CHALMERS

KeyTrack

Combining the keyboard with a track-pad

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Abstract

This thesis describes the development of a different approach to the traditional mouse and track-pads currently in use with most computers both at home and in the workplace. The traditional ways of controlling a computer takes up a lot of physical space and may cause pain to the user due to repeating user patterns.

This project aims to create a new way of controlling the PC, which has resulted in a prototype, *KeyTrack*.
The report describes a pre-study, done by the project team to increase knowledge of electronics and hardware. The report also includes the development process.

The report describes the prototype and the different functions the prototype is capable of. Functions such as moving the mouse-pointer, doing left- and right-clicks and two-finger-scrolling.

METHOD MISSING

RESULTS MISSING

Sammandrag

Denna rapport beskriver utvecklingen av en annorlunda approach till den traditionella datormusen och track-pad som återfinns på alla datorer både i hemmet och på arbetsplatsen. De traditionella sätten att kontrollera en dator tar upp mycket utrymme, och kan i vissa fall åsamka användaren skada. Detta projekt ämnar ta fram ett nytt sätt att kontrollera PCn, vilket har resulterat i en prototypm *KeyTrack*.

Rapporten beskriver en litteraturstudie, gjord av gruppmedlemmarna för att öka kunskapen inom elektronik och hårdvara. Rapporten innehåller även utvecklingsprocessen.

Rapporten beskriver prototypen.

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Contents

1 Introduction **1**
1.1 Background . . . 1
1.2 Technical background . . . 2
1.2.1 Infrared light . . . 2
1.2.2 Arduino . . . 2
1.2.3 Components . . . 3
1.3 Software development . . . 5
1.4 Related work . . . 5
1.5 Problems . . . 5
1.6 Goal and purpose . . . 5
1.7 Boundaries . . . 6

2 Method **7**
2.1 Literature review . . . 7
2.2 Developing phase . . . 7
2.2.1 Hardware . . . 7
2.2.2 Software . . . 8
2.2.3 Design . . . 8
2.3 Test/polishing phase . . . 8

3 Results **9**

4 Discussion **10**

5 Conclusions **11**

Bibliography **12**

1

Introduction

The mouse pointer is traditionally controlled with a computer mouse. The first computer mouse was invented by *Tom Cranston*, *Fred Longstaff* and *Kenyon Taylor* as a secret military project in 1952.

But a public introduction would have to wait until 1968 when *Douglas Engelbart* held the now famous *mother of all demos*, which introduced now everyday commands such as copy-paste, but more importantly, the computer mouse.

His patent would end in 1987 but at that point the computer was already very different from his original. Ever since it was invented it has been the primary way to control the computer and still is today. Nowadays there are plenty of solutions out there to challenge the computer mouse.[1] [2]

1.1 Background

In this following section, several already existing solutions are presented to get a grasp on the good and bad features for controlling the mouse-pointer.
Today almost all computer mice are either optical or using some kind of laser. An optical mouse uses a *light-emitting diode* (LED) and photo-diodes to detect movement on a surface. Instead of a LED, a laser mouse uses an infrared laser diode to light a surface beneath the sensor. Their predecessor, the classic mechanical mouse, had a ball that rotated orthogonal shafts that drove a chopper wheel used to measure the distance moved. The mechanical mouse had the mainstream market up until 2004 until it was slowly replaced.
Not everyone uses desktop computers today. Laptops are becoming more and more popular. This includes working, gaming and just everyday usage. For example, 55% of US households own laptops. That is a 40% increase from 2010.
A laptop usually comes with a track-pad, a touch-sensitive surface below the keyboard by which the user can control the mouse-pointer on the computer. The track-pad is

a pointing device which has a tactile sensor and is integrated in the laptop. Since a computer mouse then isn't needed to move the mouse-pointer, you save a lot of space. Nowadays there's smart-phones and tablets that uses both keyboard, mouse and display on the same surface. the surface is normally smaller than a computer screen even on the biggest models.

Since the keyboard is on the screen as well it's hidden away when you don't need it. The small surface along with the non-physical keyboard can cause problems when doing trying work on the move. However, the accuracy and comfort of such a surface is un-challanged.
Another solution that is often used by dentists takes the form of a pipe formed plastic wheel at the bottom of the keyboard. This wheel can be moved horizontally to make the mouse-pointer move left and right, and can be scrolled to make the cursor move up and down. The left and right mouse buttons are located just below the pipe.

