Mobile Phones may be the Right Devices for Supporting Developing World Accessibility, but is the WWW the Right Service Delivery Model?

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Rural Computing Challenges

Environmental challenges
- Temporally intermittent power
- Spatially intermittent connectivity
- Difficult roads and transportation
- Lack of buildings and infrastructure

User challenges
- Low purchasing power
- Limited literacy and educational opportunities
- Many languages and scripts
- Ubiquity of paper-based processes
Hardware is a great fit for rural conditions
- Battery-powered, networked, low-cost
- Numeric keypad familiar to billions of users
- Immediate utility of voice communications

Mobile agents can collect data and provide services
- Common strategy for offering rural services
- Convenient for users / clients
- Leverage underemployed local workforce

But... mobile apps are hard to use and develop

The Economist, Mar 10, 2005
CAM: Mobile Paper Programming Toolkit

CAMForms
interactive 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
Navigation
- Barcodes and printed numeric strings used to access records and functions

Content - XML scripting language
- API for accessing phone features
- Audio, video - play and record

```
<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");
    if (amt != 0)
        email("tap2k@yahoo.com", "a="#amt, "name.wav");
</function>
```

Networking
- Synchronous
- Asynchronous
Leveraging Mobile Phone “Features”

**Small screen** - Sequential interaction limits decision-making

**Microphone / Speaker** - Audio feedback reinforces “dialog”-style

**Camera** - Physical, paper-based navigation and data entry

**Numeric Keypad** - Reduces literacy and localization requirements

**Messaging** - Provides offline access; Reduces UI latency
<table>
<thead>
<tr>
<th>Platform</th>
<th>Description</th>
<th>Offline Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>XHTML / WAP</td>
<td>Layout syntax. Navigate using URLs, links and scrolling. Usually requires online connection</td>
<td>Yes</td>
</tr>
<tr>
<td>IVR / VoiceXML</td>
<td>Scripted syntax? Navigate using voice commands and DTMF codes. Usually requires online connection.</td>
<td>Yes</td>
</tr>
<tr>
<td>SMS / MMS</td>
<td>No client interactivity. Navigate using numeric / textual strings. Supports offline connection.</td>
<td>Yes</td>
</tr>
<tr>
<td>NET / BREW</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>CAM</td>
<td>Scripted syntax. Navigate using printed barcodes and numeric / text strings. Supports offline connection</td>
<td>Yes</td>
</tr>
</tbody>
</table>
CAM Applications

Supply Chain  Javid and Parikh - ICTD 2006
- Track distribution of products
- Manage inventory at rural warehouses
- Integrated with location tracking

Microfinance  Parikh et al. - CHI 2006
- Capture financial transactions
- Monitor clients and loans
- Reduce cost of service delivery

Health Monitoring
- Monitor disease outbreaks
- Link to electronic patient records
Conclusions

A new framework for rural mobile information services
  – Leverage paper / mobile synergies
  – Unique feature set for user / device / environment

Many potential applications
  – Amortize costs across many users and services
  – Browser to be released under an open source license

Lots of potential value
  – Villages will benefit by managing information better
  – World will benefit by building linkages with villages

Come to my (longer) talk tomorrow at 4PM in Ochil-C
Thanks for all the Fish

Anil K. Gupta, Vijay Pratap Singh Aditya, Jaimin, Bhavin, Rushabh, Nilesh, Bharat, Kinjal, Kartik, Bhimsibhai, Narayanbhai, Kaushik Ghosh, Apala Chavan, Sarit Arora, Puneet Syal, Sasi Kumar, Paul Javid, Annaji, John, Bala, Swami, Muthu, Ed Lazowska, David Notkin, James Landay, Richard Anderson, Gaetano Borriello, Ken Fishkin, Scott Klemmer, Kentaro Toyama, Eric Brewer, SRISTI, IIM-A, CCD, Mahakalasm SHG Federations, Media Lab Asia, HFI-India, HLFPPT, UWCSE, MLC, Intel, Microsoft Research India, David Bonderman, SEEP, IDRC, Sarai, ekgaon technologies and everyone else I have had the pleasure to work with.
Self-Help Groups (SHGs) are member-owned microfinance groups

