Laser MAQs System

1.1 Introduction

Laser MAQs system is a system that was used to monitor the movement of hand. This system was almost similar to the system that has been introduced before by SCATT and NOPTEL. This system works by capturing the movement of athlete hand before shooting and after shooting with the time specified by the number of frames chosen. From the movement this system capture, it then determine the distance that has been travelled by the athlete hand with its velocity in every frame captured by the camera. This system is also featured by the comparison function that enables you to make a comparison between the two data captured by the system. This system was compatible to be used by archery and shooting sport, but further test and modification need to be done for shooting sport since it has not been tasted yet.

1.2 System Overview

This system works by capturing the movement of the Laser pointer that was attached to the shooting device (like bow) by using a camera. The data acquired by camera were than process by using image processing provided by LabView. Results of the data will then be displayed in a user friendly Graphic User Interface.

1.3 Devices for The System

This user manual is focusing on the usage of Basler Camera and laptop to run the system. Other camera might need minor modification of the device setup and the LabView program.

Here are the lists of Devices that was used for this system:

1. IEEE1394 CardBus

This card is a special IEEE Firewire card. It can be connected with a power supply from an adaptor. This card was suitable for those who are running the system in a laptop and using a camera that requires high power. This card was plugged into a PCMCIA slot available in your laptop. You can ignore this card if you are using desktop personal computer that have its own Firewire slot.

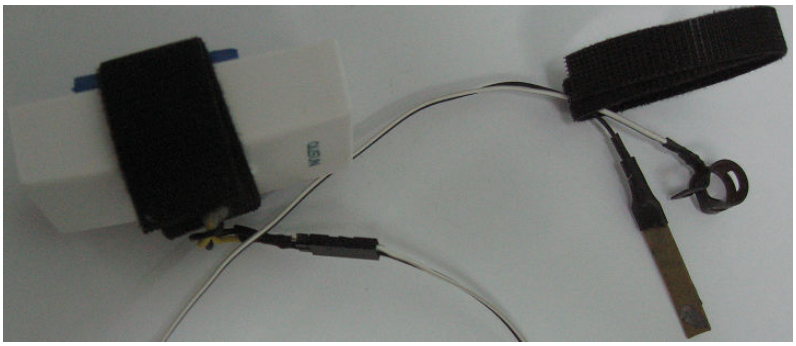
2. Adaptor

This adaptor is an adjustable Voltage that convert AC voltage source into DC voltage source. This adaptor is compatible with the previous IEEE1394 CardBus since one of the head can be fitted into the Card. This adaptor was used as a power source for a camera that require external power source.

3. FireWire Cable

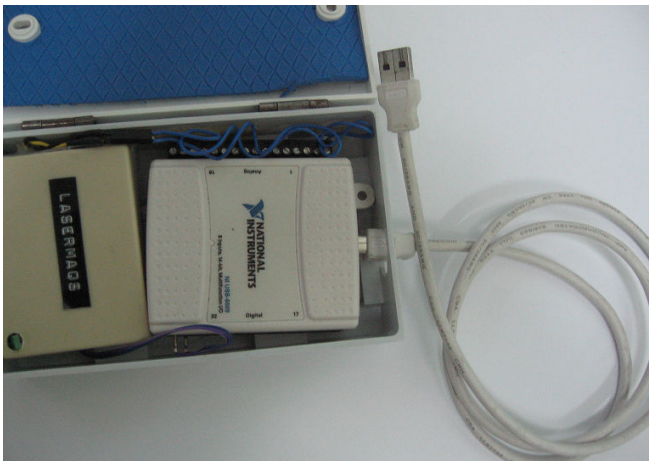
This is just an ordinary Firewire cable. It was used to connect camera with your personal computer.

4. Clicker Transmitter



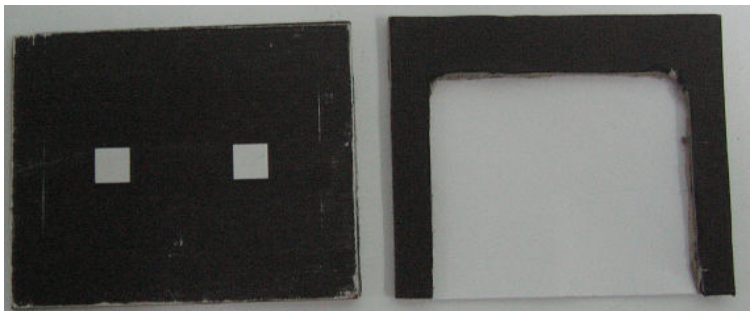
Clicker Transmitter will be used to transmit the signal of the clicker. Whenever the clicker connects, short circuit will happened that will trigger the transmitter to send high signal to the receiver.

5. Clicker Receiver and DAQ Card



Each time the clicker connects, a high signal will be sent by transmitter and the clicker receiver will receive the signal. This signal will then be acquired by DAQ card and is process through LabView.

6. Scaling Card and Secondary Target Card



Scaling card (left image) was used as a card to do a scaling for the camera on the position of the scaling card. Secondary Target card (right) will be used as the place for the laser beam light drop before captured by camera.

7. Laser Pointer and Laser Mounting device

Laser pointer was used as a pointer to show the movement of the athlete's hand. The laser will move as much as the movement of the athlete. This laser will be placed inside its mounting device so that it can be connected to the bow.

8. Basler Camera and its mounting Device

This camera is the camera that was used to capture the movement of the laser. This camera requires external power of 6 Volts to run. The focus of the camera can be adjusted manually. To communicate with computer, this camera was connected via firewire cable. All of the power will be provided by the firewire port itself. You do not need to supply external power supply to this camera if you are using desktop personal computer; but if you are using a laptop, you might need the above IEEE1394 CardBus and adaptor.

9. Tripod

Tripod will be used to adjust the position of camera. Since the position of the camera will be low, a high Tripod is not required.

1.4 How to Setup the Device

Since this user manual assumes that the system runs on Laptop, the first step you need to do is to connect the IEEE1394 CardBus to the PCMCIA slot available on your laptop. Connect the firewire cable to one of this IEEE1394 slot that was available. The next think to do was to measure the output of the adaptor. Make sure the output Voltage is around 6 Volts. Now connect the adaptor to the IEEE CardBus hold available.

