Fire and Smoke Detecting System
Group 3

Group Members:

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Summary of Proposed Project

Goal

- Checks for the presence of smoke
- Detects smoke
- Alerts people if smoke present
- LED Light glows and Buzzer starts beeping

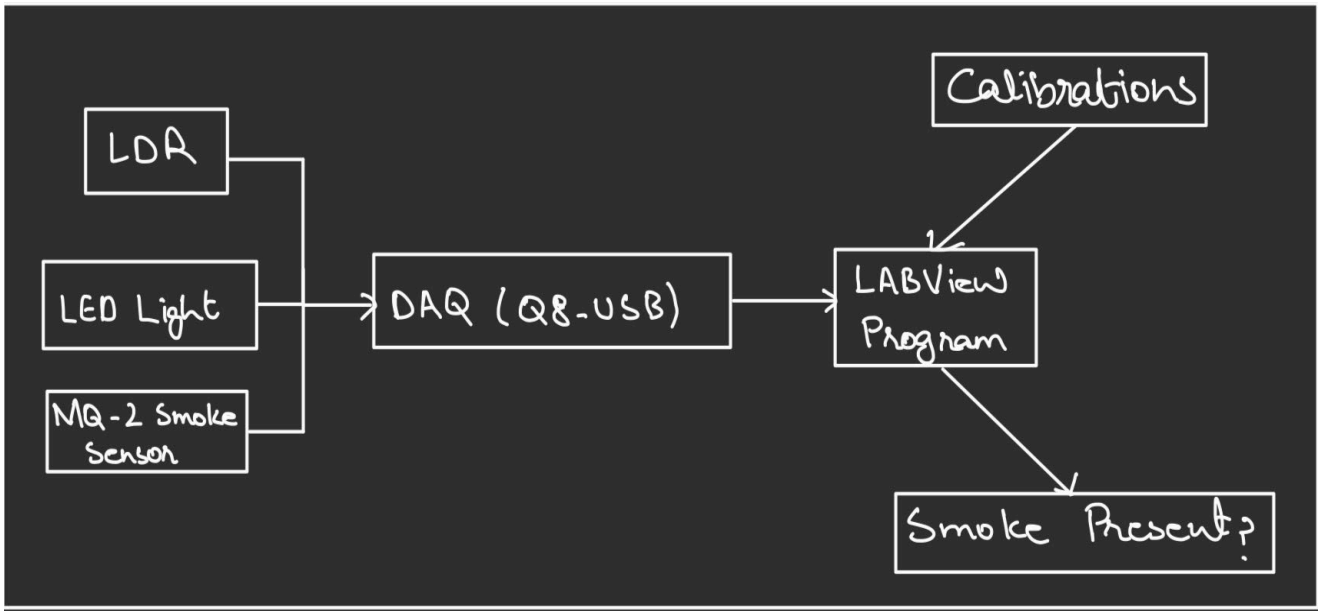
Smoke Sensor: A device designed to detect the presence of smoke in a vicinity. The MQ-2 sensor includes a heating element that allows the sensor to operate at a specific temperature, enhancing its sensitivity and response time.

Light Dependent Resistor (LDR): Photoresistors are resistors whose resistance decreases with increasing light intensity. They are made of semiconductor materials that exhibit this property. The construction of an LDR typically involves a semiconductor material whose conductivity is altered based on the amount of light it is exposed to. The material that is used mostly in LDR is cadmium sulfide. When the light interacts with the semiconductor material, it causes a change in the structure of the material that leads to the variations in the electrical conductivity.

LED Light: An LED, or Light Emitting Diode, is a semiconductor device that emits light when an electric current passes through it.

Buzzer: Buzzers are designed to generate a distinct sound when an electric current is applied. The sound is produced by the vibration of a diaphragm or other resonant element within the buzzer.

System Design



LED Light
Is a source of light for LDR to detect.

