The Computers' Collection at the Polytechnic Museum

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Abstract. The Polytechnic Museum has the Fund Collection "Electronic Digital Computing Machines". There are more than seven hundred objects and over two thousands documentary, printed and graphic items today. All four generations of electronic digital computing machines are presented in the Museum. Some of the EDCM are working. In addition, the Museum created fourteen personal funds of Russian scientists who devoted their activity to computer science. This computers' collection is the only one of such variety and size in Russia.

Keywords: Polytechnic Museum, collection, personal funds, electronic digital computing machines, using simulations and replicas to illustrate the computing history.

The fund collection of "Electronic Digital Computing Machines" (EDCM) was formed in the 1960s. There are more than seven hundred objects and two thousand documentary, printed, and graphical items today. The Museum created thirteen personal funds of Russian scientists who devoted their activity to computer science: S. Lebedev, I. Bruk, B. Rameev, V. Glushkov, A. Lyapunov, U. Bazilevskiy, N. Matjukhin, M. Kartsev, A. Kitov, N. Brousentsov, V. Petrov, V. Burtsev, S. Mergelyan. It is very important to point out that this fund collection is the only one of such variety and size in Russia.

The first electronic digital computing machines appeared in the USSR in 1951 and allowed scientists to solve difficult scientific and technical tasks. They were the Small Electronic Calculating Machine (MESM), developed under the leadership of academician Sergei Lebedev, and the Automatic Digital Computer (M-1), developed under the leadership of Isaak Bruk. N. Matjukhin and M. Kartsev were among the developers of the M-1 computer and later, they created their own computer engineering schools. The documentary materials about these machines and their developers were demonstrated in the Museum halls of datamation. The original report of the M-1 Automatic Digital Computer, developed in the Laboratory of Electro-systems at the Institute of Energy of the USSR Academy of Sciences, is one of the most interesting documents in our department.

In 1948, Isaak Bruk together with Bashir Rameev received the first author's certificate of the Automatic Digital Computing Machine in Russia. The Museum is the keeper of this certificate. Later, B. Rameev created the "Ural" family of computers. One could see the Small Automatic Electronic Digital Computing Machine "Ural-1" (Fig. 1) in the Polytechnic Museum exhibition.

A. Tatnall, T. Blyth, and R. Johnson (Eds.): HC 2013, IFIP AICT 416, pp. 53–63, 2013.

Fig. 1. The Small Automatic Electronic Digital Computing Machine "Ural-1" at the Polytechnic Museum

Some Museum objects of computer science have obtained the status of "Relic of science and technology"; as such, they are under the protection of the Museum and the state. The Small Automatic Electronic Digital Computing Machine "Ural-1", some units of the first Soviet serial computer "Strela" and other Museum objects have such designated status. There are several units of the first Soviet serial computer "Strela", developed in 1952 by the Special Design Bureau SDB-245 in the EDCM Fund collection of Polytechnic Museum. These are the fragments of the Control Panel (Fig.2), several processor blocks realized on the vacuum-valves (Fig. 3), six cathode-ray tubes (elements of quick-access storage) and wide ferromagnetic tape used as an external information carrier (Fig.4).

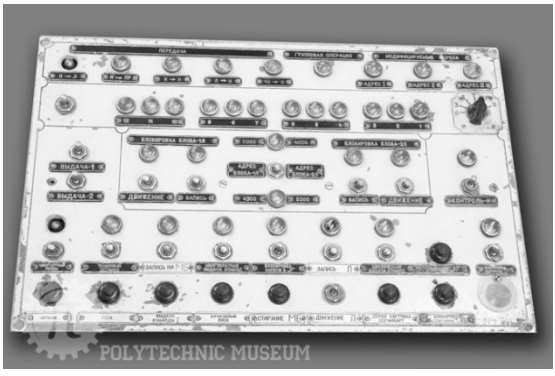

Fig. 2. The Control Panel fragment of the first Soviet serial computer "Strela"

Fig. 3. Several processor blocks of the first Soviet serial computer "Strela"

