

Singapore National Science Experiment on Big Data Visualization



Presented by
T.M. Lim
CEO, Science Centre Singapore

What is NSE?

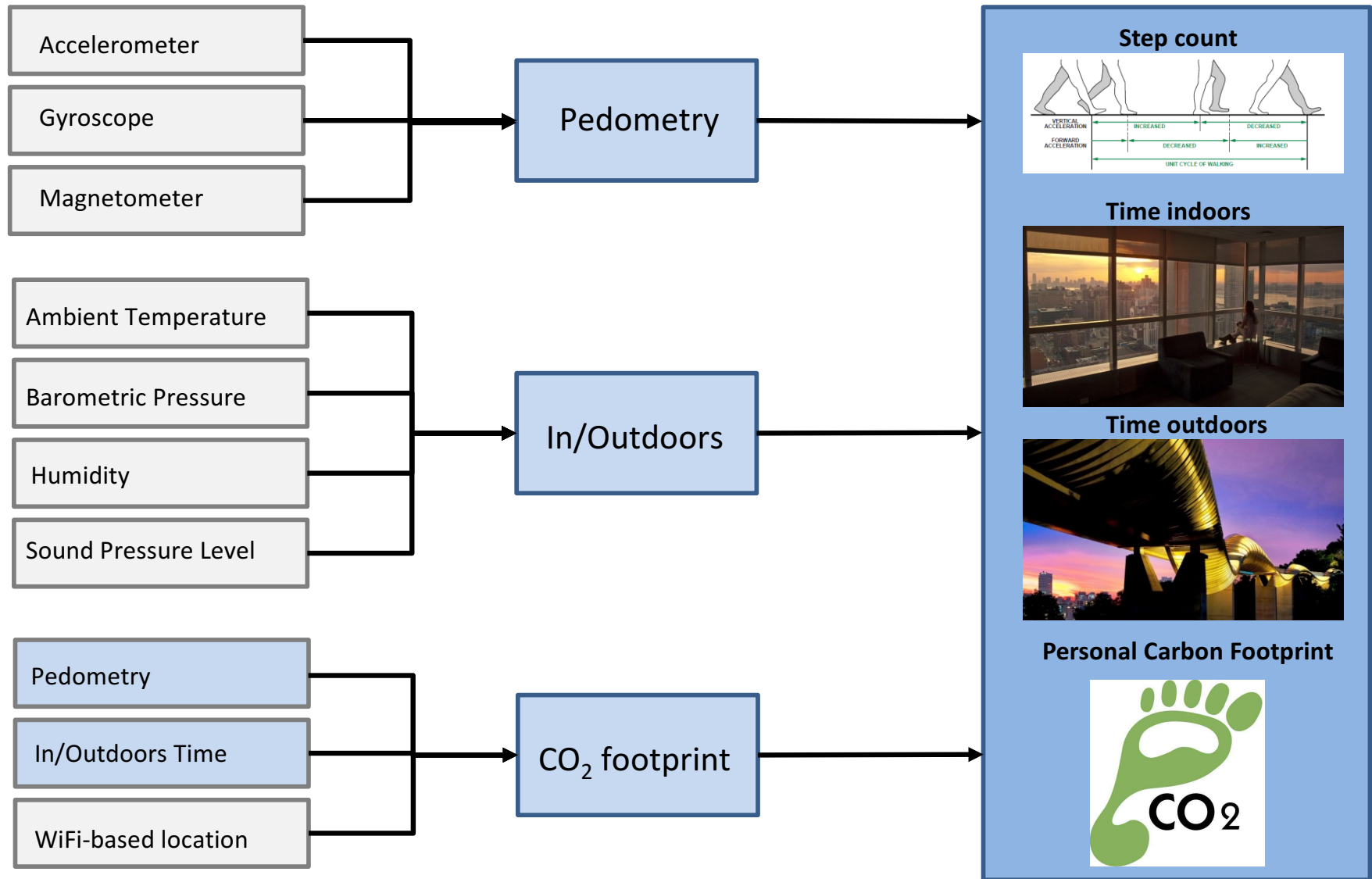
The National Science Experiment is a mass-participation event to gather data about the environment and Singaporean lifestyles.

- 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



What can the sensor do?



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

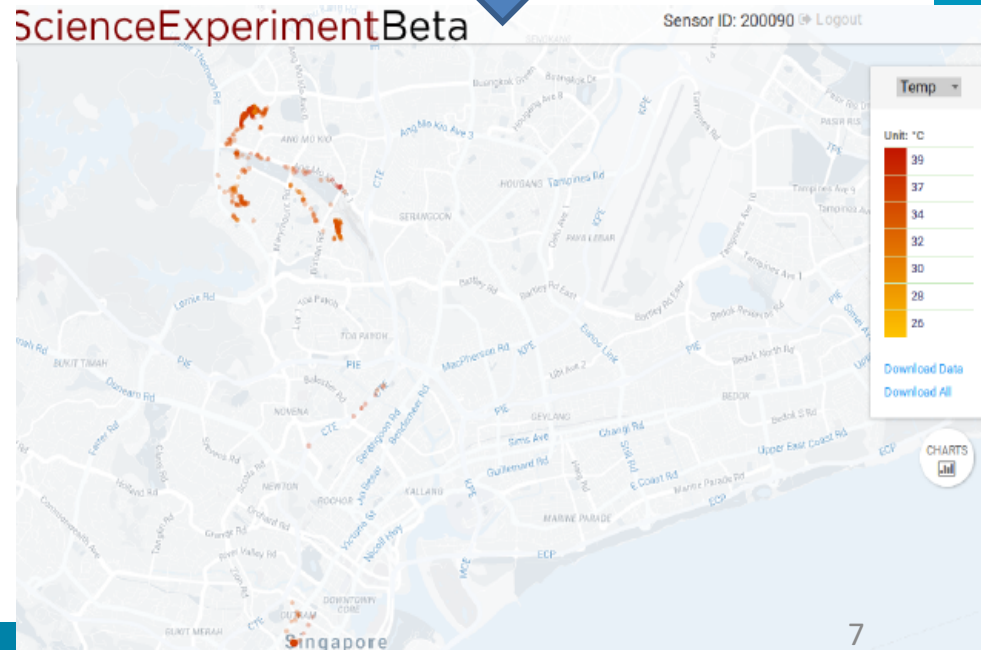
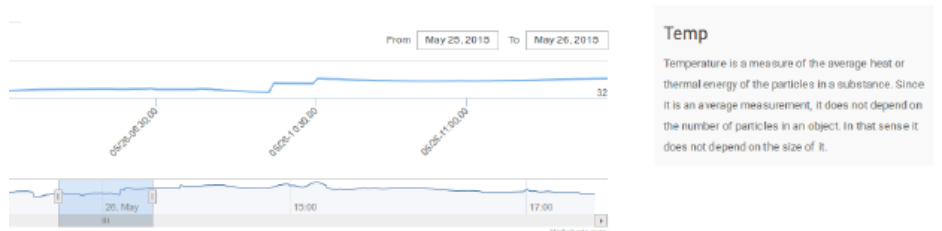
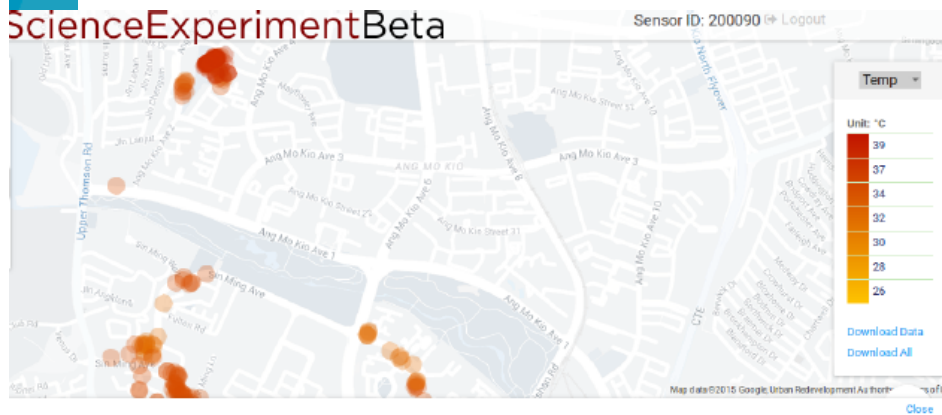
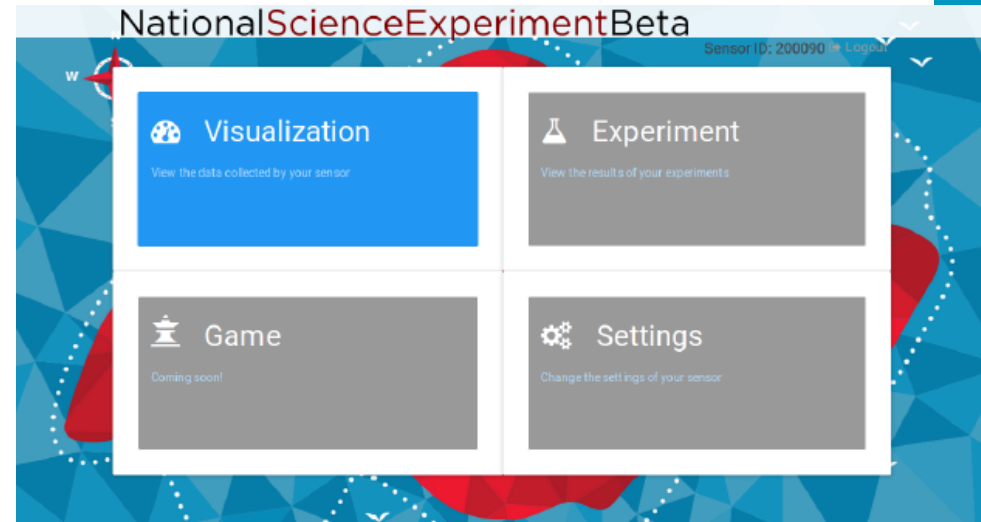
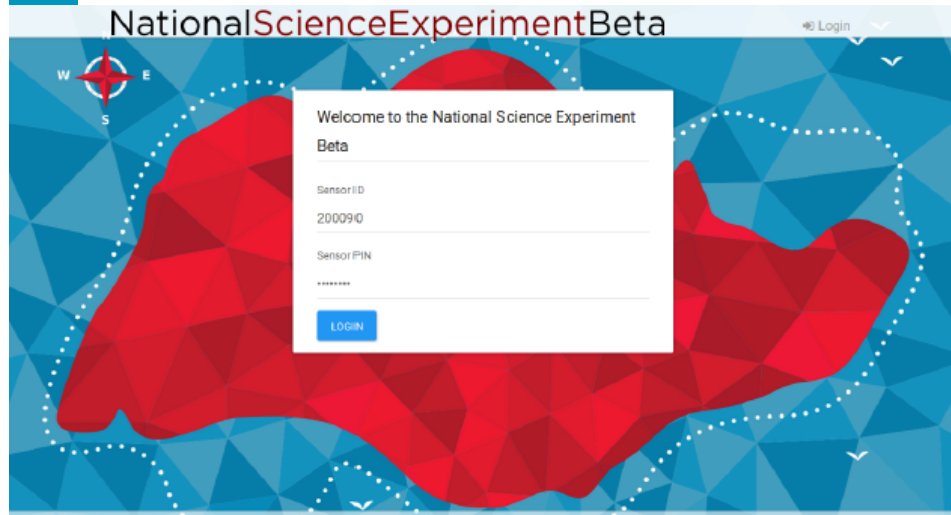
0.5 Billion steps taken

