Baseball Launcher Program Theory of Operation Manual

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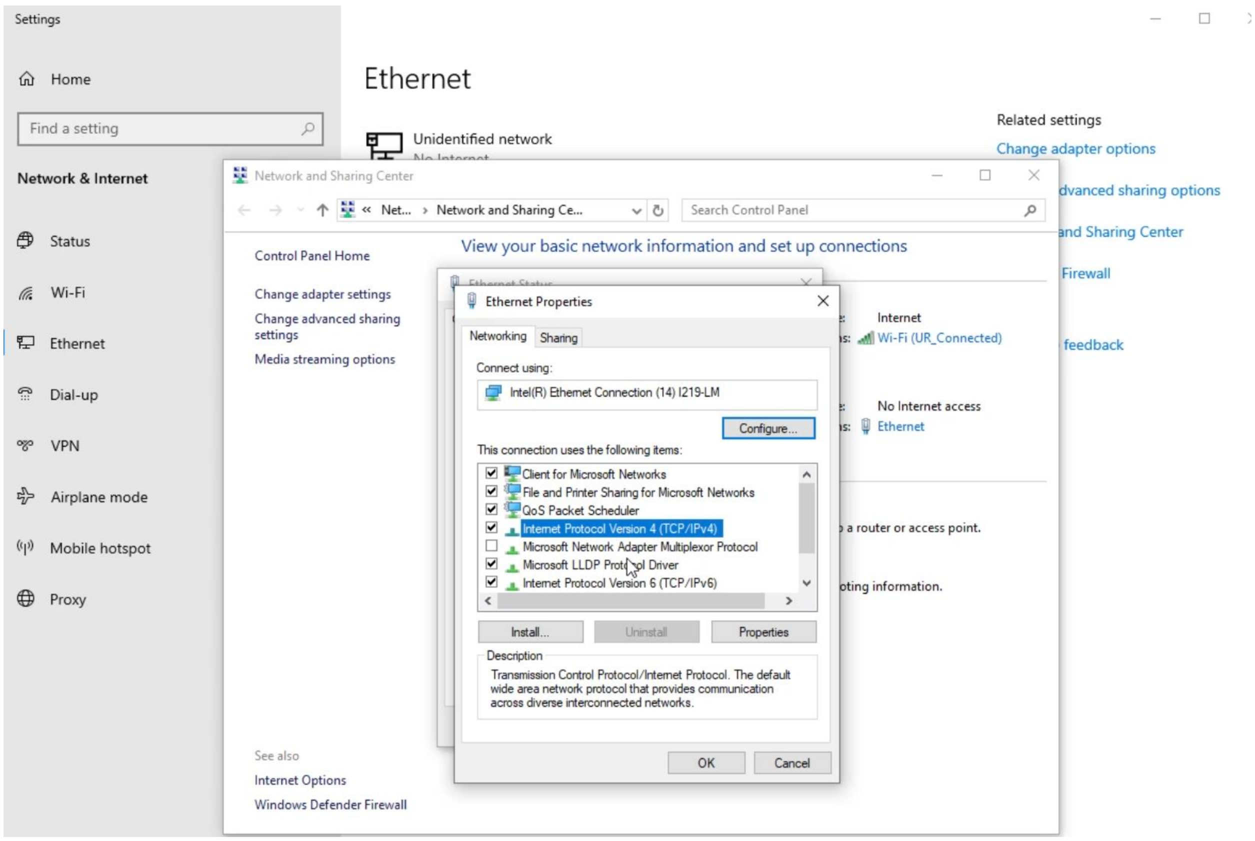
High-Speed Camera Software Setup

