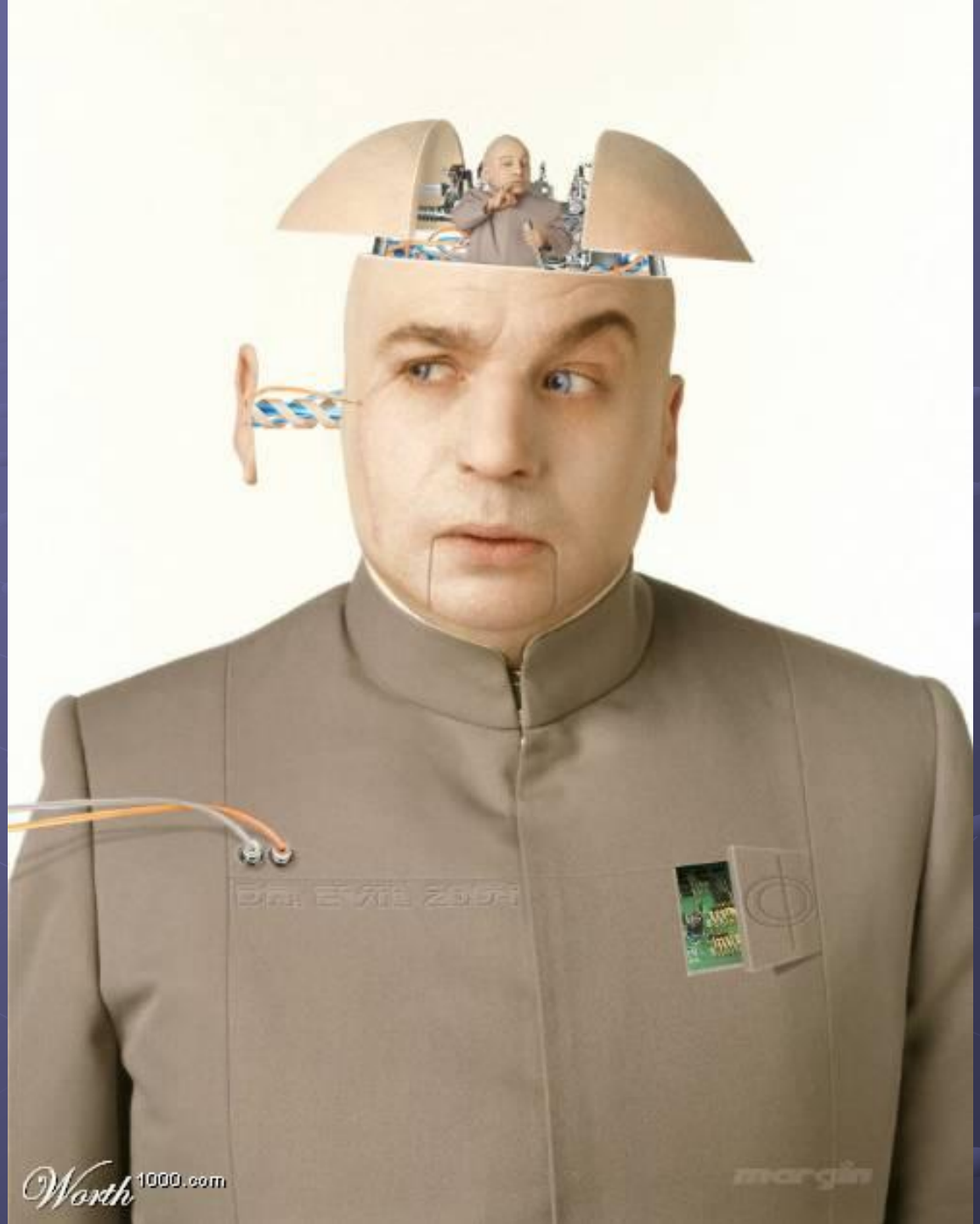

Worth1000.com

I-Guide

Intelligent Guide Robot

Joe Buckner & Nir Chezrony

Advisors:
Dr. Joel Schipper & Dr. James Irwin

Sponsored By:
Northrop Grumman

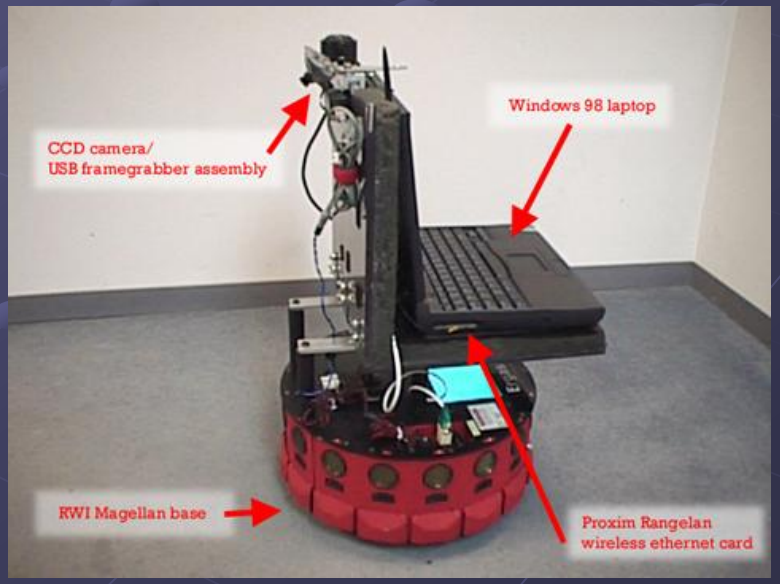
BRADLEY UNIVERSITY

Presentation Overview

- Previous Project Research
- Project Summary
- Project Goals and Functional Requirements
- System Block Diagram
- Software Flowchart
- Subsumption vs Blackboard Architecture
- Accomplishments
- Remaining Work
- GANTT Chart

Previous Project Research

- Previous Platforms
  - Magellan Robot
  - GuideBot (Using Pioneer 2)
- Localization Methods and Sensors
  - Mapping
  - Feature Recognition
  - RFID



Previous Project Research

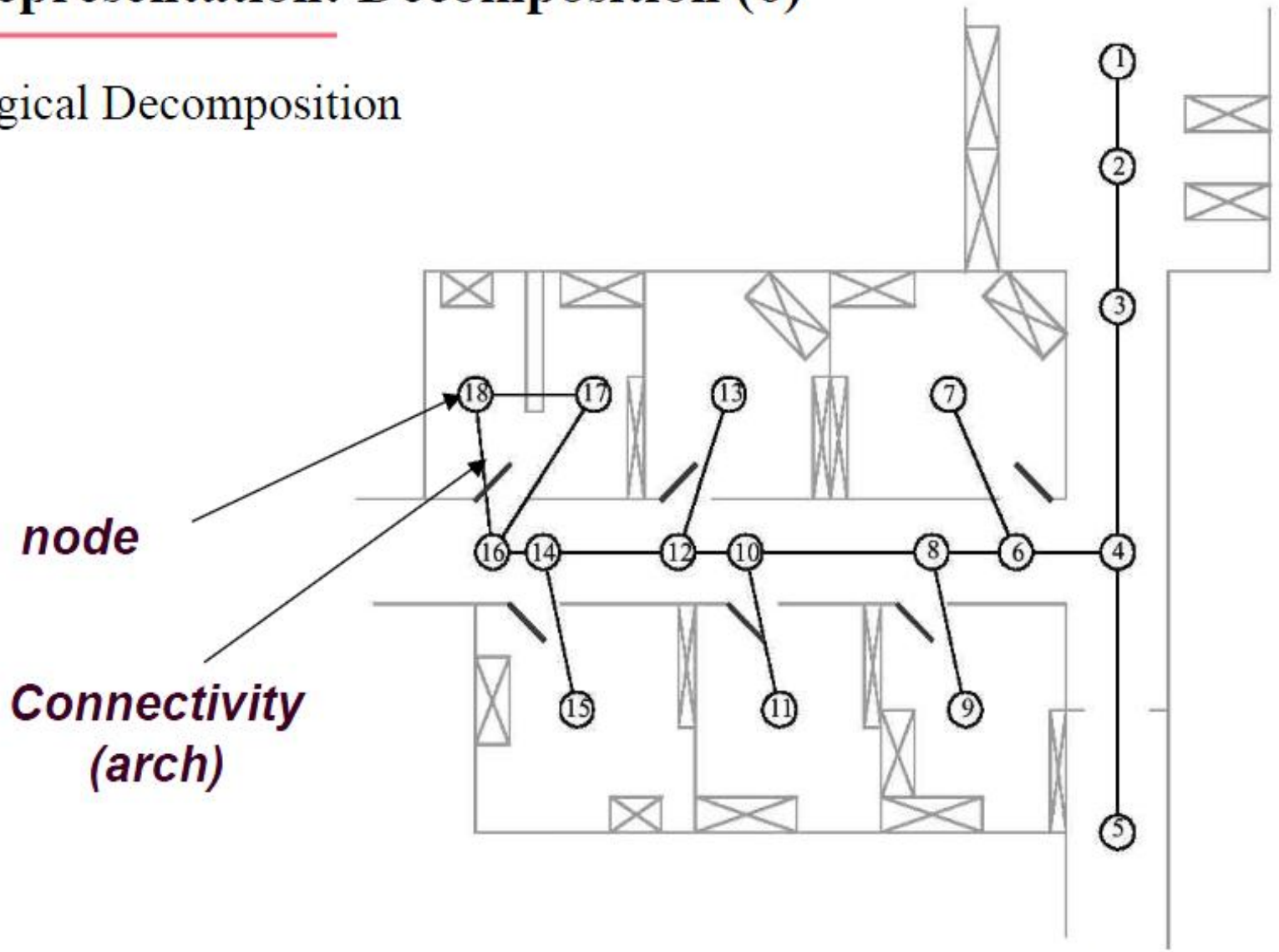
- Previous Platforms
  - Magellan Robot
  - GuideBot (Using Pioneer 2)
- Localization Methods and Sensors
  - Mapping
  - Feature Recognition
  - RFID

