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Portable Perimeter Detection and Monitoring System - PoPDaMS

The A-Team

by

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Outline

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- Problem Definition
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- Project Management
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Introduction - Background

- Late at night, when visibility is limited, the anxiety of soldiers increases greatly. It is also at night that death by friendly fire is most prevalent. To protect our troops from wrongful death or even ambushes, a perimeter detection system is necessary.

Problem Definition - Objective

- Produce and demonstrate a system that
  - Will monitor the specified perimeter
  - Can differentiate between friend or foe
  - Will sound an alarm if a foe is detected
  - Can communicate safely and securely within the network

Problem Definition – Design Requirements

- The PoPDaMs should:
  - 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)
  - have ad hoc communication system

Current State of Art – Perimeter Detection Systems

- Many perimeter detection systems on the market, but none that meet the specified requirements

- Current detection systems:
  - Are portable, but not mobile
  - Generally have one sensor technology
    - Do not incorporated multiple integrated sensors
  - Can not detect friend or foe

Current State of Art – Technologies

- Sensors and technologies used in the design
  - Processors
  - Motion Sensor
  - Night Vision Sensor
  - Sound Sensor
  - Temperature Sensor
- Ad hoc network

Processor Types

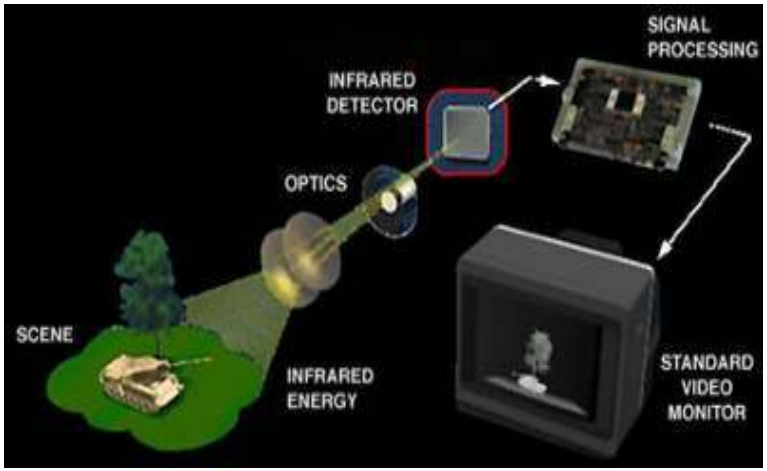
- Microprocessors
  - programmed for one time use at the time of manufacture and cannot be reprogrammed by the end user
  - To alter microprocessors a new microprocessor must be manufactured
- FPGA Boards
  - purchased and programmed by the end user. Designs can be changed and updated as needed, by the user.

Motion Sensor

- It contains two main elements:
  - Device that detects motion
  - Device that relays the information that movement is present
- Two technologies considered
  - Active Motion Detector
  - Passive infrared

Night Vision

- Thermal Imaging
  - Great for detection at near-absolute darkness
  - Needs Signal processing
- Image Enhancement
  - Mostly used for night vision



Temperature Sensors

- Contact
  - Detects temperature by making direct contact with the object and assuming thermal equilibrium
- Non-Contact
  - Makes use of the Planck’s law of thermal emission of radiation to measure temperature

