Smart Mirror

Group K

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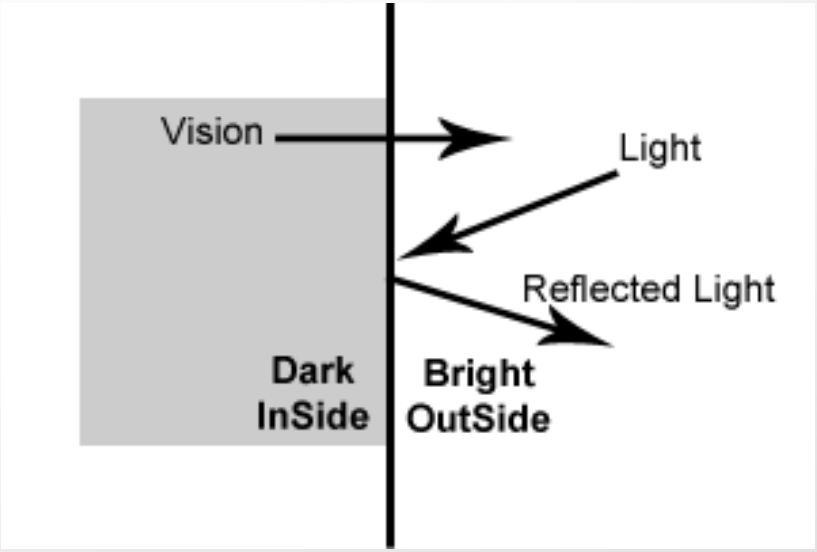
Motivation

- Seamless integration of technology into people's daily lives
- Smart Home technology is a blooming new field
  - Google Home (Nest)
  - Amazon Echo
  - Windows 10 IoT?
- Extend the idea of a 'Digital Assistant' to a room people use every morning

What Is It

- One Way Mirror in front of TV
- White/Light Colored pixels bleed through mirror
- Dark pixels do not and mirror reflects



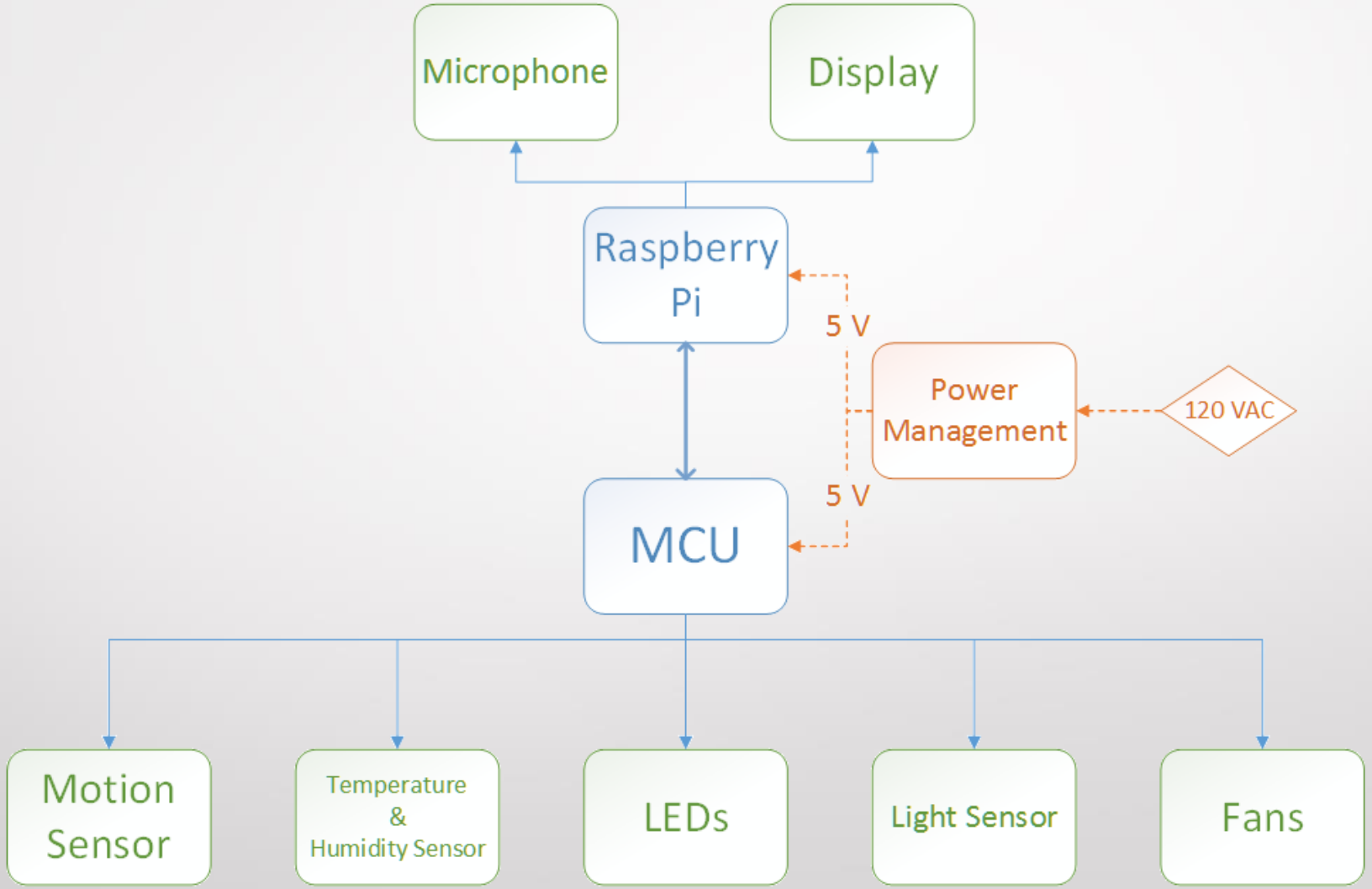
Goals and Objectives

- Quality of Life improvement in the mornings
- Provide users with information they utilize regularly
- Implement a convenient user interface
  - Voice Commands
  - Some Gesture Control

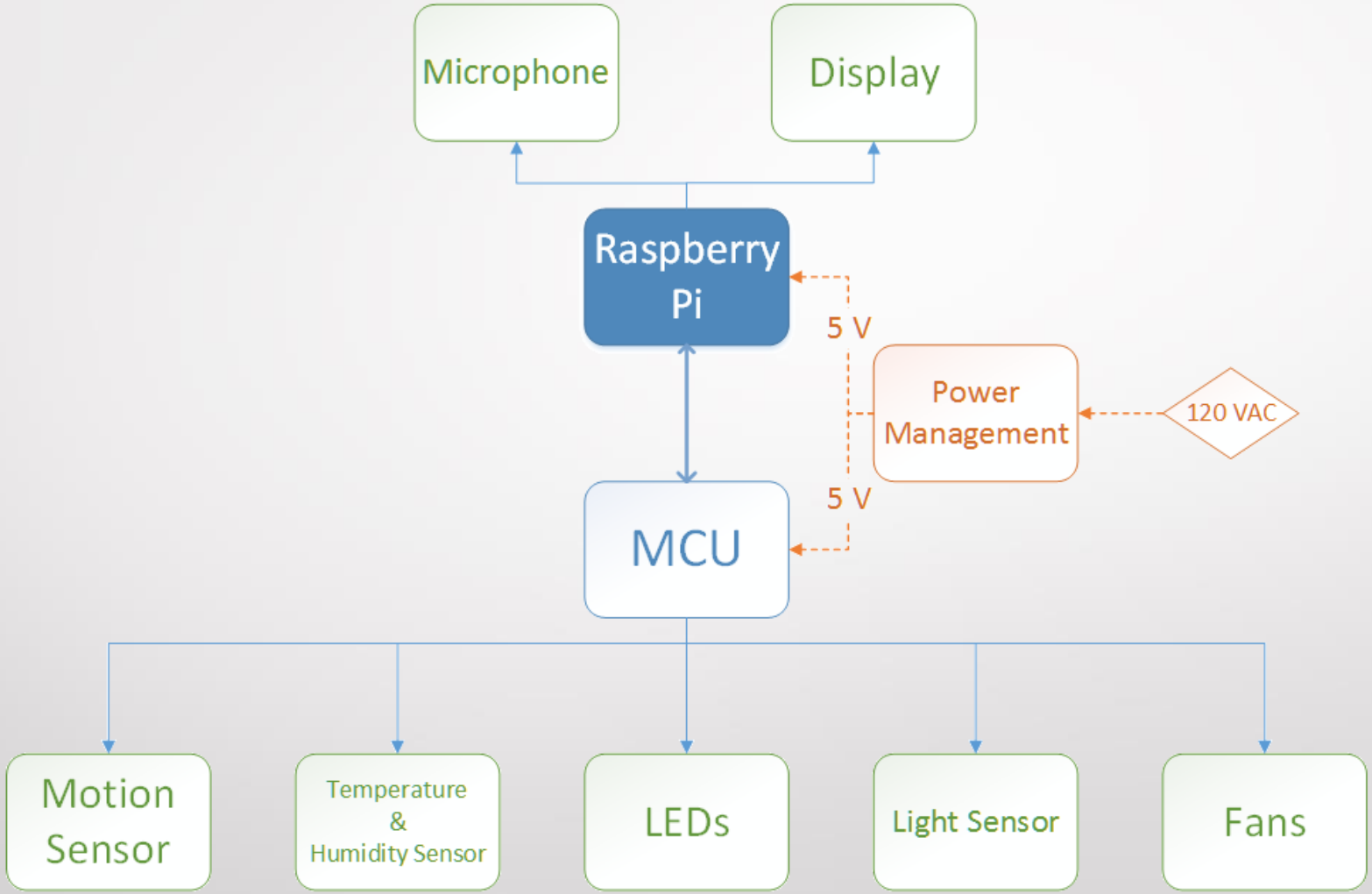
Specifications

Voice Recognition Range	Up to 5 Feet
Voice Recognition Success Rate	>80%
Display Auto-Off	After 2 Minutes of No Motion Detection
Temperature Sensor Accuracy	+/- 1 °C error
Humidity Sensor Accuracy	+/- 2.5% error
Motion Detection Distance	5 Feet
Gesture Recognition Success Rate	>90%

