Smartphone Based Nano-device for Human Breath Sensing
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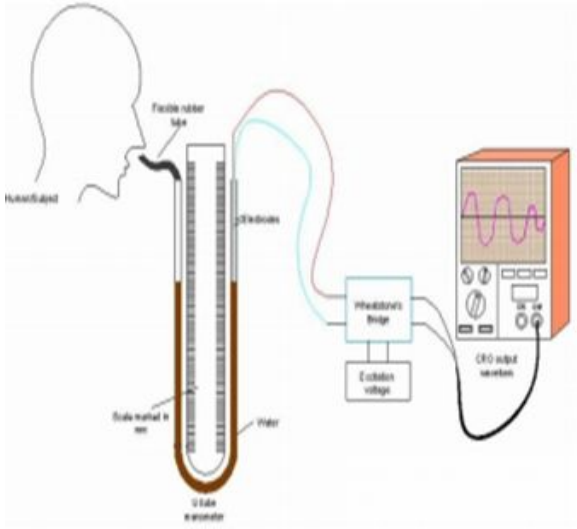
Problem statement

With the development of technology and medical treatment, the accessibility to cheap patient friendly treatments has increased. However patients are still restricted to expensive painful blood tests to diagnose their problems. Our team helped design a device that can help people to detect their diseases everywhere, which is human breath sensor. And we wish we can make it portable and affordable.



Conceptual sketch

1. Patient will breath to spectrometer.
2. The reflected light will go through the spectrometer.
3. The reflected light will be diffracted into different light frequencies and shown on the phone camera.
4. Our app will take a picture and analyze the different light patterns
5. By comparing our analysis with a database, we can find what kind of disease the patient has.

Market survey

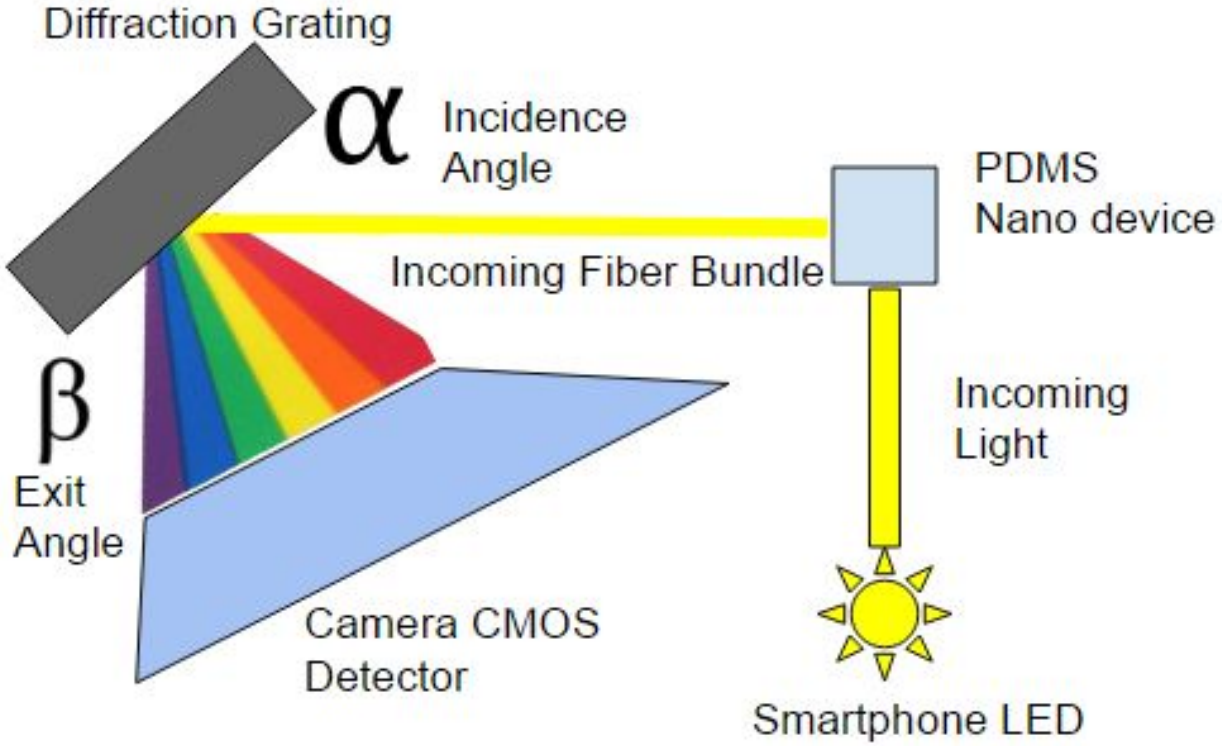
This project could replace more invasive forms of medical diagnostic testing such as blood tests, which means:

- lower cost to diagnose
- greater portability
- greater patient comfort
- more efficient use of doctor’s time,
- greater information into the hands of patients by allowing for self-diagnosis.

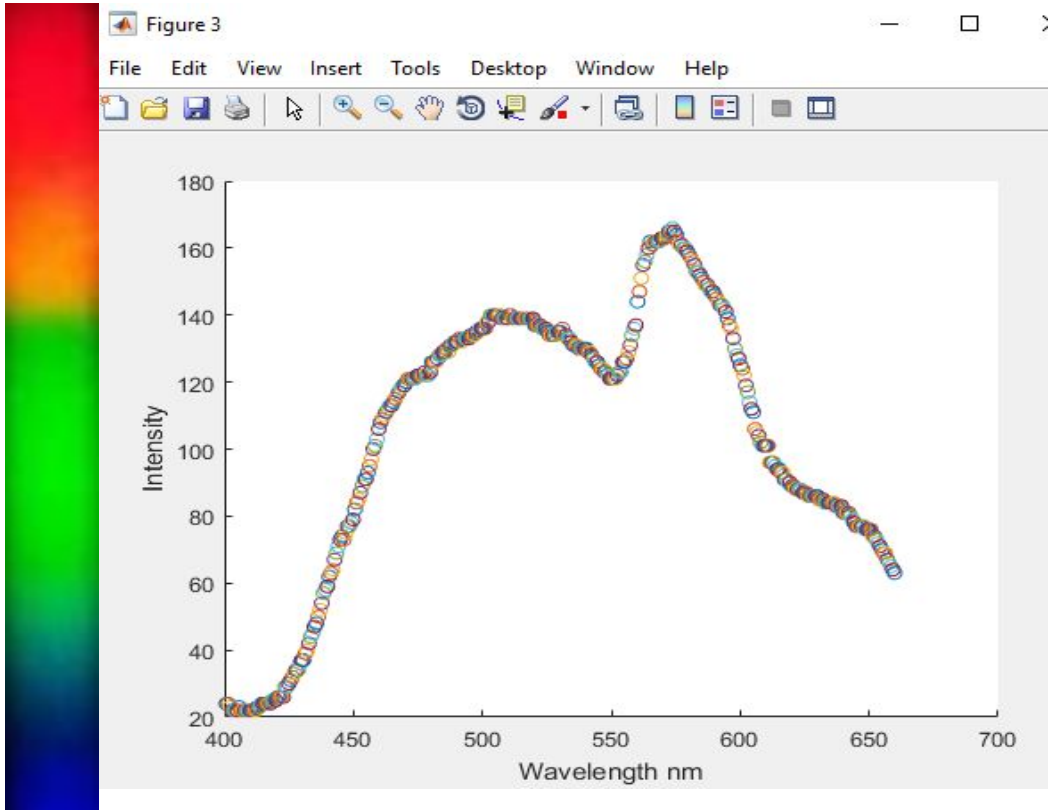
Design Overview

- An android app
- A spectrometer that fits on a phone to be developed by our mentor

