Platform-Based Development: Mobile Application Domains

BS UNI studies, Spring 2018/2019

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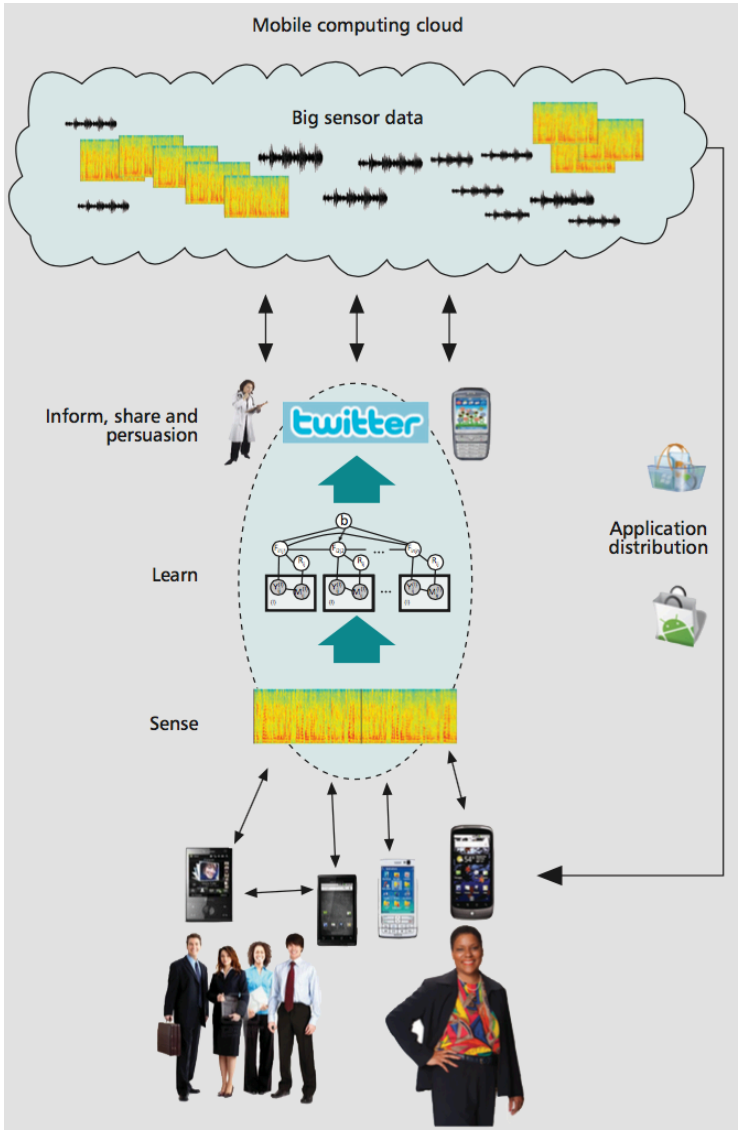
Course Admin

- Sprint #4 additional requirement:
  - Submit your .apk – for faster grading
    - Build -> Build (bundle) APKs -> Build APK
    - Add `app/build/outputs/apk/debug/app-debug.apk` to your repository, commit and push
- Consultation labs for the final exam
  - Tuesday 5pm @ P19
  - Wednesday 5pm @ P19
  - No regular lab sessions this week!
- Work on your Sprint #4!

Read
“A survey of mobile phone sensing”
by Lane et al.

