. Yeelight Pro S Desktop Knob Switch - https://ifdesign.com/en/winner-ranking/project/yeelight-pro-s-desktop-knob-switch/617796

I really like this design. Judging from the website “iF Design” I don’t think this product actually exists yet but this is a proof of concept design that won reddot in 2024 as well. Personally I love the design idea with the sleek twist knob on top and the stand also functioning as a charge plate with the four connection points.

9. KNOB Numpad - https://www.yankodesign.com/2024/12/04/modular-numpad-concept-adds-some-teenage-engineering-industrial-aesthetic-to-your-workflow/

This one is knob adjacent because the main product is a number pad, but it is a fully modular system with a modular volume knob attached. I absolutely love modularity and the sleek aluminum design is definitely something to take note of. Again I think this one is just a proof of concept because each image was a render but if this kind of product was made it would be a perfect addition to my desktop system.

10. Colo PLAY Cyberpunk Desktop Controller - https://pressplayid.com/products/colo-play-cyberpunk-desktop-controller-desk-decoration?_pos=1&_sid=8a135b1fe&_ss=r

This is designed more for PC monitoring and macro controls, and I like how functional it is built with four dedicated buttons, a knob and small screen displaying information. I don't like the form factor, it seems a bit bulky for a desktop, but I can see the uses this one could have.

3. Project Ideation

For Ideation, we will use the SCAMPER process outlined in class and outlined at:
http://www.designorate.com/a-guide-to-the-scamper-t
Split into smaller groups of 3 people (4 if necessary). Identify your partners here:

PARTNER NAME: Oliver Hansen

PARTNER NAME: Todd Rylaarsdam

PARTNER NAME: Brennan Nichols

SUBSTITUTE

1. Substitute the electro–magnetic motor for a stepper motor
2. Substitute wireless connection to computer (Bluetooth)
3. Substitute Screen display for external wireless display
4. Substitute display for backlit ring for feedback
5. Substitute battery for PoE
6. Substitute stepped scrolling for smooth scroll support
7. Substitute top screen for curved screen panel around dial
8. Substitute top screen for screen on base of device
9. Substitute buttonless base for one with macros
10. Substitute physical buttons on the outside of the ring for prox sensors for virtual buttons
11. Substitute new hardware design for hacked thermostat device
12. Substitute flat screen for a holographic display
13. Substitute smooth dial for one with grip points around the outside
14. Substitute touchscreen for hand gesture detection
15. Substitute speaker for one of those under screen vibration speakers that LG uses

COMBINE

1. Combine USB and Power
2. Combine the encoder with the electromagnetic motor to read the amount turned
3. Combine with other modular devices to allow for expandability
4. Combine with other smart home device to make it more IoT
5. Combine with mouse and add a tracking sensor to bottom of dial to let you use it as a mouse
6. Combine with RGB leds to have colored backlit
7. Combine with Alexa to add ~~Bezos' nanny cam~~ smart home functionality
8. Combine with a digital motor, that could simulate the timer decreasing back to center (like an egg timer)
9. Combine internal speakers
10. Combine with bluetooth to become a mouse or scroller
11. Combine touchscreen and dial into a "virtual dial" on the touchscreen
12. Combine with joystick for 3D movement

13. Combine with pressure sensor for added input surface
14. Combine with a motorized controller for an actual dial on the back so it can interact with physical devices as well
15. Combine with Surface dial interface to be able to use it in digital art programs

ADAPT

1. Adapt into a 3D mouse
2. Adapt circular dial to allow for modular shapes
3. Adapt the electromagnetic motor to a rotary encoder
4. Adapt different profiles for different functions (ie gaming mode or music production mode)
5. Adapt a magnetic charge/usb connection so it can be easily converted into a portable device that bluetooth
6. Adapt the dial to be a game controller
7. Adapt the dial to be a driving wheel for video games or for those little motorized elderly scooters
8. Adapt the screen to be a touch display
9. Adapt to have a magnetic base to stick onto stuff
10. Adapt to be able to sync up with multiple of its brethren to expand functionality
11. Adapt it to be able to control infotainment in cars
12. Adapt it to be able to control your door lock and use as a smart lock
13. Adapt it to scroll through video editing timelines nicely
14. Adapt the dial to interface with a home theatre receiver for a nice volume dial
15. Adapt it to be a universal remote for TVs and AV receivers

