

Remote Reporting of Freezer Temperature Status

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ECET 491 Senior Design Project II

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Topics of Discussion

- Introduction to the project
- Development platform selection and testing
- System development and testing
- Conclusion

Introduction

- **EXECUTIVE SUMMARY**
- **Primary factors in choosing this project**
- **Original Scope**
- **Initial system architecture concept**

EXECUTIVE SUMMARY

This goal of this project is to greatly increase the probability of salvaging the entire frozen food contents of a malfunctioning deep-freezer by providing prompt notification to the owner via local alarm, cell phone text, and email.

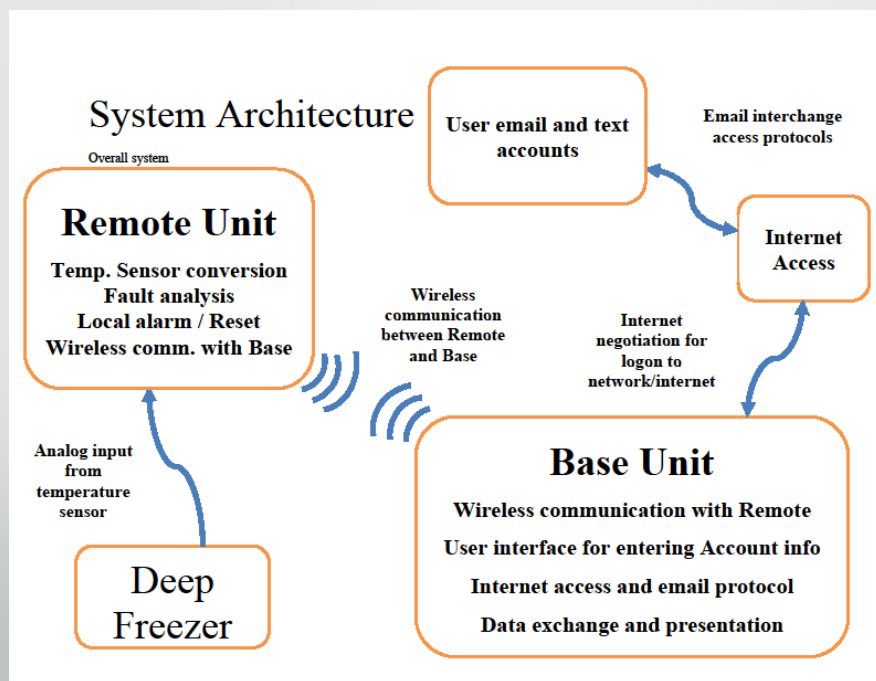


Primary factors in choosing this project

- Developing a better understanding of wireless communications and protocols.
- Learning internet and email protocols for communicating data.
- Exploration of home automation.

