Fault Location by Smart Meter

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Overview

* Background
* Problem Definition
* Design Requirements
* Current State of Art
* Solution Generation and Top Design Selection
* Solution Implementation
* Project Evaluation
* Project Management & Budget
* Acknowledgment

Background

* **Current techniques are extremely slow and expensive**

* **Utilities rely on customer calls to report faults**

* **Customers are left with no power for several hours**

Problem Definition

Create an algorithm to utilize "S.O.S" from smart meters to minimize the area utilities search for fault

Design Requirements

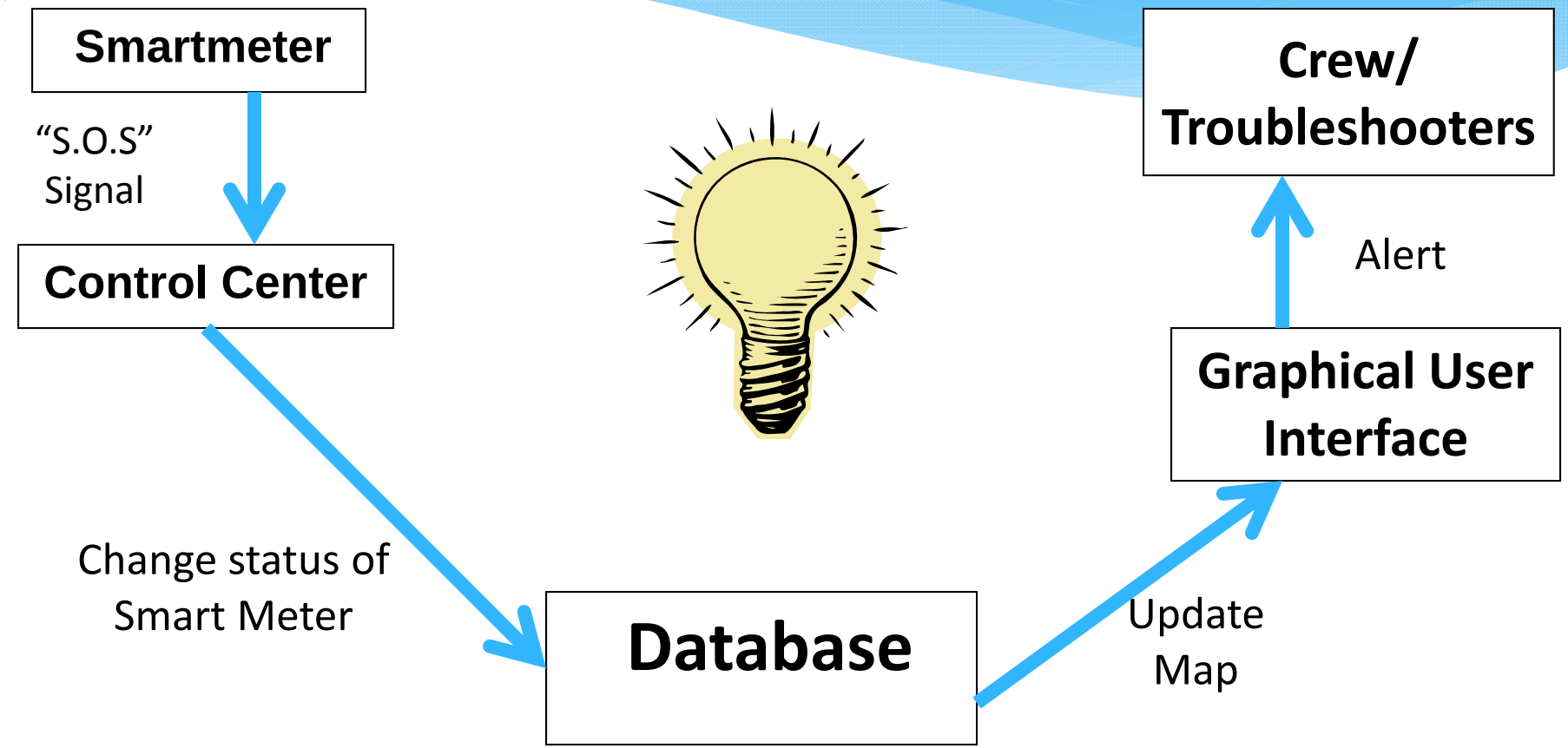
* Requirements:
  * Locate area of fault within 4 minutes of occurrence
  * Minimize area radius to 2 city blocks

