Bangladesh University of Engineering & Technology

Course No: EEE 460
Course Name: Optoelectronics Laboratory

Project Title : Detection of Particle Concentration Using Light Scattering Mechanism

Group No: 08

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Introduction :

Currently, particle detection is crucial in everyday life. There are various methods of detection of particle. For simplicity and cost measurement issue , involvement of optoelectronics is ensured. Laser based detector is thus developed in this project. Using the properties of scattering due to particle photon interaction, reflected light intensity has been measured via external webcam.

Equipments:

1. Cardboard
2. Blackchartpaper
3. Razorblades
4. Glue
5. Tape
6. Laser source
7. Webcam
8. Small electric fan
9. Power source
10. Connecting wires

Hardware Setup:

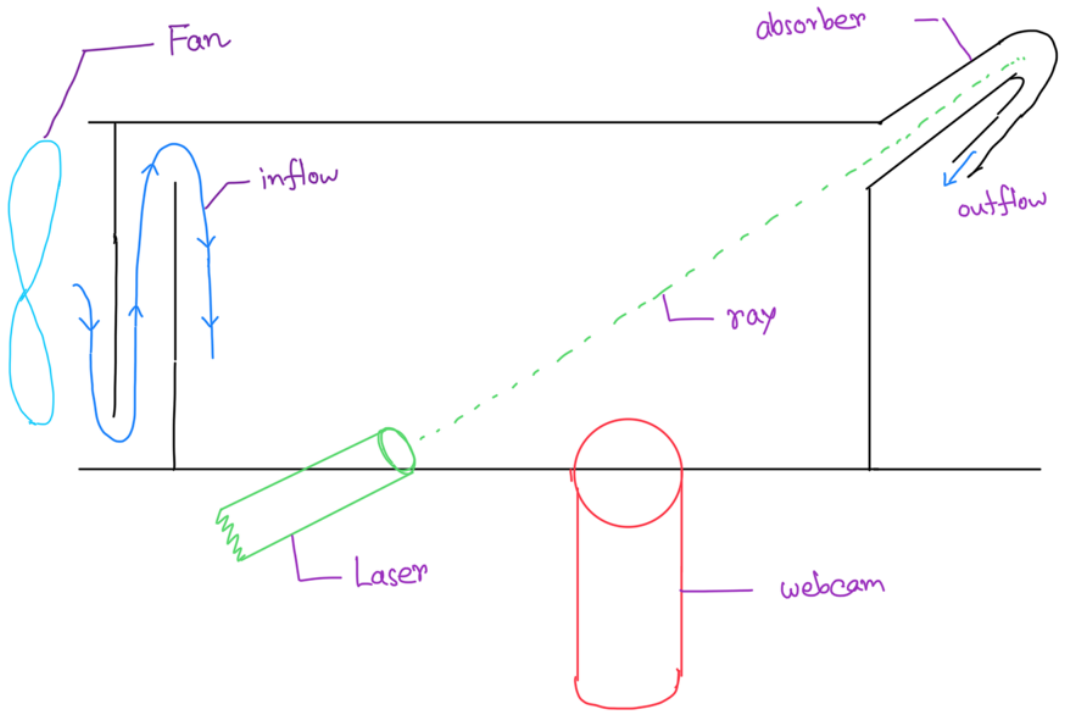


Figure 1: without scattering with particles

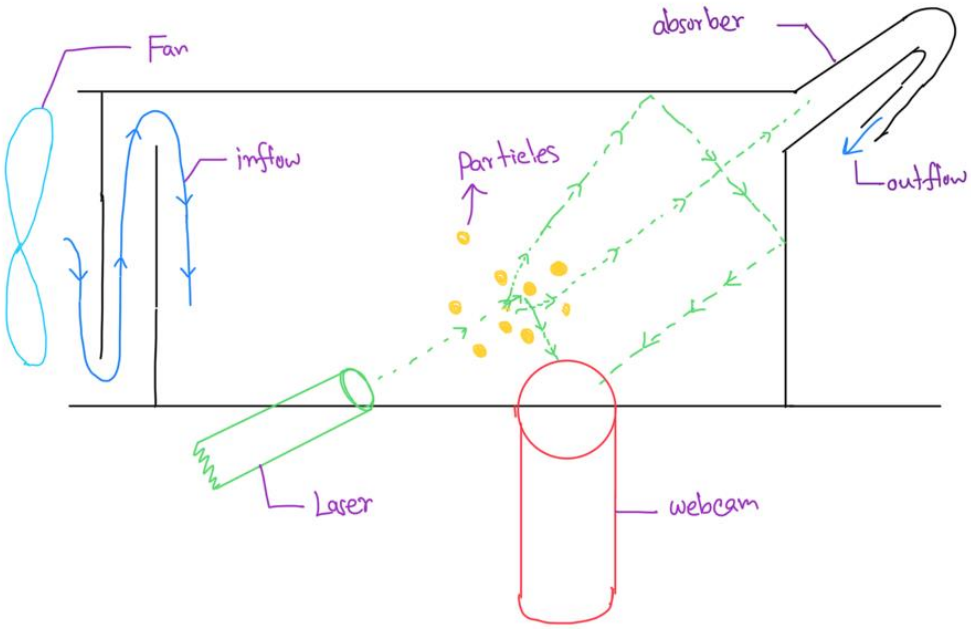


Figure 2: With particle scattering

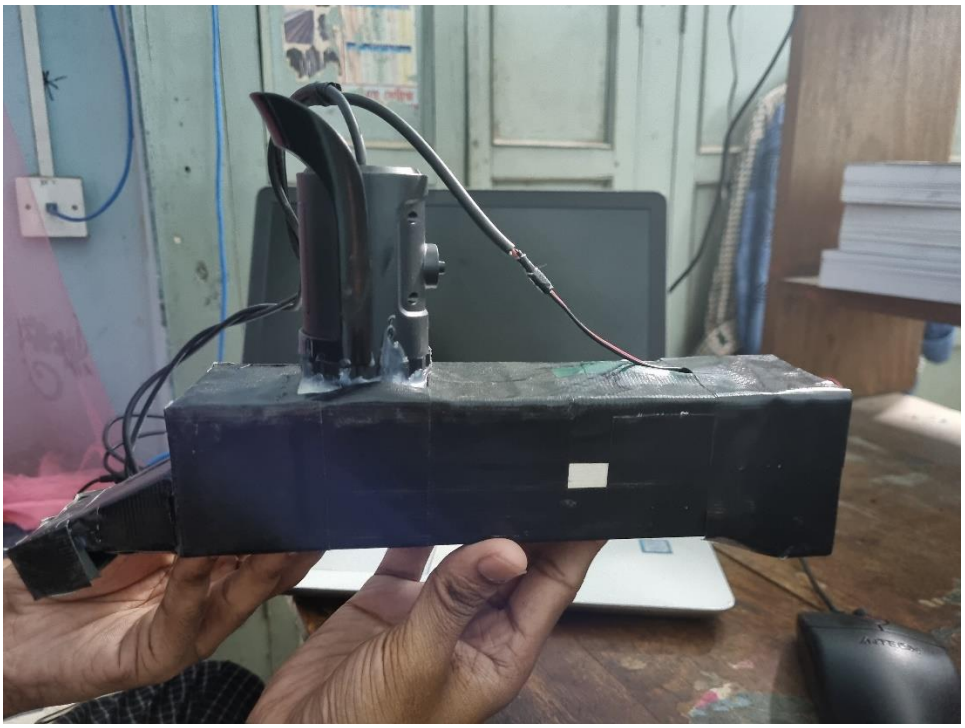


Figure 3: Complete hardware setup sideview1

Figure 4: Complete hardware setup sideview2

Figure 5: Complete hardware setup keeping fan in front

Working Principle:

First of all, let us consider the case when there is no external inflow is not present. So, at normal condition the concentration found is taken to be standard. In this case, fixed concentration of particle , so maximum laser light pass through without major scattering and absorbed in the absorber. As a result , the webcam doesn't detect much deflection.

Secondly, let us consider the case when external smoke/air particle is injected via the fan in the system. So, scattering between particles and photons from laser is now very much higher than previous case. As a result , laser rays are not directly passed to the absorber. Instead they interact with the concentrated particles. So , deflection of ray due to particles is now huge. As a result reflection from particles directly or indirectly from surface of the system lead to high intensity of light received by the optical detector (webcam).

The amount of change of incidence of light on webcam is measured , analyzed and visualized through software and programming , in the computer display.

Output and results:

The connection between hardware and computer results in a few figures in the display section of the monitor.

