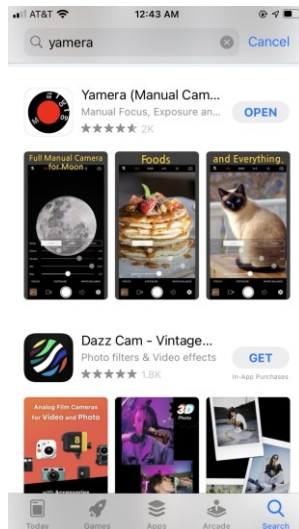


## Photos Acquisition Guide

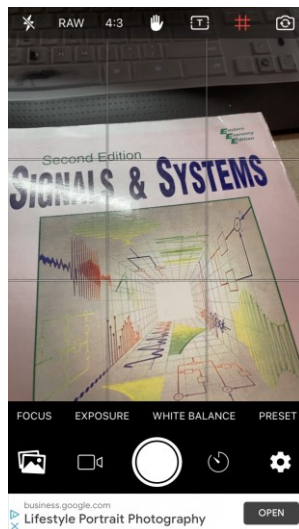
### [Pilot capturing confirmation]

- Please capture two sets of photos containing scene 1 and scene 2, respectively. This instruction relates to step 17, so please follow this instruction when on step 17.

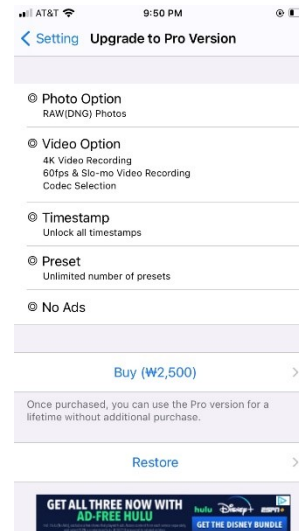
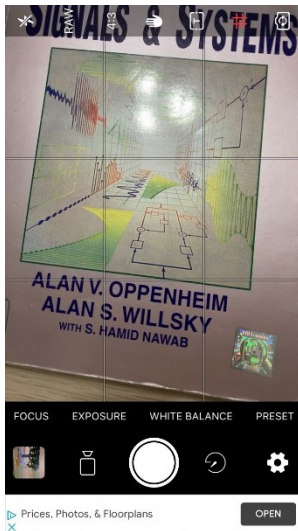
1. Download Yamera from the Apple store.



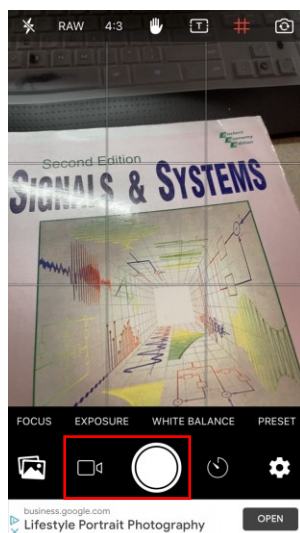
2. Open the app, and the following user interface will be seen.



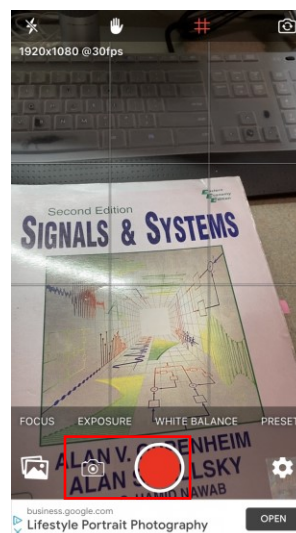
- (Optional) Please click the setting icon at the bottom right corner. Then, click “Upgrade to Pro Version” in PURCHASE and select “Buy” to make payment. The difference between the free and paid versions of the application is how many physical camera settings we can save. In the free version, we save up to two camera settings. On the other hand, the paid version offers a lot more. Thus, if we purchase the application, we can easily capture different scenes under the same setting by simply loading the saved camera setting. Otherwise, manual labor for setting the parameters including focus, ISO, shutter speed, and white balance is needed whenever camera scenes differ or shutter speed levels differ.



- Please make sure to be in the Image mode. In the Image mode, the white button and the video icon will be shown at the bottom. On the other hand, the red button and the camera icon will be shown in the Video mode. Therefore, please switch to the Image mode by clicking the camera icon if in the Video mode.