Project Summary

- Autonomous Tour Robot – Pioneer 3
- 2nd and 3rd floor of ECE Department
- Utilize Elevator
- Localization - Barcodes
- Navigation – Topological Decomposition

Map Representation: Decomposition (6)

- Topological Decomposition



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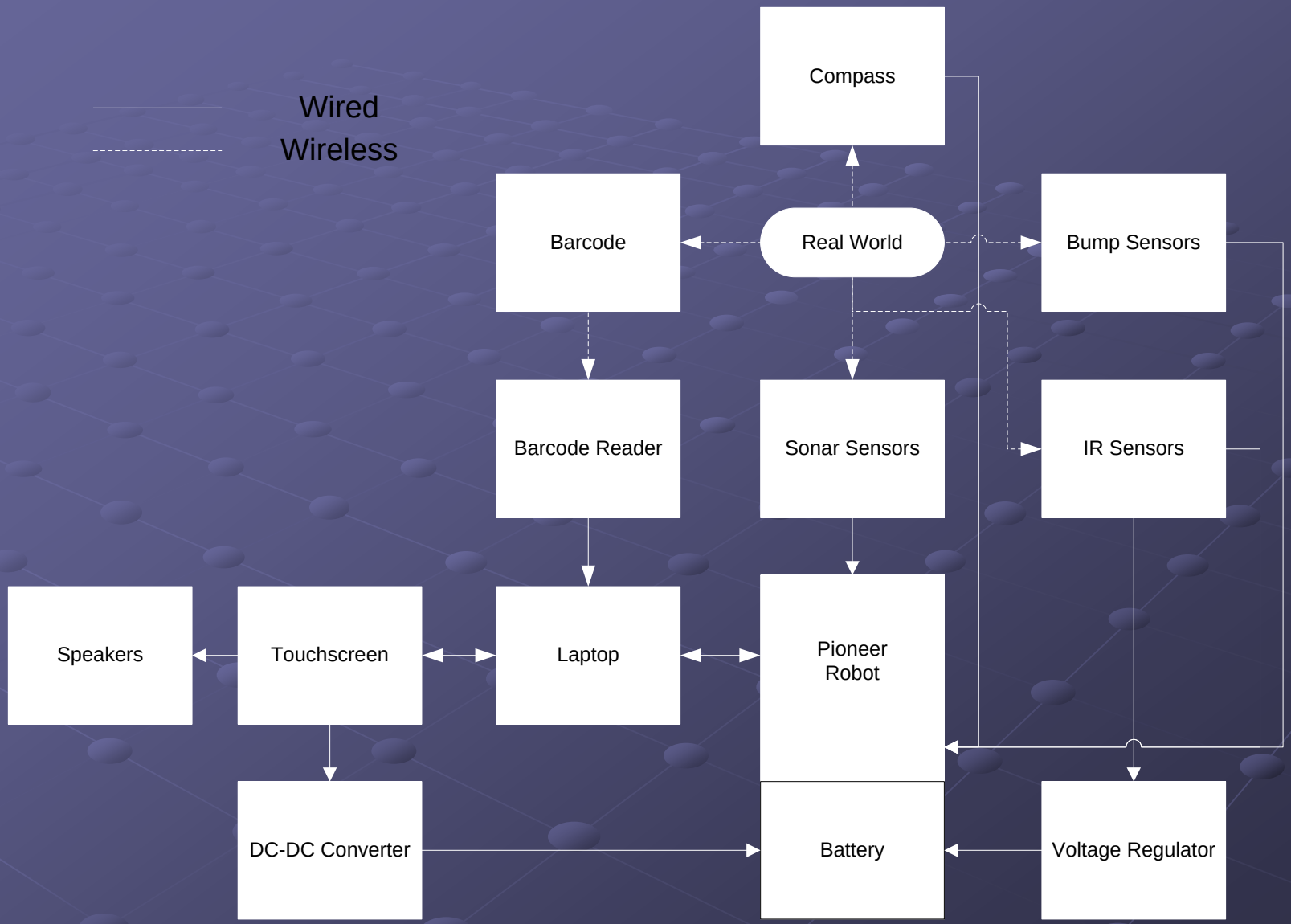
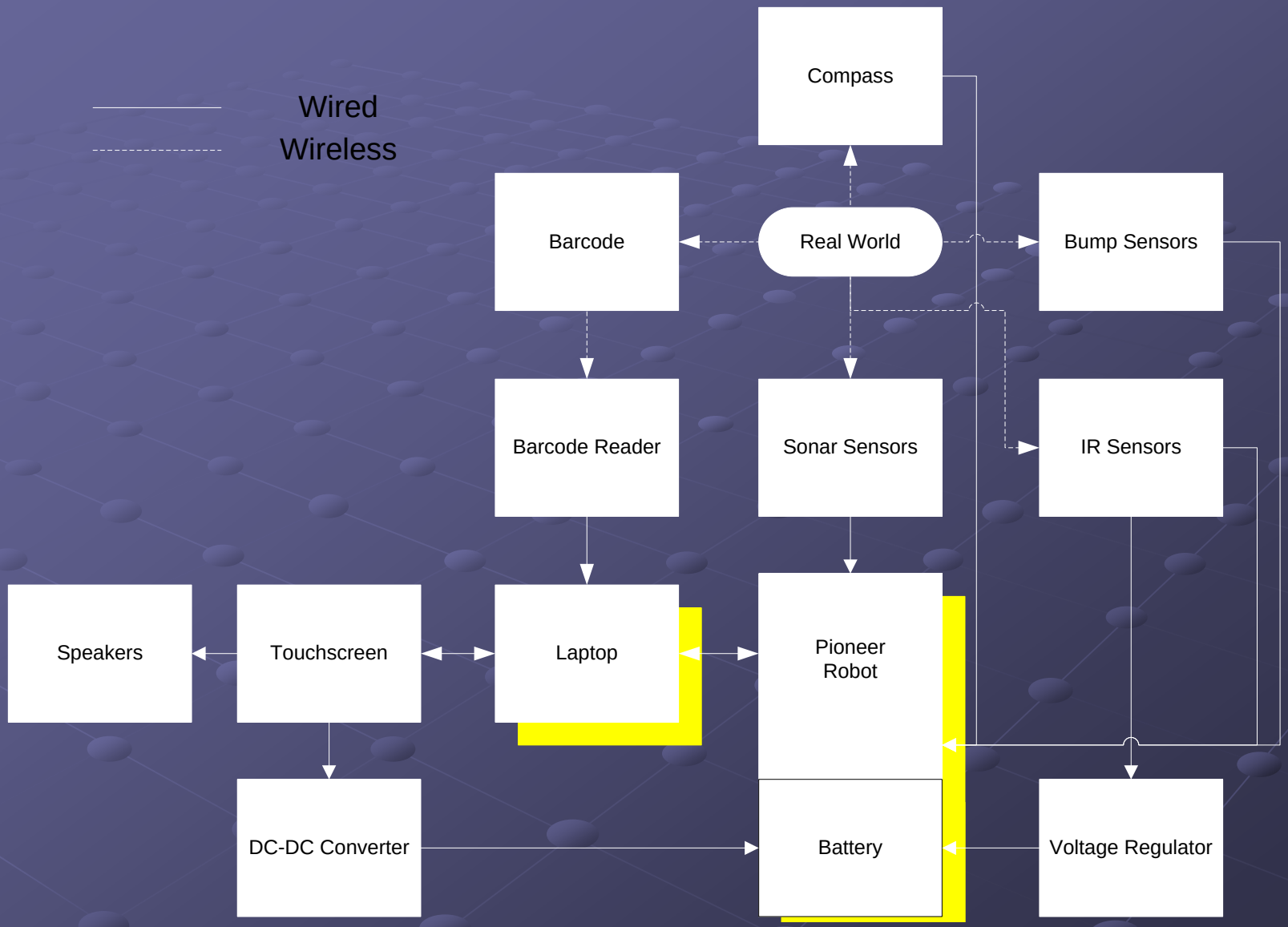
Project Goals Drive Functional Requirements

