Singapore National Science Experiment on Big Data Visualization

Presented by
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CEO, Science Centre Singapore
What is NSE?

The National Science Experiment is a mass-participation event to gather data about the environment and Singaporean lifestyles.

• Students to carry SENSg devices as they carry on with their everyday tasks
• SENSg device collects data passively
• Data analysed with visualization
• From survey study to experimental applications
SENSg: Lab on a Lanyard

- Atmospheric Pressure
- Relative humidity
- Temperature
- Light level
- Sound Pressure Level
- Motion

School Wi-Fi

Secure Server

Your Experiment Portal
What can the sensor do?

- Accelerometer
- Gyroscope
- Magnetometer
- Ambient Temperature
- Barometric Pressure
- Humidity
- Sound Pressure Level
- Pedometry
- In/Outdoors Time
- WiFi-based location
- Pedometry
- In/Outdoors
- CO₂ footprint
- Step count
- Time indoors
- Time outdoors
- Personal Carbon Footprint
NSE 2015: Step out for Science

**Individual Challenges**

1. How active am I? Steps taken & time spent outdoors
2. What is my travel carbon footprint? Mobility patterns
3. My fav hangout spots Pictures taken with device

**National Experiment**

Data aggregated at National Level

1. How active are young Singaporeans?
2. Mobility patterns of young Singaporeans?
3. Top hangout spots in each neighbourhood?
4. Data useful for infrastructure planning
2015 Step Out for Science Statistics

43,140 students
128 schools
0.5 Billion steps taken
155,843 km per day
206,739 page views
2,742 hours of portal use
Student Experiment Portal
Student Experiment Portal

SENsgBeta

Visualize Geospatial Data

Explore Personal Data

Erik Wilhelm, SUTD
Noise Pressure Level

Note: Measurement of Noise Level is based off Pressure readings, not frequencies or recordings

Sharon Chang, STEM Inc.
Day Temperature

Erik Wilhelm, SUTD 5:30-19:30
Night Temperature

Erik Wilhelm, SUTD
NSE 2016: Step UP for Science

1. How many stairs climbed per day
2. Capture positive moments
3. How much CO₂ per day

Key CO₂ Contributors (2005) (kilo tonnes)

<table>
<thead>
<tr>
<th>Source</th>
<th>CO₂ (kilo tonnes)</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>Primary Consumption</td>
<td>19,315</td>
<td>45%</td>
</tr>
<tr>
<td>(combustion fuel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary Consumption (use</td>
<td>8,128</td>
<td>21%</td>
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<tr>
<td>electricity)</td>
<td></td>
<td></td>
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<tr>
<td>Overall</td>
<td>21,793</td>
<td>45%</td>
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TOTAL CO₂ = 40,377 kilo tonnes
NSE Web Portal

View individual data tagged to locations

Compare against the national average

Educational modules

Game linked to step count and charging patterns from NSE
NSE Data Challenge

Objectives:
1. To educate students on big data and “Internet of Things”
2. To familiarize students with the use of big data tools and analytics

<table>
<thead>
<tr>
<th>NSE week</th>
<th>NSE Data Challenge</th>
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<tbody>
<tr>
<td>Data collected by individual student using SENSg device</td>
<td>Data sent to respective school</td>
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<tr>
<td>Students to use tools to perform analysis (with mentor guidance)</td>
<td>Students to present the analyses (video, slides, blog, etc)</td>
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Criteria:
- Categories: Sec 3/4, JC1/2, Poly/ITE
- 3-4 members/team
- Up to 3 submissions per school (1 entry/team)
NSE Data Challenge - Sample analysis

• The furthest distance from school
• The major choke points in the school vicinity
• Places where students spend their time before school, during recess and after school
• The distribution of students reaching and leaving school at different time interval
“Step out for Science” - Analysis

Steps/day
Mean steps: 5,853

Time spent outdoors
Mean hours: 1.1

Carbon Footprint
Mean grams/student/day: 333

The three main questions for the 2015 National Science Experiment ‘Step Out for Science’ were answered using on-board intelligence developed by the SUTD.
Transportation Mode Analysis

Over the course of the experiment, students travelled over 155,000 km daily to reach their schools. They tended to travel by road in the morning, and rail in the evening. More than 85% of student travel to school is by public transport.

The further you live from school, the more likely it that you take the train. Most students walk to school if they live within 2km.

Removing car travel entirely would halve CO2 emissions, travelling exclusively by car would result in five times more.
Analysis of Time Spent Commuting

Bus commutes tend to have more unpredictable durations compared with train commutes, as can be expected.
Do students live close to school?

Primary students tend to live much closer to their schools than secondary/JC students.

Over 100 students were observed travelling to Singapore from Johor Bahru.

Heat map indicates density of homes, white points.
How connected is Singapore?

Over 1.8 million unique Wi-Fi access points were detected and mapped in Singapore; including the Singapore Zoo and Pulau Ubin.
NSE 2017

- No specific theme for this year, given general subthemes to explore: Physical Comfort, Mobility, Neighbourhood, Health & Wellbeing and Arts, Culture & Heritage.

- 92 teams that took part in this year’s event, 11 teams in finals.

- >10,000 devices used over 4 weeks
Polytechnic winning project on students traveling time to school

• The project aimed to find out if home-school distance affected the time students left for school. It was found that regardless of distance between students’ homes and SP, students tended to move hastily to avoid being marked late. Therefore, our hypothesis that only students who lived far and commuted by train tended to move hastily while travelling to SP was proven wrong.
How far is Dover MRT from their residence?
Recommendation

1. Morning E-Learning
2. Promote the use of Train
3. Bike Sharing Services
Educational Objectives achieved

• Through the NSE, students learned about the Internet of Things and Big Data, gained knowledge and tools to teach them to read and analyse the information, interpret visualisations, and compare trends.

• Teachers could leverage the data to develop interesting science lessons and teach concepts such as humidity, linear kinematics and pendulum motion through hypotheses testing and hands-on experiments.

• NSE is relevant to the EPIC learners.
Acknowledgement

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Bige Tuncer - Principle Investigator from Aug 2016