# Strabismus

Strabismus is Crossed eyes, where two eyes do not line up correctly in the same direction. We detect this by comparing the pupil-center to white dot vectors for both eyes. [ old way = We detect this by detecting the differing ratios of sclera(the white of the eye) area in eyes that are looking not in the same direction ]

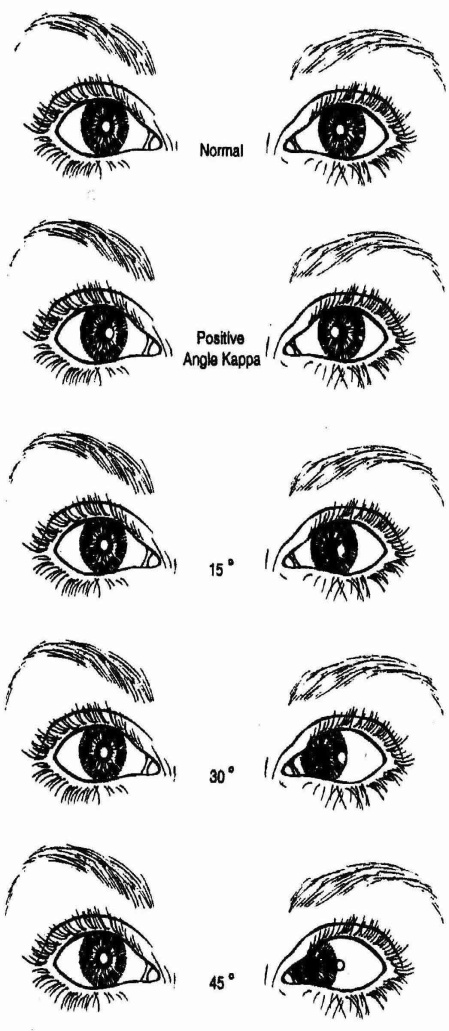
## Algorithm Idea – New ( by Arvind Rao & David Chan, 12.10.13 )

1. Detect face, eyes, then pupil
2. Detect White dot in both pupils
3. Calculate the distance from Pupil-center to White-dot-center for both Pupils
4. Calculate the angle of Pupil-center to White-dot-center line [ using numpy.arctan on (y component of distance) / (x component of distance) ]
5. Compare the two vectors from both pupils [ compare distances & angles ]
   * 1. For a healthy eye, the angles should be same (looking in the same direction)
     2. We could also measure the severeness of the off pupil-center and white-dot-center offset (healthy eye would have both in center)
     3. If the White dot is not found (within the Pupil), severe Strabismus

## Old Algorithm

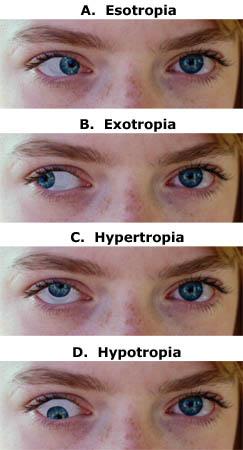
1. Detect face
2. Detect eyes
3. Obtain area of left and right sclera for each eye
4. Compare area of left sclera on left eye to area of left sclera on right eye
5. Compare area of right sclera on left eye to area of right sclera on right eye
6. If the comparisons are significantly[[1]](#footnote-2) off then it is likely the patient has astigmatism

## Examples



***Figure 1:*** *As the angle between the eyes increases the ratio of the left eye’s sclera to the right eye’s sclera becomes diverges*

*(continued below)*



***Figure 2:*** *As pictures C and D show an eye can also be misaligned in along it’s vertical axis.*

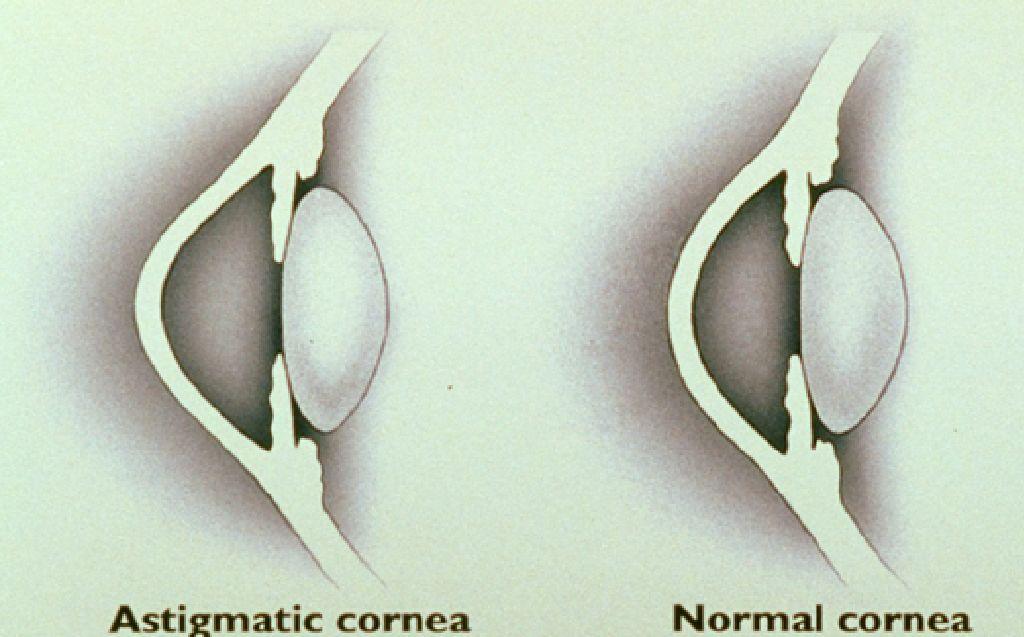
# Astigmatism

Astigmatism is a malformation of the eye. This can be detected by looking at the crescent shaped reflection in the eye that appears because of the red eye effect. An unhealthy eye will have a crescent to pupil ratio that is significantly[[2]](#footnote-3) different from that of a normal eye. Both a horizontal and a vertical picture are taken so that we can normalize the crescent size in that patient’s eye and detect horizontal or vertical malformations.

