**1st Semester**

1. Setup (time required: 1 day)
   1. Dartboard: using the tripod, it has an *adjustable height* and is also *movable*.
   2. Mobile Phone: using a monopod for mobile phones (currently we are only considering *one phone* to capture the images) with a *210° adjustable head* and *360° rotatable phone holder*. We can also use this for GoPros or other small cameras.
2. Data Collection (time required: 15-20 days)
   1. Initially, it will be done using one plain background.
   2. The factors on which we will mainly focus are *orientation* (the angle at which the dart is positioned with respect to the camera), *different dart positions,* and *different distances of the dartboard from the camera.*
3. Model (time required: 20-25 days)
   1. We are going to use *template matching*, *feature detection and matching*, and *contour detection*.
   2. *Template Matching*: A dartboard can be detected in a current image by comparing it with a template image of a dartboard.
   3. *Feature detection and matching*: *SIFT*, *SURF*, or *ORB*. This is useful for tracking the movement of darts.
   4. *Contour detection*: Edge detection in images, is useful for detecting objects in images with varying backgrounds and lighting conditions.

Total time required: 1 Month 16 days

**2nd Semester**

1. Setup
   1. We will use more than one camera.
2. Data collection (required time: 1 to 2 months days)
   1. We will introduce *variations in lighting, background,* and *colors*.
   2. Lighting: brightness, contrast, and colour temperature. Different types of lighting sources such as natural light, artificial light, and ambient light.
   3. Background: different types of backgrounds such as plain backgrounds, textured backgrounds, and complex backgrounds. different colors and patterns of the background.
   4. Colours: a collection of images with darts of different colours. different shades and intensities of the same colour can affect the visibility of the dart tip in the image.
3. Model (required time: 1 months)

1.(Optional: if previous method would not work well)

* 1. If we will use deep learning, then we will do data labelling through labelling. (required time: 1-2 weeks)
  2. Applying image segmentation techniques such as thresholding or clustering to segment the dartboard from the background.
  3. Using object detection techniques such as Haar cascades or HOG+SVM to detect the dartboard in the segmented image. This step requires labelled data where the dartboard is annotated in the images.
  4. Once the dartboard is detected, apply image segmentation again to segment the individual dart regions on the dartboard.
  5. Using object detection or computer vision techniques to detect the dart tips in each dart region. This step may not require data labelling, depending on the specific method used.

2. We will probably use YOLO for person detection, as it works really well in real-time and is also not that heavy.

1. Mobile Deployment (required time: 2 - 3 weeks): A platform-independent application.

Total time required: 5 months