HCI and Design

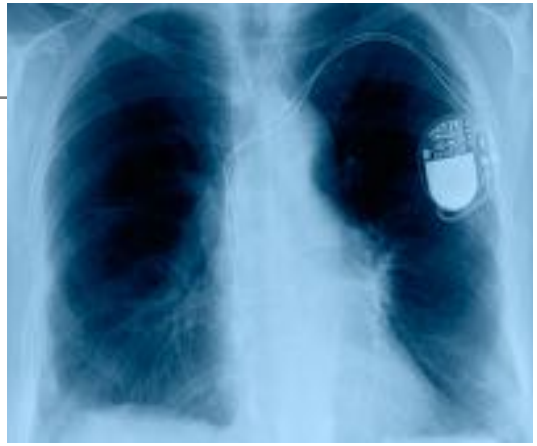
SPRING 2016

Today

Computing and the developing world

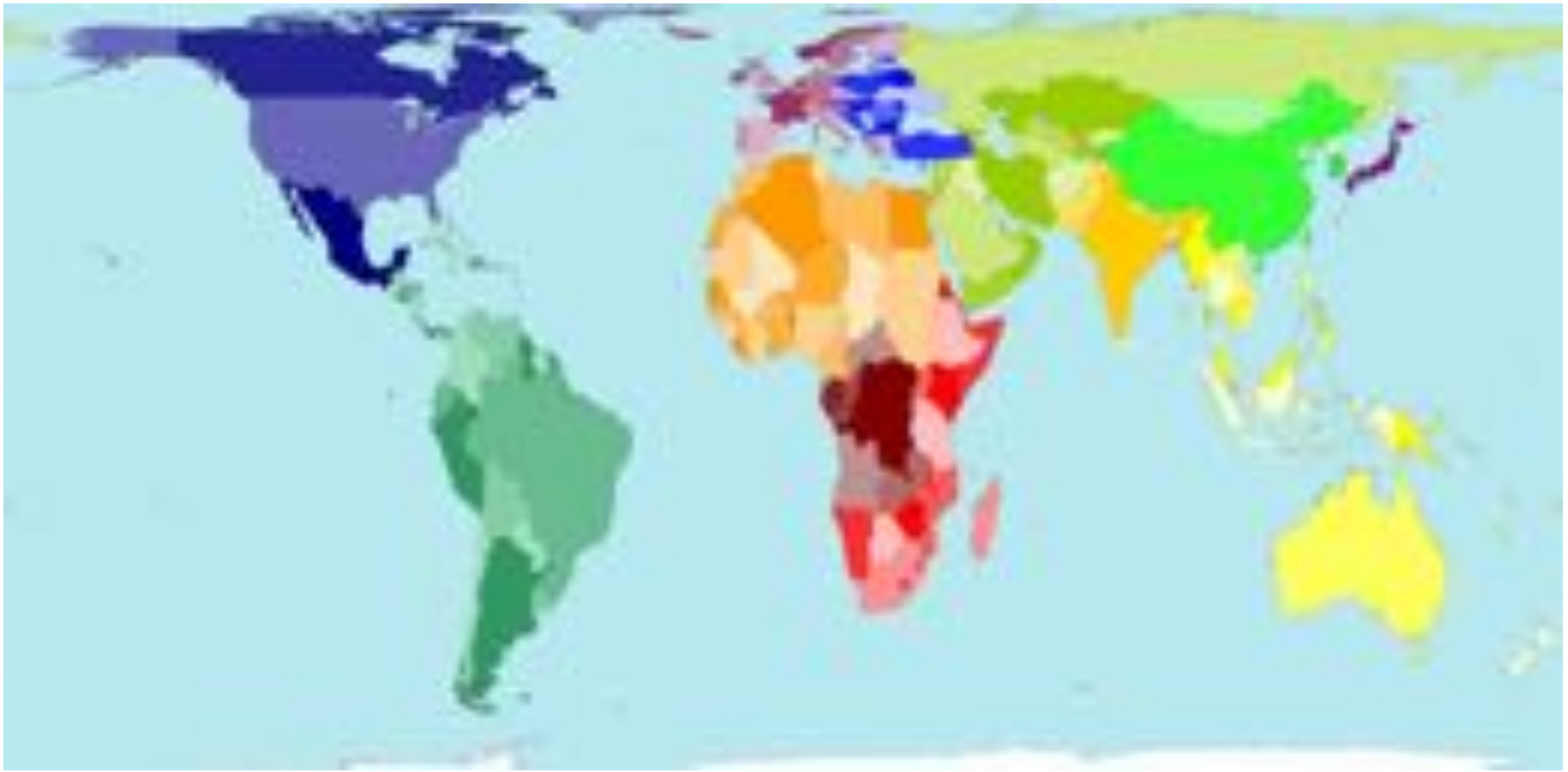
- Overview
- Version 1.0
- Version 2.0
- Some of Nicki’s projects