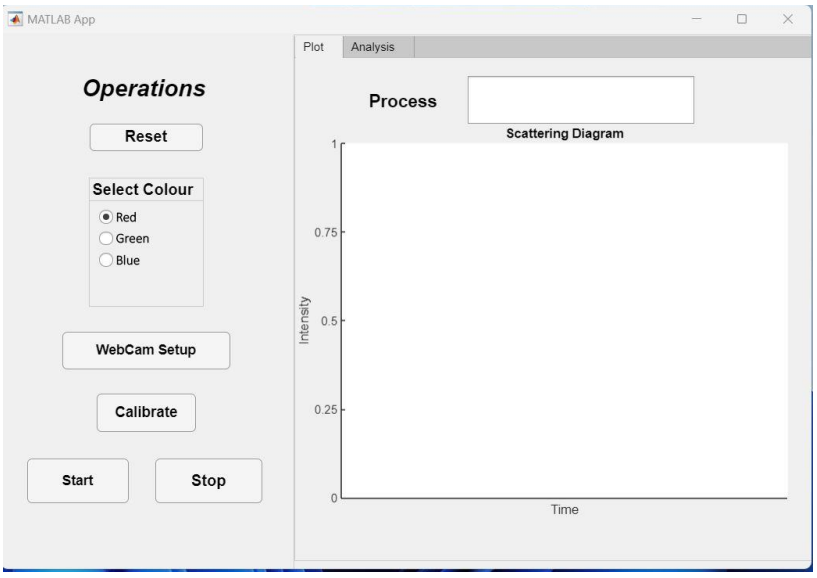


Figure 6: GUI of the interface

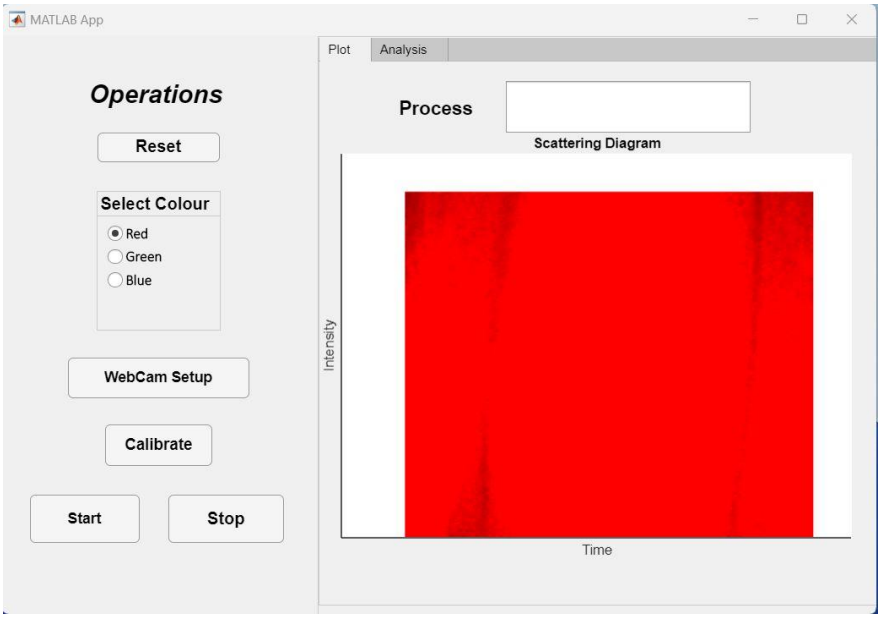


Figure 7: webcam setup view

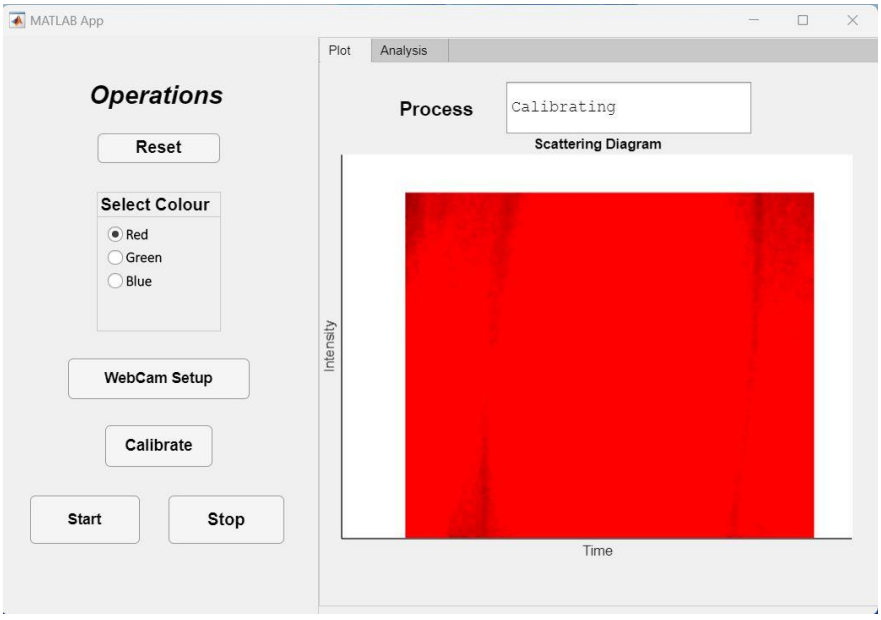


Figure 8 : Calibration process