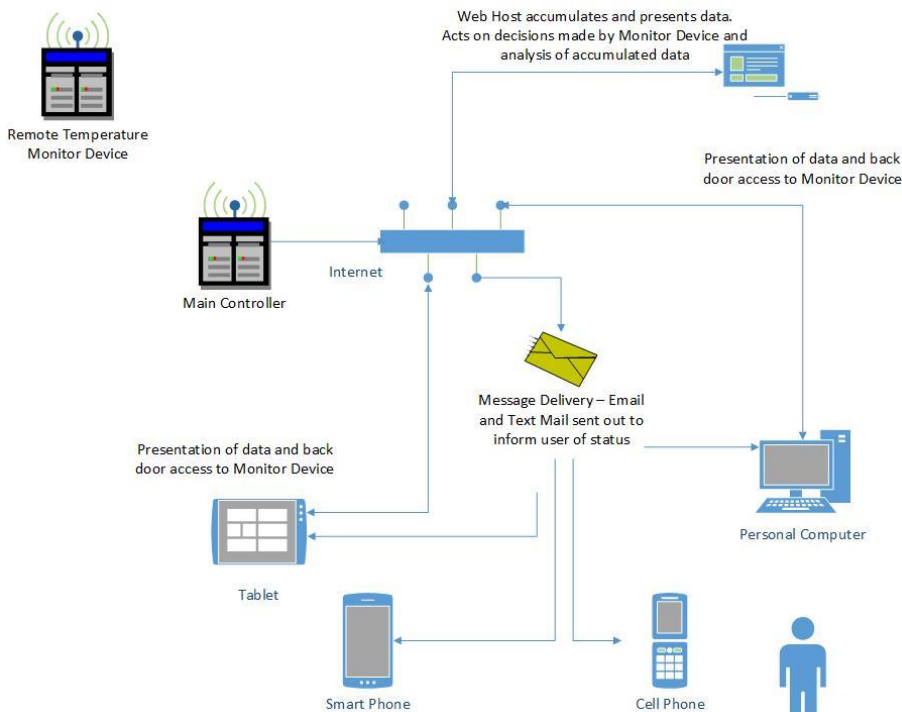
Original Scope

- Dedicated Remote sensing unit programmed to analyze temperature sensor input and wirelessly transmit information to Base unit.
- Base unit programmed to handle internet/email access and user interface.
- Prototype circuit board to be used for the Remote unit once the code has been developed.




Development platform selection and testing


- Intermediate System Architecture
- Selection of Development system
- Elimination of Wireless capability
- Selection of Exosite Portals web service
- Final System Architecture



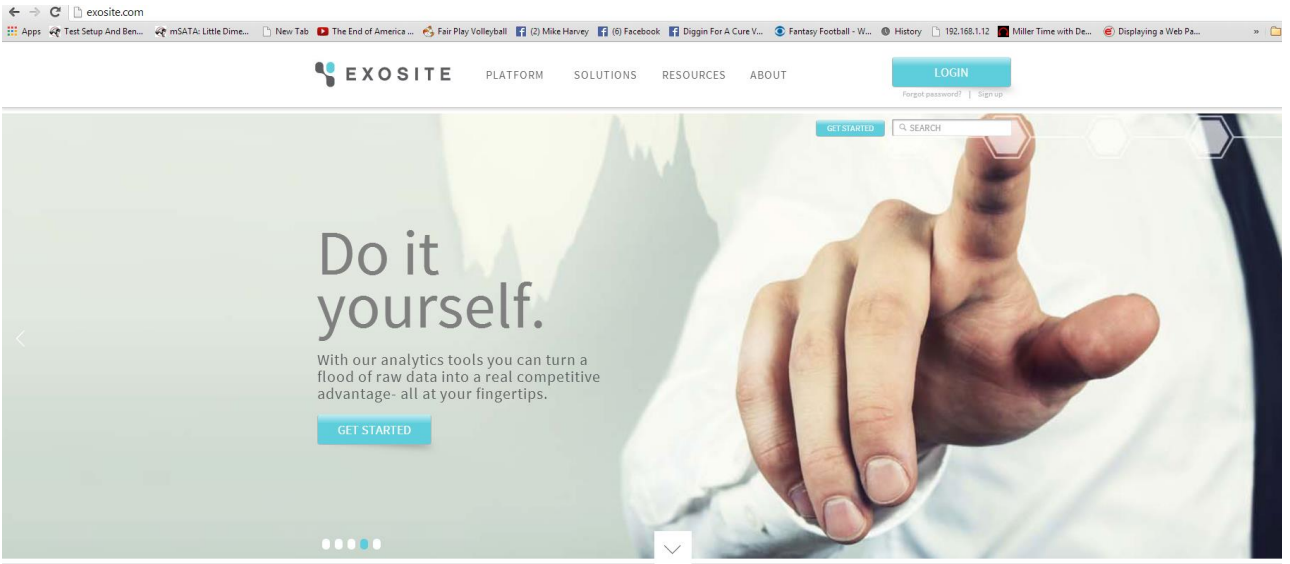
Intermediate Graphical System Architecture



Commercial development tools from Microchip and Freescale were considered but the Arduino family of products was selected due to the low initial investment and wide availability of support files and hardware.

