

## Google AIY Technical Review and Hardware Analysis

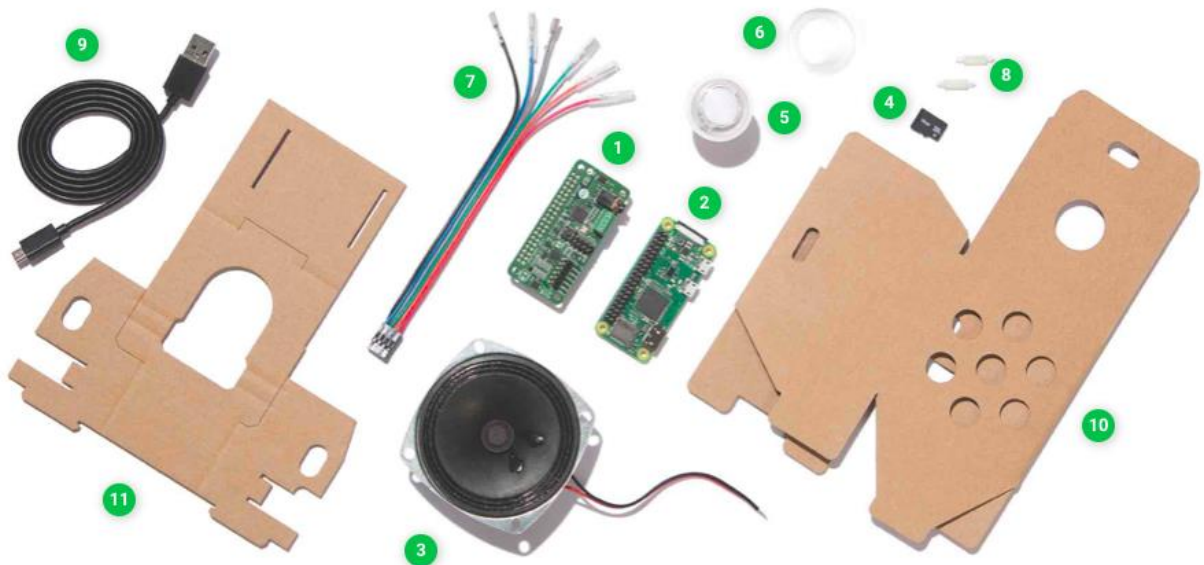
After completing several micro projects and running out of ideas, I searched the internet for some motivation. One of the coolest and most innovative little gizmos I stumbled upon this holiday shopping season is the new Google AIY kits - <https://aiyprojects.withgoogle.com>. Dubbed “Vision Kit” by Google, it’s a fully functional DIY intelligent camera that allows experimentation with image recognition using neural networks. Another kit, the “Voice Kit” is a DIY intelligent speaker, tinker with voice recognition and the Google Assistant. Both devices are available for purchase at Target.com, the Voice Kit costs 49.99 and the Vision Kit costs 89.99.

Purchase Voice Kit: <https://www.target.com/p/-/A-53416295>

Purchase Vision Kit: <https://www.target.com/p/-/A-53417081>

The following projects will provide an depth technical review and computer hardware analysis of the Vision Kit – project 6 and Voice Kit – project 7.

### Project 6 – Voice Kit



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Ga5010  
Micro-Project 6 and 7

IN YOUR KIT

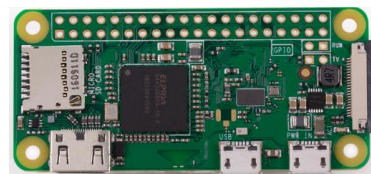
1	Voice Bonnet	(x1)	7	Button harness	(x1)
2	Raspberry Pi Zero WH	(x1)	8	Standoffs	(x2)
3	Speaker	(x1)	9	Micro USB cable	(x1)
4	Micro SD card	(x1)	10	Speaker box cardboard	(x1)
5	Push button	(x1)	11	Internal frame cardboard	(x1)
6	Button nut	(x1)			

