

FALCON

Design Review I

EE 41440-01

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1. Introduction

This project aims to design and build an electronic rig that will be attached to a falcon, which will fly around swarming colonies of Mexican free-tailed bats to collect data on the bats' communication and flight patterns. The electronic package will house an ultrasonic microphone, along with means to store and process the data recorded by the microphone.

2. System Requirements

Ultimately, the final package's weight should be on the order of 20-30 grams, and be attached to the falcon via a training harness. The final board will be divided into two connected parts: a smaller unit containing the microphone located on the falcon's head, and a larger unit containing the microcontroller, storage device, battery, and other accessory components located on the falcon's back. The combined area of the boards should be no larger than 1"x1.5". The rig should also be rugged enough to handle jostling from colliding bats, movement of the falcon itself, and other environmental factors.

A PIC32 microcontroller will be used to process the incoming data from the microphone and store it in a microSD card, and all systems will be powered by an on-board battery. More specifically, the ultrasonic microphone must be able to measure a range of frequencies from 15kHz to 100kHz with amplitudes of up to 120dB. The aim is to sample audio at ~200kHz, using Automatic Gain Control (AGC) or a tunable amplifier to provide adjustable gain. The entire system must be powered by a battery that can accommodate for up to a half hour of use.

Within the system, the microphone will output an analog signal of the recorded audio to the PIC32 microcontroller, where it will be processed and converted to digital data. This data will then be dumped in the microSD card, possibly in the form of a .csv file.

3. Descriptions of Subsystems

There will be several subsystems making up the final project, each of which will be detailed in this section.

3.1 Microphone

As was described above, the microphone will record a range of ultrasonic frequencies between 10kHz and 100kHz with amplitudes up to 120dB. The part itself is called the “Mini SiSonic Ultrasonic Acoustic Sensor,” developed by Knowles Acoustics, and will output an analog signal of varying voltages representing the different frequencies it records.

We demonstrate its functionality by measuring its output waveform and comparing the similarities it has with the original audio signal recorded by the microphone.

Furthermore, none of the other systems work properly unless the microphone does, so we can assert that it functions correctly.

3.2 ADC Data Collection

To store the audio signal in the microSD card, it must first be converted to digital data in 8-bit representation by the PIC32MX270U microcontroller. This is done by sampling the signal at a rate of ~200kHz, and converting the given float-type numbers into char-type values as the microphone continues to record audio.

We demonstrate this functionality by assuming that the microSD card would have gibberish written in it unless the ADC data collection worked properly. Because the SD card contains the data we expect it to have, we assert that the ADC functions as planned.

3.3 microSD Card Data Writing

Digital data is written into the microSD via the SPI protocol.

PIC ←SPI→SD

PIC←UART→just for testing

Computer →USB →CHIP →UART→MICROCONTROLLER