

## Smart Health – CSE 40816

University of Notre Dame  
Spring 2020



## Class Project

- Ideally teams of 2 or 3 students (smaller/larger possible, but need to discuss with instructor)
- First milestone: project proposal, which can be a rough road map for your project
- Proposal:
  - PDF file, up to 3 pages
  - Project title, name(s) of author(s)
  - Problem description
  - Proposed solution
  - Technical details (incl. **hardware/software needs**)
  - References (optional)
  - Submission via Sakai
  - Instructor will provide feedback via Sakai

## Course Project

- If help needed identifying team members, let me know!
- Teams are expected to “produce more” than individuals!
- Project can align with your doctoral, MS, honor’s thesis, or other projects (e.g., participation in coding competition), but this must be disclosed in proposal and approved by instructor!
- Cross-team collaboration is encouraged (disclose significant collaborations or sharing in reports)

## Course Project

- Mid-semester report (finalize project goals by then)
- Final report (up to 3 pages), delivered with any code, design documents, etc.
- Brief in-class demo/presentation of project

## Hardware/Software Needs

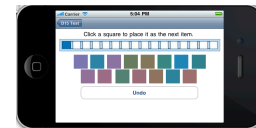
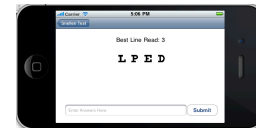
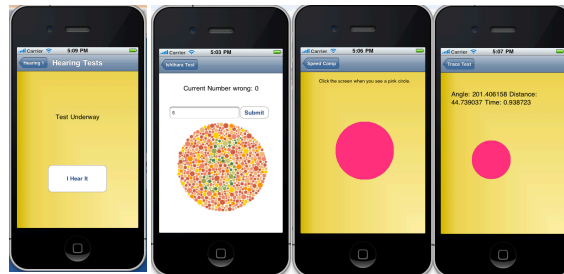
- Clearly indicate if you already have access to HW/SW or if you need help
- Lots of equipment available in our lab (and if price reasonable, we can acquire what you need)
  - iOS devices, Android devices, smartwatches, fitness bands, robots, UAVs, Raspberry Pi, Arduino, Intel Galileo, sensors, various electronics and tools for fabrication, 3D printer, Google Glass, RFID/NFC tags, ...

## Class Project Ideas

- Types of projects:
  - Software projects (web services, applications, mobile apps, etc.)
  - SW/HW projects (explore devices, build services around devices, build sensor/control components)
  - Data/biomarker/analytics projects (data collections, data analysis, etc.)

## Home Medical Exams

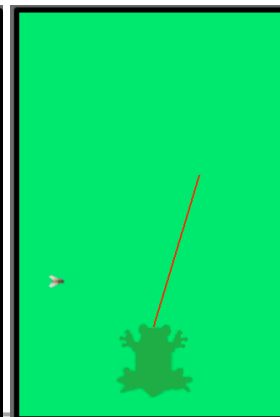
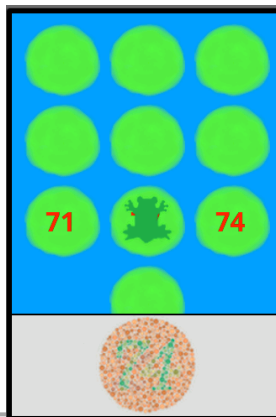
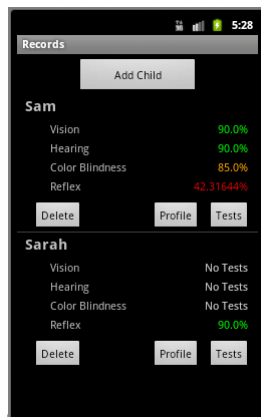
- Snellen Test
- D15 Test: Color blindness test
- Ishihara Test: Red Green Colorblindness Test
- Audiometry
- Reflex Test
- Trace Test



