Assignment 1A Report

EECE 443

Team 2: MCU TNC Design

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March 3,2020

Pier Review of Team 1: Package Delivery Robot

Organization

The sections of this report are laid out very nicely and are easy to follow and understand. However, with this structure it is obvious that things are missing. A fault in the organization of this paper is the need for an entire extra page for their figures rather than placing them strategically in the documents. In addition, these figures are not referenced in the paper. Lastly, through review of the entire paper we believe some sections were repetitive and some sections could be replaced by others. For instance, we believe the scope of work could be entirely replaced by the requirement specifications and explain the topic scope of the project a lot more thoroughly.

Coversheet

There was no cover sheet in the copy supplied to us. So, this needs to be added to the report.

Scholarly Paper and Formatting

The report lacks the formatting of a scholarly paper. It does not follow the specifications set by Dr. Darby for this paper and needs to be reformatted in the required manner. I would also recommend not using google documents for this form of a paper.

Section II – Research Done by Others

There was no research done by other supplied to us in this paper. We would recommend doing some research on whether this project was done before and what strategies they used and what problems they ran into. Another good thing to include in this section would be some research done on image processing and robotic movement.

Section III – Feasibility / Alts and Tradeoffs

The project was analyzed very well in the terms of whether it was feasible or not. The team took the time to look at cost, time, and technological feasibility with each organized into their individual sections. The alternatives to a few subsystems of the project were looked into and analyzed but we feel as if more alternatives could be looked into for the arms of robot. Lastly, this section needs to have an appendices entry which this report lacks. This is most likely where a parts list and a few figures would fit in for a more visual comparison of the tradeoffs and feasibility.

Scope of Work

The scope of work of this paper explained what the project as about as well as some requirements and deadlines to meet. This was well organized but lacked detail. For someone with a lack of knowledge on the subject, this section could be hard to understand exactly what the team is trying to do. In addition, some concepts need to be explained in greater detail. The section called Requirement Specifications would serve as a better version of the scope of work.

Objective Tree

We believe the objective tree was very well done and very detailed. In reference to whether it considered safety and environment, we believe this section of the objective tree is not necessarily due to the size of the robot and lack of high voltage risk.

Level 0 Diagram

- System Start-up input is vague.
- Consider the “location of blocks” as an input.
- Is the delivery code the program itself? If so, shouldn’t that be a given?
- Consider “video stream” as an input
- Consider “package recognition” as an input.
- Remove “mobility”
- Specify Telemetry in scope of work.

Functional Requirements Specifications

This section of the paper is well written and detailed. However, some of the details are worded incorrectly and need reference points. We also think it needs to define:

- How the robot acquires box locations or are all the boxes at the start point?
- How the robot knows where to bring the blocks to?
- Does robot need to return to the starting position at the end?

Lastly, the telemetry system shown on the Level 0 diagram needs to be referenced and explained in this section.

Preliminary Feasibility Analysis/ Preliminary Design/Subsystem Design Alternatives Detail

The feasibility of the project is well analyzed but lacks detail. For instance, why is the pixie cam 2 the best option? In many parts of the paper, the arms seem to be a main challenge, but no alternatives and trade offs are really referenced in detail. Lastly, it is not clearly stated why black and white differentiation is such a difficult process.

Appendix

Formal Format? Name? Coversheet?

Scope of Work:

For our senior design project we were tasked with designing and building a package delivery robot. This robot must be highly efficient along with practicality to be built in the deadline times we have. We have seven members working on and off on this robot for approximately one year. Our end goal is an autonomous robot that completes the game set out in a competitive time frame.

? awkward sentence what game? time frame?

Adhering to rules of the game:

In order to achieve a successful win at the game the robot has to adhere to the rules set up by Dr. Darby. These rules contain the information about how the robot has to recognize packages and be able to deliver these packages to and from the post office. The robot also must stay on the road while avoiding pedestrians along the way. These things need to be done efficiently since the robot is being graded on timing as well as precision.

real people?

