Higher Speed of Data between Computers and Mobile Robots Based on Increase in the Number of Transmitters Robosoccer

Marek Sukop, Mikulas Hajduk, and Jaromir Jezny

Department of Production Systems and Robotics, Faculty of Mechanical Engineering, Technical University of Kosice, 042-00 Kosice, st. Nemcovej 32
{marek.sukop,mikulas.hajduk}@tuke.sk

Abstract. A very important feature in the management of robotic soccer is the response time of the system. This article is one of the possible ways of reducing the time and using concatenation transmitters. This way to the first team (under MiroSot) used by FME TUKE Robotics World Championship 2009 in Korea. The first section describes the conventional method of data transmission as it said it applied. The second part describes the hardware and software method by which transmitters and finally compare responses with conventional manner.

Keywords: robot soccer, transmitter, receiver, mobile robot.

1 Introduction

Robot soccer is an application for testing multi-agent systems consisting of multiple mobile robots. Each team, consisting of five robots, has a camera attached above the playground in hight of 2 to 2.5 meters. Camera is connected to the control computer in which image processing algorithms are being recalculated, and then algorithms strategy. Then the robot player instructions are sent through the transmitter. In this article is described how to decrease the response by adjusting the transmitting part.

2 The Standard Configuration the Transmitting Device

The system is very sensitive to the speed of response (time from shooting scenes to perform interventions in the scene) and the number of hits per unit of time (usually a specified frequency framing cameras around 50-100 fps). The speed of response in general is mainly dependent on the system parameters: speed image acquisition (camera shutter, the speed of data transfer to a computer), the speed of image processing (to obtain required positional data on all participating entities), speed over the strategic calculations (to generate commands for robots), the data rate to transmit

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module (eg via RS232 or USB), the speed of data transfer between the RF transmitter module and robots (eg 433MHz, ZigBee, Bluetooth), the processing of the data microcontroller robot and finally the change of the speed parameters.

One of the ways to positively affect the rate of response was applied to non-standard transmitting data in category MiroSot. The standard configuration transmitter link to the transmitter requires a computer with RS232 or USB interface (Fig.1).

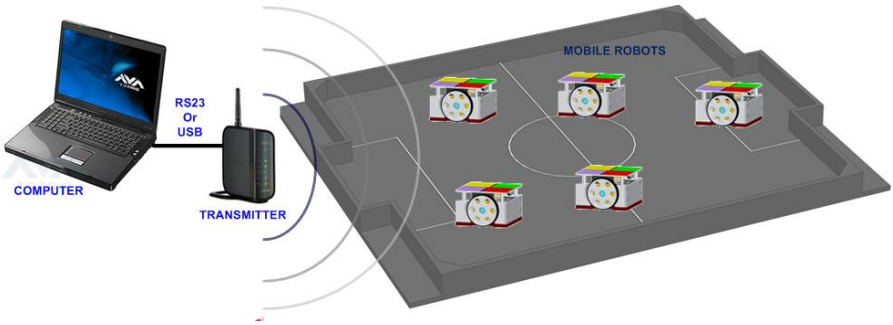

Fig. 1. The standard configuration of devices in the transmit chain

As a final member to use modules with free frequencies 433MHz (418MHz in some countries), or 915MHz. The disadvantage of these modules is normally quite low bit rate of RF parts. Modules can transfer data up to 115.2 kbit / s. Data is sent with the sequence to all mobile robots. Each robot receives data with a delay of:

$$t_n = \frac{n * BM}{TR} * 10 \tag{1}$$

n...ID of robot (n=1,2,3,4,5, large league n=1,2,...,11)
BM...number of bytes in message for one robot
TR...transfer rate v bit/s

When using the maximum possible transmission speed 115.2 kBaud number of bytes being transferred and 4 for each robot (speed 16 bit, 16 bit angular velocity), the resulting delay complete information for the last robot in the chain of 1.74 ms. But it delays the ideal situation is that using conventional transmitter can not be achieved. Transmitters operating with a carrier frequency hundred MHz are limited data transfer by the ratio of ones and zeros in a short time should it be 1:1, 1:3 in the worst case.

SjF TUKE Robotics team was due to technological limitations, and with the help of using coding delay amounted to around 870us per robot, which is 4.35 ms for the fifth robot.

3 The Use of Multiple Transmitters

Philosophy arrangement of several transmitters in the transmit chain is on Fig.2.

