IRIS ITS ROBOTIC TEAM

Mechanical and Electrical Description with SoftwareArchitecture

1. Mechanical Structure

Recently, our new generation robot has been built completely. This robot is totally changing than the last one. We combine 3 omnidirectional wheels to drive the robot. The body of our robot is mostly built from 7 series alumunium that has more light and rigid material to anticipated any crash with other robots or objects. The dimension do not exceed than 52 cm x 52 cm x 80 cm according to robocup guidelines.

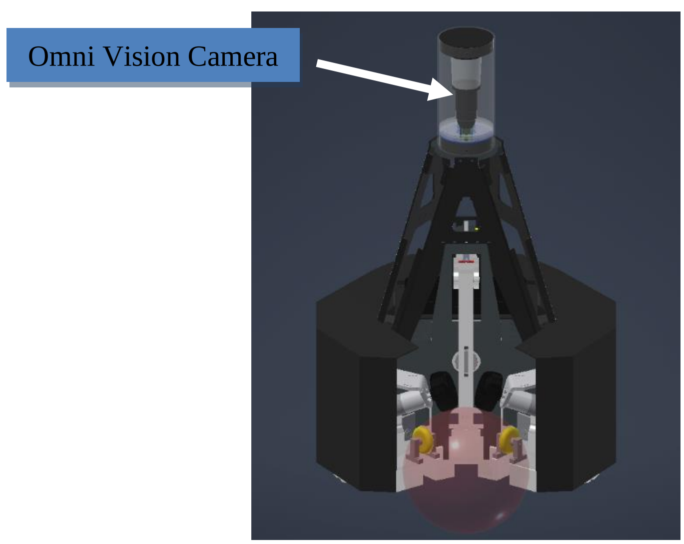

Fig.1. IRIS Robot

1.1 The Shooting System

Kicker system mechanism on this robot uses a solenoid system. The mechanism is designed using a solenoid as the actuator. The use of solenoids is considered based on their durability and the capacity of the space required to be installed in the robot. The capacitor as a voltage storage medium of 400 V will be transmitted to the solenoid coil so that a magnetic field arises which will move the plunger and kicker. The magnitude of the transmitted voltage is controlled using a microcontroller. Because our robot's kicking mechanism is not fixed, it can move up and down. The mechanism is powered by a microcontroller - controlled PG36 DC motor. This system enables the robot to adjust the height of the kicker (low pass and lob pass) and the speed of the kick based on the target's distance from the robot position.

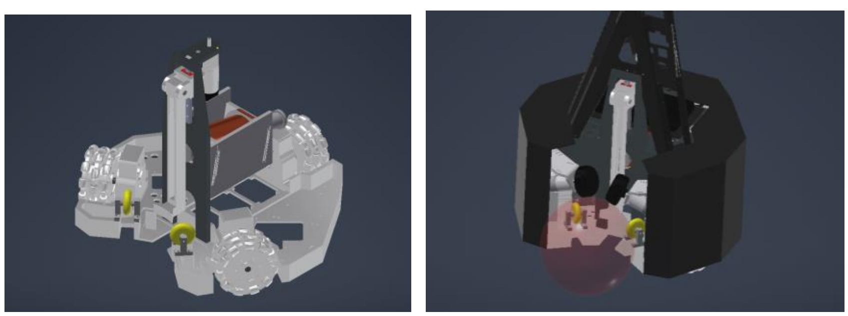

Fig. 2. The Ball Shooting

1.2 Frame

In our omnidirectional wheeled robot, we use custom-designed omnidirectional wheel, with the three omnidirectional wheels are arranged like Fig 3. The rectangular-cut edge is also represented in the base design, which measures almost 51 cm x 51 cm. The entire body of the robot is made of aluminium sheets. On the connection of each base there is alumunium plate bending so that it can withstand pressure andcan make the robot more rigid.