High performance design:

define what makes it high p

Our goal is to design a high performance robot that will optimize the best strategy to win the game. The most efficient way of winning the game would be to create a robot that can carry around three to four blocks to eliminate travel time around the board. We hope to create a robot that is efficient in understanding the best way to distribute the blocks on the board in the time frame. Because we are using Mecanum wheels the robot is able to move sideways along with forwards and backwards eliminating unnecessary time to move around the board.

how is this most eff? why?

repetitive sentence

can't start sentence that way

Deadlines:

Since starting the senior design process in the Spring semester we will have our final design choices due by the end of the Spring semester. After finishing our design plans we will implement the design for the following semester and have a working robot by the end of the fall semester. This gives us an approximate timeline of slightly less than one year to have our senior design project done. In order to succeed in completing this robot, it is critical that we implement deadlines and stay on track in order to have it fully autonomously running by the end of Fall.

Performance vs Cost: repeated

For our design project we were given a budget around 500 dollars to be used in the design of our robot. However, we have access to all the spare parts of the robotics and senior design room. This leaves us with multiple options on how we can spend our budget since we are not constrained to buy every part needed to make the robot run. Having lots of spare parts allows us to show creativity in the design process without maxing our limited budget.

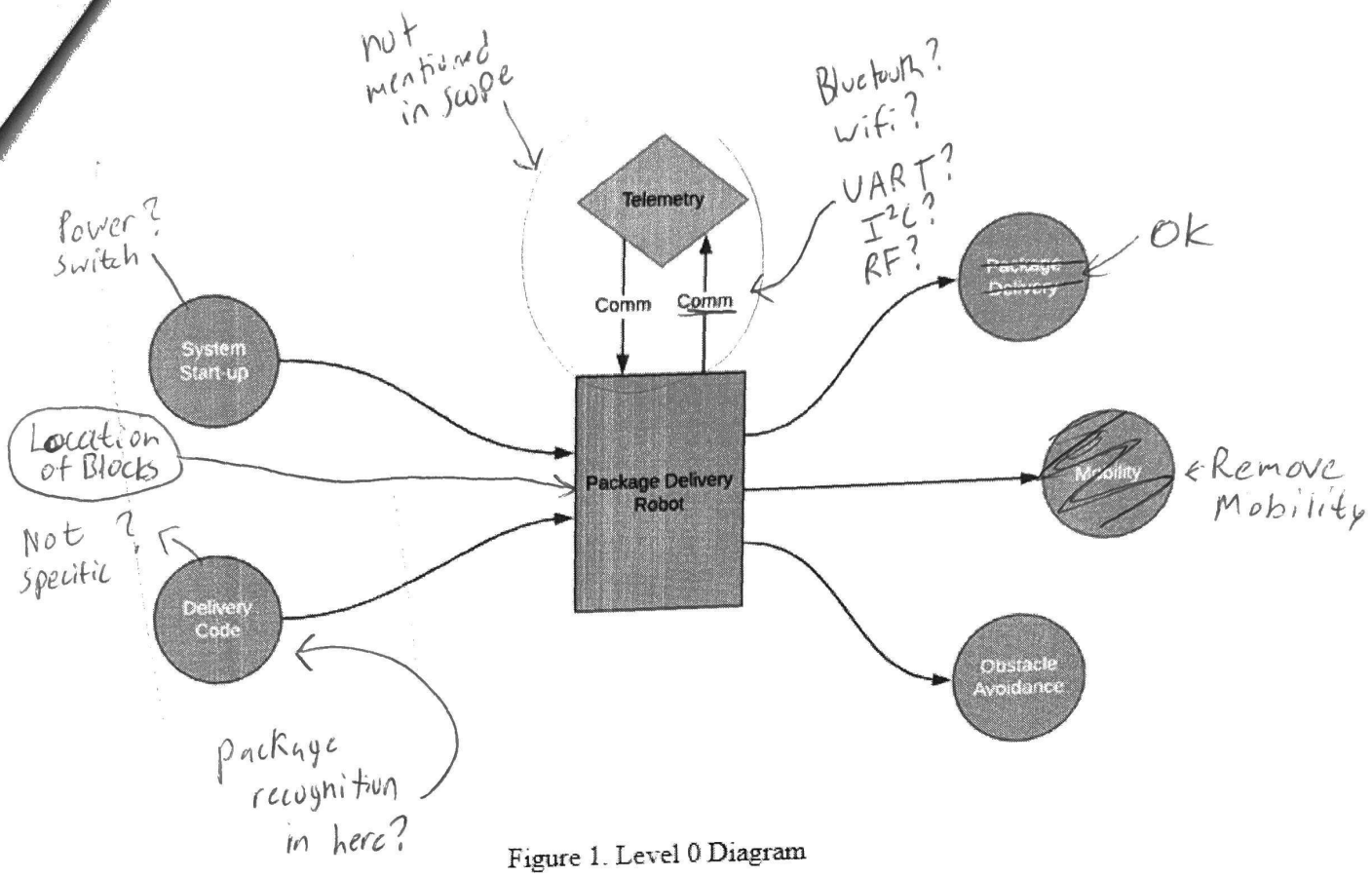

Figure 1. Level 0 Diagram

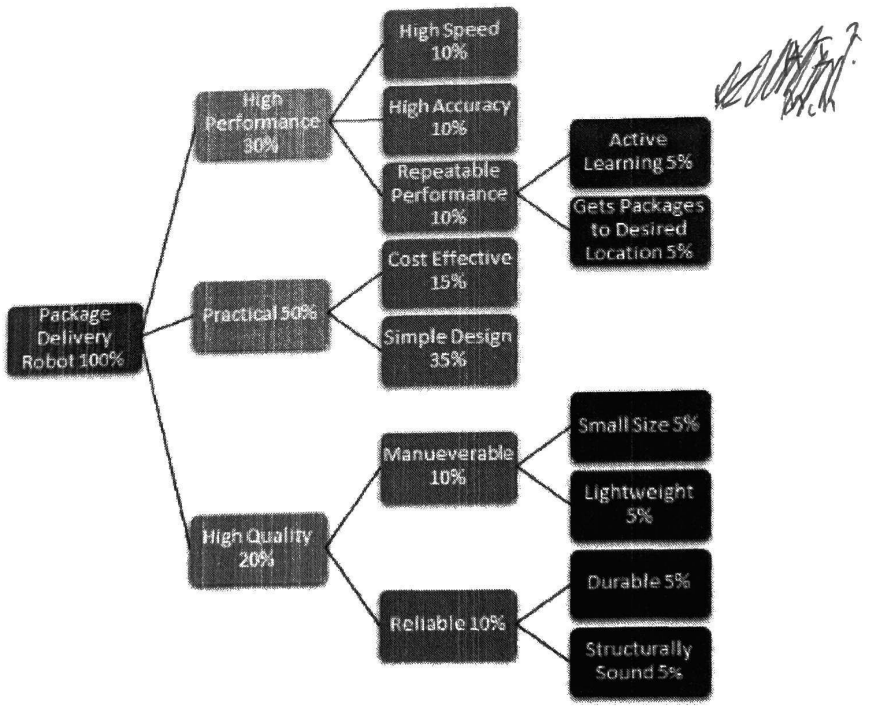

Figure 2. Objective Tree

Preliminary System/Subsystem Design Alternatives:

The robot is still in its early stages. Ideas are currently being pitched regarding the best course of action when it comes to making The Package Delivery Robot fully autonomous and successful at completing the game in the shortest amount of time possible.

The robot that was given already had wheels mounted on them. The wheels have the ability to move frontwards, backwards, sideways, and even turn within a one square foot area. A code was implemented to test the wheel capabilities. The wheels work, but maneuvering sideways is still a challenge. A conclusion was made that the wheels will have to be taken off and adjusted to achieve its maximum capabilities. The current wheels are the only option that is allowed.

Identifying the lettered blocks and houses (pickup and drop-off locations) proves to be more challenging than anticipated. The lettered blocks are to not be heavily modified. The letters are black, and the background is white, so identifying the letters based on the black/white differentials will not be simple. So, utilizing a Pixy 2 Cam Image Sensor may be the best option. The blocks can be modified by adding a single dot of color. This will make it easy to identify by the Pixy 2 Cam Image Sensor. Then, it can carry out those instructions based on the color alone. Another idea that was introduced was utilizing QR codes. A simple QR code can be placed on the blocks. Once the QR code has been read by the Pixy 2 Cam, the robot will carry out the instructions associated with that code. From a coding perspective, this will be the easiest course of action.

