MIDAC:
exhibit manual

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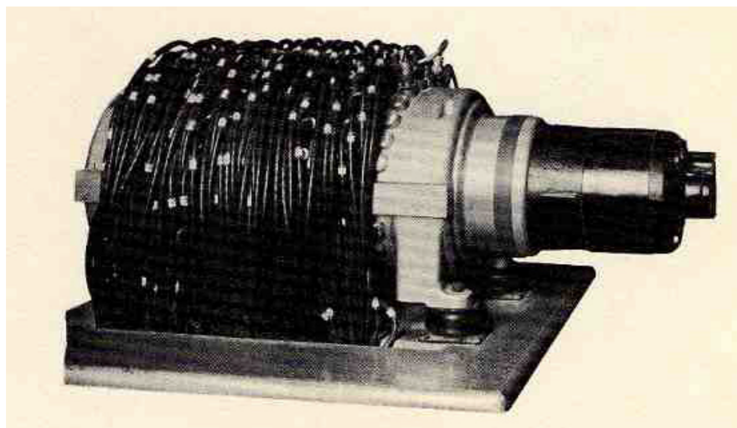
the university of MICHIGAN VIRTUAL MUSEUM PROJECT histories of information technology

Cover Image: Willow Run Research Center, 1954. University of Michigan News and Information Services Records, Bentley Historical Library. Bentley Image Bank: http://quod.lib.umich.edu/cgi/i/image/image-idx?id=S-BHL-X-BL005659]BL005659/

EXHIBIT CONTENT

Module Vision

"Mind and Machine" features exhibits relating to the history of computer machinery design and use at the University of Michigan. Exhibits in this module document the development of computers as mechanical objects of calculation, encouraging visitors to look beyond the designer interfaces of contemporary computer devices, and to explore the histories behind the mechanical underpinnings of technologies that have been at the core of the research activities of the past century. While "Mind and Machine" does not have a restrictive date range, it should focus primarily on computing hardware advancements prior to the rise of personal computers.



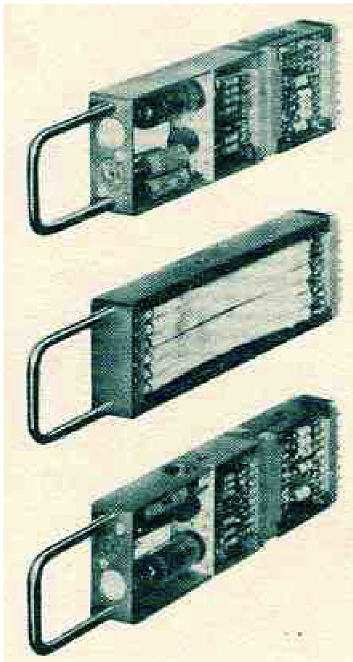
MIDAC drum storage, "MIDAC: A New High-Speed Digital Computer", pg. 14. http://hdl.handle.net/2027.42/6609/

The primary audience for exhibits in this module includes current and former computer engineers and computer researchers at Michigan, as well as new students to the computer engineering field. Another possible audience could include high-school level students, who are expected to "identify changes in hardware and software systems over time and discuss how these changes might affect the individual personally in his/her role as a lifelong learner" according to Michigan State Educational Technology Standards and Expectations.[1] Because of the wide range of expertise of target audiences, exhibits in this module will need to be accessible to visitors with no background knowledge of computer engineering, while at the same time engaging those who have worked in the field.

Exhibit Topic: MIDAC

Although it is difficult to cite one event as the beginning of computer research at the University of Michigan, construction of the Michigan Digital Automatic Computer (MIDAC) in the early 1950s was arguably the first serious development in the University's engagement with computer technology. MIDAC was constructed through a military contract, and was built in accordance with specifications ap-

1 "Education Technology Standards & Expectations: Grades 9-12" Michigan Department of Education, Approved 2006.



MIDAC packaged units, "MIDAC: A New High-Speed Digital Computer", pg. 16. http://hdl.handle.net/2027.42/6609/

proved by the National Bureau of Standards: it was not an exclusively Michigan project. However, it was a first foray into computing technology development at the University, providing faculty with a taste of the possibilities for computers integrated into departmental activites. As such, MIDAC provides an opportunity to construct an exhibit, which educates visitors on the mechanics behind early computing devices, as well as their enormous implications for powering research in many different areas. The story of MIDAC's design also serves as an example of the inter-institutional collaborations which have been a hallmark of many of the IT projects at Michigan.