* Standards:
  * ANSI C12.22 (Industry)
    * Standard protocol for 2-way communication with an electricity meter over a network
  * IEEE 802.15.4 (Project)
    * Standard which specifies the physical layer and media access control for low-rate wireless personal area networks

Current State of Art

* Trouble Calls
  * Customer calls about power outages
* Impedance Algorithms
  * Location of fault through distance from substation
  * Crews have to go out and search the entire line

Solution Generation



Solution 1 and 2

Solution 1

* Smartmeter sends information to control center
* Within the control center the database is updated
* Then sends information to graphical interface that would be located in crewmen laptop

Solution 2

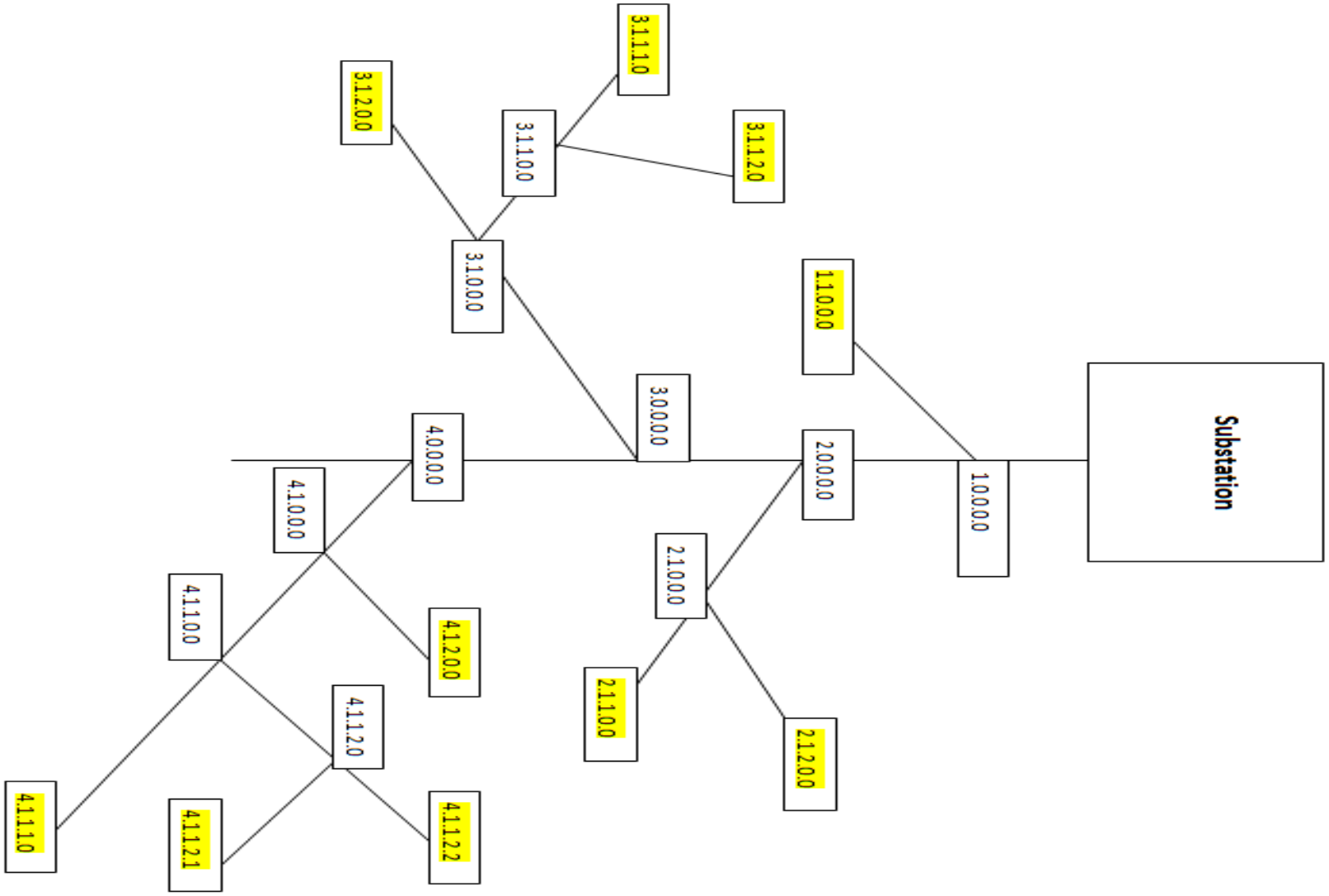
* Smartmeter sends information to control center
* Within control center the database is updated
* Dispatcher calls crewmen with coordinates of location
* Crewman travels to location

