

# REST API for a Wireless Sensor Network

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# Presentation Structure

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

# Problem Statement & Justification

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- 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

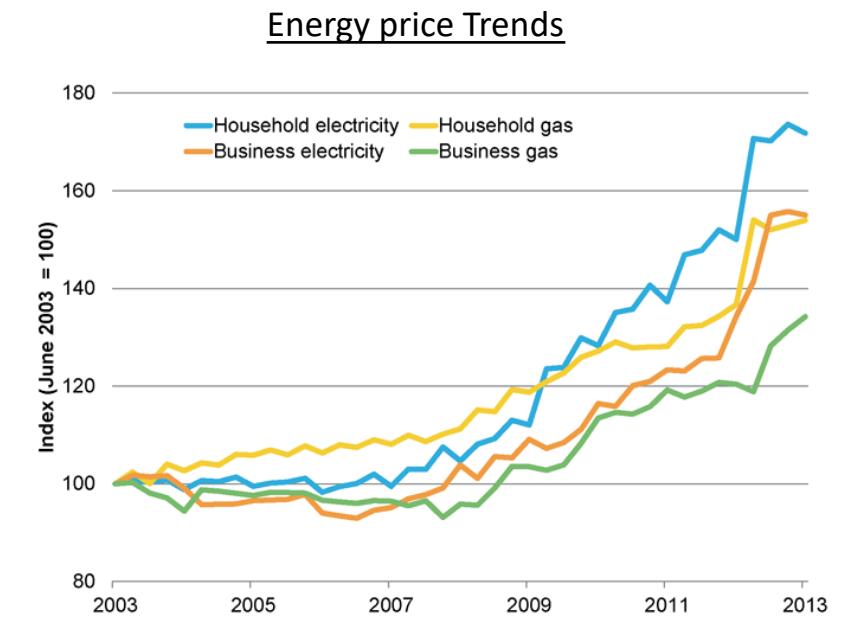


Figure 1: showing trends in energy prices across households and businesses

# Aims & Objectives

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- 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.