155,843 km **per day**

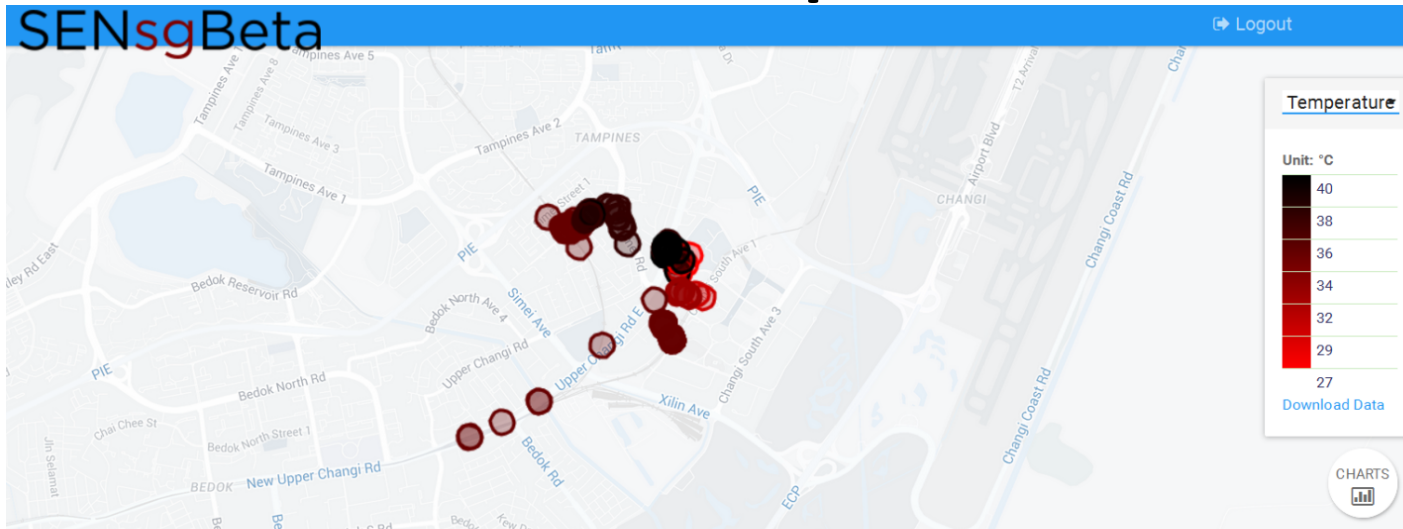
206,739 page views

2,742 hours of portal use

Student Experiment Portal

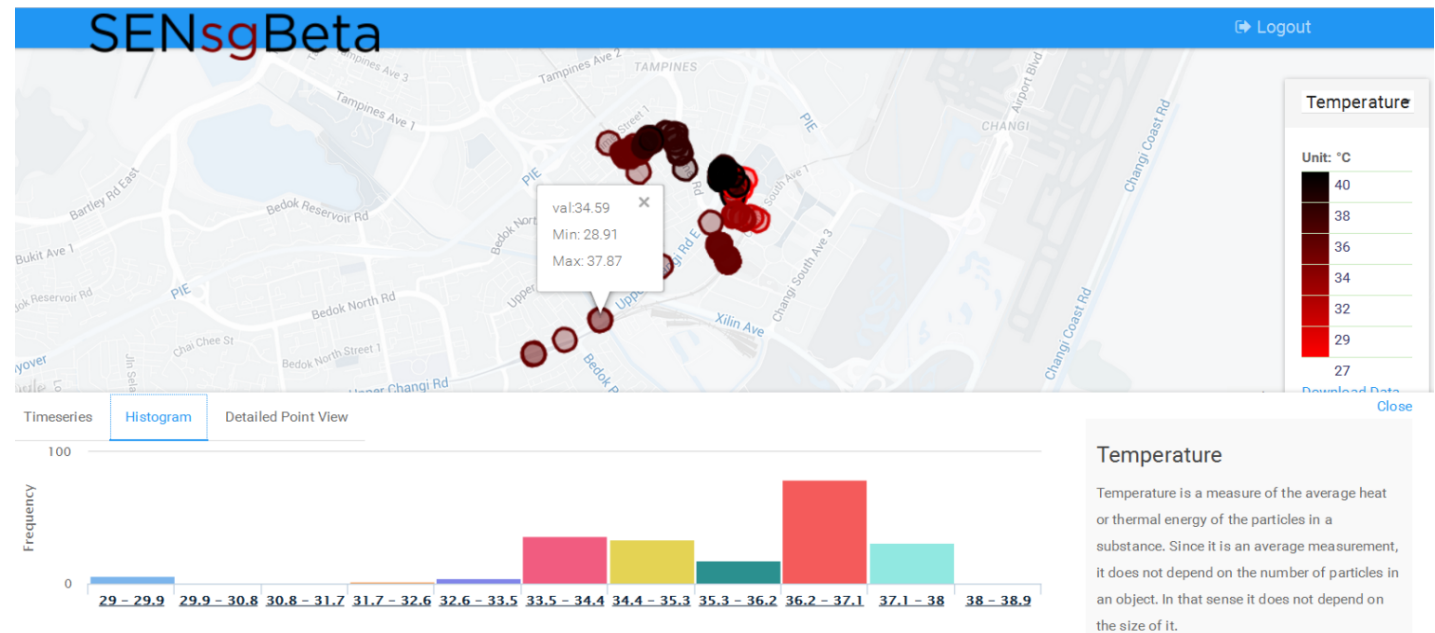


Student Experiment Portal



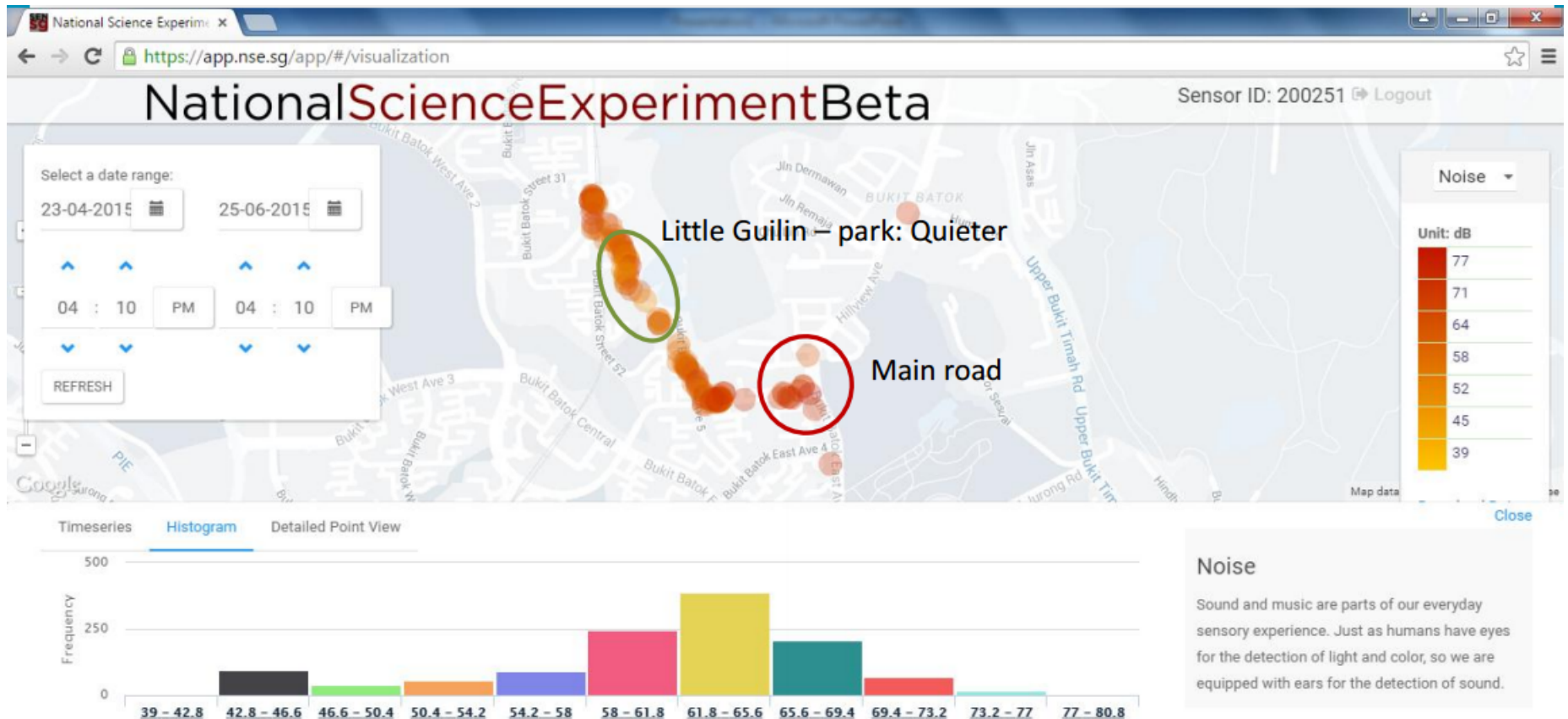