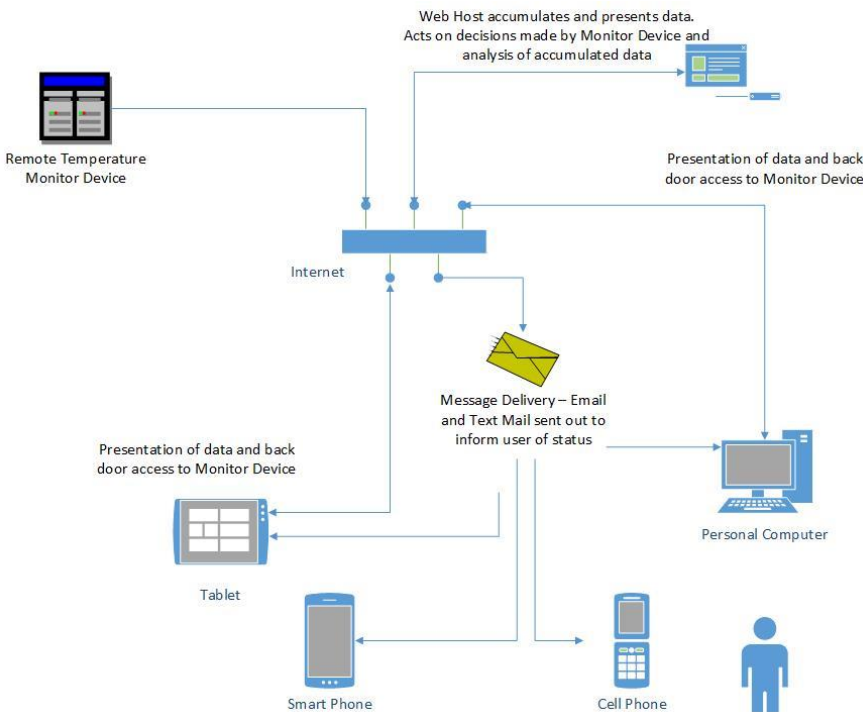


Experimentation with Arduino Ethernet Shield demonstrated ease of internet communication from the basic UNO microcontroller board. Focus changed to finding a system that would support an Ethernet-capable, single device approach.



See for yourself.

Organizations of every size, in every industry, have data that can deliver insights. Here are just a few examples.



Current Graphical System Architecture

System development and testing

- Initial investigations of Arduino platform
- Initial investigations of Exosite platform
- Combined Arduino Exosite experimentation
- System functionality testing

Arduino Exploration

- Learning user interface/programming environment
- Experimenting with digital I/O
- Analog Input
- PWM output
- Data storage/presentation via SD card / Ethernet Shield
- One-Wire “smart” device functionality - Maxim temperature sensor.

The screenshot shows a desktop environment with a web browser displaying a message from an Arduino SD card server. The browser address bar shows the URL `http://192.168.1.1/index.cgi?active%5Fpage_...`. The network configuration interface is for a router, showing the 'Port Forwarding' section. The interface includes a sidebar with navigation options like 'Main', 'Wireless Settings', 'My Network', 'Firewall Settings', 'Parental Control', 'Advanced', and 'System Monitoring'. The 'Port Forwarding' section contains a table of applied rules.