This solution eliminates the need for a regular computer mouse and therefore saves space.

1.2 Technical background

1.2.1 Infrared light

IR-light, is light composed of wavelengths above the spectrum visible to the human eye. The human eye can comprehend light in the range of about *380 nm* to about *700 nm*. IR-light lies in the range of *700+ nm* up to a millimeter. IR can be used in a variety of areas, like remote temperature sensing, short-range wireless communications, night-vision and weather forecasting.

1.2.2 Arduino

Arduino is an open-source electronics platform, based on flexible and easy to use hardware. It is meant for anyone to be able to start developing prototypes of small interactive devices. The Arduino has got a variety of inputs and outputs where one can easily connect sensors, lights, motors and such. Arduinos can be stand-alone projects or communicate with software running on a PC or other devices.

Hardware

The Arduino used in this project is the Arduino Due. The Due microcontroller board is based on the Atmel SAM3X8E Arm Cortex-M3 CPU. Arduino Due is the first Arduino board based on a 32-bit ARM microcontroller, and has a large number of digital and analog ports. The clock is running at 84 MHz.[3]

Table 1.1: Arduino Due hardware.

Microcontroller	AT91SAM3X8E
Operating Voltage	3.3V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 12 provide PWM output)
Analog Input Pins	12
Analog Output Pins	2 (DAC)
Total DC Output Current on all I/O lines	130mA
DC Current for 3.3V Pin	800mA
DC Current for 5V Pin	800mA
Flash Memory	512KB all available for the user applications
SRAM	96 KB (two banks: 64KB and 32KB)
Clock Speed	84 MHz

Software

The microcontroller on the Arduino boards are programmed using the Arduino programming language based on Wiring, and using the Arduino development environment based on Processing. The language is very similar to C/C++ and can therefore be extended using C++ libraries.

There are two basic functions that must be included in every Arduino software, the setup() and loop() functions. In setup() the roles of different pins/ports of the Arduino are defined, the serial communication with the PC and the Baud rate are defined. In loop() the rest of the program is written (except defining new functions).

1.2.3 Components

Since none of the project members has experience in the electronics field, it is important to study the basic specifications of the components needed and how they interact with each other.

Resistors

A resistor is an essential component in all electronic devices. It is used to add a resistance to the circuit independent of current, voltage and external factors like temperature and light conditions.

Pull-Up Resistor There is always a risk of output anomalies when you connect different circuits and components with each other. This will in some cases result in unwanted

values while measuring the input data. A pull-up resistor are used to ensure that an input stay within the expected measurement levels. This is done by connecting a resistor towards its voltage source.

Pull-Down Resistor A pull-down resistor work in the same way as a pull-up resistor, but with the difference of being connected towards the ground. This will keep the signal near zero volts when no other active component is connected. This will help us control what values the photo transistor will output in the state of being in shadow.

Photo-transistor

Our Input data is collected with a number of phototransistors. As the name suggest, a photo transistor is a photo diode combined with a transistor. A simplification of the transistor would be to see it as component that regulates the amount of current that passes through a particular circuit. The amount of current passing through the transistor is controlled with the transistor base, which you operate with a current.

This current could come from a photodiode since it will generate a current when, but only when, it is exposed to photons of sufficient energy. By changing the current flowing through the phototransistor, the sensitivity is calibrated on the photons registered. This is a property a conventional photodiode lack.

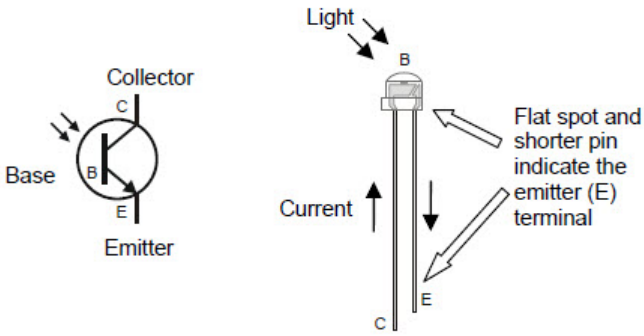

Figure 1.1: Schematic of a phototransistor.

