IPRO 334

Robotic System Applications to Elderly Living Environments

The Assistive Robotics Team (IPRO 334) is faced with the problem of creating a prototype for a robot meant to be used in a hospital setting or assisting the elderly. The robot should be modular so that future improvements and applications can be easily added. The focus of this semester will be on mobility and interfacing. Other modules may be designed and prototyped throughout the course of the semester. Our progress, resources, and results will be compiled and presented to our professor's department at the Institute of Design.

"An automatically controlled, reprogrammable, multipurpose, manipulator"
-- ISO 8373 definition of a robot

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Semester Goals

- Create a prototype of a robot that is modular in design.
- Enable the robot to deliver an item or message between two points
- Construct a module that demonstrates how future modules must be designed to be powered and identified by the robot.

Future Goals

- Develop modules that would benefit the robot in its task of elderly care, such as face recognition or arms and hands for handling medicine.
- Facilitate interfacing between the robot and a person, possibly through a touch screen.

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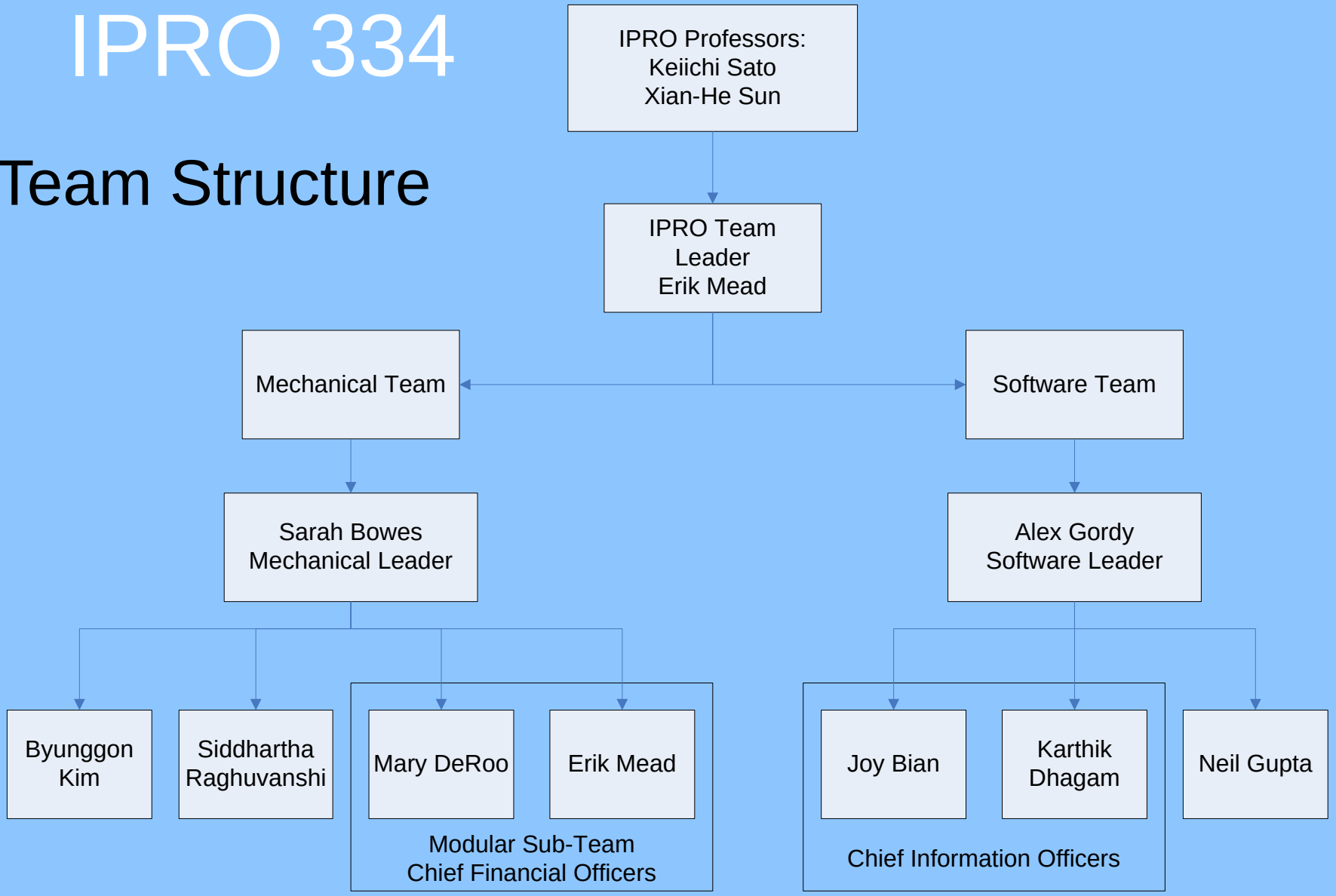
Team Structure