Picking up and dropping off the blocks will not be an easy feat. Using an arm and/or scoop and a conveyor belt to hold and drop off blocks are ideas that are currently being explored. No extensive research has been done with this aspect of the design.

Designing the robot to hold/secure the blocks and contain all the necessary components while in motion will be imperative to the robot's success. Building a housing that is too wide will knock down game board pieces. The best option for the housing is to simply build vertical. To create housing, 3D printing is the method of choice. An online CAD software called TINKERCAD and SolidWorks will be used to design a proper housing for the Package Delivery Robot.

rephrase

Requirement Specifications:

Included in this project are several requirement specifications for the robot to satisfy. These requirements were given by the project mentor and must be accounted for by the group to the best of their ability when planning and building the robot.

Robot Requirements:

repeats

Included in the project are several requirements for the robot itself to comply with. Firstly, the robot should move around using the mecanum wheels provided by the mentor for the project. These wheels allow for multidirectional input and that should be utilized in the robot design. Secondly, the robot must be able to pick up blocks to transport. This can be done with either a claw or some other moving device. The only requirement is the robot is able to move the blocks across the board. Part of moving the blocks is the quantity that the block can move at a time. It is expected that the robot can move three or more blocks at a time to allow for multitasking and time saving. However, the robot isn't expected to just deliver unidentified blocks. The robot must keep track of each block it collects and moves. It must be able to sort blocks by the letter on it, a marking on the block, or some other identification method. Using this information it must then deliver the block on the game board to the correct location to drop off.

is not

Board Requirements:

The robot isn't the only aspect to the project. The robot is to be operated on a 4x8 ft. or similar board while allowing room for both houses and obstacles. Given for the houses are 8 in. square blocks that are to be used as houses. The robot is expected to not run into any of these houses while searching the board. In addition to the houses, there will be obstacles placed on the board to simulate pedestrians. The robot is expected to identify these obstacles and avoid them by finding an alternate route. Both the houses and obstacles can be arranged in many different ways and the robot is expected to adapt to the environment. Finally, the robot is expected to pick up the blocks that will be used for the experiment. The blocks given are about 1.5 square inches in size with letters on them. The robot must identify these blocks by either reading the letter or some other marking on the blocks.

General Project Requirements:

R

Besides direct requirements on the board and robot, there are a few other requirements that this project must fulfill. The final design of the game board and robot must be built in a way where it can be removed from the robotics room and be transported for demonstration. Any changes or additions to the board must allow for this mobility. Second, the entire project should be done in under two minutes. This time requirement can change but a points based system was mentioned by the mentor to judge the robot. Speed of delivery, avoiding obstacles, and delivery accuracy are all factors that can determine the value of the points scored in each round.

run in two minutes

Feasibility Assessment:

Cost Feasibility:

Since we are still very early in the design process for the robot, the estimated cost for the project is currently a rough estimate based on our current design goals. As of now, we are considering purchasing a set of robotic arms to pick up the packages. Based on individual prices, we may have anywhere from one to four arms, but these arms will quickly take up a majority of our budget. Overall, we are estimating our budget to be up to $500.

Time Feasibility:

Currently, we need to have the robot fully functioning to meet the deadline set on December of 2020. Our current goal is to get the 3D printed body built by March 1st. Shortly after this, we would like to get the robot's basic autonomous movement completed. If everything is working by that time, we would like to get the robotic arm started and finished by early next semester. In the far future, we wish to have the robot working by mid fall semester to allow for testing and minor improvements. With these goals in mind and if everything goes as planned, we should be able to deliver a finalized by the desired due date.

Technical Feasibility:

Technical feasibility for the robot depends on how quickly we are able to finish key requirements and how cost efficient the components will be. Ideally, we would like to get four fully functioning robotic arms for the project. This highly depends on the difficulty surrounding a robotic arm and the price of each arm. The arm would have to know exactly where the block is located and be able to reliably hold onto the block. We would also ideally like to have the robot learn its environment and be able to traverse a modular environment. This would require us to implement machine learning to enable the robot to learn from its surroundings. Whether or not we are able to implement this depends on how efficiently we can get the programming to function.