Networked Computer / Device	Applications & Ports Forwarded	WAN Connection Type	Status	Delete
localhost 127.0.0.1	Frontier Service TCP Any -> 4567	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.4-49960	Teredo UDP Any -> 49960	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.4-65534	Teredo UDP Any -> 65534	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.4-64628	Teredo UDP Any -> 64628	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.2-23216	Skype UDP at 192.168.1.2:23216 (2200) UDP Any -> 23216	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.2-23216	Skype TCP at 192.168.1.2:23216 (2200) TCP Any -> 23216	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.4-9485	Skype UDP at 192.168.1.4:9485 (2202) UDP Any -> 9485	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.4-9485	Skype TCP at 192.168.1.4:9485 (2202) TCP Any -> 9485	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.4-59503	Skype UDP at 192.168.1.4:59503 (2202) UDP Any -> 59503	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.4-59503	Skype TCP at 192.168.1.4:59503 (2202) TCP Any -> 59503	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.2-23957	Skype UDP at 192.168.1.2:23957 (2436) UDP Any -> 23957	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.2-23957	Skype TCP at 192.168.1.2:23957 (2436) TCP Any -> 23957	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.12	HTTP TCP Any -> 80	All Broadband Devices	Active	<input type="checkbox"/>
192.168.1.6-3658	192.168.1.6-3658 to 3658 (UDP) UDP Any -> 3658	All Broadband Devices	Active	<input type="checkbox"/>

Exosite Portals experimentation

- Importing data from public data sources
- Analysis of incoming data by using events and alarms
- Designing “Dashboard” user interface utilizing a selection of configurable “widgets” for data presentation.
- Sending output through email when alarm is triggered or for continued normal operation.

Event/alarm generating email every time the temperature hit 70 degrees in Minnesota

The screenshot shows a Yahoo! Mail inbox with an email from Exosite. The email subject is "Minn. temp has reached 70deg" and the body text says "Very nice and comfortable here in Minnesota at 70 degrees." Below the email is the Exosite Portals dashboard. The dashboard has a sidebar with "MANAGE" options: Home, Data, Devices, Events, Dashboards, Scripts, and Admin. The main content area has two sections: "Events" and "Alerts".

Name	Alias	Active	Last Reported Time	Occurrences (7 days)	Condition Description
Device: Exosite Device					
Data: Minneapolis, MN Temperature					
max temp		True	14:12:51 Oct 8, 13 America/New_York	2	simple: gt (70)

Name	Type	Last Queued	To	Interval
Events: max temp				
Max temp (70deg)	email	14:12:51 Oct 8, 13 America/New_York	ssce_bienz@yahoo.com	0

Combined Arduino Exosite experimentation

- Initial struggles with installing personal Arduino stemmed from not realizing that the two Dashboards each have a separate “key” code.
- Three different devices can be selected for a dashboard, but up to 100 sets of data can be streamed to account from the three devices.
- Multiple events and alarms can be configured from one or multiple data streams.
- By varying data rate accumulation in the Arduino and Exosite, data can be formatted for system analysis or normal operation.
- Communication is robust, if internet connection is maintained.

The screenshot displays the Exosite Portal interface for an Arduino-based temperature monitoring system. On the left, a code editor shows the Arduino sketch with comments and code for sensor initialization and data logging. The main dashboard area features several widgets:

- temperature**: A bar chart showing temperature values over time, with a legend indicating the last value over a specified time range.
- temp tracking**: A line graph showing temperature fluctuations over time.
- temperature points**: A table displaying a list of temperature readings with their corresponding timestamps and units.
- graph**: A larger line graph showing temperature data over a longer period, with a legend for the 'temperature' series.

The 'temperature points' table data is as follows:

Timestamp	Value	Unit
21:53:26 Oct 10, 2013	73	
21:53:08 Oct 10, 2013	74	
21:52:50 Oct 10, 2013	74	
21:52:33 Oct 10, 2013	74	
21:52:16 Oct 10, 2013	74	
21:51:57 Oct 10, 2013	76	
21:51:39 Oct 10, 2013	79	
21:51:22 Oct 10, 2013	75	
21:51:04 Oct 10, 2013	78	
21:50:46 Oct 10, 2013	79	
21:50:29 Oct 10, 2013	73	
21:48:39 Oct 10, 2013	73	
21:48:36 Oct 10, 2013	74	
21:48:19 Oct 10, 2013	80	