## Home Medical Exams for Kids



Gamification





**EasyEMR 1.0**  
iPad electronic medical records software for doctors

← Back to Homepage  
← Back to Arthritis form #1000

**Demographics** ☒ O/G: Yes ☐ 2-3 oral ulcers a year

**Reason for Visit** 0 / 1 Skin photo: No ☐

**Free Field** 0 / 1 Hepat: No ☐

**Review of Systems** ☒ Hemat: No ☐

**PM/PSHx** ☒ Sjog: No ☐

**Social History** ☒ Rayn: No ☐

**Family History** ☒ Tick/emp: No ☐

**Medications** ☒ Heat: No ☐

**Allergies** ☒ Weather: Yes ☐ **Save & Continue**

**Patient Records**  
Jon Rich

**EasyEMR 1.0**  
iPad electronic medical records software for doctors

**Records for Jon Rich**

4/13/11 Wednesday, Apr 13 at 10:17am	1 / 12
12/31/09 Wednesday, Dec 31 at 7:00pm	0 / 12

Calendar Appointments  
Admin Tools  
Log Out

**EasyEMR 1.0**  
iPad electronic medical records software for doctors

← Back to Homepage  
← Joseph Rich's Records

**Free Field** 0 / 1 **Save & Continue**

**Review of Systems** ☒

**PM/PSHx** ☒

**Social History** 0 / 3

**Family History** ☒

**Medications** ☒

**Allergies** ☒

hello

**Patient Records**  
Admin Tools  
Log Out

**EasyEMR 1.0**  
iPad electronic medical records software for doctors

**Search Patients**

Patient's Name Contains: andrew

Andrew Rich

**Create a New Patient**

MRN:

Last Name:

First Name:

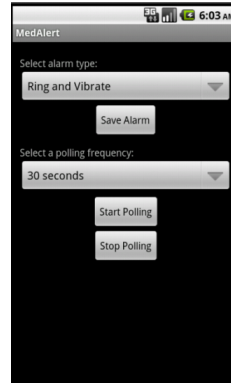
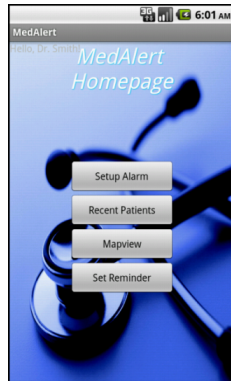
Middle Initial:

DOB: MM DD YYYY

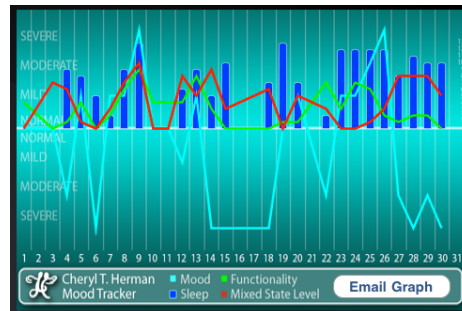
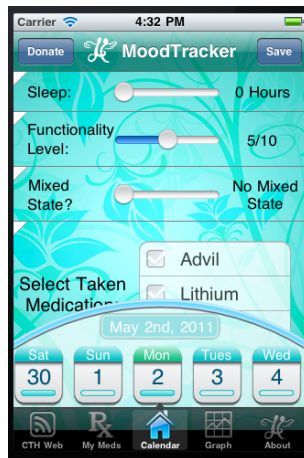
Referred By:

