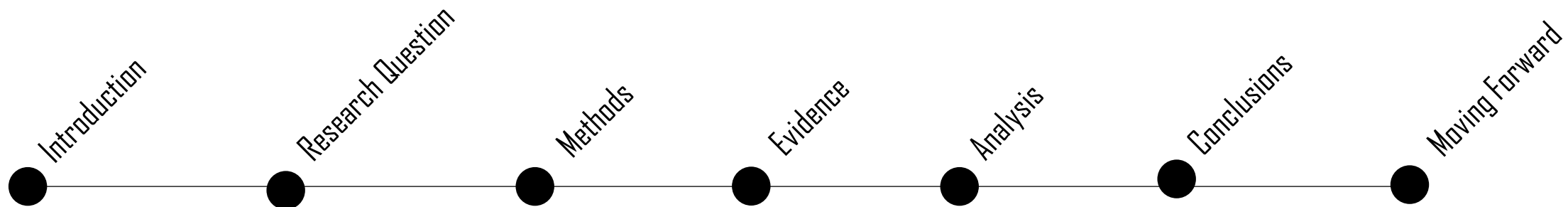


Air Quality Platform Problematics: Illuminating the Gap Between PLATFORM Design & Applications



Contents





Introduction



ABOUT THIS MAP

AMERICA

ASIA

ANTARCTICA

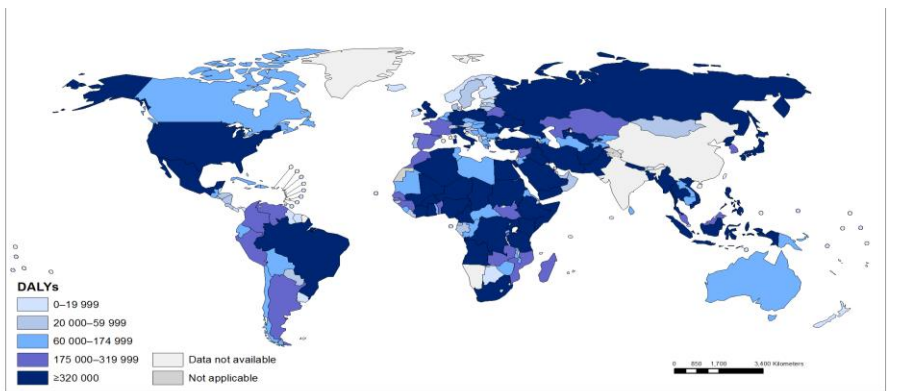


Dangerous air quality in Pakistan



(Photo: [bikeriderlondon](#) Shutterstock)

High rates of childhood asthma



The boundaries and names shown on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization
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4.2 million deaths per year due to ambient outdoor air pollution (WHO, 2018)



Increasing wildfires damage across the U.S.



Research Question



Does the design of low-cost air quality sensing platforms align with their advertised applications?

