WiFi Data Communication System Design for Wheeled Soccer Robot Controller

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Abstract—This paper presented the data communication systems between game controller and wheeled soccer robot using WiFi communication. The designed system consisted of a game software controller installed on PC, a network router connected to the PC via a network cable, ESP8266 module as data recipient and transmitter on the robots. The PC and ESP8266 module is connected through the router, PC game controller is used to send command data signals to ESP8266 module on the robot. The response from robots is processed on ArduinoMega2650 and transmitted to the PC controller. The designed system is expected to enable WiFi data communication on wheeled soccer robots and calculating the performance of WiFi communication by means of Quality of Service (QoS) as well as to compare data communication using WiFi and data communication using bluetooth with the parameters of response in the form of communication time, communication time difference, distance, and signal interference.

Keywords : Game Controller, Comunication, ESP8266 Module, Wheeled Soccer Robots

I. INTRODUCTION

This paper presented the data communication systems between game controller and wheeled soccer robot using WiFi communication. The designed system consisted of a game software controller installed on PC, a network router connected to the PC via a network cable, ESP8266 module as data recipient and transmitter on the robots. Communication system using a wireless used with a standard IEEE 802.11b with a frequency 2.4 GHz. By the application of wireless based IP it would be help a man to control as well as on the monitoring of the. A controller game is a program pc designed to provide a display interface desktop application that serves to transmit serial data in the form of the character or the status of football matches the robot. Communication between games of a controller with the robot can be carried out a wireless or without cable by the use of WiFi. Still there were deficiencies in using a wireless as a medium of communication control robots football for example such as limited benefits of WiFi distance of PC to robot.

II. PURPOSE AND OBJECTIVES

A. Scope of Problem

In order to avoid discussion in this paper from becoming too broad and deviated from the given topic, the authors limits the problem as follows:

a) WiFi recipients uses ESP8266 module.
b) Communication data used on Game Controller software.
c) Counting data parameter quality of service (QOS).
d) WiFi data communication performace in response time communication, displacement time distance communication, and interference signals.

III. BASIC THEORY

Game a controller is a PC program designed to provide desktop display interface application that serves to send serial data of character or status to soccer robot.

A. Data Communication

Communication is a process to send and receive information between one device and other device(s) through a transmission media. The devices can act as transmitter and receiver at the same time. A device can be communicating data with another device when the data passed through a transmission medium.

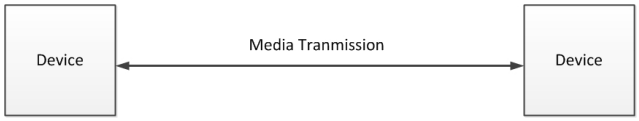

Fig. 1. *Diagram block processes of communication data..*

In a data communication system there are three basic components that must be present: the source that serves to transmit or emit the information that will be sent, the receiver that acts as the destination information that is sent from the source, and the transmission medium that serves as a channel of the transmitted information. Transmission medium used in data communication system can be either a physical media or a non physical media.

B. Wireless Communication

Wireless communication is a transmission method that uses radio wave as the transmission medium. The information

is modulated into the electromagnetic wave and transferred between points that not connected physically. Wireless communication has the broadcast characteristics, in which the electromagnetic wave is radiating to all direction and allows receiver to collect the information regardless of its position to the source as long as it is within effective radiation range.