**Save & Continue**

## MedAlert

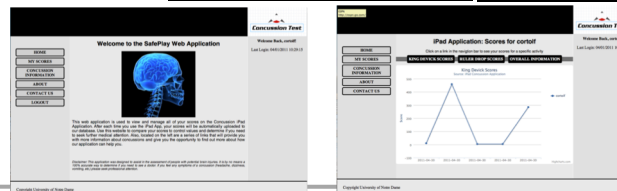
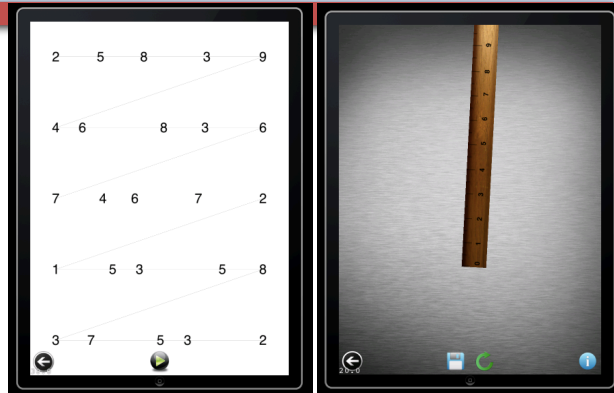


## Mood Tracker



## Concussion Detection

- King Devick Test
- Ruler Test

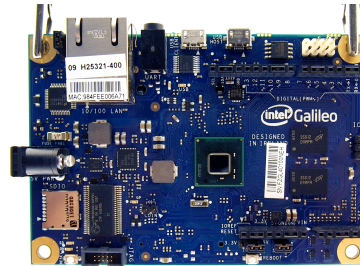


## Audiometry Tool



## Medical Sensor Toolkit/Evaluation

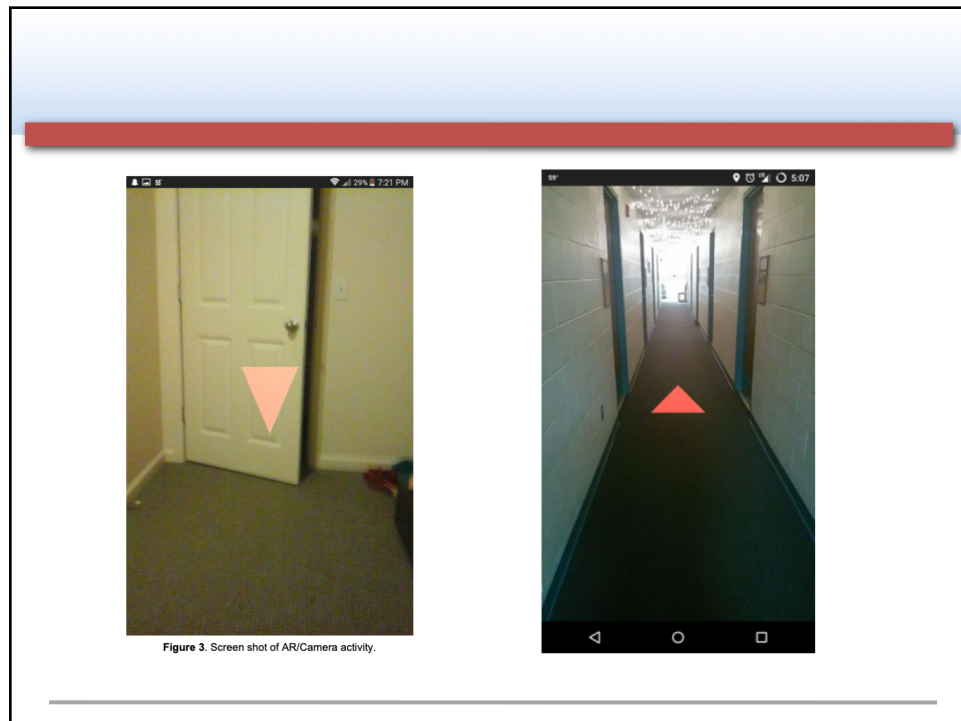
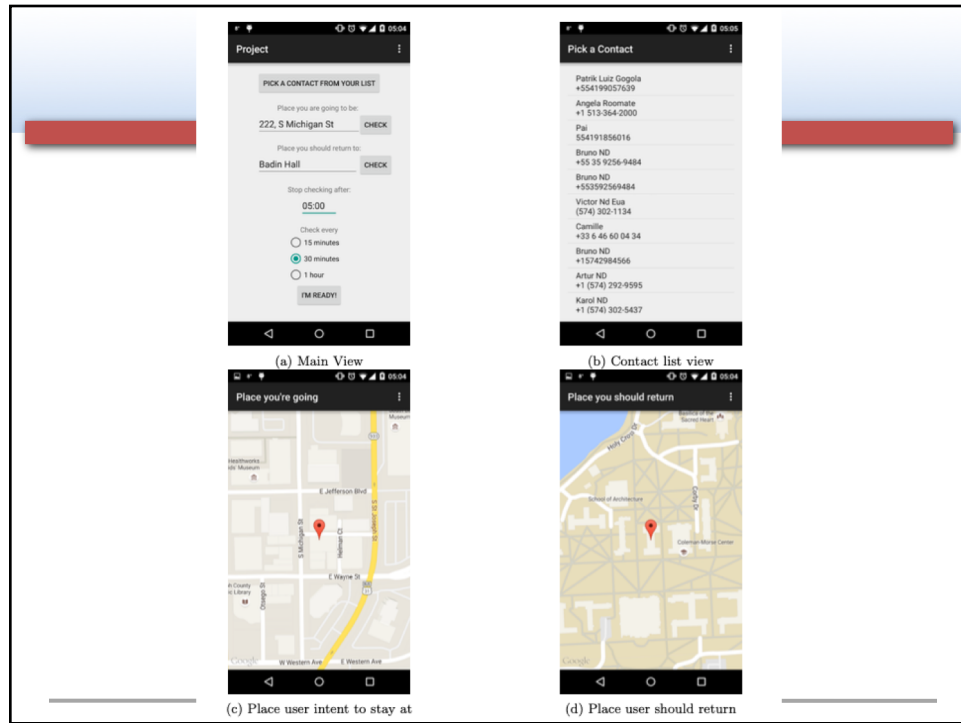
- Hardware
  - Intel Galileo dev board
  - Biometric sensors
  - eHealth Shield
  - Wi-Fi card
- Software
  - Arduino/Galileo IDE, iOS, Xcode
  - Parse, Core Plot
  - C/C++, Python, Objective-C



