THE CONCEPTION OF A WIRELESS NETWORK OF MICROCONTROLLERS

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Abstract: This paper reflects the feasibility of a bidirectional wireless communications between remote microcontrollers to form a wireless network. In order to prove this hypothesis, a wireless network including two microcontrollers which use data transmission sub modules will be conceived.

Keywords: wireless communication, wireless network of microcontrollers

1. INTRODUCTION

Wireless communication is now most common in computer networks. Wireless network was first developed at the University of Hawaii in 1971, this network allowed seven computers scattered across the four islands to communicate with a central computer using radio waves [1].

When you want the interconnection of remote microcontrollers, you can use both wires and cables interconnecting them by means of wireless transmission equipment. A solution for achieving a wireless network of microcontrollers is the interconnection of microcontrollers through wireless transmission-reception modules.

This paper will address the possibility of building a wireless network of microcontrollers. In order to prove the hypothesis, an application that includes two wireless networking PIC microcontrollers will be realized, giving the opportunity of making several modules. For data transmission from the wireless transmitter to the receiver, use the serial communication protocol, RS-232 protocol. Under this protocol, it will be used a different protocol making it possible for the modules to connect to each other [2].

2. THE APPLICATION IMPLEMENTATION

2.1. The Block Diagram

An overview of the system can be viewed through the block diagram in (Figure 1). It consists of two modules. Each module is composed of: a microcontroller, a wireless transmission sub-module, a wireless receiver and a testing sub-module.

2.2. The Electric Diagram

The Electric Diagram (Figure 2) was developed in Proteus 7.

The electric diagram consists of two modules, each having components such as: a microcontroller, a testing circuit for simulation and visualization of signals, a wireless transmitter sub-module, a wireless receiver sub-module.

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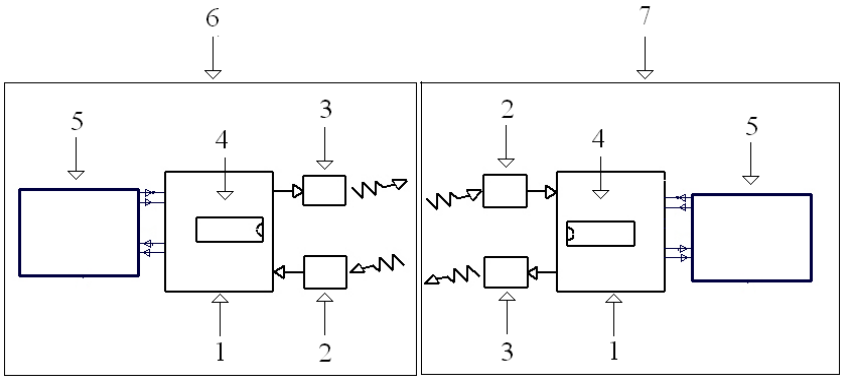

Fig. 1. The Block diagram:
1 - PIC development circuit; 2 - wireless receiver sub-module; 3 - wireless transmission microcontroller 16F84; 4, 5 - testing sub-module; 6 - module no. 1; 7 - module no. 2.

