

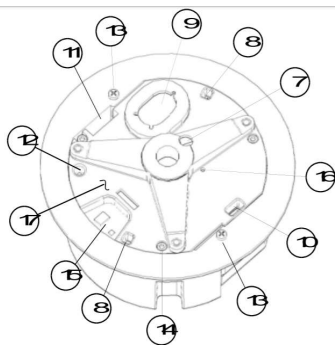
## Abstract:

Vaping is a prevalent issue that exists in many communities, especially in middle and high schools. Many teenage students are facing health issues as a result of vaping because of harmful chemicals they are exposing themselves to. Currently, the two most popular vape detectors include the HALO IOT Smart Sensor and the FlySense detector. Both devices are designed to detect the presence of vape in addition to other abnormalities that can indicate violence or other safety concerns. This report discusses the technical components of each of these devices and their effectiveness. In addition, this report includes the popularity of each of these devices and an overall comparison of each device and its components.

## HALO IOT Smart Sensor

The HALO IOT Smart Sensor is designed to detect the presence of vape, smoke, THC and key sounds, such as gunshots, in areas where a camera cannot be placed. The device is commonly used (but not limited to) schools. Other areas where the device can be implemented include; hospitality, healthcare, real estate, manufacturing, food processing, and commercial facilities. In addition, this device has won numerous security device awards. This device is priced at **\$1295** (according to Amazon).

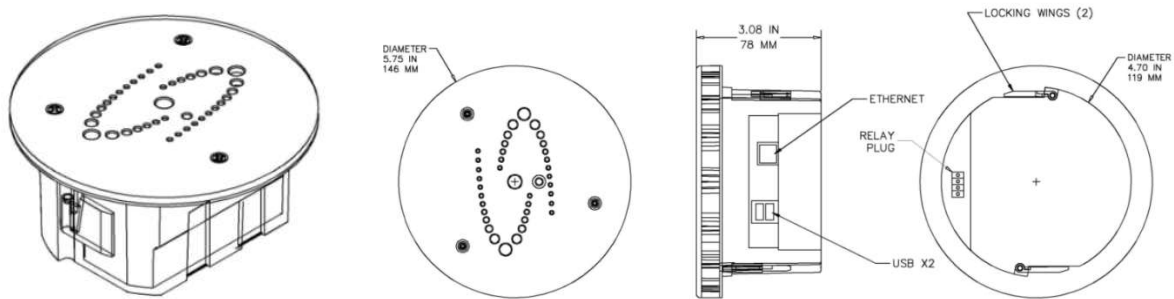
The device has 12 sensors that include; audio, chemical, environmental, air quality and light detectors. As part of the chemical detector, the sensors detect harmful gases such as ammonia, carbon monoxide, carbon dioxide and nitrogen dioxide. In terms of environmental changes, sensors can detect changes in temperature, humidity, pressure and tamper. Air Quality sensors detect **vape**, **THC**, smoke, formaldehyde, benzene, and volatile organic compounds. Light sensors detect occupancy and different light levels. The new HALO 2.0 includes the audio sensors. As part of the audio detector, the sensor can detect key words inputted by the user, abnormal noise levels, gunshots / shouting, etc.



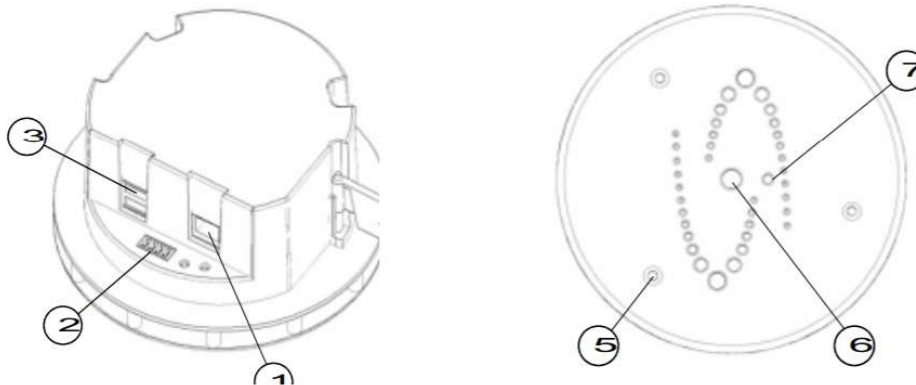
- 13. Light Sensor on PC board
- 14. Microphones
- 15. Loudspeaker
- 16. Particle air intake port
- 17. Particle air exhaust port

- 7. Temperature and Humidity sensor
- 8. Clamping screws
- 9. Inner cover mounting screws (3)
- 10. Gas Sensors
- 11. Reset button on PC board
- 12. Inner Cover

In terms of general specifications, the HALO IOT Smart Sensor operates at temperatures between 32 to 122 degrees Fahrenheit. Its power supply is PoE (IEEE 802.3af Class 3 Compliance) 9W. Its dimensions are 5.75" x 3.08" and its weight is 0.8 lbs. The chemical sensors are specified for a 12' x 12' room, and if the desired room exceeds these dimensions, another device must be installed. The range of aggression and gunshot detection in the HALO 2.0 is still continuing to be tested.



