# Development Engineering

CSEP 590 B
Remote Temperature Monitoring
Richard Anderson
April 20, 2020

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## Today

- Announcements
- Martin Lukac and Terry Chern, Nexleaf
- Discussion with Martin and Terry
- Related Projects

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## Announcements

- Discussion Sections – Zoom – Attend one
  - Wednesday: 3:00-4:00 pm
  - Wednesday: 5:00-6:00 pm

- Homework 3, Due April 27.
  - Submit by email
  - Course grade based on 7 of 9 assignments

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## Course Schedule

| Date | Topic | Lead |
|------|-------|------|
| April 6 | Engineering the Vaccine Cold Chain | |
| April 13 | Community Cellular Networks | Kurtis Heimerl |
| April 20 | Remote Temperature Monitoring | Martin Lukac, Nexleaf |
| April 27 | Election Monitoring | James Long |
| May 4 | Voice Based Social Networks | Aditya Vashistha |
| May 11 | TBD | |
| May 18 | Fintech for Rural Networks | Jenny Aker |
| May 26 | TBD | |
| June 1 | Open Data Kit | Waylon Brunette |

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## Development Engineering

Technological interventions to improve human and economic conditions in low-resource settings

Technical aspects of development engineering
Context for development engineering

How is development engineering practiced in different settings and domain

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## Remote Monitoring

- Technology
  - Sensors + Communication + Power

- Use of data
  - Immediate action
  - Delayed action
  - Aggregate use of data

- Business case
  - Is the data sufficiently useful that someone (with money) will pay for it

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## DevEngr Startups

- Startup model
  - An innovative disruptive idea
  - A small dedicated team
  - A supportive ecosystem

- Many examples as Social Enterprises
- Ecosystem
  - Challenge grants from BMGF and other organizations
  - Programs such as USAID "Saving Lives at Birth"
  - Support from Philanthropists

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## Startups

- Dimagi : Mobile support for community health workers



- Bempu : Low cost hypothermia monitoring for babies



- Embrace:  Low cost infant warmers



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## Today – Nexleaf Analytics



- Founded by UCLA PhD Graduates
  - Nithya Ramanathan, CEO
  - Martin Lukac, CTO
- Focus on remote monitoring at scale
- Founded as non-profit in 2009
- Strong technology development and engineering development

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## Over to you Martin and Terry . . .

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## UW Work on Remote Monitoring

- Smart Connect
  - Basic connectivity for health clinics

- Fone Astra
  - Making dumb phones less dumb
  - Making smart phones smarter

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## Smart Connect:  What is the minimum useful connectivity.  Nicaragua   2010



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## What is the minimum useful connectivity

- SMS Connectivity
  - Low cost, wide reach
  - At time, 2G was the realistic option
- What are the data needs associated with peripheral clinics
- Integrate clinic communication with vaccine refrigerator
  - Refrigerator the only powered device
  - Support remote temperature monitoring

## Cold Chain



## Data Needs and Use

- Reporting of diseases, immunization, cold chain
- Much of the communication done during regular visits
  - Sufficient for logistics
- Very remote facilities relied on radios, cell phones replacing radios in other areas
- Surveillance a priority from MoH
  - Wanted more frequent reporting

## Smart Connect



## Fone Astra (Rohit Chaudhri)

- Sensor connection to low cost phone
  - Phone for communication and output
- $25 board + $25 phone
- Temperature monitoring

## Android Fone Astra

- Version 2 of FoneAstra replaced basic phone with Android phone
- Communication by bluetooth or USB
- Separate power for FoneAstra device
- Programmability and UI on phone
- Build on ODK Sensors

## Breast milk pasteurization

- Recognized health benefits of breast milk
- Milk banking an option when breast feeding not possible
- Providing safe breast milk in low-income regions is a challenge
  - Commercial pasteurizers are expensive
  - Low-tech methods lack quality control

## Milk Pasteurization

- Human milk pasteurization
- Replace high price pasteurizer with hotplate
- Temperature monitoring to ensure proper heating and verify quality

## Practical, affordable breast milk pasteurization



- Temperature probe monitors milk temperatures
- Android mobile app:
  - Collects donor information
  - Guides user through pasteurization process based on milk-temperature
  - Prints pasteurization report and labels for processed milk-bottles
  - Uploads temperature data to server for review by supervisors

## Pasteurization process

## Development of FoneAstra

- Initial interface board developed for basic phone in collaboration with MSRI
- Deployment in Albania for vaccine monitoring
- Identification of HMB application
- Prototype developed and tested
  - Process design work from HCDE students
- Interface board for Android developed
- Deployment in South Africa
  - Introduction of Bluetooth printer
  - Data use
    - Support of process
    - Quality Assurance
- Development of new interface board to support battery powered use