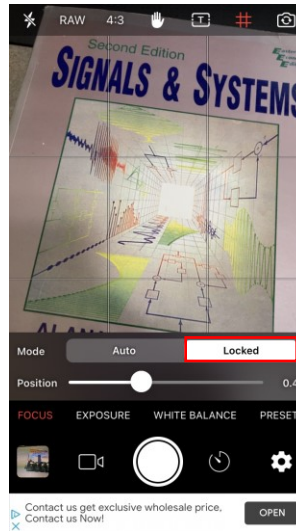


[Image mode]

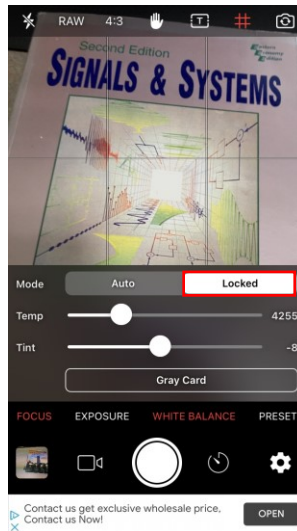


[Video mode]

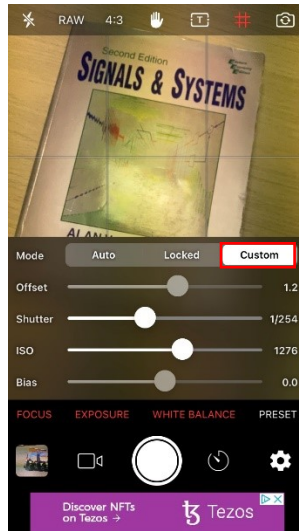
5. Please click “FOCUS” and select “Locked” mode.



6. Please click “WHITE BALANCE” and select “Locked” mode.

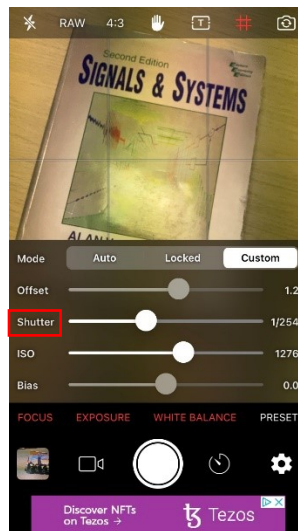


7. Please click “EXPOSURE” right above the video button. Under “EXPOSURE,” there are three modes: Auto, Locked, and Custom. We do not work on Auto and Locked. Instead, please select “Custom.”

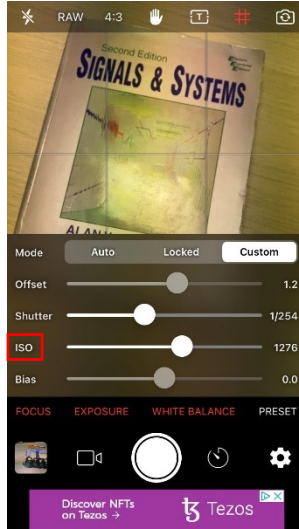


8. Once we are on “Custom,” there are “Offset,” “Shutter,” “ISO,” and “Bias.” “Offset” characterizes the strength of the DC component (average intensity) of a video or image signal. Only “Shutter” and “ISO” are user-controllable parameters associated with brightening or darkening photos. Both “Shutter” and “ISO” impact image brightness.

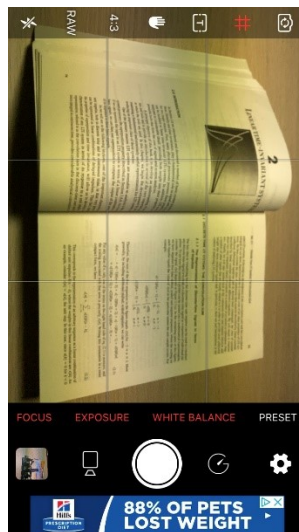
On “Custom” mode, we can fully control the shutter speed through “Shutter” below. The shutter speed, known as exposure time, determines the amount of time the shutter is open, shown in fractions of a second:  $1/10$  s,  $1/50$  s,  $1/100$  s, etc. When we drag the shutter speed control to the right (longer exposure), it brings in more light and makes the acquired picture brighter. When the control is dragged to the left (shorter exposure), it lets in less light and makes the image darker. Please set the shutter speed to **1/258**.



