The SignWare -- Story from the originator

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The First Sign Language Software Developed in the United State

I saw my first microcomputer, a Radio Shack TRS-80 computer in 1977 while at Mankato State University in Minnesota (now Minnesota State University, Mankato). Three years later I was programming on an Apple II computer for my doctoral dissertation project at the University of Northern Iowa (UNI). The computers belonged to the Component Works division of John Deere in Waterloo, Iowa. The project required extensive data manipulation and involved a dozen floppy diskettes that were notched so data were recorded on both sides. Dealing with the limitations of a 48-kilobyte standard memory size on the Apple IIs taught me a lot about efficient use of memory space.

It happened that my then girlfriend (and now wife of 40 years), Carol, was fluent in the American Sign Language. Before transferring to UNI, she had had a deaf roommate in community college; and had learned to sign. We had met at UNI and I often watched her practice her sign language. The thought occurred to me that if I take pictures of each letter of the alphabet, I could use an Apple Graphic Tablet and trace the images into the computer. It would then be easy to program so that when a letter key is pressed on the computer keyboard, the hand sign for that letter would show up. Easy, I thought.

But after I loaded the first couple of line drawings of sign language letters into the memory of the Apple II, it ran out of memory. The digitized hand signs consumed too much memory space. Trying to read the signs off the floppy disk drive was too slow and time consuming. So, to conserve space, I had to come up with an idea to remove all the supplicate pieces of the hand shapes. For example, I reasoned that there is no need for the wrist, to appear 26 times if it is the same in the hand signs. Or the thumb may appear in the same position in 6 of the 26 letters of the alphabet's signs; it could be drawn once and recalled when needed in those signs.

So, I re-took the pictures of the 26 letter hand signs in a way that there was minimal movement of the hand; and all the pictures were the same size and faced the camera. Figure 1 illustrates how the wrist is the same in the three letters of A, E, and N. The common areas of these three hand letter signs are circled in different colors: red illustrates the wrist and part of the palm that could be drawn once and used in all three hand signs; the blue lines show the middle finger in closed position drawn once and could be recalled for the letters A and N, and yellow indicates the side of the hand that could be the same for the letters E and N.
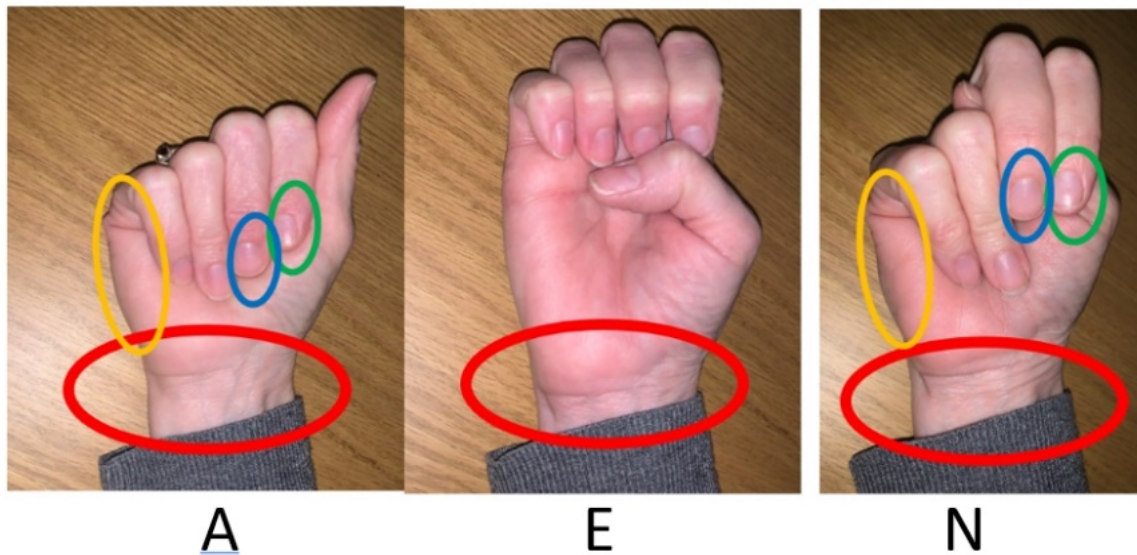
Figure 1: Areas common to more than one picture were drawn once and used in other pictures

