Mobilized Construction

Refined Project Proposal

Agenda

- Context
- Problem
- Approach
- Related Work
- Work Plan

Context

Road infrastructure maintenance in sub saharan Africa.

International Roughness Index as the standard by which road conditions are measured.

Problem

Damage and uncomfort: Rough roads may cause more **damage to vehicles** and **discomfort for vehicle occupants**. They can also damage transport goods.

Expensive and fairly fragile equipment not suited for emerging markets with constrained budgets and minor companies.

Vast areas to measure, taking a lot of time. Possibly more valuable to get more measurements of a lesser quality.

Project Description / Scope

Designing and implementing a prototype of a **robust, low-cost device** to mount in a government vehicle to gather **GPS- and accelerometer-data**.

Power will be sourced from the vehicle, either directly from the battery or from the 12V plug.

The gathered data will be **sent in bundles over wifi**, once a connection to a known wifi network is established (e.g. when the vehicle is returned to the garage).

The device and its function should preferably **be invisible to**, and not need the intervention from **the driver** of the vehicle.

Configuration and installation of the device can be handled by a professional mechanic or it-specialist if necessary.

Approach I

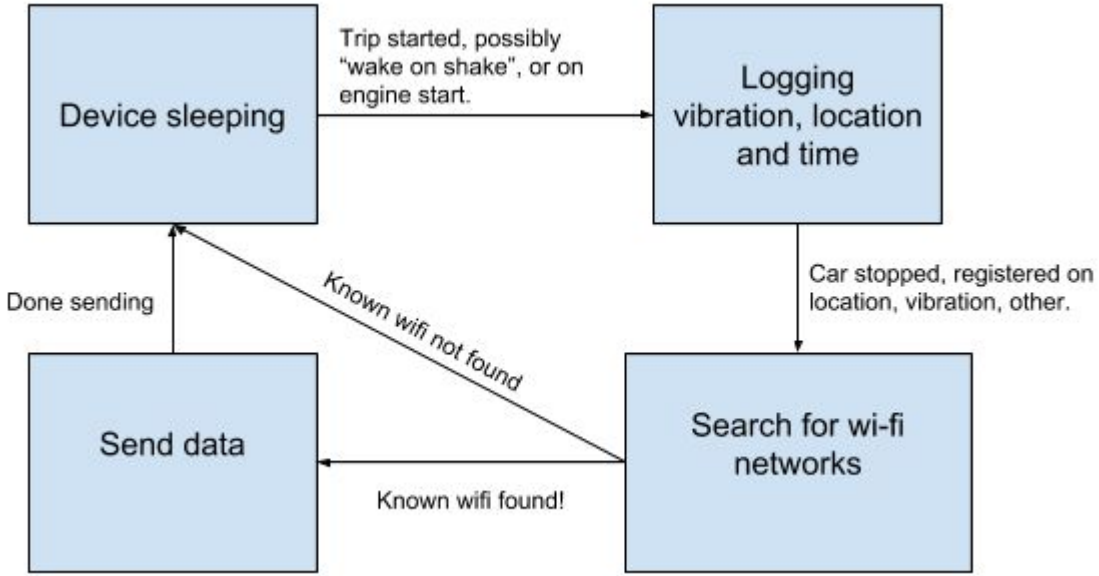
“Crowdsourcing”: This is the inspiration for the method, although at first only vehicles from the client organisation will be included.

Non-reliance on smartphones: Not optimal due to device loss and interference.

Low-cost IoT device: Our goal, in order to maximize scalability and robustness.

Data transfer once a day, approx: Real-time data is not necessary for the measurements.