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Project Status

- Week 1: Team Building Session and preliminary brainstorming, Microsoft Robotics Studio familiarization
- Week 2: Presentation on previous research from Institute of Design; Team division, roles, research about robotics kits and sensors
- Week 3: Presentation on Segway IPRO & Interactivity; Goal definition for semester, possibilities for future expansions, decision about parts, ordering, & budget, Decision: Vex Robotics and EasyC software

- Objectives: Introductions, research, structure semester goals, and assign team positions

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Project Status

- Week 4: Project Plan; Received parts for robot, began assembly and studying code/algorithms
- Week 5: Ethics Discussion, modular robot base, separate team meetings to decide on tasks
- Week 6: New software received, team meetings, Midterm Presentation Preparation

- Objectives: Plan semester, design basic structure, and begin programming

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Project Status

- Week 7: IPRO Midterm Presentation, Batteries and Line Tracking Parts Arrived, Forward movement tested, Discovered unbalanced weight issue
- Week 8: Independent teams work to solve robot's balance, adjust basic movement and line following code, Fall Break
- Week 9: Discovered wheel problem, Testing placed on hiatus, Began touch sensor development

- Objectives: refine structure of robot, assess problems, and begin coding specific tasks

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Project Status

- Week 10: Base redesign completed, Additional sensors mounted on frame, Code testing resumed
- Week 11: Election Day cancelation, Line following code tested, Right motor determined as broken
- Week 12: Ordered new parts, Malfunctioning motor replaced, Gear Ratio Adjusted, Began ultrasonic sensor code

- Objectives: Create more modules, perform tests and corrections of line tracking, and support simple interfacing

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Project Status

- Week 13: Received additional sensors and metal pieces, Succeeded in lighting an LED via microcontroller
- Week 14: Final model rendering complete, Deliverables work divided, Thanksgiving Break
- Week 15: Final testing, preparations, and IPRO Day

- Objectives: Investigate microcontroller expansions, and document progress for future semesters