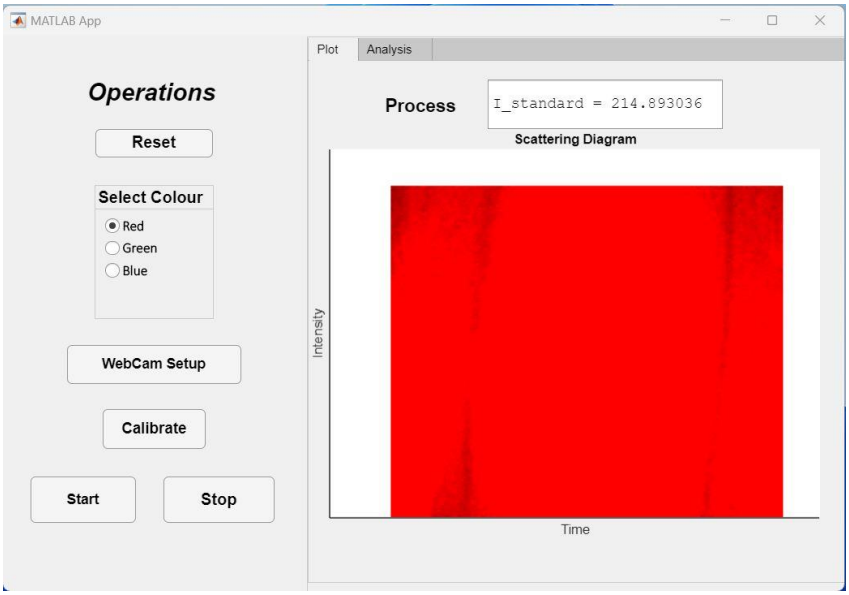


Figure 9: After calibration, setup of standard intensity

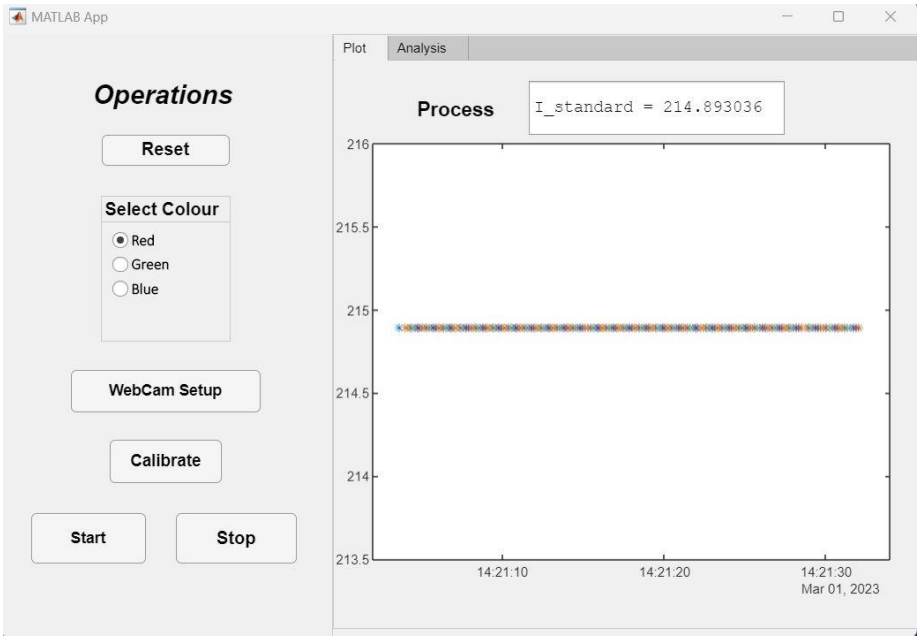


Figure 10: Value of standard concentrated particles

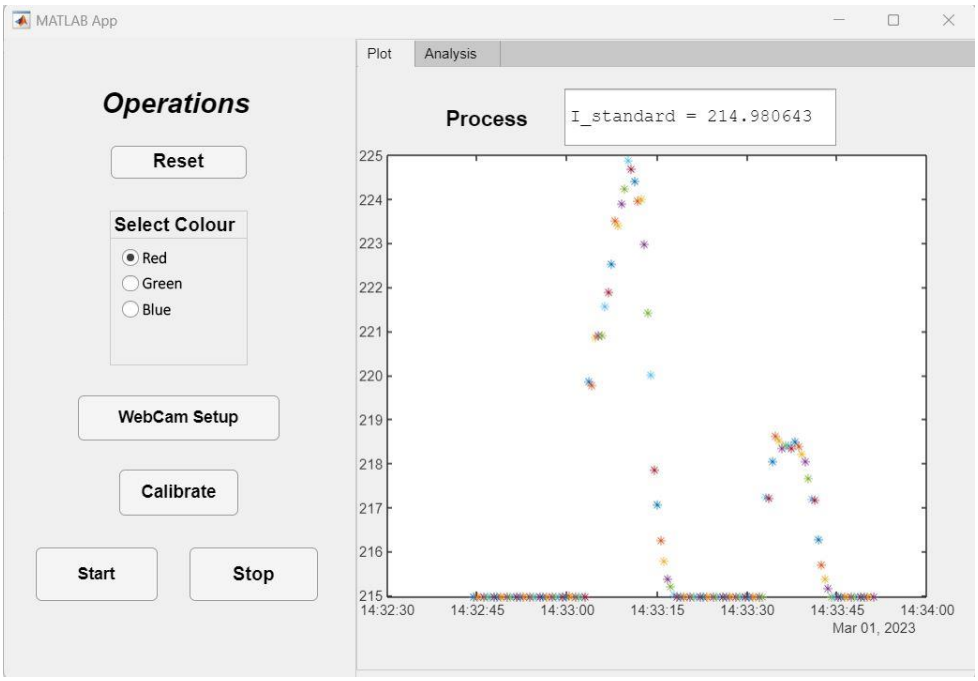