Overall Hardware Diagram

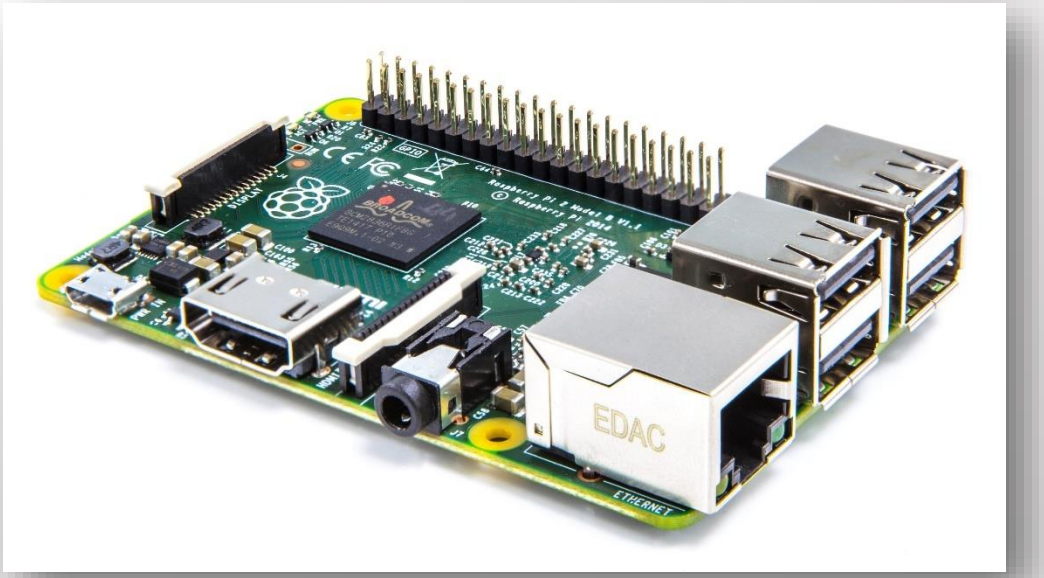


Raspberry Pi

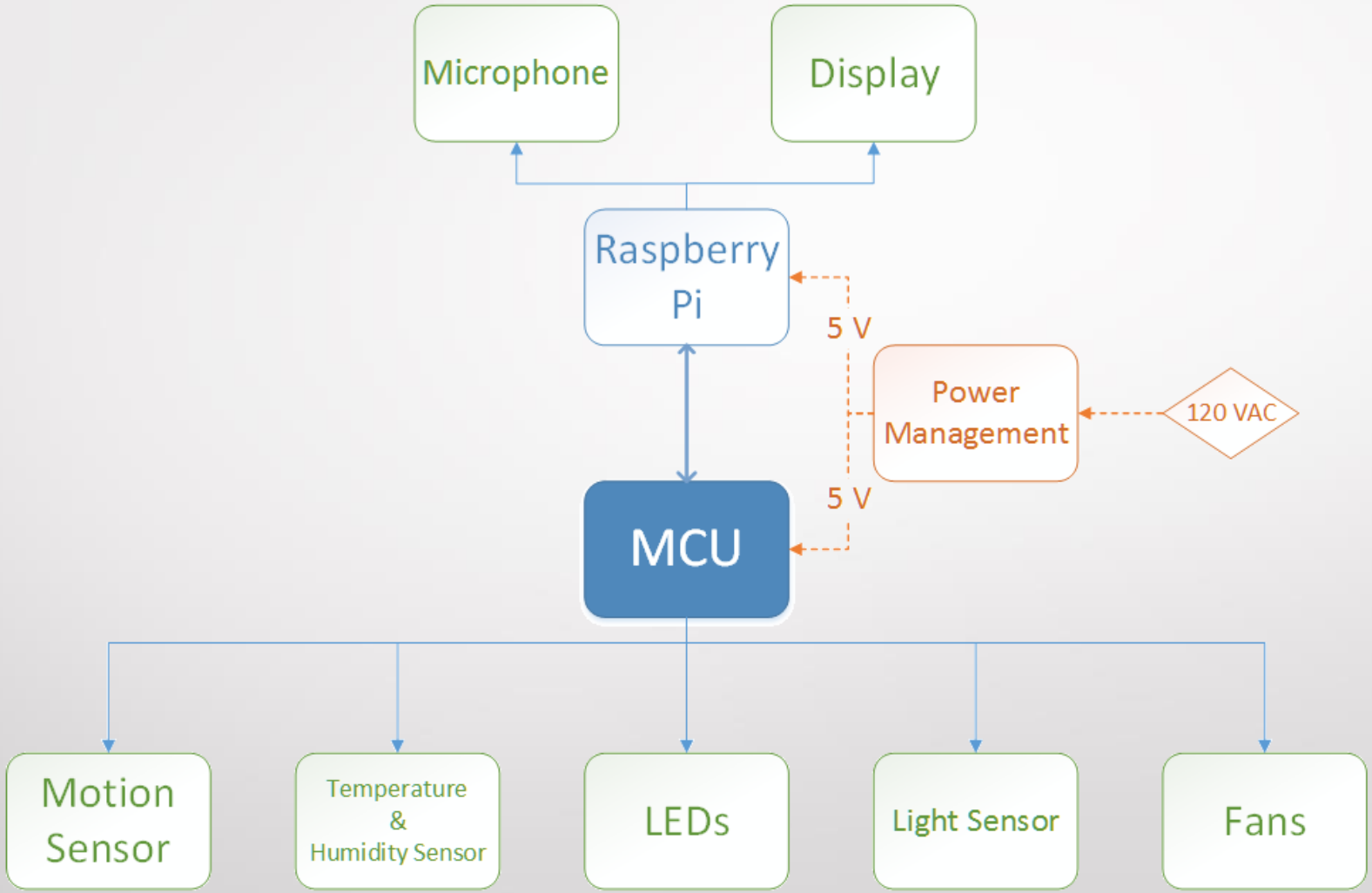


Raspberry Pi 2

Raspberry Pi 2 Model B	
CPU	Broadcom Quad-Core ARM7 900MHz
Memory	1GB SDRAM
Storage	8GB microSD
Power Supply	5V microUSB
Wi-Fi Module	802.11b/g/n
Video	HDMI 1.4
Audio	3.5mm Audio Port
USB	4x USB 2.0
GPIO	40 pin extended GPIO
OS	Windows 10 – IoT Core

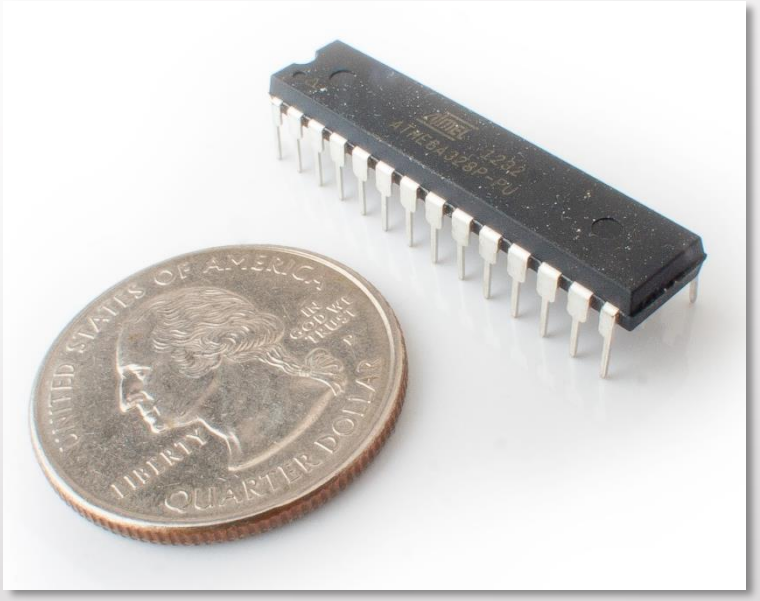


MCU

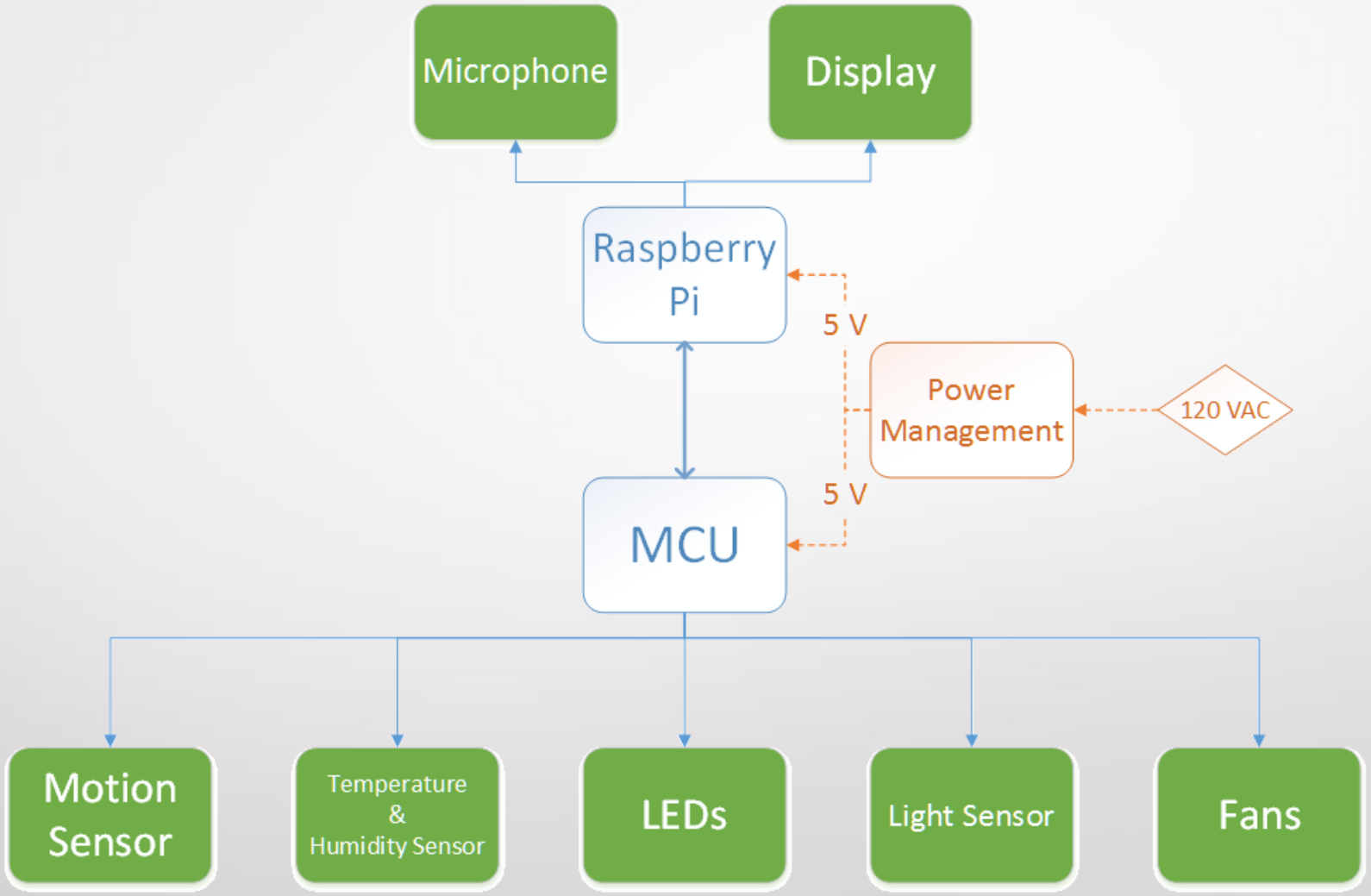

Microphone
Display
Raspberry Pi
5 V
Power Management
120 VAC
5 V
MCU
Motion Sensor
Temperature & Humidity Sensor
LEDs
Light Sensor
Fans

MCU Specs

ATmega328-PU	
Operating Voltage	1.8 to 5.5 V
Operating Temperature	-40 to 80 C
EEPROM	1 KB
SRAM	2 KB
Digital Pins	14
Analog Pins	6
Clock Speed	16 MHz