- Successfully Navigate ECE Department
  - 3 floor tour options or 28 locations
  - Locate waypoints within a 4’ radius
- React in a ‘Human-like’ Manner
  - Avoid all obstacles → humans avoid obstacles
  - Software loop time → human reaction time
  - Transit speed → human walking speed

System Block Diagram



System Block Diagram



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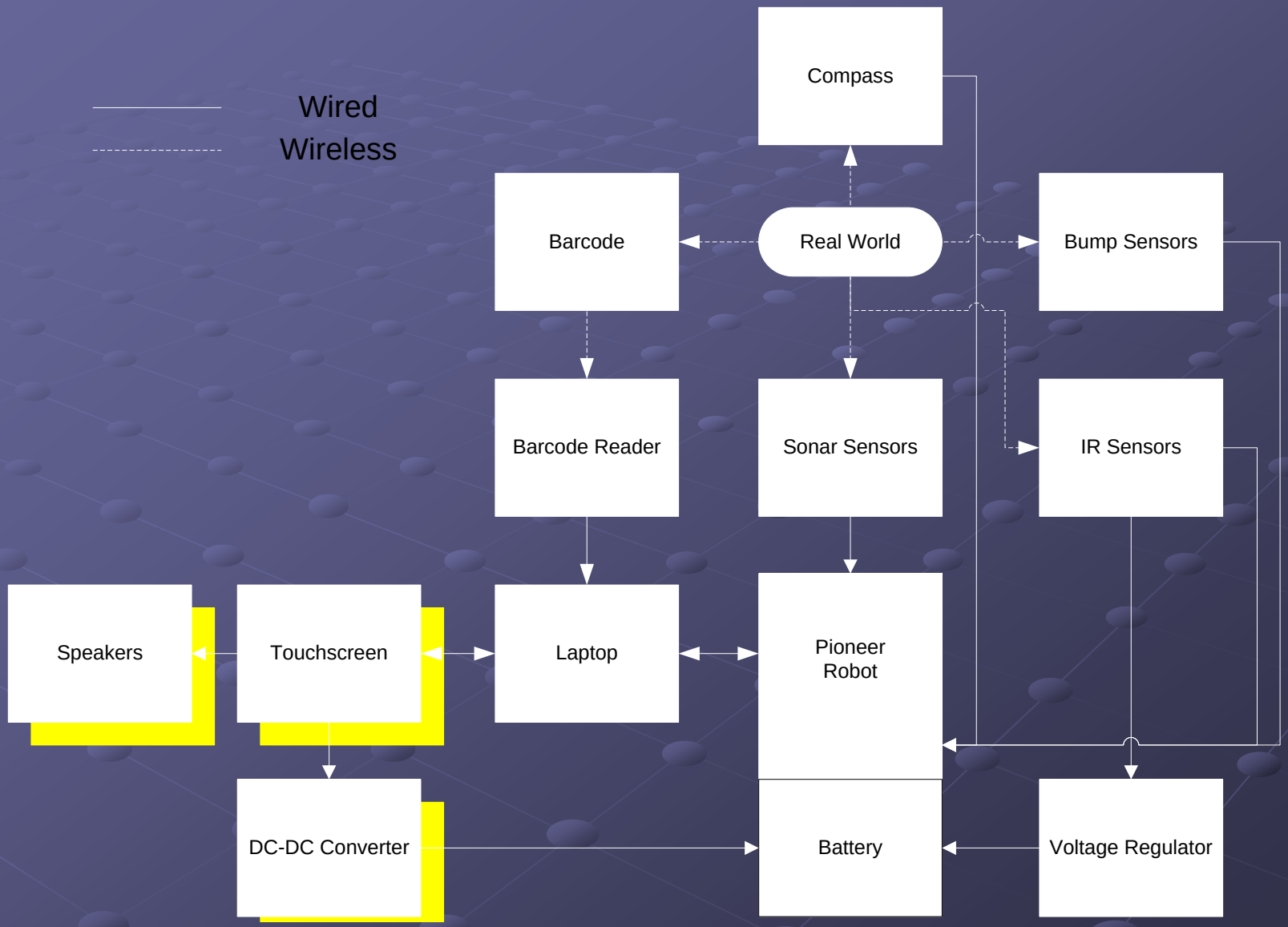

