Autonomous Water Taxi

By: AutoPirates

Date: 24th September 2015

Project Sponsors:

THE ROBOTICS INSTITUTE

NREC National Robotics Engineering Center

Content: Layout for Project Kick-off

Focus on Requirements

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   - Mentors and Sponsors
2. Requirements
   - Project Goals
   - Objectives tree
   - Major functional requirements
   - Performance requirements
3. Architecture
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   - Draft cyber physical architecture

Introduction

Team: Here to Achieve the goal together

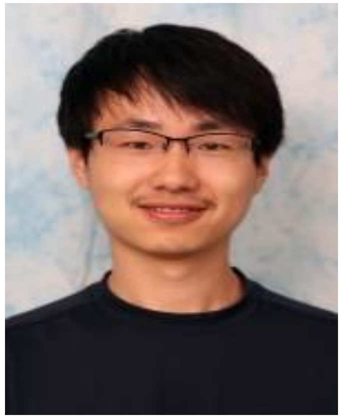
Interdisciplinary team both technically and culturally

Tushar Chugh

Path Planning, Simulator, PM

Background: Microsoft (3 Years)

Electronics and Communication



Shiyu Dong

Perception, Simulator

Background: Intelligent Car

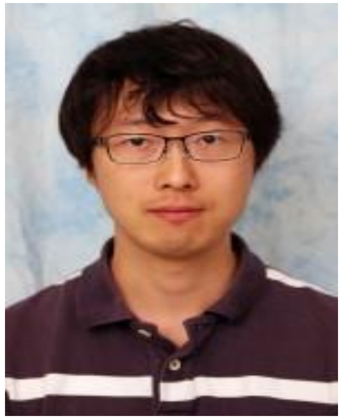
Control and Instrumentation

Bikramjot Hanzra

Perception, System Integration

Background: IRSEEM (6 Months)

Electronical and Electronics

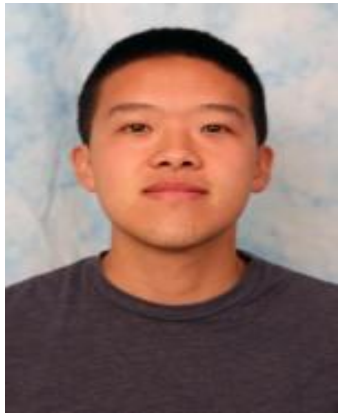


Tae-Hyung Kim

Path Planning, Operator Interface

Background: Samsung(4 Years)

Control and Instrumentation



William Seto

Log Play Back, Perception

Background: UCLA (EE)

Computer Science

Mentors: To help both our team and boat sail successfully

Mentors and Sponsors of the project

Jeremy Searock
Technical Project Manager, NREC

Research Interests:

Autonomous Vehicle Technologies, Multi-Vehicle Coordination, System Integration & Testing

National Robotics Engineering Center

THE ROBOTICS INSTITUTE

Dr. John Dolan
Principal Systems Scientist, RI

Research Interests:

Autonomous Driving, Telesupervisory human-robot systems, Robot Reliabilty

Dr. Dimitrios Apostolopoulos
Senior Systems Scientist, RI & NREC

Research Interests:

Modeling and Simulation, Electromechanical Design, System Integration & Test

Requirements

Project Goals

Goals defined by the sponsor

1. Demonstrate the ability to operate an autonomous taxi service taking passengers to hubs along the Allegheny, Monongahela, and Ohio Rivers. (autonomous docking is not required)
2. Write/port/integrate the perception algorithms to track dynamic obstacles (other boats) and identify static obstacles (shore, buoys)
3. Write/port/integrate a path planning algorithm to travel to waypoints without hitting anything and not "confusing" other human boaters

Equipment provided

1. 2015 SeaHawk OS 2700S
2. Velodyne VLP-16
3. SimRad 4G FMCW Radar
4. Novatel SPAN with IMU positioning
5. Laptop

Boat Specifications

27′ Length x 8′ 6″ Width
Twin 150Hp Yamaha engines
180 gal fuel tank
Top cruising speed (40 mph)
9 foot cabin

A/C and heating
10 kw AC generator
Internal Ethernet network
Fathometer
Navigation Screen

Sneak Peak of the Boat and Sensors

Functional Requirements

Autonomy | Log Play-back | OCU

Autonomy of the boat shall

1. Provide control for throttling and steering
2. Navigate boat through way points given no obstacles
3. Detect and avoid Static obstacles
4. Drive through bridges

Stretch

1. Detect Dynamic Obstacles
2. Estimate path of dynamic obstacles

Log Play back feature shall

1. Record data from sensors
2. Play-back data to boat/simulator
3. Find and Integrate simulator

Operator Control Unit (OCU) shall

1. Provide interface to enter destination
2. Display current location on map (display)

Non-Functional and Performance Requirements

Non-Functional Requirements

1. Follow right alignment on path
2. Not confuse other manual boats
3. Keep 25-30 trails for testing (Budget constraint)

Performance Requirements

1. Maximum Speed: 15 MPH
2. Testing distance: 2 miles in 15 minutes (5 static obstacles)
3. Obstacle size: Proportional to the resolution of sensors
4. Types of obstacles: Shore, buoys, other boats