LDR
Detects the change if any in the light source by changing its resistance.

MQ-2 Smoke Sensor
Detects the presence of smoke which is going to be expressed by the blinking LED at the top.

DAQ (Q8-USB)
The voltage signal goes to Q8-USB DAQ where it gets digitized and sent to the LabVIEW program to be processed.

Calibration
In order to map the digitized voltage values to the corresponding change in resistance values, a calibration dataset is required.

LABView Program

The LABView program acts as both the data processing and user interface of the proposed instrumentation system. Within this program the digitized voltage values are compared with the calibration dataset to reveal the presence of smoke.

Design Specification

MQ-2 Gas Smoke Sensor

Specifications

- Operating voltage 5.0V±0.2V
- Adjustable sensing resistance 2KΩ-20KΩ
- Combustible gas detection with concentration 300-10000 ppm
- Heater Resistance 31Ω±3Ω (Room Temperature)
- Heater consumption ≤900mW
- Temperature Humidity 65%±5% RH

10k Ohm resistor.

1. Resistance Value: The resistor's nominal resistance is 10,000 ohms or 10k ohms, with a tolerance that specifies the range within which the actual resistance can vary. Common tolerances for resistors include ±1%, ±5%, ±10%, etc.

2. Power Rating:This indicates the maximum amount of power the resistor can dissipate without being damaged. For a 10k ohm resistor, common power ratings might be 0.125W, 0.25W, 0.5W, 1W, etc.

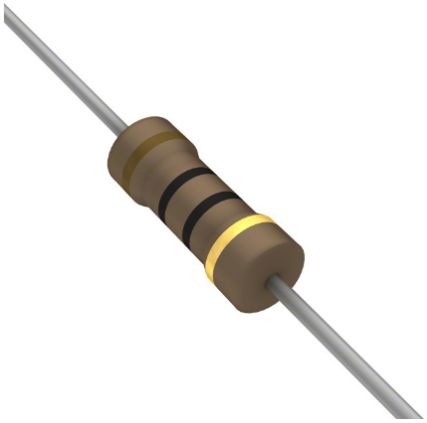
3. Tolerance: This specifies the allowable deviation from the nominal resistance value. For instance, a 10k ohm resistor with a ±5% tolerance means the actual resistance can be within 5% higher or lower than 10k ohms.

4. Temperature Coefficient: Indicates how much the resistor's resistance changes with temperature. It's typically expressed in parts per million per degree Celsius (ppm/°C).

5. Physical Size and Package: Resistors come in various sizes and package types. Surface mount resistors (SMD) and through-hole resistors differ in their physical dimensions and the way they are mounted on a circuit board.

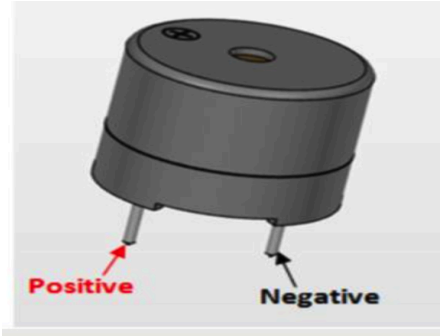
6. Maximum Voltage:Specifies the maximum voltage the resistor can handle without breaking down or causing issues.

Remember, these specifications can vary between different manufacturers and resistor series. Always refer to the datasheet provided by the manufacturer for precise details about a specific 10k ohm resistor.



Buzzer Features and Specifications

- Rated Voltage: 6V DC
- Operating Voltage: 3.3-5V DC
- Rated current: <30mA
- Sound Type: Continuous Beep
- Resonant Frequency: ~2300 Hz



Active Passive Buzzer Pinout

Light Dependent Resistor (LDR) Specifications:

1. Resistance Range: LDRs have a wide resistance range depending on light conditions

- In darkness or low light, resistance can be in the range of several megaohms (MΩ).
- In bright light, resistance can drop to hundreds of ohms (Ω) or even lower.

