FSU/FAMU College of Engineering
Departments of Electrical and Mechanical Engineering

Restated Project Definition and Scope/Project Plan

Robotic Weeding Harvester
Team Numbers: ECE#16 - ME#11

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Abstract

The objective of our senior design project is to design an autonomous weeding robot with minimal ground pressure. This report aims to explain some of the changes we have made to the project from fall semester, and to also provide insight on future plans for the design for the remainder of the semester. The challenges the team has experienced will be explained as well as procurement details.

I. Introduction

For the fall semester, the Weeding Robot team spent a good deal of time on project logistics, in essence, setting up the work to be done in the spring semester. During this previous semester, the Weeding Robot team chose designs for the mechanical and electrical aspects of the projects. For the mechanical portion, the team decided on the basket weeding mechanism and a robust, modifiable frame. As for the electrical design, there will be a vision system and navigation system that will be responsible for positioning the robot as it goes through the plot. After examining the work done in the last semester, the team has determined that the objectives for the project should be scaled back. This will be discussed in the following sections of this report. While the group acknowledges the importance of scaling back the objectives, the group wishes to retain the essence of the weeding robot project.

II. Restated Objectives (Updated Scope)

Last semester, the Weeding Robot team made a set of goals to be fulfilled by the end of the Spring 2015 semester. The goals were as follows: fabricate a frame and a weeding mechanism, create a vision/navigation system, and weed a plot with several rows. Due to the time constraints imposed by this semester, it is prudent for the senior design team to not overpromise. As such, reductions will be made in the mechanical goals, and the goal for the plot, as will be explained in the objectives for this semester.

As it relates to the mechanical portion of this project, the goals were to deliver an original, fabricated frame and weeding mechanism. In order to best deliver results to the sponsor, the group believes that the mechanical aspects of the project will have to be scaled down. Instead of fabricating a frame for the robot, the new objective is to find a frame on the market. This frame should be highly modifiable, and could even include motors and wheels. Another goal for this project, which has not been scaled down for this semester, is the construction of a weeding mechanism. This is the essence of the project, so it is important that this goal is fulfilled. Although it was desired to build a wide enough frame to realistically weed the plot, a scaled down robot could be constructed in order to have a proof of concept.

In relation to the logistics and management of the system, the team wishes to have a robust set of tests and documentation for the robot. This includes the testing and troubleshooting of the combined mechanical/electrical system, as well as a set of safety, manufacturing and assembly instructions.

The goal for the ECE portion of this project for the end of this semester is to fully design and build the electronic navigation and motor control systems for the weeding robot. This involves setting up the Beaglebone Black with vision software and coding it to use color detection to determine its position in the rows relative to an orange guide line, then navigate through the row without damaging the crops. Initially the weeding robot project was to also have the robot autonomously charge via a charging station, but this task has been deemed beyond the current scope of the project and will be given a lower priority. Also the more elaborate functions of the robot such as fertilizing the crops, pest control, and watering the crops will be given a lower priority due to time constraints.

The set of objectives is summarized below

- Purchase frame from market
- Fabricate weeding mechanism, couple with frame
- Get visual system fully operational
- Interface visual information with motor controls to navigate through the rows
- Testing of systems
- Provide documentation

III. Challenges/Lessons Learned

While working on the project last semester the team encountered a few challenges that taught us some very valuable lessons that will aide us this coming semester. During last semester our team tried to have weekly conference calls with our sponsor at a designated time, however our sponsor was unable to participate in some of the calls which led to the team receiving less feedback than was originally anticipated. This semester our team will be making it more of a priority to be in constant contact with our sponsor in order to satisfy his needs and keep him updated. Due to the fact that our sponsor has many ideas on what this robot should be able to do it is essential that we get a clear idea of what he wants that can actually be accomplished in the scope of this project.

Another major thing the team learned from last semester is that decisions, which are still carefully thought out, need to be made quickly due to the time constraints of the semester. For example last semester the team spent an excess amount of time deciding between a find and pluck or a general area weeding method. This slow decision making process has put our team a little behind form where we would like to be in the project. This semester decisions will be made in an adequate amount of time to ensure that the project can move quickly but also the right decisions are still being made.

IV. Procurement

Thus far, the majority of the electrical components needed for prototyping the navigational aspects of the weeding robot have been ordered from various vendors through the FAMU-FSU College of Engineering. These materials are presented in table 1 below.