Top Design Selection

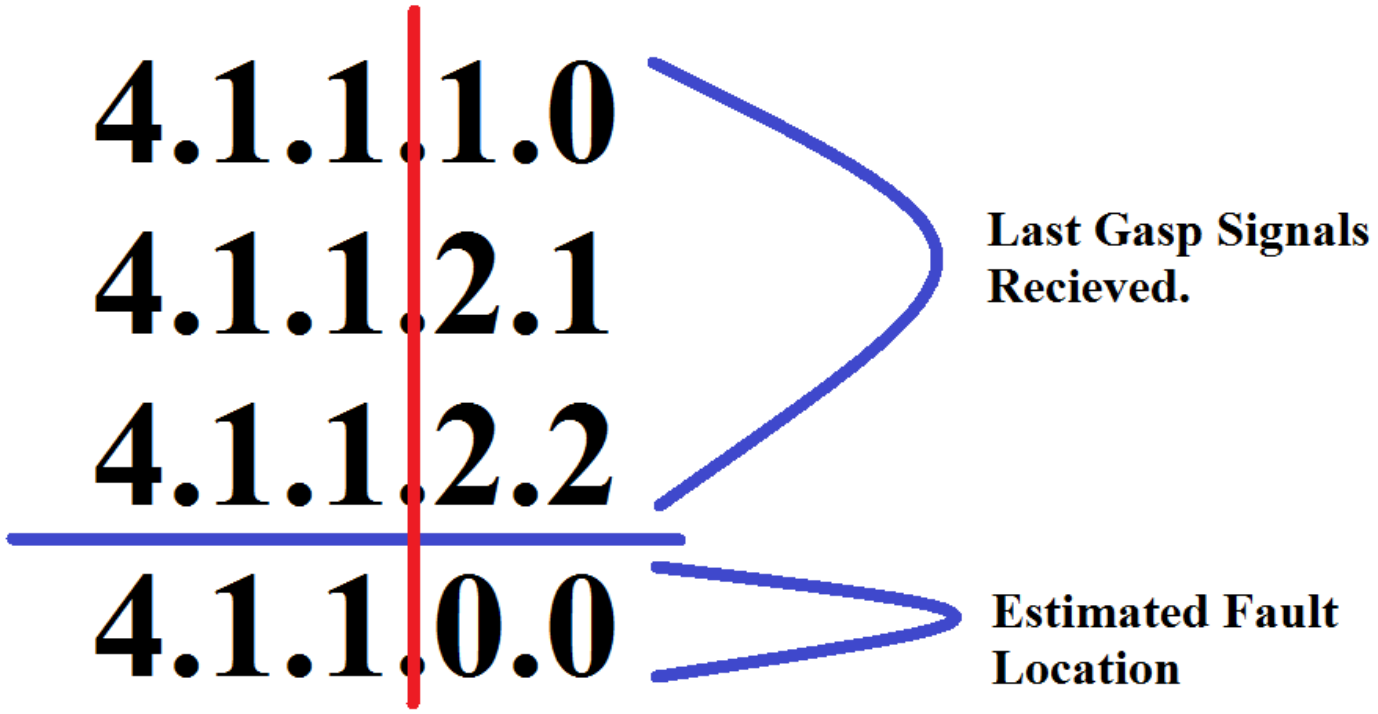
		Solution			
		Solution 1		Solution 2	
Time	Weight	Rating	Weighted Score	Rating	Weighted Score
Time	4	3	2.2	1	1.6
Reliability	3	3	0.9	2	0.5
Total Score			3.1		2.1
Rank			1		2

Solution Implementation

Solution Implementation (Algorithm)



Solution Implementation (Algorithm)



Arduino Board vs. Atom Board

Arduino Board

* 2 way wireless capabilities using zigbee protocol
* Runs in Windows environment
* Operates with GUI