New technologies provide new benefits

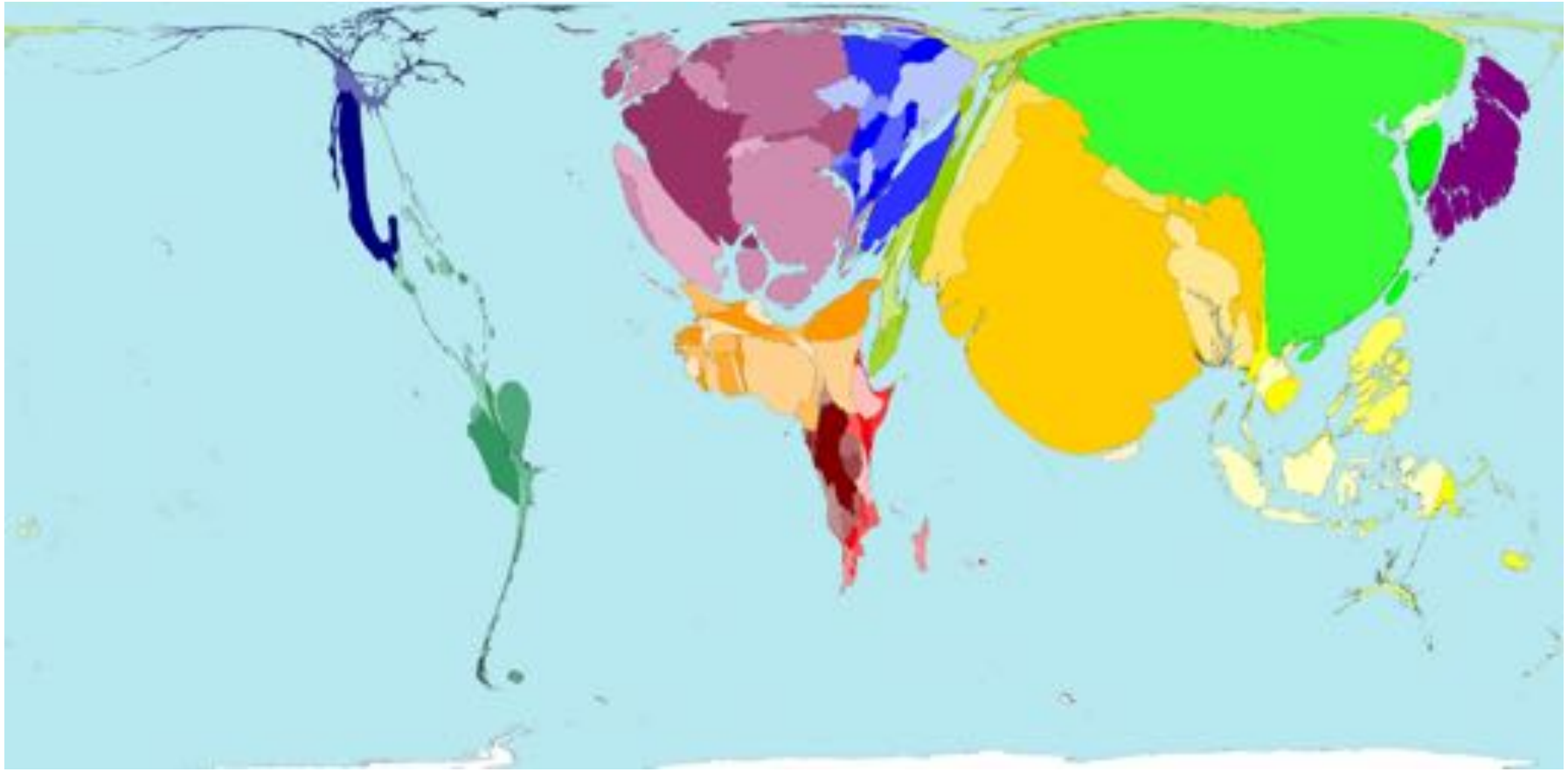


Most new technologies benefit a small fraction of the global population

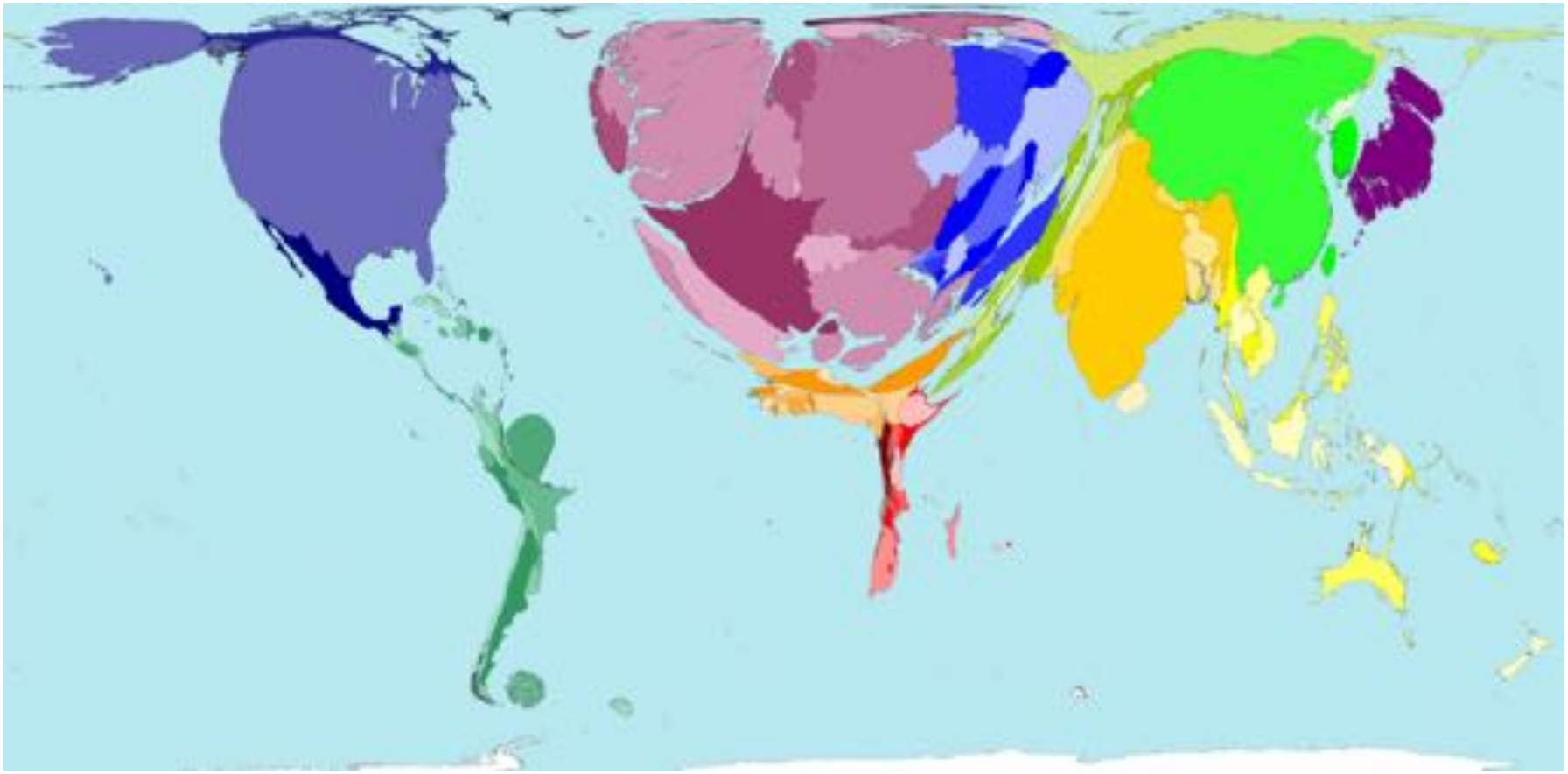
A Map of the World



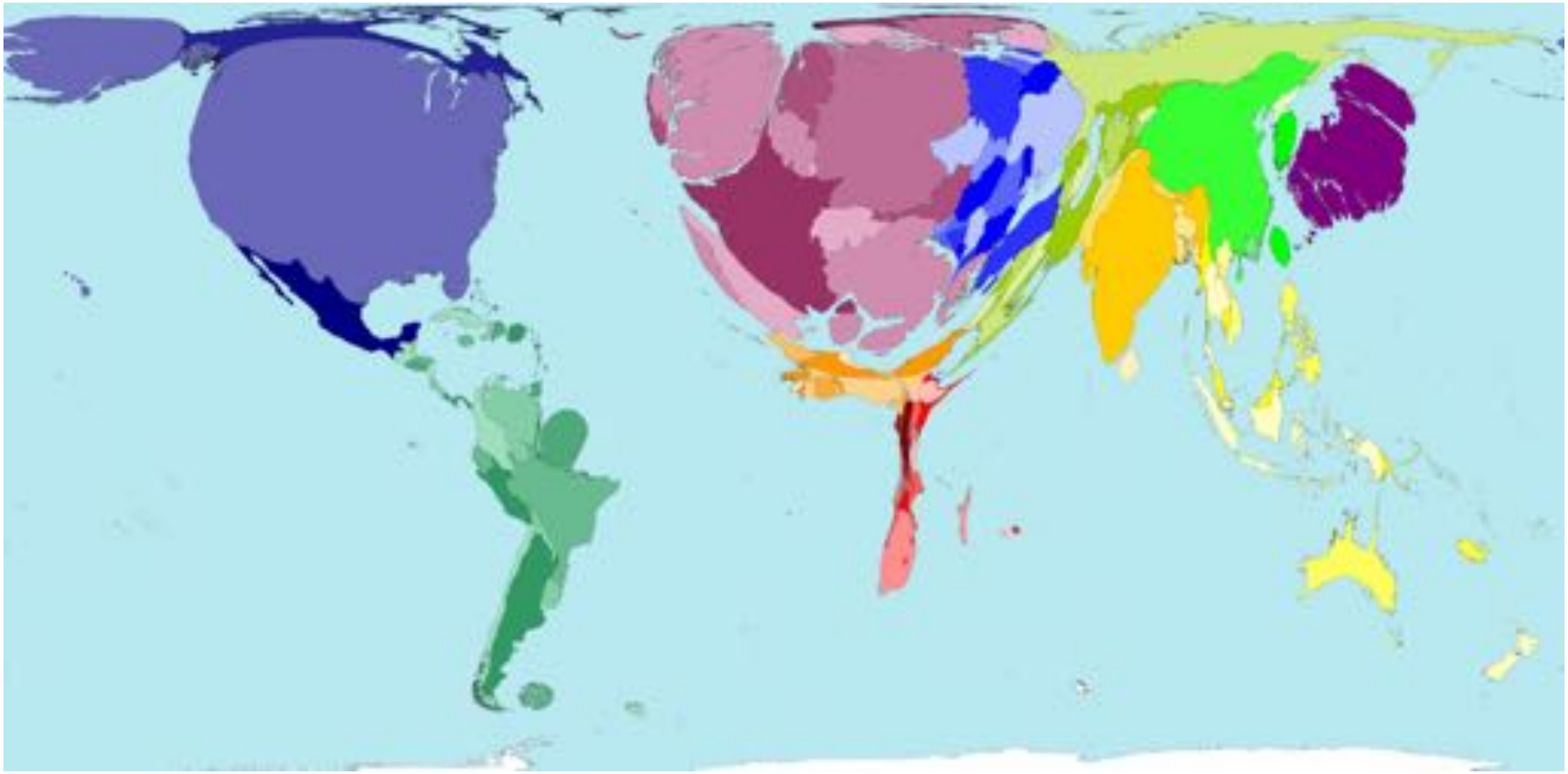
Global Wealth Distribution: circa 1500



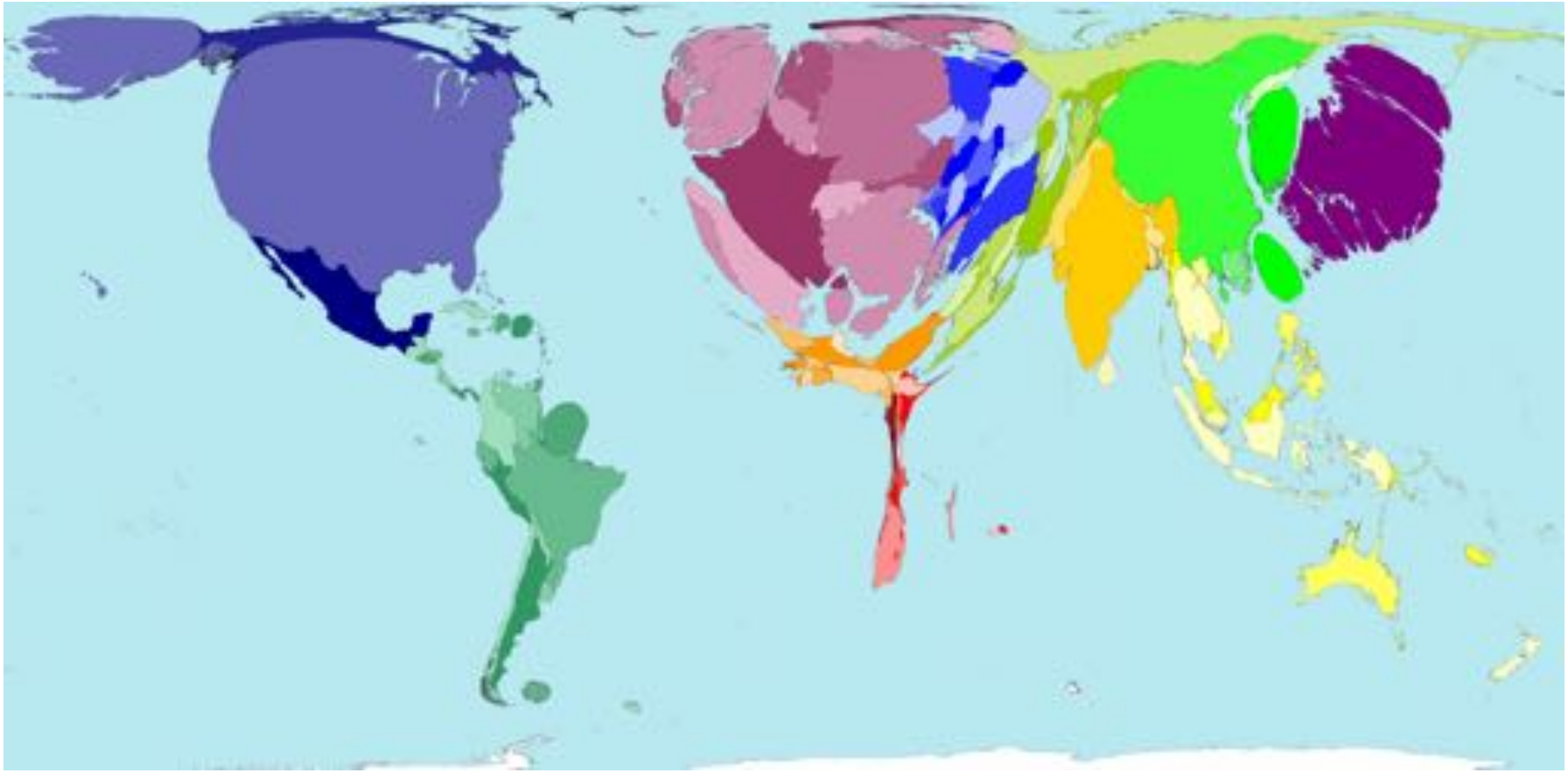
Global Wealth Distribution: circa 1900



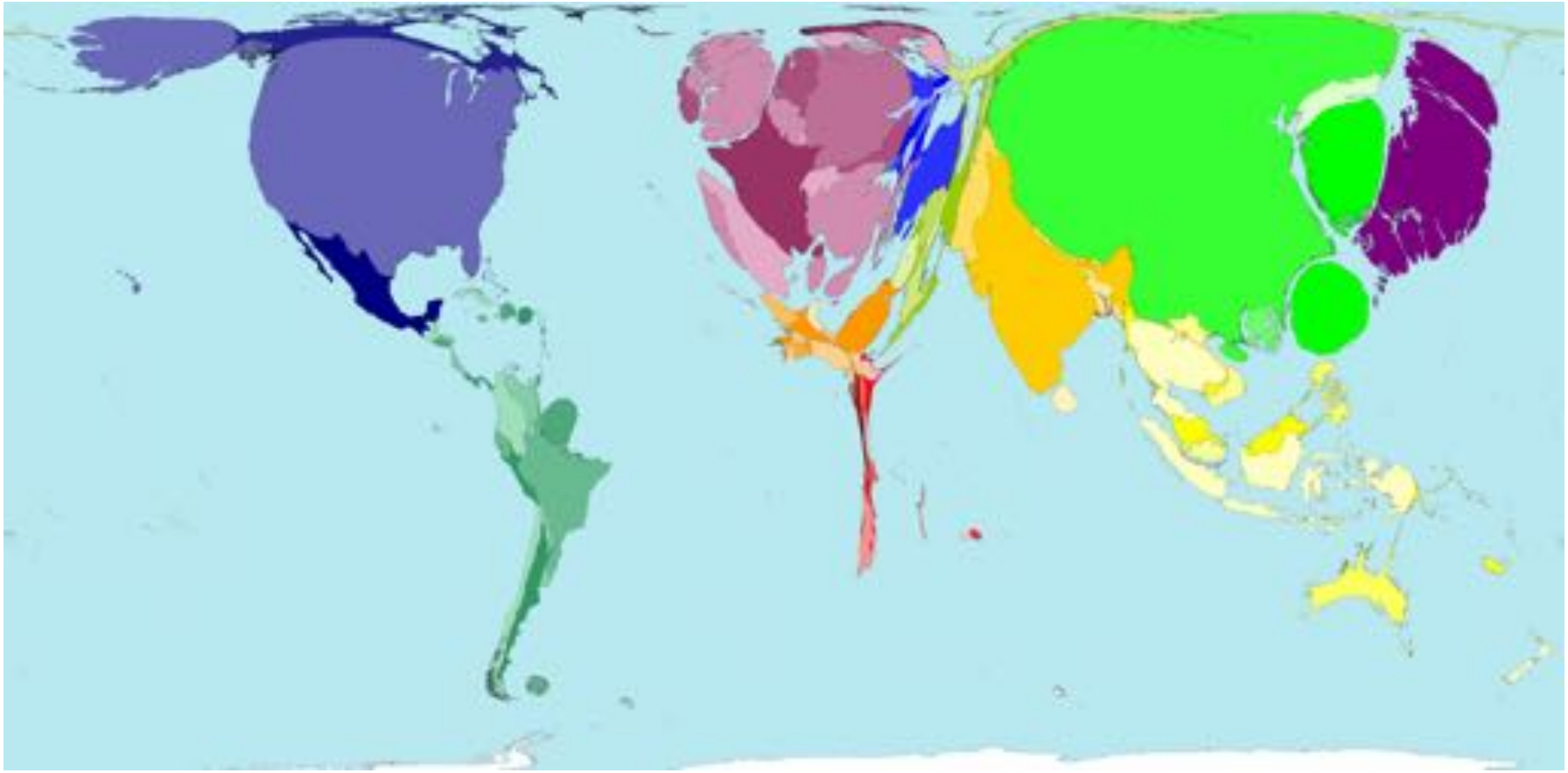
