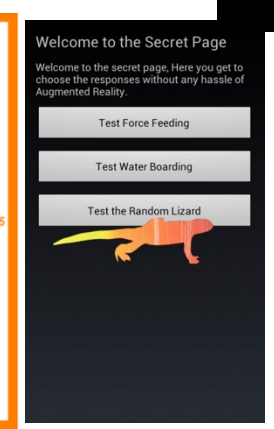
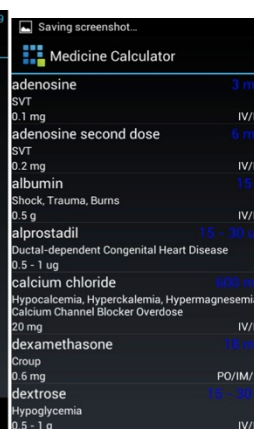
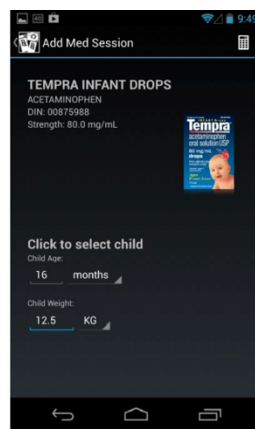
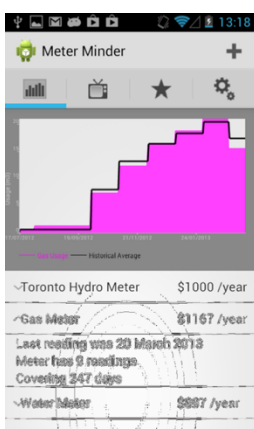
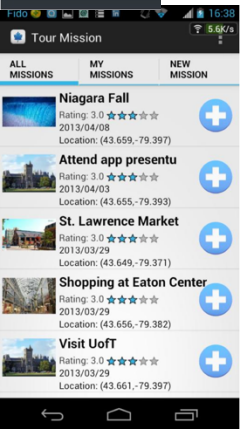
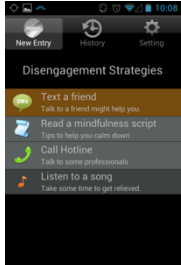


ECE 1778:

Creative Applications for Mobile Devices

Instructor: Jonathan Rose

Department of Electrical & Computer Engineering



Welcome!

- There has been an avalanche of progress in **mobile devices** in the past 5 years
- They are revolutionary
 - despite prior existence of both computers and cell phones



(2)

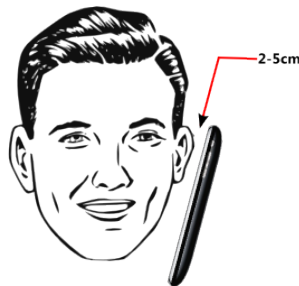
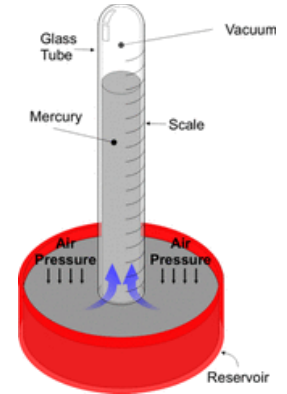
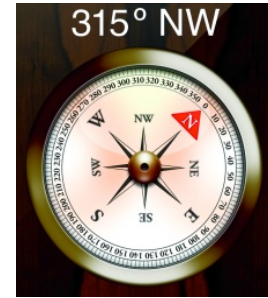
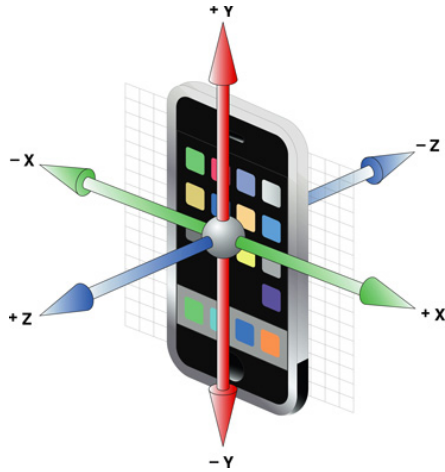
Smartphones are a Huge Leap:

Because they contain in one portable package:

- A powerful computer you can carry in your pocket
 - More easily programmed than ever before
- Connected to the Internet
 - More knowledge & compute power
- Can **sense** its environment in many ways
- Can **speak** to its environment in several ways
- Can also make phone calls



What's in a Smartphone? A lot!



(4)

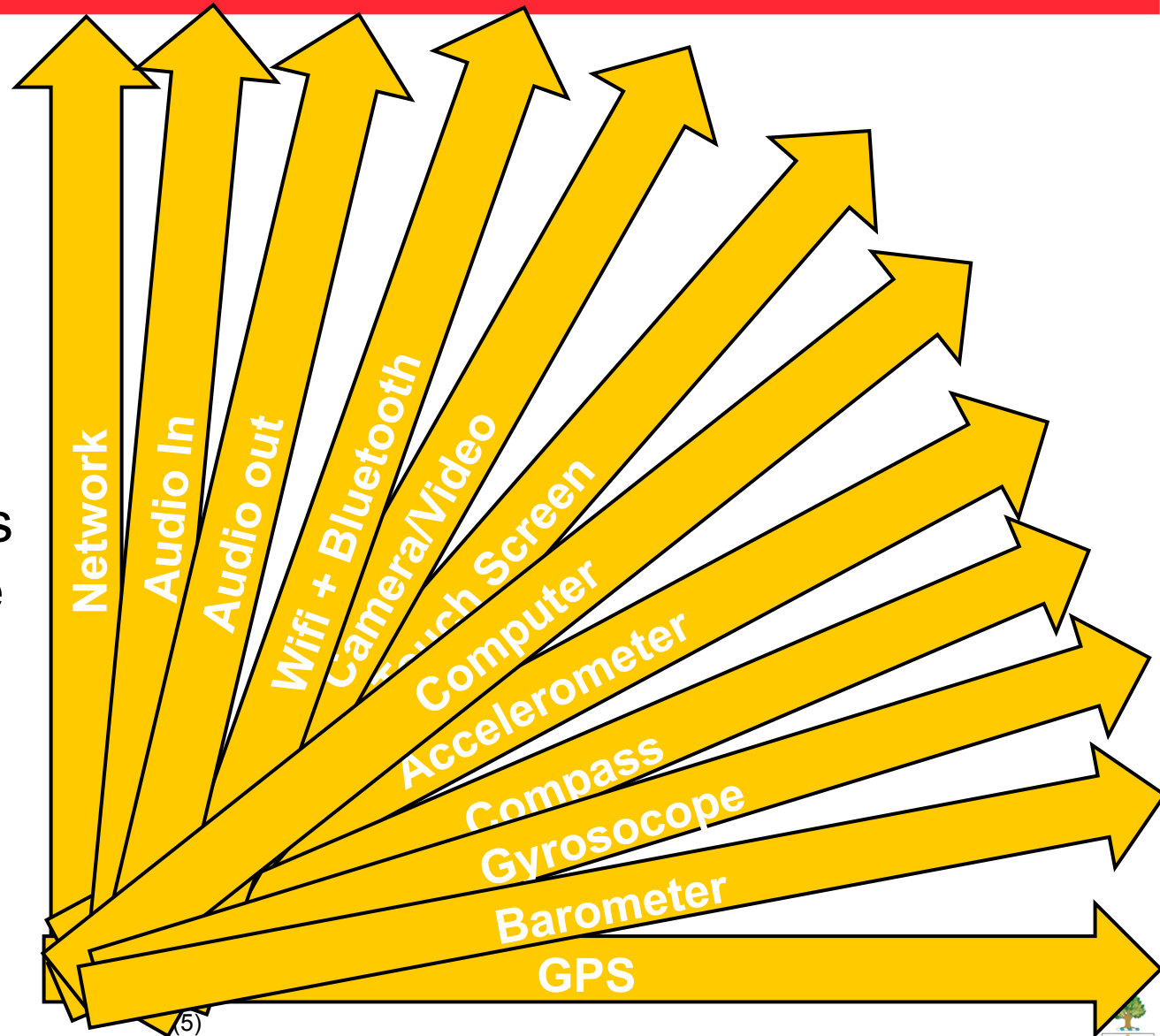



Bluetooth®



Each Capability is an *Axis of Invention*

- Each kind of software capability is also an axis
- Each axis multiplies what is possible with the others!



