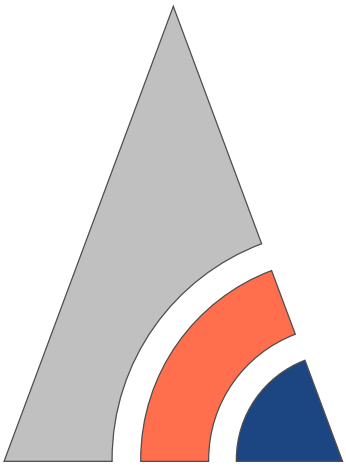


The technikum29 Computer history museum

The Tony Sale Award 2014, Application

A voluntary project located in one of Germany's largest metropolitan areas, privately funded to make computer history experiental for everybody.

Frankfurt am Main
July 2014

Sven Köppel, Heribert Müller
http://www.technikum29.de
post@technikum29.de

Contents

1 A place for education and technical experience

Tech·ni·kum ['tɛçnɪkʊm] – *college of technology, applications laboratory, technical school*

— PONS german dictionary

TECHNIKUM29 is a museum of computer and communication technology in the Frankfurt am Main metropolitan area. The two pillars are (1.) all-working devices in the exhibition and (2.) sophisticated pedagogy of museum learning. Our topics are versatile: They range from early broadcasting to 1970's computers. In the *computing* division, we cover the whole range of computer generations, starting from the "zeroth" generation (calculators with relays) to the third generation (computers with simple integrated circuits). Our fully bilingual site (german/english) gives a broad overview, whereas this information brochure contains only selected currently active restauration projects which are i.a. of special interest for the communication accross generations (section 2).

In German, a *Technikum* once was a special school for polytechnics (nowadays integrated into other forms of institutes). Our choice for the name was to emphazise the strong focus on education already at the foundation in 2003. The museum was founded by HERIBERT MÜLLER, a suitable building could be acquired on private funding (figure 1).

In section 3, we discuss the impact, publicity and outreach of our work. In our view the public outreach is the very important for a museum.

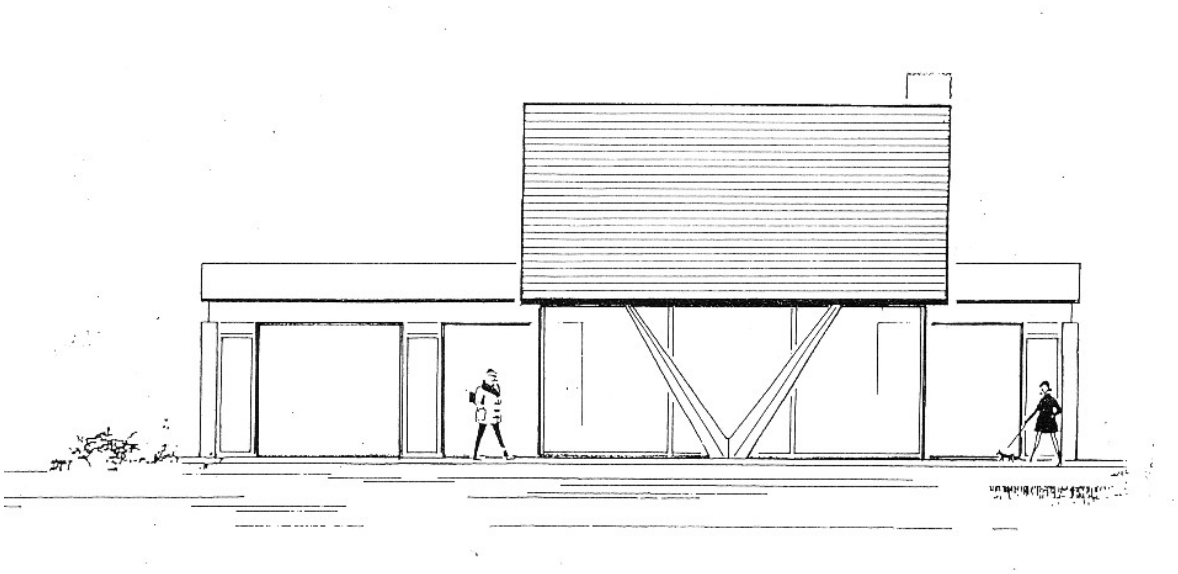


FIGURE 1: *A former bank branch is the home of the museum. The building features two exhibition floors, a presentation area with a seating for 30-50 persons and several measuring faculties for work on devices.*

2 Selected running projects

In this section we want to present some restauration projects that are currently under development or were finished not long ago. Whereas machine maintenance is a continuous task, an initial and partially longstanding restauration is almost allways neccessary when obtaining new devices.

