POC – Motion Detection

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| **Version:** | **Date:** | **Changes:** |
| Incomplete V1.0 | 10/18/2022 | Start |
| Incomplete V1.1 | 10/20/2022 | Added sensor possibilities and pros/cons. |
| Complete V1.0 | 10/21/2022 | Added conclusion |

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# Introduction

This document will show existing ways in which motion can be captured. The goal is to have an overview of existing technology for motion detection. This overview will be used to select the best sensor for the EdTech project (link to canvas).

# Legenda

|  |  |
| --- | --- |
| **Word/abbreviation:** | **Meaning:** |
| Aesthetic | In the context of the EdTech project, something will be considered aesthetic it is small and has a design that suites the object designs made in the project document. |
| IR | Infrared |
| AIR | Active Infrared |
| PIR | Passive Infrared |

# Sensor possibilities

The following passage will contain possible sensor types that can be used for motion detection. Here follows the list of sensor types that will researched.

|  |  |  |
| --- | --- | --- |
| **Sensor Type:** | **Detection medium:** | **Sensor type:** |
| Ultrasonic distance | Ultrasonic sound | Digital |
| IR Distance | Infrared Light | Analog/Digital |
| PIR | Infrared Light | Digital |
| AIR | Infrared Light | Digital |

## Ultrasonic distance

The ultrasonic distance sensor uses ultrasonic frequencies to measure distance using the time elapsed after a ping was sent (sound travels to object and bounces back towards sensor). To use this sensor type for motion detection one must program a trigger distance. This trigger distance should be over 5cm as most distance sensors can’t accurately detect object that closer.

Diagram

Description automatically generated

Example:

<https://www.tinytronics.nl/shop/en/sensors/distance/ultrasonic-sensor-hc-sr04>

|  |  |  |  |
| --- | --- | --- | --- |
| **Advantages:** | **Reasoning:** | **Disadvantages:** | **Reasoning:** |
| Senses all material types | Will be able to detect when hands are in front of the sensor | Sensitive to temperature variation. | The temperature in the Netherlands continuously changes throughout the year. |
|  |  | Slow refresh rate | The children will be waving at time so the sensor might not pick of these fast movements. |
|  |  | The look | Ultrasonic sensors are unaesthetic and are usually big. |

## IR Distance

Like the ultrasonic sensor, this sensor also sends a beam of IR light (ping). The distance is calculated using the angles from the reflected light. To use this sensor type for motion detection one must program a trigger distance. This trigger distance should be over 5cm as most distance sensors can’t accurately detect object that closer.

Diagram

Description automatically generated

Examples:

<https://www.dfrobot.com/product-572.html> (digital)

<https://www.dfrobot.com/product-1083.html> (analog)

<https://www.elektor.nl/new/new-in-the-store/ldrobot-d300-lidar-kit-360-degree-laser-range-scanner-12-m?gclid=Cj0KCQjwhsmaBhCvARIsAIbEbH6WGnAgzU8b2Bvjs1CMaKk7juLJdQ5Z2LNk--wYSak-3iFSQ8sTzrMaAiSGEALw_wcB> (LiDAR)

|  |  |  |  |
| --- | --- | --- | --- |
| **Advantages:** | **Reasoning:** | **Disadvantages:** | **Reasoning:** |
| Sens soft objects | The combination of the motion and the size of the children’s hands might be registered as a soft object. | Affected by the sun | It will be in a classroom where sunlight might fall on the object. |
| The look | Are somewhat aesthetic, being smaller in size. | Can damage eyesight at higher frequencies. (Waves) | Since these objects will be used is classrooms it might be unethical to have light sources that could damage the eyesight of the children. (Highly unlikely) |
| More affordable | The object should be inexpensive seeing that children will be using them. |  |  |
| Low power cost | Object should last a whole day while in use. |  |  |

## PIR

The PIR sensor uses a pyroelectric sensor pair to detect heat energies. The PIR detects motion based on the heat & IR radiation that organisms (in this case humans) emit. Nothing is emitted, everything is received hence the name Passive Infrared.

Diagram

Description automatically generated

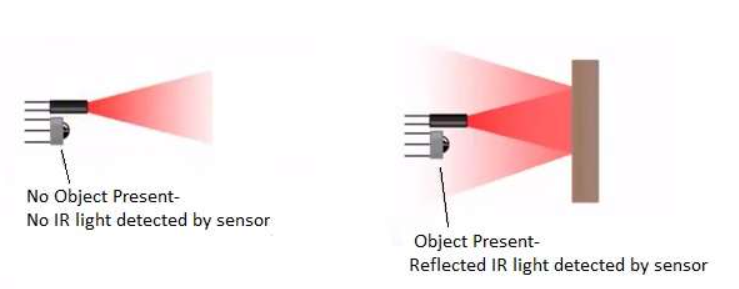
Example:

<https://www.dfrobot.com/product-2130.html>

|  |  |  |  |
| --- | --- | --- | --- |
| **Advantages:** | **Reasoning:** | **Disadvantages:** | **Reasoning:** |
| Sens soft objects | The combination of the motion and the size of the children’s hands might be registered as a soft object. | Affected by the sun | It will be in a classroom where sunlight might fall on the object. |
| The look | Is aesthetic, being small and having a good design shape. | Affected by Temperature. | The weather in the Netherlands constantly changes. |
| More affordable | The object should be inexpensive seeing that children will be using them. |  |  |

## AIR

Like the IR distance sensor, the AIR sensor also uses reflected IR beams to detect. The difference is here, nothing is calculated, it is purely on/off. So, the more focused the initial beam the closer the object must be.



Example:

<https://www.tinytronics.nl/shop/nl/sensoren/optisch/infrarood/object-detectie-sensor-module>

|  |  |  |  |
| --- | --- | --- | --- |
| **Advantages:** | **Reasoning:** | **Disadvantages:** | **Reasoning:** |
| Sens soft objects | The combination of the motion and the size of the children’s hands might be registered as a soft object. | Affected by the sun | It will be in a classroom where sunlight might fall on the object. |
| The look | Are somewhat aesthetic, being smaller in size. | Can damage eyesight at higher frequencies. (Waves) | Since these objects will be used is classrooms it might be unethical to have light sources that could damage the eyesight of the children. (Highly unlikely) |
| More affordable | The object should be inexpensive seeing that children will be using them. |  |  |
| Low power cost | Object should last a whole day while in use. |  |  |

# Conclusion

In this passage a sensor will be chosen for the motion prototype. To start based of the pros & cons list it was determined that an Ultrasonics sensor would not be used seeing that it had too many cons and no redeeming pros. So, that leaves the IR distance, PIR & AIR sensors. Based on the pros & cons it was determined that **PIR sensors** would be the best choice seeing that it doesn’t emit IR radiation. The only other extra con, being that it is sensitive to high temperatures (the other are also affect but not as much), would not matter as much seeing that the temperature does not typically go higher than the average humans body temperature.

# Summary

<https://www.rfwireless-world.com/Terminology/Advantages-and-disadvantages-of-Ultrasonic-Sensor.html>

<https://www.rfwireless-world.com/Terminology/Advantages-and-Disadvantages-of-Infrared-Sensor.html>

<https://www.rfwireless-world.com/Terminology/Advantages-and-Disadvantages-of-PIR-sensor.html>

<https://www.seeedstudio.com/blog/2019/12/23/distance-sensors-types-and-selection-guide/>

<https://www.arrow.com/en/research-and-events/articles/understanding-active-and-passive-infrared-sensors>

<https://robu.in/pir-sensor-working-principle/>