Scalable REST API for a Wireless Sensor Network

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Presentation Structure

- Problem Statement and Justification
- Aims and Objectives
- Related work and Literature
- Conceptual Frameworks
- Methodology
- Findings
- Conclusion
- Implications and Recommendations

Problem Statement & Justification

- Monitoring energy consumption has become increasingly important as a result of rising energy costs.
- Whilst Wireless Sensor Networks enable monitoring, managing sensor networks requires custom APIs which is tedious and error prone.
- Justification
  - Use REST framework to ease the process of interacting with sensors and making them accessible over the web.
  - Rise in popularity of Smart Home Technology and Internet of Things

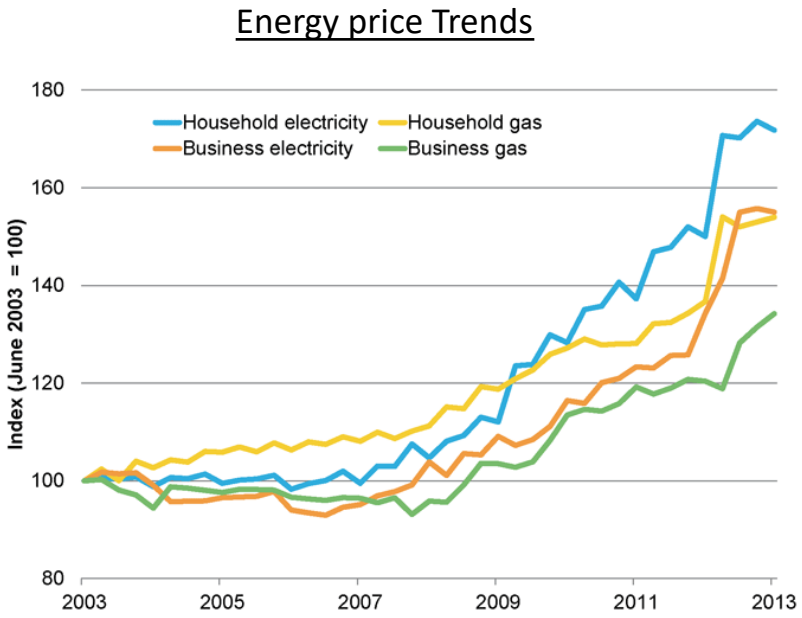


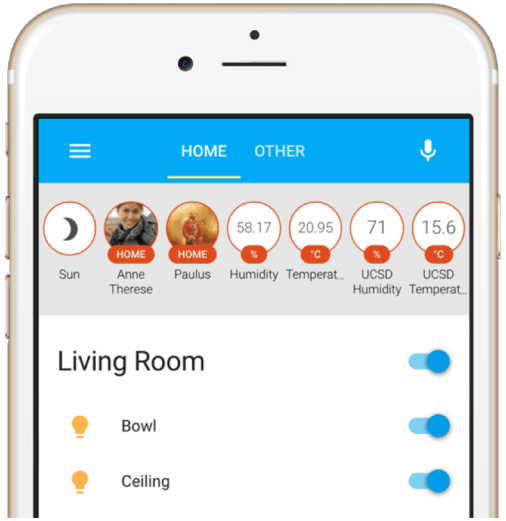
Figure 1: showing trends in energy prices across households and businesses

Aims & Objectives

- Aims
  - To provide users with insights on the energy consumption of the appliances they use in their household.
  - To provide users with an estimated cost of energy for appliances within the household, so they can make smarter decisions on how to reduce energy costs.
- Objectives
  - Implement an efficient and scalable web application that allows users to monitor energy consumption of appliances and provide an estimated cost.
  - Users should be able to view all/specific appliances in their household.

