WWW.MWFTR.COM

HOWARD UNIVERSITY
1867
Leadership for America and the Global Community

Portable Perimeter Detection and Monitoring System - PoPDaMS

The A-Team

by

Elijah Adedire

Monique Kirkman-Bey

Ehimwenma Nosakhare

March 9th 2011

Outline

- Background
- Problem Definition
- Design Requirements
- Solution Generation
- Top Design Selection
- Implementation Plan
- Progress Made
- Conclusion & Questions

Background

- Late at night, it is difficult for soldiers to differentiate between friend or foe. To protect our troops from wrongful death or even ambushes, a perimeter detection system is necessary.

Problem Definition

- The challenge we have is to design a system that has proximity alarms and monitors that should be activated if soldier is approached by an enemy within the perimeter specified by the system.

Design Requirements

- Have a detection range of 15-30 feet.
- Have an operating temperature of -10 - 25 degrees Celsius (14 - 77 degrees Fahrenheit).
- Have night time image detection.
- Be able to classify the detected object as a threat or non-threat
- Have wireless communication.
- Be battery powered (12V DC, 100AHr).
- Be portable (exact weight - TBD)

Current State of Art

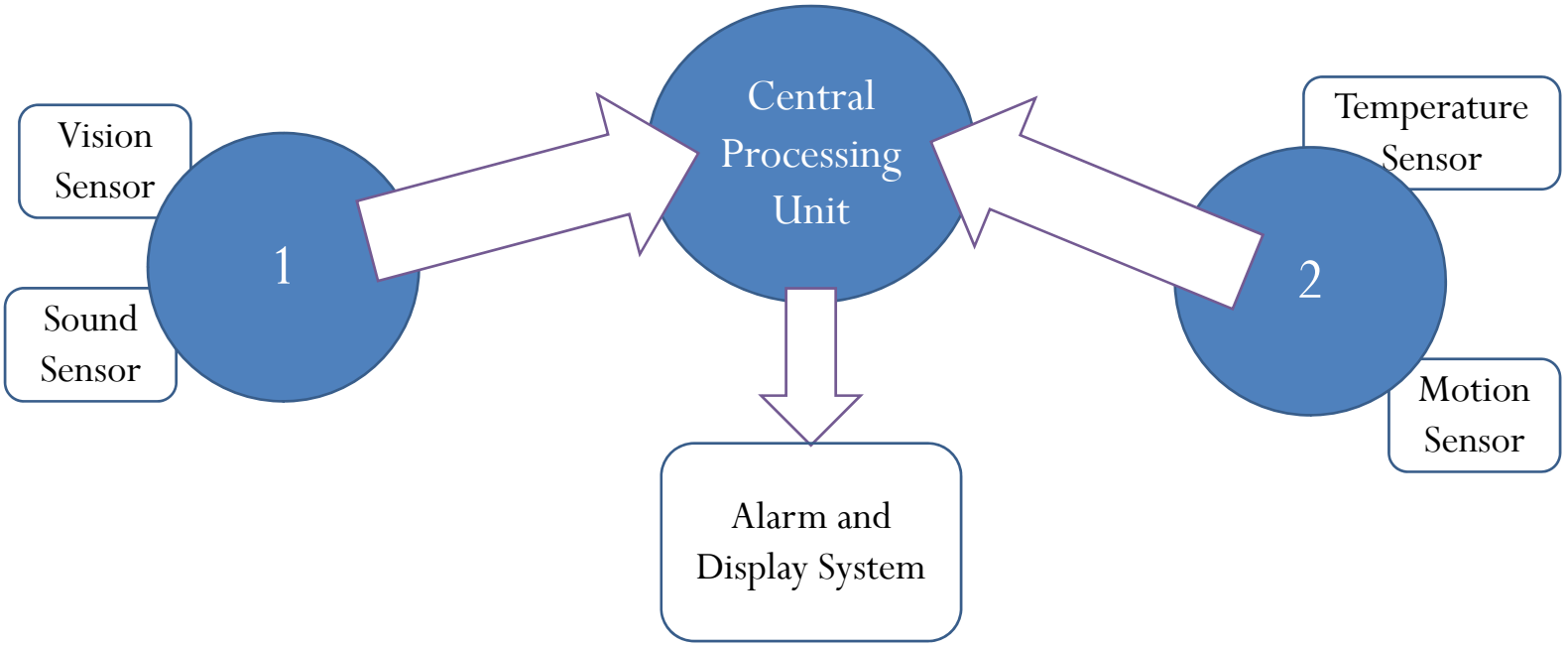
- *Qual-tron EMIDS - Enhanced Mini Intrusion Detection System (EMIDS)*
  - Can monitor 999 sensors and operates in 3 frequency bands
  - Break wire sensors, infrared break beam, PIR sensors
  - Dependent on intruder physically breaking through a wire in a perimeter
- *Robotic Perimeter Detection System*
  - MIDS, Robotic All terrain Lunar Exploration Rover (RATLER), Base Station
- *Personal Portable Electronic Perimeter Alarm (PPEPA)*
  - *Warns of a breach in a pre-determined perimeter*
  - *Alarm System*

