wDAQ: Design (Part 1)

TEAM 19: LISA, ADAM, HENRY, VAUGHN

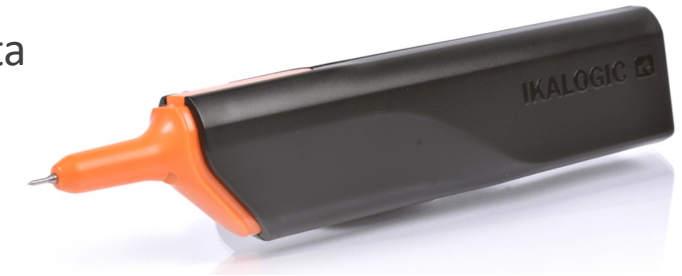
CLIENT: AVISHEK DAS

FACULTY ADVISOR: PROF. MANOJIT PRAMANIK

Project Overview

Project: Wireless Data Acquisition (wDAQ) system to capture/transmit high-frequency analog signals to a device in real time using Wi-Fi technology

- The DAQ will amplify a 1 mV analog input signal to approximately 1-2 V before digitizing it
  - ADC will have a 12-bit resolution
- Wi-Fi will be used to wirelessly transmit signals to a computer
  - Bluetooth can be used for signal transmission, but has a significantly lower data transfer rate than Wi-Fi
- The DAQ will be fabricated on a small PCB with surface-mount components
- A graphical user interface (GUI), written in LabVIEW, will be used to analyze data



Ideation

Our team created a Lotus Blossom in Figma with eight of our device's key needs

- Amplification and Filtering of Input Signal
- High-Speed Data Processing
- Graphical User Interface (GUI) Software
- Wireless Data Communication
- Analog-to-Digital Conversion (ADC)
- Wireless Power Supply
- Printed Circuit Boards (PCBs)
- Photoacoustic Tomography (PAT) System Application

The image on the right shows the layout of the Lotus Blossom, with each color representing a different one of the eight "needs" and additional notes corresponding to each need

Ideation

For each central need, we formulated four to eight different relevant needs, issues, or ideas

- **Amplification and Filtering:** High gain (amplification factor), low signal degradation, fast operating speed, and implementation on a small IC chip
- **High-Speed Data Processing:** Capture inputs at a high frequency, convert between parallel and serial data, and interface between the ADC and MCU (microcontroller)
- **GUI:** Accessible LabVIEW program for users of multiple skill levels
- **Wireless Communication:** Seamless laptop connectivity and high-speed data transfer
- **ADC:** 12-bit resolution with differential inputs at 100M samples per second
- **Power Supply:** Wireless technology that can be charged quickly
- **PCBs:** Header pins and SMA-type ports (for connections)
- **PAT System:** 10 to 20 copies of our device in a rotating configuration

Potential Solution

Promising solution that meets our requirements: Wi-Fi connected device with rechargeable battery power supply and low-noise amplifier technology

- Using Wi-Fi to wirelessly connect to software, we can transmit data at over 100 Megabits per second
  - Bluetooth has a much slower data transfer rate
- Rechargeable battery is a cheap and compact wireless power source
  - Lithium-ion, NiMH (Nickel-metal hydride), and NiCd (Nickel Cadmium) are all good rechargeable battery options
  - The battery could be charged externally or within the device with a USB-C charging connection
- Low-noise amplifier ensures we will meet our amplification & filtering requirements
  - High gain (amplification by a factor of 1000)
  - High frequency range (compatible with our radio frequency applications)
  - Minimal degradation of signal-to-noise ratio (SNR) - how clean the signal appears

Market Research: IkaLogic

Similar Product: IkaScope WS200

- Connects wirelessly to computers and mobile devices to display signals
- Wi-Fi connected
- Battery lasts up to a week between charges
- Similar specifications to our design
- Priced at around 250 USD

IkaLogic partners with major distributors (like DigiKey) to distribute products

Small size of company (less than ten employees) limits the scope of its operations

Market Research: Digilent

Similar Product: Analog Discovery 3

- Data Acquisition system that connects to computers via USB Type-C
- Currently used by some ISU ECpE labs
- Can also be used to generate signals and waveforms
- Compatible with MATLAB, LabVIEW, and NI WaveForms app
- Priced at $379.00

Owned by National Instruments (NI), a multinational hardware & software company

Devices are compatible with most new and existing technologies

Offers discounts for academic and university users

Market Research: Pokit

Similar Product: Pokit Pro

- Uses Bluetooth to connect to software
- Powered by USB-C rechargeable battery
- Bandwidth is limited to 200 kHz
- Sampling rate and input specifications are like our device

Company has other products on the market, including a more compact version of Pokit Pro

Limited bandwidth of DAQ device makes it useless for RF (radio frequency) applications

Bluetooth connection has a much slower data transfer rate than Wi-Fi (our choice)

Conclusions

By visualizing our needs with a Lotus Blossom Diagram and narrowing down our ideas to formulate a potential solution, we have a clearer idea of what to expect for the project

By performing market research and analyzing the pros & cons of different companies offering similar products, we can understand the areas where we excel or fall behind competitors

- Some of the companies specialize in one or two products, while others are more versatile
- The products offered by the companies differ widely in price point
- We can incorporate many existing technologies from these devices as well as create new ones
- We can strive to improve on things like battery life, speed, and accuracy with our product
- By using widely available resources, we can create a more accessible and economical device