Effective Earth Observations from the ground through Citizen Observatories

Dr Stuart Wrigley
Research Fellow
Department of Computer Science
The University of Sheffield, UK

s.wrigley@sheffield.ac.uk
@stuwrigley

In collaboration with Prof Fabio Ciravegna, Dr Suvodeep Mazumdar, Dr Vita Lanfranchi, Neil Ireson, Jie Gao and the WeSenseIt consortium

wesenseit.eu

@WeSenseIt

EU FP7 Project Grant Agreement Number 308429

The University Of Sheffield.

INTRODUCTION

The University Of Sheffield.

Our rivers

The University Of Sheffield.

But we must take care of them

River monitoring

- UK Environment Agency does a huge job in monitoring the environment
  - Over 1,000 rivers stretching 22,000 miles
  - 3,100 miles of coastline seawards to the three-mile limit
  - 2 million hectares of coastal waters
- Not possible to monitor everything
  - Low number of sensors
  - Infrequent data points
  - Some sensors manually operated
  - Finite budget!

Traditional sensing

- Traditional approaches to observing the water cycle can be viewed as flawed
  - Poor density and resolution
    - too low to describe water cycle status
    - especially during anomalous (critical) events (floods, continuing droughts, etc)
  - Promote passive role for the community
    - Citizens are traditionally considered **consumers** of information services: the very end of the information chain
    - In reality, local communities embody a rich source of historical knowledge - commonly **more extensive** and/or nuanced than that held by the local authority.

The University Of Sheffield.

We – citizens – know the score!

The University Of Sheffield.

CITIZENS' OBSERVATORY

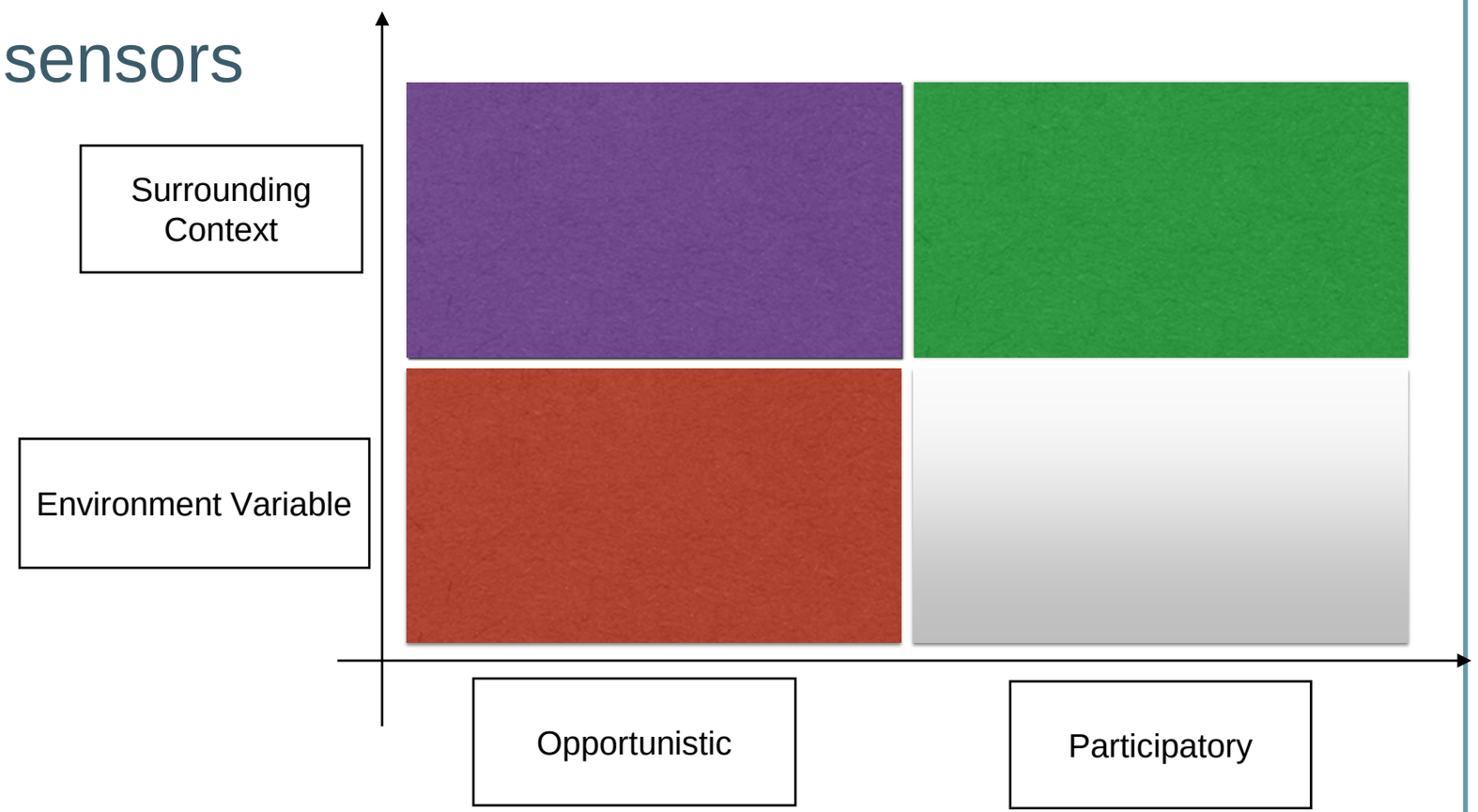
WeSenseIt

- WeSenseIt is an EU FP7 project to create a method, environment and infrastructure
  - To manage water resources (and knowledge of them) more effectively and efficiently via **citizen involvement**
  - Expand amount of collected environmental data
  - For citizens, policy makers, decision makers, industry & academia

- Citizens and authorities
  - Two-way communication model for decision-making, policy-making etc.
  - Citizen involvement in data collection & water resource governance
  - Tools to support decision-making
    - incorporating physical, social and predictive information

5 Billion Social Sensors

- Crowdsourcing can fill gaps in existing observations
- People can act as sensors by:
  - Making analogue sensors digital
    - e.g. water depth boards read by people and results sent by mobile
  - Using mobile phones and their in built sensors
  - Using simple low-cost sensors
    - Arduino
    - Raspberry Pi

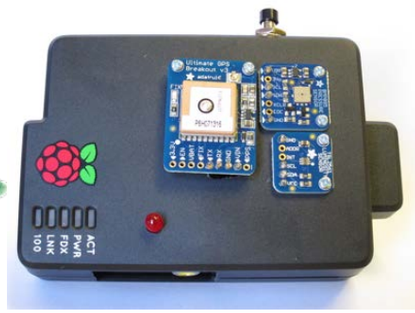


Non-sat EO collection approach

- WeSenseIt adopts a two layer approach
  - Hard layer: static and portable devices sensing and transferring water information via mobile phones
  - Soft layer (social layer)

Non-sat EO collection approach

- Hard Layer (physical sensors & cost reduction)
  - Rainfall, temperature, evaporation, water levels, quality, moisture, cloud coverage, water use, sewer overflows
    - Objective: large number of sensors providing spatial patterns and temporal evolution and real-time information for decision-making
  - Sensors for:
    - Citizens, Citizen scientists and Professionals
  - Low cost as a main gear to availability



The University Of Sheffield.

