Memorandum

To: Dag Spicer, Curator, Computer History Museum

CC: NLS Technical Working Group

From: Jonathan Cheyer, Technical Lead, SCC NLS Restoration Project

Date: 10/18/2006

Re: Results of CHM Keyset Testing

Introduction

Chording keysets were originally conceived by Doug Engelbart and built by Bill English at SRI around 1963, not long after Engelbart invented the mouse. The keyset (along with the mouse) was used in the NLS system in the 1960s and 1970s. Usage continued in the Augment system (the successor to NLS) in the 1980s, but wide-spread usage of the keyset never caught on.

At least three different pinouts were used over the three decades of NLS/Augment-style keysets. We have designated these three pinouts as types A, B, and C. It is currently unknown why there were three different pinouts, but presumably they each plugged into different kinds of computers or line processors. It is also not currently known which pinout style was used over which time period.

Around 1971, Bill English left SRI and went to Xerox Parc, where he brought the idea of the keyset with him. The keyset was later used in the Xerox Alto and Alto II computers. The Alto keysets used a completely different connector and pinout from the NLS/Augment-style keysets. We have designated this pinout as type D.

Over the last year, I have been working with a colleague, Brian Cardanha, to investigate and document the pinouts for all known chording keysets. I have been able to work with Doug Engelbart closely, and as a result have had the opportunity to test eight different NLS/Augment-style keysets. However, I did not have a way to test any Alto-style keysets.

In visiting the CHM over a number of visits, I realized that the CHM is in possession of a number of keysets, both Alto-style and NLS/Augment-style keysets. This would provide an ideal opportunity for me to complete the keyset pinout, as well as provide the CHM with useful information about its own keysets for historical purposes.

Objective

In May of 2006, Phil Gust wrote a proposal to the Computer History Museum detailing our work with various chording keysets that were loaned to us from Doug Engelbart. The objective of the proposal was to perform a test of all chord keysets that are owned by the CHM. This would accomplish the following goals:

- Determine if all of the keysets are in working condition. Some keysets were expected to be in partial working condition; and if so, identify which keys are working.
- Determine the pinout type of the NLS/Augment-style keyset.
- Verify the pinout of the Alto-style keysets. It had been assumed that they were all the same type (unlike the NLS/Augment-style), but this was to be tested.

Results

On May 15, 2006, we were granted the opportunity to perform basic testing of each of the keysets which the Computer History Museum owns.

We were able to confirm our expectations that all the keysets which the CHM owns use known keyset pinouts. We were able to confirm the pinout of the Alto-style keysets. We were able to determine which type of pinout the NLS/Augment keyset has. And finally, we were able to tell determine that not all the keysets are in working order.

Below is a summary of our findings:

Keyset	*Pinout Type*	*CHM Tag*	*Other Info*	*Condition*
Alto Keyset 1	D	1 026 3586 8	Assembly 209962 S/N 3166	Keys 0, 3 work; keys 1, 2, 4 are broken Keys 2, 4 “click” when pressed as they should, so they likely just have loose wires. Key 1 does not “click” when pressed. It may have a different problem.
Alto Keyset 2	D	1 026 4680 0		Working condition
Alto Keyset 3	D	X124.82C		Working condition
Alto Keyset 4	D	X1378.97A	Assembly 209962 S/N 3159	Working condition
NLS Keyset	A	1 026 4710 1		Working condition

All the keysets were able to be successfully connected to a laptop through hand-crafted adapter cables that were made by Brian Cardanha. As mentioned in the proposal, the adapter cables were connected to a store-bought analog-joystick/USB converter cable, which was itself plugged into a laptop. Special software written by me (Jonathan Cheyer) was used to read the values sent by each keyset when a key was pressed, to determine if the keyset was working properly.

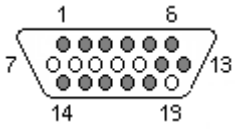
NLS/Augment Keyset

The information that we had about NLS/Augment style keysets was already known and verified on other keysets before doing the test at the CHM. However, as mentioned above, we were able to determine that the NLS/Augment keyset which the CHM has is a Type A keyset. Information about Type A keyset pinouts can be seen in Appendix B of this document.

The NLS keyset which the CHM owns is in full working condition.

