Programmable Wireless Sensor Package for CprE Students

Group: May 1624
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Meet the Team

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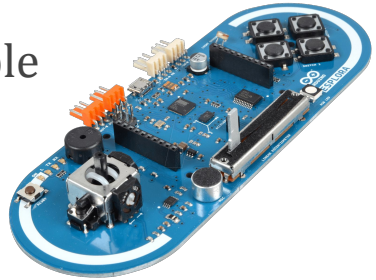
Presentation Overview

1. **Project Plan**
    a. Problem Statement
    b. Scope
    c. Budget
    d. Requirements
    e. Deliverables
    f. Schedule
2. **Design**
    a. Final Component List
    b. PCB Diagram
    c. Testing
3. **Final Steps**
    a. Demo
    b. Questions

Project Plan

Problem Statement

- CprE 185 lab teaching tools are currently outdated and unreliable
  - Nintendo Wii Controller
  - Arduino Esplora Gamepad



- Design a new wireless sensor “controller” that can be used in beginner-level programming lab classes (CprE 185, EE 285) for engineering students

Initial Scope

- Produce approximately 30 controllers
- Design comprehensive software suite
- Create in depth instruction manual for controller setup and installation
- Create comprehensive API instruction guide
- Create hardware specification guide

Technical Challenge - Components

Challenge

- PCB contains many different types of sensors and components
- Each component has varying levels of documentation
- Very time consuming to add each part to the PCB design

How we overcame this challenge

- Read through components' documentation
- Breadboarded out components individually

Refined Scope

Due to unforeseen time delays from PCB component testing:

- Scope has changed into a proof-of-concept project
- Board prototype will be submitted
- Basic interfacing software between controller and lab computer should be completed
- Comprehensive documentation should be created for future project leaders
- Brian Gillenwater will be developing new labs for CprE 185 utilizing controller

Budget

- Maximum $250/controller
  - Sensors
  - PCB
  - Case
  - Batteries
  - Intel Edison
  - Miscellaneous

- Budget should include PCB production cost

Hardware Requirements

- Must be able to communicate wirelessly via Bluetooth
- Must survive on battery power for at least 4 hours on a single charge
- Must be able to turn off controller
- Must include these sensors/components:
  - Accelerometer
  - Joystick
  - Buttons
  - Audio input/output

Software Requirements

- Sensor data must be easily accessible
- Bluetooth communication must be simplified on both sides
- Programmers must not experience interference from bluetooth commands
- Controller must be reprogrammable
- Sensor sample rate must be configurable

Deliverables

- Wireless Controller-like prototype with multiple sensors that can communicate via Bluetooth
- Software suite alpha that can load programs into controller memory, control communication, and display sensor data
- Comprehensive Documentation for software and hardware

Current Schedule

Week	Hardware	Software	Other
10	Receive PCB from production	Modification of Prototypes	Instructor Presentation
11	PCB testing	Test Software with PCB	Documentation
12	PCB testing	Linking software via Bluetooth	Documentation
13	PCB documentation	Documentation	Poster/Presentation/Demo Development
14	PCB documentation	Finalize Demo Software	Practice Presentation/Demo
15 (Dead Week)	Presentation	Presentation	Presentation

Technical Challenge - SPI Bus

Challenge

- SPI communication new to team members
- Edison sends messages in Little Endian form
- Poor documentation covering system libraries

How we overcame this challenge

- Accounted for Little Endian form
- Lab testing with breadboards

Design Specifications

Intel Edison Specifications

- Dual-core CPU at 400 MHz
- Wifi and Bluetooth 4.0 enabled
- 1 GB RAM
- 4 GB Flash memory on-board
- 20 digital I/O pins including 4 as PWM pins
- 1 I^2S pin (audio)
- Low power consumption
- ~$50 price tag

Final Component List

- Intel Edison
- 9 Degrees of Freedom (Accelerometer, Gyro)
- Joystick
- Buttons
- Status LEDs
- RGB LED
- ADC/DAC
- Voltage Regulator
- Custom Acrylic Case
- Audio Codec
- Charge Circuit
- Battery Holder
- Logic Leveler
- USB-B Port
- Header Pins
- On/Off Switch
- Mic-In/Line-In/Headphone Out