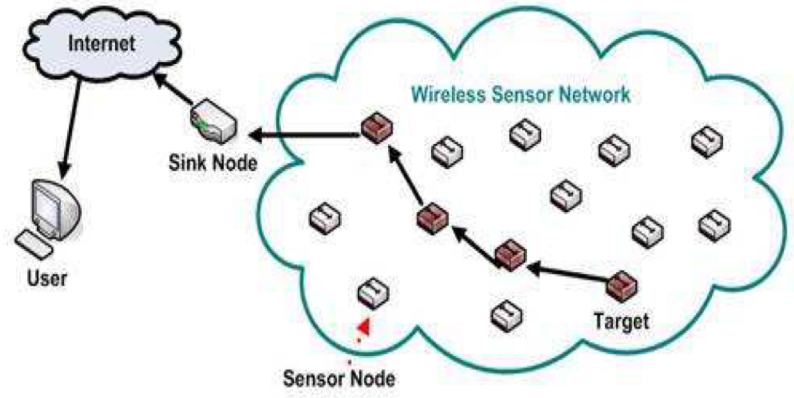
Related Work & Literature

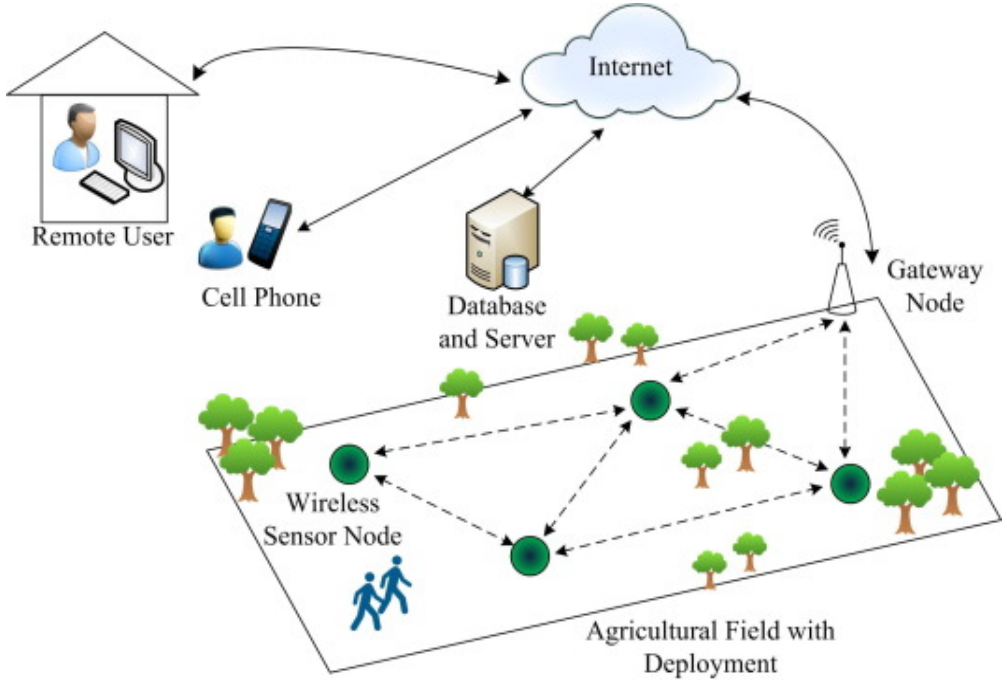
- Smart Home Technology
- Internet of Things
- Home Assistant
- Literature Review
  - WSN: A Betts
  - REST: Roy Fielding, A Diaz



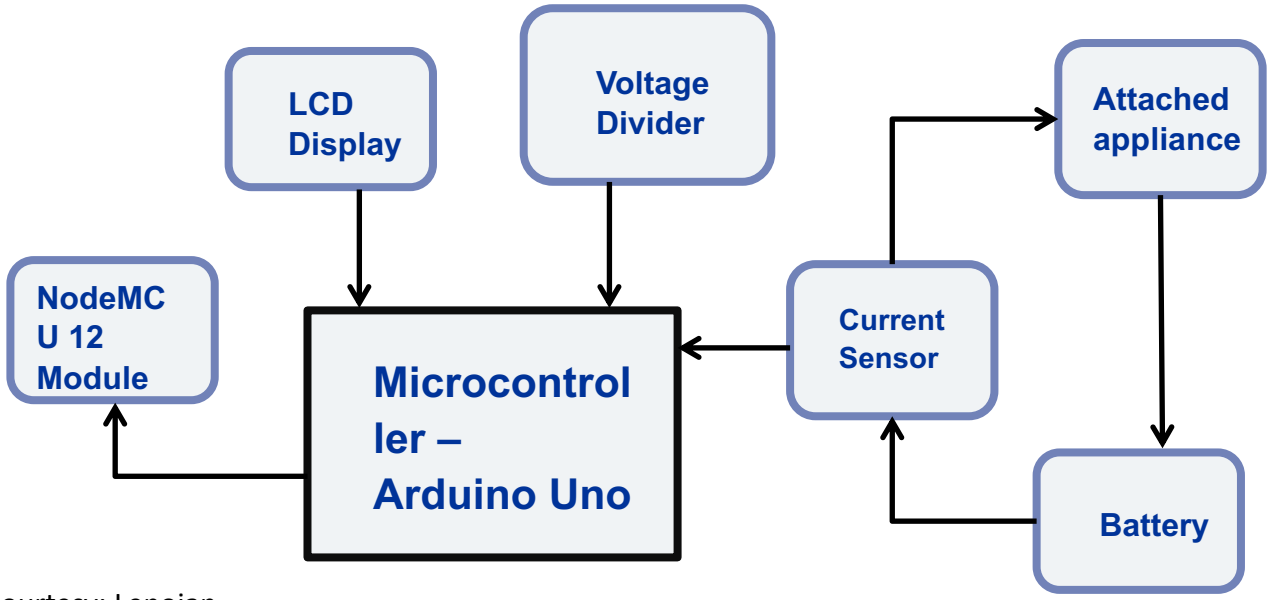
Conceptual Framework: Wireless Sensor Network

