ELCT 404
Final Presentation

Team:Smoaking Hot
4/14/2024

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Meet The Team: Smoaking Hot

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Project Overview

The objective of this project is to create a waystation that collects data from the sensors packages on a bridge via wireless communication. This data should then be processed and converted into a csv file with various forms of information such as standard Deviation, mean, and Fast Fourier Transformations (FFT's) to provide insight of the bridges structural integrity.

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Design Philosophy

Our team's vision is to provide smoking hot products that are innovative and reliable. This is achieved by our philosophy that centers around ease and scalability.

- Affordable and reusable materials
  - Flexible
  - Repeatability
- Stability
  - Hazardous conditions
  - Risk Mitigation

System Requirements

- Wireless communication
- Onboard Processing
- Power Management
- Storage Capacity
- Low Cost
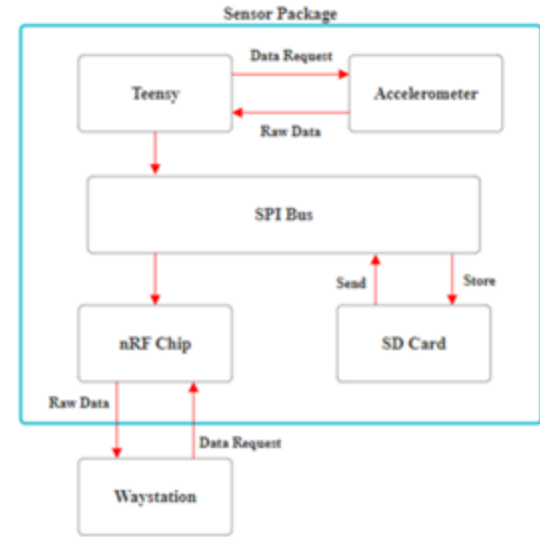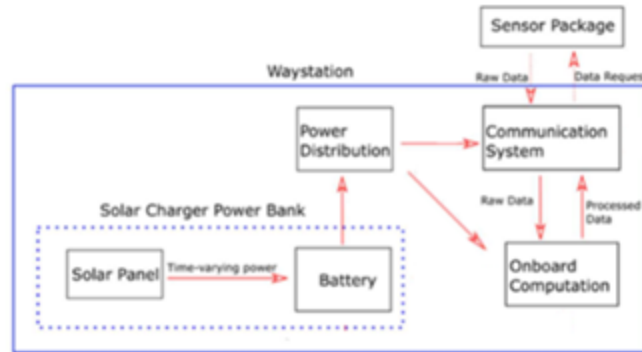
Achievements

- Wireless communication has been accomplished
  - Teensy to Teensy/PI
- PCB Design
  - Different Variations
  - Tested First PCB
  - Designed Second PCB
- Onboard Processing has been finished and successfully shows data
- Team has accomplished the scope of the project

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Financials

A large goal for this project is repeatability and low cost. Due to this we have resorted to recycling materials and finding cost effective materials.

Material	Cost	Amount
Recycled Materials		
Teensy 4.0	33	2
nRF24L01 (4 pack)	10	1
HDMI Cable	7	1
SD cards (8GB)	10	2
Parts We Ordered		
Rasberry Pi Model 4B	50	1
Micro USB (3 pack)	8	1
First PCB	20	1
To Be Ordered/Recycled		
Buck Converter	8	2
Solar Panel	60	1
Solar Panel Power Bank	60	1
Waystation Cover	10	1
Total:	327	

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Problems Faced

- Understanding nRF chips
  - Research
- Transmitter Issues
  - Minimum power line code
  - Range restrictions
- Raspberry Pi Issues
  - Inexperience
  - Wireless communication
- PCB issues
  - Inexperience

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Individual Contributions:

- Project Planning
  - Determine Project scope and deliverables
- Team Coordination
  - Build and lead a high-performing team by assigning achievable tasks and responsibilities
- Resource Management
  - Ensure that the team has the necessary equipment to perform their tasks
- Communication
  - Planned Meeting Times with Sponsor and Team
  - Ensured everyone communicated regarding the interconnects of subsystems