All devices on the following pages are from the *computer history* section, which got the main focus of our exhibition in the last years, since we were able to reconstruct a fully operational punch card workflow datacenter.

2.1 Bull tabulating machine (approx. 1954)

We demonstrate a fully operative tabulating machine from BULL, featuring approximately 1500 relais and 10 arithmetic units (ALUs). With the help of a former BULL engineer, we could program this machine to compute the square root of up to 8-digit decimal numbers (the program is shown in figure 2). Back in the 1950s, the IBM concurrency claimed that as impossible.

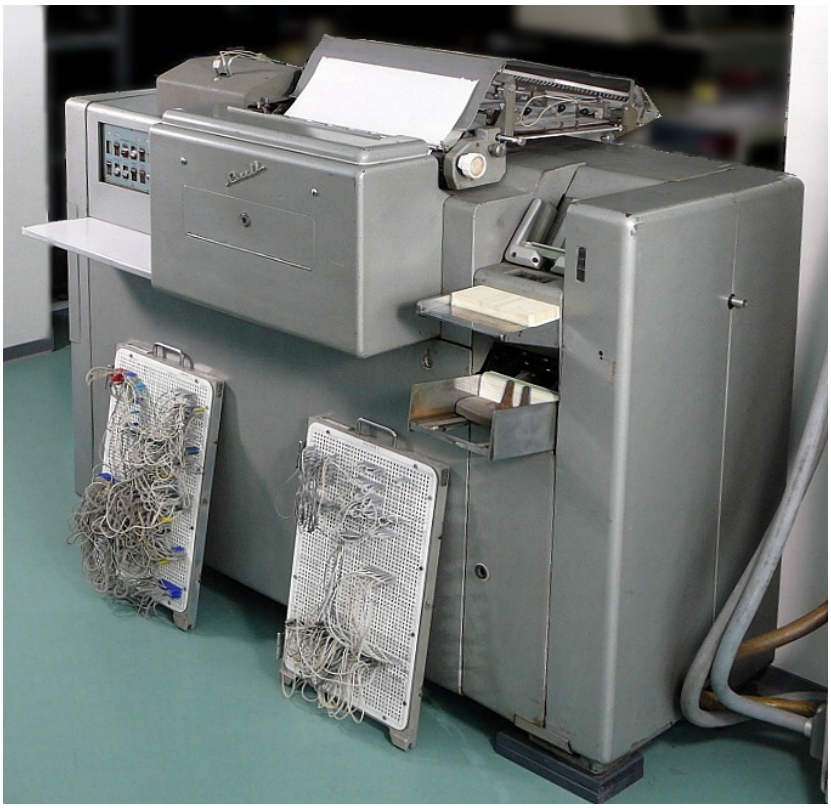


FIGURE 2: *Front view of the tabulating machine. The white trays in the foreground hold the program, plugged by cords.*

2.2 Microcontroller-aided Bull Gamma 10 restoration (1964)

The BULL Gamma 10 is a commercial punch card computer, built in France. Such a device may be rather unappealing for a computer museum with American focus, but the German industry in the 1960s was characterized by that kind of hardware.

The Gamma 10 contains approximately 500 relays and 580 boards equipped with germanium electronics. Without the help of microcontrollers, it would have been impossible to refurbish the computer. The CPU alone had ≈30 defects we could localize with the help of former BULL employees.

