

3. Experiments performed for Analog output I

Description of the Experiment:

After checking how the A/D converter works and analysing the analog output of the photosensitive light sensor in different scenarios, the experiment of detecting the right to left movement or the left to right movement is conducted. The detection of the hand movement is done by using two light sensors and their analog output values.

Explanation of the Code used in the Experiment:

From the above experiments, it is possible to know that the analog output value of the photosensitive sensor increases when the surrounding environment gets darker. Based on the insight from previous experiments, the code for detecting the hand movement is created.

Team AD thought that the difference in the analog output of the light sensors at the initial condition and at the changed condition can be used to detect the presence of the hand on the sensor. Based on the assumption that there will be no hand on the sensor at the beginning, the first analog output values of the light sensors are stored as initial values of each sensor. Then, the analog output values collected from the light sensors are subtracted by the initial values of each sensor. If the difference between the initial value and the measured value is less than a certain arbitrary number (eg 0.1), zero is appended to the corresponding pre-defined lists. Otherwise, the difference between the two analog output values of the light sensors is appended to the corresponding pre-defined lists.

The pre-defined list has a fixed length of three. The reason why the pre-defined list with the length of three is because Team AD thought that the light sensor collects the light measurement while the hand moves from one sensor to another. In other words, the length of the list is fixed to three because Team AD thought that the time.sleep value(ms) is faster than the speed of the hand motion.

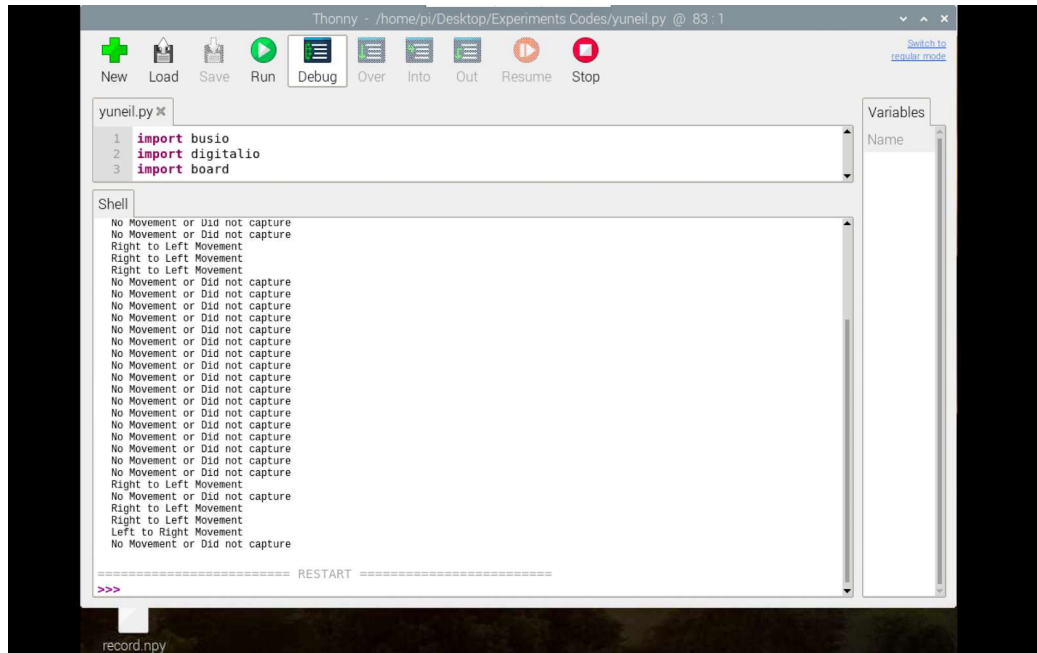
In order to explain it better, the example scenario is presented. Let's say there are light sensor 1 and light sensor 2. Before the light sensors detect the presence of the hand, both lists look like [0,0,0]. When light sensor 1 detected the presence of the hand, the list of light sensor 1 changed to [0,0, a] (a = difference between the initial value and measured value) while the list of light sensor 2 is still [0,0,0]. While hand moves from light sensor 1 to light sensor 2, the light sensors measure the light values on each sensor. Since there is no hand on both light sensors, zeros are appended to both lists. As a result, the list of light sensor 1 becomes [0,a,0] when the list of light sensor 2 is [0,0,0]. After the second measurement, the hand moves to the light sensor 2. Then, the list of sensor 1 becomes [a,0,0] while the list of sensor 2 becomes [0,0,b] since the difference between the measured value and initial value, b, is appended. Based on the scenario, Team AD thought that having the list with a fixed length of three can be used to detect the hand movement.

Based on the values and the index of the values in the list of both sensors, the hand movement can be detected. If the first value in the list of the left sensor is bigger than 0 and the last value in the list of the right sensor is bigger than 0, then the software concludes that there was a left to right movement. If the first value in the list of the right sensor is bigger than 0 and the last value in the list of the left sensor is bigger than 0, then the software concludes that there was a right to left movement. The code for the experiment is shown in the Appendix

In order to test whether the code works, the experiment is conducted. Like previous experiments, two light sensors are connected to A/D converter and to Raspberry Pi. Then, the hand is moved from left to right and right to left several times. Then, the output of the code is observed to know whether the system detected the hand movement or not. The python code is ran at the Raspberry Pi and the output of the code is shown through Virtual Network Computing (VNC) Viewer.

Result of the experiment:

Below figure shows the output of the code shown on the shell while the code is running to detect the movement of the hand.



The screenshot shows the Thonny IDE interface. The top toolbar includes buttons for New, Load, Save, Run, Debug, Over, Info, Out, Resume, and Stop. The editor window displays a Python script named 'yuneil.py' with the following code:

```
1 import busio
2 import digitalio
3 import board
```

The Shell window shows the output of the script, which consists of a series of messages indicating detected hand movements and failures to capture data. The messages are as follows:

```
No Movement or Did not capture
No Movement or Did not capture
Right to Left Movement
Right to Left Movement
Right to Left Movement
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
No Movement or Did not capture
Right to Left Movement
No Movement or Did not capture
Right to Left Movement
Right to Left Movement
Left to Right Movement
No Movement or Did not capture
```

Below the shell output, there is a 'RESTART' button and a prompt '>>>'. The Variables panel on the right is empty, showing only a 'Name' label. The file 'record.npy' is visible at the bottom left of the IDE window.

Figure: Output of the Code for Experiment 3

Based on the output of the code, it is possible to know several things about the experiment. The system with the code detects the movement of the hand on some occasions. However, the system either detected the wrong hand motion or cannot detect the hand movement on some other occasions. Team AD realized that the system cannot the hand movement either when the hand moved too quickly or when the hand moved too slowly. When the hand moved too quickly, the sensor either cannot detect the presence of the hand or detect the presence of the hand earlier than what is expected. If the hand moved too slowly, the sensor detects the presence of the hand later than what is expected. In order to solve this problem, a new experiment is conducted.