Next, connect the firewire cable to the camera that has been attached to tripod. Check the connection of the camera through LabView program called Measurement & Automation (MAX). Make sure that MAX can detect the camera through Legacy driver like shown in the picture bellow.

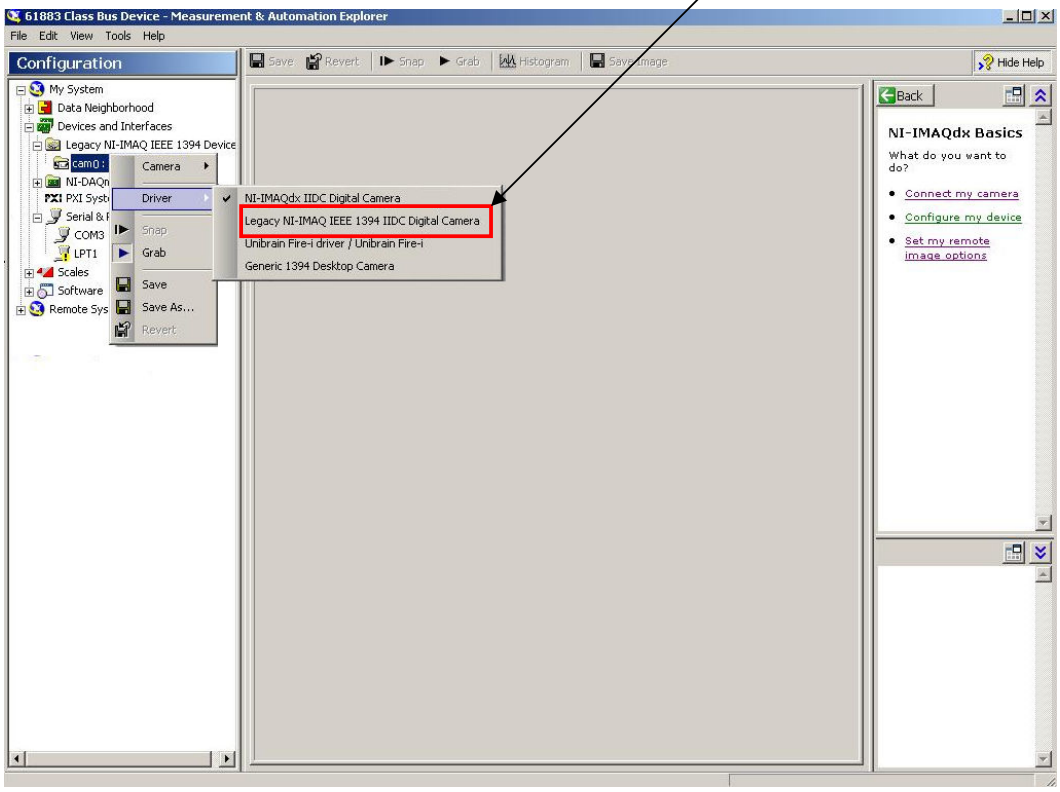


Figure 1. Measurement & Automation for Basler Camera

Some adjustment and setting about the brightness and gain of the camera can be done through this software if necessary.

Now use the Velcro cord wrap available in the transmitter to stick it to the base stabilizer of the bow. The other end of the transmitter was connected to the clicker of the bow. The circle connection is attached to the base of the bow and the metal plate to the clicker. Use a tape to stick the metal plate to the bow clicker. Make sure that the clicker will be able to conduct electricity when it touches the base. The mounting laser was attached to the other side of the bow sight. The laser will be pointing down with some degree of angle. (The angle is not fix. Choose an appropriate angle so that you will get the shortest distance of camera to the bow without disturbing the movement of the bow after the arrow was shot). The full setup of the bow is shown in the following figure.