2. Resistance Sensitivity: The change in resistance concerning light intensity is significant. For instance:

- Sensitivity might be in the range of **several orders of magnitude** (e.g., 10^4 - 10^6 ohms) from dark to bright light.

3. Response Time: The response time of an LDR to changes in light can vary.

- Typically, it responds within milliseconds, but the exact response time can depend on the specific LDR model.

4. Dark Resistance: The resistance of an LDR in total darkness.

- Usually ranges from megaohms (MΩ) to tens of megaohms (MΩ).

5. Illumination Range: The range of light intensities the LDR can effectively detect.

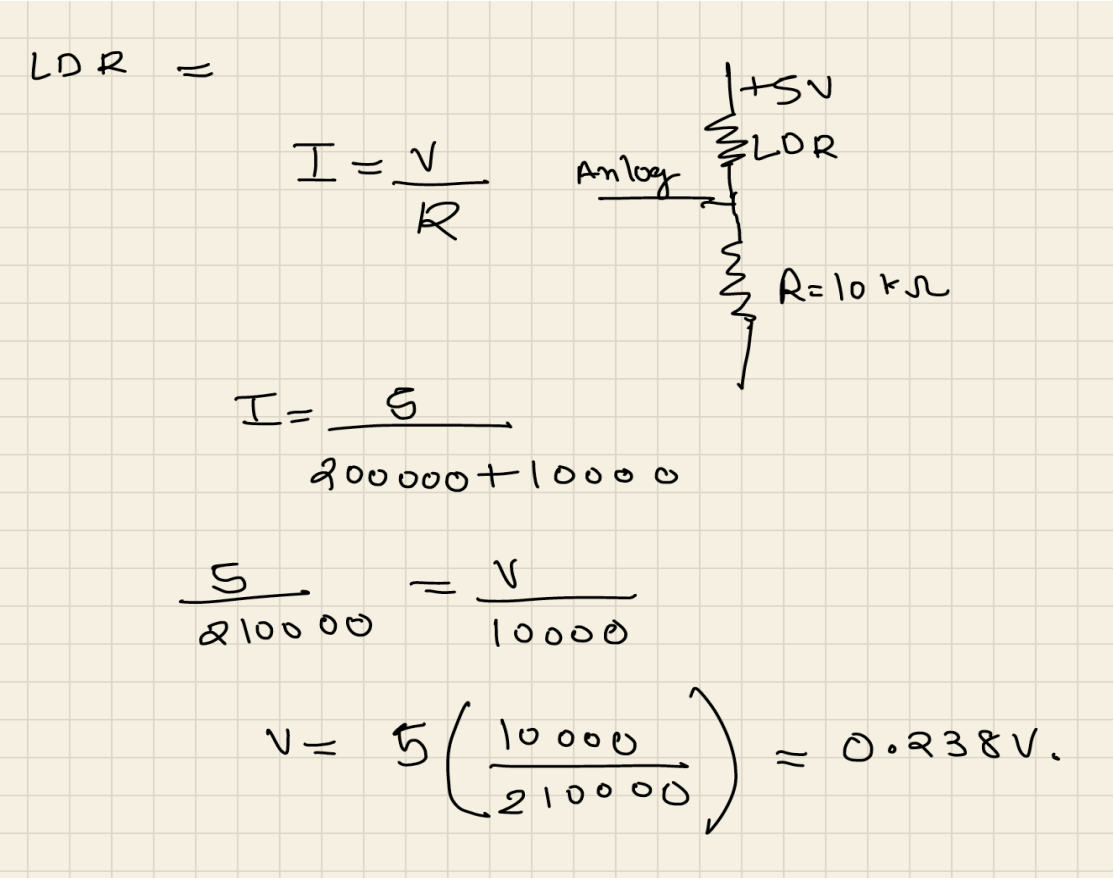
- From very low light levels (like moonlight or below) to intense daylight or artificial lighting.