System functionality testing

- Initial Freezer temperature investigation with T/C meter
- Thermal mass addition for adding stability to measurement.
- Insertion of Thermal sensor into freezer
- Connecting Thermal sensor to same thermal mass as T/C
- Cyclic monitoring of freezer T/C temperatures vs Arduino/Exosite
- Incremental addition of events and alarms for profiling freezer.
- Addition of local LED indication of system operational parameters

Setup for the Freezer Temp over 15F for 10 minutes Event

Event Information

Event Update

Name: Freezer Temp exceeds 15
 Alias: Freezer Temp Over 15f 10
 Data Source: Deep Freezer temperature
 Condition Type: Duration
 Comparison: Greater Than (>)
 Constant: 15
 Duration: 600 (seconds)

Event Timeline

IF ((Comparison IS TRUE) FOR Duration)
 THEN (enter event)
 UNTIL (Comparison IS NOT TRUE)

Event Log (last 50 records)

Date/Time	Duration
08:59:51 Nov 26, 13 America/New_York	38 min 28 sec

Large temperature swing can be seen here, with times corresponding to 8:51 and 8:59, as indicated in the screen Log above and emails below.

temperature

Value in legend shows the average value of data over specified time

temp tracking

Deep Freezer temper...

temperature points

The data shown has been truncated.

Timestamp	Value	Unit
09:02:31 Nov 26, 2013	60	Degrees F
09:09:32 Nov 26, 2013	59	Degrees F
08:58:34 Nov 26, 2013	58	Degrees F
08:57:36 Nov 26, 2013	57	Degrees F
08:56:38 Nov 26, 2013	55	Degrees F
08:55:40 Nov 26, 2013	54	Degrees F
08:54:42 Nov 26, 2013	52	Degrees F
08:53:43 Nov 26, 2013	49	Degrees F
08:52:45 Nov 26, 2013	46	Degrees F
08:51:47 Nov 26, 2013	41	Degrees F
08:50:49 Nov 26, 2013	35	Degrees F
08:49:51 Nov 26, 2013	24	Degrees F
08:48:53 Nov 26, 2013	-5	Degrees F
08:47:42 Nov 26, 2013	-6	Degrees F

Current temperature

Deep Freezer temperature
 60 Degrees F
 Last Reported Time: 09:00:31 Nov 26, 2013