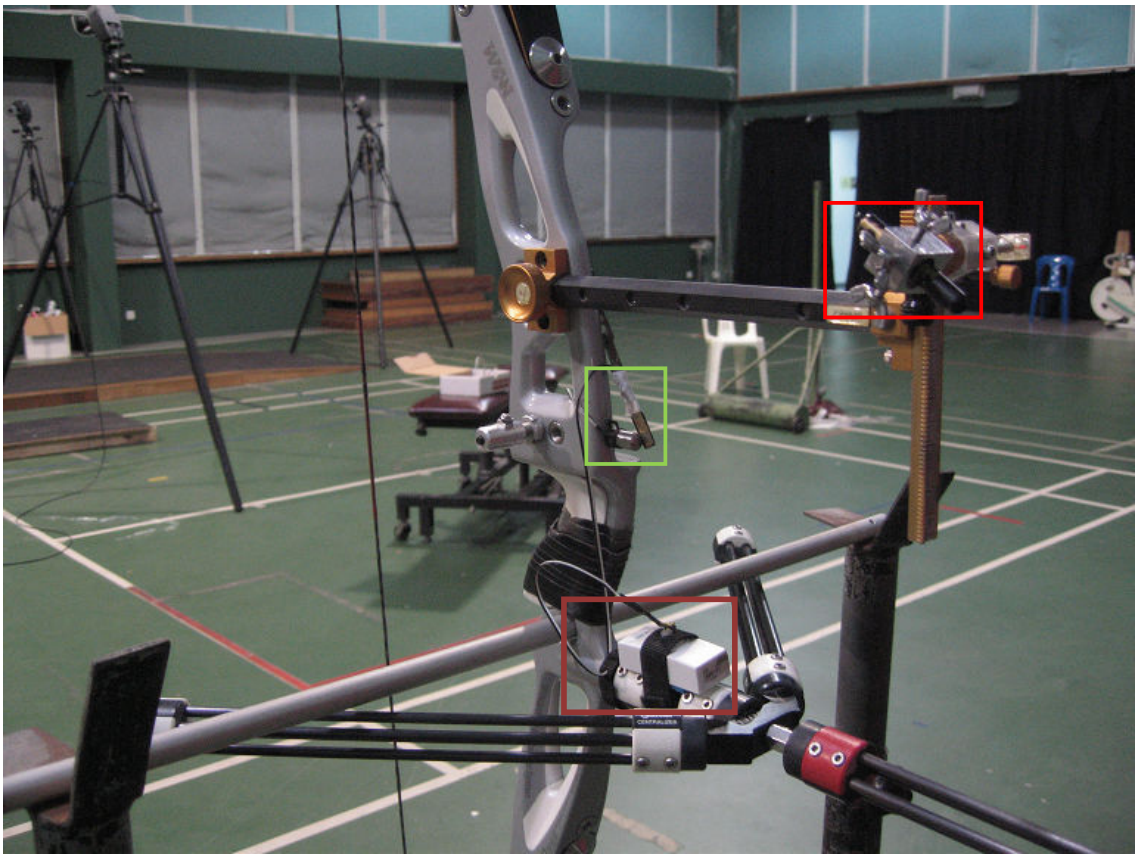


Figure 2. Setup of the hardware in the bow.

Set the tripod so that the camera is facing a bit upward. Put the secondary target to the mounting device of the camera. Switch on the Laser and make sure the laser light beam will be able to drop at the secondary target.

Figure 3. Camera Hardware Setup

The full setup of the hardware will be shown by the following image.

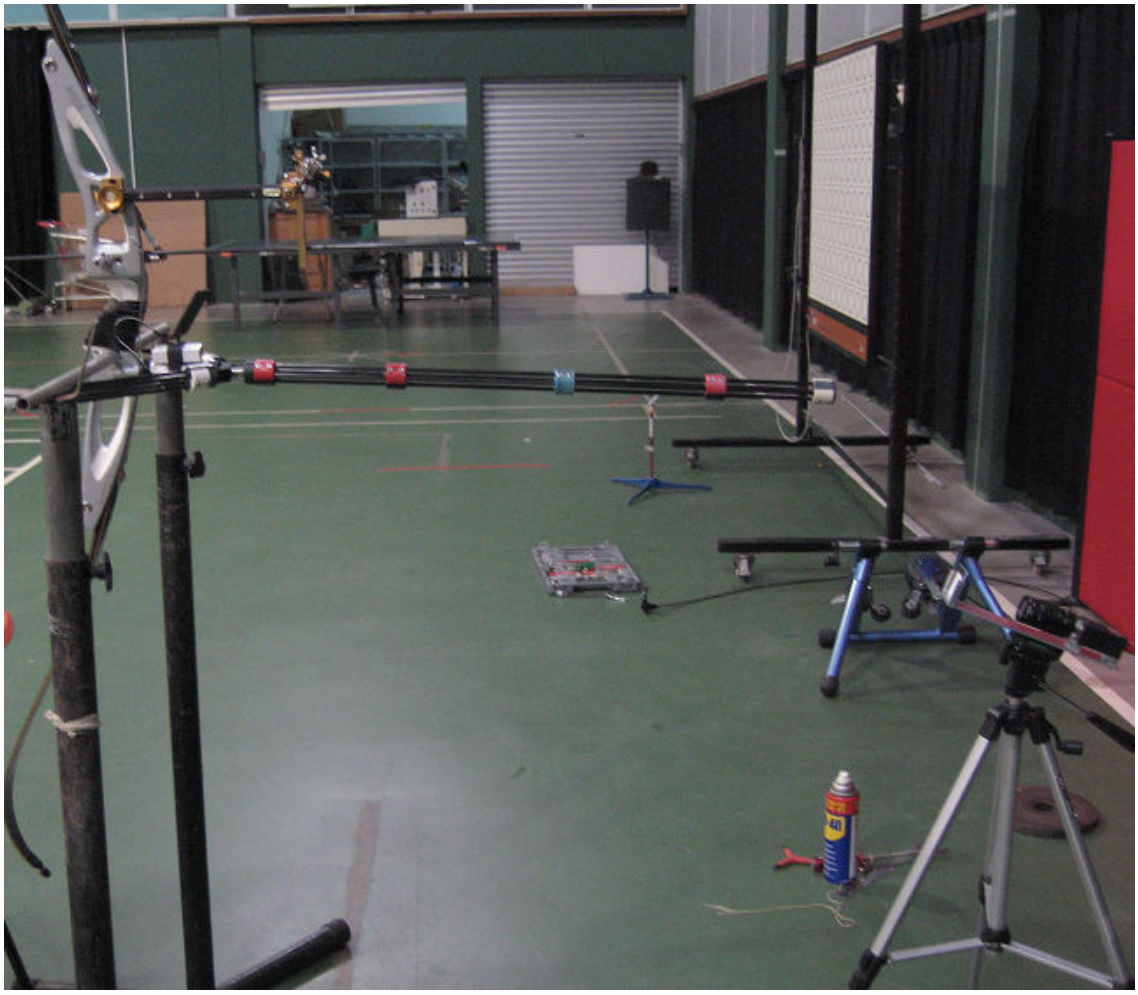


Figure 4. Full setup of the hardware

1.5 How to Use The System

Before operating the program, make sure that you have two important programs inside your folder. There are **LaserMAQS Version 3.0.vi** and **scan_cam.vi**. Make sure that your LabView was also installed with **NI Vision Development Module** and **NI Vision Acquisition**. The system can be operated by simply double clicking **LaserMAQS Version 3.0.vi** file inside your folder. You will see an image shown on the following screen. This screen has four process tabs; Capture, Process Data, Compare and Option.

Capture Tab was used to calibrate your camera and capture the laser pointer.

Process Tab was used as a processing data file. This Tab contains all information that was required by the archer and coach.

Compare Tab was almost exactly the same as Process tab. It was used to compare the result between two shoots or two attempts.

Options Tab was used to set a predefined operation include Data Save path, Process Data path, Target Distance and Final Scale. This tab also allows us to scan the available camera and Show the camera information.

Click the run button shown bellow to start the system.

