Autonomous System "Car Robot"

Denis Varabin[1], Dmitry Bagaev[2]
Kovrov State Academy of Technology, Kovrov, Russia
[1]*denvar@bk.ru*, [2]*dmitry_bag@mail.ru*

***Abstract*— This paper shows the structure of an autonomous system of "car-robot." It is a vehicle capable of moving completely independently or with a remote control. A description of the system being developed and created a prototype.**

Keywords*— *autonomous robots; control system, car-robot; competition of unmanned robotic vehicles

I. INTRODUCTION

The facility review - an autonomous "robot car" - a self-contained mobile unit that can move around and perform some actions, like using a remote control and fully autonomous. The system is a versatile robotic system with preinstalled hardware. Existing solutions have the following disadvantages: high cost and low flexibility (made for a specific narrow task).

II. MAIN TASKS

The tasks:

A set of functions are performed:

- Movement of vehicle in manual mode:
- The operator controls the vehicle on the wire / radio communications (in the absence of visual contact with the vehicle - guided by the video data).
- You can save the geographical coordinates of the traversed path and transfer to the operator.
- Possible implementation of a map of the route the vehicle to a map in real time
- Movement of vehicle in automatic mode:
- Ability to vehicle motion along the trajectory defined by the operator through the input of geographic coordinates of the nodal points of the route into the system.
- Ability to vehicle motion along a trajectory previously saved, while driving in manual mode.
- Bypass the obstacles are in front of the vehicle. If you can not - stop the vehicle.
- Issuance of the operator to telemetry data and video.

Channels of communication with the vehicle:

- The primary radio channel, the maximum range - up to 3 km:
- Transfer video from cameras located on the vehicle.
- Transfer of information about the obstacles in front of the vehicle.
- Obtaining information on the vehicle telemetry (speed, direction, inclination angles, the current coordinates, the parameters of the engine, etc.).
- Manual control of the vehicle through the computer.
- Starting and stopping programs automatically control vehicle.
- Emergency stop vehicle.
- Standby radio channel, the maximum range of up to 1.5 km:
- Control vehicle with the remote.
- Emergency stop vehicle.
- Wireless Channel - repeats all the basic functions of the radio channel (the maximum length of cable utp 5e 100m using fiber-optic cable - up to 2 km).
- Technology - is necessary for the direct control of electric vehicle in transport operations and debugging.

III. THE PROPOSED SOLUTION

Block diagram of the developed system is presented in Figure 1.

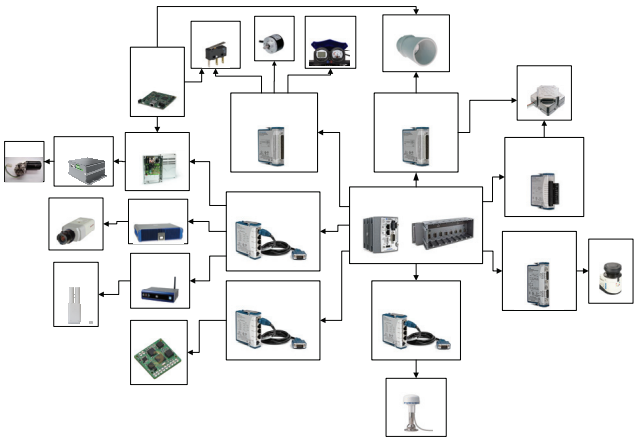

Figure 1.

As a platform to be used four-wheel drive ATV with mounted electric steering, brakes, throttle position (feedback - on the situation).

The basic system for collecting and processing information is based on the NI CompactRIO to a set of modules required. The positioning system consists of a GPS receiver and the orientation system, girotahometr (as supplementary information) and data on the traveled way, can process data using a Kalman filter. Construction of maps and detection of obstacles built on the basis of the laser scanner firm Sick (optional stereo cameras can be installed in order to improve accuracy). Ultrasonic range finders are located around the perimeter of the vehicle provide an emergency stop of the vehicle when it approaches an obstacle undetected. The camcorder is designed to transmit images to the operator.

Currently, developed a prototype of the "car-robot" (Figure 3). For the base unit is taken automobile "Gazelle-business." The control system is shown in Figures 2,4.

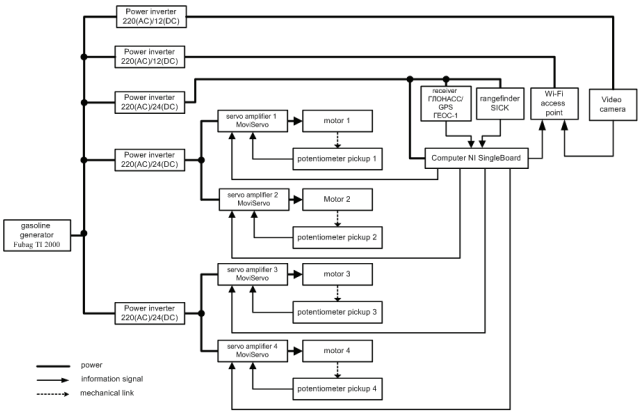

Figure 2

As a system for collecting and processing used NI SingleBoard. For obstacle detection we used an ultrasonic range finder. Minimum distance obstacle detection was about 5 m, thus there is a full stop of the vehicle.

Implemented key features:

- Manual control (over the air)
- Automatic Movement (on a predetermined route)
- Ability to an emergency stop when it detects obstacles in front of the car

Figure 3

- The transfer of video and motion of the main parameters for the position of the operator

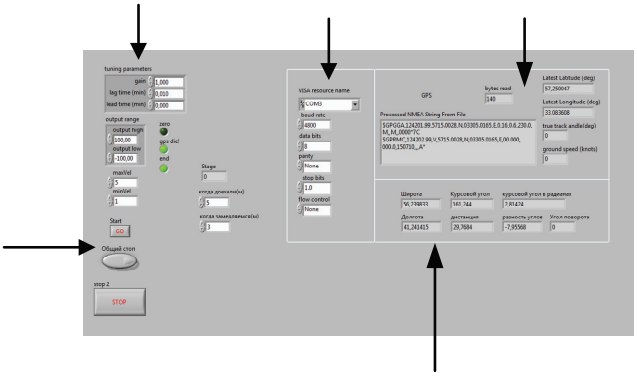

Figure 4. The software module top-level

IV. CONCLUSIONS

The above analysis gives us the following conclusions:

1. As a result of the use of special algorithms for the vehicle deviation from the specified path was not more than 3 meters. The average speed of 25km/h.
2. This car took first place in the competition of unmanned robotic vehicles in Russia, "Robokross-2010" and "Robokross-2011."

REFERENCES

[1] Yurevich E.I . "Fundamentals of Robotics". - 2nd ed., St. Petersburg.: BHV-Petersburg, 2005.

[2] Durrant-Whyte, H.; Bailey, T. (2006). "Simultaneous Localization and Mapping (SLAM): Part I The Essential Algorithms". Robotics and Automation Magazine 13 (2): 99–110. doi:10.1109/MRA.2006.1638022.

[3] Myles Durkin, Kevin McHugh, Ryan Ehid, Brian Lepus, Stephen Kropp "Firefighting Robot. A Proposal." May 5 2008.

[4] F.Zhimarshi, M.A.Komarov. "Device control robots", - M., NT Press, 2007.