MOBILE COMFORT CONTROL

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Course Instructor:
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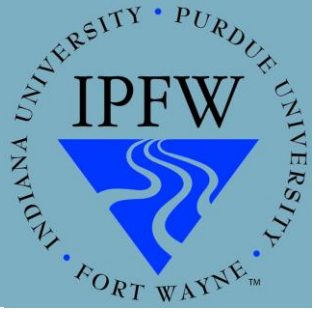

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Chapter 1

Introduction

- Problem Topic
- Background
- Criteria
- Methodology
- Primary Purpose
- Overview

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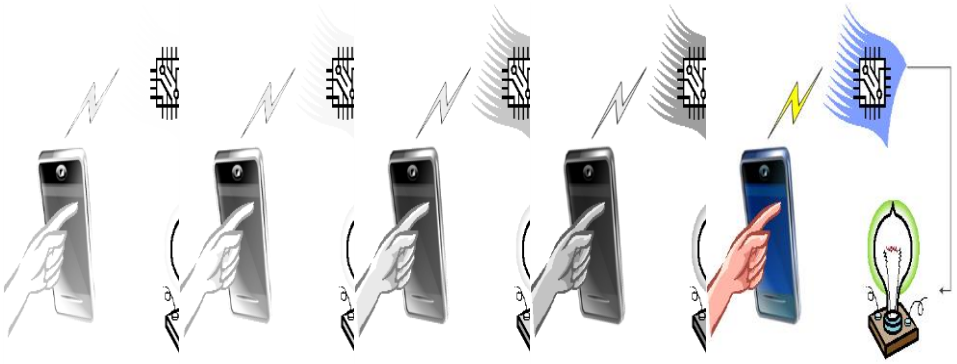

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Background

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Criteria

- Mobile phone must be able to connect to the hardware using Bluetooth
- Use the Android app to control the external hardware
- App must be usable with several OS versions and less than 15MG
- Bluetooth connectivity must be maintained for a distance of at least 3 feet
- The external hardware must be readily portable

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Methodology

SOFTWARE

- Eclipse Integrated Development Environment
- Android Software Development Kit
- Application Programming Interfaces (10, 15, 18, 19)
- Arduino IDE Version 1.0.5

HARDWARE

- Arduino Uno
- Bluetooth Shield
- Relay Shield
- Light Bulb, CPU Fan, Household Receptacle, Wires

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Primary Purpose

Benefit | Possibility | Reception | Standard | Benefit

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Overview

Software

- See what interior temperature is
- Adjust comfort level
- Program set temperature for automation

Hardware

- Modular design
- Compatible with most vehicular DC electrical systems
- Subsystem, getting power from the main power of the vehicle

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Chapter 2

System Design Overview and Research

Feasibility

Design Process

System Scope

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Feasibility

- Started simply
  - Just a LED light
- Added more as the semester progressed
- Became more of a challenge with the added equipment
- We created an app that connects with Bluetooth from > 30ft
- App reads the temperature, turns lamp On/Off
- Can be expanded further in the future

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Design Process

- Bluetooth On/Off light switch
- Understanding of Bluetooth and App creation
- Updated the design with more connected equipment – fan, lamp, receptacle, relays, LED
- All controlled by the Android App/Arduino Sketch with Bluetooth

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System Scope

- Android App
- Bluetooth connection to with Arduino microcontroller
- Devices connected to the Arduino microcontroller
- Arduino program to operate connected devices
- Will not include designing of the Bluetooth hardware
- Will not include designing/creating of the PCB to connect the hardware

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Chapter 3 Hardware Design

- Arduino Proto-typing Board
- Circuit Design
- Simulation Results
- Circuit Prototypes and Testing