Solution Generation

- Existing systems on market do not satisfy all requirements
- Possible Solutions
  - 2 systems with different sensor combinations
  - A network of backpack systems
  - A stand-alone complete system with all sensors

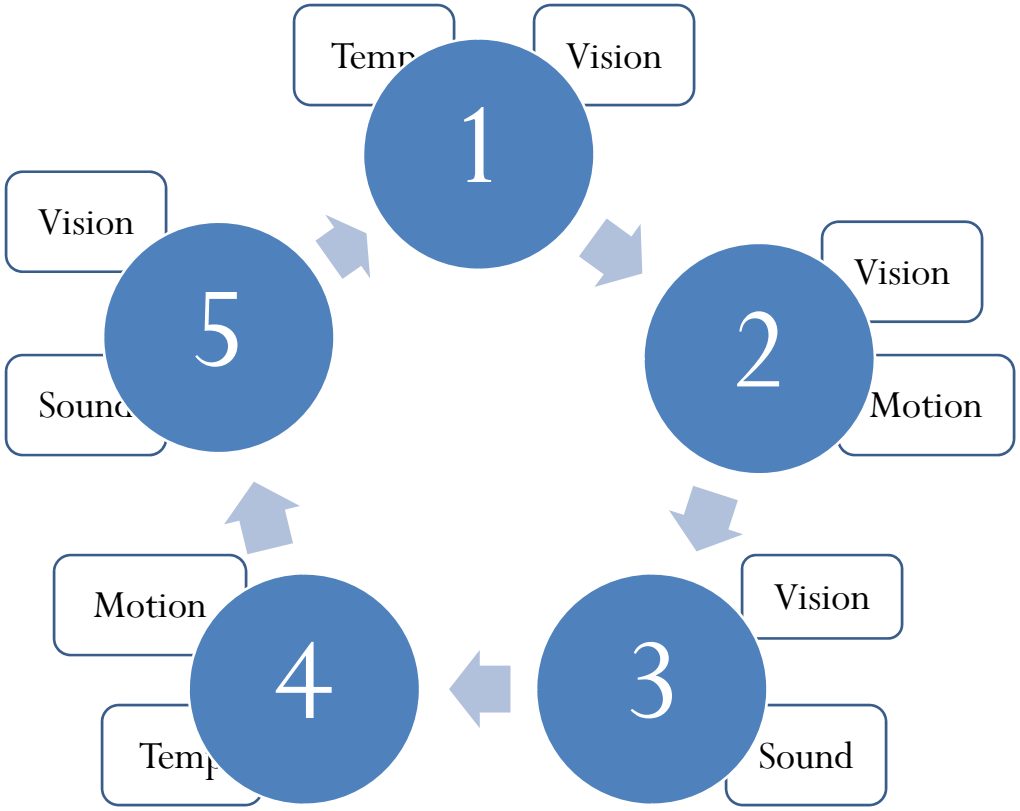
Solution Generation

- Two systems with different sensor combinations

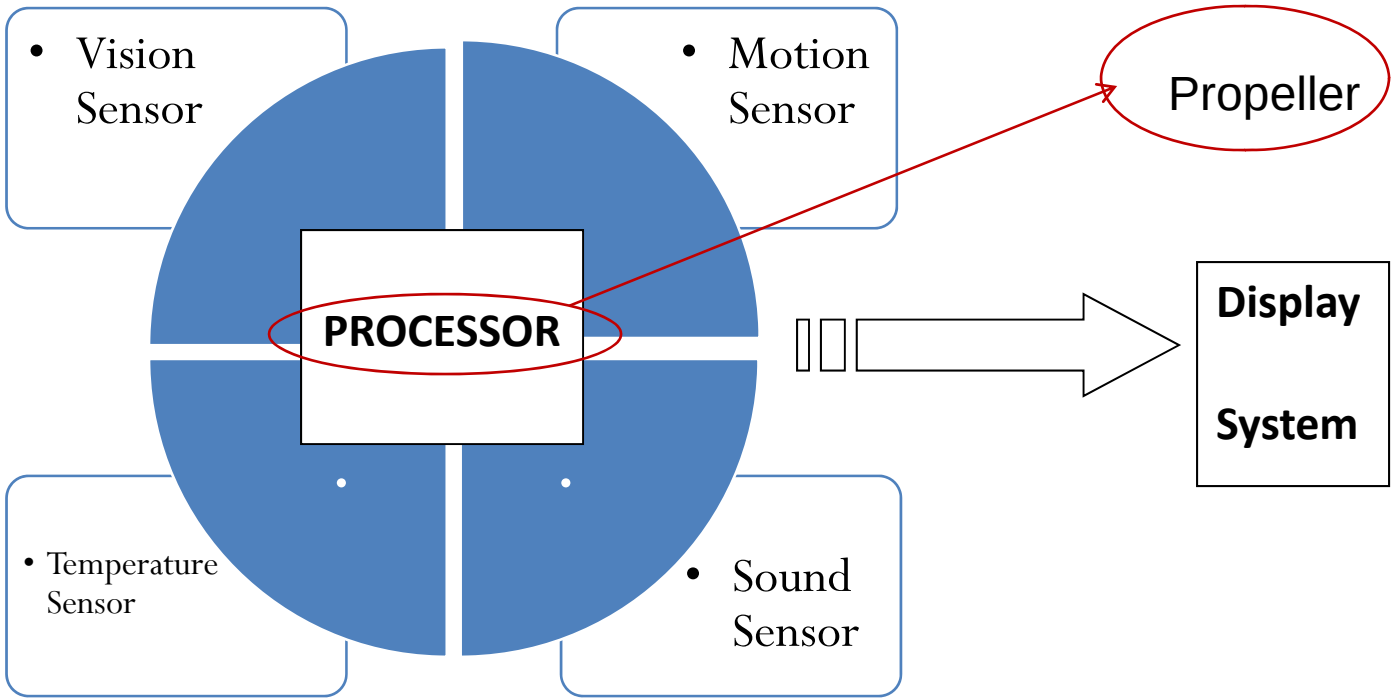


Solution Generation

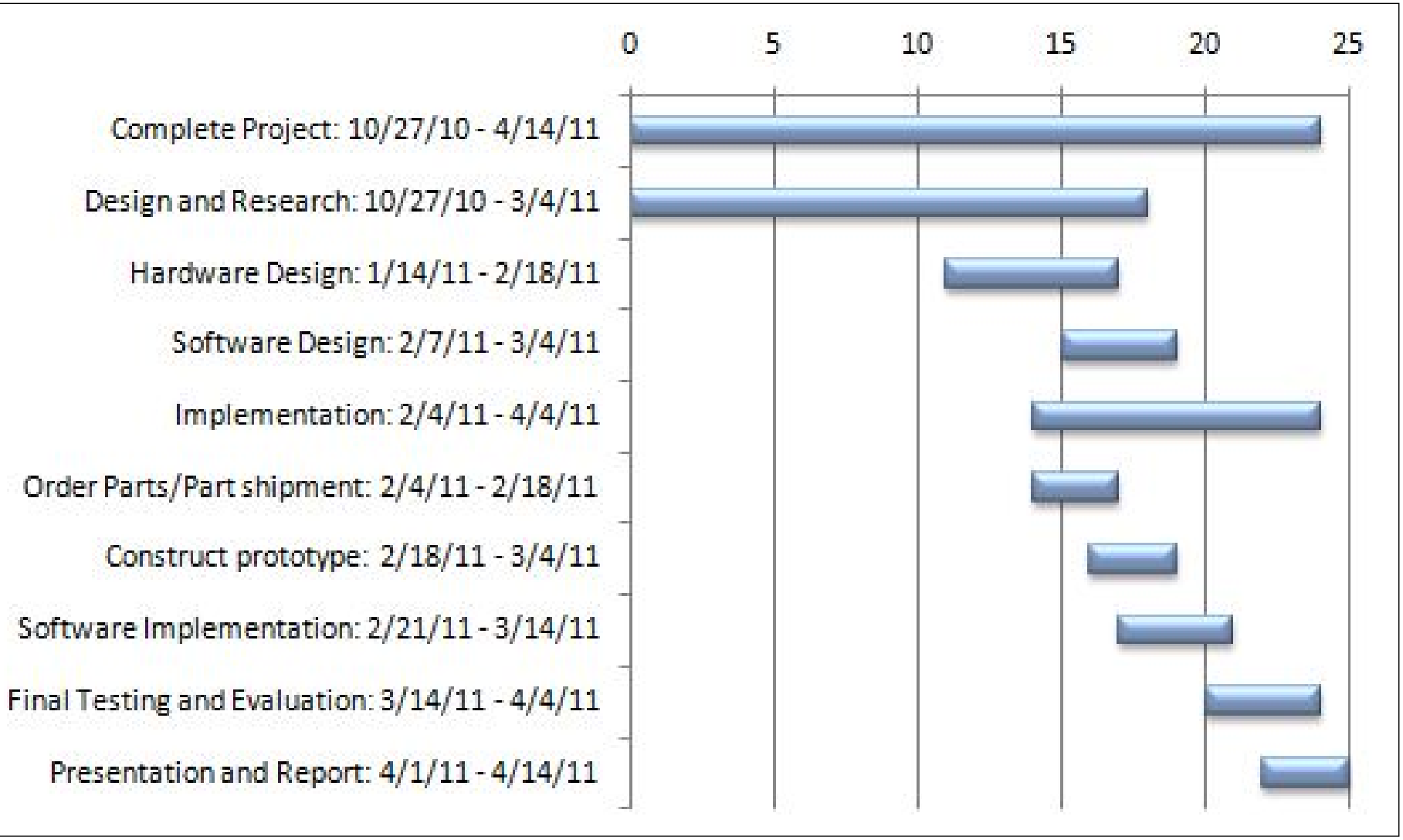