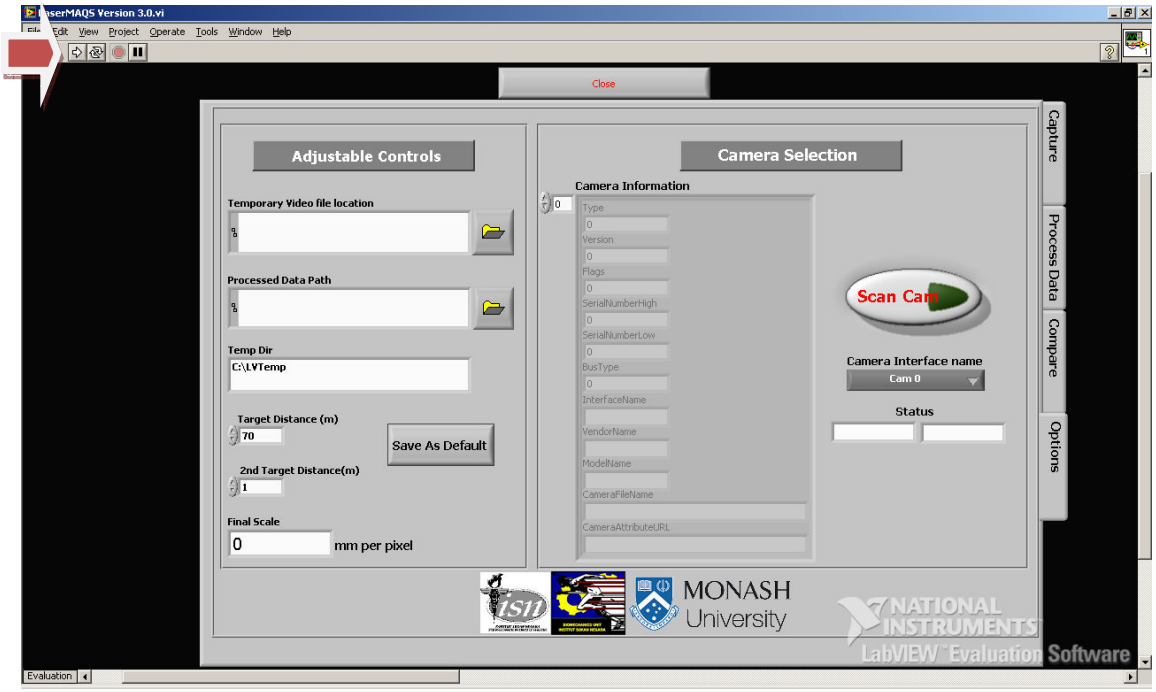


Figure 5. Front View of the system

After running the system, the first thing you need to do is to select the folder of the Temporary video file location and the process Data path. This two data path will be the place where you store all the information after the data has been acquired and process. You can create a new folder in your drive and choose current folder Remember also to set the Target distance of your system. The initial value will be 70 m for the actual target and 1 m for secondary target. Remember to save the data as default to avoid repeating the same steps again in future.

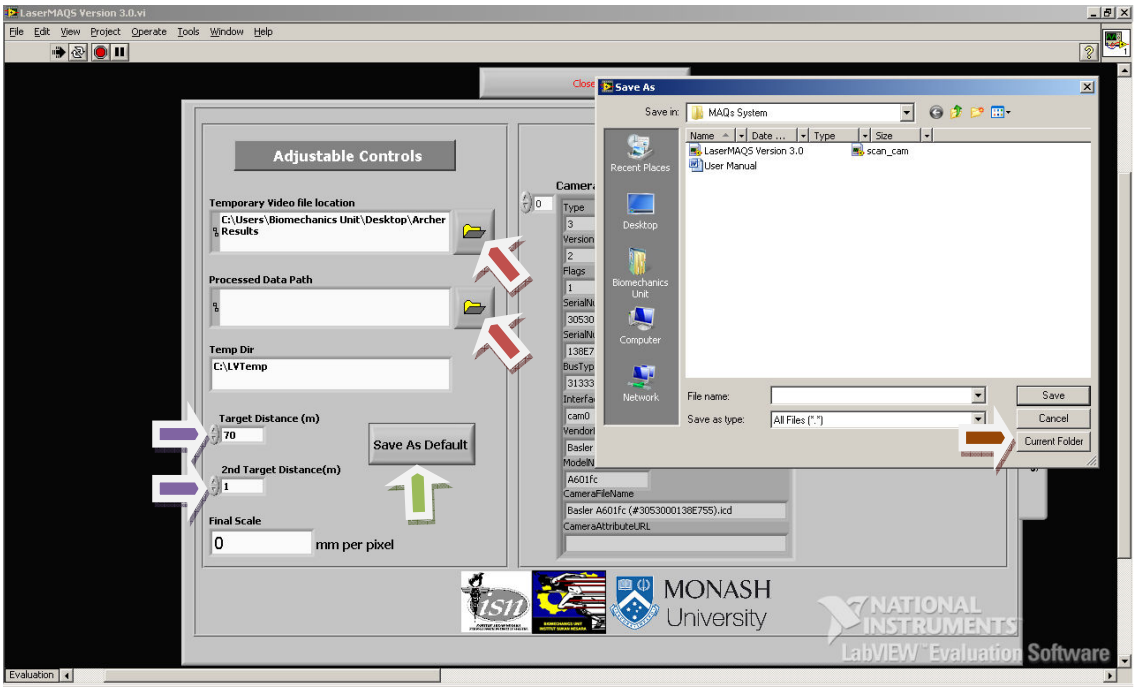


Figure 6. Pre-Setup

Now connect your camera to the firewire slot and do not forget to power the camera up by using an external power adaptor to the IEEE 1394 slot provided if you are using a laptop. Click the scan button in the screen and make sure the camera is connected and detected by your system. If the camera was detected and connected, an indicator to show your camera connected and information of your camera will be listed in the screen.

