Department of Computer Science & Engineering
The University of Texas at Arlington

Project Charter
CSE 4316: Senior Design I
Fall 2018

You only completed maybe half of this assignment. update it and resubmit to earn back some credit

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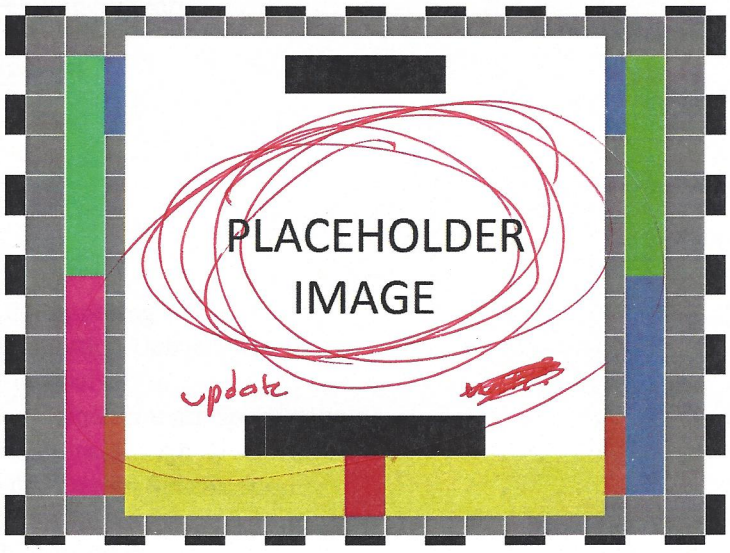

IGVC ← Team name + project name

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Revision History

Revision	Date	Author(s)	Description
0.1	10.01.2018	DU, AT, AB, AA, WS	initial draft

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1 Vision

Our vision for this project is to design and construct an intelligent ground vehicle. With this vehicle we plan to go and compete in the International Ground Vehicle Competition (IGVC). Our goal is to qualify and win the competition. By completing this project to all its requirements, we will come away with new skills and have a capability to show the ability to come together as a team to create something new and be successful without previous knowledge. After the competition we will bring recognition to the University of Texas at Arlington and the CSE department.

2 Mission

Our mission is to build an autonomous ground vehicle that will qualify and win the International Ground Vehicle Competition.

3 Success Criteria

For us to be successful we need to meet all the requirements in order to qualify for the 2019 International Ground Vehicle Competition here are the requirements to needed to qualify:

- Length: The vehicle will be measured to ensure that it is over the minimum of three feet long and under the maximum of seven feet long.
- Width: The vehicle will be measured to ensure that it is over the minimum of two feet wide and under the maximum of four feet wide.
- Height: The vehicle will be measured to ensure that it does not to exceed six feet high; this excludes emergency stop antennas
- Mechanical E-stop: The mechanical E-stop will be checked for location to ensure it is located on the center rear of vehicle a minimum of two feet high and a maximum of four feet high and for functionality.
- Wireless E-Stop: The wireless E-Stop will be checked to ensure that it is effective for a minimum of 100 feet. During the performance events the wireless E-stop will be held by the Judges.
- Safety Light: The safety light will be checked to ensure that when the vehicle is powered up the light is on and solid. When the vehicle is running in autonomous mode, the light goes from solid 5 to flashing, then from flashing to solid when the vehicle comes out of autonomous mode.
- Speed: The vehicle will have to drive over a prescribed distance where its minimum and maximum speeds will be determined. The vehicle must not drop below the minimum of one mile per hour and not exceed the maximum speed of five miles per hour. Minimum speed of one mph will be assessed in the fully autonomous mode and verified over a 44-foot distance between the lanes and avoiding obstacles. No change to maximum speed control hardware is allowed after qualification. If the vehicle completes a performance event at a speed faster than
- Lane Following: The vehicle must demonstrate that it can detect and follow lanes.
- Obstacle Avoidance: The vehicle must demonstrate that it can detect and avoid obstacles.
- Waypoint Navigation: Vehicle must prove it can find a path to a single two-meter navigation waypoint by navigating around an obstacle.