- A system which that wirelessly monitors physical and environmental properties through the use of sensor nodes.

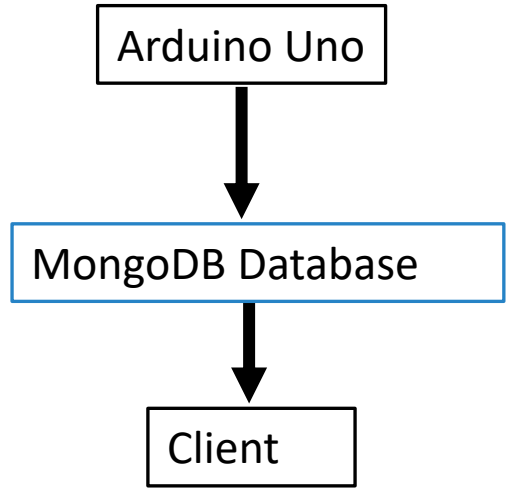




Hardware & Flow of Data

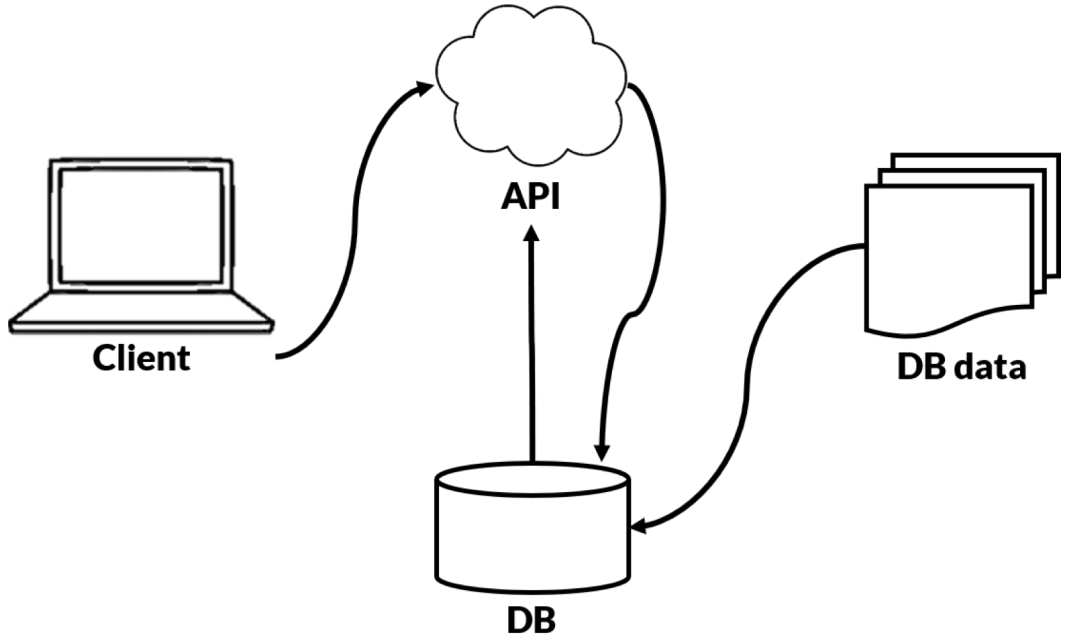


Courtesy: Lenojan Jeyarajan



Conceptual Framework: REST API

- Representation State Transfer
- Commonly used for web applications.
- Main reasons for choice:
  - Stateless architecture
  - Uniform interface
  - Layered system
  - Provides potential for scalability
- 4 principles used to interact with data:
  - GET
  - POST
  - PUT
  - DELETE