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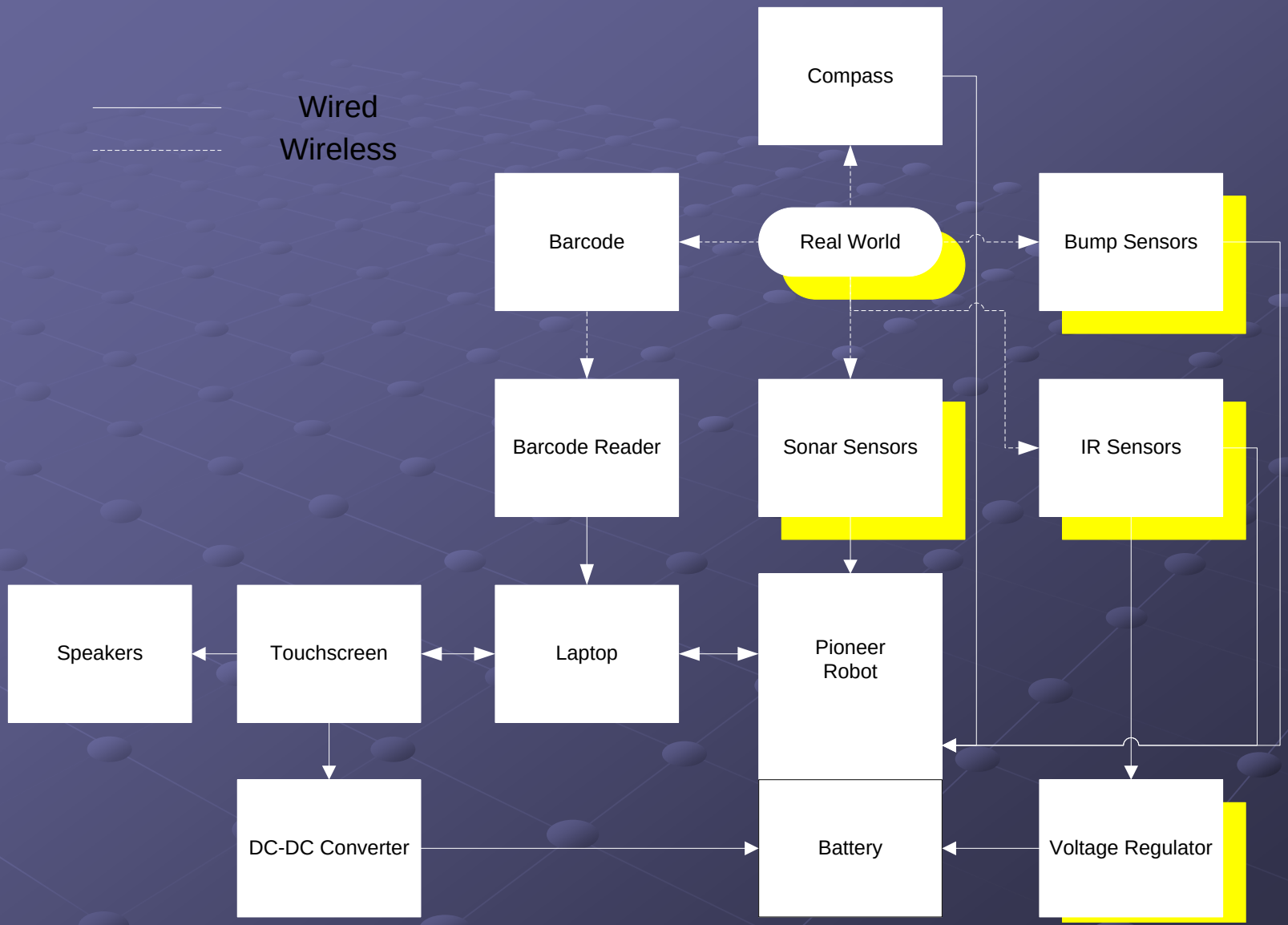
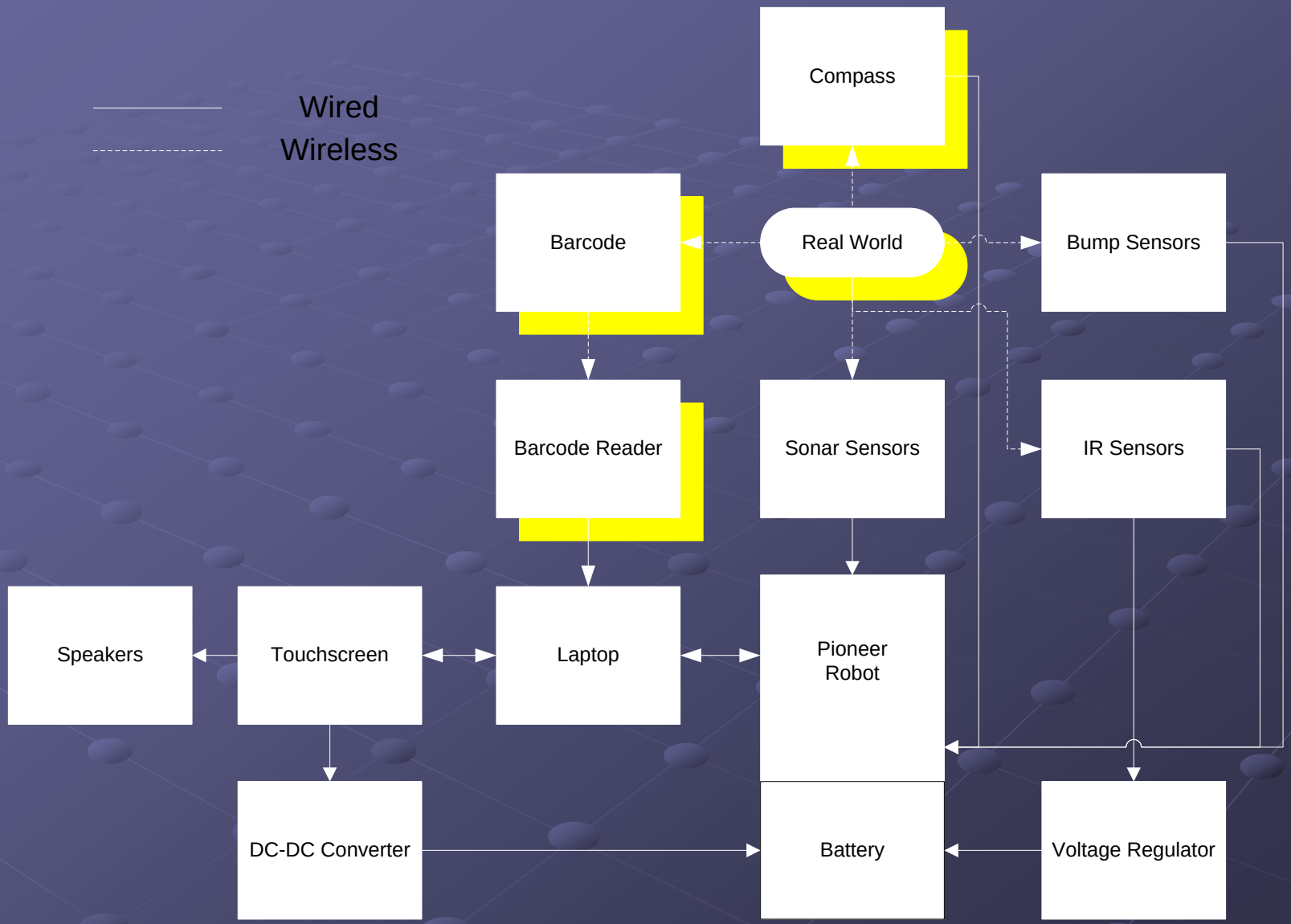
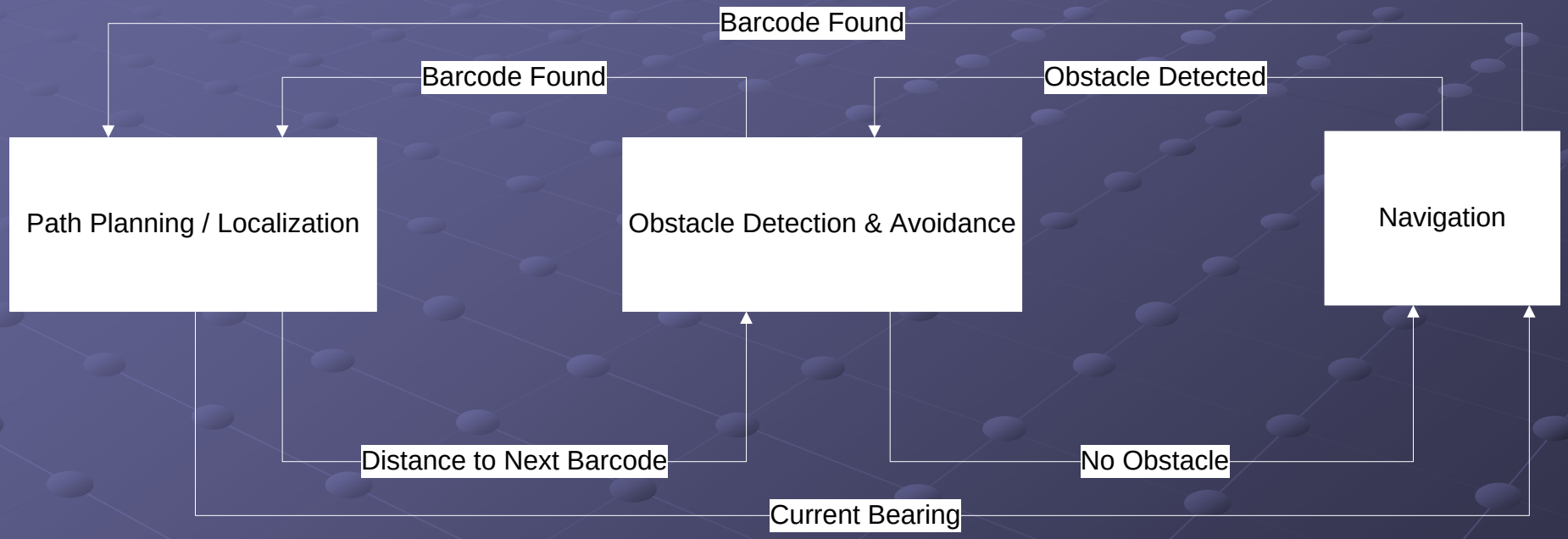