Budget Breakdown

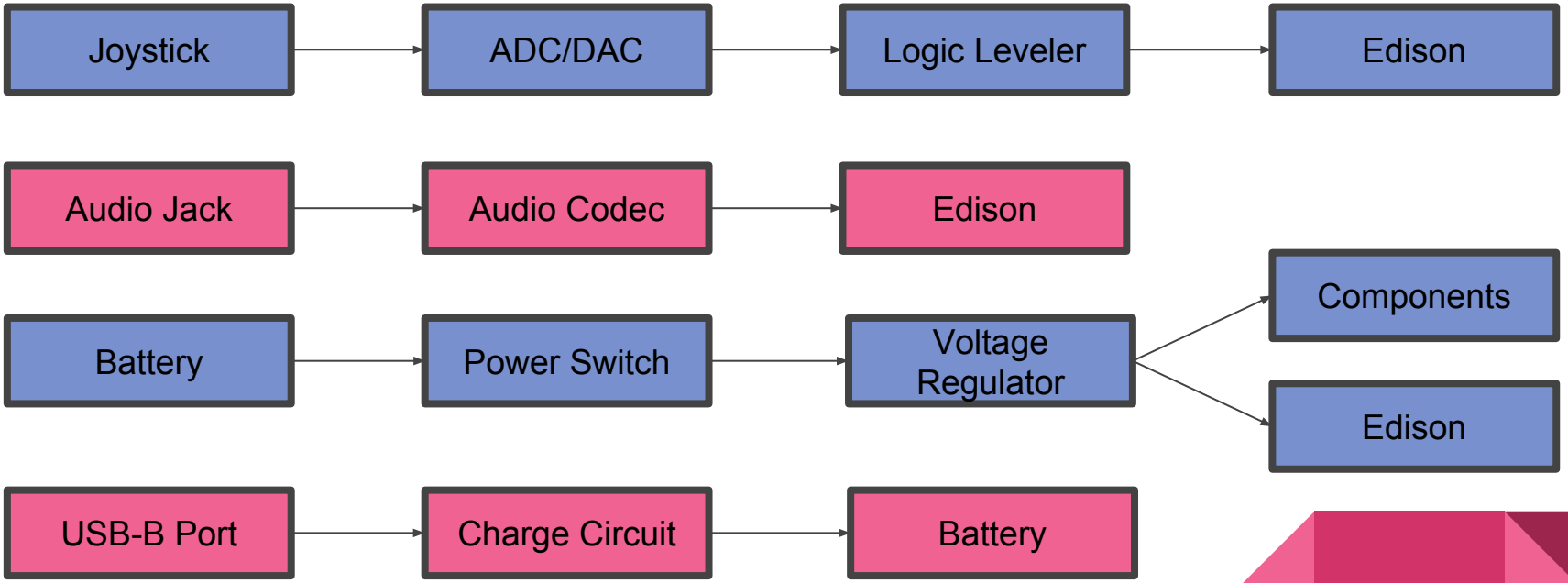
Part Number	Description	Price
H11630CT-ND	70 pin connection for Intel Edison	1.37
MPU-9250	9 degree of freddom sensor	10.64
AD5592RBRUZ	ADC/DAC	7.51
SGTL5000XNAA3R2	Audio Codec	2.34
txb0108	Logic Leveller	1.88
450-1650-ND	Button	0.11
18650	Batteries	8.38
BK-18650-PC4	Battery Holder	4.48
ED2983-ND	USB-B female port	0.58
SC1488-1-ND	Audio Jack	0.69
MCP73831T	Battery Charge Circuit	0.56
Parts Total		48.74

Budget Breakdown Cont.

