Immortals 2009 Team Description Paper

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Abstract. Below, we have classified information in 4 major parts: mechanics, electronics, programming and vision. Pictures of available instruments are attached and further information about future improvements is added.

1-Introduction

“Immortals” is a robotic team consisting of university students of Sharif, Tehran, IUST and Shahed Universities. The team was formed in 2003 to attend junior soccer league competitions while team members were all studying in high school (Nikan high school). The team successfully participated in the 3rd Hellicup Robotic competitions in 2004. After placing 3rd we qualified for 2005 Osaka Robocup , taking part under the name of Robonik. The team was also placed 2nd in the first IranOpen Robotic competitions in 2006 and 3rd in Iran Open 2007. The small size project started in summer 2007 and simple-structured robots were made by summer 2008. Since then many developments and upgrades have been implemented.

In this paper we mention the properties of the 3rd generation of our robots and final upgrades and developments going to be implemented by spring 2009, when ordered motors and board with higher efficiency arrive.

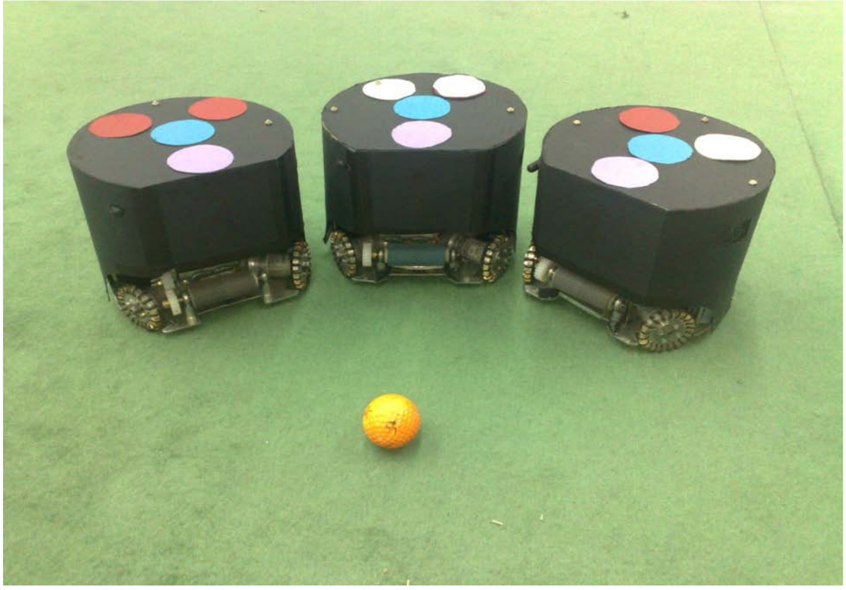

Fig.1. current Immortals Robots

2-Mechanical System

Our robot has 3 plates on which, motors, electronical boards and power boards are mounted. On the first plate, heavy devices such as motors, battery, solenoid and capacitors are placed. By this, we have lowered the altitude of mass center to stabilize movements and kicking.

It has a height of 147mm & diameter of 176mm. The maximum percentage of ball coverage is approximately %19.

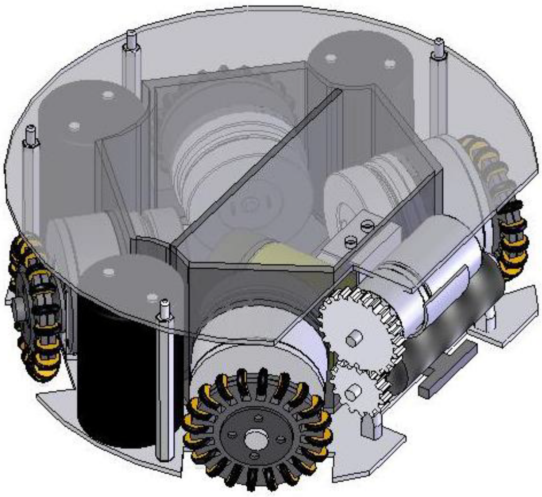

Fig.2. 3D figure of the Immortals robots base

2.1-Motors

Our robots are designed Omni-directional with four Omni-wheels of 51mm diameter having 20 sub wheels. Lesser thickness and better movement are important characteristics of this type. Our main motors are 30 watt Maxon EC-45 flat with 1:5 gearhead but existing motors are cheap, weak and functioning just to help the programming team have real tests.