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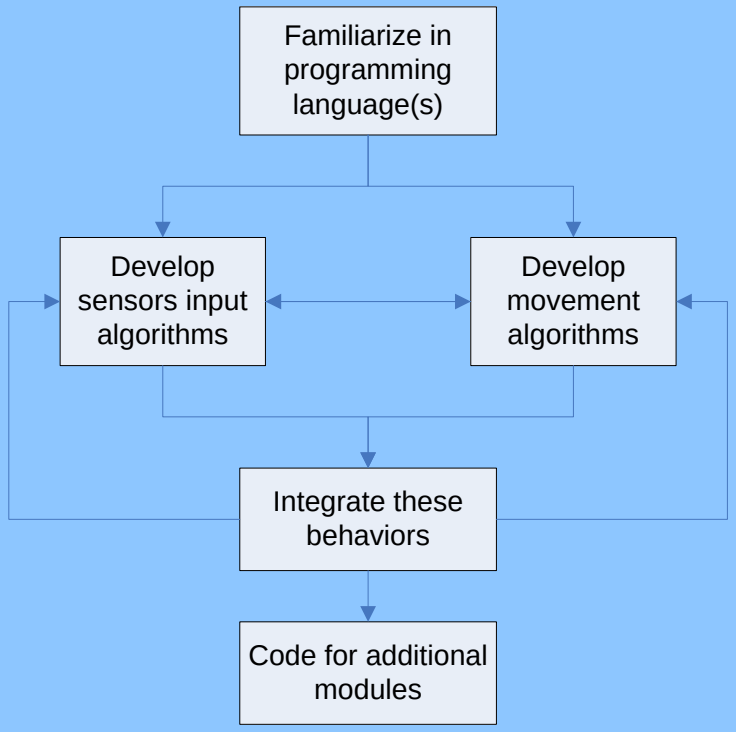
Software Team



Software Team Procedure

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Software Problems Encountered

- Code divided amongst the team—time taken for development, documentation, and testing varied on the complexity of the algorithm
  - Solution: Through the help, advice, and support of the other team members these tasks were accomplished successfully
- Testing delayed by availability, functionality of robot, work space, & equipment
  - Solution: Communication and flexibility was necessary to ensure that the area was available and the equipment was present and functional
- Lack of RobotC documentation slowed down problem solving
  - Solution: Searching for online resources such as RobotC wikis, forums, and testing segments of code through trial and error
- Began the semester learning Microsoft Robotics Studio, switched to Vex Robotics kit, used EasyC software, and later RobotC

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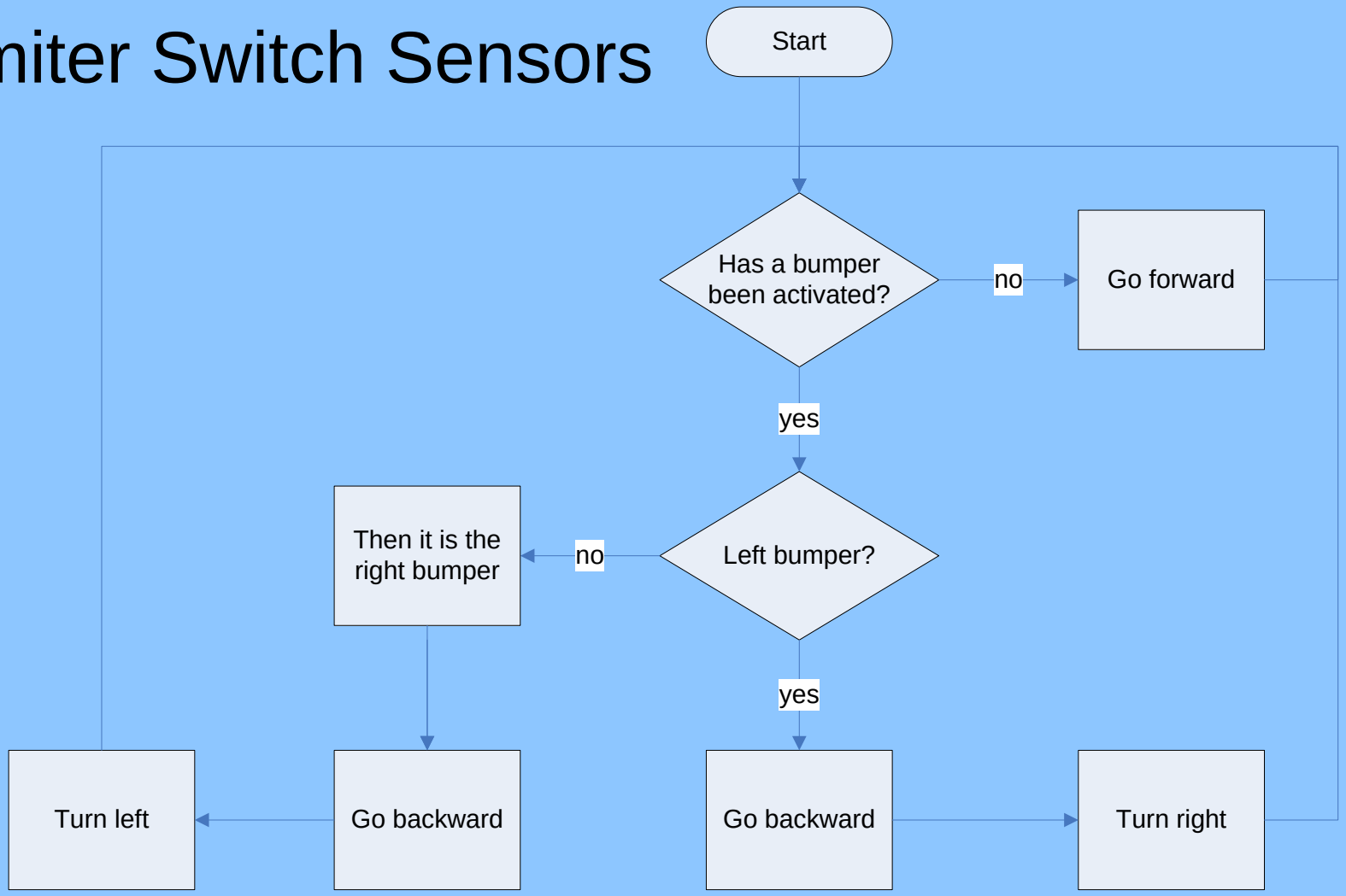
Limiter Switch Sensors