Soft Layer – Social Sensors

- Harnessing citizens' collective intelligence
  - At differing levels of (physical / conscious) involvement

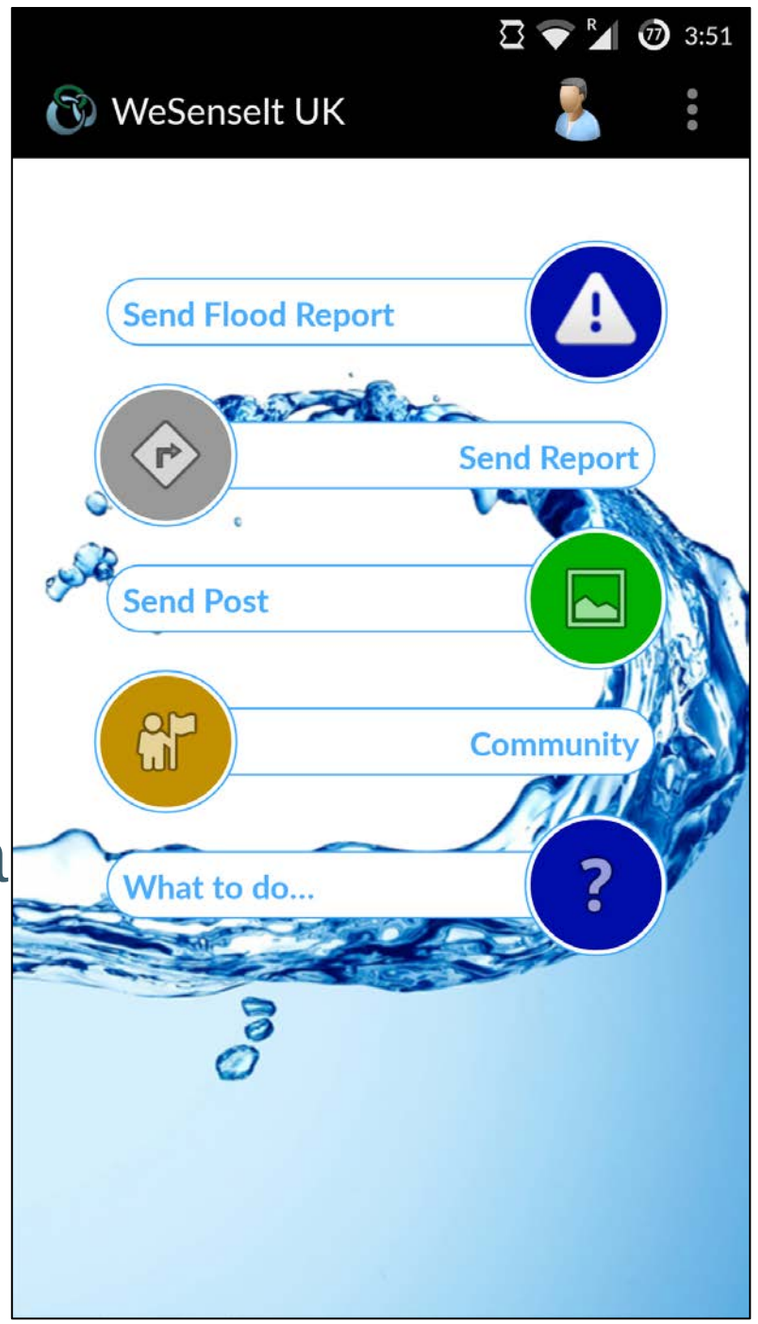
- 3 core aspects to technology-based engagement
  - Participatory sensing
    - Collaborative, spatially distributed sensing
  - Automated human activity understanding and engagement
    - Understanding behaviour in specific areas
    - Engaging with citizens in specific locations at specific times
  - Large scale social media analysis
    - Mining social trends, social activity for situation awareness

The University Of Sheffield.