Sensors


Microphone
Display
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Power Management
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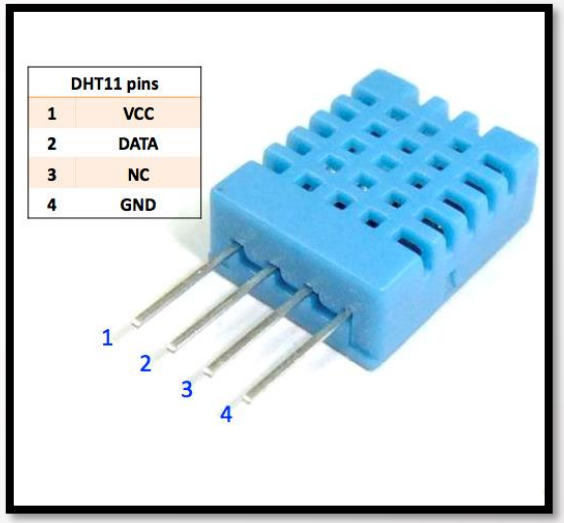
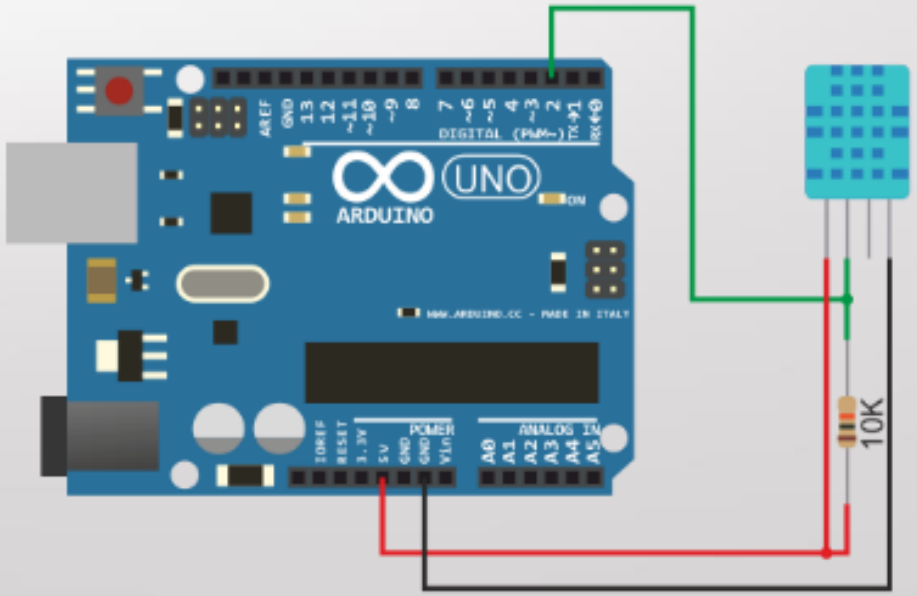
5 V
MCU
Motion Sensor
Temperature & Humidity Sensor
LEDs
Light Sensor
Fans

Temperature & Humidity Sensor Specs

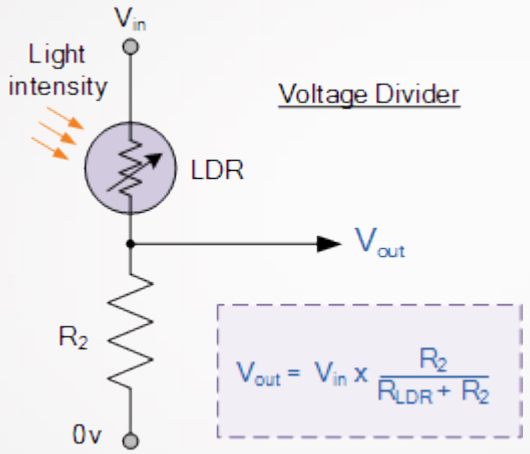
DTN11	
Voltage Supply	3 to 5.5 V
Current Supply	0.5 mA
Humidity Temperature Range	20 to 95%
Operating Temperature Range	0 to 50C
Accuracy (Humidity)	+/- 5% RH
Accuracy (Temperature)	+/-2C
High Chemical Resistance	low
Hysteresis	+/-1.0 % Rh
Response Time	6 s

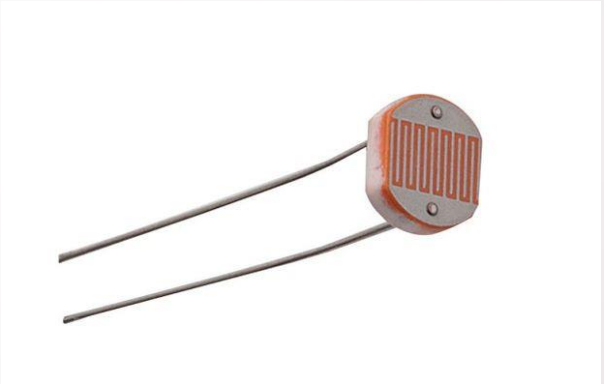


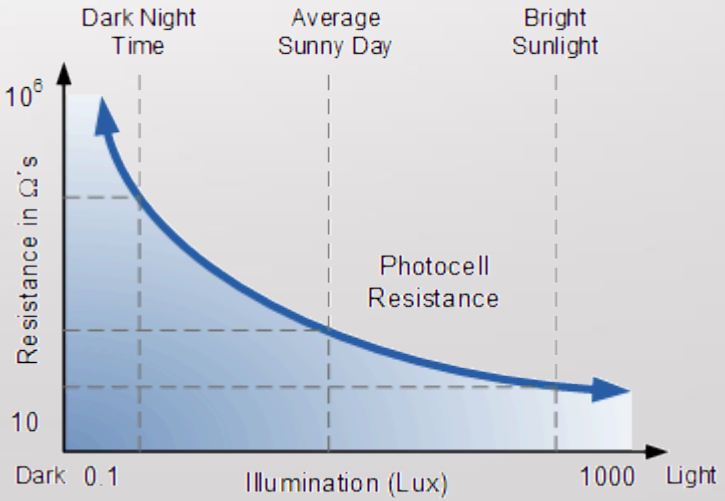


Light Sensor Specs

- Converts light energy into an electrical signal output
- A piece of exposed semiconductor changes its electrical resistance

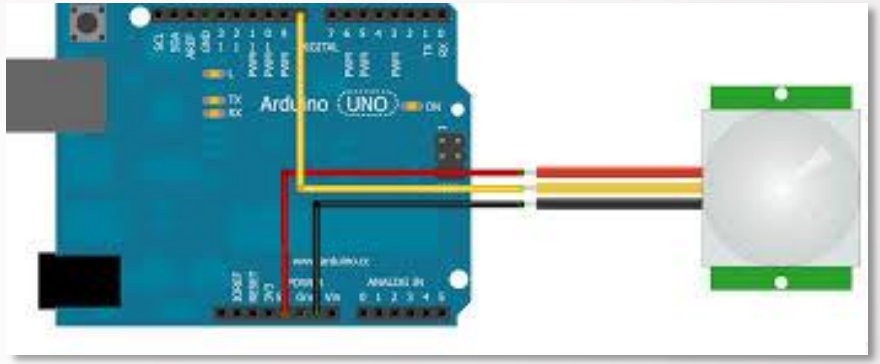


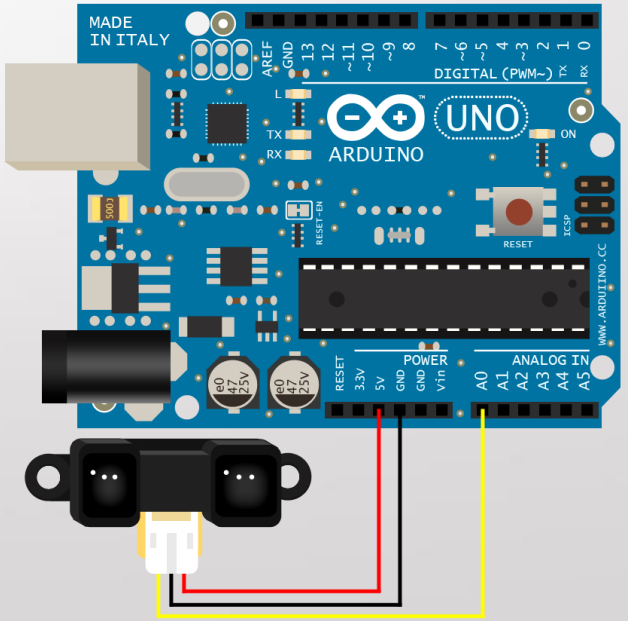




Close Range Motion Sensor Specs

Sensor	HC- SR501	GP2Y0A02YK0F
Voltage Supply	5 to 20 V	4.5 to 5.5V
Power Consumption	65 mA	33 mA
Output type	Digital	Analog
Output Voltage	3.3V	-0.3 to 5.7V
Maximum Sensing Distance	7m	150 cm
Operating Temperature	-15 to 70 C	-10 to 60 C