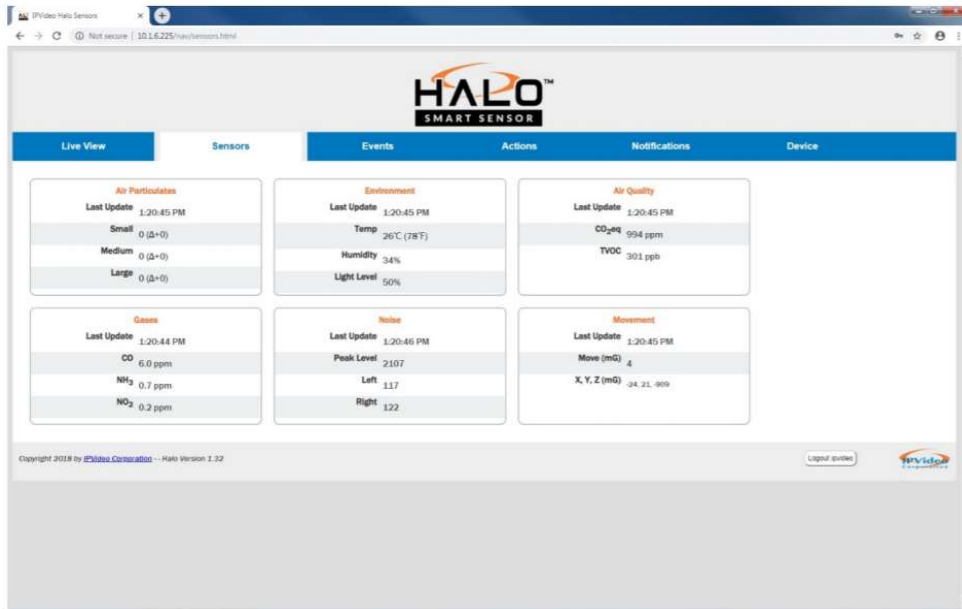
This device can be either ceiling flush mounted or surface mounted. It requires a 120 mm hole in a ceiling panel / sheetrock.



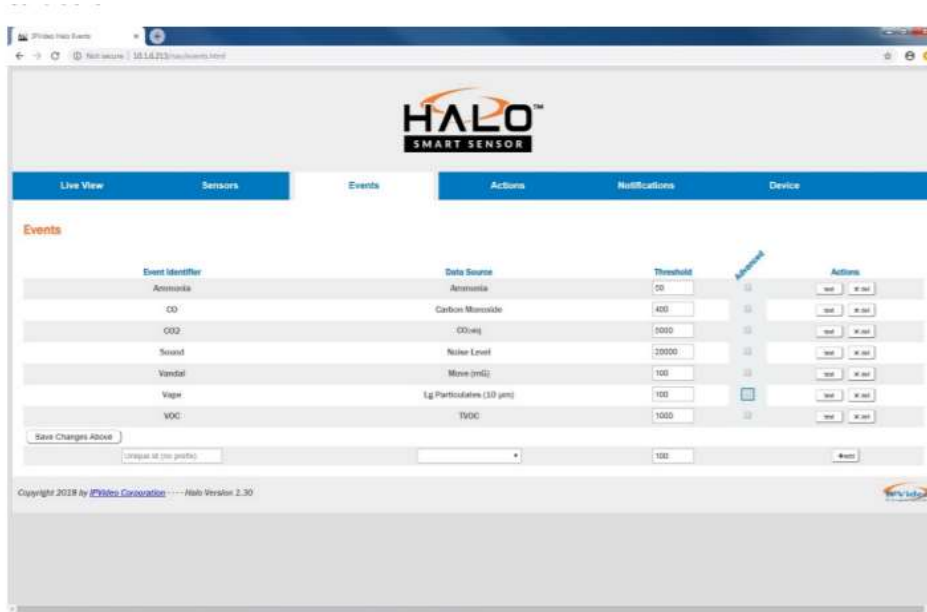
1. Network Connection (RJ-45) – requires 802.3af Power

- over Ethernet
- 2. Relay Connection (Plug supplied)
- 3. USB Ports – currently unused
- 4. Locking Wing – see installation guide
- 5. Cover Securing Screws (3) – T10 Torx driver required
- 6. Multi-color LED Indicator
- 7. Light Sensor

The HALO IOT Smart Sensor relays data to a Live View that can be accessed through a web browser which displays:



A threshold can be inputted by the user for the different events on this Live View. Once this threshold is achieved, the HALO IOT sets off an action.