- A Network of Backpacks



Solution Generation - Top Design Selection



Implementation Plan



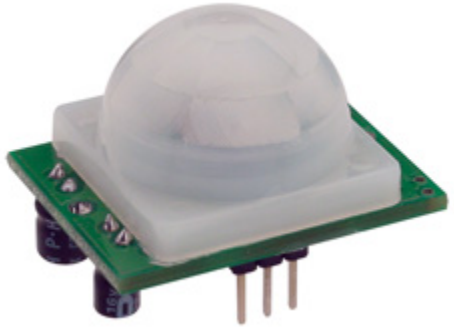
Solution Implementation

- Hardware
  - Sensor selections
    - Motion
    - Sound
    - Temperature
    - Vision
  - Platform selection
    - Processor
- Software
  - Propeller/Spin Tool Software v1.2.7
  - Matlab

Sensor Selection - Motion

- X-band motion – primary motion sensor
  - Can detect motion through walls and windows
  - Longer detection range
  - More immune to false triggers than PIR
  - Trim potentiometer for manually adjustable sensitivity

- PIR Sensor
  - Secondary motion sensor

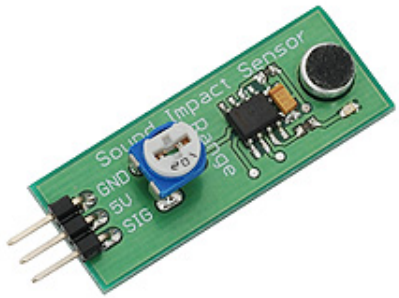


- Accessory - Continuous Rotation Servo
  - Bidirectional continuous rotation

Sensor Selection - Sound

- Sound Impact Sensor
  - Single bit output
  - No A/D needed
  - Potentiometer for easy adjustment of range of detection
  - Drawback – maximum of 9ft range

