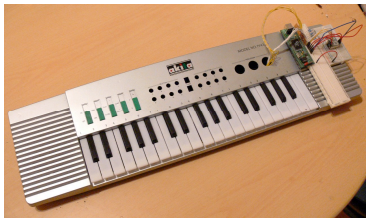

GUI's and Keyboards

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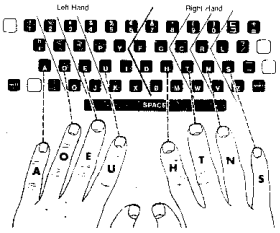


User Interface Goal

- **Convey and gather information from user(s)**
  - when user is not sitting in front of a PC
- **Support a set of standard actions and outputs**
- **Graphical User Interfaces (GUI) have been well studied**
  - Must understand them before generalizing
    - *Pervasive computing uses many types of user interfaces*
- **A web page is an example of a GUI**
  - Why is there a need for anything else?
  - Because of historical and efficiency reasons
  - Want more direct and richer variety of interface

User Interface Goal II

"As interfaces become easier to use, they become harder to create" [Meyers 1994]

- **Do you agree?**
  - KISS: Keep It Simple
  - It takes a lot of hard work to make things look simple
- **What user interfaces do you like?**
  - iPod, Tivo, ...
- **Microsoft Windows 2000 have dynamic pulldown menus**
  - Does anyone like them? why not?
- **The new Microsoft office menu's -- do they help?**

KISS: Keep it simple

- **Goal is for user to not think about how to do something; it should be automatic:**
  - If there is a choice, then one must think
    - *movie theaters offer very limited choice of candy*
    - *supermarkets offer huge variety of soft drinks -- what is difference?*
  - Save file via menu, keyboard, icon, rightclick, ...
  - One mouse button simpler than three
  - Pay a lot of money for large screen, why waste it on rarely used menu bar

KISS: Keep it simple

- **People do not think about repetitive actions**
  - "Do you really want to delete file?"
    - *after third time, people usually click OK without thinking*
- **Lots of research on design principles**
  - and it is often ignored :(

Manipulation

- **Indirect Manipulation**
  - E.g. program places graphic objects on screen
  - Nothing is "clickable"
  - Today it feels awkward to use keys on mobile phone to manipulate objects on screen.
    - *Everything used to be that way.*
- **Direct Manipulation of Objects**
  - User directly manipulates Graphical Objects with mouse or keyboard
  - "Tangible User Interface" of the future, users will manipulate physical objects with their hands

Alphagrips

Widgets

- **For lack of natural term, GUI objects are Widgets**
- **Everything in a GUI is a widget**
- **Widget is picture displayed on screen that is under control of the GUI.**
- **Widgets are hierarchical: they contain other widgets. Examples are:**
  - Window frame, radio button, scroll bar, menu, ..
- **GUI's support certain types of pictures**
  - others types must be converted

Big Idea: Abstraction

- "Any problem in computer programming can be solved by adding a level of abstraction"
- "Performance can be improved in programs by removing a level of abstraction"
- Indirection used to support abstraction

Non-widgets

- **A GUI is a level of abstraction between user and program, hence it affects performance**
- **Graphical Computer Games demand high performance for realistic animations**
  - They directly manipulate the screen, mouse, keyboard
- **Audio not part of GUI**
  - Duh. OK, but not part of window system either
  - Could do it by assigning a "channel" to each application and have user select the channel as in a radio

Mice

- **Mouse is clicked inside of window or widget**
  - e.g.: controls standard widgets: drag a slider, twist a dial, scroll up or down -- all ways to enter a number
- **Major innovation: mouse cursor changes sprite as moves between widgets**
  - Real world analogy: frog looks different on a lilly pad and in the pond, car looks same in drive- & park-way
- **Mouse is part of GUI, but not multiple mice**
  - New need arising from wireless mouse and from pda or cell phone as "mouse"
  - Perhaps we need different sprites per user?

Mice II

- **Mouse actions:**
  - Click is two actions: "button down" and "button up"
  - Movement is relative: "delta x, delta y" events
  - Drag: move while button is down
  - Wheel: "Button D" or "Button U" events
- **One button mouse easier to handle**
- **Multiple button mouse requires training**
  - people have been successfully trained already
- **Mouse acceleration big success.**
  - Are there other applications of acceleration?

