IRIS ITS ROBOTIC TEAM

Mechanical and Electrical Description with Software Architecture

1 Mechanical Structure

We developed a new generation of robot platform. As the upgrade of the last generation with 3 Omni wheels, this new generation can be more quickly move and more stable. We designed the external frame of robot can be adapt to the competition impact with size 45 cm x 45 cm x 80cm and weight around 25 kg. The body of our robot is mainly from Alumunium Sheets that has more light and rigid material.

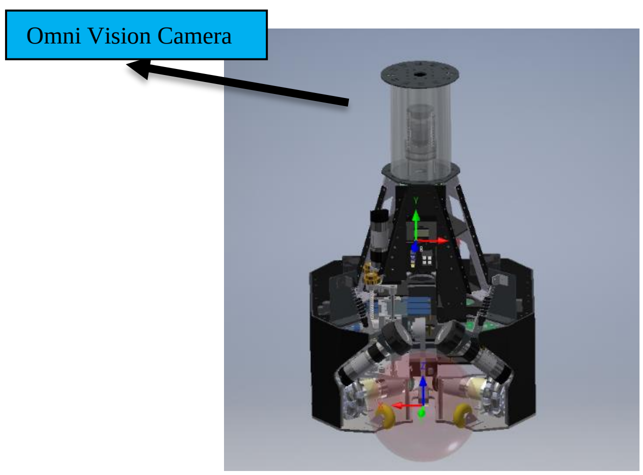

Fig.1. IRIS Robot

1.1 The Shooting System

To generate more impulsive power, the shooting system in this robot used a brushless DC motor attached to a gearbox. The power transmitted to the shooting rod, as well as the momentum generated by the rotational force of the rod, will then strike the ball. After the shooting is completed, the proximity sensor will detect the rod and cause it to remain in a specific position. Because our robot's kicking mechanism is not fixed, it can move up and down. The mechanism is powered by a microcontroller-controlled high-torque brushed 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.

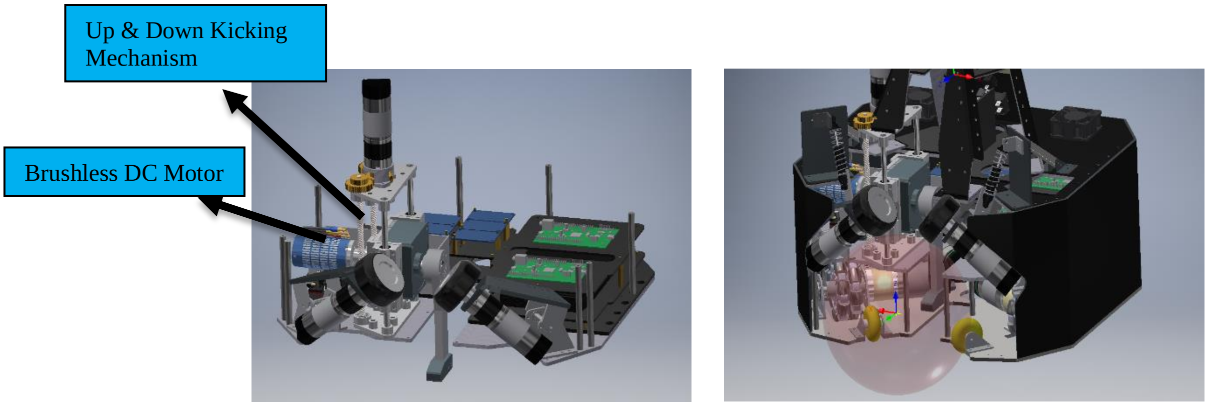

Fig. 2. The Ball Shooting System

1.2 Frame

In our omnidirectional wheeled robot, we use custom-designed omnidirectional wheel, with the four omnidirectional wheels are arranged like Fig 3. The rectangular-cut edge is also represented in the base design, which measures 45cm x 45cm. The entire body of the robot is made of aluminium sheets. On the connection of each base there is a spacer made of stainless steel with a thickness of 8mm so that it can withstand pressure and can make the robot more rigid.