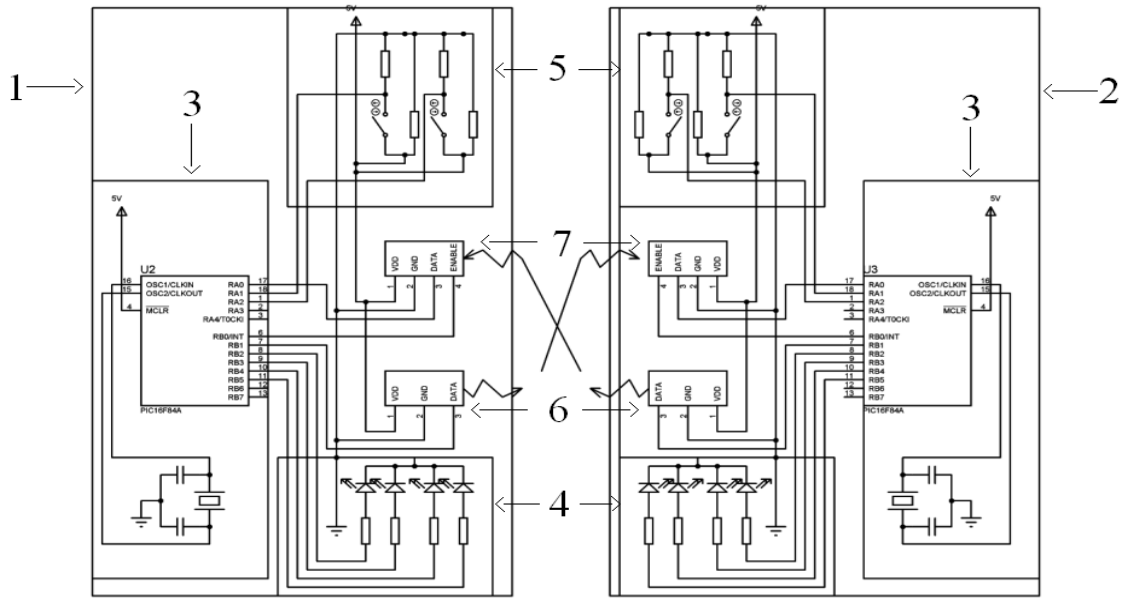

Fig. 2. The Electric Diagram:
1 - module no. 1; 2 - module no. 2; 3 - PIC development circuit; 4, 5— testing circuit;
6 - wireless transmission module; 7 - wireless receiver module.

For the development of the software were used: two PIC microcontrollers (PIC16F88) [2], two wireless receiver modules (HM-R868S, Figure 3) and two wireless transmission module (HM-T868S), (Figure 4) that have these features (Table 1) [3,4].

Table 1. The characteristics of the emission-reception sub-modules [3, 4].

	Min	Typical	Max	Unit
Voltage	2,5	3	5	V
Temperature	-35	-	80	C
Data rates	600	4800	9600	bps

Fig. 3. Wireless receiver sub-module HM-R868S [4].

Fig. 4. Wireless emission sub-module HM-T868S [3].

In practice, the communication is accomplished by connecting the wireless emission-reception sub-modules to the microcontroller pins. To simulate the application a test sub-module was made, which consists of two switches used to control the microcontroller to send commands through the wireless emission sub-module to the other module, which will display the order through four LEDs located on the testing circuit.

2.2. Data transmission [5, 6]

For the data transmission, it is used the RS-232 serial transmission protocol. When modules exchange information among themselves via RS-232 protocol, each module must recognize the way the information comes from. The information transmitted from a transmitter is received by each receiver.

For microcontrollers to recognize each other, it is needed the achievement of a different communication protocol integrated RS-232 and includes (Figure 5) RS-232 code cycle number, authentication code (which is consisted of the code of the information receiver module, the code of the module that sends the information) and the code itself (the command code to be executed).

The authentication code (the code of the module that gets information, the code of the module that sends the information) were set each to have a length of seven bits of data and command code was set to have four bits of data (Figure 5).