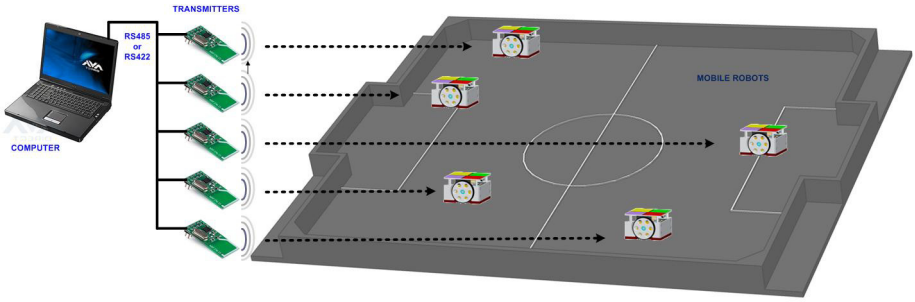

Fig. 2. Non-standard configuration of devices in the transmit chain

To shorten the time of data transmission modules were used, based on the nRF24L01 chip. Its advantage is the data transfer speed of up to 2 Mbit / s. Communication with the control processor runs over SPI at up to 8MHz. Minimum configuration is sent bytes: 1 byte preamble, 3 byte address, data transferred 1-32bytov, 1 CRC byte. The non-standard configuration, we achieved a delay of sending data to capture all the data about the last robot. 300-320us. There was room for repetition level data microcontroller, which ensures repeat transmission to reception of new data. Using the principle of that problem is eliminated accidental data loss. If the robot does not capture the first data pack, then catch the second resp. third etc. Of course there is a longer delay, but that would not be still, so long as the standard broadcast. Time display data transfer from PC to microcontroller and RF module is then to Fig.3.

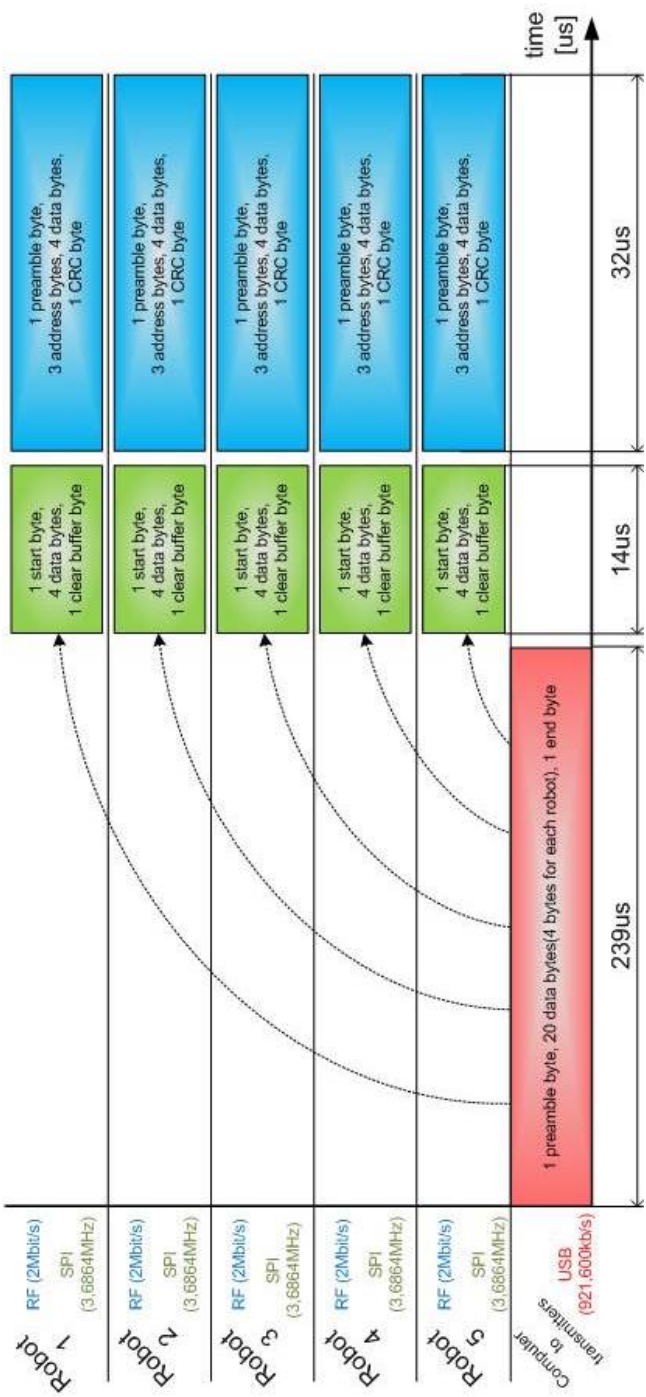

Fig. 3. Time display data transfer

The big advantage is visible in the graph is constant delay for all robots. The delay does not depend on the number of robots, but only from faults in transmission. In the earlier arrangement, however, there has been a complete failure in the data processor for the image, if there is a failure of transmission between the transmitter robot. The complete block diagram of the implemented data transmission between the control computer and the mobile robot is shown on Fig.4.