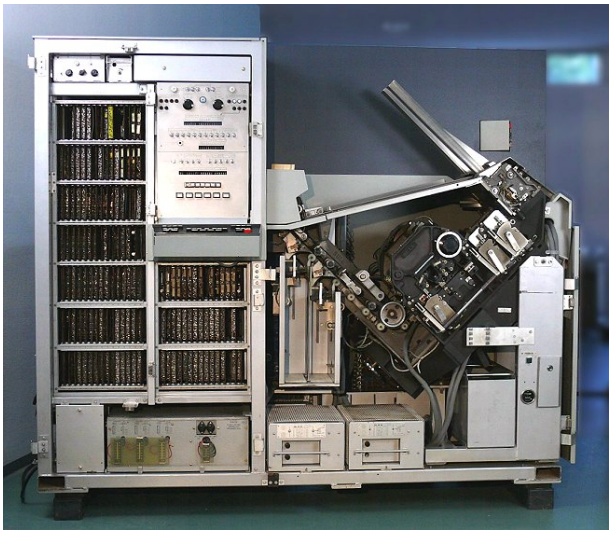
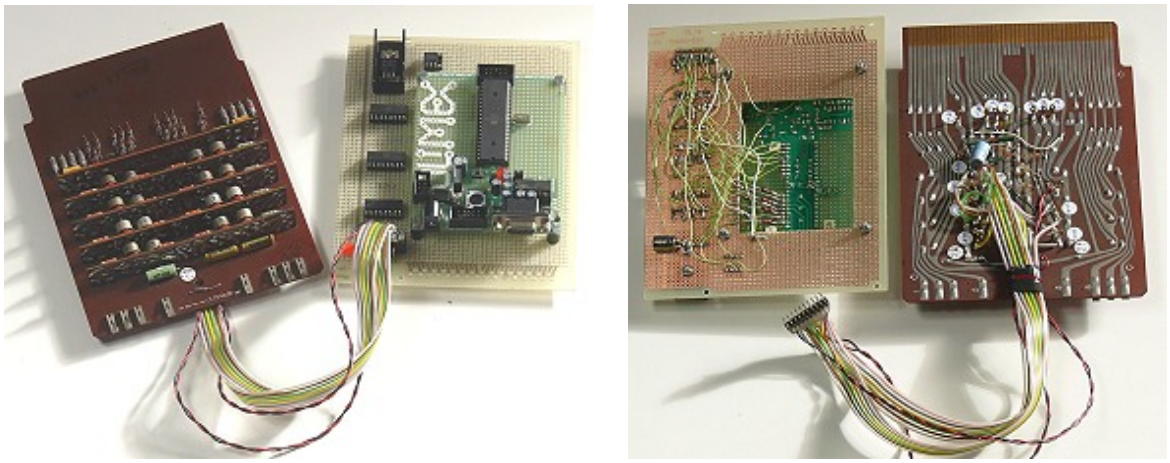


FIGURE 3: *Front of the opened* BULL *Gamma 10 mainframe*

We could not repair the original printer from the Gamma 10, but from the French branch of BULL in Angers we got another similiar-looking printer that unfortunately communicates by means of the special Bull-internal card code. That code is incompatible to the Gamma 10, using the H14 code for exchange. With the help of a "simultaneous translator" (figure 4) we could successfully connect the printer to the Gamma 10.



(A) *top side* (B) *bottom side*

FIGURE 4: *A microcontroller driven character code translation unit, allowing the BULL GAMMA 10 to print on another BULL printer.*

2.3 High speed printer life performance (1965)

This stand-alone high speed printer from ANELEX is always still fascinating for visitors. We initially planned to connect this printer to the Bull computer (see section 2.2), but instead we programmed a microcontroller to equip the printer with a RS-232 standard interface, featuring an additional autonomous mode for demonstration purpose (figure 5). The printer weights 635 kilograms and once was the fastest printer of the world, printing 1250 lines a minute.

Evventually it is just a line printer and a good place to discuss with the audience why printing text line by line still determines computing today at many places. Serial communication for printer operation was up to the 1990's a common practize. Many people still know a RS-232 plug from their early Personal Computer days.

Like in the the section 2.2 project, we make use of incredibly reasonable IC sized computers (*system on a chip*, based on ATMega by AVR)

