Automated NFC enabled Rural Healthcare for reliable patient record maintenance

Divyashikha Sethia\textsuperscript{a}, Shantanu Jain\textsuperscript{b} and Himadri Kakkar\textsuperscript{b}
\textsuperscript{a} Assistant Professor, \textsuperscript{b} Student

Department of Computer Engineering, Delhi Technological University, Delhi India

Outline

- Introduction
  - Remote Healthcare Scenario
  - Mobile healthcare with Body Sensor Networks
- Issues of Interest
- NFC (Near Field Communication)
- Proposed Architecture
- Conclusion and Future Work

Remote Healthcare Scenario

- Remote Rural Villages
- Disaster struck Areas
- Number of Doctors per 1000 in India: 0.6 [Jhunjhunwala, 2007]

Mobile Healthcare with Body Sensor Networks

[Bart, Ingrid et al., 2010]
Rural Telehealthcare

- Issues of interest:
  - Reliability patient record
  - Training of healthcare helpers
  - Automation for fast processing of patients

Traditional Form Based Mobile Applications

- Manual interface:
  - Step 1: Enter Patient ID
  - Step 2: Medical Sensor Data interface
  - Step 3: Send data to medical server

- Problems:
  - Error in patient record entry
  - Time consuming form entry
  - Training of healthcare helper

Automated Application

Requirement for health monitoring of Mass population and lack of trained healthcare helpers:

- Reliability of patient record
- Simple interface
- Fast processing of patients

SmartPhone Communication Interfaces

- Wifi
- Bluetooth
- Near Field Communication
**NFC (Near Field Communication)**

- Contactless short-range communication
- Based on Radio Frequency Identification (RFID)
- Mobile 13.56 MHz RFID reader and writer
- Information at < 4 centimeters
- Maximum communication speed of 424kbps


**NFC Modes**

- **Modes**
  - **Active device** - generates own RF field
  - **Passive device** - retrieves power from RF field of other device

- **Reader/writer mode:**
  - Use the mobile to read/write external tags

**NFC Applications**

- **Easy interfaces**
  - Applications – ticketing, contactless payment etc

- **Improved Healthcare procedures**
  - Alzheimer patients incidents on NFC tags
    [Bravo, Hervás et al, 2008]
  - Avoid errors in medication in hospitals
    [Lahtela, Hassinen et al, 2008]
  - NFC tags for pneumonia detection in Karachi, Pakistan
    [Adam, Guido et al, 2009]

**Proposed Solution for Automated HealthCare**

- **NFC to trigger Bluetooth with Passive Tags**

- **Community Healthcare center**
  - Healthcare helper
  - Body sensor
  - NFC tags
  - NFC enabled Smartphone

- **Purpose**
  - Patient Records
  - Automate health flow
### Automated Healthcare System Main Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NFC TAG with the Patient ID</strong></td>
<td>• Type 2, Mifare Ultralight&lt;br&gt;• Type 1, Topaz with 144 bytes memory capacity</td>
</tr>
<tr>
<td><strong>Simulated Pulse Oximeter Sensor</strong></td>
<td>• Java Bluetooth application&lt;br&gt;• Linux with bluez</td>
</tr>
<tr>
<td><strong>NFC Enabled Android based Smartphone</strong></td>
<td>• Google Nexus S&lt;br&gt;Analysing module&lt;br&gt;Visualization module</td>
</tr>
<tr>
<td><strong>Local Server</strong></td>
<td>• Medical Database&lt;br&gt;• Remote Medical Server</td>
</tr>
</tbody>
</table>
Proposed Architecture Workflow

NFC Card

Local Server

Remote Medical Server

1. Bluetooth
2. HTTP Connection
3. GPRS / DTN

Automated Steps

Nexus S (With Android API)

Patient Identification
1. Passive NFC Read
2. Patient verification
3. Patient history

Diagnostics
1. Bluetooth sensor
2. Diagnosis
3. Report

Connect & Upload
1. HTTP connection
2. Upload (Id, diagnosis)
3. SMS, email etc

Steps:
1. Step 1
2. Step 2
3. Step 3

Patient Identification
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Snapshots:

Write/Read Patient ID

Patient NFC Card
Patient Id: 100...

Snapshot: Write/Read Patient ID

Sensor Signals

Snapshot: Sensor Signals
Snapshot: Report Generation

- **Standard Rules For Report Generation**
  - Normal SpO2 range: 96 – 99%
  - Acute condition:
    - SpO2 < 88%
    - Desaturation event: SpO2 drops by 3 to 4% in 10 seconds

- **Basal SPo2**
  - Average of top 20% readings

Conclusion

- **Benefits**
  - Easy to Use intuitive Interface
  - Patient identification and history
  - Automatic generation of preliminary reports
  - Early Disease diagnosis

- **Application**
  - Remote areas with bulk population
  - Lack of trained healthcare helpers

Future Work

- **Live Deployment using body sensors**
  - Rural healthcare and emergency
  - Elderly home healthcare

- **Efficient algorithms for report diagnosis**

- **Security of Health care data with NFC**
  - Health data security
  - Privacy patient

THANKS