Participatory sensing

Social Sensors: WeSenseIt app

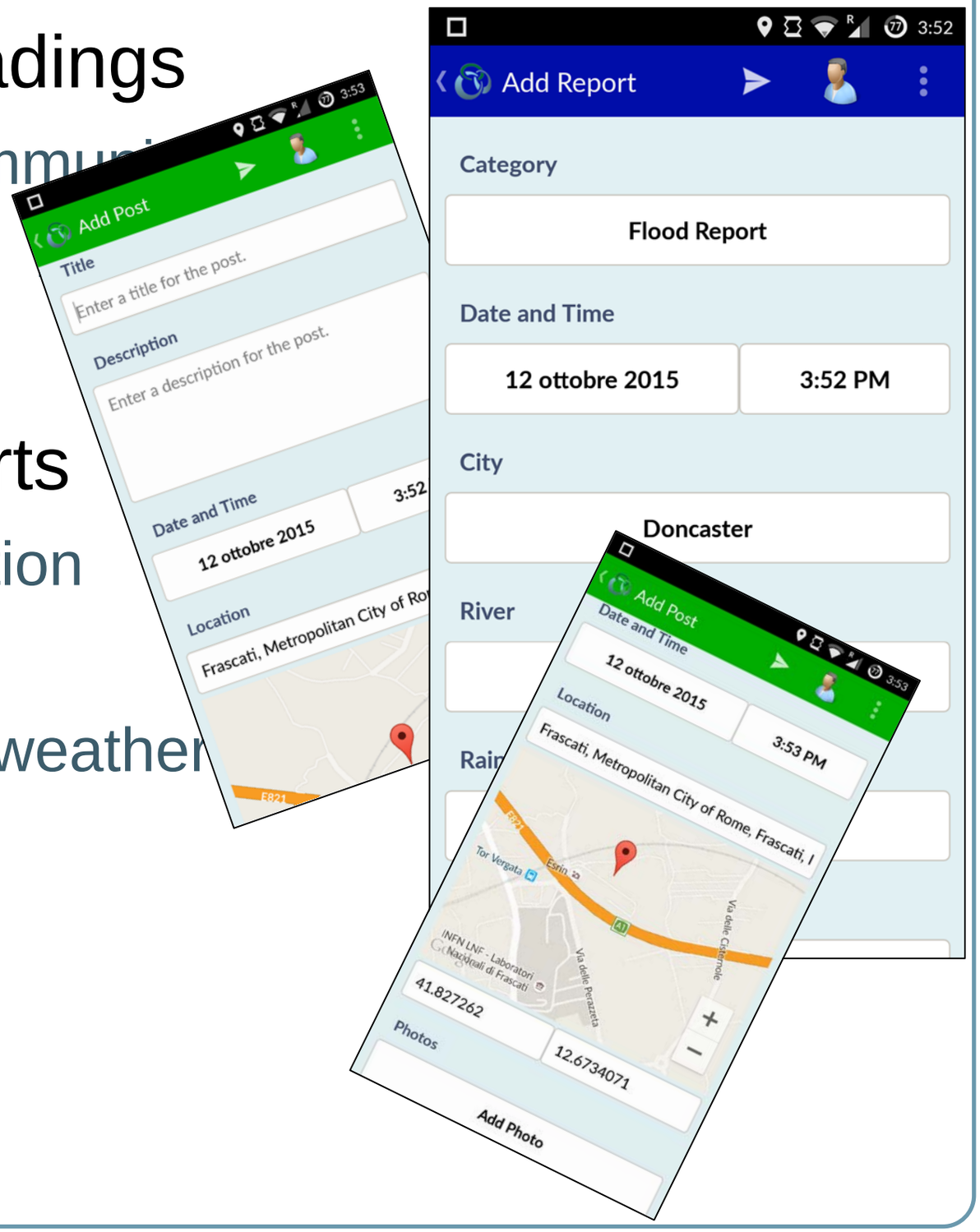
- A custom mobile app to engage citizens in the Citizen Observatory
  - Piloted in Doncaster and Italy
- Features
  - Location-based discussion forums
  - Integrated with Social Media
  - Flood report submissions
  - Sensor reading submission
  - Direct dialogue between citizens and a
  - Interactive flood planning



The University Of Sheffield.

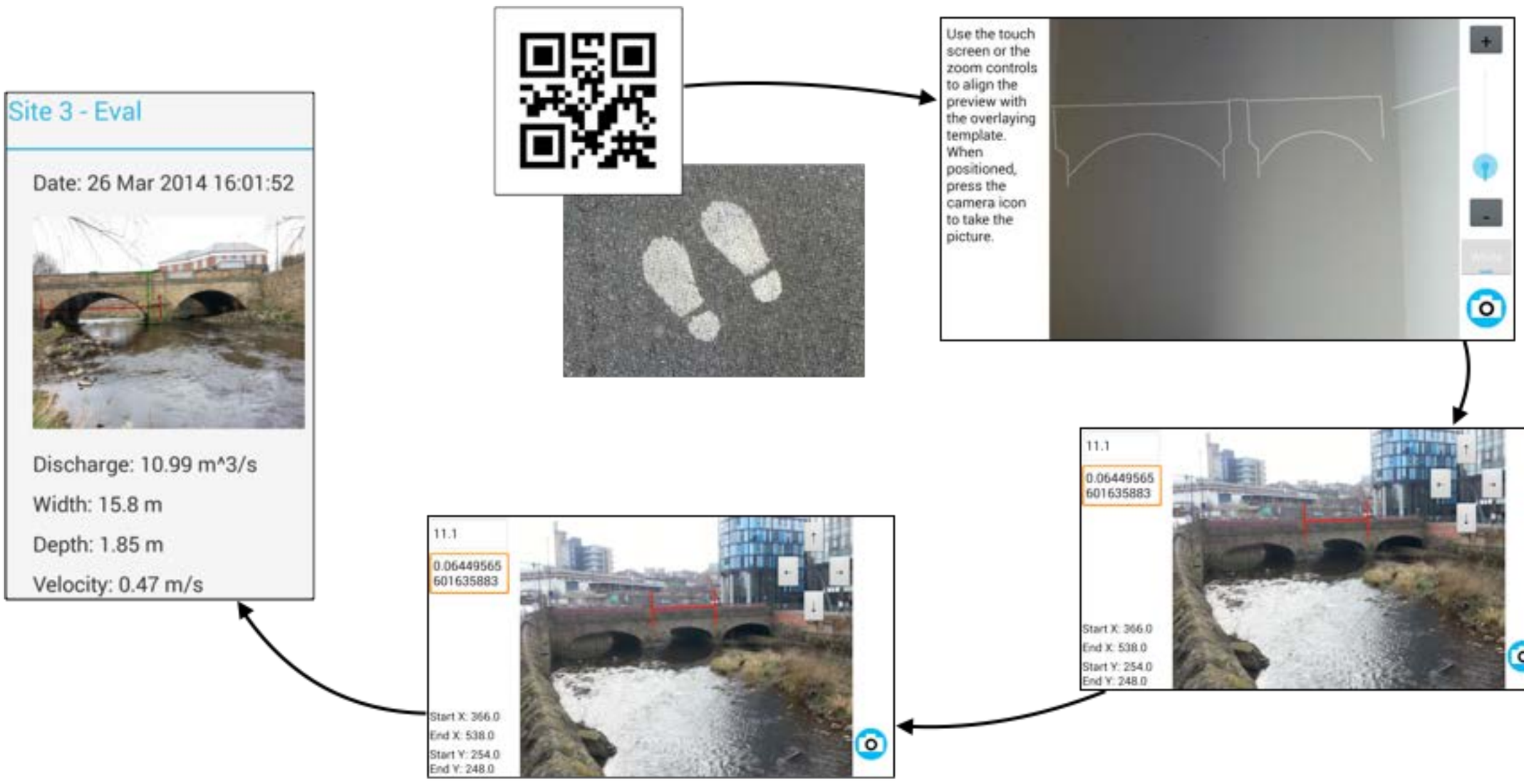
Flood report and sensor readings

- Users can submit sensor readings
  - Sensors distributed through communi
  - App knows ‘type’ of each sensor
- Users can submit flood reports
  - Qualitative report of a local situation
  - Can attach photos
  - Can also provide information on weather and extent of event