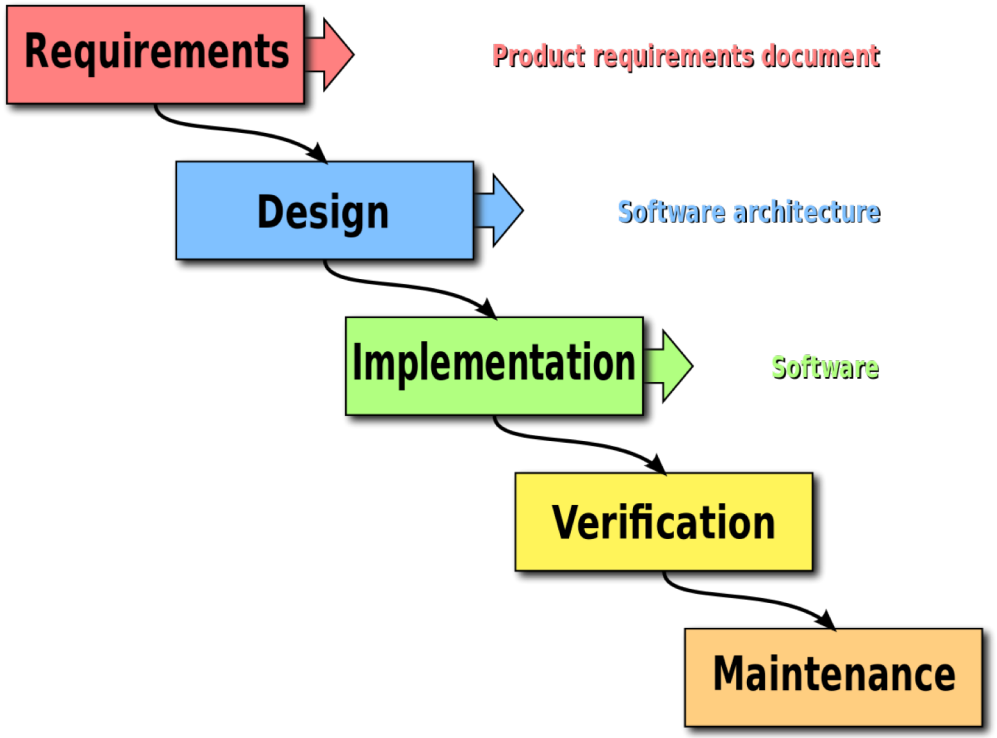


Important Technologies used

- Node.js
  - Open source JavaScript runtime used to build network applications.
  - Provides “full-stack” capability for client and server side operations.
- Express.js
  - Enables definition of routes between application endpoints and requests from the client.
  - Composed of Routes, Router and Middleware.
- MongoDB
  - Non-relational database that collects are stores documents formatted in JSON.
  - Hosted in the cloud for scalability and security purposes.

Methodology

- Waterfall development method
  - Sequential design process, commonly used for many software implementations.
- Data analysis & performance measurements
  - Load Testing for each REST component.
  - Network Usage.
  - PC usage (memory, CPU).
- Non functional/functional Requirements
  - Users must be able to view all appliances in the database.
  - Each GET request must be processed by the application within 100ms.