Global Wealth Distribution: circa 1960



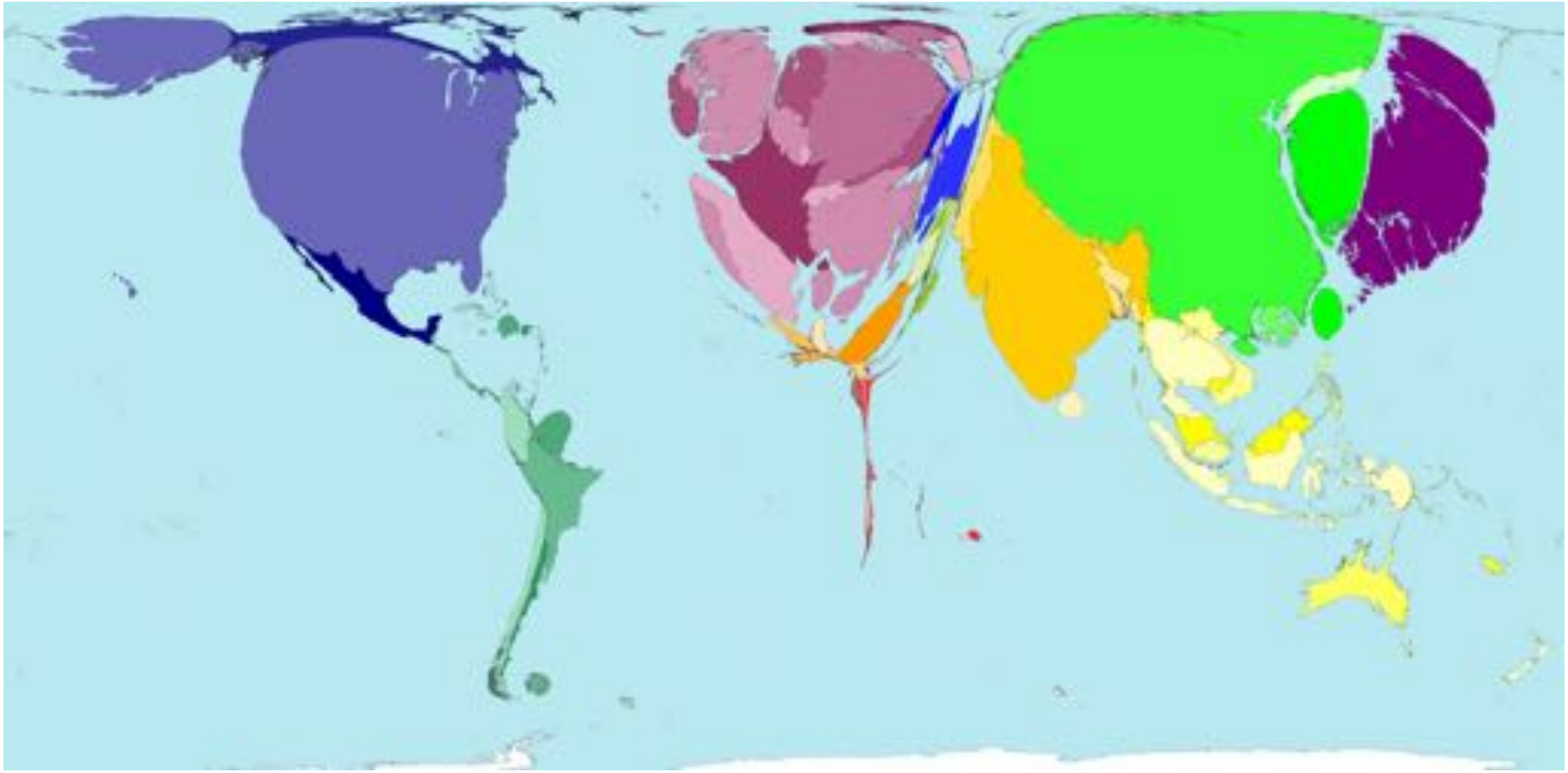
Global Wealth Distribution: circa 1990



Global Wealth Distribution: circa 2015



Global Economic Growth since 1975



Computing for Developing Regions

Create technologies that empower underserved communities to overcome global challenges

HCI for Development (HCI4D)

Human-Computer Interaction (HCI) + Information and Communication Technologies for Development (ICTD)

