

Team Contract Fulfillment

Team 3

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1 Project Goals

Our main goal is to build a wheeled-legged balancing robot that is capable of traversing through different terrains. Our goals can be broken down into several specific aspects.

On functionality, the robot should be able to maintain balance when stationary and move according to the command from the remote controller. Currently, we can balance the robot for a limited period and we still need to add the remote control functionality.

Mechanical-wise, our robot should be able to support 1-2.5 lb of loads and the robot's height can be changed between 90 mm to 250 mm. Our tests demonstrate the leg motors are powerful enough to support the suggested weight, but more tests are needed to assess the robot's ability to support this weight during movements. The requirement for changing the robot's height is satisfied.

On the electronic side, our goal was that the onboard battery should be able to support the robot for at least 15 minutes and our board should have reverse-polarity and over-voltage protection. We tested the robot and proved that the battery was enough to sustain the robot for 15 minutes. The reverse polarity of the board is fully functional, but there are some issues with over-voltage protection. However, this does not affect the main functionality of our robot.

For safety, the robot should have the emergency switch to allow a quick shutdown. In our design, we actually included three switches for emergency shutdown. We have a shutdown switch at the front of the robot, a switch on the remote controller to halt the robot on the software level, and a remote-controlled relay switch that can shut down the robot's power completely. Therefore, I believe our system has enough safety guarantees.

Most of our goals are satisfied. During fall break, we will do our best to complete the rest of our targets and perform more tests on the robot.

2 Expectations

Our team did a great job meeting our initial expectations. We were always prepared and informed for our meetings, which made our discussions productive. We kept in touch regularly and solved problems together effectively. Everyone was quick to respond to messages, keeping the project moving smoothly. We were good at giving and taking constructive feedback, which helped improve our work. We all understood and respected each other's outside commitments, making sure our project plan was fair and balanced for everyone. Whenever we hit a snag or disagreed, we listened to each other and worked out solutions together. Finally, we all were committed to doing our best work and sticking to our standards. Moreover, our project has exceeded the initial goals, and we are now aiming towards completing a fully functional robot. In short, we successfully met the goals we set at the start.

3 Roles

The responsibilities and roles of each team member in our team have not undergone significant changes. Zehao is responsible for the DC power board design of the robot and the drawing and manufacturing of the robot body. Jerry is in charge of the design of the robot's main control board, as well as the implementation of the IMU and the low-level motor driver. Gabriel is responsible for the simulation and implementation of the robot control algorithm. We do not have a designated leader; instead, we mutually monitor and check each other's progress to ensure the overall project is on track.

For each task, we divide the work individually and then integrate it together in the end. We believe that as members of the team, everyone should have the ability to independently solve problems. The workload for each person is also almost equal. If a team member encounters a problem that requires collaboration to solve, we promptly hold meetings to discuss and address the issue.

So far, the progress of the entire project has been quite rapid. We have successfully manufactured the robot, and both of our PCB boards are working successfully. The simulation of the control algorithm has also demonstrated that our model can converge.

4 Agenda

Throughout the entire project, all decisions and goals require unanimous agreement from each member because we value and respect the individual thoughts of each team member. In cases of differing opinions, we engage in continuous negotiation until the consensus is reached. Since this project is a collective effort and represents the dedication of each member, we all aspire for the project to progress in the direction we envision. Therefore, respecting and considering the viewpoints and ideas of each member is crucial to us.

5 Team Issues

So far, our team hasn't faced any major issues related to teamwork or collaboration, and the project progress is also being pushed forward. The vast majority of the difficulty comes from a technical perspective, and many parts are more difficult than expected, resulting in some task listing on time table cannot complete on time. However, we've adjusted our schedule to accommodate these technical hurdles. Our focus has been on addressing and overcoming these challenges, ensuring that our project continues to progress effectively.

Regarding the direction of the control algorithm, we are currently facing a discrepancy between simulation and reality. In the simulation process, all our parameters are theoretical values, such as the rotational inertia. When we transfer simulation parameters, such as the feedback matrix K for LQR, to the actual robot, we encounter an issue of insufficient feedback. We are currently in the process of addressing this issue and are experimenting with the replacement of some parameters in an attempt to resolve it.

Overall, our strategy for resolving issues remains in line with our team contract's methods. We collaboratively address problems and reach solutions with unanimous agreement. This collaborative method has proven effective in overcoming the challenges we are facing so far.