## Technical Implementation (Cont.)

- Biometric sensors
  - Electrocardiography
  - Electromyography
  - Galvanic skin response
  - Blood pressure
  - Body position
  - Air flow
  - Temperature
  - Blood sugar





## Emergency QR Code



## Personal Health Record System



## Personal Health Record System

The screenshot shows the MEDVISOR Personal Health Record System interface. At the top, there is a "LOGOUT" link. Below it is a search bar with a "Search" button. A checkbox labeled "Enable Context Search" is checked. The main navigation bar includes links for Home, Account, Contact, Schedule, and Emergency. On the left, a sidebar lists: My Profile, My Health, My Wellness, My Medication, My History, and My Network. The main content area displays a "Welcome Back" message and a prompt: "Still feeling under the weather? Let us know if any of the following illnesses have cleared up!" Below this prompt are two buttons: "Influenza" and "Asthma". The footer features the MEDVISOR logo.

## Health Search



Smart  
Search

todo: query the database  
and get the family info.


[help](#)
☒ Context Search

Hits 1-10 (out of about 736 total matching pages):

[ScienceDaily: Diabetes News](#)

... Pain Birth Defects Blood Clots Cancer Bladder Cancer Brain Tumor Breast Cancer Cancer  
Cervical Cancer Colon Cancer Leukemia Lung Cancer Lymphoma ...  
[http://www.sciencedaily.com/news/health\\_medicine/diabetes/](http://www.sciencedaily.com/news/health_medicine/diabetes/) (cached) (context\_score) (anchors)  
(more from [www.sciencedaily.com](http://www.sciencedaily.com))

[Five diabetes myths busted - The Chart - CNN.com Blogs](#)

... breast cancer and AIDS combined: While diabetes (both type 1 and ... breast cancer and ...  
<http://thechart.blogs.cnn.com/2011/06/24/five-diabetes-myths-busted/> (cached) (context\_score)  
(anchors)