- Table of Important Hardware Components

1 Voice Bonnet



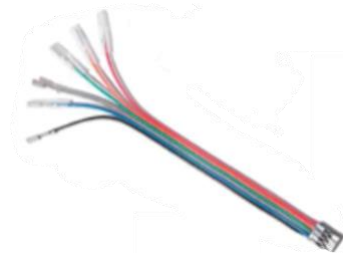
2 Raspberry Pi Zero WH



4 Micro SD Card



## 7 Button Harness



## Voice Bonnet



As shown in the table below, the voice bonnet has dedicated pins (paths) for interactions with the Raspberry Pi – the main system computer.

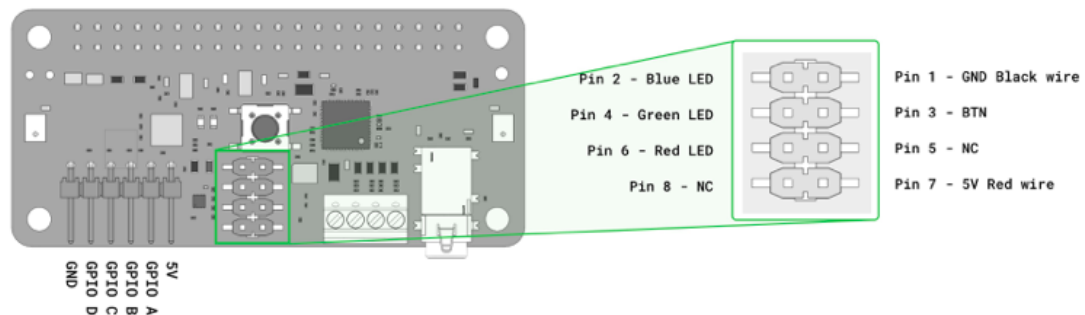


Figure 2. Voice Bonnet top

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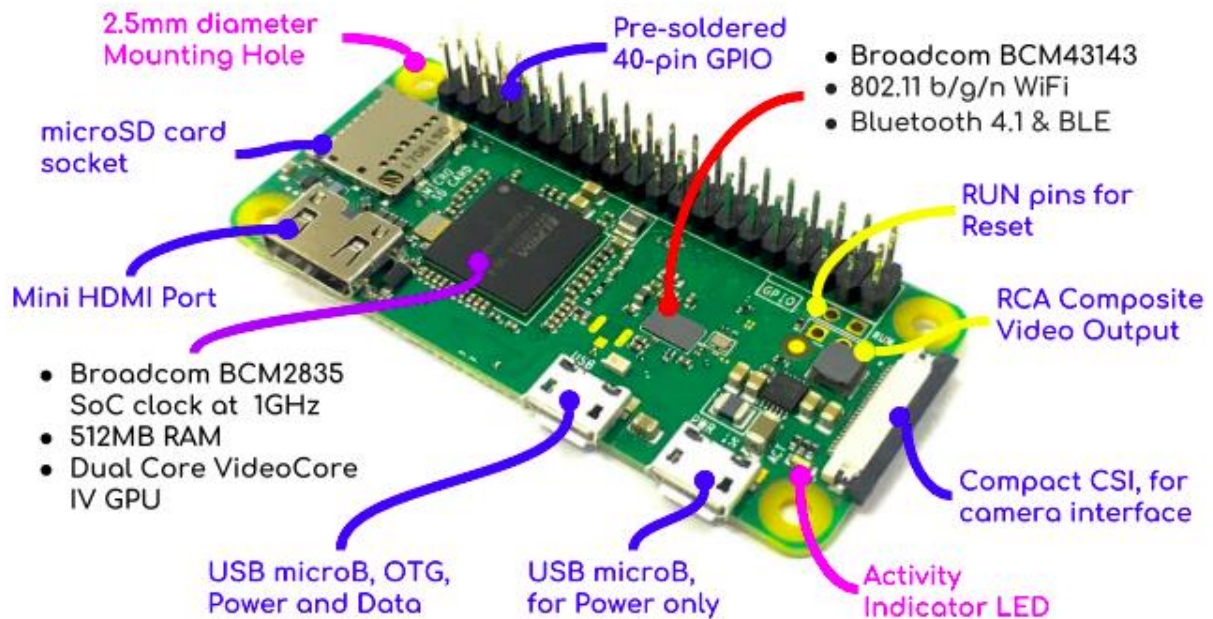
PIN NAME	FUNCTION	Voice Bonnet		FUNCTION	PIN NAME
	3V3 power	1		2	5V power
GPIO 02	I2C SDA	3		4	5V power
GPIO 03	I2C SCL	5		6	Ground
GPIO 04	GPIO	7		8	UART TXD
	Ground	9		10	UART RXD
GPIO 17	GPIO	11		12	I2S BCLK
GPIO 27	GPIO	13		14	Ground
GPIO 22	GPIO	15		16	GPIO (LED button)
	3V3 power	17		18	GPIO
GPIO 10	SPI MOSI	19		20	Ground
GPIO 09	SPI MISO	21		22	GPIO
GPIO 11	SPI SCLK	23		24	SPI CE0
	Ground	25		26	SPI CE1
GPIO 00	I2C (EEPROM)			28	I2C (EEPROM)
GPIO 05	GPIO	29		30	Ground
GPIO 06	GPIO	31		32	PWM0
GPIO 13	PWM1	33		34	Ground
GPIO 19	I2S LRCLK	35		36	GPIO
GPIO 26	GPIO	37		38	I2S SDIN
	Ground	39		40	I2S SDOOUT