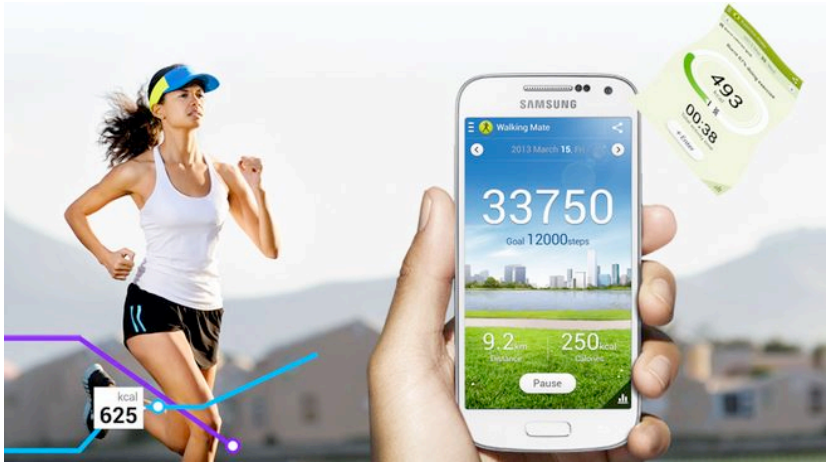
Advanced Application Architecture

- Architecture:
  - Mobile sensing
  - Learning from the data
  - Inform, share, persuade
  - Local and cloud processing
  - Application distribution



Mobile Computing Application Scales

- Individual scale:
  - E.g.: fitness apps, healthcare apps, personal assistants



- Group scale:
  - E.g. students use phone cameras to log contents of recycling bins
- Community (metro) scale:
  - E.g. App for mapping pollution levels
  - Paradigms: Participatory sensing and Opportunistic sensing

Mobile Computing Application Domains

- Example domains:
  - Personal assistance
  - Location-based OSNs
  - Healthcare
  - Transport safety
  - Smart commuting
  - Environment monitoring
  - Many more!

Healthcare

Health and Wellness

- Mobiles are revolutionising healthcare:
  - Remote diagnostics
  - Continuous patient monitoring
  - Supporting positive behaviour change

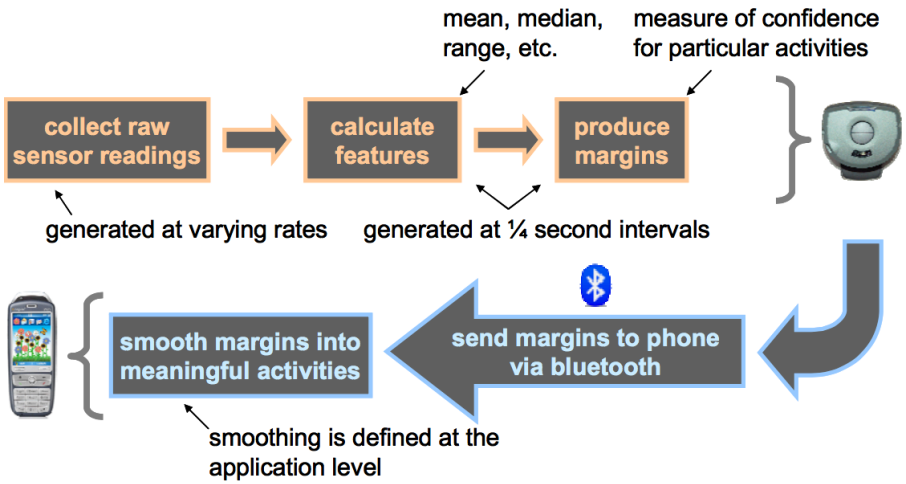
- Mobile health (mHealth) affordances:
  - Pervasive devices ➔cheap
  - Sensors ➔ track numerous phenomena
  - Wireless ➔ real-time diagnosis/feedback
  - Personal devices ➔ personalised care

UbiFit (2008)

- Sense user's physical activity
  - MSP device and a mobile phone
  - Detect walk, stairs, run, cycle
- Provide feedback
  - Dynamic wallpaper display
  - More activity – richer garden
- Idea: induce a positive behaviour change

UbiFit – Machine Learning

- Activity recognition:
  - Boosting: multiple weak classifiers perform well when each tackles a part of the dataset
  - Features: start with a large number of features and then iteratively reduce the number of features as long as the classification error reduces
  - Importance of making human-scale inferences: classify as “a half an hour walk”, not “at this particular moment your activity was walk”



UbiFit – HCI

- Human-Computer Interaction (HCI) is one of the most important aspects of a behaviour change intervention application
  - Reward positive change, don't punish the lack of change
  - Real-time easy-to-comprehend feedback
  - Ability to correct the data

"what was really funny was, um, I did, I did some, um a bunch of housework one night. And then boom, boom, boom, I'm getting all these little pink flowers. I'm like ooh, that was very satisfying to get those."