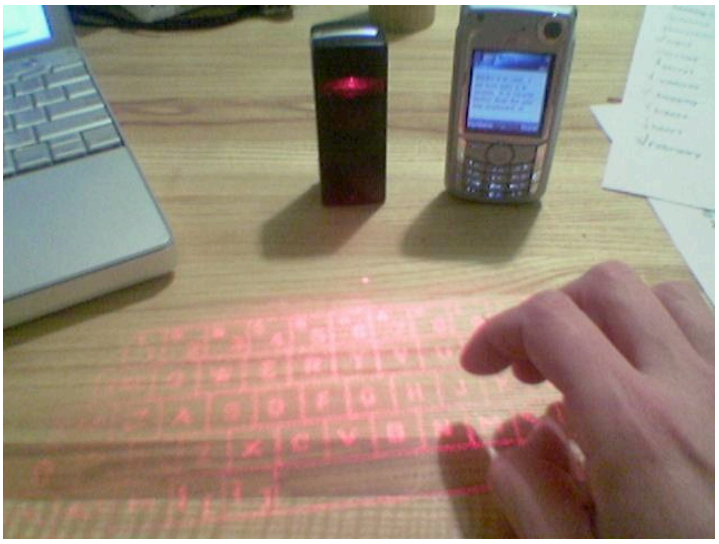
Touch Screens

- **Not exactly the same as a mouse**
- **Click: no button down or button up**
  - dwell: leave finger in same location
  - double click hard to hit same pixel twice in a row
- **Movement: absolute, no consistent origin**
  - top left, or bottom right can be (0,0)
- **Drag: very difficult, need "modal" command**
  - modes are considered harmful, e.g. shift lock is bad
- **Wheel: perhaps use some gesture?**
- **Not easy to simply replace mouse with touch**

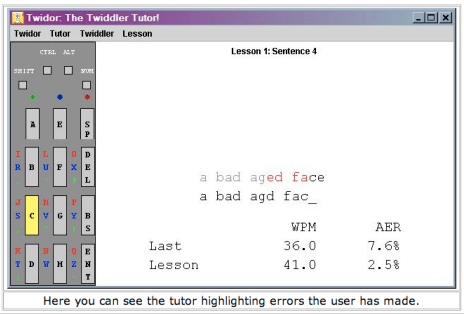
Keyboards

- It seems simple, precise, and nothing new
- One hand typing --
  - my idea: double keypress -- means mirror key
    - "aa" means ";;" "ss" means "ll" & "gg" means "hh"
    - I needed it when I sat with a baby in my lap
  - there exist other one hand keyboards:
    - twiddler (chording keyboard)
    - half keyboard
  - Telephone pad keyboard: 1-2, 2-3, 1-4, 1-4-2-5, 2-5
- Keyboard entry not exact
  - on-screen keyboard
    - a "G" could be an "f", "t", "h", or "b"
  - Cellphone keyboard
    - a "G" could be a "4" or "H" or "I"

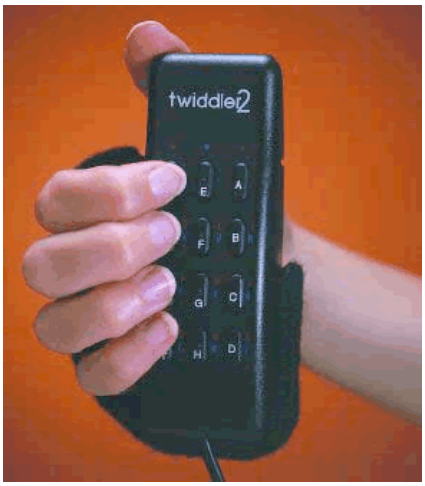
Virtual Laser Keyboard



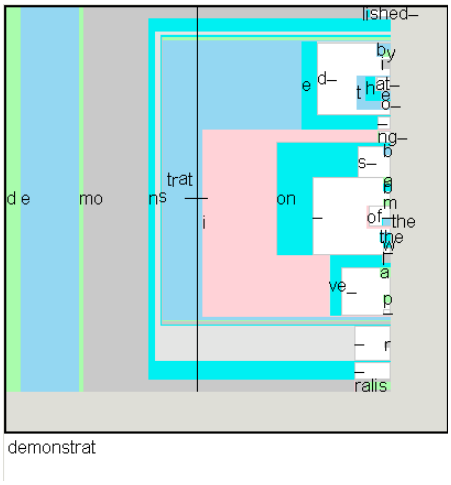
Twiddler Keyboard



Here you can see the tutor highlighting errors the user has made.



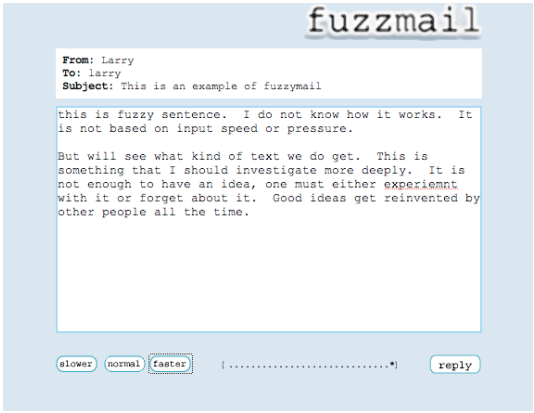
Dasher



- go to www.finference.phy.cam.ac.uk/dasher

Expressive Typing

- **Writing with a pen on paper does more than express words:**
  - it is a picture & conveys non-verbal expression
- **Use the intercharacter typing speed to vary either the font or the inter-character spacing or vertical alignment**
  - fuzzymail.org is like this to show speed directly



GUI Programming

- Embed in code
  - Java AWT, Python TCL,TK
  - Very hard to code, debug, maintain and modify
- Use GUI builder, e.g. Visual Basic
  - rapid prototype
  - reliable
  - consistency across applications
  - easier to implement "help" and "undo"
  - easier to port