The main goals for the MIDAC exhibit are to educate visitors on the impact of early digital computing in a University setting, and to demonstrate the basic mechanical functionality of MIDAC through a recreation of the experience of working with this enormous and complex machine.

Content Brief

Although the main goal of the MIDAC exhibit is to convey the basic functionality of the computer itself, the story of the MIDAC's design and use at the University of Michigan will be important to include. The following brief essay sums up basic information about MIDAC at Michigan from several secondary sources:

- "MIDAC: A New High-Speed Digital Computer Now at the Service of the National Defense, Science, and Industry" Willow Run Research Center, Engineering Research Institute, University of Michigan: UMM-101. Available in Deep Blue: http://hdl.handle.net/2027.42/6609/
- Norman R. Scott, "Computing at the University of Michigan: The Early Years Through the 1960's" Compiled by Toby Teorey of EECS. Contact Bentley Historical Library for copy.
- Atsushi Akera, *Calculating the Natural World.* Cambridge: MIT Press, 2007.

In 1951, under collaborative sponsorship from the Wright Air Development Center and the United States Air Force, the Willow Run Research Center of the Engineering Research Institute, University of Michigan began development of the Michigan Digital Automatic Computer (MIDAC) with the intention of producing a machine to assist with "the solution of certain complex military problems." The MIDAC was created according to the design standards set in the creation of the SEAC, the computer built for the National Bureau of Standards. MIDAC was the sixth such digital automatic computer at a research university, and the first computer of its kind in the midwest. Its utility for the projects underway at the Willow Run Research Center was to streamline design processes, allowing scientists to "test" mathematical models that had been previously too complex to undertake. However, using the MIDAC was no simple task—a team of scientists and researchers were required to determine if a problem could be solved using the MIDAC. Problems required complex programming, and the results required expertise in interpretation.

MIDAC console, "MIDAC: A New High-Speed Digital Computer", pg. 10. http://hdl.handle.net/2027.42/6609/

Perhaps the most striking feature of the MIDAC was its shear size and mechanical components. Photographs of the Willow Run facility reveal that the MIDAC occupied two expansive rooms, dwarfing its operators. The MIDAC required 12 tons of refrigeration equipment to cool its 500,000 connections and tubes. Additionally, its main memory storage device was a rotating magnetic "drum," which could store just 6,000 "words," or short segments of data. The MIDAC became functional in 1953, and was operated by Willow Run's Digital Computation Department under the leadership of John Carr III until 1958 when the Air Force removed the equipment.

Virtual Approach

The goals of the MIDAC exhibit are to feature the computer's physical presence, it's functionality, and to provide information on its use in the University environment. In order to accomodate these goals, a multi-dimensional approach to exhibiting MIDAC has been developed. The main exhibit feature will be a 3-D virtual reproduction of elements of the MIDAC in the Cave Automatic Virtual Environment (CAVE), the virtual reality studio in the Duderstadt Center. The CAVE experience will give visitors a sense of the scale of MIDAC in addition to demonstrating the mechanics behind its performance of computations. Precise formulation of the contents of the CAVE feature-- its level of interactivity, selection of parts for simulation, etc.-- will need to be determined in consultation with an advisor familiar with the MIDAC's

Flexowriter Automatic Typewriter, "MIDAC: A New High-Speed Digital Computer", pg. 11. http://hdl.handle.net/2027.42/6609/

design.

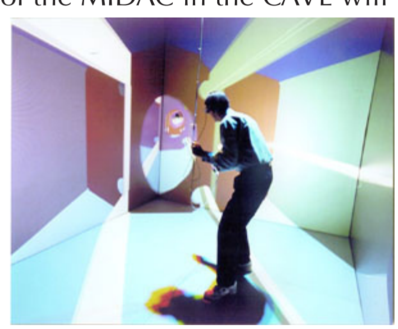
The virtual recreation of MIDAC will be supplemented by a web-based exhibit component, which will host more thorough text-based narration than the CAVE experience. The website will feature 3-D renderings of MIDAC components which can be manipulated at 360 degrees by site visitors. The site-based exhibit will also provide references for further research, allowing visitors with expertise in the area to more fully explore the mechanics of MIDAC according to archival resources and published documentation.

Finally, the MIDAC exhibit will make use of the chunk of the ENIAC currently on display in the foyer to the Computer Science and Engineering Building on North Campus. This feature will primarily serve as a hook, in order to engage current students and faculty who frequent the space. Because the ENIAC rack already has some interpretive text as part of the display, material relating ENIAC to the MIDAC will be supplemented, along with information directing visitors to the web-based and CAVE-based exhibit components.