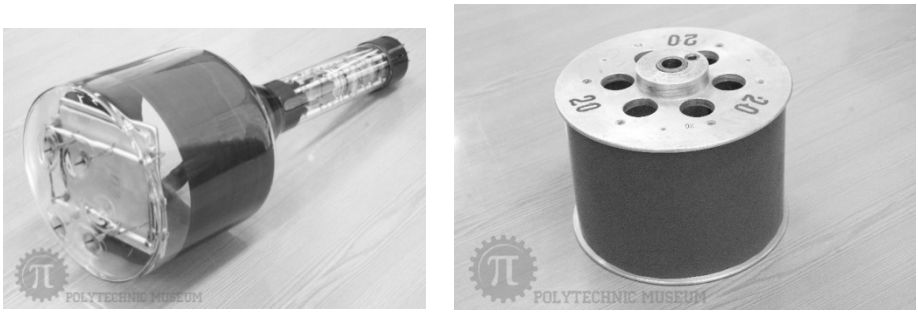

Fig. 4. The cathode-ray tube and the wide ferromagnetic tape the first Soviet serial computer "Strela"

Usually all electronic digital computing machines are divided into four generations. The Small Automatic Electronic Digital Computing Machine "Ural-1"and the first Soviet serial computer "Strela" present the first generation of machines in the Museum. The processor of these machines was realized on electronic tubes, and the operative memory was realized on magnetic drum or cathode-ray tubes.

Then the second generation of machines is represented by the electronic digital computing machine "Razdan-3" (Fig. 5) and others soviet mainframes. The processor was built by using semiconductors and operative memory was built of ferrite cores. There were several ferrite cubes in one machine. There are many matrixes of ferrite cores inside such cube. We can see how these devices worked on the demonstration model.

The Museum collects and keeps the various types of memory on ferrite cores. For example, it contains the Ferrite Cube of the Operative Memory of the Electronic Computing Machine (ECM) M-4 (Fig. 6), developed under the leadership of M. Kartsev. The capacitor-type ROM block of the ECM M10 (Fig. 7) is a very interesting object, which was designed in the Scientific Research Institute of Computing Complexes also under the leadership of M. Kartsev.

Fig. 5. The electronic digital computing machine “Razdan-3”

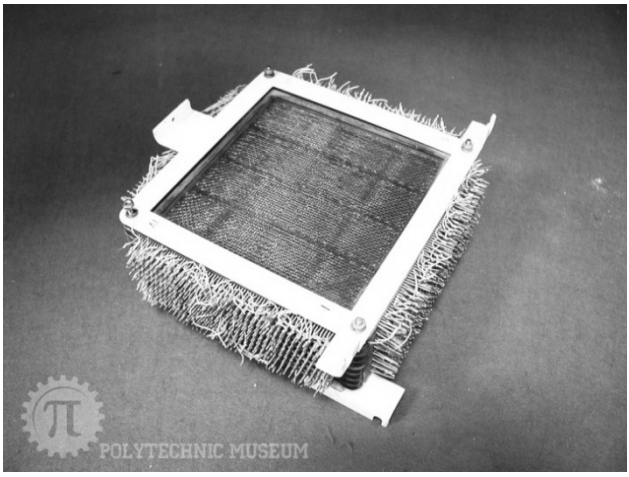

Fig. 6. The Ferrite Cube of the Operative Memory of the Electronic Computing Machine M-4

Fig. 7. The capacitor-type ROM block of the ECM M10

The unified system of electronic computing machines on integrated circuits represents the third generation, developed in the USSR at the beginning of the 1970s in cooperation with the socialist countries. It represents a family of software compatible machines with different productivities that build on the unified elemental and constructive base with a unified structure and a unified set of peripheral units. The processor and the operative memory were mounted on integrated circuits.

A remarkable exclusion is the experience of creating the ternary computers "Setun" (Fig. 8) and "Setun-70" at Moscow State University. The experience convincingly confirms practical preferences of ternary digital techniques. N. Brousentsov initiated the design of small digital computing machine "Setun" in 1956. (Note that Setun is the little river that flows into the river "Moscow" near the University.) The Setun was a small, inexpensive computer that was simple to use and to service for schools, research laboratories, offices, and manufacture control. Fast miniature ferrite cores and semiconductor diodes were used as the element base for this machine. Simplicity, economy, and elegance of computer architecture are the direct and practically very important consequences of ternary machines. The computer "Setun" has the status of "Relic of science and technology".