With this trick and using about 120 line drawings of different hand parts (such as finger nails, wrists drawn in 3 different positions, knuckles, and lines representing creases in the hand), I was able to form all the 26 signed letters of the ASL alphabet in less than 48 Kilobytes of memory. This allowed all the parts to be loaded in the memory for immediate access. This meant that when the users pressed the letter A on the keyboard the hand sign for the letter A would immediately appear on the screen without the user noticing that the drawing of the hand is made up of 10 to 12 different pieces of line drawing assembled to look as one drawing. Figure 2 shows, how the final results appeared.
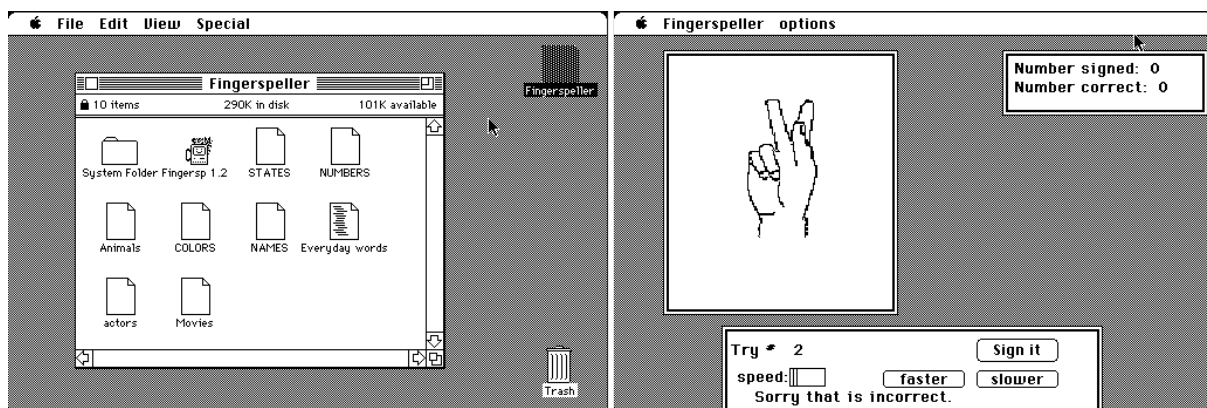

Figure 2: Screen Shots of the Fingerspelling Program Released in 1983

This program was a smashing success. The Des Moines Register wrote a blurb about "Professor Teaches Computer to Sign". There was an evening variety show called PM Magazine that was broadcast every evening. They came to the UNI Price Laboratory School where elementary level students were learning to fingerspell using the Fingerspeller software on Apple II computers. Rick Steves who nowadays has a series of travel videos, was the host of PM Magazine at that time and had fun with it.

I released the Fingerspeller software in 1983 the same year our son was born. The price was set at $49.95 and with some classified advertisements in a few educational magazines, the first order along with the first check came from Sandusky, Ohio. There were many educational features including the capability for teachers to program a number of words and have the computer to fingerspell those in order or at random and interactively test the students' learning comprehension and keep scores.

By this time, memory expansions were becoming available and Apple computers were getting faster. There were also "accelerator" cards that were available to install inside the Apple computers to speed up the processing. So, I thought what if we were to repeat the same concept, but this time create human hand and arm movements to actually sign words. For example, if we want to sign the word "Hi" or "Hello" we raise our hand as if we are saluting and move the hand away from the forehead. This would require a still line-drawing of the face and upper body, with the arm through the elbow in the same position and just drawing the hand near the forehead as one frame and then erasing the hand and drawing it in the second position. If shown fast enough, it would appear as if the person is signing "Hi". Figure 3 shows the screen shot of two words being signed.
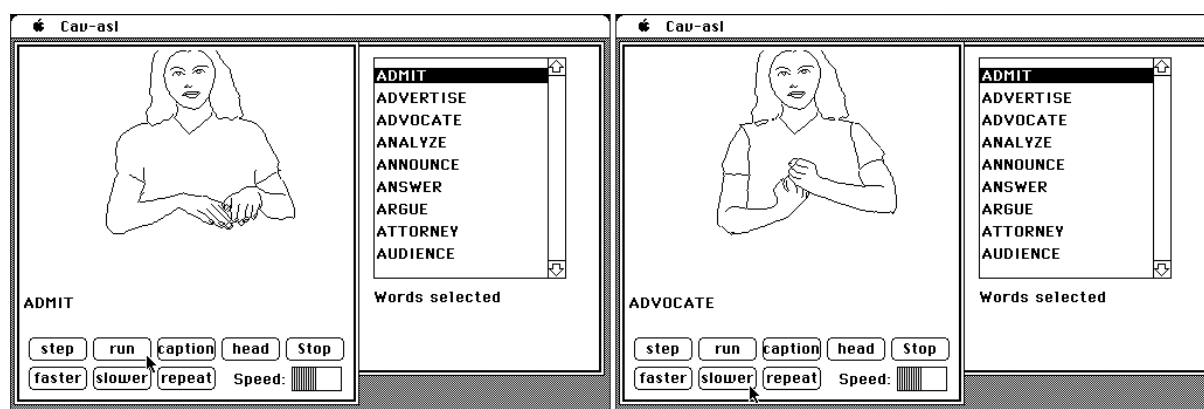