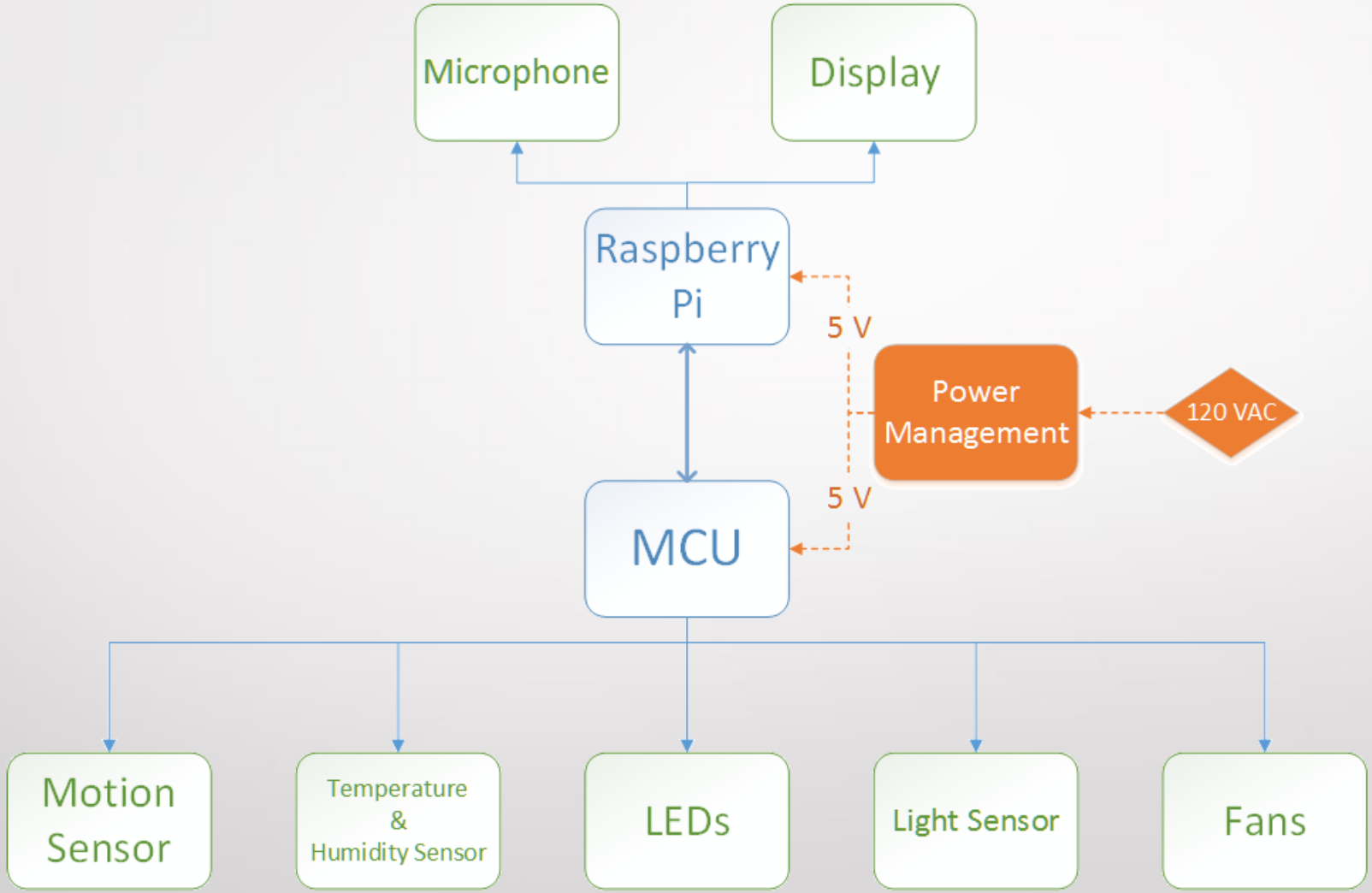
Fan

- Uxcell 12 VDC
- 92mm X 25mm

Other Hardware

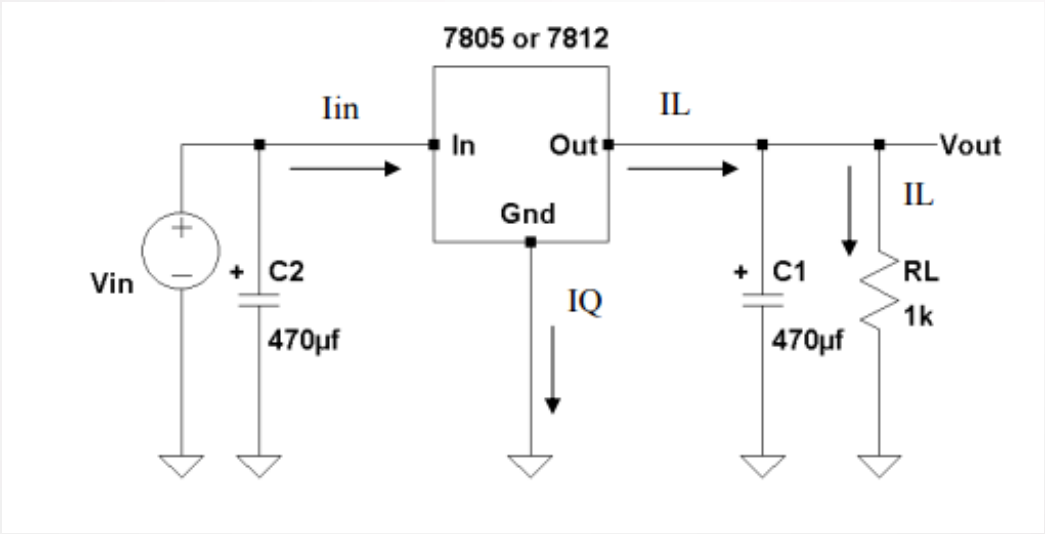
- Display Device
  - Utilize a television behind one way mirror as earlier discussed
- Speakers
  - In our case, audio will be output via the speakers on the television. The Rpi has a 3.5mm auxiliary out jack for any other case
- Microphone
  - We will be using a webcam as the mic to save money, it is a Logitech C920 Pro
- There will be a single, 3W, LED on the bottom of the mirror for low light situations

Power Control



Linear Voltage Regulator

- Same as the ones used in Experiment # 3 in the EEL 4309
- 12 V
- 5 V



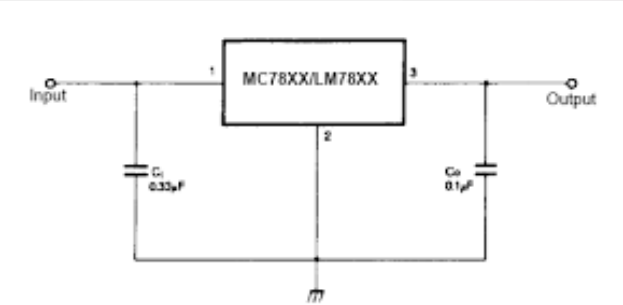
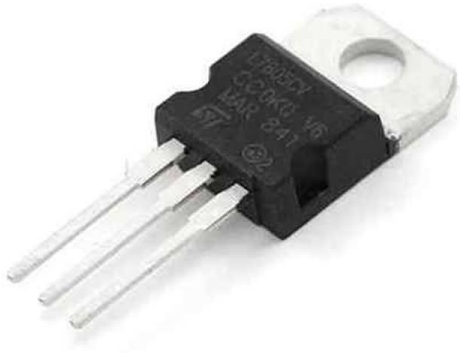
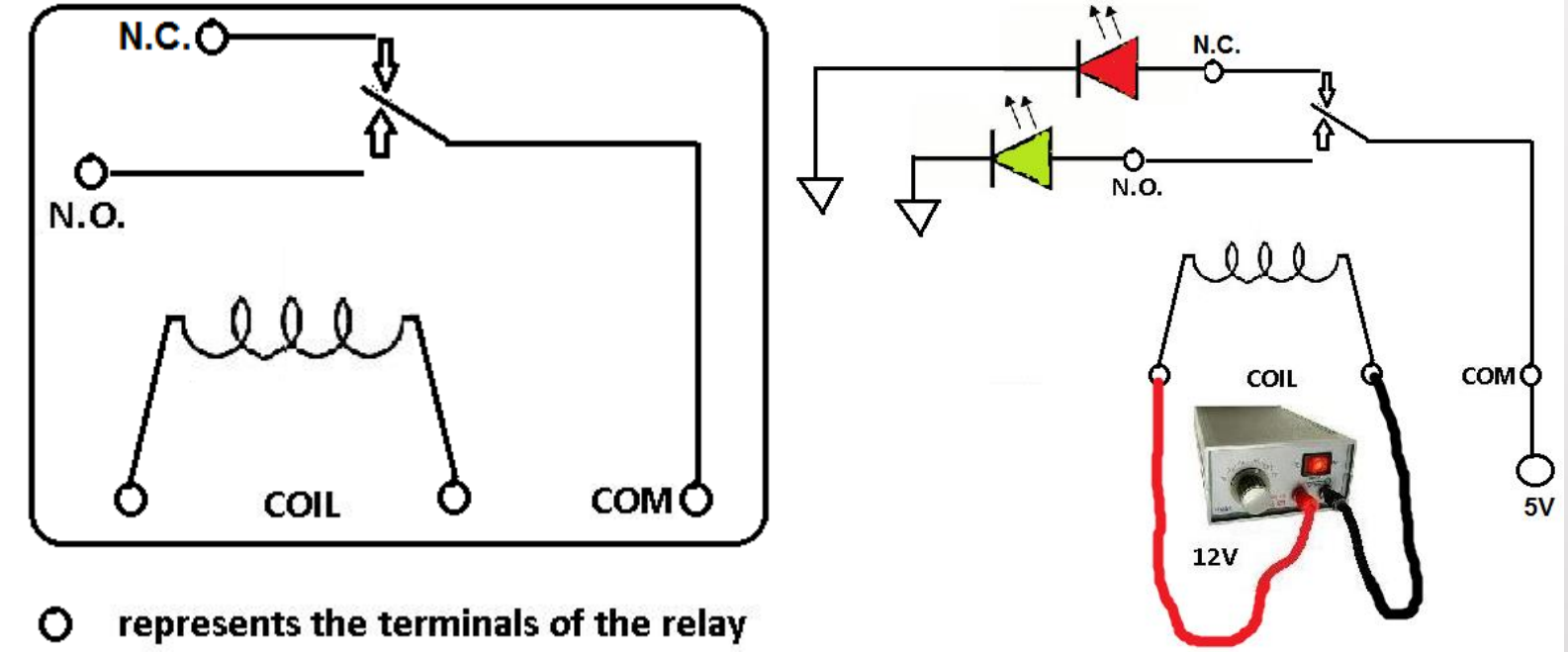


Figure 5. DC Parameters

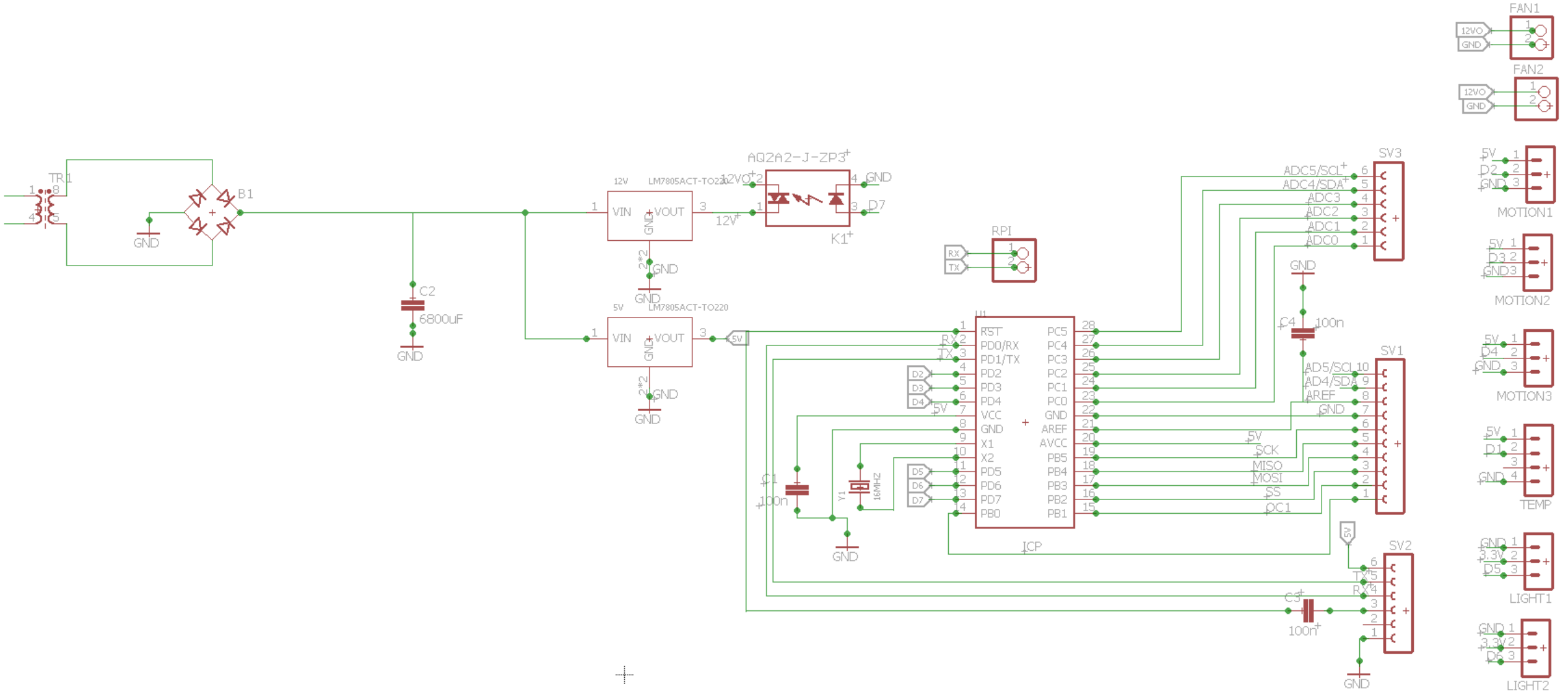


Single Pole Double Throw (SPDT)