Visualize
Geospatial
Data

Explore
Personal
Data



Erik Wilhelm, SUTD

Noise Pressure Level

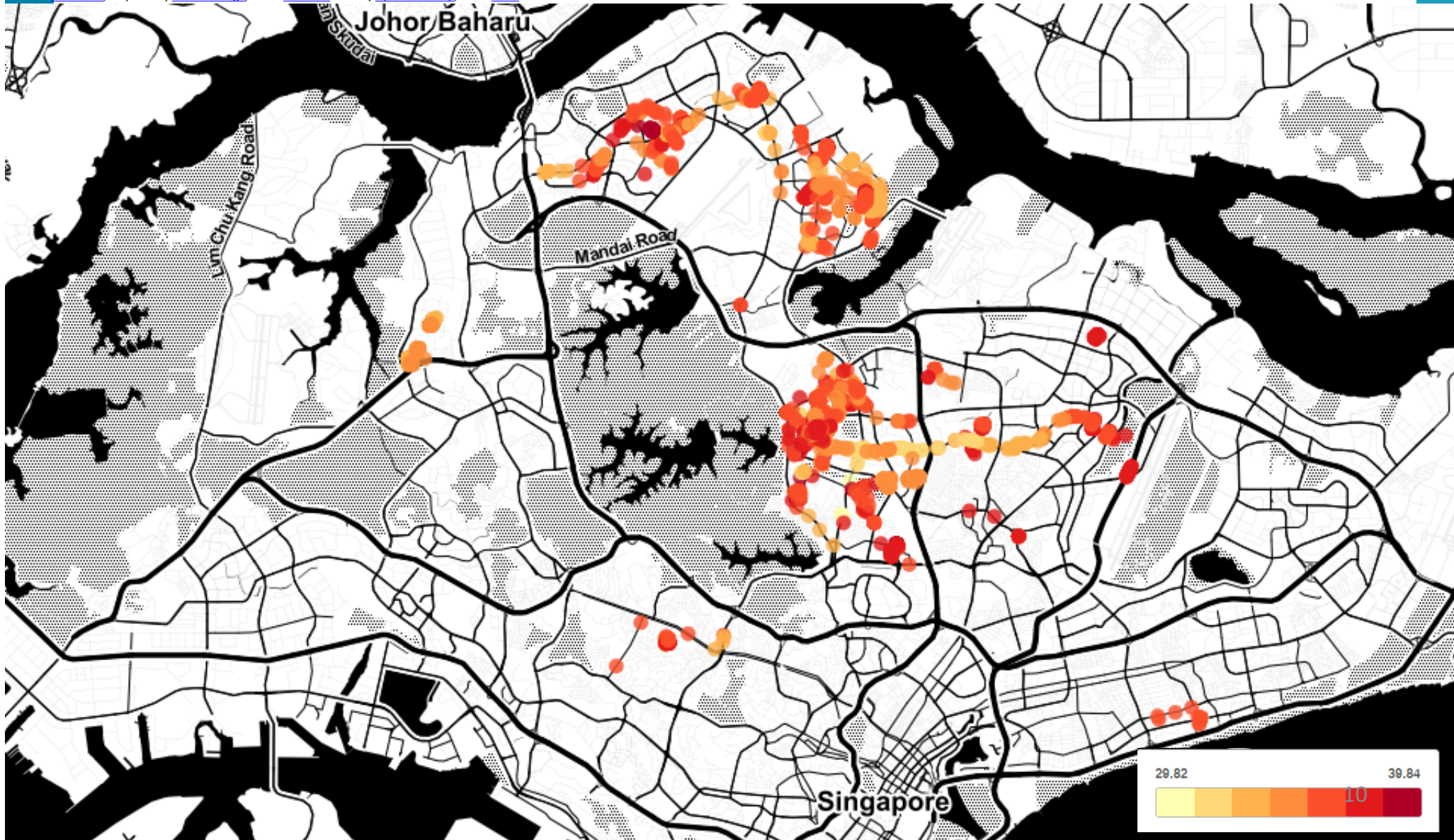


Note: Measurement of Noise Level is based off Pressure readings, **not** frequencies or recordings