- PCB Components: ~$49
- PCB Production: ~$50
- Controller Case: ~$12
- Intel Edison: ~$50
- Miscellaneous: ~$10

- **Total: ~$171**

Component Interaction Diagram



Technical Challenge - Edison I/O Voltage

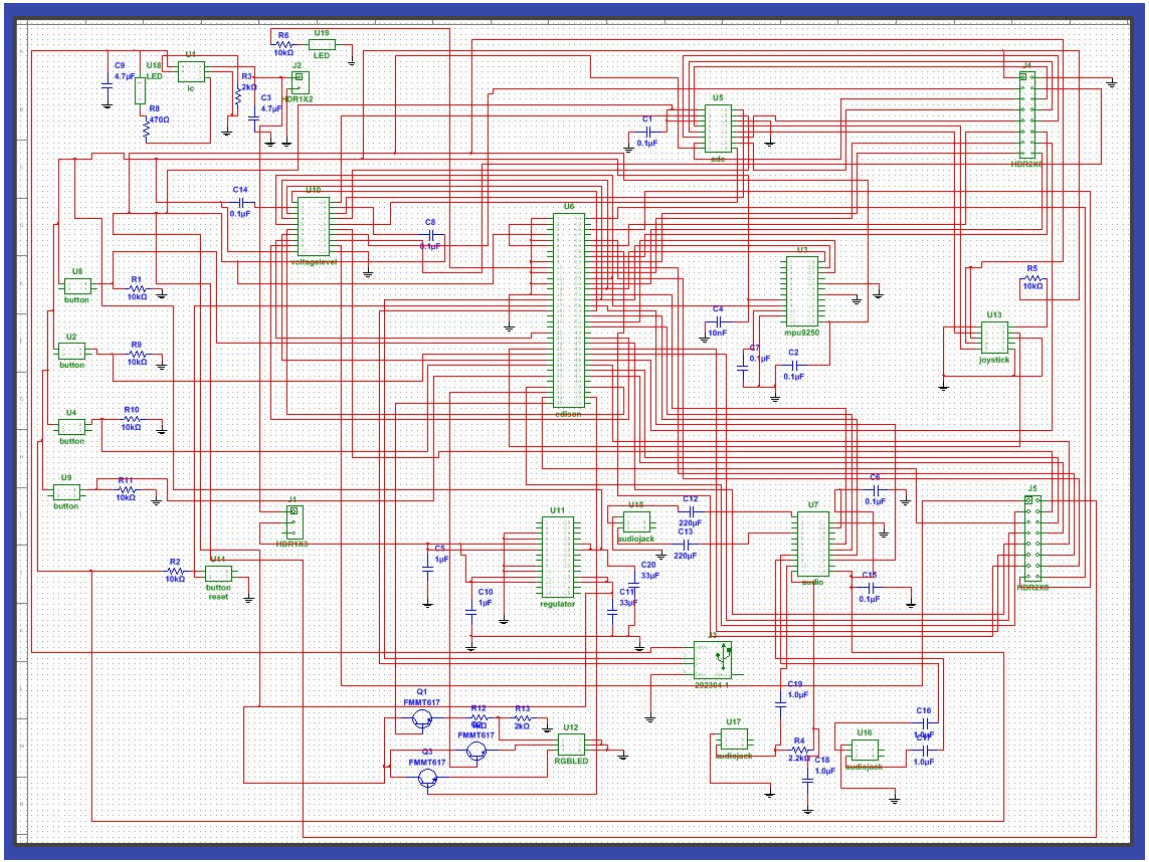
Challenge

