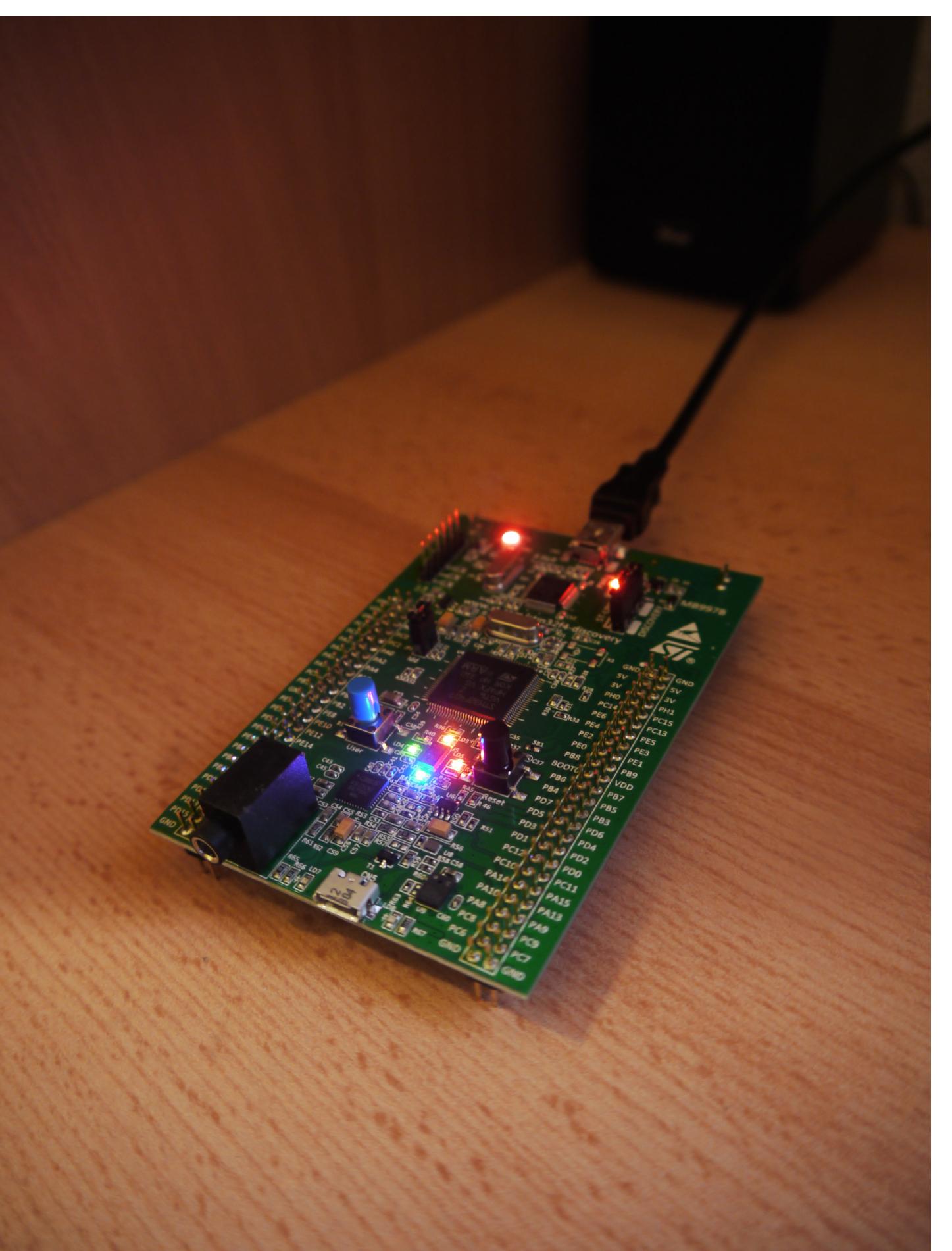


Summary

A servo signal processor and PWM generator unit was developed for an ARM Cortex-M4-based microcontroller development board, the STM32F4-Discovery Kit, using Model-Based Design approach with MATLAB-Simulink. The scope of the project, assigned by the High-performance Microcontrollers class held by the Department of Measurement and Information Systems, Budapest University of Technology and Economics, was to introduce the students to advanced 32-bit microcontroller-based software development, and provide application experiences. A fixed-point software [1] was designed and verified in a simulated environment, and it was deployed on the target using Embedded Coder code generation. To test the system, a commercial RC transmitter and receiver was integrated with the developer board, and a mobile ground vehicle platform was prepared.