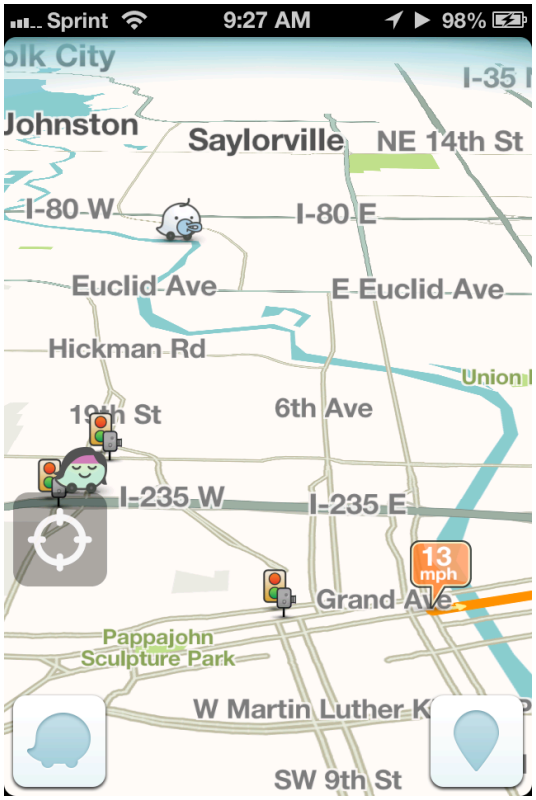
UbiFit – Limitations

- The need for a bulky external device (MSP)
- The lack of social component
  - Social support is important for behaviour change
    - Competition
    - Motivation
- No evidence of a long-term behaviour change
  - Twelve users over three weeks
  - Explicitly targets only some of the behaviour change stages

Transportation

Transportation

- Transportation apps across different scales:
  - Individual scale: road safety (e.g. Carsafe)
  - Community scale: crowdsourced traffic measurements (e.g. Waze)

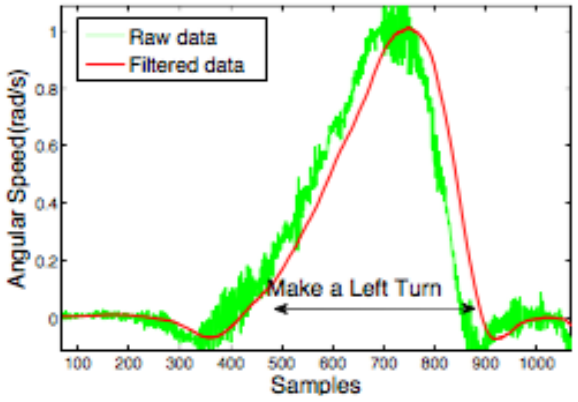


V-Sense (2015)

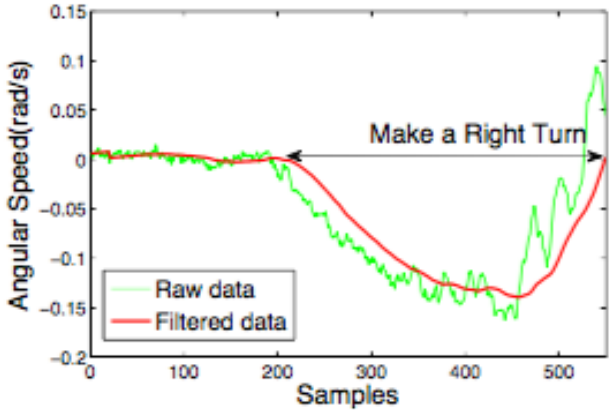
- Detect turns, lane changing, and curvy roads with a smartphone
- Uses: detect careless steering and guide during lane changes
- Constraint: can't use the camera – it should work even in low visibility settings
- Idea: use accelerometers and gyroscopes
  - Inertial measurement unit (IMU)
  - Augments human perception – we use our eyes only