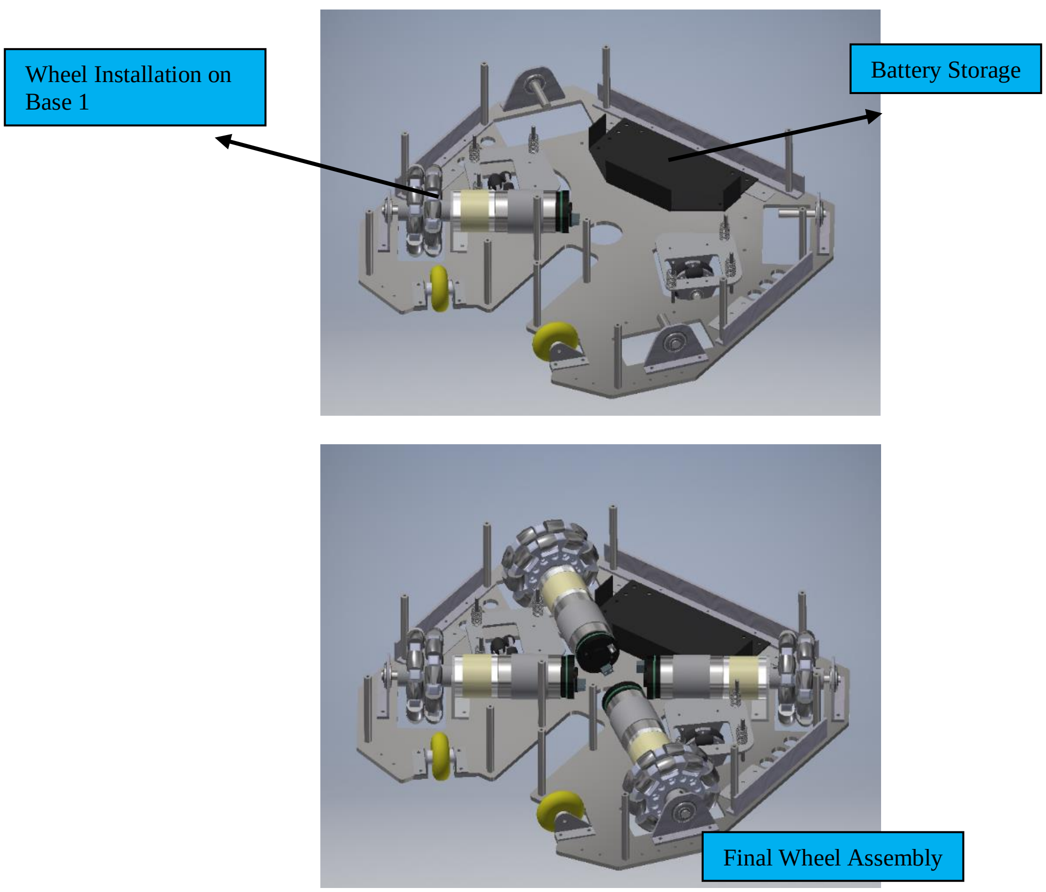

Fig. 3. The Omnidirectional wheel and frame

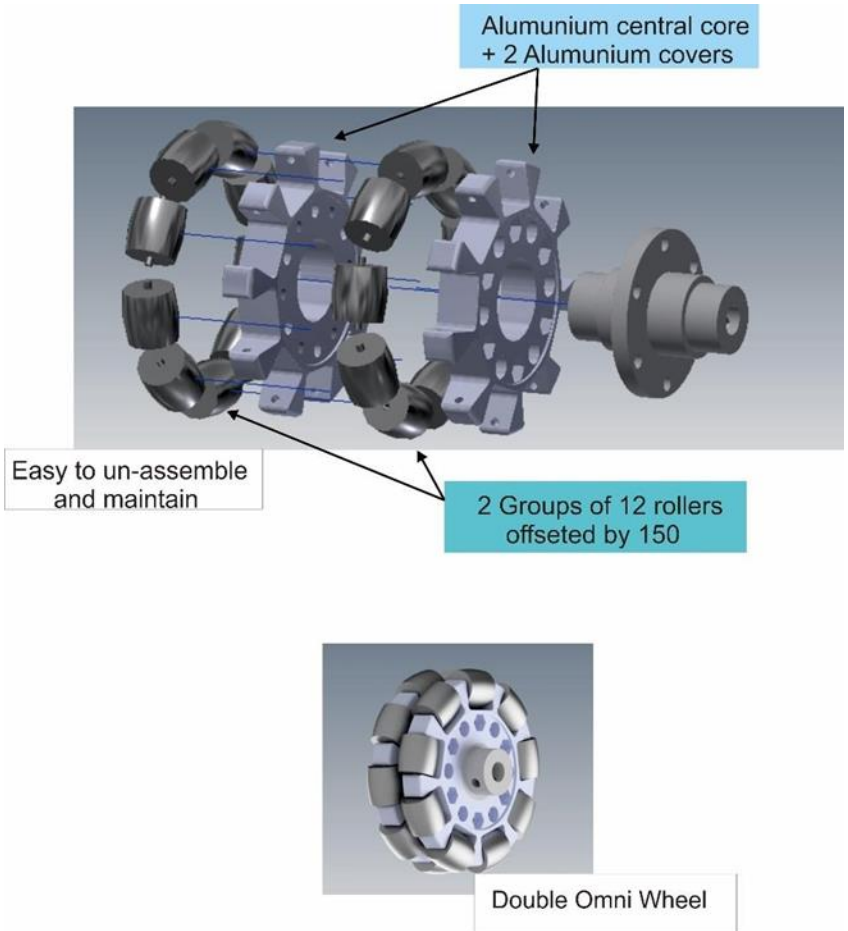

Fig. 4. Double Omni Wheel

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.

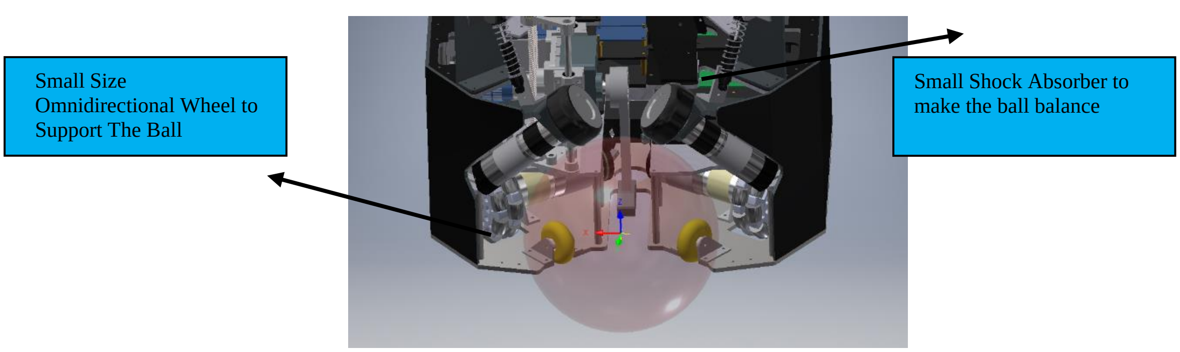

Fig. 5. The Ball Handling System

2 Electrical Structure

The electrical system of IRIS ITS four-wheel based robot uses 6 cell Lithium-ion batteries with 5000mAh power. There are two important parts of our electrical system, first is the sensor, which is subdivided into the low-level sensor system and the high-level sensor system. In low-level sensor systems, we use sensors such as the 6Axis-IMU. IMU that stands for Inertial Measurement Unit is used to determine the robot angle based on the field with a triple-axis gyroscope and triple-axis accelerometer. There is also a 360 PPR (Pulses Per Revolution) odometry sensor that is used to get the coordinates in the field. Then a proximity sensor to detect the distance of the ball from the robots, a photoelectric sensor to detect the position of the kicker, and fiber optic sensor to detect field lines and calibrate the gyro sensor. Our robot uses a camera as a high-level sensor system. Second is the controller, there are two types of controller, the first is a microcontroller as the low-level controller, where all low-level sensors are connected to the microcontroller and then send a sequence of commands to the actuators of the entire robot system. There are 3 microcontroller boards used in the robot, one of the microcontrollers acting as the master which control the main low-level sensors, while the last two controllers acting as the slave controller. Each master-slave controller uses the serial TTL communication protocol in order to communicate with each other. In addition to the kicking system, an Electronic Speed Controller (ESC) is used, which is connected to the microcontroller. The high-level controller of this robot is a Mini PC that acts as the main processor which controls the camera and the robot movement algorithm. The electrical system schematic is shown in the Fig. 7 below.