[ScienceDaily: Cancer News](#)

... Pain Birth Defects Blood Clots Cancer Bladder Cancer Brain Tumor Breast Cancer Cancer  
Cervical Cancer Colon Cancer Leukemia Lung Cancer Lymphoma  
[http://www.sciencedaily.com/news/health\\_medicine/cancer/](http://www.sciencedaily.com/news/health_medicine/cancer/) (cached) (context\_score) (anchors)  
(more from [www.sciencedaily.com](http://www.sciencedaily.com))

[Health Information, Resources, Tools & News Online - EverydayHealth.com](#)

... Blood Pressure Experts: Allergies Arthritis Cancer Cardiovascular Health Diabetes Digestive  
Health Emotional Health Senior ... Asthma and Allergies Cancer ...  
<http://www.everydayhealth.com/> (cached) (context\_score) (anchors) (more from  
[www.everydayhealth.com](http://www.everydayhealth.com))

[Centers for Disease Control and Prevention](#)

... & Conditions ADHD, Birth Defects, Cancer, Diabetes, Fetal Alcohol Syndrome, Flu, Hepatitis ...  
& Tobacco Use Autism STDs Cancer ...  
<http://www.cdc.gov/> (cached) (context\_score) (anchors) (more from [www.cdc.gov](http://www.cdc.gov))

[Health News - Medical, Mental and Dental Treatment - Beauty, Nutrition and Fitness - CNN.com](#)

... I find information about pre-diabetes? Can my tailbone pain be ... treatments for breast cancer?  
Get Some Sleep Beware sleeping ...  
<http://www.cnn.com/HEALTH/> (cached) (context\_score) (anchors)

## Personal Health Record System

The first screenshot shows the 'Welcome! Gregory Carroll' screen with a sidebar menu containing: My Wellness, My Medications, My Health, My Network, and My History.

The second screenshot shows the 'Welcome' screen after login, displaying 'Logged in: Gregory', 'Next medication in: 0 hrs 28 mins', and a search bar for 'Relative Medical News'. Below are links to Account, Exercise, Medications, and MyNetwork.

The third screenshot shows the profile form with fields for Last Name (Carroll), Date of Birth (1989-11-12), Gender (Male), Address (625 Reynolds Bend Ro), City (Boston), State (Alabama), Zip Code (30161), Telephone (706-331-7347), and Home Phone (706-331-7347). A 'Save' button is at the bottom.

The fourth screenshot shows the 'Ibuprofen' medication entry screen with fields for Route (Mouth), Strength (200mg), and Quantity (3). A 'Frequency' dropdown is set to 'By Mouth' with options for Injection and Eye Drops.

## Personal Health Record System

The first screenshot shows the 'Account' screen with 'Basic Information' (Firstname: Gregory, Middlename: Clothier, Lastname: Carroll) and 'Contact Information' (Address: 625 Reynolds Bend Road, State: GA, Zip Code: 30161, Home Phone: 706-235-5634).

The second screenshot shows the 'Health Tools' screen with options for Pedometer, Emergency Info, and Pain Journal.

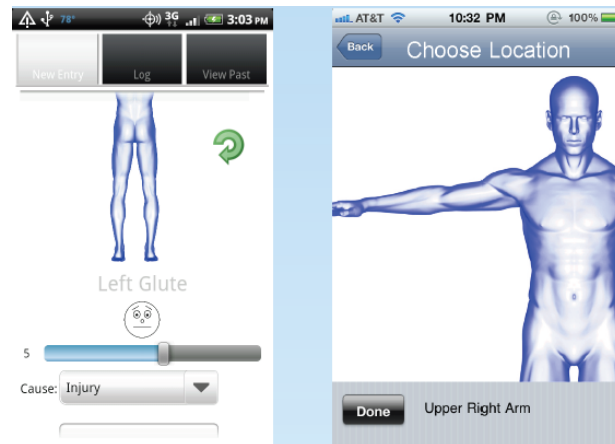
The third screenshot shows the 'Medications' screen listing: Provigil (2 pills every 24 hours), Nexium (1 pill every 24 hours), Ibuprofen (3 pills every 4 hours), and Codene (0 pills every 6 hours).

