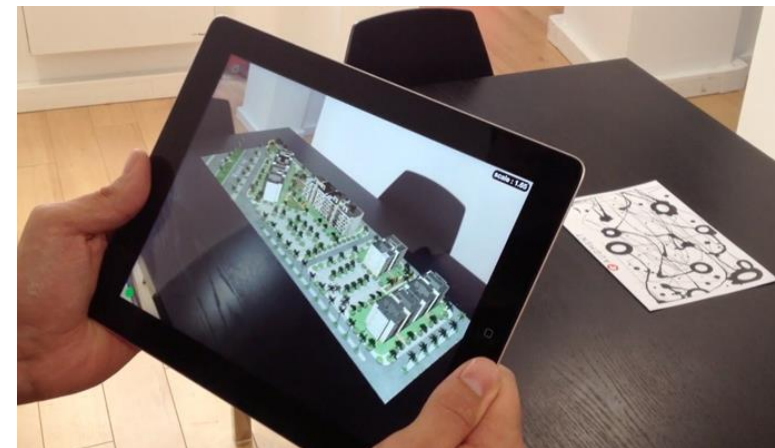# AUGMENTED REALITY APPS BASED ON SQUARE MARKER
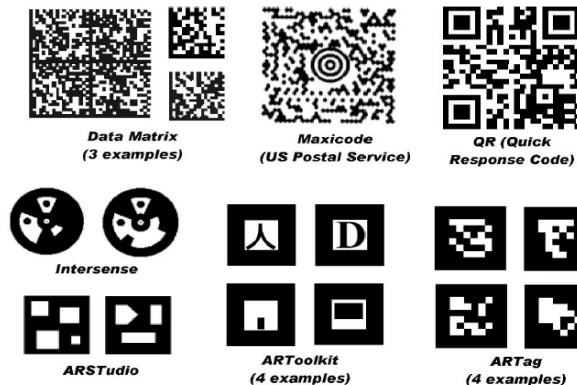
By: Debora Melinda

BACKGROUND

- Combine real world and digital world
- Show the object as it is real in real world
- Allow human in real world to interact with the object in digital world

HOW AUGMENTED REALITY WORKS

- Obtain the position where the object want to be augmented
  - Real time tracking
  - Use marker that is easily recognized by computer

- Augment the object on the detected marker
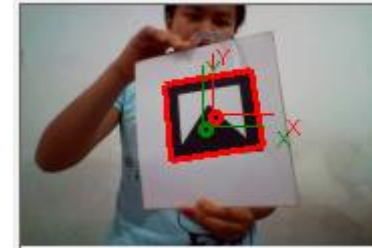 - Estimation of marker position

PROCESS STAGES

Input image

Grayscaling

Smoothing

Segmentation

Line detection

Corner detection

Square shape detection

Obtain marker intersection to calculate translation
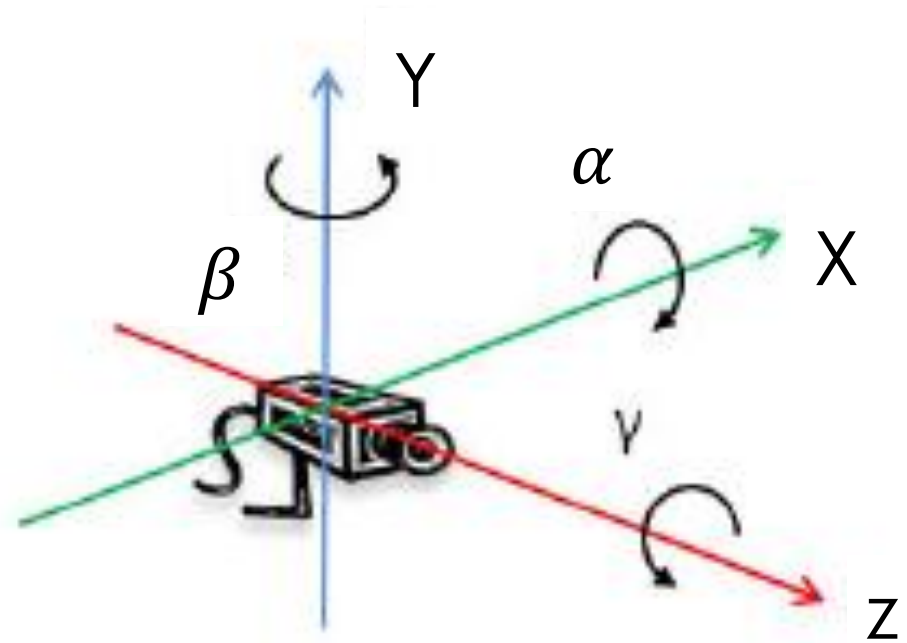
Calculate the magnitude of rotation