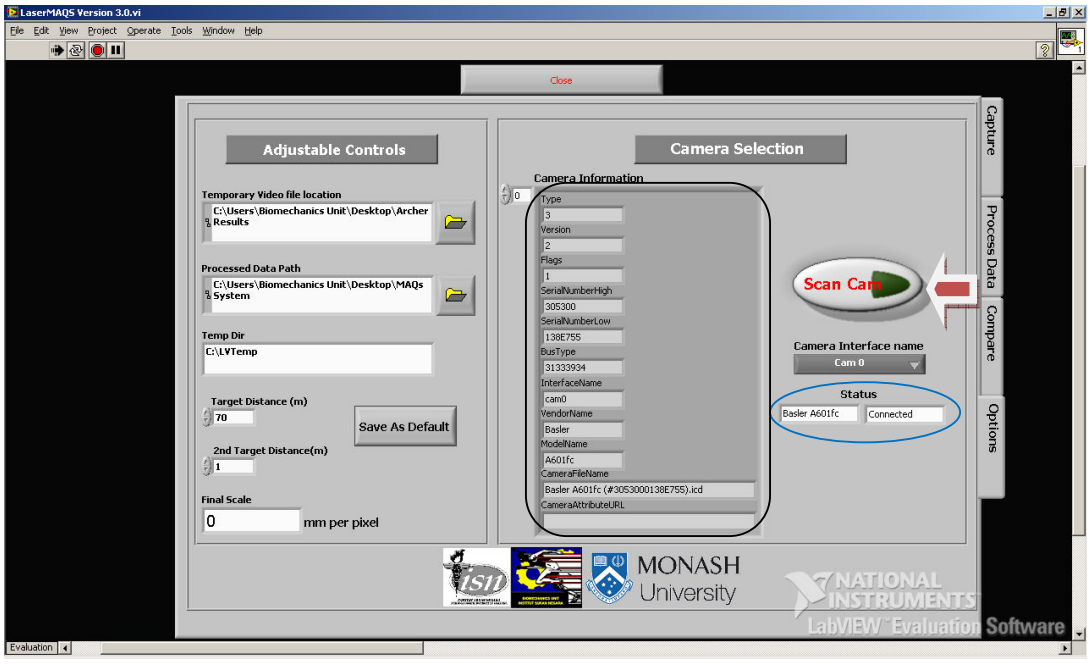


Figure 7. Scan Camera

Now put the scaling card into the provided slot in the camera. Go to capture tab and choose calibrate camera. Follow the instruction provided on the top of the image.

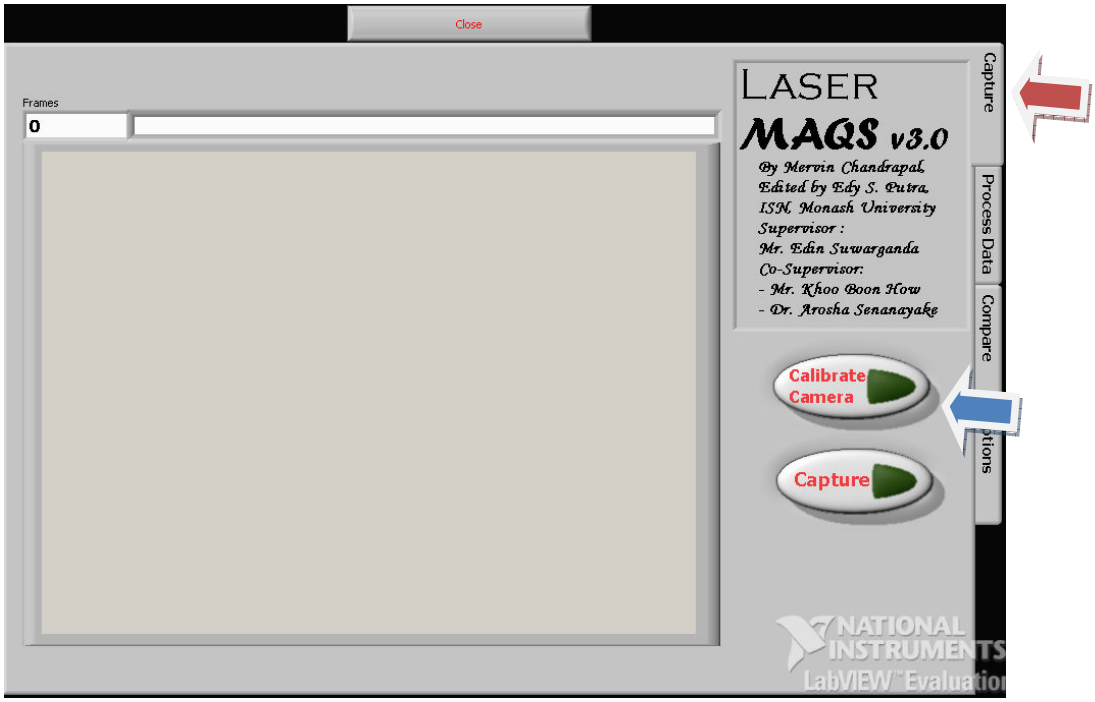


Figure 8. Capture Process Tab

Make sure you can see two circles on the screen when you press toggle button at the right side of the image. Press done button and follow the instruction again until you get the scaling size.

