Data Collection and Information Management for Rural Development

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Financial Services for the Poor

Microfinance: Global Movement
– Grameen Bank & Muhammad Yunus – 2006 Nobel Prize

Self-Help Groups (SHGs) - ROSCAs, ASCAs, Village Bank, etc.
– Collect savings during meetings
– Use capital for small loans
– Business, livestock, education, health care, etc.
– Repayment based on peer pressure

Decentralize financial service provision
SHGs are being linked to banks

- ✔ Access more credit at better rates
- ✔ Other services (insurance, investment, savings, etc.)
- ✔ Local intermediation can reduce cost of service
- ✔ Excellent repayment performance (90-98%)

However, many obstacles

- ✗ Spread across remote rural areas
- ✗ Limited education, infrastructure, financial capacity
- ✗ Documentation practices are inconsistent
- ✗ Difficult to assess credit risk and make decisions

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Parikh - ICTD 2006
Information can bridge the divide

– Connect the formal and the informal
– Provide oversight and understanding for SHGs
– Provide credit ratings and risk analysis for banks
– Result: SHGs get better rates for better performance

Can we design a system for SHGs to aggregate data?

– Accessible to users
– Accurate and efficient
– Intermittent power, connectivity
– Generalizes to other applications
Step 1: Understand

2002-3
Investigate interface design space for rural users
- SHG members and supporting staff
- Some may be semi-literate or illiterate
- Use SHG data collection as sample application

Only previous work was Grisedale et al., CHI 1997
- Data collection for rural health care workers in Rajasthan
- Using Apple Newton

We used laptop / PC for maximum flexibility
- Not considering real deployment issues
contextual study
<table>
<thead>
<tr>
<th>பங்க் எண்</th>
<th>பெற்றை</th>
<th>வாங்கங்கள்</th>
<th>வருமான்</th>
<th>கட்டுப்பாடு</th>
<th>சுற்றுலா</th>
<th>கூட்டுணி</th>
<th>குறிப்பிட்டுதல்</th>
<th>பொருள் வாங்க முறை</th>
<th>முதல் கூட்டுணி</th>
<th>முடிவு கூட்டுணி</th>
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கோண்கள்: நாகர்கள் யும் வாங்கங்கள் யும் கூட்டுணியை கூறுவது முடிவு கூட்டுணியை கூறுவது.
prototype testing
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<tr>
<th>எண்</th>
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<td>6</td>
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<table>
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<tr>
<th>தொகை தொலை</th>
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<td>Group Investments</td>
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</table>
Design Guidelines for Rural Users
Parikh et al. - ACM CHI 2003, ACM CUU 2003 (Best Paper)

Two-month iterative design study conducted in a village
32 rural users - farm laborers (10 semi or illiterate)

✔ Paper formats are important
✔ Local language audio builds trust
✔ Numeric input/output is accessible
✔ Guide the user through the task
✔ Realistic icons are better
Step 2: Build

2004-5
1) Agents - Rural Service Providers

Agent Model: Provide services through local intermediaries

- Employ underemployed youth and women
- Convenient for users / clients (travel is hard!)
- Common motif for many services
  - Primary health care
  - Retail supply chains
  - Agriculture
  - Communications, etc.
- In microfinance, {bank, NGO} field staff collect info, repayments & deliver reports
2) Mobile Phones

Mobile phones are the perfect client device
- Exponential growth across developing world
- Numeric Keypad, Speakers & Microphone
- Intermittent network, Battery-operated, Low-cost
- Supports Agent-based service model

Problems and Limitations
- Small screen: adapted WIMP metaphor
- Numeric keypad: text entry is difficult
- Difficult to program applications

source: grameen-info.org
3) Paper User Interfaces

Leverage affordances of paper in digital UIs

However, thus far these approaches have had limited impact

Rural developing world could be the killer application
– Familiarity with paper formats
– Offset high technology cost by performing some operations on paper “client”
**CAM**: Application Toolkit for Mobile Phones


**CAMForms**

Interactive paper forms

**CAMBrowser**

Mobile phone app to process forms

```python
<function name="a_click">
    d = input_date("Date", "date.wav");
    i = input_int("Interest", "int.wav");
    p = input_int("Principal", "pri.wav");
    if (d & p & i)
        http_put("...");
</function>
```