– 12-20 members, over 1m SHGs in India (90% women)
– Members from poor, disadvantaged classes
– Save money during meetings, make small loans for starting a business, buying livestock, education, etc.
– Repayment based on peer pressure
– Similar groups exist worldwide – Grameen, Village Banking, Credit Unions, ROSCAs, etc.
SHG MIS using CAM

- Online accounting and reporting service for SHGs
- Conducting pilot in Tamil Nadu, India
- Reports will be provided to NGO and banks
Usability Testing  Parikh et al. - CHI 2006

Task: Record transactions during SHG meeting
- “Controlled” and in-field testing during real meetings
- Using barcode navigation
- Users: 14 NGO field staff from villages
- Literate - 7th grade to college education

Results: Mobile phones are a usable solution
- Learned system within 3 days
- Avg 30 secs per form, 8-10 mins per meeting
- Less than 1% error rate
- All users described interface as very easy or easy
Related Work


**Mobile UIs** — West (UIST 1999), PowerBrowser (CHI 2000), Dial-And-See (UIST 2005), WAP, SMS, IVR

**Technology for Developing World** — Grisedale et al. (CHI 1997), Daknet, TEK, TIER, DSH, $100 Laptop, etc.

**Mobile Microfinance Data Collection** — Compartamos / Accion, SKS, HP Rural Transaction System
The Rural Developing World

4.8B people live in developing countries (many in rural areas)

Rural developing world people have many information and communication needs

- Manage finances
- Learn about business opportunities
- Access government services
- Access medical guidance
- Communicate with friends and family
- Transact with customers, suppliers

Mostly met by 'analog' means

- Paper, fax, voice communications, physical exchange
8 Rules for Rural Computing

- **Easy to Use**: Deal with all classes of novice users
- **Easy to Teach**: Conveyed by *word of mouth*
- **Easy to Distribute**: Remotely, and person-to-person
- **Easy to Share**: Individuals can't afford devices
- **Easy to Develop**: Allow local content and applications
- **Flexible**: Language, culture, infrastructure varies
- **Trusted**: By both users and community
- **Serving a Need**: Technology is a big investment
8 Rules for Rural Computing

- **Easy to Use**: Demonstrated for novice rural users
- **Easy to Teach**: Simple 1-step interaction model
- **Easy to Distribute**: Paper, Numbers, Messages
- **Easy to Share**: One agent can serve many villages
- **Easy to Develop**: XML-based scripting language
- **Flexible**: Mobile Phones, SMTP, Numbers, Audio, Images
- **Trusted**: Audio and video, linkage to paper records
- **Serve a Need**: Several economically relevant apps
Vision: Breaking the Information Chains

- events
- objects
- stories
- 123 numbers
- CAM
- multimedia
- paper
- knowledge
- analysis
- access
Which CAM applications can have the most Impact?
- Huge potential in microfinance and related areas
- Security, Trust, Privacy, Transparency

Can this system be used for Other Naïve Users?
What does our design mean for Mobile Device Design?
Can we make it easy to Offer Knowledge-based Services?
How does this all contribute to Sustainable Development?
Knownet-Grin
Knowledge Network for Grassroot Innovators: A Honey Bee Project

- Honey Bee Network shares local knowledge and grassroots innovation
- Publishes regional magazines
  - agricultural practices and other innovations
- Interested in finding new ways to share content and facilitate multi-stakeholder communication
- Visual Basic app with multi-media distributed database with asynchronous updates and messaging
- Implemented at kiosks in Gujarat, Madhya Pradesh, Maharashtra and Tamil Nadu
Importance of Paper
- Ubiquitous in existing work practices
- Understanding tied to current tabular formats

Numeric Input / Output
- Calculators are commonly used
- Even semi-literate users can input numbers
- Avoids local language input

Audio Output
- Local language audio great for building rapport
- Accessible to semi-literate and illiterate users
Scaling Microfinance in India

Banks would love to work with SHGs
- Demand for capital exceeds supply
- Excellent performance (90-98% repayment)
- Fulfill social (and regulatory) objectives

However, there are many obstacles
- Members have little or no education
- Many practices are inconsistent
- Groups spread across remote rural areas
- Expensive to collect information and money
Problem Statement

Information systems are key to scaling microfinance
  – Transaction processing
  – Monitor members and groups
  – Analyse performance and impact
  – Offer more services
  – Link to formal institutions

Can we design a UI to document member-level SHG transactions?
  – Accurate and efficient
  – Accessible to a variety of users
 CAM: System Features

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