The fourth screenshot shows the 'Current Issues' screen with categories for Illnesses (Diabetes, Asthma, Alzheimer's) and Conditions (Irritable Bowel Syndrome, Diabetes, Obesity).

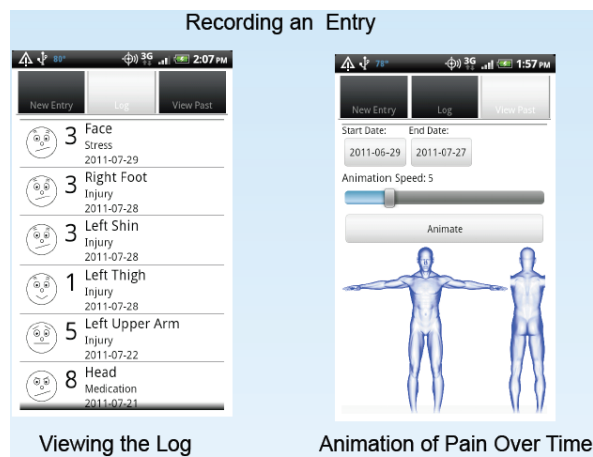
Below the screenshots are labels: Account, Health Tools, Medications, and Health.



## Pain Tracker/Analyzer



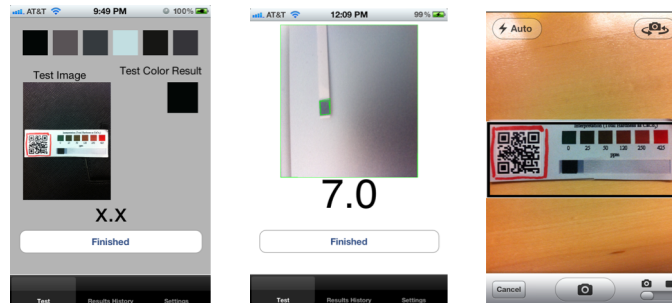