Output: augment virtual object on the marker

AXIS OF ROTATION

ROTATION MAGNITUDE CALCULATION

Axis z

$\theta 1$

$\theta 2$
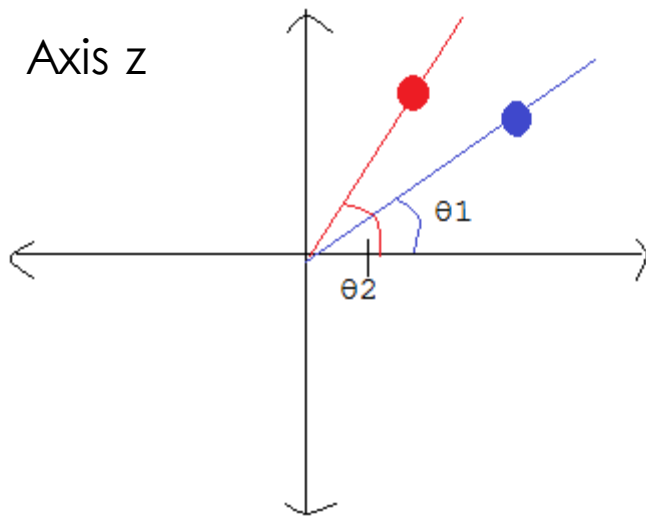
Rotation matrix on axis x $R_x = \begin{bmatrix} 1 & 0 & 0 \\ 0 & cos\alpha & -sin\alpha \\ 0 & sin\alpha & cos\alpha \end{bmatrix}$

Rotation matrix on axis y $R_y = \begin{bmatrix} cos\beta & 0 & sin\beta \\ 0 & 1 & 0 \\ -sin\beta & 0 & cos\beta \end{bmatrix}$