(5)



Consider: Ocarina Musical Instrument

- A case study in inventiveness
 - Using a novel combination of capabilities
 - “Blow” into microphone; multi-touch touch screen; speaker



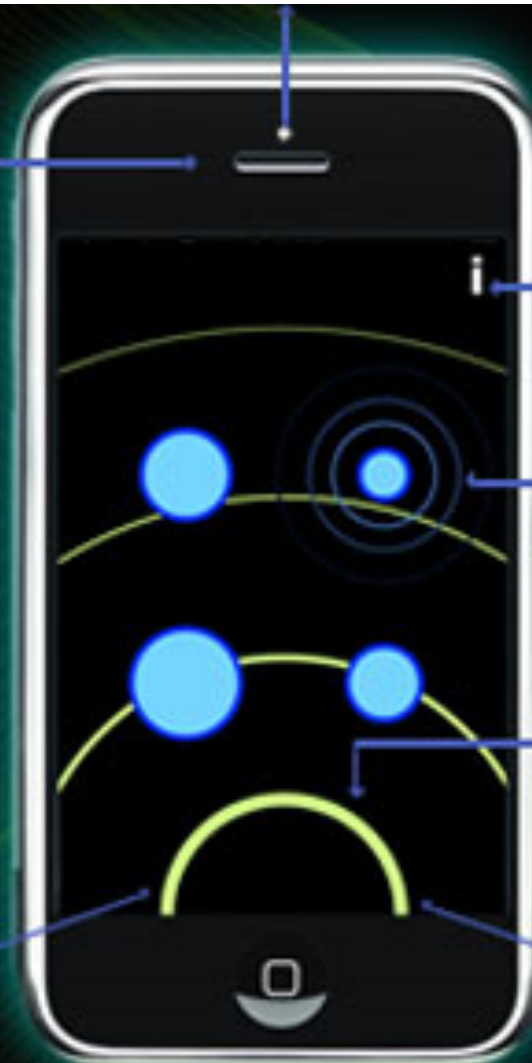
Ocarina

Synthesized ocarina

dynamically generated,
parametrically controlled
ocarina model; options:
digital delay, reverb



multitouch (1-4 points)
for pressing up to 4
finger holes



Real-time map display

(see map display)

Visual Feedback 1

as finger presses down

Visual feedback 2

con-centric rings
radiate from the
bottom as user blows

Accelerometer

controls vibrato
(left/right)

controls timbre
(front/back)

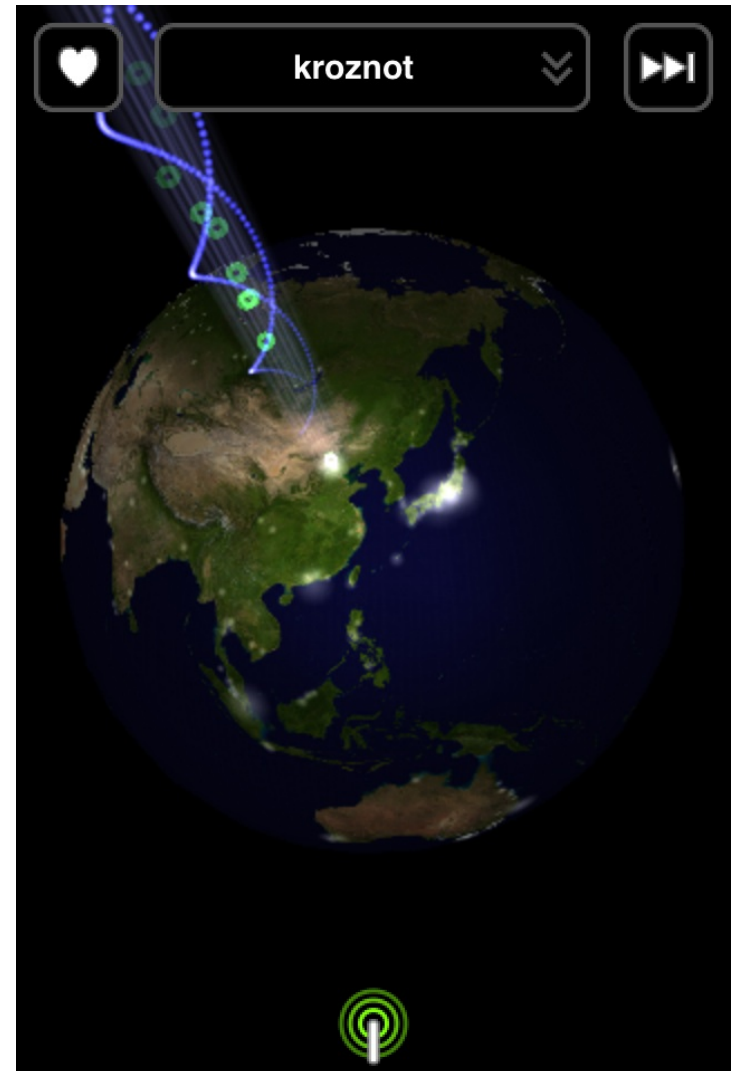
Microphone

plays the instrument

OCARINA

Ocarina: The Really Neat Part

- World map
 - uses GPS to locate users
 - White dots on globe show users
- Ocarina records the sound everyone plays *by default*
 - Dot ‘plays’ music from randomly chosen Ocarina player, anywhere in the world!
 - Nice graphic too;
 - Moving
- Top 20 iPhone app of all time, according to Smule

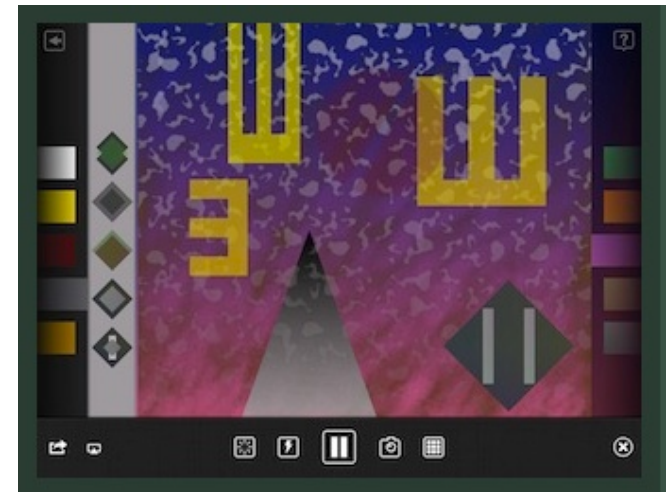


Axes are Different Kinds of Paint Brushes



Consider: Scape, a Musical Composer App

- A case study in inventiveness
 - Uses touch screen, sound and computer
- Make music that thinks for itself.
 - a new form music creation
- Musical elements can be endlessly recombined
 - behave intelligently: reacting to each other, changing mood together, making new sonic spaces.



- <http://youtu.be/8zNLIKRRUVk>

Painting & Programming

- We can create new things with mobile devices, more easily than ever before.
- But not so easily that everyone can do it
 - need ability to program
- The purpose of this course is to bring together people from different disciplines, including programmers, to be able to create new things on this remarkable canvas.



The Revolution Began July 2008

- With the advent of the Apple iPhone App Store
 - & associated development tools
- Today:

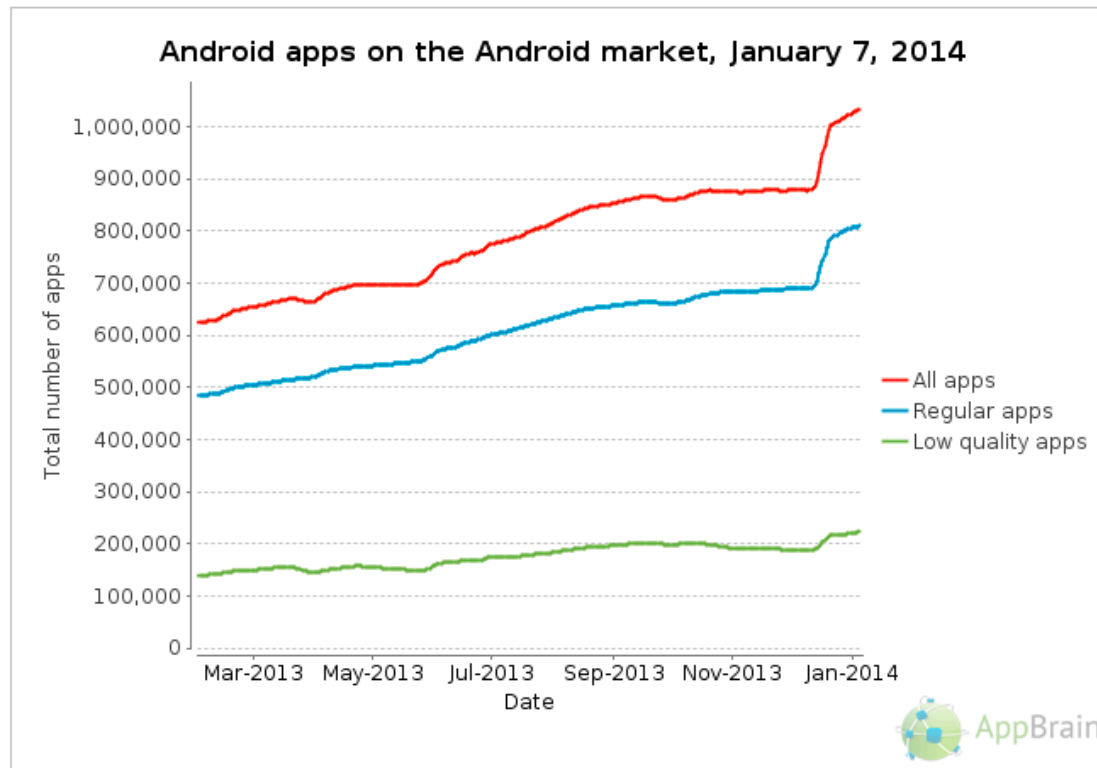


Hundreds
of thousands
of endless
possibilities.

Built-in apps are just the beginning. Browse the App Store to find even more amazing apps designed specifically for iPhone — by Apple and by third-party developers. The more apps you download, the more you'll realize there's almost no limit to what iPhone can do.

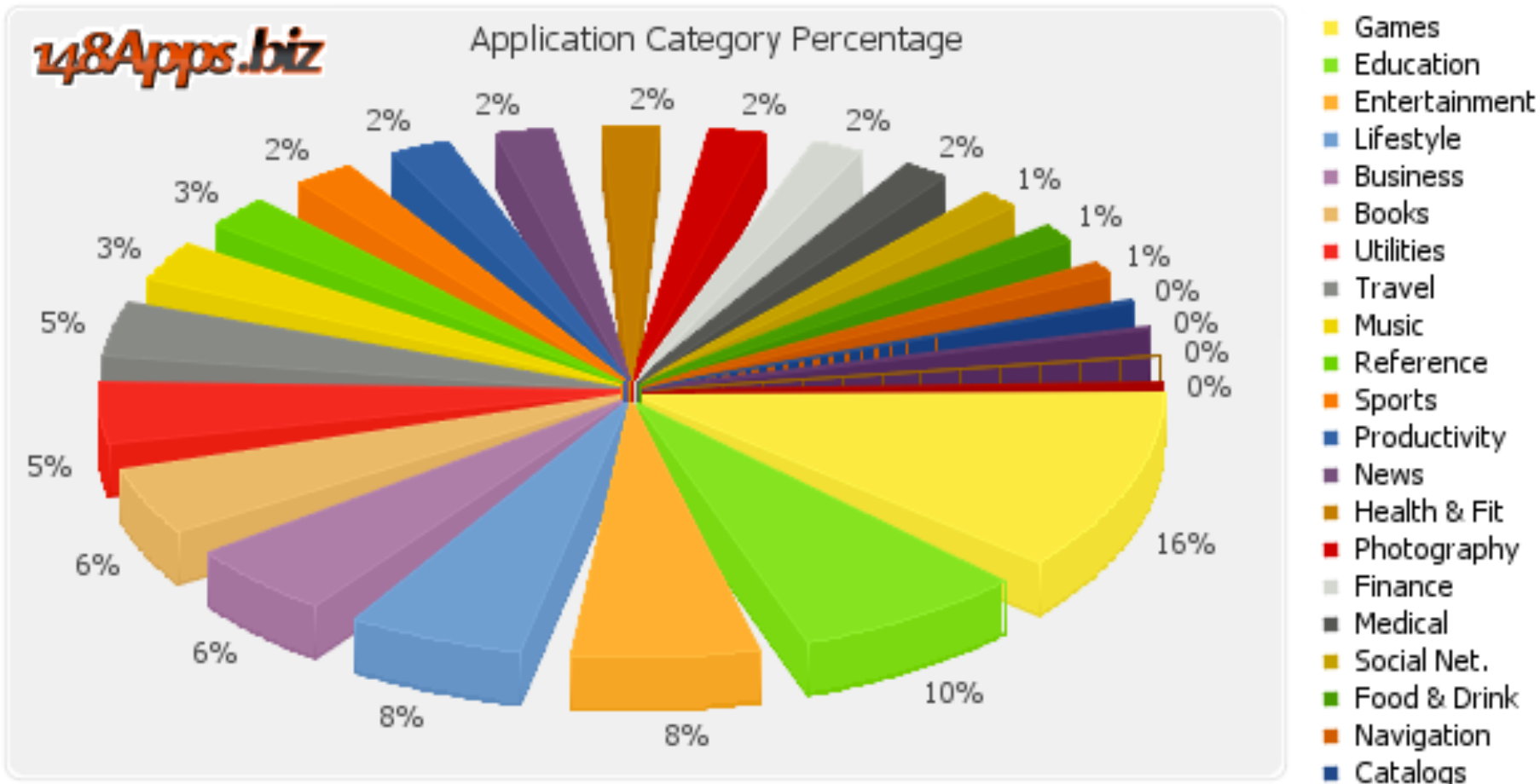
Given Rise to Many Great Ideas

- Perhaps one of the greatest surges of creativity in human history has occurred in the past 5 years
- 1,001,555 Apps in Apple App Store
- 1,036,815 Apps in the Android Market



Hundreds of Thousands of Great Ideas

Apple App Store by Type of App



There are Many More Ideas to Come

1. We are not used to what is possible when all these things - powerful computer, sensors, internet, portability - are brought together
 - We're developing habits and understandings that will lead us
 - These devices are changing us!
2. Monthly progress in technology
 - Fierce competition: Apple, Samsung, HTC, Google, Huawei, Lenovo, ZTE, Blackberry
 - Economics of large-scale market
 - Technology that would otherwise be expensive in low volume, becomes inexpensive in high volume
 - viz – Google Glass, external sensors



Fast Moving Technology

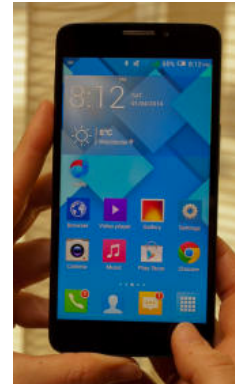
From this week's Consumer Electronics Show:



**Remote
Light Bulb**



**Flexible
Screens**



**8 Core
Processor**



**New Pebble
Watches**

Course Goals & Outcomes



Goals of Course

1. Create an interesting & novel mobile application
 - In a group project
 - That enhances/enables research in a specific field
 - **Or** that enhances a specific field in a new way
 - That is of sufficient technical depth
2. Participate in a creative inter-disciplinary environment
 - Interaction between programming & non-programming disciplines
 - Interactions between many disciplines
3. Teach literacy in mobile programming & potential
 - Gain engineering project experience with hard deliverables



Two Kinds of Students/Paths in Course

1. 'Programmer'

- Engineering, Computer Science or other **graduate** students with good programming backgrounds
- Skilled in the art of programming
- Undergraduates with permission of instructor

- Should have undertaken **serious** programming projects in past
- Taken courses beyond introductory programming that include larger-scale projects
 - 1000+ lines of code
 - Operating systems
 - Graphics
 - Design Project



Two Kinds of Students/Paths

2. 'Apper'

- Graduate Students from every discipline
- With some computer literacy
- A desire to create new app, in art, science, engineering
- YOU BRING EXPERTISE IN THAT DISCIPLINE

- e.g. from 3 years ago: Wound Care:
 - Robert Fraser was a registered Nurse
- e.g. last year Mozart's Ear
 - Andrea Stewart was in faculty of Music



Programmer or Apper?

