Arduino FM Radio

James R. Di Re   Abdulrahman Kikia   Claudio Scione

Initial Objectives

- Must be portable —------->
- Should support different bands of reception (FM, AM, Shortwave, etc.)
- Display information on an LCD
- Support presets (ex. 1, 2, 3, 4, 5)
- RDS (prints current song)
- Scanning
- Bluetooth compatibility (i.e. play audio from your phone)

Inspiration

- James's idea. Wanted to do something involving audio (MIDI controller, synthesizer, etc.).
- Decided on radio after watching many YouTube videos and visiting Instructables links
- Intuitive - can pick up signal anywhere, for free.
- Practical - can listen to music, news, talk shows, traffic report, etc.

Put some images of inspiration videos

Design and Planning

- Initial radio sketches
- Problems
    - Speaker wires kept disconnecting
    - Speakers hard to mount on box (no screw holes)
- Adding features gradually (first rotary encoder, then LCD, then radio module, then amplifier and speaker)
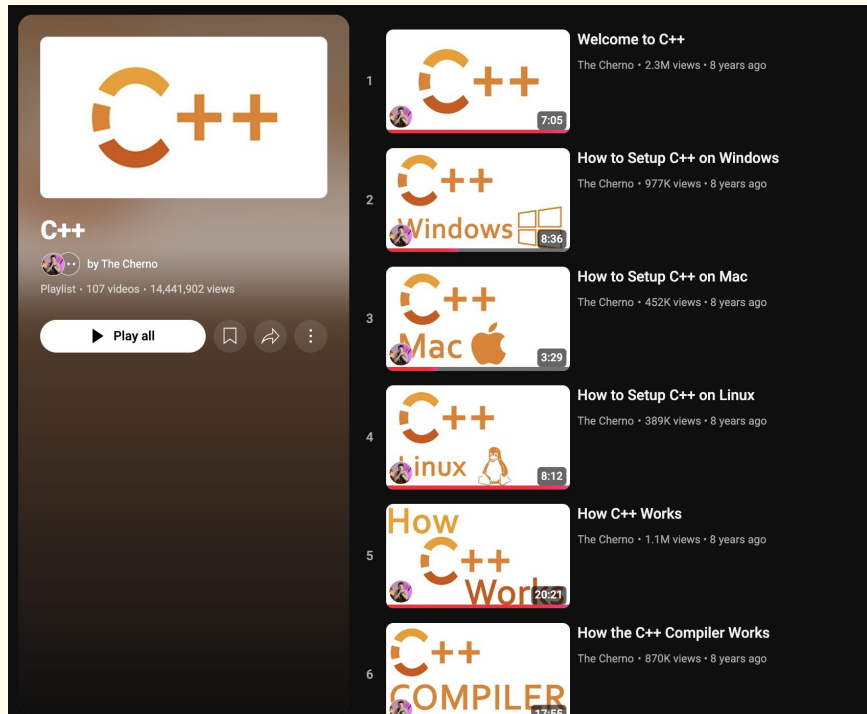- Cardboard prototype

Hardware Setup

List hardware

Put some of the in-progress images here

Put some diagram here for the circuit

<!-- Code -->

- Already had some prior knowledge of CPP from this tutorial series ————————>
- Made writing the radio code simpler
- However, this was the first time putting that knowledge into practice

```
hd44780_I2Cexp lcd;

FrequencyType type = AM;
int frequency = 977;
// int amFrequency = 800;
int lastFrequency;

volatile int lastClkState = LOW;
volatile int count;
int lastCount;

void setup() {
  Serial.begin(9600);

  pinMode(PIN_CLK, INPUT);
  pinMode(PIN_DT, INPUT);

  attachInterrupt(digitalPinToInterrupt(PIN_CLK), pollRotaryEncoder, CHANGE);

  int status = lcd.begin(16, 2);
  if (status) {
    hd44780::fatalError(status);
  }
}

void loop() {
  delay(100);

  UpdateCurrentFrequency();

  if (frequency != lastFrequency) {
    lastFrequency = frequency;

    PrintStationData();
  }

  Serial.print("Count: ");
  Serial.println(count);
}

void UpdateCurrentFrequency() {
  int currentCount = count;

  if (currentCount != lastCount) {
    int delta = currentCount - lastCount;

    if (type == FM) {
      frequency += delta * 2;
```

First code iteration:
Only LCD display
functionality

Later code iteration: separated into six files!
Reasons: Scalability, more control, more organized

`main.cpp` -
Entry point of the program. Contains `setup()` and `loop()` functions

`RadioHeaders.h` -
Header file for all the following classes. Contains variables and function declarations. All other files `#include` this

`class RadioHandler { }` -
General class for managing many of the properties of the radio. Manages current station, states, etc

`class RadioInput { }` -
Handles functionality for the rotary encoder and the joystick

`class RadioDisplay { }` -
Handles everything to do with displaying information on the LCD screen, including methods for printing text

`class RadioModule { }` -
Handles communicating with the radio module and tuning to stations.