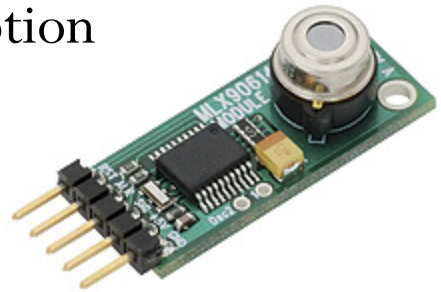
- Impact of Drawback – We will continue to look for other sound sensors while we use this



Sensor Selection - Temperature

- Thermal Imaging camera and Laser camera

- Infrared Thermometer Module
  - Intelligent non – contact sensor
  - 16 – bit digital temperature output data
  - -70°C to 380°C temperature range
  - Sleep setting for low power consumption

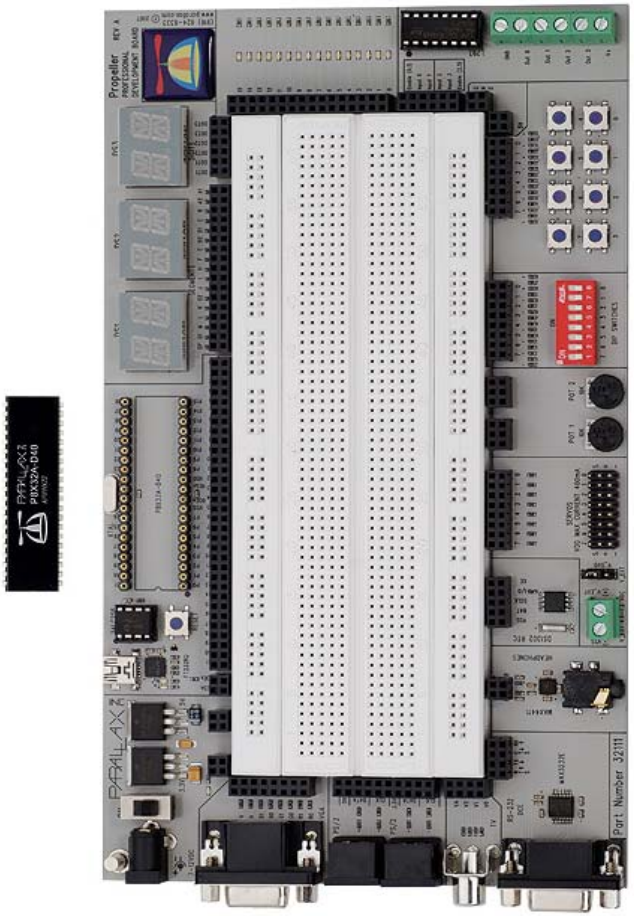


Sensor Selection - Vision

- Lorex SG7555B night vision camera
  - Sharp and clear color - daytime
  - Black and white at night for optimum performance
  - Built in microphone
  - Day/Night vision range of 50ft
  - Plugs directly to monitor
  - Has 24 IR cut filter to maximize day and night performance
- Mini LCD A/V Color Display
  - Has audio output
  - 480x234 resolution

Platform Selection

- Propeller Chip
  - Eight processors on each chip
  - Parallel processing – simultaneous monitoring of sensors
  - 32 I/O pins
- BS2pe
  - Additional processing power if needed