Planned Spectrometer Design



App Design-Frequency vs Intensity Calculation



Spring Plans/Change in Scope

Focused more on working with PDMS nano-devices to identify pathogens

Determined we would still develop app but later team would develop attachable smartphone spectrometer

Determined we would start by seeing if we could determine % ethanol content in air

New Design

Determined we are going to start with commercial spectrometer to develop algorithms

New Sensor design Consists of PDMS that expands when it observed the gas

Gas concentration can be obtained by gap on graph

Developing Design

Need given concentration of gas, see if we can identify it

Final Test Process

Develop PDMS

Stick diffraction grate on

Put into petri dish with given amount of ethanol

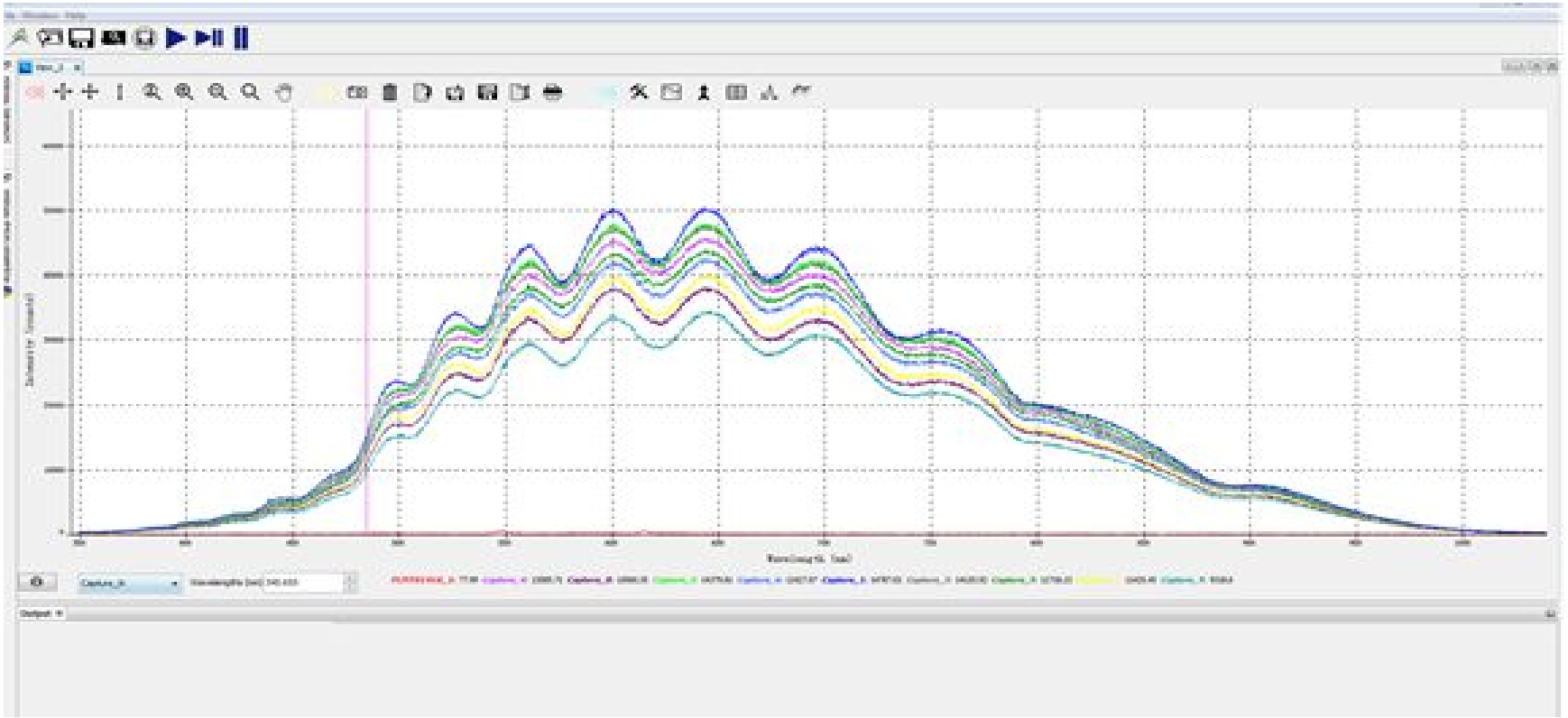
Put on hot plate to let evaporate

Calculate concentration in air

Wait 40 minutes for pdms to fill

Take graphs

Result



Results

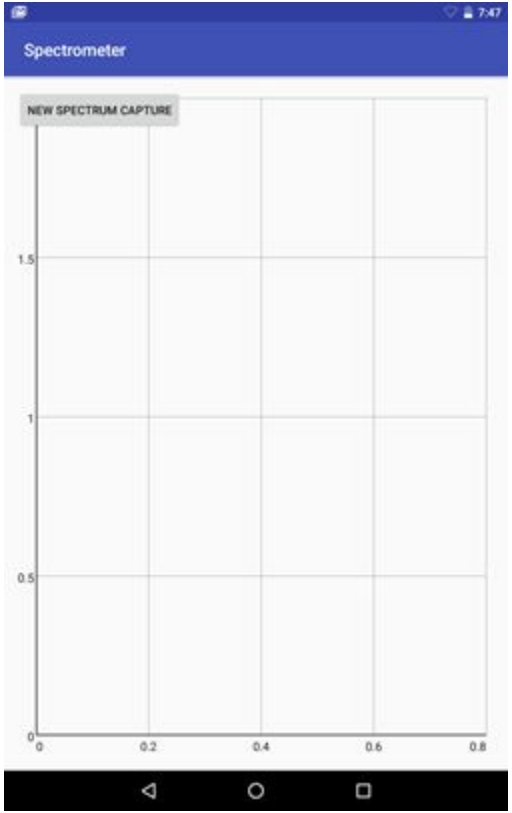
Used regression to find differences in intensity

Found the percentage change of alcohol gas VS the percentage change of intensity graph

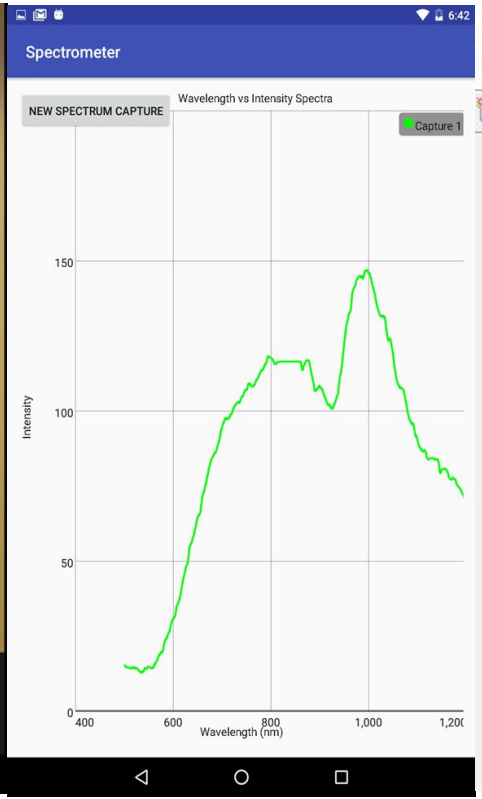
Found that 1% decrease in intensity correlates with 14% increase in ethanol concentration