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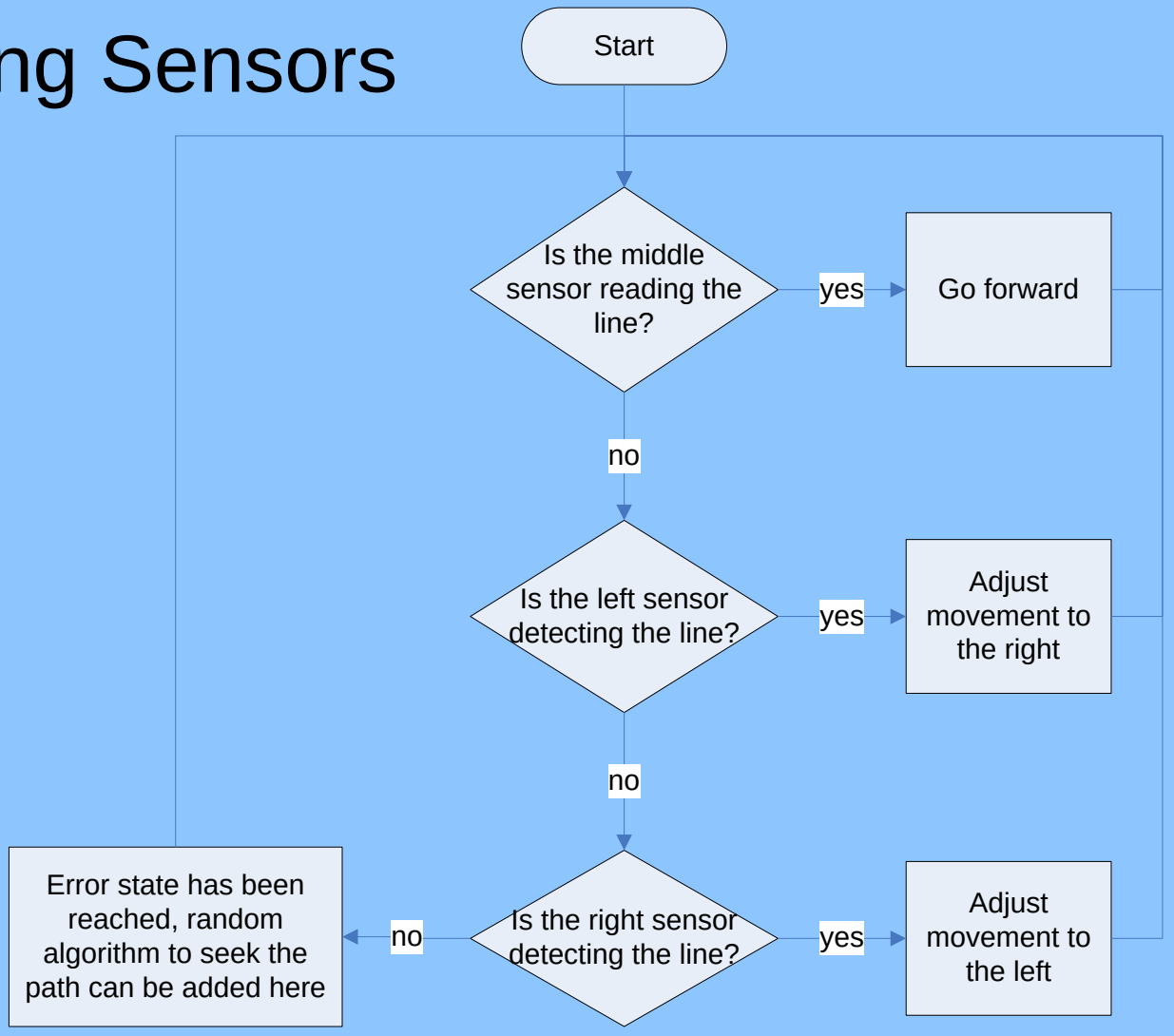
Line Tracking Sensors