Success criteria is not the same as requirements. What is success? Going to the competition? Passing the qualifying round? Placing top 10? Setting up a future team to win? Think about these...

4 Background

The International Ground Vehicle Competition gives us an opportunity to get design experience and get experience with some new cutting-edge technology. The International Ground Vehicle Competition is a multidisciplinary, theory-based, hands-on, team implemented, outcome assessed, and based on product realization. It encompasses the very latest technologies impacting industrial development. The main goal of the Intelligent Ground Vehicle Competition (IGVC) is to build an autonomous unmanned ground vehicle that goes through an obstacle courses and completes it by avoiding any obstruction in its path and it must not go over its mandated lane.

5 Related Work

Solutions that currently exist in related work to this project include the previously created vehicles at the IGVC competition. The first place winner in the 2017 IGVC competition was IIT Bombay, their design included 2 motor powered wheels with a single caster wheel in the front, with changes in torque on each wheel affecting how it turns. There sensor included, LIDAR, IMC, 2 cameras and a GSP sensor[1]. The winner of second place of that year had two front powered wheels with two caster wheels in the back. There sensors included a 3D and a 2D LIDAR camera, along with a gyroscope, GPS and omni directional camera.[2] The third place winner used a compass, GPS, Camera and LIDAR for their sensors. With these sensors, the camera data is used to detect lines, while LIDAR is used to detect the obstacles and obstacle avoidance.[3]

These go under the references section

[1] Indian Institute of Technology Bombay http://www.igvc.org/design/2017/8.pdf
[2] Hosei University http://www.igvc.org/design/2017/6.pdf
[3] Bob Jones University http://www.igvc.org/design/2017/2.pdf

6 System Overview

To create a solution for the IGVC competition, the group will be handed off the hardware implementation of a robot for the competition from the previous semesters group. Given this hardware framework, the group will split the software aspect of the robot into 4 parts, these parts including way point navigation, which will comprise of the GPS navigation required to reach each checkpoint in the course. The second being in-bounds pathing, which initials creating the logic that will guide the robot through the course on its way to the way points, while avoiding the obstacles in the course, in staying in the lanes of the course. The third being computer vision, which is training the system to recognize the various obstacles that will be on the course, as well as recognizing the lanes and the dashed lines in the middle of the lanes. The final aspect being central data processing and handling, which will include sending instructions to the motor controller, pulling data from the sensors, processing this data, and demeaning where it needs to go. All of the data that will be used for these processes will be collected by the various sensor on the robot, including but not limited to, GPS sensor, LADAR system, and camera.

7 Roles & Responsibilities

Who are the stakeholders of the project? Who will be the point of contact from the sponsor or customer side? Who are the team members, and what will be their areas of responsibility? Will your team maintain the product owner and scrum master for the whole project, or will that role change periodically? This section should occupy 1/2 - 1 full page.

8 Cost Proposal

This section contains the approximate budget for the project, where that money will come from, and any other support. This text should be replaced with a discussion and justification of major expenses, but not the actual monetary amounts (that will go in the preliminary budget section below).

8.1 Preliminary Budget

Include a high level budget table for components, fabrication, software licensees, development hardware, etc.

8.2 Current & Pending Support

What are all of the funding sources for the project, and are there any potential funding sources that haven't been secured yet? List all funding sources (including the default funding amount provided by the CSE department) and their dollar amounts.