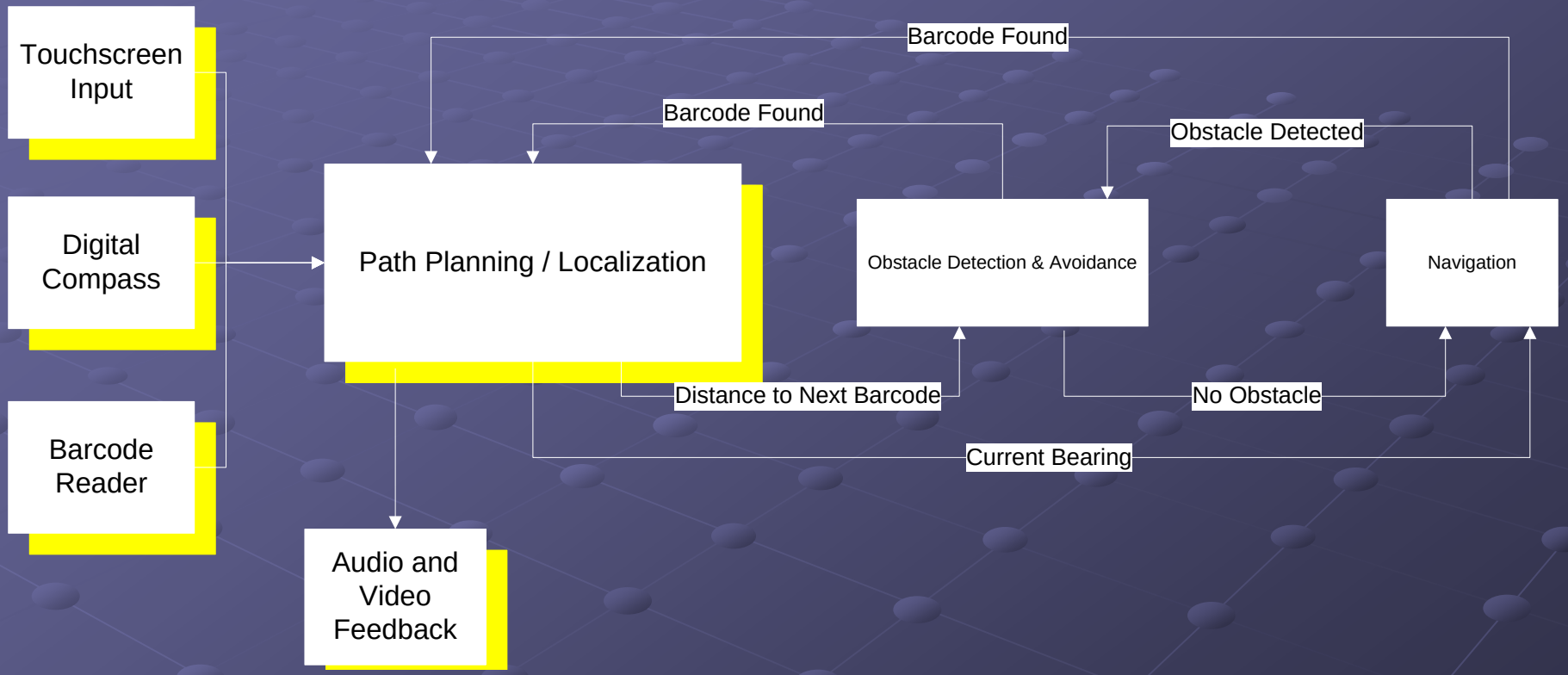
System Block Diagram



Software Flowchart



Software Flowchart



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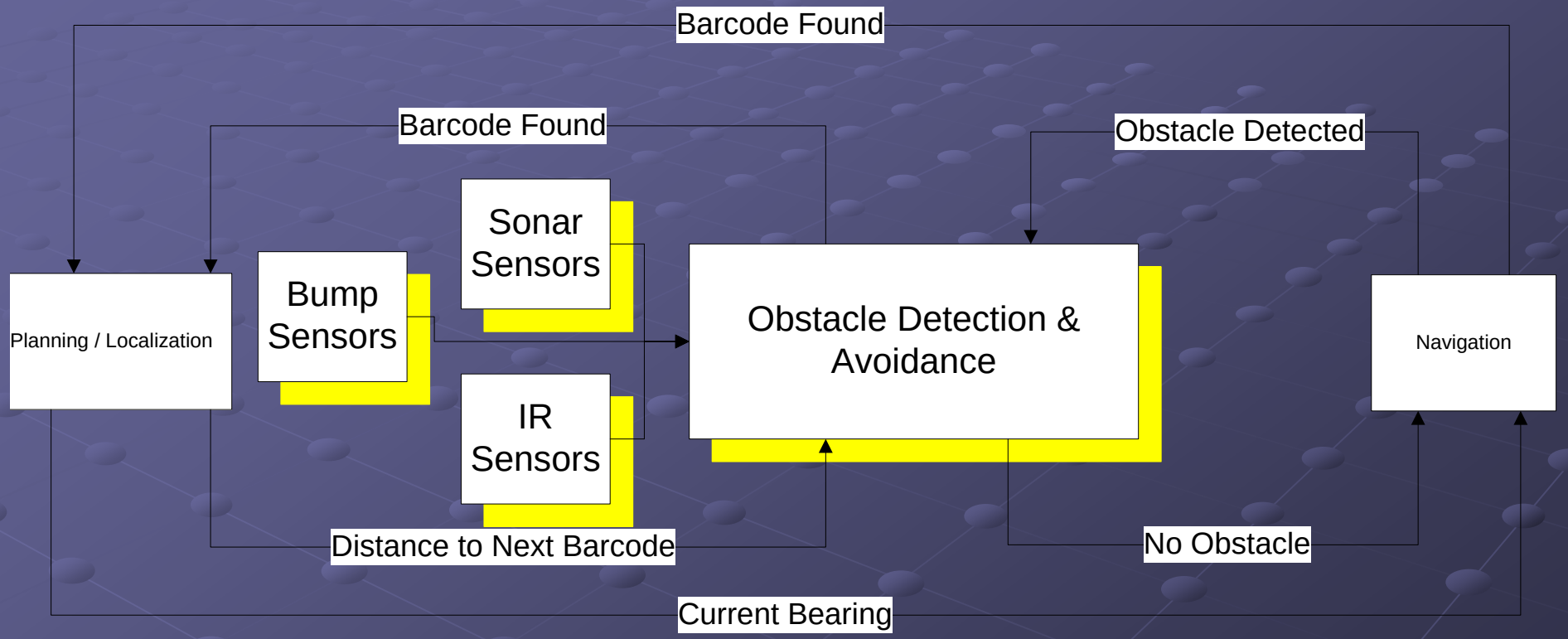

