Progress Report

ARC - Autonomous RC

Senior Capstone Project

Oregon State University

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1 Project purpose and goals

The purpose of the Autonomous RC (ARC) project is to determine if it is possible to build an autonomous RC vehicle using commodity components, meaning components that are relatively inexpensive and can be bought at places like Radio Shack® or Best Buy®.
Our goal is to make an RC vehicle navigate autonomous to a given waypoint/location, preferrably at a high rate of speed. Stretch goals are to make the vehicle drift around corners and parallel park.

Fig. 1. Drifting example. Image from https://autorally.github.io/

While our main goal is to have a functioning autonomous RC vehicle we also hope that we can produce instructions that RC enthusiasts can follow to produce a functioning, consumer-grade autonomous RC vehicle of their own.

2 Current Status

3 Week-by-week summary of activities

One thing to note about the following weekly activity summary: if some of our descriptions seem a bit vague, that is because our understanding of this project is still fairly vague. We are discovering what we need for this project to succeed as we go. As the project progresses our focus will narrow and details will become more concrete. Right now, our understanding of the project is still very abstract, therefore the concepts and details that we describe are also vague and somewhat abstract.

3.1 Weeks 1 - 2

Weeks one and two were general introduction and orientation weeks. It was not until week 3 that projects started in earnest and the first assignment was assigned.

3.2 Week 3

- *Activities*:

  Worked on creating the problem statement. This required getting an overall understanding of what our autonomous RC vehicle should be able to do. In other words, getting on paper the expectations of our client for the final product. We also started researching what we would need for the SRS document, both in terms of the ARC project and in terms of the LaTeX document. We needed a Gantt chart for the SRS, so we started researching how to do that.
- *Problems*:

  Our client was ill during this time, so feedback for the problem statement was understandably delayed. We struggled a little with using the proper tense in the document and getting a high-enough, yet detailed enough written view of the ARC project. We needed clarification on details for the expected vehicle capabilities.
- *Solutions*:

  We talked with our client on how to frame our project appropriately. For the vehicle capabilities, our client told us to aim high, if we need to scale things back later we will.

3.3 Week 4

- *Activities*:

  Received feedback on our problem statement and made required changes. We needed to clarify what our motivation for the project was, namely that we are trying to create an autonomous RC system that is considerably less expensive than current research platforms (think $1-2k vs $10-15k). Created a template for the SRS document and started looking into what requirements our project needed.
- *Problems*:

  The three of us on the ARC team have no prior experience with ECE, in general and Autonomy or RC vehicles, in particular. This lack of experience makes writing these beginning documents somewhat abstract because we do not know what is involved.
- *Solutions*:

  We spent time with our client to talk through some of the requirements. Clarifying why this project matters also helped us narrow the scope of our requirements a little bit. We could focus on low-cost, readily available components. While that still leaves quite a bit to discover, it also eliminates expensive, yet otherwise viable, options.

3.4 Week 5

- *Activities*:

  Worked on the SRS document. This phase of the project required us to brainstorm what components our system needed and how they fit together.

  For instance, system interfaces has many parts so we had to sit down and talk through what connects and talks to what and visualize how that looks. For the SRS, filled out the introduction, software interfaces, communications interfaces, and the overall layout of the general control flow.

  Researched how to construct a Gantt chart in LaTeX. We also decided on what parts we each would take responsibility for and write about in the tech review document.

- *Problems*:

  The SRS document needed different indexing (numeric, as opposed to Roman numeral). This required some effort to figure out how to reformat the document to use a different indexing scheme without changing the controlling document class.

