Wearable Mouse and Keyboard

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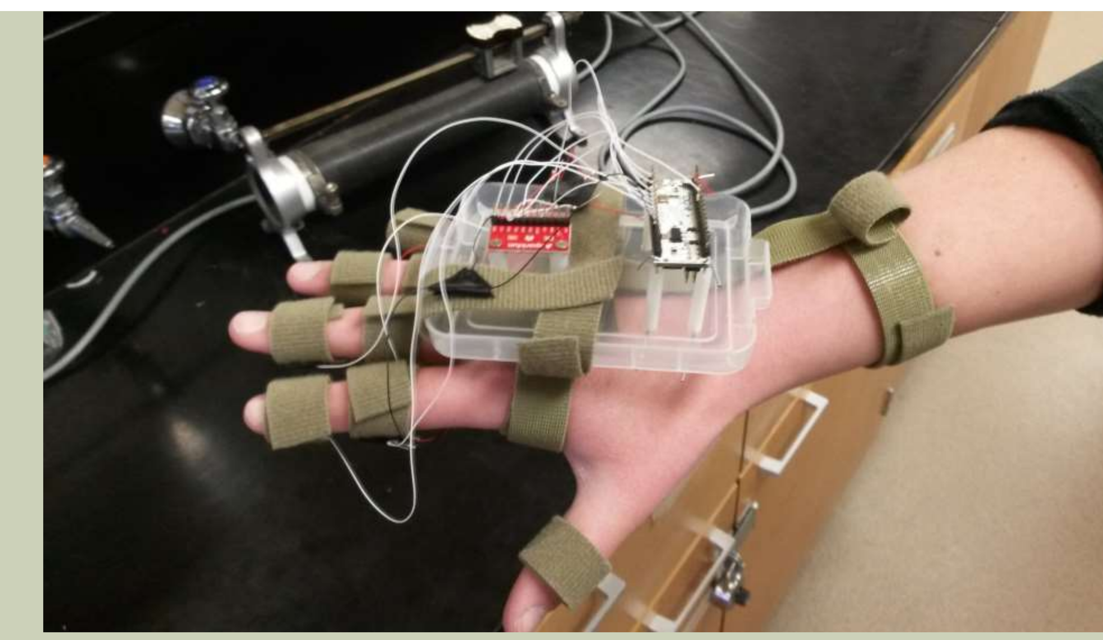
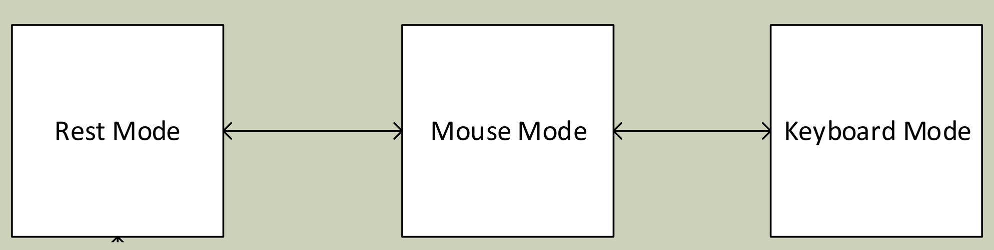
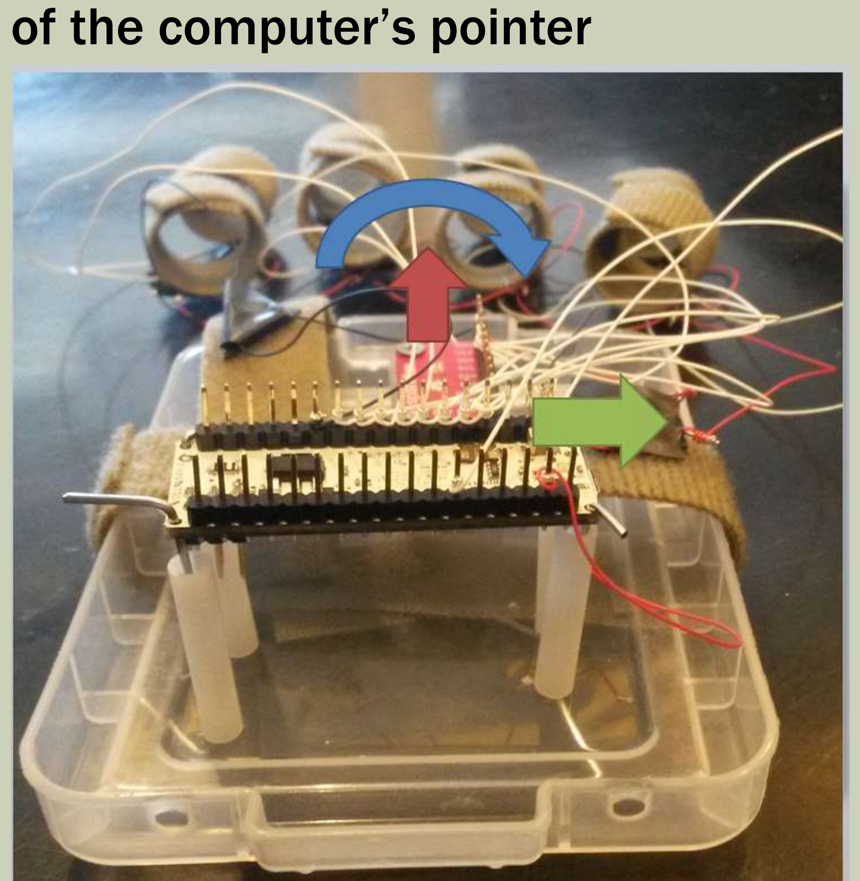