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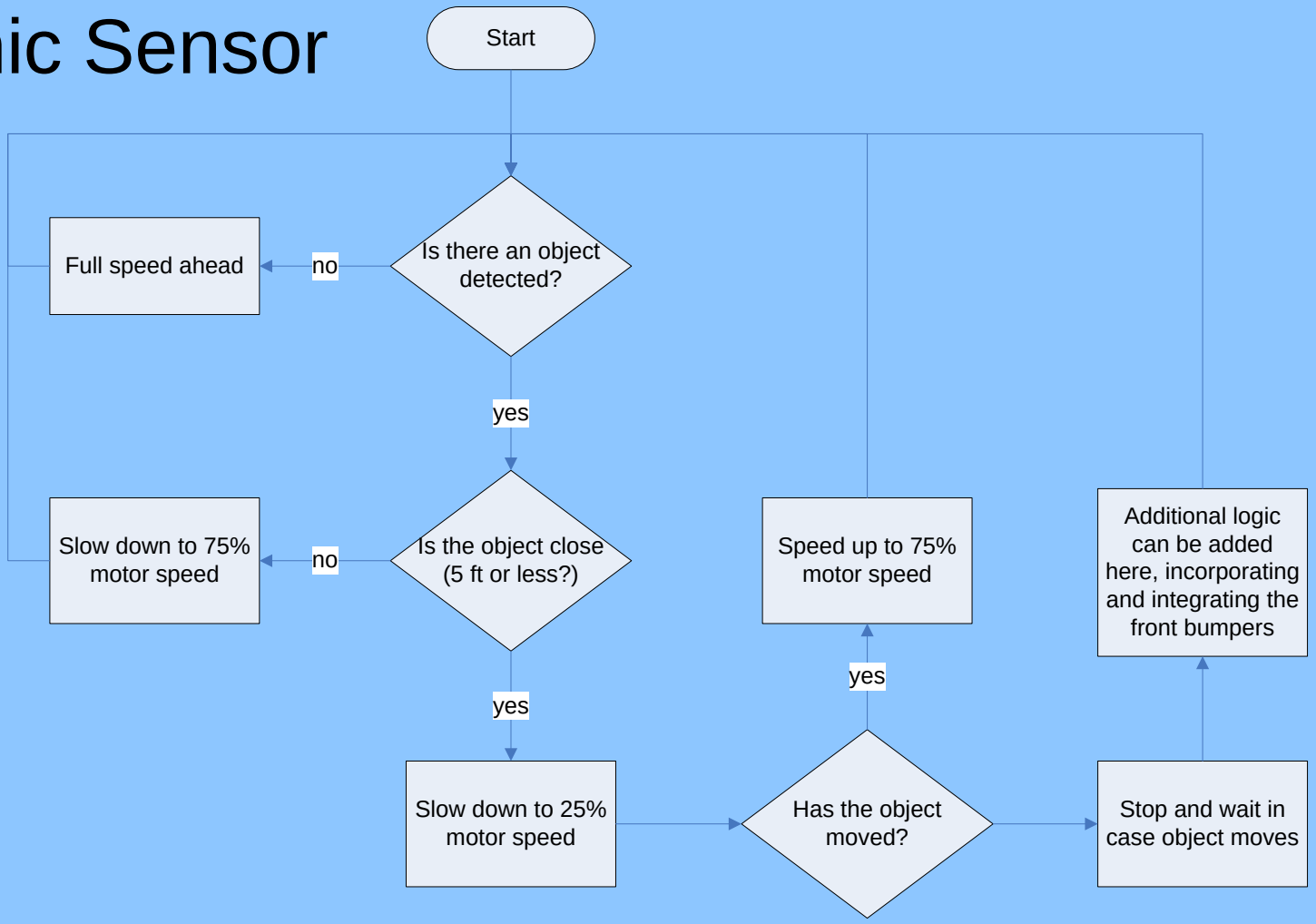
Ultrasonic Sensor



