WIRE BOARD PROTOTYPING METHOD

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ABSTRACT

The modern development of new electronic devices requires rapid manufacturing of their prototypes. Printed circuit boards (PCB) used for this purpose are expensive and, as a rule, time consuming. PCB milling machines are also expensive. Here we propose a wire board manufacturing method that could be used in any laboratory for rapid prototyping of electronic devices. This method allows us to create wire boards for surface mounting technology, with space between pins down to 0.5 mm. This method demands no special equipment and makes it possible to manufacture a wire board in a few hours.

RESUMEN

El desarrollo moderno de nuevos dispositivos electrónicos requiere la fabricación rápida de sus prototipos. Los tableros de circuito impresos (TCI) usados para este propósito son costosos y, en general, demandan mucho tiempo. Las máquinas que muelen los TCI son también costosas. Aquí proponemos un método de fabricación del tablero de alambre, que se podría realizar en cualquier laboratorio para agilizar la fabricación de los prototipos de dispositivos electrónicos. El método permite hacer los tableros de alambre para la tecnología del montaje superficial con el paso entre los contactos abajo a 0.5 milímetros. Este método no demanda ningún equipo especial y permite fabricar un tablero del alambre en unas horas

KEYWORDS: wire board prototyping, electronic devices, rapid manufacturing, magnet wire connections, neurocomputers.

1. INTRODUCTION

There are two basic approaches to manufacturing prototypes of electronic devices. One approach is to order the printed circuit board in specialized companies - the so-called outside prototyping. The other approach is to manufacture the PCB in the same laboratory (in-house prototyping). Outside prototyping usually demands a minimum quantity of 10-20 boards and 1-2 week lead-time to receive the initial prototype (http://www.lpkfcadcam.com/RapidPCB/index.htm). In-house prototyping allows us to obtain the initial prototype in one day. It results in a significant reduction of time spent on project development, which is very important in modern competition.

Traditional methods of in-house prototyping demand rather expensive special equipment, such as milling machine tools, laser-based devices, special printers, and so on.

In this paper, we propose a method of in-house prototyping which could be performed in any laboratory without the need for expensive special equipment.

2. WIRE BOARD CREATION BASED ON MAGNET WIRE CONNECTIONS

To make a prototype wire board it is necessary to execute the following procedure.

Step 1 –Place the prototype component on the polymer board and mark the positions of the component pins. For this purpose, it is sometimes possible to print the positions of the components and the pins on paper with a normal printer. Afterwards, the paper must be glued to the board.

Step 2 – drill two holes for each pin (Fig. 1).

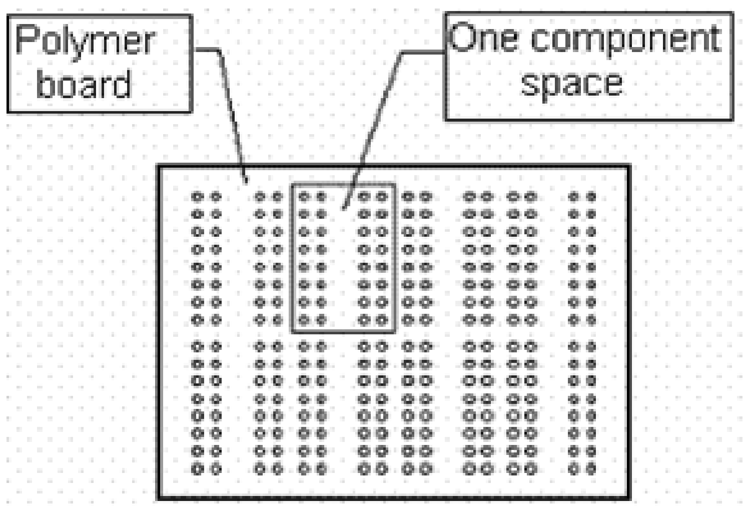


Figure 1. Step 2: drilling the polymer board.

