Remotely Operated HyperRail System Team 11 Executive Summary

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ECE 342: Junior Design II - Winter 2021

The HyperRail has been an on-going project through the OPEnS Lab at OSU and was created for analyzing crops in a greenhouse setting which required the overall system to be relatively fast and accurate in order to inspect specific aspects of the crop. For the purpose of this Junior Design class, the system we developed must include a majority of the hardware that had already been created, be controlled using G-code commands, and be able to change the tool mounted on the z-axis arm within a short period of time. Our team came up with the idea to implement a wireless user interface as well as a "low-power mode" in which the stepper motors and drivers will be disconnected from the power supply.

Initially, our team split up the project into 4 main parts; the user interface, a wireless communication block, a G-code interpretation block, and a power distribution block. The first aspects of the project that were focused on were the push-button user interface, creating a wireless MQTT network to allow communication between an ESP32 wireless microcontroller and the user's computer, installing and utilizing grbl on an Arduino Nano as a G-code interpreter, and creating a DC-voltage regulator to power both of the microcontrollers in our designed system.

The next step in our project was to then create the back-end of the user interface to send the commands the user had chosen to the ESP32, initialize communication from the ESP32 to both the Arduino and back to the user interface, designing a grasping mechanism, refining and debugging some of our motor control, designing a block that would allow a signal from the Arduino to disable power to the stepper drivers and corresponding motors for our low-power mode, and designing a PCB that would hold all of the components included in the power distribution block (the DC-DC buck converter and the design for our low-power mode hardware).

Throughout this project, there were many lessons learned about starting and finishing a project. One of the most outstanding lessons we learned was how much research goes into starting a project. As stated earlier, a significant amount of the time spent on this project went into research. For any project to be tackled in the future, this time for research needs to be taken into account, as this stage is almost unavoidable in any circumstance. Another lesson that we learned was focused on teamwork in a remote setting. Due to the circumstances of this term, all of the Junior Design groups had to communicate and finish a project using web-based communication. As we all know, this leads to many challenges into problem solving and figuring out where the state of the project is at at all times. Due to these challenges, our team learned that communication is key, and without frequent communication between team members, even simple tasks become much more difficult.

ECE 342-W21 HyperRail Timeline

PROJECT TITLE	HyperRail Team 11
PROJECT MANAGER	Jorian Bruslind

Term	Winter 2021
DATE	3/4/21

Timeline sections: **342 Design** (Week 1–Week 5), **342 Build** (Week 6–Week 8), **342 Present and Verify** (Week 9–Week 10). Each week columns: M T W R F.

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE
1	**Project Conception and Initiation**					
1.1	Project Requirements	Full Team	1/8/21	1/11/21	3	100%
1.2	Block Diagram	Full Team	1/8/21	1/15/21	7	100%
1.3	Project Timeline	Full Team	1/8/21	1/15/21	7	100%
1.4	Progress Reports	Full Team	1/8/21	2/26/21	48	100%
1.4.1	Week 12 Progress Report	Michael Guske	1/9/21	1/15/21	6	100%
1.4.2	Week 13 Progress Report	Samuel B.	1/16/21	1/22/21	6	100%
1.4.3	Week 14 Progress Report	Kyle B.	1/23/21	1/29/21	6	100%
1.4.4	Week 15 Progress Report	Orion H.	1/30/21	2/5/21	5	100%
1.4.5	Week 16 Progress Report	Michael G.	2/6/21	2/12/21	6	100%
1.4.6	Week 17 Progress Report	Samuel B.	2/13/21	2/19/21	6	100%
1.4.7	Week 18 Progress Report	Kyle B.	2/20/21	2/26/21	6	100%
2	**Project Requirement Revisions**					
2.1	Project Requirement Revisions	Full Team	1/8/21	1/11/21	3	100%
2.2	Design Feedback Session Materials	Full Team	1/30/21	2/3/21	3	100%
2.3	Design Feedback Session	Full Team	2/8/21	2/12/21	4	100%
3	**System Integration**					
3.1	Block 1 Checkoff	Full Team	1/18/21	1/29/21	11	100%
3.1.1	User Interface	Orion Hollar	1/18/21	1/29/21	11	100%
3.1.2	Buck Converter Design	Samuel B.	1/18/21	1/29/21	11	100%
3.1.3	MQTT Network	Michael G.	1/18/21	1/29/21	11	100%
3.1.4	G-code interpretation	Kyle B.	1/18/21	1/29/21	11	100%
3.2	Block 2 Checkoff	Full Team	1/30/21	2/19/21	19	100%
3.2.1	Interface Backend & Connection	Orion Hollar	1/30/21	2/19/21	19	100%
3.2.2	Relay Network For Low-Power Mode	Samuel B.	1/30/21	2/19/21	19	100%
3.2.3	PCB Design	Samuel B.	2/7/21	2/14/21	7	100%
3.2.4	Grasping Mechanism Control	Michael G.	1/30/21	2/19/21	19	100%
3.2.5	Motor movement	Kyle B.	1/30/21	2/19/21	19	100%
3.3	Remaining Block Finishes	Full Team	2/20/21	3/5/21	15	100%
3.3.1	Enclosure	Kyle B.	2/21/21	3/6/21	15	100%
3.3.2	Grasping Mechanism	Kyle B.	2/22/21	3/7/21	15	90%
4	**Project Presentation**					
4.1	Project Showcase	Full Team	3/1/21	3/5/21	4	100%
4.2	System Verification	Full Team	3/1/21	3/5/21	4	60%
4.3	Time and Cost Tracking	Orion Hollar	1/15/21	3/5/21	50	100%