- All ECE and Computer Science students should be considered Programmers
 - unless lacking in the needed background
- You can separately make a case that you wish to drive the application, but must still take the **programmer** path through the course
 - Other thoughts on this later



A Few Example Projects

From previous years



MyWalk

Measuring and Correcting Step-Time *Asymmetry*

Apper: Justin Chee

Programmers: Tuck-Voon How

Eric Wan

April 2012



Step-Time Asymmetry

- Is a walking problem
 - individual spends unequal time on each foot while walking
- Affects a wide range of patient populations
 - including stroke victims
- Has bad effects that worsen over time:
 - increased joint degeneration
 - musculo-skeletal pain
- Studies demonstrate that patients can improve with active feedback...






My Walk

- Measures step-time asymmetry
 - using accelerometer

$$\text{Step Time Asymmetry} = \left(\frac{\text{Time spent on one foot (s)}}{\text{Time spent on other foot (s)}} \right) \times 100$$

- Helps person correct it by providing timing 'beeps'

Table of Symmetry Value Meanings

Rating	Score	Meaning	Corresponding Populations
 GOOD	> 91%	Symmetrical Gait	Able-bodied adults (Normative)
 MODERATE	80-89%	Mild Asymmetry	Stroke patients (3 years post-stroke)
 POOR	< 80%	Severe Asymmetry	Stroke patients (6 years post-stroke)

My Walk Screen Shots

The image displays three sequential screenshots of the MyWalk application interface. The first screenshot shows the main menu with the 'MYWALK' logo, a 'TRAINING' button, and user activity statistics. The second screenshot shows the 'TRAINING INSTRUCTIONS' screen with four numbered steps: 1. Place phone in harness, 2. Begin walking when ready, 3. Improve step regularity when cued (with a 1-minute timer), and 4. When directed, stop and view results. The third screenshot shows the 'TESTING IN PROGRESS' screen with a large silhouette of a person wearing a harness and a phone, with instructions to place the phone in the harness and ensure the screen is facing the body. A 'STOP TEST' button is visible at the bottom.

MYWALK

TRAINING

Last Activity ?

3 Days Ago **Moderate** Status 86% Symmetry

Feedback Options

Sounds ON

Vibrations OFF

BEGIN TRAINING

TRAINING

TRAINING INSTRUCTIONS

ASYMMETRY THRESHOLD: 80%

1 Place phone in harness.

2 Begin walking when ready.

3 1 MIN Improve step regularity when cued.

4 When directed, stop and view results.

READY TO BEGIN

TRAINING

TESTING IN PROGRESS

Place phone in harness.

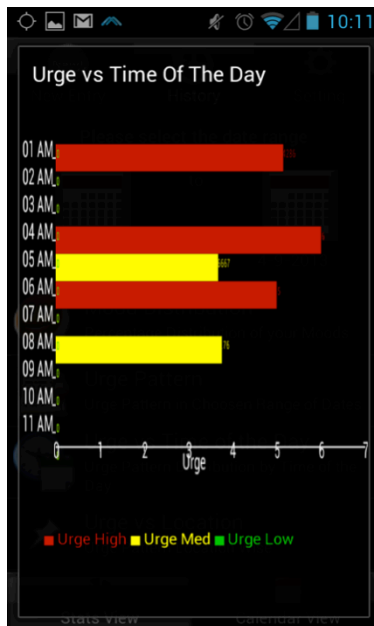
Ensure that the screen is facing your body. ⚠

Waiting for appropriate phone placement . . .

STOP TEST

Mindful Me

Journaling for Addiction and Intervention



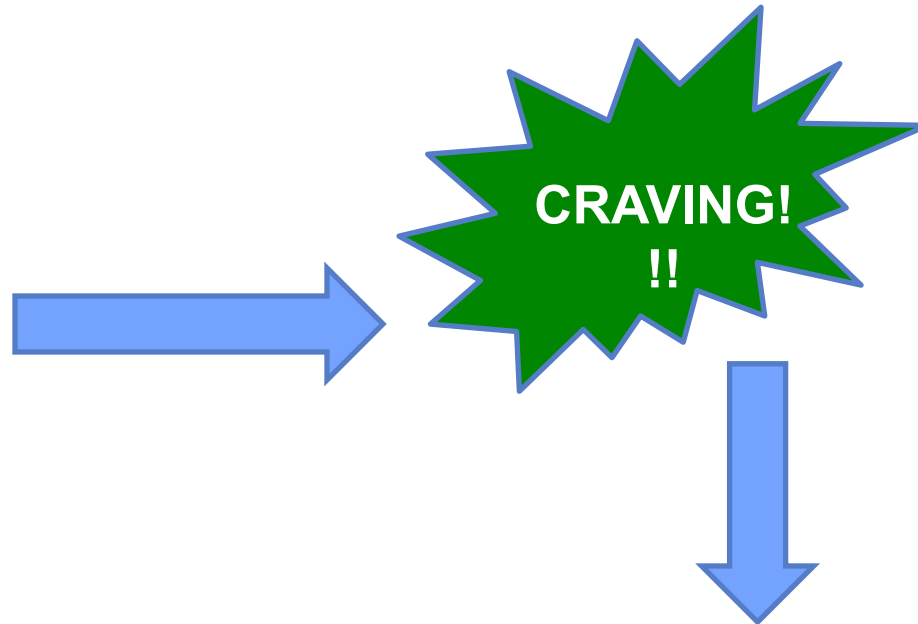
Apper: Elizabeth Glenn Guy
Programmers: Shobhit Puri
Yvonne Chen

April 2013

(27)

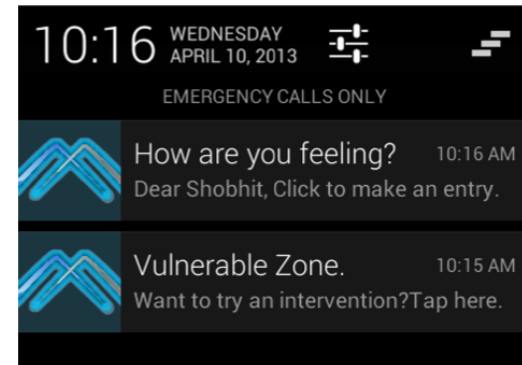


Addictions are Tough Problems



'Journaling' part of addiction treatment

- Part of the treatment of an addict is to *Journal*
 - Write down cravings in a diary
 - Identify vulnerable *contexts* → practice intervention strategies
- **Problem:** paper-based journaling
 - Invasions of privacy
 - Tedious
- **Solution:** use mobile device to aid journaling
- Increase journaling frequency → efficacy:
 - Easy to use interface
 - Automatic location identification/data processing
 - Data visualization & vulnerable location identification
 - Identify best intervention strategies for each *individual*



Big Idea

- With a phone, you can not only record the issues/cravings, but it can record:
 - Where you are
 - How you were moving
 - What you were hearing
 - Perhaps what you were seeing
- It could learn that a certain location is a problem for you (e.g. near a Bar that an Alcoholic frequents)
- It could then **Intervene!**