Step 3 – in accordance with the connection layout, connect the pins with a magnet wire (Fig. 2).

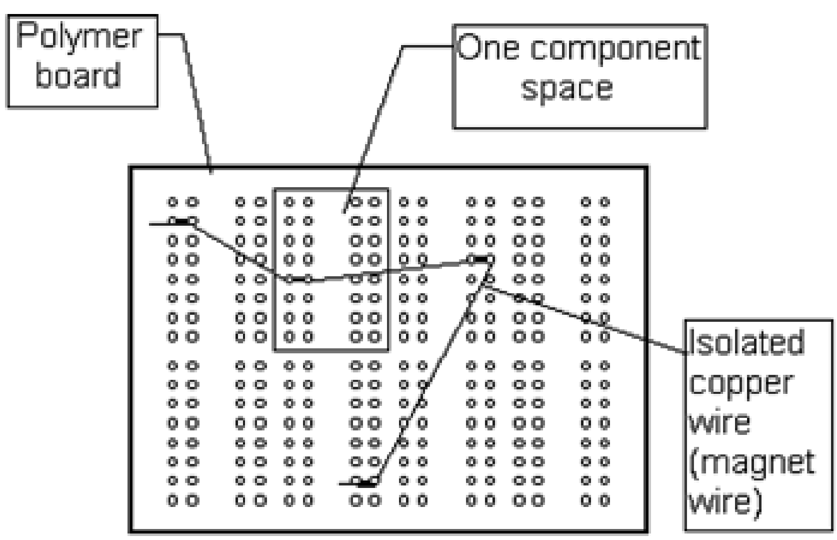


Figure 2. Step 3: connection of the pins positions with magnet wire

The magnet wire is located in each pin position in the manner shown in Fig. 3.

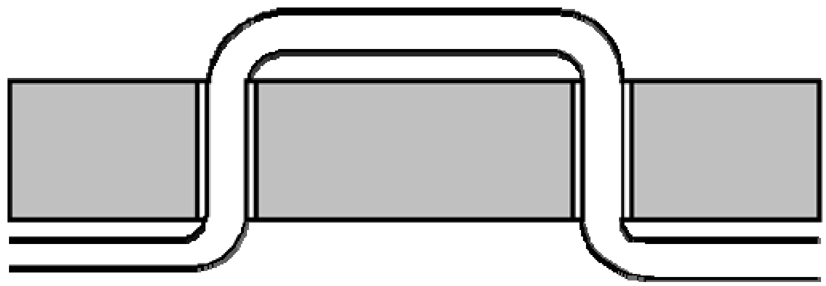


Figure. 3. Pin position on the polymer board.

The magnet wire passes through a hole from the back to the front of the polymer board and returns through the neighboring hole from front to back.

Step 4 - cover the front side with the adhesive. The adhesive must penetrate the holes and dry.

Step 5 - using the cutter to eliminate the insulation from the wires on the front side (Fig. 4).

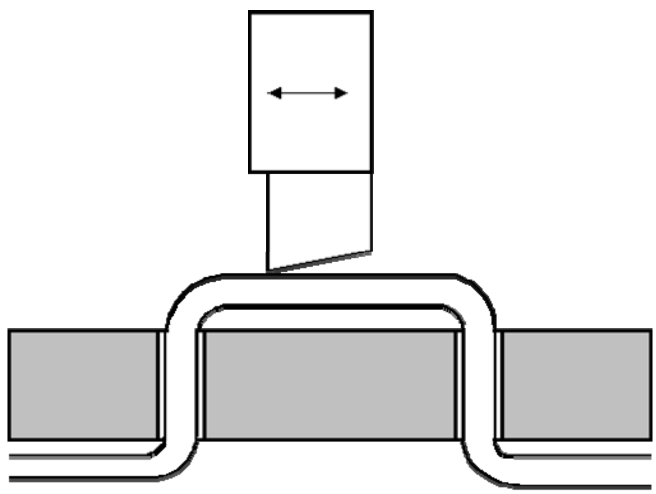


Figure. 4. Step 3: Elimination of the wire insulation.