- One common terminal and 2 contacts in 2 different configurations
- 12 VDC

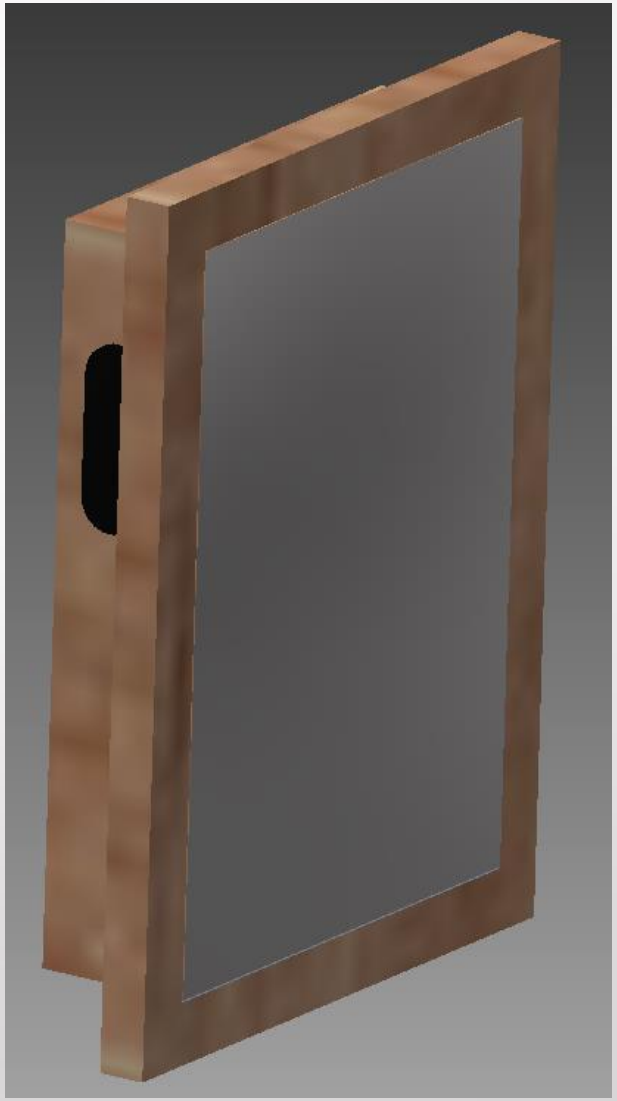


Schematic


TR1
B1
GND
C2
6800uF
AQ2A2-J-ZP3
12V
LM7805ACT-TO220
VIN
VOUT
GND
12VO
D7
K1
5V
RPI
RX
TX
U1
RST
PD0/RX
PD1/TX
PD2
PD3
PD4
VCC
GND
X1
X2
PD5
PD6
PD7
PB0
PC5
PC4
PC3
PC2
PC1
PC0
GND
AREF
AVCC
PB5
PB4
PB3
PB2
PB1
C1
100n
Y1
16MHZ
C4
ICP
SV3
ADC5/SCL
ADC4/SDA
ADC3
ADC2
ADC1
ADC0
SV1
AD5/SCL
AD4/SDA
AREF
SCK
MISO
MOSI
SS
OC1
SV2
C5
FAN1
FAN2
MOTION1
MOTION2
MOTION3
TEMP
LIGHT1
LIGHT2

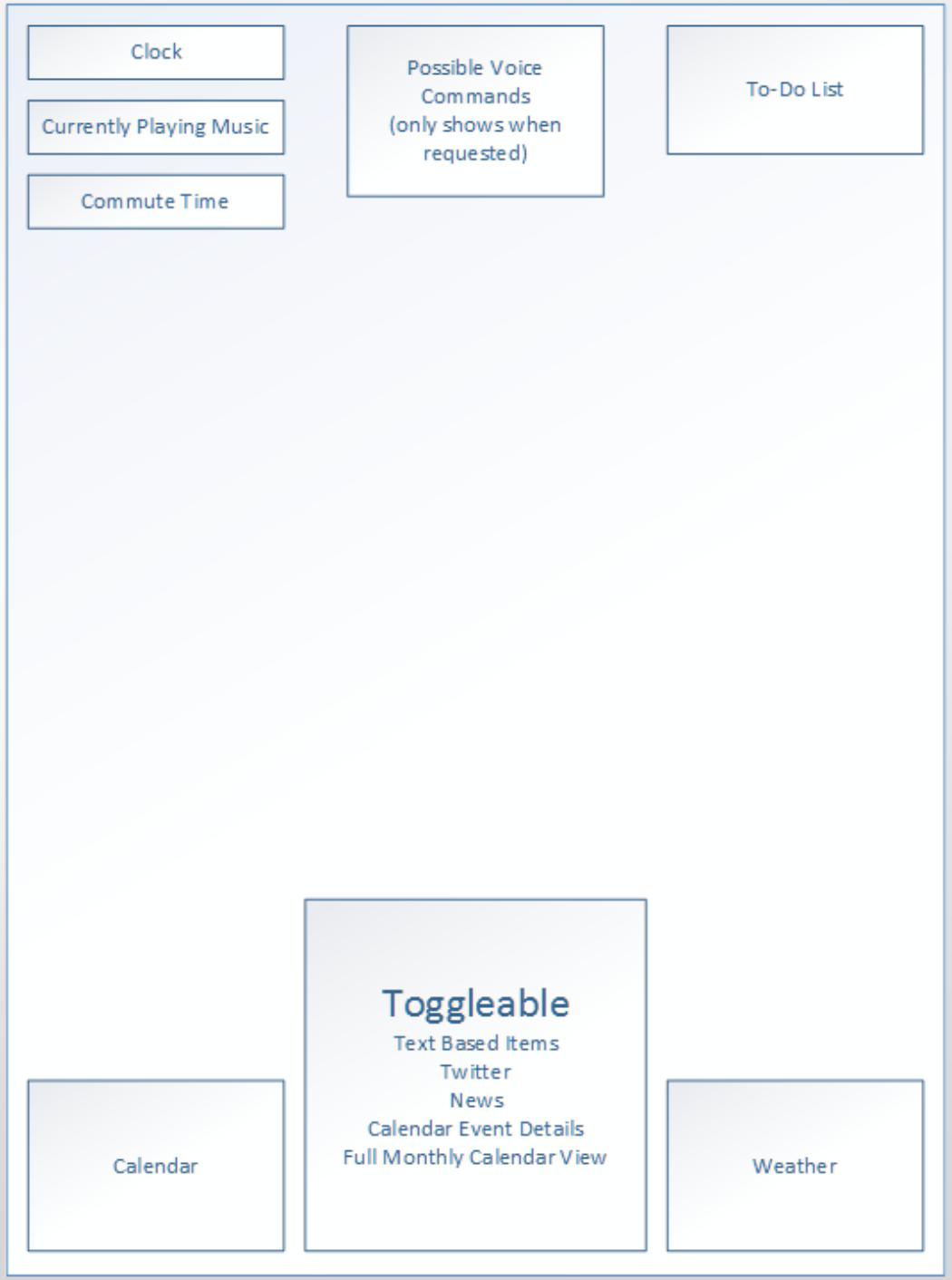
Mirror Housing

- Stained Wooden Frame
  - Frame backed by sturdy housing
- One-Way Mirror In Front of TV
- Motion Sensor Mounted on Bottom
- Speakers on Sides
- Raspberry Pi USB Access on Side
- Single LED Mounted on Bottom



Display Layout

- Offer information at all times
- Preserve mirror space
- Display important information closest to where your eyes fall
- Removable display elements for different use cases



Software Design

Considerations

- Run on multiple platforms seamlessly
- Adaptable UI across platforms
- Modularity
  - For ease of creation with multiple developers
  - For future additional features

Results

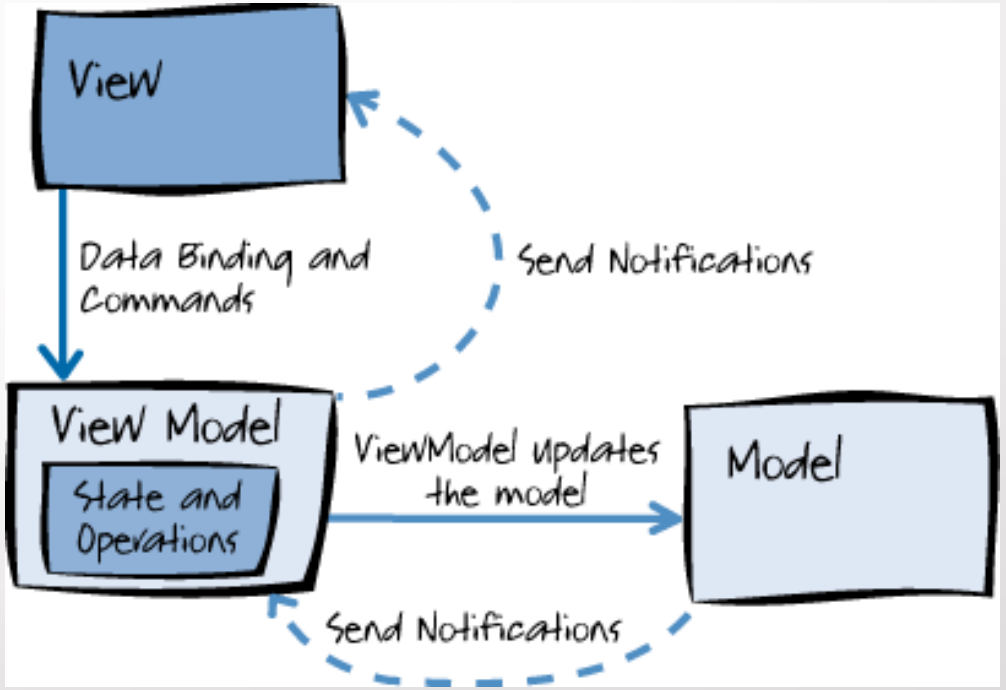
- Universal Windows Platform
- Model-View-View Model Pattern

Universal Windows Platform (UWP)