Figure 11 : Change of intensity due to smoke injection

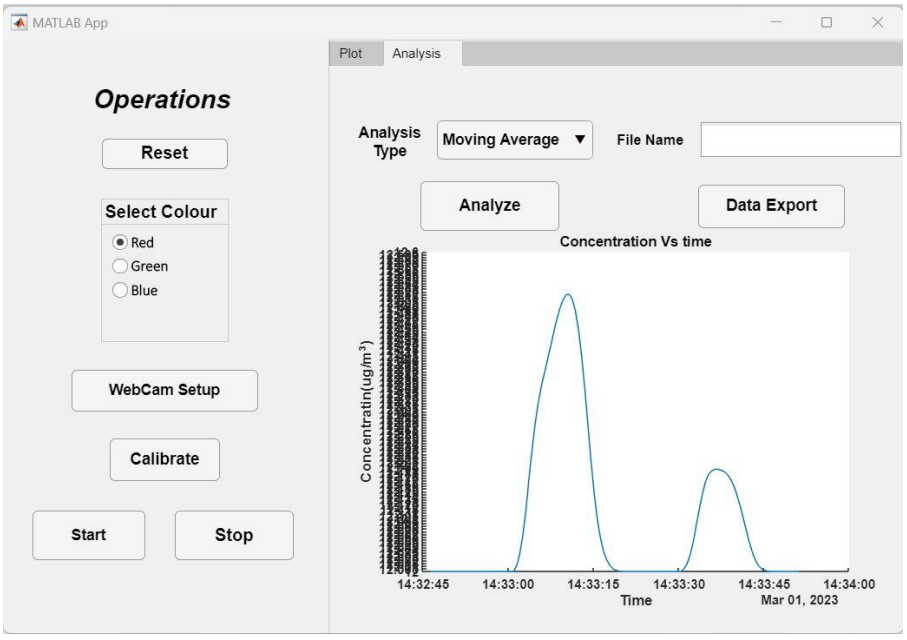


Figure 12: moving average plot of particle concentration with injected smoke

- Repeatation of the process :