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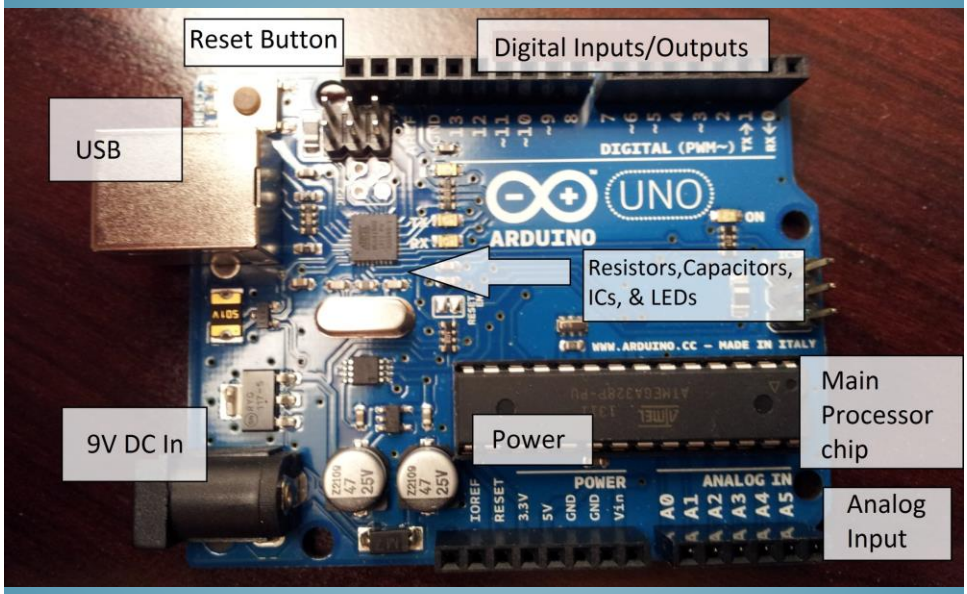
Arduino Uno's Major Components



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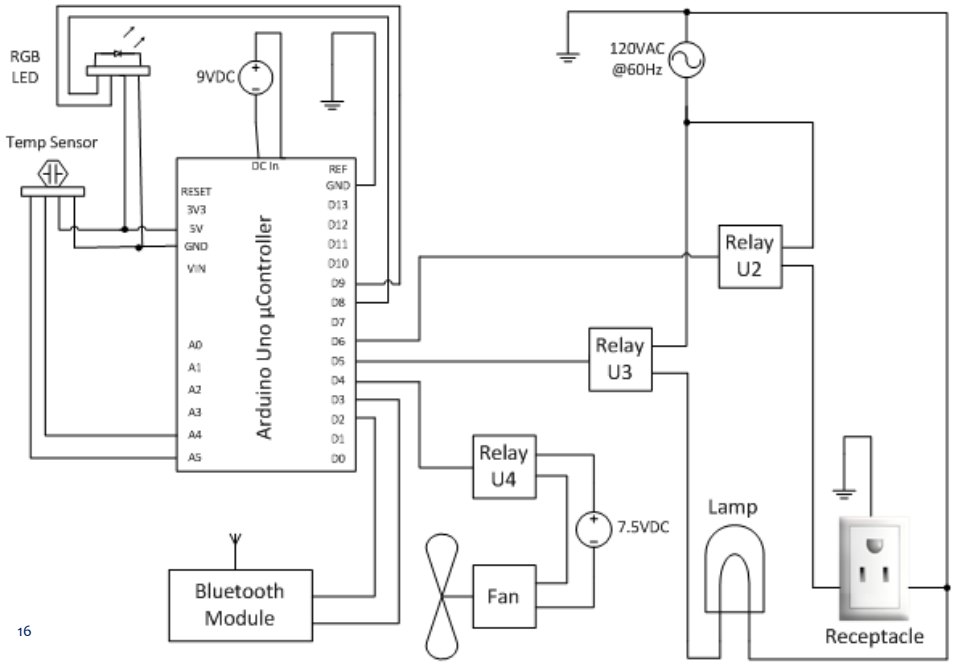
Hardware Schematic