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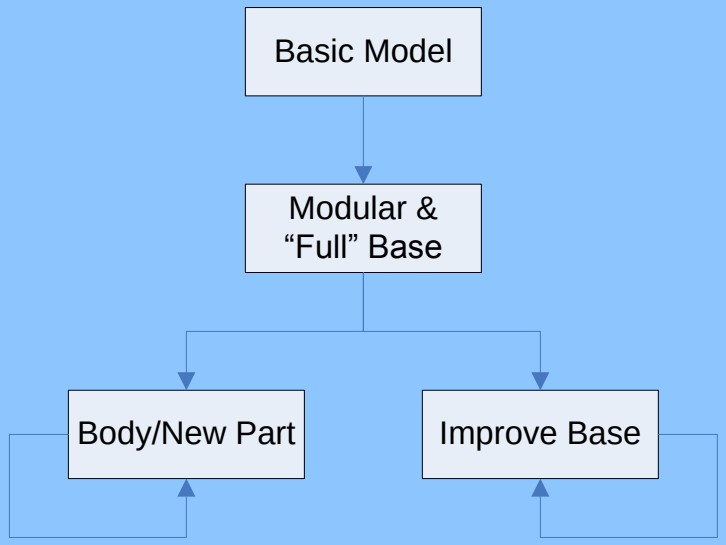
Mechanical Team



Mechanical Team Procedure

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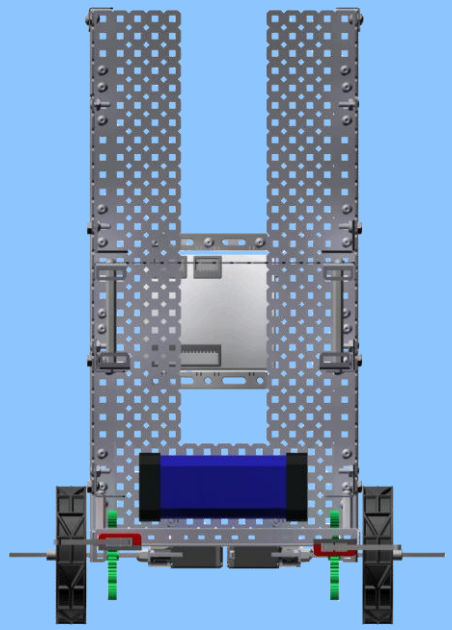
Mechanical Team Steps