Day Temperature

Erik Wilhelm, SUTD 5:30-19:30

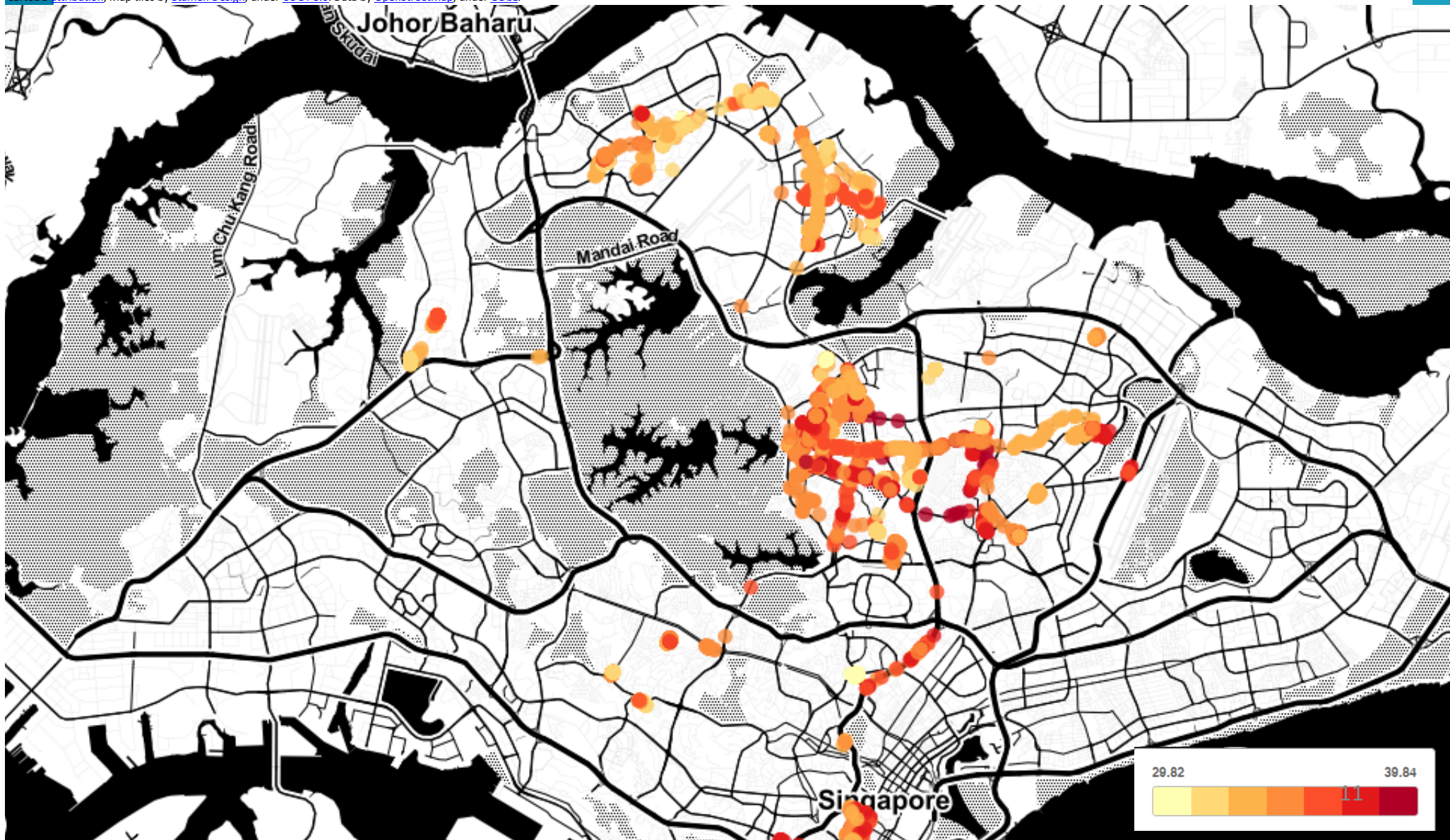
CartoDB attribution, Map tiles by Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL.



Night Temperature

Erik Wilhelm, SUTD 19:30-5:30

CartoDB attribution, Map tiles by Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL.

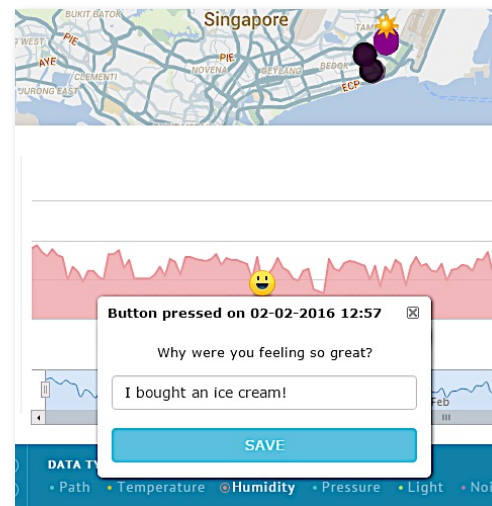


NSE 2016: Step UP for Science

1. How many stairs climbed per day



2. Capture positive moments



3. How much CO₂ per day

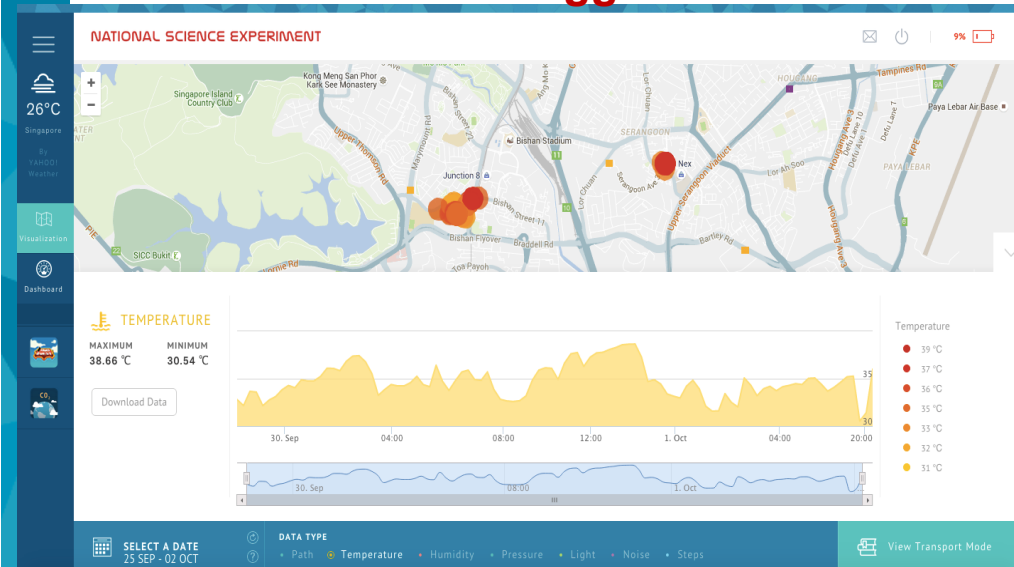
Key CO₂ Contributors (2005) (kilo tonnes)

