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ATON Report 2000.4: User Input and Output Devices for Advanced Software Systems

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Preface

Researchers working on the DiMI ATON Project UCSD and UCSB are developing a number of novel large-scale software systems that encompass wide-area distributed simulations, virtual reality, remote robots, video streaming, and 3D surround sound. To enhance the user interaction with these programs, we are developing a laboratory for multimedia I/O devices, which will include gestural input as well as 3D visual and sound output.

This report surveys the field of user input/output devices for simulation, virtual reality, gaming, and multimedia applications. It is intended as the first step in the establishment of the ATON I/O laboratory.

Introduction

One of the ATON tasks being carried out at CREATE is developing the human to machine interface that will be used. As part of this effort we have researched the virtual reality input and output devices that are currently commercially available. Although none of these devices have become mainstream, the Virtual Reality market has become large enough that they all have standard interfaces and should be supported on most platforms and with most VR software. This report gives our findings and recommendations on which devices should be purchased for the ATON project.

Datagloves

There are a few types of VR input devices currently available. The dataglove is among the most well known. We compared several models of datagloves in order to determine which is best suited to our needs.

Powerglove

The Powerglove by Mattel is an inexpensive (US \$100) glove device designed for consumer video games. It uses an ultrasonic position and roll sensor and senses the flexure of each finger. But, it is not designed to be used with a PC. There are many "hacked" systems for interfacing these gloves with a computer but there is no official support from the manufacturer. Also, the Powerglove was discontinued about three years ago, so they are difficult to find.



Virtual Technologies

Virtual technologies offers three dataglove type products. First is the CyberGlove (\$5000) which measures two degrees of flexure on each finger to high

accuracy. It also measures the distance between the tips of each finger along with the bend across the arch of the hand. The CyberTouch (\$7000) is the same glove with the addition of a tactile feedback system in the form of vibrating pads on each finger. Finally they offer the CyberGrasp (\$14000) which offers controllable tactile feedback on each finger joint with an exoskeleton that fits over the back of the hand.



FakeSpace

FakeSpace makes a dataglove called Pinch. The Pinch glove detects when any two or three fingers come into contact with each other. I do not believe that this will be useful for us.

5th Dimension Technologies

Two dataglove products are offered by 5th Dimension Technologies: 5DT Data Glove 16 (\$3950) and 5DT Data Glove 5 (\$495). The Data Glove 16 measures two degrees of flexure on each finger and the distance between each fingertip. The Data Glove 5 measures the flexure in each finger along with the pitch and roll of the hand. This is the product that I recommend for our purchase. The price of the Data Glove 5 will allow us to purchase other devices also and remain within our budget. Also, 5th Dimension Technologies is willing to working with us to provide the support we need. If this system works well we can easily upgrade to the Data Glove 16 with minimal changes to our configuration. Finally, 5th Dimension Technologies offers drivers for Windows NT and Linux and there are 3rd parties that offer a free IRIX driver for use on SGIs.



Trackballs

Spaceball

The Spaceball (\$695) is a force sensitive device that measures forces and torques applied to the ball. I believe that this could be a very natural device for vehicle control and that we should purchase one to experiment with. Drivers are available for SGI, SUN, DEC, and Windows NT.



Motion Trackers

There are currently three manufacturers of motion tracking devices. These devices measure their position and orientation. For the most part these devices operate by measuring the electrical charges that result from moving a coil of wire through a magnetic field. A combination of three coils is used in each device so the position and orientation can be measured.

We will need a motion tracking device for our head mounted display and one for the dataglove. Also, one could be used as a “wand” in 6D space.

Intersense

The InterTRAX and IS-300 are both 3 degree of freedom (orientation) devices. And the IS-600 is a 6 degree of freedom (DOF) tracker. I don't believe that these products will fit our needs. A device that only tracks 3 DOF is not what we need and

the IS-600 uses an inconvenient bar that you keep the device in proximity to in order to measure position.

Polhemus

The FastTrak and IsoTrak II systems from Polhemus both are adequate for our needs. They are both 6 DOF trackers. The FastTrak boasts a latency of only 4ms versus 40ms for the IsoTrackII.



Ascension

The Ascension trackers seem to have slightly more advanced technology than those from Polhemus. They will introduce less interference with computer monitors. The Flock of Birds (\$4046) is their product that fits our needs best.



Head Mounted Displays

In order to develop an immersive environment a head mounted display (HMD) is required. The HMD puts the user into the virtual environment visually separating him from the real world. We researched the available HMD units. Following is a spreadsheet with an overview of the information we found. The pertinent information includes the screen resolution supported by the display and the weight. Some displays include a transparency option that lets the user see the real world in addition to the virtual world. We do not need this option. The screen size, angle of viewing and quality of the headphones are also factors.