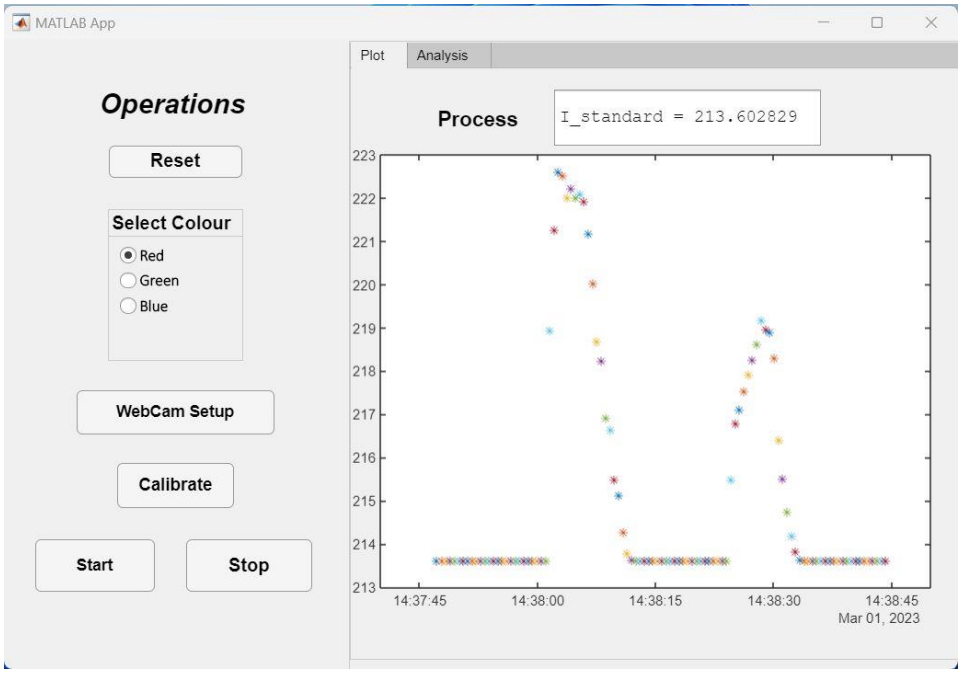


Figure 13: Change of intensity due to smoke injection

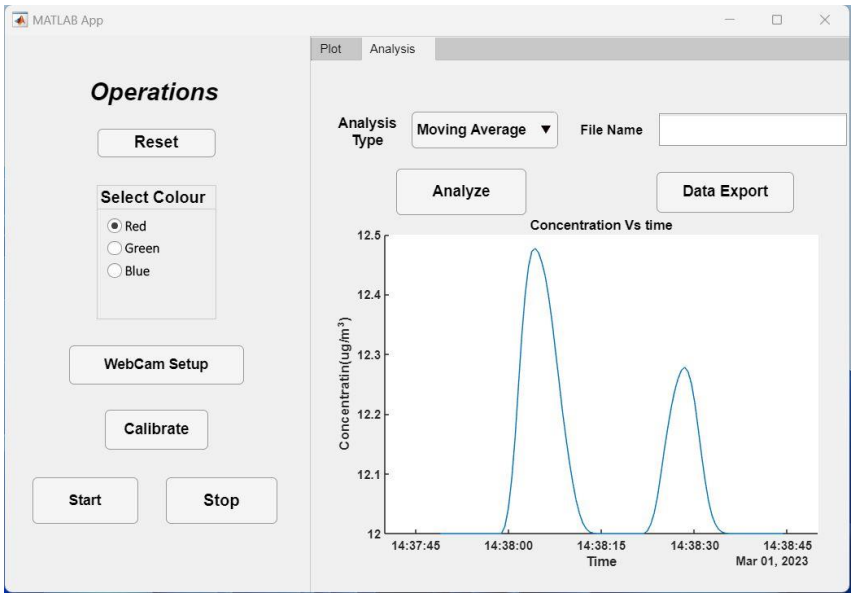


Figure 14: moving average plot of particle concentration with injected smoke

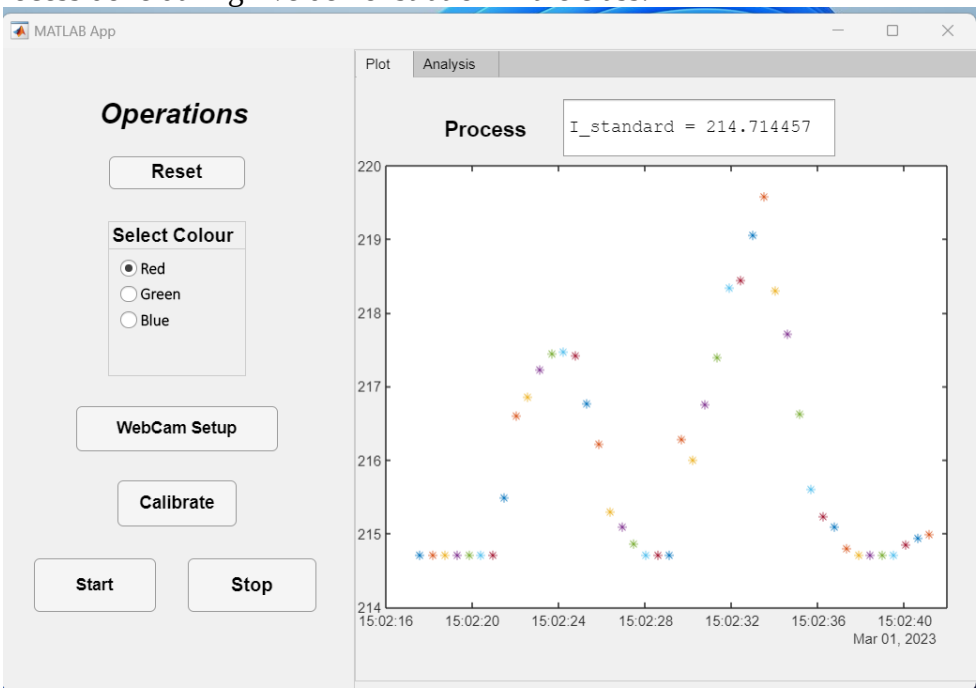
- Same process done during live demonstration in the class:
  - 