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Components

- Arduino assembly
  - Arduino Uno
  - Bluetooth shield
  - Relay shield
    - Rated for 3A each
    - 40W bulb draws 0.33A
  - Power adapter (outputs 9V / 1A)
- 20 gauge wire
  - 2-conductor
  - strand
- 14 gauge extension cable
  - 2-conductor w/ ground
  - with 3-prong connector
  - strand
- 120V lamp base
- 40W bulb
- (2) 120V / 15A receptacles
- CPU fan
  - 12V / 150mA
  - Powered by power adapter
    - Outputs 7.5V / 100mA
    - Actual output is 7.8V / 84mA
- 15.5" x 11" ¾ inch plywood board
- 15.5" x 11" x 6" transparent, plastic container
- Various bolts, nuts, screws, hinges, and brackets

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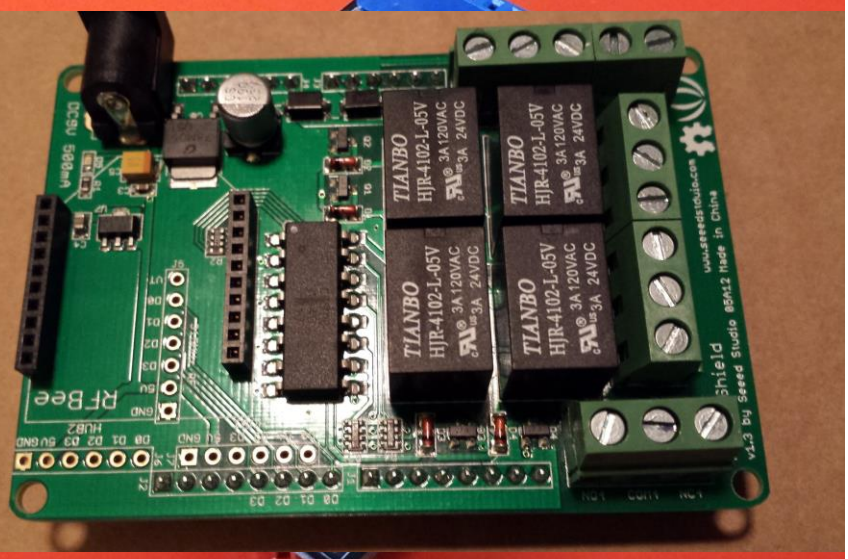
A R D U I N O S H I E L D S

Bluetooth Shield
Relay Shield



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Chapter 4

Software Design

- Software Architecture
- Integrated Development Environment
- UML Diagrams

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Software Architecture

Android Software

Main Activity

used to chose between the other 2 activities

Manual Activity

- Turn Bluetooth on if not already
- Negotiate a Bluetooth connection
- Display temperature
- Turn Fan, Lamp and Receptacle On/Off

Auto Activity

- Turn Bluetooth on if not already
- Negotiate a Bluetooth connection
- Display temperature
- User enters 2-digit degree
- Turn lamp off if fan comes on

Arduino Software

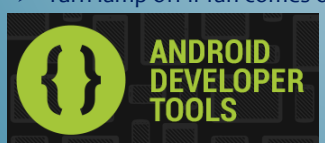
- Declare/define pins

Setup

- Serial communication starts
- Bluetooth shield initialized
- Pins assigned as input/output

Loop

- Read data from temp sensor
- Perform calculations on read data to convert it to degrees Fahrenheit
- Send temp over Bluetooth to phone
- Auto mode checks if temp is too high –turns fan on (lamp off)
- Manual mode user turns fan, lamp, and relays on/off



