Monitoring and visualising of night time activity patterns of people with early dementia

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Background

- It is estimated that around 820,000 people in the UK have dementia, and the annual cost of dementia is £23bn.
- Sleep disorders and disruptive nocturnal behaviours present both a significant clinical problem and a cause of increased stress for caregivers.
- The degree of the irregular sleep-wake pattern can reflect the cognitively impairment stage.
Related work

• Self-report and report from carers
  – the most low-cost and easy approach
  – Subjective, inaccurate (easy to forget etc)

• Polysomnography
  – Accurate
  – not suitable for home-based telecare

• Assistive technology
  – Using an array of bed sensors and cameras
  – Generating large amount of data stream
  – Privacy issues
NOCTURNAL Project

• NOCTURNAL is designed to address the needs of people at the early stages of dementia, specifically to provide therapeutic support and guidance to this group of people during the hours of darkness

• Broad Objectives:
  – to provide new technological capabilities that support sophisticated service offerings
  – investigation of the needs of people with dementia at night time
NOCTURNAL Architecture
NOCTURNAL Sensor settings
## Example of Data

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Location</th>
<th>Status</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>bed</td>
<td>masterbedroom</td>
<td>out</td>
<td>07/06/2010 08:51</td>
</tr>
<tr>
<td>bed</td>
<td>masterbedroom</td>
<td>in</td>
<td>07/06/2010 08:51</td>
</tr>
<tr>
<td>bed</td>
<td>masterbedroom</td>
<td>out</td>
<td>07/06/2010 08:52</td>
</tr>
<tr>
<td>pir</td>
<td>masterbedroom</td>
<td>roomvisited</td>
<td>07/06/2010 09:21</td>
</tr>
</tbody>
</table>
Sleep measurements variables

• Quantity of sleep
  – the total amount of daily sleep time

• Quality of sleep
  – the number of sleep episodes

• Rhythm of sleep
  – central-sleep-time
Framework for sleep pattern detection

Visualization Module:
1. Display user-friendly GUI for selecting dates wherever required
2. Visualize daily sleep pattern
3. Visualize sleep pattern over 7 days
4. Visualize sleep pattern over 4 weeks
5. Visualize number of sleep hours and trend line over 7 days
6. Visualize number of sleep hours and trend line over 4 weeks

Sleep Pattern Detection Module:
1. Select valid start and end point of each sleep episode.
2. Calculate length of valid sleep episodes.
3. Calculate number of valid sleep episodes.
4. Calculate sleep trend line
5. Summarize the sleep pattern of client

Detection Module:
My SQL database connected to Nocturnal system
Case study: Mrs. F’s sleep pattern
Case Study: Mr M’s sleep pattern
Sleep pattern analysis and visualisation system
Conclusions and outlook

• People with early dementia may have different sleep pattern

• NOCTURNAL system can provide objective and ubiquitous monitoring of sleep patterns for healthcare purposes with relatively little effort.

• Future work: to investigate more closely the correlation between sleep patterns and dementia stages.
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