Ovoshnoe_Ragu, Russia, Novosibirsk

2. Abstract

Our robot experienced huge changes this year: we added the system of machine vision which helps to navigate the goal. Also, we implemented line detectors which help to define the line with high accuracy. Moreover, there is a 12V solenoid in this model that allows to reach a bigger potential while deploying the attack.

3. About US

Our team started taking part into RoboCup competitions in 2019, and throughout this time the robots had gone through many changes. Our team consists of two members – Makarov Semen as an engineer and Abdullaev Timur as a programmer, with our mentor – Ryabcov Igor. The most important modification of this year is the implementing of a camera with a mirror.

4. Hardware:

Our construction consists of two PCBs which have a role of foundation. The main part of the components is placed on the top plate when motors and line detectors are placed on the bottom one. The development of the model was in CAD Kompas with the following creation of the PCB in KiCad. If we talk about the peculiarities of the construction, it's necessary to mention the system of machine vision, self-made line detectors, omni-wheels and solenoid. The biggest part of the details was printed on a 3D printer. This way of production was chosen due to good resistance and weight of plastic.

We used solenoid 12 V in our robot. It is situated in a way so the impact point of the solenoid, while the ball is in grab, was right in the centre of the ball. It was made to rise the accuracy.

Software:

We use Arduino IDE for programming as it's quite simple in usage and mastering. The program itself is written in the C programming language. There is only one core in our controller so the whole program is functioning linearly.

There are 8 buttons on the sides of the robot and each one of them has its own task. They are: robot's start\finish, booting of calibration adjustments, server's calibration, calibration of light detectors, turning on\off of the motors, solenoid's testing, checkout of sensor's reading and Bluetooth connection.

We use 12 self-made light detectors, which are placed on the bottom plate, to detect the line. These detectors consist of photosensitive transistors and light-emitting diodes. The data is collected through analog ports. The cosine rule is used to conduct the robot's leaving from the line, through the mathematical vectors' plotting.

A 9-axis sensor of BNO055 compass is placed on the top plate. It's plugged through the i2c protocol. With the formula we receive the deviation from the geographical north, and after that we get the deviation of the necessary spot in the format of 180-180. After that we get the turnover ratio with the help of proportionally-differential regulator. This number goes to the motor regulator afterwards.

To identify the ball we use 2 IR sensors; the locator and seeker – these two are also connected through i2c. The locator gives us the info about the ball's position relative to the robot in the form of 360-degree grid with the step of 5 degrees.

The robot can detour the ball basing on the distance to it: the closer the ball, the bigger the rate of the motion's curvature. The seeker is used only in case of locator's inability to spot the ball on far distances.

To identify the goal we use Pixy2 camera as it's extremely simple in the usage. Also, it has enough processing speed to follow the orange RCJ Open league ball.

For ball's dribbling in the direction of the goals, it's firstly necessary to calculate the biggest empty part of them, which will be aimed to lead the ball in. The robot later turns towards the goal to get the ball there.

Results:

While creating the robot we faced difficulties with calculating mirror for camera and choosing the colour for the line detector LEDs. The first problem was solved with realistic rendering. To solve the second problem there were several tests conducted. They showed that red, white and green LEDs have the highest range of values.

According to the competition's rules along with our requirements we chose motors Pololu 20d; and the plate Arduino Mega PRO on a basis of Atmega 2560 microchip was chosen as a controller.

5. Results

In the process of creation we had gone through all stages beginning from the robot's engineering, its assemblage, finishing with programming and tuning up the algorithms. We've learnt how to work in CAD, create printed plates in CAD, program robot and create algorithms, and also developed critical thinking even in the most difficult situations.

6. Our Video

https://youtu.be/L0WDbiqLpJ0

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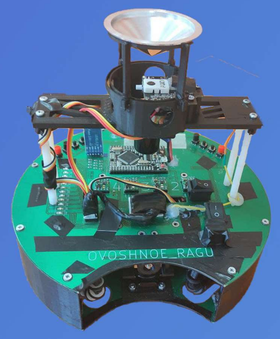

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Button massive

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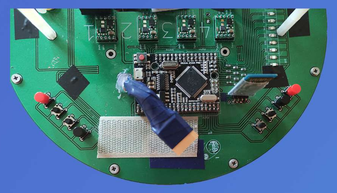

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Aligning to the goal

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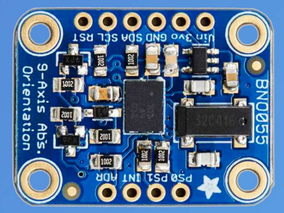
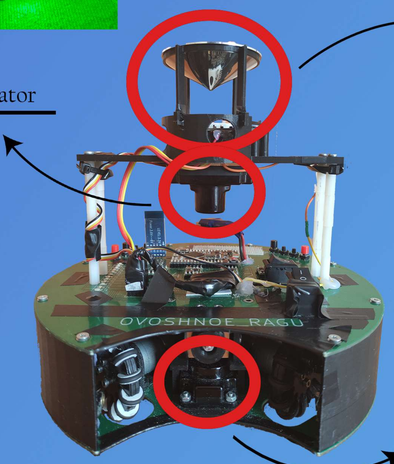


Camera with miror

Locator



Seeker

Defining the ball

To identify the ball we use 2 IR sensors; the locator and seeker – these two are also connected through i2c. The locator gives us the info about the ball's position relative to the robot in the form of 360-degree grid with the step of 5 degrees.
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Goals detecting

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Conslusion

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