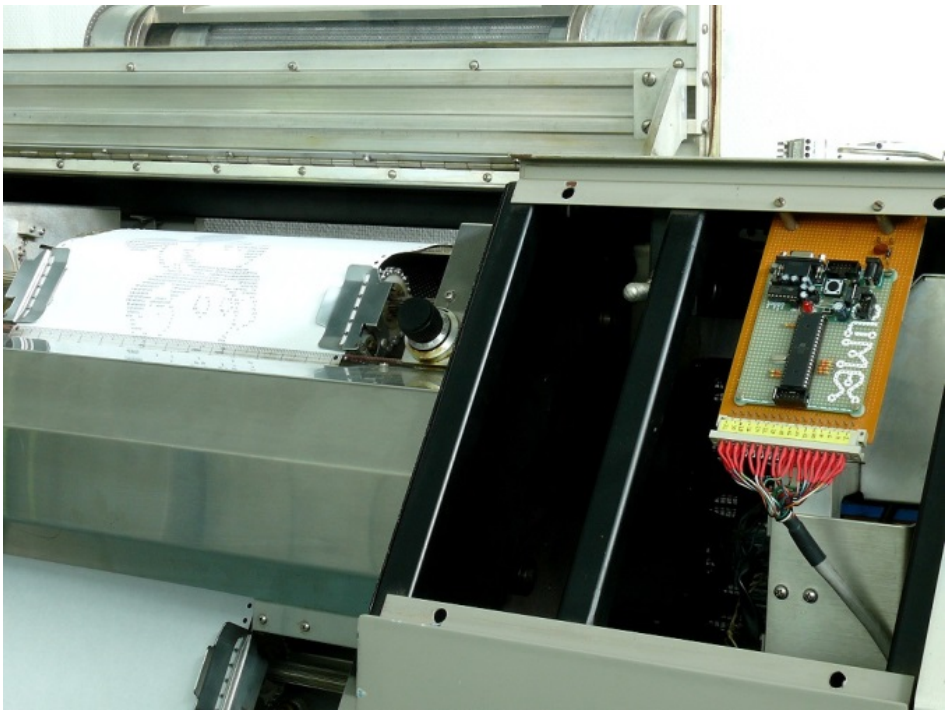
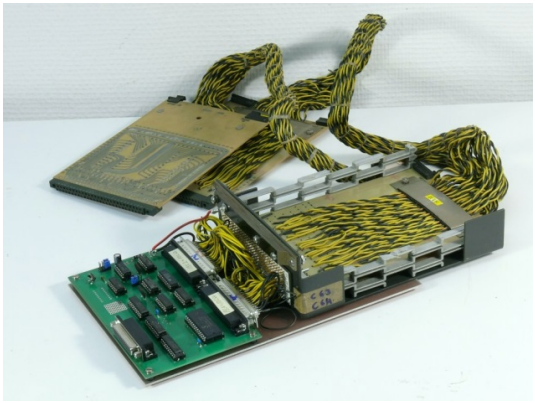
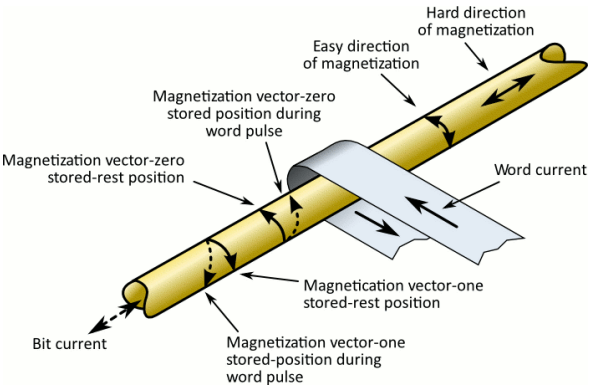


FIGURE 5: *The breakout board with a microcontroller is mounted at eye level. When pressing a button, the printer goes wild to print out an ASCII art mickey mouse (left hand of the picture)*



(A) *The new storage on a plug-in interface board for the CPU*



(B) *An exemplary picture from our paedagogical introduction about plated wire storage technology.*

FIGURE 6: *About the Univac 9200 storage*

2.4 Running punch card computing data centers (1967-1969)

The *Sperry UNIVAC 9200* and the *BULL Gamma 55* are two fully operational punch card driven EDP centers, both worldwide unique.

Recovering the Univac 9200 started in 2010 and was accompanied by a blog. Recently we developed a modern semiconductor replacement (fig. 6a) for the plated wire storage – an historical storage technology which is irreparable in case of failure. We created graphics like fig. 6b to explain the functional principle of historical storage technics to our visitors.

The *Sperry Univac 9400* is another mainframe, and last, but not least, it is our biggest one. Our Univac 9400 weights 4.5 tons and is truly a one-of-a-kind machine, the world's unique fully operational one.

To save this computer from damage at showcase (frequent power-switching), we developed an autonomous control unit for the peripheral devices: An hidden microcontroller (fig. 7) simulates tape access with 16 relays. It is an unobstructive addition to the Univac CPU, so the Univac 9400 is still operational when really turned on. This approach is a solution to keep both the fascination when viewing the huge machine working and maintaining a long term operability.