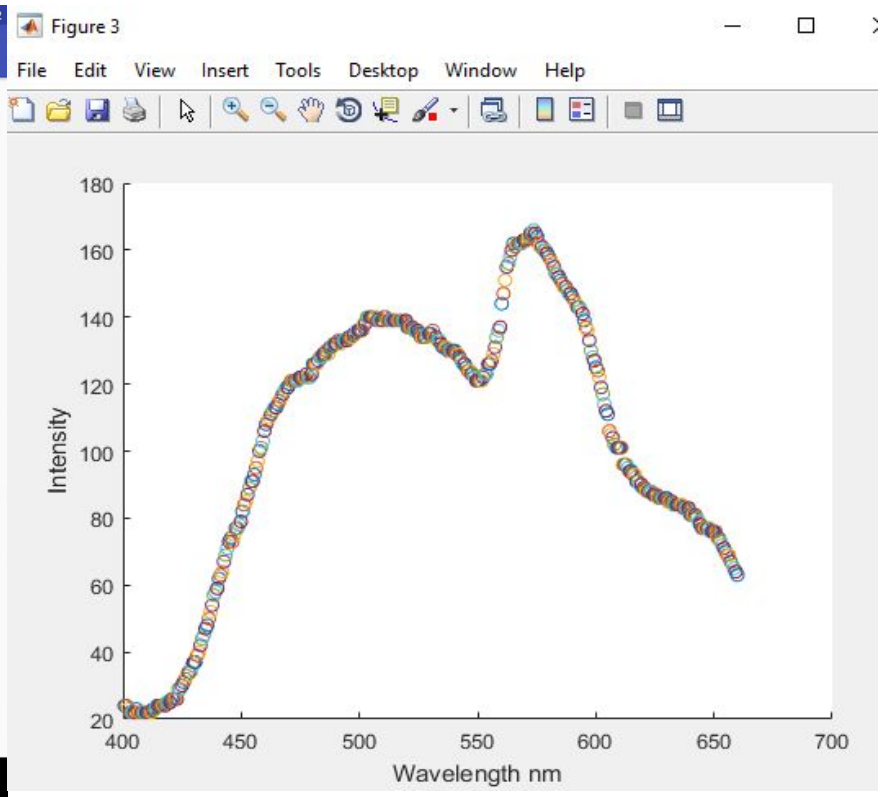
Tested by running experiment again and predicting concentration values from our previous regression

App design



Step instruction of App



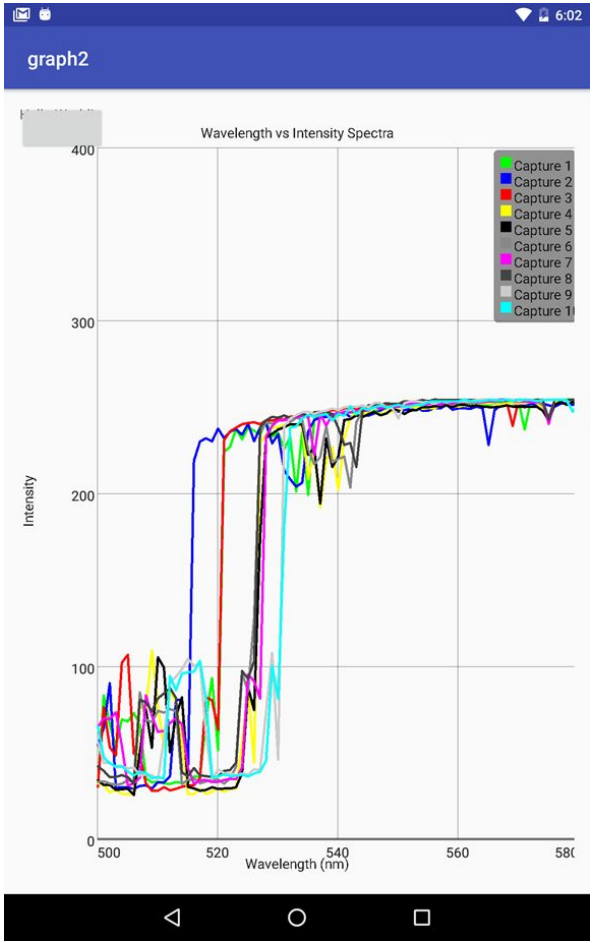


App design

Up to 10 Spectrums

Frequency plotting

Intensity plotting



How future could build on this

Utilize our method to determine how PDMS responds to pathogens and develop equation to test for their presence

Develop spectrometer to fit over smartphone camera

Use app to find differences in PDMS waveform graphs and determine if disease is present

Questions?