6. Temperature Sensitivity: LDRs might exhibit some sensitivity to temperature changes.

- The resistance could vary slightly with temperature fluctuations.

These specifications help in understanding the range, sensitivity, and behavior of an LDR in response to varying light conditions. The circuit design and signal conditioning for an LDR would depend on these characteristics to accurately measure and utilize its output for a specific application.

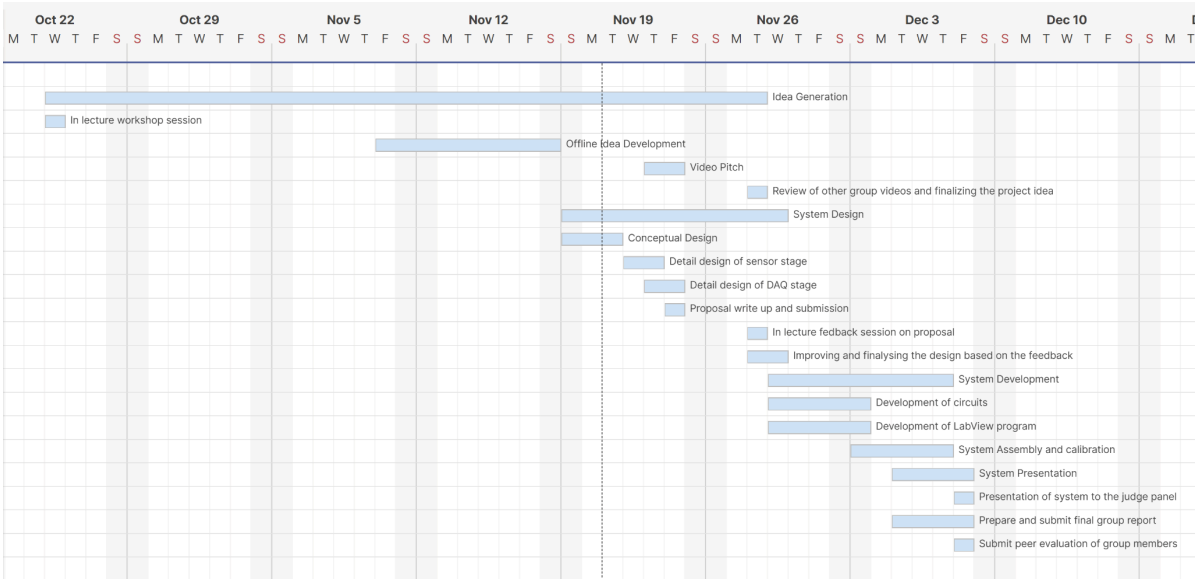
Smoke Sensor : When concentration of the smoke is 200 ppm then the resistance will be 25% of its original voltage.



Project Planning and Management

Task Name	Start Date	End Date	Assigned To	Duration(days)
Idea Generation	10/25/2023	11/28/2023		35
In lecture workshop session	10/25/2023	10/25/2023	All members	1
Offline Idea Development	11/10/2023	11/18/2023	All members	9
Video Pitch	11/23/2023	11/24/2023	All members	2
Review of other group videos and finalizing the project idea	11/28/2023	11/28/2023	All members	1
System Design	11/19/2023	11/29/2023		11
Conceptual Design	11/19/2023	11/21/2023	All members	3
Detail design of sensor stage	11/22/2023	11/23/2023	Amayou, Gabe, Yug	2
Detail design of DAQ stage	11/23/2023	11/24/2023	Jeet and Muneeb	2
Proposal write up and submission	11/24/2023	11/24/2023	All members	1
In lecture fedback session on proposal	11/28/2023	11/28/2023	All members	1
Improving and finalysing the design based on the feedback	11/28/2023	11/29/2023	All members	2
System Development	11/29/2023	12/7/2023		9
Development of circuits	11/29/2023	12/3/2023	Amayou, Gabe, Yug	5
Development of LabView program	11/29/2023	12/3/2023	Jeet and Muneeb	5
System Assembly and calibration	12/3/2023	12/7/2023	All members	5
System Presentation	12/5/2023	12/8/2023		4
Presentation of system to the judge panel	12/8/2023	12/8/2023	All members	1
Prepare and submit final group report	12/5/2023	12/8/2023	All members	4
Submit peer evaluation of group members	12/8/2023	12/8/2023	All members	1