Software

- Propeller/Spin Tool Software v1.2.7
- Matlab

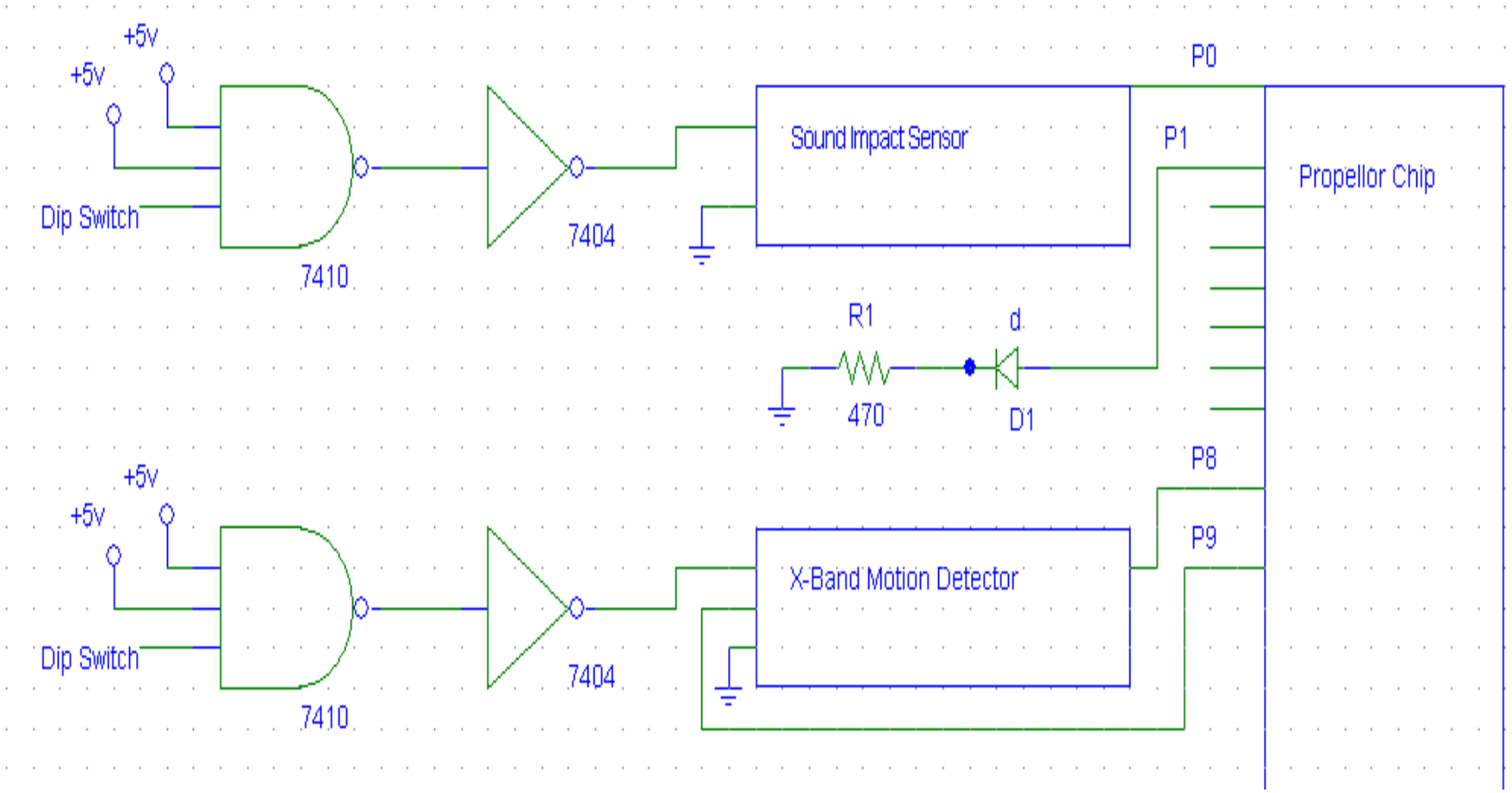
Accessories/Parts

- Majority of the parts needed have been purchased, including:
  - Propeller Microcontroller
  - X-band motion detector
  - PIR Motion detector
  - Mini LCD A/V Color Display
  - Sound Impact Sensor
  - MOBO power cable
  - USB Cable
  - Parallax (Futaba) Servo
  - Books/Manual
  - Temperature Sensor

Project Implementation: Hardware and Software

- Familiarized ourselves with
  - Spin language and multiprocessor programming
  - Propeller Professional Development Board
  - Propeller Chip
- Implemented sound sensor
  - Parallax Sound Impact Sensor
- Partially implemented motion sensor
  - Parallax X-Band Motion Sensor