V-Sense Preliminaries

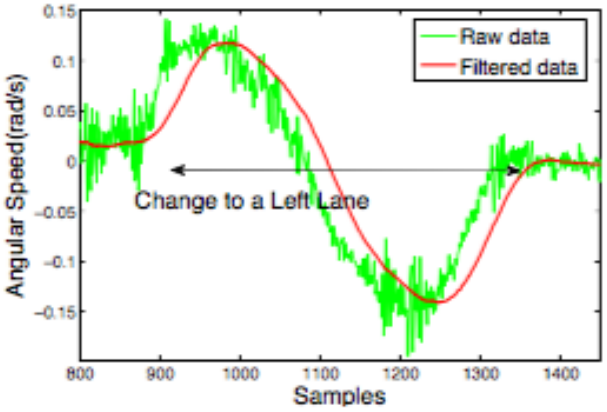
- Empirical analysis - gyroscope measurements



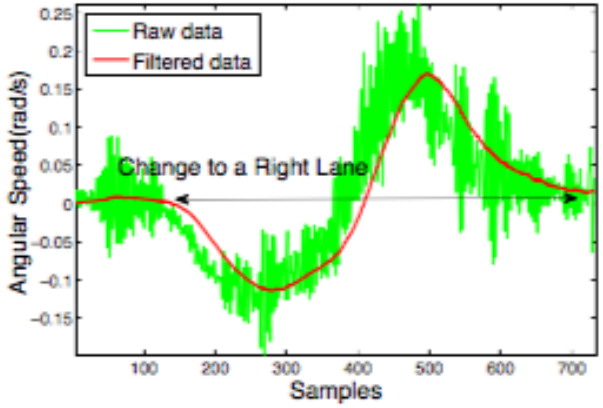
(a) Make a left turn



(b) Make a right turn



(c) Change to a left lane



(d) Change to a right lane

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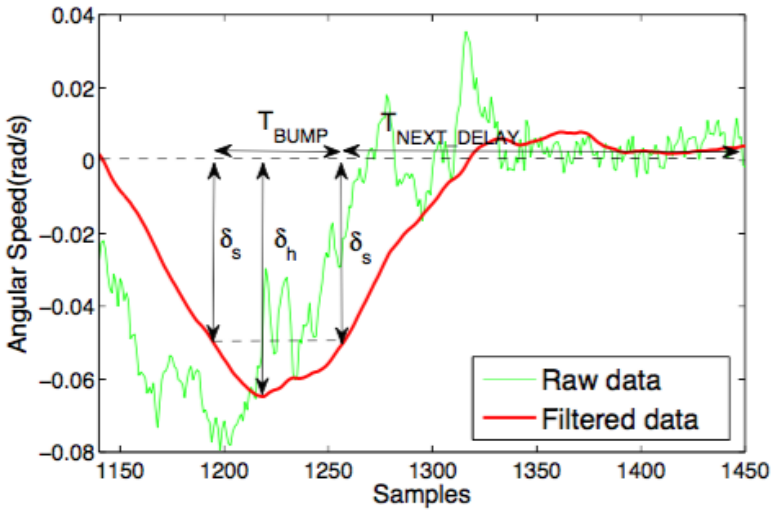
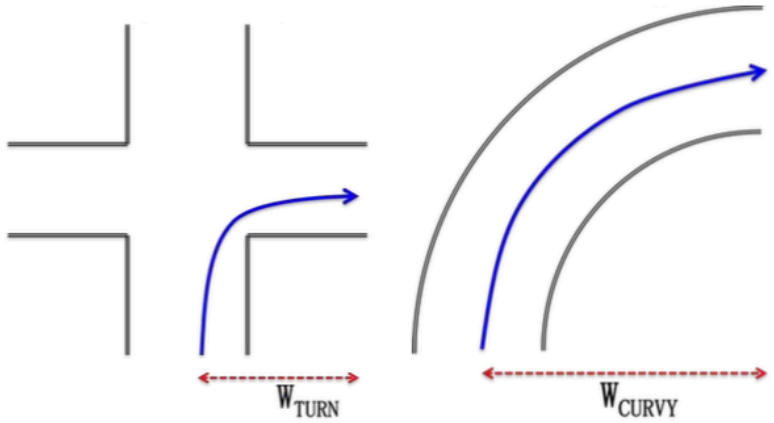
V-Sense System Design

