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

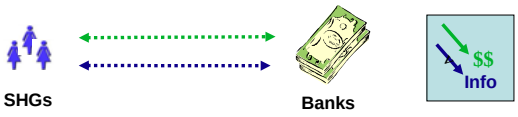
Linking Formal and Informal

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 *Parikh · ICTD 2006*

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



Information can be the Bridge

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

Design for Rural Users

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

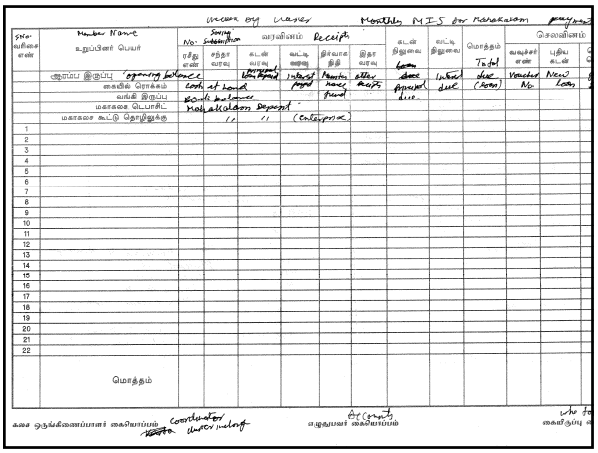
Only previous work was Grisedale et al., CHI 1997

- Data collection for rural health care workers in Rajasthan
- Using Apple Newton

We used laptop / PC for maximum flexibility

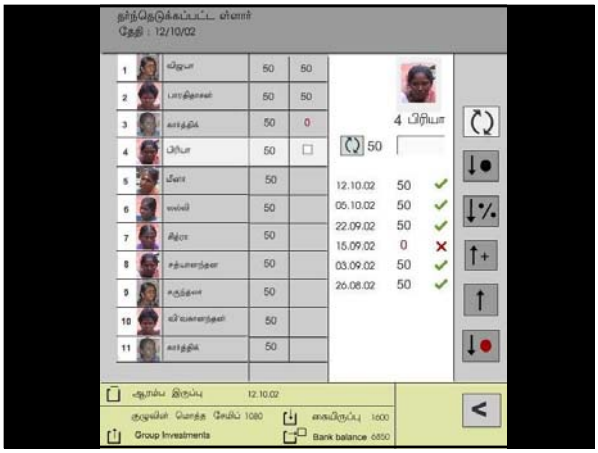
- Not considering real deployment issues

contextual study



prototype testing

design iteration



Design Guidelines for Rural Users

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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***

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Step 2: Build

2004-5

1) Agents - Rural Service Providers

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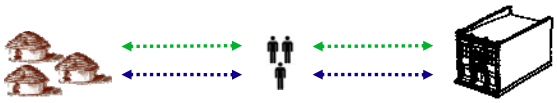
Agent Model: Provide services through local intermediaries

- *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*



Villages **Agents** **Services**

2) Mobile Phones

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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

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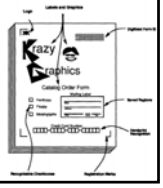
Leverage affordances of paper in digital UIs

- XAX, Digital Desk, A-Book, Paper PDA, Cooltown, Books with Voices, etc.

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

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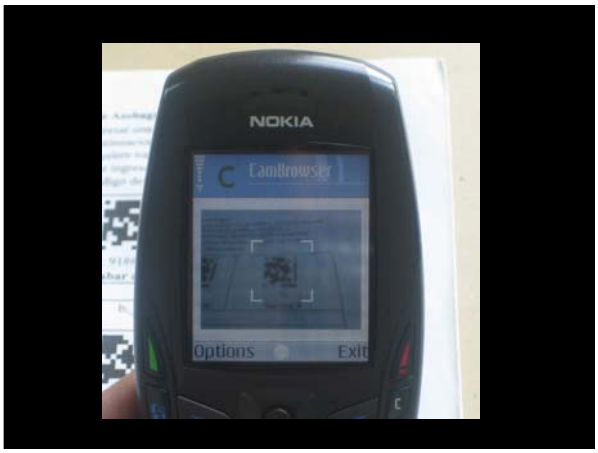
Parikh et al. - IEEE Pervasive 2005, WWW 2006