Approach II


Device sleeping
Trip started, possibly "wake on shake", or on engine start.
Logging vibration, location and time
Car stopped, registered on location, vibration, other.
Search for wi-fi networks
Known wifi not found
Known wifi found!
Send data
Done sending

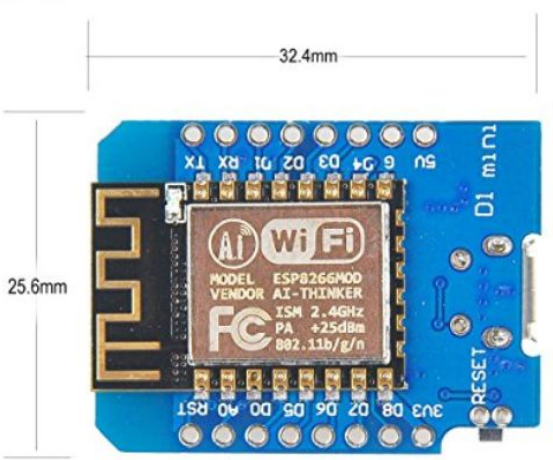
Technical specifications

WeMos D1 mini MCU w/WiFi (Arduino-C or Lua-Script)

WeMos D1 mini shield SD card adapter

GPS Module (GY-NEO6MV2)

Accelerometer+Gyroscope (6DOF GY-521) 3 axis

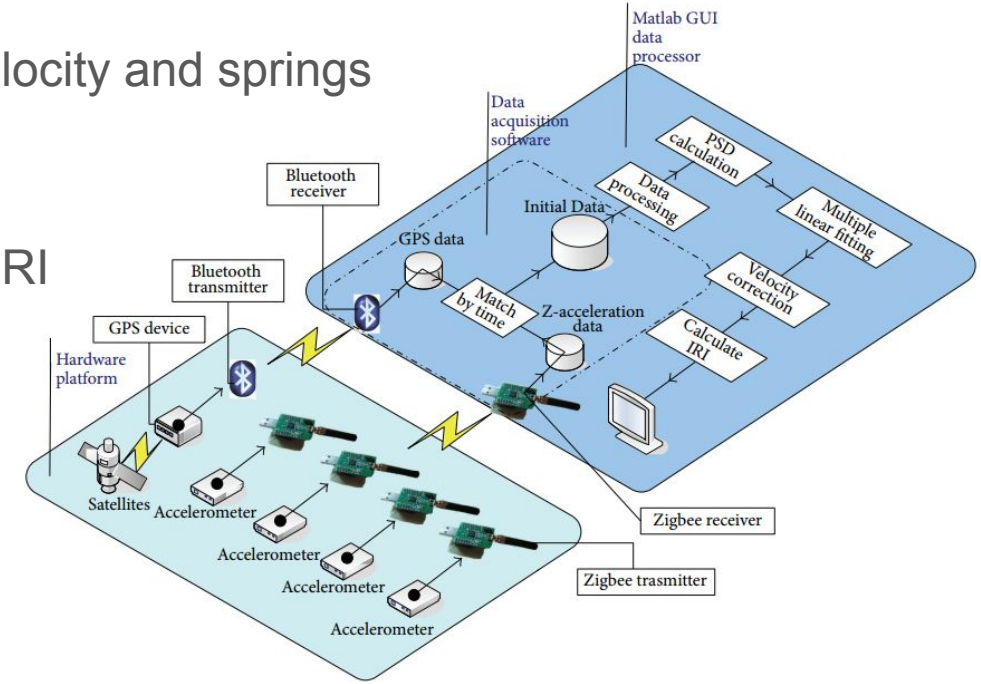


Related Works

Related Work I

[Measurement of International Roughness Index by Using Z-Axis Accelerometers and GPS]