Figure 15: Change of intensity due to smoke injection

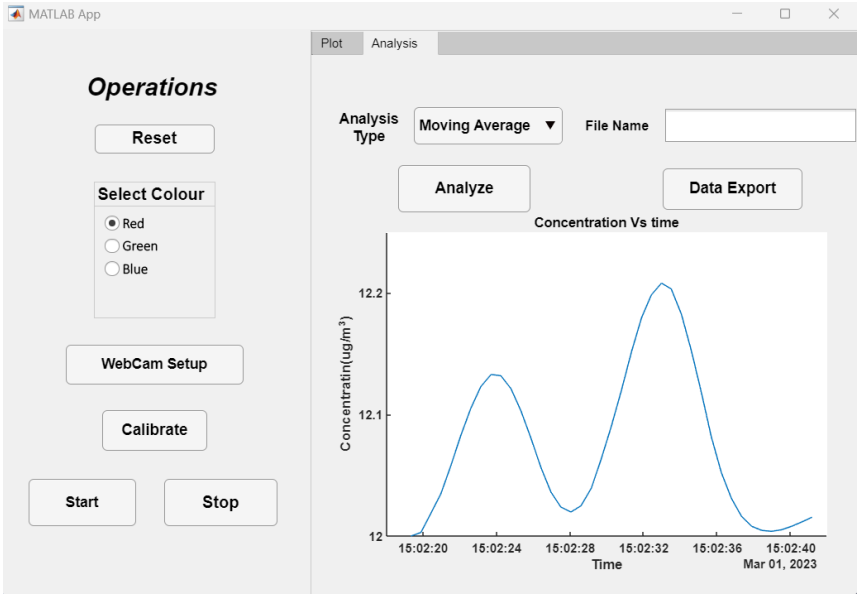
  - 

Figure 16: moving average plot of particle concentration with injected smoke

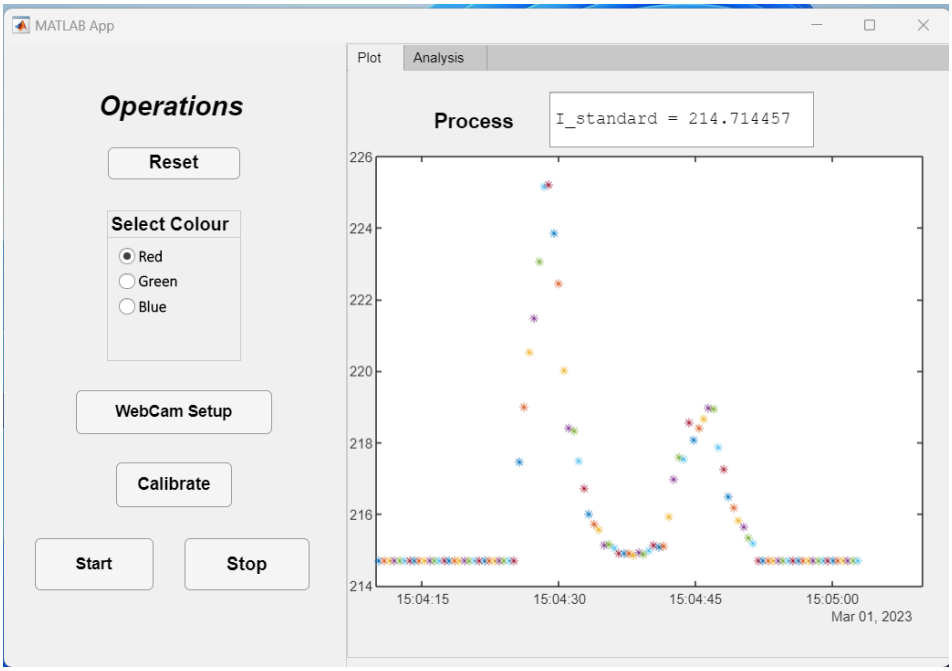


Figure 17: Change of intensity due to smoke injection

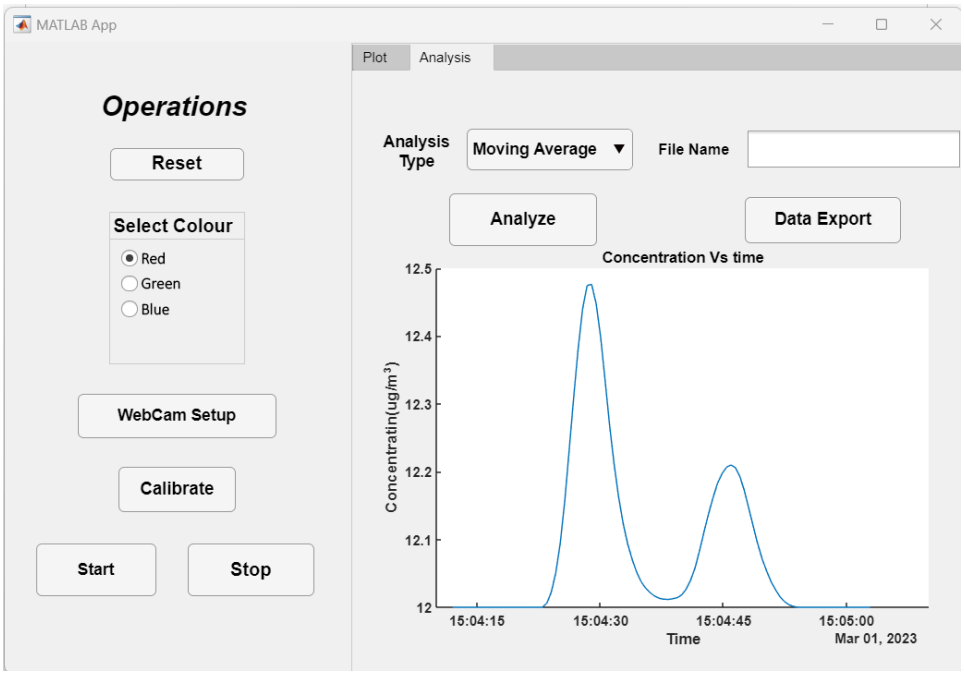


Figure 18: moving average plot of particle concentration with injected smoke

- Real time data export: In real time , the data of concentration and intensity with respect to time can be stored and then analyzed further.

- **Plot explanation**:

For figure 17 , initially the intensity is equal to the standard intensity when no smoke was introduced. At real time t=15:04:26 , smoke was injected to the system, so we can see a high peak, then it slowed down to standard as smoke source was removed and outflow was on. Then we again introduced smoke at real time t=15:04:45 , so another peak was seen. But this peak is smaller in value as smoke source was a little far away, hence the smoke particles injected were less.

Similarly for concentration , the same case happened.

Thus Using this method , any unusual and sudden infiltration of any air component can be easily predicted , in a very cost effective way.

Limitations & solution:

Any kind of vibration where the instrument is placed results in vibration of the light source. As a result an inaccurate deviation happens. So, a little more arrangements to stabilize the instrument has to be installed.