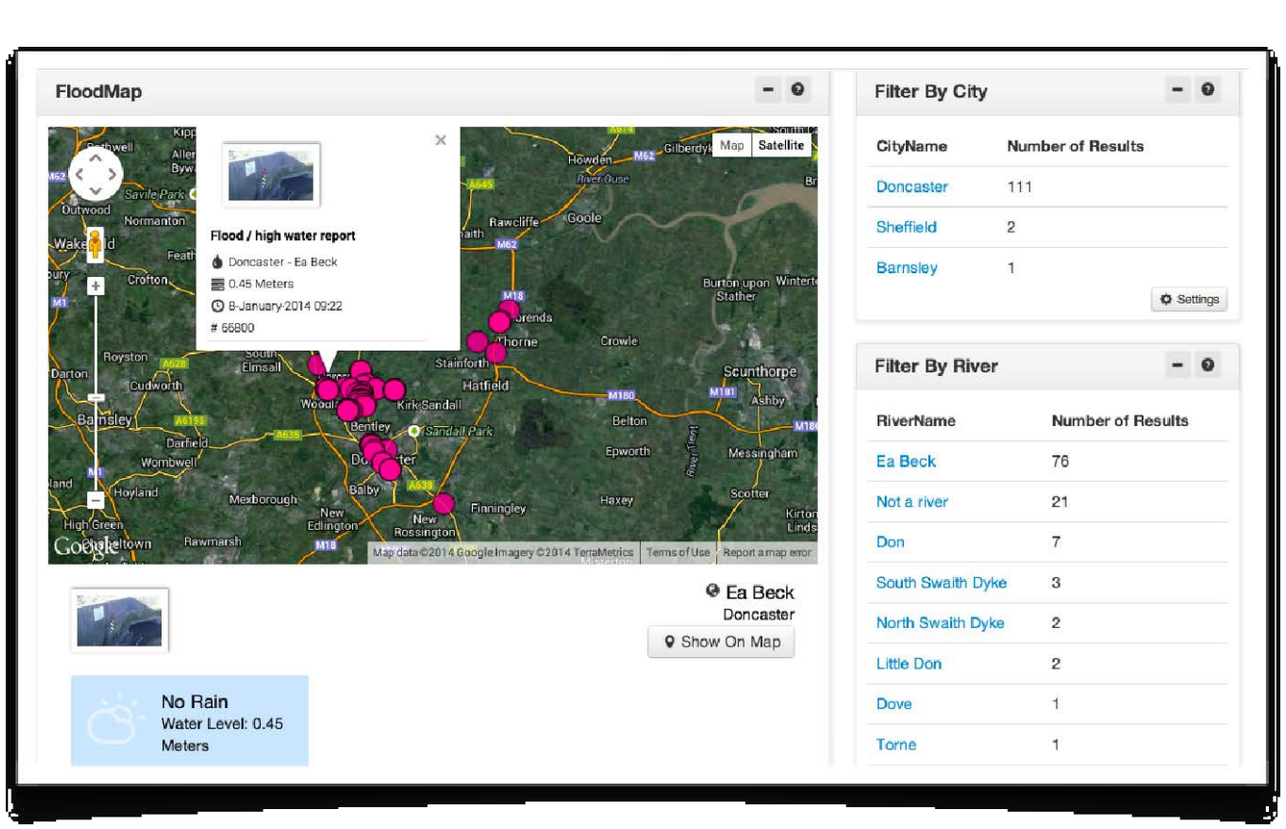
Water flow rate estimation

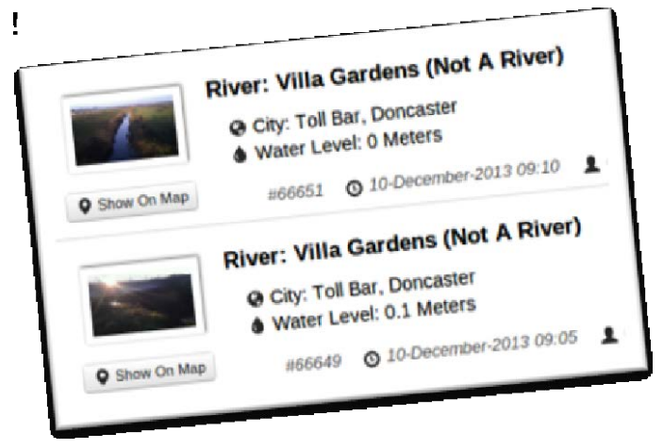
- Using a simple app at predetermined locations
  - Uses *a priori* knowledge of in-image structure sizes



Participatory sensing

- All app data instantly accessible by authorities as part of decision-making system
  - Combined with live ‘professional’ sensor data
  - Also accessible by citizens





The University Of Sheffield.