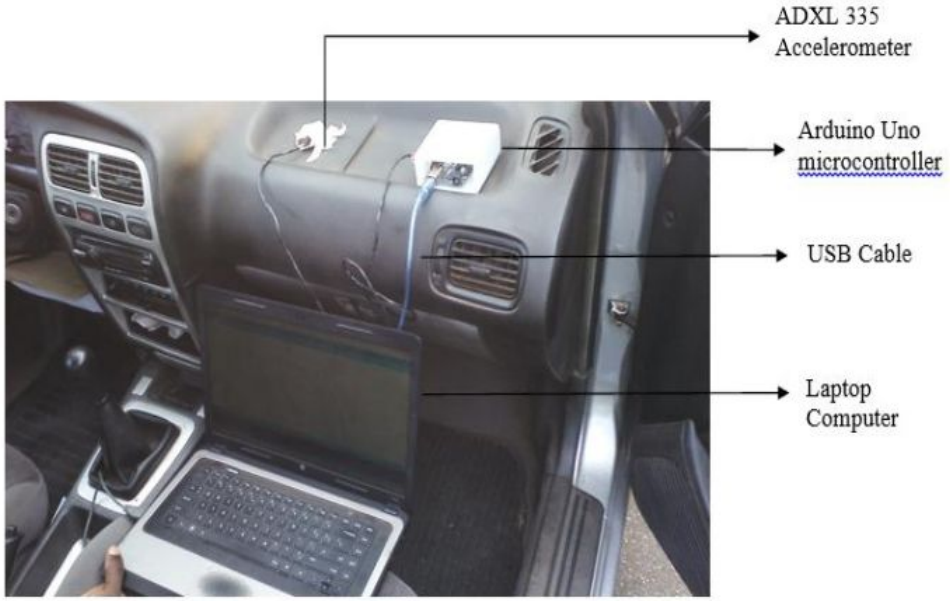
- Heavy calculations of effects of velocity and springs
- Shanghai (urban environment)
- 4 Accelerometers, Z-Axis
- Fairly accurate measurements of IRI
  - Relative error < 15%
- Uses a lot of equipment
  - Expensive
- Only short range wireless transfer



Related Work II

Development of a Decision Support System for Road Maintenance Scheduling

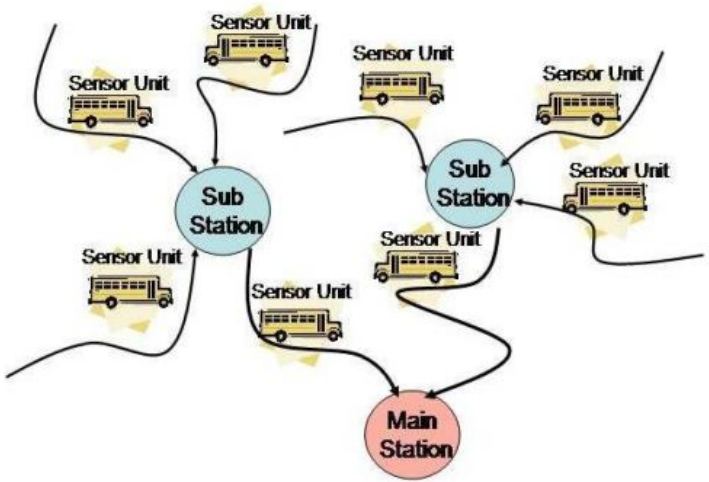
- Usage of Arduino microprocessor and 3-axis accelerometer
- Nigeria, mixed road environment
- No wireless transfer, data is transferred by cable to a computer and processed locally.



Related Work III

[A public transport system based sensor network for road surface condition monitoring]

- Sensor-nodes distributed on buses in Colombo, Sri Lanka, to sense environmental conditions and potentially road roughness.
- Uses “sub-stations” to transfer data from bus to bus until it reaches the main station.
- Has no implementation of road roughness sensing yet, but protocol for data-transfer could be useful.



Workplan I

Our **preparation** includes clarification on scope and parts, and prototyping.

- **Skype call** with client for scope and requirements clarification [*Completed 19th September*]
- **Order parts** [*Completed 19th September*]
- Start **prototyping** w/ parts [*Completed 26th September*]
- Possible **meeting** with client for clarification or demonstration [*3rd October*]

Workplan II

Functionality is split into **three iterative prototypes**:

1. Gather GPS and Sensor-data (Deadline October 10th)
2. Transfer data bundle on wifi-connect (Deadline October 31th)
3. Source power from vehicle and casing/installation (Deadline November 14th)

Each of these iterations will also **include general improvements** derived from evaluation of the earlier iteration. Beside these construction deadlines we have **concurrent report-writing** deadlines.