9. There is “ISO” right below “Shutter.” ISO characterizes the camera’s sensitivity to light. The higher the ISO, the more sensitive camera sensors become, and the brighter pictures appear. First, set the ISO to the highest (probably, 1840) and gradually reduce it until we obtain a similar brightness as the images provided under step 17 have. Please remember the ISO value for shutter speed  $1/258$  and denote it as  $m$ .



10. Once we are done setting everything up, please click “EXPOSURE” to close the window and view the entire camera scene as below.



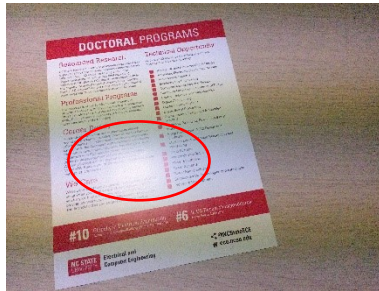
11. Now, rotate the camera counterclockwise to position it in the landscape. We want to take landscape photos. Please print a pdf file named “scene1” uploaded in this link ([https://www.dropbox.com/sh/91az12j5p3301dp/AACG-diSFWc\\_p1luZMiuR4V9a?dl=0](https://www.dropbox.com/sh/91az12j5p3301dp/AACG-diSFWc_p1luZMiuR4V9a?dl=0)) and put the printed paper under an old-style and cheap **fluorescent** lamp that operates at the same 50 Hz or 60

Hz frequency as the periodicity of the power mains. Please make sure that the light source is fluorescent, not LED.

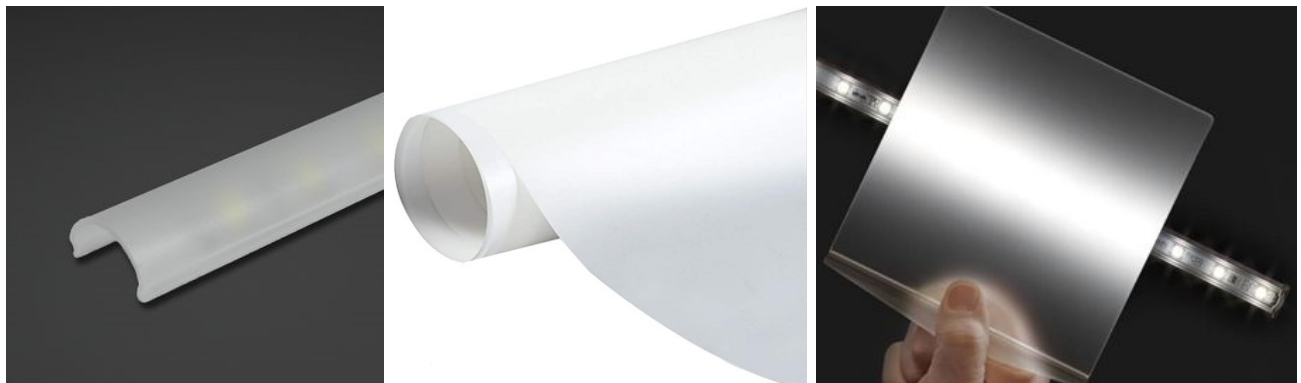
12. If we set the shutter speed to 1/258, we will see similar horizontal strips, as shown below.



13. Before taking a photo, there is a precaution we should know: avoid specular reflections (see the below image) as much as possible.



To have almost no specular light within an image, we may want to use an optical diffuser (see the below image) to cover the lamp we are using. Also, please make sure to avoid shiny shooting object(s), move the shooting object(s) to the side, and/or change the camera angle/location.