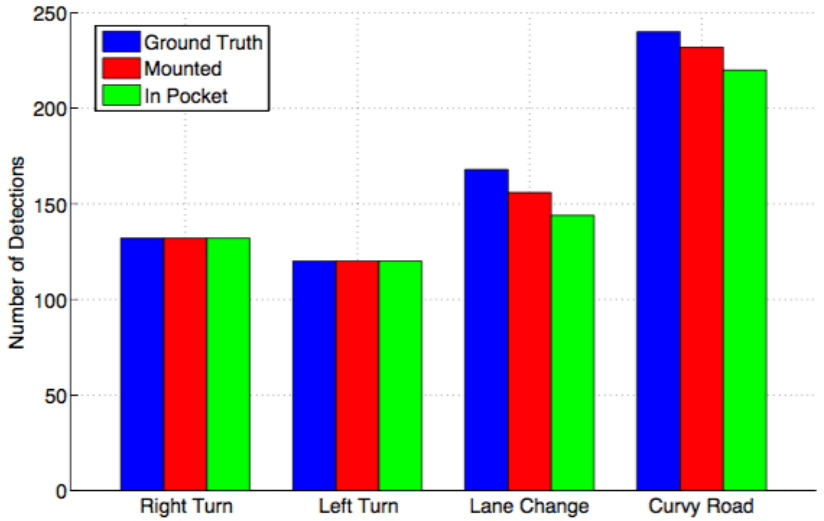
- Detecting bumps:
  - Define parameters
  - Bump detection algorithm
- Horizontal displacement measurement:
  - Use speed and angle measurements to discern between turns and curvy roads





V-Sense – Tuning

- A large (unspecified) amount of labelled data (e.g. know when a turn happened) used for training the algorithm (setting parameter thresholds)
  - Is there a better way?
- Evaluation:
  - Detects changes well
  - Uses fewer CPU cycles than camera-based apps



Mobile Computing for Development

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ICT for Development

- Every ICT intervention that leads to positive societal change is ICT for development
- We concentrate on "the developing world", as people there have unequal opportunities
- In addition, the lack of alternative ways of communication, trading, health care means that ICTs can have a huge transformative impact

ICT for Economy

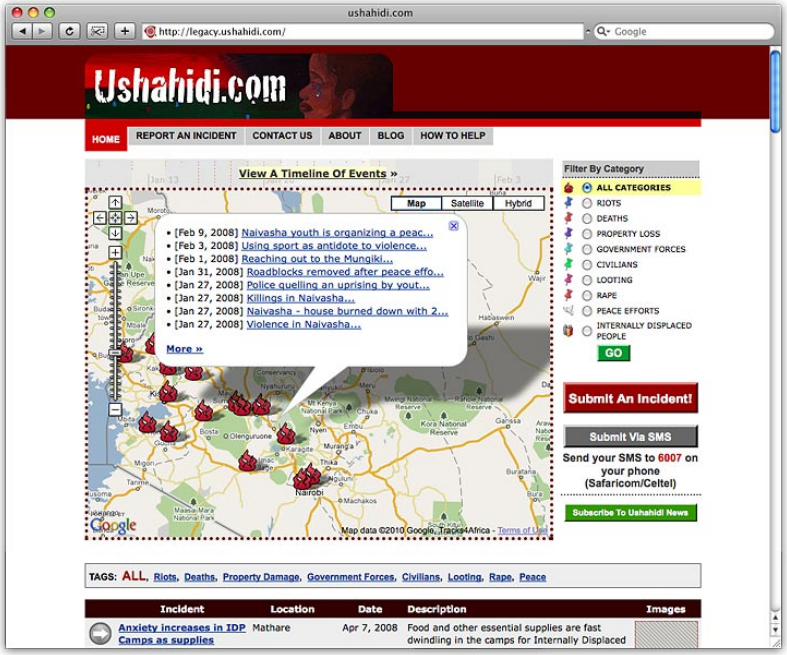
- With mobiles fishermen know the demand and supply and can adjust prices on-the-fly
- Information about crop rotations, good farming practices improves crop yield