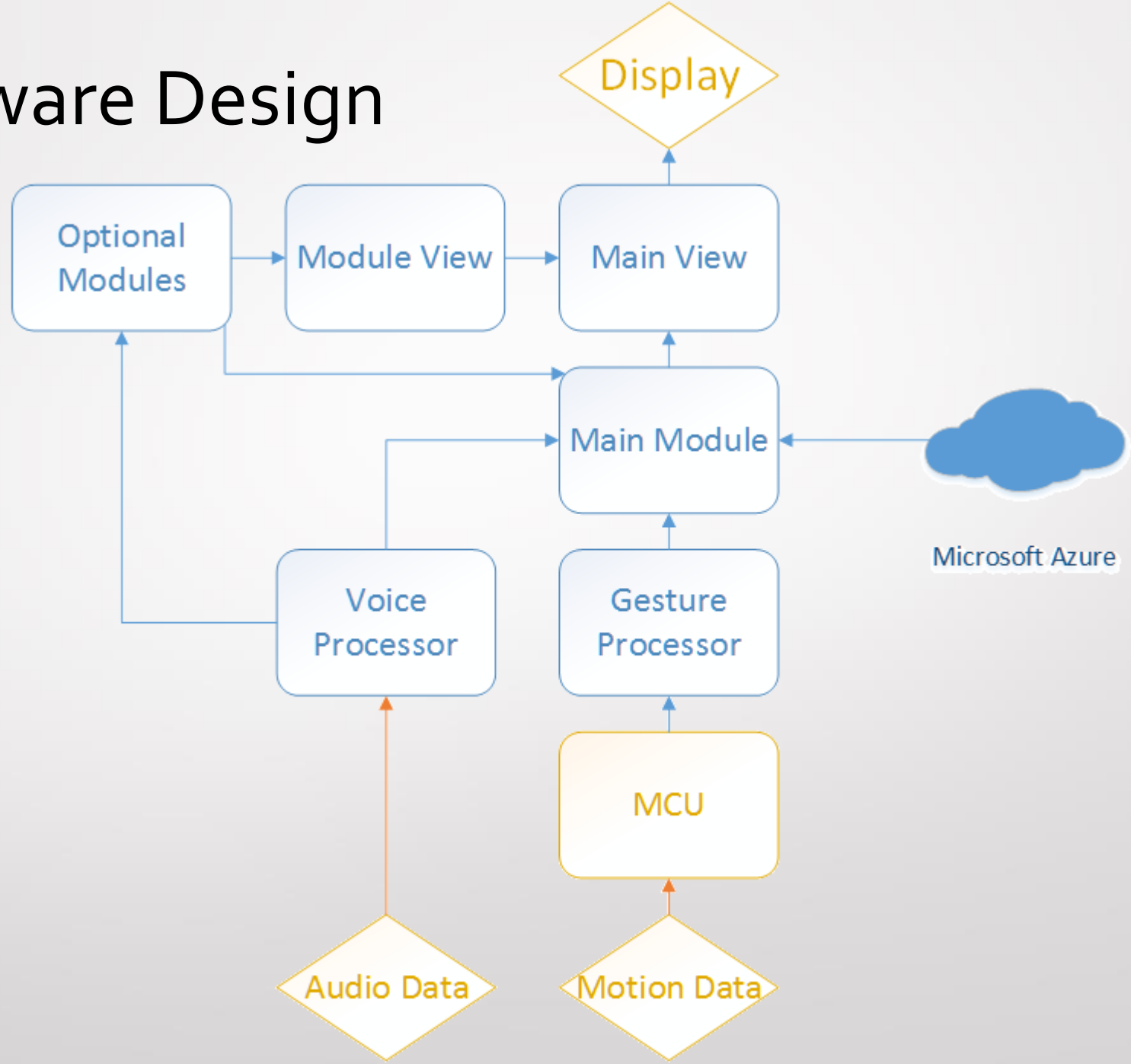
- Standard Windows 10 runtime model
- GUI defined by XAML files using data binding for modularity
- Common API accessible by all Windows 10 devices
- Different API's accessible by individual platforms

Model-View-View Model (MVVM)

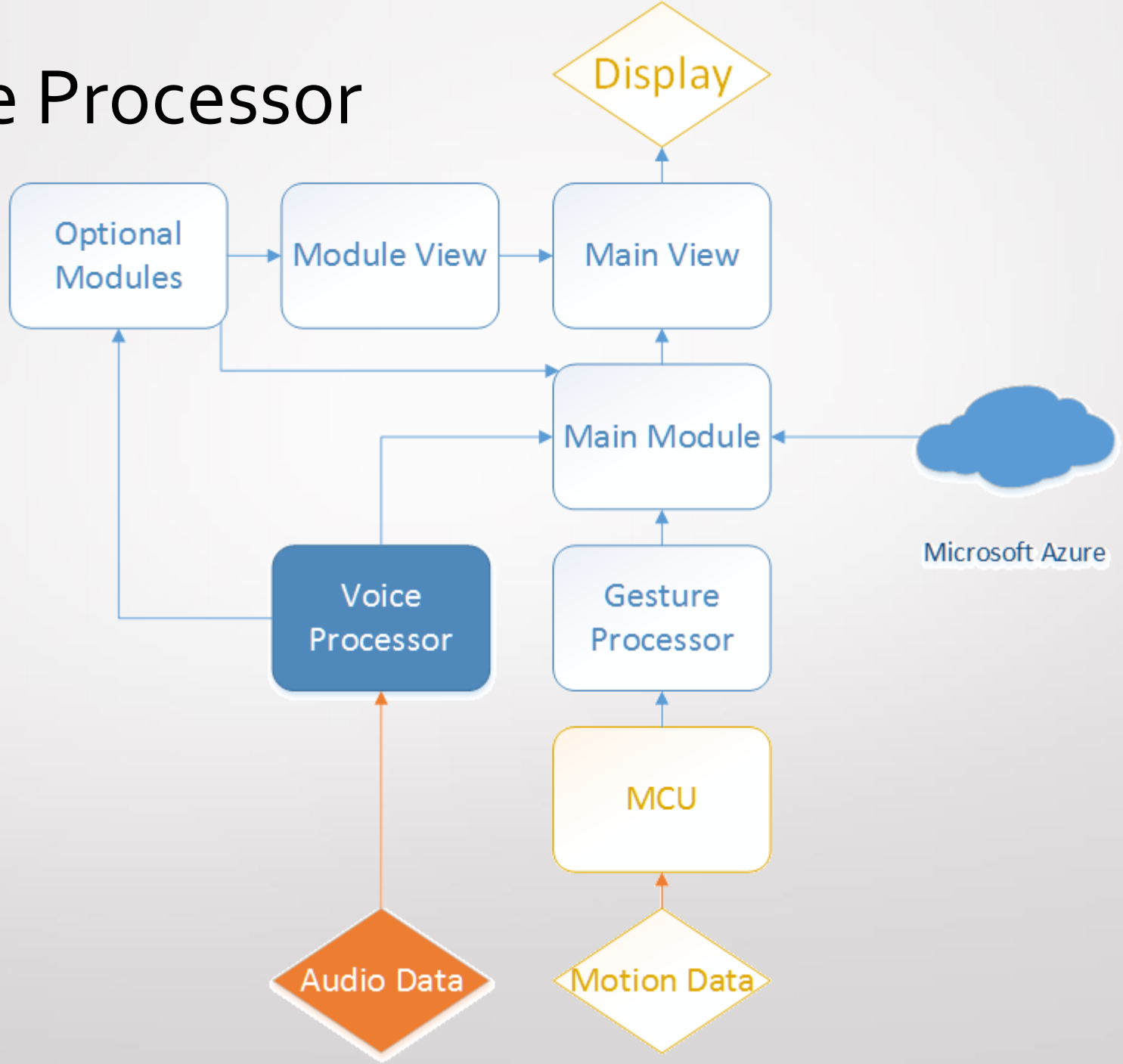
- Two reasons
  - Works great with UWP
  - Supports Modularity
- Loose coupling with Data Binding allows information to be seamlessly switched
- Easily format different data into similar layouts
- Easily create multiple GUI layouts from the same data bindings