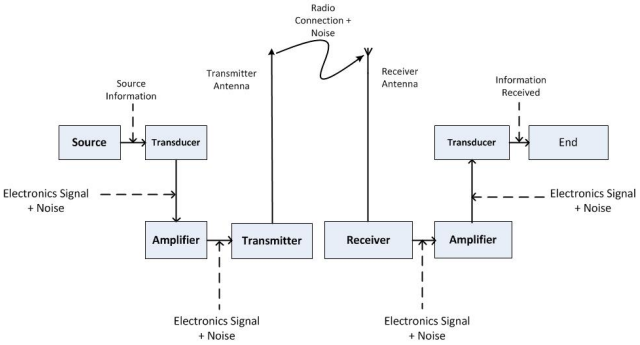

Fig. 2. *Block diagram of wireless communication system*

C. Data and Signal

A data that will be distributed through the medium of transmission of shaped a row of bit .But in the medium of transmission of (for example: cable not bit 1 and 0 of the end of a cord one to the end of a cord other. To can be transmitted, data must be tranformation first into the form of electromagnetic waves. Bit 1 and 0 will be represented by voltage with the amplitude different. For example bit 1 represented by voltage 1 volt and bit 0 represented by voltage -1 volt. The in the illustration, bit 1 and 0 was the data, while voltage that passes through the medium of transmission of was the signal.

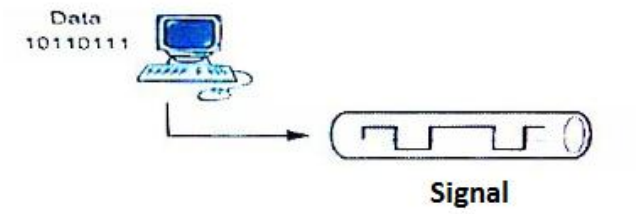

Fig. 3. *Data and Signal*

D. FSK (Frequency Shift Keying)

This method is a form of modulation that allows a wave of modulation of the frequency of output shift the carrier wave. This shift has occurred between the prices of which have been determined to the wave which was originally an output that does not have a disjointed phase. In the process of the magnitude of this modulation of the frequency of the carrier wave change according to change the presence or absence of a signal digital information. In this process the carrier wave shifted up and down to obtain bits 1 and beets 0. This condition called respectively space and mark .Both constituting a standard transmission of data that is consistent with recommendations CCIT. Technique fsk much used for information long-distance travel or teletype. Standard FSK to teletype have been adopted for years, which is to frequency 1270 Hz represent a mark or 1, and 1070 Hz represent space or 0.

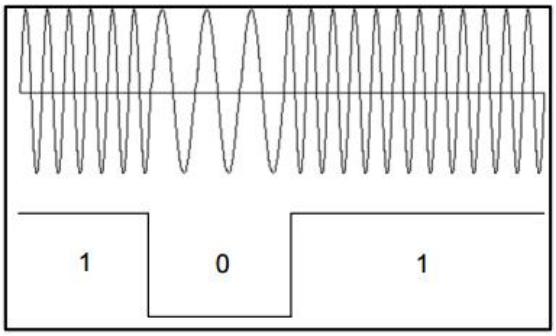

Fig. 4. *Signal Modulation of Frequency Shift Keying*

E. TCP (Transmission Control Protocol)

TCP serves to perform data transmission in segments, it means data packets broken down in an amount matching with the value of the package then sent one by one to finish. That data transmission until well, so every delivery package TCP will enclose a serial number. But the computer receive a package has to be sent back a signal ackwoledge in one a specified period. If in time computer end not also provides acknowledge, and there is "time out" signifying package delivery failed and must be repeated. Model protocol TCP referred to as connection oriented protocol.

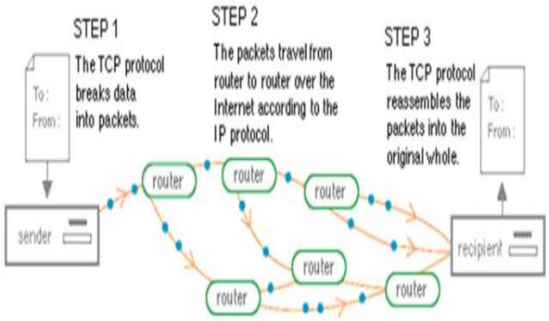

Fig. 5. *How TCP/IP Works*

F. IP (Internet Protocol)

IP address is a component vital on the internet, because without IP address no devices can be connected to the internet. Any computer connected to the internet at least must have one IP address on any device connected to the internet and IP address itself must unique because there can be no other computer network device used same IP address.