	Electricity Generation	Industry	Transport	Buildings	Consumers/ Households	Others
Primary Consumption (combust fuel)	19,315 (48%)	13,465 (33%)	7,056 (17%)	325 (1%)	216 (1%)	-
Secondary Consumption (use electricity)		8,328 (21%)	930 (2%)	5,910 (15%)	3,415 (8%)	732 (2%)
Overall		21,793 (54%)	7,986 (19%)	6,235 (16%)	3,631 (9%)	732 (2%)

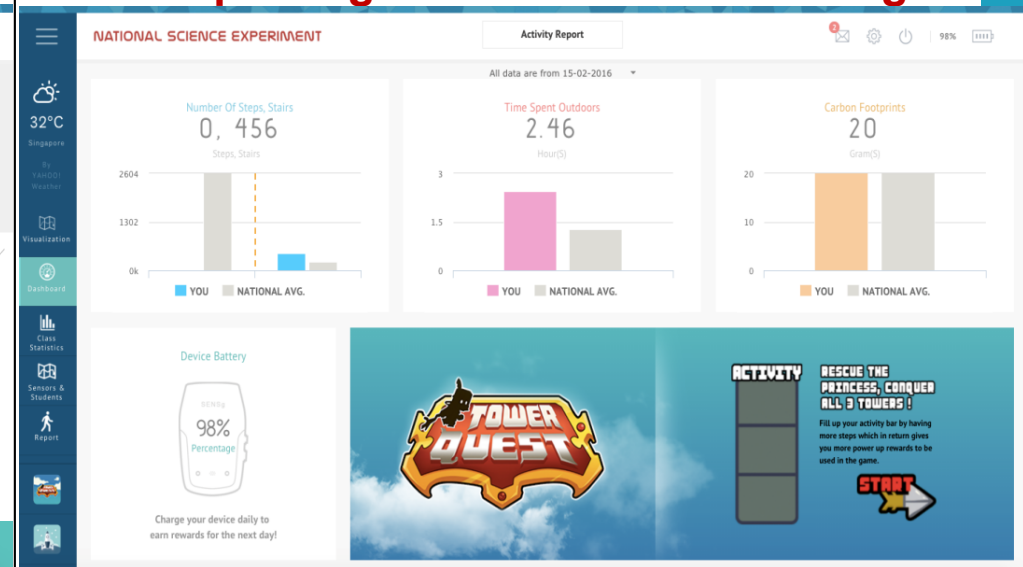
TOTAL CO₂ = 40,377 kilo tonnes

NSE Web Portal

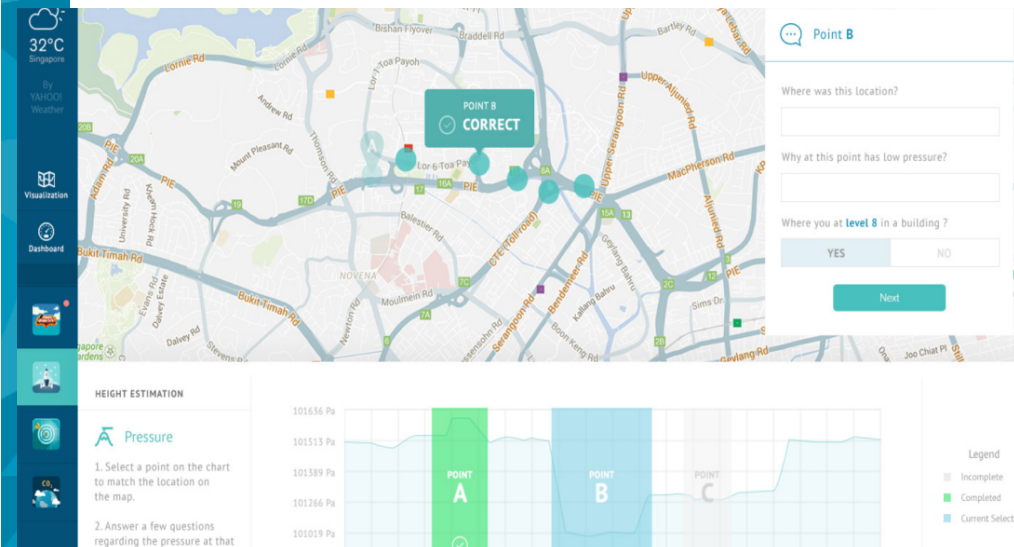
View individual data tagged to locations



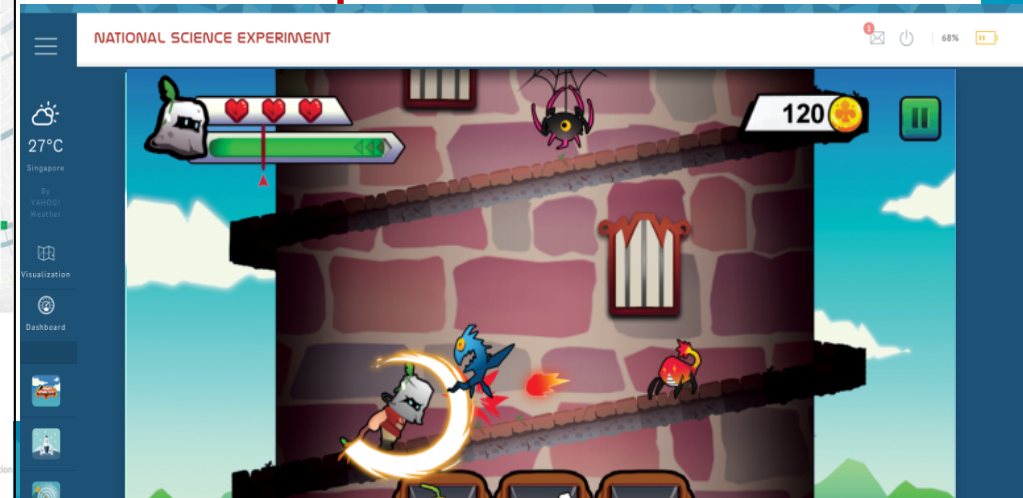
Compare against the national average



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

NSE week

Data collected by individual student using SENSg device

NSE Data Challenge

Data sent to respective school

Students to use tools to perform analysis (with mentor guidance)

Students to present the analyses (video, slides, blog, etc)

Criteria:

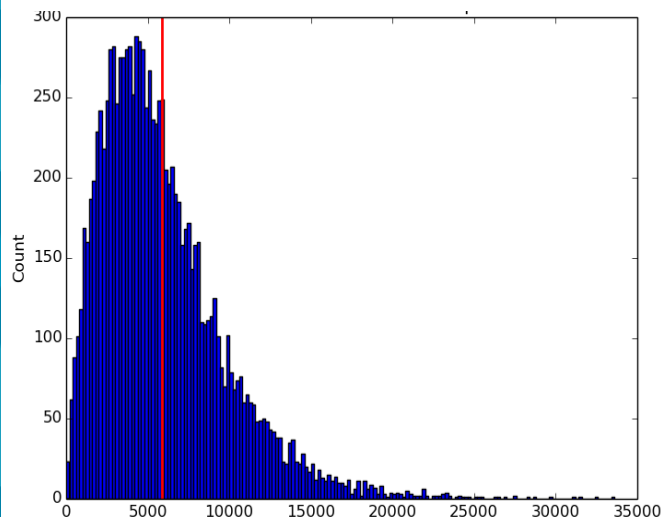
- Categories: Sec 3/4, JC1/2, Poly/ITE
- 3-4 members/team
- Up to 3 submissions per school (1 entry/team)