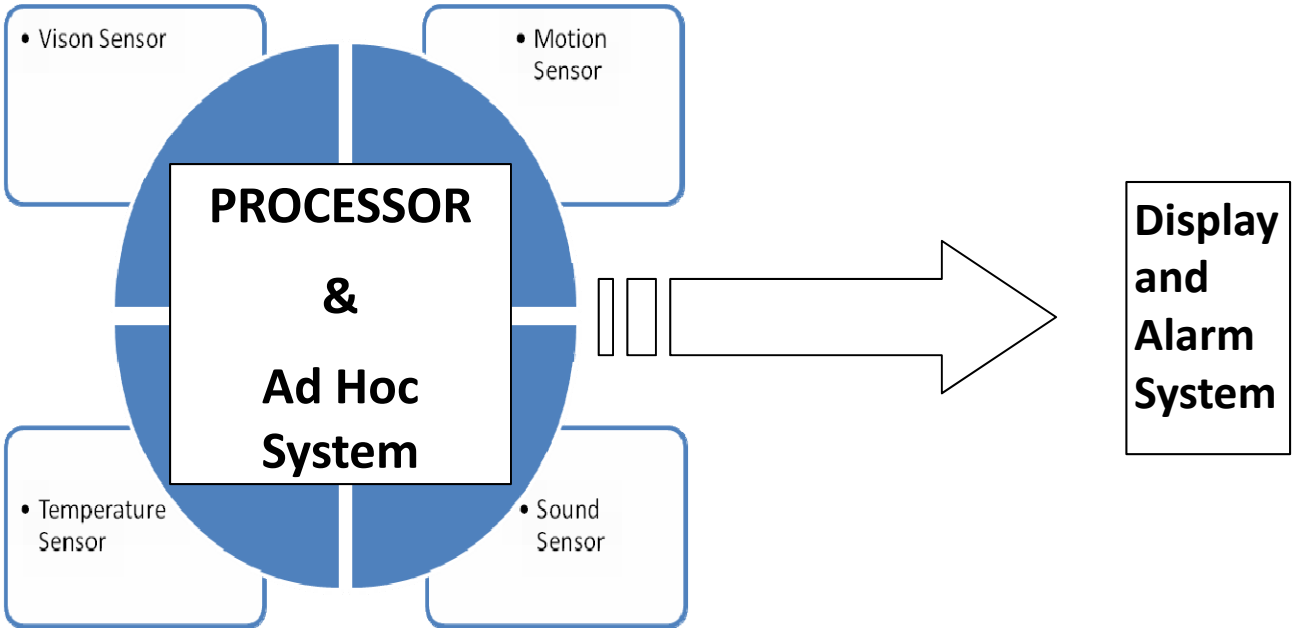
Sound Sensors

- Sound activated switch and microphone combination

- Intensity-Microphone Pairs (tool for locating sound sources)
  - sound intensity measurement allows accurate identification, isolation and ranking of individual sound sources

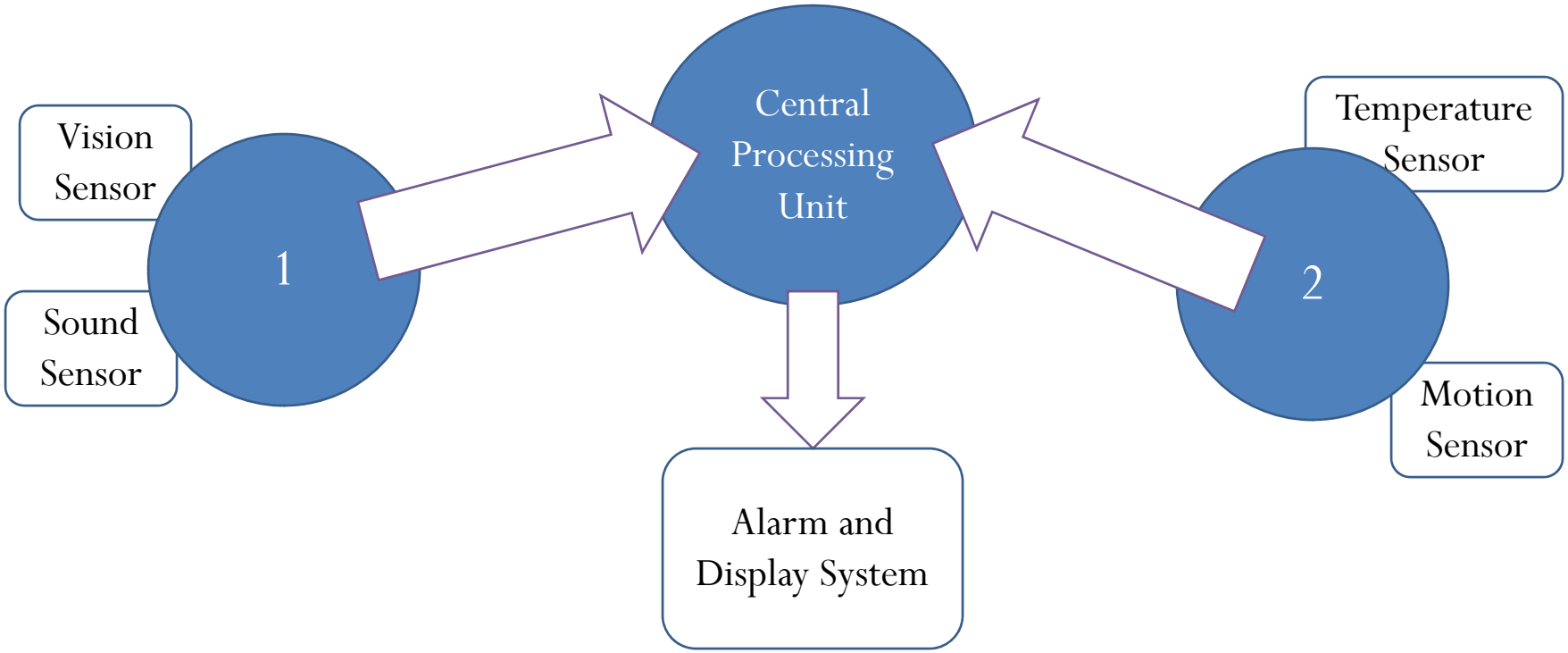
Engineering Approach - Initial

- One stand-alone system
  - Incorporates all of the sensor technologies
  - Communicates only with the user carrying the bag, or communicates with all soldiers