graph

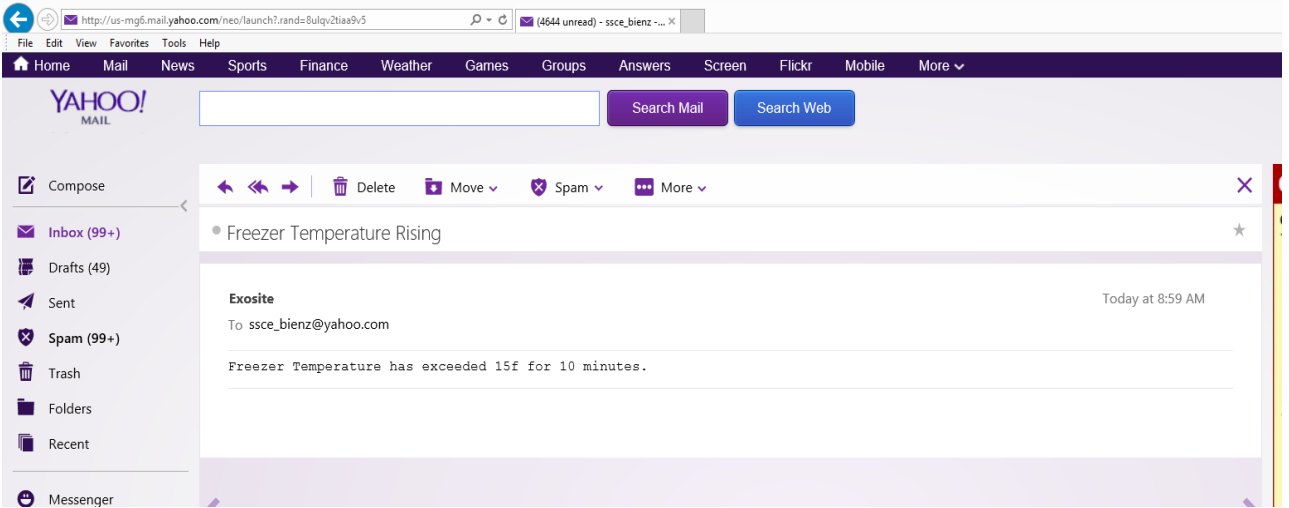
Deep Freezer temperature
 60 Degrees F

temperature data

Device	Value
stevens_arduino	60

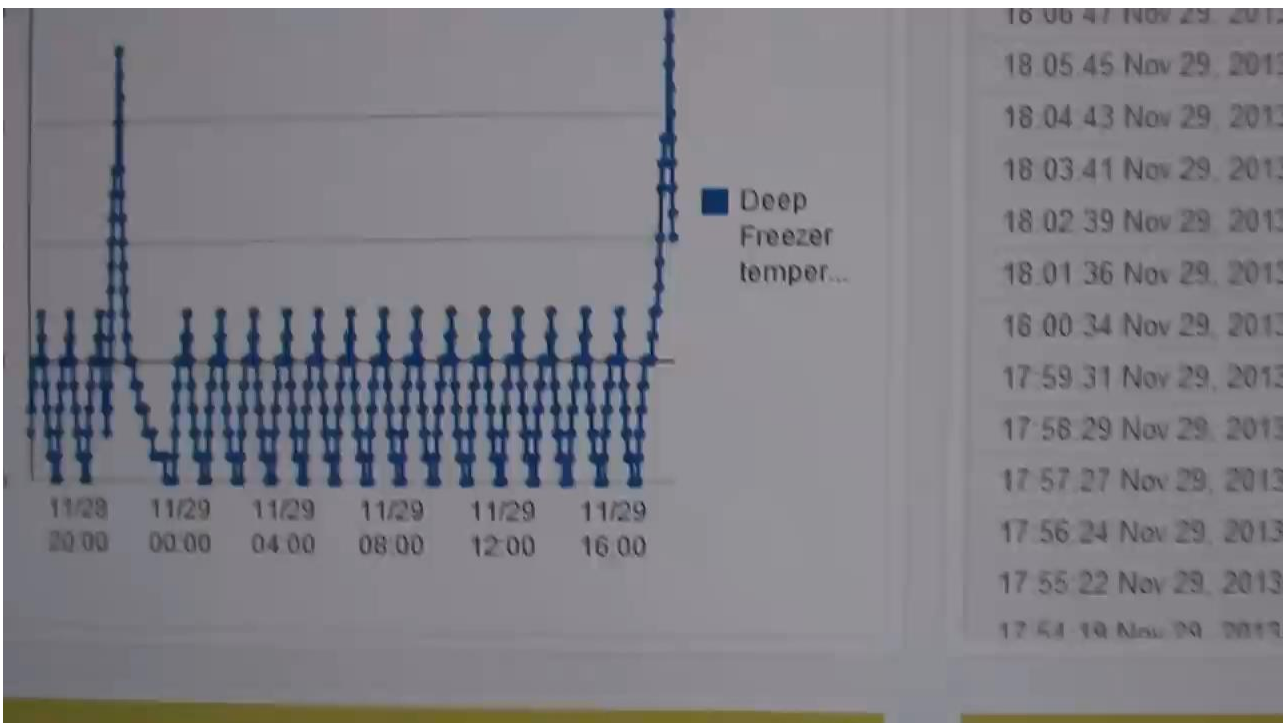
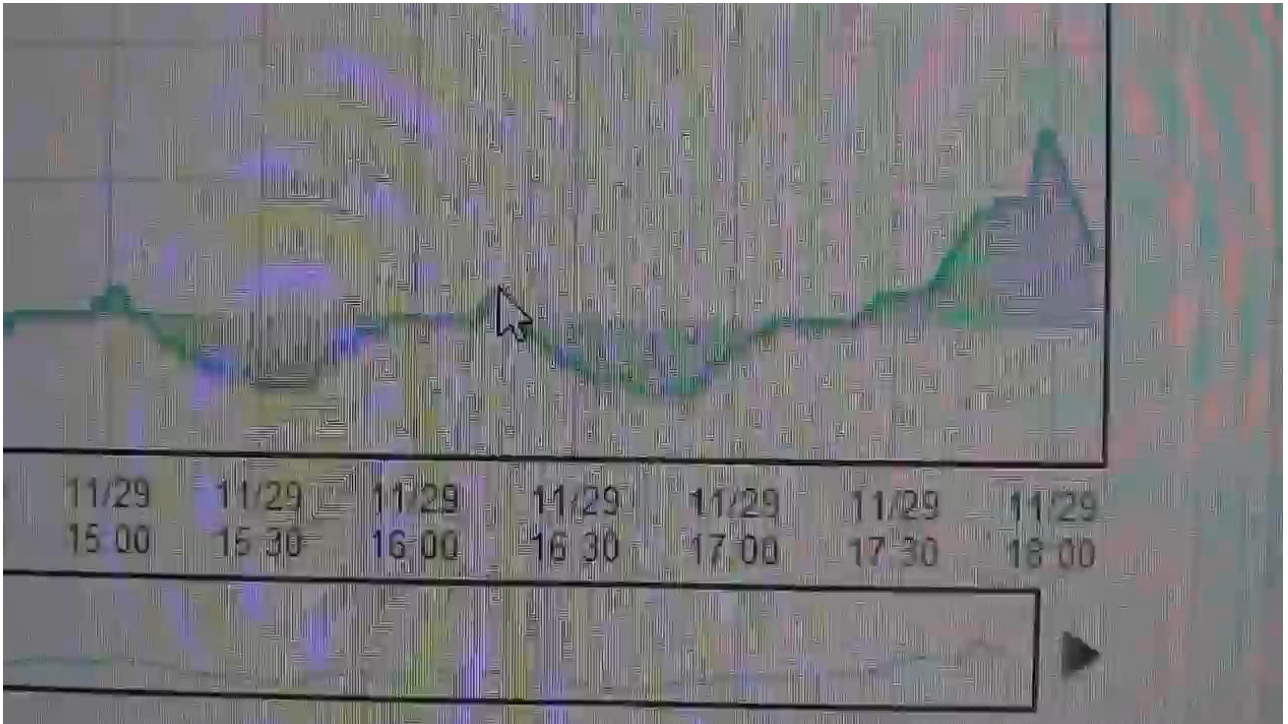
URL to observe dashboard at Exosite(made public).