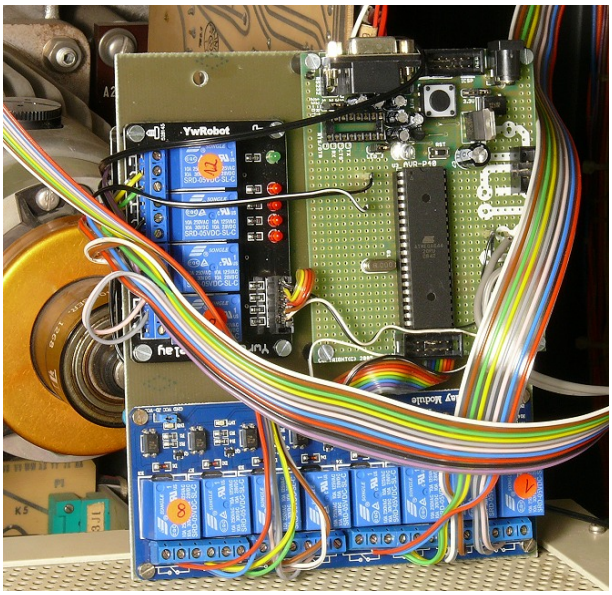


FIGURE 7: *The microcontroller based "music box" with a bunch of relays*

2.5 Scientific computers (1965-1970)

Of course our collection also includes the well-known DIGITAL EQUIPMENT CORPORATION (DEC) computers: From the Classic PDP8 up to LAB8E we have almost all DEC computers from the 1960s, of course fully operational with nice instructive demonstration programs. In guides, the DEC computers are crucial: Famous operating systems like the first UNIX were written on such DEC machines. Since the PDP's are really widespread, there is a big field of applications. Connecting some notebook to a PDP machine with the RS 232 is quickly done.

2.6 Conclusion

The restoration projects presented on the previous pages share a common objective: Displaying the history and development of computer technology in the 20th century, eventually to establish a platform to discuss the cultural implications. Our ambitions changed in the same way we made progress: Starting to collect big punch card devices generated the new goal to present a complete 1960's style punch card computing center, including the original feeling when working with the loud, widespread and big machines. We are proud that we could complete this goal.

Of course, we keep setting ourselves new objectives. For example, we are currently busy with the restoration of a highly developed IBM 1130 computing system. After a lot of research, we could recover the last existing schematics saved on microfiches, and we now get support for digitalization in cooperation with *Bitsavers* (c.f. section 3.3). We currently begin with early system checks and we are about to construct replica for missing boards.

3 Public outward

We offer workshops, guided tours, events and talks to all people interested. While we cannot offer styled sceneries due to room capacity, we try compensate that with good and diversified content.

3.1 Guided tours and special events

Due to our location and very special content, we cannot offer daily guided tours. Instead we offer group tours at the weekend which are always booked out.

On a regular level we offer cultural events like talks to encourage controversies with topics like the information society. For that purpose, we frequently invite guest speakers, for example in july 2014 a philosopher who talked about computing and responsibility in the nuclear age and cold war (fig. 8).

Furthermore, we frequently recieve group applications of IT-rich business. So in the end we reach a broad target audience.

FIGURE 8: *Young visitors make an experiment: How many punch cards does it need to store a whole book?*

FIGURE 9: *The 50 seats in the presentation area do not last if the topics in our talks are chosen well. Here, the philosopher* PATRICK HEDFELD *(front left) speaks about computing in the cold war.*

3.2 School outreach

The current generation of pupils is the first one that do no more know a world without internet and omnipresent computers. Therefore, young students are a special audience we want to reach. They are often characterized by their impartiality and curiosity.

We attract attention by interactivity. Therefore we prepared many experiments from the electronic data processing scope that are carried out by groups of students. Usually the setup is a treasure hunt: Successful groups are rewarded with a small award.

This section lists up three examples of projects that were (or even are currently) carried out from local school's students.