The Voice Bonnet also includes a dedicated microcontroller (MCU) that enables the following GPIO features:

- Control of four additional GPIO pins, freeing up the Pi GPIOs for other uses
- PWM support for servo/motor control without taxing the Raspberry Pi's CPU
- Analog input support via on-board analog-to-digital converter (ADC)
- Control of the two LEDs on the bonnet

The extra GPIO pins are provided on the top of the Voice Bonnet (see figure 2). You can control the GPIOs and LEDs with the [gpiozero library](#), using pin names PIN\_A, PIN\_B, PIN\_C, PIN\_D, LED\_1, and LED\_2.

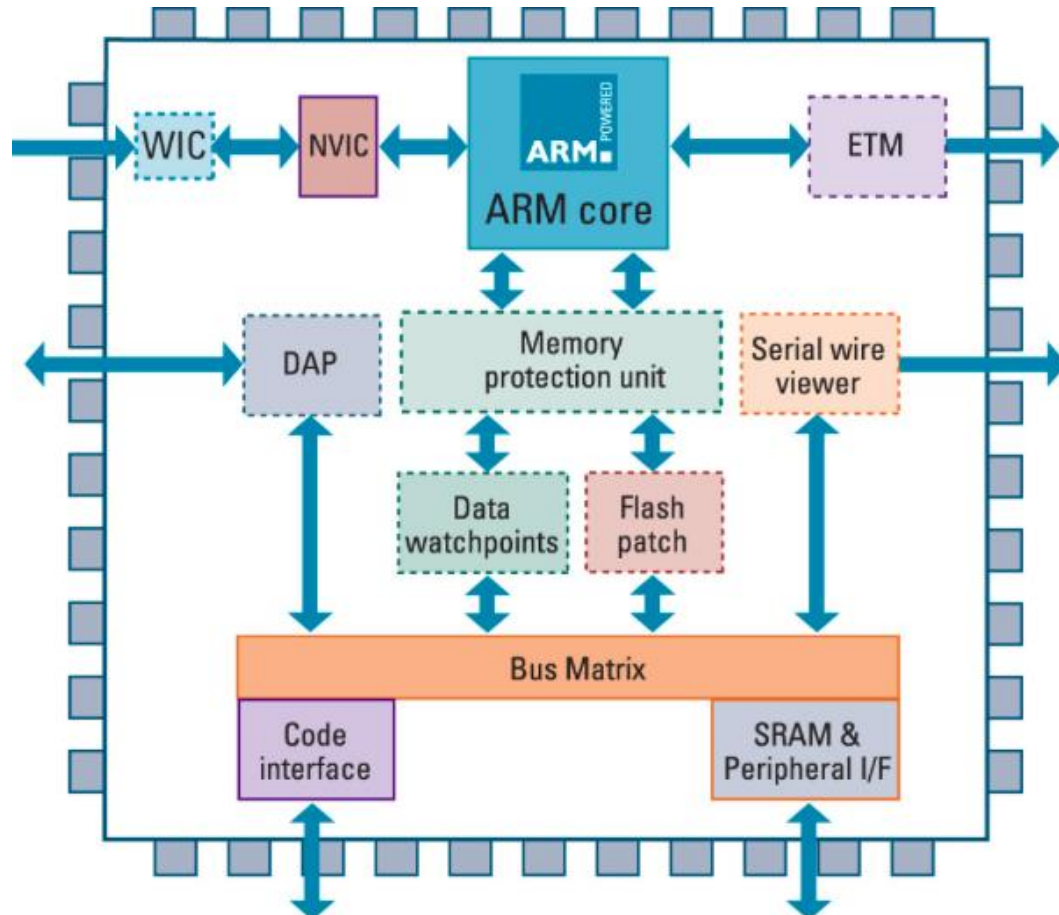
## Raspberry Pi Zero WH



Shown above is the architectural mapping of the Raspberry Pi Zero WH, most importantly it has Broadcom BCM2835 CPU which has a clock speed of 16Hz – 16 revolutions of instructions processed every second.

BCM2835 CPU – Uses ARM (Advanced RISC Machine) instruction set in contrast to M68k instruction set implement in class. For a comprehensive explanation of BCM2835 CPU visit

<https://www.raspberrypi.org/documentation/hardware/raspberrypi/bcm2835/BCM2835-ARM-Peripherals.pdf>



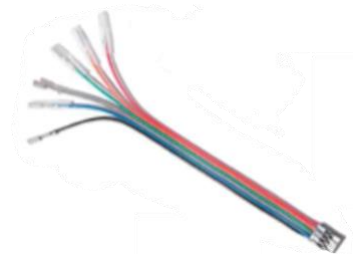
Micro SD Card



A micro SD card is peripheral memory device that enables the transfer of data between the memory location and CPU buses.

Button Harness

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The button harness is the connection between the activation button and the voice bonnet. This utilizes an I/O bus to communicate high and low button inputs and a control bus to communicate instructions in the voice bonnet.