MODIFY, MINIFY, or MAGNIFY

1. Modify the top screen to have a edge touch detection
2. Modify dial to be removable from base
3. Modify Base to include more button macros
4. Modify the resistance of the dial to be strong enough so that it can be used for physical therapy
5. Modify firmware to allow users to customize top screen
6. Minify the system to be 1 inch by 1 inch
7. Modify the dial to also include a joystick
8. Magnify the pixel density of the screen to be higher resolution
9. Magnify the dial size to match the average american's hand size best
10. Modify the enclosure to be IP67 resistant to allow for outdoor use for doors and such
11. Modify the colors on the screen to be color blind accessible
12. Modify the dial materials to be eco-friendly to offset the rare earth metals used in the production of the board and the very very well paid labor in China that created it
13. Modify dial to have buttons around the exterior for more controls
14. Modify the device to be able to
15. Modify the battery to be mag safe charging

PUT TO ANOTHER USE

1. Thermostat control system
2. Audio control

3. Scroll wheel
4. Versatile feedback based control
5. Use as a pole position control
6. Use to wirelessly control a slideshow
7. Smart lock for a door
8. Resistive fidget spinner
9. As a 3D mouse
10. Use to control motors in a project
11. Use to set oven temperature
12. Use to Dim Lights
13. Use as a macro in video games
14. Use as an alarm for studying
15. Use as a smart light controller

ELIMINATE OR ELABORATE

1. Remove the haptic feedback from the electromagnetic motor in favor of a mechanical ratchet
2. Remove the connection to a computer component to simplify
3. Remove the sound from the timer completion
4. Make the sound upon completion of the timer a piezo that plays a preprogrammed tone
5. Eliminate some of the 3d printed parts in favor of machined aluminum
6. Remove the screen on top and simplify features
7. Remove the rotary encoder and change for a free moving bearing
8. The idea behind the haptic feedback is to use an electromagnetic motor to provide physical resistance to motion in a programmable way.
9. High resolution HID scrolling is a must for this, so any low resolution sensor like a rotary encoder needs to be removed
10. Eliminate electromagnetic motor and haptic system in favor of absolute position IC with a free spinning wheel
11. eliminate screen on scroll wheel in favor of small display on base
12. eliminate base and have the scroll knob form the entire device with a hidden static base
13. make the screen section of the dial static while a thin ring around the main dial piece is what really twists
14. Make a clear housing to “eliminate” the visual barrier between the electronics and the user
15. Eliminate motor with encoder in favor of the absolute position sensor

REVERSE

1. Make a app for your phone which is a dial that you can set times with
2. Have the alarm be going off constantly while a time is not set
3. reverse the direction of the dial and have housing come up around the dial
4. Start with a rapid prototype on a breadboard before any set design is made. Try several different methods before settling on the best one and designing a body for it
5. Maybe make a dial that is set into a desk
6. invert the dial and embed the screen further into the dial

7. rotate the entire dial to be laterally turning like a mouse
8. remove the charging port in favor of a charger base with contacts
9. remove the charge port in favor of induction based wireless charging
10. rearrange the components to make a super flat scroll wheel
11. move the motors haptic feedback to the edges of the dial for better feedback
12. maybe shrink the dial and add more buttons for a more versatile design
13. working off the shrunken dial, the screen could be moved down and the buttons below control certain functions
14. rearrange the leds to form a ring around the base
15. place the leds in a ring around the top of the dial right by the screen