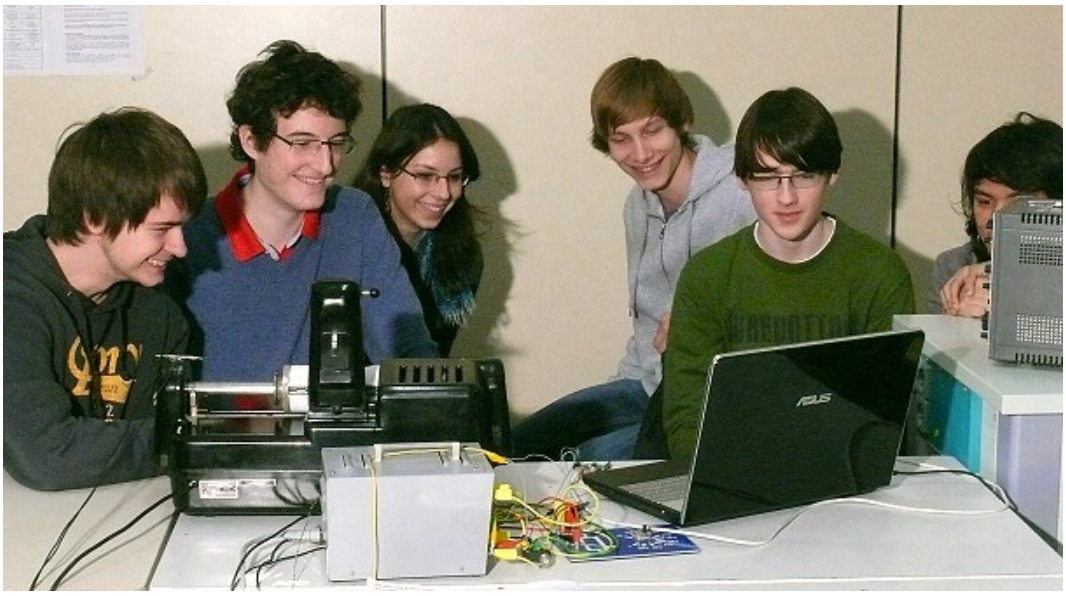


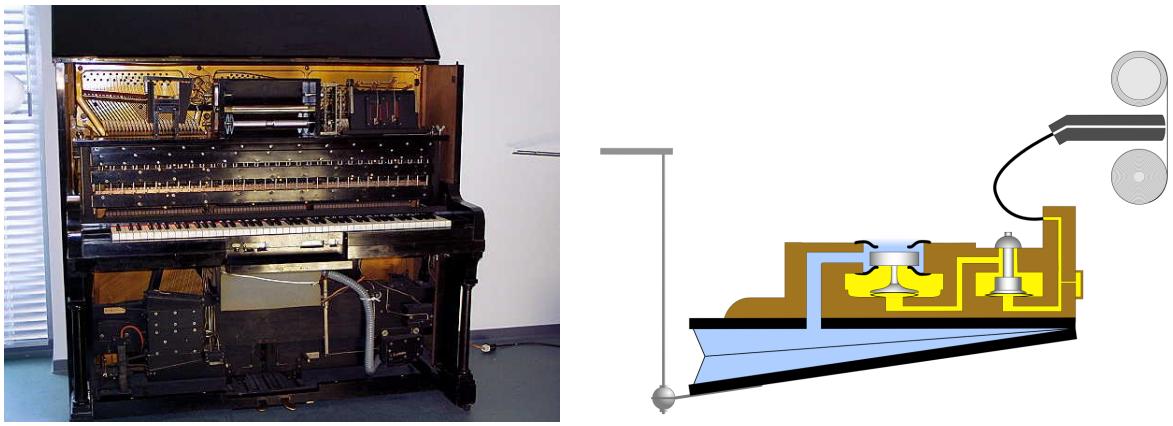
FIGURE 10: *Upper school students presenting their selfmade facsimile notebook interface*

3.2.1 Project week in an upper school

After an initial presentation, upper school students (aged between 15 and 17, German "Oberstufe") learned how to program with the Arduino platform on their own. Within one week they could connect a 1920's fax device from our museum to their notebook, electronically addressed with just three wires (figure 10). This was a great success and they had a lot of fun with the vintage device.

3.2.2 Presentations on the intermediate school

We frequently get visits from school classes where we offer the chance to hold presentations directly at the devices. Students aged between 10 and 15 may prepare with arranged learning materials provided in a closed e-Learning area on our website. An example is the self-playing piano *Pianola* (figure 11a) for which we produced an animated sequence of the air pressure physics (figure 11b).



(A) *Front of the opened piano*

(B) *Schema of an individual bellow responsible for playing a note, with color-encoded pressure levels.*

FIGURE 11: *Reality and model going hand in hand when presenting an historical device (of course still working)*