**CAMScript**

Scripting language for form interaction
Formulario de Inspección Interna de Asobagri

**Direcciones:** Este formulario de inspección consta de 12 secciones. Para ingresar una sección al teléfono, deberá de ingresar el código de barras correspondiente, seguido del código del productor. A continuación, el teléfono comenzará a proporcionar espacio para contestar las preguntas de esa sección. Si usted quiere tomar alguna fotografía o hacer una grabación de audio para proporcionar evidencia de su inspección, usted puede ingresar el código de barras con el título "tomar fotografía" o "grabar audio", respectivamente, seguido también del código del productor.

### Sección 0: Información General

<table>
<thead>
<tr>
<th>Código de barras</th>
<th>Tomar fotografía</th>
<th>Grabar Audio</th>
<th>Sección 0</th>
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<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- **0.1.** Código de barras
- **0.2.** Fecha: __/__/__
- **0.3.** ¿Cuántas parcelas tiene? __

### Sección 1: Semillas y Tratamiento

<table>
<thead>
<tr>
<th>Código de barras</th>
<th>Tomar fotografía</th>
<th>Grabar Audio</th>
<th>Sección 1</th>
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<tr>
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<td></td>
</tr>
</tbody>
</table>

- **1.1.** ¿Hizo 1. Si semillero?
  - **2. No**
  - **3. Sí**
    - **4. Cód. de la parcela de origen de semillas**
    - **5. Estado de la parcela**
      - **6. Organica**
      - **7. Natural**
    - **8. Conversion**
    - **9. Convencional**

- **1.2.** Cantidad de semillas en libras: 1. Plantas 2. Ceniza 3. Agua Caliente
    - **1.4.** Código que uso para desinfectar
    - **2. Tierra**
    - **3. Ceniza**
    - **4. Agua Caliente**

**Recomendaciones inmediatas:**

### Sección 2: Fuente de planteles y Ciclo de producción

<table>
<thead>
<tr>
<th>Código de barras</th>
<th>Tomar fotografía</th>
<th>Grabar Audio</th>
<th>Sección 2</th>
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<tr>
<td>2</td>
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<td></td>
</tr>
</tbody>
</table>

- **2.1.** ¿Compré 1. Si almacen de café? 2. No
  - **3. Sí**
    - **4. Cód. de la parcela de origen:**
    - **5. Estatus**
      - **6. Organica**
      - **7. Natural**
    - **8. Conversion**
    - **9. Convencional**

- **2.2.** ¿Señaló 1. Si algunos frutales dentro de la parcela? 2. No
  - **3. Sí**
    - **4. Cód. de la parcela de origen:**
    - **5. Cual es?**
      - **6. Cítico**
      - **7. Basano**
    - **8. Estatus**
      - **9. Organica**
      - **10. Natural**
    - **11. Conversion**
    - **12. Convencional**
**CAM: Key Features**

**Tight linkage to paper practices**
- Retain paper as the authoritative local record
- Avoid abstract, menu-driven interaction
- Not optimizing for local labor – don't need OCR!

**Simple, scripted programming model**
- Easy to program and use

**Multimedia Input & Output**
- Capture audio and images instead of text

**Disconnected Operation**
- Transfer data using SMS, MMS, Email (and HTTP)

```xml
<function name="a_click">
  date = input_date("Enter Date" "date.wav");
  amt = input_int("Enter Amount", "amount.wav");
  message_note("Say your name", "sayname.wav");
  record_audio("name.wav");
  email("tap2k@yahoo.com", "a="#amt, "name.wav");
</function>
```
Framework for SHG data collection and reporting
Increased transparency within SHG
Improved documentation when applying for loans
Provide new services to members (e.g. flexible savings)
Step 3: Evaluate

2006-8
**Task**: Record transactions during SHG meetings
- Users: 14 field agents from NGO
- 7\textsuperscript{th} grade to college educated
- Simulated and in situ testing

**Results**:
- Learnable: Learned within 1-3 sessions
- Efficient: 30 secs per form, 8-10 mins per meeting
- Accurate: Error rate < 1\% (0\% for in situ tests)
- Users performed significantly better with audio
CAM: Impact in Microfinance