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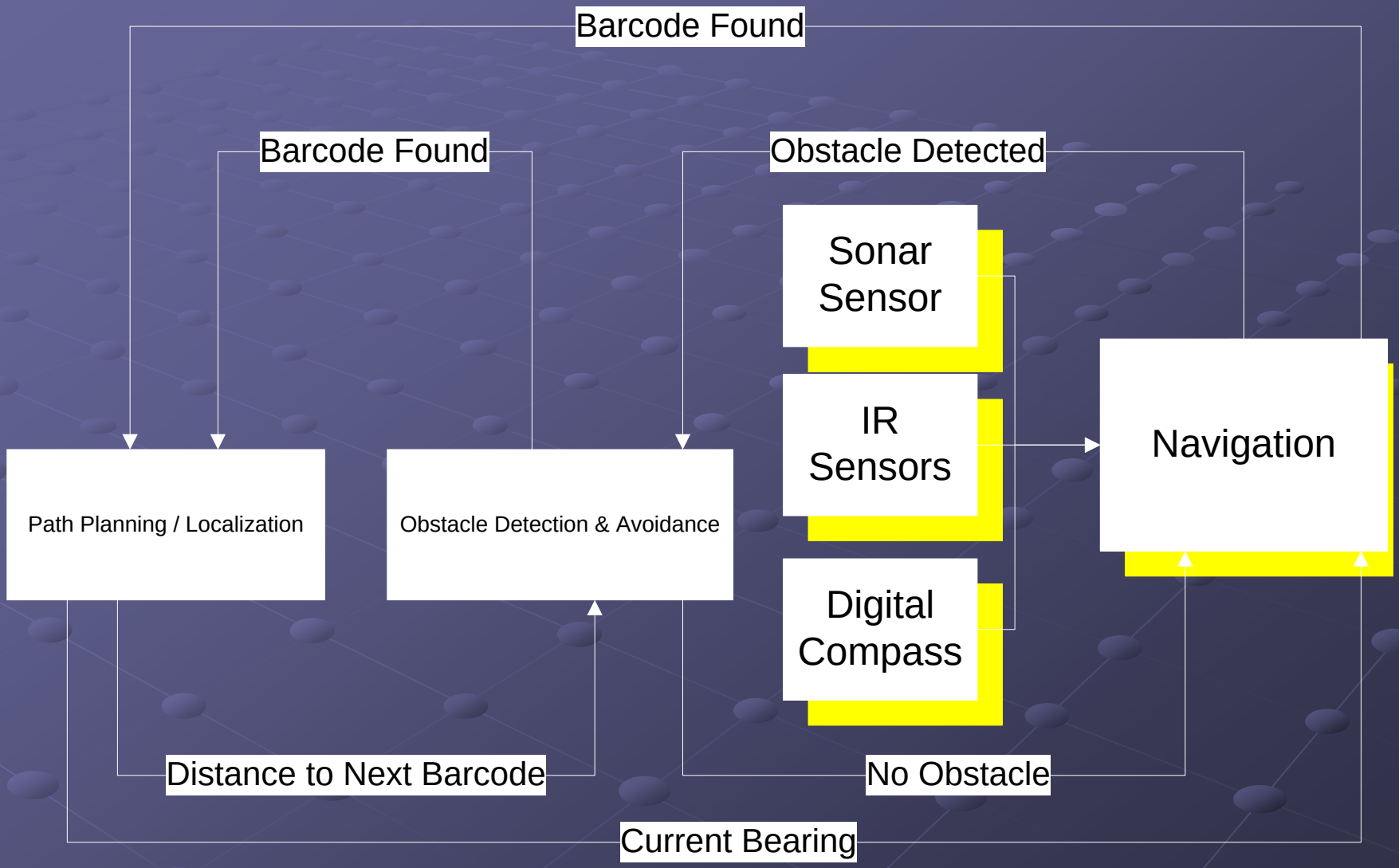
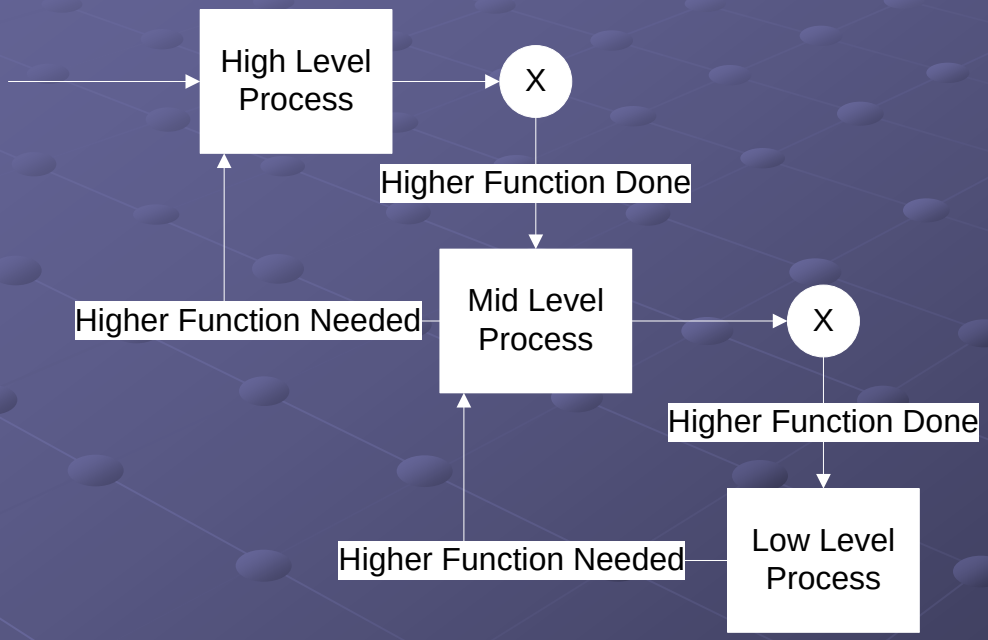
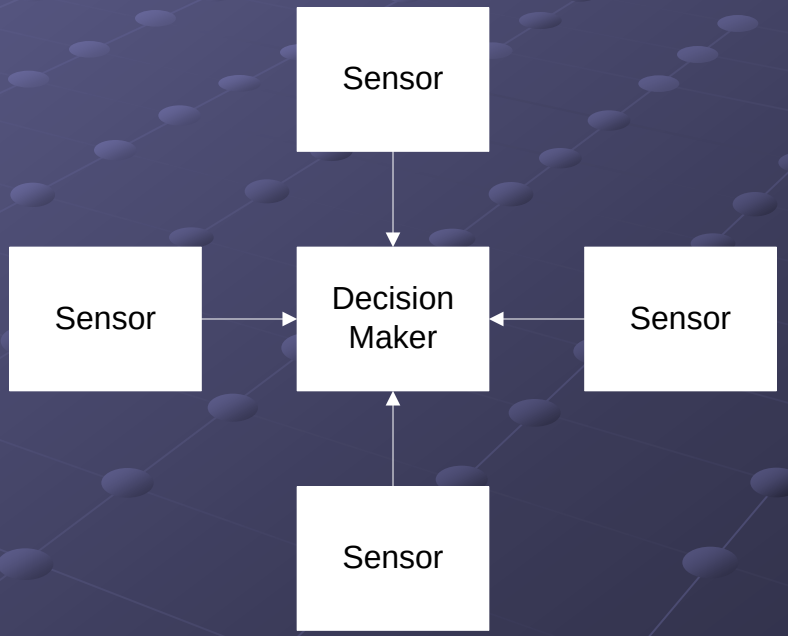


Subsumption vs. Blackboard Architecture

- Subsumption



- Blackboard

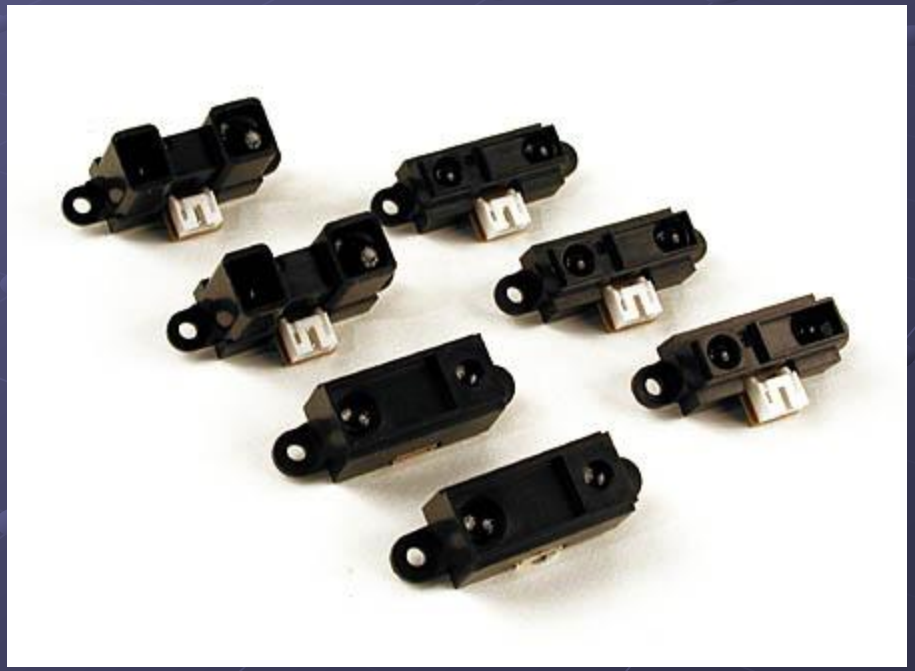


Accomplishments

- Selected Robot Platform
- Built ModelSim Environments
- Developed Flowcharts
  - Path Planning Algorithm
  - Navigation Algorithm
- Interfaced Development HID - Joystick

Accomplishments

- Selected Localization & Navigation Sensors
  - Native Sonar Sensors
  - Barcode Reader
  - Digital Compass
  - IR Sensors



Incomplete Work

- Obstacle Detection/Avoidance Algorithm
- Sonar Sensor Filtering Research
  - Adjusting Gain
  - Adjusting Firing Order
  - Erratic Value Check
  - Rolling Average
  - Kalman Filter

