

# GEU111 – Engineering Problem Solving

## Lab 2 - Experiment Extensions

### A. Automatic Rotation Counting

Create a program to determine the angle per step to an estimated accuracy of 0.01 degree/step using an automated technique to count the number of complete revolutions. Do this in two ways:

1. Have your program prompt the user for an initial angle (between 0 and 360 degrees) from the dial and a number of steps  $n$ . The program will then move  $n$  steps, keeping track of the number of complete rotations. At the end of the rotation, the program will prompt the user for a final angle (between 0 and 360 degrees) and then calculate the degrees/step and the error.
2. Have your program move the dial to 0 degrees, make ten complete rotations (=3600 degrees) and stop at 0 degrees again - counting the number of steps taken - and then calculate the degrees/step and the error.

Compare the value of step angle calculated in Experiment 3.1 and in the two programs above. What are the advantages and disadvantages of each method?

### B. Plotting the Photocell Output

With the pointer starting in an arbitrary position, have your program move the pointer to 180 degrees. Then rotate 360 degrees clockwise while recording the output of photocell 1 and photocell 2 at each step. Have your program plot the voltage from Photocell 1 and Photocell 2 in volts vs. angle in degrees on a single graph. Make the plot a point plot using asterisks for Photocell 1 and circles for Photocell 2.

### C. Challenge Problems

Do the following Challenge Problems as time allows.

#### 1. Sequential Programming Task

Write and demonstrate for the instructor or TA a program that, with the dial starting in a random position, will do the following steps in order:

- a. Move the pointer to 0 degrees.
- b. Prompt the user to enter a number  $M$
- c. Oscillate back and forth between 0 and 90 degrees  $M$  times
- d. Print "End of Oscillation"
- e. Move to 270 degrees and stop
- f. Print "End of Mission"

#### 2. Threshold Sensitivity (Very challenging!)

Modify the Sequential Programming Task above so that it will work even if the lamp shining on the dial is turned off during the run.

#### 3. Make Your Own Program

Make up your own program to do some set of tasks with the dial. See if you can use `for` and `while` loops as well as an `if-else` statement. For inputs, you can use the output of the photocells as they are covered and uncovered by the pointer or by your fingers, as well as any variable values you want to prompt the user to input. See if you can include an instruction that moves and pauses every one, two, or three steps depending on whether the user inputs the text "single", "double", or "triple" and asks for another input if the user types any other text.