SMIRROR

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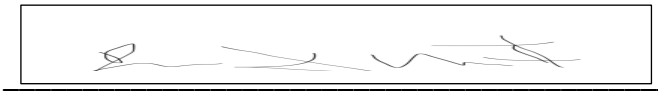

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James Moore II Date

Faculty Advisor: Ryan Moore

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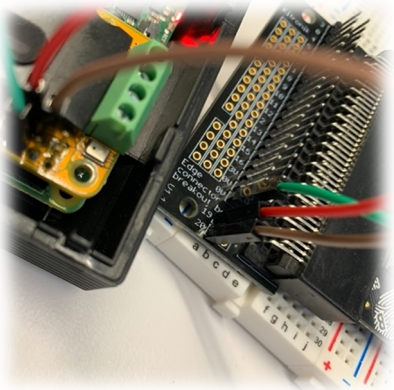
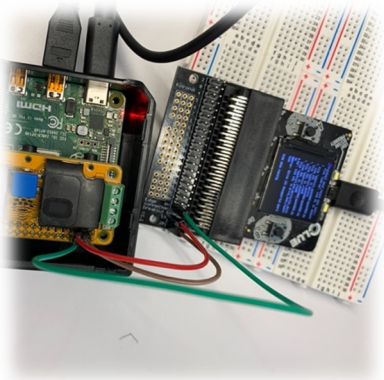




Abstract

The global smart mirror market is projected to reach $4.9 million by 2025, registering a compound annual growth rate of 11.5% from 2018 to 2025. We created a unique “smart” mirror that allows an individual to efficiently fetch useful information while they get ready for the day. Useful information could include the news or current events, weather forecast, time and date, final scores of sporting events, and other information. What makes a smart mirror “smart” is the ability to display useful and reliable information and interact with other smart enabled devices. The combination of a smart display mirror, hand gestures, simple user interface, and different modules to interact with substantially increase the freedom and organization individuals will have with this kind of technology. This device allows users to experience a hands-free environment. Being able to take in all this useful information without interrupting your normal routine is very liberating.

Introduction

People of all ages today have smart home devices in their home that they utilize daily as they get ready for the day or simply for entertainment use. The good thing about most smart home devices is that they are equipped with a voice assistant like Siri, Google, or Alexa. Most of these devices are visible no matter where they are placed in the home: whether it’s the bathroom, kitchen, or living room. Voice assistants provide information by voice but do a poor job of displaying the information on screen. Based on our research so far, there aren’t many homes with a personal digital assistant that lives in a mirror. It can be a hassle trying to find the

perfect spot to place your Home Pod, Google Nest, or Amazon Echo, or any other smart home device without it being visible. Adding technology to a mirror helps elevate user experience by showing qualitative and quantitative data for sports, weather, and music. This is done while cleaning up in the mirror.

Problem

Most households utilize a smart home device that is visible to guests, kids, and even pets. It can be hassle to try to find the perfect “hidden” spot in the home for a smart home device like the Amazon Alexa, Google Nest, or Apple Home Pod. Our device SMirror will eliminate the hassle of finding that perfect spot to have your expensive smart home device out on display where it is vulnerable to accidental damage. The smart mirror, SMirror is a hidden smart home device behind a mirror that is unnoticed by guests, kids, or pets.

Solution

SMirror is a display mirror that has smart functions and capabilities. We used a monitor to display the Magic Mirror modules and attached it to the back of the Mirror. The raspberry pi is the minicomputer running the Magic Mirror modules with Google Assistant installed on the OS. The CLUE microcontroller is attached to a driver with jumper wires connecting the pins on the raspberry pi and driver. The raspberry pi can be used to call up and customize daily information like news, traffic reports, weather, etc. using a voice assistant. The smart home devices that are in homes will now be hidden and out of site. There will be no hassle for

homeowners or residents trying to find the perfect spot to place their smart home device(s). Users can simply place their smart mirror anywhere they would as if it was a typical mirror.

Project Goals

The main goal of our project is to limit the visibility of a smart home device and provide a contactless smart mirror that displays relevant information while allowing individuals to navigate through customizable interfaces by hand gesture or external device connected via Bluetooth. The information displayed is a calendar module along with a schedule, weather, news, timers, and reminders.

Overview

Throughout this final report, there will be information provided on the development of the project. This report will include details on the process and include these sections: design objective, budget, timeline, problems encountered, and future recommendations. Our project goals and the deliverables that we need to produce will be outlined, the schedule for our project will be provided as well. Finally, the functionality of our device will also be demonstrated using the prototype that our group has designed.

Discussion

User Profile

Project: SMIRROR

Potential Users

- Developers/Administrators
- Consumers
    - Family members
    - Friends

Table 1:

There are two tables below for user profile. The first table demonstrates the developers and administrators' profile for project SMirror. Our group will update the profile based on the different technologies used to meet consumer needs for the hidden smart home device.