## Pain Tracker/Analyzer



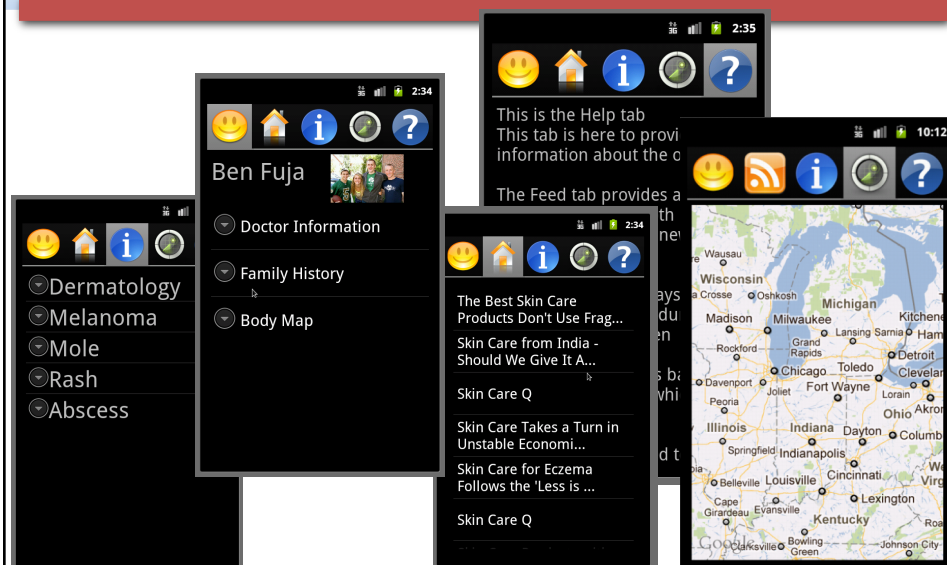
Viewing the Log

Animation of Pain Over Time

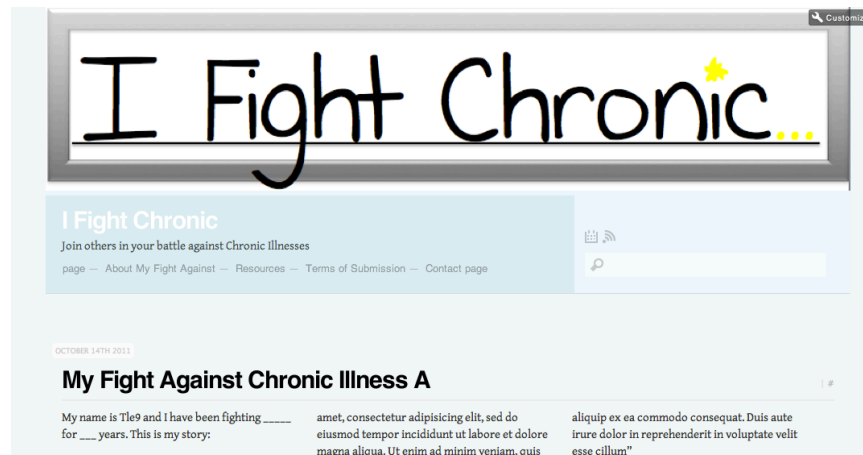
## Colorimetric Analysis



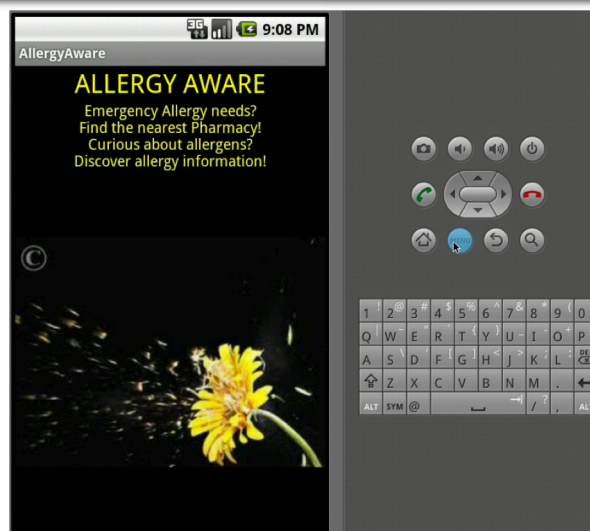
## Skin Care



## Chronic Illness Support Network



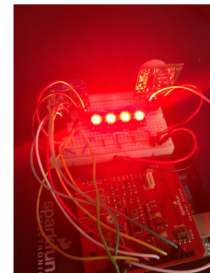
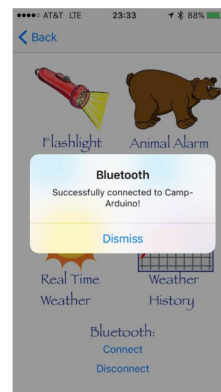
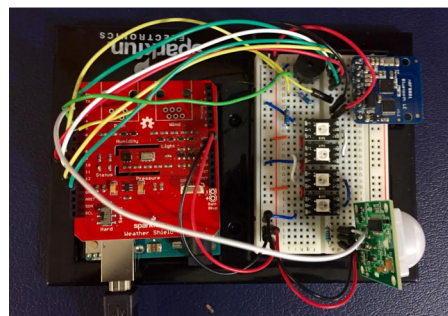
## Allergy Support