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

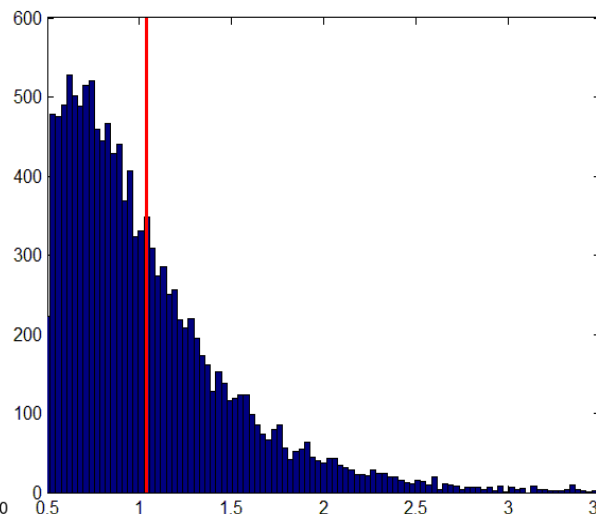
“Step out for Science” - Analysis

Steps/
day



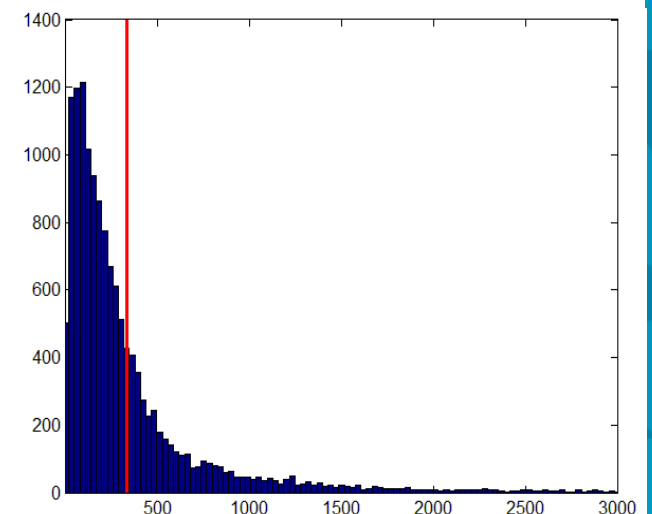
Mean steps:
5,853

Time spent
outdoors



Mean hours:
1.1

Carbon
Footprint

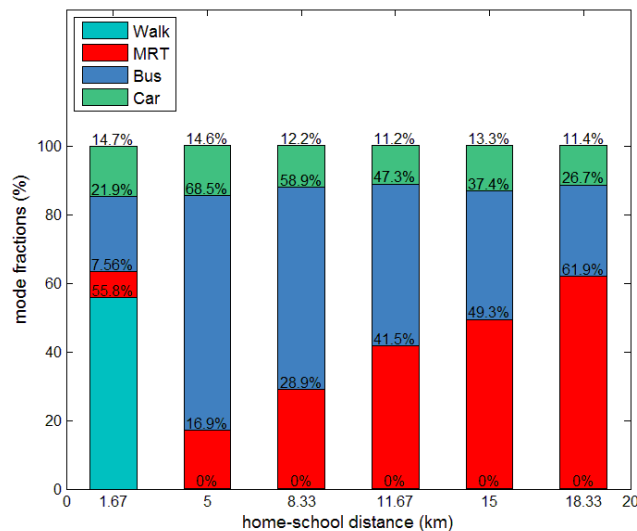
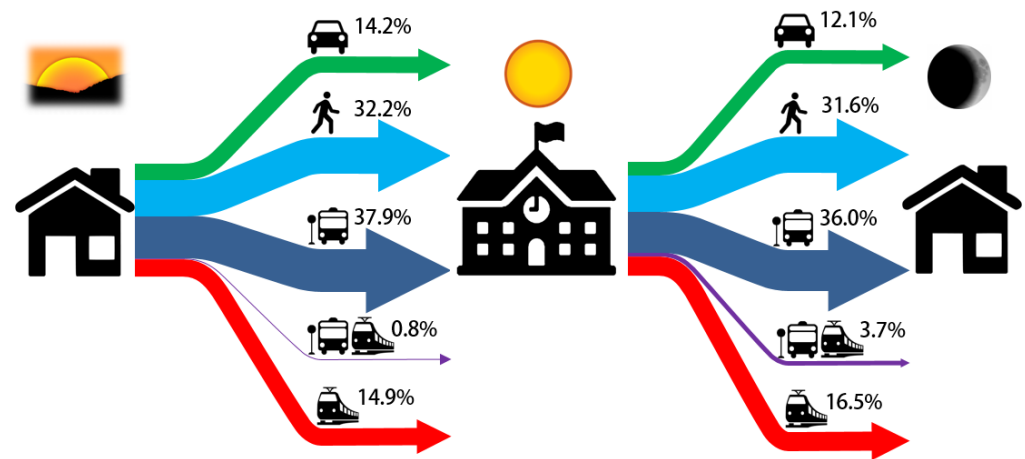


Mean
grams/student/day:
333

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

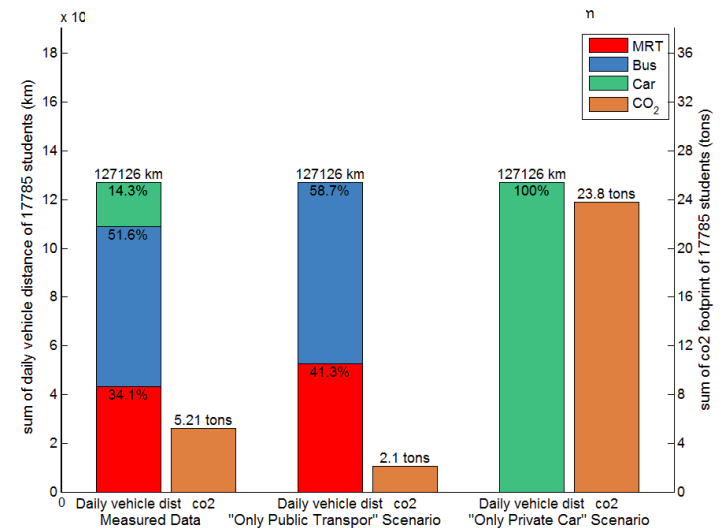
Transportation Mode Analysis

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.