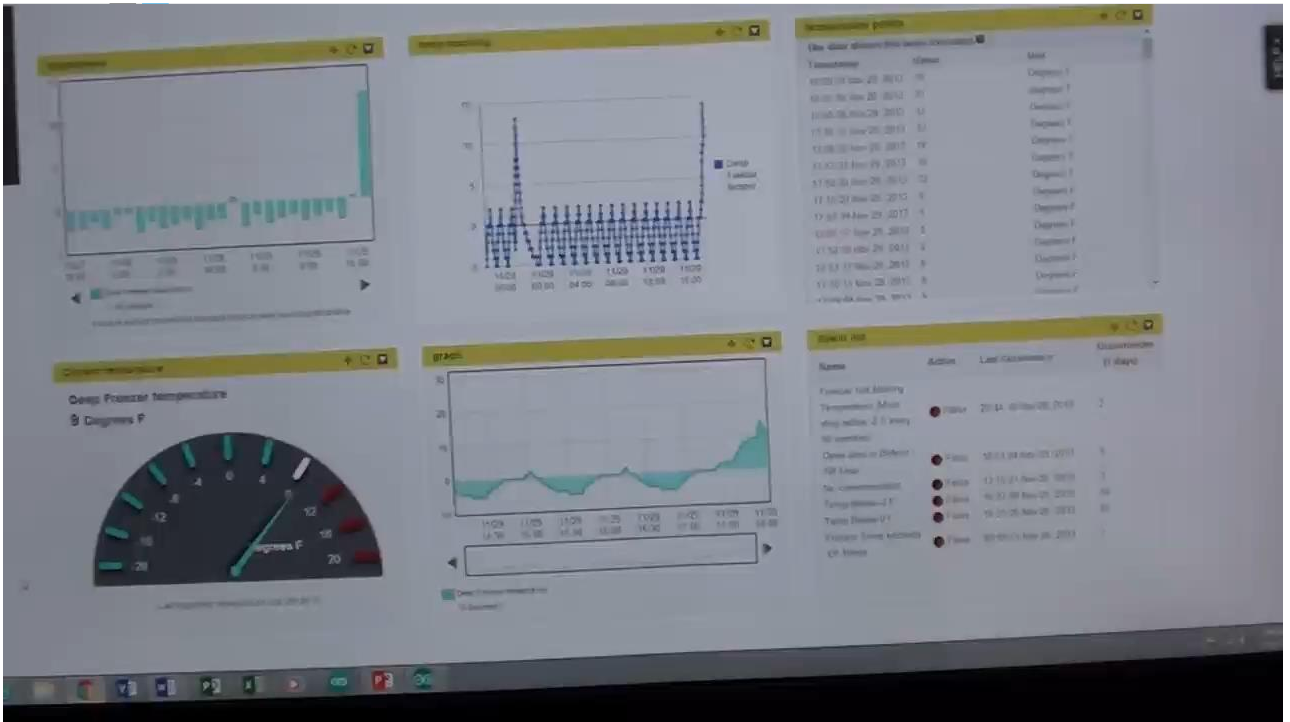
<https://portals.exosite.com/views/1151182056/2435822232>



