1. **Project title, names and email addresses of team members**

   NASA LEC Robotic Mining

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2. **Faculty Advisor: name and email address**

   Dr. Marius Silaghi - msilaghi@fit.edu

3. **Client: name and affiliation**

   Aerospace NASA Lunabotics Engineering Competition (LEC) and
   Dr. Kimberly Demoret, FIT Aerospace Department

4. Progress of current Milestone (progress matrix)

Task	Completion %	James	Bailey	Taylor	To do
1. Investigate tools	100%	33%	33%	33%	none
2. Hello World demos	100%	33%	33%	33%	none
3. Implement, test & demo *ZED camera testing with Jetson*	80%	20%	20%	40%	Implement to simulation better. Use on physical robot
4. Implement, test & demo *Improvements to simulation*	100%	80%	10%	10%	none
5. Implement, test & demo *ZED camera demos*	100%	10%	10%	80%	none

5. Discussion (at least a few sentences, ie a paragraph) of each accomplished task (and obstacles) for the current Milestone:

For all tasks in this milestone, it was hoped that we would be able to start integrating the progress we have made in our simulation into a draft of the fabricated robot. Unfortunately, due to the ongoing strict COVID regulations present at the Harris Student Design Center, the Aerospace team has not been able to meet their milestones in robot construction. However, during the time of this last milestone, significant progress has been accomplished by the Aerospace team and we should be able to meet all physical robot related requirements from this last milestone in milestone 5. Being prepared for this, we decided to treat this milestone as an R&D opportunity further preparing our eventual convergence to physical hardware.

- Task 1: Many general features of the ZED camera were tested by either using pre-built samples included in the ZED camera ROS wrapper, or creating our own tests. Through these tests, we were able to determine what features were most relevant to our project, and how these features could be further fine tuned though our code samples. One of the most important features we got to test, that we ultimately made a demo out of, was the ZED camera's depth sensor. It is important to remember the complete details of our stretch goal. While full automation would be amazing, really we want to just focus on automating certain tasks of the competition as ultimately it *will* be more helpful to have manual control of certain processes. We determined that regardless of the status of full automation, measurements such as depth and orientation can be used to help manual control.
- Task 2: Since we are still having issues using the 3D model of the robot in Gazebo, we decided to continue adding to our box model simulation, Stilton, so that we can better utilize our Python controller code. We added two arms to the front of the robot that are able to move on the z-axis, namely they can move up and down. This was down to simulate the movement of the conveyor belt arms on the physical robot that are used for mining. In the future, we may look to add more parts to Stilton so that even more parts of the physical robot can be simulated. This is currently up for debate, as we are unsure how much more we need to simulate before the competition date draws near.
- Task 3: We were able to complete two demos showcasing the camera's unique ability of orientation tracking and live 3D modeling using depth sensing. This demo was created by heavily modifying a code sample provided by the ZED ROS wrapper. Ultimately, this will not be immediately useful to us but it helps familiarise ourselves with the characteristics of the library and how it could be configured to be relevant to our project. The second, more useful, demo we created utilizes the depth feature of the camera to accurately give the distance between the camera and the **specified** object. It was through this demo we were able to determine that the camera's accuracy slowly degrades as the object gets out of it's rated field of distance, but also wildly becomes inaccurate once the object gets too close. We were able to use this data to then make adjustments to our current transition plan to the final fabricated robot. It will be important for us to choose an accessible spot on the robot to place the camera so it's field of vision is not obstructed by these two issues.

6. **Discussion (at least a few sentences, ie a paragraph) of contribution of each team member to the current Milestone:**
    - Bailey Hamant: Researched multiple ways to utilize the ZED camera in conjunction with ROS and Gazebo. Helped write the documentation for milestone progress evaluation and created the presentation.
    - James Spies: Added arms to the simulation box robot that can move up and down to help simulate mining. Added to the writeup documentation and presentation.
    - Taylor Ertrachter: Used the ZED camera in real life to better understand what it is capable of and how it works in general. Helped with milestone writeup.

7. **Plan for the next Milestone (task matrix)**

Task	Bailey	James	Taylor
Further testing with ZED camera code	Find and use more tutorials as a basis	Understand how the physical camera works with the machine	Start making new code for use of the robot
Use camera with physical robot	Attach camera	Hook up camera to the Jetson	Use our written code to implement camera in real simulation

8. **Discussion (at least a few sentences, ie a paragraph) of each planned task for the next Milestone**
    - Task 1: We currently have code that demonstrates how the ZED camera operates. It is able to take a full 360 degree view of a room and create a mapping of that room. We wish to further this code to identify possible obstacles so that in the future the robot can use this information to move accordingly.
    - Task 2: If possible, we would like to start using our code in conjunction with the actual physical robot. We are not sure if this is possible yet because of the other hardware subteams, but if possible we would like to get the basics going with that.

9. **Date(s) of meeting(s) with Client during the current milestone**:
    - January 18
    - January 25
    - February 1
    - February 8
10. **Client feedback on the current milestone**
    - Dr. Demoret and the rest of the NASA LEC team appreciate our work and hope to let us get to implement our code with the physical robot soon. We have debated continued work on the simulation, but have yet to make a final decision on what to do.
11. **Date(s) of meeting(s) with Faculty Advisor during the current milestone:** .
    - February 14
12. **Faculty Advisor feedback on each task for the current Milestone**
    - Task 1: ...
    - Task 2: …
    - Task 3: ...

Faculty Advisor Signature: _____ Date: _____

13. Evaluation by Faculty Advisor

- Faculty Advisor: detach and return this page to Dr. Chan (HC 214) or email the scores to pkc@cs.fit.edu

- Score (0-10) for each member: circle a score (or circle two adjacent scores for .25 or write down a real number between 0 and 10)

Taylor Ertrachter	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Bailey Hamant	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
James Spies	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10

Faculty Advisor Signature: _____ Date: _____