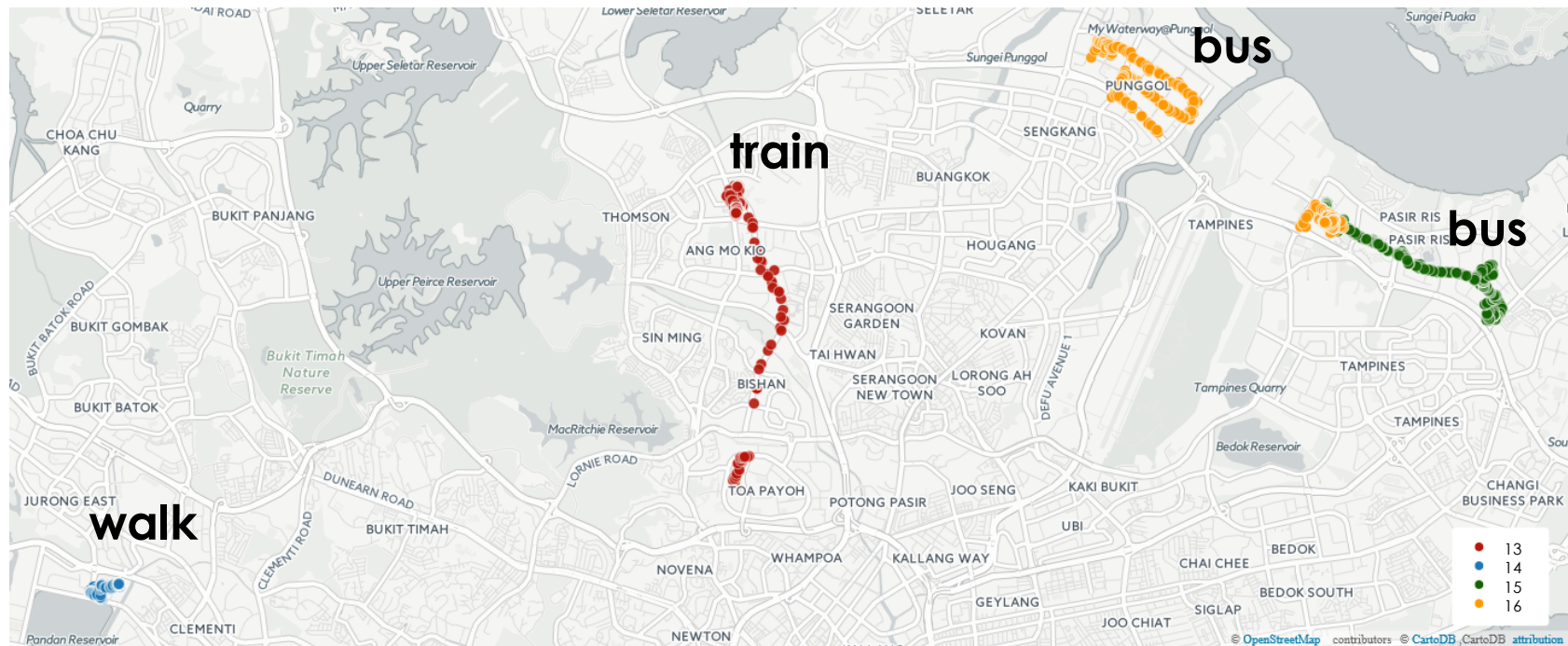


The further you live from school, the more likely it that you take the train. Most students walk to school if they live within 2km.

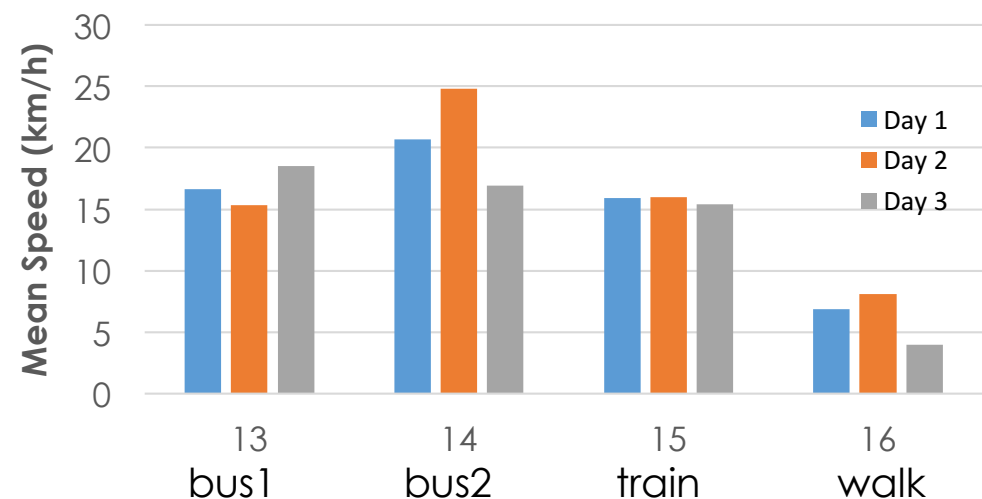
Removing car travel entirely would halve CO₂ emissions, travelling exclusively by car would result in five times more.



Analysis of Time Spent Commuting

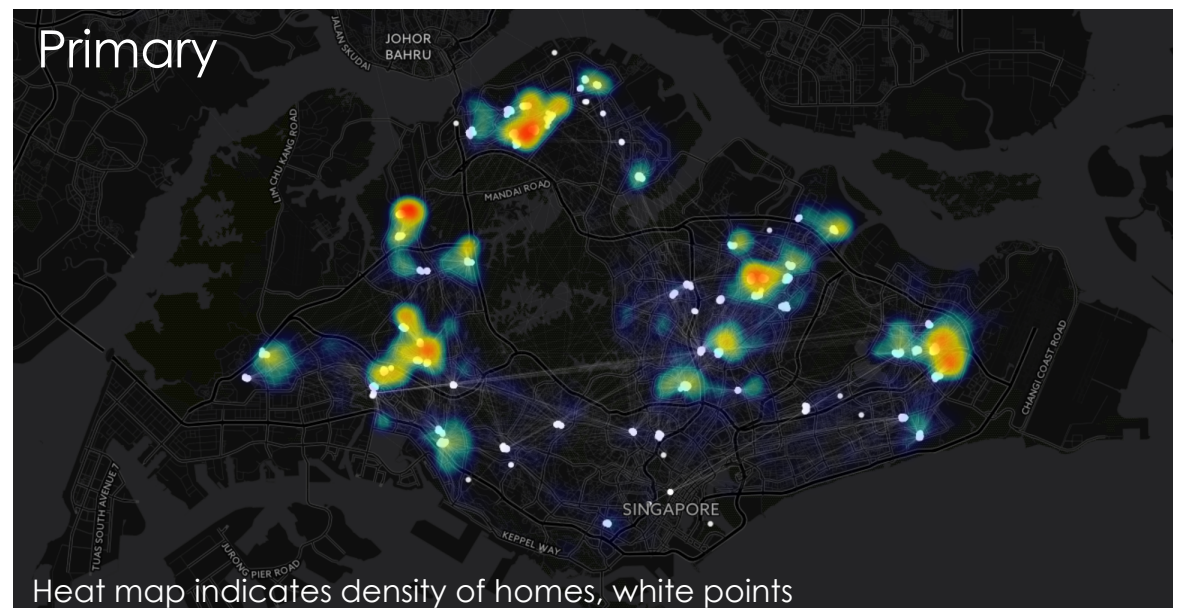
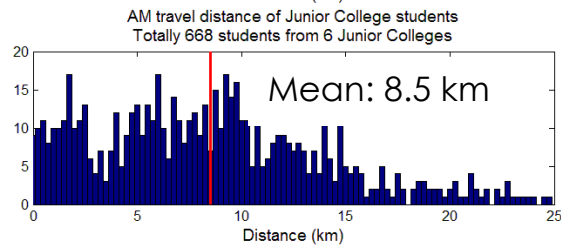
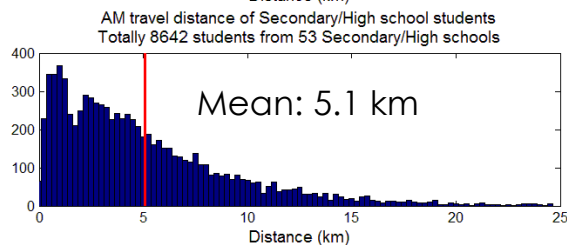
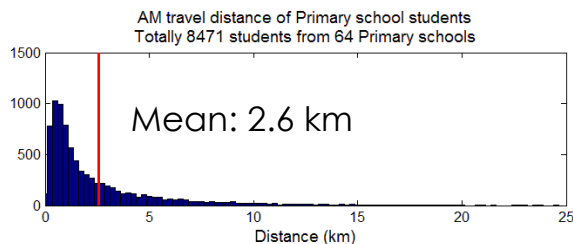


Bus commutes tend to have more unpredictable durations compared with train commutes, as can be expected.



Do students live close to school ?

