**Graduation Project Report**

* Choose MCU that have audio peripherals like I2S, SAI, DAC
* Chose STM32F446RC & Ordered it online
* Getting started with STM32F4xxxx MCU hardware development to develop it’s custom breakout board.
  + Started designing MCU PCB breakout board using EAGLE with the standards of ARM cortex power supply guidelines
  + Searched for a place can print our PCB Design
  + Actually this step was little tough and ended up having our custom designed PCB breakout board which we can make nearly to all STM32F4 family which was a great success.
  + Soldered and tested our MCU
* Getting started with MEMS (MicroElectrical-Mechanical System) microphone
  + Designed a test double layer PCB board for MP34DT06J
  + Why MEMS was chosen
    - MEMS microphone is alike condenser microphone which is typical has higher gain
    - The market for MEMS microphones has been growing rapidly in recent years for a variety of applications, primarily mobile devices, but also other products such as **hearing aids**, Bluetooth headsets
    - It’s compact size
    - Using traditional Electret Microphones needs analog amplifying circuit which usually have a lot of noise
  + Soldered an tested the microphone ( the soldering was a little headache because the Mic pins were capsulated and surrounded with a ground ring
* Sound acquisition through I2S peripheral using MEMS microphone which is a digital microphone output the audio signal in the form of digital signal called PDM (pulse density modulation)
* Captured PDM signal from MEMS microphone with I2S and DMA then pass it PDMtoPCM library where decimation happen
  + PCM (pulse code modulation) is a digital representation for our audio signal
* Passing PCM signal to DAC

**What’s next:**

* Digital Filters (the core of our project) to manipulate frequency ranges gain, chosen Digital Filters will occur in the MCU according to user desire
* Simple mobile app to choose the desired gain for a specific frequency range (typically like an equalizer)
  + Mobile app will communicate with MCU through Bluetooth Module connected to MCU with SPP (Serial Port Profile)
  + Mobile app will be mostly done in one day work
* Send audio signal over Bluetooth to a Bluetooth speaker using Advanced Audio Distribution Profile (A2DP), we chose RN52SRC to do that and **still waiting DR Heba approval** to be able to order it online