Atom Board

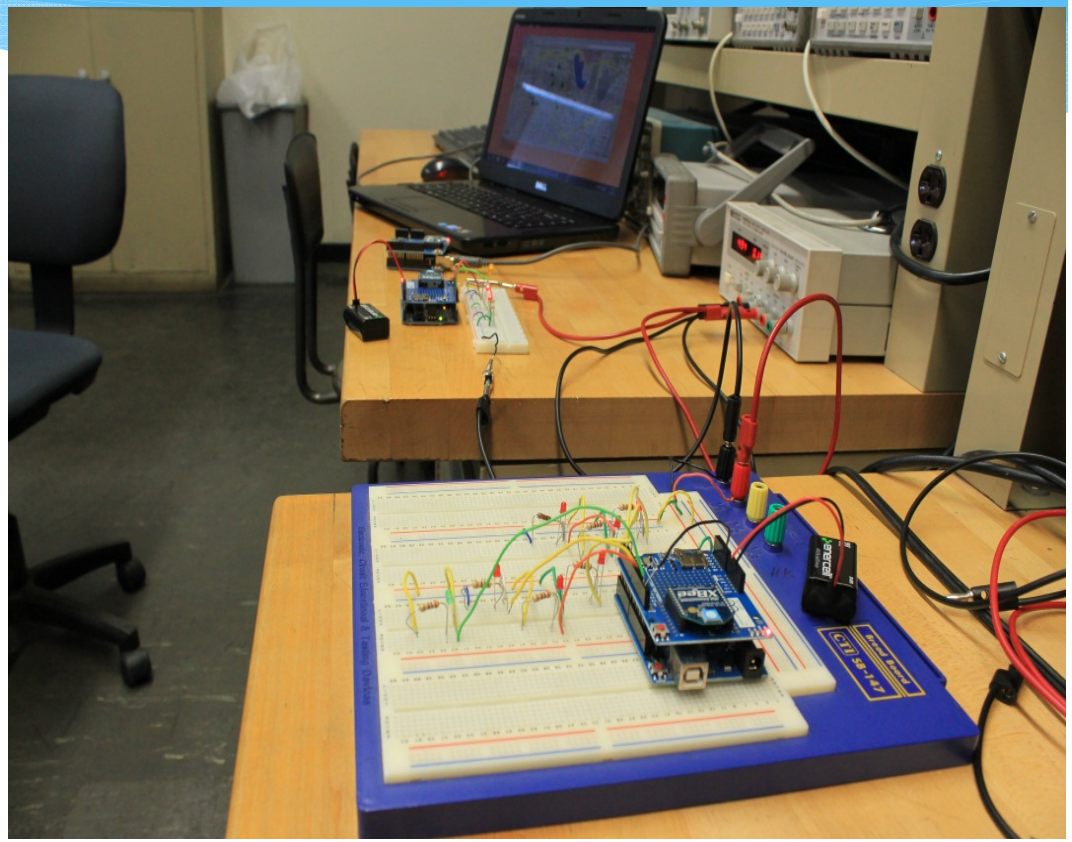
* Microprocessor
* Runs in Linux environment.
* Operates with either GUI or command line interface

Hardware Selection

		Solution			
		Arduino UNO R3		ATOM Board	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score
Ease of Implementation	4	3	1.2	2	0.8
Time	3	3	0.9	2	0.6
Cost	3	3	0.9	3	0.3
Total Score			3		1.7
Rank			1		2

Solution Implementation (Hardware)

* Laptop
* 3 Arduino Boards
* 3 Wireless Sheilds
* 3 Zigbee Chips
* USB Connection



Google Maps VS Bing Maps

Google Maps

* Map Layer that can be easily created with fusion tables
* Well known by the general public.
* Able to use SQL and Java to produce output
* Easy to Implement

