



HomeBerry

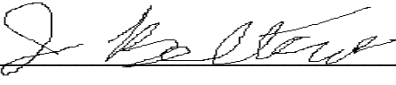
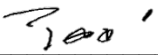
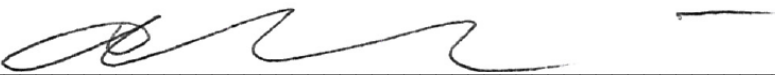
by

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HomeBerry

Home Automation Solutions

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Acronyms and Abbreviations

App – Application: Software installed on a smartphone to help accomplish a specific task.

MFA – Multi-Factor Authentication: Using two different types of authentication such as fingerprint and passcode.

VPN – Virtual Private Network: A network created on the public internet to connect to a private network.

OS – Operating System: Software that allows processes to run and data to be saved to a computer.

GUI – Graphical User Interface: An interface or screen that allows a user to interact with an environment using visuals



ABSTRACT

Using modern technology to monitor, analyze, and control a domestic environment can provide immense value to homeowners and residents by allowing them to understand their consumption of costly resources and live more efficiently. Enter HomeBerry, a home monitoring and automation solution designed to alleviate the stress of managing one's home amidst a busy lifestyle. HomeBerry will collect data from various sensors to be positioned inside of one's home which will be analyzed and provided to the user in a meaningful and interactive fashion. With this insight, as well as the power to control certain home devices including cameras and a thermostat from any mobile device, HomeBerry users will never have to leave home behind.



1. Problem Statement

1.1 Introduction

HomeBerry provides a solution for complete home automation. Our goal is to take aspects of the home that are controlled independently and organize them to be easily controlled from a user's smartphone. We will have a wide variety of users, from a technology novice to the experts in the field. So, our design, implementation, and user interface must be easy to use and traverse. The user can feel safe knowing their home is secure with the provided technology of HomeBerry. Live camera feeds let he/she see what's happening, a variety of sensors give he/she warning of emergencies, and a cooling/heating interface lets he/she control the temperature. It is essential that people can feel safe being away from their home.

1.2 Project Description

We designed a complete home automation system. HomeBerry connects the user with all aspects of the home through the use of a smartphone or computer. A variety of sensors and cameras let our user control things from heating/cooling to checking the status of lights. The HomeBerry offers more all-in-one benefits than buying the current automation systems available for the home. The current market would require the user to buy multiple systems to integrate the entire home. But with HomeBerry the user can choose which sensors are needed and everything is integrated into one system and easy to control from any smartphone.



1.3 Problem

Accidently leaving on the heat or the lights when out for the night leads to an increase in energy cost. HomeBerry will let users monitor what is turned on and what the heat/air is set at and will control each using a single interface. Not only will it help control energy consumption but it will also provide cameras and other potential sensors such as smoke and carbon monoxide to help improve security. The HomeBerry is a more cost effective way to protect the entire home. See cost comparison below (1).

Figure 1: Cost Comparison

HomeBerry

Thermostat	\$60.00
Smoke Alarm	\$15.00
Camera	\$50.00
Garage Door	\$15.00

nest

Thermostat	\$249.00
Smoke Alarm	\$99.00
Camera	\$199.00
Garage Door	N/A

SAMSUNG

Thermostat	N/A
Smoke Alarm	\$50.00
Camera	\$99 – \$199
Garage Door	N/A

1.4 User Profile

HomeBerry home automation is designed with the general consumer in mind. It integrates multiple Raspberry Pi computers with a phone application for easy use and control. The user will be able to control their entire home system from their phone/tablet/computer with full control over their temperature, camera, and garage door.

**Table 1: User Profile**

PROJECT: Home automation using a Raspberry Pi
POTENTIAL USERS: The general consumer
SOFTWARE, INTERFACE, AND RELATED EXPERIENCE: The interface will need to be easy to use so that we can encompass all our users. It will be smartphone based and the layout will be easy to navigate.
EXPERIENCE WITH SIMILAR APPLICATIONS: The user will need to be familiar with installing/using apps on a smart phone. Any experience in plugging in computers to a router or connecting to a wireless network is also a plus because this device will require internet connection. The user will be able to pull up live streams of various security cameras in real time. The user will be able to check various sensors statistics (ex. Temperature)
TASK EXPERIENCE: The user will be able to pull up live streams of various security cameras in real time. The user will be able to check various sensors statistics (ex. Temperature)



FREQUENCY OF USE:

This device and application will be in constant use by the home. The device will be connected to the network and monitor sensors 24/7. The user may disconnect power to the device to stop usage.