Commercialized by ekgaon technologies pvt.ltd
2 NGOs / 17 agents / 700 SHGs / 10000 members
In active use in Tamil Nadu since October 2006

ekgaon.com
Supply Chain  Javid and Parikh - ICTD 2006
- Monitor inventory at rural warehouses
- Plan collection & distribution
- Tested in Uttar Pradesh, India

Public Health  DeRenzi et al. - ACM CHI 2008
- Automate clinical protocols
- Reduce training, improve adherence
- Tested in Tanzania

Agriculture  Schwartzman and Parikh - MobEA 2007
- Monitor cultivation using pictures, audio
- Provide extension and certification
- Pilot w/ 1000 coffee farmers in Mexico
Internal control system for agri-cooperatives
Maintain quality, certifications (organic, fair trade)
Pilot w/ over 1000 small farmers in Oaxaca, Mexico

**Inspection**
Inspectors use mobile phones to monitor farms

**Evaluation**
Evaluators use a web application to give feedback

**Report Generation**
Generate reports for extension and certification
OpenRosa Consortium

Building mobile tools for public health
Standards-based (XForms), Open Source

Applications
- Disease Surveillance
- Clinical Protocols
- Clinical Trials
- Household Surveys
- Birth and Death
- Support CHWs

Organizations
- OpenMRS
- EpiHandy
- EpiSurveyor
- Berkeley
- Washington
- MIT
- Cell Life (South Africa)
- MRC (South Africa)
- IRD (Pakistan)
- Dimagi
- D-Tree
Future Work: Trust & Ownership

Rural users may never “own” technology

How do different identification technologies, interaction mediums and social contexts impact trust in computing?

Can we facilitate distant personal / business relationships?
Empower local people to build their own solutions

Physical tools for content creation and application development

Paper formats, visual and tangible programming
Final Thoughts

Design for real people & problems
Attracts diverse & energetic students
Impact sustains credibility & collaboration
Thanks for all the Fish

Yaw Anokwa, Brian DeRenzi, Paul Javid, Neil Patel, Yael Schwartzman, Anil Gupta, Vijay Pratap Singh Aditya, Kaushik Ghosh, Apala Chavan, Sarit Arora, Puneet Syal, K. Sasikumar, Muthu Velayutham, Gaetano Borriello, Neal Lesh, Kentaro Toyama, ekgaon technologies, CCD, Mahakalasm, Asobagri, CEPCO, D-Tree, Dimagi, Cell Life, IHRDC, Jataan, HLFPPT, Media Lab Asia, HFI, UW CSE, UW MLC, Intel Research, MSR India, Ricoh Innovations, Transfair, David Bonderman, SEEP, IDRC, ekgaon and everyone else I've had the pleasure to work with.
paper prototyping
ekgaon technologies

ekgaon was founded in 2002 and works in providing technical, managerial and strategic support to community-led initiatives around India and the world. Currently we are based in New Delhi with a field office in Madurai, Tamil Nadu.

http://www.ekgaon.com

Other Partners and Supporters

Covenant Centre for Development
Mahakalasam SHG Federations
CARE India
Deutsche Gesellschaft for Technische Zusammenarbeit (GTZ)
Small Enterprise Education and Promotion Network (SEEP)
International Development Research Centre (IDRC)
Sarai New Media Initiative
Ricoh Innovations
Microsoft Research
Intel Education Program
Honey Bee shares grassroots knowledge and innovation

Publishes 7 regional magazines about agricultural practices and other innovations

Interested in new ways to share content and facilitate communication

Developed multi-media distributed database and communications application

Networked using asynchronous CD-based updates

Implemented at kiosks in Gujarat, Madhya Pradesh, Maharashtra and Tamil Nadu
IMCI: Reducing Mortality

Under five mortality was 13% less in two districts implementing IMCI

Source: Armstrong et al., 2004
### Assess side effects, OI

<table>
<thead>
<tr>
<th>Feeling Ill</th>
<th>No different from before</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Change</td>
<td>Same or Little Change</td>
</tr>
<tr>
<td>Lack of Energy</td>
<td>The same or better</td>
</tr>
<tr>
<td>Needing medical care</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>ASK:</strong> Are you taking any new drugs or traditional medicines</td>
<td>[ ] No</td>
</tr>
<tr>
<td>Feeling Ill</td>
<td>No different from before</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Weight Change</td>
<td>Same or Little Change</td>
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<td>Lack of Energy</td>
<td>The same or better</td>
</tr>
<tr>
<td>Needing medical care</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**ASK:** Are you ?