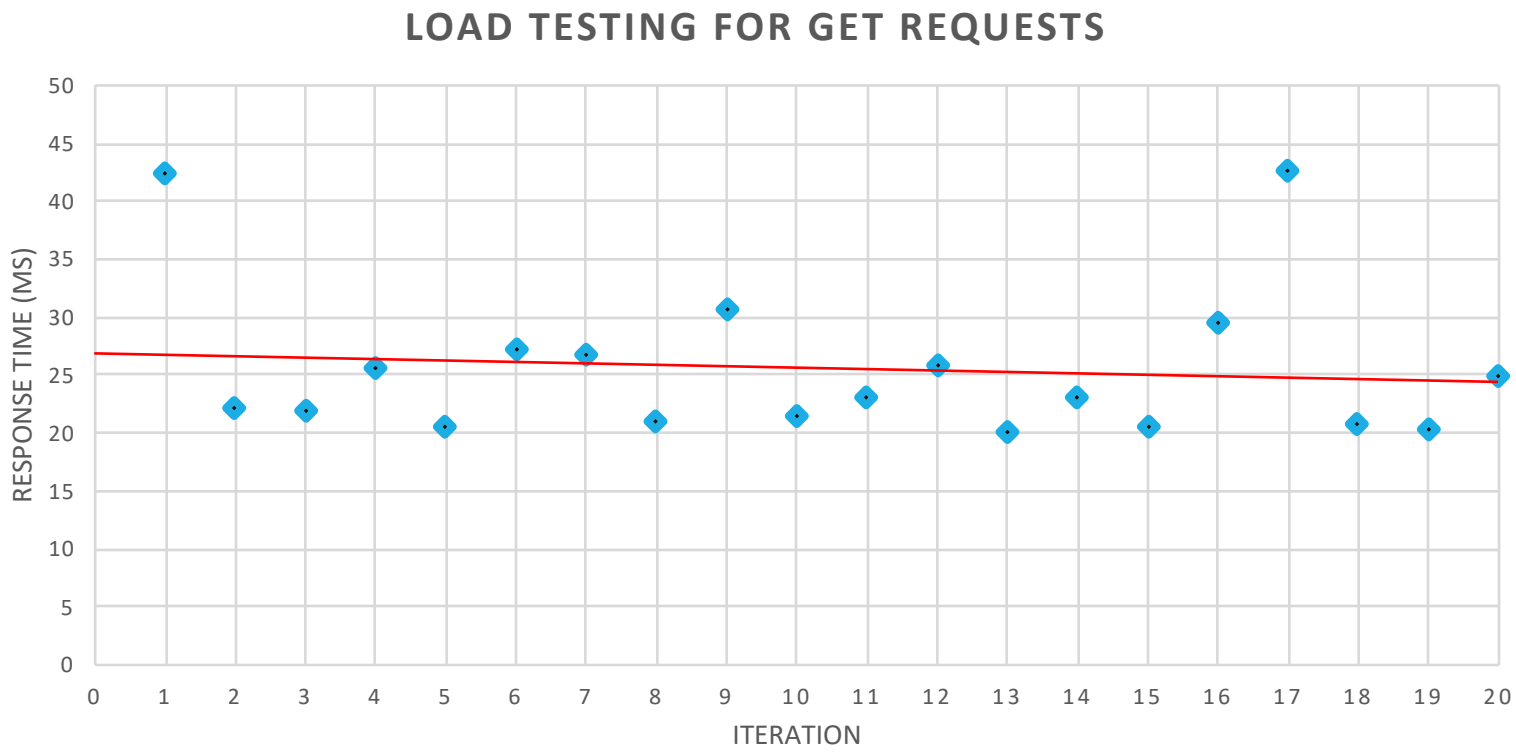


Methodology: Sensor Model

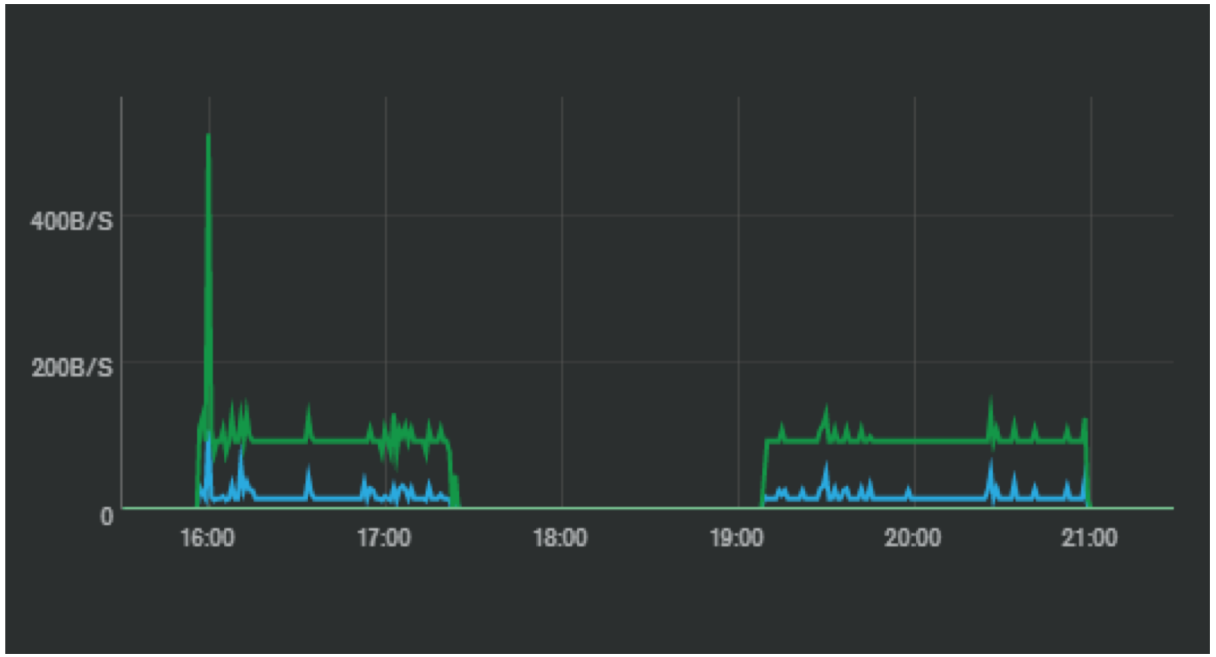
- Schema – defines how each sensor is modelled and stored within the database.
- Essential component of the whole system.

```
10  var senSchema = mongo.Schema({
11      _id: mongo.Schema.Types.ObjectId,
12      name: String,
13      voltage: Number,
14      watt: Number,
15      costperHour: Number,
16      costperDay: Number,
17      costperMonth: Number,
18  });
```