KEY PROJECT DESIGN REQUIREMENTS THAT THE PROFILE SUGGESTS:

- Visually and aesthetically pleasing designs
- Easy navigation
- Live stream functionality for camera
- Temperature control sensor
- Various other sensors



1.5 Use Case Diagram

HomeBerry can be accessed by two different types of users. There are administrators and everyday users. Please see [Figure 1](#) below for information on what each user will be accessing.

Figure 2: Use Case Diagram





2. Technical

2.1 Technical

2.1.1 Software

The user will be required to install an application or use the web on his/her smartphone to monitor the home. All software will come preinstalled on the Pi itself and will only need to be connected to the network.

2.1.2 Hardware

The software will run on multiple Raspberry Pi devices and it will come preinstalled. The user will be required to install the app or use the web on his/her smartphone to monitor sensors and cameras.

2.1.3 Network/Security

The user will need to attach the device to a home network. Once the device is attached and an account is created for the application the user will need to create a username and password for access. A secure connection will be made from the mobile device to the home network using a VPN. MFA (Multi-Factor Authentication) may be an option at launch.



2.2 Deliverables

2.2.1 First Semester

2.2.1.1 Hardware

Acquire by: 10/20/16

- Raspberry Pi
- Sensors
- Phone/Computer

2.2.1.2 Software

Acquire and set up by: 10/20/16

- VPN
- OS
- GUI – Working prototype by 11/28/16

2.2.1.3 Security

- Secure Remote Connection



- Physical Security
- Secure device from hardware and internet attacks

2.2.1.4 Network

- Prevent Failure
- Connection Type
- Wireless
- Ethernet

2.2.1.5 Location

- Hidden inside home
- Wireless sensor integration
- Useable from anywhere

2.2.2 Second Semester

2.2.2.1 Final Web Application

- Working design



- Easy to navigate layout
- Easy to read all sensor data

2.2.2.2 Final HomeBerry Product

- All completed sensor modules
- The main raspberry pi/thermostat
- Easy to control from any device
- Accurate readings

2.2.2.3 Secure Software and Product

- Working authentication (two factor if possible and time allows), Token based
- Locked down pi
- No security holes in Web App
- Mac filter on all devices

2.2.2.4 Expo Ready

- Final presentation completed for expo with plenty of time to practice
- Expo requirements met

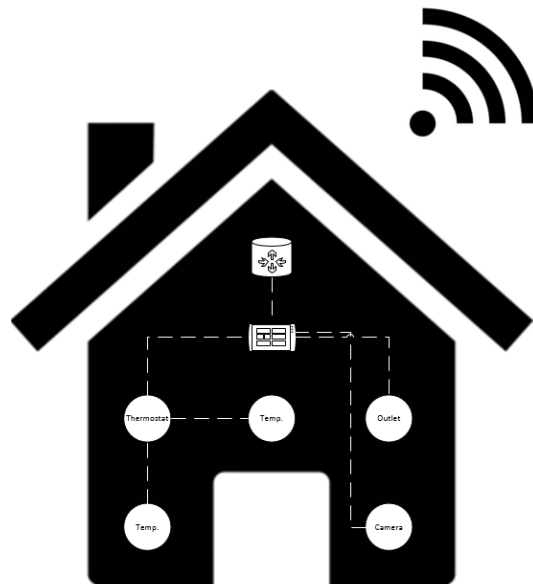


- Equipment requirements
- Expo Poster
- Fully functional product

2.2.2.5 Final Paper

- Paper revised and finalized
- Turned into Safe Assign
- Turn in Paper

Figure 2 below shows how HomeBerry will be integrated with the entire house. Having control over each of these components even while away from the home will give the user peace of mind in knowing their home can be protected.

**Figure 3: Home layout**

3. Project Management

3.1 Budget

The budget for this project is displayed below in [Table 2](#). When referring to the chart the prices are listed per units purchased. The Chart displays the current hardware and labor associated with this project. Open source software is being utilized to minimize costs.