4. Project Valuation

PROJECT TITLE: Smart Dial
PROJECT DESCRIPTION:
The smart dial is a haptic feedback twisting dial with a screen to connect to a computer system or operate fully standalone. The dial will have wireless and wired capabilities, and power on a lithium battery set into the base. It will be freely spinning on a bearing and also include a vibration motor to provide haptic feedback. The functionality is customizable, but it will include alarm features, computer support for scrolling and browsing documents, and macro functionality to skip songs or adjust volume settings. The embedded system will connect either an ESP32 or Photon 2 microcontroller to the power management circuits, motor control modules, screen drivers, and the core functionality of a 14-Bit On-Axis Magnetic Rotary Position Sensor (AS5047P). This IC is going to be a key feature, because it will allow for high resolution tracking of the rotation of the dial. The device is going to be designed to interface like a HID (Human Interface Device) such that a PC will pair via bluetooth and treat it like a scroll wheel, volume knob, etc depending on the setting.
The key physical features of this device are the vibration motors and bearings which allow for a smooth scrolling experience, yet provide enough haptic feedback to feel each tick of scrolling. The screen will sit at the top of the dial and provide the visual feedback that allows the user to use the device fully standalone without a computer.
The design is still a work in progress, and some implementation details are still being worked out. One such detail is the screen. At the top of the dial there is going to be a small display, that may be touch based, but likely not. If it isn't, a couple buttons might be added into the base to allow for a user to actually control the device without a computer. Another design change would be to configure the dial to be a button itself and allow the user to press the entire dial down to engage a small tactile button. Another optional feature would be a small led ring around the base of the dial to indicate timers or the position of the dial.

CUSTOMER JOBS

1. What is the one thing that your customer couldn’t live without accomplishing? What are the stepping stones that could help your customer achieve this key job?

Scrolling a mouse. They could buy a mouse.

2. What are the different contexts that your customers might be in? How do their activities and goals change depending on these different contexts?

I am guessing my customers are working on the computer, but the specific task they are doing could vary vastly.

3. What does your customer need to accomplish that involves interaction with others?

NA

4. What tasks are your customers trying to perform in their work or personal life? What functional problems are your customers trying to solve?

Mostly the issues with a mouse scroll wheel or productivity difficulty while at your desk.

5. Are there problems that you think customers have that they may not even be aware of?

I would guess that most workers don't realize how bad their scrolling experience is until they use something that is high resolution and well built.

6. What emotional needs are your customers trying to satisfy? What jobs, if completed, would give the user a sense of self-satisfaction?

Mostly the end user should feel a better sense of integration with their work while they focus in. Scrolling docs, controlling audio, or setting focus timers should be able to integrate into their workflow.

7. How does your customer want to be perceived by others? What can your customer do to help themselves be perceived this way?

NA

8. How does your customer want to feel? What does your customer need to do to feel this way?

Good? NA

9. Track your customer's interaction with a product or service throughout its lifespan. What supporting jobs surface throughout this life cycle? Does the user switch roles throughout this process?

NA

CUSTOMER PAINS

1. How do your customers define too costly? Takes a lot of time, costs too much money, or requires substantial efforts?

The customer I am trying to isolate feels like the current scrolling solutions are time consuming and inefficient. They also probably find using their phone to set focus timers to be distracting and wants a standalone solution.

2. What makes your customers feel bad? What are their frustrations, annoyances, or things that give them a headache?

Similar to Q1, bad mice while trying to read through documents or work on CAD.

3. How are current value propositions under performing for your customers? Which features are they missing? Are there performance issues that annoy them or malfunctions they cite?

NA

4. What are the main difficulties and challenges your customers encounter? Do they understand how things work, have difficulties getting certain things done, or resist particular jobs for specific reasons?

NA

5. What negative social consequences do your customers encounter or fear? Are they afraid of a loss of face, power, trust, or status?

No this product doesn't pertain to that at all.

6. What risks do your customers fear? Are they afraid of financial, social, or technical risks, or are they asking themselves what could go wrong?

I think they mostly fear a loss of productivity, either because of the whole scrolling thing or focus. The device is also mainly designed for myself, so those are two of my fears while at my desk getting work done.

7. What's keeping your customers awake at night? What are their big issues, concerns, and worries?

NA

8. What common mistakes do your customers make? Are they using a solution the wrong way?

Using a trackpad while getting work done! You can't be doing that when doing STEM work.

9. What barriers are keeping your customers from adopting a value proposition? Are there upfront investment costs, a steep learning curve, or other obstacles preventing adoption?

Probably a user would have to want this product because they would need to integrate it into their current workflow.

CUSTOMER GAINS

1. Which savings would make your customers happy? Which savings in terms of time, money, and effort would they value?

Saving Time is the biggest benefit for this customer.

2. What quality levels do they expect, and what would they wish for more or less of?

I am assuming the only way a customer would adopt this product is if the scrolling experience is smooth and works perfectly. If the device is not easy to set up and use it won't be viable.