9 Facilities & Equipment

This project will require the following facilities and equipment corresponding to the IGVC Guidelines defined on October 26th, 2017:

- *Work Space*: A space reserved for project development. Facilitates project design and construction and provides storage for components and tools.
- *Physical Test Space*: The IGVC features an obstacle course that the vehicle must navigate. We require a test space that sufficiently emulates elements of the IGVC course in order to test the vehicle's performance.
- *Virtual Test Space*: Test software that allows us to analyze the performance of the vehicle's software without a physical test.
- *Software*: Various software for operating individual components of the vehicle. Development environments that facilitate the development of new software for vehicle navigation.
- *Sensors*: Cameras, lasers and/or other sensory equipment for the vehicle to collect data about its surroundings.
- *Wheel Base*: A base that facilitates vehicle mobility and can support the weight of all vehicle components and payload as defined in the IGVC guidelines.
- *Motor Controllers*: Necessary for mobility of the robot.
- *Battery*: An on-board power source that supplies power to all components for the duration of the competition.
- *Remote Control*: IGVC guidelines require that the vehicle can be manually controlled by a remote control system that includes a remote shutdown feature.
- *GPS*: IGVC guidelines require GPS Point-to-point navigation for autonomous navigation.
- *Computer*: Central computing unit that obtains and processes data from all sensors and controls automated navigation.

10 Assumptions

The following list contains critical assumptions related to the implementation and testing of the project.

- A suitable outdoor testing location will be available by the 5th sprint cycle.
- The majority of components acquired by the previous IGVC team will be compatible with the project's final design.

- The previous IGVC team will have remote vehicle control functional by the 4th sprint cycle.
- Software drivers for all components will be created by the previous IGVC team by the 5th sprint cycle.
- The Ross Gazebo robot simulation software will meet our requirements for virtual testing of the vehicle software.

11 Constraints

The following list contains key constraints related to the implementation and testing of the project.

- Final vehicle implementation must be functional before the date of the IGVC (TBA).
- The vehicle must feature a hardware based shutoff feature, activated by both remote control and on-board control as defined in the IGVC guidelines.
- The vehicle must be designed to operate while carrying a payload defined in the IGVC guidelines.
- Total development and travel costs must not exceed the allocated budget.
- The vehicle must meet minimum and maximum length, width and height dimensions as defined in the IGVC guidelines.

12 Risks

The following high-level risk census contains identified project risks with the highest exposure. Mitigation strategies will be discussed in future planning sessions.

Risk description	Probability	Loss (days)	Exposure (days)
Debugging and error handling	0.75	20	15.0
Difficulty to integrate systems	0.50	15	7.5
Outdoor testing grounds are not available	0.30	15	5.0
Delays in shipping from overseas vendors	0.40	10	4.0
Software learning curves	0.20	20	4.0

Table 1: Overview of highest exposure project risks

13 Documentation & Reporting

13.1 Major Documentation Deliverables

13.1.1 Project Charter

As documentation for each system that comprises the robot becomes available that will be added to this document. Furthermore, major milestones essential to the completion of the autonomous vehicle will be added at the end of each sprint following their completion.

13.1.2 System Requirements Specification

Requirements will be recorded into a list and included in this document. As the project develops and more requirements are identified or updates are made, the official changes will be posted at the end of the sprint where the requirements list will be reviewed by the team.The final copy will be submitted along with all documentation upon completion of the project.

13.1.3 Architectural Design Specification

As the design begins to develop this portion will be updated.

13.1.4 Detailed Design Specification

As the design begins to develop this portion will be updated

13.2 Recurring Sprint Items

13.2.1 Product Backlog

How will items be added to the product backlog from the SRS? How will these items be prioritized? Who makes the decision (product owner, group vote, etc.)? What software will be used to maintain and share the product backlog with team members and stakeholders?

13.2.2 Sprint Planning

(Still in development) For now, we have assigned roles based on interests. Moving forward as more information about the project is provided, work will be delegated more efficiently.

13.2.3 Sprint Goal

The team will set reasonable deadlines as whole and together determine the work to be done for the sprint.

13.2.4 Sprint Backlog

Who decides which product backlog items make their way into the sprint backlog? How will the backlog be maintained (collaboration software, a "scrum board", etc.)?

13.2.5 Task Breakdown

How will individual tasks be assigned from the sprint backlog? Will it be up to each team member to voluntarily claim a task, or will it come from the product owner? How will time spent on tasks be documented?

