Smart Cities and Wellbeing

- Use case formed using inputs from discussions carried out as part of HEALTH-I project with Cisco Smart City demonstrator, CityVerve (Manchester) and Southampton City Council (SCC)

Wellbeing in Smart Cities

Air Quality Monitoring
- Lamp Posts
- Train Routes
- Parking

Healthcare Service Management

Asthma
- Use lamp posts for installation of air quality sensors
- Use data collected for reducing asthma symptoms

Cars drive around car-parks to find space, causing more pollution
- Challenge is to monitor air quality around a car park at low cost
- Use of low-cost sensors and lighting system to collect data

Unavailability of real-time guidance for people with health conditions to avoid areas with pollutions that can trigger an attack

Lack of understanding on to what extent the improvement of air quality could reduce health risk and healthcare cost

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An Example Intervention

GP Briefing

Enhanced Patient History (sensing based environment, lifestyle, exercise monitoring)

Daily-basis

Questionnaire Prompt

Real-time monitoring
Exacerbation Warning

Air Quality Prompt

BreathEasy App

Medication prompt

Warnings for triggers, predictive analysis of response to prescribed treatment plan and medication

GP De-briefing

Personalized adjustments to medication, treatment plan and guidance

Adapted from (Burnett, 2013)
Scope

Sensor driven real-time air quality (environment) monitoring, individual’s health and lifestyle (behavioral and physiological) monitoring

Develop insight into environmental (indoor/outdoor) triggers, categorize vulnerable groups, recommendations

Integrate air quality data, lung function data to provide therapies, self-management, and medication

Draw baseline for interventions at population and personal level

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The Mobile App

- Extends the UBhave framework for designing behavioral interventions (Hargood et al., 2014)
- Intervention for any behavioral condition can be designed using the framework
- An intervention can be loaded from a *json* file
- The mobile application is built using Apache *Cordova* and front-end using *Ionic* framework
Why breatheEasy.city
Monitoring Lifestyle Parameters

• Cross-platform wellbeing mobile application
• Captures general wellbeing of patients on a daily-basis
  • Lifestyle and physical activity
• *Personal data* captured—username, password and their geo-location
Wellbeing Questionnaire
Discussion with Healthcare Experts

• **Data Collection**
  - Pollution, patient’s lifestyle parameters

• **Current BreatheEasy Application**
  - Environmental triggers, lifestyle management
  - Social component – explore social media data to observe post recovery lifestyle
Pollution Exposure

• According to AsthmaUK, when pollution levels are high we all breathe in harmful substances, but if you have asthma, you’re more likely to feel the effects.

• **Pollution is more of a risk for people with asthma** because:
  • Traffic fumes, wood smoke, quickly irritate airways and trigger asthma symptoms
  • Particles found in dust, soot, smoke, and diesel fumes are small enough to get right into the lungs, making airways inflamed and swollen and bringing on asthma symptoms. *(Outdoor)*
  • Pollution can make one more sensitive and more likely to react to usual asthma triggers (such as house dust mites, pollen, pets, molds and fungi) *(Indoor)*.

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**TOP 10 CAUSES OF ASTHMA ATTACKS**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLDS &amp; FLU</td>
<td>81%*</td>
</tr>
<tr>
<td>DUST</td>
<td>61.6</td>
</tr>
<tr>
<td>AIR POLLUTION</td>
<td>61.6</td>
</tr>
<tr>
<td>POLLEN</td>
<td>61.6</td>
</tr>
<tr>
<td>EXERCISE</td>
<td>53.5</td>
</tr>
<tr>
<td>CIGARETTE SMOKE</td>
<td>53.4</td>
</tr>
<tr>
<td>PERFUMES &amp; AEROSOLS</td>
<td>47.7</td>
</tr>
<tr>
<td>STRESS</td>
<td>43.3</td>
</tr>
<tr>
<td>MOULDS &amp; FUNGI</td>
<td>42.3</td>
</tr>
<tr>
<td>PAINT FUMES</td>
<td>37.9</td>
</tr>
</tbody>
</table>

* PERCENTAGE OF ASTHMA PATIENTS REPORTING SYMPTOMS
Outdoor Pollution Exposure

- Determine – where Asthma attack was triggered
- Reverse engineer from user’s approximate responses
- Data point is critical
What are we capturing

How do you describe location of your home

According to AsthmaUK- Living in congested areas, near green areas also impact the conditions of Asthma.

Distance between your home and office *

How much time on an average do you spend in your daily commute? *

What is your usual time of commute in the morning? *

If your most frequent mode of commuting is CAR, then please tell us about air circulation mode you set?

Mode of transport *

Tell us about most frequently used mode of commuting

• Bike
• Walk
• Car / Taxi
• Train
• Bus
Indoor Pollution Exposure

• **What is it?**
  • A build-up of pollutants in home to the extent that it affects an occupant’s health and comfort

• **Why it matters?**
  • UK citizens spend 90% of their time – indoors

• **Increasing importance**
  • Air quality is poor as homes are more air tight, making pollutants accumulate
  • A study at Reading University predicts 80% of asthma patients will be impacted by indoor air pollution

• **What are the symptoms**
  • Sneezing, coughing, headaches, respiratory infections and more...
What are we capturing

Which of these relate to your home

Do you have an air-purifier *

The flooring at your home

How often do you clean your house

For cleaning your home, which method do you prefer?

Your cooking preferences *

What is your preferred method of cooking

☐ Stir-fry

☐ Oven cooking

☐ Microwave

Do you open windows when cooking? *

☐ Yes

☐ No

☐ Use an extractor fan or a chimney
## Offline Study

### What we expect?

- A study about the impact of POSSIBLE pollution exposure on Asthma patient’s lifestyle
- Complete data collection
- Quantitative analysis
  - Weather patterns
  - Environment patterns
- Design an example intervention based on environmental triggers
- Integrate into BreatheEasy app (2.0)
- Evaluation – User Study

### What we get!

- Tell you at Nanjing...
- May be organize a user-study session to evaluate all the apps within NExT++.
References


• Honkoop PJ, Simpson A, Bonini M, et al. MyAirCoach: the use of home-monitoring and mHealth systems to predict deterioration in asthma control and the occurrence of asthma exacerbations; study protocol of an observational study,  *BMJ Open* 2017;7:e013935. doi: 10.1136/bmjopen-2016-013935