Abstract

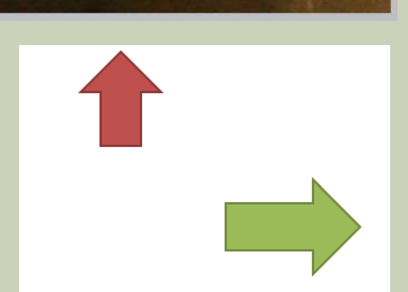
Modern computers are becoming smaller, cheaper and more powerful, allowing them to become more common and more necessary in our day-to day and moment-to-moment lives. A number of technologies have arisen to take advantage of this by supplying computers that are constantly accessible, most notably Google Glass. Unfortunately, these technologies are often plagued by interface issues; the input devices commonly have severe deficiencies in portability, social acceptability, security, ease of use or data input rate. My project is a simple wearable input device designed to emulate a traditional mouse and keyboard by tracking certain discrete hand movements and converting them into signals usable by a computer. Design considerations include being easy to learn and to use, and being minimally encumbering when not in use. Interface devices of these sorts will be useful in the integration of always on personal computers into people's lives.



In mouse mode different movements can be configured to create different movements of the computer's pointer



Rotation of wrist mapped to X
Bend of wrist mapped to Y
Requires little movement
Less intuitive
Harder to learn



Bend of Elbow mapped to X
Bend of Wrist mapped to Y
Requires more movement
Movement of hand corresponds to movement of pointer
Easy to Learn

Goal

This project was intended to develop a device that could be used to interface with a wide range of computers. It was meant to emulate a traditional mouse and keyboard when used with a desktop computer to demonstrate some of the hardware's range. Different displays would likely demand different configurations and make use of the hardware in different ways.

Development

The project was originally intended to use only an accelerometer for motion tracking and conductive pads in place of the magnetic sensors now used on the fingers. The magnetic sensors were investigated at Dr. Legowski's recommendation and decided upon because they would require less exposure of the device's electronics to the outside world. Magnets work just as well through a thin protective layer.

When designing the mouse functions the accelerometer was largely replaced by a gyroscope when it was found that the accelerometer tended to result in either gradual drift over time or significant overshoot and overcorrection problems, depending on how it was filtered. The gyroscope still tracked those components of movement deemed relevant quite well due to the levered nature of the human arm, and did not suffer from these problems.

Future Development

- At the moment, each configuration consists of a single mouse mode and a single keyboard mode the functions of which can only be changed by programming an entire new configuration onto the Arduino from scratch. A simple next step will be to configure the device to take commands from whatever computer it was attached to to so that different programs could request different data without having to entirely reprogram the glove.
- Bluetooth capabilities will allow the device to communicate wirelessly with a wide range of portable devices. This will also require a power supply to be mounted on the glove.
- Different devices demand different interfaces, an app to usefully integrate

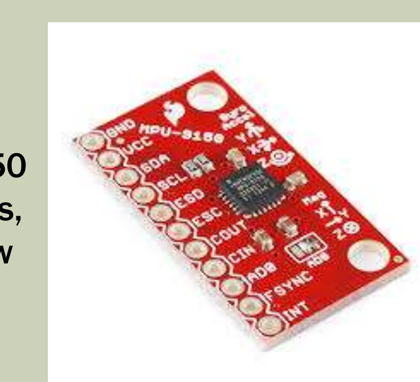
Conclusions

Different devices demand different interfaces. What works on a desktop may be all but useless on a tiny handheld or face-mounted screen.
Datasheets should be read very carefully, I wasted hours working around a problem caused by two values being placed in a different order than I thought they would be.