Sensor Package Functionality

- Gather accelerometer data
  - Measures intensity of a vibration at the point it is attached to on the structure
- Store data on SD card
  - Allows for manual data retrieval if needed
- Transmit Data to waystation
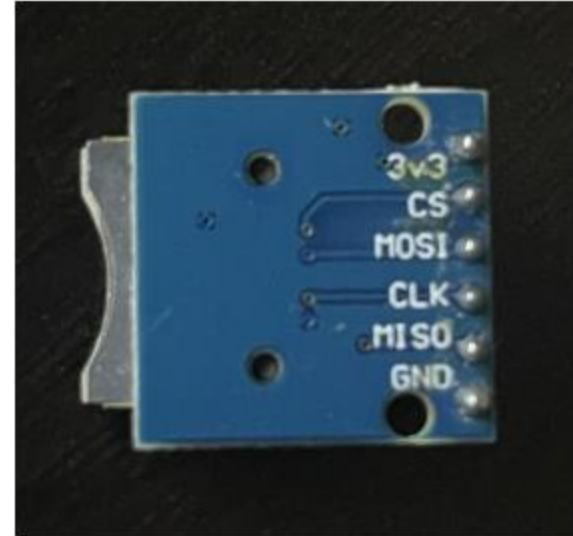 - Send accelerometer data to waystation for computation

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Teensy 4.0

- Programmable microcontroller used for prototyping
- SPI bus
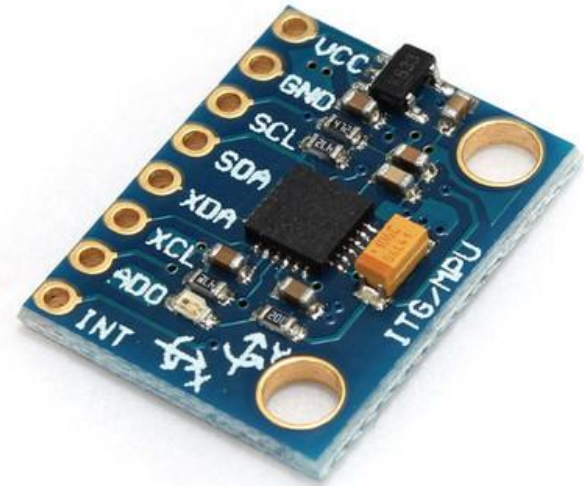 - 2 subsystems
- Digital pins
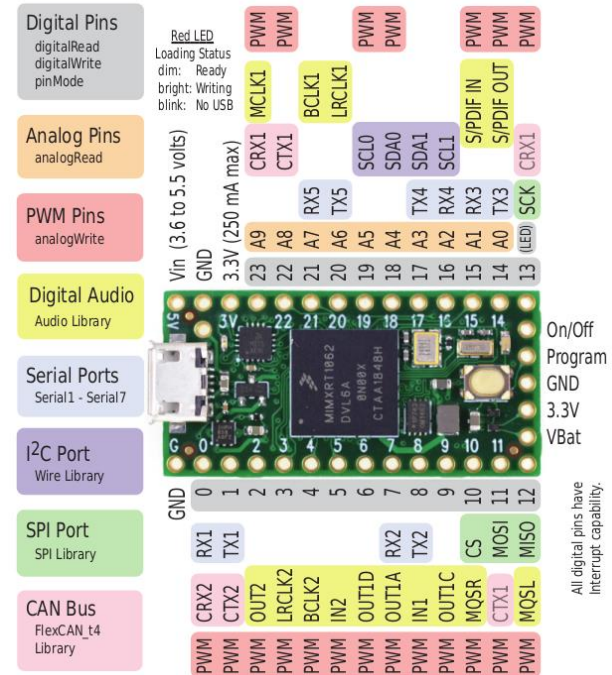
SD Card Module

- Interfaces with micro SD card
- Uses SPI bus
  - Has its own unique chip select pin
- SD card data stored in a .csv file