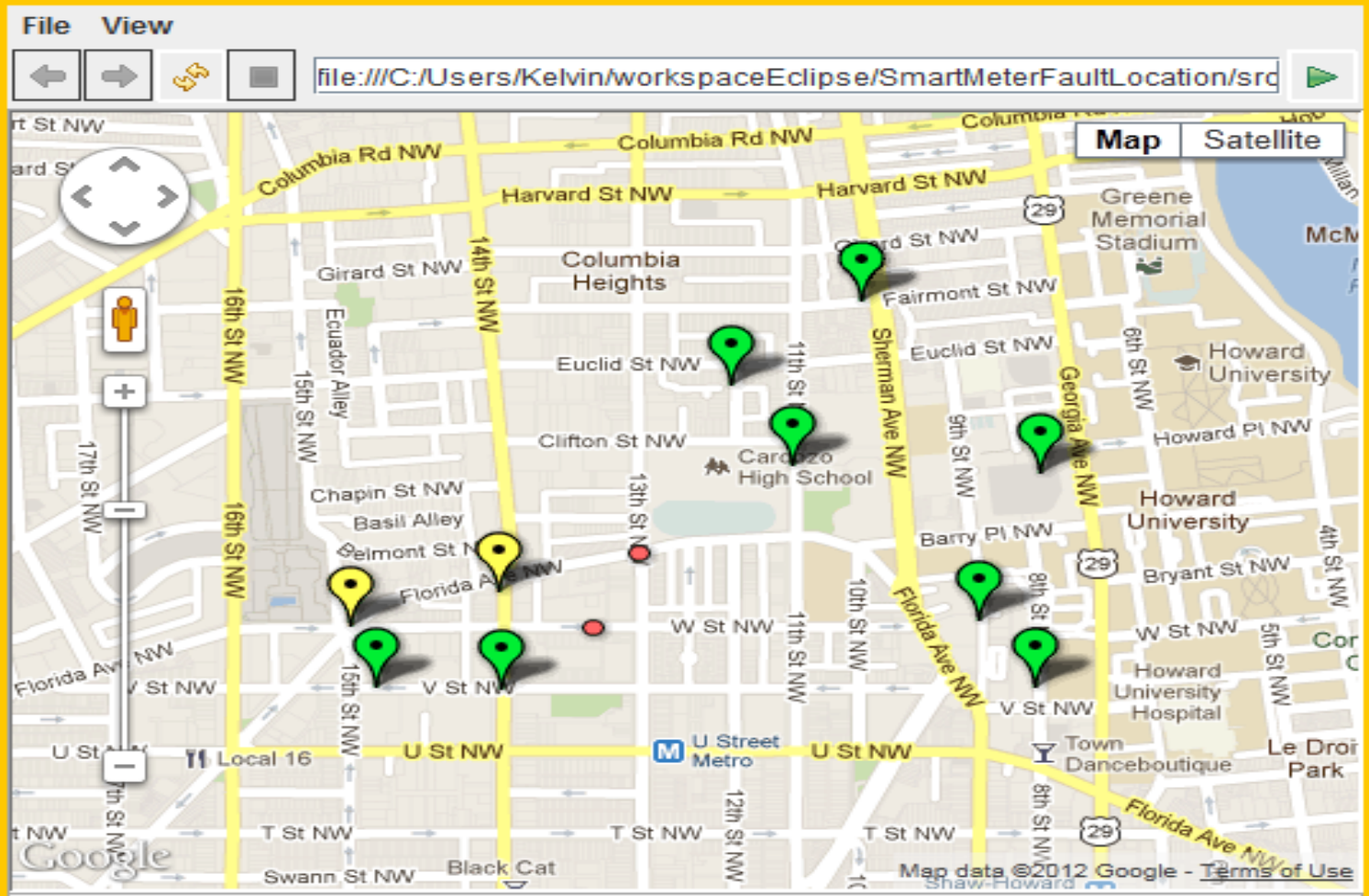
Bing Maps

* Able to use C++, C# and XML
* Uses Bird's Eye View for map
* Uses AJAX System Development Kit