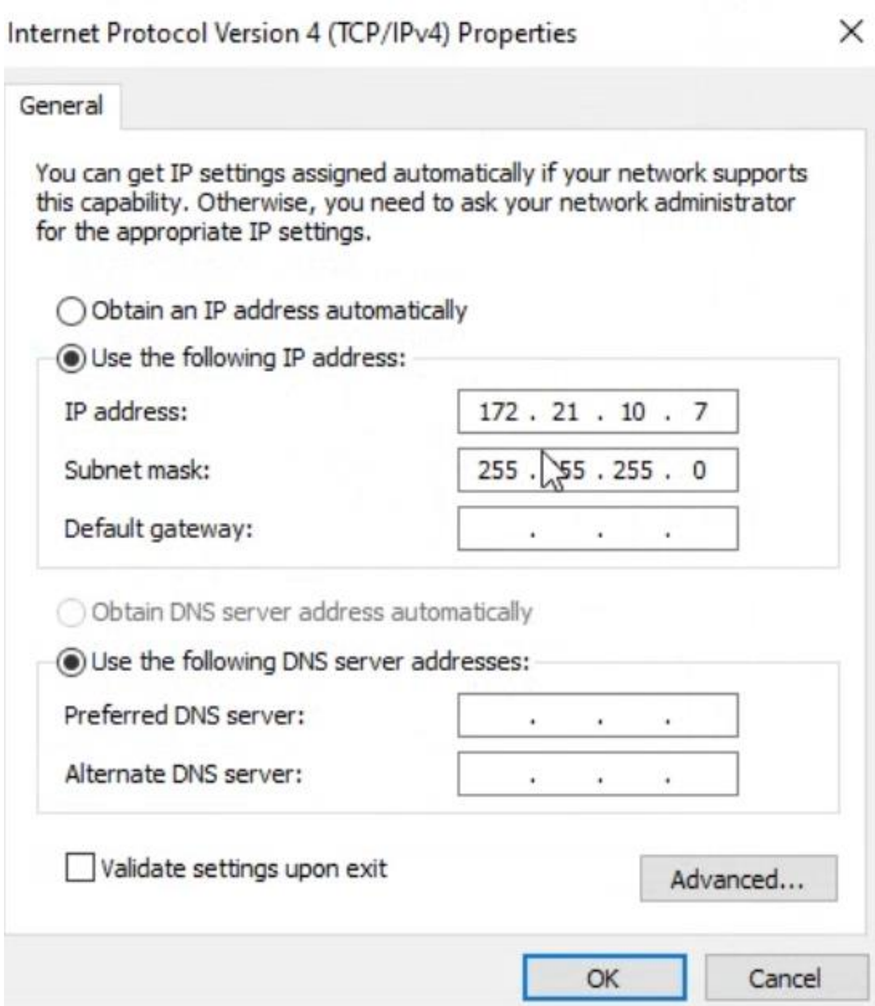
In order to use the camera, the camera must first be registered with the computer on the network.

To do this, open the Windows settings and navigate to the **Network > Ethernet > Network and Sharing Center > Ethernet > Ethernet Properties > Internet Protocol Version 4.**



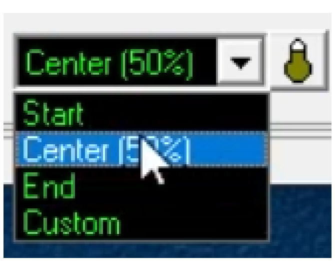
Click the “Properties Option” and then select “Use the following IP address”. Then input 172.10.28.x for the IP address, where ‘x’ is any number between 1 and 255 that is not 18 (that is the camera’s number).

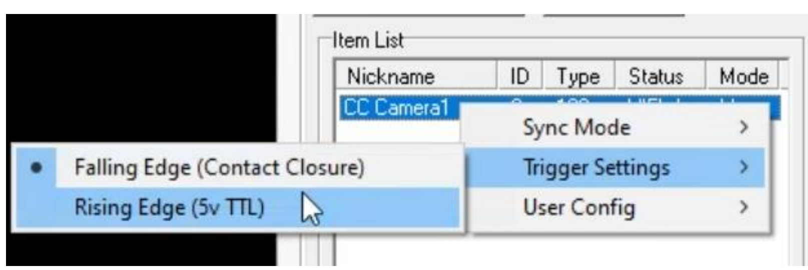
Set the subnet mask to 255.255.255.0 and confirm. This process only needs to be done once for the computer that the camera is connected to. It is not necessary to perform this setup if the program is closed or if the computer is powered off and on in between uses of the camera.



Open the NAC Hotshot program. On the main screen, click the "connect" button to connect the camera to the computer. It may take a few tries for the camera to properly connect if the program was just opened.

Other options also must be changed from the main screen. Switch the trigger type to "Rising Edge" and the recording mode to "Start" instead of "Middle". The frames per second can be adjusted in the bottom left corner of the interface if needed.





Now with the parameters set, the camera can be used to record. By clicking the hollow blue circle under the camera feed portion of the screen, the circle will change to green and will start displaying a feed of the camera to the program. Use this to determine if the camera is in the correct location and if the lighting is satisfactory.