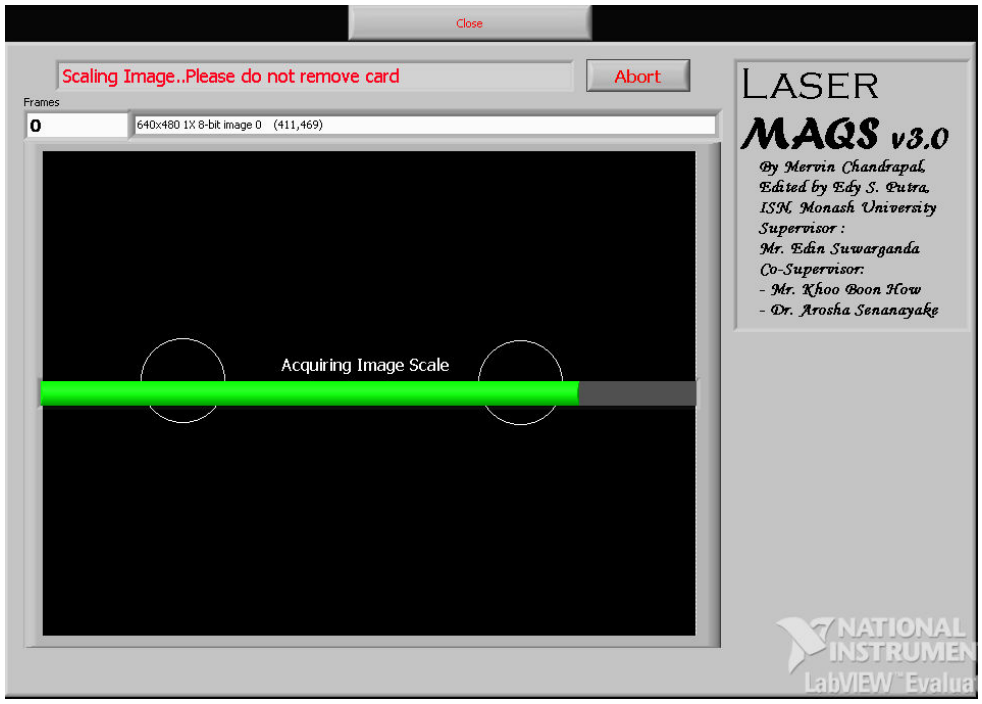


Figure 9. Calibrating the camera

Go back to Options tab and make sure that you have a value (not zero) in your final scale.

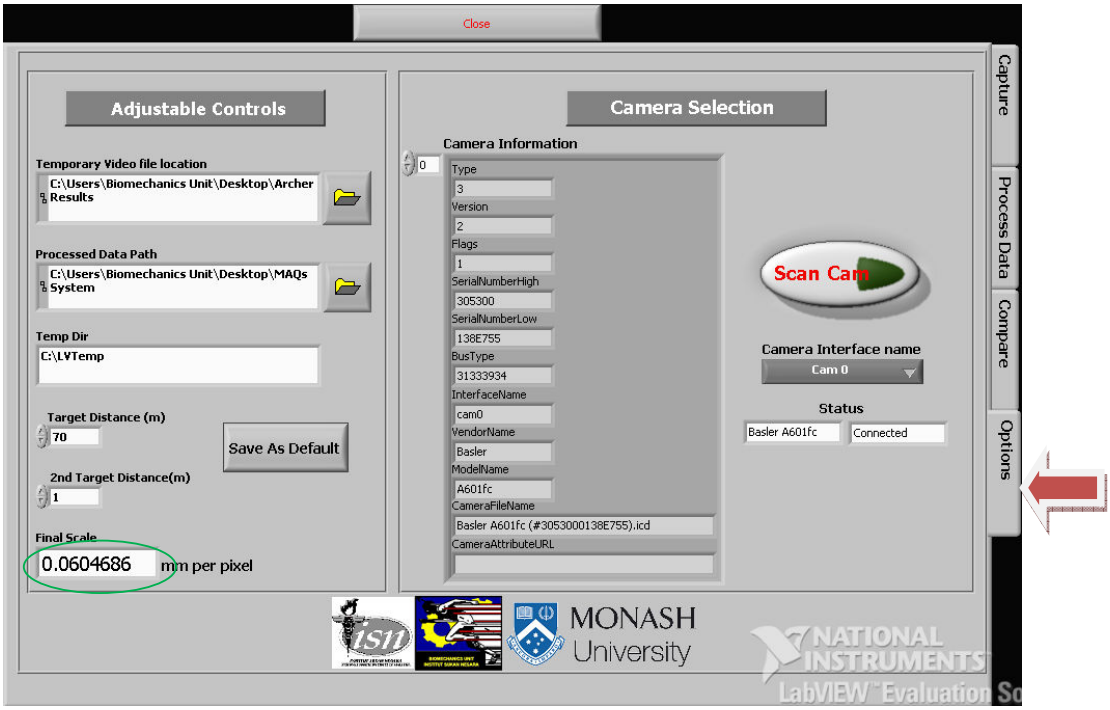


Figure 10. Obtain Final Scale Camera

Now you are ready to use the system. After the setup for the device has finished, go to the capture tab and press capture. Put the detail of the athlete inside the pop-up window.

Figure 11. Pop up window to insert athlete information

Replace the scaling card with secondary target card. And the archer can start to shoot. Ask the archer to raise the bow and do some adjustment to the camera position. Make sure that the laser pointer can be seen in the image screen. If not try to adjust the camera so until you can see the laser light.

Capture and Process Data

This system works by capturing the laser light position, therefore when the archer was trying to aim, make sure that the camera can capture the laser light.

The clicker Light Indicator will be on when the clicker was touching the base (when there is no arrow or when the arrow was shot). Therefore initially before the archer load the bow by arrow, the light will be on.