## Voice Kit Conclusion

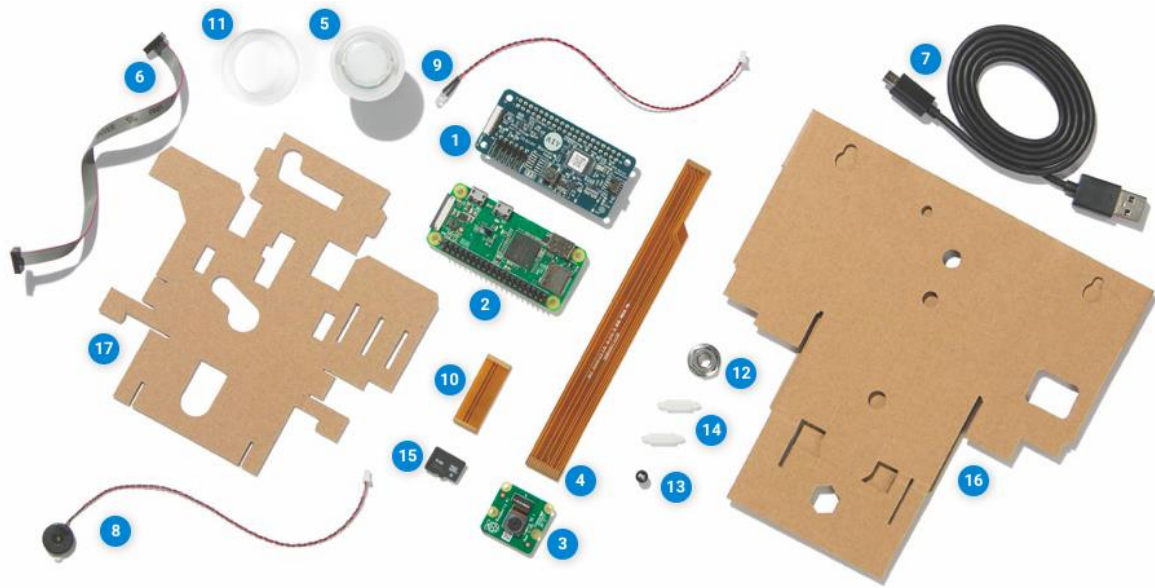
Full assembly and customization tutorial can be found at  
<https://aiyprojects.withgoogle.com/voice/#makers-guide>

Suggested Custom Project: Model Train Controller -  
[https://www.youtube.com/watch?time\\_continue=107&v=upwcDQnQhIs](https://www.youtube.com/watch?time_continue=107&v=upwcDQnQhIs)

## Project 7 – Vision Kit



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IN YOUR KIT

1	Vision Bonnet	(x1)	10	Short flex cable	(x1)
2	Raspberry Pi Zero WH	(x1)	11	Button nut	(x1)
3	Raspberry Pi Camera v2	(x1)	12	Tripod nut	(x1)
4	Long flex cable	(x1)	13	LED bezel	(x1)
5	Push button	(x1)	14	Standoffs	(x2)
6	Button harness	(x1)	15	Micro SD card	(x1)
7	Micro USB cable	(x1)	16	Camera box cardboard	(x1)
8	Piezo buzzer	(x1)	17	Internal frame cardboard	(x1)
9	Privacy LED	(x1)			

- Table of Important Hardware Components

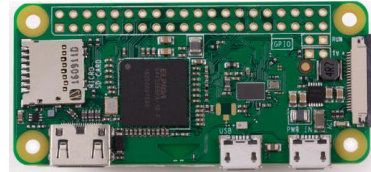


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1 Vision Bonnet



2 Raspberry Pi Zero WH



3 Raspberry Pi Camera V2



Assorted I/O and Control Devices:

- 4 – Long flex cable
- 5 – Push Button
- 6 – Button Harness
- 8 – Piezo Buzzer
- 9 – Privacy LED
- 10 – Short Flex Cable