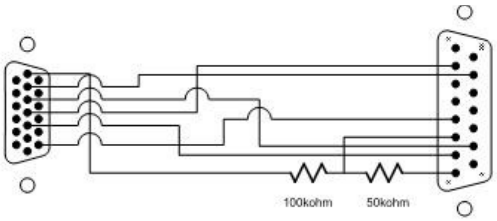
Alto Keysets

All the Alto-style keysets owned by the CHM are from the “Alto” or “Alto II” computer. Our guess in the original proposal (Appendix B) about the pinouts of the Alto-style keysets was almost right. We got pinout numbering in the opposite order, due to an error in misreading the Alto schematics. This is a simple fix and did not impact our testing of the keysets in any way. The updated diagrams appear below. (Appendix B was left unchanged, in its original inverted numbering.) Note that KEY0 has been designated as the right-most key on the keyset and KEY4 is the left-most key.



Type D
DA-19 Male

Pin	Signal
7	KEY0
8	KEY1
9	KEY2
10	KEY3
11	KEY4
19	Ground



DA-19/Alto (socket)
ITT-Cannon 2DE-19S
D

Pin	Function	Color
7	Key 0	Green
8	Key 1	White/Brown
9	Key 2	Brown
10	Key 3	White/Blue
11	Key 4	Blue
19	Common (Ground)	White/Green

DB-15 (male)
to gameport

Pin	Function	Color
1	+5V	N/A
2	Button 1 (Key 0)	Green
3	X-axis (Key 4)	Blue->resistor
4	Ground	White/Green
7	Button 2 (Key 1)	White/Brown
10	Button 3 (Key 2)	Brown
14	Button 4 (Key 3)	White/Blue

We were able to determine that three out of the four Alto-style keysets are in full working condition.

The Alto-style keyset with CHM tag “1 026 3586 8” is in partial working condition. Keys 1 and 2 (from the right, starting with key 0) are not working. It is most likely just loose wires for both keys, as the keys themselves appear to be in good condition. The CHM could easily fix this problem if so desired, or the keyset can be left as-is in “artifact” condition.

Photos

Photos were taken during the testing process. The list of photos is available in Appendix A.

Adapter Cables

Brian Cardanha has graciously agreed to build and donate three adapter cables to the CHM. The “SN-XX” is the serial number of the cables (so we can keep track of how many, and which type were made).

- SN-08, Type D cable (for Alto-style keyset)
- SN-09, Type D cable (for Alto-style keyset)
- SN-10, Type A cable (for NLS/Augment-style keyset)

Public Information

The technical information in this paper has also been detailed on a public wiki page:
http://blueoxen.net/c/hyperscope/wiki.pl?KeysetPinouts

Appendix A – Captions for Photos

The following photos were taken during the testing process at the CHM on May 15, 2006. The photo numbers start at 62, since that was the name of the file of the first digital picture from Phil's camera. Hypertext links point to online versions of the photos. The photos are also included in a zipped file that accompanies this document.

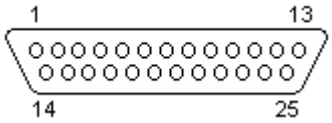
- 62 - Overall View - CHM keysets on right, Engelbart keysets on left
- 63 - CHM Keysets - From left to right: Alto Keyset 1, Alto Keyset 2, Alto Keyset 3, NLS Keyset, Alto Keyset 4
- 64 - CHM Keysets - another view
- 65 - Alto Keyset 1 Detailed View - CHM tag "1 026 3586 8". Writing on the keyset can be seen.
- 66 - Alto Keyset 1 Closeup - closeup of previous pic
- 67 - Alto Keyset 2 Detailed View - CHM tag "1 026 4680 0"
- 68 - Alto Keyset 3 Detailed View - CHM tag "X124.82C"
- 69 - NLS Keyset Detailed View - CHM tag "102647101"
- 70 - Alto Keyset 4 Detailed View - CHM tag "X1378.97A"
- 71 - Alto Keyset 4 Closeup - The P2 on the keyset ending can be seen clearly
- 72 - Alto Keyset 4 Bottom - CHM tag "X1378.97A" can be seen
- 73 - Alto Keyset 3 Bottom - CHM tag "X124.82C" can be seen
- 74 - Alto Keyset 1 Bottom - S/N 3166 can be seen
- 75 - CHM Keysets - From right to left
- 76 - CHM Keysets - another view, from right to left
- 77 - Alto cable - a view of the endings of the cable that Brian Cardanha made to test the Alto
- 78 - Alto cable closeup - a closeup of the above

Appendix B – Original Proposal

Background

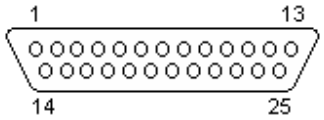
The NLS Restoration Project has been working with the six remaining keysets that Doug Engelbart's group at SRI built for the NLS project, to understand the pin-out scheme used by the SRI keysets. Our purpose is two-fold. The first is to document the pin-outs of the keysets for preservation purposes. The second is so that we can connect the keysets to a computer through a USB interface and use them with a running NLS system.