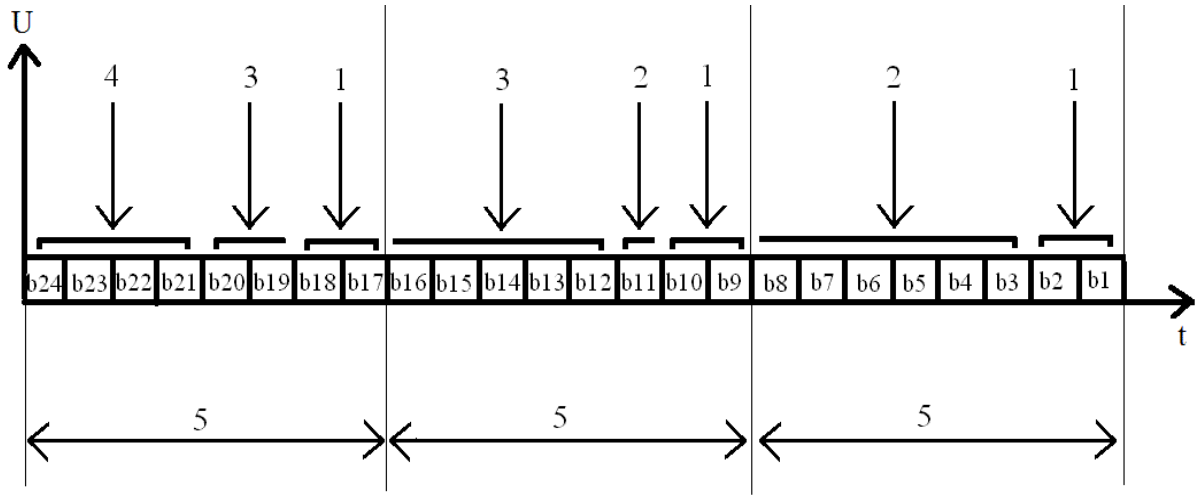

Fig. 5. The representation of the information transmitted inside RS-232 protocol:
1 - the code of the RS-232 cycle number; 2 - the code of the sub-module which receives the information; 3 - the code of the sub-module which transmits the information; 4 - the code of the command; 5 - the period of the cycle.

On each cycle the RS-232 protocol can carry eight bits of data. The entire code of the developed protocol will be sent in three cycles of transmission of RS-232 protocol. For the recognition of the cycle number that was sent (three possibilities) in order to place the code recomposing protocol developed by the microcontroller, there were allocated two bits of data per cycle (Figure 5), (Table 2).

Table 2.Coding of the cycles.

Cycle no.	Bits cycle	Bits value
1	b2/b1	0/0
2	b10/b9	0/1
3	b18/b17	1/0

There was established a number of four commands that can be implemented by the forming of combinations on the two buttons (pressed, depressed) component of the test circuit. When a button is pressed, it will change the status of the microcontroller port pin input (pin corresponding to that button) of logic 0 in logic 1. For every order, the other module will receive a command via a wireless transmission LED lights, in Table 3.

Table 3.Coding of the commands.

Nr.	Module no 1 transmitter data to Module no. 2					
	Module no 2 transmitter data to Module no. 1					
	Button 1	Button 2	Led1	Led2	Led3	Led4
1	OFF	OFF	ON	OFF	OFF	OFF
2	OFF	ON	OFF	ON	OFF	OFF
3	ON	OFF	OFF	OFF	ON	OFF
4	ON	ON	OFF	OFF	OFF	ON

3. THE SIMULATION OF THE APPLICATION [7]

Basically, each module is composed of a circuit testing view / control received / issued signals. When performing the simulation of the application it was done as mentioned. Pressing buttons on one testing circuit of a module, in that moment the microcontroller sends through the RS-232 emission sub-module the protocol code that is composed of the code for recognition between each of the modules and the code of the command. The signals will be received by the microcontrollers inside the wireless modules through the wireless reception circuits, checked and then interpreted. When a microcontroller within a module validates a received signal, it will show you through the test circuit (four lights to watch a transmitted signal).

4. CONCLUSION

After implementing the application of the simulation, the following are revealed:

- because the wireless transmitter and receiver have a power of 5 dB, the maximum transmission distance is 180 m;
- the speed transmission has the following limits 600 ÷ 9600 bps;
- it is found that the idea can be successfully used in industrial automation;
- other modules can be added.

REFERENCES

[1] http://en.wikipedia.org/wiki/Wireless (28.03.2011).
[2] Microchip, PIC 16F84 Data Sheet, U.S.A, 2001, p. 44 - 46.
[3] Hope Microelectronics, HM-T Series FSK TX module, Guangdong, China, 2009.
[4] Hope Microelectronics, HM-R Series FSK receiver module, Guangdong, China, 2009.
[5] Dardari, D., Tralli, V., High-Speed Indoor Wireless Comm. at 60 GHz with Coded OFDM, IEEE Trans. on Comm, vol. 47, no. 11, 1999, p. 1709 - 1721.
[6] Ryu, H. G., Lee, Y.S., Phase Noise Analysis of the OFDM Communication System by the Standard Frequency Deviation, IEEE Trans. on Consumer Electronics, vol. 49, no. 1, 2003, p. 41-47.
[7] El-Tanany, M. S., Wu, Y., Azy, L. H., OFDM Uplink for Interactive Broadbad Wireless: Analysis and Simulation in the Presence of Carrier, Clock and Timing Errors, IEEE Trans. on Broadcasting, vol. 47, no. 1, 2001, p. 3 - 19.