Awareness Modelling of Collaborative Mobile e-Health

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Pradeep Ray, Nandan Parameswaran, Victor Chan and Weider Yu
ApuHC (www.apuhc.unsw.edu.au)
University of New South Wales, Sydney, Australia
Agenda
Outline of Presentation

1. Background
2. Introduction
3. CSCW Agent Support
4. Design
5. Evaluation
6. Conclusion & Future Work
International Ubiquitous Healthcare (u-Health) Initiative

- IEEE/ITU D Mobile e-Health Initiative for Developing Countries (trials in Tsunami affected countries) deliberations at IEEE Healthcom (www.ehealthcom.org)
- Launched at Med eTél (one of the largest events in e-Health in Europe, organised by the International Society for Telemedicine) 2006 in Luxembourg on April 6, 2006
- Current Partners: Australia, France, Greece, India, Japan, Singapore, Taiwan, South Korea, USA
- Asia Pacific ubiquitous Healthcare Research Centre (APuHC) with nodes at Sydney, Buisan, Kolkata and Taipei
APuHC Research Goals

- Health Systems in different layers (Network, Applications, Service, Process and Governance)
- Ontology Based Multi Agent Systems (OBMAS) strategies for semantic interoperability and disaster management
- Studies on the Impact of Health and eHealth
- Models for integrating Health in governance and business processes
- Paradigms for Promoting Healthy Life with the help of governments and businesses
- Pandemic and Bio-terrorism Control in collaboration with other global centres, such as WHO GOARN, APEC EAN HIV, Korean Centre for Genome Sciences and APEC EINET
- To Showcase the Health technologies, processes, and services at IEEE Healthcom and related international events
Research Programs

1. Cooperative Management and Semantic Interoperability attracted 6 (including four ARC) Research grants since 2000 with UNSW (CSE), WCH (Aust), CGU, SNHU, SJSU (USA)

2. Service Level Management and icare attracted 5 (including one ARC, one international and 1 industry) research grants since 2004 with NCCU (Taiwan), IBM Global, Netstar (Aust), UC Irvine, RPI (USA), I2R Singapore

3. E Health for Chronic Illness Management attracted 2 (including WHO and ITU- initiatives) since 2005 with NTU (Taiwan), Netstar and four developing countries (India, China, Vietnam and Philippines)
ITU-D/IEEE Mobile eHealth Initiative for Developing Countries

- Joint Effort of ITU-D Q14 and IEEE Healthcom started in 2004 (consortium of twenty countries)
- Use of Mobile Wireless Technologies for supporting eHealth for applications, such as
  - Emergency Telemedicine
  - Epidemic Control
  - Combating Bioterrorism
**Important Elements of a Telemedicine System:**

- Computer-based Medical station (Desktop or Laptop PC)
- Remote Computer-based Medical station(s) = e-Health Kiosk(s) – Movable/Mobile (Desktop or Laptop PC)
- Telecommunication Network/Infrastructure
  - Telephone Network (PSTN, wired & wireless, mobile phones)
  - Wireless Telecommunication Network (Wireless LAN, Satellite Communication Network)
  - The Internet (through Internet Service Providers)
- Hardware and software Modules
Initial Applications Targets

- Limited Tele-consultation can be conducted through “store & forward” – not in real time (for non emergency cases)
- Tele-coordination through e-mail (for non emergency cases) and direct phone call (or Voip, Skype) in emergency
Web-based Distance Education

- Distance Education for the community: health education, preventive medicine (Web-based)
- Distance Education for medical personnel
- Web-based tele-consultation can also be used
Trials in 2004 Tsunami Affected areas

- Trials in Indonesia and India
- Collaboration with the Healthcare IT vendors
- Mobile unit with diagnostic equipment and communication link-up with natural referral hospital (s) (district / medical college / specialty hospitals)
- Communication link between remote site and major hospital through various wireless mobile technologies, such as satellites, GSM cellular, WiFi, WIMAX etc.
- Operated by trained general practitioner /health worker from within the public health system
Impact of Tsunami 2004 in Indonesia

- 26 Dec 2004 tsunami disaster happened in Aceh province (Nangroe Aceh Darussalam, NAD, Indonesia) –
  - About 128,515 people died
  - 37,063 were missing
  - 513,278 refugees (80% in temporary shelters, tents & homes, 20% in temporary camp)