Global problems	Technology constraints	Diverse challenges
Poverty	Computers	Culture
Education	Cell phones	Gender
Gender equality	Mobile devices	Politics
Infant mortality	Networks	Language
Maternal health	Connectivity	Literacy
Human rights	Energy and power	Social structures
Conservation	Transport	Communication

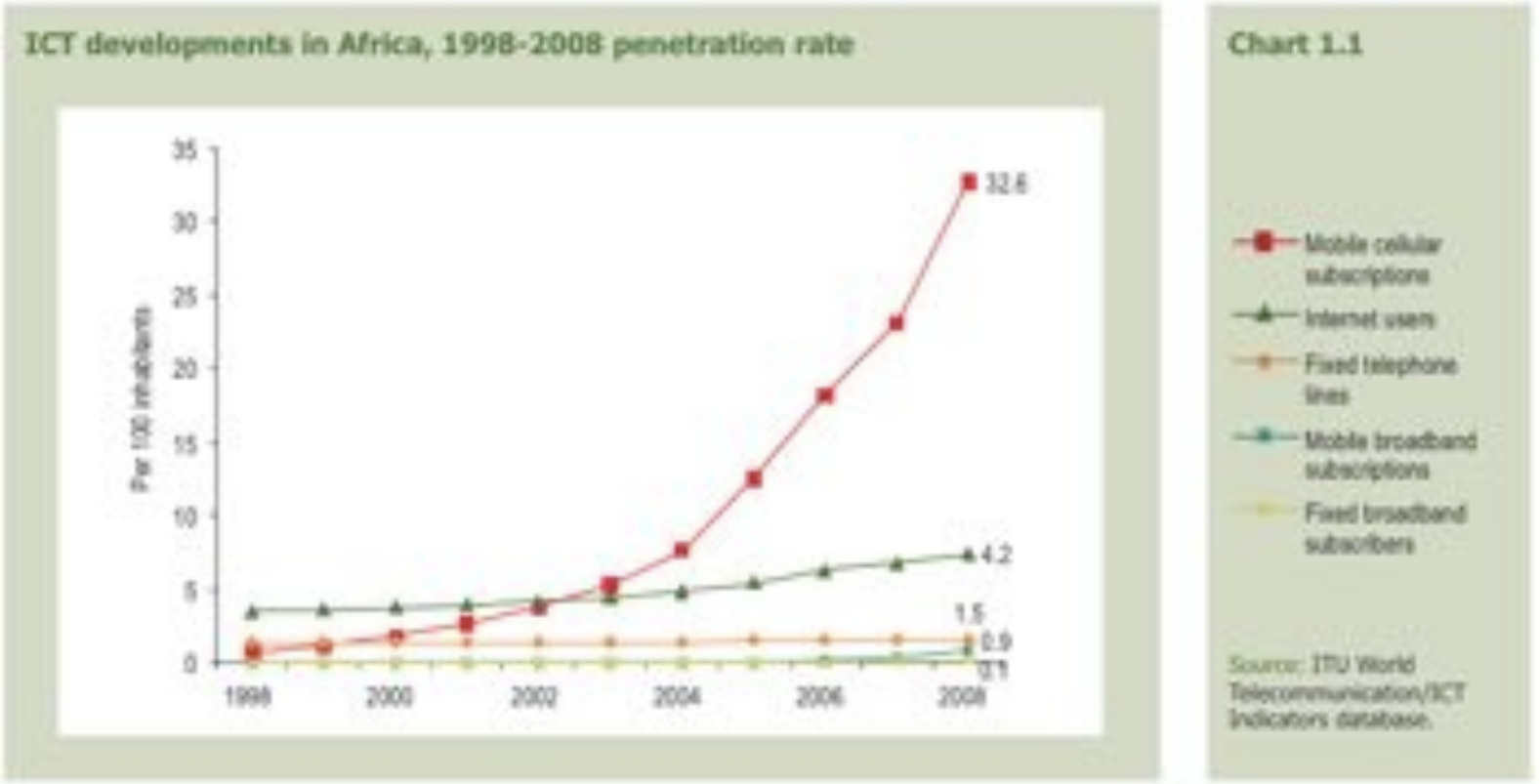
Technology alone is not enough!