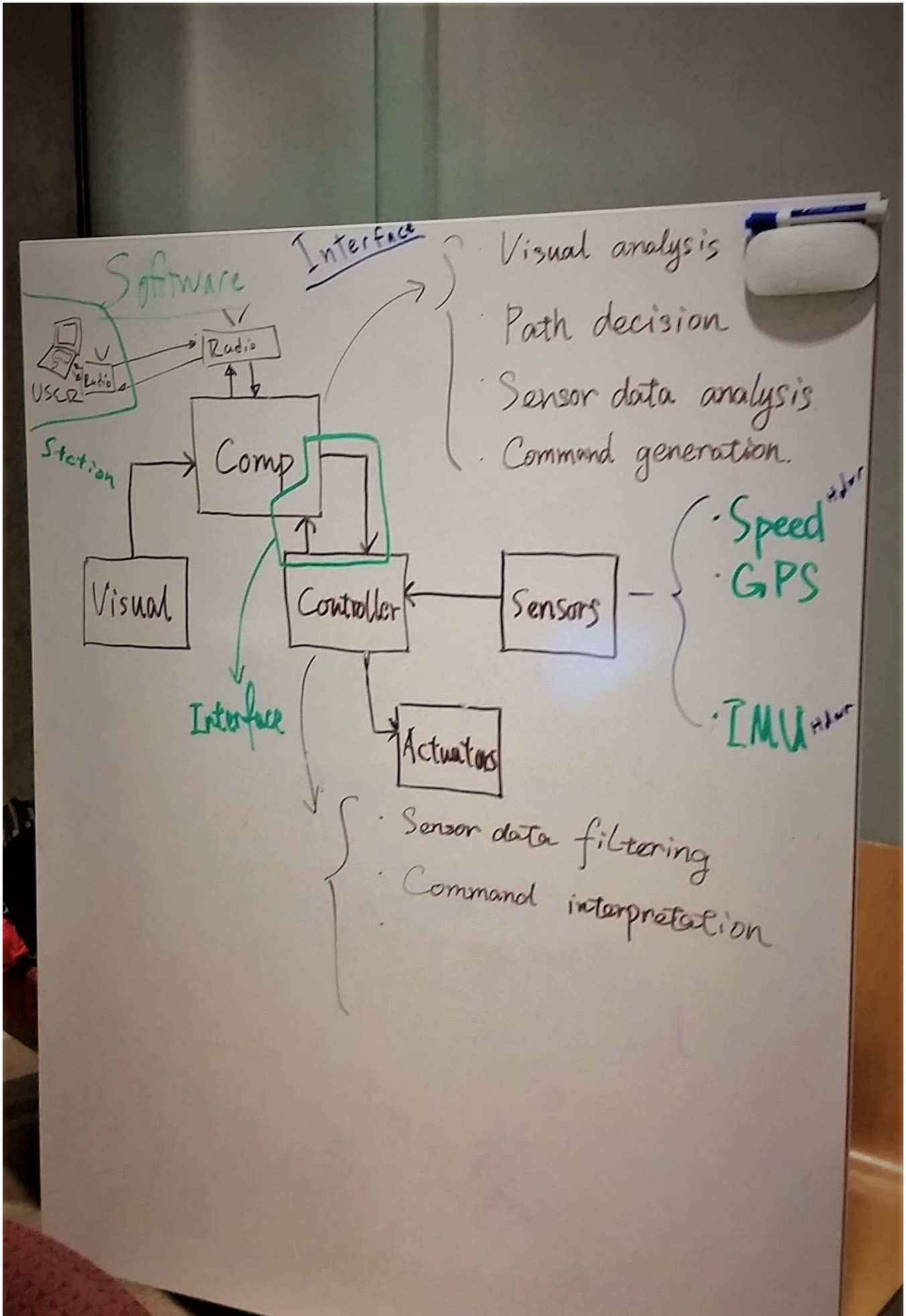
  Other problems: The nature of our project is complex. Therefore, there are many parts to the requirements for this project. We needed to estimate what the project would need, but again, without experience.

  Researching and building a working Gantt chart in LaTeX took about 9 hours. The system is very cumbersome, which makes one not want to revisit it to make changes.

- *Solutions*:

  Fixed the LaTeX index formatting issue by adding an argument to the IEEEtran.cls options. This turned out to be a pretty easy fix, but took quite a while to figure out.

  We tackled the complexity of this project by meeting together and drawing out a rough sketch of major components and how they relate to each other.


Software
Interface
Visual analysis
Path decision
Sensor data analysis
Command generation.
Radio
User
Radio
Station
Comp
Visual
Controller
Sensors
Speed
GPS
IMU
Interface
Actuators
Sensor data filtering
Command interpretation

This gave us a starting point to work from and fill out details for what will be required in this project. A big caveat is that these are still an *estimate* of requirements. We won't really know where we are correct or where we need to add until we get hands-on with the hardware and software.