Software Selection

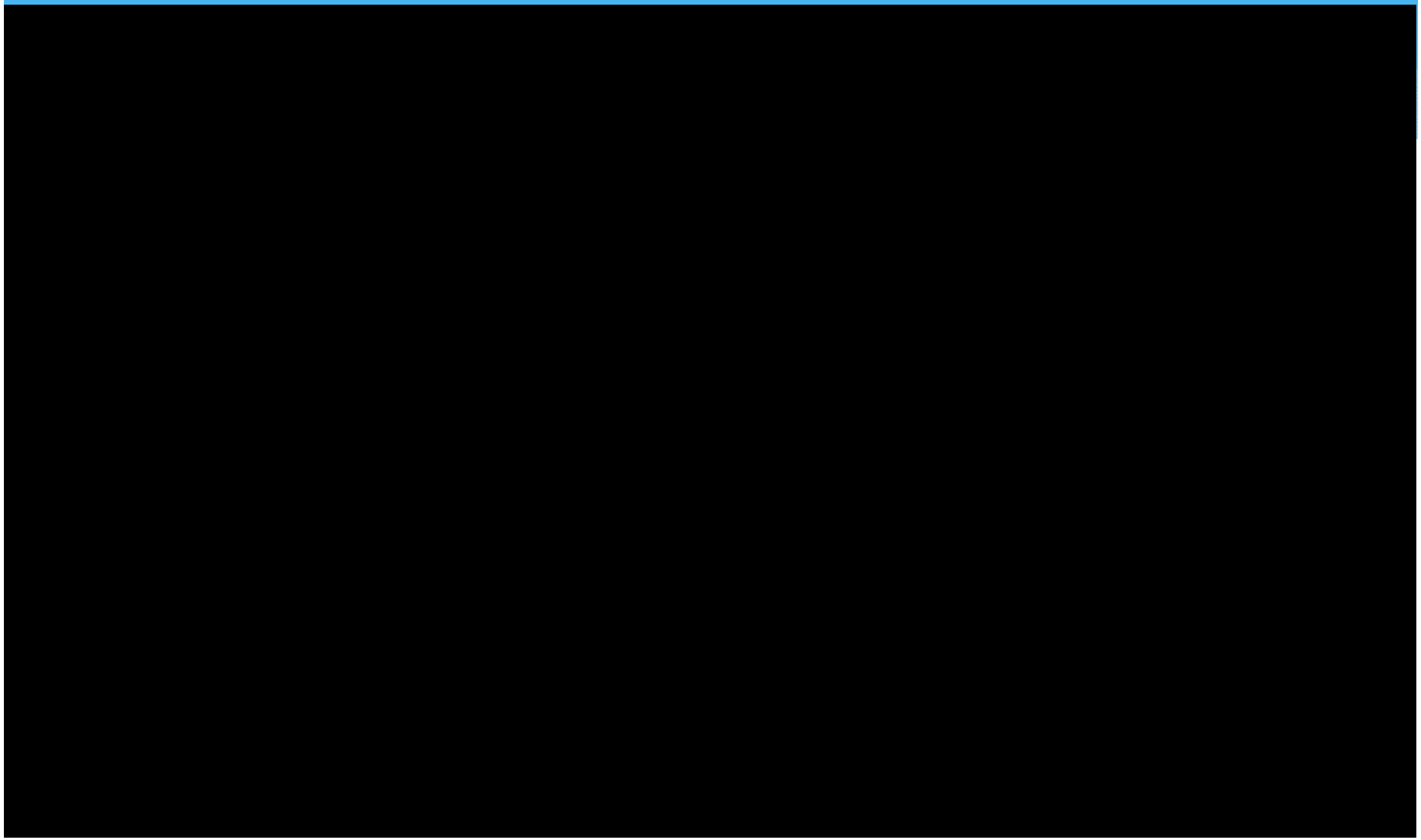
		Solution			
		Google Maps API		Bing Maps API	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score
Ease of Implementation	4	3	1.2	2	0.8
Time	3	3	0.9	1	0.3
Knowledge	3	3	0.9	2	0.6
Total Score			3		1.7
Rank			1		2

Solution Implementation (Software)



Number of Gasps: 2
Up Stream Address: 4.0.0.0.0
Down Stream Address: 4.1.0.0.0

Demonstration



Project Management

Andrew	• Responsible for networking Arduino boards • Responsible for sending information to PC
Kevin	• Responsible for receiving information from smart meters and updating Google Fusion Table database
Kelvin	• Responsible for taking information from Google Fusion Table database and creating user interface with Google Maps API

Project Budget

Senior Design Budget			
Item	**Cost ($)**	**Quantity**	**Total ($)**
Zigbee Chip	22.95	3	68.85
Arduino Uno R3 (Radio Shack)	34.99	1	34.99
Arduino Uno R3 (Online)	29.95	2	59.9
Wireless Shield (Digi Key)	35.15	1	35.15
Wireless Shield (Jaycon Systems)	28.95	2	57.9
Battery Clips (5 per pack)	2.99	1	2.99
9 V Batteries (4 per pack)	11.99	1	11.99
Total			**271.77**

Conclusion

* The time it takes for the faults to be located will drastically decrease . No longer will crews have to wait for a homeowner to call and say the power is out and go out, searching the entire line. Even though the algorithm needs to be changed for more complex maps we believe that this would be very successful in the future.

Acknowledgments

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