New Drugs:
This includes drugs that are prescribed by another doctor or nurse or bought in a pharmacy or market as well as herbal remedies.
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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<tbody>
<tr>
<td>Unsafe Sex</td>
<td>No</td>
</tr>
<tr>
<td>Disclosing to Partner</td>
<td>Yes, I’ve disclosed</td>
</tr>
<tr>
<td>Thinks Pregnant</td>
<td>No</td>
</tr>
<tr>
<td>Missed Period</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**ASK**: Do you have other problems that I didn’t ask about that you need to discuss with the doctor?

- No
- Yes
Patient has several new problems including:

- Needing medical care
- Fever
- Sores in mouth

Refer to Doctor
3 billion people in the rural developing world need the same information we do

- **Business**: new opportunities
- **Finance**: capital to invest
- **Government**: services & programs
- **Health**: informed, consistent care
- **Education**: personal advancement
3 billion people in the rural developing world have different **limitations** and **capabilities**

- **Money**: to buy technology
- **Education**: to use technology
- **Infrastructure**: power, connectivity
- **Time**: lots of available labor
- **Community**: lots of relations
Outline

1 Background: Microfinance
2 Contextual Design for Rural Users
3 CAM: Data Collection for Mobile Phones
4 Evaluation: Usability, Breadth, Impact
5 Future Work
6 Conclusions
Problems with Mobile UIs

User Interface

– Adapted point-and-click metaphor
– Text entry is difficult; limited use of other media

Mobile UI research has largely focused on improving display of web content on small screens

– WEST, PowerBrowser, Wingman, Digestor, AppLens, Summary Thumbnails, Collapse-to-zoom, etc.

Programming Model

– Proprietary APIs and programming environments
– Web-based applications require online connection
TIER Group, UC Berkeley
- Long-distance wireless, DTN
- Mobile educational software

Digital Studyhall, Princeton / UW / MSR
- Video for education
- Postmanet – physical networking

Emerging Markets, MSR India
- Design for semi-literate users
- Multiple mice for education

One Laptop Per Child (OLPC)
- Laptops for education

Other Efforts
- MSR funded 17/162 proposals
Contributions

Design Lessons for Rural Users
- importance of paper
- local language audio
- numeric i/o

CAM Toolkit
- paper user interface
- multimedia i/o
- scripted & asynchronous

CAM Evaluation
- usability
- generalizability
- real-world impact
Understand Context

ACM CUU 2003
ICTD 2006, 2007
IEEE Pervasive

Build Solutions

WWW 2006
IEEE Pervasive
MobEA 2007

Evaluate Results

ACM CHI 2006
ICTD 2006
ACM CHI 2008
E-Z Rural Computing

Easy to Use: Max outreach
Easy to Teach: Word of mouth
Easy to Access: Travel is hard
Easy to Share: Amortize high costs
Easy to Create: Local ownership
Easy to Adapt: Localization essential
Understand Context
A highly 'embedded' approach to designing, developing and evaluating technology

Build Solution
CAM: a mobile phone toolkit for distributed data collection in the rural developing world, and several applications using it

Evaluate Impact
Microfinance – actively used in India
Agriculture – pilot in Guatemala and Mexico
Public Health – tested in Tanzania
Integrated Management of Childhood Illness (IMCI)

Use of IMCI protocol can significantly reduce child mortality (Armstrong, 2004)

Automate using mobile device to reduce training, improve adherence

w/ DeRenzi, Lesh, Borriello, Mitchelll
Tested with IHRDC in Mtwara, Tanzania

Measured adherence to the IMCI protocol

Observed 27 e-IMCI sessions, 24 paper-based sessions

Use of e-IMCI can significantly improve adherence compared to current practice

Preferred by all users
Long-term Vision

- Equitable Economic Development
- Environmental Sustainability
- Freedom & Political Stability
- Information Technology
- Decentralization