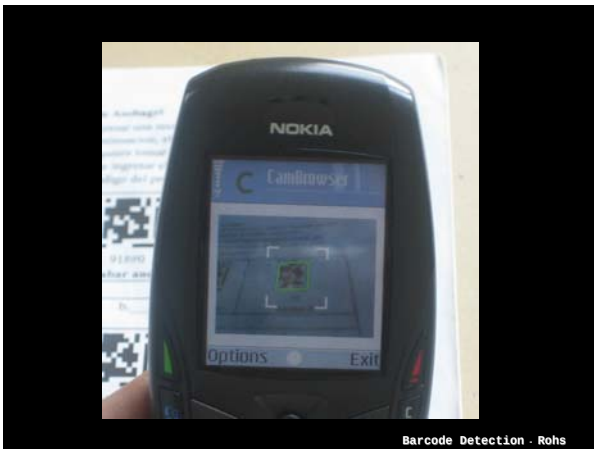
CAMForms
interactive paper forms

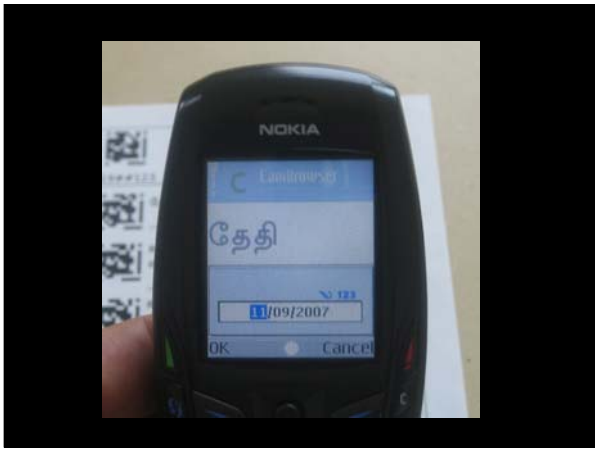
CAMBrowser
mobile phone app
to process forms

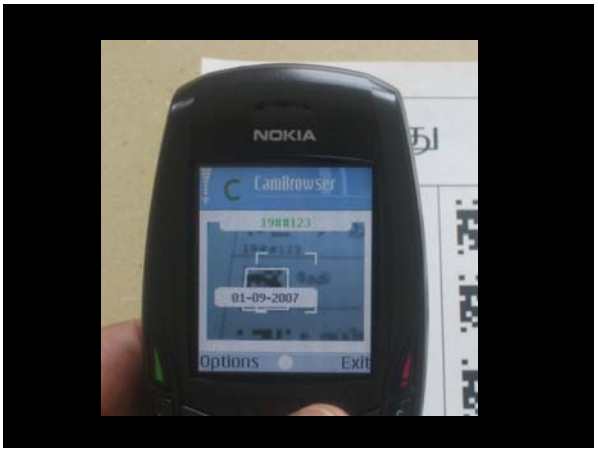
```
<function name="a_click">
     d = input_date("Date", "date.wav");
     i = input_int("Interest", "int.wav");
     p = input_int("Principal", "pri.wav");
     if (d & p & i)
       http_put("...")
</function>
```

CAMScript
scripting language for
form interaction









CAM: Key Features

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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)

```
<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>
```