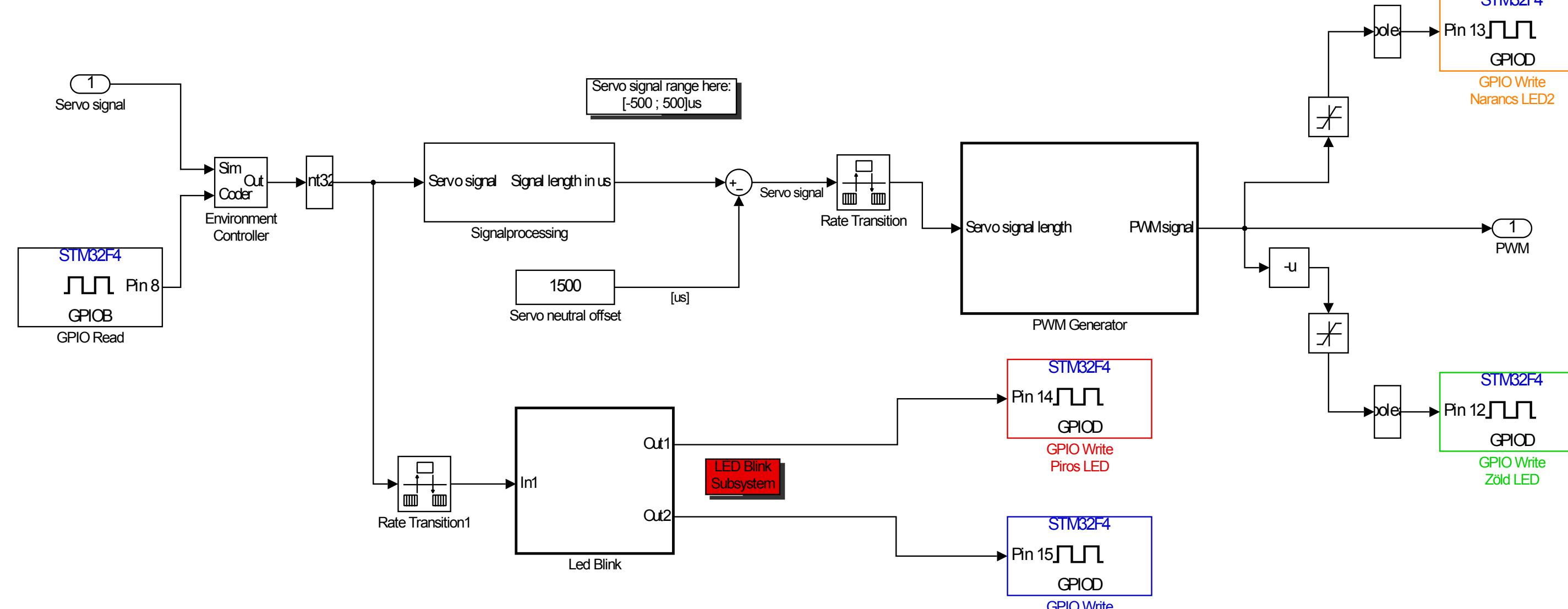
Introduction

Model-Based Design provides a fast and efficient approach to software-engineering. In addition to the advantages of easy maintenance, reusability and reliability, the development cycle becomes shorter and faster [2]. MBD allows easy implementation of complex software functions and control systems, and the automated code generation for the target hardware assures rapid deployment capabilities. Although the processing of servo signals require low level access to the hardware, it became clear that very high level methods can provide sufficient results as well, with significantly shorter development duration.



Modeling

The software was designed in the visual environment of Simulink. MathWorks offers the ST Discovery Hardware Support Package that provides the necessary Target Language Compiler files. With the correct settings of the Embedded Coder, the model can be compiled to executable binary code.



