

Executive Summary

Parking lot striping is an annual task with the current major issues being efficiency and cost. Though striping technology exists, there are limits to what it can do. Parking lot striping machines are costly due to labor and maintenance, but a fully autonomous machine could be more efficient while mitigating the costs. This project serves to develop a low cost autonomous rover that can stripe parking lots at a more efficient and accurate rate than current manual machines.

Experimental Setup

Components:

- Two 12-volt batteries to power the two motors
- Sabertooth motor driver
- DC converter and fuse block
- Pixhawk and power management module
- ZED F9P RTK Board and antenna
- Telemetry radio
- GPS base station (temporary or permanent)

Constraints:

- GPS base station can only be used outside, away from large structures in the surrounding area.
- The prototype may not be in use during certain weather conditions such as rain, snow, etc.
- The customer will provide no maintenance personnel to assist in on-site installation.
- Customer installation site will only be accessible by development team during normal business hours
- Total development costs should not exceed \$800.

Experimental Results

- We were able to rebuild the rover
- The rover can now be controlled without setting up configurations in Mission Planner
- The RTK base station was built and an RTK2go server was also setup.

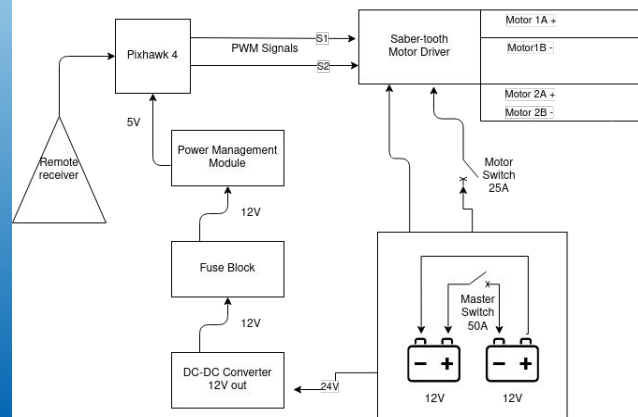


Background

The current process for parking lot paint striping is lengthy and expensive, with companies expected to estimate the total cost. This includes the total amount of parking spaces needed, paint, and labor costs of operating manual machines. This current process is inefficient, expensive, and time consuming. With an autonomous rover, companies could have the same quality job completed at a fraction of the cost and time. A fully autonomous paint striping rover has the potential for widespread distribution, replacing the current inefficient machines for companies worldwide.

Experimental Test Plan

- To get manual control of the rover we will use the DS6E remote and the DSMX receiver. As for the circuitry, two 12 volt batteries will provide power to both the Pixhawk through the PMM which provides a 5v output. The motors will also be powered by 24 volts. For the RTK base station, it will be mounted on the roof of Nederman Hall. The data will be published to an RTK2Go server. The pixhawk will then be receiving the data through the telemetry radios.



Conclusions

- The current design of the rover is an in-progress project and will be continued by a following team. Our team was able to integrate GPS capabilities with the rover, as this was the main focus that our sponsor required. We also created a base station (mounted on the roof of Nedderman Hall) that will be used for GNSS correction.
- For future plans, the following team will integrate a painting mechanism that will paint parking stripes when given a specified GPS waypoint path. The waypoints will be generated by the user and processed by the current GPS capabilities now available on the rover.

References

1. Liu, S., and Bobrow, J. E., "An Analysis of a Pneumatic Servo System and Its Application to a Computer-Controlled Robot," *ASME Journal of Dynamic Systems, Measurement, and Control*, 1989, Vol 110 pp 228-235.
2. Rubin, Kenneth S. 1st, Addison-Wesley Professional, "Essential Scrum: A Practical Guide to the Most Popular Agile Process", 2012.
3. GPS.gov, United States Code, "10 U.S.C. 2281: Global Positioning System", <https://www.gps.gov/topic/legislation/uscode/>, 2020.
4. Primavera Eng., "GPS usage in Road Construction: Global Positioning System Usage in Road Construction", <https://www.primavera.com/news/2016-05-06-gps-usage-in-road-construction/>, 2016.
5. Risto, Tiusanen, Timo, Malm, Ronkainen, Ari., "Review of Standards: An Overview of current safety requirements for autonomous machines", <https://www.dccruiter.com/document/doc/10.1615/eng-2020-0074.html>, 2020
6. U.S. Department of Transportation, "Regulations", <https://www.transportation.gov/regulations>, 2021.