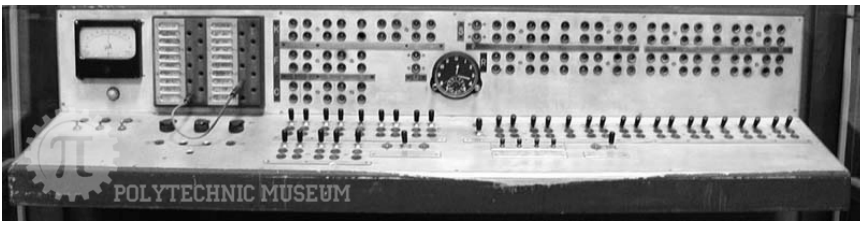

Fig. 8. The Control Panel of the ternary computer "Setun"

The Computing Center with the third generation machine is showed through the scale model of the Electronic Computing Machine US-1050 (Fig. 9) and some original units of this machine (Fig. 10). Visitors can see integrated circuits, which made the peculiar revolution in computing science, on the boards of the operative memory of the ES-3222. Plotters were used widely with these machines for the first time.

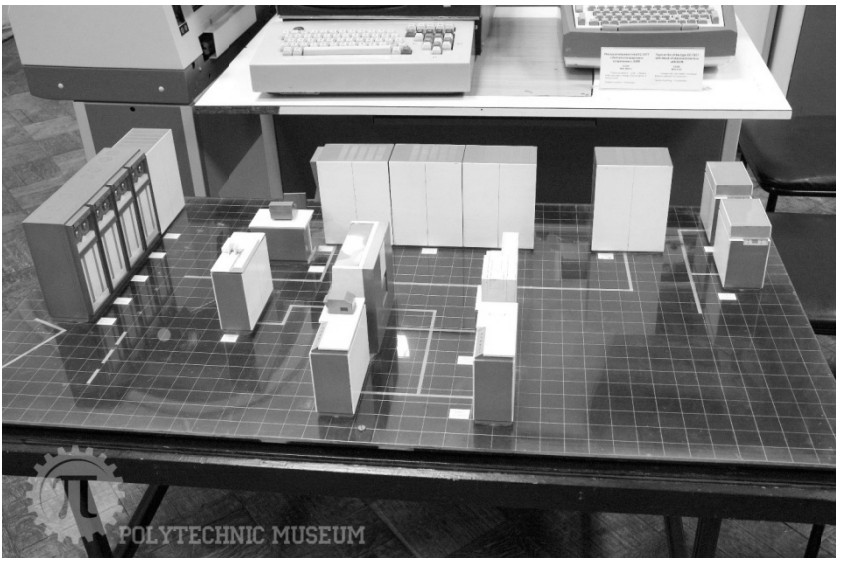

Fig. 9. The scale model of the Electronic Computing Machine US-1050

Fig. 10. Some original units of the Electronic Computing Machine US-1050

The processor and operative memory of the fourth generation of electronic computing machines appeared on very large-scale integrated circuits. We demonstrate the functioning of one of the first such Soviet computers – the Microprocessor Laboratory “МикроLab КР580ИК80” in the Museum.

There is a unique computer for spaceship use called the "Argon-16" (Fig. 11), that can be seen only in this Museum. It contained a synchronous computer system with triple redundancy and majorization carried out on per unit base with eight levels. It consists of three computers with data channels and a set of interfaces to the control system. The instruction set is specially designed for control tasks. I/O operations combine with the calculation process.

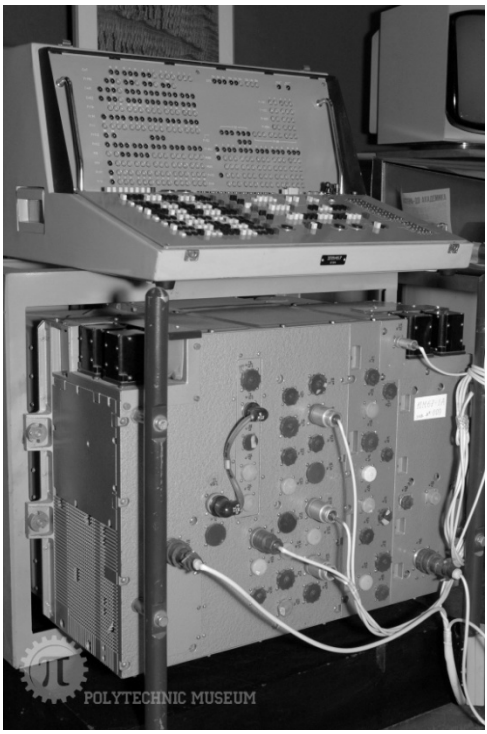

Fig. 11. The computer for spaceship "Argon-16"

Since 1975, the "Argon-16" computer became the basic component of control systems of "Soyuz" spaceship, the "Progress" transport ships, and orbital space stations "Salute", "Almaz", and "Mir". Exclusive reliability had provided long usage for it. The total output for these machines is 380. No failure of the system was noted during its twenty-five years of operation when working in control systems. It is unrivalled among space computers by production volume. The specialized computers for aviation are presented in the Museum exposition.