Gantt Chart



Appendix

1. LDR specifications:

Typical Electro-Optical Characteristics

Operating Temperature Range: -20...+70 °C (non-continuous)
Storage Temperature Range: -20...+80 °C (non-continuous)

Type	R_{10}	R_{100}	R_{01}	R_{05}	V_{max}	P_{max}	$\gamma_{10/100}$	λ_{peak}
Units	KΩ	KΩ typ.	MΩ min	MΩ max	V	mW	typ.	nm
A 9950 09	4...11	2	0.04	0.12	100	90	0.65	530
A 9950 11	9...22	3	0.05	0.15	150	90	0.6	530
A 9950 12	18...44	7	0.15	0.45	150	90	0.65	530
A 9950 13	36...88	12	0.4	1.2	150	90	0.7	530
A 9950 14	20....200	20	1.0	3.0	150	90	0.75	530
A 7060 09	4...11	2	0.04	0.12	100	90	0.65	600
A 7060 11	9...20	3.5	0.06	0.18	150	90	0.65	600
A 7060 12	16...33	5	0.18	0.5	150	90	0.7	600
A 7060 13	27...94	8	0.5	1.05	150	90	0.8	600
A 7060 14	77...340	15	1.5	5.0	150	90	0.9	600
B 9060 32	5...13	2	0.1	0.3	300	200	0.7	600
B 9060 33	11...40	5	0.2	0.6	300	200	0.8	600

Light Resistance Characteristics

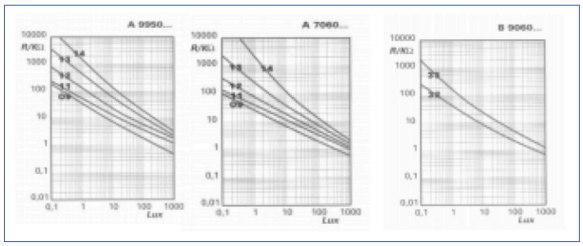


Figure 1
A9950..
A7060..
B9060..
Typical Light Resistance Characteristics

Resistance range: 200KΩ (dark) to 10KΩ (10 lux brightness)
Sensitivity range: CdS cells respond to light between 400nm (violet) and 600nm (orange) wavelengths, peaking at about 520nm (green).
Power supply: pretty much anything up to 100V, uses less than 1mA of current on average (depends on power supply voltage)

2. Smoke sensor specification:

Model			MQ-2
Sensor Type			Semiconductor
Standard Encapsulation			Bakelite, Metal cap
Target Gas			Flammable gas, smoke
Detection range			300～10000ppm(flammable gas)
Standard Circuit Conditions	Loop Voltage	V_c	≤24V DC
	Heater Voltage	V_H	5.0V±0.1V AC or DC
	Load Resistance	R_L	Adjustable
Sensor character under standard test conditions	Heater Resistance	R_H	29Ω±3Ω（room temp.）
	Heater consumption	P_H	≤950mW
	Sensitivity	S	Ro(in air)/Rs(2000ppm C_3H_8)≥5
	Output Voltage	Vs	2.5V～4.0V（in 2000ppmC_3H_8）
	Concentration Slope	α	≤0.6($R_{3000ppm}$/$R_{1000ppm}$ C_3H_8)
Standard test conditions	Tem. Humidity		20℃±2℃；55%±5%RH
	Standard test circuit		Vc:5.0V±0.1V； V_H:5.0V±0.1V
	Preheat time		Not less than 48 hours
	O2 content		21%（not less than 18%） O2 concentration effects initial value, sensitivity and repeatability.
Lifespan			10 years