Activity understanding and engagement

Activity understanding

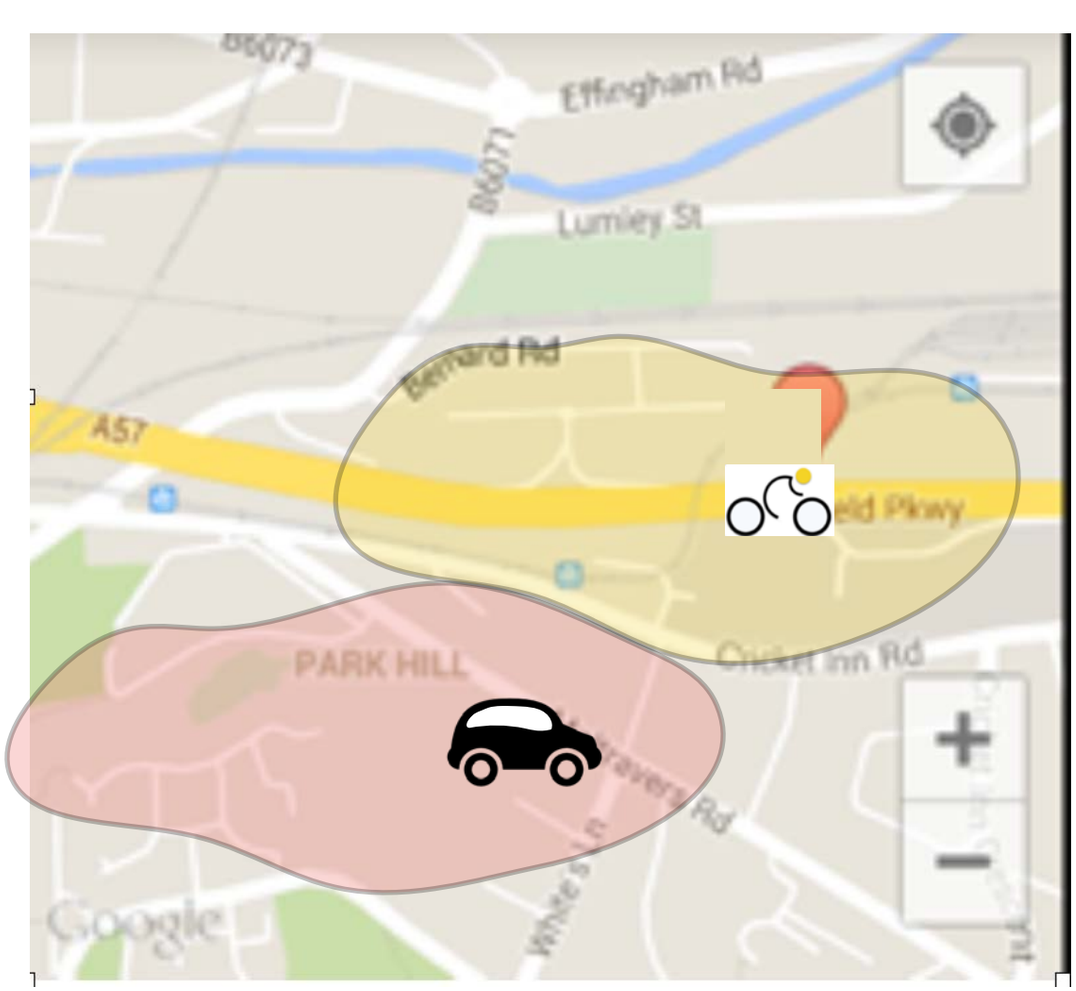
- Live analysis of individuals' activity via phone app
  - Walking
  - Cycling
  - Sitting
  - Travelling by vehicle

- Useful for many tasks. For example:
  - Commercial: contract compliance, workforce analysis; insurance
  - Health: assessing degree of activeness of individual
  - Tailoring notifications based on current activity

Geo-aware engagement

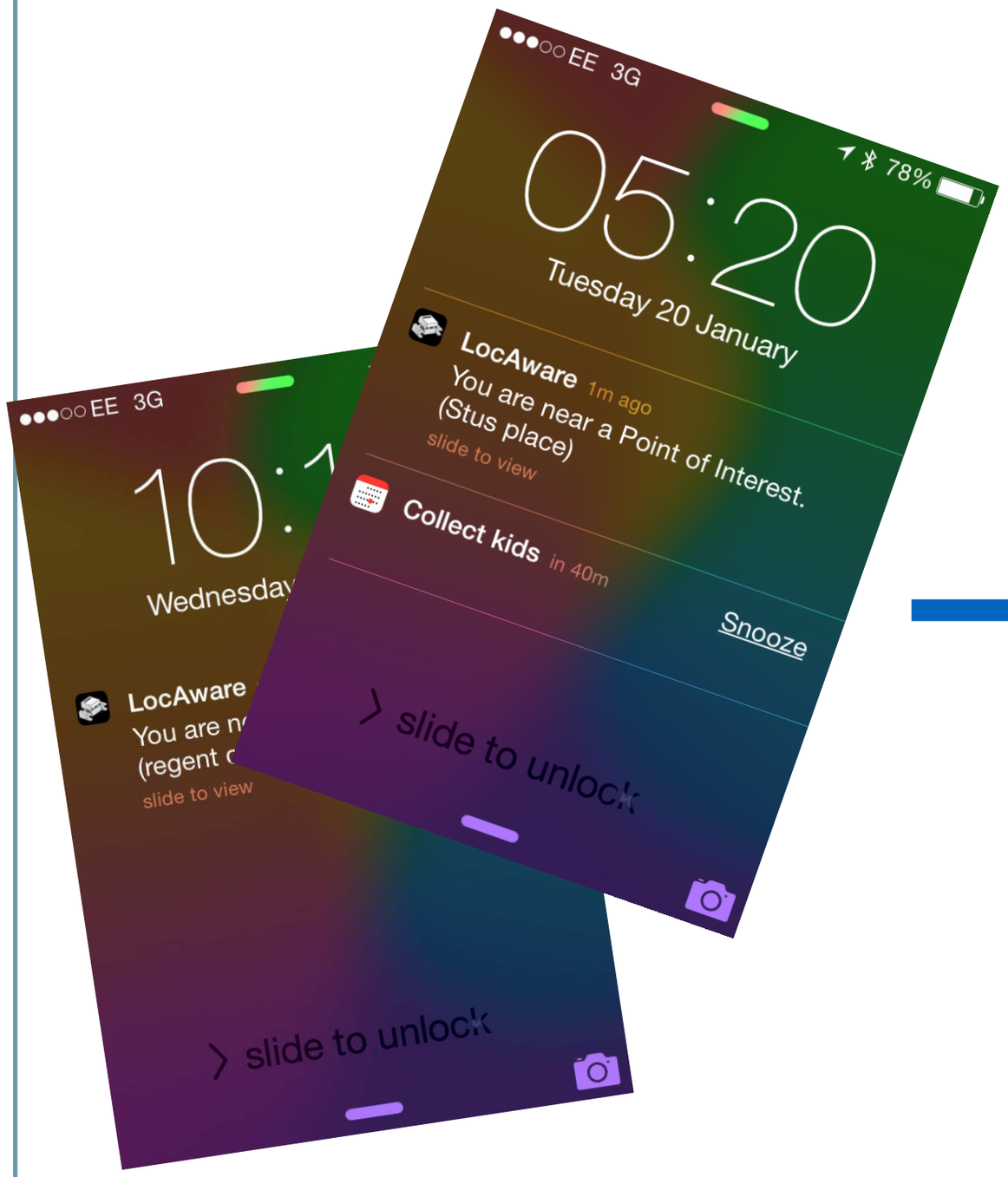
- Citizen involvement in tasks based on activities and locations
  - e.g. take photo if walking in a specific area / on a specific street
  - e.g. evacuate the area as in danger zone
  - e.g. avoid specific paths in heading in that direction by car