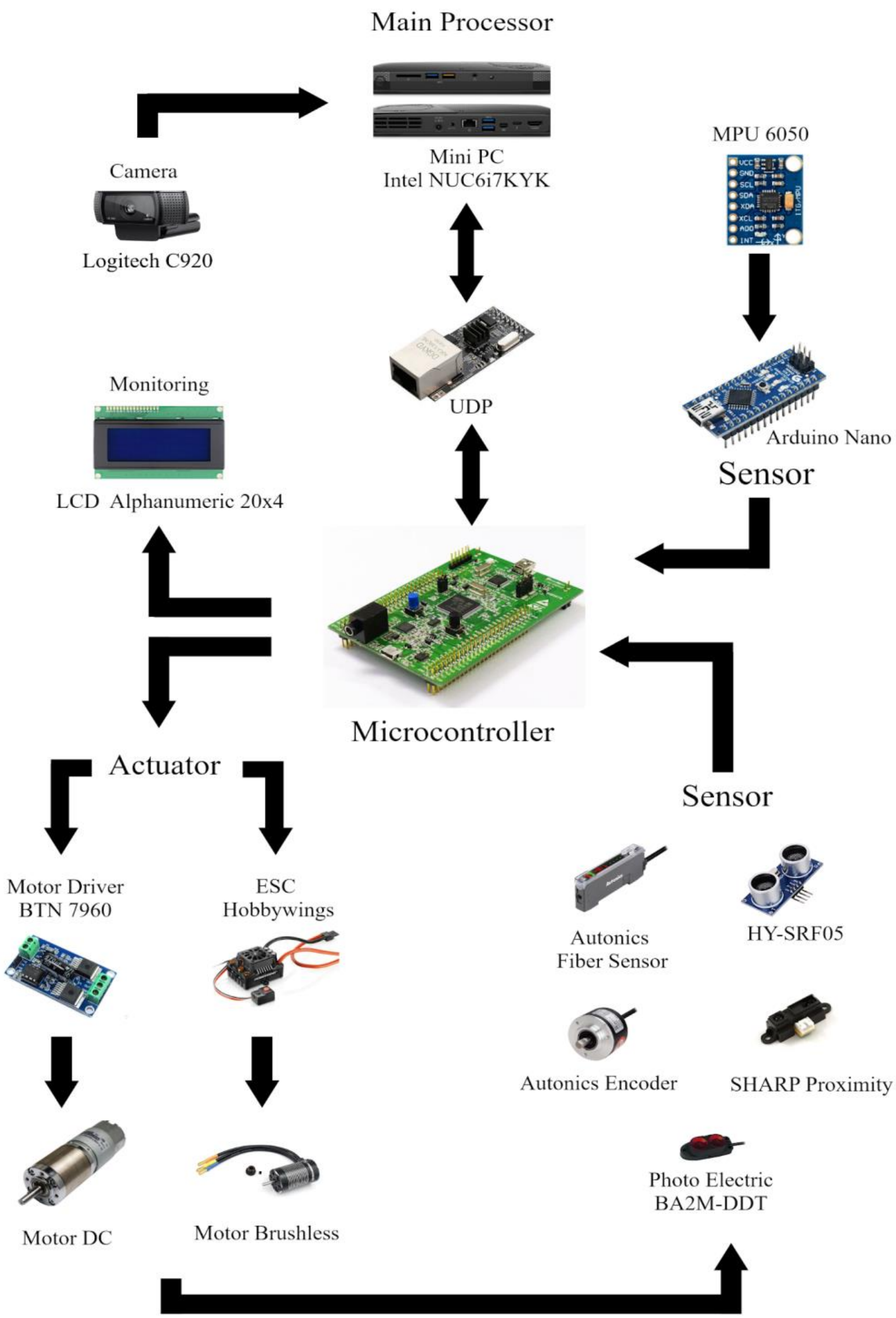

Fig. 7. Electrical System Diagram

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 that was sent by the controller as well as the role of the robot. The robots use wireless 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, and scoring. 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 algorithm is 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 flowchart of the software structure

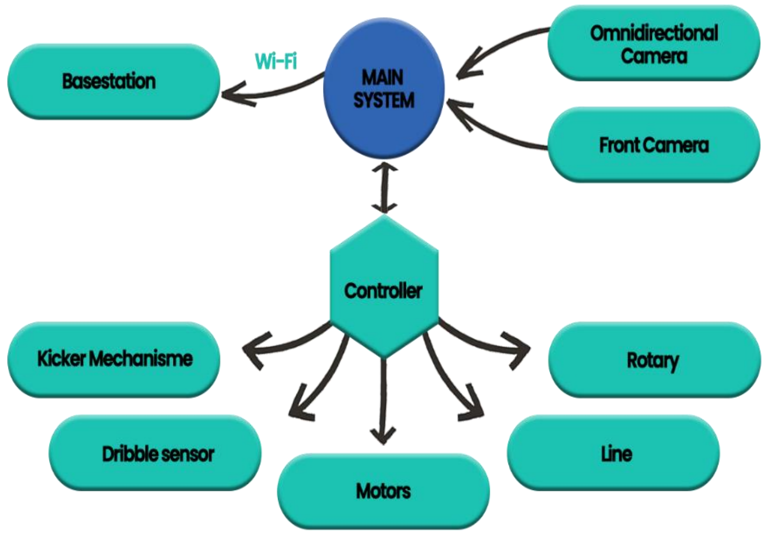

Fig. 8 Software Structure