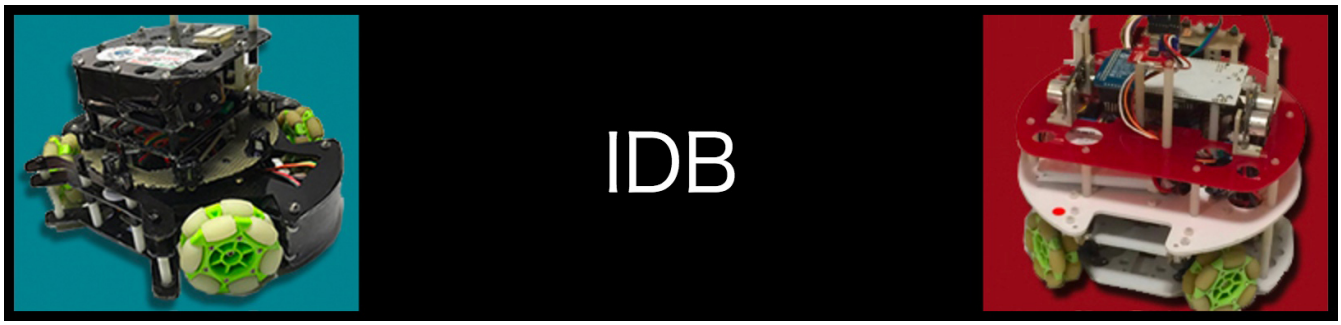
RoboCup Asia Pacific Team Description Paper



1. Abstract

In this article, we will explain the technical information of Team IDB participating in RoboCup Junior Soccer Light Weight League Secondary, the background to team formation, strategy.
For technical information, we will explain in detail the hardware technology and software technology of FW machine and GK machine.

2. Introduction

We attend the robot class in Tokyo, Truth Academy. We have participated in the RoboCup Junior Soccer Challenge since 2013 and originally belonged to different teams from each other. So, we decided to form a team together and “IDB” was formed. At present, we take advantage of what we have experienced with the previous team, and sometimes exchange information and are making an effort to make a robot.
We have participated in RoboCup Junior Japan Open twice so far, the result was 4th overall in 2016, 6th in total in 2017 (mixed primary and secondary).

3. Robot

3-1 Hardware Architecture (FW machine)

Characteristic

FW is a position that be request to move quickly and powerfully in the RoboCup Junior Soccer competition. Therefore, this machine had a low center of gravity structure and stabilized the aircraft. Also, since the motor uses high torque, we use strong GFRP (glass fiber reinforced plastic) for the chassis material. The material of the upper plate is made of impact resistant PC (polycarbonate). Using these plates firmly fixed the motor, realized a speedy and powerful movement, and made a strong machine against the collision with the opponent's machine and the wall.

Gyro sensor (MPU6050)

It is a sensor that detects the direction the machine is facing. It is used for posture control of the machine. Unlike the magnetic sensor, it has the merit that it is not influenced by the magnetic field of the field to obtain the angle from the angular velocity. However, since the amount of calculation to calculate the angle is large and complicated, in addition to the main microcomputer, a sub-microcomputer for calculating the angle is carried.

Infrared sensor (TSSP58038)

It is a sensor for finding a pulse ball. We use 8 elements in total to see 8 directions. Also, since this element is highly sensitive, it can find the ball no matter how far away it is in the normal B field. However, because of its high sensitivity, I also find balls that are behind them. So we shielded from acrylic pipe and copper tape so as not to find the ball behind.

Line sensor (Light modulation type photo IC)

It is a sensor that detects white lines. This element has the merit that it is not affected by ambient light and is high performance. Moreover, since it is a digital output, it can be controlled easily. Adjusting the brightness of the LED can correspond to various fields. We have 12 elements in total, and we use 3 each in front, back, left and right.

Ultrasonic sensor (MB1010 LV-Max Sonar-EZ1)

It is a sensor that measures the distance between the robot and the field. It's small and light and easy to control. I mounted one in the back so that the robot quickly returned near of our goal when the ball came out of the field.

Microcomputer (main; Meduino Mega 2560 Pro mini , sub; Arduino micro)

The main microcomputer of the FW machine in 2016 was Arduino Mega 2560, but from 2017 it changed to compatible Meduino Mega 2560 Pro mini in order to reduce the size and weight of the main board. As a result, the main board shrunk, making the machine compact. In addition, the microcomputer for calculating the angle of the gyro sensor uses Arduino micro.

Battery (Lipo battery 11.1V 1300mA G5 series)

I use Hyperion's Lipo battery. The power supply for the motor and the main microcomputer and sensor power supply are covered with this battery.

3-2 Hardware Architecture (GK machine)

Characteristic

Unlike the FW machine, this machine does not make a speedy and powerful movement, but it captures the ball accurately and chases the ball according to the situation, moves back and forth quickly and accurately to the front of its own goal, supports FW machine.
The structure of the machine is low center of gravity like FW machine; the materials of the board are all strong, lightweight and easy to process acrylic.