Introduction

Research Question



Methods

- Empirical approach – 3 case examples



Speck Sensor

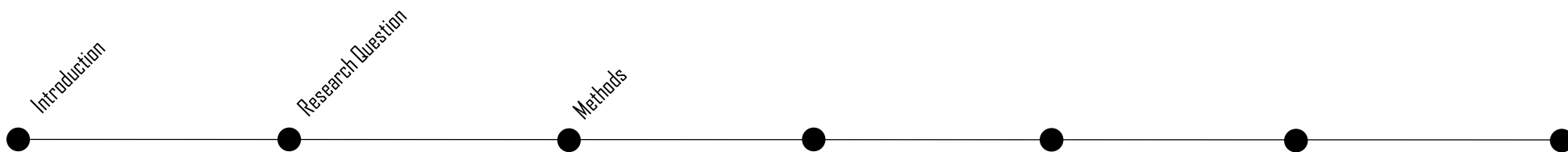


Air Quality Egg



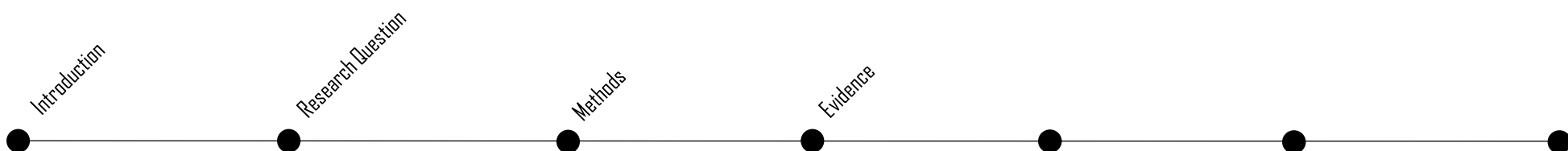
Smart Citizen

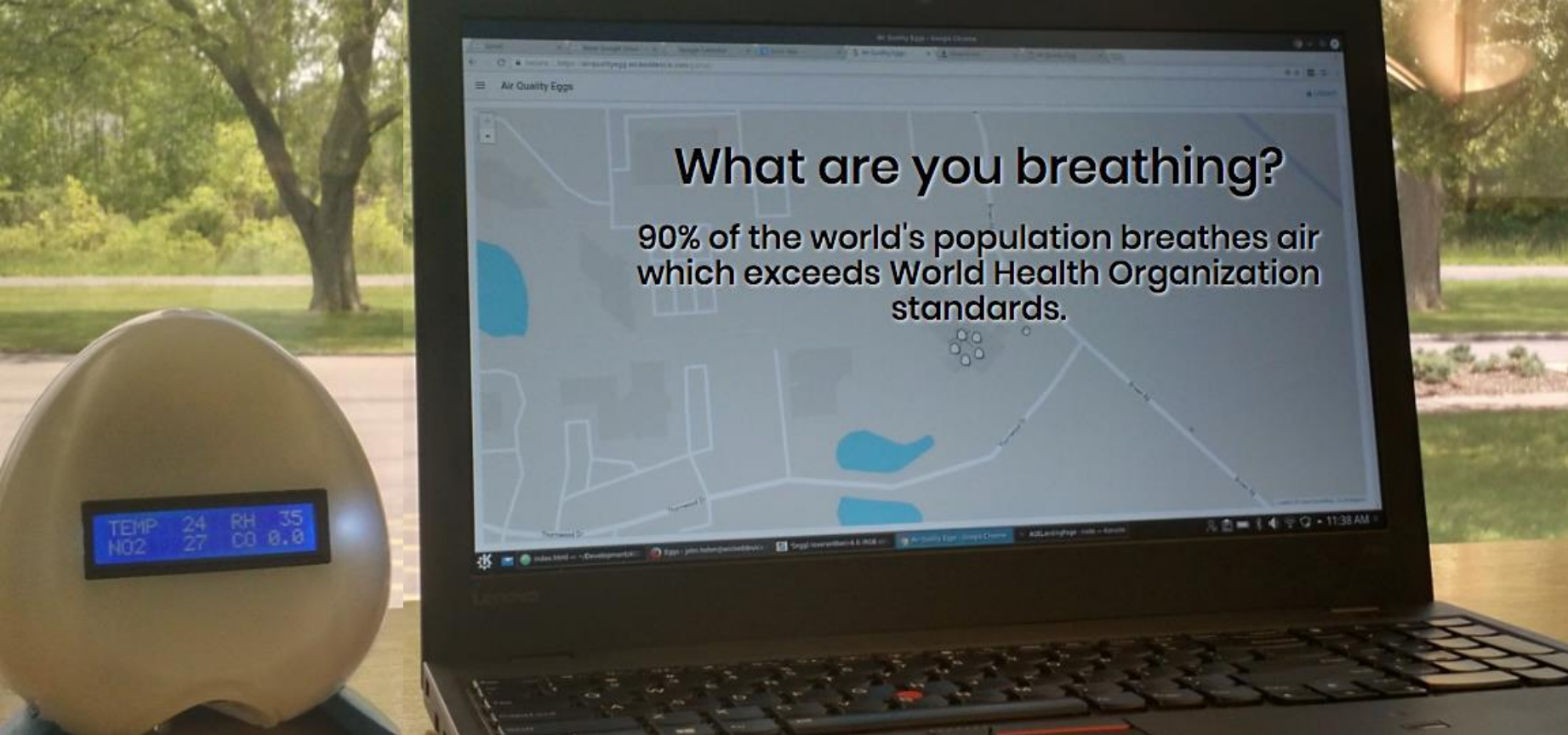
- Focus on the 'architects' – programmers, engineers, developers & designers
- Ethnography, visual analysis of device and platform displays, content/discourse analysis of open access code obtained via GitHub and transcribed interviews



Evidence

DESIGN	APPLICATION
Source code	Website homepages (platform entry points)
Interview transcripts	Interview transcripts
Hardware	User Interface