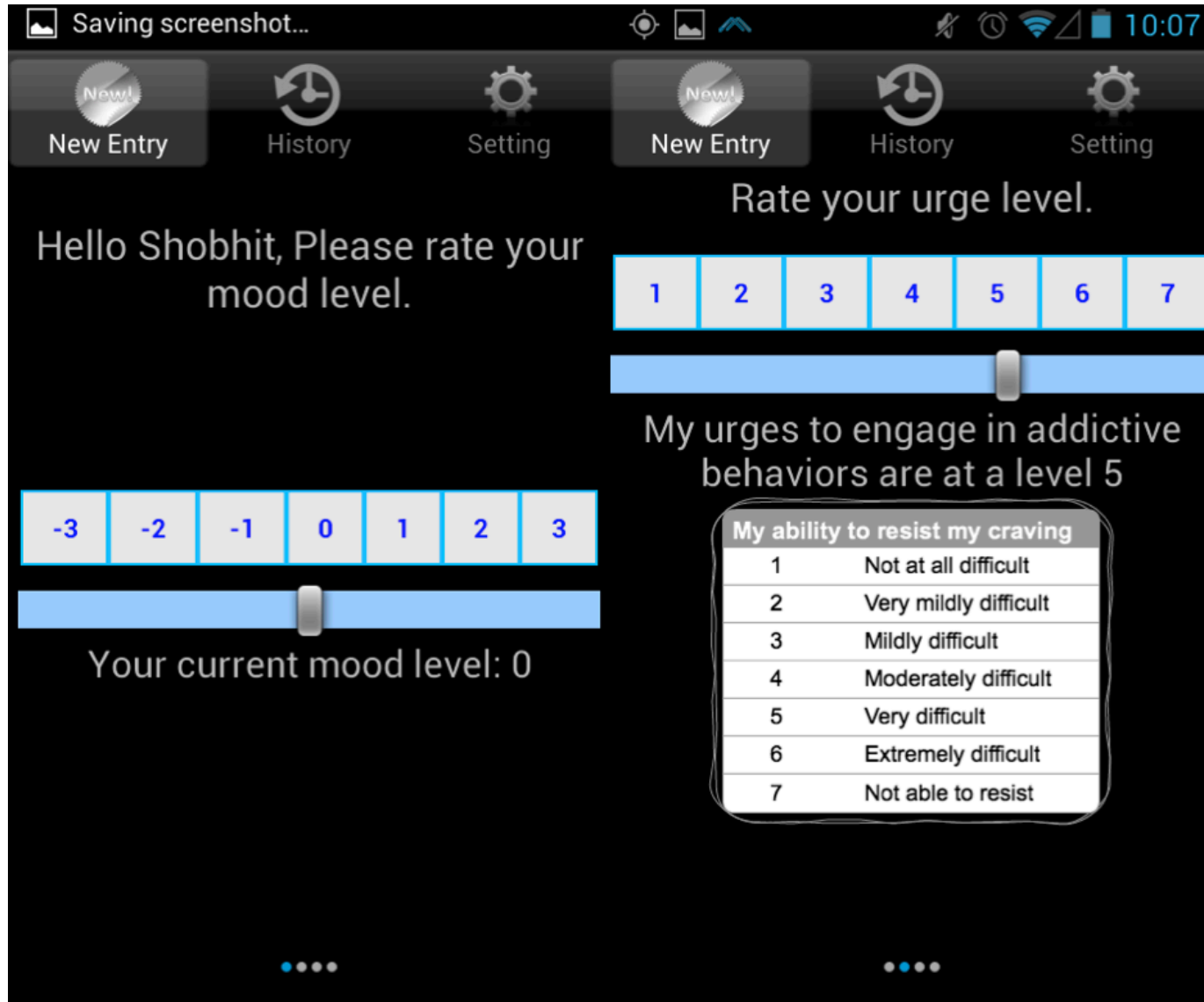
Interventions?

- Call your Alcoholics Anonymous Sponsor for you
- Play a song to distract you.
- Send you a text.

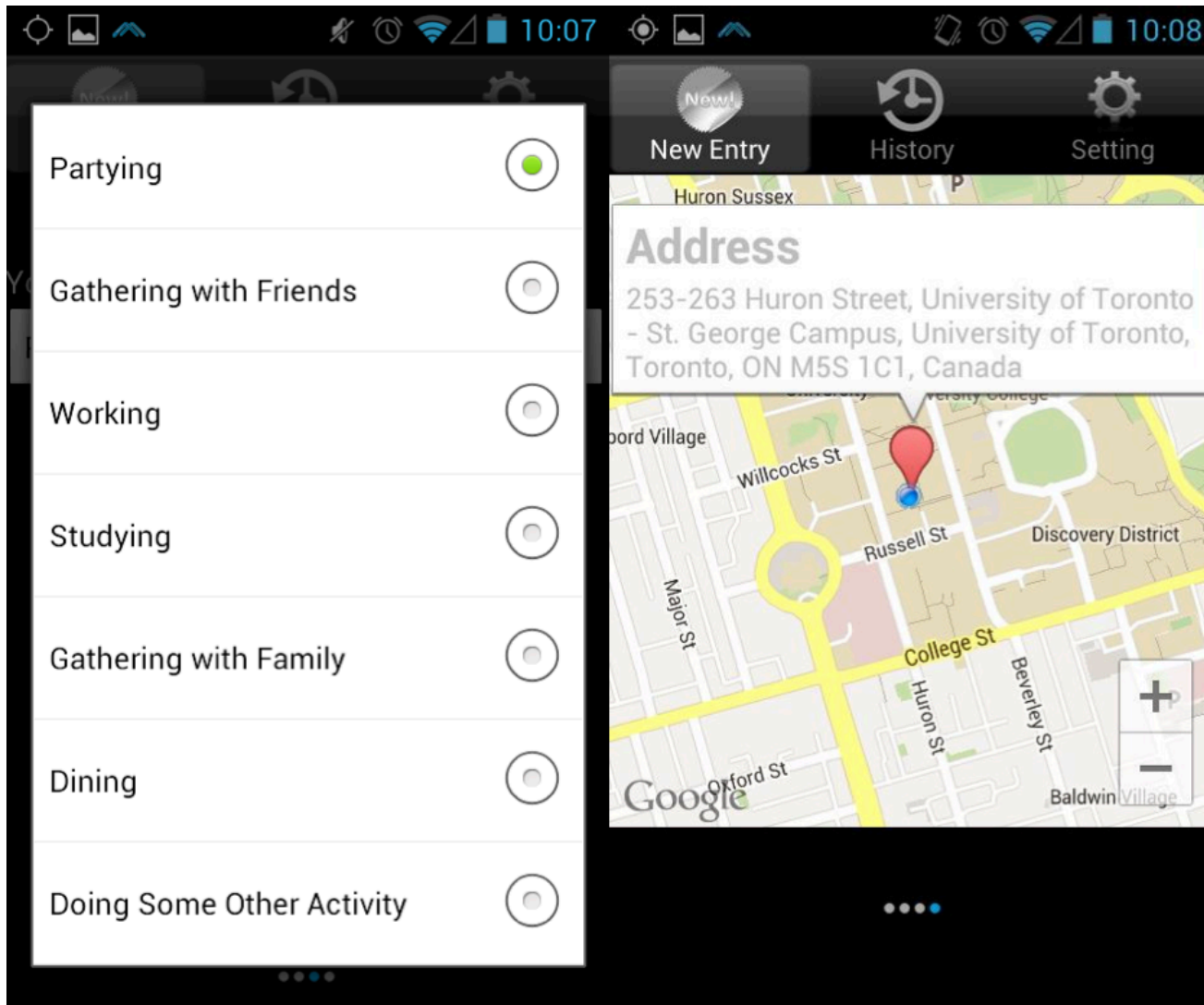
- Many other possible ideas.