Objectives Tree: Categorizing the Functions

Autonomous Water Taxi Shall

Detect Obstacles: Perception

- Detect static obstacles like shores and Buoys
- Detect dynamic Obstacles like other boat
- Navigate through bridges

Plan the path: Planning

- Navigate autonomously given no obstacles
- Plan new path in case of static obstacles
- Estimate path of other boats
- Plan and navigate on new estimated path

Provide User Interface: OCU

- Provide interface to enter destination
- User can enter up to 12 destinations
- Show current location and projected path on map (display)

Follow Traffic Rules: Safety

- Follow traffic rules of 3 rivers (same as manual boats)
- Not confuse other sailing boats

Collect data & relay: Play-back

- Record data from sensors
- Playback data to boat/simulator
- Interface simulator for testing

Work Division: Playing to our strengths

Technical Work

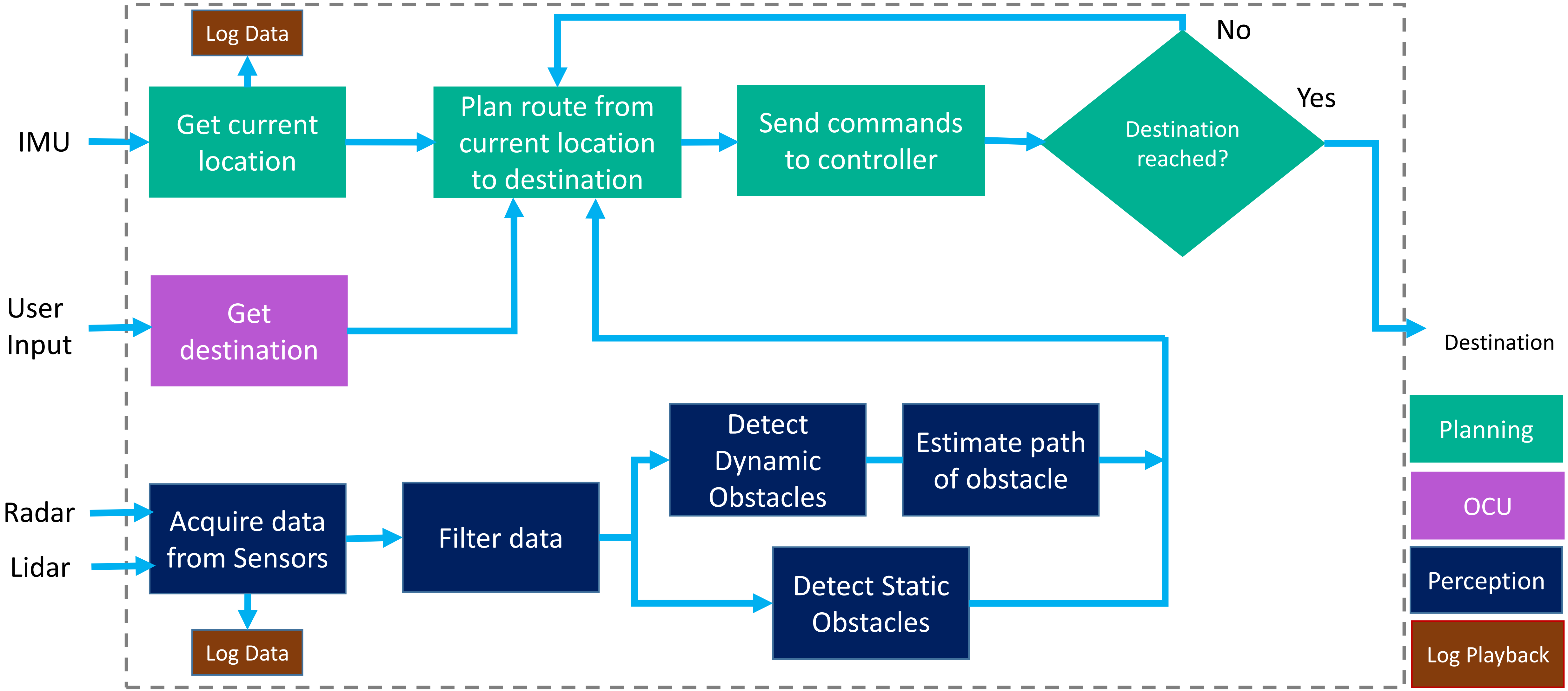
Perception	Planning	OCU	Log Play Back	Simulatior	System Integration
Bikram	Tushar	Tae-Hyung	William	Shiyu	Bikram
Shiyu	Tae-Hyung		Tushar		
William					