- Design initial structure
- Order VEX parts
- Build robot and module inserts, modifying when needed

Design Challenges

- Maximize number of modules while keeping robot stable
- Distribute weight appropriately throughout robot
- Add modules easily with minimal effort



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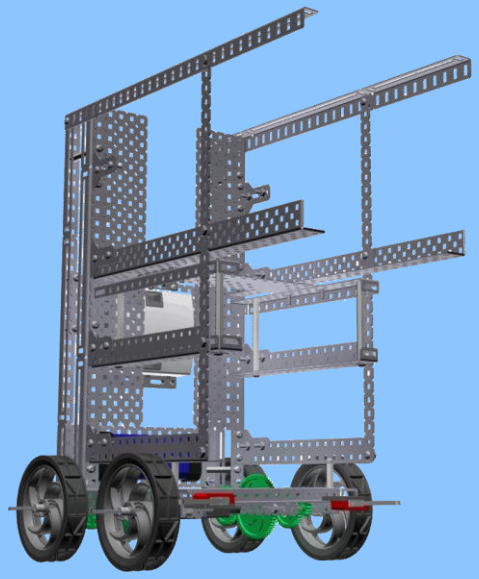
Mechanical Problems Encountered

- The back is weighted down
  - Solution: spread wheels further apart to redistribute weight
- The robot veers to the right
  - Solution: readjust wheel alignment on the base
- Large gears are too close to floor
  - Solution: Use bigger wheels to lift robot higher
- Gear ratio is incompatible with needs of robot
  - Solution: Change gear ratio to slow the robot