- Edison utilizes 1.8V logic
- Other chips demand 3.3V logic

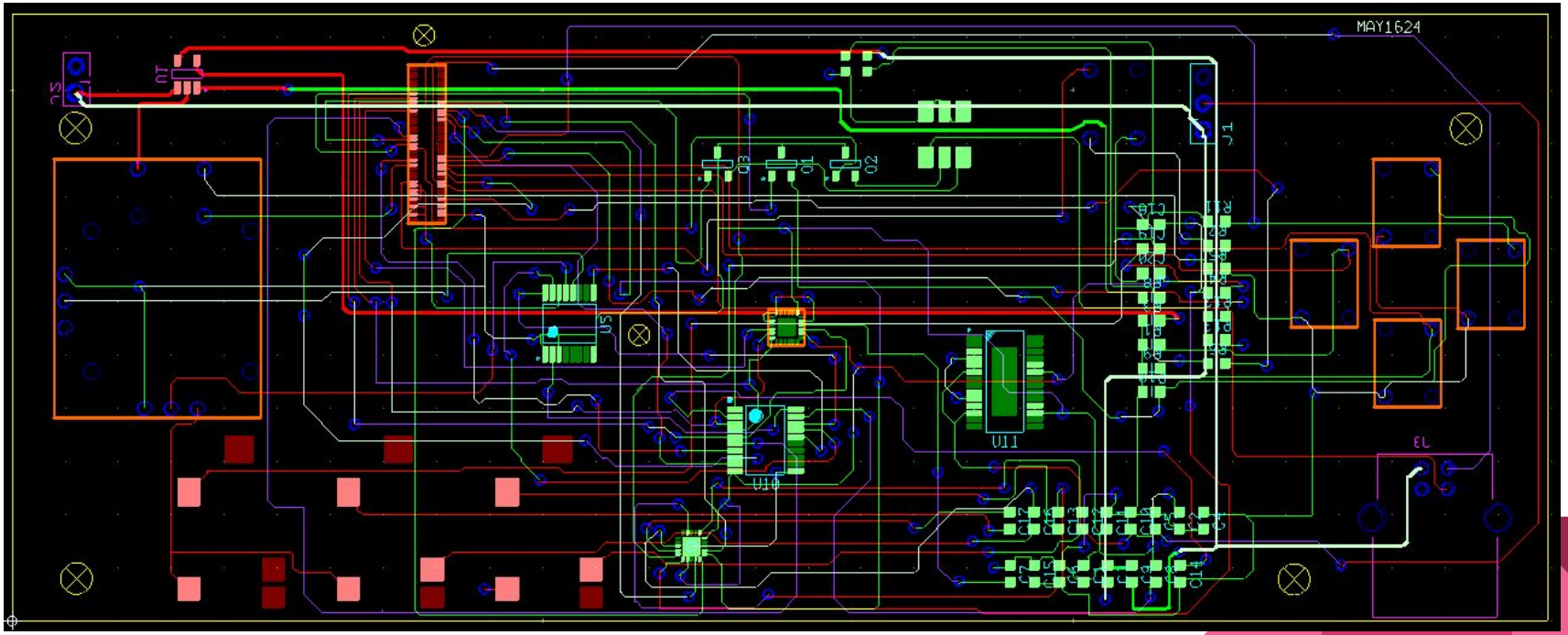
How we overcame this challenge

- Read component documentation
- Testing with oscilloscope to measure voltages
- Logic leveler used to modify logic to proper voltages

