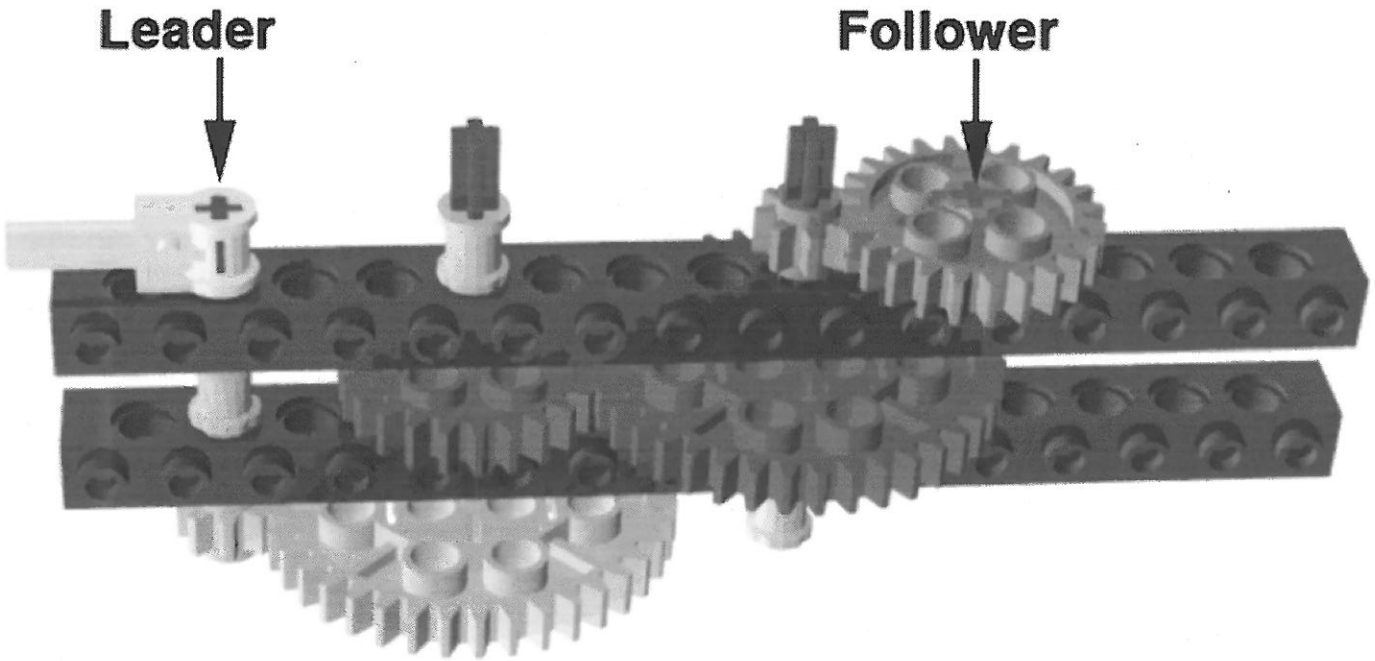
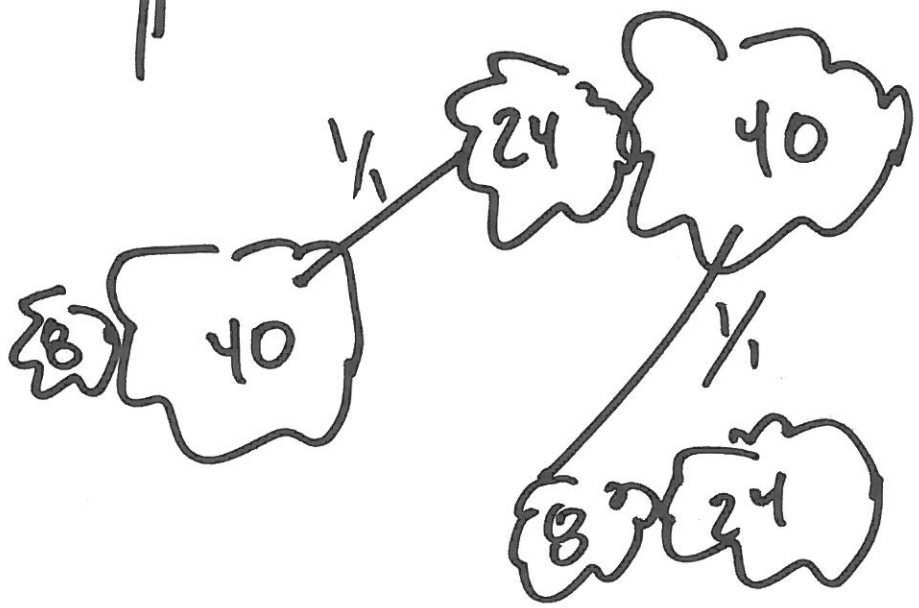
For the following gear setup, calculate the rate (amount) that the "follower" gear will turn when the yellow "leader" turns once. The three gears used in this gear train are 8-tooth (smallest), 24-tooth (middle), and 40-tooth (largest). Show your work.