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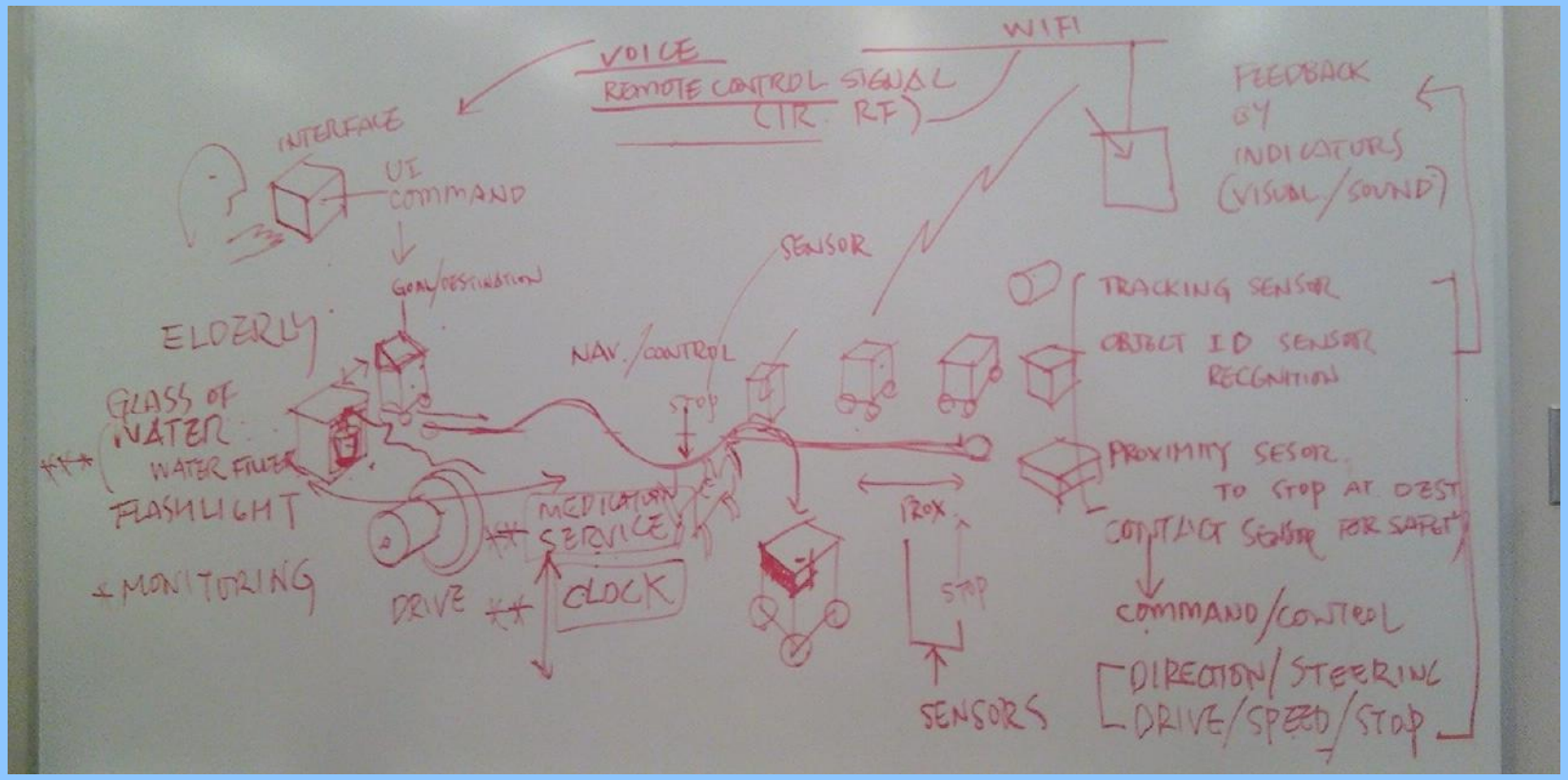
Brainstorming for the Future



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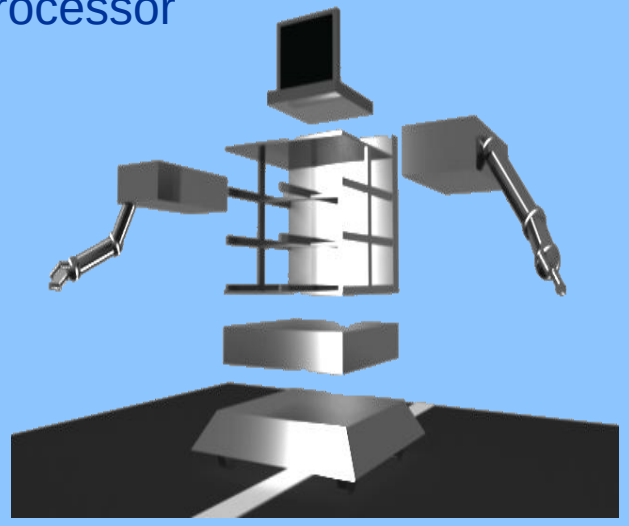
Future Obstacles

- Building a to-scale model of the robot
- Creating an interface between the user and the robot
- Designing more advanced robot algorithms and modules
- Implementing external circuitry via the microprocessor
- Developing a “plug-and-play” modular bay



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Ethical Dilemmas

- Safety
  - Working with healthcare (medicine, cleanliness)
  - Movement/awareness
  - Privacy
- Job opportunity
  - Robot should redistribute work, not displace workers
- Efficiency
  - Robot performs more work than it requires
- Business
  - Cost effective

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Acknowledgements

We would like to thank:

- Our professors, Professor Sato and Professor Sun
- The IPRO office for providing us a valuable workspace

Any Questions?