Table 1. Current Parts List

Vendor	Item	Part Number	Quantity	Price	Total Cost
Amazon	Logitech HD WebCam C310	NA	1	$29.99	$29.99
Adafruit	BeagleBone Black Rev C - 4GB	1876	1	$55.00	$55.00
Exadlers Technologies	Dual Motor Controller Cape Mk.6	NA	2	$68.00	$136.00
PICAXE	PICAXE-08M2 Microcontroller	AXE007M2	4	$2.35	$15.67
STREAMLED	UltraSonic Module Distance Sensor	NA	1	$8.99	$8.99
Optimal Shop	USB Hub + AC Adapter	NA	1	$8.99	$8.99
Fosmon Technologies	HDMI to Micro HDMI Cable	NA	1	$3.99	$3.99
Amazon	Samsung Class 6 SDHC	MS08DA	1	$6.99	$6.99
Amazon	AC to DC Converter Adapter	EK1545	1	$6.08	$6.08
				Total	$298.27

Some initial materials such as wood and scrap metal were purchased on our own at the Home Depot in Tallahassee, allowing us to work with those materials as soon as we could for more efficient prototyping. In the coming week after some electrical considerations, we expect to order the frame component of the robot. The remainder of the materials will be purchased within the next few weeks and will consist mainly of coupling components after we are confident in all aspects of our design. Additional electronic components that will be purchased in the next few weeks are shown in table 2 below.

Table 2. Pending orders

Item	Quantity	Price	Total Cost
1450-00 Polycarbonate Waterproof Case	1	$14.99	$14.99
11.1 V 8000 mAh LiPo Battery	2	$189.99	$379.98
		Total	$394.97

V. Resources/Budget

The FAMU-FSU College of Engineering has many resources for the team to use. One resource that will be helpful next semester will be the Machine Shop for manufacturing purposes. The FAMU-FSU College of Engineering Machine Shop has a lathe, drill press, laser cutter and other very useful tools for the assembly of our design. In addition to this, if the Machine Shop is ever too busy or there is not ample time for our parts to be manufactured, our sponsor has mentioned another machine shop in Thomasville, CNS Machines, which could also manufacture any parts needed.

The total budget for our design project is $3,000 provided by our sponsor, Jeff Phipps. Of this total, $298.27 has been spent, 10% of the total. After the remaining electrical components have been purchased, we will have spent 19% of the total budget. This leaves us with a large amount of money to buy the best materials for manufacture and gives us some breathing room in the case that something goes wrong and additional parts are to be ordered.

VI. Project Plan

a. Gantt Chart

The Gantt Chart presenting the tasks to be completed in the upcoming months is presented below.