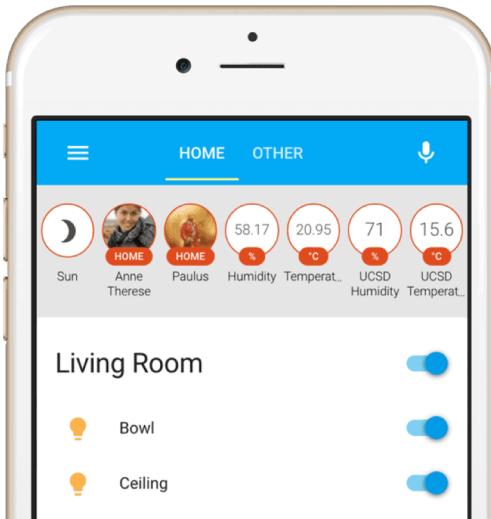
- Objectives

- 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

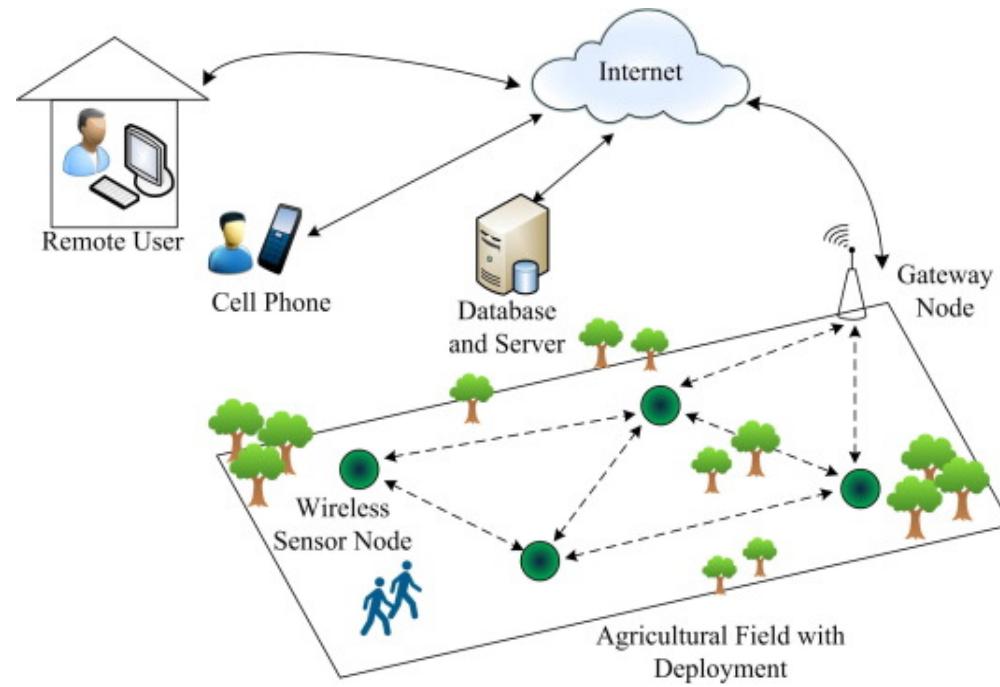
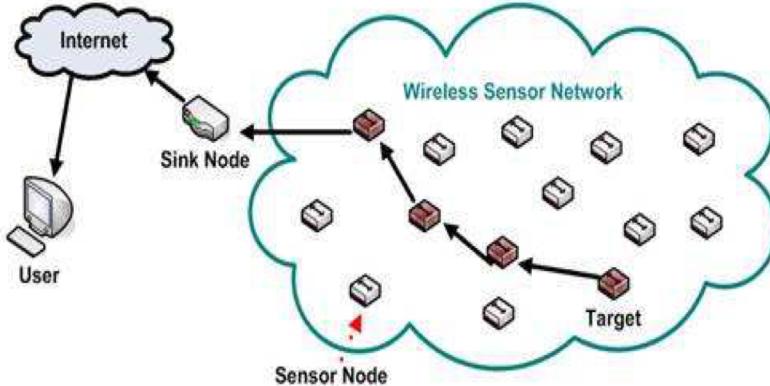
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- Smart Home Technology
- Internet of Things
- Home Assistant
- Literature Review
  - WSN: A Betts
  - REST: Roy Fielding, A Diaz



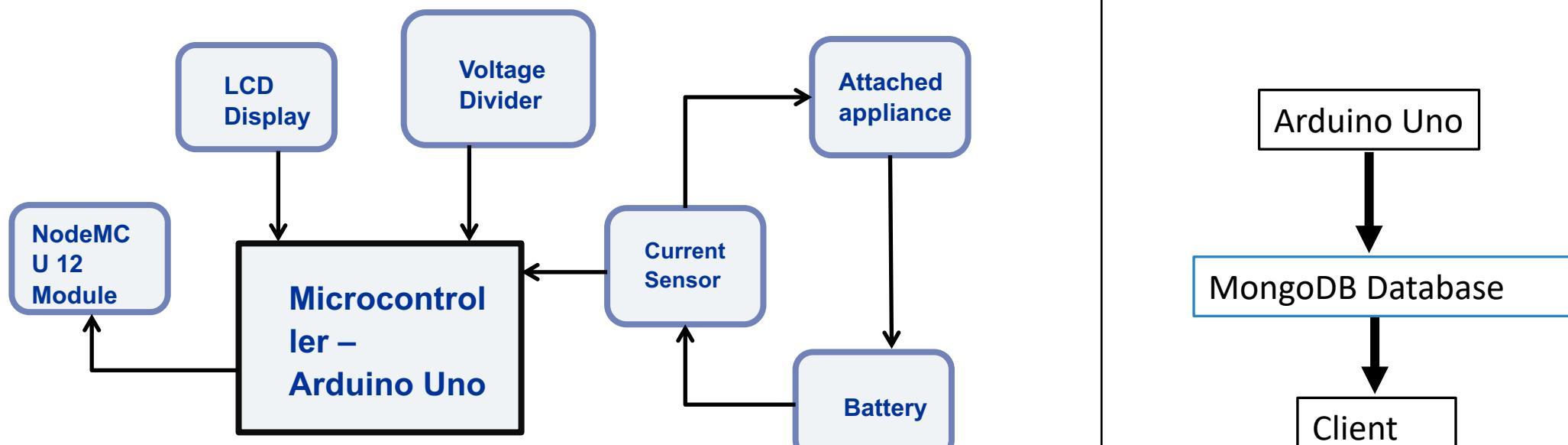
# Conceptual Framework: Wireless Sensor Network