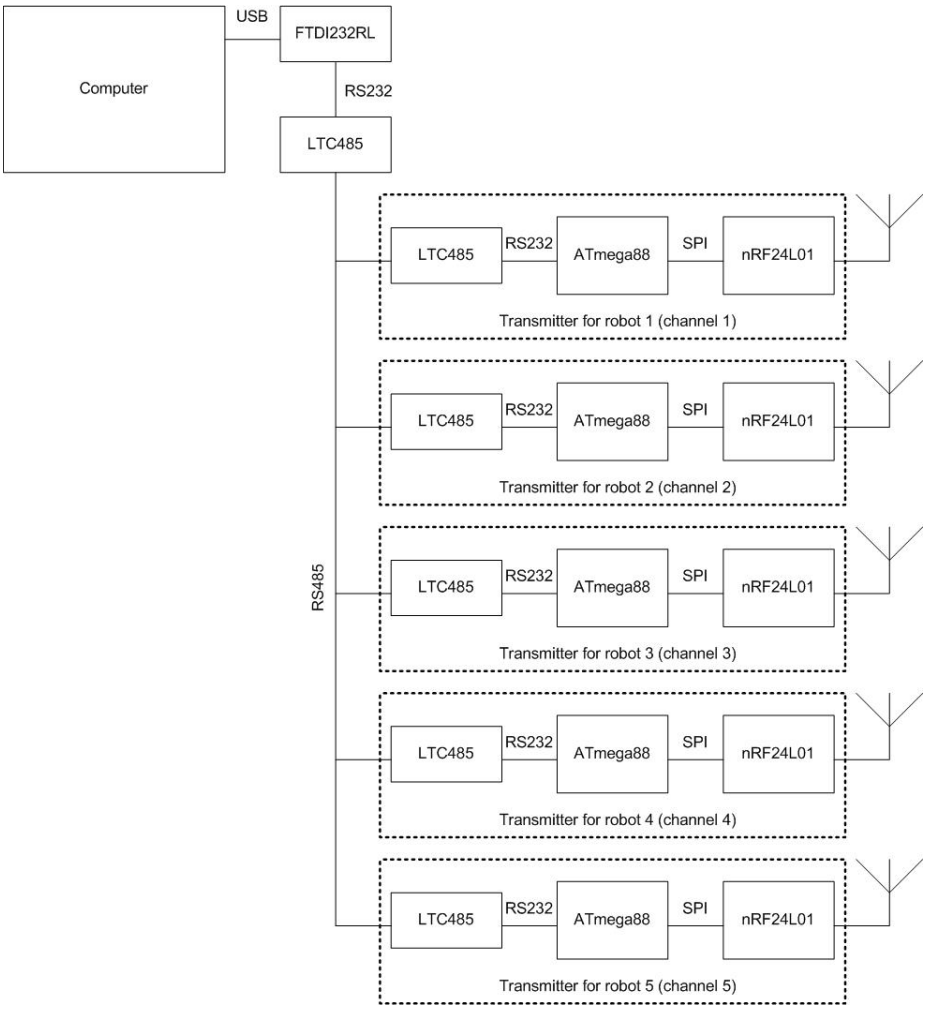

Fig. 4. Block diagram of transmission system

Part of the algorithm in the control computer, which is responsible for transferring data from a software module strategic calculations to the transmitter via USB, remained unchanged. After filling the system as shown in Fig.4, it was necessary to change the algorithms in microcontrollers upstream transmitter module and also part of the algorithms in the robot which processes data from the receiving module.

4 Conclusions

The advantage of applying the method described in shortening the response time of mobile robots to load images from a camera positioned above the playground. For optimal transmission, we reduced the time required for data transmission speed and the desired yaw rate compared to our old system of approx. 4ms, so we reduced the total delay in the control loop by more than 20%. It is a delay that is constant for all 5 robots. This latter feature is another important advantage. With such transmitters arranged in a chain, our team SjF TUKE Robotics presented at the 2009 World Championships in Korea.

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