% Concentration	% Decrease in Intensity
1	-0.184269107
2	-0.233094265
3	-0.258586921
4	-0.275514875
5	-0.294472145
6	-0.312936409

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.955728101
R Square	0.913416203
Adjusted R Square	0.713416203
Standard Error	1.255318728
Observations	6

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	1	83.12087	83.12087	52.74753	0.001909
Residual	5	7.879126	1.575825		
Total	6	91			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
% Decrease in Intensity	-14.14039456	1.946975	-7.26275	0.000773	-19.1453	-9.13553	-19.1453	-9.13553

% Concentration	% Decrease in Intensity	Predicted Concentration * -14.14
1	-0.06728287	0.951406334
2	-0.084129391	1.189622785
3	-0.151647451	2.144354785
4	-0.233731833	3.305060339
5	-0.302150695	4.272530044
6	-0.422288082	5.971319395
7	-0.496715015	7.023746303
8	-0.646921794	9.147729417

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.990896258
R Square	0.981875395
Adjusted R Square	0.839018252
Standard Error	0.7267756
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	1	200.3025806	200.3026	379.2153	1.19E-06
Residual	7	3.697419414	0.528203		
Total	8	204			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
X Variable 1	0.989038244	0.050789057	19.47345	2.35E-07	0.868941	1.109135	0.868941	1.109135

$N\lambda = d(\sin\alpha - \sin\beta)$

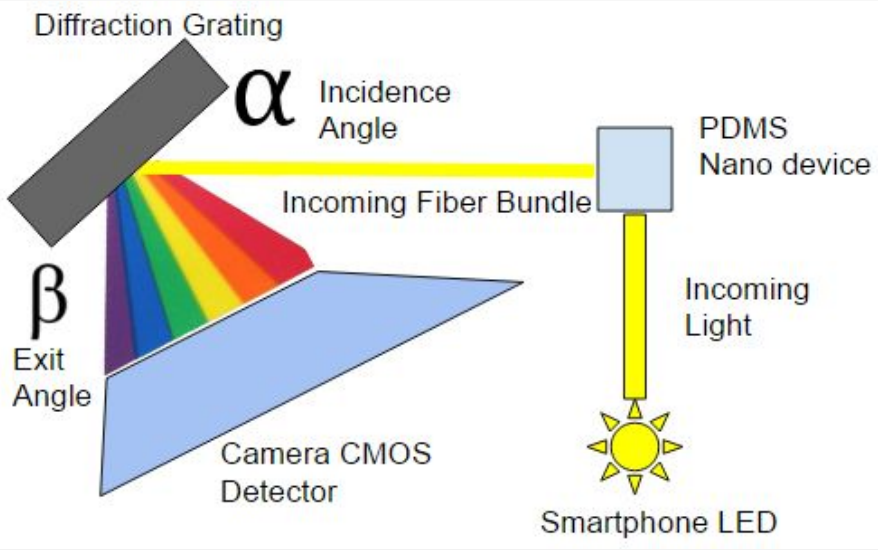
N: diffraction order (use 1)

λ: wavelength (nm)