Somewhat mitigated the arduous nature of the LaTeX Gantt chart by creating a sort of auto-calculation of the percentages for the different tasks and sub-tasks.

3.5 Week 6

- *Activities*:

  This was a *very* research-heavy week. We did in-depth research on our main areas of emphasis: system interfaces, user interfaces, hardware interfaces, communications interfaces, sensors, navigation, hardware mounting (how to physically attach the components to the vehicle), system control and data processing, and path planning. We created a block diagram of the structure and data flow of the project.

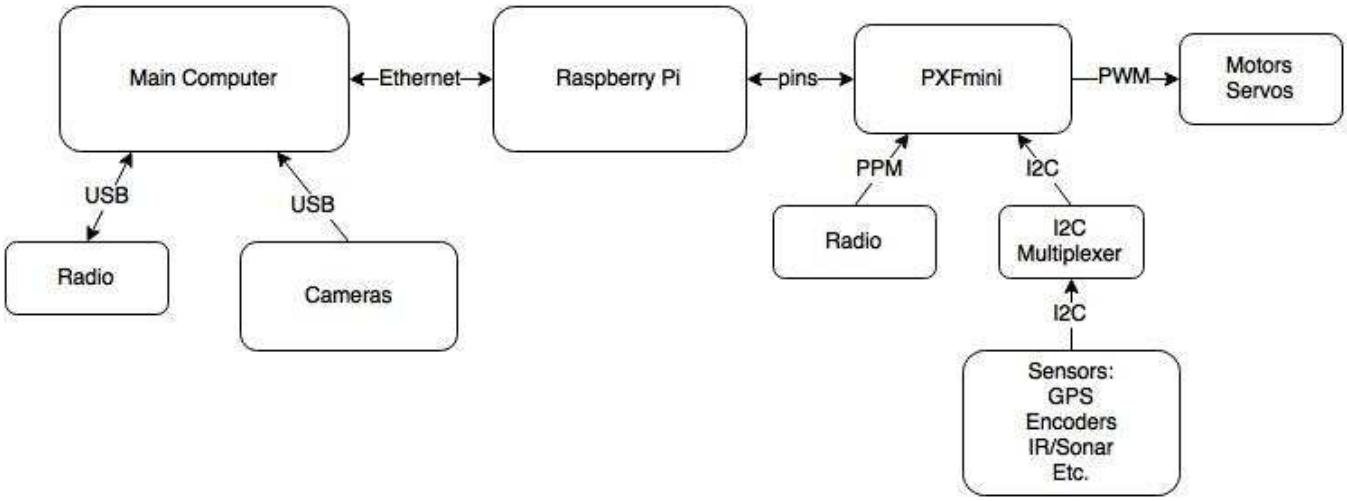


Fig. 3. Structure and data flow of the ARC project

  We worked simultaneously on the tech review and SRS documents. This is likely going to be a better strategy moving forward, research some area of the project, determine a requirement based off of the research, try to implement, record our findings and adjust the requirements further if necessary.

- *Problems*:

  Which came first, the chicken or the egg? This is how it feels to be writing the documents for this research project. In order to know what requirements are reasonable/feasible, we need to know what tech is out there and if/how it fits with related components.

- *Solutions*:

  To get around some of the issues we are having we decided to write the SRS and the tech review somewhat concurrently. This allowed us to research our areas of the tech review and then have a better understanding of what a reasonable requirement might be for the project.

3.6 Week 7

- *Activities*:

  Fill me in!
- *Problems*:

  Fill me in!
- *Solutions*:

  Fill me in!

3.7 Week 8

- *Activities*:

  Fill me in!
- *Problems*:

  Fill me in!
- *Solutions*:

  Fill me in!

3.8 Week 9

- *Activities*:

  Fill me in!
- *Problems*:

  Fill me in!
- *Solutions*:

  Fill me in!

3.9 Week 10

- *Activities*:

  Fill me in!
- *Problems*:

  Fill me in!
- *Solutions*:

  Fill me in!

4 RETROSPECTIVE

Positives: Anything good that happened.	**Deltas:** Changes that need to be implemented.	**Actions:** Specific actions to resolve deltas.
dummy positives	dummy negatives	dummy actions
more dummy positives	moredummy negatives	more dummy actions