Research Directions

Individuals

Intermediaries

What devices make sense?



A billion mobile subscriptions in Africa by 2015!

Why target mobile devices?

Portable

Battery-powered

Familiar

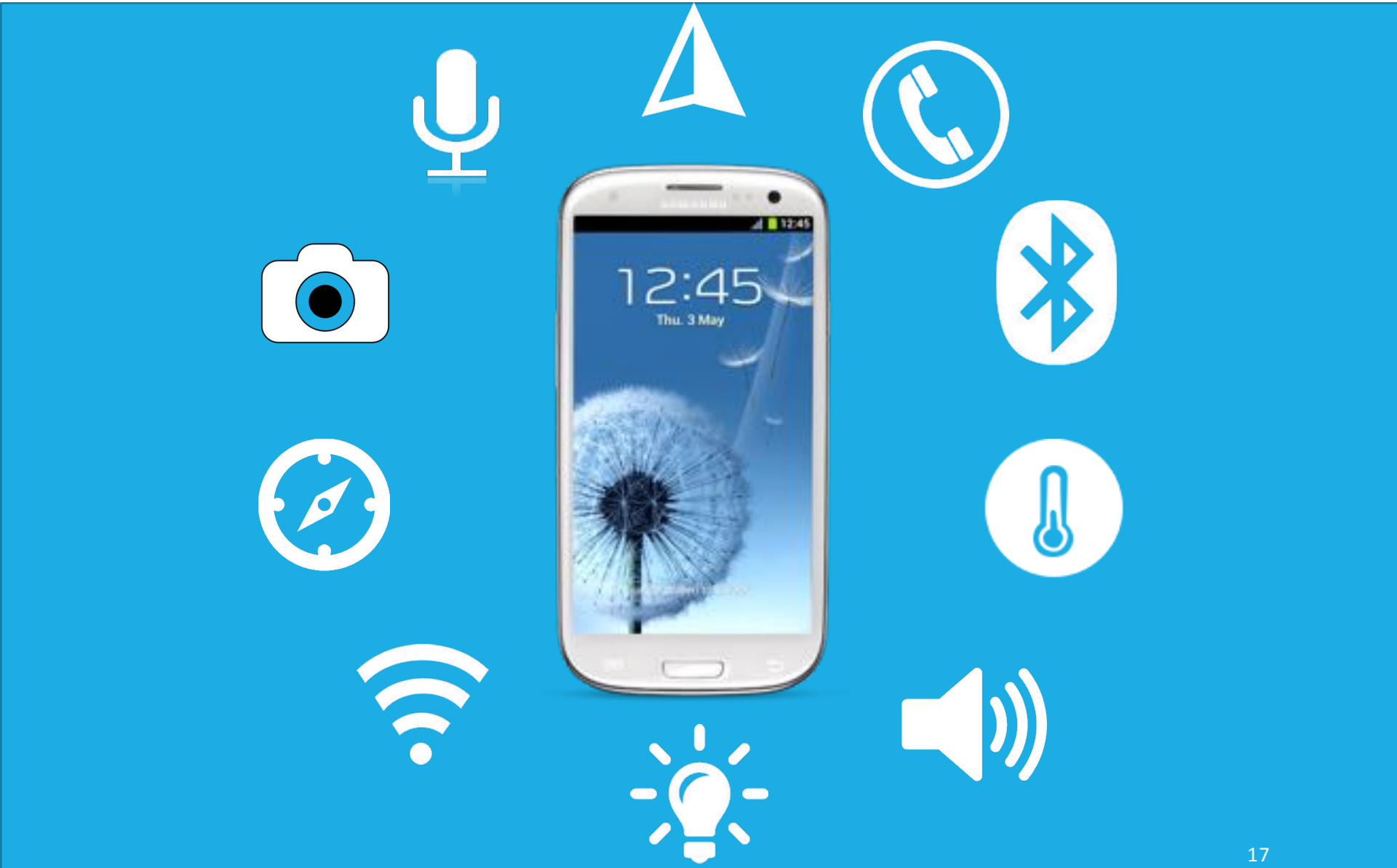
Intuitive touchscreen

Built-in sensors

Network interfaces

Storage capacity

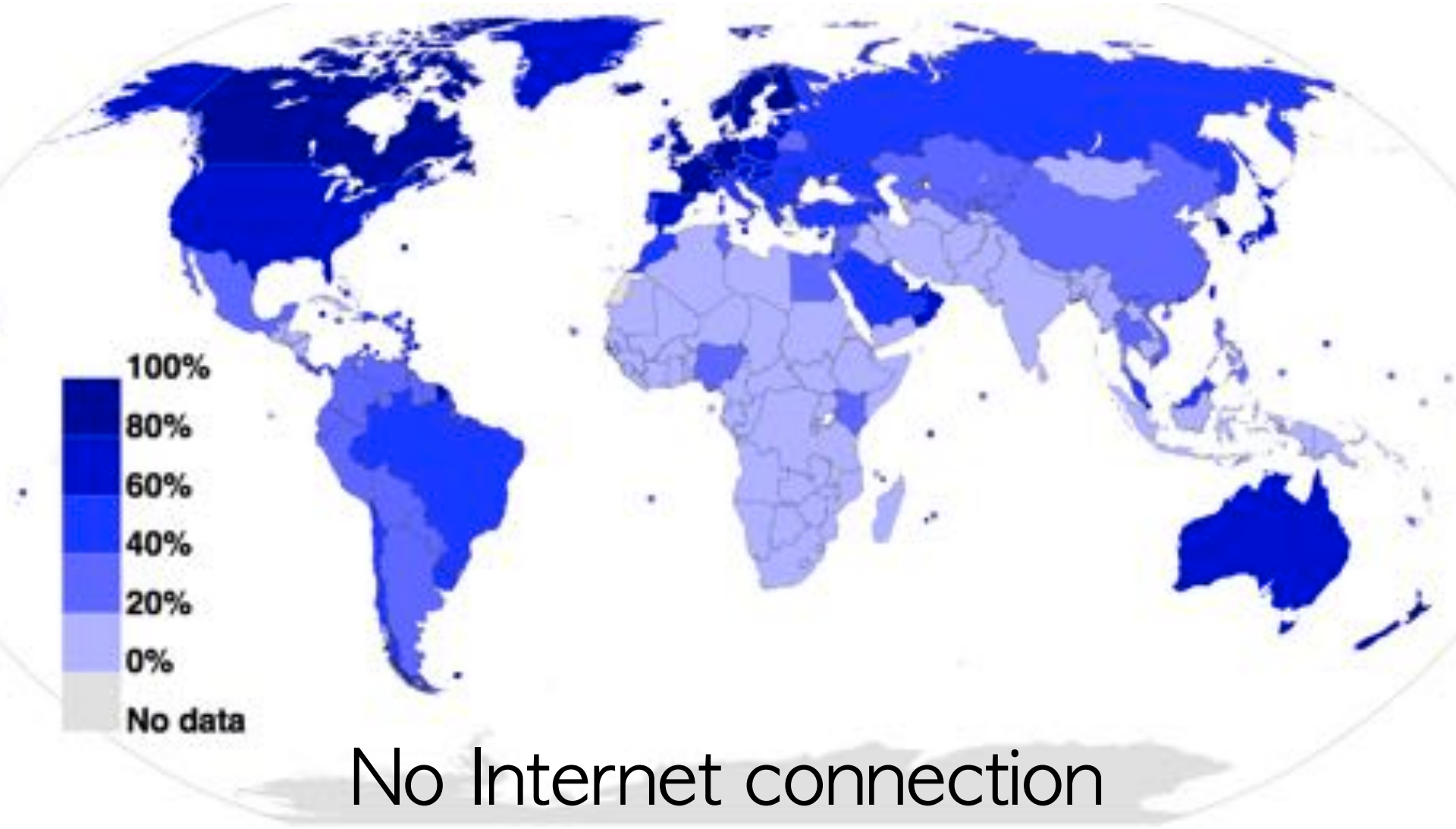
Built-in sensors provide many opportunities