The switch to Visual Studio Code

- Allowed for easy version control
- Underlines errors and points out flaws in the code
- Easy refactoring tools
- Easy way to see project structure
- Extension used:

Libraries Used

- hd44780 by Bill Perry. LCD library. Includes functions like `setCursor(0, 0)`, `print("")`, `clear()`
- RotaryEncoder by Matthias Hertel. Includes functions like `tick()` and `getDirection()`
- Also used code provided in the description of a YouTube video by Kevin Darrah, for tuning with the TEA5767 FM radio module
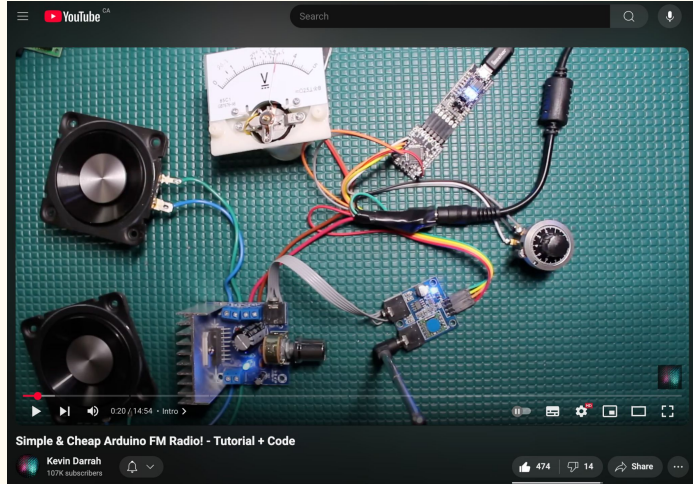


```
void setFrequency(float frequency)
{

    //Code from: http://playground.arduino.cc/Main/TEA5767Radio
    //Datasheet: https://www.sparkfun.com/datasheets/Wireless/General/TEA5767.pdf

    unsigned int frequencyB = 4 * (frequency * 1000000 + 225000) / 32768;
    // this is from the datasheet

    byte frequencyH = frequencyB >> 8;//shift over to get the high byte
    byte frequencyL = frequencyB & 0XFF;//cut off the top to get the LOW
    Wire.beginTransmission(0x60);//start talking to the radio
    Wire.write(frequencyH);//1st
    Wire.write(frequencyL);//2nd
    Wire.write(0xB0);//3rd
    Wire.write(0x12);//4th
    Wire.write(0x00);//5th
    Wire.endTransmission();
    delay(100);
}
```

Initial Design for the box

Had to be changed to make the assembly possible

Put the results/successes here !!!
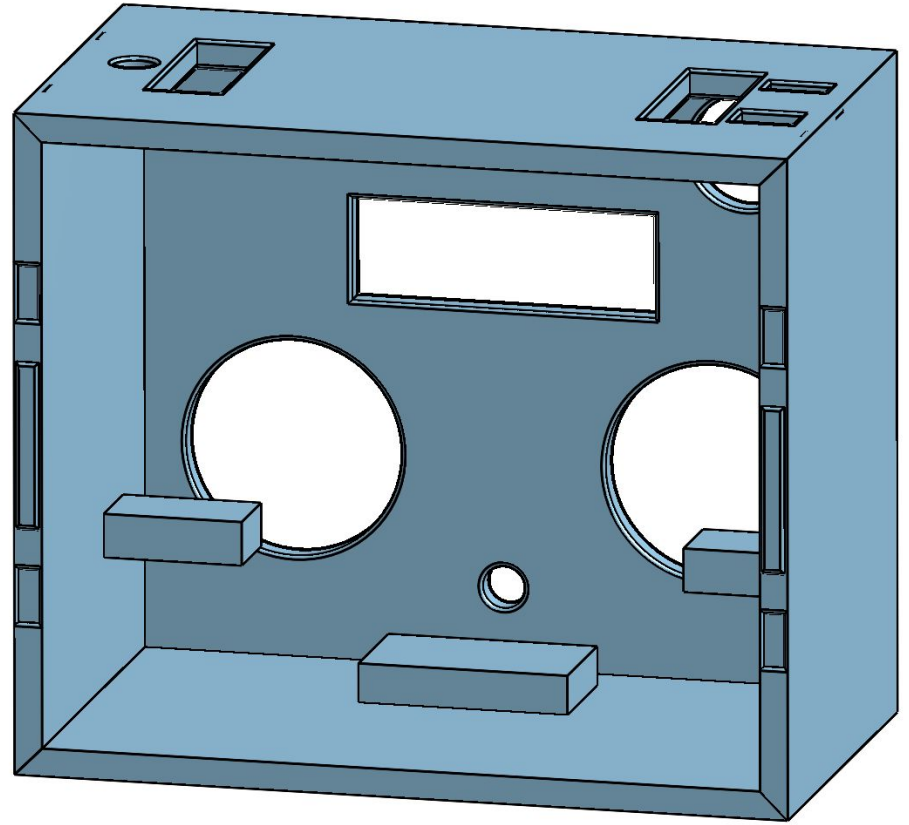
Persisting Issues:
- Interference noise caused by the LCD screen updating and joystick movement
- Joystick messing up the 1^2C communication lines. Causes code freeze ups. (Isolated problem by removing joystick code and changing station every 1 second)

Lacking Features:
- Only FM support. Plans to try out different (more low-level, complicated) radio module, but no time
- No Bluetooth connectivity
- No RDS, scanning, bluetooth support

Discussion and conclusion ?

https://www.shutterstock.com/search/time-running-out

https://en.m.wikipedia.org/wiki/File:Visual_Studio_Code_1.35_icon.svg

https://commons.wikimedia.org/wiki/File:PlatformIO_logo.svg

https://www.amazon.ca/PRUNUS-J120-Shortwave-Rechargeable-Playing%E3%80%902023/dp/B0BMT86PBV