## Algorithm

1. For the horizontal and the vertical photo:
   1. Detect the face
   2. Detect the eyes
   3. Detect the pupil
   4. Measure the area of the pupil
   5. Detect the crescent
   6. Measure the area of crescent to pupil
2. If the crescent:pupil ratio is unhealthy in either photo the patient may have astigmatism

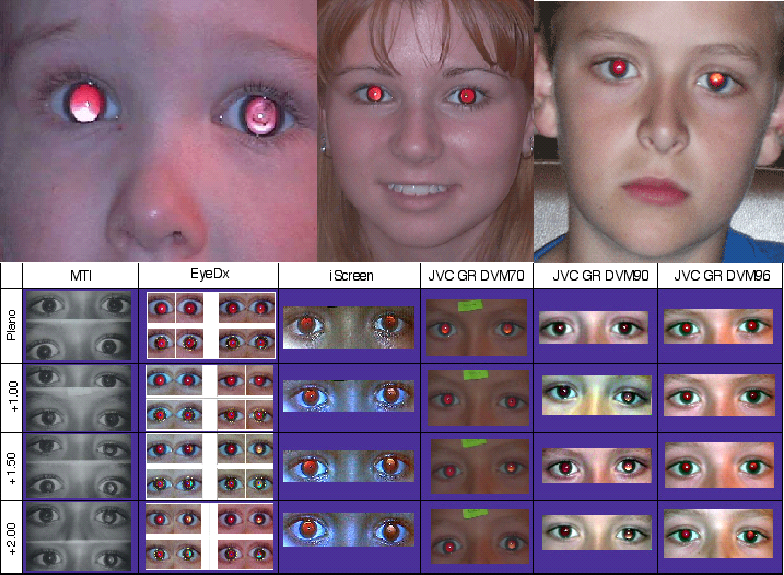
## Examples



***Figure 3:*** *Difference between astigmatic and normal cornea*

A description...

***Figure 4:*** *An example of the crescent detection process*



***Figure 5:*** *Examples of the images we’ll be working with*

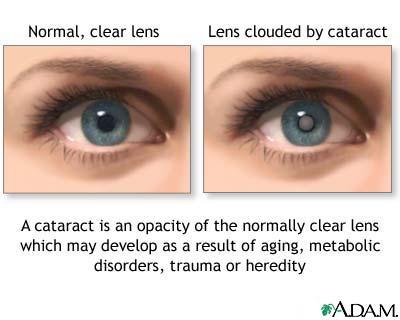
# Cataracts

Cataracts is characterized by cloudiness in the eyes.

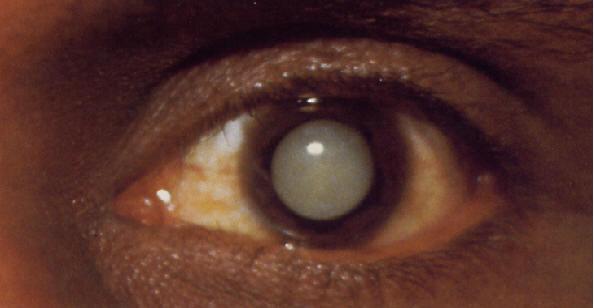
# Algorithm

1. Detect face
2. Detect eyes
3. Detect pupils
4. Detect cloudiness[[3]](#footnote-4)

# Examples



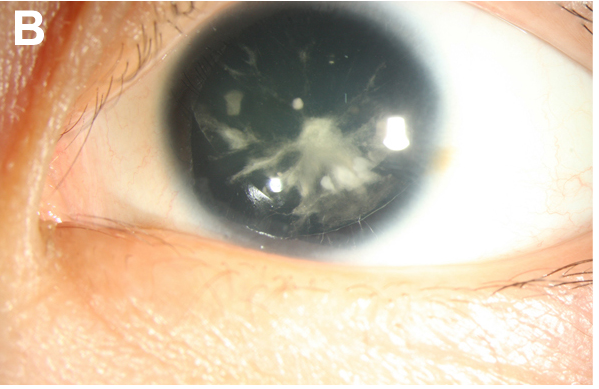
***Figure 6:*** *Overview of Cataracts*



***Figure 7:*** *Eye fully occluded by cataracts*



***Figure 8:***  *Another cataracts eye*



***Figure 9:*** *Eye partially occluded by cataracts*

1. significance is trained through machine learning [↑](#footnote-ref-2)
2. significance is trained through machine learning [↑](#footnote-ref-3)
3. We currently do not have a more fine grain algorithm than this. [↑](#footnote-ref-4)