Can we just use the same apps and systems that we use in the US?

Internet users in 2010 as a percentage of a country's population

Source: Percentage of Individuals using the Internet 2000-2011, International Telecommunications Union.



No Internet connection

Many other constraints

No or intermittent electricity

Low levels of education

Low levels of literacy

Unfamiliar with technology

Linguistic challenges

Social and cultural challenges

Poverty

Political challenges

Many more….

Example problem domains

- Healthcare
  - Low-cost diagnostics
  - Telemedicine
  - Healthcare informatics
- Agriculture
  - Supply chain efficiencies
  - Crafts
  - Crop quality information
  - Geophysical sensing
- Education
  - Low cost computing
  - Computer sharing
  - Distance education
- Governance
  - Information organization
    - Manpower costs
    - Healthcare informatics
- Design
  - Text-free interfaces
  - Assistive technology
- Financial services
  - Microfinance information

Global Health Challenges

Basic Health Care

- Life Expectancy: Zambia 43 yrs, Germany 79 yrs
- Infant Mortality: Niger 109, Italy 5

Control of Major Diseases

- HIV/Aids: Namibia 20%, Canada 0.3%
- Malaria: 500M infections, 2M deaths per year

Improved Health Practices

- 1.1 B people lack access to safe drinking water

Education

Literacy Rates

- Mali 19%, Pakistan 49%, Laos 69%

School Attendance, Primary Enrolment

- Somalia 17%, Sudan 60%, Congo 88%,
- India 116%, Rwanda 120%, Cambodia 134%

Teacher Absenteeism

Language Study

Vocational Training

Livelihood

"The reason most poor people are poor is because they don't have enough money"

180 Million Smallholder Farmers in Sub-Saharan Africa earning under 1$ a day

Costs of being poor

- Many goods more expensive for poor

In Africa the informal sector accounts for 20% of the GDP and employs 60% of the urban workforce

UN Millennium Development Goals

Eradicate extreme poverty and hunger

Achieve universal primary education

Promote gender equality and empower women

Reduce child mortality

Improve maternal health

Combat HIV/AIDS, malaria and other diseases

Ensure environmental sustainability

Develop a global partnership for development

Today

Computing and the developing world

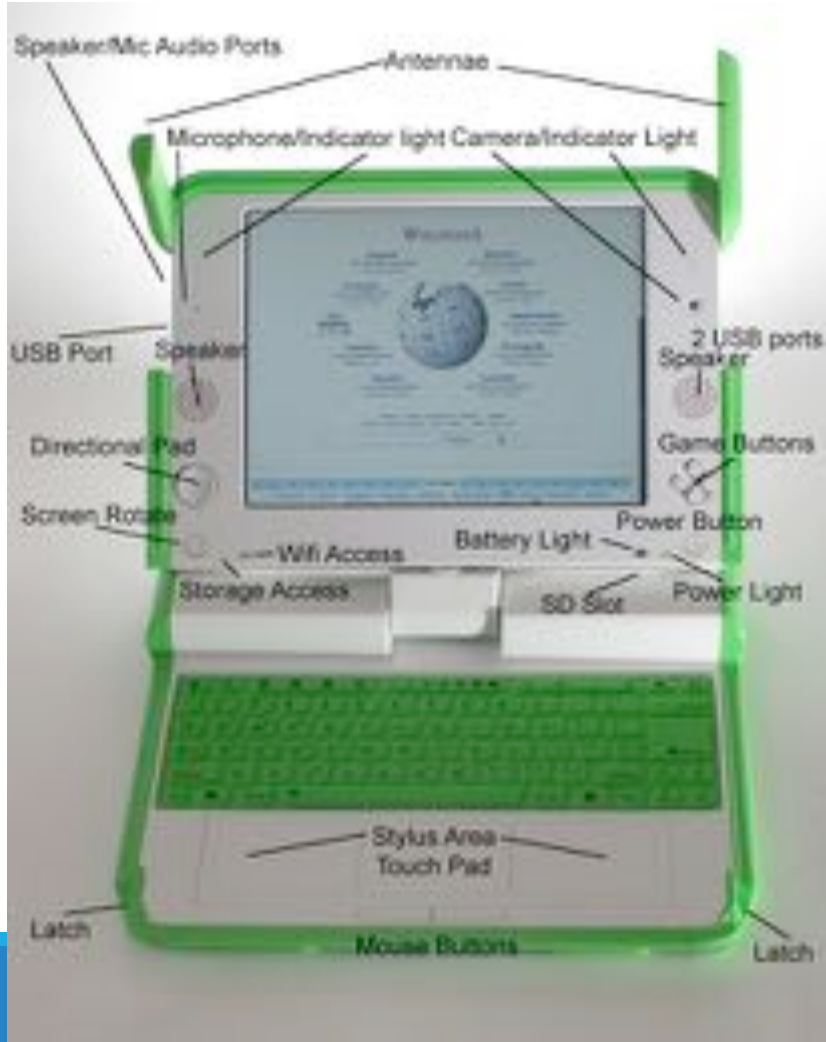
- Overview
- HCI4D v1.0
- HCI4D v2.0
- Some of Nicki's projects

HCI4D version 1.0

Technology will save the world!