Step 6 – install the electronic components to the front side of the board and solder them (Fig. 5).

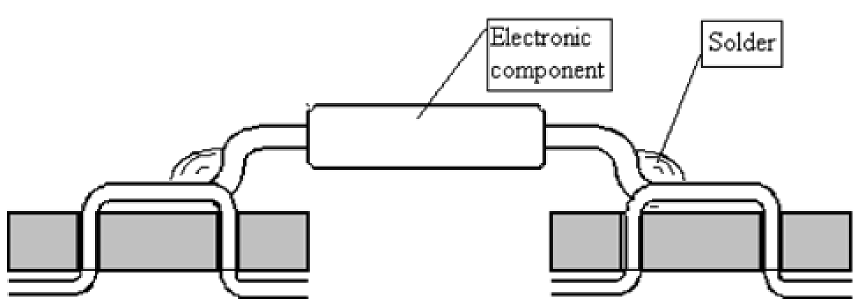
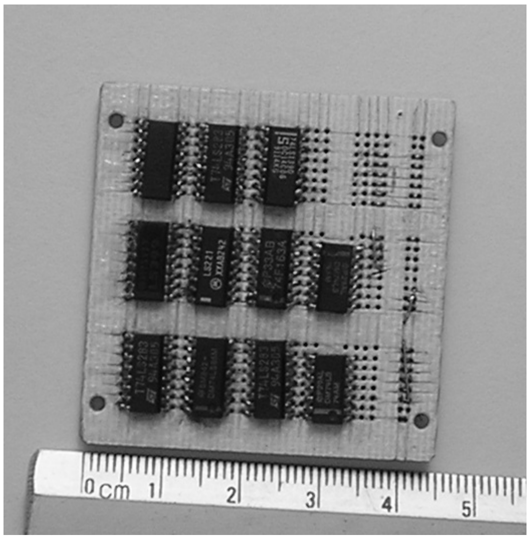


Figure. 5. Step 6: Superficial assembly of integral schemes.

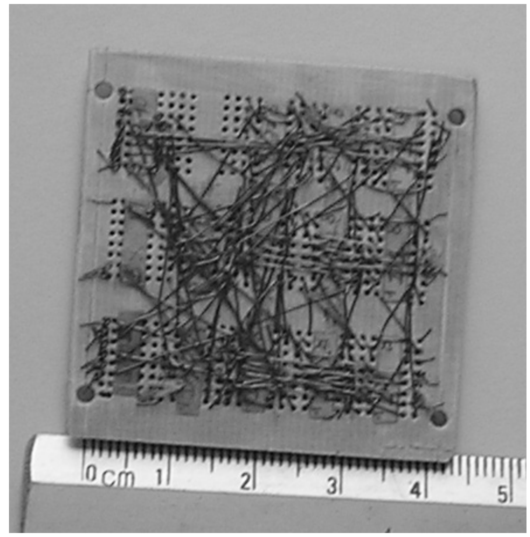
3. EXPERIMENTAL RESULTS

We made and tested some prototypes of wire boards using the method described. The spacebetween pins was 2.5 mm. We made one of the prototypes with a space of 1.25 mm (Fig. 6a, b). Good results were obtained with all the prototypes.