Community healthcare is the primary need
BEFORE TSUNAMI
Banda Aceh
AFTER TSUNAMI
DECEMBER 26, 2004
Mobile eHealth System trialed in Tsunami Affected Areas

- DKK Banda Aceh
- Zainal Abidin Hospital
- Medical Faculty Unsyiah
- Wireless/Microwave LAN
- The Internet
- e-Health Kiosks (mobile units)

AI3 Unsyiah

Internet through JCSat satellite
CSCW Field

- CSCW provides: provides a fusion of business processes and possibilities of communication & intelligent agent technologies

- CSCW application to management is also called Cooperative Management

- Human roles are assisted with agents

- Mobile awareness through CSCW model (called ‘Awareness Model’) can specify cooperation levels among agents
CSCW & Agents

- Not all decisions can be automated
- Human driving force will make important end decisions
- Agents seen as autonomous social and reactive components, acting in specific settings
- With aid of CSCW and agents, an improvement in response and decisions can be made
Role Interaction Scenario

Figure 3: No CSCW Agent Support
Successful collaborative work requires info sharing, knowledge of group and coordination.

In order for agents to realise this, they must be aware and encompass knowledge and context.

Awareness brings awareness levels which express the level of cooperation within an interaction.

E.g. Level 0 = knowledge related to a particular interaction, higher level awareness involves higher level knowledge.
CSCW Agent Support Scenario

Figure 2: CSCW Agent Support Scenario
## Awareness Matrix
### CSCW Scenarios

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Telephone/Verbal/Fa ce-To-Face</td>
<td>C1 - C3</td>
<td>1</td>
<td>Patient Agent</td>
<td>C1 - C9</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Telephone/Verbal/Fa ce-To-Face</td>
<td>N/A</td>
<td>N/A</td>
<td>Patient &amp; Server Agent</td>
<td>C1 - C9</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Telephone/Verbal/Fa ce-To-Face</td>
<td>N/A</td>
<td>N/A</td>
<td>Patient &amp; Server Agent</td>
<td>C1 - C9</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Server Agent</td>
<td>C1 - C9</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Pagers</td>
<td>C1 – C5, C7</td>
<td>2</td>
<td>Server Agent &amp; Video Conferencing</td>
<td>C1 - C9</td>
<td>3</td>
</tr>
</tbody>
</table>
### Awareness Matrix
Communication Mechanisms

<table>
<thead>
<tr>
<th>Communication Mechanism</th>
<th>Description</th>
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<tbody>
<tr>
<td>C1</td>
<td>Same time, same place (face-to-face meeting)</td>
</tr>
<tr>
<td>C2</td>
<td>Same time, different place (telephone conference, video conference)</td>
</tr>
<tr>
<td>C3</td>
<td>Same time, different unpredictable place (mobile phones, pagers)</td>
</tr>
<tr>
<td>C4</td>
<td>Different time, same place (desktop computers)</td>
</tr>
<tr>
<td>C5</td>
<td>Different time, different place (email, voice mail, fax)</td>
</tr>
<tr>
<td>C6</td>
<td>Different time, different unpredictable place (mobile phones, email, fax)</td>
</tr>
<tr>
<td>C7</td>
<td>Different unpredictable time, same place (impromptu problem meetings)</td>
</tr>
<tr>
<td>C8</td>
<td>Different unpredictable time, different place (email)</td>
</tr>
<tr>
<td>C9</td>
<td>Different unpredictable time, different unpredictable place (mobile phones, email, pagers)</td>
</tr>
</tbody>
</table>
Awareness Relevance
Awareness Levels & Cooperation Repositories

Figure 4: Awareness Levels & Cooperation Repositories
Initial heuristic qualitative evaluation performed in terms of usability and appropriateness

Range of responses covered 5 health professionals aged 20s to 30s working as doctors, nurses and specialists.

Collaboration and communication would determine what they did next to reduce errors

Groupware tools enhance communication among the professionals widely seen as beneficial

CSCW is more essential in rural hospitals where the staff numbers may be lower

System brings instant results, mismatch of speeds may lead to loss of data

Concern for patient privacy
Evaluation of this has already shed light into this area which provides:

- a real potential to assist via CSCW and agents and;
- Supporting chronically ills patients in remote healthcare monitoring.

To address limitations, additional layers required to provide support between CSCW and the lower layers.

A new work has been undertaken to evaluate mobile e-Health solutions using a longitudinal study involving a number of countries as part of the ITU-D m-Health initiative for developing countries.