3. How do current value propositions delight your customers? Which specific features do they enjoy? What performance and quality do they expect?

NA

4. What would make your customers' jobs or lives easier? Could there be a flatter learning curve, more services, or lower costs of ownership?

I am hoping that there is no learning curve for my product, and it is so intuitive they don't even need a manual.

5. What positive social consequences do your customers desire? What makes them look good? What increases their power or their status?

NA, what even are the questions??

6. What are customers looking for most? Are they searching for good design, guarantees, specific or more features?

This customer is looking for a good design that guarantees a good scrolling experience with extra smart features.

7. What do customers dream about? What do they aspire to achieve, or what would be a big relief to them?

They probably dream of higher productivity and fall asleep counting employees.

8. How do your customers measure success and failure? How do they gauge performance or cost?

I guess this is subjective, but if they can work an entire work day without noticing something off with their scrolling while going through documents I think that would be a success.

9. What would increase your customers' likelihood of adopting a value proposition? Do they desire lower cost, less investment, lower risk, or better quality?

Better quality products will likely be the deciding factor for most users. And of course lower cost would alway play a factor.

PAIN RELIEVERS

1. Could your products and services produce savings? In terms of time, money, or efforts

Yes. I think time would be saved, and in industry that also means money.

2. Could your products and services make your customers feel better? By killing frustrations, annoyances, and other things that give customers a headache

Yes, I think this would eliminate some specific frustrations they might be having.

3. Could your products and services fix under-performing solutions? By introducing new features, better performance, or enhanced quality

I think this will be a fix for underperforming mice with sub par scroll wheels.

4. Could your products and services put an end to difficulties and challenges your customers encounter? By making things easier or eliminating obstacles.

Yes, this is a repeat of Q3.

5. Could your products and services wipe out negative social consequences your customers encounter or fear? In terms of loss of face or lost power, trust, or status.

NA, what?

6. Could your products and services eliminate risks your customers fear? In terms of financial, social, technical risks, or things that could potentially go wrong.

NA

7. Could your products and services help your customers better sleep at night? By addressing significant issues, diminishing concerns, or eliminating worries.

No, this product isn't going to reinvent the wheel.

8. Could your products and services limit or eradicate common mistakes customers make? By helping them use a solution the right way.

I think so, it's hard to tell the specific effect, but I think it will lower the number of erroneous inputs the user makes to their PC.

9. Could your products and services eliminate barriers that are keeping your customer from adopting value propositions? Introducing lower or no upfront investment costs, a flatter learning curve, or eliminating other obstacles preventing adoption.

I would hope this value proposition will lower the learning curve for my product.

GAIN CREATORS

1. Could your products and services create savings that please your customers? In terms of time, money, and effort

I swear I've answered this like 3 times, but yes it should save time.

2. Could your products and services produce outcomes your customers expect or that exceed their expectations? By offering quality levels, more of something,or less of something.

The hope is to surprise the end user with how useful this device can be, and how many features it is supporting.

3. Could your products and services outperform current value propositions and delight your customers? Regarding specific features, performance, or quality.

I think some of the features and quality of the device would beat some other value propositions within the same product category. That is the hope at least

4. Could your products and services make your customers' work or life easier? Via better usability, accessibility, more services, or lower cost of ownership.

Hopefully this will make the customer's work easier via better usability of their PC, which is the most common thing to be using at work these days.

5. Could your products and services create positive social consequences? By making them look good or producing an increase in power or status.

INCREASE POWER, their status and power will be unmatched when they use my product!

6. Could your products and services do something specific that customers are looking for? In terms of good design, guarantees, or specific or more features.

This product is very specific, so it is tailored for a specific customer that has this kind of need.

7. Could your products and services fulfill a desire customers dream about? By helping them achieve their aspirations or getting relief from a hardship?

It would relieve them from the hardship of a bad document scrolling experience.

8. Could your products and services produce positive outcomes matching your customers' success and failure criteria? In terms of better performance or lower cost.

I think the cost to performance ratio for this device will be favorable to the customer.

9. Could your products and services help make adoption easier? Through lower cost, fewer investments, lower risk, better quality, improved performance, or better design.

I think the low risk nature of this product will make it very easy to adopt. If the customer doesn’t like it there isn't any harm done.