MPU6050 Accelerometer

- Multipurpose sensor
  - Accelerometer
  - Gyroscope
  - Internal thermometer
- Accelerometer measures in magnitudes of gravity
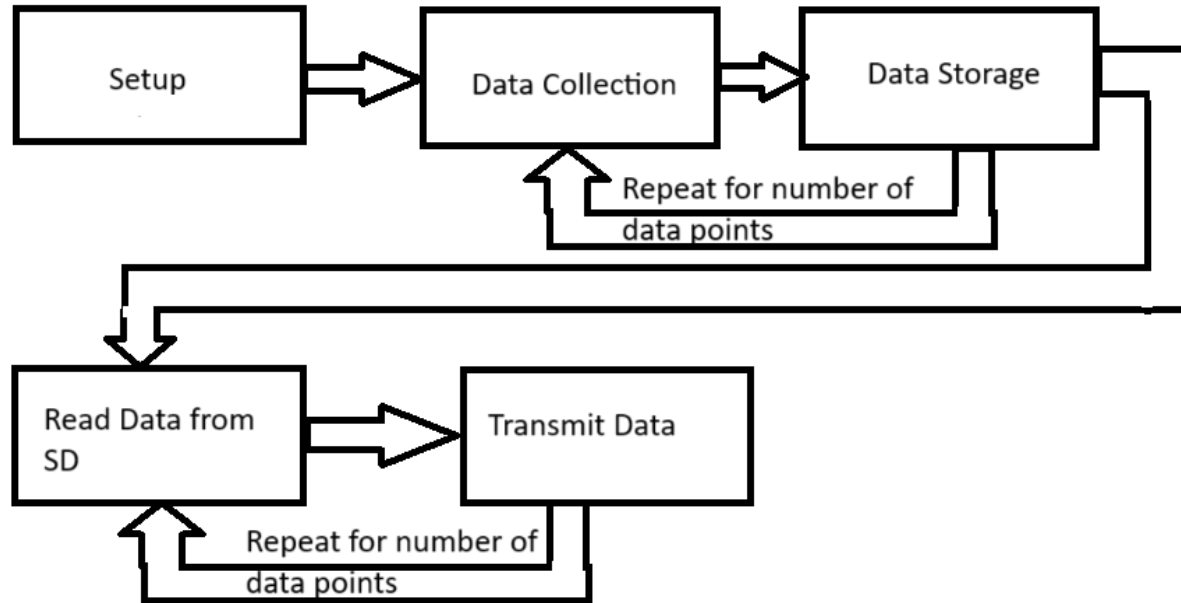
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NRF24L01

- Device that uses radio frequency to achieve wireless communication
- SPI bus
  - Has its own chip select pin
- Range limitations
  - Small antennae
  - Teensy to Teensy currently working at ~2ft apart

nRF24L01 Pinout

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Sensor Package Code Flow Chart

Sensor Package Future Iterations

- Turn it into a transceiver
  - Will be prompted by the waystation to record and transmit data
  - Achievable by transmitting a basic true/false message to the sensor package

Raspberry Pi Setup

- Raspberry Pi Setup
  - Downloaded Raspberry OS
  - Troubleshooted setup for Pi due to network issues at UofSC
  - Wired nRF chip to Raspberry Pi
  - Setup Libraries
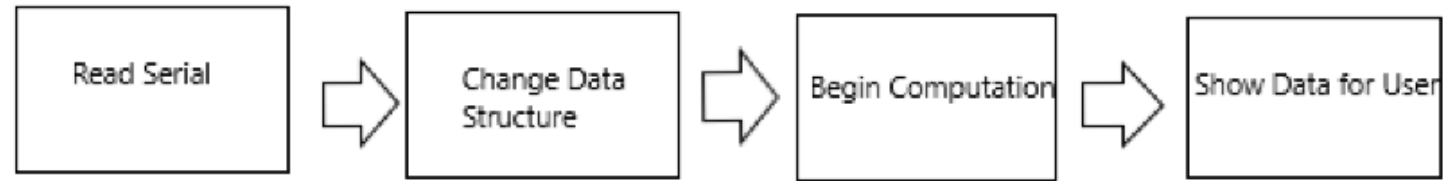