Table 2:

The second table demonstrates the consumer profile. The different functionalities that are available for consumer experience will be updates throughout the course of the project.

User Profile: SMirror

Team: James Moore, Casey Bacon, Atakorah Oteng

There will be two types of users interacting with our in-home device: SMirror.
The first user group described are the developers\administrators who will be maintaining the device after development as well as providing system updates.
The second user group is made up of family and friends (end users).

Table 1: Developers/Administrators Users Profile

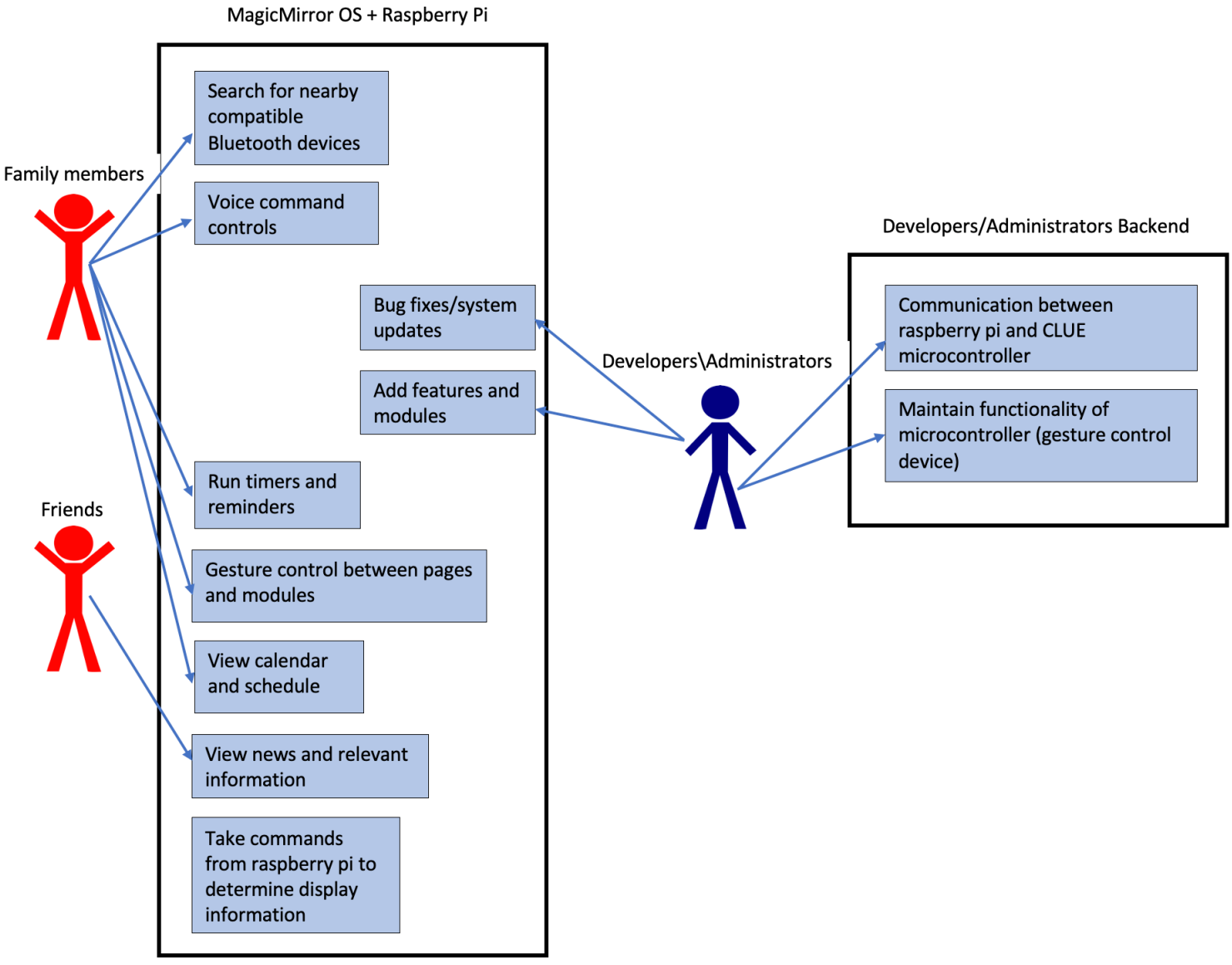
User Profile Form 1
Application: Java, raspberry PI GitHub, Mapping API'S, LCD display
Potential Users: Java developers, network/system administrators
Software and Interface Experience: The user should be familiar with the GUI and command line used in the raspberry pi. The user should also be familiar with AWS and the coding used in the creation of the web application.
Experience with Similar Applications: The users need to be familiar with the languages (i.e. java, python, c#) used in the creation of the in-home device. Should also be familiar with GitHub and the raspberry pi.
Task Experience: Using the aforementioned applications in the development and maintenance of the in-home smart device.
Frequency of Use: Once the device is created the user will only interact with the device as needed. The user will interact with the in-home device after its creation to stay compliant with security requirements, to correct application bugs discovered after launch, and to update features based on end users' feedback.
Key Interface Design Requirements that the Profile Suggests: This user will need to be able to work with the programming languages and interfaces to create and maintain the in-home device properly.