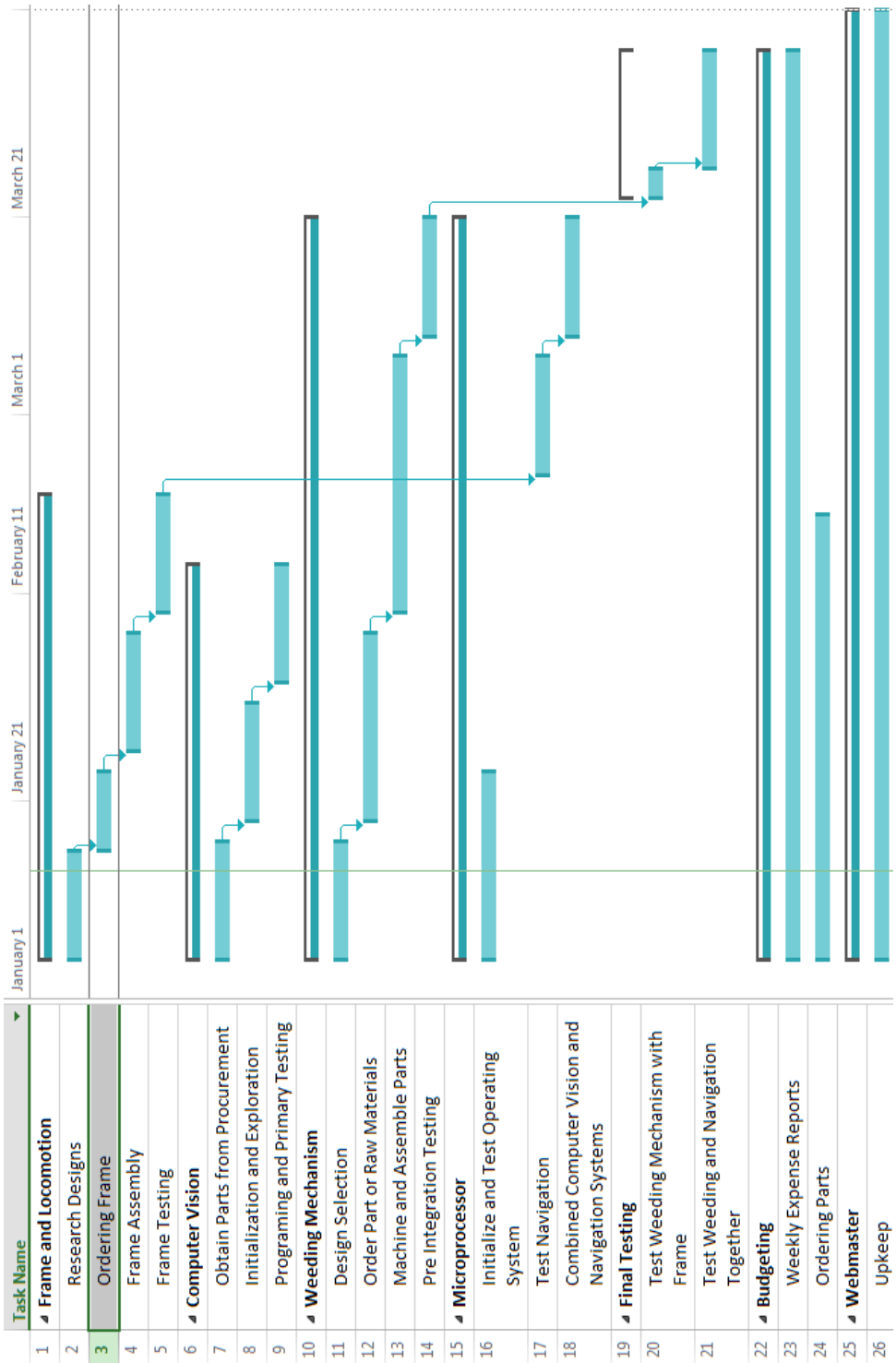

Figure 1. Gantt Chart

b. Resource Allocation

As can be seen in the Gantt Chart in Figure 1, not all of the task last the entire semester. Table below is used to estimate the hours each member will be devoting to the specific task when the tasks are available based on the Gantt Chart in Figure 1.

Table 3. Allocation of Hours

Components	Component Breakdown	Member Name	Weekly Hours
Frame and Locomotion	Research Designs	Nathan	7
	Ordering Frame	Amanda	3
	Frame Assembly	Coen	7
	Frame Testing	Grant	7
Computer Vision	Obtain Parts from Procurement	Amanda	3
	Initialization and Exploration	Ian	5
	Programing and Primary Testing	Jeremy	6
Weeding Mechanism	Design Selection	Grant	7
	Order Part or Raw Materials	Amanda	4
	Machine and Assemble Parts	Coen	7
	Pre Integration Testing	Nathan	7
Microprocessor	Initialize and Test Operating System	Ian	4
	Test Navigation	Jeremy	6
	Combined Computer Vision and Navigation Systems	Ian	5
Final Testing	Test Weeding Mechanism with Frame	whole team	5
	Test Weeding and Navigation Together	whole team	5
Budgeting	Weekly Expense Reports	Amanda	2
	Ordering Parts	Amanda	2
Webmaster	Upkeep	Jeremy	2

VII. Conclusion

After reviewing the work done last semester, the Weeding Robot team has laid out a revised set of objectives for the spring semester. As mentioned, the team wants to keep the essence of the project, so in order to do work on the weeding mechanism, the team decided to purchase a frame. (Electrical stuff)

Following the work on the project from last semester, the group has synthesized a set of lessons learned, to be applied through this semester. Primarily, the group wishes to keep the sponsor more informed, even if he is unavailable to receive feedback and progress reports. Additionally, the group will be focusing on accelerating the decision making process, instead of allowing the progress of the project to be bogged down with lengthy debate. This way, the group can go ahead with many aspects of the project.

As described in the Procurement section, the team is well into the process of ordering parts. These parts have mainly been electrical in nature, as it is important that the ECE/CpEs begin work on the computer vision and navigation systems. After several other purchases by the team, the budget will have been only 19% consumed.

Overall, with the revised scope of the project, as well as the lessons learned, the team will be able to move forward with our goals this semester, and ideally deliver a satisfactory product to the sponsor.