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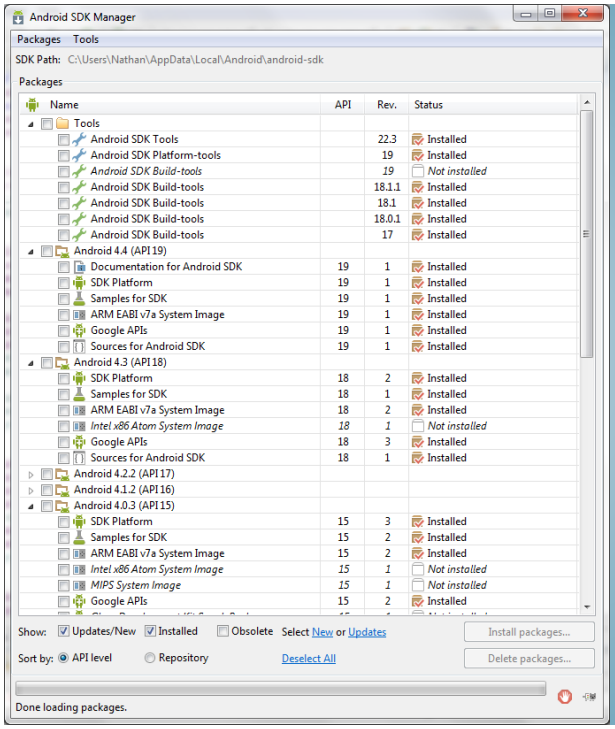

Android SDK Manager inside of Eclipse allowed us to develop for multiple versions of Android in one App

Integrated Development Environment

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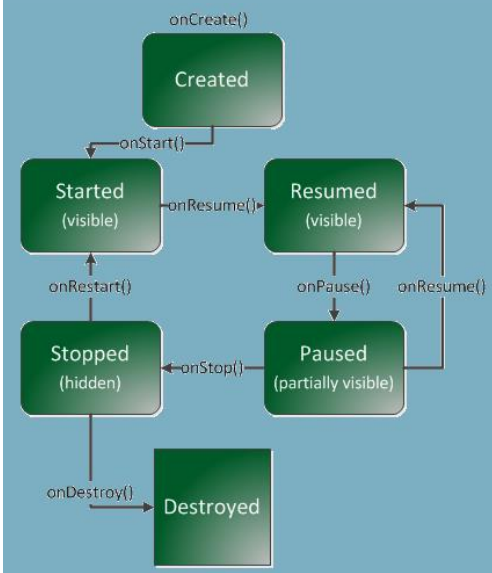
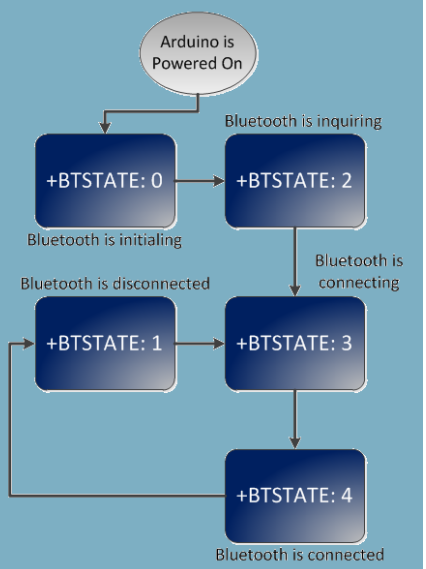
Android Activity Life Cycle



Bluetooth State Diagram



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Chapter 5

Unit Testing and System Integration

- Software Testing and Validation
- Hardware Testing and Validation
- System Integration, Testing and Validation

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Software Testing and Validation

The Android application compiles successfully and installs on the Samsung Galaxy SII smart phone without any problems. We even created a custom icon for the app.