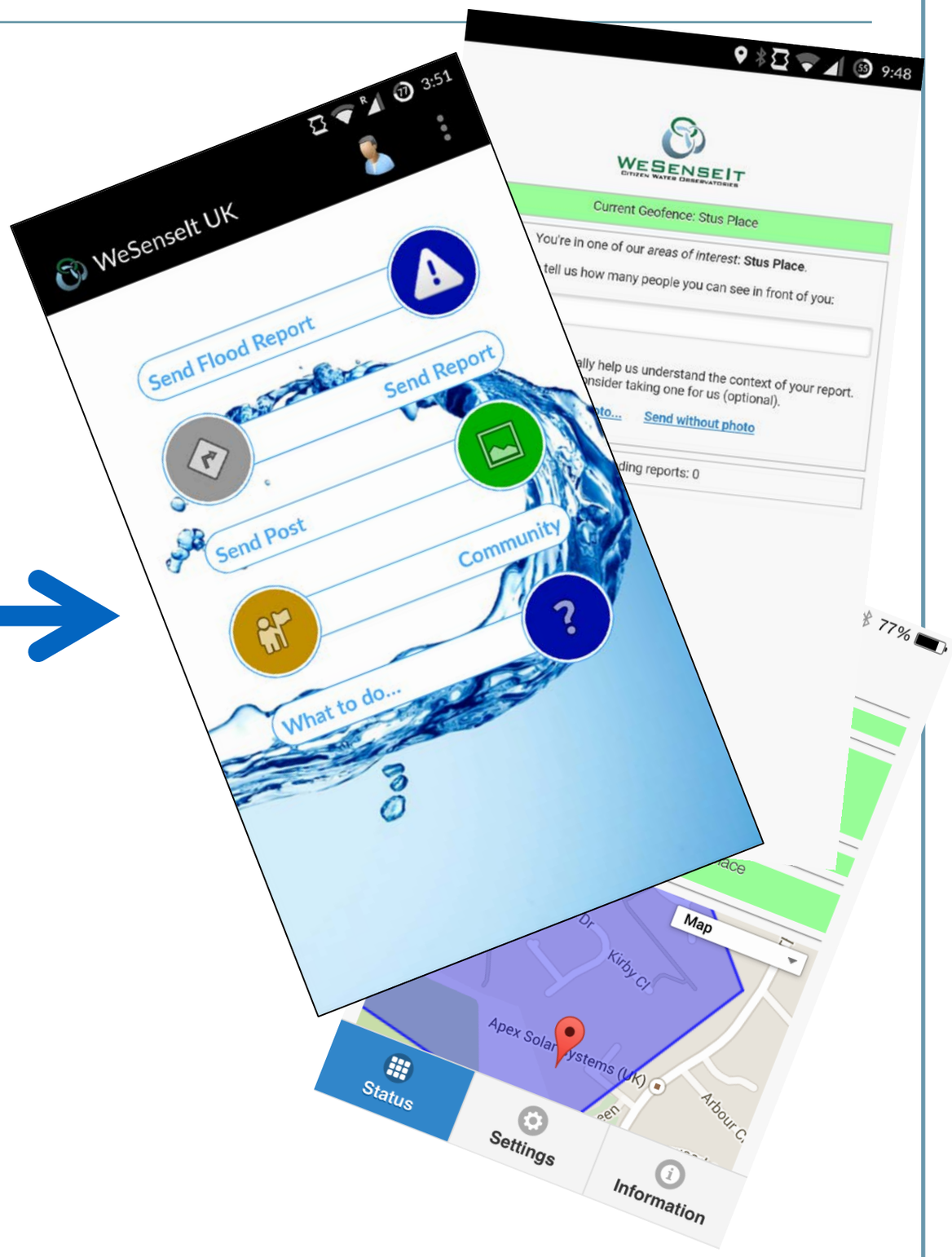
- Uses “Geofences”
  - a virtual perimeter for a real-world geographic region
  - created and ‘typed’ by control room personnel in an easy way
  - used to solicit or narrowcast local information



The University Of Sheffield.