CAVE Simulation

The CAVE

The design of an application which simulates pieces of the MIDAC in the CAVE will require the active participation of one or more faculty engineers or computer history experts who can help to determine the most appropriate functions to model. This manual can, however, give a sense of the CAVE as an exhibit space, what will be required to mount an exhibit there, some preliminary suggestions for topic focus, as well as considerations for staffing the design process.



Work in UM3D Lab CAVE, http://um3d.dc.umich.edu/hardware/CAVE/#gallery/

The CAVE is located in the Duderstadt Center and is under the supervision of the UM 3D Lab, a subunit of the Digital Media Commons. It is a 10x10x10 foot square room which features projections on three walls and the floor. The illusion of 3-D immersion comes from LCD shutter glasses, which contain sensors, allowing the computer to track the movements of a visitor and move through the projected environment accordingly. Because the CAVE is only equipped to respond to one set of sensors, there may only be one lead visitor at a time-- the one the computer responds to-- but other visitors may cluster around the lead and achieve a similar if slightly skewed effect. The maximum number of viewers at a time is five, though 3D lab staff recommend even fewer depending on the volume of people and the level of interactivity of the virtual simulation.

The CAVE is not available to visitors on a drop-in basis. Viewing times must be prearranged due to staffing requirements, as well as the fragility of the space and the significant expense of operating it. A primary concern is bulb-life. The bulbs which power the projection of the simulations have a limited life-span, and once one bulb fails, all bulbs must be replaced at the same time. This places some constraints on the extent to which the MIDAC installation can be conceived of as a traditional museum exhibit. Visitors will mostly likely experience it as a planned event with restricted time frames for actually viewing the MIDAC. Consideration should be given to planning an activity to go along with the CAVE experience, to keep people involved in the exhibit even while they cannot be in it.

Types of Models

There are different levels of complexity that the MIDAC installation could take.

1. Static Model: This would be the simplest virtual reality simulation possible, and would take approximately 2 months to design. A static model would allow visitors to move through the space, but would not contain any interactive features, such as buttons or tools. It would also exclude any animation independent of the movement of the visitor through the CAVE.
2. Static Model with Pedestals: This option would expand on the static model to include pedastals, where discrete objects or cross-sections of MIDAC would be on display. They could be accompanied by text or audio descriptions. This would be a low budget alternative to doing animated cut-aways of sections of the computer.
3. Animated Model: With an animated model the MIDAC simulation could move, perform a function, or involve pre-programmed close-ups or views that wouldn't be possible in a static model. With an animated model, production time and staffing requirements are significantly increased. Estimated design time for animated or interactive models is minimum 5 months.
4. Interactive Model: This is the fanciest option, allowing visitors to manipulate the simulation by pressing buttons, using tools, moving objects out of the way, etc. The interactivity would require greater expertise on the programming team, and would probably require contracting with outside designers to augment the 3D

lab's staff. The interactive model would be the ideal option for recreating the experience of using the MIDAC-- visitors could use controls in order to see a function being performed. However, short-cuts might be possible to circumvent the costs and time associated with this option.

Staffing Needs

The UM 3D Lab offers support for the design and implementation of university projects, and has partnered with campus museums before (The Kelsey Museum did a recreation of the city of Antioch in 2006). However, for larger or more complex projects, the lab suggests hiring outside designers to speed up the design process and to free up staff time for other tasks. Eric Maslowski is the contact person for CAVE related activities, and can provide references to local designers who have worked with the CAVE before. The 3D lab offers training sessions for any external staff brought onto projects, and is also available to help in the selection process for external teams.

Initial Costs

The cost to impelement this exhibit feature will depend largely on the scope, as determined by designers and experts. Some preliminary costs associated with use of the CAVE and UM 3D Lab facilities can be listed here, though for larger projects a flat-rate fee is generally agreed upon.

- $150 per use of the CAVE
- $50/hour staff time
- $150 first hour of training workshops + $75/hour after

An opportunity to fund the conceptual phase of the design project is available through the GROCS program. This grant provides funding for student driven projects which employ digital technology in an academic context. The UM3D Lab suggests GROCS as a way to get research started on the MIDAC project in WS09. After conclusion of the GROCS work, design work could begin in the beginning of the summer for a Fall '09 opening date.

Contact person at the UM3D Lab is Eric Maslowski: emaslows@umich.edu

MIDAC Online

Because the CAVE is a site-based virtual experience, the MIDAC exhibit will also include a web-based component which allows visitors who cannot attend the CAVE viewings to access the exhibit. Because of the accessibility restrictions for the CAVE component of the exhibit, it must be assumed that the website will be the most heavily accessed exhibit feature. It should not, however, seek to recreate the CAVE experience, but rather supplement it through more detailed textual and visual materials.