Calculate Gear Ratios:

$\frac{8}{40} = \frac{1}{5}$ $\quad$ $\frac{24}{40} = \frac{3}{5}$ $\quad$ $\frac{8}{40} = \frac{1}{3}$



$$\Rightarrow \frac{1}{5} \cdot \frac{1}{1} \cdot \frac{3}{5} \cdot \frac{1}{1} \cdot \frac{1}{3} =$$

$$= \frac{1}{5} \cdot \frac{1}{5} = \boxed{\frac{1}{25}}$$

The color sensor in the LEGO MINDSTORMS EV3 kit can also be used to detect light levels in two different modes. For these two modes additional modes, describe in general what they are/why they exist (1pt each) and give a specific example for when you would use each mode (1pt each).

COLOR SENSOR MODES:

1) COLOR : [0, 1, ..., 7]

NO COLOR

COLORS

2) AMBIENT : LIGHT IN THE ENVIRONMENT

0 → 100

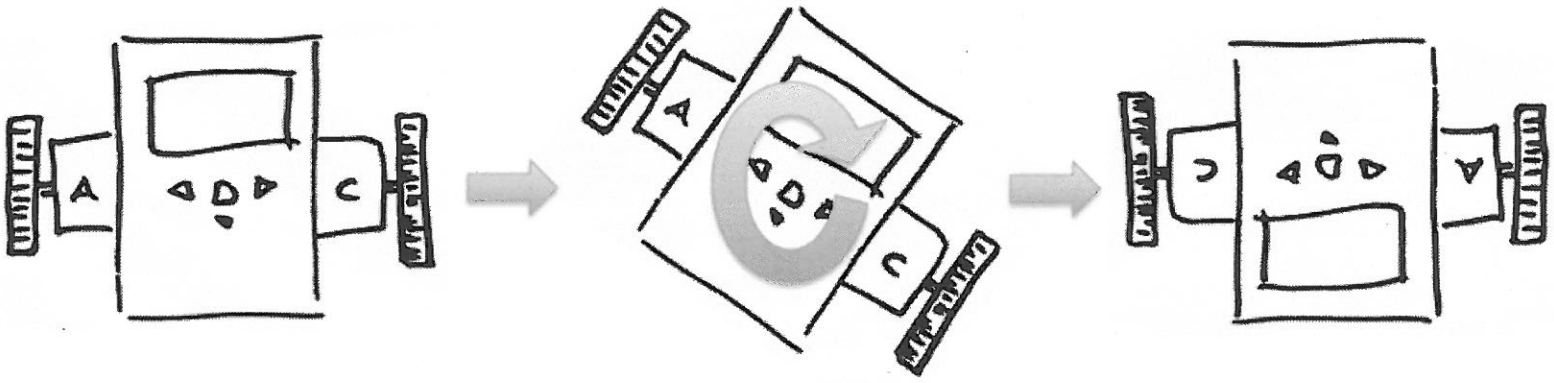
EG. BRIGHTEST SPOT IN THE ROOM
AUTOMATIC LIGHT DETECTOR

3) REFLECTED : LIGHT REFLECTED OFF SURFACE
(SHADES, DISTANCE)

