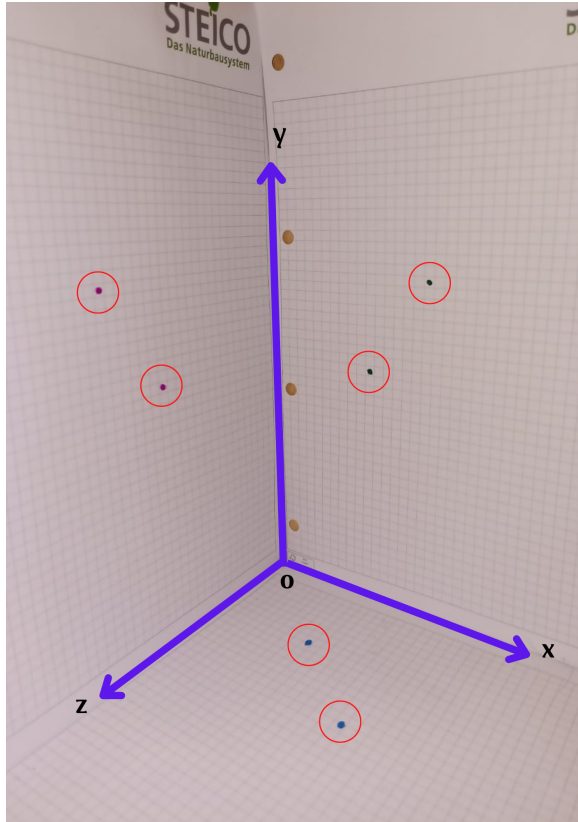


## Assignment 3

### Task: 1



- a) The picture has been taken in such a way that all the axes are 90 degrees between each other and are clearly visible. We have used [canva.com](https://www.canva.com) to mark the points, draw and name the axis. We have used a mobile camera to click the picture.
- b) Camera Used: Redmi Note 10S mobile is used to click the picture.

#### **Camera Specifications:**

64 MP 1/1.97-inch sensor with  $0.7\mu\text{m}$  pixel size, f/1.79-aperture lens

Ultra-wide: 8 MP sensor,  $118^\circ$  field of view, f/2.2-aperture lens

Macro: 2 MP sensor, f/2.4-aperture lens

Depth: 2 MP sensor, f/2.4-aperture lens

## Task: 2

- a) Right-hand rule has been used to define the axes of the object coordinate system, i.e. the right-hand middle finger represents the X-axis, the right-hand thumb represents the Y-axis and the right-hand forefinger represents the Z-axis.
- b) Each object coordinate has been measured with a ruler 3 times and the average of the measured value is taken.

## Task: 4

- a) Exterior orientation:

Projection Matrix: Projection matrix is a linear projection of a matrix where three-dimensional objects are projected on a picture plane.

Projection center: The projection center is the mathematical relationship between the coordinates of a point in three-dimensional space and its projection onto the image plane.

Rotation Matrix: A rotation matrix is a transformation matrix that is used to perform a rotation in Euclidean space.

Rotation angle:

Omega( $\omega$ ):  $\text{atan}(r_{32}/r_{33})$

Phi( $\phi$ ):  $-\text{asin}(r_{31})$

Kappa( $\kappa$ ):  $\text{atan}(r_{21}/r_{11})$

Interior orientation:

Principle distance: Principal distance is the separation between the image plane and lens off-center along the optical axis of the camera.

Skew: The skew coefficient defines the angle between the x and y pixel axis.

Principle point: The off-center of the camera optical axis with respect to the image plane is the principal point.

Aspect ratio: The camera matrix has two different focal lengths. The ratio between them is called the aspect ratio.

- b) In order to get proper measurement calibration is very important. We need to make sure all the axes are at 90 degrees from each other, the camera orientation should be perfect so that all the planes and the points are clearly visible.

In order to get proper camera orientation we took pictures of the object from different angles and selected the photo that had the best orientation among them.

Camera's quality depends on the sensor