Example: One Laptop per Child

- Originally the $ 100 Laptop
  - Later OLPC, finally XO ($399 for 2)
- Technological Innovation
- Learning approach
  - Constructivism
  - Take laptops home, play with them
- Critiques
  - “Little or no sustained and scaled effects on teaching, learning, and achievement” (Bain and Weston)



Problems with OLPC

Technology centric approach – no focus on humans

Did not fit people's actual needs

Did not pay attention to local contexts and challenges

Did not provide on the ground support

Did not plan for sustainability

The Failure of OLPC:

http://hackeducation.com/2012/04/09/the-failure-of-olpc

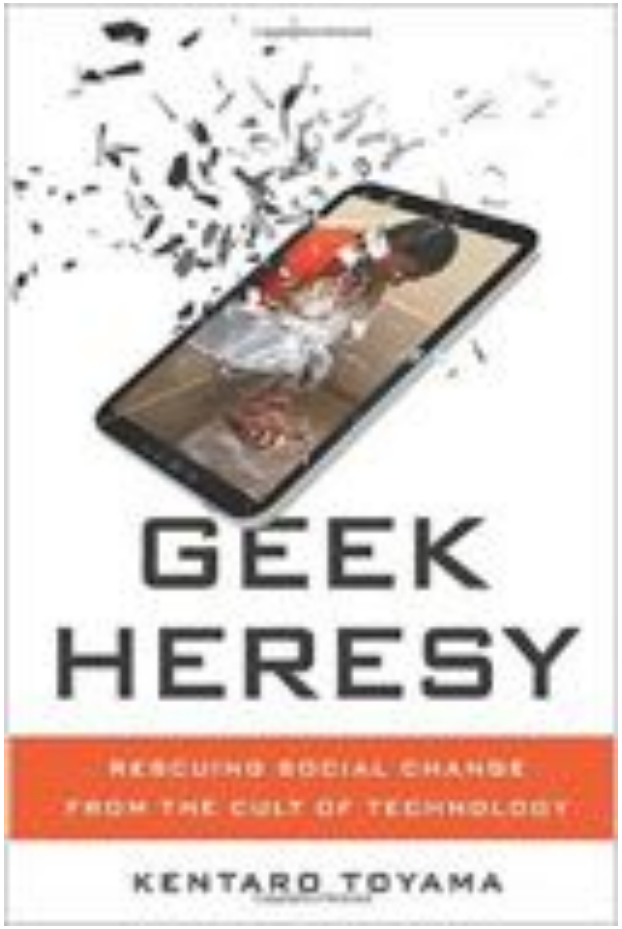
HCI4D version 2.0

Amplification theory

- Technology can only amplify human intent (Toyama)

Technology on it's own won't do anything

People have to want to change the situation, solve the problem



Digital Green

Problem: Teach poor farmers better farming practices

Solution: Digital Green

- Mediation / Mediator
- Highly formatted, targeted video content
- Contextual content: local presenter, not “well-dressed” scientist
- Supporting organizations on the ground

Outcomes: 55% adoption of new practice over 8% in old system

Why it works

Pays attention to local culture and context

Specifically designed to suit the needs of target population

Gives people the tools to solve their own problems

Provides support through organizations on the ground

Today

Computing and the developing world

- Overview
- HCI4D v1.0
- HCI4D v2.0
- Some of Nicki's projects

My Research Approach

Analyze the entire ecosystem
Many stakeholders, different needs

Technology hand-off
Broad impact

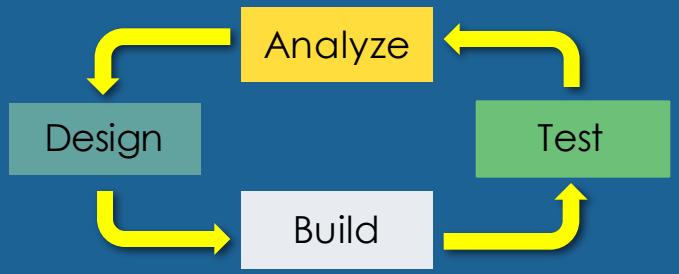
GS ID GLOBAL SOLUTIONS FOR INFECTIOUS DISEASES

PATH A catalyst for global health

VILLAGEREACH Starting at the Last Mile

MercyCorps Be the change

Iteratively design, build, test
Create robust and usable systems



Longitudinal deployments
Partner with organizations

What do we build?



Camera-based systems

computer vision, machine-learning



Text-based systems

social computing, crowdsourcing


Voice-based systems

machine-learning, NLP

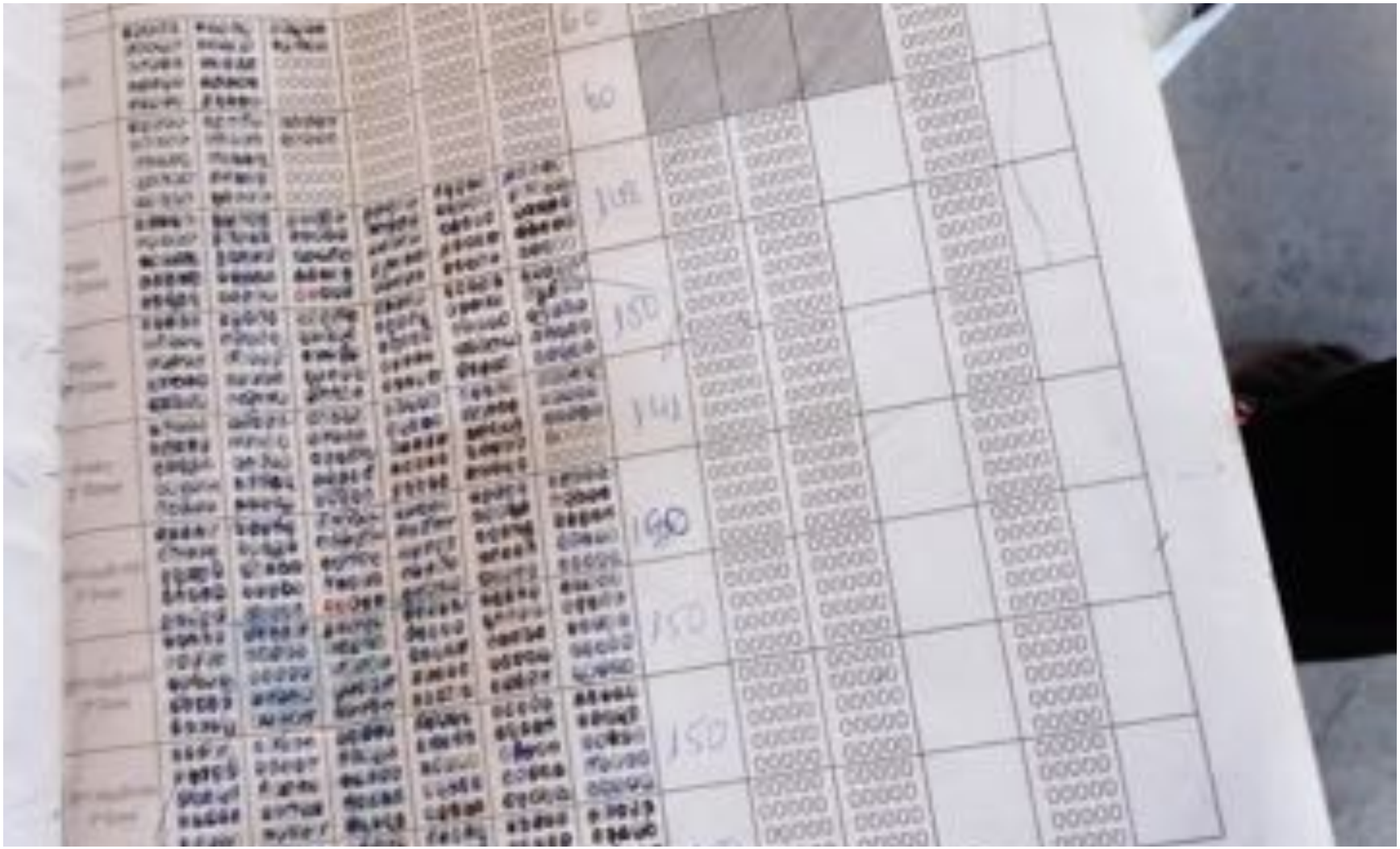

More….

sensors, web systems. VR and AR

Case Study

Improve data collection by automatically digitizing data from paper forms

Paper forms are widely used for data collection in low-resource settings



Querying, accessing, and analyzing paper-based data is difficult

Manual data entry is time consuming and error prone

Data entry is a huge bottleneck for many organizations

How can we improve paper-digital workflows in global development?