Software Design

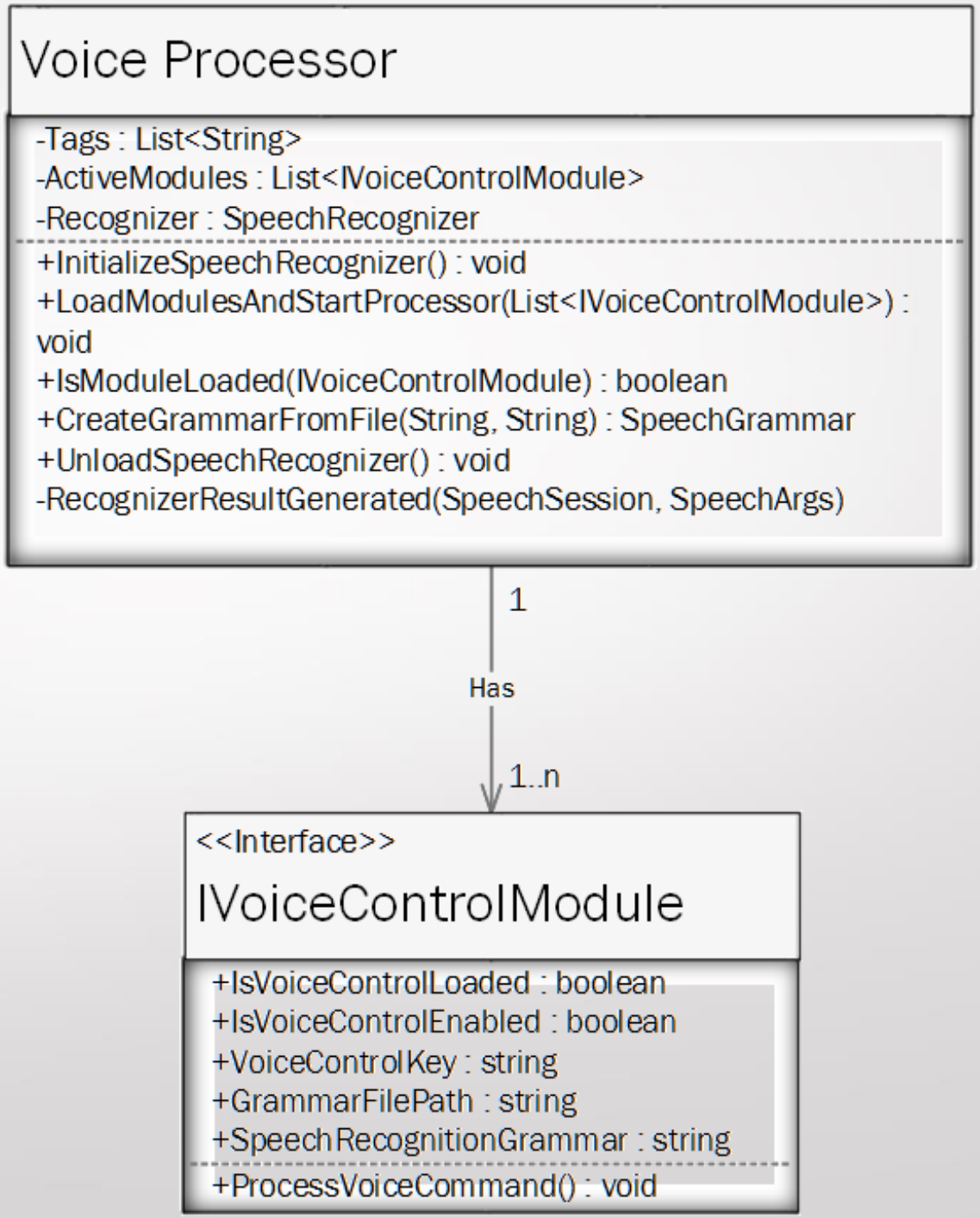


Voice Processor

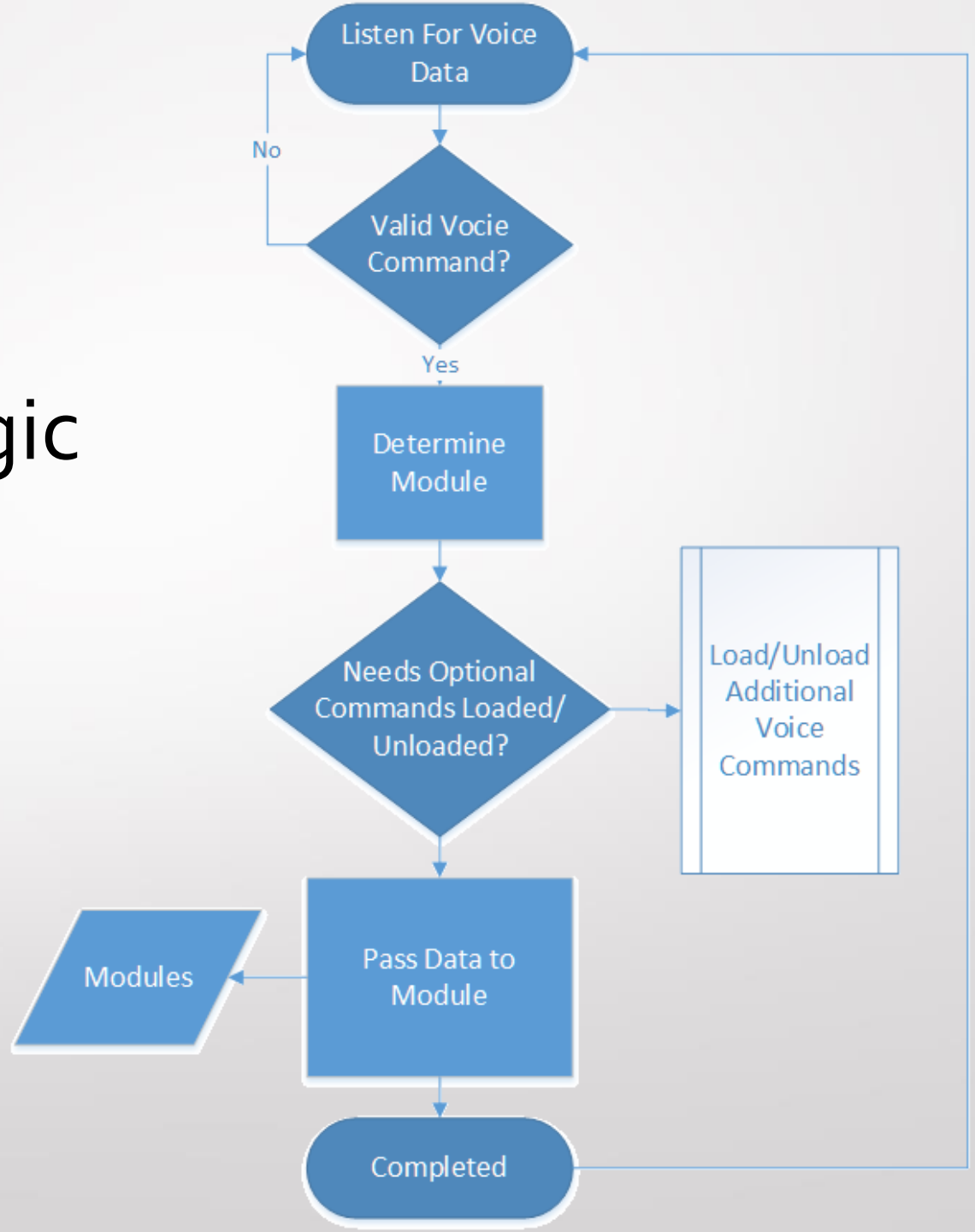


Voice Processor Class Diagram

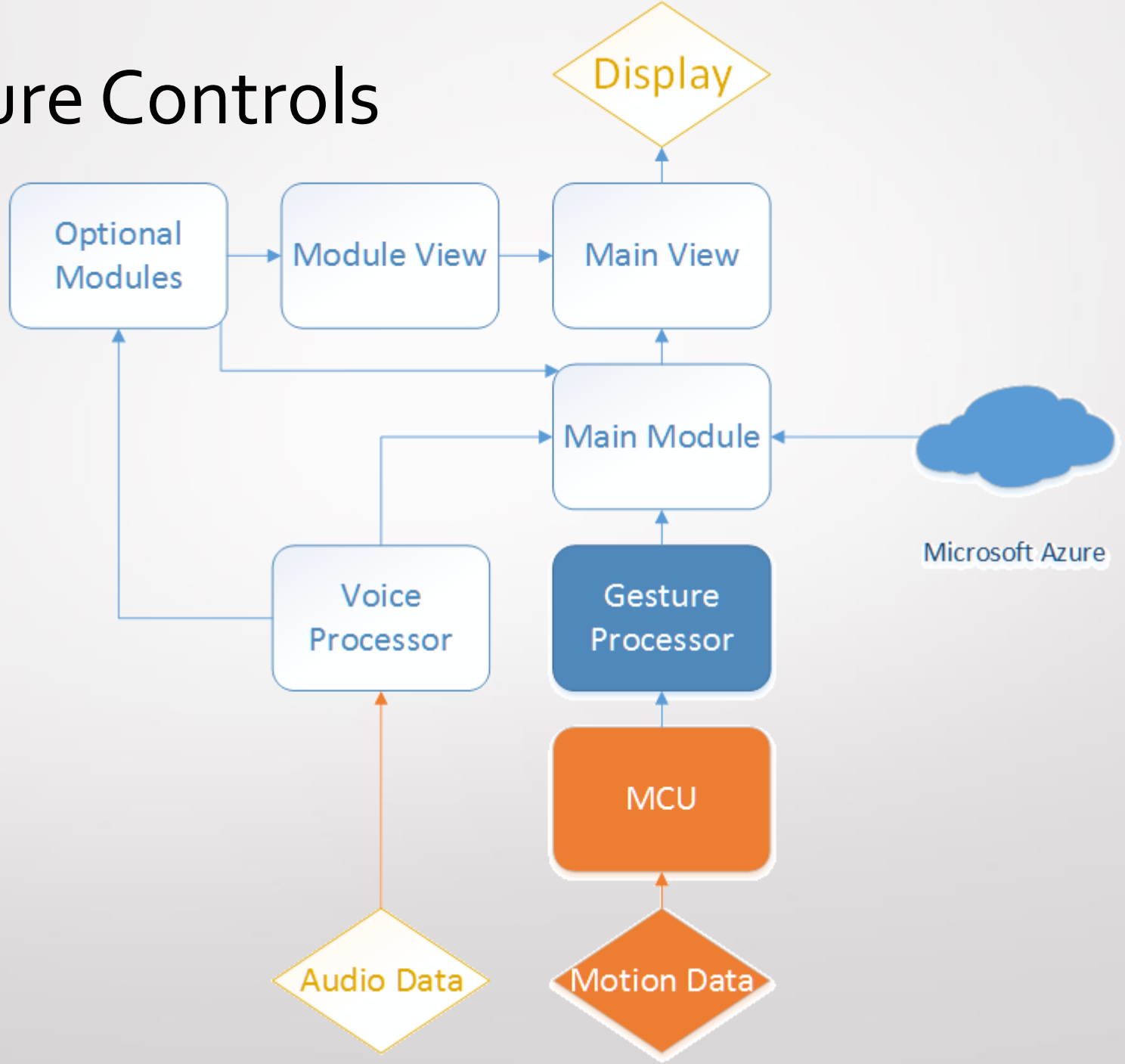
- Singleton Class
- Runs in separate thread
- Contains reference to all voice controlled modules
- Passes control to appropriate module when command received