3. Resistors- We will use the resistor with the resistance of 10k ohm.

4. DAQ USB-6001:

Device Specifications

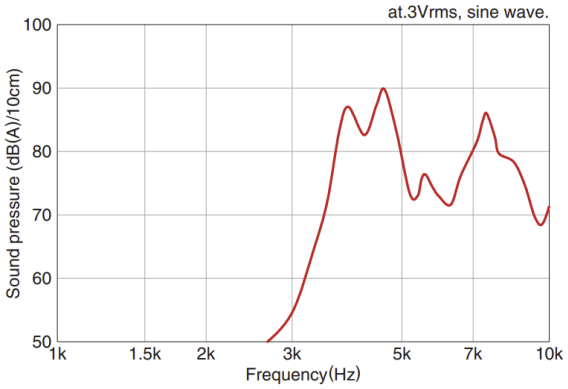
	Q2-USB	Q8-USB	QPIDe
Connectivity	USB 2.0	USB 2.0	PCIe
Analog Inputs			
Number of channels	2	8	8
Resolution	12-bit	16-bit	16-bit
Input range	+/- 10 V	+/-5 V, +/-10 V	+/- 10 V
Analog Outputs			
Number of channels	2	8	8
Resolution	12-bit	16-bit	16-bit
Output range	+/- 10 V	+/-5 V, +/-10 V	+/- 10 V
Encoder Inputs			
Number of channels	2	8	8
Max count frequency in X4 quadrature decoding	10 MHz	99 MHz	40 MHz
Digital IO			
Number of channels	8 (DI) 8 (DO)	8 (DI) 8 (DO)	56 (DIO)
PWM Outputs			
Number of channels	2	8	8
Resolution	16-bit	16-bit	16-bit
Output low (max)	0.40 V	0.55 V	0.40 V
Output high (min)	2.40 V	4.50 V	2.40 V
Min frequency	2.4 Hz	24 Hz	9.6 Hz
Max frequency	40 MHz	49 MHz	20 MHz
SPI			
Max data rate	-	-	10 MHz
Bit width range	-	-	1-32 bit
General Purpose Counter/Timers			
Number of channels (16-bit)	-	-	2
Resolution (16-bit)	-	-	800 ns
Number of channels (32-bit)	-	-	2
Resolution (32-bit)	-	-	25 ns

5. Buzzer(Pin terminal type PS12 PS1240P02BT):

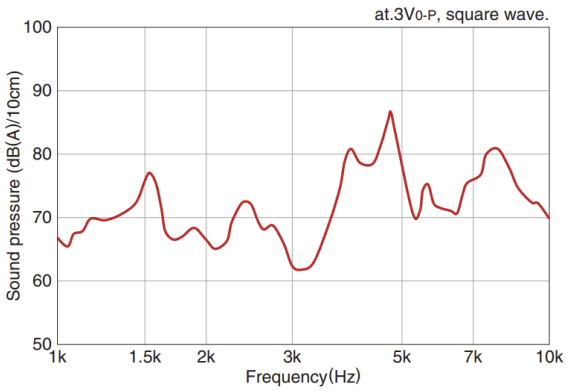
Sound pressure	70dB(A)/10cm min.	[at 4kHz, 3V0-P rectangular waves, measuring temperature: 25±5°C, humidity: 60±10%]
Operating temperature range	–10 to +70°C	
Storage conditions	+5 to +40°C, 20 to 70%RH, please use within 6 months	
Maximum input voltage	30V0-P max.	[without DC bias]
Minimum delivery unit	2500 pieces	[500 pieces/1 reel×5 reels]