Key Idea

Ease the data entry bottleneck by using a mobile device to automatically digitize paper-based data on the device

Challenges and Constraints

Handle forms in very poor condition

Range of applications and data types

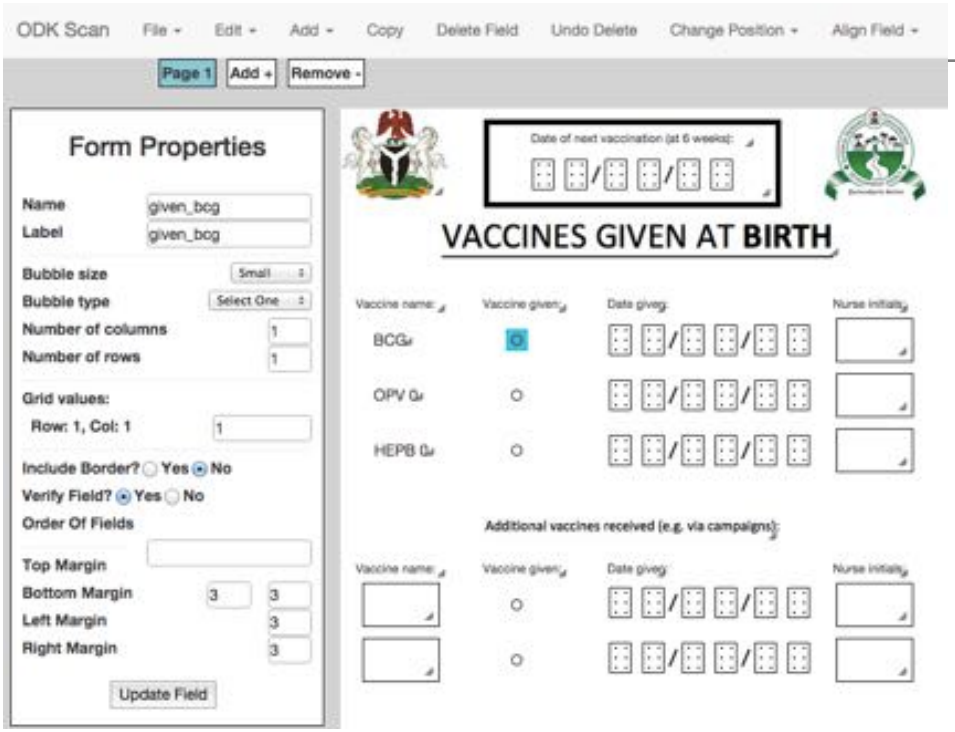
Robust performance

Perform computation locally

Usable by different stakeholders

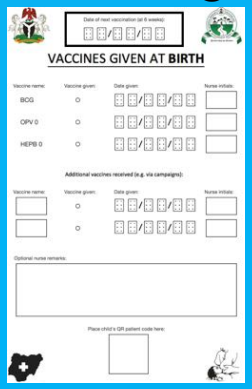
Make it easy to design digitizable forms

Designers create form in browser



Automatically generate files

Printable form image

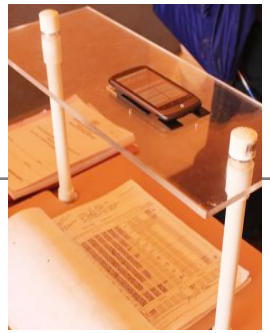


Form description

Database table definition

Editable digital form

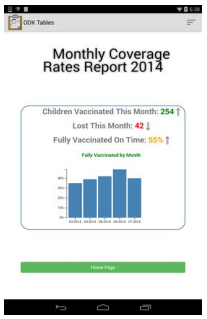
Algorithm for digitizing forms



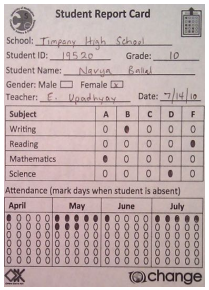
Capture image

Sync with server

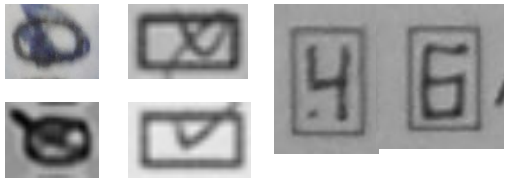
Save and visualize data



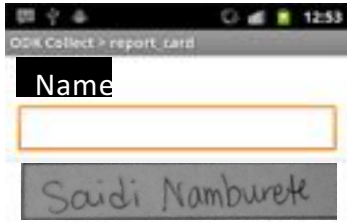
Align and segment image



Classify data (~99% accuracy)



(Optionally) enter text



Field evaluation with health workers in Mozambique

Track and report health workers' usage of medical supplies.

Use a digitizable paper form to track usage

Digitize and report usage data monthly

Four-month deployment in two districts

45 health workers

Two page form tracking 16 medical supplies

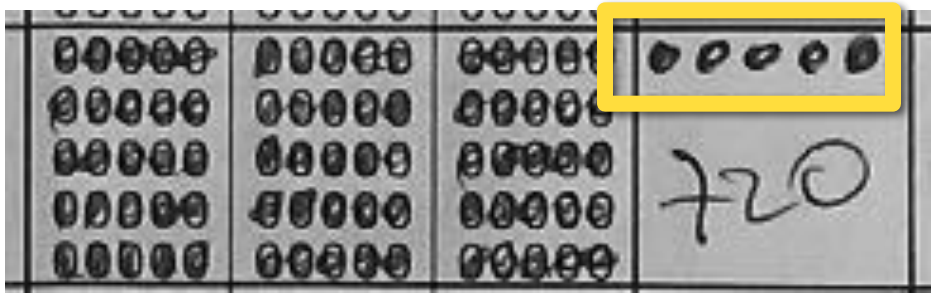
Does the system really work in the field?

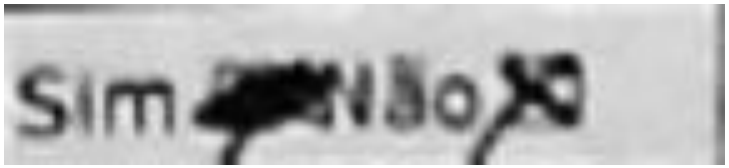
Ground truth data set for ~30% of forms

Analyzed digitized data against ground truth

Data collection accuracy > 98%

Interesting Observations and Errors





Impact and Technology hand-off

Track attendance of ~10,000 students at 300 schools in Kyrgyzstan.

Digitizing patient registers collecting maternal and child health data in 4 districts in Malawi.

Digitizing patient registers at 5,000 health camps serving 650,000 people in Nigeria.

More Projects: Promoting Behavior Change

Giving pregnant women in Kenya access to medical advice and information through an hybrid computer-human communication system. 300 women, year-long randomized experiment.

A voice-based social media platform in India. 11-week deployment: 25,381 calls by 1521 callers, 5376 voice messages recorded by 516 people, around 200,000 playbacks of these messages. Impassioned adoption by blind community.

Transport tracking system to improve disease diagnosis

CM specialization project (Sean and Xiaoyang)

Collaboration with Clinton Health Access Initiative (CHAI) and Lesotho Ministry of Health

Tools to improve wildlife research and conservation

Develop mobile and sensor-based approaches to document, analyze, and track wildlife behavior.

Create tools to minimize human-wildlife conflict, fight poaching, etc.

The Jane Goodall Institute (Tanzania), WILDCru (Zimbabwe)

Today

Computing and the developing world

- Overview
- HCI4D v1.0
- HCI4D v2.0
- Some of Nicki's projects

Activity: Education

Literacy Rates: Mali 19%, Pakistan 49%, Laos 69%

School Attendance, Primary Enrolment

- Somalia 17%, Sudan 60%, Congo 88%,
- India 116%, Rwanda 120%, Cambodia 134%

Teacher Absenteeism

Language Study

Vocational Training

How can computing technology be used to improve education/enrolment/quality of teaching?

Propose three ideas for using technology to improve education in underserved communities (could be local or international).