IV. SYSTEM DESIGN

Wireless data communication design uses router that will be connected on the wheeled soccer robots. Discussion covering communication data design consists of communication system and wireless data design, and software design consisting of formulations of the algorithm of the program that will implanted in robot controller.

A. System Block Diagram

Wireless data communication system using router on the wheeled soccer robot.

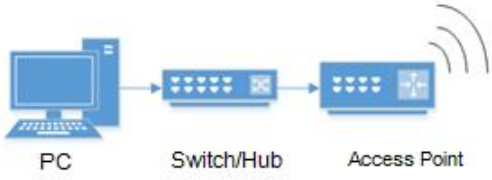

Fig. 6. *Block Diagram Transmitter*

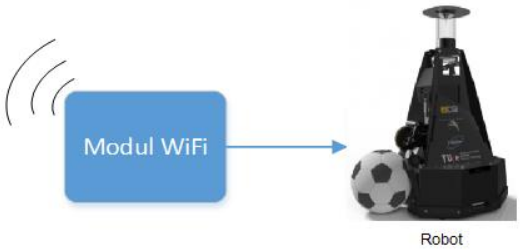

Fig. 7. *Block Diagram Receiver*

B. Computer as Game Controller Interface

Game Controller Applications is used as referee box used by a jury during the game based on Java as specified by the Indonesia Robot Contest Committee.

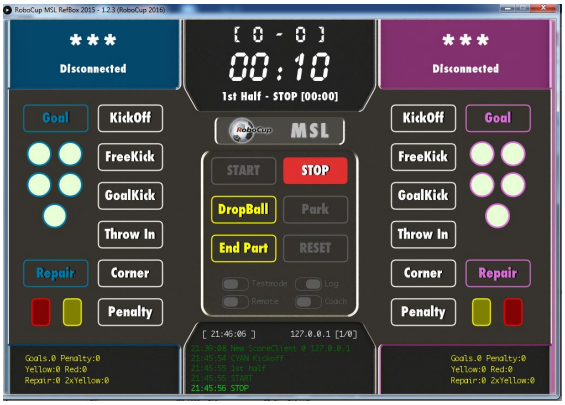

Fig. 8. Display game controller

C. Communications Device Design

The Arduino Mega 2560 minimum system with 16 MHz clock ATMega2560 microcontroller is used as WiFi data processor. ESP8266 WiFi modules are used as command receiver that connected to PC through WiFi router. The received data is used by the robot for reference recognition.

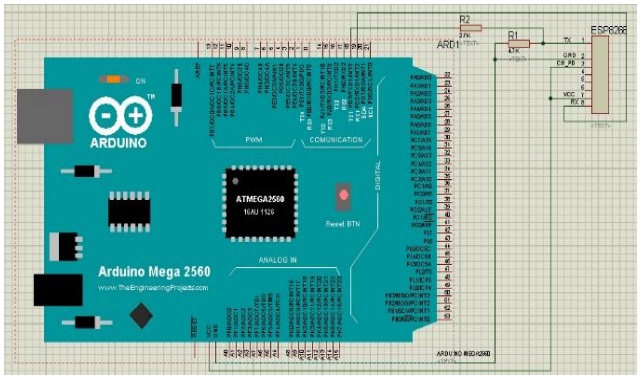

Fig. 9. *Arduino Mega 2560 to ESP8266*

D. Comand WiFi Module ESP8266

Testing is done by sending several commands to WiFi module through serial communication using AT Command. The result is shown in Fig. 10.