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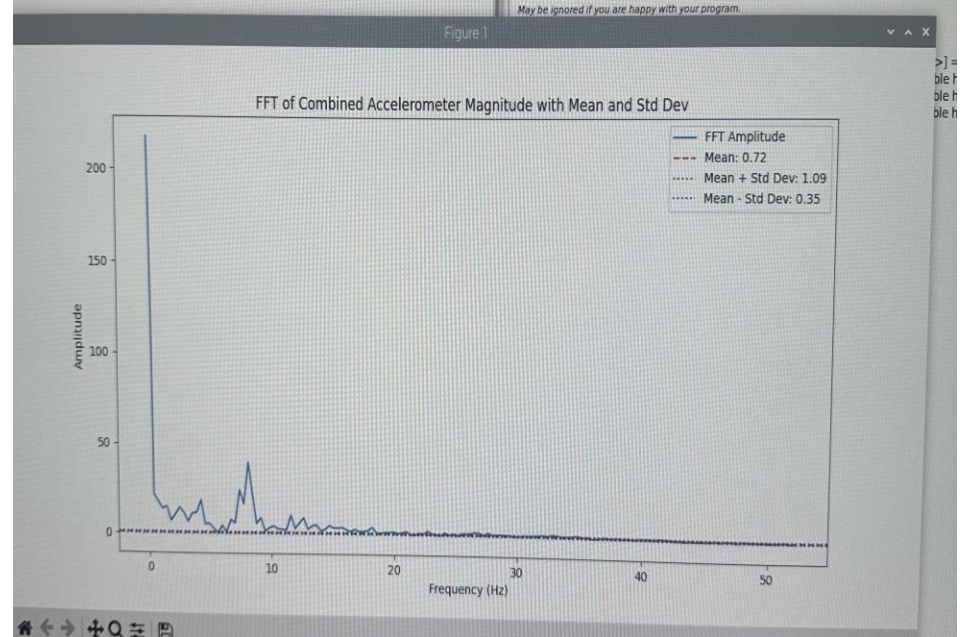
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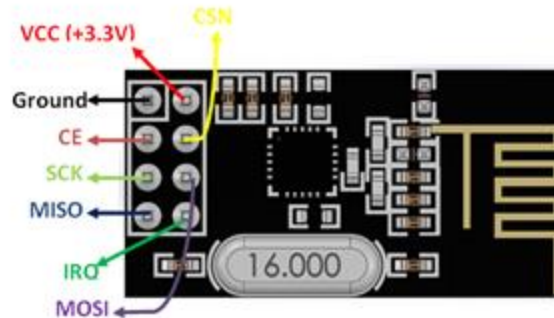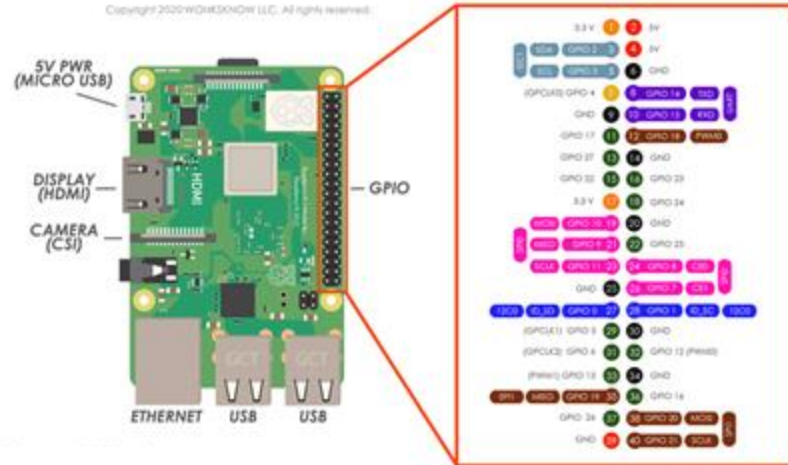
Onboard Processing

Once the Data is on the PI then it needs to be processed into information for the user to access bridge infrastructure.

- Accessible Data:
    - Mean
    - Standard Deviation
    - Fast Fourier Transformations

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Onboard Processing Code

Read Serial → Change Data Structure → Begin Computation → Show Data for User

Demonstration

What's Next

- Turn the PI into a transceiver
  - Remove extra teensy
- Order the new set of PCB's
- Begin testing with the new nRF modules
- Design Physical Waystation
  - Weatherproof
  - Easily accessible
  - Secure

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Special Thanks:

We would like to express our sincere gratitude to the following individuals for their invaluable contributions and unwavering support:

- Austin Downey
- Ryan Yount
- Wilson Smoak
- Joe Gucwa

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