The most time-consuming step in this process is step 3. In accordance with our experience, the operator can connect 100-150 pins per hour. Manufacturing the prototype shown in Fig. 6 requires about 3 hours.



a



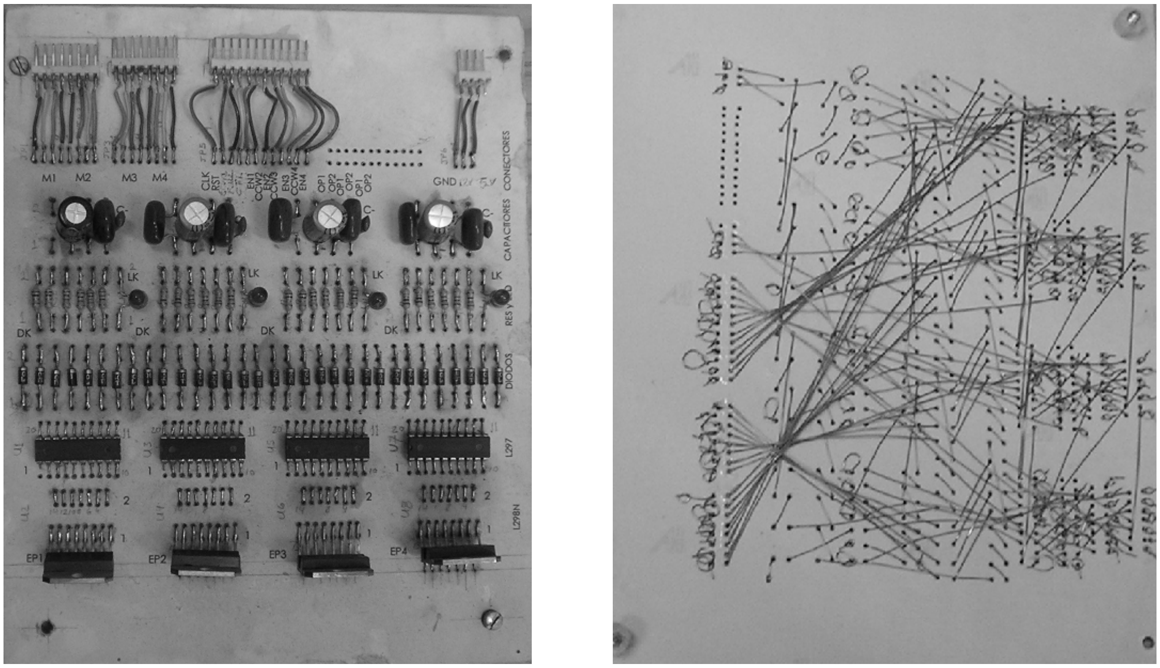
b

Figure. 6. System of parallel control containing shift registers and binary counters: a) front side, b)back side.

The proposed method was tested on some prototypes of electronic devices. We developed various neurocomputers (electronic devices for neural network simulation) in the early 1990s. The prototypes of these neurocomputers [1], [2] were made following the proposed methods. No failures were detected in the wire board during the neurocomputers examination. One of these neurocomputers is shown in Fig. 7.

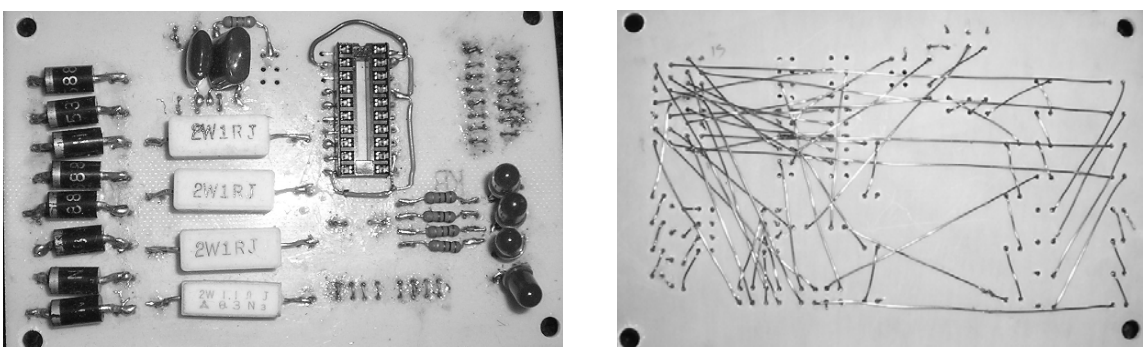
Figure.7. The neurocomputer "NIC"

The same method was used in the Micromechanics and Mechatronics Laboratory to make prototypes of control systems for micro machine tools. For example, two prototypes of wire boards for these control systems are shown in Fig. 8 a, b and Fig. 9 a, b.



a *b*

Figure.8. The amplifiers for micro machine tool control system. a) front side, b)back side.



a *b*

Figure.9 a,b. The amplifiers for micro motor control system

a) front side, b) back side.