2.3-Dribler

We had two choices: strop and gear. After examining both of them, gear passed the test successfully. Decrease in noise, shaking and dissipation are the most significant features of gear systems. A gear head motor with two gears attached is used and the final RPM of spin-back cylinder is 1500.

2.4-Kicker

We use a solenoid to kick the ball. To optimize the solenoid function we changed the material of the plunger and shield for a higher kicking speed but we did not get demanded results. So we increased the voltage to obtain the desirable goal. Temporarily we charge our capacitors up to 600 volts and ball speed reaches approximately 9 meters per seconds. Some preventive measures are taken to avoid unwanted discharging. The kicker's efficiency will be increased by using a better soft-magnetic material in the kicker's plunger and shield.

3-Electronical System

Two AVR microprocessors are used to form a network to which other devices are connected. The main processor receives information from an RF transceiver and controls motor speeds. Other processor is responsible to control the dribbling and kicking systems. Some more functions such as temperature control, one touch shoot and battery control are applied by the second microprocessor. To avoid vision malfunctioning, we use a compass on each robot. This computation is done in two ways.

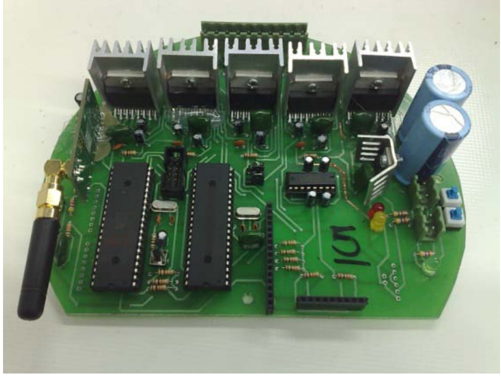

Fig.3. Existing main board

3.1- Motor driving

Our primary motors (Maxon EC-45) are driven by an L-6235 driver microchip and our reserve robots (existing ones) are driven by L-298 drivers.

3.2-Shooting system

We have three stages of shooting that are used in various conditions of the game. Robots use a charger board functioning as a current source that can charge a 560 µF capacitor up to 200 -250 Volts in about 10 seconds. The elements doing this are separated from the main board to avoid unpredictable shocks. They are in a PCB on the second plate.

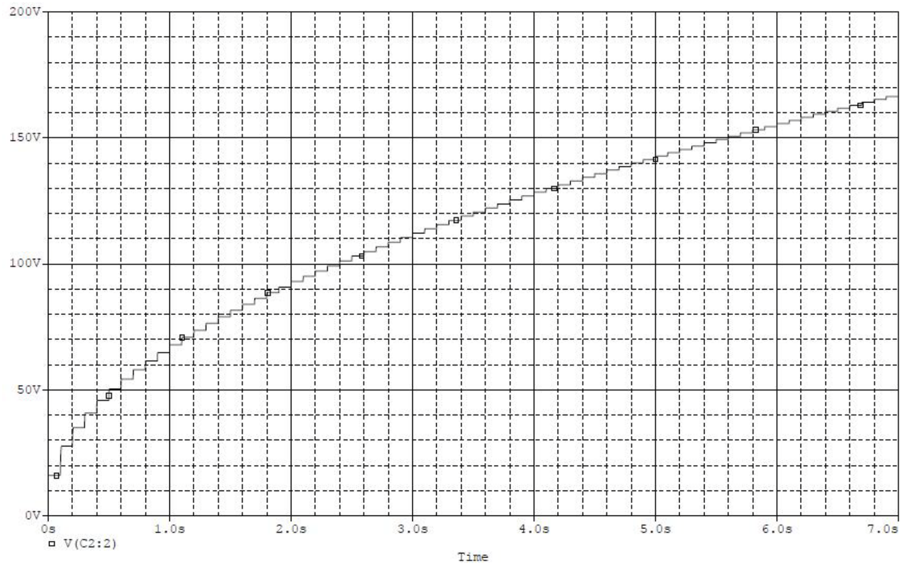

Fig.4. Our current charging system simulation

3.3- Wireless Communication

Transmission of data between the server and robots in our secondary team is done by two transceivers on two different frequencies. Our primary robots use Telecontrolli RXQ2-XXX GFSK multi-channel radio transceiver, operating within the 433 MHz band. The module operates in user selectable channels.