Parts List

Component	Vendor	Part Number	Quantity	Ordering Cost
Touchscreen	3M	11-81375-225	1	
Speakers	Cyber Acoustics	CA-2908	1	$ 40.00
IR Sensors	Sharp	GP2Y0A700K	8	$ 100.00
Barcode Reader	Wasp	WLS8400ER	1	$ 600.00
Rear Sonar Sensors	ActivMedia	ACAX032	1	$ 470.00
Compass	ActivMedia	ACT012	1	$ 1,395.00
DC-DC Converter	Recom	RP30-1212SF	1	$ 110.00
Bumper	ActivMedia	ACAX013	1	$ 945.00
ADC to USB with Terminal Board	Pico Technology	PP241	1	$ 189.00
Voltage Regulator	National Semiconductor	LM317T	1	$ 1.86
Pioneer	ActivMedia	P3X0001	1	
Grand Total				$ 3,850.86

Parts List

Component	Vendor	Part Number	Quantity	Ordering Cost
Touchscreen	3M	11-81375-225	1	
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Barcode Reader	Wasp	WLS8400ER	1	$ 600.00
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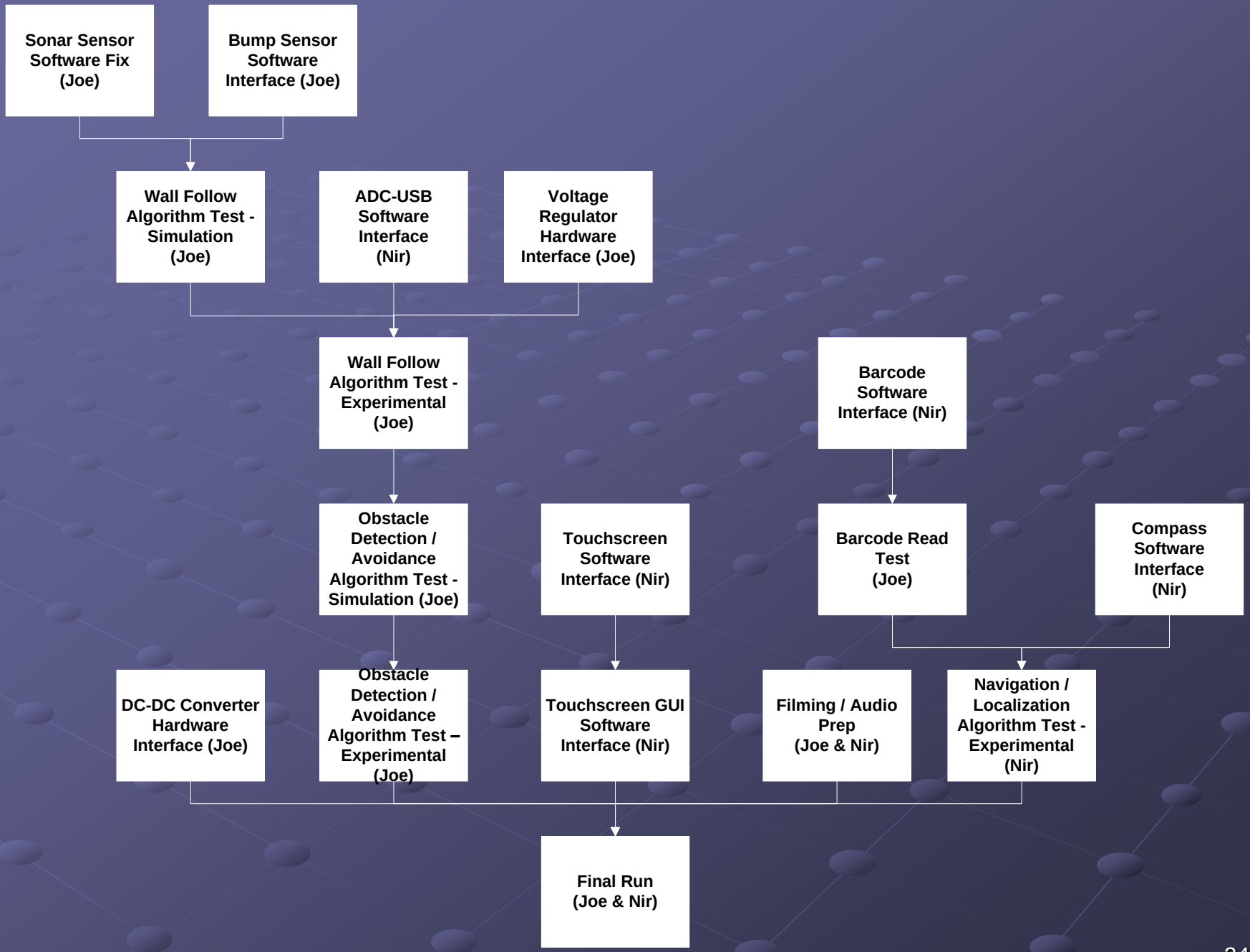
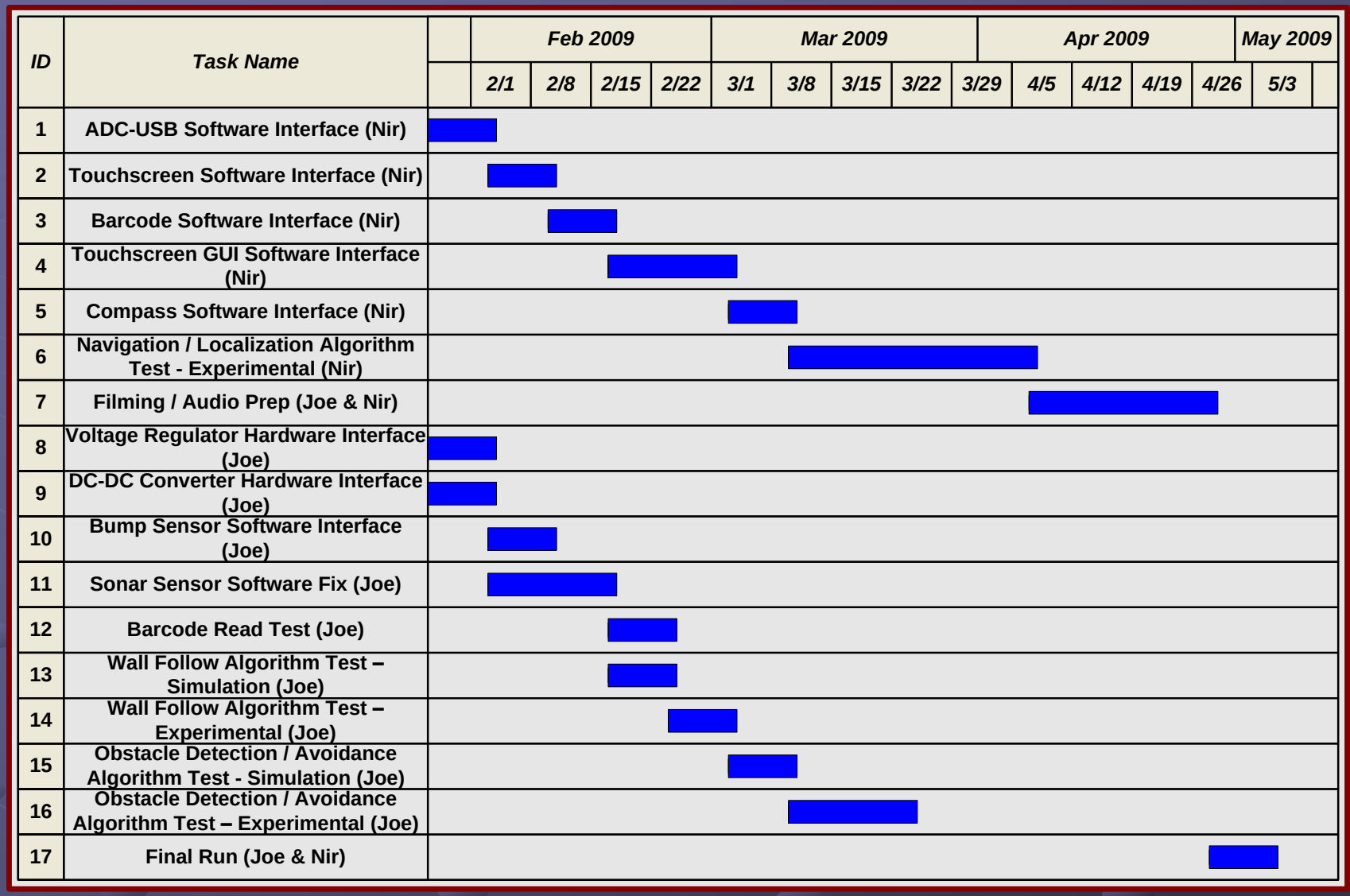