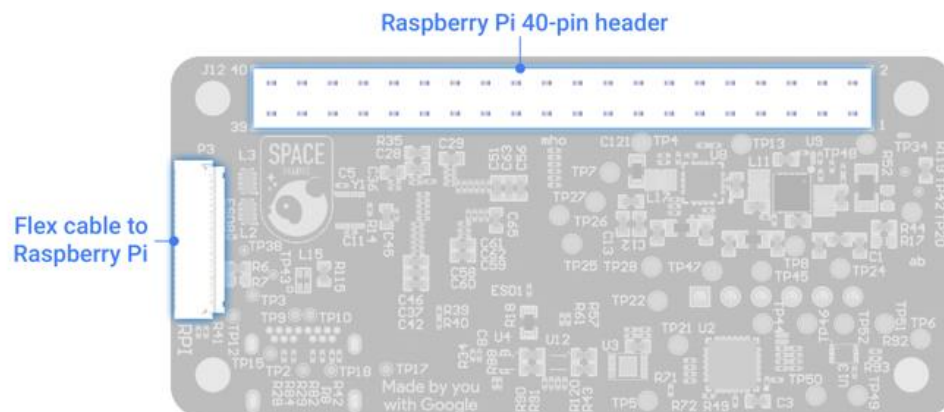
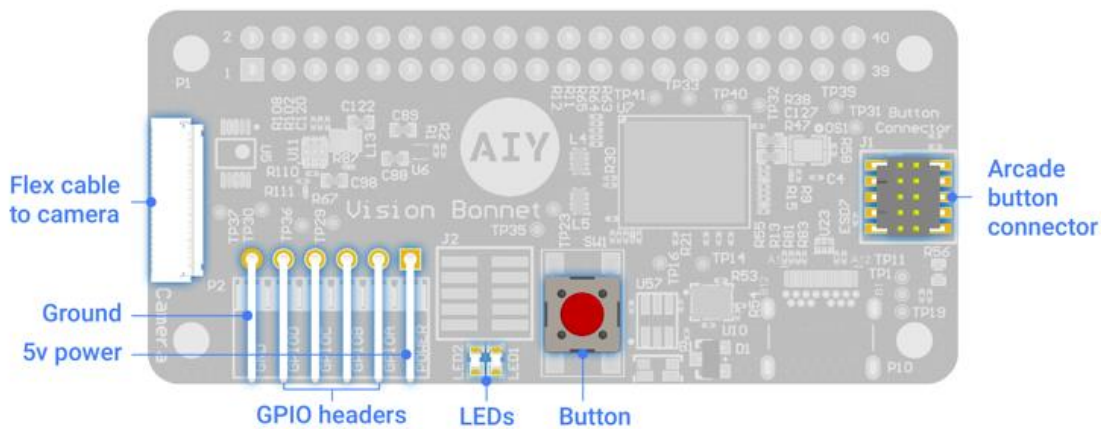
15 Micro SD Card



## Vision Bonnet



- Communication structure between vision bonnet and raspberry pi, dedicated pins (paths) for various functions (see table below).



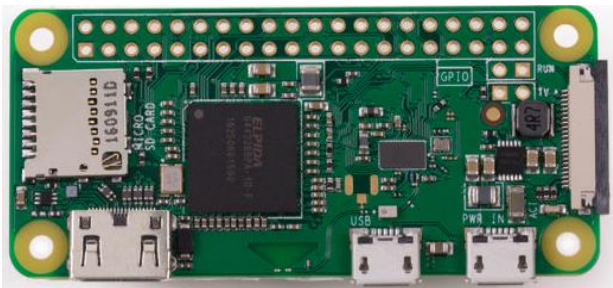
PIN NAME	FUNCTION	Vision Bonnet		FUNCTION	PIN NAME
	3V3 power	1	<input type="radio"/>	2	5V power
GPIO 02	I2C SDA	3	<input checked="" type="radio"/>	4	5V power
GPIO 03	I2C SCL	5	<input checked="" type="radio"/>	6	Ground
GPIO 04	GPIO	7	<input type="radio"/>	8	UART TXD
	Ground	9	<input type="radio"/>	10	UART RXD
GPIO 17	GPIO	11	<input type="radio"/>	12	I2S BCLK
GPIO 27	GPIO	13	<input type="radio"/>	14	Ground
GPIO 22	GPIO (Piezo buzzer)	15	<input checked="" type="radio"/>	16	GPIO (LED button)
	3V3 power	17	<input type="radio"/>	18	GPIO
GPIO 10	SPI MOSI	19	<input checked="" type="radio"/>	20	Ground
GPIO 09	SPI MISO	21	<input checked="" type="radio"/>	22	GPIO
GPIO 11	SPI SCLK	23	<input checked="" type="radio"/>	24	SPI CE0 (Myriad)
	Ground	25	<input type="radio"/>	26	SPI CE1
GPIO 00	I2C (EEPROM)	27	<input checked="" type="radio"/>	28	I2C (EEPROM)
GPIO 05	GPIO	29	<input type="radio"/>	30	Ground
GPIO 06	IRQ (Pi to Myriad)	31	<input checked="" type="radio"/>	32	PWM0
GPIO 13	IRQ (Myriad to Pi)	33	<input checked="" type="radio"/>	34	Ground
GPIO 19	GPIO	35	<input type="radio"/>	36	GPIO
GPIO 26	GPIO	37	<input checked="" type="radio"/>	38	GPIO
	Ground	39	<input type="radio"/>	40	GPIO