Table 2: Family and Friends Users Profile

User Profile Form 2
Application: The MagicMirror OS
Potential Users: Family members and friends of all ages.
Software and Interface Experience: Users should have experience using voice command like Siri, Google, or Alexa. Users will experience contactless interaction with SMirror by hand gesture controls in different modules. Modules will be customizable to users based on their preference (ex: entertainment, sports, general information interface module)
Experience with Similar Applications: Experience with Google Home, Amazon Alexa, Apple's Home Pod or any other smart home devices.
Task Experience: Basic interactions – using the voice command to bring up information they would like displayed on the mirror or read out loud. Users can use hand gestures to complete small tasks like swiping from page to page or in between modules.
Frequency of Use: The use of the SMirror can be as often as the user would like, it can be used daily, weekly, or even monthly. The frequency of use is completely up to the user.
Key Interface Design Requirements that the Profile Suggests: The device needs to be secure, easily accessible to the user, easily navigated by the user, picks up voice command without the user having to raise their voice. Also being able to pick up motion from the user without delay or much of a delay.

Use Case Diagram

The below diagram shows the components of the Magic Mirror OS and the Raspberry Pi. With the components displayed, the diagram also shows the different functionalities of the device and the standard modules that are available to the consumers which in this case are family members and friends. Additionally, the responsibilities of the developers and administrators is illustrated in the diagram.



Budget

The budget sheet below illustrates the financial requirements of our SMirror project. Calculating the cost of this project, the hardware cost, estimates time of completion, and the average pay for those working on the project: our risk score is also factored in. The risk score calculates the work effort and complexity identified by how many hours we worked and the challenging nature of the project. Prior to the initiation of the project, a couple of our group members already had the hardware so that saved us some expense.

Project Name:	Smirror		**Project Manager:**	Casey Bacon, Atakorah Oteng, James Mo	**Team #** 3
Project Members:	Casey Bacon, Atakorah Oteng, James Moore		**Project Areas:**	Artificial Intelligence & Machine Learnin	**Project Advisor:** Ryan Moore

Problem Statement

People of all ages today have smart home devices in their home that they utilize daily as they get ready for the day or simply for entertainment use. The good thing about most smart home devices is that they are equipped with a voice assistant like Siri, Google, or Alexa. Most of these devices are visible no matter where they are placed in the home: rather it's the bathroom, kitchen, living room, etc. Voice assistants provide information by voice but do a poor job of displaying the information on screen. Based on our research so far, there aren't many homes with a personal digital assistant that lives in a mirror. It can be a hassle trying to find the perfect spot to place your Home Pod, Google Nest, or Amazon Echo, or any other smart home device without it being visible. Adding technology to a mirror

Project Description

Our task as a team is to develop a functional product that allow users to call up and customize daily information like news, traffic reports, weather, etc. using a hidden voice assistant. Our product, SMirror, will be able to pair with other compatible devices in home like speaker, lights, tv, and more via Bluetooth technology. Residential spaces would benefit heavily from this design. This product design would be user friendly and customizable to the user based on their preferences. The convenience of having a hidden personal assistance a voice command away while being able to view yourself in the mirror.

The hidden smart home device can be utilized by users with the following features and functionality:

CLUE (microcontroller) Gesture control functionality that will allow users to turn on/off the display or navigate between pages and modules on screen.
Raspberry Pi 4 Allow users to connect other devices via Bluetooth technology and use voice assistant to find information online, control music, run timer and reminders, etc.

A script is run for the CLUE and then waits for gestures; then sends the data to the computer where the raspberry pi detects it. Human Interface Device (HID) is implemented into circuit python (CLUE board) meaning keyboard and mouse capabilities are present. The CLUE board has multiple sensors for upgrading the project and adding additional elements barring what the raspberry pi has to offer.