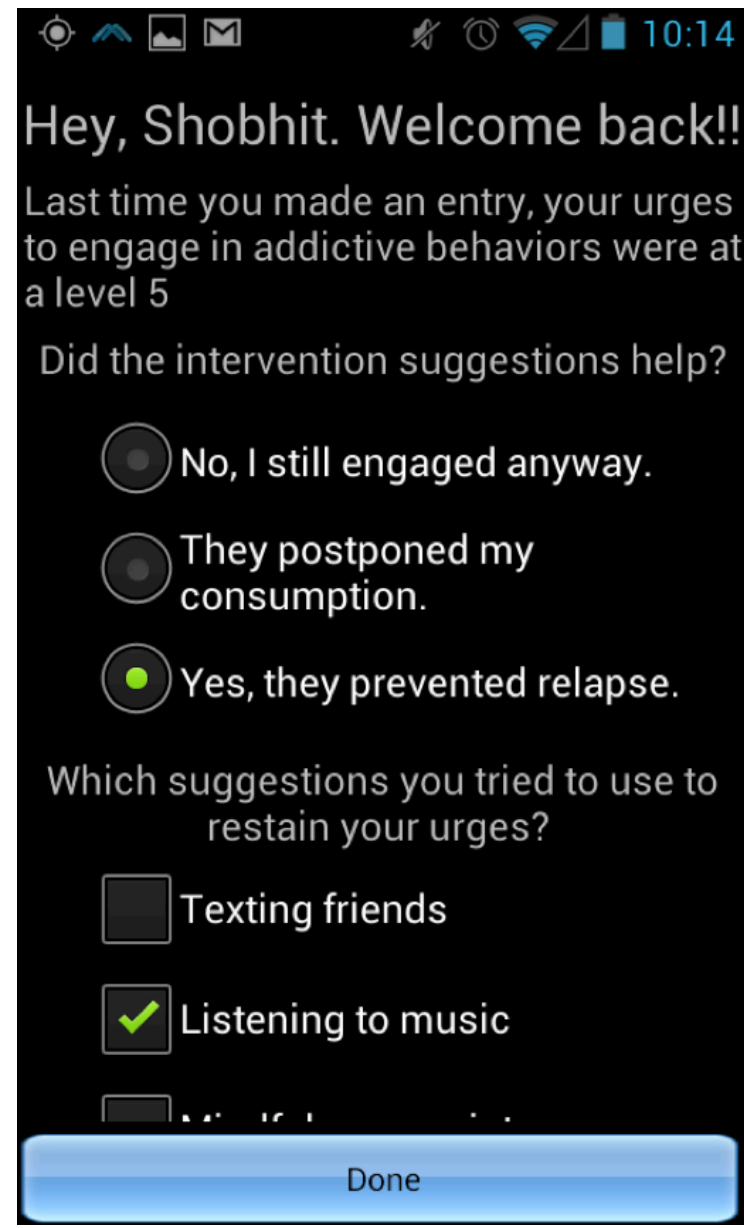
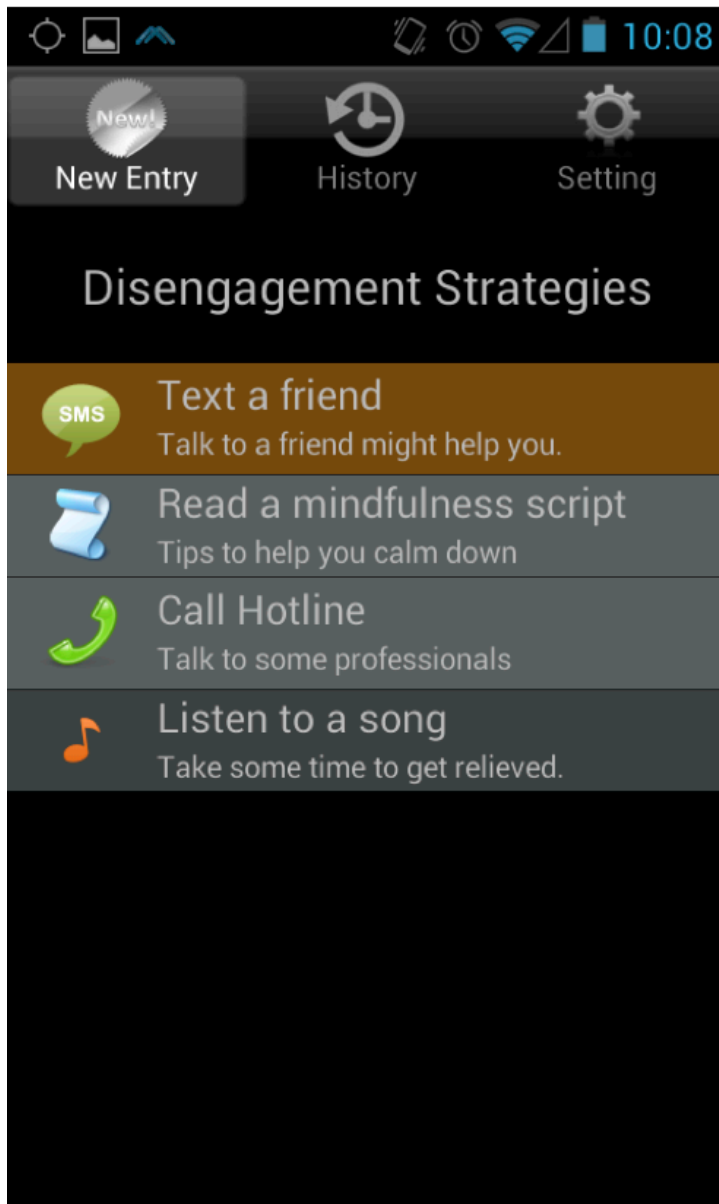
Journal Screens



Locating & Specifying Activity



Intervention Suggestions



Data Collection

The screenshot shows the 'Stats View' of the application. At the top, there are three buttons: 'New Entry' (with a 'New!' badge), 'History', and 'Setting'. Below these is a prompt: 'Please select the date range'. Two calendar icons are shown, with the first selected for '4-2-2013' and the second for '4-9-2013'. Below the date range selection, there are four data analysis options, each with an icon and a description:

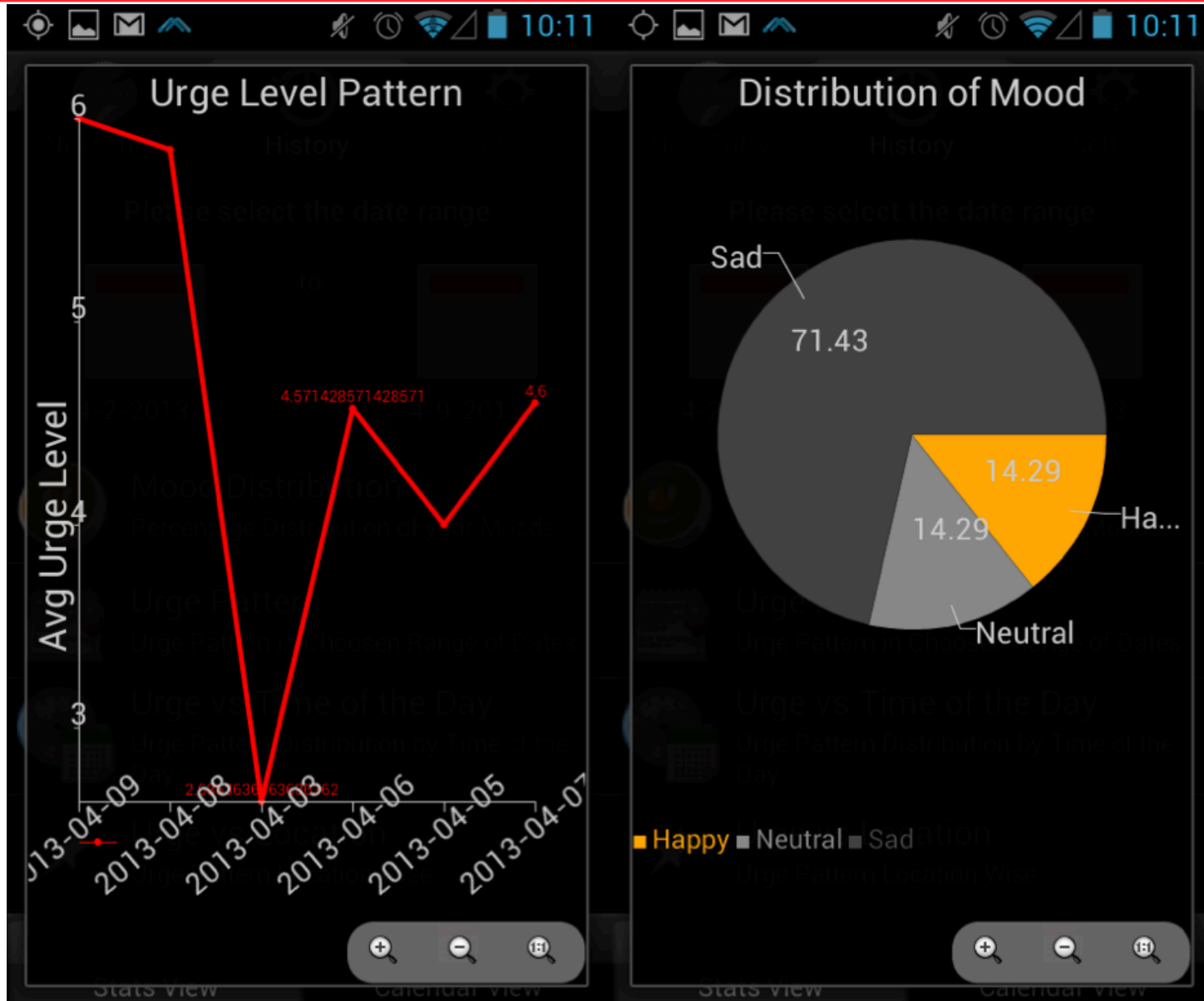
- Mood Distribution**: Percentage Distribution of your Moods (with a smiley face icon)
- Urge Pattern**: Urge Pattern in Chosen Range of Dates (with a calendar icon)
- Urge vs Time of the Day**: Urge Pattern Distribution by Time of the Day (with a clock icon)
- Urge vs Location**: Urge Pattern Location Wise (with a star icon)

At the bottom, there are two buttons: 'Stats View' (which is highlighted) and 'Calendar View'.

The screenshot shows the 'Calendar View' of the application for the month of April 2013. At the top, there are three buttons: 'New Entry' (with a 'New!' badge), 'History', and 'Setting'. Below these is the title '2013 April'. A calendar grid is displayed with days of the week (SUN to SAT) as columns and dates as rows. The dates are color-coded: green for 3, 10, 11, 12, 13, 18, 21, 25, and 27; red for 14, 15, 16, 17, 19, 20, 23, 24, 26, 28, 29, 30, and 31; and yellow for 4, 5, 6, 7, 8, 9, 22, 29, and 30. At the bottom, there are two buttons: 'Stats View' and 'Calendar View' (which is highlighted).