4-Computer

Our main algorithm is taking information from the field by global cameras, passing them to the server, and then communicating processed values to the robots, in each frame.

4.1 - Vision

4.1.1- Hardware

For each half of the field, we use AVT Stingray F-46-C which is capable of a 780×580 resolution with maximum frame of 61 and a Fire wire 1394B computer connection. The reason of this choice was its ½ inch CCD format, enabling us to avoid using a wide lens with its problematic image processing.

There is no special image processing hardware, all processing are done via software running in the PC.

4.1.2-Image Processing

Image processing stages:

1- Low-level image taking which is considerably faster than open-source, predesinged libraries like OPEN-CV.

2- Color classification which enables us to adjust colors to different environments.

3- Using algorithms like Color Density Measurement and Ball-Robot Persue, our robots easily find the coordinates.

Though accurate, this algorithm has really low processing speed. For a 60fps image would be processed only at 30 fps rate, making a huge loss of information.

Measures for increasing processing efficiency:

1- We only use the surrounding of the previous coordinats for a robot cannot move a lot from its former position in passing a frame.

2- Speeding up the program by using linear algorithms.

4.2 - Server

In our algorithm, any possible movement is scored. These scores are determined by the robots real experience. As an example, in a fast match, cheap kick has a low score while a shot has the highest one. This only determines the main strategy.

According to the main strategy, robot's function in each frame is defined in 6 variables:

Robot's linear speed in two dimensions, final angle-angular velocity, dribbler speed, and shot speed.

4.3 - Robot motion:

In this part, 4 motion variables are translated into motor movements. For this purpose we use an Omni-matrix. We rotate the axis and enter the linear speeds of X and Y in the matrix for the robot to reach the final angle. Angular speed is also entered with certain proportions.

4.4 - Simulator

Simulator plays the role of the vision system and with the aid of the server it could simulate a game of two virtual teams. To obtain best physical results, the Leadwerks Game Engine 2 is used. The engine uses Newton Dynamics 2.

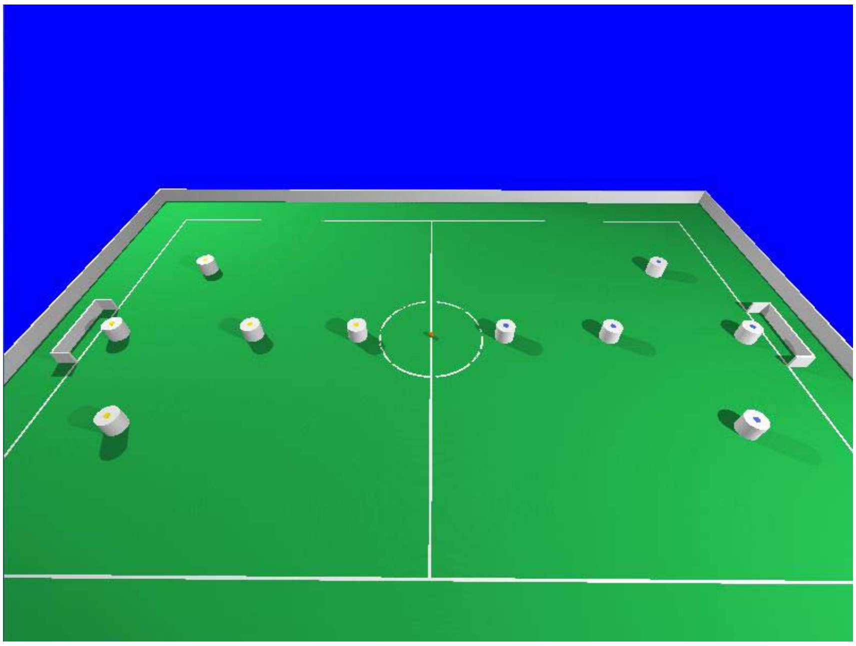

Fig.5. Simulator program