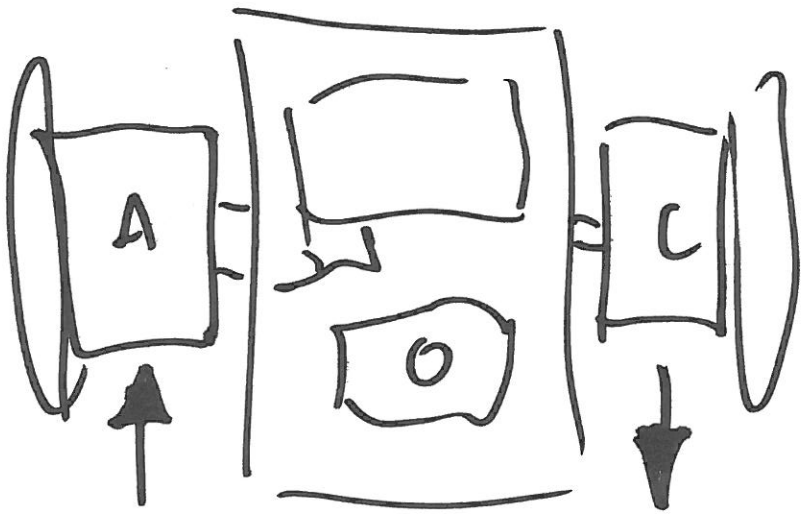
0 → 100

EG. COLORS W/ MORE DETAIL (SHADES)
LINE FOLLOWER

Professor Danahy wants his robot to turn around, clockwise, in place so that it ends up in the exact same spot but facing 180-degrees in the other direction. What power values would you suggest sending to his "A" motor and what power value to his "C" motor, and give a short explanation why you chose the values that you did.



MOTOR POWERS FOR TURNING ROBOT:



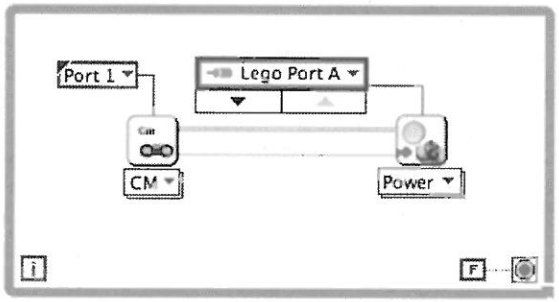
A: +30

C: -30

- VALUES ARE EQUAL BUT OPPOSITE (SPINS IN PLACE)
- NOT TOO SLOW, AND NOT TOO FAST

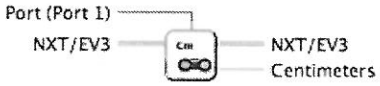
* ASSUMPTION: APPLYING POSITIVE POWER TO MOTORS MAKES THEM GO FORWARD ("UP" THE PAGE)

In the following LabVIEW code, the output from the Read Ultrasonic (cm) sensor (reading in the range of 0cm to 255cm) function is plugged directly into the Move Motors command to try and control the speed of a one-motor car (Port A) based on the distance read by the Ultrasonic Sensor (larger distance, faster speed). What is the limitation of the system (for what values will this work, and for what values will this not work, considering both the output of the ultrasonic and the input of the motor)? How can this code be improved to be more responsive to a wider range of distances (describe and draw out your code)?



Context Help

Read Ultrasonic (cm)
[EV3_Ultrasonic_CM.vi]



Reads the EV3 ultrasonic sensor connected to the specified input port to detect distance from surrounding objects.

Inputs

NXT/EV3 connects to NXT/EV3 terminal of previous VI to establish the flow of the program.

Port (Port 1) is the port connected to the ultrasonic sensor.

Outputs

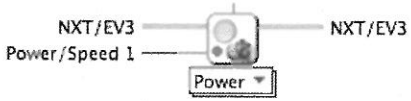
NXT/EV3 wires to NXT/EV3 terminal of next VI to establish the flow of the program.

Centimeters returns the distance in centimeters, or -1 if distance cannot be detected.

Detailed help

Context Help

Move Motors



Moves motors with either constant power or constant speed.

If Motors is not wired, the default behavior is to move LEGO motors connected to all motor ports.

For motors that do not have built-in encoders, you must connect motor encoders to move with constant speed. LEGO motors have built-in encoders.

You can specify whether to use constant power or constant speed by selecting a value from the polymorphic selector below the VI icon.

Inputs

Motors specifies which motor controller and port each motor is connected to.