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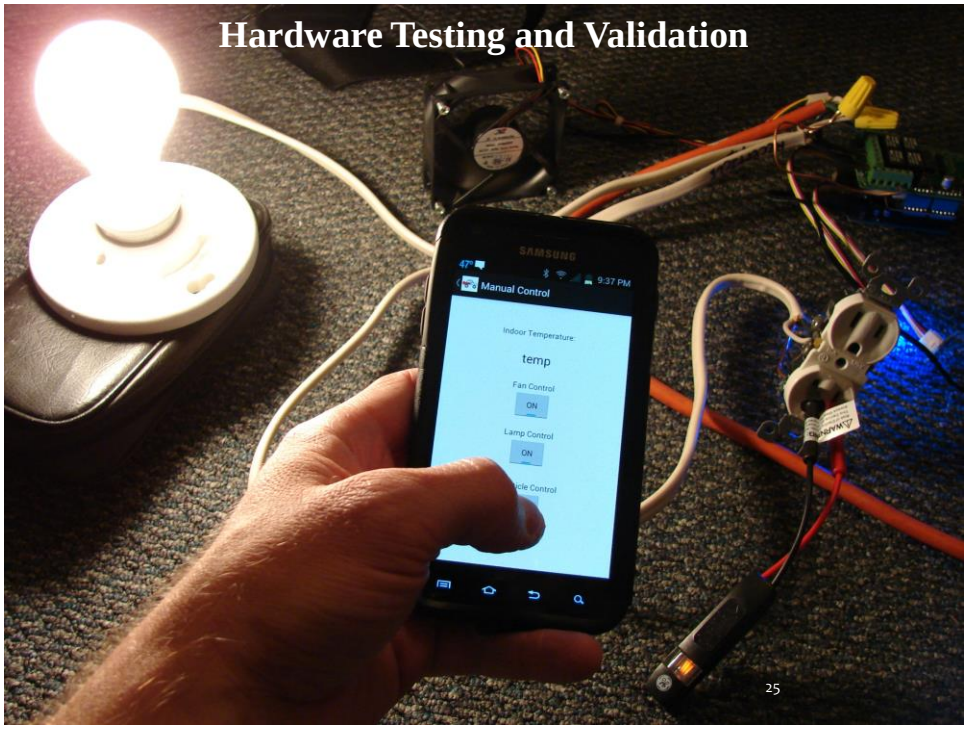
Hardware Testing and Validation
SAMSUNG
9:37 PM
Manual Control
Indoor Temperature
temp
Fan Control
ON
Lamp Control
ON
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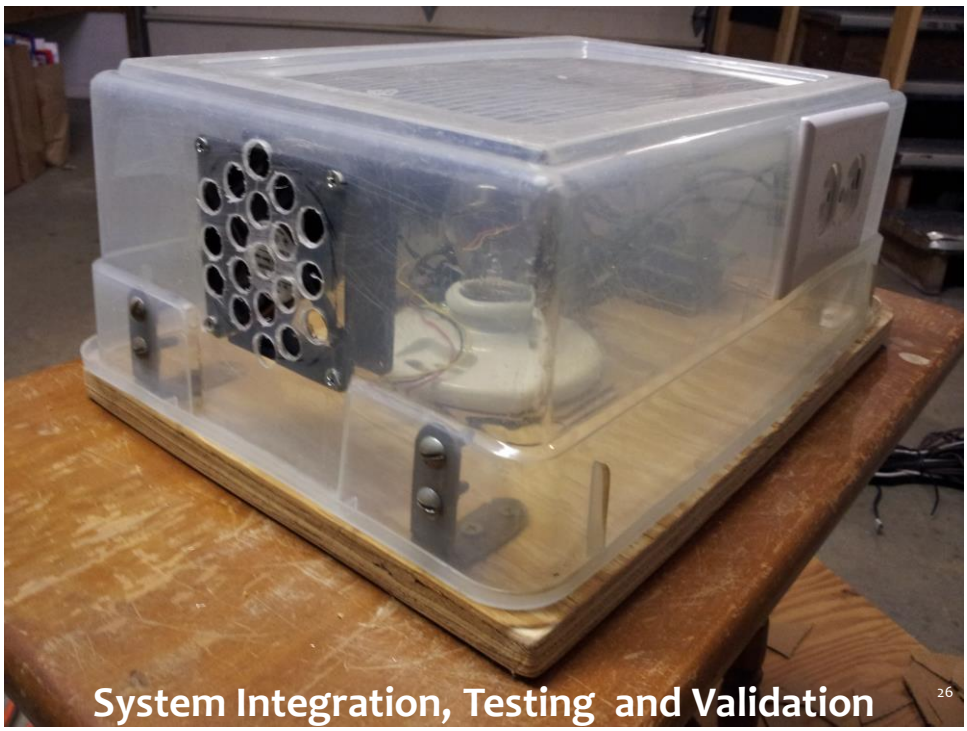
System Integration, Testing and Validation
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Project Management

