# GPS Guided Robotic Car

Progress Report 3

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# "GPS Guided Robotic Car"

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## Objective

The objective of this document is to inform the reader of progress made towards the project's goal during the past three weeks.

## Procedure

General overview of the activities performed during the period of time since the last progress report has been written is shown below.

1. The first two weeks were dedicated to writing assembly code to output the GPS data onto LCD display in an organized matter. This task was continued since last report. The main reason that it took so long to finish seemingly simple task of outputting data onto display lies entirely in the fact that programming (end especially troubleshooting) assembly code is rather troublesome and frustrating. The other reason that might have influenced the progress of the project during those two weeks is the fact that hardware parts of the system (particularly LCD display and the microcontroller) seemed to communicate improperly on the hardware level. In fact they still "don't like" each other. For example, the latest version of the code (version twelve, see Appendix 1) works fine once it is freshly loaded into the microcomputer, but completely refuses to work after a restart. Problems like this one require a lot of logical-elimination or, at times, even trial and error troubleshooting.

2. Some time was spent on organizing the components of the control system into a portable carriage structure for testing purposes. Pictures of the outcome of these endeavors can be found in the Appendix 2. At first sight, this solution might look strange, but it is designed to serve only as a temporary solution and will be replaced with a sturdier structure once the system goes onto the Supermileage car. At the same time, this new structure is better than nothing at all (compare with figure 3, Appendix 2). In addition to new enclosure, the

system's wire harness survived a complete remake. This was done as to get rid of excessively long wires and extreme amount of unnecessary connectors. Another result worth mentioning about this renovation is the fact that almost every part in the system (except IMU) now has a duplicate which will simplify troubleshooting.

3. Once the system was fully assembled, it was tested outdoors (mainly due to the fact that GPS signal isn't strong in the lab where all the coding work is done). It has proven that all contributing parts of the system function properly, although some software problems showed their existence as well. As you can see in figure 2 that the display reads V 4707.1651 08832.7283. The first letter represents the status of the GPS satellite fix ('V' stands for not enough satellites for triangulating the position and 'A' is enough). Since the picture was taken inside a building, it's reasonable to expect that the GPS couldn't quite lock on the required number of satellites (minimum of four). The next number on the screen is latitude in degrees and minutes (ddmm.mmmm). The following number is longitude in a similar format (dddmm.mmmm).

4. As a part of the testing experience an RC car was acquired and taken apart. Once the part numbers of the motors used on the car were acquired, the datasheets were found online where some valuable data (like current rating and torque curves) were presented. The next step taken in this discovery process was a design procedure of a motor controller. It started from a simple BJT (Bipolar Junction Transistor) biased by the car's battery and the input signal from the microcontroller, but soon it was found that this design is 'single-sided' (in terms it allows steering or accelerating only in one direction, it doesn't give the user a reverse gear, so to speak). This design will be a part of the research process during the next three week period.

## Conclusion

Tasks completed during the time period covered in this report show steady progress in the project's completion. This time through, the assembly code becomes more and more transparent and the laws guiding the world of embedded systems more apparent. It is reasonable to say that in the last quarter of the allotted time code writing will take a lesser portion of time due to skill honed by the student.

Near-future tasks include enabling the system to recognize the signals from the inertial measurement unit and feeding these signals into Kalman filter. Also, the work on motor controller design will be continued and will ultimately lead to a small scale testing (RC car).

## Appendix 1. Latest version of the assembly code

For electronic version only: Please see attached file or go to
http://www.enterprise.mtu.edu/ase/gps/PR3_Appendix1.pdf for an online copy.

## Appendix 2. System comparison: previous setup vs. current setup

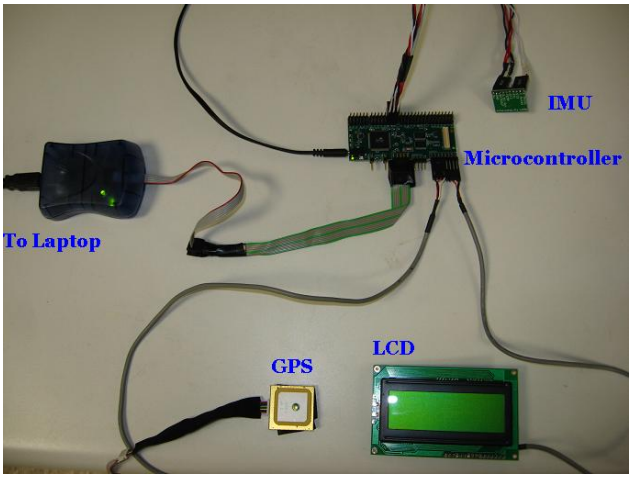


Figure 1. Old setup


Figure 2. Current setup

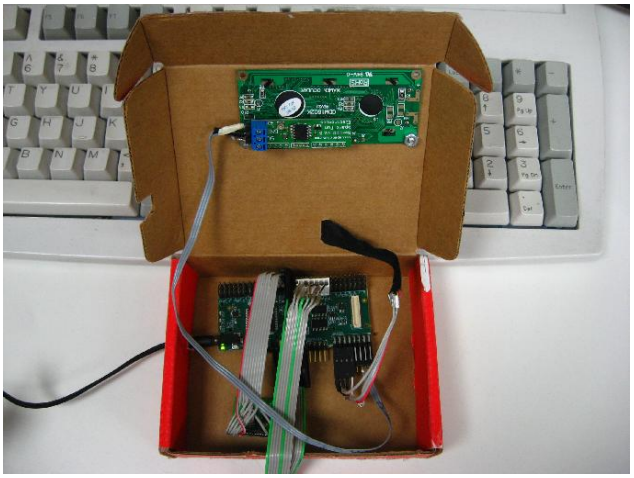

Figure 3. Current setup unfolded