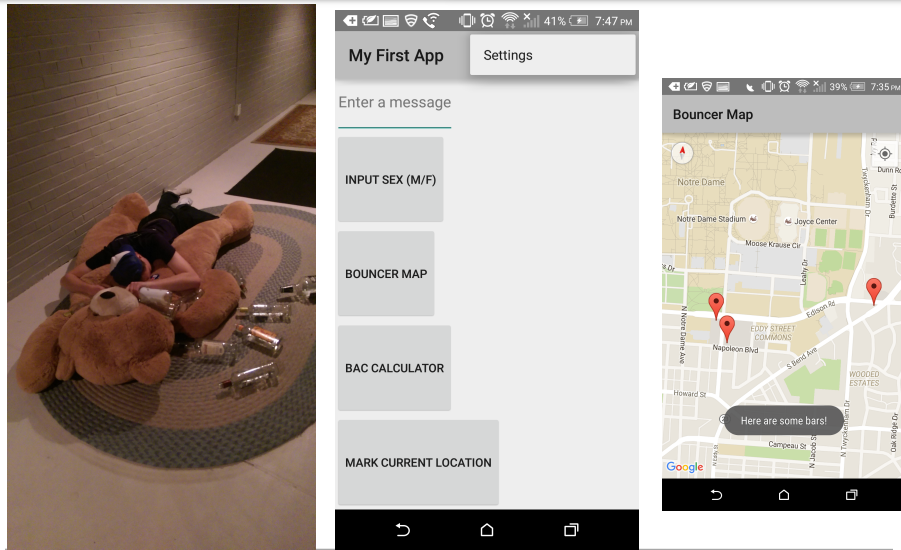
## Allergy Support



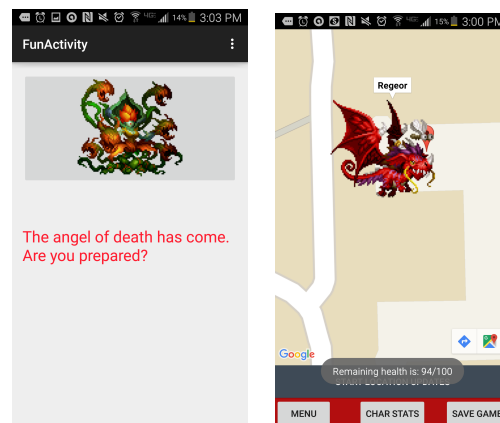
## Camp-Arduino



## Bouncer



## Monster Hunter – Gamified Exercise



## Potential Project Features

- Camera, microphone
- Accelerometer, gyroscope, barometer, magnetometer, ...
- Social media
- Back-end integration
- Networking/communication features, NFC/RFID
- Push notifications
- Input/output features; control of objects; etc.
- Location-awareness
- Touch, swipe, etc., interface
- Account management, sign up, log in
- Build/re-design new hardware; 3D print
- Augmented reality, virtual reality
- Exploiting various senses
- Third-party frameworks, libraries, services, features, ...
- ...

## Data-Centric Projects

- Public domain repositories & databases:
  - Investigate for certain trends and correlations
  - Build novel analysis & visualization tools
  - Develop new biomarkers
- NetSense/NetHealth
  - ND student population
  - Data such as GPS, phone activity, Fitbit data (NetHealth), etc.
- Parkinson's patients
  - Ongoing data collection & analysis project
- Speech data
  - Recordings of patients with PD, concussions, ALS, autism, etc.
- Crowdsignals.io: <http://crowdsignals.io/>
- Collect your own data

## Finding a Project

- Think about specific health problems/challenges
  - Chronic, childhood, wellness concerns, proactive or reactive, trauma and accidents, fitness, overall wellbeing, stress, ...
- Think about specific technologies
  - Smartphones, smartwatches, wearables, web technologies, databases and repositories, health sensors, ...
- Think about stakeholders
  - Patient, physician, therapist, family member, caregiver, nurse, ICU/NICU, case manager, communities, hospital, first responders, insurance, pharmacy, schools, ...
- Type of solution
  - Prevention, predictive, diagnostic, treatment, assessment, rehabilitation, quality of life, information and education, ...
- Location
  - Developed world, developing world, urban, rural, travel, ...
- Do you want to practice existing skills or learn new ones?