Daylight filter

Another problem is that we need the emitter to match, only, with the phototransistor specular characteristics. This is solved by a daylight filter which has a specular characteristic that only allow light in the infrared spectrum to pass through. This will be placed in front the phototransistor to eliminate all light sources expect our own infrared emitters.

Infrared emitter

The input data we collect from the phototransistors are generated by a number of infrared emitters. A major problem is that each emitter has a fixed angle in which infrared light is being emitted. If the angle is too narrow, we would have to compensate with more emitters. And if the angle is too wide, we would have inaccurate shadow casting. SKRIVA HÄR VILKEN VINKEL VI TOG OCH VARFÖR JUST DEN ÄR SÅ BRA!

1.3 Software development

Since a lot of code will be written by multiple project members during the implementation period, a version control software is needed. We chose to use Bitbucket(GIT).

1.4 Related work

There is a product called *LeapMotion* that uses infrared light and CCD cameras that can register movements above the device in a 3D space. This enables you to control the cursor with hand movements. It's small, practical and seems to be very accurate. *LeapMotion* can be used for other things than just moving the cursor. It can for example be used to rotate animated objects in a CAD program.
LeapMotion is set for release the 22th of July 2013.[4]

1.5 Problems

One of the first problems that came to mind when developing this prototype is how important the design really was. If the design was flawed then the functionality of the prototype would suffer severely. Therefore it was very important to think through the design choices.

Another problem is how much functionality is decided to be included in the final version of the prototype. The more that gets implemented the more work is required and needs to be planned carefully. However, the basic functions of a computer mouse will be included as a minimum.

1.6 Goal and purpose

The purpose of this project is to design and build a prototype that has the basic features of a computer mouse. The goal is to replace the computer mouse with a more ergonomic and space-saving solution. This prototype is mainly meant for making it easier to conduct work in a workenviroment.

1.7 Boundaries

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Method

The project was divided into three different phases. The literature study, the developing phase and the test/polishing phase.

The first phase was where all the information needed to make the project possible was gathered. The second phase was the phase where the prototype was created and it's functionality implemented. Finally, the last phase was used to make the finishing touches on the prototype to make sure it was working as expected.

2.1 Literature review

During the literature review there were several solutions to consider. Ultrasound, IR and an optic solution. These solutions were documented in databases that Chalmers provides for its students. Information was gathered from various websites, articles and reports inside and outside of the database.

Along with finding a proper solutions, proper hardware was required for the project. When gathering information from reports, articles and from other sources, a lot of hardware was presented. This made it easier to chose hardware because of the natural combination. The hardware information itself was gathered from it's creators website, since some of the articles and reports didn't provide enough information for what the project needed.

2.2 Developing phase

2.2.1 Hardware

The first small prototype was made using a breadboard and an Arduino Uno. The prototype include four phototransistors and a single IR-LED. This first edition was capable of interpreting sideways mouvements and left-mouse-clicks. Because of the limited space

on the breadboard the next version of the prototype had to be made using some other base on which to put the hardware.
Stripboards were cut into circa 14 centimeter long pieces and put together to make a square frame on which the hardware was fastened using wire-wrapping.

Wire-wrapping is an alternative to and not as skill-demanding as soldering.

2.2.2 Software

2.2.3 Design

Frame design

This design of this project is based on a "keyboard name" keyboard. The frame is entirely based on the measures of the keyboard. This includes the height and length, since it's important that the frame is not in the way when operating the keyboard. With this in mind the prototype was given the measurements "lol", "lol", "lol". The frame is connected with a lot of cables to a arduino card at the other end. Even though these cables will hurt the design and the prototype's adaptability, this project will not treat the matter due to limited time. From the arduino card goes a USB cable (mini to 2.0 USB) into the computer.

Mouse movements and clicks

Since the prototype was created to replace a normal mouse, this chapter is showing how the different commands are translated from the mouse to the IR-frame. Since the mouse we choose as reference has 3 buttons, the prototype won't go any further than that. The scroll-click is also excluded.

The card Arduino Due that is used in this project has already a software library with mouse commands. This made it easy to locate and translate the mouse command in to what ever command desired.

The different mouse commands were then translated to the IR-frame. This proved to be difficult since it was not obvious what hand gestures worked best with what command.

2.3 Test/polishing phase

N/A

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Results

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Discussion

5

Conclusions

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