SUN	MON	TUE	WED	THU	FRI	SAT
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	1	2	3	4
5	6	7	8	9	10	11

Data Display



Follow-up Research

- In discussions with CAMH researcher/clinicians on adapting this for use in smoking cessation.
 - Lots of people addicted to smoking!
- Small centre for smoking cessation at bottom of King's College Road.

Declaration (non-binding)

Raise Your Hand if you Think you are a Programmer

Raise Your Hand if you Think you are an Apper



Sign Up Sheet

- Name
- Student Number
- Department/Field
- **Degree**
- Taking Course for credit
 - Yes/Maybe
 - Audit: cannot without special permission; can't do project as an auditor
- Full time or Part Time
- Programmer/Apper self designation
 - Can check both
- Phone Type: What kind of smartphone do you have?
 - Android/iPhone/Blackberry/Windows ...



Course Learnings & Outcomes

- Knowledge & Experience
 - **Programmer:** How to program in a mobile environment
 - **Apper:** Capabilities of mobile devices & basic technical understanding & how it can be applied to your discipline
- How to Work across disciplines
 - Inter-disciplinary creativity
- Project Experience
 - With tangible deliverables
- Clear, Concise Presentation Experience/Feedback
- Advance of research capability through use of mobile dev



This is an Experimental Course

- Open to students from *all* disciplines
 - Multi-disciplinary project-based course
- Fourth time taught
 - course has evolved each time
- We welcome suggestions for improvement
 - will continue to adjust as we go along this year
- It will be quite a bit of work

- **Key:**
 - to reach across the boundaries of disciplines
 - learn the language of the ‘other’ discipline



Instructor Bio: Jonathan Rose

- Professor in Electrical & Computer Eng since 1989
 - Bach, Master's & PhD from here, Post-Doc at Stanford
- Research Field: Field-Programmable Gate Arrays
 - 'Soft' hardware that can be programmed to become any circuit
 - Also Inter-disciplinary mobile applications (!)
- Entrepreneurial/Business Experience:
 - Co-founder of Right Track CAD Corp in 1998
 - Senior Software Engineering Director of Altera 2000-2003
 - Run the [Engineering Entrepreneurship Seminar Series](#)
- Administration:
 - Dept. Chair of ECE 2004-2009;
 - Director of Eng Biz Minor; Chair of Eng **Hatchery** Board
- F.IEEE, F.ACM, F.CAE, FA NAE, FRSC, Sr Fellow Massey College



Why I Began Teaching this Course

- I have always felt that mobile devices would one day take a central role in human progress
- I've always been thrilled with possibilities of small, portable, highly integrated computers
- That time is now upon us; let's make interesting things happen!



Teaching Assistants

■ Braiden Brousseau

- TA'd course for last 3 years
- Ph.D. Candidate in ECE
- M.A.Sc. thesis: Accelerating computer vision for smartphones using FPGA hardware
- Ph.D. Thesis: Eye Tracking in Mobile Devices & Application
- braiden.brousseau@utoronto.ca

■ Alexandra Makos

- Ph.D. Candidate, OISE
- Ph.D. Thesis: the nature and impact of non-task social interaction on productive discourse in online learning environments
- Took course last year, as Apper in 2012, TA'd in 2013
- alexandra.makos@utoronto.ca



The Project



The Project Group

- Done in Groups of 3
 - 2 Programmers
 - 1 Apper
- Need enough programmers : appers to make this work
 - otherwise will have to restrict enrolment
- OK to have groups of programmers-only, if extra, but only if no Appers left
 - Have a few 'external' Appers that I have pre-approved in the case that there are insufficient Appers



Rules on Project App

1. Subject Must be in the discipline of the Apper

- an idea to support research
- or something useful/worthwhile/interesting within the discipline
- should leverage expertise that discipline
- Message to those who want to be programmer+appers: wait
 - Should first hear ideas
 - I will (mostly) enforce pure Apper-driven projects

2. Must have sufficient technical depth

- Will be an approval step in process to ensure this

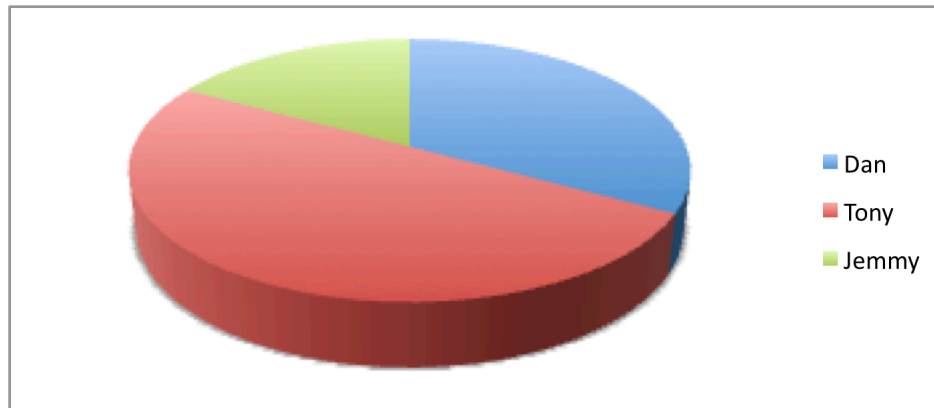
3. *Should* be a new idea

- Can be variant of existing app if enough different



e.g.: Measure the Fraction of Conversation

- Listen to a conversation, and measure the fraction of the conversation that each participant takes up!
- Daniel DiMatteo's (one of my grads) undergraduate thesis
 - Known as 'Diarization'
 - Using open source software
- Could be used to measure 'turn taking' behaviours in different cultures in Anthropology



Project Stages

1. Forming Groups

- Within 2-3 weeks; special get together Wed Jan 15 @6:30pm

2. One-Page Proposal

- Due January 29th; Must receive approval to proceed

3. Project Plan

- Due Feb 5th

4. Proposal & Plan Presentations

- February 12 & 13
- **NOTE EXTRA LECTURE Thursday Feb 13, 6-8pm, TBD**

5. Spiral 2 & Spiral 4 Presentations

- 2: March 5/12 4: March 19/26

6. Final Presentations

- Weeks of April 2 & 9

7. Final Report Due April 10th



Course Material



There are Three Course Websites:

- <http://www.eecg.utoronto.ca/~jayar/ece1778/>
 - Has link to videos & reports from previous years' projects
 - Assignments will be placed here and on Blackboard
 - Lectures posted here
- Plus Blackboard Portal for basic stuff
 - Grades
 - Announcements
 - Handing in Assignments
- **Pepper** system from OISE for interaction & upload
 - See announcement on Portal that tells you how to access



Course Material

■ Lectures

- Basic phone capabilities
- Thinking/discussion about how to use capabilities in project
- Programming concepts, but not that much
- Project basics
- Case Studies of interesting/inspiring apps
- Visitors planned:
 1. Design for User Experience Lecture – Offierski & Clarke from the Konrad group
 2. Security issues in mobile – Prof. David Lie

■ Mostly presentations from class

- proposal, progress, final



Course Material, cont'd

- 4 Assignments in first 5 weeks!
- Programmers:
 - Introduce yourself
 - learning basic development in mobile
 - Mobile programming – sensors, database
 - Leverages the experience requirement
- Appers:
 - Introduce yourself
 - Case studies;
 - Learning 'design' software;
 - Learning technology concepts



Mobile Platform - Android

- We will focus on, and I will teach to, Google's Android
 - Widely available, works on all major operating systems (Windows, Mac, Linux)
 - Many phones available, some donated for class
 - Is successful
 - **Con:** Eclipse environment not very clean;
 - Programming Language: **Java**



Alternative, if You Have Mac & iPhone

- If you wish to do assignments & project on iPhone, that is allowed, but talk to me first
 - **Pro:** Better development environment
 - **Con:** less common language: Objective C
 - **Con:** Must have a Mac computer
- Assignments are set up to be for Android and iPhone
- Other platforms possible, with permission, at user's risk.
 - Need to know that project partners agree with platform!
 - Can be issue with iPhone too!