Chapter 6

- Schedule and Time Management
- Resource and Cost Management
- Quality Management
- Risk Management
- Lessons Learned

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Schedule and Time Management

ACTUAL COSTS							
Material (dollars)				Labor (hours)			
Item	Quantity	Cost	Total	Task	Mike	Nathan	Total
Android Books	3	$15.00	$45.00	Research	17.0	13.0	30.0
Arduino Uno	3	$27.95	$83.85	Design System	5.0	4.0	9.0
Relay Shield	2	$19.99	$39.98	Create Schematic		1.5	1.5
Bluetooth Shield	3	$21.75	$65.25	Select Required Components		3.0	3.0
Grove 4-pin cable	1	$4.80	$4.80	Order Parts	0.5	1.0	1.5
Grove RGB LED	2	$3.80	$7.60	Design Software Architecture		1.0	1.0
Grove Temp Sensor	2	$2.80	$5.60	Develop Software	12.0	2.5	14.5
USB Cable	2	$2.95	$5.90	Write Code	6.0	10.0	16.0
Power Supply	2	$13.95	$27.90	Debug Code	6.0	23.0	29.0
TIP31 Transistors	10	$0.29	$2.90	Assemble Components	4.0	7.5	11.5
1KOhm Resistors	10	$0.10	$0.99	Test Assembled Prototype	15.5	20.5	36.0
22AWG Solid Wire	1	$7.95	$7.95	Verify System	5.0	2.5	7.5
60W Light Bulb	1	$0.00	$0.00	Write Report Outline	3.0	1.0	4.0
Light Fixture	1	$0.00	$0.00	Write Report Draft	10.0	21.0	31.0
AC Receptacle	1	$0.00	$0.00	Write Final Report	1.5	2.5	4.0
CPU Fan	1	$0.00	$0.00	Create Presentation Outline	2.0		2.0
			$0.00	Create Presentation Draft	5.0		5.0
			$0.00	Create Final Presentation	7.0		7.0
			$0.00				0.0
			$0.00				0.0
			$0.00				0.0
			$0.00				0.0
		Total	$297.72	Total	99.5	114.0	213.5

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Resource and Cost Management

- Original Cost = $100
- Actual Cost (with replacements) = $297.72
- Actual Cost (Without replacements) = $245.08
- Overage = $22.54 each
- Original Time = 205
- Actual Time 226

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Quality Management

For quality management we made sure to keep our project requirements. We tested each stage several times between the two of us and made sure that the requirements were met.

- Mobile app shall control a remote electronic device via Bluetooth
- Device shall connect using Bluetooth at a range specified by the Bluetooth Standard (30 feet)
- The software app will be less than 15MB once installed
- The remote device shall be easily portable
- The app shall allow the user to issue instructions to the remote device via Bluetooth
- The app shall allow the user to monitor parameters of the remote device

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Risk Management

May not complete all code within one semester	Completed all required code within the semester
Cost of project exceeds budget	Required to spend more to compensate for destroyed parts
Bluetooth range does not meet the 30 foot requirement	The range reaches 70 feet before noticeable delay, 80 feet till lost signal
Android tools not free	The tools were freely available online
App is larger than 15 MB	The app is only several 921.6 KB

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Lessons Learned

- Michael learned not to cross wires when working with 120V.
- We learned there are many possibilities to what can be accomplished with an Android App
- We learned to manage time and resources on a long term project
- Nathan learned that doing more research earlier would have made for less stress
- We have a better understanding of Bluetooth and its capabilities
- It is easier to stay on schedule if you start early rather than late

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Chapter 7 Conclusion

Conclusion

Conclusion

- There are many possibilities to mobile apps
- We have seen how two programs in different languages can work together for on task
- Created an App that will cool down/heat up your RV
- All from your smart phone

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Questions and Answers

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