Team "University of Latvia" GCDC 2011 Technical Paper

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***Abstract*— This paper presents technical approach and progress of GCDC Challenge team representing University of Latvia and Institute of Electronics and Computer Science, Riga, Latvia. Our main goal is to create a solution with simple and reasonable adaptation capabilities for wide range of mainstream vehicles.**

I. THE TEAM

Our team consists of researchers and engineers affiliated with University of Latvia and Institute of Electronics and Computer science, both located in Riga, Latvia. Our expertise is in computer hardware and software, including signal processing, sensor networks and wireless communication. In GCDC challenge context we have the following roles: Leo Selavo: project lead; Andris Gordjusins: vehicle control; Georgijs Kanonirs: positioning; Vadims Kurmis: communication; Artis Mednis: system analysis; Girts Strazdins: algorithms; Reinholds Zviedris: user interface.

II. THE VEHICLE

Mazda6 (Figure 1) has been chosen as a representative of a large vehicle group to create and research a robust, adaptive, cooperative cruise control. Mazda6 represents one of the largest car groups equipped with electronic accelerator pedal and mechanical braking. Automatic gearbox was chosen as part of the challenge requirements. Additionally, solution for this particular platform gives ability to make inexpensive and simple retrofitting solutions for people with special needs. The car is not equipped with any drive-by-wire solution, therefore our team is developing both the throttle and brake controls.

Fig. 1 Our vehicle: Mazda6

III. Approach

Our design rules are: a generic and dynamic solution, which can be applied to wide range of contemporary mainstream vehicles. The system architecture is depicted in Figure 2. Although there are existing solutions for drive-by-wire vehicle control, for example EMC AEVIT [1], due to time constraints and device manufacturer installation restrictions, we decided to build our own vehicle control system, consisting of throttle and brake control modules. Acceleration is controlled electronically, brake system is fully mechanical and control is based on stepper motor. We are developing a very accurate vehicle positioning system based on GPS and Inertial Measurement Unit (IMU) combination. Commercial GPS-RTK devices are too expensive to be used in mainstream vehicles and are therefore against our design rules. Unex DCMA-86P2 802.11p miniPCI modules [2] have been chosen and are being adapted for communication with other vehicles and infrastructure. Laptop PC is used as central processing unit.

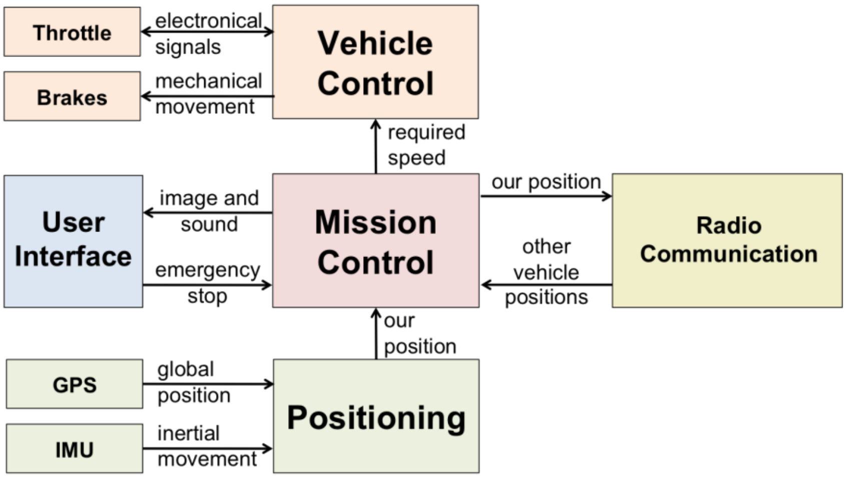

Fig. 2 System architecture.

IV. Progress and Ongoing Work

We have explored drive-by-wire options for our Mazda6 and its generic parts, which are extensible for other vehicles. We have built a throttle control system prototype, which is being tested. Theoretical model of brake control system is designed based on real physical force measurement results. Accurate positioning systems using GPS and IMU combination with Kalman filtering are researched and we have chosen a model, which is being implemented. 802.11p communication modules are incrementally developed, using patches provides by GCDC and developed by our own team. Our ongoing work focuses on state-of-art cooperative cruise control, platooning and collision avoidance approach research, GCDC test scenario development and simulation.

Acknowledgement

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References

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[2] Unex DCMA-86P2: industrial grade, high power 5.86~5.92GHz wifi mini-PCI module for 802.11p/DSRC application, AR5414A-B2B, http://www.unex.com.tw/product/dcma-86p2