Smart Thermostat/Knob

Description

This smart knob offers precise control over various appliances using a smooth, 360-degree spinning knob and a push button. Its on-board Wi-Fi allows seamless integration with existing IoT ecosystems. For example, instead of directly managing your home's temperature, the knob can connect to smart thermostats like Ecobee to adjust settings. The device dynamically adapts its function based on the connected device. When plugged into a laptop, it controls elements like volume and brightness, while wall-plugged, it manages room lighting via Wi-Fi. If time allows, it will also feature either a desktop or mobile app to edit these settings and add a customized user experience. This will be done via Electron for a desktop application, or Expo for a mobile application. Electron allows traditional HTML, CSS, and Javascript to interface with a computer’s native API, while Expo allows for HTML, CSS, and React Native to run on iOS and Android devices.

The integrated display enhances the user experience by indicating the selected mode. When connected to a laptop, it could show the volume percentage. The display can also function as a standalone infotainment screen, displaying the time, weather, or other data. A 0.96-inch OLED module with 128x64 resolution, connected via I2C, will be used for graphics. Seeing as this screen is a rectangle shape, it will be essential for me to create a visually appealing bezel that shapes it into a circle and masks out its pcb. This will make the device look more like a knob, rather than a rectangle.

The project utilizes an Adafruit QT Py ESP32 Pico as the microcontroller, chosen for its built-in Wi-Fi, Bluetooth Classic + BLE, and ample GPIO pins. A KY-040 rotary encoder handles the knob's rotation, and a tactile push-button switch, located beneath the knob, provides another input method. Finally, a NeoPixel Ring (16 x RGB) will add an underglow effect, visually indicating specific settings. The Ring will have lights dynamically turned on or off to indicate a progress bar that is used for things like showing the user which direction they are turning in, or indicating the temperature.

Links & Resources

DIY Multifunctional control knob using Pi Pico

Hello, today I will show you how to built your own multifunctional knob using Raspberry Pi Pico board

The creator of this project demonstrates how it is possible to use a raspberry pi pico to control the brightness or volume of a computer. While this isn't using an Arduino, the concept is the same and it can easily be adapted to work with my ESP32 Pico. I will use this resource to learn how a rotary encoder is utilized and read from a microcontroller

DIY haptic input knob: BLDC motor + round LCD

Building a haptic input knob from scratch! - YouTube

SmartKnob View
Open source haptic input knob
https://github.com/scottbez1/smartknob

The creator of this project is very talented and was able to create a knob that has haptic touch feedback through motors. This is out of my expertise, however the creator shows their design process, as well as how the rotation piece works. Since I will be using a Rotary Encoder, I will not be implementing haptic feedback, which will make this much easier to replicate. My vision is to have a similar layout where the underglow is able to provide information, and the display tells the user what is happening. This video will teach me how to implement a beautiful user interface into a display.

(15) They Never Shipped, So I Built My Own Focus Dial from Scratch - YouTube

This device actually doesn't rotate, however the creator documents how they created a case for a knob, as well as using the same NeoPixel Ring to show progress. The creator tells us how they were able to design a case on a CAD software, prototype the circuit, as well as provide us with code for the display. I will use this resource to structure my design, as the way they stacked each component is very compact and user friendly.

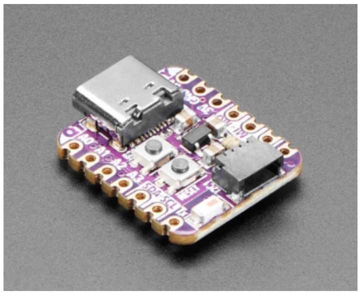
ecobee API

The thermostat in my home is from ecobee, and fortunately they have an API that is free to use and interface. I can use this to read and write temperatures to my house over wifi. This will allow the smart knob to change the temperature in my house.

Materials (Total Cost of ~ $55)

OLED Display
$12.99

This is what the user will see their info and configuration on
Adafruit QT Py ESP32 Pico
$14.95



This is the microcontroller that will be powering the smart knob

KY-040 Rotary Encoder

$9.99

This is what will allow the knob to rotate 360 degrees. The Rotary Encoder is how the smart knob will know which direction the user is rotating, as well as how much they have rotated.

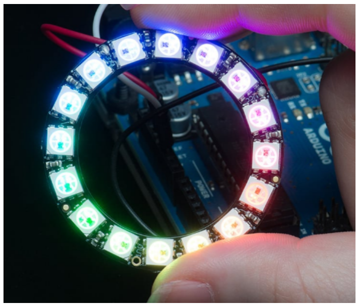
Tactile Push Button 20pcs

$5.99

This is what will give a click input to the knob. This will be utilized as a second input for conformation or mode switching.

NeoPixel Ring - 16 x 5050 RGB LED

$9.95



This will add underglow to the smart knob to make the aesthetics more pleasant, as well as show the direction that the knob is turning

Housing for the smart knob will be 3D Modeled then printed

Timeline

1) Obtain the parts either online or/and from the school’s collection of parts
2) Set up a breadboarded prototype that is able to utilize the rotary encoder to change volume on computer
3) Look into most efficient and compact way to package into a single device
4) Begin CADding the device
5) 3D Print Cad Files to house all electronics
6) Create the production code that has all features (working underglow, realtime info on OLED display)
7) Solder everything to microcontroller and begin building final product
8) If time remains, create a desktop / mobile UI to edit and manipulate the smart knob.