The screenshot shows a web browser window displaying the Yahoo! Mail interface. The address bar shows the URL <http://us-mg6.mail.yahoo.com/neo/launch?.and=8ulqv2tiaa9v5>. The page title is "(4644 unread) - ssce_bienz ...". The navigation bar includes links for Home, Mail, News, Sports, Finance, Weather, Games, Groups, Answers, Screen, Flickr, Mobile, and More. The main content area shows the Yahoo! Mail logo and search buttons. The left sidebar lists folders: Compose, Inbox (99+), Drafts (49), Sent, Spam (99+), Trash, Folders, Recent, and Messenger. The main email view shows a message from "Exosite" to "ssce_bienz@yahoo.com" received "Today at 8:59 AM". The email body contains the text: "Freezer Temperature has exceeded 15f for 10 minutes."







Risks

Primary Technical Risk:

Software and system integration.

Primary Schedule Risk:

Implementing each of the software interfaces, major components of the project.

Primary Cost Risk:

If the developmental H/W and S/W can be obtained gratis, the primary cost risk will be production of the Remote prototype device.

Sample requirements

Utilization Environment Requirements

D-1	System shall be capable of operating in the presence of other residential/commercial wireless systems. (phone/mouse/Wi-Fi)	Test
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Performance Requirements

B-3	Alarm will be set when the maximum temperature safety barrier is breached.*	Test
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Operational Requirements

A-4	Base unit shall be capable of accessing internet for email and data interchange.	Demo
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Experience Gained

- Setup of router for external communication to a particular device on local network through port forwarding
- Identifying project priorities when initial timelines are compromised
- Introduction to configuring network and internet communications
- Identifying required milestones and allocation of resources
- Setting specific goals to facilitate achieving milestones.
- Providing dedicated time for each task, prioritizing essential tasks.
- Initial introduction to personal home automation.

Questions?

Demo

- <https://portals.exosite.com/views/1151182056/2435822232>

ssce_bienz@yahoo.com

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