Lab Report 1

Physics 261-001

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**Objective:** The objective of the lab is to use the Lab Pro to measure the position, velocity, and acceleration of objects in motion. The data will be used to study the relationships between those three measurements and the way that a change in one affects the others.

**Theory:** Ultrasonic motion detectors are used to measure the position and speed of an object in motion. They work by emitting an ultrasonic signal in the direction of an object, then comparing the time it takes for the signal to reflect and return to the device at the speed of sound to calculate the current distance of the object. Velocity is stated as the directional change in position over time. Therefore, using the measured object at many instances, we can assume velocity:

Eq.(1)

where v(t) is the average velocity of an object at a moment at time t and Δx is the change in an object’s position over a period, Δt. If the average velocity at a point is 0, then the position at the time of initial measurement will be the same as the position at the time of final measurement. Otherwise, if the velocity is positive, then the relative position of an object will increase, and will decrease if the current velocity is negative.

Likewise, the acceleration of an object is stated as the directional change in velocity over time:

Eq.(2)

where a(t) is the momentary average acceleration of an object at time at time t and Δv is the change in an object’s velocity over the same period, Δt. If the acceleration at the point t is 0, then the object’s velocity will remain constant, and the object’s position will continue to change at the same rate. If the acceleration of the object is negative, the velocity of the object will increase, and the relative position of the object will increase at a second-degree polynomial rate. Contrarily, if the acceleration is negative, then the velocity will decrease over time, and the relative position of the object will decrease at a second-degree polynomial rate.

From the reference point of an Ultrasonic motion detector, a higher positional measurement indicates a longer distance between the device and the measured object, whereas a lower positional measurement indicates a shorter distance in the same regard.

**Procedure:**