CSE481K/HCDE596 (Winter 2013): Designing Technology for Resource Constrained Environments

IRIS | Mobile Patient ID and Tracking

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Problem

Positively ID'ing patients/subjects and tracking care is essential to improving health outcomes, and is the foundation of virtually all research work (healthcare, or otherwise). Tracking patients' medical care is difficult in isolated and developing areas:

- **Identification** - difficult without photo IDs / national identification schema. Complicated by:
  - Linguistic/cultural hurdles; eg, too few names in language to cover population, or villagers with first names only.
  - Language barriers between providers and patients.
- **Medical Records** – Frequently non-existent or difficult to use and poorly kept.
  - Nomadic populations and/or mobile clinics often render paper records valueless.
  - Paper records are not very secure, often leading to poor record keeping.
  - Lack of equipment, power, internet, funding, training, etc.

Solution = IRIS

- **Biometric Patient Identification**
  - fingerprints, may use others in future where fingerprints are inappropriate
- **Device/Platform Agnostic Software**
  - low cost fingerprint scanner connects via USB
- **EMR in Cloud**
  - secure storage
  - access from anywhere in the world
- **Usable**
  - even with limited local language skills / low education
- **Globally Scalable**

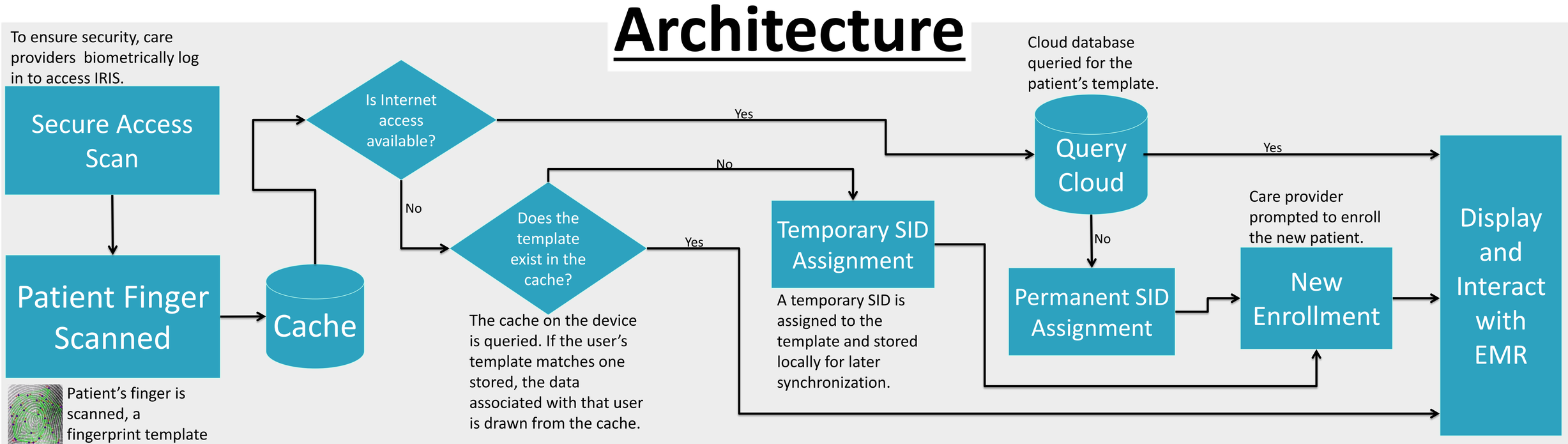
Field Work

- **iRespond (stakeholders) – meetings to discuss**
  - Identification problems and how to design SIDs
  - Platform/Interface Design. Decision to be as device agnostic as possible (browser-based , HTML5, JavaScript, SQL).
  - iRespond's preliminary testing in Thailand
    - ~80% success with initial scan (scanning through callouses of farmers was difficult), 100% success achieved after 2-3 attempts
  - Other biometric possibilities. Palm scanning (used on ATMs in Japan, in lieu of ATM cards), iris scanning (for multiple amputees), vein maps, voiceprints.
- **UW CSE Machine Learning, Speech Group – met to discuss** voiceprints as a biometric. (Global validity inconclusive ; group offered help on it next quarter.)

Related Work

- **UIDAI – Unique Identification Authority of India –** intends to biometrically ID all of population (will track patients and healthcare data)
- **ODK – Open Data Kit for Android** focuses on improving mobile device data-collecting abilities. ODK is already being used by care providers
  - ODK is open source, could be supplemented by IRIS (possibly, an ext. call)
- **WeReport** – Improves the usefulness of Peace Corps efforts by learning about actual consequences of projects
  - IRIS can do this for vaccine programs, prenatal education, etc.
- **Bill Gates' 2013 Annual Letter** was a virtual 'Call to Arms' for 'measurement'

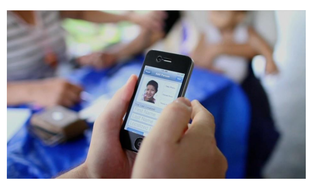
Architecture



Components

- **Device** – smartphone, tablet, laptop, etc.
- **Biometric Scanner** – presently, usb connected fingerprint scanner
- **IRIS System** – HTML5 / JavaScript interface
  - SQL Cloud Database with Two Tables
    1. Table of fingerprint templates, and SIDs
    2. Table of SIDs, and patient EMRs [or log of GUIDS]
       - [for SIDs beginning with zero (temporary SIDs), patient info will be replaced by log of what GUID the temporary SID has been associated with and when.]
  - Local temporary caching of database allows work with poor connectivity
    - SID/GUID system allows for near-completely automatic reconciliation of temporary records when re-connected

note: *in countries that disallow cloud storage of medical info, secure, remote servers can be used; this will be done during testing in Thailand*



Determining SID Format:

How to identify a single individual from an infinite pool of subjects and assign them a Subject ID (SID)

CONSIDERATIONS for SID:

- MUST be anonymous and secure.
- MUST be assigned randomly (rather than sequentially, or by country).
- MUST be human-usable (manually transcribable, short; '*Miller's Law*').
- MUST be globally scalable.
- MUST be tolerant of intermittent network connectivity.
- MUST allow for a system of temporary SIDs (that can still be used in temporary local storage and on paper in a clinic), that can be supplanted by real SIDs upon reconnection.

SOLUTIONS:

- Verhoeff Check-Digit (to minimize transcription errors; final digit in SID).
- 12 digit SID, Arabic numerals only (universally input-able, excluding check-digit, up to 99 billion entries).
- Temporary SIDs only use numbers between 0 and <10 billion, so any SID with a leading zero is recognizable as temporary. On reconnection to the database, local data is reconciled with the cloud; assigning permanent SIDs or applying data to existing SIDs' records.
- Invisibly, system assigns GUIDs (Globally Unique Identifiers; 32 hexadecimal digits) to fingerprint templates and SIDs. GUIDs have approaching-zero probability of duplicate random numbers even without checking the database first.
- A log is kept of the temporary SIDs used, with what GUIDs, and when, allowing audit trail and reconciliation of orphaned paper records

If zero, SID is temporary — **Check Digit**

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Spring Quarter Timeline

April

- Finish Backend Development
  - Database, interaction with fingerprint scanner, etc.
- Finish UI Design
  - Test UI paper prototypes in laboratory
- Implement Frontend
- Plan Local Testing

May

- Conduct Local Testing
  - Evaluate,
  - Iterate
- Plan Field Testing
  - Find funding partners, if possible

June

- Conclude Local Testing
- Begin Field Testing, if possible
  - Likely , using remote partners
- Write-Up
- Present

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