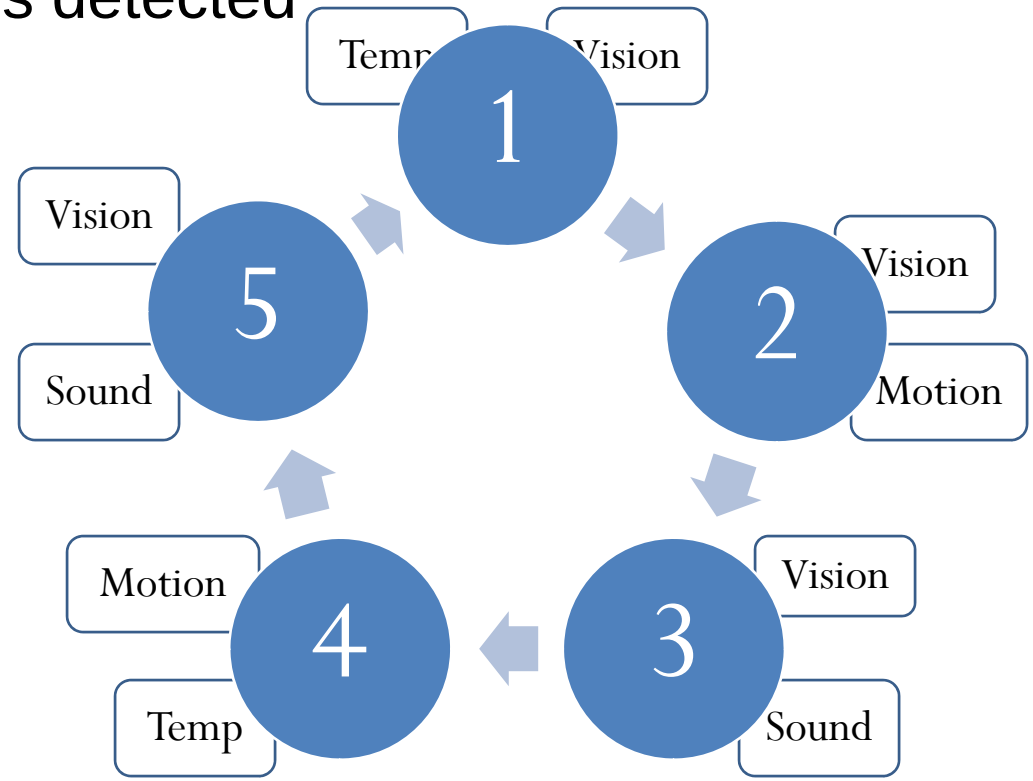
Engineering Approaches - Continued

- Two systems, with various sensor technologies
  - Systems communicate with a central processing unit
  - Central processing unit alerts every soldier if a threat is detected