The available Data Sources are:

<ul style="list-style-type: none"> <li>• Temperature (C)</li> <li>• Temperature (F)</li> <li>• Relative Humidity</li> <li>• Visible Light</li> <li>• TVOC</li> <li>• CO2eq</li> <li>• TVOC (Filtered)</li> <li>• CO2eq (Filtered)</li> <li>• Gunshot</li> <li>• Keyword</li> </ul>	<ul style="list-style-type: none"> <li>• SM. Particulates</li> <li>• MD Particulates</li> <li>• LG Particulates</li> <li>• SM. Particulates (ROC)</li> <li>• MD Particulates (ROC)</li> <li>• LG Particulates (ROC)</li> <li>• Ammonia</li> <li>• NO2</li> </ul>	<ul style="list-style-type: none"> <li>• Carbon Monoxide</li> <li>• Noise Level</li> <li>• Noise Level Left</li> <li>• Noise Level Right</li> <li>• X orientation</li> <li>• Y orientation</li> <li>• Z orientation</li> <li>• Move</li> </ul>
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These actions are defined by the administrators and include:

Trigger Relay 1 On/Off	On, 5 sec, 10 sec, 20 sec, 1 min
Trigger Relay 2 On/Off	On, 5 sec, 10 sec, 20 sec, 1 min
Change LED Color	Red, Green, Blue, Yellow, Violet, Cyan, White
Change LED Pattern	Steady, 1 Sec Blink, 2 Sec Blink, 5 Sec Blink
Change LED Priority	High, 2, 3, 4, 5, 6, 7, 8, Low
Play Audible Notification	Select Sound File from Drop Down Menu

### Actions

Event Identifier	Email Sent	Email Reset	VMS Sent	VMS Reset	Relay 1	Relay 2	LED Color	LED Pattern	LED Priority	Sound
Ammonia	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	---	---	---	Steady	High	---
CO	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	---	---	---	Steady	High	---
CO2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	---	---	Green	1 Sec Blink	High	---
Sound	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	---	---	---	Steady	High	---
Vandal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	---	---	Red	1 Sec Blink	High	Siren-Euro.wav
Vape	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	---	---	---	Steady	High	---
VOC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	---	---	---	Steady	High	---

Save

The security platform alerts the designated personnel through a third party application. As a device on the network, it alerts the user through email/text.

In terms of popularity, the HALO IOT Smart Sensor has been advertised on television through channels such as CBS, Aol, Newsday, NBC, CBSN, abc, CNN and News12. It is currently being used in schools throughout the United States. The device has many school district testimonials and has been mentioned in 91 news reports / articles. Some articles include [NBS San Diego, CA article](#) and [Pleasanton, CA School District Patch article](#).

Some benefits to the HALO IOT Smart Sensor is that the device appears to be very similar to a smoke detector making it discreet. The FlySense vape detector is shaped as a rectangle and is easily identifiable making it a target for students to tamper. Because this device does not stand out, students are less likely to tamper with the device. Another benefit is that the silent alarm sends notifications to a smartphone meaning that it will not disrupt classes if implemented in classrooms. The addition of 12 sensors, also allows for a low chance of a misdetection and false alarms. The device is also small and compact, making it easy to install. According to the HALO website, each device takes less than 5 minutes to install.

Some flaws that can be improved include the range of detection. The device's sensors only span a distance of 12' by 12' which is less than the average size of a high school classroom (typically 32' x 32'). Because of this, schools would have to have multiple devices installed in one room and several rooms as well. This would result in the overall cost being more expensive. If only certain rooms have the device installed, students will find other areas to vape to avoid being caught. In addition, the new addition of sound detectors in the HALO 2.0 may result in misdetections. There is no recording audio or visuals because of privacy issues which makes it difficult for administration to pinpoint students who vape. There could be alternatives that can prove to be beneficial. Additionally, students tend to find creative ways to avoid being caught such as vaping into backpacks or exhaling into toilets. This has proven to be undetectable by the device as well.