TABLE I. ESP8266 AT COMMAND

AT Command	Description
AT+RST	reset module
AT+CWMODE	configure as access point
AT+CIPSERVER	turn on server on port 80
AT+CIPMUX=1	configure for multiple connections
AT+CIFSR	configure as access point get ip address

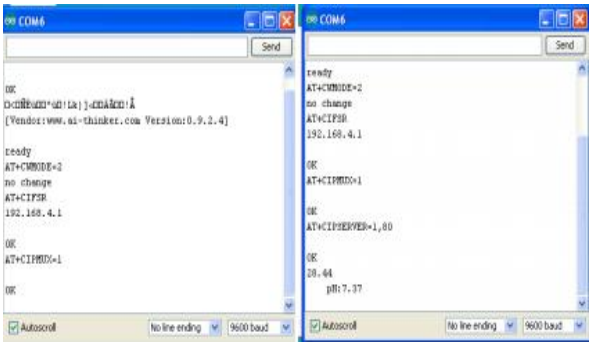

Fig. 10. Result AT command at Serial Monitor Arduino

E. IP Configuration

IP configuration is used in order for any robot to be assigned different IP addresto prevent conflict during the match. The corresponding devices, IP address, communication port, and VLAN assignment is shown in Table II.

TABLE II. IP CONFIGURATION

PC	IP address	Port	VLAN
Game Controller	192.168.1.12	Fa 0/4	VLAN 20
User 1	192.168.1.10	Fa 0/2	VLAN 10
User 2	192.168.1.11	Fa 0/3	VLAN 10

F. Game Controller and Client Port Configuration

Testing done by means of change a port which it is in basestation client so basestation client and game controller can be connected, and can receive data from game controller later on the data will continued to robot.

Fig. 11. Setting Client Data Port to Game Cotroller

G. Data Transmission from Game Controller

In this testing the data in the controller is sent from basestation client. Packet Data is sent in the form of characters to each robots.

TABLE III. DATA FROM GAME CONTROLLER

Button	Data Sent	character
Start	050003	A
Stop	050103	D
Reset	050203	G
Drop Ball	050303	F
Pick Up	050403	E
Park	050503	H

H. Game Controller Data Communication Test

In this test, command data from game controller is transmitted by base station client to the robots. Testing performed without any obstacles and conducted by sending a command from Game Controller with WiFi to the receiving robots with a push button to run the robots. The results are shown in Table IV.

TABLE IV. DATA FROM GAME CONTROLLER

Range (meter)	Bautrate (Bps)	Command	Result	Description
5	115200	Start	Robot Start to Play	Received
		Stop	Robot Off	Received
		Reset	Robot Back to fisrt Position	Received
		Drop Ball	Robot Prepare for Play	Received
		Pick Up	Robot Pick to Out	Received
		Park	Robot Out	Received

I. QoS Parameter Analysis

Quality of service (QoS) refers to a network's ability to achieve maximum bandwidth and deal with other network performance elements like latency, error rate and uptime. Quality of service also involves controlling and managing network resources by setting priorities for specific types of data (video, audio, files) on the network.

a) Delay

Delay is the time it takes to send data from terminal source until terminal the purpose.The sound qualities would be very hanging from time delay. That recommend to application sound, delay maximum is 150 ms, while delay maximum with sound quality is still could be accepted by the user are 250 ms.

$$\Delta\ Delay = \frac{delay}{\text{packet data receive}}$$

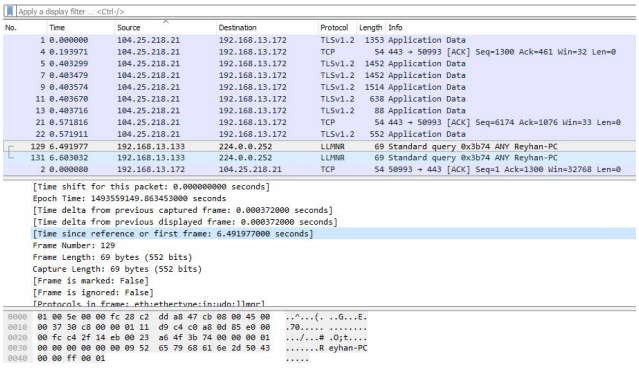

Fig. 12. Capture Delay

b) Jitter

Jitter is a variety delay due to the difference in time or of intervals between the packages in recipients. To overcome jitter so data packets coming collected first in jitter a buffer for a while to package acceptable with the recipient with proper order.