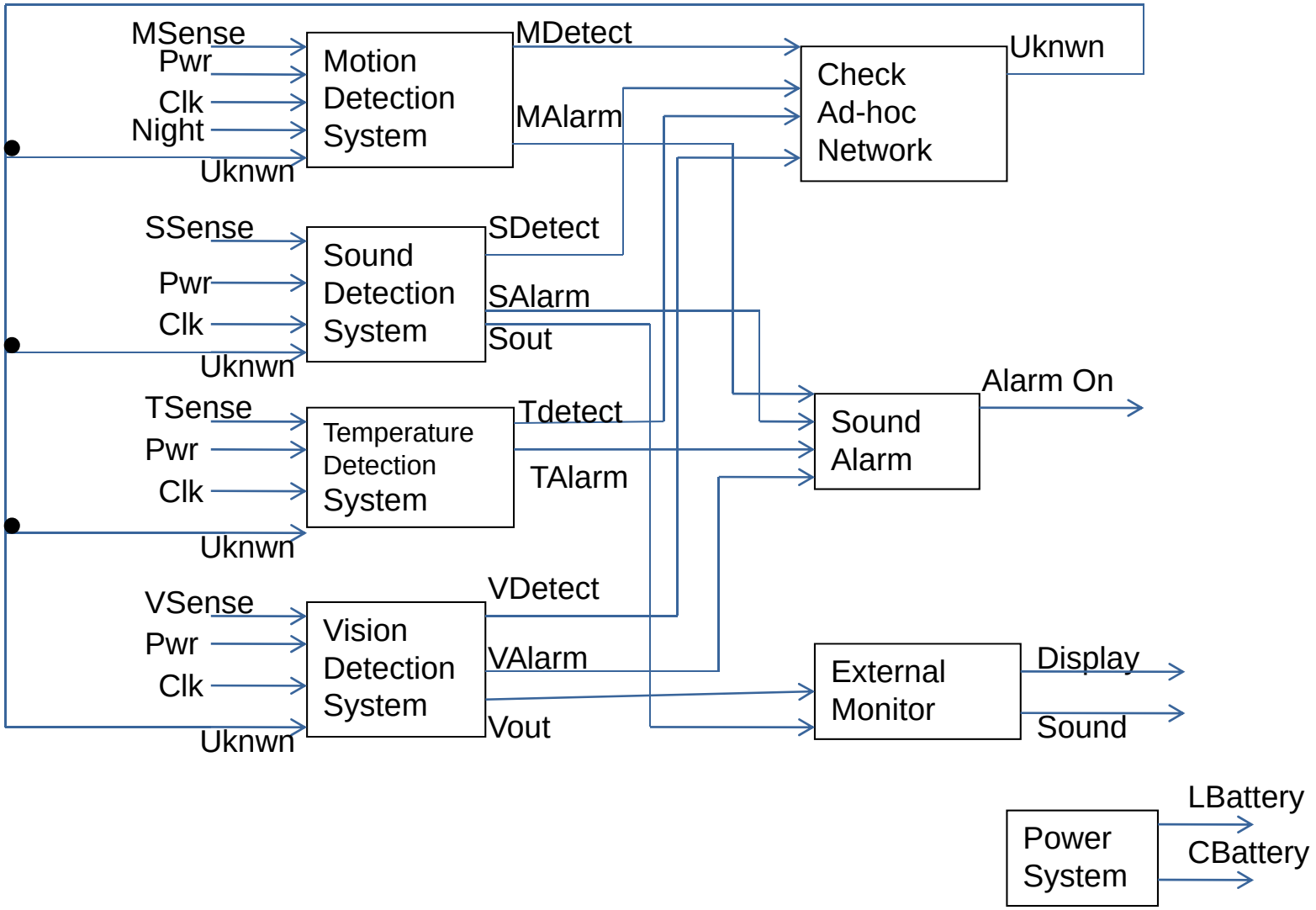


Engineering Approaches - Continued

- Network of backpacks
  - Each with own sensor combination
  - Each pack communicates with the other backpacks if a threat is detected



Engineering Approach – Digital System



Engineering Approach – Knowledge and Course work

- Digital Systems
- Advanced Digital System
- Signals and Systems
- Communication Theory
- Electronics

Tasks and Deliverables

- Tasks
  - Elijah - research and understand the working principle of the motion sensor and temperature sensor
  - Ehi - expected to research on Vision and temperature sensor
  - Monique - specialize on the sound sensor and the digital circuit.
  - Group - work on the ad hoc system, system integration and other peripherals.
- Deliverables
  - Working Prototype
  - PoPDaMs Report
  - Excel Spreadsheet of Cost/Benefit Analysis

Project Management – Timelines and Milestones

Task	Date
Final Design Proposal	November 30, 2010
Final Proposal Presentation	December 1, 2010
Peer Evaluations	December 1, 2010
Evaluation/Selection of Design	December 2, 2010
Ordering of components/Parts	December 10, 2010
Commencement of the development of the design	January 10, 2011
Completion of project prototype	March 01, 2011
Testing of project	March 02, 2011
Documentation of project	March 31, 2011
Presentation slide	March 31, 2011
Project Presentation	April 2011

Project Management – Resources and Budgets

Item	Unit cost ($)	Quantity	Cost
Back pack	60	1	60
Motion Sensor	150	1	150
Vision Sensor		1	
Temperature Sensor	130	1	130
Sound Sensor	20	1	20
FGPA	200	1	200
External Monitor	0	1	0
Power pack	356	1	356
ID units	6	2	12
Miscellaneous			200
Total Cost			1,128

Conclusions

- We need to design a system with a proximity alarms and monitors which would be activated if soldier is approached by an enemy within the perimeter specified of 15 - 30ft.
- Based on our rough estimate, the project should cost approximately $ 1,128 and the annual maintenance cost is projected to be approximately $200
- By March 31st 2011, we hope to have finished building the project, and have a working prototype for display on the ECE presentation day.

Questions