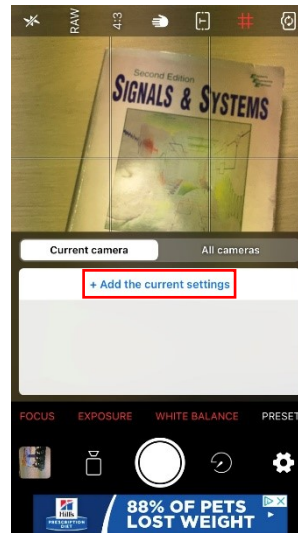
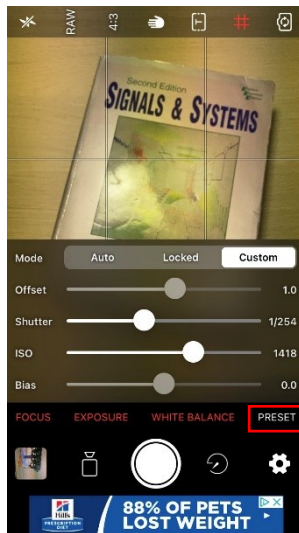


The geometric setup used for acquiring images in Cary, USA, is given below. To avoid direct light rays from the source light, we placed the shooting object and the camera slightly to the side.



14. Please take a photo which will be taken at the shutter speed level 1/258.

15. (Optional) Please click “PRESET” right above the setting button. Then, select “+ Add the current settings” to add the current setting and load this setting later. Since it is not easy to set the shutter speed to a specific value due to the sliding mode controller, storing the given seven shutter speed settings and loading them for different scenes would be very useful.



16. Please take photos at another six shutter speed levels **1/208, 1/170, 1/125, 1/83, 1/46, 1/25** for the same scene (roughly, no need to be 100% the same).

Please note that ISO sensitivity also needs to be changed along with the shutter speed change because we want to obtain a similar brightness on images even with different shutter speeds. Thus, whenever shutter speed levels change, we also need to adjust ISO sensitivity as follows:

|                     |         |         |         |          |          |          |       |
|---------------------|---------|---------|---------|----------|----------|----------|-------|
| Shutter speed (sec) | 1/25    | 1/46    | 1/83    | 1/125    | 1/170    | 1/208    | 1/258 |
| ISO                 | 25m/258 | 46m/258 | 83m/258 | 125m/258 | 170m/258 | 208m/258 | m     |

Since ISO sensitivity should be an integer, for 1/25 sec, the ISO value needed to be set will be a neighboring integer around 25m/258. So, for example, if you set  $m$  to be 1800, the ISO values for each shutter speed level could be as follows:

|                     |      |      |      |       |       |       |       |
|---------------------|------|------|------|-------|-------|-------|-------|
| Shutter speed (sec) | 1/25 | 1/46 | 1/83 | 1/125 | 1/170 | 1/208 | 1/258 |
| ISO                 | 174  | 320  | 579  | 872   | 1186  | 1451  | 1800  |

17. Check if at least three photos contain noticeable ENF traces. If yes, take another nine sets of photos with different image contents, which of each set has seven different shutter speeds. Thus, a total of 70 images will be as follows:

- 1) 1st – 7th set: Please print a pdf file named “scene x (x is a set number)” in the link and use the printed one for a shooting object to mimic the scenes of Scene 1 – 7 of the following figure.
- 2) 8th – 10th set: Please print some relevant pages on ENF and SP CUP (may want to use two pdf files named “enf\_paper” or “SP\_magazine”). If not, use pages from books, newspapers, magazines. Each of the pages should not contain too many dark figures, but one or two is okay. In the latter case, please caution the choice of content to include. We want to avoid copyright issues.

|                |       |                    |                    |                    |                   |                   |                   |
|----------------|-------|--------------------|--------------------|--------------------|-------------------|-------------------|-------------------|
| Shutter speed: | 1/258 | 1/208              | 1/170              | 1/125              | 1/83              | 1/46              | 1/25              |
| ISO:           | m     | $\frac{208k}{258}$ | $\frac{170k}{258}$ | $\frac{125k}{258}$ | $\frac{83k}{258}$ | $\frac{46k}{258}$ | $\frac{25k}{258}$ |





18. After finishing all ten sets of photos, each containing images taken under seven different shutter speed levels, exit the app.
  
19. Please take the following image export procedure designed to avoid unintended image compressions that may lower the quality of the output images.
  - 1) Connect the iPhone to the PC with a USB cable.
  - 2) If asked, unlock the device using a passcode.
  - 3) Open File Explorer from the taskbar and select This PC.
  - 4) Double click: Apple iPhone → Internal Storage → DCIM
  - 5) Double click a folder containing photos to be imported and transfer them to the PC.