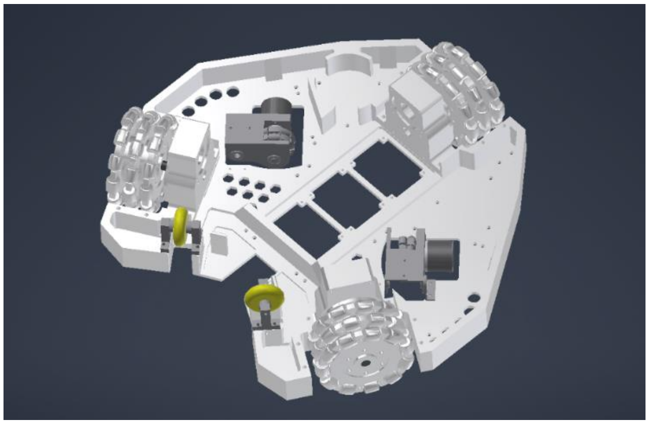

Fig. 3. The Omnidirectional wheel and frame

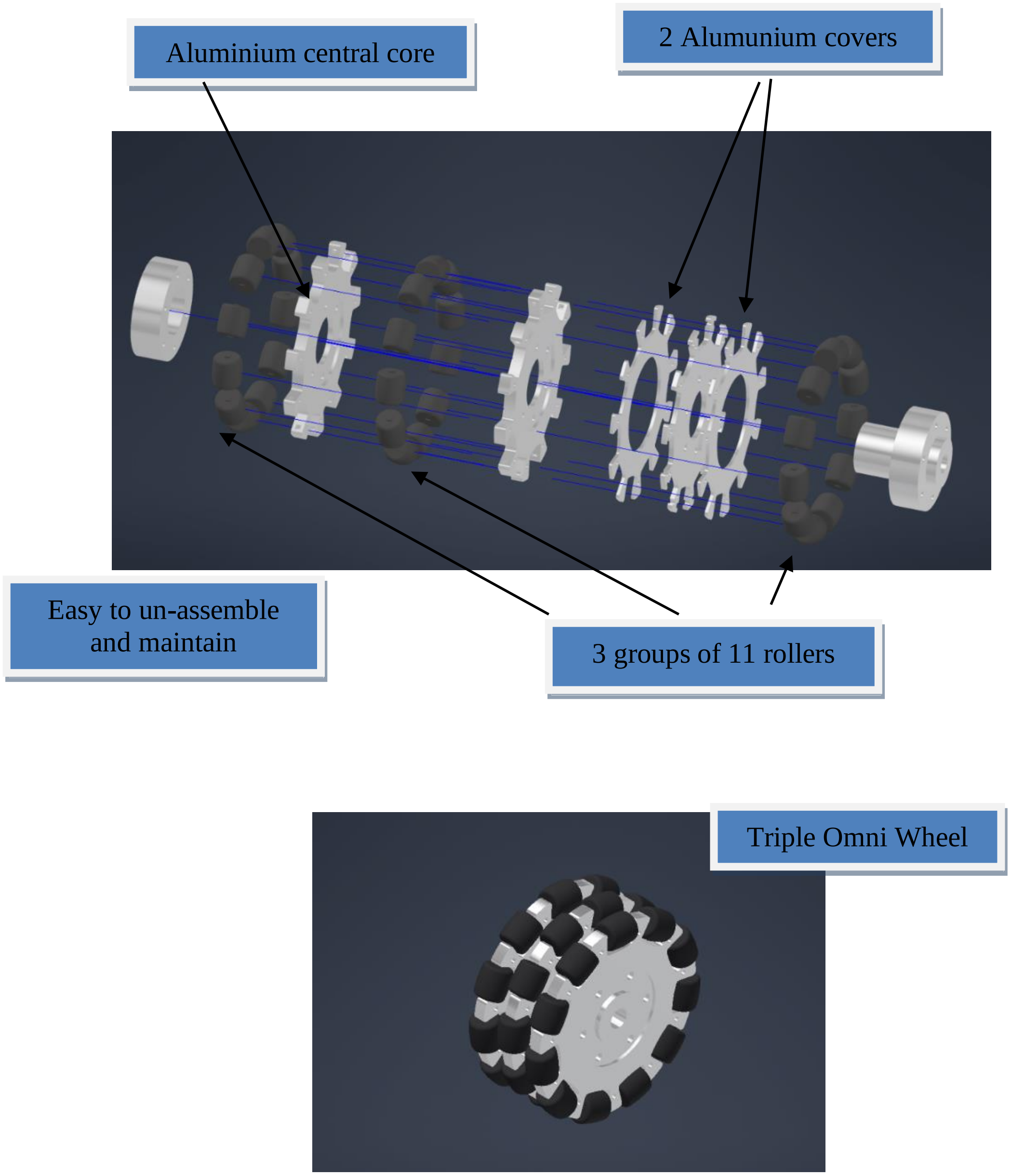

Fig. 4. Double Omni Wheel

1.3 The Ball Handling System

The ball handling system, which is designed for dribbling the ball. We use highly – torque DC motor for dribbling. There are two symmetrical assemblies and DC motor with a specific angle. The wheels are driven by the DC motor in desired direction. This mechanism used closed-loop control system with the ball distance as the feedback signal, which is measured by proximity sensor in the dribbling mechanism. When the ball approach the robot, the motor will rotate in higher speed than when it in standby condition. With this simple system it works well.