Figure 3: Screen Shot of one frame of the ASL sign for the word "admit" (left) and "advocate" (right)

At that time the book Joy of Signing was one of the better-known sign language books with about 2600 illustrated signs. The signs were organized in different categories such as Education Category, Geography, Religion, Accounting, etc. So, I embarked on taking frame by frame pictures of Carol signing one word at a time. The camera was on the tripod in the same marked location and she always sat on a chair at the same distance from the camera and held her upper body in the same position when signed. She posed for a position or a frame and I took the picture and then she only moved her arms to the next position, and I took another picture and then the third or fourth positions and so on. Some signs would need only two frames while others could require 4-5 frames.

I would buy bulk rolls of black and white photography films and load my own rolls of film into reusable kodak film canisters, in a darkroom (in order to save money on the cost of film rolls). After the pictures were taken, I would develop the films and print them on black and white photo paper which were all the exact same size. I hired several students to work minimum wage in our basement and trace each photo on a transparency sheet. So, if the sign for the word "Hi" required two motions, there would be two photographs and two line-drawing traces of the

photos. I would then superimpose the transparencies to identify the common parts and mark them as needed. The student workers would then use Apple digitizer tablets which had an easy to use corded stylus to trace the parts that I had identified; and save them on floppy diskettes with a carefully designed file name. My job was then to assemble the pieces of the signs in the program in a way that when a word was typed a file would call up different pieces of the drawings for that word and use the x and Y coordinates of starting and ending pieces to assemble each frame from several line drawing pieces. They would then be flashed one frame at a time on the screen. This gave the appearance of smooth animation.

This was an enormous undertaking. We had in excess of 10,000 photographs. The hinge on the door of the Kodak camera, used for taking the pictures, broke because of overuse. Our second child (now 34) was born two weeks before her due date which hindered the completion of the final dozen signs because Carol, who was the model for the signs, had to go to the hospital.