■FREQUENCY SOUND PRESSURE CHARACTERISTICS

□SINE WAVE DRIVE



□SQUARE WAVE DRIVE



6. Breadboard:

Twin Industries
Electronic Hardware Prototyping Tools

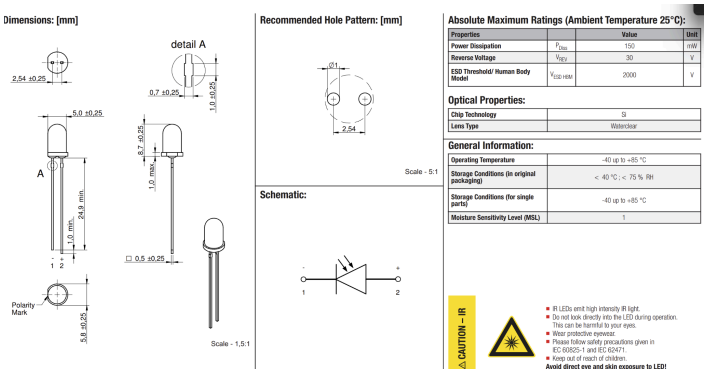
Solderless Breadboards

Twin Industries solderless breadboards are ideal for electronic projects, rapid prototyping, and educational programs. Select part numbers include 70 or 140 piece wire kits. Part numbers; TW-E40-510 TW-E40-1020, TW-E41-1020, TW-E41-102B, TW-E41-1060, TW-E012-000(*140 jumper wire kit)*

FEATURES:

- 22awg solid core jumper wires
- Holes spaced 0.1" x 0.1"
- Clearly labeled rows and columns
- Compatible with all Twin Industries machine pin jumper wires

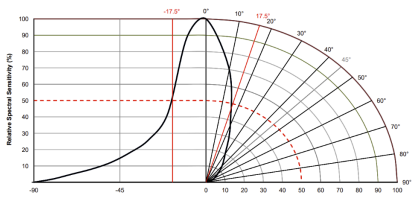
7. LED:



Electrical & Optical Properties:

Properties		Test conditions	Value			Unit
			min.	typ.	max.	
Wavelength of Peak Sensitivity	λ_{Peak}			940		nm
Range of Spectral Bandwidth	λ		400		1100	nm
Photo Current	I_P	V_R = 5 V Ee = 1 mW/cm² λ = 940 nm	5	28		µA
Dark Current	I_D	V_R = 10 V Ee = 0 mW/cm²			30	nA
Viewing Angle Phi 0°	$2\theta_{50\%}$			35		°

Viewing Angle:



Bill of material

Part Name	Part Number	Quantity	Needs to be purchased? If yes, estimated $ and source
DAQ	Quanser Q8-USB DAQ	1	No
LDR	N/A	1	No
Breadboard	N/A	1	No
RCA Cable	N/A	1	No
Resistor Kit	N/A	1	No
Jumper Wire	N/A	15	No
Smoke Sensor MQ-2	N/A	1	Yes, $5.50 https://www.amazon.ca/Reland-Sun-MQ-2-Sensor-Module/dp/B09NN39G8X]
Adjustable Power Supply	TENMA 72-8335A	1	No
LED	N/A	1	No

References

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https://www.circuits-diy.com/mq-2-gas-smoke-sensor-module/#Specifications

https://components101.com/resistors/ldr-datasheet

https://cdn-learn.adafruit.com/downloads/pdf/photocells.pdf(LDR)
https://product.tdk.com/system/files/dam/doc/product/sw_piezo/sw_piezo/piezo-buzzer/catalog/piezoelectronic_buzzer_ps_en.pdf(buzzer)
https://cdn.sparkfun.com/assets/3/b/0/6/d/MQ-2.pdf(smoke sensor)
https://quanserinc.app.box.com/s/3okme4669k44ixfpc0y81wu7c617ppb9(DAQ)