The vision bonnet also has some extra pins for external uses as detailed below:

- Control of four additional GPIO pins, freeing up the Pi GPIOs for other uses
- PWM support for servo/motor control without taxing the Raspberry Pi's CPU
- Analog input support via on-board analog-to-digital converter (ADC)
- Control of the two LEDs on the bonnet

The extra GPIO pins are provided on the top of the Vision Bonnet. You can control the GPIOs and LEDs with [the gpiozero library](#), using pin names PIN\_A, PIN\_B, PIN\_C, PIN\_D, LED\_1, and LED\_2.

## Raspberry Pi Zero WH



The raspberry pi for the vision kit is exactly the same for the Vision and Voice Kit, please reference the Raspberry Pi Zero WH section in Project 6 – Voice Kit.

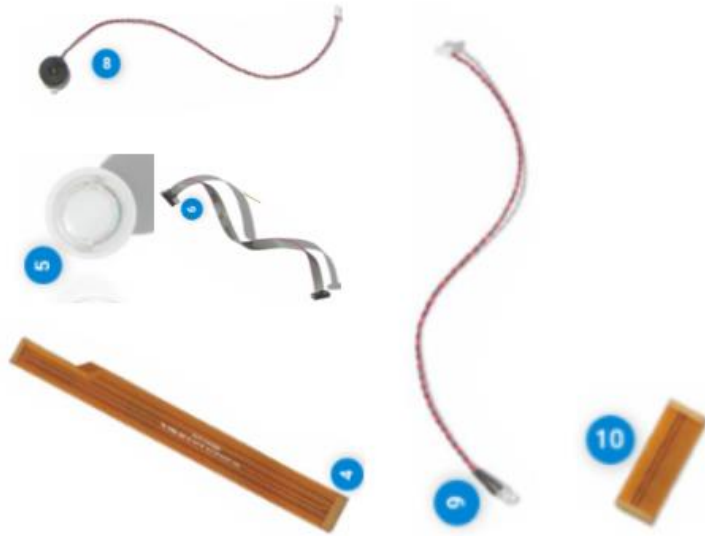
## Raspberry Pi Camera V2



The Raspberry Pi Camera V2 is an 8 megapixel camera capable of taking photographs of 3280 x 2464 pixels. Capture video at 1080p30, 720p60 and 640x480p90 resolutions.

It is connected to the vision bonnet (for image processing) and ultimately the Raspberry Pi (via vision bonnet). This utilizes I/O bus, data bus, control bus, and address bus. For a more in depth explanation of the uses and customizations of this camera visit <https://picamera.readthedocs.io/en/release-1.12/fov.html>.

## Assorted I/O and Control Devices



The devices shown above establish a connection between themselves and the vision bonnet and Raspberry Pi. This utilizes an I/O and control buses to communicate high and low inputs and a control bus to communicate instructions within the vision bonnet.

## Micro SD Card



The Micro SD Card for the vision kit is exactly the same for the Vision and Voice Kit, please reference the Micro SD Card section in Project 6 – Voice Kit.

## Vision Kit Conclusion

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Full assembly and customization tutorial can be found at  
<https://aiyprojects.withgoogle.com/vision/>

Get in the Holiday Spirit with this Suggested Custom Project: Joy Detector (Object Recognition) - [https://www.youtube.com/watch?time\\_continue=124&v=Y8iQJOjw4S4](https://www.youtube.com/watch?time_continue=124&v=Y8iQJOjw4S4)