Project Asset Type		**Funding Source (if applicable)**	
Operational Improvement	Comments:	Self	Comments:

Risk Identification (See Risk Types tab)

	Risk Rating 1-5 (5 is high)*	*Comments*	*Weight*	*Score*
Work Effort (days)	4		40%	1.60
Complexity	5		60%	3.00
Project Risk Score:				**4.60**

Project Stakeholder(s)

People at Home, School, Work, Hospitals, Innovation Centers, and Businesses

Estimate of Benefits

Select other benefits the project may bring a customer or user:	
Risk Avoidance	☑
Improved customer satisfaction	☑
Increased system availability	☑
Productivity or process improvement	☑
Reduced costs	☐

Estimated Cost Rough Order of Magnitude:

	Rate Per/Hr	Work Effort (Hours)	1 X Costs	Ongoing Annual Rate Per/Hr	Ongoing Annual Work Effort (Hours)	Ongoing Annual 1 X Support Cost	Comments:
Labor - IT	20	200	$ 4,000.00	20	10	$ 200.00	(1) Microcontroller $39.95, (1) Raspberry Pi 4 Model B $30
Labor - External			$ -		0	$ -	
Software - External			$ 30.00				
Hardware - External			$ 39.95				
Misc.							
TOTAL			$ 4,069.95			$ 200.00	

5-Year ROI Analysis

Description	5- Year Expected	Conservative (1.5)
Total Costs	**$ 5,069.95**	**$ 7,604.93**
Total Benefit	**$ -**	$0
Total Costs/Benefit Differential	**$ (5,069.95)**	
Conservative Costs/Benefit Differential	**$ (7,604.93)**	

Design Objectives and Deliverables

The table below outlines the entire schedule for our project across both fall and spring semester. The first column represents the number of tasks needed to be completed to reach our goal of the project. The second column is the task that needs to be achieved with accordance to the task number. The third column is the ideal duration for each task as well as the start and end date in the fourth and fifth columns.

Task #	Task Name	Duration	Start Date	End Date
1	module/feature research	1 month	8/28/20	9/29/20
2	contract approval	5 weeks	9/28/20	10 /2/20
3	OS installation on pi/config file	2 days	9/16/20	9/18/20
4	hardware assembly (LCD display w/ frame)	1 day	9/23/20	10/20
5	coding for circuit/pi integration	12 weeks	9/30/20	2/20
6	Human Interface Device (HID)	6 weeks	10/2/20	12/1/20
7	HID + CLUE + Raspberry Pi	2 weeks	10/9/20	12/8/20
8	HID + CLUE + Raspberry Pi	2 weeks	10/16/20	12/15/20
9	Alpha Testing	1 week	1/15/20	1/22/20
10	Beta Testing	2 weeks	1/29/20	2/09/20

Technical Elements

Hardware and Software Infrastructure

The raspberry pi is the main source of the hardware used. It is the center piece of the project. The Magic Mirror UI is downloaded onto the raspberry pi that is running Raspbian OS. The Magic Mirror UI has standard preloaded modules including time, date, and current events. Our group was able to create additional modules for consumer interaction and experience. All the information for each of the modules were pulled from repositories and files created and loaded in the GitHub web application. Some of the additional modules that our group was able to

incorporate with the preloaded modules were weather, Google Assistant, finals scores for professional sports, notification module, Wi-Fi indicator module, page indicator module that was intended for the implementation of the CLUE board microcontroller.

The CLUE board microcontroller was the external device that would act as the sensor for the raspberry pi. The external sensor also has an accelerometer and Gyro IMU (change orientation of information being displayed). Both the raspberry pi and the CLUE board microcontroller communicated via I^2C communication using drivers updated for the microcontroller and jumper wires for the raspberry pi. Getting the two devices to communicate was a matter of understanding I^2C functionality. Jumper wires and a driver allow for data to feed from the CLUE board (microcontroller) to the Raspberry Pi. The functionality of Magic Mirror is accomplished by running a set of necessary command through the terminal. To have certain UI components display on the screen, a series of code was added into the configuration file. Going forward we want to implement this technology for personal use. Eventually the system will gather data and preferences over a period user interaction to determine a user's daily routine.

Conclusion

Fall 2020

Our biggest thing this semester is just getting everything right. There is no room for error. We spend most of the semester playing catch up and backtracking. We still prevail, nonetheless. We learned a lot about IoT devices and how they work. Our goal for the fall semester has been to learn about the technologies that we'll be using for our project and how we'll have to

integrate them with each other. Initially we hoped to have a better idea of what our advisors wanted to see in the device and what situations they think our target audience would use it for. We think we have a great project; we obviously need to add more components to make it appealing, but we don't think that will be a problem.

Spring 2021

Our group was able to accomplish one of the biggest hurdles this semester. We were able to get the raspberry pi and the CLUE board microcontroller to be able to recognize each other via the I^2C communication. We were able to configure the Google Assistant module to be awake at a certain time instead of running in the background like how it was during the fall semester. More modules were added to the Magic Mirror UI that our group thought it would be useful to the potential audience.

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