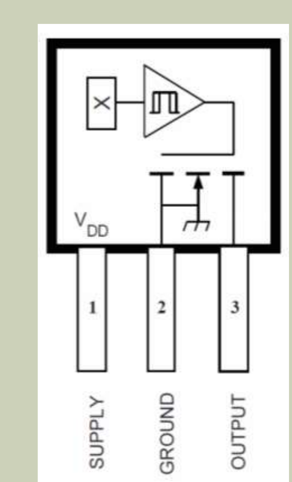
Parts

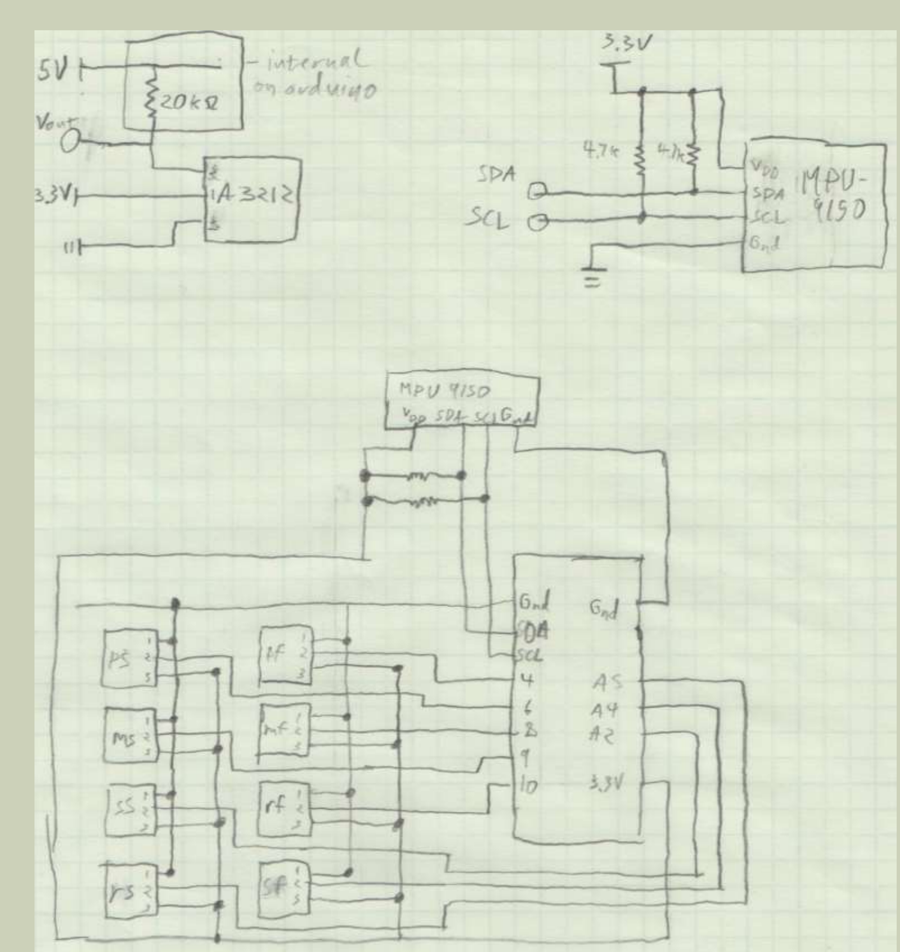
The device was controlled by an Arduino Micro microcontroller board. This selection was made due to the existence of drivers allowing the use of the Arduino as a mouse and keyboard. Creating entirely new driver code for every computer the device was to be used with would not have been feasible.

Motion tracking was performed with an MPU-9150 chip, which combines an accelerometer, compass, and gyroscope in one chip. This was done to allow different applications to use any of a wide range of sensors as was most appropriate for the application's needs.



The finger contacts were A3212 Hall Effect sensors. These sensors detect the strength of nearby magnetic fields and pull a digital output down when the field strength is over a certain threshold.





While in keyboard mode each key is input with a combination of several sensor contacts performed in order.

Keyboard mode:							
First Touch			Second Touch				
	if2	is2	mf2	ms2	rf2	rs2	ps2
if1	a	b	c	d	f	g	[space]
is1	h	e	j	k	l	m	[backspace]
mf1	n	p	i	q	r	s	[return]
ms1	t	v	w	o	x	z	[period]
rf1	0	1	2	3	u	4	[sym]
Rs1	5	6	7	8	9	y	[sym]
ps1	see shift	see shift	see shift	see shift	see shift	see shift	navigate

	Shift table		starts with ps1				
Second Touch			Third Touch				
	if3	is3	mf3	ms3	rf3	rs3	ps3
if2	A	B	C	D	F	G	[sym]
is2	H	E	J	K	L	M	[sym]
mf2	N	P	I	Q	R	S	[sym]
ms2	T	V	W	O	X	Z	[sym]
rf2	[sym]	[sym]	[sym]	[sym]	U	[sym]	[sym]
rs2	[sym]	[sym]	[sym]	[sym]	[sym]	Y	[sym]

This method was chosen For ease of learning, but other layouts are also possible. To the right is a simple chorded layout where keys are input by activating multiple sensors simultaneously.

Chord Configuration							
1		2		3		4	
1	e	12	r	125	p	1256	[Space/Backspace]
2	t	23	d	126	b	2367	[Shift]
3	a	34	0	156	v	3478	[Return/exit]
4	o	56	l	256	k		
5	i	67	c	236	j		
6	n	78	1	237	x		
7	s	15	u	267	q		
8	h	16	m	367	z		
		25	w	347	6		
		26	f	348	7		
		27	g	378	8		
		36	y	478	9		
		37	2				
		38	3				
		48	4				
		47	5				