There are several HMDs based on Virtuality/Retinal Displays panels -- Sony Glasstron, Philips Scuba, and others. All of these use identical panels, but different optics and mounting, NONE of them are stereo (it is a so-called virtual monitor - looks like a 30" monitor in 3 feet). There are two different Sony Glasstrons: PLM-A35 (obsoletes PLM-A55) and PLM-S700 (PLM-S700E is the PAL version).

The PLM-A35 is largely similar to Philips Scuba and it has a single color 800x225 panel and they both have only SVHS inputs. These are very inexpensive (\$400-\$600) and (not surprisingly) the image quality sucks. Sony has a narrower FOV than Philips.

The PLM-S700 is the real thing with three 824x624-pixel panels and both VGA and SVHS inputs. It also has a built-in LCD shutter to block the see-thru (in the see-thru mode the unit gives an illusion of a 30" monitor hanging in mid-air). Working resolution for PCs is 800x600. Image quality is acceptable. Price: \$2600 MSRP. An optional head tracker (Intertrax 30 made by Intersense) can be obtained for <800 dollars.

Mounting of the head tracker to the helmet may be painful if the mounting hardware is missing from the package (surprisingly often so). The tracker is mostly gaming oriented and plugs into a mouse port of a PC (or SGI) and operates like a mouse (horizontal axis is left-right head rotation, vertical axis is up-down). It is also quite sluggish. Overall the PLM-S700 is quite usable. Built-in headphones (Sony earbuds) are of very much substandard quality, however the HMD construction (open on the sides) permits the use of better phones.



For us, I would recommend the Virtual Research V6 or the Kaiser ProView 60. Both are in our budget and meet our needs.



The companion document to this brief introduction is attached; it is also available on the Web at <http://www.mat.ucsb.edu/200C/slides4.pdf>, and gives a broader survey-style presentation of the research literature in user input/output devices.

In the next phase of this work, we will assemble a testing laboratory at the UCSB ATON site for evaluating user input and output devices in the context of the DRIVE system and ATON applications, and will develop DRIVE vehicle software to support flexible methods of user navigation and object interaction.

User Input Device Feature Comparison Chart

Motion Trackers	Range	Interface	Price
Ascension			
Flock of birds 6 DOF tracking device	4'	RS-232	\$4,046.00 a pair
3D Bird 3DOF Device		rs-232	\$1,495.00
Polhemus			
FastTrak Up to 4 6DOF Sensors	10'		
IsoTrak II Up to 2 6DOF Sensors	5'		
Intersense			
InterTRAX Sourceless 3DOF tracker		RS-232	
IS-300 More Accurate 3DOF tracker		RS-232	
IS-600 6DOF tracker	?	RS-232	
Alsos			
SpaceBall Senses 6DOF by measuring pressure in any direction		RS-232	\$695.00
Gloves			
5th Dimension Tech			
5DT Dataglove 5 Flexure of each finger and 2 DOF		RS-232	\$495.00
5DT Dataglove 16 2 degrees of flexure on each finger and distance no motion or orientation		RS-232	\$3,950.00
5DT Space Controller 5 buttons and 2DOF		RS-232	
Virtual Tech			
CyberGlove 2 deg of flex per finger and other information		RS-232	\$5,000.00
Cyber Touch Provides tactile feedback via vibrating pads on tips of ingers			\$7,000.00
CyberGrasp Provides feedback to each joint via an exoskeleton.			\$14,000.00
Fakespace			
Pinch Senses when any two fingers come into contact	V	RS-232	

User Output Device Feature Comparison Chart

Model	Resolution	Weight	Transp.	Headphones	Screen Size	Angle of view	Price
Sony							
Glasstron LDI 50B	108K	120g	semi	included			
Glasstron LDI 100B	832x624	120g	semi	included	.7in LCD	28 deg	\$2,600.00
Virtual Research							
V6	640x480	821g	no	Sennheiser	1.3in LCD	60 deg	\$5,900.00
V8	1920x480	821g	no	Sennheiser	1.3in LCD	60 deg	\$9,900.00
IO Display							
X2	360k			yes	.7in LCD		\$599.00
PROTEC	640x480	354g		yes	1.35in LCD	42	
n-vision							
Datavisor HiRes	1280-1024	1587g	yes		1" CRT	52	
Datavisor VGA	640x480	1587g	yes		1" CRT	52	
DataVisor 80	1280x1024	1814g	yes		1"CRT	80	
Datavisor LCD	640x480	1133g	yes		1.3" AMLCD	48	
Kaiser							
ProView 30	640x480	907g	no	buds	AMTFT	30	\$4,995.00
ProView 40ST	640x480	589g	yes	Milcom	AMTFT	40	\$49,995.00
ProView 50ST	640x480	589g	yes	Milcom	AMTFT	50	\$49,995.00
ProView 60	640x480	850g	no	buds	AMTFT	60	\$5,665.00
ProView XL35	1024x768	1020g	no	buds	AMTFT	35	\$15,000.00
ProView XL50	1024x768	1020g	no	buds	AMTFT	50	\$15,000.00
ProView 80	640x480	1133g	no	buds	AMTFT	80	