ICT for Economy

- Money transfer:
  - M-Pesa:
    - Mobile payment system used extensively in Kenya
    - Load your SIM card with monetary funds and send an SMS when you want to pay for goods, services or transfer money to someone

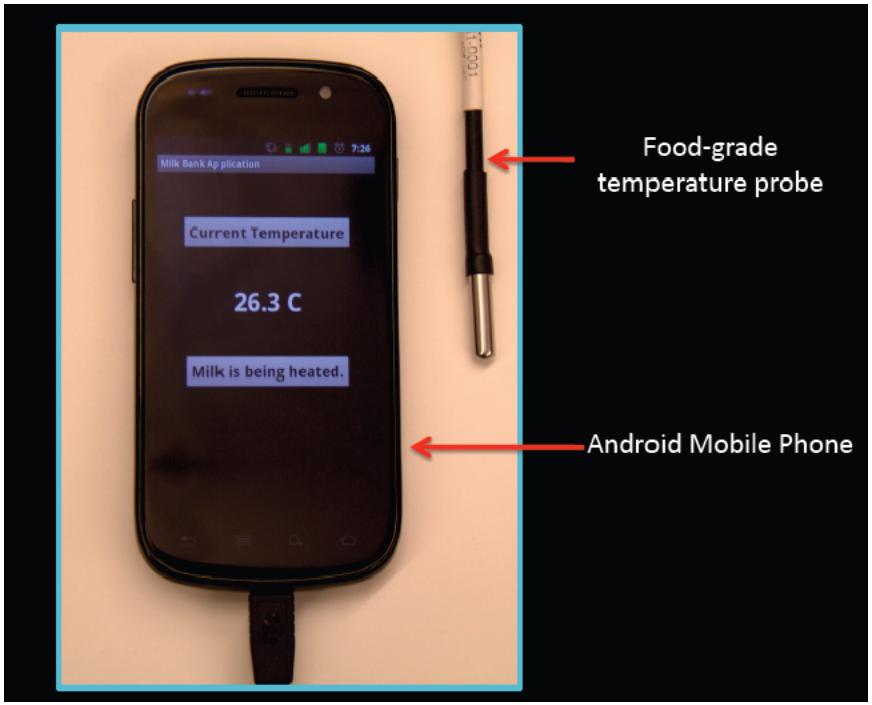
ICT for Democracy

- Monitoring elections
  - Ushahidi: collect reports of violence via SMS
- Organizing demonstrations
  - Online social networks used in the Arab spring