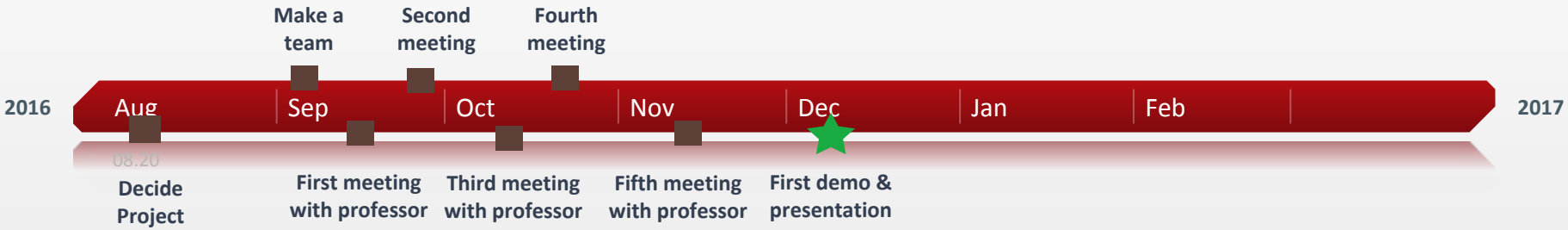
d: grating groove space (nm)

α: incidence angle on grating

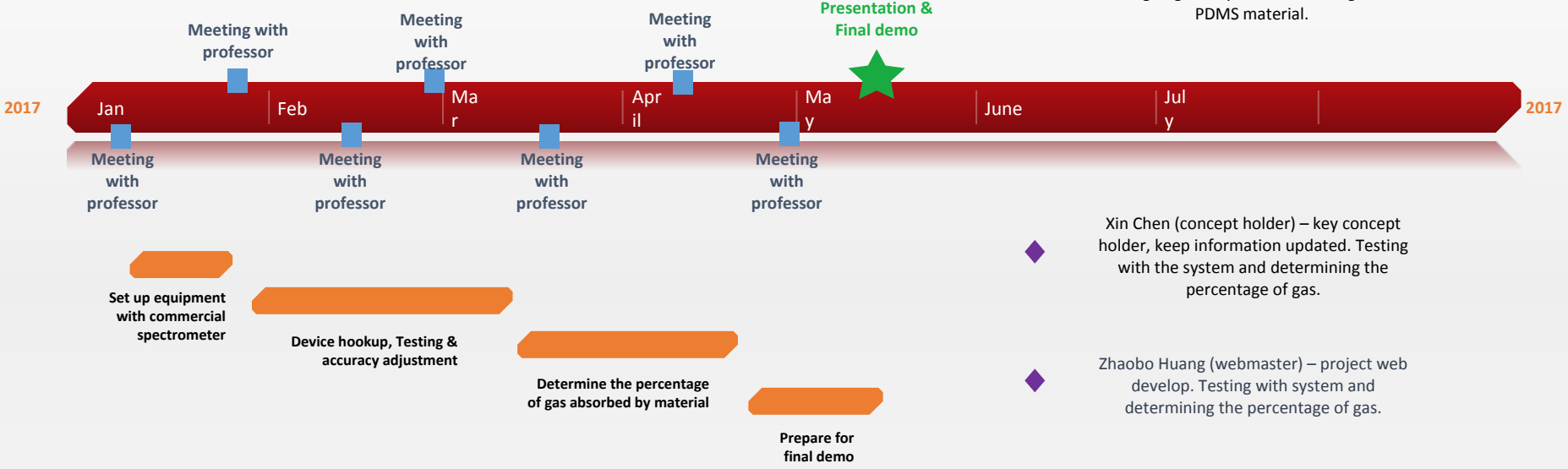
β: exit angle



Fall Project Milestones & Schedule



- Jared Smiley (team leader) – set up meetings with professors. Working on the matlab code.
- Mengzhou Sha (Communication Leader) – weekly report , progress reporter. Working on the matlab.
- Xin Chen (concept holder) – key concept holder, keep information updated. Revise the code in matlab.
- Zhaobo Huang (webmaster) – project web develop, revise the code in matlab.



Jared Smiley (team leader) – set up meetings with professors. Designing test system and testing with PDMS material.

Mengzhou Sha (Communication Leader) – weekly report , progress reporter. Designing test system and testing with PDMS material.

Xin Chen (concept holder) – key concept holder, keep information updated. Testing with the system and determining the percentage of gas.

Zhaobo Huang (webmaster) – project web develop. Testing with system and determining the percentage of gas.