In 2005, the Museum received the "El'brus 3.1" super computer system (Fig. 12), developed at the Institute of Precision Mechanics and Computer Technology. It also received one processor block and one operative memory block of the "Electronica SS BIS-1" super computer (Fig. 13), created under the leadership of academician V. Mel'nikov at the Cybernetics Problems Institute and the "Del'ta" Scientific Research Institute. In addition, the Museum actively collects Russian and foreign personal computers.

Fig. 12. The "El'brus 3.1" super computer system

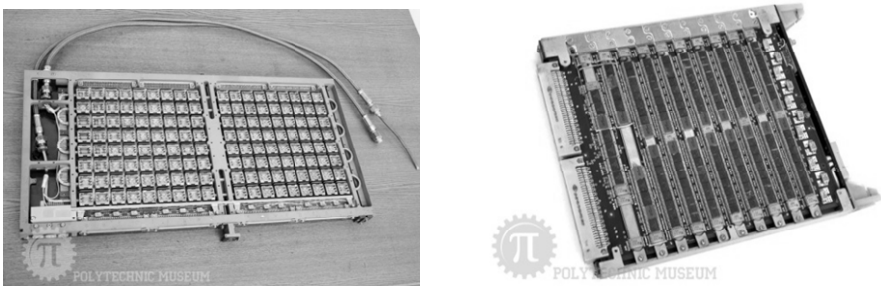

Fig. 13. The processor block and the operative memory block of the "Electronica SS BIS-1" super computer

Up to the end of the last year we had the Museum's halls devoted to Soviet scientists and engineers who worked in computing science. The visitors could see documentary, printings, and graphic materials of scientific, official, and biographic activity. Also there are materials about international recognition of Russian scientists

in computer science. The International Computer Society of the Institute of Electrical and Electronic Engineers awards scientists of different countries the title "Computer Pioneer". Russian scientists S. Lebedev, A. Lyapunov, and V.Glushkov received this title in 1996. The children of these scientists presented the diplomas and large bronze medals to the Museum.

Since 1994, the Department of Computer Engineering and the Automatics Department of the Russian Academy of Science awards a premium, named after S. Lebedev, for successes in the area of computing systems development. This Museum keeps copies of the diplomas awarded by the Russian Academy of Sciences to Russian scientists.

Unfortunately, it is practically impossible to restore the first electronic digital machines for demonstration of their work. However, with the aid of modern computers it is possible to show the operation of the separate devices. One of such complex demonstration was created on the base of plotter "US-7051M" and the personal computer, which works in the DOS medium. This plotter worked under the control of a special block in composition of United System computers. We didn't have such a control block, but a student of Moscow Institute of Electronic and Mathematics, Dmitry Schepovalin developed a new interface between this plotter and personal computer on modern microchips (integrated circuits). The control programs, written in the algorithmic language C++, and the demonstration programs allowed drawings of images chosen by the user from the computer library, for example, the logo of the Polytechnic Museum. It is important to note that in the created demonstration complex in the base of plotter US-7051 and personal computer partially the history of appearance and development of the algorithmic languages is reflected and remains the same.

With the aid of a modern multimedia computer, it was possible to listen to computer music: from the first solo-voice melodies "Uralskie napevy" of R. Zaripov, to the polyphonic compositions of A. Stepanov (played on the first computing machines in the 1960s). They were rewritten from old recording tapes.

In 2005, the Museum began to carry out work according to digitization of video films from the scientific-auxiliary fund of the Museum. Five films are already in digital format. For example, the Museum digitized "Academician Lebedev", "Machine Geometry and Graphics" and "Curved Surfaces in Automatization System". The Museum plans to continue this work.

At this time the Polytechnic Museum has entered a period of global modernization. The Board of Trustees of the Museum adopted a new scientific concept of exposition of the Museum, the proposed "Event Communication". The Museum staffs are working on the creation of new expositions together with colleagues from the "Event Communication". The Duffel Fund of the Museum will be transported to the Territory of Techno Park of one of the former car factories. Temporary exhibition will be created in the Pavilion «Transport» on the territory of the all-Russia Exhibition Center. The Museum must vacate the building fully by July 2013. Then its reconstruction will begin.