Pressing the green button again will turn it to red, setting the camera to the “armed” state. In this state, the camera will record once it receives the trigger voltage from the Arduino. The camera will automatically record for the set time duration once it is triggered. In order to exit “armed” mode without recording, click the blue “stop” square.

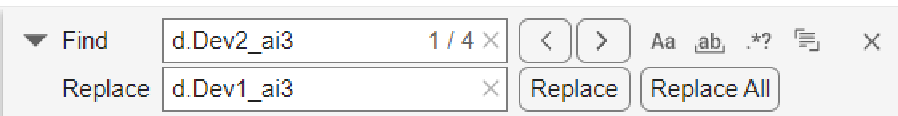
After the camera records, use the “Export Capture” button to save the recording. It is recommended that the recording is saved in the folder or a subfolder of the folder where the MATLAB code is stored.

The Release Control MATLAB Script

The release control script ("Release_Script.m") is designed to be simple to run. Before running the script, copy and paste and run these two commands into the command window, then pay attention to the device ID that is outputted from the command.

```
dl = daqlist;
di = dl{1, "DeviceInfo"}
```

Scroll to line 42 of the code and note the device ID used in the plot command. If it does not match the device ID, then use ctrl+f in the editor window to open the find window. Open the replace window using the arrow and then put the old "d.deviceID_ai3" in the "Find" box and the new "d.deviceID_ai3" in the "Replace" box as shown below, and then click "Replace All".



There also is a section for various variable inputs. The most important of which is the "targetRPM" variable, which should be set to the desired value before running the test.

```
% ---- CONSTANTS AND INITIAL VARIABLES ----
testMode = false;  %If true, does one sample cycle then displays results
testFilter = true;%If testMode and testFilter, figure shows filtered data
readTime = 1;    %Seconds to sample for each cycle
dq.Rate = 15000;    %Sample rate in Hz
cutoff = 2.5;       %Voltage cutoff for thresholding of values
tonewheelTeeth = 25; %Number of teeth on tonewheel
targetrpm = 1750; %Target RPM for Launch
target_count = 0;%Number of times the DAQ has read the target RPM
rpm = 0; %Initial RPM
```

This completes the setup for the Release Control. The program needs to be run and the camera set up for recording prior to beginning the baseball launcher spinning up. After launching, the program will save a record of the time and rpm data as "testData.txt". Rename this file in order to save it before running another test.

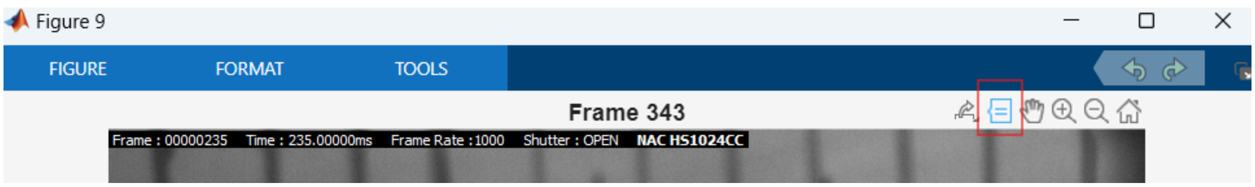
Ball Speed Analysis

Once the camera recording has exported, the video must be analyzed to determine the speed of the ball before and after impact as well as its impact location.

First, open the video in a standard video player and determine the time in seconds when the ball first appears in the frame. Also, use the dimensions of the ball or standard distance markings to determine the field-of-view of the camera in inches to calculate the pixels-per-inch of the frame.

Then, open the "Video_Analysis.m" file and run the program. The program will first open a file explorer tab to select the video to be opened. The program will then prompt for the time where the ball first appears in frame, which should then be inputted.

The program will then open a figure for each frame for 20 successive frames. Navigate to the frames immediately before and immediately after collision. Click on the "data tooltips" button as shown below to be able to click on the image and determine the position of an individual pixel.



Determine the pixel location of the center of the ball in two frames before and two frames after as well as the location of the ball where it strikes the bat. These values will be used to run the "ball_speed" function.

To run the "ball_speed" function, type the command into the command window and then input the pixel positions of the two frames either before or after the collision, the pixels-per-inch, as well as the frames per second of the recording. An example can be seen below. This function will return the speed of the ball in mph. This concludes the video analysis operation guide.

```
>> ball_speed(423,482,468,407,126.67,1000)

ans =

   39.2323
```