Pin Connections



PCB Layout



Technical Challenge - Case

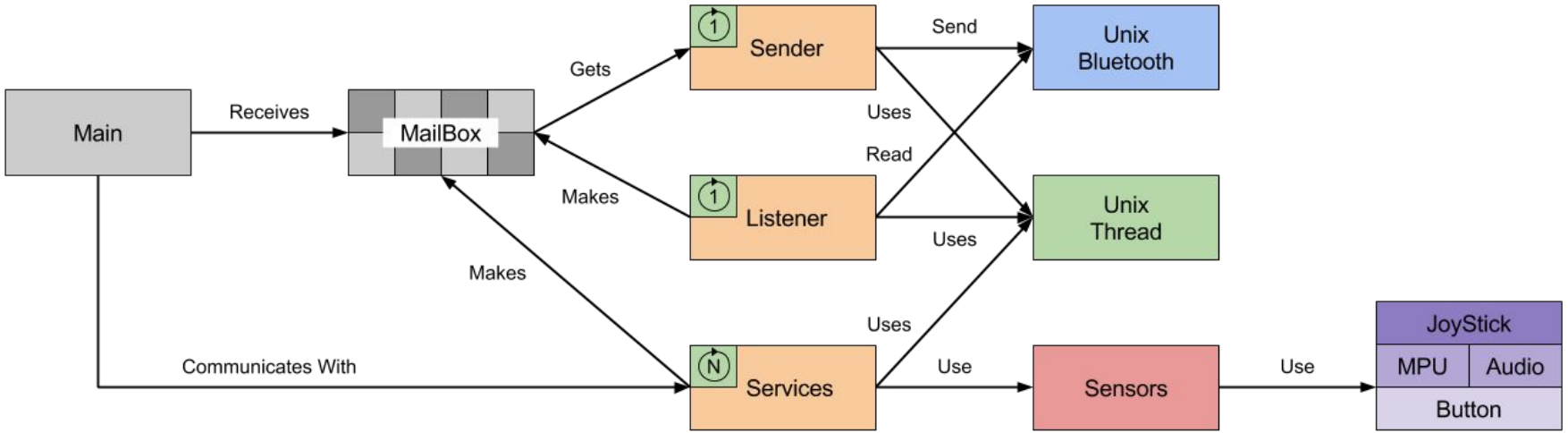
Challenge

- Commercially available cases are expensive
- Case needs to have easy access to batteries and PCB

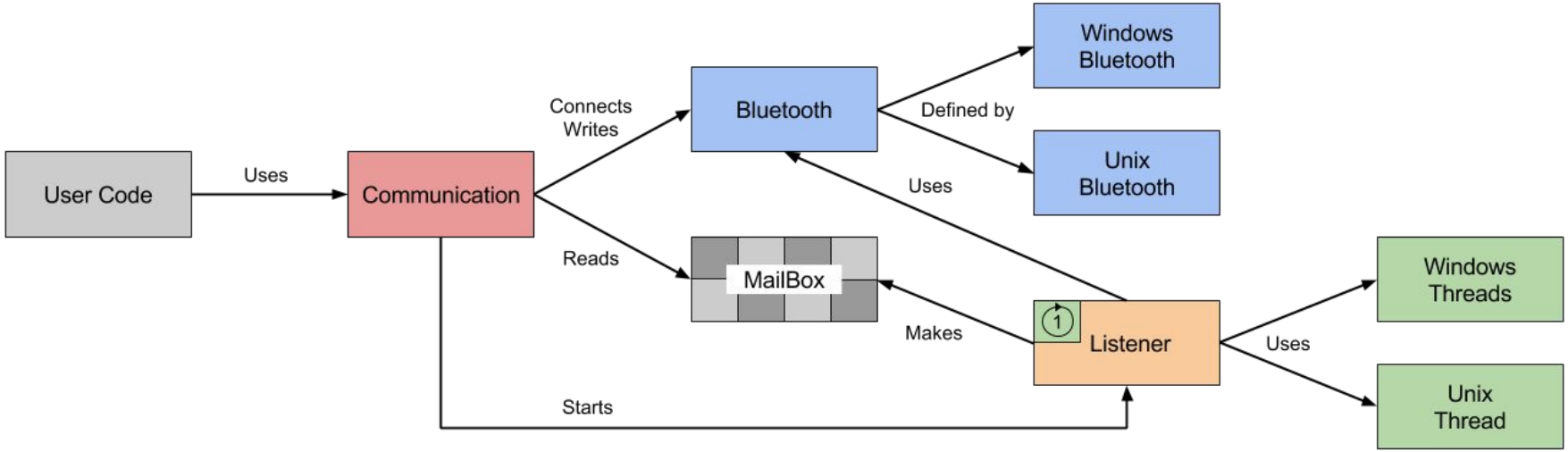
How we overcame this challenge

- Develop custom acrylic case
  - Cheap
  - Configurable

Software Overview - Controller



Software Overview - Lab Computer



Testing

Testing Plans

- Hardware Testing
- System integration testing
- White-Box Testing
- Performance Testing
- User Experience Testing

Final Steps

Final Steps

- PCB Modifications
- Project Plan
- Design Document
- Testing
- Documentation
- Poster/Presentation
- Demo

Senior Design Reflection

- Cross discipline communication
- Reading technical documentation
- Mentoring from advisor
- Balancing timeline versus scope
- Managing roadblocks
- Dealing with unexpected issues
- Learned new skills

Demo/Review/Questions

- Re-programmable Controller-like device utilizing Intel Edison
- Controller used for CprE 185 labs (possibly EE 285 labs)
- Dump data from sensors over Bluetooth to lab computer
- User-friendly interface to monitor sensors from lab computer
- Beginner level API calls to utilize sensor information