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



# Hardware & Flow of Data

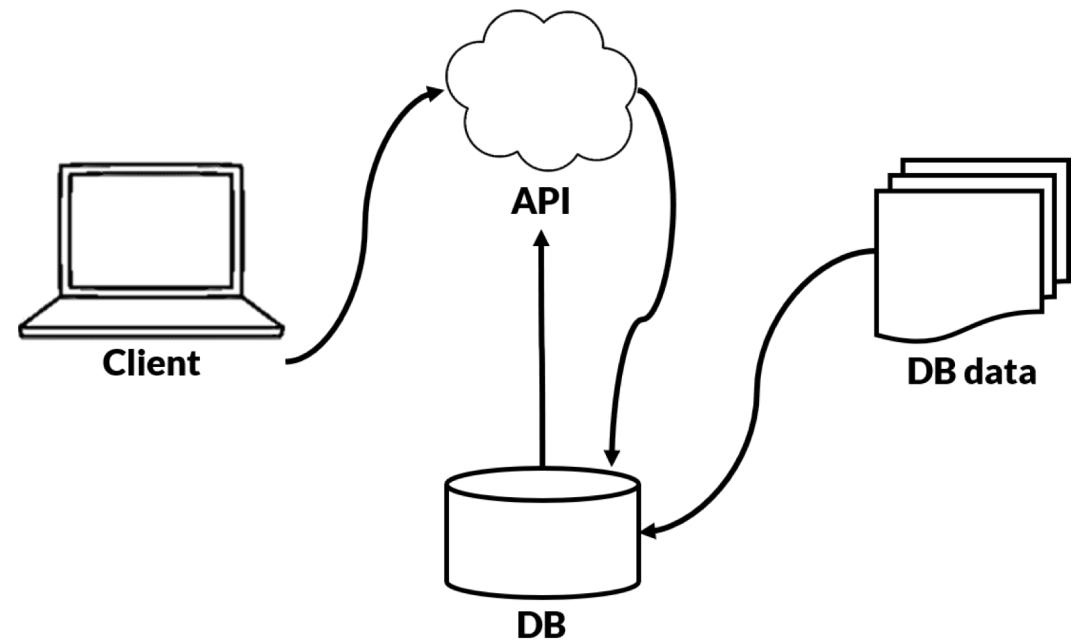
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# Conceptual Framework: REST API

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- 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

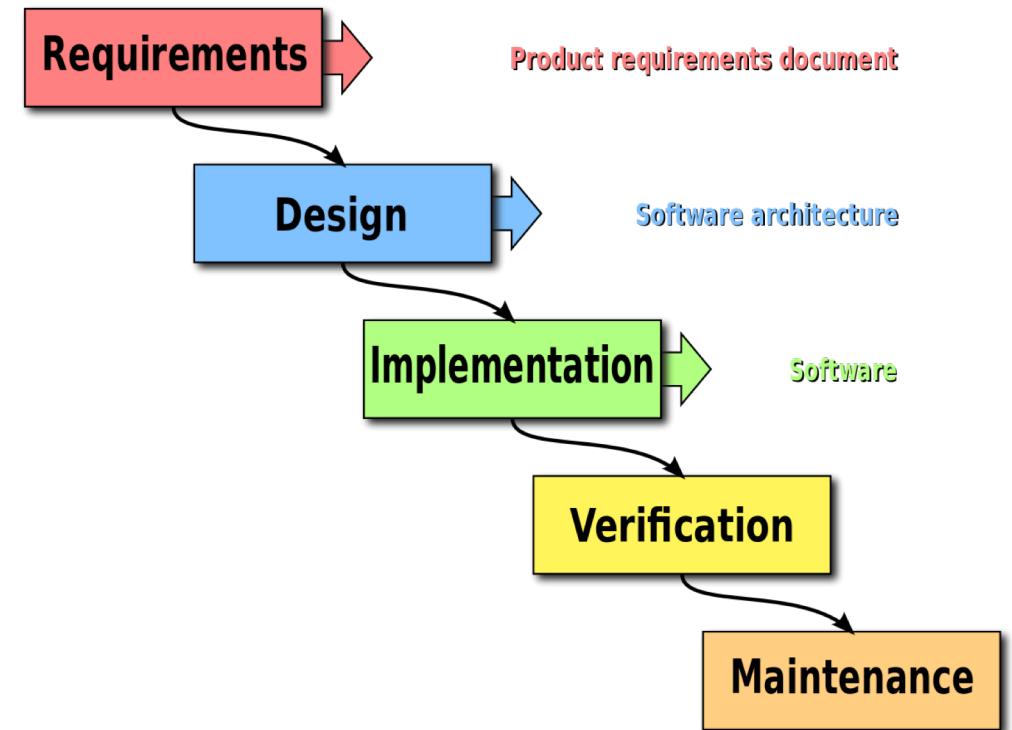
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- Node.js
  - Open source JavaScript runtime used to build network applications.
  - Provides “full-stack” capability for client and server side operations.
- Express.js
  - Enables definition of routes between application endpoints and requests from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