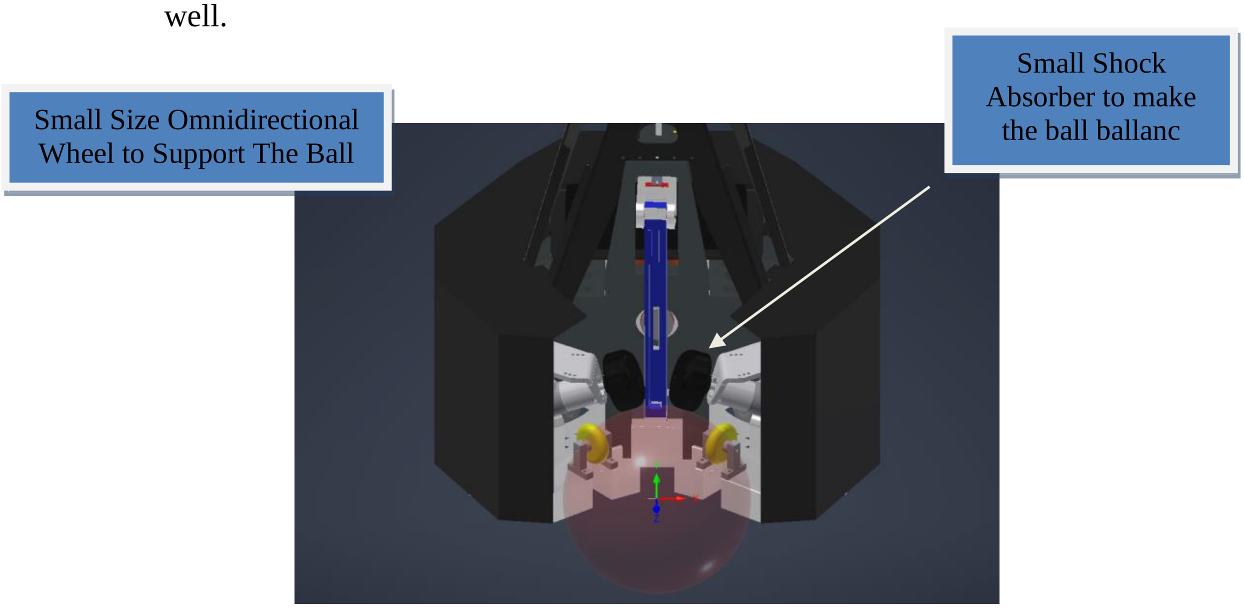

Fig. 5. The Ball Handling System

2 Electrical Structure

The electrical system of IRIS robot uses lithium-ion batteries with 5000mAh. There are four important parts of our electrical system, first is sensors which subdivided into outer and inner sensors. In outer sensors system, we install line sensors to calibrate, GP sensors for dribbling, and cameras to take visual environment of robot. We install two camera each robot, one is for general camera which installed on centre top of robot and the other is for obverse camera to take robot's front environment. We also install several of SRF distance sensors on goalkeeper robot to calibrate robot based on goal position. The inner sensors consist of encoder to measure motor's speed and robot's position, MPU gyroscope and accelerometer sensors to get robot's angle value, and SRF sensors to get robot's distance from goal. The actuators consist of DC motor, AC servo motor, and solenoid. We use capacitor to store energy before transfer to solenoid when kicking. We make custom supply board to support power management of our robots. Our supply board can switch power input from adaptor charge or from batteries. The controller that we use in this robot consist of low level and high level controller. The lowe level controller consist of STM32F407VG, STM32F103C8T6, and Arduino Nano. Besides, for high level controller we use mini PC. These controller communicate with each other use serial communication by UART and ethernet. We also use an HMI to monitor several numbers of important variable. For general input-output, we install several of button to make debugging easier. Below is the display of HMI which show several variables.