## FlySense

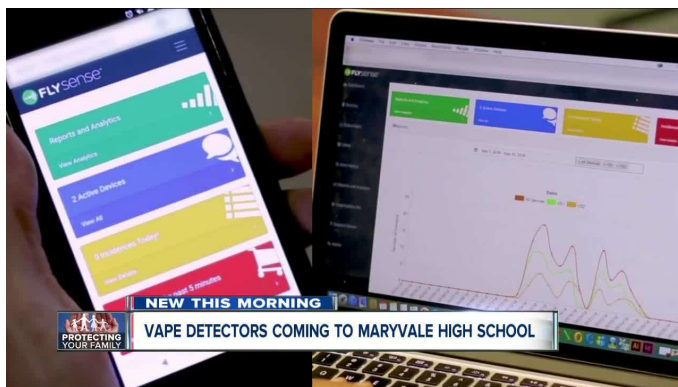
The FlySense detector is a cloud based vaping detector with hard wired sensors. The device is capable of detecting vape, smoke and abnormalities in noise levels that could potentially indicate violence. The device allows for real-time sensor data reporting features such as analytics and data reports. The device provides users with a zero-delay, location-specific notification as well. Similar to the HALO IOT Smart Sensor, the FlySense detector has a web portal where users can set up the device and customize alert notifications. In addition to a web portal, FlySense also provides a mobile app. The cost of the device is **\$995**, which can be split into \$149 annual payments. For school districts, the cost comes to a \$495 one time fee.



In terms of general specifications, the FlySense detector operates on PoE+ power supplies or an external input power source with Wi-Fi capability. The device operates between temperatures of 55 to 95 degrees Fahrenheit. Similar to the HALO IOT Smart Sensor, the sensors in the FlySense detector can only span a room with 12' x 12' dimensions. The device is 4.26" in width, 6.03" in length and 2.20" in height. The device weighs 9 ounces or 0.56 lbs. The device can be installed on ceilings that are 8 feet in height. When receiving alerts, the event indicators include an RGB LED Alert Indicator.



The device has been purchased by schools in 21 states in the U.S. and also by schools in Canada. The device has been mentioned in the news through channels such as Fox News and CNN. The device was also recognized in 2018 “ASTORS” homeland security award program.



Some benefits to this device include easy installation and set up as it only requires two screws and a single RJ45 connection. The device senses real-time vape, smoke and elevated sound detection that can suggest to violence for areas such as bathrooms, locker rooms, etc.. This can be done because the device does not provide audio or camera recordings of any sort and has zero invasion on student privacy. The FlySense detector has also been proven to successfully identify, analyze and manage incidents occurring on school grounds with customizable, real-time SMS and email alert notifications. Adding on, Flysense are able to detect the difference between perfumes/cologne from vaping.

Like smoke detectors, the FlySense detector can prove to be unreliable and presents flaws. For instance, the device does not record video or audio to maintain privacy which makes it difficult to gather evidence. As one spokesperson had commented, “It was like chasing ghosts”. The device is also shaped as a rectangle which can stand out in schools. There have been accounts of students tampering with the device because it is not as discreet. There have also been reports of the device setting off randomly. Vibrations and high current could potentially affect the quality of sensor readings. Similar to the HALO IOT Smart Sensor, the FlySense detector cannot detect if students vape into their backpacks or jackets. Some improvements that could be made to this device include the addition of sensors that can detect THC oil like the HALO IOT Sensor.

**Comparison of Devices:**

HALO IOT Smart Sensor	FlySense
<ul style="list-style-type: none"> <li>● <b>Cost:</b> \$1295</li> <li>● <b>Sensors detect:</b> <ul style="list-style-type: none"> <li>○ Audio</li> <li>○ Chemical</li> <li>○ Environmental</li> <li>○ Air quality</li> <li>○ Light detectors</li> </ul> </li> <li>● <b>Can detect THC Oil</b></li> <li>● <b>Circle Shaped</b></li> <li>● <b>Dimensions:</b> 5.75” x 3.08”</li> <li>● <b>Weight:</b> 0.8 lbs</li> <li>● <b>Operating Temperature:</b> 32 to 122 degrees Fahrenheit</li> </ul>	<ul style="list-style-type: none"> <li>● <b>Cost:</b> \$995</li> <li>● <b>Sensors detect:</b> <ul style="list-style-type: none"> <li>○ Vape</li> <li>○ Smoke</li> <li>○ Noise Abnormalities</li> </ul> </li> <li>● <b>Rectangle Shaped</b></li> <li>● <b>Dimensions:</b> <ul style="list-style-type: none"> <li>○ 4.26” width</li> <li>○ 6.03” length</li> <li>○ 2.20” height</li> </ul> </li> <li>● <b>Weight:</b> 0.56 lbs</li> <li>● <b>Operating Temperature:</b> 55 to 95 degrees Fahrenheit</li> </ul>



**Conclusion:**

Both detectors have proven to be effective in vape detection, although both present flaws. This research can be used to improve the existing designs and contribute to the mitigation of vaping. That being said, once a student has been caught by either detector, it is important that the situation is handled appropriately. There must be proper measures taken to inform and influence students to stop vaping which would be our next steps.

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