5. Final Project Statement

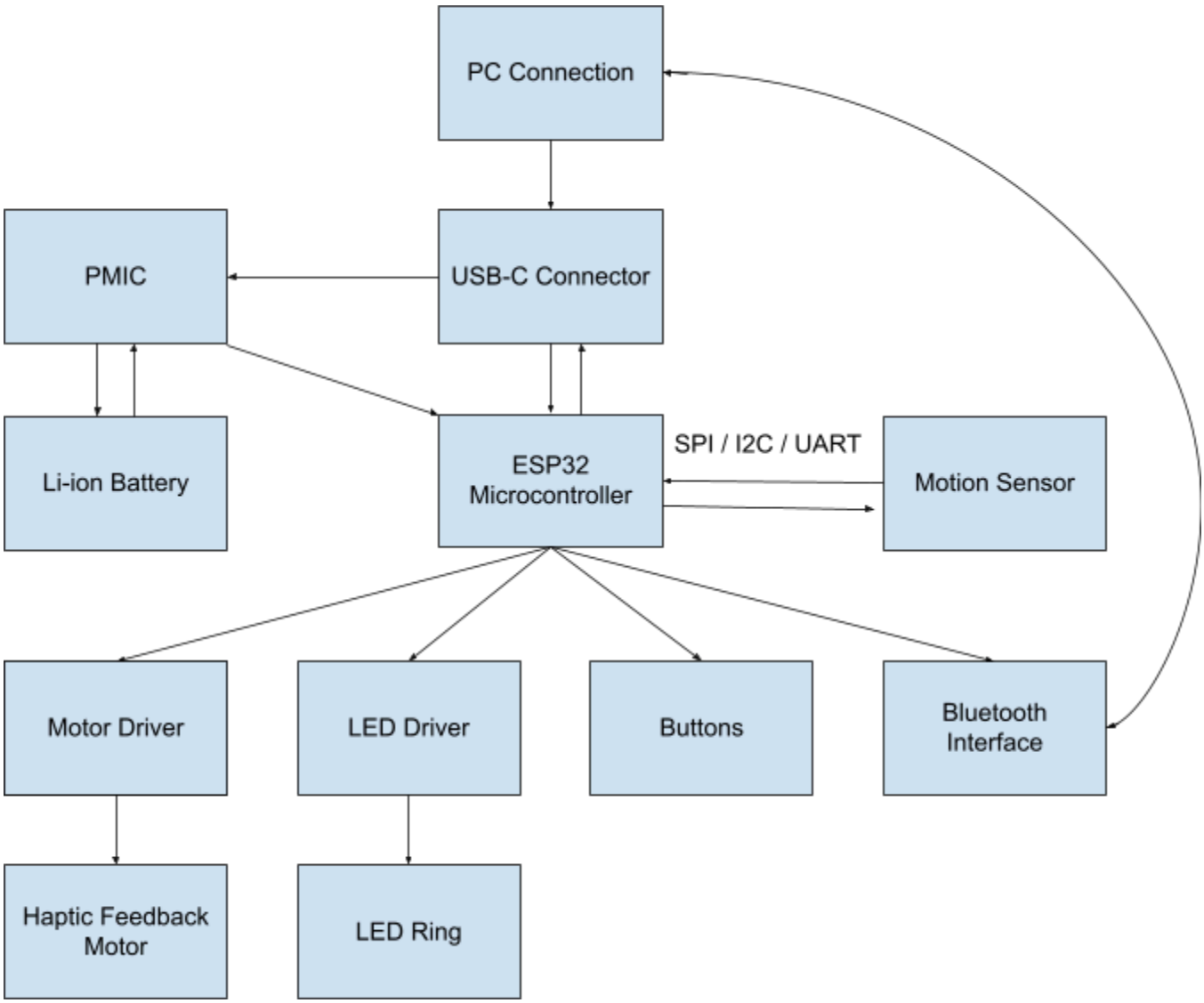
PROJECT TITLE: Haptic Smart Dial
PROJECT DESCRIPTION:
The smart dial is a haptic feedback twisting dial with a screen to connect to a computer system or operate fully standalone. The dial will have wireless and wired capabilities, and power on a lithium battery set into the base. It will be freely spinning on a bearing and also include a vibration motor to provide haptic feedback. The functionality is customizable, but it will include alarm features, computer support for scrolling and browsing documents, and macro functionality to skip songs or adjust volume settings. The embedded system will connect either an ESP32 or Photon 2 microcontroller to the power management circuits, motor control modules, screen drivers, and the core functionality of a 14-Bit On-Axis Magnetic Rotary Position Sensor (AS5047P). This IC is going to be a key feature, because it will allow for high resolution tracking of the rotation of the dial. The device is going to be designed to interface like a HID (Human Interface Device) such that a PC will pair via bluetooth and treat it like a scroll wheel, volume knob, etc depending on the setting.
The key physical features of this device are the high torque 3-phase motor which provides programmable feedback of the turning motion. An LED ring at the top will provide some visual feedback of where the dial is currently engaged to.
The design is still a work in progress, and some implementation details are still being worked out. A couple buttons might be added into the base to allow for a user to actually control the device without a computer. Another design change would be to configure the dial to be a button itself and allow the user to press the entire dial down to engage a small tactile button.