Hardware Implementation



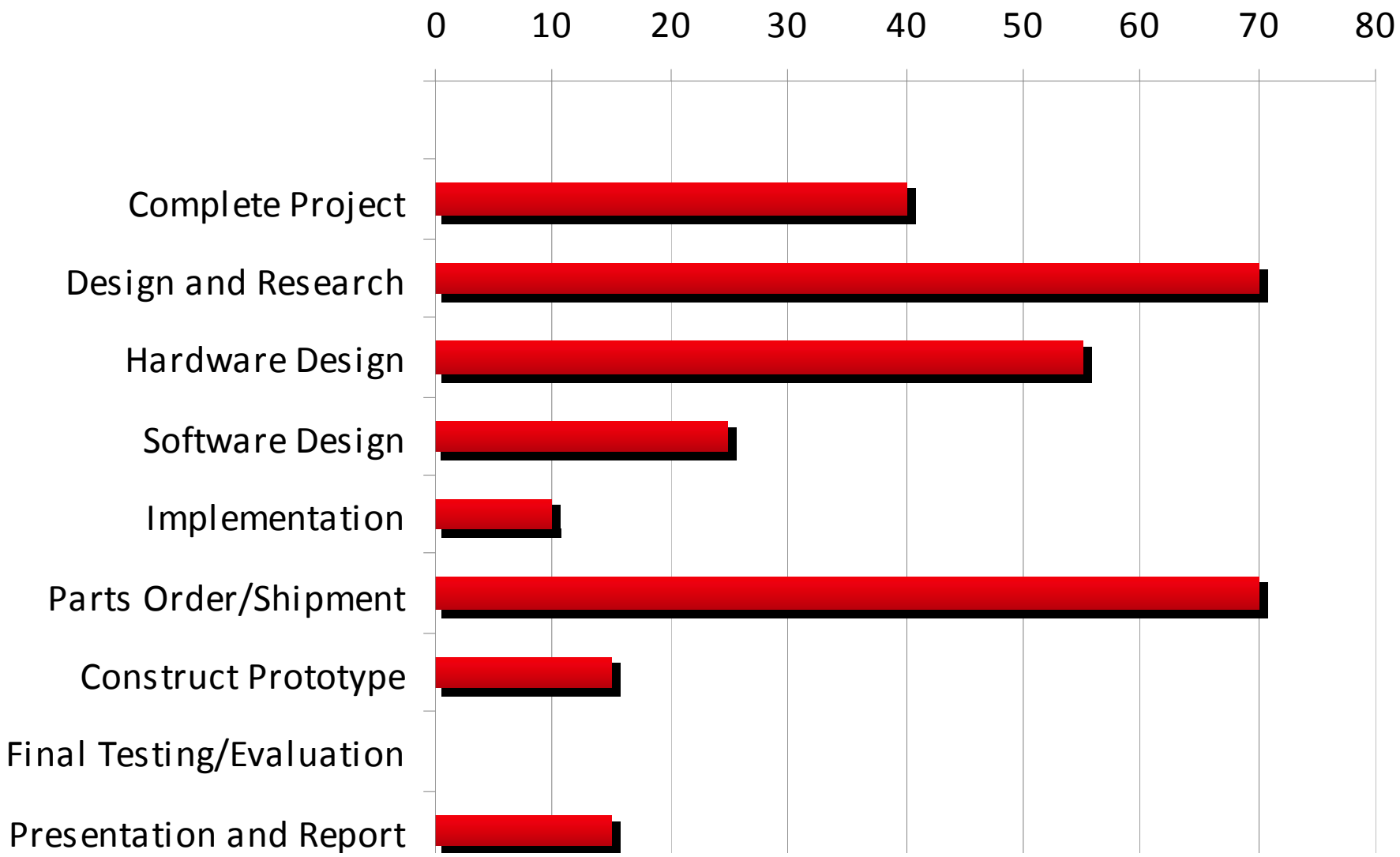
Project Implementation: Temperature Measurement

- Case Study: Measuring Object's Temperature
- Hardware:
  - Thermal Imaging Camera - for pixel measurement
  - Laser Camera - For range/depth measurement
  - Onboard Computer - To run the software
- Software:
  - Matlab -For processing

Project Lowlights

- The capability of the sound impact sensor
- Delayed funding
  - Threatens timeline
  - No replacement parts
  - Less robust system

Conclusions



Next Steps

- Implement other sensor systems
- Finalize temperature measurements
- Decide on method of integration
- Decide on packaging
- Power the system via battery

Acknowledgements

- Dr. Charles Kim
- Gregory West
- Dr. Mohammed Chouikha
- Thomas Gilmore

Questions