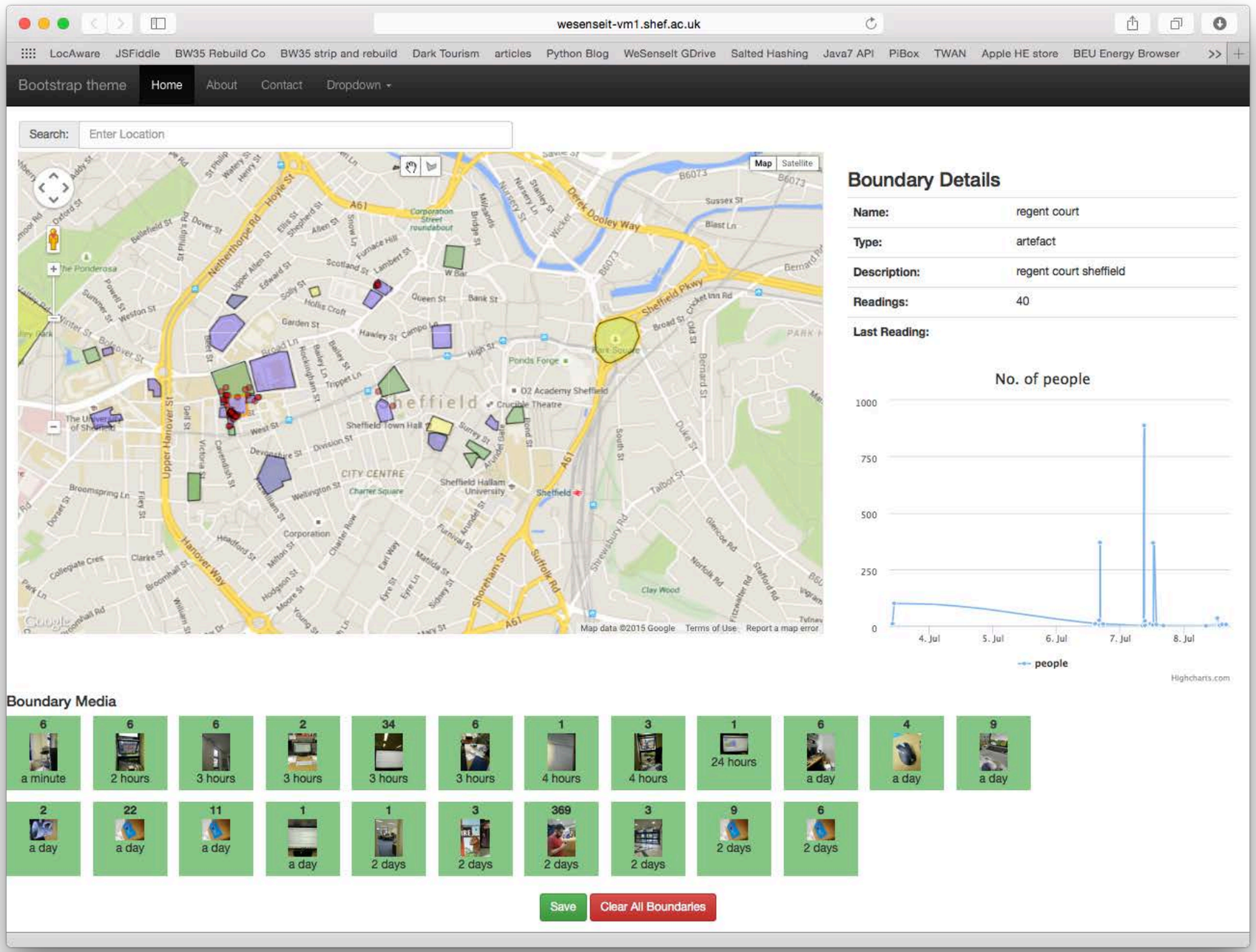
Geo-aware engagement





Geo-aware engagement

- Geofences and associated observations managed in control room.
  - Numerical data
  - Photographs
  - Analyses



The University Of Sheffield.

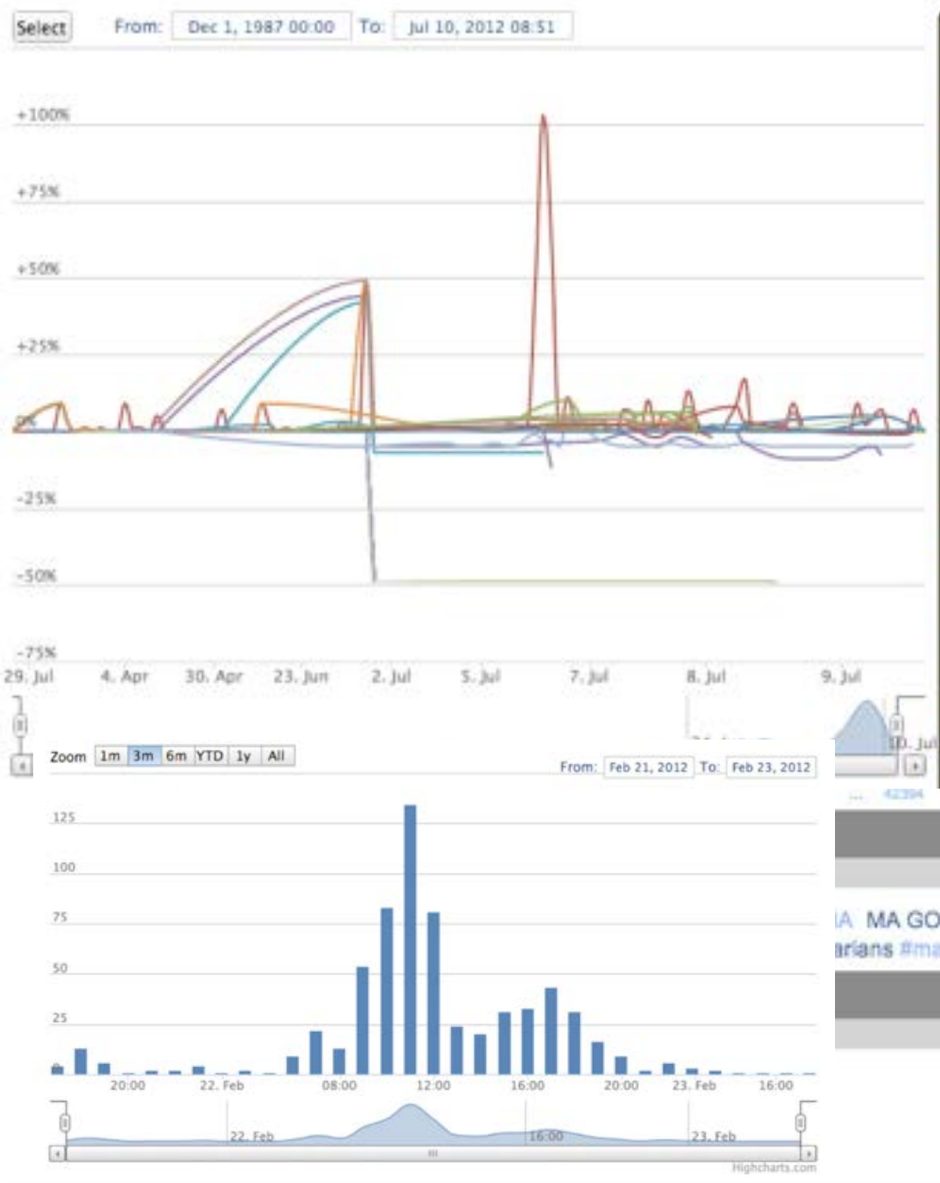
Social media analysis

Social media analysis

- Social media analysis over large scale for event monitoring
  - Use of traces and signals to perform surveillance of public and private spaces/events
- Real-time communication between citizens
  - Alerting friends, relatives
  - Alerting authorities
  - Providing advice, help, support
- Real-time communication from authorities
  - Alerting population
  - Contacting people
  - Providing advice, help, support
- Constant monitoring of social media to spot and follow emerging situations
- Supporting all the phases of an emergency

Social media analysis

- TRIDS infrastructure to monitor social media (Twitter, Facebook, Flickr, etc.) over large scale
  - Used in control rooms of events involving over a million people in last 18 months



The University Of Sheffield.