Supposing the CAVE experience aims to give visitors a sense of the larger workings of MIDAC, the website should host small 3D pieces of the computer which demonstrate its operation on a more detailed level. Individual elements of its mechanics such as vacuum tubes and delay lines, or principles involved in its design, such as switching, or acoustic storage could be featured, including animations that may be too complicated to model in the CAVE.

Because of the complexity of the principles and components involved in MIDAC, every effort should be made to make the web-based material as dynamic and interactive as possible. Animations should abound, objects should be 360 degree manipulateable, and text should always be accompanied by graphic examples. All information on the website should also make an effort to relate to the archival material on hand. These publications should be particularly featured, and links should direct visitors to their locations in the Bentley, and in DeepBlue where applicable.

- J.E. De Turk, H.L. Garner, J. Kaufman, J.W. Bethel, R.E. Hock. "Basic Circuitry of the MIDAC and MIDSAC" University of Michigan Engineering Rearch Institute, Ypsilanti, MI. 1954.
- "MIDAC: A New High-Speed Digital ComputerNow at the Service of the National Defense, Science, and Industry" Willow Run Research Center, Engineering Research Institute, University of Michigan: UMM-101
- Harry H. Goode, Carl Pollmar, Jesse B. Wright, "The Use of A Digital Computer to Model A Signalized Intersection" The University of Michigan industry Program of the College of Engineering, 1956.

Because of its relevance to the Education Technology Expectations and Standards set forth by the Michigan State Department of Education, the MIDAC exhibit has great potential to connect school groups with the activities of the virtual museum. If the museum wishes to make a concerted effort to serve this target audience, the web-based portion of the MIDAC exhibit should also be a venue for classroom activity suggestions that preface or build from the experience of MIDAC in the CAVE. Activities may include directed use of web-based applications, or projects that can be conducted in the classroom.

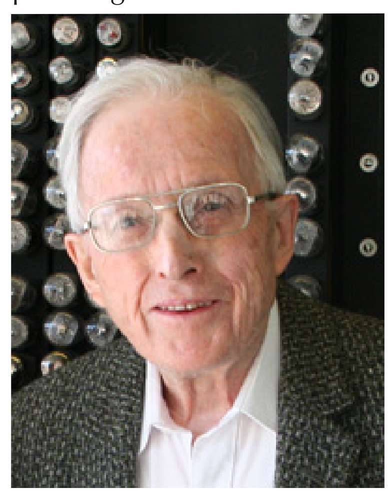
<u>Example Sites for Reference</u>:
The National Museum of Scotland's "Connected Earth" Exhibit Series features 3-D object manipulation as well as allow visitors to 'get inside' gadgets.

http://www.connected-earth.com/Daysout/NationalMuseumsofScotland/3Dobjects/obj001.htm/
and
http://www.connected-earth.com/FunandGames/Gadgets/index.htm

The Field Museum's Chocolate exhibition features a web-based interactive demonstrating the manufacturing process of chocolate.
http://www.fieldmuseum.org/Chocolate/manufacture_interactive/manufacture.html

ENIAC Display

Incorporating the rack of the ENIAC on display in the foyer of the new Computer Science and Engineering Building has the goal of informing current students and faculty about the MIDAC exhibit, while promoting attendance at CAVE openings and use of the web-based features. However, this exhibit feature can also serve to promote awareness of the link between ENIAC and Michigan through the work and teaching of Arthur Burks. Burks came to the University of Michigan in 1946 as a professor of philosophy, after having served as a principle designer of the ENIAC (Electronic Numerical Integrator And Computer), a first digital electronic computer developed at the Moore School at the University of Pennsylvania. He brought the piece of ENIAC to Michigan in the mid-1960s. The ENIAC display should indicate the Michigan connection, and point out mechanical differences between ENIAC (originally released in 1946) and MIDAC (released 1953). The site serves the museum's overall mission to connect virtual displays to the real physical resources which abound on the Ann Arbor campus, intersecting the lives of the museum's core audience: the current university community. Connecting these physical resources with virtual exhibits will promote not only an awareness of the virtual museum, but also an understanding that the history of information technology corresponds to a fuller and richer understanding of the University of Michigan.



Arthur Burks in front of the ENIAC in the new CSE Building, http://www.eecs.umich.edu/eecs/about/articles/2008/Burks.html/