Our investigations have shown that five of the SRI keysets have 25-pin DB-25 male connectors with one of two pin arrangements, which we have designated Type A and Type B:



Type A
DB-25 Male

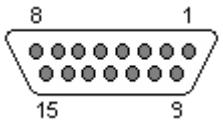
Pin	Signal
10	KEY3
11	KEY4
12	KEY2
13	KEY1
15	KEY0
18	Ground



Type B
DB-25 Male

Pin	Signal
2	KEY4
3	KEY3
4	KEY2
5	Ground
18	KEY1
25	KEY0

One of the keysets (CHM-01) has a 15-pin DA-15 female connector with a pin arrangement that we have designated as Type C.



Type C
DA-15 Female

Pin	Signal
2	KEY4
3	KEY3
4	KEY2
5	KEY1
6	KEY0
7	Ground

Brian Cardanha, a Sun electrical engineer, has built converter cables for Type A and Type B keysets that provide standard game port pin-outs. For simplicity, he also created a Type C to Type A converter cable that connects to the Type A to game port cable.

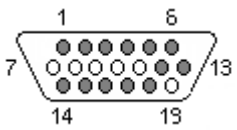
Using these cables together with a Radio Shack game port to USB converter and appropriate game port drivers, we can use the keysets with the Java Augterm GUI that the project built to access to the NLS/Augment system through a Java-enabled web browser. We also plan to interface the keysets with the NSF-funded Hyperscope system being developed under Doug Engelbart's direction.

Proposal

When the NLS project was terminated at SRI, a number of staff members moved to Xerox PARC, where some of them continued aspects of their work at SRI. Some of the concepts developed for NLS were adapted for Xerox PARC Alto system. Bill English, one of the key NLS engineers, created a version of the NLS keyset for the Xerox Alto. CHM has several of these Xerox Alto keysets in its collection.

We have examined several of these keysets in the CHM connection and have discovered that they use a 19-pin DA-19 male connector, which we have identified it as ITT-Cannon 2DE-19S.

From Alto schematics scanned by Al Koslow, we believe that all of the Xerox keysets have a single pin-out scheme, which we have tentatively designated as Type D, and have identified the pin-outs (see http://www.bitsavers.org/pdf/xerox/alto/AltoSchems/05b_KBD.pdf)

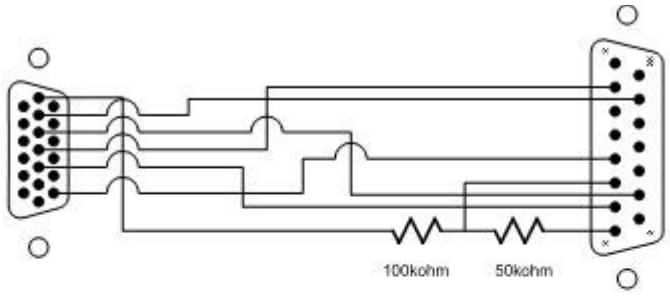


Type D
DA-19 Male

Pin	Signal
7	KEY4
8	KEY3
9	KEY2
10	KEY1
11	KEY0
19	Ground

We propose to validate our findings by testing each of the Xerox keysets in the CHM collection to determine whether our identification and assumptions are correct.

The test consists of connecting each of the Xerox keysets to a Radio Shack game port to USB adapter through a custom Type D cable that Brian Cardanha has built, in the same way we did for the SRI keysets. Here is a schematic of this cable.



DA-19/Alto (socket)
ITT-Cannon 2DE-19S
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7	Key 4	Blue
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DB-15 (male)
to gameport

Pin	Function	Color
1	+5V	N/A
2	Button 1 (Key 0)	Green
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4	Ground	White/Green
7	Button 2 (Key 1)	White/Brown
10	Button 3 (Key 2)	Brown
14	Button 4 (Key 3)	White/Blue

We will connect the game port to USB adapter to a computer running the Java Augterm application. If we are correct, we should be able to use the Xerox keysets with the Java Augterm application in the same way we did with the SRI keysets

We believe that there will be minimal risk to the Xerox keysets, since we have already successfully conducted these tests with the SRI keysets. A qualified CHM staff member can physically connect the Type D cable to the keyset and perform the chording tests under our direction. We will observe and record the results.

CHM will derive several benefits from this investigation. First, it will gain concrete confirmation as to the pin-out arrangement of the keysets in its collection. Second, it will gain valuable information

about the relationship of the original SRI keyset design compared to the later Xerox keysets design, both of which were designed by the same engineer, Bill English. Finally, CHM will gain technology that would enable it to connect the Xerox keyset to a standard USB interface, should the need to do so arise in the future.