MOTION DETECTOR BT55i

USER'S GUIDE

CENTRE FOR MICROCOMPUTER APPLICATIONS

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Short description

The Motion detector BT55i 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. The minimum range of the sensor is 0.15 m and the maximum range is 6 m. While the sensor is operating, a slight clicking sound from the sensor will be heard. The sensor is supplied with a steel rod, which can be screwed into a mounting thread on the sensor. The rod can be used for clamping into a suitable holding device, e.g. a retort stand.

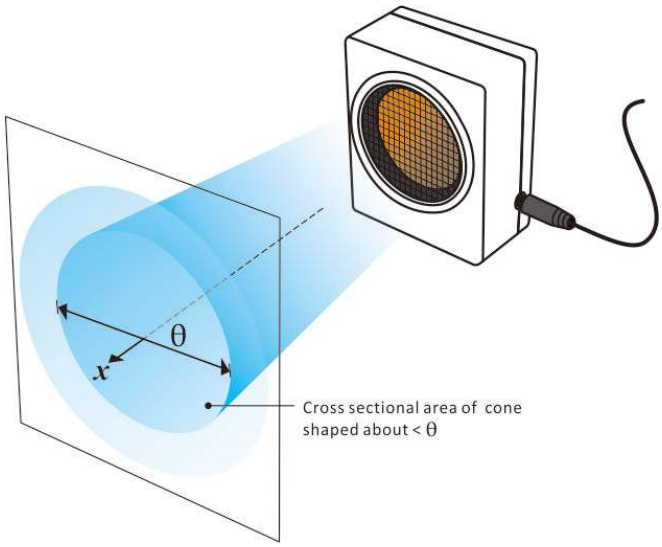
The Motion detector can be directly connected to the BT inputs of the CMA's **C**LAB, WiLab and VinciLab 2 interfaces. The BT55i cannot be used in combination with other interfaces.
The Motion detector is an I2C digital sensor, which gives calibrated values of the measured quantity. It is a digital sensor that converts the measured distance value to a digital value via 16-bit analog-to-digital conversion. The resolution of the sensor is ± 0.001 m.

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

Practical information

The Motion detector emits short bursts of ultrasonic sound waves from the gold foil of its 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.
The minimum distance between the object and the Motion sensor should be 0.15 m. Note that the motion sensor 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.
For accurate measurements the object should have a flat front perpendicular to the line between sensor and object. Note that the maximum detection distance of 6 m depends on the size, shape, orientation and surface of the reflecting object. This maximum distance 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 measurement input range also depends on the sampling rate. Keep in mind that increasing the sampling rate may lead to a lower maximum range.

Tips on getting good results with the Motion Detector

The most frequently reported problem with the motion sensor is that it does not 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. Even small objects can cause such 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 that the cone of ultrasound beam extends downward from the centerline. This can cause problems if you are using the sensor on a horizontal surface. In these cases, aim the Motion sensor slightly upward or place it somewhat higher above the surface.
- If there is another source of ultrasonic waves in the same frequency range, (like a motor, fan, air track blower, 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 sensor 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 sensor 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 sensor.
- Try changing the sampling rate. Sometimes reflected ultrasound pulses can cause erroneous readings that may disappear at other measurement frequencies.
- If you are studying the movement of people, 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.

Calibration

The Motion detector is supplied with a factory calibration in meters, 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 the Coach program.

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
Measuring range	0.14 to 6 m
Aperture (top angle/2)	Approx. 0.001 m Approx. 18˚ with respect to the central axis
Ultrasound frequency	62.5 kHz
Resolution	0.001 m
Accuracy	Typical: ±0.1% at full scale ± 0.002 m at 25°C, measurement range 0.5 m, and sampling rate 5 Hz
Maximum sampling rate	100 Hz
Current consumption	Typical 40 mA at sampling rate 5Hz
Sensor dimensions	51 x 29 x 64 mm
Connection	Analog (right-handed) BT connector

Warranty:

The Motion detector BT55i is warranted to be free from defects in materials and workmanship for a period of 12 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.*