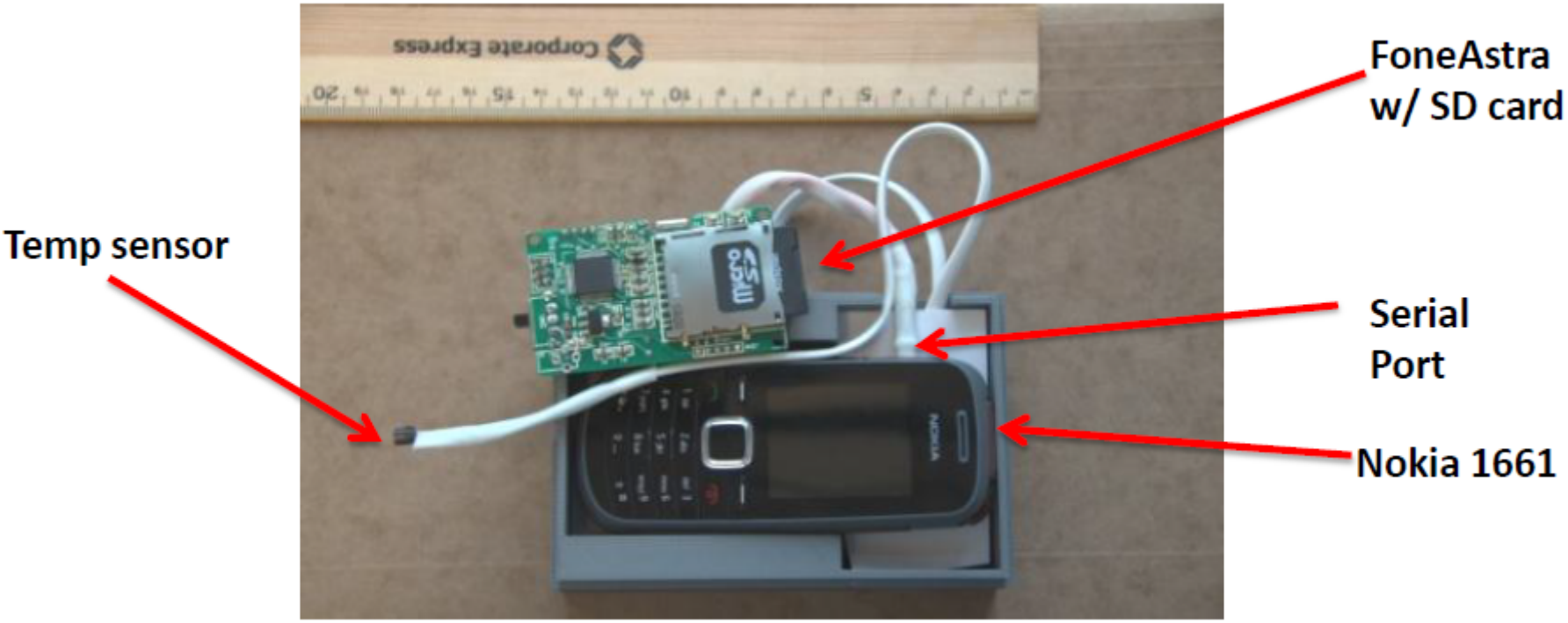
ICT for Health Care

- Safety monitoring milk pasteurization
  - 40% of HIV+ babies in Sub-Saharan Africa get infected by breastfeeding from HIV+ mothers. Phone app administers Flash-Heat Pasteurization that deactivates HIV



ICT for Health Care

- Vaccine cold chain monitoring
  - Vaccines need to be transported at T = 2^0 to 8^0 C
  - A phone installed on a vaccine fridge sends its current location (cell ID) together with the temperature reading from the sensing board



ICT for Education

- One laptop per child (OLPC)

- Dr Math via Mxit
  - Mxit - Free Instant Messaging application for even low-end phones
  - Dr Math – connect kids in rural areas with math tutors

ICT for Resource Preservation

- Sapelli app – Report illegal hunting (poaching) in the Congo Basin
- Use mobile sensors to record location/time of the observation of illegal activity, and report to the authorities
- User interface is crucial:
  - No smartphone experience
  - Non-literate societies
  - Secrecy/safety
- Key: co-design
  - Develop directly with the users and on the site

Design ICTs for Development

- Observe and learn
  - Without knowing the true needs of those whom you want to help, you are likely to only cause harm
- Partner up with key local stakeholders
  - Societies can be complex, with social systems you are not familiar with
    - Chief vs an elected politician
    - The importance of religion and church gatherings
- Iterative development with local feedback
  - Designing technologies under constraints is hard, almost impossible to be successful straight away
  - Solutions are designed to be used, listen to your users and modify on the spot

Class Conclusion

Platform-Based Development

- Overview of different platforms
  - Platform – an environment in which a software application is executed
  - Types: Web, embedded, gaming, mobile, etc.
- Evolution of platforms
  - WWW example
- Constraints of platforms
  - Embedded example
- Developing for a particular platform
  - Android and Arduino
- Applications

Android Development

- Android core
  - Android framework and libraries
  - Android Studio IDE, compilation process
- Application structure
  - Activity, Fragment, Service, Intent, Broadcast
- Sensing
  - Location, Physical activity, Sensing and Learning
- Networking and data
  - SQLite, OrmLite, REST Api, OkHttp
- Hybrid development
  - Cordova

Where to go next?

- Mobile Sensing - Master-level Course (ARP1)
  - Innovation and research oriented
  - Project-based in small teams
  - Enrollment limited to 20 students!
- Expand your Android skills
  - Android Jetpack Architecture Components
  - Kotlin programming language
  - NDK – low-level programming in Android
- Graduate and find a job you will be proud of!
  - Mobile app security internship at JRC
  - Mobile health app development at Prof Bajec's lab