Glade (for linux, x-windows)

- Three layers:
  - user application, user GUI, window system
  - we care about first two, glade deals with GUI
- Application separate from GUI
  - Interface is via "callbacks"
  - Each widget has a set of standard interfaces
- see http://glade.gnome.org/index.html

Review

- Examples of handheld interface
  - device is with you & knows location ==> it knows your location
  - can "improve" location information
- Device can interface with other devices
  - e.g. those nearby via bluetooth & those in the world via internet & that it knows and trusts

Review II

- Handhelds have functionality of computers
  - but with more constraints
  - exploit computation to compensate for shortcomings -- main message of course
- Small screens & keyboards
  - Probably also small microphones, speakers, and other I/O -- discuss implications for UI

Bi-directional Abstraction Barriers

- Expectations: (probability distribution)
  - engine --> interface
- Disambiguation: (choices and their likelihood -- n-best)
  - interface --> engine

Manipulation

- How does user interact to make things happen?
- Direct vs Indirect -- what does this mean?
  - Drag & Drop, Click, Keyboard command
  - Rule: Do something when an event happens
- Pervasive theme: direct vs indirect
  - Examples: turn on computer; word vs latex
  - Many other examples

Specifying UI View

- Direct: in code
  - within program execution
  - separate resource & specialized language
    - what are the pro's and con's
- Indirect: implicitly specify via something

Symbian Views

- (Not a python thing)
- Each application has 5 components, one is view
  - Do not want text strings with code if app is for international audience. So use ptr?
  - Use whole view. Different view package for different locations / languages / screen
  - Make view available to other applications

Implicate Method

- Structured domain, automatically generate view
- If all menu handlers are in same object (class), can use introspection to generate menu items. Done at run-time.


```
def refresh(self):
    app.title = u"Larry's First App"
    app.menu = [ ( u"add to set",  self.add_handler ),
                 ( u"new object",  self.new_handler ),
                 ( u"change mode", self.mode_handler),
                 ( u"Cut", self.cut_handler),
                 ( u"Paste", self.paste_handler),
               ]

def mode_handler(self):
    self.currentMode = ModeList[ popup_menu(List) ]
    self.display()

def cut_handler(self):
    index = self.lb.current()
    cf = self.rawentries[index]
    self.clipboard = cf
        self.display()
```

```
from  install_menu import *

class test_menu:
    def __init__(self):
          self.a = initial values
    def menu_zero(self):
          print "got a callback to zero"
    def menu_one(self):
          print "got a callback to one"
    def menu_two(self):
          print "got a callback to two"

m = install_menu( test_menu() )
```

```
def install_menu(c):
    """ given a pointer to a class, add all class methods
    whose names begin with 'menu_' to the menu."""

    menu_items = []
    for n in dir(c):
    if n.find('menu_') == 0:
        s = eval('c.'+n)
        menu_items.append( ( unicode(tag[5:]) , s ) )
    if n.find('exit_') == 0:   exit_key = eval('c.'+n)

    appuifw.app.menu = menu_items
    appuifw.app.exit_key_handler = exit_key
```

Handlers everywhere

- We have constraints on where are handlers
- In same class, easy
- In other classes, how to reference them?
  - make class instances global?
  - pass methods into menu builder?
    - what do you think?

Indirection to the rescue

```
class EventPublisher:
    """
    utility class to provide basic Publish/Subscribe functionality.
    """
    def __init__(self):
        self.__published = {}
        self.notify = e32.ao_callgate(self.__notify)

    def subscribe(self, event, callback):
        """ Subscribes a callback function to specified event. There are no
        timing restrictions on callback .  Event must have been published."""
        if event not in self.__published:
            raise ValueError("no such event %s" % str(event))
        if not callable(callback):
            raise ValueError("callback must be callable")
        self.__published[ event ].append(callback)
```

```
def publish(self, event):
    """
    publishes an event, so that subscribers can subscribe.
    """
    if event in self.__published:
        raise ValueError("already publishing %s" % event)
    self.__published[ event ] = []
```

```
def __notify(self, event, *args):
    """ notifies the event subscribers that an event has occured.  Schedules  each subscribed callback function
to be invoked with the specified  args.  Does not actually invoke them, to ensure that a call to this
method returns promptly and without blocking.  all callbacks will be invoked in the context of the thread that created
this object.  """

    funclist = self.__published[event]
    if len(funclist) > 0:
        dbg("util", "%s - callbacks to notify: %d" % (event, len(funclist)))
        for cb in funclist:
            def callback( cb=cb, args=args ):
                try:
                    cb( *args )
                except Exception, e:
                    dbg("util", "uncaught exception in callback!")
                    dbg_exc("util")
            e32.ao_sleep(0, callback)
```

- Different screen resolutions
  - e.g.176x208; 240x320 (quarter vga); 352x416
- Different screen orientations

Navigation

- On each screen, user should be able to answer questions:
  - Where am I?
  - Where can I go from here?