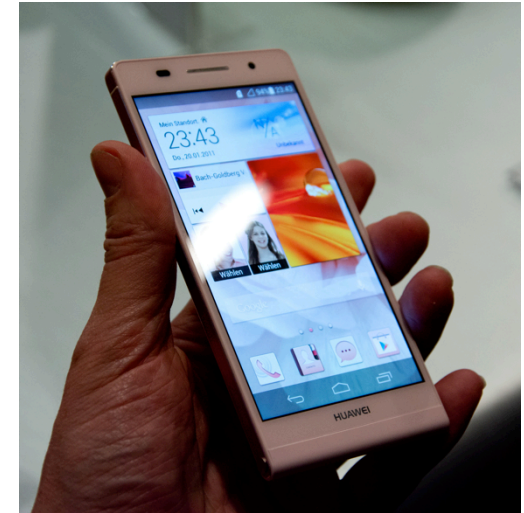


Physical Phones

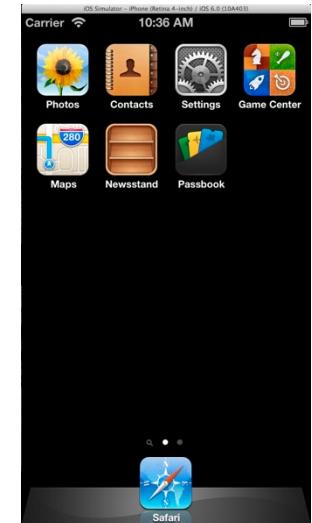
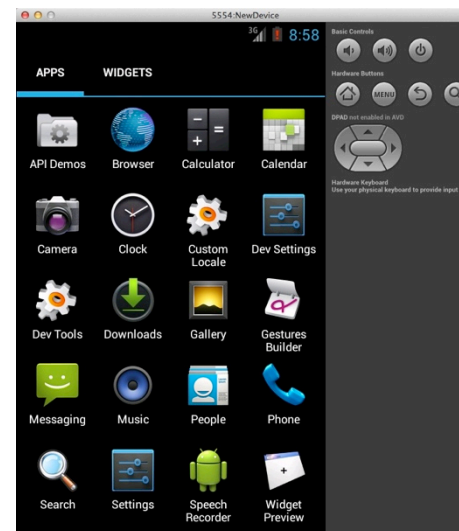
- Have some phones donated to help with assignments and projects
 - good, also, if you have one yourself
- It is much better (and sometimes necessary) to develop on actual phone
- Can use the emulator;
 - OK on android;
 - Good on iphone



Ascend P6



Android Emulator iPhone Emulator



Textbooks for Programmers & Appers:

Android

By Mark Murphy:

1. The Busy Coder's Guide to Android Development

- <http://commonsware.com>
- Murphy gives free 4 months licenses for students
 - Ask TA Braiden Brousseau for License key by email
- \$40 buys all current versions, and a year's subscription to the updates, that come out with each new version of Android
- Although this is largely for programmers, I suggest that Appers read through the first 9 chapters as well.
- Have found that the Android development website is good or better for some things:

<http://developer.android.com/sdk/index.html>



Textbook for Programmers:

iPhone

Beginning iOS 6 Development, Apress

– by David Mark, Jack Nutting, Jeff LaMarche, Fredrik Olsson

See: <http://www.apress.com/9781430245124>

For some reason, there isn't an iOS7 version out yet, but I think the iOS6 one will still work, mostly. An alternative is

Learning iOS7 App Development

See: <http://www.apress.com/mobile/ios/9781430250623>

\$28 for both e-books



Assignments!

Part 1: Due next week: **Tuesday** January 14, 6pm

Part 2: Due in 2 weeks: **Tuesday** January 21, 6pm



Programmer Assignment P1

For Programmers



Prog Assign Part 1: Describe Yourself

1. In Writing

- Give your background – what undergraduate & graduate program you've taken/are in
- List the programming courses you've taken
- List the major programming projects you've undertaken (& size)
- Give the names of all company(s) you've worked for as professional/programmer (either as co-op, summer, or full time)

2. In a video, no more than 2 minutes;

- Describe the projects and work you listed above



Prog Assign Part 1: Describe Yourself

- Upload both on **Pepper**
 - the website we'll use to interact
- Purpose
 - for Appers to get to know you;
 - for us to check background
- Part I is due Tuesday January 14th, at 6pm
 - However, do it right away, so people can get to know you!
 - Late penalty



Assignment P1 for Programmers, Part 2

- Acquire textbook – Android or iPhone
 - **Need some basic Java knowledge**
 - Get a Java book
 - http://en.wikibooks.org/wiki/Java_Programming/Language_Fundamentals
 - Download Android Environment
 - Do “Hello World” tutorial; make it work on an emulator
 - Read 123 pages of text, do small coding exercises
 - Write simple android application
 - Part 2 due Tuesday January 21nd, 6pm; late penalty
 - Posted under Assignments on Course Website and Blackboard
- <http://www.eecg.utoronto.ca/~jayar/ece1778/assignments.html>



Apper Assignment A1

For Appers



Apper Assign Part 1: Describe Yourself

1. In Writing

- Write 250 words that describe your field to a lay person
- Give your background – what undergraduate & graduate program you've taken/are currently in
- Describe what the focus of your degree/research is (e.g. 'my thesis topic is ...', or 'I'm taking courses in..')
- Brief history of work, if any

2. In a video, no more than 2 minutes;

- Name your field, give quick description of it
- Describe other things you might bring to the project – skills, access to a lab for measurements, job experience



Apper Assign Part 1: Describe Yourself

- Upload both on **Pepper**
 - the website we'll use to interact
- Purpose
 - for Programmers to get to know you;
- Part I is due Tuesday January 14th, at 6pm
 - However, do it right away, so people can get to know you!
 - Late penalty



Assignment A1 for Appers, Part 2

1. Find 5 apps in your field and describe each in 100 words
 2. Choose the best of those 5 and do deeper case study:
 - Obtain app, use it, describe it. 1000 words max
 - Mark penalty for too many words
- Part 1 due Tuesday January 14th at 6pm; late penalty
 - Part 2 due Tuesday January 21, 6pm; late penalty
 - Available on Course Website and Blackboard Portal
<http://www.eecg.utoronto.ca/~jayar/ece1778/assignments.html>
 - Hand in on Blackboard Portal



Other Assignments

Date Assigned	Assignment	Due
January 22	P2/A2	January 28
February 5	P3/A3	February 11
February 12	P4/A4	February 25



Grading

■ Assignments: **16%**

- 4 assignments

■ Class Participation: **9%**

- Offering questions and insights in class presentations

■ Project: **75%**

- Proposal 5%
- Plan (incl presentation) 10%
- Spiral 2 Presentation 10%
- Spiral 4 Presentation 10%
- Presentation/Demo 10%
- Final Report 30%



Commercialization & Intellectual Property



Commercialization

- If your group wishes to create an app for sale, feel free to do so
- If not, consider giving away if useful
 - Last year, a number of projects were released as open source, along with reports & videos, see:

<http://www.eecg.utoronto.ca/~jayar/ece1778.2013/project-list.html>

- Note: the scope of course project is broader than those apps that are commercializable
 - Apps can be motivated by research goals



Commercialization & Intellectual Property

- University of Toronto Intellectual Property Rules
 - Work that makes significant use of UofT resources
 - Requires disclosure & extraction of Universities' rights in exchange for fraction of licensing revenue
 - These rules aren't well set-up for apps/app store
 - However, if more than person contributes – group partner, your research supervisor, then their rights must be respected
 - In my view, nothing in regular course work makes significant use of UofT resources



Warning about Intellectual Property

- In my experience, all talk of IP tends to make people think about keeping secrets; that's bad
 - Most ideas live and grow well in 'the light'
 - Advice: Don't get too caught up in this



Project Step 1: Getting To Know Potential Partners



Why

- The key part of this course is the project
- You need to get to know each other, to explore who might work well together
- Assignment 1 asks you to write & speak about yourself
- Also: we will hold an extra course meeting explicitly for the purpose of forming groups:

Date: Wednesday January 15 at 6:30pm

**Location: Sanford Fleming Building room B560
(in basement)**

- We will use the remainder of this lecture for introductions



Please Introduce Yourself

1. Name
2. What discipline you work in & degree sought
3. Taking Course for Credit – yes, no, maybe
4. Part time or full time
5. What your thesis topic is (if doing thesis)
6. If you work, where & what you do.
7. Why you're taking this course
8. What kind of phone you're carrying
9. **Apper**: What idea, if any yet, you have for an app
10. **Programmer**: What you're interested in doing app on.