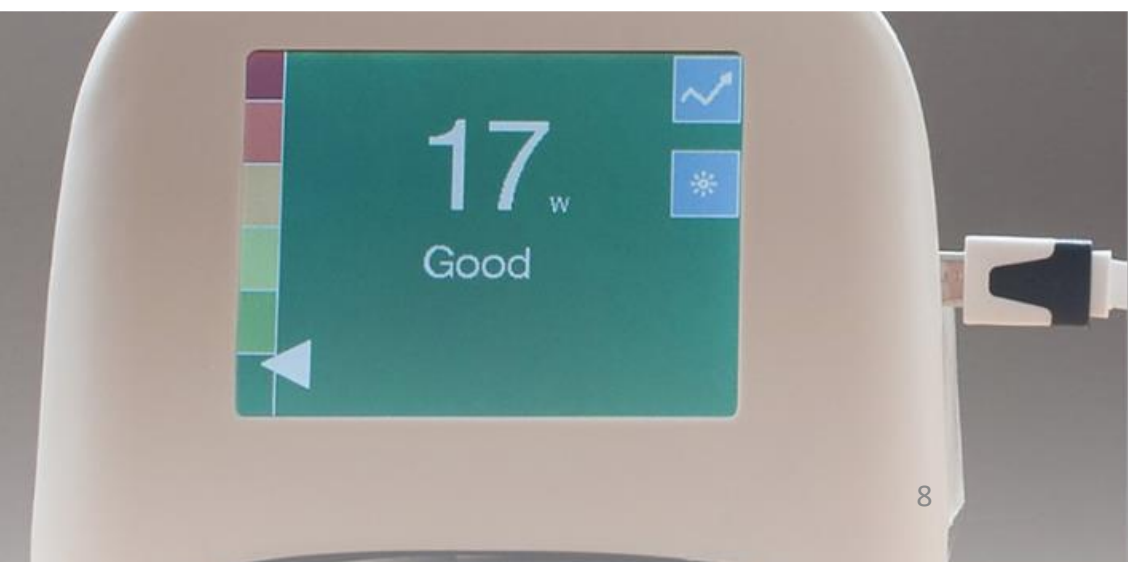
WE EMPOWER COMMUNITIES TO BETTER UNDERSTAND THEIR ENVIRONMENT

We're a team of passionate people who believe data is critical to inform political participation at all levels. We develop tools for citizen action in environmental monitoring and methodologies for community engagement and co-creation.



Meet Speck.
The indoor air quality monitor
empowering you to breathe easier.

[▶ Watch the Video](#)

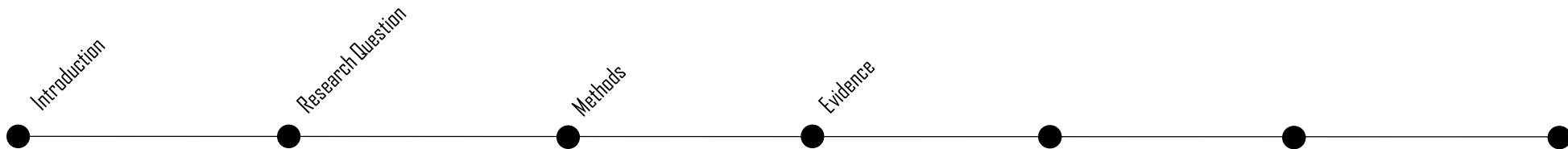


Evidence (*interview transcripts*)

"The reason we decided to measure particle pollution, ground level ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide is that those are the things that are defined by the US government as what's called criteria pollutants... the government defines air pollution as those five things and lead." - Interview, Subject 3

This architect went on to say that they wanted the platform to be measuring something the U.S. government cared about, so that there was a direct connection to policy.

All three architects mentioned that they *'hoped platform users would be able catch the attention of regulators or local policy officials with the data they collect'* - Interview, Subjects 1-3



```

class SCKSensorData
{
    /**
     * SCK11Calibration
     * Calibrates to propper SI units an SCK datapoint
     * @param array $rawBat Indexed array containing a SCK 1.1 datapoint
     * @return array Indexed array with a SCK datapoint calibrated
     */
    public function SCK11Convert($rawData)
    {
        $data = array();
        if (self::isValidDateTimeString($rawData['timestamp'])) { //Check calibration...
            $data['timestamp'] = $rawData['timestamp'];
            $data['temp'] = self::tempConversion($rawData['temp']);
            $data['hum'] = self::humConversion($rawData['hum']);
            $data['noise'] = self::noiseConversion($rawData['noise']);
            $data['co'] = self::coConversion($rawData['co']);
            $data['no2'] = self::no2Conversion($rawData['no2']);
            $data['light'] = self::lightConversion($rawData['light']);
            $data['bat'] = self::batConversion($rawData['bat']);
            $data['panel'] = self::panelConversion($rawData['panel']);
            $data['nets'] = $rawData['nets'];
            return $data;
        } else {
            return false;
        }
    }
}