c) Throghput

Speed (rate) data transfers effective, measured in bps. Troughput a total of successful package observed in destination for set period of time divided by duration interval that time.

$$throghput = \frac{data\ sent}{\text{time of data sent}}$$

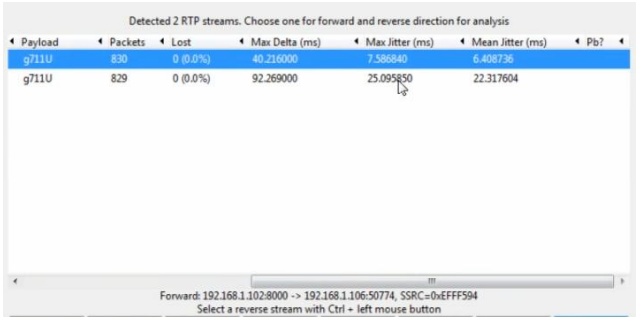

Fig. 13. Jitter

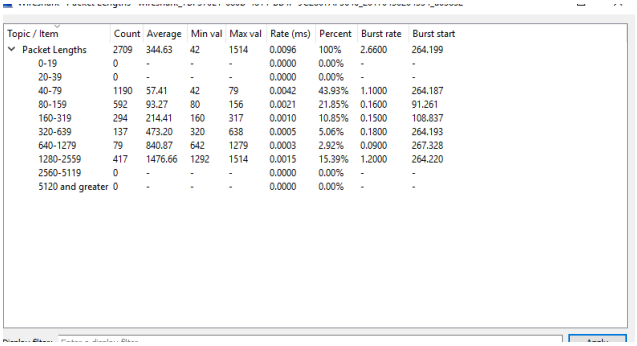

Fig. 14. Capture Throughput

d) Packet Loss

Loss packet arise when happened peak loads and congestion (traffic jam transmission package due to dense traffic that had to be served in the time limit , so frame) combined data the payload and header in the transmisikan will be discarded as the treatment of frame of other data on a network based ip. One alternative solutions these is to build link between node on a network.

$$packet\ loss = \frac{data\ sent - data\ receive}{packet\ data\ receive}\ x\ 100\%$$

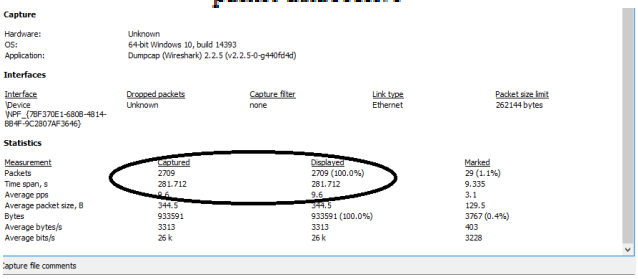

Fig. 15. Capture Packet Loss

e) Bit Error Rate (BER)

BER is the main parameter in the data communications that have used digital technologist. BER States how many bits of information that are damaged (error) in the process of transmission.

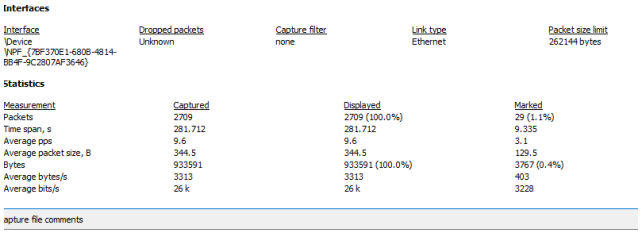

Fig. 16. Capture Bit Rate

V. CONCLUSION

After doing the planning, design, and then testing and analysis it can be concluded as follows:

1) Connections using wifi is limited to 30 meters but still within the robot soccer arena range.

2) Game Controller can be used to regulate the game match.

3) Multicast Communication that is used can be performed for three robots and one controller.

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