**Table 2: Project Budget**

Item	Price Per Unit	Unit, Each	Line Item Total
Networking			
Labor	\$50	100	\$5000.00
Software			
Open Source Software	\$0	0	\$0
Hardware			
Raspberry Pi	\$29.95	2	\$59.90
Raspberry Pi Zero	\$5.00	3	\$15.00
Camera Module	\$30.00	1	\$30.00
Assorted Sensors	\$2.00	1	\$2.00
Wireless Transceiver/Receiver	\$2.50	5	\$12.50
		Subtotal:	\$5109.40

3.2 Project Schedule

Setting deadlines is an important part of any project. It is important that design and implementation of key components stayed on track so that HomeBerry was ready to use live during the final presentation. The project schedule is below in [Table 3](#).



Table 3: Gantt Chart

Description	8/22/16	8/29/16	9/5/16	9/12/16	9/19/16	9/26/16	10/3/16	10/10/16	10/17/16	10/24/16	10/31/16	11/7/16	11/14/16	11/21/16	11/28/16	12/5/16	4/11/17
Meet Group																	
Discuss Project Ideas																	
Decide on Final Project																	
Decide on Project design and layout																	
Connectivity and VPN																	
Decide on GUI and sensors to use																	
Website or App design																	
Coding Sensors																	
Testing Prototype																	
Prototype Bug Fixes																	
Prototype																	
Troubleshoot																	
Feedback																	
Clean up																	

	Week															
	1/9 - 1/15	1/16 - 1/22	1/23 - 1/29	1/30 - 2/5	2/6 - 2/12	2/13 - 2/19	2/20 - 2/26	2/27 - 3/5	3/6 - 3/12	3/13 - 3/19	3/20 - 3/26	3/27 - 4/2	4/3 - 4/9	4/10 - 4/16	4/17 - 4/23	4/24 - 4/30
Create Plan for Semester																
Web App Design/Layout																
Configure Authentication																
Add Final Sensors																
Revise Web App for New Sensors																
Troubleshoot/Finalize Product																
Create Presentation for Expo																
Practice Presentation																
EXPO																
Work on Final Paper																
Finalize Paper																
Turn in Paper/Finished																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

4. Application

4.1 Application Architecture

4.1.1 Data Collection and Device Management

The raspberry pi device will act as the central hub to which all other HomeBerry devices connect. The hub will host a web service to expose data collected from connected devices and provide access to device configuration.



4.1.2 Web Application

Users will access and manage their HomeBerry system through a web application that will consume the raspberry pi's hosted API endpoint. This built as a mobile-first single page application and will authenticate the user prior to calling the web service on the user's HomeBerry hub.

4.1.3 Security

The web application utilizes token based authentication for users and communicates the user context to the web service for all requests. User accounts are managed within the web application and two user roles are available for assignment. Administrative users are able to utilize all HomeBerry features and authorization attributes within the web service methods further ensure that non-administrative users aren't able to make privileged requests.

Each of the devices are operating using a MAC address filter as well so that the hub can only connect to the users home router and all other HomeBerry devices can only connect to the hub.

Below in [Figure 3](#) is the preliminary test plan for HomeBerry. The final test plan will include more in depth steps because more features will be available. This plan lets us test what is available in the current state of development. For a preliminary test we can create a user, log-in to the account, and adjust the thermostat temperature.

**Table 4: Preliminary Test Plan**

Category	Test Case	Action Steps	Expected Outcome
Security	Create Account	1. Navigate to web url 2. Click Register 3. Complete registration form 4. Submit registration form	User is redirected to login page and prompted to enter their new username and password
Security	Log In	1. Navigate to web url 2. Click Log in 3. Prove username and password 4. Click Log In	User is directed to a dashboard view of their HomeBerry system
Security	Add User	1. Log in as administrative user 2. Click Settings 3. Click Account Settings 4. Click Add User 5. Select user type and provide email address 6. Submit form	Email is sent to new user containing link to web application. User will create a password and then be redirected to the log in page
Feature	Adjust Thermostat	1. Log in as administrative user 2. Click Adjust Temperature Icon 3. Enter temperature 4. Submit adjusted temperature	Thermostat is adjusted



5. Conclusion

The HomeBerry home automation system began as an idea to simply improve the experience of managing one's own home. We found that we could use modern technology to interface with domestic environments in a way that allows users to manage key components of their domicile, such as energy consumption and security. Over the next few months we plan to build multiple sensor modules that will improve the system's ability to recognize events within its environment. We believe that embracing technology is essential to improving one's quality of life and our efforts with HomeBerry are a direct result of that motivation.

6. References



- (1) "How Much Does it Cost to Install a Home Automation System?" Home Advisor, 2017, <http://www.homeadvisor.com/cost/electrical/install-or-repair-a-home-automation-system/>. Accessed 12 December 2016.