Sonar Sensor Software Fix (Joe)
Bump Sensor Software Interface (Joe)
Wall Follow Algorithm Test - Simulation (Joe)
ADC-USB Software Interface (Nir)
Voltage Regulator Hardware Interface (Joe)
Wall Follow Algorithm Test - Experimental (Joe)
Barcode Software Interface (Nir)
Obstacle Detection / Avoidance Algorithm Test - Simulation (Joe)
Touchscreen Software Interface (Nir)
Barcode Read Test (Joe)
Compass Software Interface (Nir)
DC-DC Converter Hardware Interface (Joe)
Obstacle Detection / Avoidance Algorithm Test – Experimental (Joe)
Touchscreen GUI Software Interface (Nir)
Filming / Audio Prep (Joe & Nir)
Navigation / Localization Algorithm Test - Experimental (Nir)
Final Run (Joe & Nir)

Next Year's Gantt Chart



Acknowledgments and Questions

- Dr. Joel Schipper
- Dr. James Irwin
- Dr. Aleksander Malinowski
- Dr. Gary Dempsey
- Mr. Nick Schmidt
- Mr. Chris Mattus
- ~~Phillip Faber~~

High Level Goals

- Successfully navigate the ECE Department
- Identify key points throughout a tour
- Provide accurate information to the user
- Provide a means for user input

Full Requirements (1)

- Must reach intended goal within a 4’ radius
- Avoid all obstacles, moving or stationary
- Must detect when battery is at 10% of max charge
- Additional range sensors added to the Pioneer 3 must have a minimum range from 6” to 10’

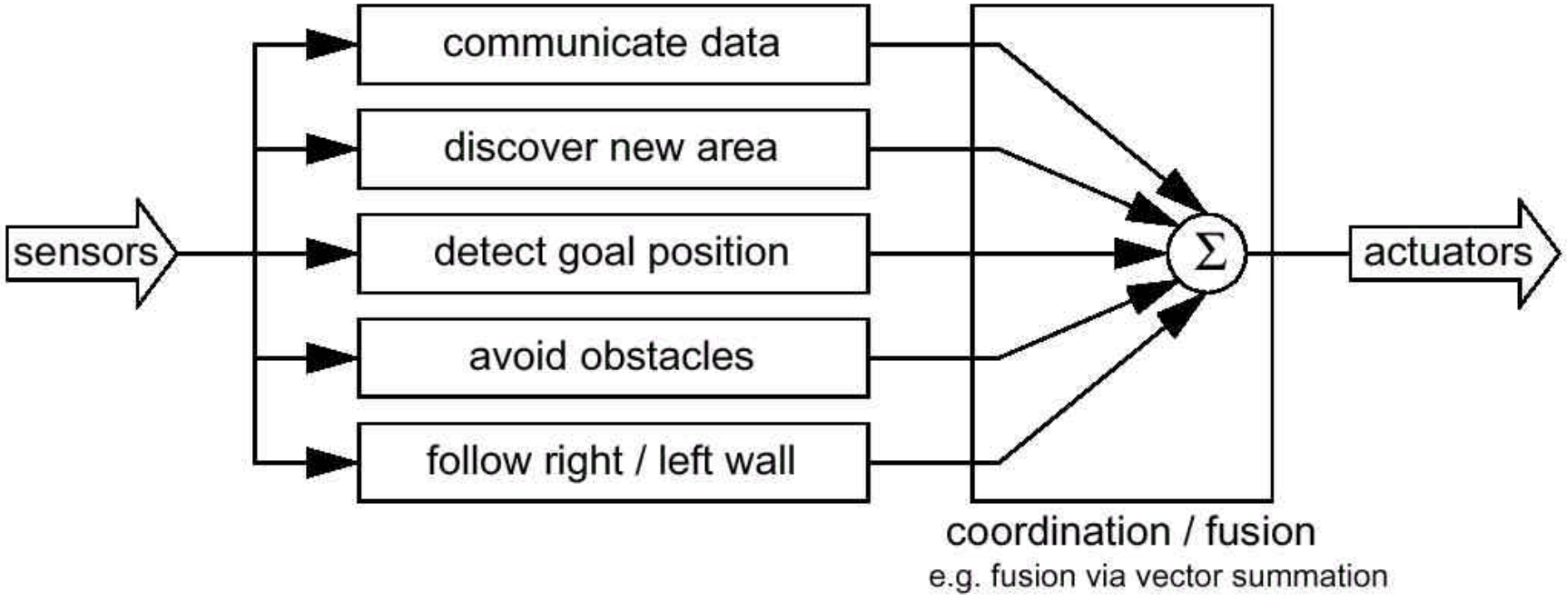
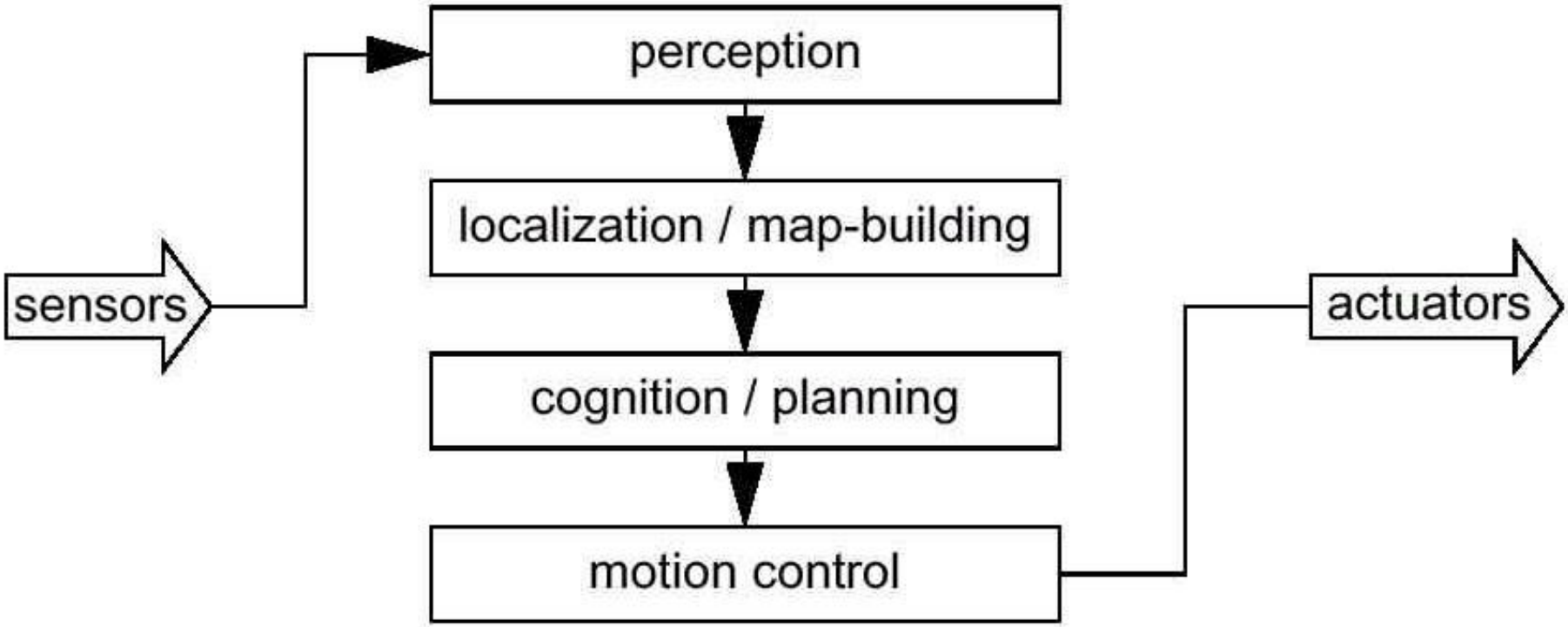
Full Requirements (2)

- Additional range sensors added to the Pioneer 3 must have a measurement accuracy of 5”
- Must allow user to select one of 28 locations or one of 3 complete floor tours
- Additional compass sensor added to the Pioneer 3 must provide an accurate magnetic bearing within 10°
- Must have a complete software loop faster than 180 ms

Full Requirements (3)

- Must have a complete software loop faster than 180 ms
- Must maintain an average speed of 31.5 in/sec during transit

Behavior Based Navigation



Model Based Navigation