Sensors

(slide 2) Sensing in robotics: sense, think, act in a feedback loop.

(slide 3) Types of sensor, active and passive. Active: Influences the surrounding and measures reaction. Passive: Measures surrounding passively, does not emit anything.

(slide 4) Sensors we have used in the past: sonar, infrared, encoder, monocular camera (used in the cv worksohp). Infrared is cheaper than sonar, and sometimes better at edge detection.

(slide 5) Other sensors that weren’t from the course: micro switch (binary), force sensor, compass, inertial measurement unit, colour sensor (detecting RGB).

(slide 6) Micro Switch. We don’t need too much force to close circuit. Aligning robots with a wall, by contacting. Distance sensors can be unreliable in this case.

(slide 7) Force Sensor. Analog values to detect contact.

(slide 8) inertial Measurement Unit. Useful for measuring acceleration. It can be prone to error when integrating acceleration, due to slips in wheels ,etc. One way to get around this is to test the sensor over a distance and see how much it drifts and use that to calibrate.

(slide 9) Compass. Use trigonometric formulas to find its direction in relation to earth’s magnetic field. Direction values maybe incorrect, but consistent and repeatable. Chris recommends HMC5883L.

(slide 10) Compass Demo. Shows heading degrees, and x,y,z components of the magnetic field.

(slide 11) Colour Sensor. Shines light onto the surface and measures reflection. s0 and s1 select scale in frequency of light, and s3 and s4 select which channels of RGB. The four values are set in the code.

(slide 12) Colour Sensor Demo. Outputs sets of RGB values. The colour sensor has to be within 5 cm from the object.

(slide 13) Filters

(slide 14) Why do we need filters? To reduce noise.

(slide 15) Low Pass Filters. Similar to the lab from ECE159. Sometimes the environment changes rapidly, we can use the low pass filter to reduce the variations.

(slide 16) High Pass Filters. Experiment to find out which type of sensors we want to use

(slide 17) Band Pass Filters. Combined the high pass and low pass filters together.Removes both high and low frequencies.

(slide 18) Band Stop Filters. Gets rid of a specific range of frequencies.

(slide 19) Simple Moving Average. It is a software (digital) filter. We did this in workshop with the IR sensor. Pick how many readings to average.

(slide 20) Weighted Moving Average. Assign a weight to each value before averaging.

(slide 21) Exponential Moving Average. Customize by changing values of alpha.

(slide 22) Applicatoins of EMA. Removing high frequency signals, and can be modified to create other types of filters.

(slide 23) Advanced Filters.

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(slide 25) Tips. Check sensors.