NXT/EV3 establishes the flow of the program. Wire the NXT/EV3 output of the previous VI in the program to the NXT/EV3 input of this VI.

Power/Speed specifies the amount of power or level of speed from -100 to 100. The default value is 75.

Outputs

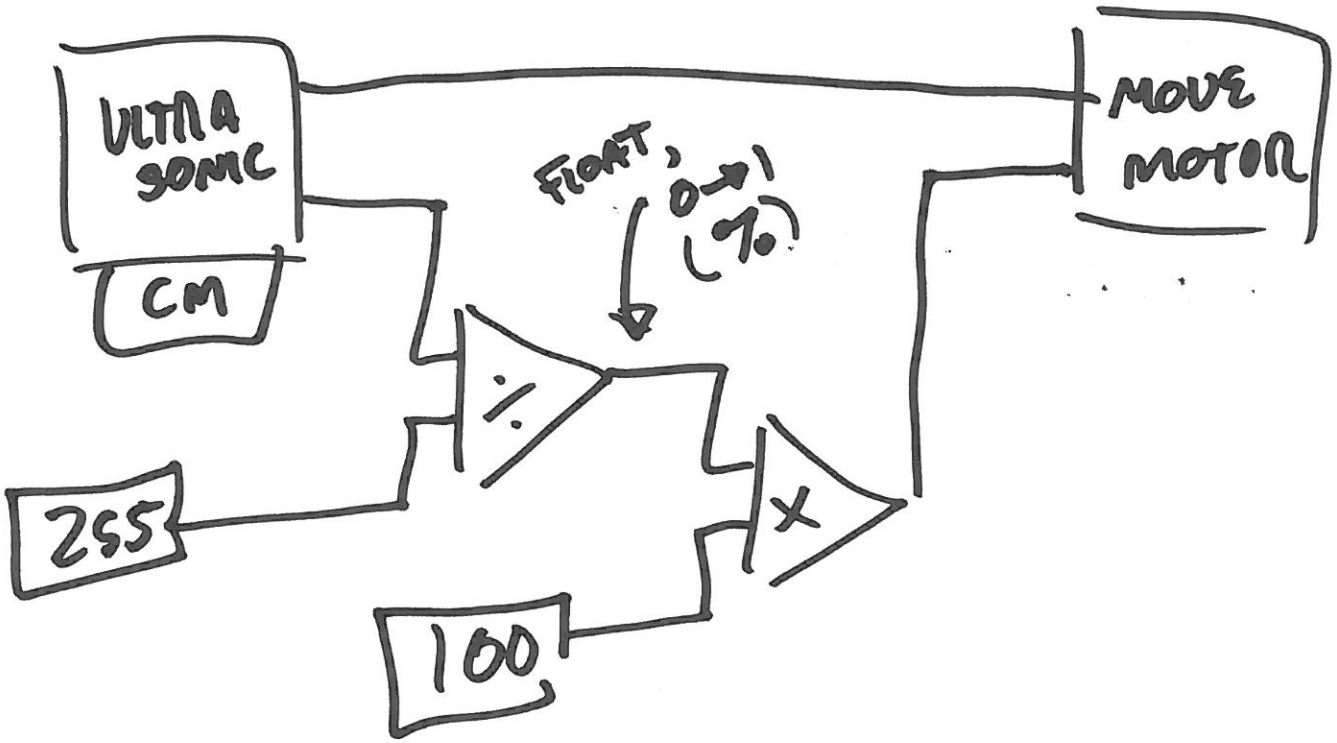
NXT/EV3 establishes the flow of the program. Wire the NXT output of this VI to the NXT/EV3 input of the next VI in the program.

Detailed help

ADJUST RANGE:

0 → 255cm

-100 → 100



- VALUES ARE TRUNCATED

0 → 100 cm

WORK + DRIVE MOTOR

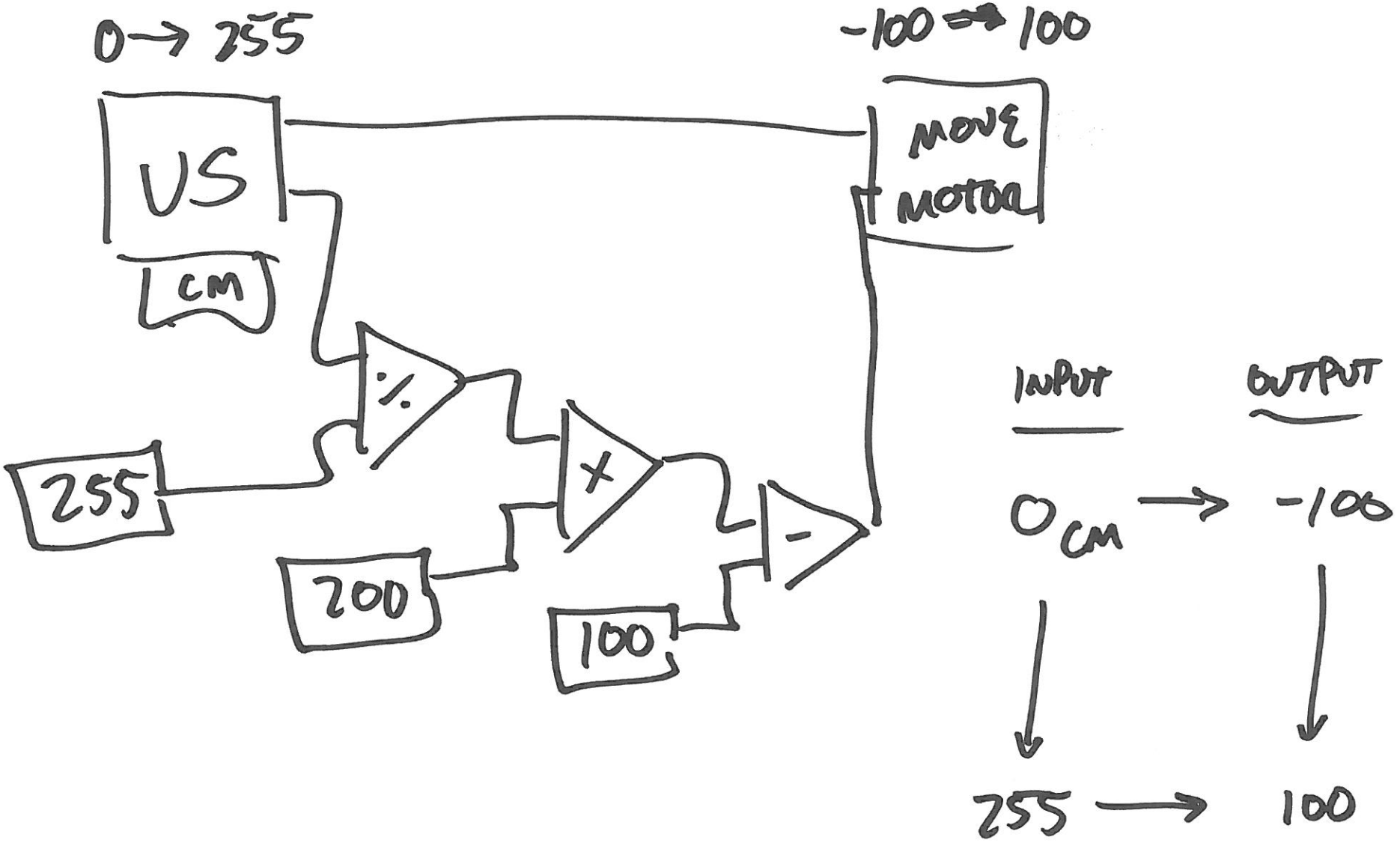
101 cm → 255cm

JUST DRIVE MOTOR AT 100 POWER

CHECK:

INPUT		OUTPUT	
0 cm	→	0	(STOPPED)
100cm	→ ≈.39 →	39	
255cm	→	100	(FULL SPEED)

ADJUST RANGE (PART 2):



Professor Danahy gives an open-ended assignment to "build a musical instrument" using your LEGO MINDSTORMS EV3 kit and any other LEGO parts you find around the CEEO (therefore, you can use more parts than just what comes in your kit, but are limited to LEGO products). Your robot must take user input(s), and be able to play 3 (or more!) tones. Give an overview of your design (describe hardware choices, sketch out robot configuration, being sure to label parts and ports) and indicate what your LabVIEW code would be (again, sketch/describe/etc) in order to make this work.

3-BUTTON TRUMPET ⇒ DESCRIBE