The hours needed to locate the x and y coordinates of each digitized hand or shoulder part and keep track of the number of frames and the naming of the files for those signs required laborious and tedious work. But the work was done and the package of Computerized Vocabulary of American Sign Language (CAV-ASL) was completed. The package had 15 diskettes fully loaded with data on front and back along with a manual; and was sold for $795.00. Many of the known schools for the deaf and departments of communicative disorders in universities across the country purchased the package. This included the Gallaudet University.
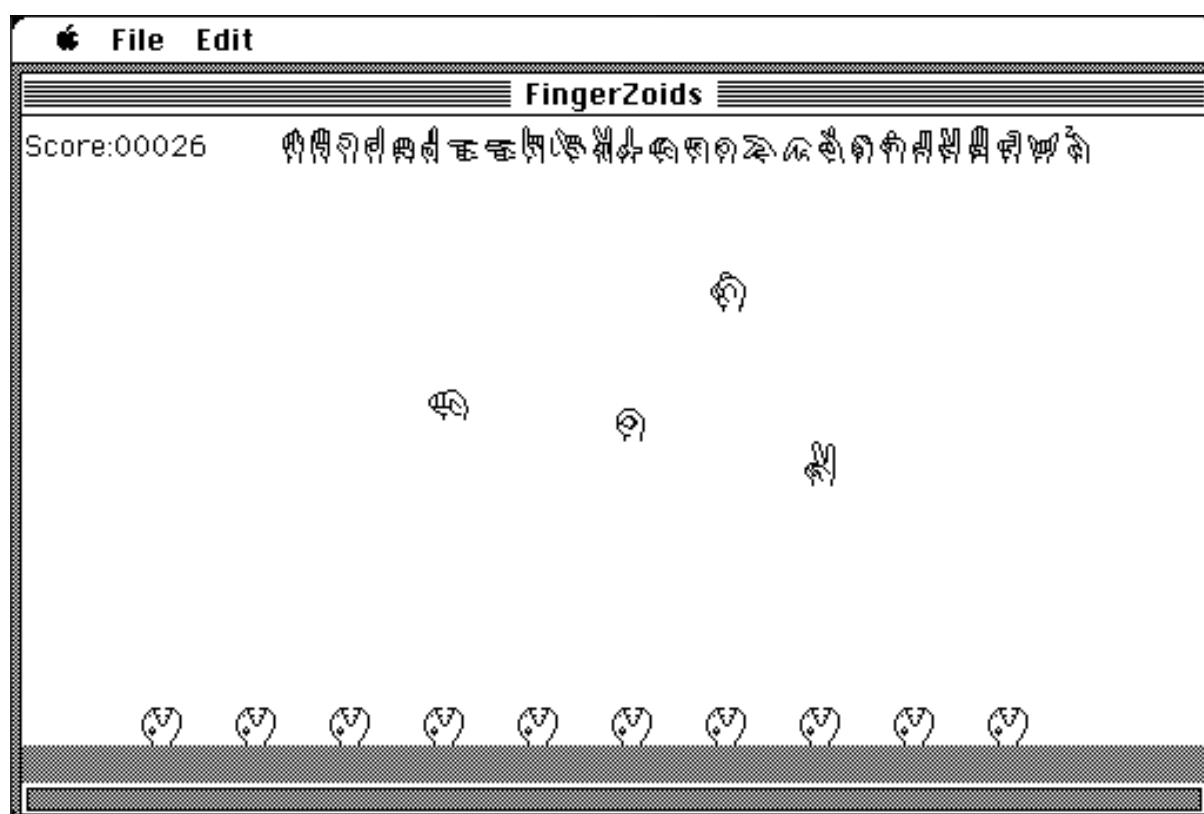

Figure 4: Sign language fingerspelling game: the Fingerzoids

By about 1987 we prepared a shorter version of the CAV-ASL called the Elementary Signer that had about 200 signs suitable for elementary level students. A student helper name John Laird adapted the fingerspelling software to a popular game and called it the FingerZoids. This was actually a pretty effective game for learning

fingerspelling as the waves of hand signs would drop from the sky and the users had to push the key that corresponded to the hand sign to shoot it down. The waves would get faster and faster at each level (Figure 4).

These developments continued as we converted the Apple version of all the packages to the IBM PC and later to the Macintosh versions. Later we digitized sound files corresponding to each signed word. This was for deaf students who had some hearing or used cochlear implants and could see the words and hear it sounded. I had a Spanish speaking student to generate the sound files for words in Spanish and a Chinese student to do the same in Chinese. So, the user could choose to hear the word that was being signed in their choice language. This was also helpful for the parents and relatives to hear the words sounded as they were being signed.

Finally, there was a Voice Recognition package called the Covox that used an interface card with Apple computers and a microphone. We programmed the Covox with the same 2600 words for which we had signs so students could speak the word and see the word signed. This was useful for the hearing students to use, but deaf students with some hearing could try to practice enunciating the words until the word was recognized and signed.

The last software we worked on and did not get to commercialize was a series of Aesop's fables. The Boy Who Cried Wolf, which included drawings of the boy in a pasture with his sheep, would appear on the screen and the signs from CAV-ASL were used to sign each of the words of the story. The English words below the signs were highlighted word by word as they were being signed. After about four years of successfully selling the SignWare packages, a complimentary computer store we had started called Microtech Consulting Company in a storefront near the UNI Campus began to eat through all the income and profits. By 1991, the company had to close and with it the SignWare business and its developmental activities ceased. I was a full-time university faculty and was doing all the work after hour and on the side; so I continued my teaching and switched to research in other areas. But, this chapter of my developmental activities ended in as a learning experience, not so unique to many young entrepreneurs.

37 years later my son who was born when I released the Fingerspeller software (now an AI software engineer) has found emulators for the different versions of the SignWare and is making it available online (thanks Ramin!). This explanation brought back many great memories from the days I worked 24-7 with lots of hope for the SignWare. My contemporaries were computers Apple and computer Microsoft software company. I had dreams of seeing my educational software packages growing to a conglomerate of hardware and software in special education. But I had to let go of that dream and focus on other areas of entrepreneurship with exciting results. Thanks for reading this.