This product will cater to any technical employee who is not satisfied with the current commercial scrolling solutions available. Whether they have to comb through large PDF documents or datasheets daily, or are looking for a standalone study/productivity solution for their desk this product will hopefully provide all of the functionality and easy integration they are looking for.
What sets this product apart from other models is the numerous specific “quality of life” features that are going to be included in the final product. There are lots of good digital scrolling solutions, with the most obvious being the mouse scroll wheel. Logitech released a mouse line that has a freely spinning mode on a bearing that allows for very quick and easy scrolling. Commercial products are also available for CAD work with additional programmable buttons. This product will find the niche middle ground between the two of these products. It will be intuitive to use, easy to integrate into the customer’s existing work environment, and have just enough extra features to make it a one of a kind addition to their workflow.
The additional features that I think will make this product stand out is the standalone mode, touch response, and HID compatibility features. All the solutions I’ve seen have had one or maybe two of these features, but I have yet to find a product that integrates all three into one desktop device. There are lots more features that could be described in detail, but they all fall into one of these three categories .

6. Housing/Test Environment

The fundamentals of this device can be tested on a breadboard with an ESP32 hooked up and wired out to different sensors, power management circuitry, and motors with motor drivers. Everything can be statically designed and programmed without a housing except for one thing. The motion sensor has some very specific design considerations that need to be tested and programmed before it can be used in the final housing. I will need to make a protoboard fit on a bearing assembly and figure out how to wire a spinning thing so that I can test and program the position sensor. My best solution is to ensure that the housing will hold the entire PCB and have all of the components spinning. The USB - C connection and battery charging assembly cannot spin, obviously, so my idea for a solution is to use a slip ring cable to allow for the cables to turn. Something like this will do the trick I think https://www.adafruit.com/product/775. The final assembly is going to be a PLA or PETG print almost entirely except for a slot for the bearing and slip ring to connect the two halves of the product, static and dynamic.

7. Block Diagram



8. Application Programming Interface (API)

This API is walking through what I might add as high level main function calls. It does not get into the driver's or data protocols that are actually going to be required to interface with the hardware. Is it comprehensive? No, but it should provide a good starting point for developing the firmware.

1. `uint16_t Read_Rotation();`

   Reads the current position of the 12 bit absolute position sensor.

2. `void spin_motor();`

   Enables the motor driver to engage the small vibration motor.

3. `bool read_button();`

   Reads whether a button is pressed. Debouncing will be done in the driver module.

4. `void print_to_screen(lots of data in parameters);`

   There's going to be some display driver interaction abstracted up to be a simple call to print with some data passed in.

5. `void enable_bluetooth();`

   Apt Description

6. `void disable_bleutooth();`

   Apt Description

7. `void zero_motion_sensor();`

   I'm not entirely sure how the sensor works, but I bet it will need to be zeroed in firmware at one point or another.

8. `void enable_serial_interface();`

   if the USB PC connection is detected I might need to make some functions to switch between USB mode and Wireless.

9. `void disable_serial_interface();`

   If you know you know.