We hope that using a microscope and thin magnet wire it will be possible to make prototypes of multi chip modules [3].

4. CONCLUSIONS

The method of wire board manufacturing is proposed. This method could be used for rapid prototyping in any laboratory, with no need for special equipment. The method makes it possible to produce a wire board prototype in a few hours.

5. ACKNOWLEDGEMENTS

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Ernst M. Kussul was born in May, 1938. He received his M.S. in mechanics from Leningrad Polytechnic Institute, Russia. From 1961 to 1965 he was with Bryansk Machine Building Factory, Russia. He received the Ph.D. in mathematical logic and programming from the Institute of Cybernetics of the Ukrainian Academy of Sciences. In 1967 he joined the Institute of Cybernetics of Ukrainian Academy of Sciences as a junior researcher, from 1976 as a senior researcher, and from 1982 as a leading researcher. In 1982 he received the D. Sci. degree in artificial neural networks from the Institute of Cybernetics of the Ukrainian Academy of Sciences. From 1988 to 1998 he was head of the department of neural networks in the International Research and Training Center of UNESCO/IIP of Information Technologies and Systems. Since 1998 he is Researcher level "C" and the head of the Laboratory of Micromechanics and Mechatronics in UNAM, Mexico. He has published over 140 scientific papers, authored and coauthored 2 books; he is author of 11 patents. He participated in international projects INTAS, ISF. In 1992 he was invited to Japan as head of an international group to create neurocomputer B-512. In 1996 he was invited by the National Science Foundation of the USA to visit different MEMS laboratories to present his work. He has been invited to present his work in England, France, Belgium, Slovakia, and Japan. He is laureate of the Prize of the Government of Ukraine in Science and Techniques in 1997. He is a member of the Mexican Academy of Technology. He has been in program committees in several IJCNN conferences. He is a member of IEEE. His present research interests are micromechanics, mechatronics, neural networks, and pattern recognition.

Tatiana N. Baidyk was born in March, 1954. She received the M.S. in Electrical Engineering from the Kiev Polytechnic Institute, Ukraine in 1977, and the Ph.D. in control systems for mobile robots in 1983 from the Institute of Cybernetics of the Ukrainian Academy of Sciences. From 1977 to 1995 she was with the Institute of Cybernetics of the Ukrainian Academy of Sciences as a post graduate student from 1977, as a junior researcher from 1980, and as a senior researcher from 1990. In 1994 T.Baidyk received D.Sci. in the area of neural networks from the Institute of Cybernetics of Ukrainian Academy of Sciences. From 1995 to 1999 she was coordinator of the International Program of Education and Science in Ukraine, International Renaissance Foundation. From 1998 she was with the International Research and Training Center of UNESCO/IIP of Information Technologies and Systems as a leading researcher. From 2001 she is Researcher level "A" in UNAM, Mexico. She has published over 120 papers, authored and coauthored 2 books, 3 patents, and edited 8 other books. She participated in international projects INTAS, ISF, worked in 1992 in the international group in Japan creating neurocomputer B-512. She is a member of the European Council of Artificial Intelligence, Association of Artificial Intelligence (Russia), a member of the Association of Developers and Users of Intelligent Systems (Ukraine), a member of the Executive Committee of the Neural Network Society (RNNS, Russia). Baidyk´s present research interests are neural networks, pattern recognition, control systems, and industrial applications.

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