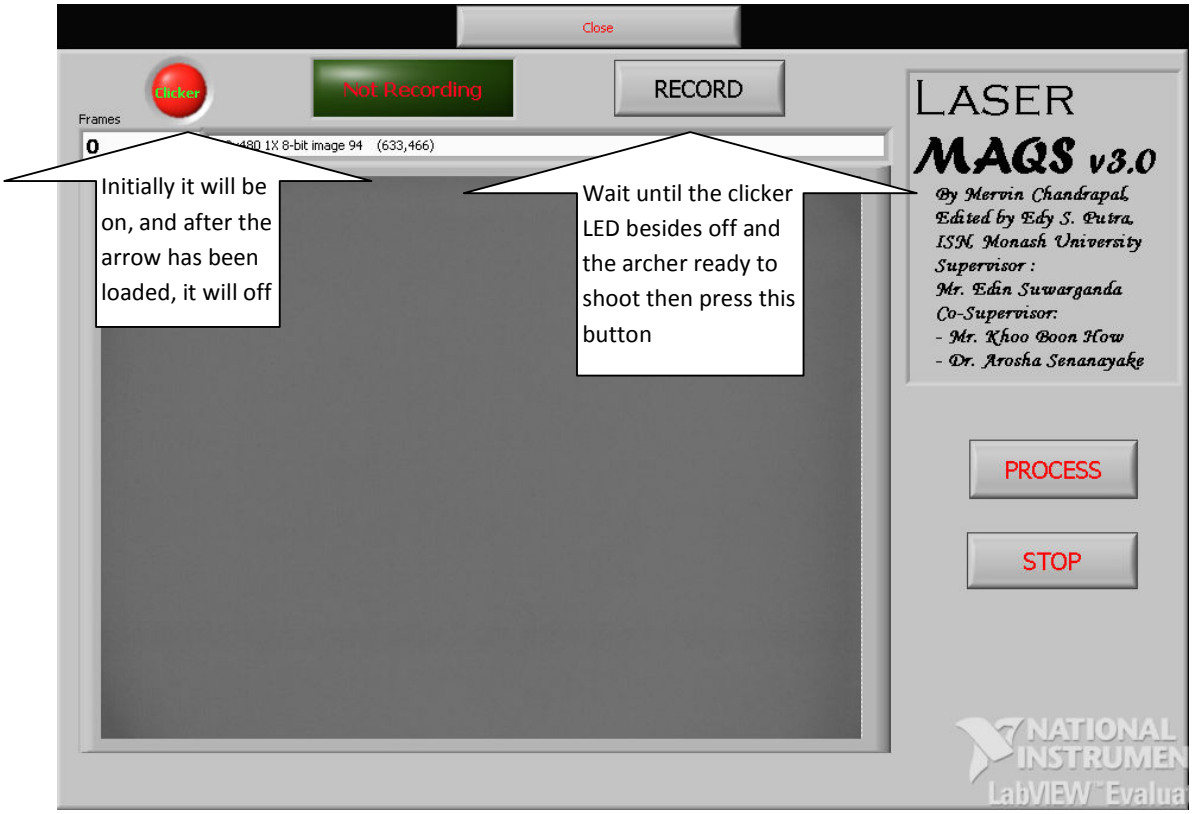


Figure 12. Capturing process window

The next step to be done was to press record button whenever the clicker light indicator is off (the bow has been loaded by arrow) and the archer is ready to shoot. Keep monitoring the camera to make sure it can capture the laser consistently.

When the record button was pressed, it will start capturing the aiming movement. Capturing process is indicated by the yellow LED showing recording process and the increasing of the frame number.

After the arrow was released (after the clicker was touching the base) it will keep continuing capture the image for about one second (60 frames) and then it will stop automatically.

Note that the only thing you need to do here is just to press the record button as the system can stop the capturing process automatically. Each time the recording process stop, the system will increase the number of attempts automatically.

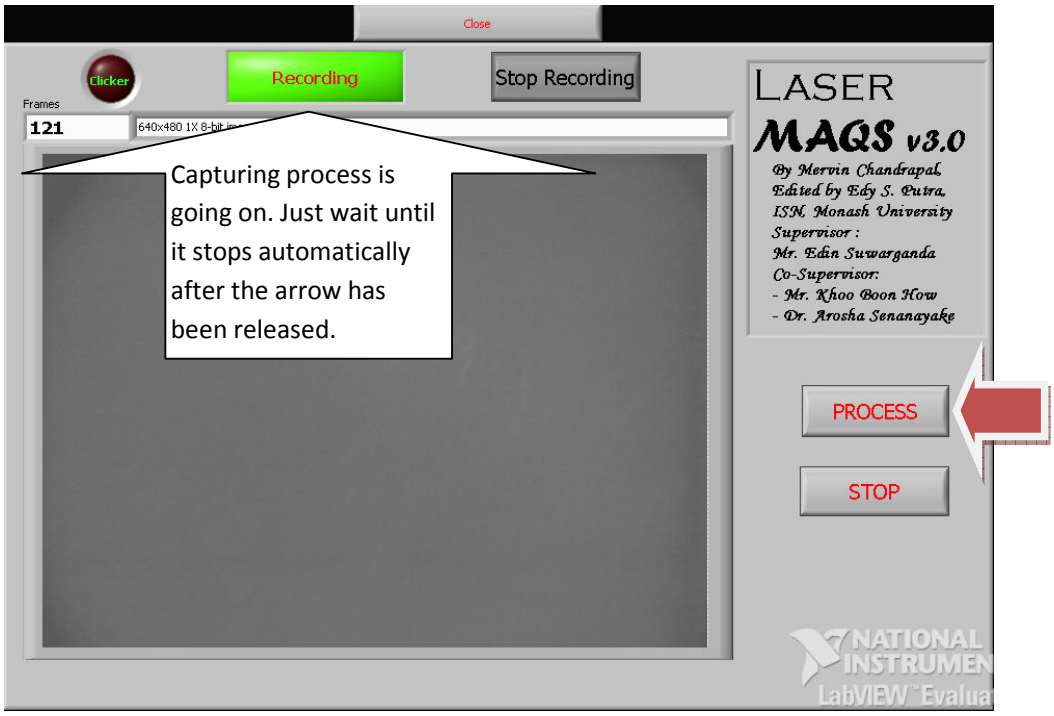


Figure 13. Recording Process

To continue for the next attempt, repeat the above process starting from pressing the record button after the clicker LED off (the arrow was reloaded) and the archer was ready to shoot.

Processing the data can be done just simply by clicking the process button. Processing will start immediately indicate by creating an AVI file followed by figure bellow. Wait until the processing finish and a popup window asking for save path confirmation will be shown. Click the ok button to save the result. Click ok to save the process data into your computer.