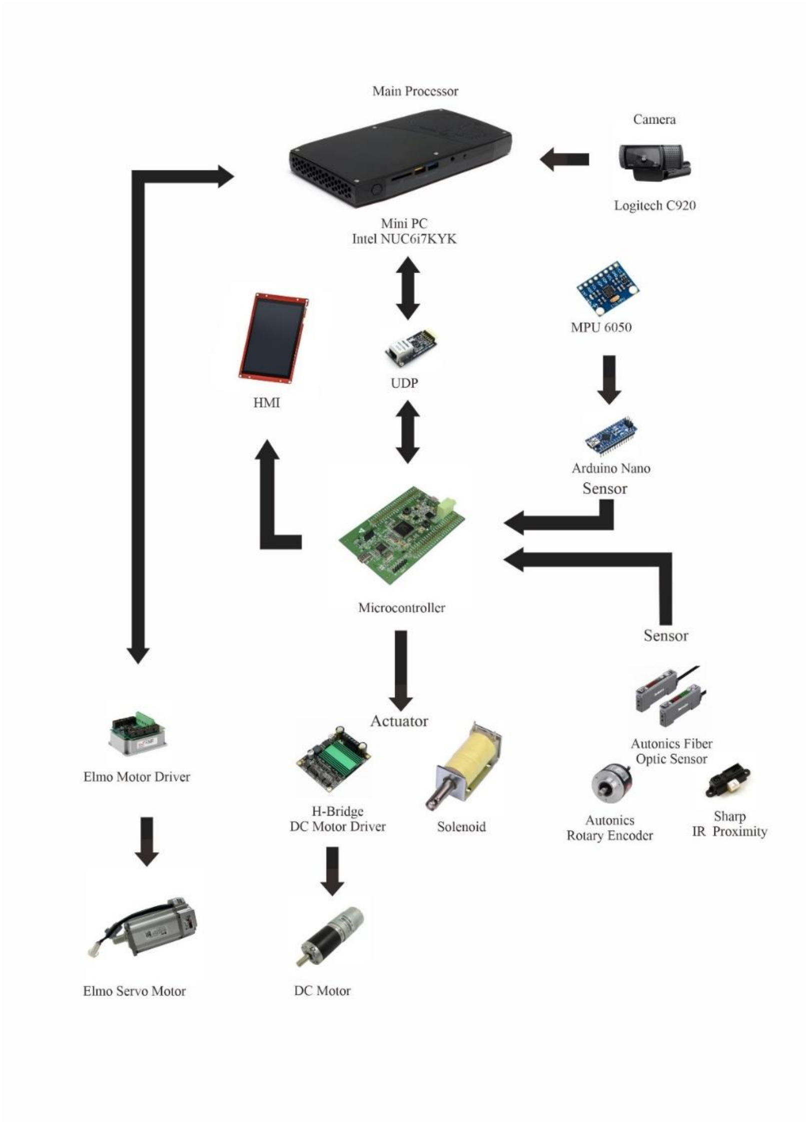

Fig. 7. Electrical System Diagram

3 Software Structure

The main system is handling all the important controls in the robot. All robots have their own main system on them. Our team uses Intel NUC mini PCs for the main system. This part handles all the strategy and decision making. The main system decides the strategy based on the information given by the omnidirectional camera, and the sensor data thatwas sent by the controller as well as the role of the robot. The robots usewireless communication to communicate with the base station. The base station gives all information about command from the referee box, and the position of all ally robots. Thus, will ensure the robot to act with coordination in mind.

Our main strategy consists of 3 algorithms, positioning, ball chasing, andscoring. The positioning algorithm is only used in the first part of every game and every command. This algorithm is used to position the robot based on the game that is played (kickoff position, free kick position, etc). The ball chasing algorithm is used to instruct the robot to grab the ball. The way the robot chases the ball will change based conditionally based on the obstacle between the robot and the ball. The robot will use an obstacle avoidance function to pass through it. The scoring algorithmis called when the robot grabs the ball and is ready to shoot the ball. This will calculate the best position to shoot to the goal. Below is the flowchartof the software structure

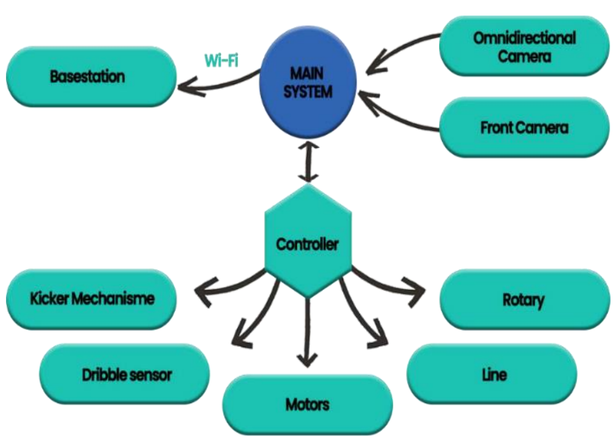

Fig. 8 Software Structure