Non-Technical Work

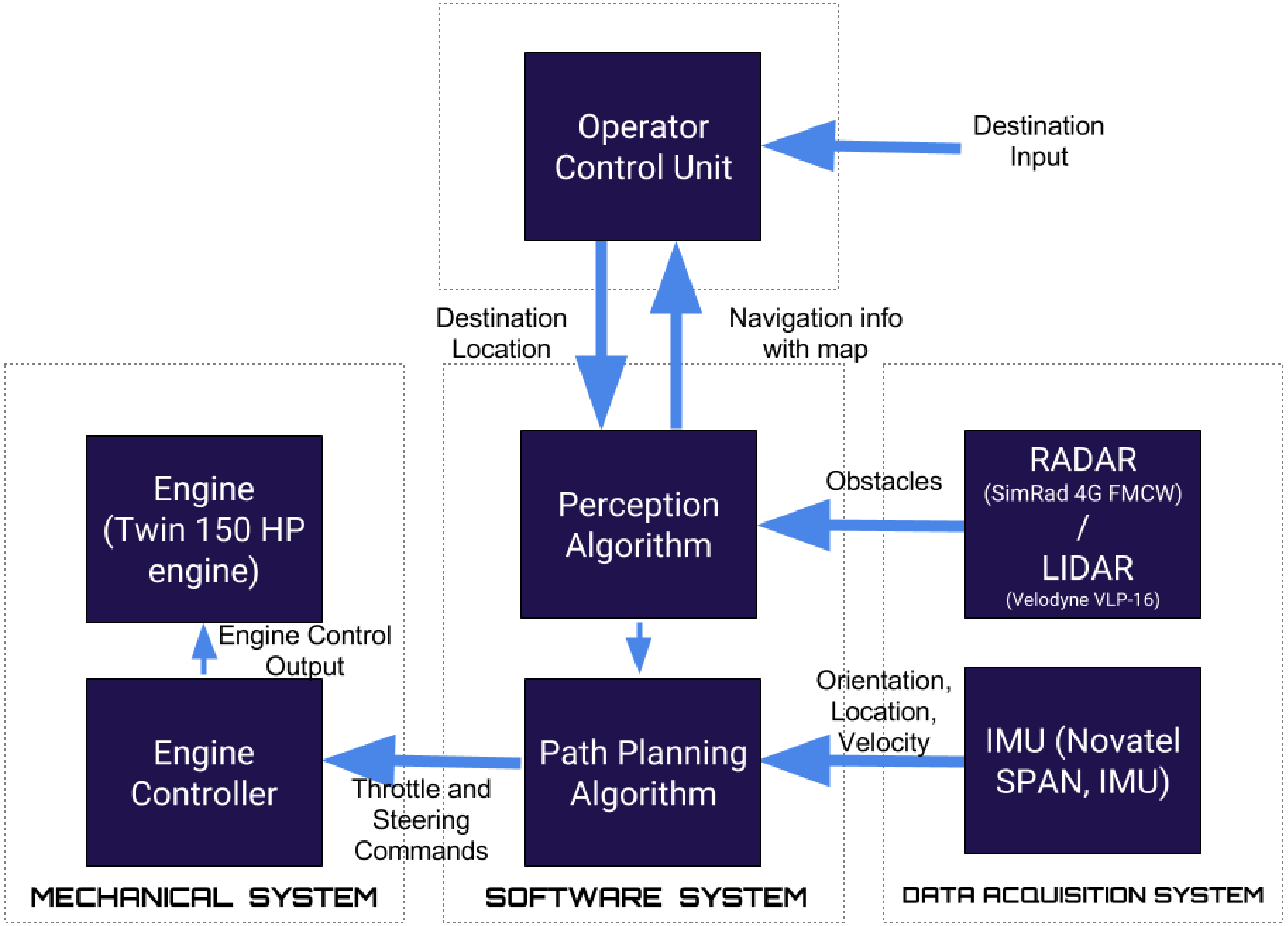
Program Management	Field Management	Web Management	Code Quality Management	Project Kick-off	Team Management
Tushar	William	Bikram	Shiyu	Team	Tae-Hyung
• Release Mgt. • Scrum Scheduling meetings • Communication • Purchasing	• Logistics for Field Trials • Data collection and management	• Publish content website • Handle Latex for documentation	• Repository • Code Reviews • Version control • Check-ins	• Structure to kick-off the project • Documentation and presentations	• Team Culture • Stress management • COI Management

Architecture

Functional Architecture: Defining functions of the project



Cyberphysical Architecture: Draft



Questions?

Appendix

Risk Assessment and Mitigation

Risks Associated with the Project

1. A very challenging project which all team members are passionate about.
2. Cold and snow in winters would be the hindrance for field testing.
3. Time taken to go to NREC/field testing would be significant
4. Might be too much of a work for MRSD project

How we are planning to mitigate the risk?

1. Got budget for 25 trails (increased from 4)
2. Buying an extra radar to speed up the development on the perception part
3. Laying out mechanism to ensure good code quality
4. Appointed 'Field Manager' in the team to manage logistics and to keep track of data collection (including deciding what to track) related to field tests.
5. Figuring out to find empty ground space near NREC for testing (will save us time and budget)