```

```

/**
 * <p>
 * Reads the current sample from the Speck and returns the it to the given <code>callback</code>. The callback
 * function has a signature of the form <code>callback(err, data)</code>.
 * </p>
 * <p>
 * For The data object contains the following fields:
 * <ul>
 * <li><code>sampleTimeSecs</code>: integer</li>
 * <li><code>particleCount</code>: integer (only included in Specks supporting protocol version 1 or 2)</li>
 * <li><code>particleConcentration</code>: integer (only included in Specks supporting protocol version 3)</li>
 * <li><code>humidity</code>: integer</li>
 * <li><code>rawParticleCount</code>: integer</li>
 * <li><code>temperature</code>: integer (only included in Specks supporting protocol version 1)</li>
 * </ul>
 * </p>
 * @param callback {function} - the callback function with a signature of the form <code>callback(err, data)</code>
 */
this.getCurrentSample = function(callback) {
    getDataSample(GET_CURRENT_SAMPLE_COMMAND_CHARACTER, callback);
};

```

```

/* sensor vars and read functions */

//debounce time (milliseconds) between each analog sensor reading
const int sensorDebounceTime = 15;

int tmp102Address = 0x48; //temp sensor 2-wire address

CS_MQ7 MQ7(4); //sensor "tog" pin on 4

void readSensors(){
    //sensors
    Serial.println("reading sensors");
    currNo2 = getNo2();
    delay(sensorDebounceTime);
    currCo = getCO();
    delay(sensorDebounceTime);
    currQuality = getQuality();
    delay(sensorDebounceTime);
    currHumidity = getHumidity();
    delay(sensorDebounceTime);
    currTemp = getTemperature();
    delay(sensorDebounceTime);

    MQ7.CoPwrCycler(); //for CO sensor power cycling
}

//----- e2v MiCS-2170 NO2 sensor -----
int getNo2(){
    int thisReading = 10;

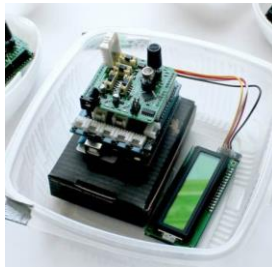
    //set reference voltage to 3.3 here?
    thisReading = analogRead(No2SensorPin);
    return thisReading;
}

//----- MQ-7 carbon monoxide sensor -----
//breakout info: http://citizensensor.cc/make
int getCO(){
    int thisReading = 11;

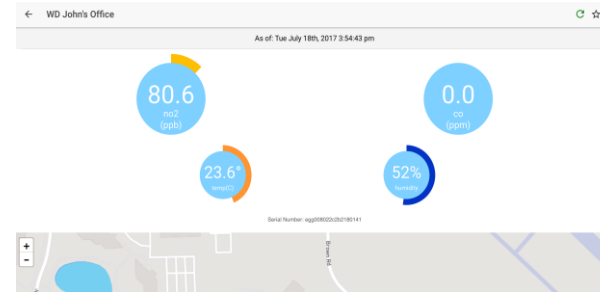
    if (MQ7.currentState() == LOW){ //not heating, ready to read.
        thisReading = analogRead(CoSensorPin);
    }
    else { //heating, leave value where it was
        thisReading = currCo;
    }
}

```

Hardware



User Interface



Introduction

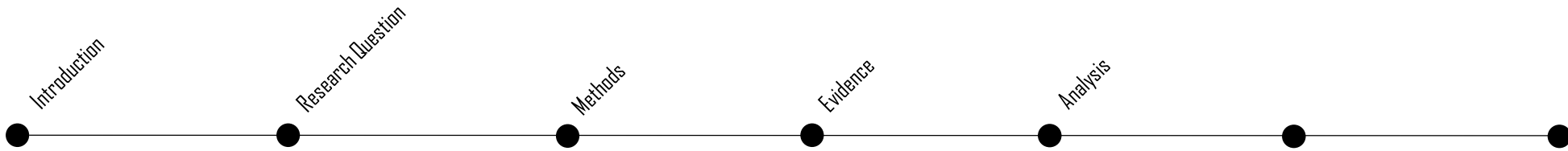
Research Question

Methods

Evidence

Analysis

DESIGN	APPLICATION
Source code	Website homepages (platform entry points)
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Conclusions

- Air quality sensing devices reviewed are not designed according to their advertised applications
- Pressure to align with the dominant statutory paradigm for defining air pollution restricts infrastructural capacity to collect important social data
- Platform “identity crisis” is responsible for application misalignments, rather than being due to a lack of “users’” technical knowledge

Moving Forward

- Greater transparency about what these devices and platforms are
- Positionality is key! Diversity is good 😊
- Expand the infrastructural capacity of platforms to account for contextualizing data (beyond timestamp/geolocation)
- Encourage participatory practices for collective/comprehensive knowledge production
 - Lessons learned from: Gabrys et al 2017, Whatmore & Landstrom 2011, Jasanoff 2001, Kaufman et al 2017

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