MOTION DETECTOR 0664

USER'S GUIDE

CENTRE FOR MICROCOMPUTER APPLICATIONS

https://cma-science.nl

Short description

The Motion detector 0664 is a sonar device that emits ultrasonic pulses, which reflect off an object. The sensor measures the time it takes an ultrasonic pulse to travel from the sensor to the object and determines the distance from the object based on the measured time and the speed of sound.

While the Motion detector is operating, a slight clicking sound from the sensor will be heard. The minimum range of the motion detector is 0.15 meters. The maximum range is 6 to 12 m, depending on the size, shape, orientation and surface of the object that is detected. Note that the maximum detection distance of 12 m can only be reached under ideal conditions, i.e. for a large, flat surface (e.g. a wall) that is perpendicular to the detector. For smaller objects or objects that are not very flat, the maximum detection distance will be smaller.

The motion detector has mounting threads on the bottom and both sides of the unit. These threads can be used to mount the detector to a stand and they are compatible with typical tripod mounting hardware. The sensor is supplied with a steel rod, which can be screwed into a mounting thread. The rod can be used for clamping into a suitable holding device, e.g. a retort stand.

The Motion detector can be directly connected to the digital BT inputs of the CMA interfaces.

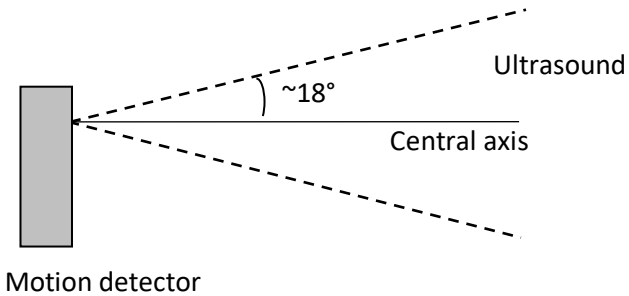
Sensor recognition

The Motion detector has a memory chip (EEPROM) with information about the sensor: its name, measured quantity, unit and calibration. Through a simple protocol this information is read by the CMA interfaces and the sensor is automatically recognized when it is connected to these interfaces.

If your Motion detector is not automatically detected by an interface you have to manually set up your sensor by selecting it from the Coach Sensor Library.

How the Motion Detector works

The Motion Detector emits short bursts of ultrasonic sound waves from the transducer. These waves fill a cone shaped area about 18° off the axis of the centerline of the beam. The detector then "listens" for the echo of these ultrasonic waves returning to it.



By timing how long it takes for the ultrasonic waves to make the trip from the detector to an object and back, the distance to the object can be determined (based on the speed of ultrasound in air). Note that the motion detector will report the distance to the closest object that produces a sufficiently strong echo. Objects, such as chairs and tables, in the cone of ultrasound can be picked up by the detector.

The sensitivity of the echo detection circuitry automatically increases as the ultrasound travels outward. This is to allow the detector to pick up weaker echoes from distant objects. For accurate measurements the object should have a flat front perpendicular to the line between sensor and object.

Calibration

The sensor is calibrated by the driver of the interface, so applying another calibration is not necessary. However, the speed of sound in air is dependent on the temperature and humidity of the air. So, for very precise measurements, the sensor can be re-calibrated at the time of measurement by applying an additional calibration in Coach.

Note: *The detection range maximum is not always 12 m, but varies between 6 to 12 m, depending on the size, orientation and surface of the object to detect. In the Coach program the maximum range is set to 12 m in order not to limit the detection range by the software.*

Tips on getting good results with the Motion Detector

The most frequently reported problem with a motion detector is that it doesn't work beyond a certain distance. Here are some things to check if you have problems.

- Check for a stationary object (chair, table, etc.) in the cone of the ultrasound. This object may be detected when you are trying to study an object further away, it may not take a very large object to cause problems. If you have trouble with a stationary object causing unwanted echoes, try placing a cloth over it. This minimizes the sound reflection.
- Also note the cone of ultrasound extends downward from the centerline. This can cause problems if you are using the motion detector on a horizontal surface. In these cases, aim the Motion Detector slightly upward or place it somewhat higher above the surface.
- Note that the sampling frequency is limited by the speed of sound in air: if e.g. a distance of 12 m is measured (such a large distance can only be measured for large, flat objects), the sound signal takes about 70 ms to travel from detector to object and back to the detector. This means that if a sample frequency of 14 Hz or more is used, a new sound pulse is emitted before the previous one is received, leading to erratic readings.
- If there is another source of ultrasonic waves in the same frequency range, (like motors, fans, air track blowers, the sound made by air exiting the holes of an air track, and even students making loud noises) this can cause erroneous readings.
- If the room in which the motion detector is being used has a lot of hard, sound-reflecting surfaces, you can get weird effects caused by the ultrasound bouncing around the room. Standing waves can be set up between the detector and a sound reflector. Try placing a cloth horizontally just in front of and below the detector. This sometimes helps eliminate ultrasound that is "skipping" into the detector.
- Try changing the data collection rate (measurement frequency in Coach program). Sometimes reflected ultrasound pulses can cause erroneous readings that may disappear at other measurement frequencies.

- If you are studying people moving, have them hold a large, flat object (e.g. a large book) as a reflector. If you have an irregular reflecting surface, sometimes the waves will be reflected back to the transducer, and sometimes not. The result will seem erratic.

Suggested experiments

The Motion sensor can be used for studying a variety of motions including:

- Walking toward and away from the sensor.
- Simple harmonic motion, such as a weight hanging on a spring.
- Newton's laws of motion.
- Acceleration due to gravity - free fall, objects dropped or tossed upward.
- Air track experiments.

Technical Specifications

Sensor kind	Digital,
Measurement range	0.15 … between 6 and 12 m (depending on object size, orientation, and surface)
Resolution	1 mm
Ultrasound frequency	49.4 kHz, 15 cycles / pulse
Aperture = (top angle) / 2	Approx. 18º with respect to the central axis
Power supply	5V supplied by interface
Current used	~ 50 mA
Speed of ultrasound in air used to calculate distance	343 m/s
Connection	Attached cable with left-handed BT (British Telecom) connector

Warranty:

The Motion detector 0664 is warranted to be free from defects in materials and workmanship for a period of 24 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

Note: *This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.*

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