Findings: Load Testing



Findings: Network Usage



Graph showing network usage (Bytes per second) for two different time intervals, where green = bytes in, blue = bytes out.

Findings: Data Retrieval

Conclusion

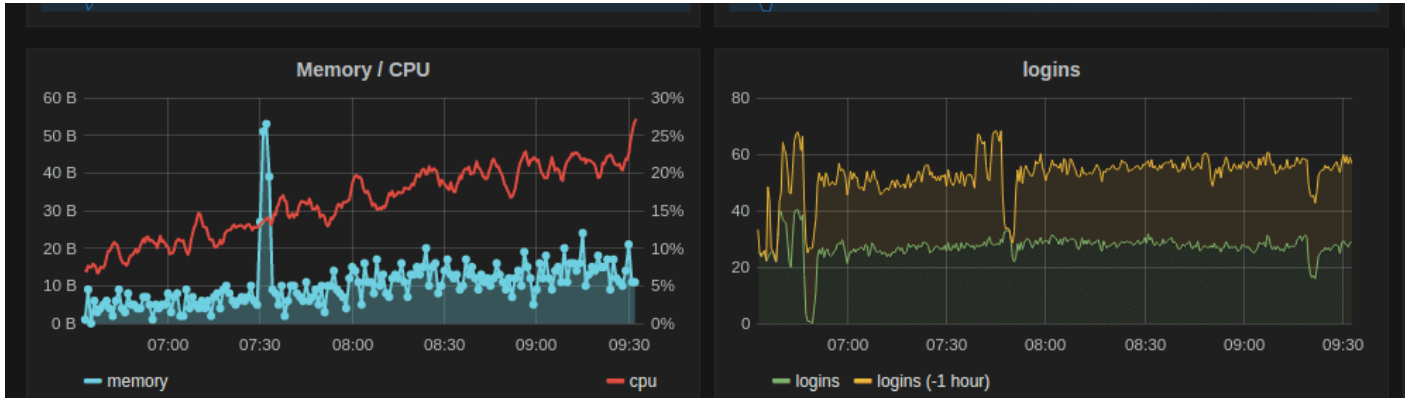
- REST API provides the most efficient solution for managing interactions between a client and database.
- The combination of Node.js, REST and MongoDB provides an effective method of creating a useful web application, in one language (JavaScript).
- Load testing highlights that the application is performing better than expected, and is capable of handling large volumes of data (Scalability).
- Fast response times indicate that the applications performs well, which is one of the fundamental requirements of the software.

Strengths and Weaknesses

- Strengths
  - Web application is fast and efficient.
  - No bottleneck issues.
  - Fast response time.
  - Data is secured throughout each request/response.
- Weaknesses
  - No recommendations based on trends in energy consumption (Users must predict this by themselves).
  - Implementation limited to house appliances, cannot be used for other processes that consume electricity (e.g Lights, portable devices).

Implications & Recommendations

- Ethical implications
- Recommendations for future research
  - Machine Learning: Applying algorithms to collected data to provide insights into energy consumption.
  - Visual Representation of data.
  - Enhancing Security: Using HTTPS instead of HTTP protocol.



Thank you!

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