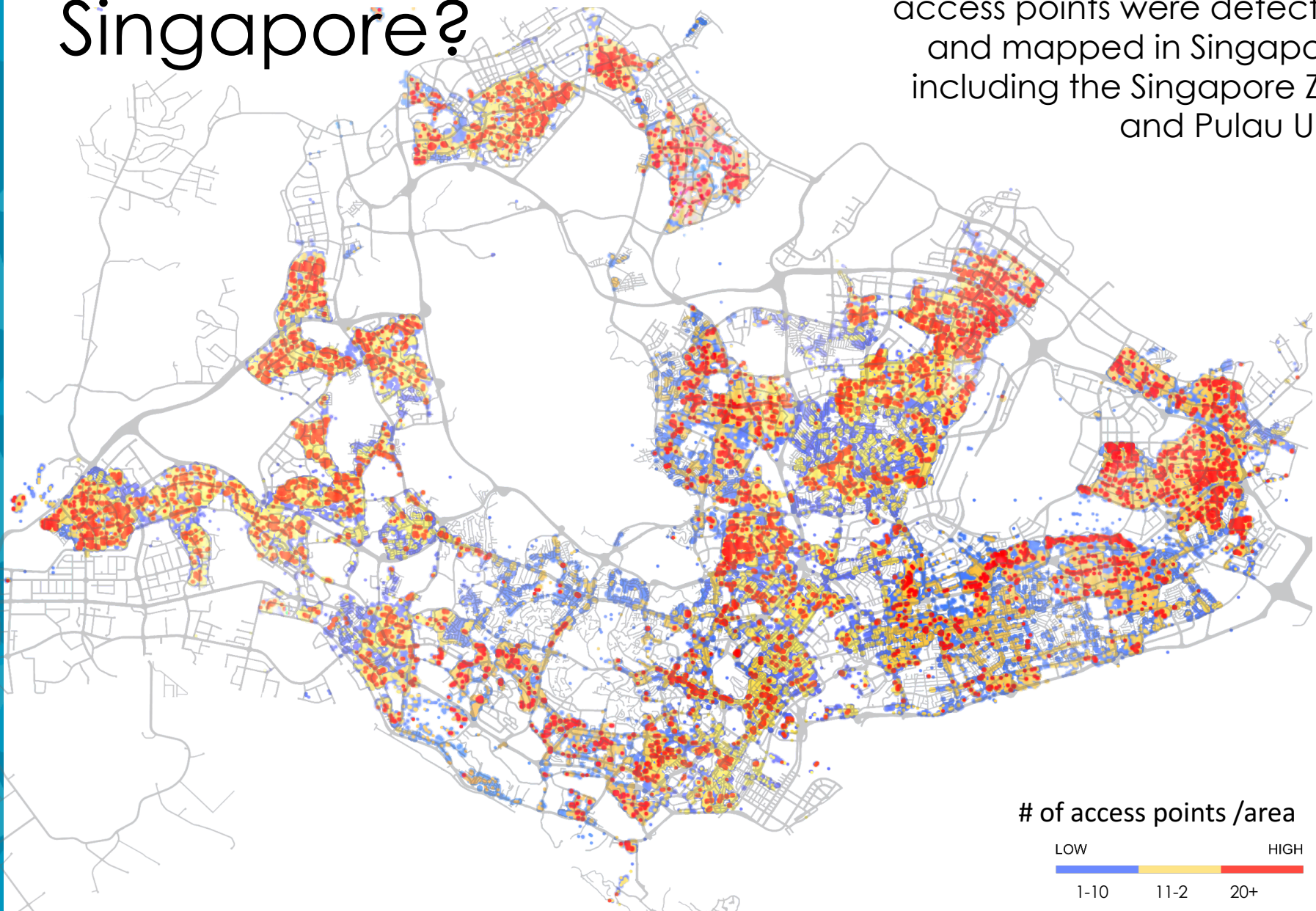
Primary students tend to live much closer to their schools than secondary/JC students
Over 100 students were observed travelling to Singapore from Johor Bahru



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

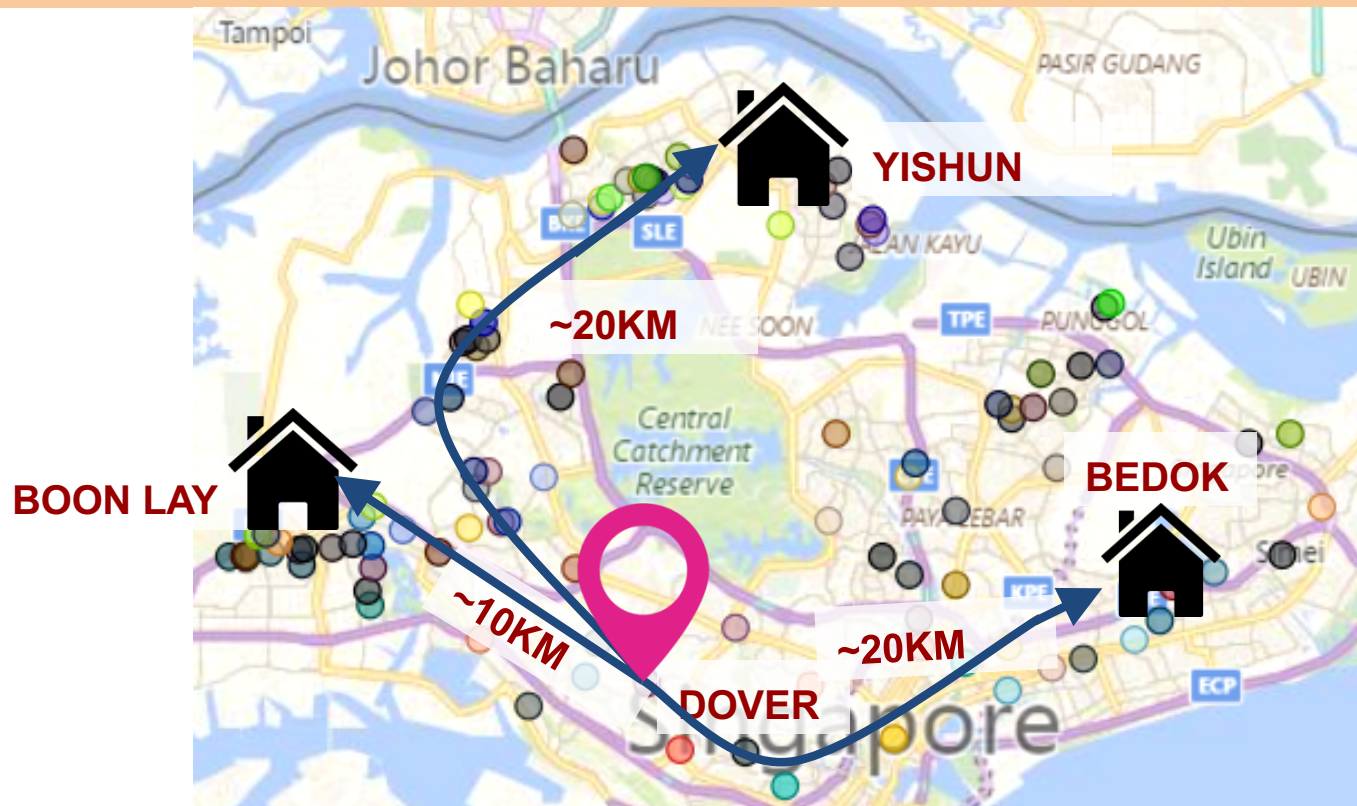
- No specific theme for this year, given general subthemes to explore: Physical Comfort, Mobility, Neighbourhood, Health & Wellbeing and Arts, Culture & Heritage.
- 92 teams that took part in this year's event, 11 teams in finals.
- >10,000 devices used over 4 weeks

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?



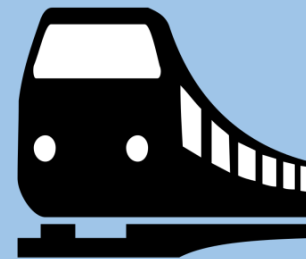


Recommendation

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

NSE is organised by the National Research Foundation (NRF) Singapore and the Ministry of Education (MOE), in partnership with the Singapore University of Technology and Design (SUTD), the Science Centre Singapore (SCS), the Agency for Science, Technology and Research (A*STAR), the Singapore Land Authority and OneMap Singapore, to excite young Singaporeans in science and technology.

Technology sponsors of NSE include A*STAR's Institute of High Performance Computing (IHPC), the Infocomm Development Authority of Singapore (IDA), Wireless@SG, NVIDIA, SAP, Dassault Systèmes and Skyhook. The logistic sponsor of NSE is Singapore Post Limited.

Technical expertise came from the Singapore University of Technology and Design:
Erik Wilhelm (Principle Investigator from inception till Aug 2016, developed and kickstarted NSE)

Bige Tuncer - Principle Investigator from Aug 2016