9. Bill of Materials (BOM) / Budget

Vendor	Vendor Part #	Description	Quantity	Price per unit	Total Cost	Weblink to item page
DigiKey	1965-ESP32-DEVKITC-32E-ND	ESP32-WROOM-32E - Transceiver; 802.11 b/g/n (Wi-Fi, WiFi, WLAN), Bluetooth® Smart Ready 4.x Dual Mode (BLE) 2.4GHz Evaluation Board	1	10	10	https://www.digikey.com/en/products/detail/espressif-systems/ESP32-DEVKITC-32E/12091810?s=N4IgTCBcDaIKIGUAKBmMBaAInAagQEkAVAYXTThAF0BfIA
SparkFun	ROB-20441	Three Phase Brushless Gimbal Stabilizer Motor	1	29.95	29.95	https://www.sparkfun.com/three-phase-brushless-gimbal-stabilizer-motor.html
Digikey	TMC6300-LA	LOW VOLTAGE BLDC MOTOR/PMSM DRIVER	1	3.66	3.66	https://www.digikey.com/en/products/detail/analog-devices-inc-maxim-integrated/TMC6300-LA/18693469
LCSC	C3003196	Hall Based Angle Position Encoder Sensor	1	2.17	2.17	https://www.lcsc.com/product-detail/Angle-Linear-Position-Sensors_Magn-Tek-MT6701CT-STD-R_C3003196.html
LCSC	C2890037	OPSCO Optoelectronics Smart RGB LEDS	50	0.07	3.50	https://www.lcsc.com/product-detail/RGB-LEDs-Built-in-IC_OPSCO-Optoelectronics-SK6812SIDE-A-RVS_C2890037.html

10. Journal

20250113 – First day of class. The professor inspired me to do my absolute best to make this project the greatest thing the world has ever seen. Man, I love this professor! I am so excited about this class! We introduced the general structure of the Embedded Systems class and while Dr. Spivey was talking I activated my Altium License

20250114 – First Lab. I mainly just worked on getting my Altium licence and then beginning the very lengthy tutorial for the Traffic light pcb.

20250115 – Lecture 2, spend several hours this evening working on the traffic light project.

20250116 - Not much in the way of embedded, I think I looked into some of the assignments due Friday and next week.

20250117 - Friday Lecture, I spent a good amount of time today working on the ideation section of this document and then worked on finalizing the pcb design.

20250121 - I went back through and updated my log for week one. Lab 2, I spent way too much time SCAMPERing around.

20250122 - I spend a little more time working on the SCAMPER section of this document

20250123 - I did some more research on my project idea, trying to find resources online and iron out some implementation details.

20250124 - I spent more time finishing the SCAMPER section and wrote out all of section 4. I also updated the journal.

20250126 - I spent an hour or so finishing the value proposition trigger questions, then I zipped up the Altium PCB and submitted that too.

20250127 - Monday Lecture, Began working on ESP8266 Shield

20250128 - Spent the entire lab working on the shield, didn't do more outside of lab

20250129 - Wednesday Lecture

20250131- Spend several hours working on the pcb layout and tracing, fixed an issue with my schematic

20250203 - Finalized the design and created fab outputs

20250204 - Updated the project documentation late, Finalized PCB Design for WIFI Shield. Added Logo and exported to Gerber Files.

20250205- Submitted Gerber Files to JLCPCB for fabrication, begun work on led shield (mainly just created Altium project)

20250206 - I didn't do much today on Embedded Systems

20250207 - I did some more work on the embedded Systems project document

20250208 - I completed the required sections of the embedded systems project document, also updated the journal. Began working on the schematic for the LED shield.

20250210 = finished schematic, began working on the layout

20250211 - spent all of lab working on the PCB layout and tracing, mostly finished

20250217 - Finalized PCB tracing / fixed some issues with the design. Also updated the Embedded Systems project documentation.

20250302- I got a little behind on the journals, but to sum it up I wrote a driver for the ESP8266 that could setup a local server and turn on an LED remotely then assemble the LED board and test it with some of Jack Sides code. I also have been working on the BOM, but I do not have everything finalized yet. I am hoping to have it all ready to order by Monday.

20250310- I've been working on catching up with the project design. I specifically have been trying to figure out how to power the entire board off of both USB-C and off a battery if the cable is disconnected. Most of the other ICs are sorted out, there's a motor driver, motion sensor, USB to serial chip, and LEDs with an integrated protocol for lighting. The display has a built-in SPI chip so it can be wired straight to the ESP32.