Voice Processor Logic



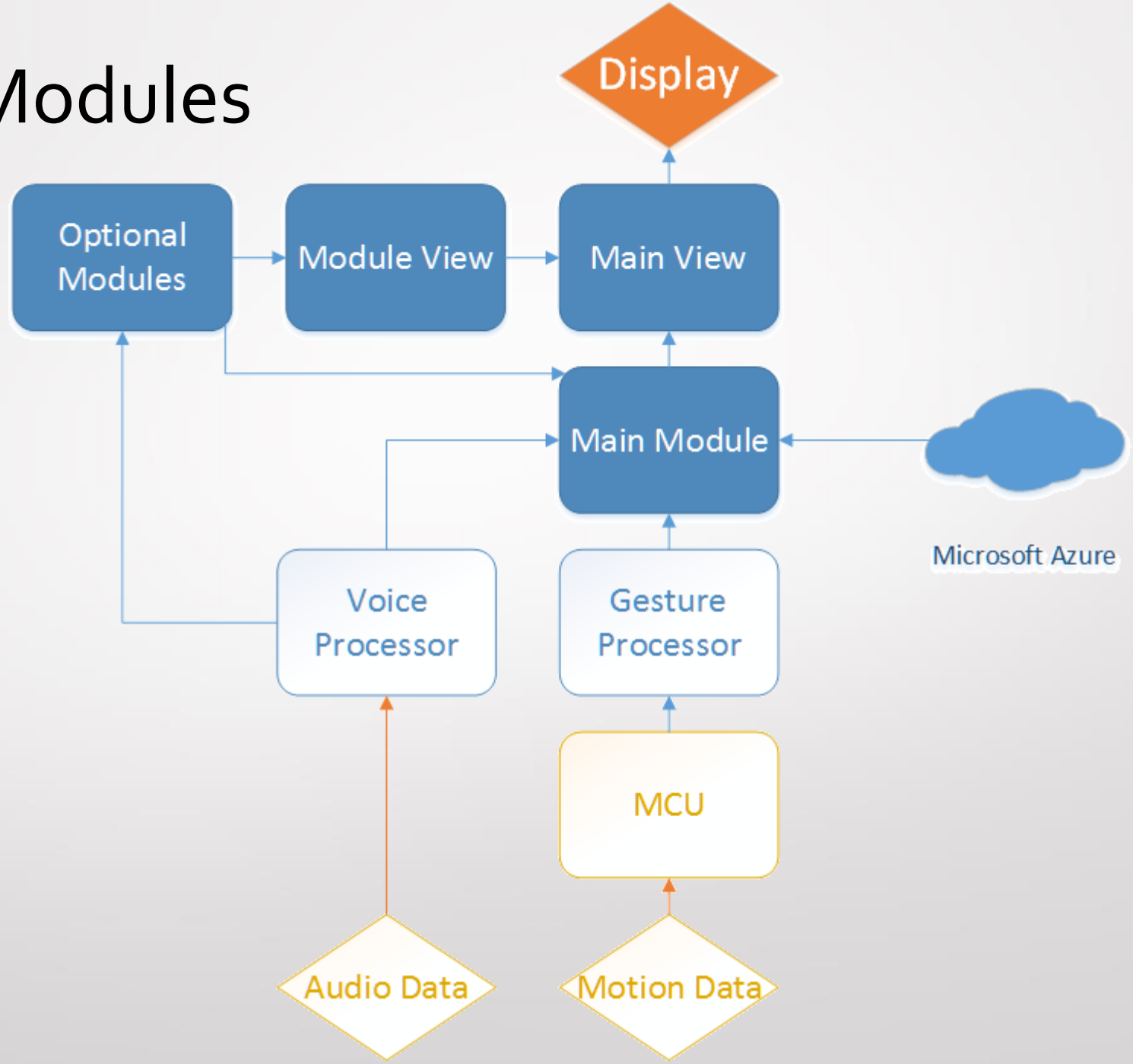
Gesture Controls



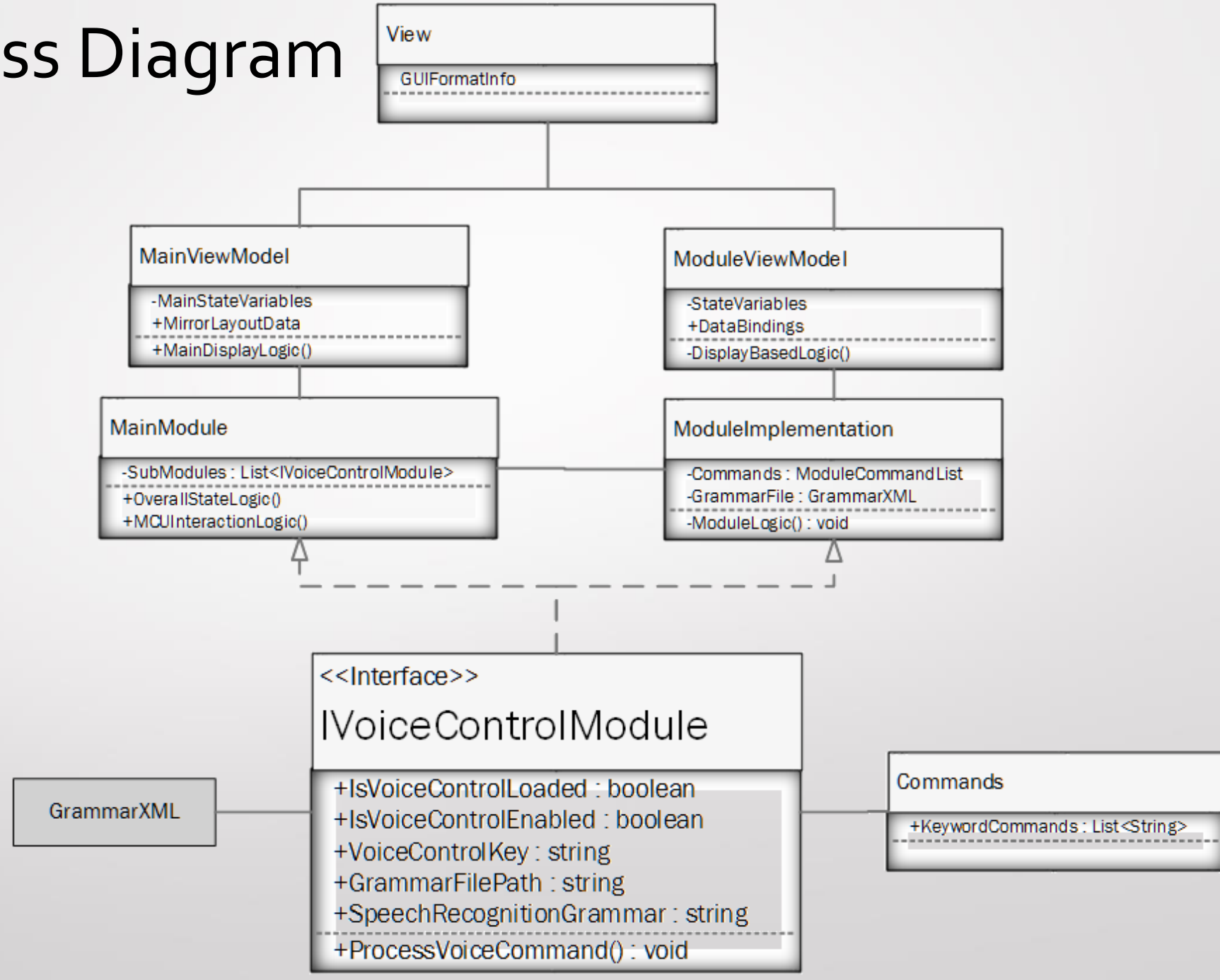
Gesture Controls

- Simple Gesture Controls
  - Use of the mirror itself
  - Hardware Limitations
    - Kinect: 3.1GHz Processor, USB 3.0, 4GB RAM
    - Leap Motion: 2GB RAM
- Uses
  - Pause music to give voice command.
  - Scroll through certain text based display items
    - News
    - Twitter
  - Next/Previous song

Modules


Display
Optional Modules
Module View
Main View
Main Module
Microsoft Azure
Voice Processor
Gesture Processor
MCU
Audio Data
Motion Data

Module Class Diagram



Main Module

- Boot into Main Module on startup
  - Win10 IoT boot option
- Maintains a reference to all submodules for information exchange
- Handles all sensory information from MCU

Software Modules

- Clock
- Weather
- Calendar
- To-Do List
- News
- Twitter
- Music
- Commute Time

Clock

- Digital Format
- Uses System Time
  - Raspberry Pi – Windows 10 IoT
    - NTP server
- Stretch Goal:
  - Analog clock display

10:02 AM

Weather

- OpenWeatherMap API
  - Returns JSON object
- Formats:
  - Current Weather
  - Today's Weather
    - 3 hour intervals – Highs and Lows & Icon
  - Tomorrow's Weather
    - 3 hour intervals – Highs and Lows & Icon
  - Week's Weather
    - 5-day forecast – Highs and Lows & Icon

Calendar

- Google Calendar API | Microsoft Calendar | Other
- Today View
  - Upcoming Events
- Month View
  - Days with events will be bolded

To-Do List

- Todoist API
  - Returns JSON object
- Task Manager | Reminders
- Task List Syncing
  - Multiplatform

News

- News Headlines
  - List of 4 Headlines
- CNN
  - RSS2JSON API
    - Returns JSON object
- Request different categories via Voice Command
  - World News
  - Local
  - Politics
  - …

Twitter

- Twitter API
- Show latest 4 tweets
- Show/Hide module via Voice Command

Music

- Spotify | Pandora | Google Play | Local Media
- Now Playing View
  - Artist – Song – Album Cover
- Request music via Voice Command
- Sound output to integrated speakers

Commute Time

- User sets location
  - Work | School

Commute Time

- User sets location
  - Work | School
- Google Maps
  - Distance Matrix API
  - Fetch travel time from current location

Configuration & Setup

- Initial User Setup
  - User accounts
    - Twitter
    - Todoist
  - Music Library
  - Work/School Locations
- UWP app to configure these settings
- Stretch Goal: iOS/Android app

Administrative Content

Work Distribution

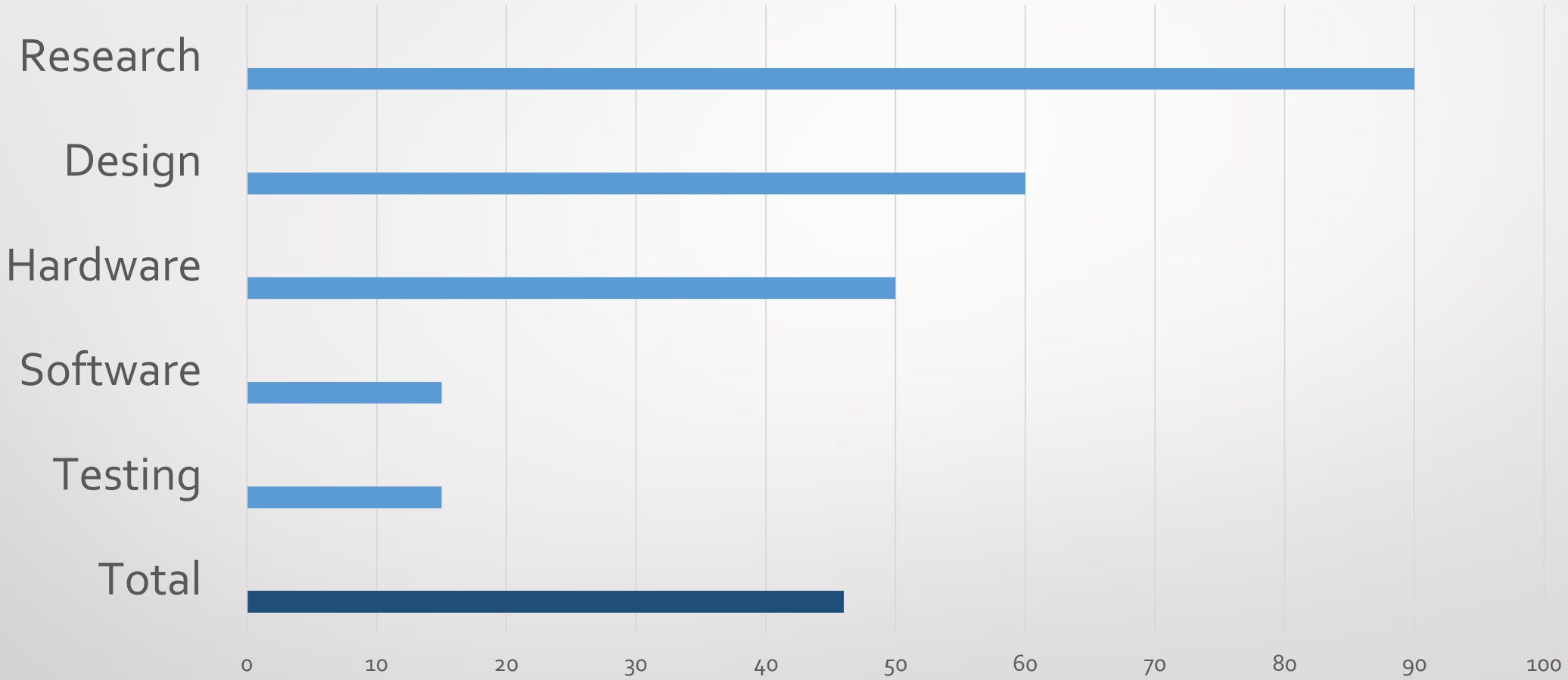
Name	Embedded Hardware	Voice Recognition	Software Modules	Frame Design
Hector Zacarias	P			S
Justin Gentry	S	P	S	P
Michael Trivelli		S	P	S

Budget

Item	Quantity	Cost
MCU	0	$0
Power Relay	1	$1.41
Fan	2	$20.48
Diodes	4	$1.25
Proto Broad	2	$0.76
Motion Sensor (Long-Range)	2	$3.60
Motion Sensor (Short-Range)	1	$21.95

Item	Quantity	Cost
Humidity and Temp	1	$1.75
Transformer	1	$18.99
Auria 32" 1080p HDTV	1	$100
Raspberry Pi 2	1	$114.95
Microphone	1	$10.64
Speakers	1	$0
Mirror Assembly/Frame	1	$104.25
Total:		$448.53

Progress


Research
Design
Hardware
Software
Testing
Total
0
10
20
30
40
50
60
70
80
90
100

Issues

- OAuth
- Music Player
  - APIs
- Motion/Light sensor
- False voice recognition
- Eagle learning curve

Questions?