# Methodology

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- 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

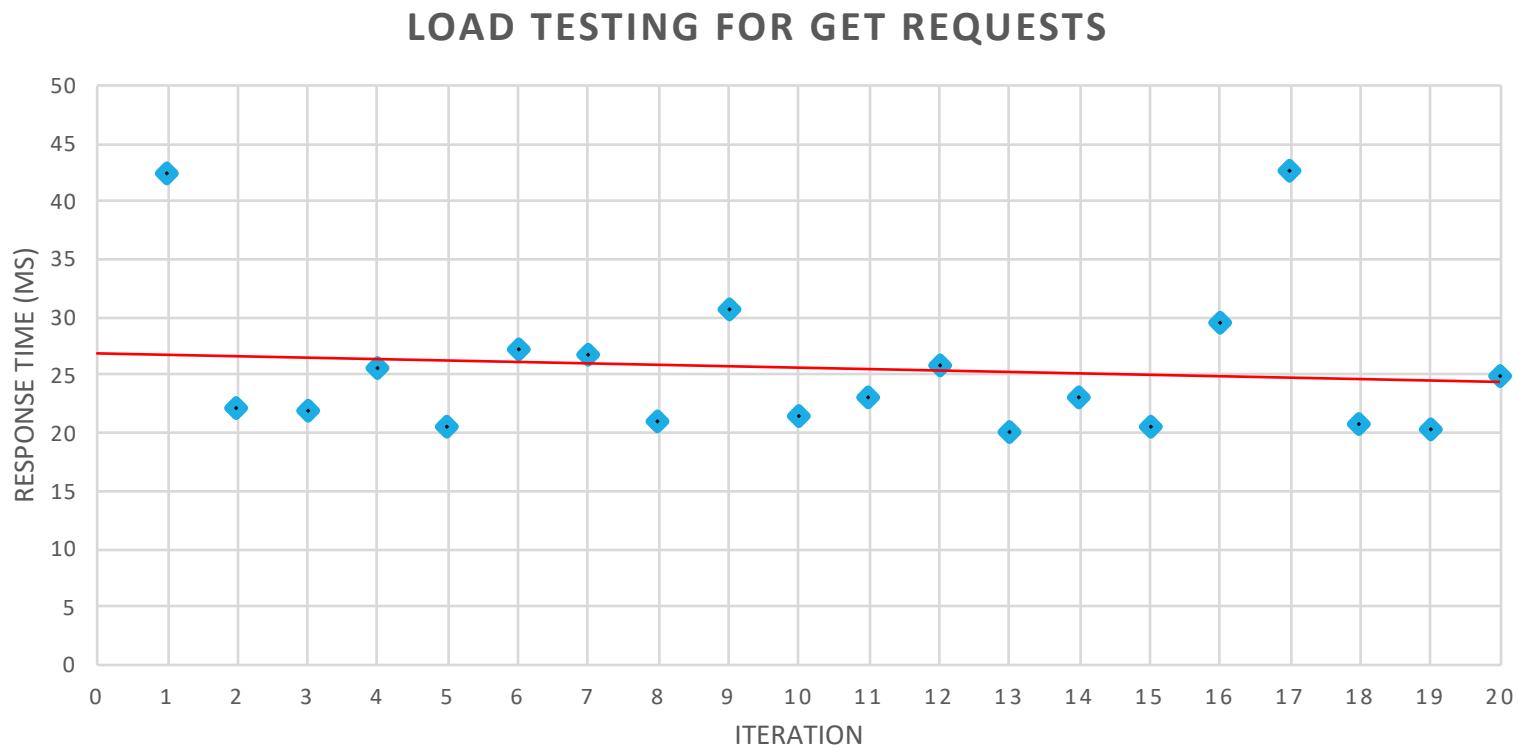
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- Schema – defines how each sensor is modelled and stored within the database.
- Essential component of the whole system.

```
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 });
```