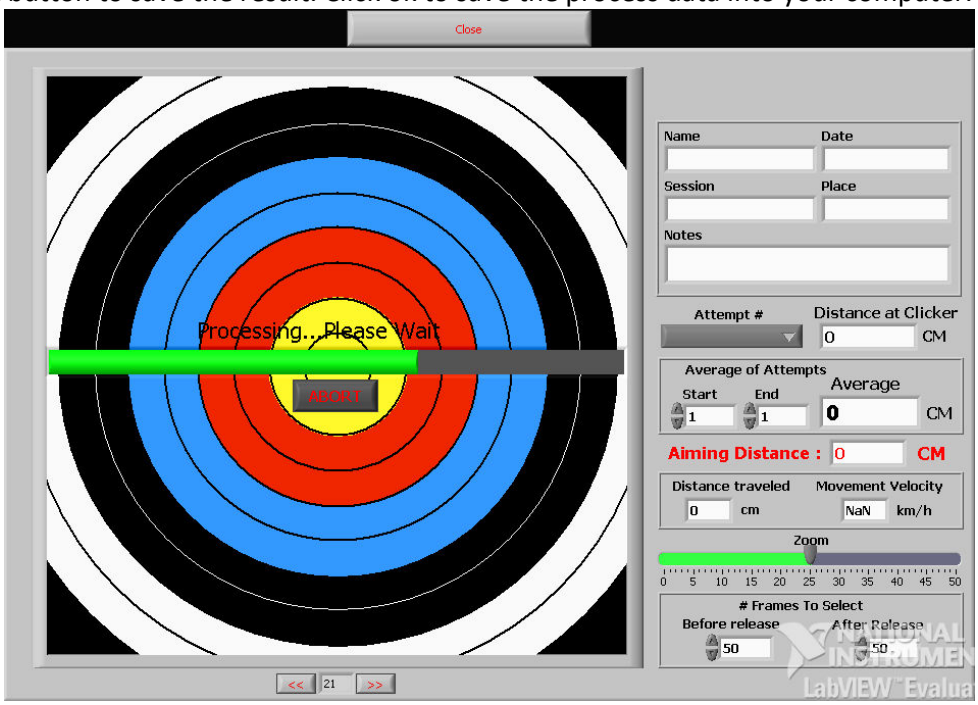


Figure 14. Processing the data

Displaying Result in Process Data Tab

After the data has been processed, it will automatically go to Process Data tab. This tab contains all the information of the aiming before and after the arrow was released. Choose the number of attempt you want the graph to show. You can increase the image size by sliding the zoom slider. Going more back in time before the arrow was shot can be done simply increase the number of frames before it was released. The Movement velocity of each frame can be change by changing the cursor on the graph or changing the index either by clicking the indexing button or simply by pressing arrow button (up,down,left,right) in the keyboard of the computer.

Besides displaying after capturing, you can also load the file you have saved before by using the Load File button.

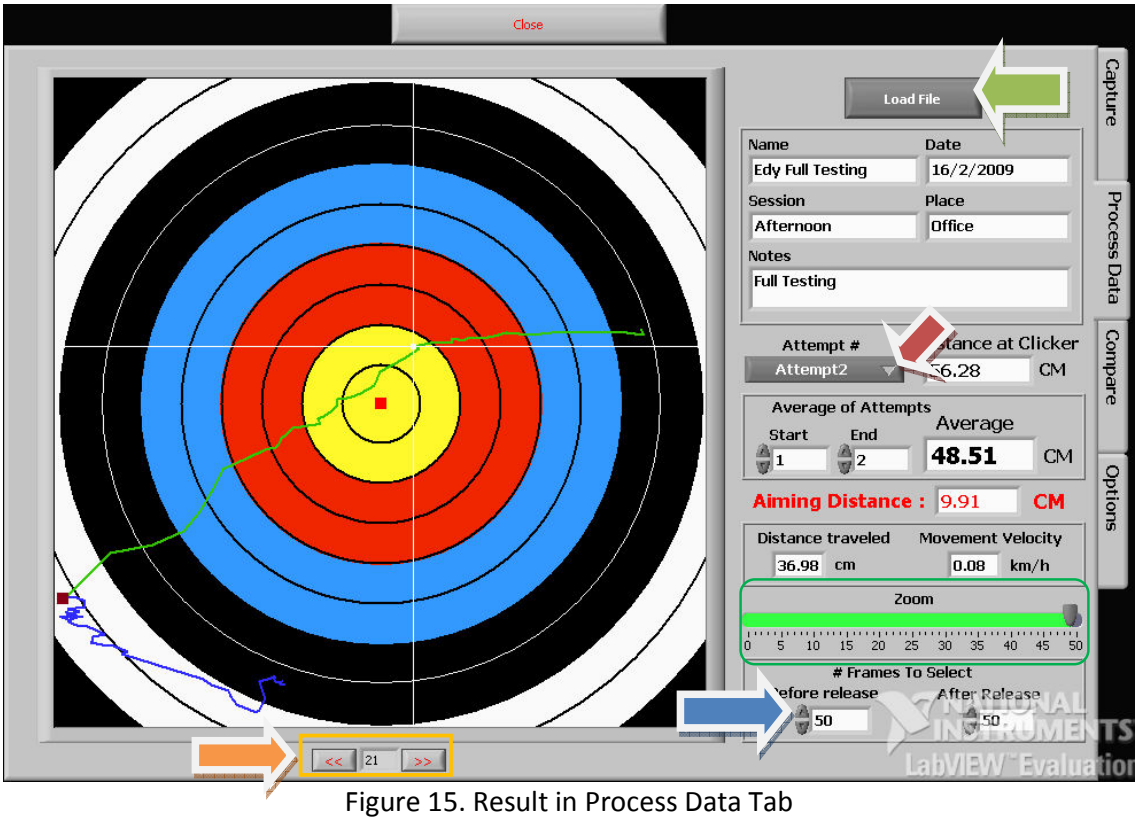


Figure 15. Result in Process Data Tab

Displaying Result in Compare Tab

Compare Tab basically works exactly the same with Process data tab. The difference was it can show two graphs in one screen. This will enable us to compare one result with the others. Compare tab was basically the smaller version of process tab because it contains almost all of the information inside the process data tab.

How it works was basically the same with the process tab with first loading the data from your computer and chooses the attempt you want to see.

The left image indexing was controlled by either the indexing button located at the bottom of the left graph or the “A”,”W”,”D” and “S” button on your keyboard. The right indexing was controlled by either the indexing button located at the bottom of the right graph or the “I”,”J”,”K” and “L” button on your keyboard.

Figure 16. Compare Process Tab