13.2.6 Sprint Burn Down Charts

Who will be responsible for generating the burn down charts for each sprint? How will they be able to access the total amount of effort expended by each individual team member? What format will the burn down chart use (include an example burn down chart below).

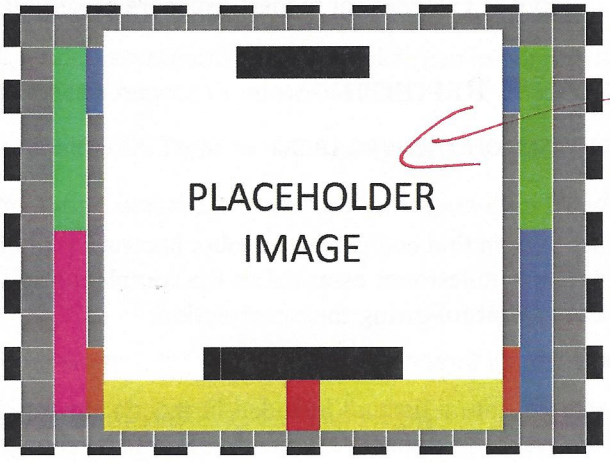

Figure 1: Example sprint burn down chart

13.2.7 Sprint Retrospective

Following the sprint review for a given sprint, the following team meeting will consist of discussion to review the sprint and focus on what needs to be accomplished during the next sprint.

13.2.8 Individual Status Reports

Each Friday during team meeting each team member will speak on their progress and any issues or accomplishments will be discussed.

13.2.9 Engineering Notebooks

Engineering notebooks will be handled at the discretion of each team member; however, should they require witness signatures, they can be obtained at Friday meeting for convenience.

13.3 Closeout Materials

13.3.1 System Prototype

What will be included in the final system prototype? How and when will this be demonstrated? Will there be a Prototype Acceptance Test (PAT) with your customer? Will anything be demonstrated off-site? If so, will there be a Field Acceptance Test (FAT)? The final prototype will be a system that adheres to all regulations specified in the rules of the IGVC competition. Prototype acceptance test will consist of necessary requirements to qualify for the IGVC competition.

13.3.2 Project Poster

What will be included on the poster, what will be the final dimensions, and when will it be delivered?

13.3.3 Web Page

What will be included on the project web page? Will it be accessible to the public? When will this be delivered? Will it be updated throughout the project, or just provided at closeout (at a minimum, you need to provide a simple web page at the end).

13.3.4 Demo Video

What will be shown in the demo video(s)? Will you include a B-reel footage for future video cuts? Approximately how long will the video(s) be, and what topics will be covered?

13.3.5 Source Code

How will your source code be maintained? What version control system will you adopt? Will source code be provided to the customer, or binaries only? If source code is provided, how will it be turned over to the customer? Will the project be open sourced to the general public? If so, what are the license terms (GNU, GPL, MIT, etc.). Where will the license terms be listed (in each source file, in a single readme file, etc.).

13.3.6 Source Code Documentation

What documentation standards will be employed? Will you use tools to generate the documentation (Doxygen, Javadocs, etc.). In what format will the final documentation be provided (PDF, browsable HTML, etc.)?

13.3.7 Hardware Schematics

Will you be creating printed circuit boards (PCBs) or wiring components together? If so, list each applicable schematic and what sort of data it will contain (PCB layout, wiring diagram, etc.). If your project is purely software, omit this section.

13.3.8 CAD FILES

Will the project involve any mechanical design, such as 3D printed or laser-cut parts? If so, what software will you use to generate the files and what file formats will you provide in your closeout materials (STL, STEP, OBJ, etc.). If your project is purely software, omit this section.

13.3.9 INSTALLATION SCRIPTS

How will the customer deploy software to new installations? Will you provide installation scripts, install programs, or any other tools to improve the process? Will there be multiple scripts provided (perhaps separate scripts for the graphical front end and back end server software)?

13.3.10 USER MANUAL

Will you customer need a printed or digital user manual? Will they need a setup video? Decide now what will be provided and discuss.

References