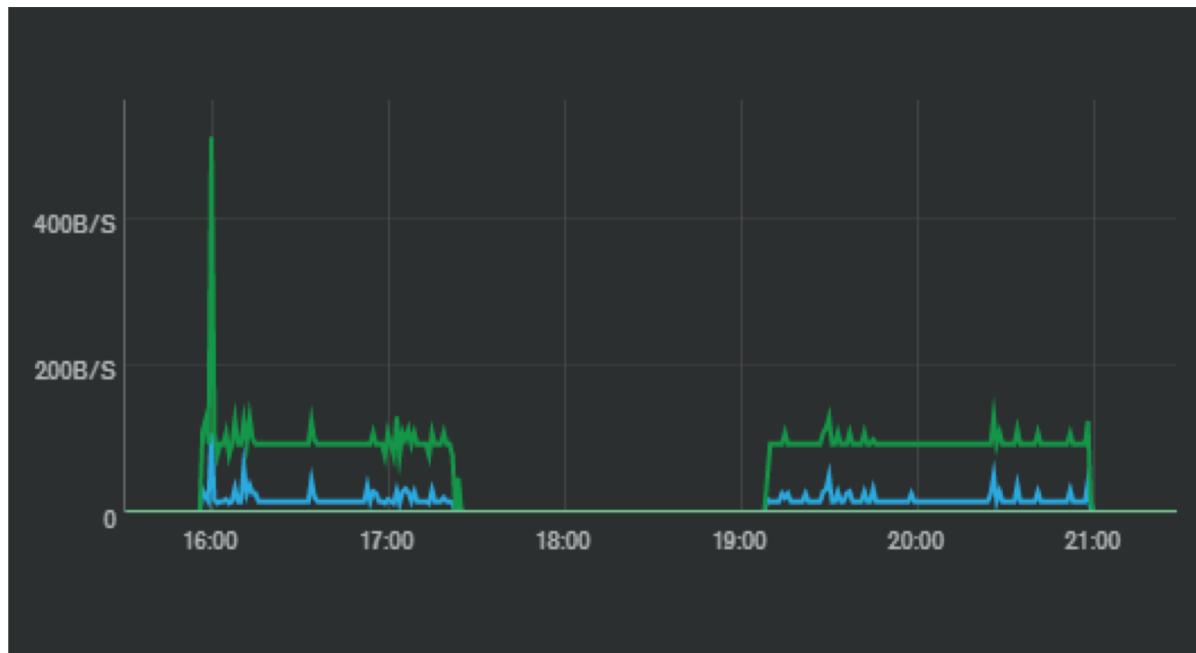
# Findings: Load Testing

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# Findings: Network Usage

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

# Findings: Data Retrieval

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```
_id: ObjectId("5cbf8b41c04ad54be4722eba")
name: "Microwave"
voltage: 5.76
amps: 22
costperHour: 0.034
costperDay: 0.82
costperMonth: 24.48
__v: 0
```

```
_id: ObjectId("5cbfec3f77f3bc4b2869382d")
name: "Kettle"
voltage: 10.2
watt: 2000
costperHour: 0.052
costperDay: 1.25
costperMonth: 37.44
__v: 0
```

```
_id: ObjectId("5cbfed0777f3bc4b2869382e")
name: "TV"
voltage: 110
watt: 150
costperHour: 0.042
costperDay: 1.08
costperMonth: 30.24
__v: 0
```

# Conclusion

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- 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

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- 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.
- Implementation limited to house appliances, cannot be used for other processes that consume electricity (e.g Lights, portable devices).

# Implications & Recommendations

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- 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.



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