CAM: Data Flow in Microfinance

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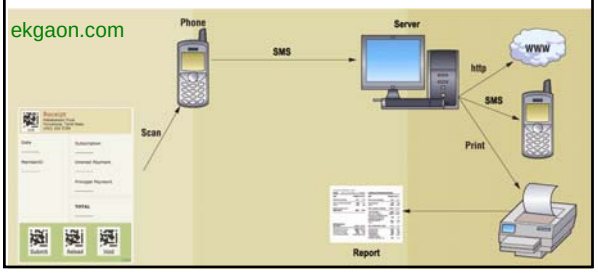
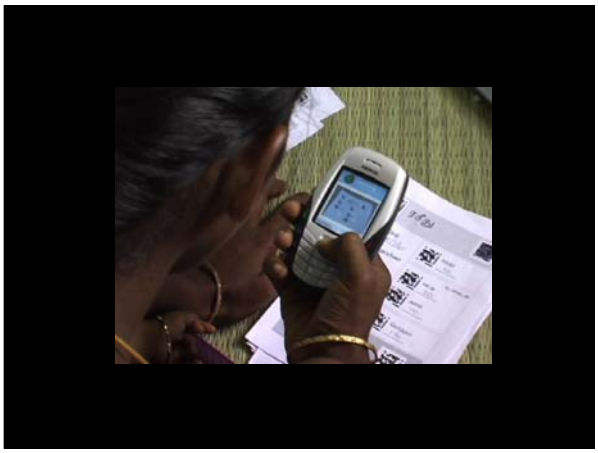
Framework for SHG data collection and reporting
Increased transparency within SHG
Improved documentation when applying for loans
Provide new services to members (e.g. flexible savings)





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Step 3: Evaluate

2006-8

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CAM: Usability Evaluation

Parikh et al. - ACM CHI 2006

Task: Record transactions during SHG meetings
- Users: 14 field agents from NGO
- 7th 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

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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

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Beyond Microfinance

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

Understand, Build, Evaluate

Agriculture: Digital ICS

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Schwartzman et al. - MobEA Workshop at WWW 2007

Internal control system for agri-cooperatives

Maintain quality, certifications (organic, fair trade)

Pilot w/ over 1000 small farmers in Oaxaca, Mexico

Inspection	Evaluation	Report Generation
Inspectors use **mobile phones** to monitor farms	Evaluators use a **web application** to give feedback	Generate **reports** for extension and certification

w/ Yael Schwartzman

OpenRosa Consortium

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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

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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?

Future Work: Support Local Creators

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Empower local people to build their own solutions

Physical tools for content creation and application development

Paper formats, visual and tangible programming

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Final Thoughts

Design for real people & problems

Attracts diverse & energetic students

Impact sustains credibility & collaboration

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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

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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
Mahakalasm 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

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Knownet-Grin

Knowledge Network for Grassroot Innovators: A Honey Bee Project

- **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

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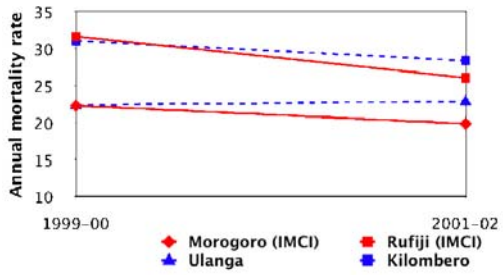
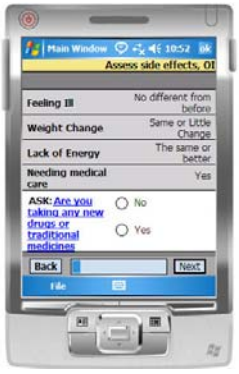
Under five mortality was 13% less in two districts implementing IMCI



Source: Armstrong et al., 2004



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*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

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*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

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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

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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

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ICTD: An Emerging Area

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

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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

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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

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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

Overview & Methodology

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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

Public Health: e-IMCI

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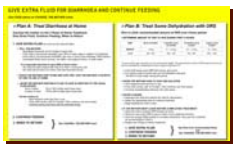
Integrated Management of Childhood Illness (IMCI)

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

e-IMCI: Improving Adherence

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DeRenzi et al. - ACM CHI 2008 (to appear)

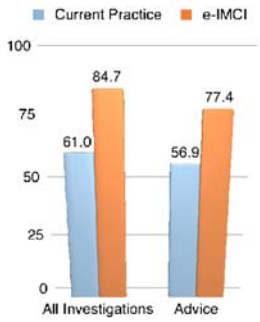
Tested with IHRDC in Mtwara, Tanzania

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