Technical Report

Mechanical and Electrical Description

Original chassis of the car was extended with metal plate with dimensions 130x200 mm. Camera holder was attached to the front of the car. Holder consists of two rails, which hold the camera and also two lighting modules. First lighting module is attached right under the camera and is made of one 5W CREE LED. The second lighting is mounted to the front right above the level of wheels. This module has two Luxeon 1W white LEDs on sides which are supplied from battery voltage. Linescan TAOS camera was not replaced with other model. TRK-MPC5604B was placed in the front of the metallic plate and motor drive board in the back. See Fig. 1 Side view of the car.

Motor drive board was modified to allow breaking. This was performed by disconnecting INH1 of both H-bridges and connecting to PE14 and PE15 of MPC5604B.

Two hall sensors were added to the chassis and two magnets to each wheel to determine speed of the car.

Bluetooth module was used in the state of development to control the car and observe wirelessly variables of the MPC5604B control software.

![Fig. 1 Side view of the car]
Software Description

Software first initiates ADC, eMIOS, ADC, LinFLEX UART initialization and pin configuration. Output pins are used to control motors, servo and LED indicators. Input pins are used to detect button press and speed measurement. The UART LinFLEX helps with debugging the code cooperating with Bluetooth module, which brings mobility to work procedure.

Moves and directions of the car depend on linescan camera. Frames from this camera are analyzed and contain only monochrome pixels. Difference of the pixel values defines the edges of the line(s) and only lines with valid width are evaluated. The center of the line is found with respect to the last found center which helps to determine what line to choose as a main line, when there are more lines detected. The Stop is defined by three lines.

Servo is turned to the direction of line center, which was analyzed previously. Line center is filtered by Weight Moving Average to prevent oscillation of the wheels. The speed of the car is determined by center of detected line. Highest speed is set when line is detected in the center of the view, lower on the both sides and the lowest speed is set when line is detected on the edge of view. In total, view of the car is divided into 5 speed intervals (Fig.2). Sector 1 is lowest speed, sector 3 highest.

![View of the car](image)

Fig. 2 Speed levels of the car according to line position
We developed a small utility called “Freescale Cup Camera Monitor” to watch system variables, which was written in C# using Visual Studio 2010. It communicates with car through Bluetooth com port and it can also record an image from camera and then replay the images afterwards.

Images are being send in packets which one pixel is defined by 2 ASCII characters and then converted to a number – brightness from 0 (lowest) to 255 (highest).

Fig. 3 Image made in low light conditions

Fig. 4 Image made with additional lightning
Total weight, dimensions and power consumption of the reengineered car

Dimensions: 300mm x 230mm x 170mm

Weight: 1300g

Power consumption: maximum speed, lights on- 1500mA

No additional motors were used in our reengineered car. For speed measurements hall sensors were added to each wheel. Two magnets were placed on each wheel for more precise data.

![Fig. 5 Dimensions of the reengineered car](image-url)