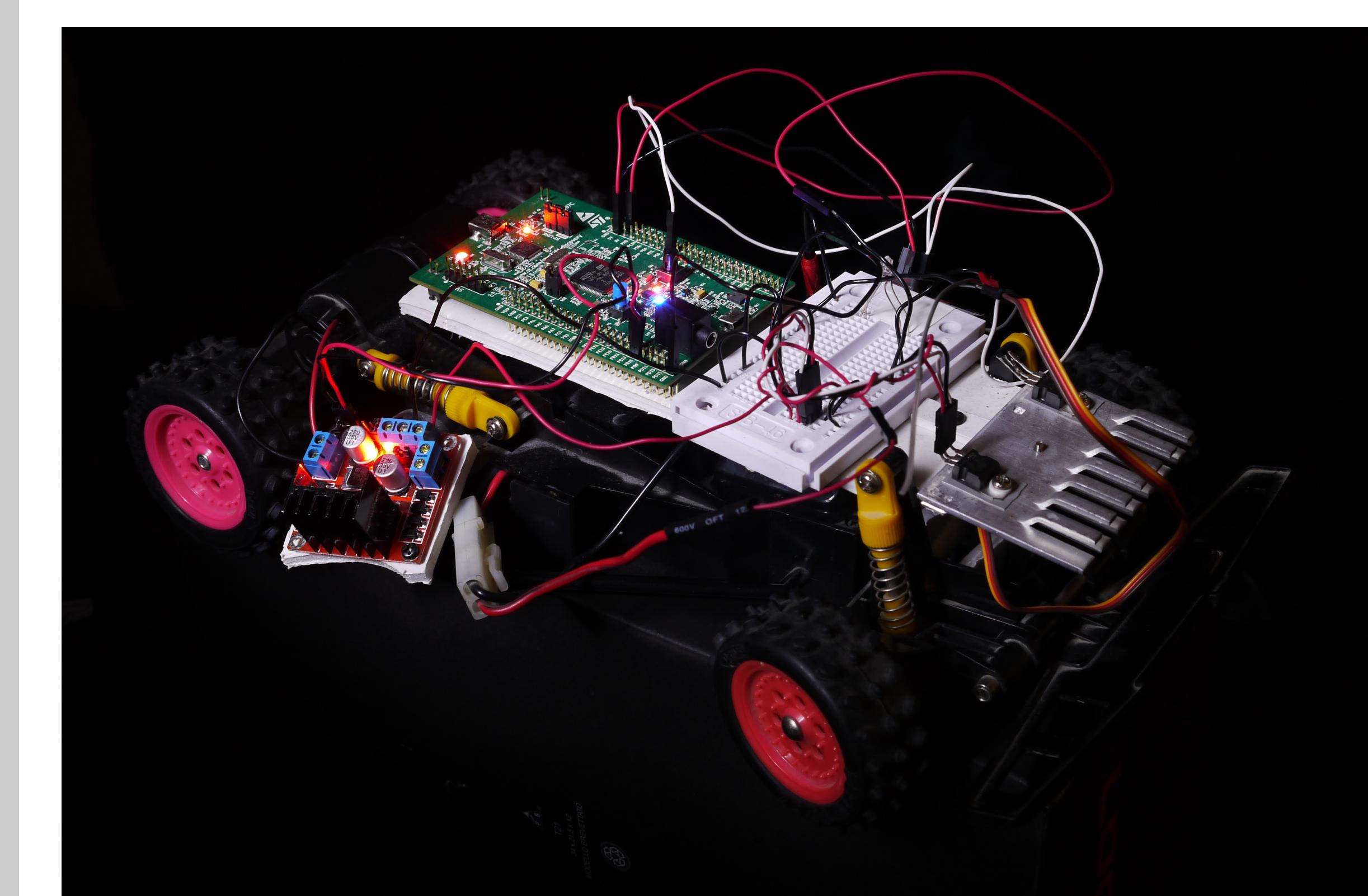
Results

After the programming of the Discovery board, a series of quick tests conducted on the system has revealed that it operates according to the specifications. Sometimes during idling short pulse bursts can be experienced, if the RC transmitter is not configured correctly. The QR code on the right will take you to MATLAB Central, where the source model and documentation can be downloaded, and a demonstration video can be played.



Vehicle Platform

The base of the system is an old Remote Control car body, without any electronics. A commercial position servo was fitted to the front to handle the steering tasks [3]. The main electric motor was connected to the board PWM outputs through an amplifier unit that powered the engine. The power required by the Discovery board is drawn off from the 12V battery by a voltage regulator IC, which is located on the front heat sink, in order to avoid failures due to overheating.



References

- [1] Steven W. Smith. *The Scientist and Engineer's Guide to Digital Signal Processing*.
- [2] *Model Based Design Accelerates the Development of Mechanical Locomotive Controls*. SAE 2010 Commercial Vehicle Engineering Congress, October 2010.
- [3] Darren Sawicz. *Hobby Servo Fundamentals*.