3.2.3 Robotics-AG in the primary school

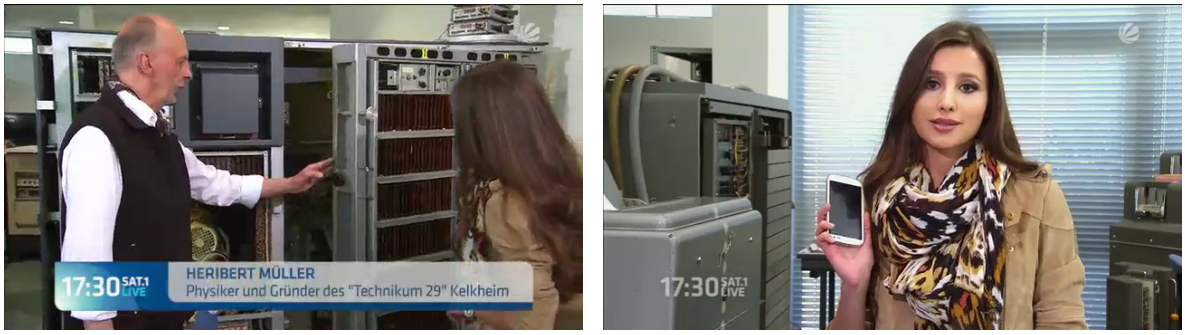
In the basic primary school (students aged between 6 and 10 years, in German "Grundschule") we currently offer a holiday course on robotics. Of course everything is made for children: The Lego Mindstorms platform (fig. 12) is especially designed for the use in school. Playfully children get in contact with an up-to-date topic.

FIGURE 12: *Part of a flyer for the* Lego Mindstorms *based Robotics course. We are curious to find ways to combine that to old computers together with the children.*

3.3 Internet

For more than ten years we offer an increasingly big website[1] in both English and German where many exhibits, historical context and work on the objects is presented together with vivid photographs. The website also contains source code repositories, bug trackers for our software, mailing lists, learning materials and much more.

We are in contact with many organisations via the internet. For example, we joined digitalization projects on manuals, schematics and data together with *bitsavers*[2]. Almost daily we recieve image using requests from writers who want to use our pictures in their prints and publications, and sometimes a strong connection arises from such contactings. For example, in the last years we got closer to *Wikipedia*[3] for contributing text and pictures for a sustainable knowledge transfer.



(A) *Heribert Müller at the Gamma 10 (Sec 2.2)*

(B) *The interviewer with her Samsung Galaxy 3 smartphone in front of the BULL machine (sec. 2.1)*

FIGURE 13: *Television report in one of Germany's biggest TV stations*, Sat 1.

3.4 Outreach to television and press

The public perception on national level is reflected by the media. We hosted TV teams several times, most recently the TV station *Sat 1* (figure 13). TV also attended spectacular transport activities like the Univac 9400 move with two trucks.

In 2014, the combination of smartphones and the huge old mainframes encounters particular interest (c.f the girl in figure 13b). Moore's law is invariably amazing: The handy smartphone has a lot more power than all museum devices altogether. Recent press reviews confirm:

> »When the term "computer history" makes you think about Atari or Commodore 64, you will be surprised: The "Technikum 29" in Kelkheim features devices that work with punch cards, paper tapes or magnetic tapes. Almost all

[1] technikum29, Living museum http://www.technikum29.de
[2] Bitsaver's Software Archive, http://www.bitsavers.org
[3] Wikipedia, the free encyclopedia, http://en.wikipedia.org

devices are fully operational. [...] The Technikum is increasingly gaining international interest. Very much [web visitors] come from the USA.«

– Steffen Boberg: *The smartphone forebear's*, 28. January 2014, Frankfurter Rundschau

(original quote in german: »Wer bei Computergeschichte an Atari oder Commodore 64 denkt, liegt falsch: Im "Technikum 29" in Kelkheim-Hornau stehen Geräte, die Informationen mit Lochkarten, Lochstreifen oder Magnetbändern vermitteln. Fast alle Geräte funktionieren noch. [...] Das Technikum findet Interessenten auf der ganzen Welt. Besonders viele [Websitebesucher] kommen aus Amerika.«) – Steffen Boberg: *Die Urahnen der Smartphones*

»This guided tour is about the historical evolution of broadcasting, television, sound recording technology, fax copies, telex and many more. A 100 year-old automatical piano brings the tour with a musical performance to a great conclusion. Children and young people are very welcome.«

– Wein: *computer dinosaurs*, 19. July 2014, Höchster Kreisblatt

(original quote in german: »Bei dieser Führung geht es um die historische Entwicklung von Rundfunk, Fernsehen, Tontechnik, Faxkopien, Telex und vielem mehr. Ein 100 Jahre altes programmgesteuertes Klavier bildet den musikalischen Abschluss. Auch hier sind Kinder und Jugendliche ab etwa zwölf Jahren willkommen.« – Wein: *Computer-Dinos*)

3.5 Arts and culture

Computer history is gaining attraction on artists and performers. We enjoy fruitful collaborations, for example modern art with punch cards by the Austrian artist LEANDER SCHWARZER, awarded in the annual Austrian graphic design competition. Figure 14 shows one of our exhibits in the role of a rhythm instrument in a concert called *Punchcard music*. The concert was dedicated for this device. Of course, if the device would not be functional, there could be no concert. Maybe this is the most exotic reason why operational computer history is so important in modern times.