Rotation matrix on axis z $R_z = \begin{bmatrix} cos\gamma & -sin\gamma & 0 \\ sin\gamma & cos\gamma & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$$R = \begin{bmatrix} cos\beta cos\gamma & -cos\beta sin\gamma & sin\beta \\ sin\alpha sin\beta cos\gamma + cos\alpha sin\gamma & -sin\alpha sin\beta sin\gamma + cos\alpha cos\gamma & -sin\alpha cos\beta \\ -cos\alpha sin\beta cos\gamma + sin\alpha sin\gamma & cos\alpha sin\beta sin\gamma + sin\alpha cos\gamma & cos\alpha cos\beta \end{bmatrix}$$
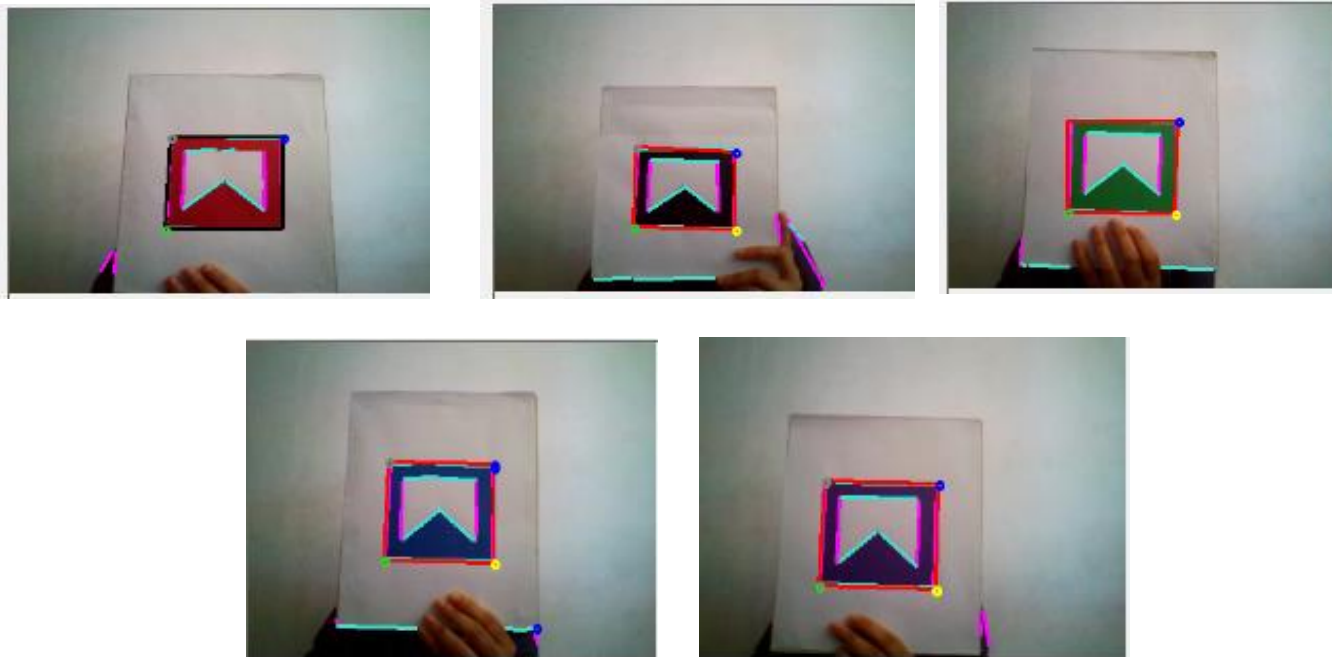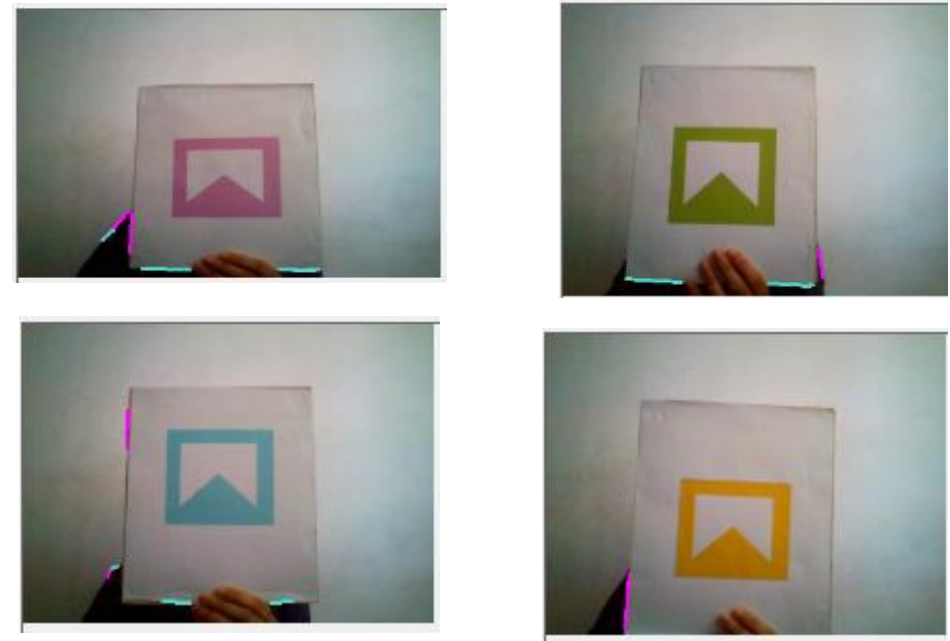
$$x1 + x2 + x3 + x4 = Z * sin\beta$$
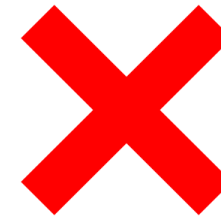
$$y1 + y2 + y3 + y4 = -Z * sin\alpha cos\beta$$
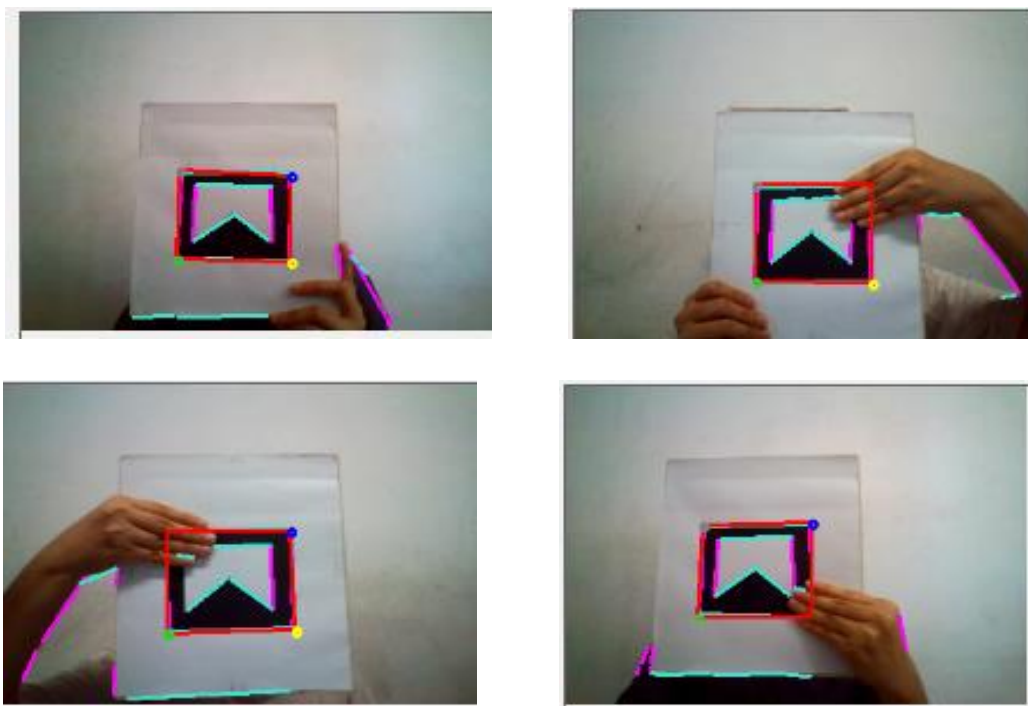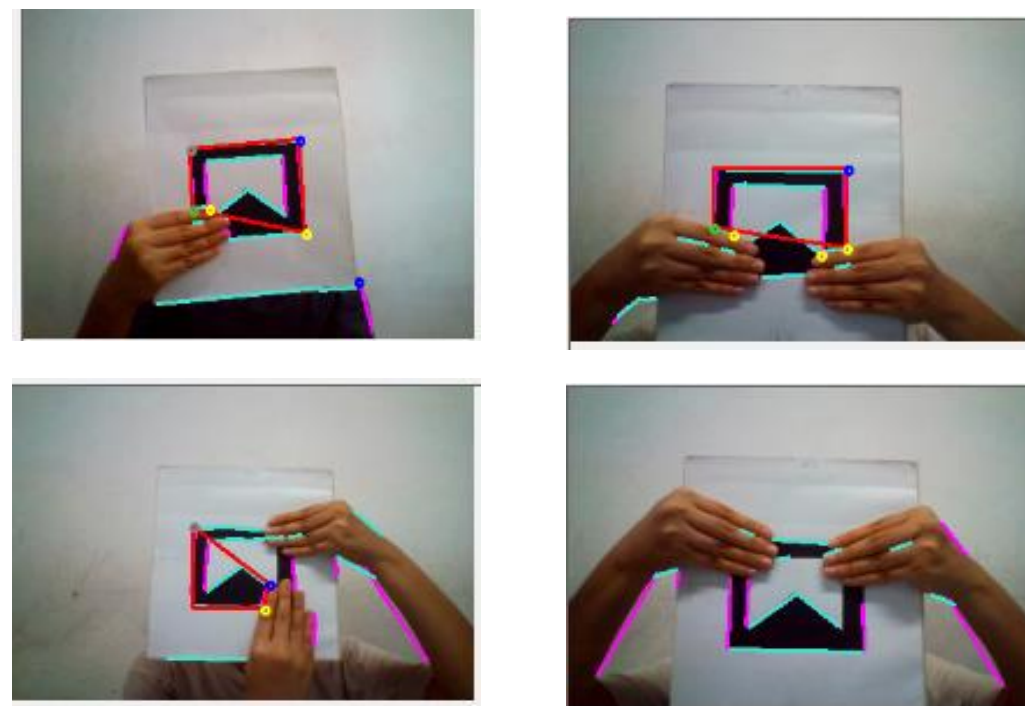
EXPERIMENT RESULT
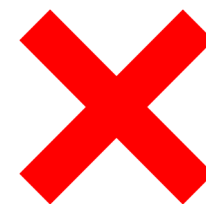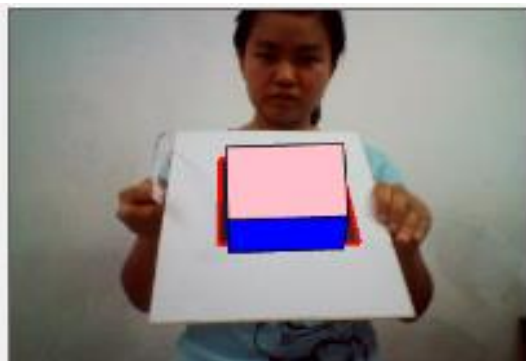
Detected

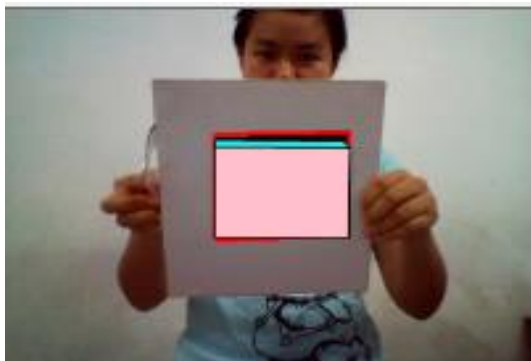Not detected

EXPERIMENT RESULT

Detected ✔

Not detected ✗

EXPERIMENT RESULT

Axis x

Axis y

Axis z

Thank you