Impact

UK Large Scale Events (2013-)

- Glastonbury: Largest Music Festival in the World, June 2013 and 2014
  - User: Organisers and Silver Command, 200,000 participants
- Tour de France (UK), July 2014
  - Users: Sheffield CC control room
- Bristol Harbour Festival, July 2013 and 2014
  - Emergency Services, July 2013: 250,000 participants
- Leeds Music Festival, August 2013
  - Security Company, 80,000 participants
- Bristol St Paul's Carnival 2013
  - User: Bristol Emergency Services (Silver and Bronze Commands)
  - Estimated 70-150,000 participants
- Brixton Kerrang Event 2014
  - Organisers, 20,000 participants

The University Of Sheffield.

Impact: Italy

VICENZATODAY

NOTIZIE ZONE EVENTI SEGNAL

ZONE Centro Storico Montecchio Maggiore Stadio Torri di Quartesolo Isola Vicentina Schio Bassano del

Esercitazione a Vicenza con drone e smartphone: ora il Bomba day

Durante l'esercitazione è stato testato anche un drone capace di raccogliere in volo le immagini di una possibile piena, mentre una squadra di sommozzatori ha simulato il recupero di una persona caduta nel fiume

VT Redazione · 30 Marzo 2014

Città di Vicenza | CITTÀ PATRIMONIO UNESCO

Cittadino Impresa - SUAP Servizi online Uffici Amministrazione ViviVicenza

Bomba Day

Evacuazione per disinnesco
venerdì 25 aprile 2014

> Uffici > Dipartimento territorio > Settore Infrastrutture, Gestione Urbana e Protezione Civile > Protezione Civile > **Bomba Day - Evacuazione per disinnesco**

Bomba Day - Evacuazione per disinnesco

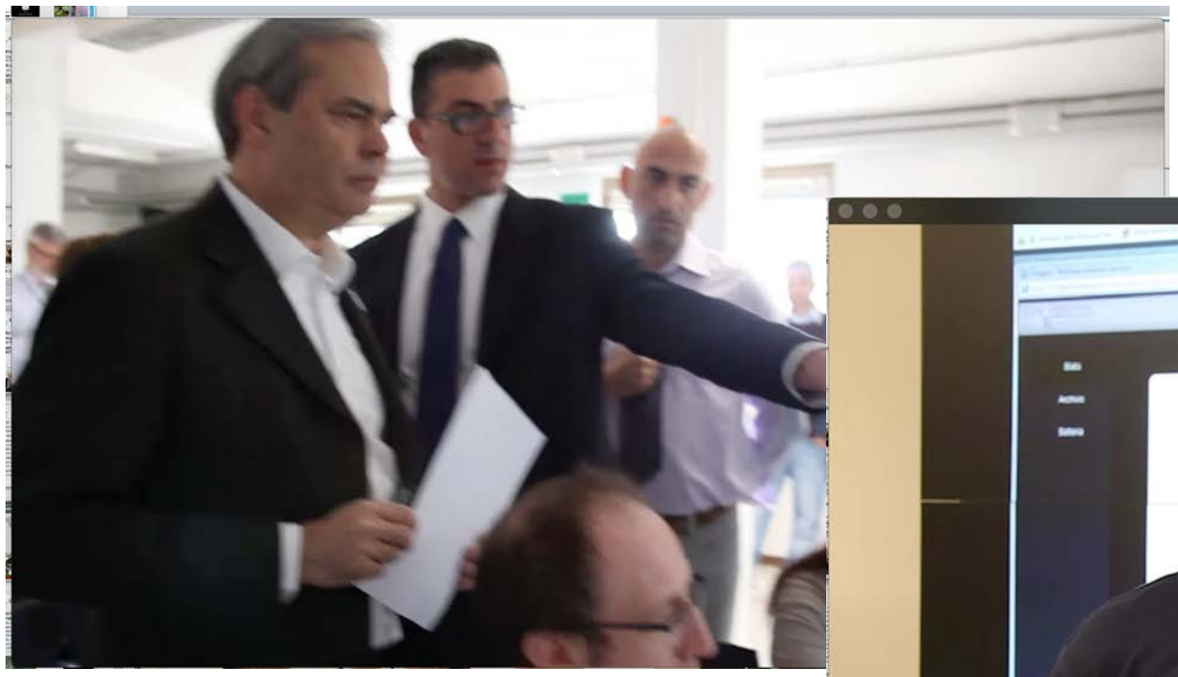
Bomba Day - Evacuazione per disin venerdì 25 aprile 2014

Qui, in particolare, tramite la nuova applicazione per smartphone più di 40 operatori hanno via via registrato e inviato i dati sull'evoluzione della piena al Centro operativo comunale (Coc) costituito nella sede di AIM. Al Coc, accanto allo staff decisore diretto dal sindaco, stamane sedevano infatti anche **i ricercatori del progetto europeo WeSenseIt**, coordinati da esperti dell'università di Sheffield, con il compito di testare la trasformazione in mappe, curve di piena e grafici di tutte le segnalazioni "qualificate" inviate tramite app dai volontari posizionati in prossimità dei sensori fisici, integrandole con le segnalazioni "spontanee" inviate da volontari chiamati a vestire i panni dei cittadini sul territorio e con i commenti reali raccolti dalla rete dei social media in merito all'evento.

"At the start of the day we had 2 sensors on the river
During the day we had 42 sensors sending data"
Achille Variati, Mayor of Vicenza

Application in Real Life

- Technology and approach adopted by the City Council and Civil Protection in Vicenza.
- Proposed by Italian Government as key measure of the *European Flood Directive (2007/60)* and Water *Framework Directive (2000/60)* in the Italian Eastern Alps District.



The University Of Sheffield.

Conclusions

- WeSenseIt empowers citizens to be involved in the management of their own community's resources and infrastructure
  - Not just for water!
- Provides the ability to involve citizens in understanding a situation as it evolves
  - Gathering data and knowledge
  - Helping authorities and emergency responders to make more informed decisions
- Keeping citizens safe
  - Up-to-date, location-specific information broadcasts

Questions

Dr Stuart Wrigley
Research Fellow
Department of Computer Science
The University of Sheffield, UK

s.wrigley@sheffield.ac.uk
@stuwrigley

In collaboration with Prof Fabio Ciravegna, Dr Suvodeep Mazumdar, Dr Vita Lanfranchi, Neil Ireson, Jie Gao and the WeSenseIt consortium

wesenseit.eu

@WeSenseIt

EU FP7 Project Grant Agreement Number 308429