Compass sensor (HMC6352)

It is a sensor that detects the direction the machine is facing. It is used for posture control of the machine. Unlike the gyro sensor, it receives the influence of the magnetic field of the field, but as a countermeasure, it uses a magnetic shield.

Infrared sensor (GP1UX511QS)

It is a sensor for finding a pulse ball. The arrangement of the sensors makes it possible to see the eight directions as well as the FW machine. This element is as sensitive as that of the FW machine, so it responds to distant balls, but it also reacts to the ball behind it. So I put a cover on the back so as not to respond to the ball, shaded.

Line sensor (Daisen white line sensor)

It is a sensor that detects white lines. This sensor is sold by Daisen Electronics Industry. Four sensors are installed and it is arranged in front and back and left and right. In addition, in order to increase the reaction speed, a sub-microcomputer is used for white line processing.

Ultrasonic sensor (PING)

It is a sensor that measures the distance between the robot and the field. Three of them are installed in this machine in total, and they are arranged behind and to the left and right. I use these to make it possible to return to the front of our goal when I lose sight of the ball.

Microcomputer (main; Arduino Mega 2560 Pro mini , sub; Arduino mini)

For the main microcontroller, Arduino Mega 2560 with high program extensibility is used. Also, the sub-microcomputer that performs white line processing uses an Arduino mini compatible machine.

Battery (Life battery 6.6V 1600mA Receiver Pack G3 series)

I use Hyperion’s Life battery. The power supply for the motor and the main microcomputer and sensor power supply are covered with this battery.

3-3 Hardware Architecture (common)

Motor and Motor driver (motor; Joinmax , motor driver; VNH2SP30)

For FW and GK machines, we use high torque Joinmax motors. And, for the motor driver, I use Pololu made VNH 2 SP 30 which can flow up to 14 A.

Protection of lithium battery

We are using a lithium type battery as the power source of the machine. So we have a fuse to prevent secondary disasters caused by short circuit etc. It also features a low voltage alarm that constantly monitors the voltage of the battery so as not to shorten battery life at low voltage. When this alarm falls below the set voltage, the buzzer sounds at a loud volume.

3. Robot
3-4 Software Architecture (FW machine)

Ball tracking

FW is a position that be request to move quickly and powerfully in the RoboCup Junior Soccer competition. Therefore, this machine had a low center of gravity structure and stabilized the aircraft. Also, since the motor uses high torque, we use strong GFRP (glass fiber reinforced plastic) for the chassis material. The material of the upper plate is made of impact resistant PC (polycarbonate). Using these plates firmly fixed the motor, realized a speedy and powerful movement, and made a strong machine against the collision with the opponent's machine and the wall.

Control of ultrasonic sensor

When the balls are removed from the field, they return to near the goal of their own. Also, to prevent double defense, it stops outside the penalty area.

3-5 Software Architecture (GK machine)

Ball tracking

As with FW machines, the ball position finding method is the search for the maximum value of the sensor. However, the GK machine will not chase even if a distant ball is visible, and will follow the ball as the ball approaches.

Control of ultrasonic sensor

When the FW machine is holding the ball or when the ball is lost from the field, it uses three ultrasonic sensors and quickly returns to the front of the self-goal. Also, while waiting in front of the own goal, if another machine or the like interrupts either the left or the right, it is possible to distinguish whether it is the distance from the wall or not based on the data stored beforehand, Other than tracking it will not leave the goal.

3-6 Software Architecture (In common)

Control of Line sensor

Before Out of Bounds was introduced in the rule of football challenge, delay was used to count the number of seconds when stepping on a white line. However, during the count, other movements cannot be made, so it came out of the bounces with a high probability if it came near the corner of the white line. So we used millis and while to count the number of seconds, so we could handle it by stepping on another white line during counting. Furthermore, if the ball is out of the white line even after the end of the count, it stops until the ball is moved and reduces the probability of out-of-bounds.

Posture control while moving

When the robot is following the ball, the direction of the front will inevitably deviate. So, I am correcting the orientation of the robot using a compass sensor gyro sensor. In past programs the azimuth correction had priority over ball tracking. However, if it turns when you are following the ball, you will get a gap. So, when we were chasing the ball, if we turned the direction, we chose to correct the direction while chasing, so we could follow the ball smoothly.

4. Strategy

4-1 Role of robot

We divide the role of the robot with FW and GK. FW attacks the opponent quickly and powerfully to the opponent's position, and GK always prevents the opponent's attacks coming in front of the self-goal goal. In addition, they may go to avant-garde as necessary.

4-2 Robot development within the team

Team mates are building one robot. We are gathering at the Truth Academy three to four times a month, exchanging information by using SNS messages and others. Also, as the tournament gets closer, they play against each other's machines and point out each other's improvement points.

5. Acknowledgements

We has been able to continue developing robots that have been fulfilling for a long time since we formed with the warm support of trainers and mentors of Truth Academy and family members who kept us going to Truth Academy. I would like to take this opportunity to thank you.

6. References

・Truth Academy's homepage (Robot development in general)
http://truth-academy.co.jp/
・Hayanesan Kobo　(Gyro sensor development)
http://blog.livedoor.jp/hymne333/