The updated exposition on the history of electronic computing machinery is intended to make this more understandable and accessible for all categories of

visitors. Today many people are active users of personal computers and know that their main devices are CPU, memory, external devices for changing information, but they are hidden from our eyes. All these devices are in the computers of all generations, but in the first three generations of computer we can see these directly and observe the evolution of the element's base. Now many of the students who will be specialists in information technologies don't know about the first computers and don't know about the existence of supercomputers. Frequently we can hear from visitors: «I thought that computers are only desktop!». For many, the history of computers consists of a maximum of the last 2 decades. An understanding of the history of computing needs to show all computer generations and compare the characteristics of these devices.

As is well known, the operating exhibits caused the greatest interest among the visitors. In the Polytechnic Museum Small automatic electronic computing machine «Ural-1» was exhibited, which was released by the Penza computing-analytical machines plant in 1959. It is the tubes computer extant in Russia fully. Of course more visitors would be interesting to see how this machine works. This complex problem was decided by two Moscow students Mixail Glyanenko and Dmitry Solov'ev. They developed and implemented a demonstration complex on the basis of a Small automatic computer «Ural-1». The students used modern integrated circuits instead of the processor based on electronic lamps and memory on a magnetic drum. For demonstration of the functioning of the machine a very simple task was selected: addition in binary code. The solution of this task can be observed on the indication panel. At the same time the electronic lamps of the processor glow. Thus, visitors get a full idea about how worked the very first computers.

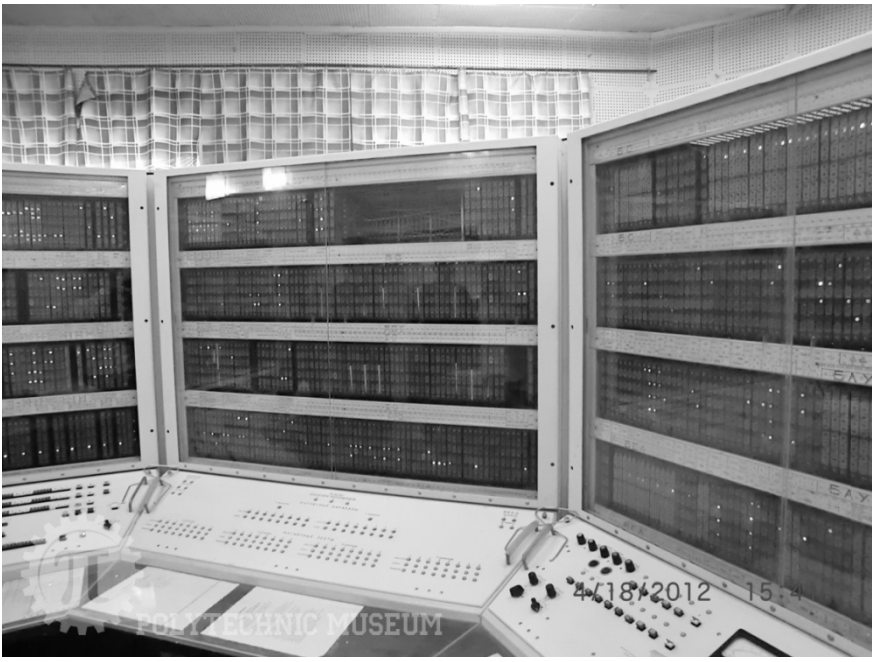

Fig. 14. The working BESM-6

In 2012, the Museum got working the BESM-6 (High-speed Electronic Counting Machine) (Fig. 14), the best semiconductor computer, which was created in the USSR. Now this Machine is in the Museum's Depository. After the reconstruction of the Museum's building BESM-6 will be exhibited and I hope that we will be able to show visitors its work. There are more specialists who were involved in building or using this machine and I am sure of their support.

Many visitors do not know about the most important task of computers: to compute, and solve the most complicated scientific-technical and engineering tasks. Many of our contemporaries think that computers are designed for office work and games. It is therefore important to show clearly what problems were solved on the first computers and on the most modern powerful super-computers.

Also the preservation of the past years' software is very difficult, and especially its demonstration in the Museum space. The corresponding working equipment is required to demonstrate such programs. It's possible for personal computers, but for the old mainframe it's a practically impossible task.