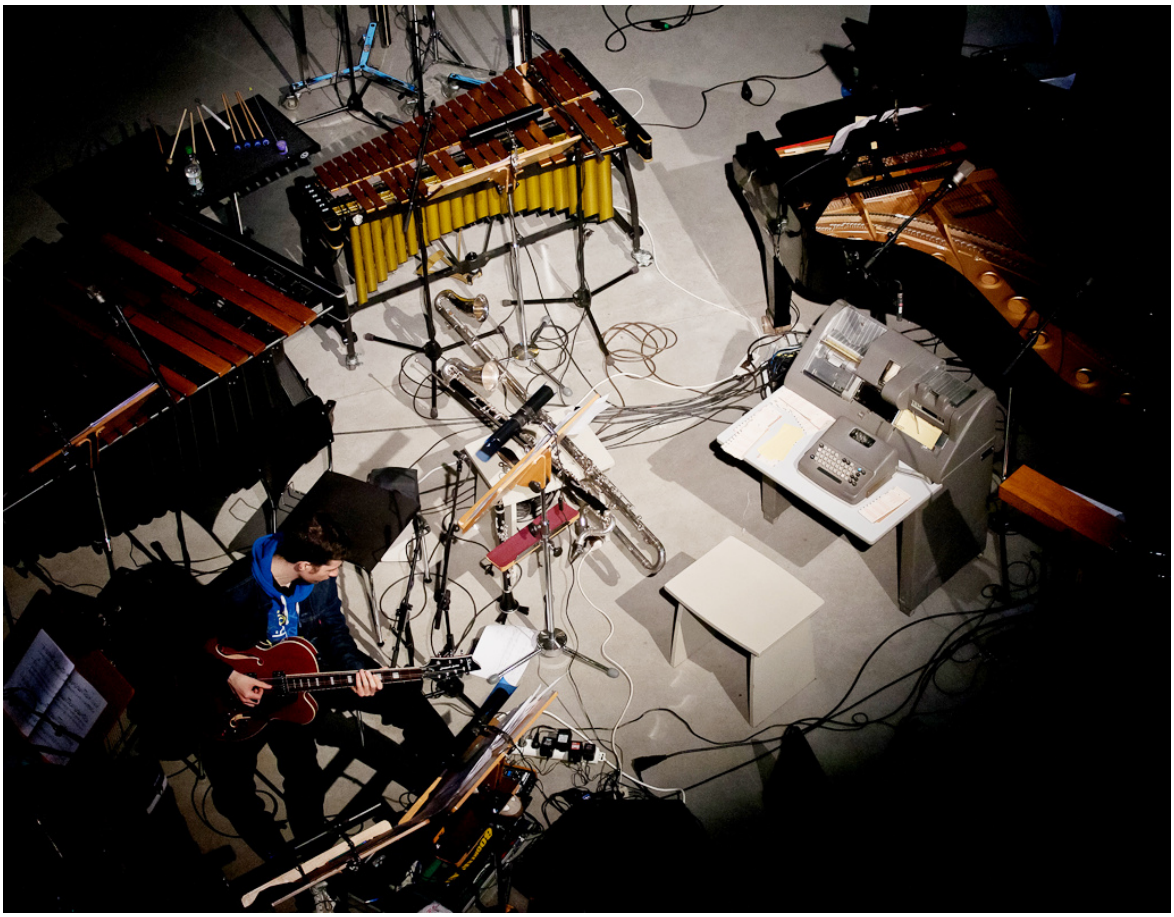


FIGURE 14: *An IBM printing card punch on it's journey in Cologne at the center of a musical production.*

4 Summary and conclusion

On the last 14 pages, we presented a lot of details, actually representing years over years of voluntary work by many people, both young and old. We got both experts who studied engineering or were former senior executives in IT companies like BULL and IBM. And we have contributions by teenagers, starting to explore the world of programming and hopefully developing an understanding of the importance of computer conservation. We do not have any financial support, everything is paid privately. However, a lot of things we have done are worldwide unique.