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Department of Electrical and Electronics Engineering
Technical seminar Presentation
Final SEE

Object detecting gimbal using camera and servos

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INTRODUCTION:

❖ Gimbals are typically used in aerial vehicles to attenuate vibrations and stabilize the camera in the presence of angular motion of the vehicle and other disturbances.

❖ Autonomous target tracking using a camera/gimbal combination is an extremely important functionality for vision enabled robotic systems, e.g., in autonomous cinematography/ intelligent shooting applications.

❖ In the paper selected, Image processing part is taken.

Literature survey:

S.no.	Title	Journal / Conference	Major Observations
1	On-Board Object Tracking Control of a Quadcopter with Monocular Vision Alex G. Kendall, Nishaad N. Salvapantula	**2014 International Conference on Unmanned Aircraft Systems (ICUAS) May 27-30, 2014. Orlando, FL, USA**	Design and integration of algorithm with the hardware
2	Gimbal Control for Vision-based Target Tracking Rita Cunha, Miguel Malaca	**Conference Paper · September 2019**	Design of 2-axis servo mechanism for gimbal action
3	Gimballed Camera Control for On-Point Target Tracking Indhu B1*, VPS Naidu2	**American Research Journal of Electronics and Communication Engineering**	Design of servo mechanism

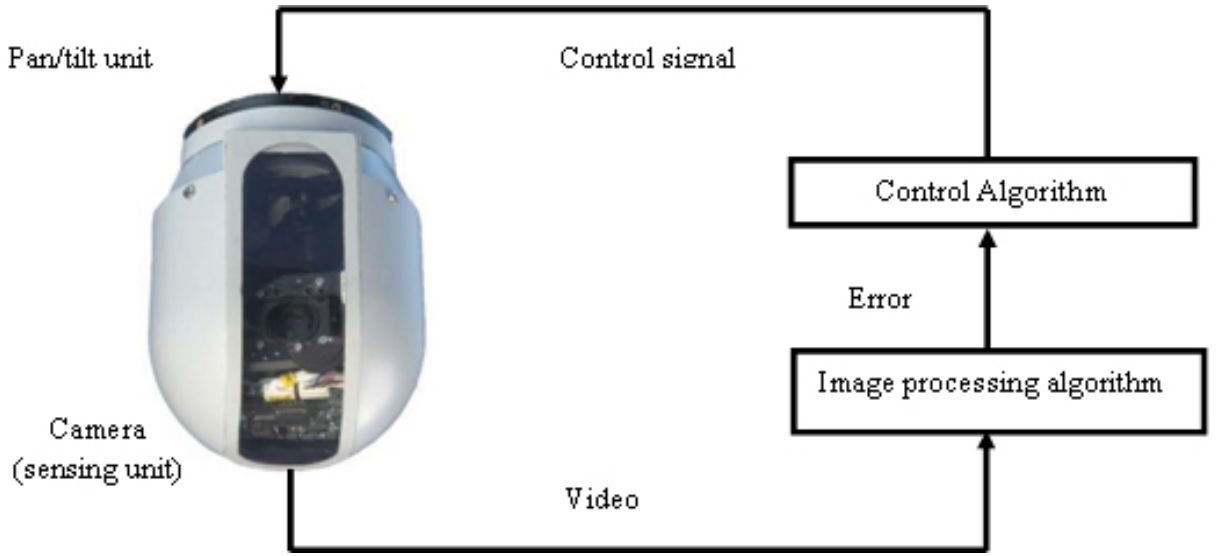
Problem Statement:

- The problem to be solved in this paper is the design of servo mechanism for gimbal action and include object detection for tracking the object.

Objectives:

- Development of an algorithm for detecting moving object from a video feed
- Design and development of pwm signals for the actuation of servos.
- To design and implement 2 axis servo mounts

Methodology:



Hardware components:

Servo 9g:

- Model: SG90
- Weight: 9 gm
- Operating voltage: 3.0V~ 7.2V
- Servo Plug: JR
- Stall torque @4.8V : 1.2kg-cm
- Stall torque @6.6V : 1.6kg-cm

Hardware components:

Arduino uno:

- Microcontroller: ATmega328.
- Operating Voltage: 5V.
- Input Voltage (recommended): 7-12V.
- Input Voltage (limits): 6-20V.
- Digital I/O Pins: 14
- Analog Input Pins: 6.
- DC Current per I/O Pin: 40 mA.
- DC Current for 3.3V Pin: 50 mA.

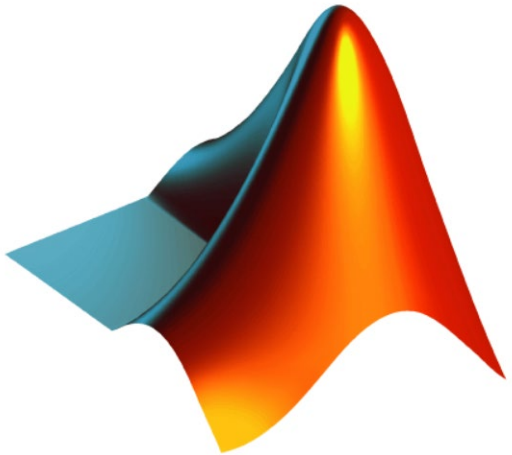
Hardware components:

USB CAMERA:

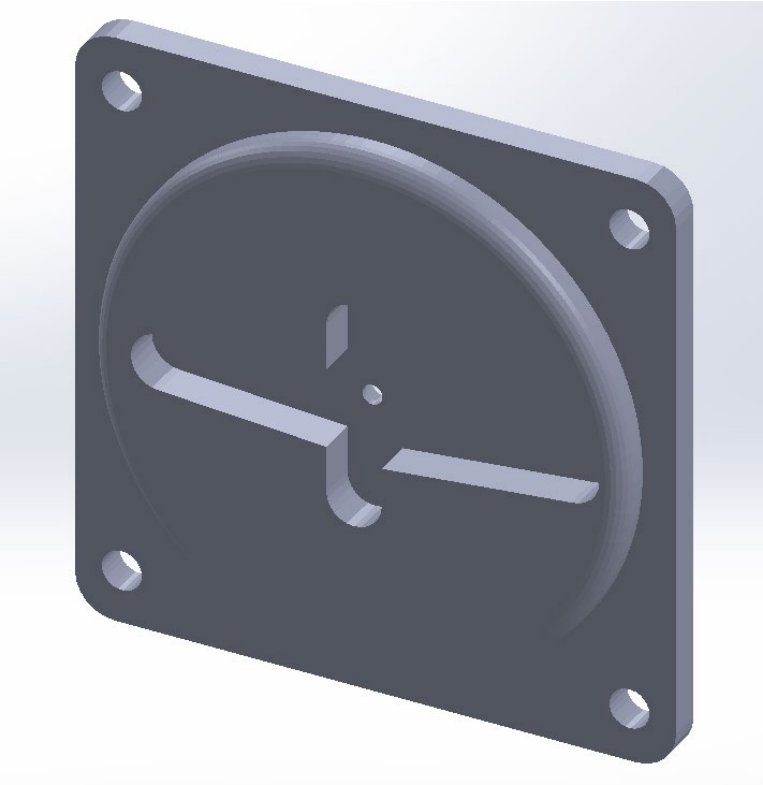
- 720p
- 30fps
- 5MP

Softwares:

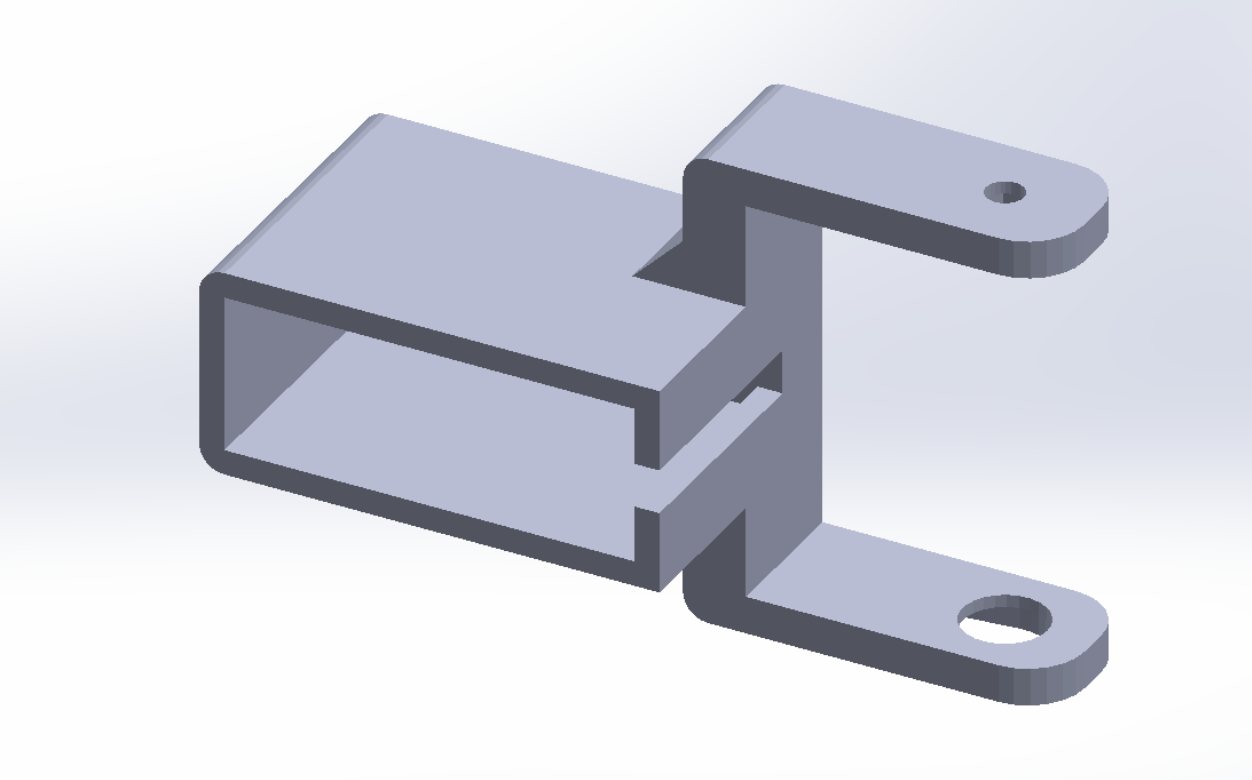
- Matlab with image processing modules
- Arduino IDE
- Droidcam client and android application
- Processing IDE



Design of Pan and Tilt mechanism:

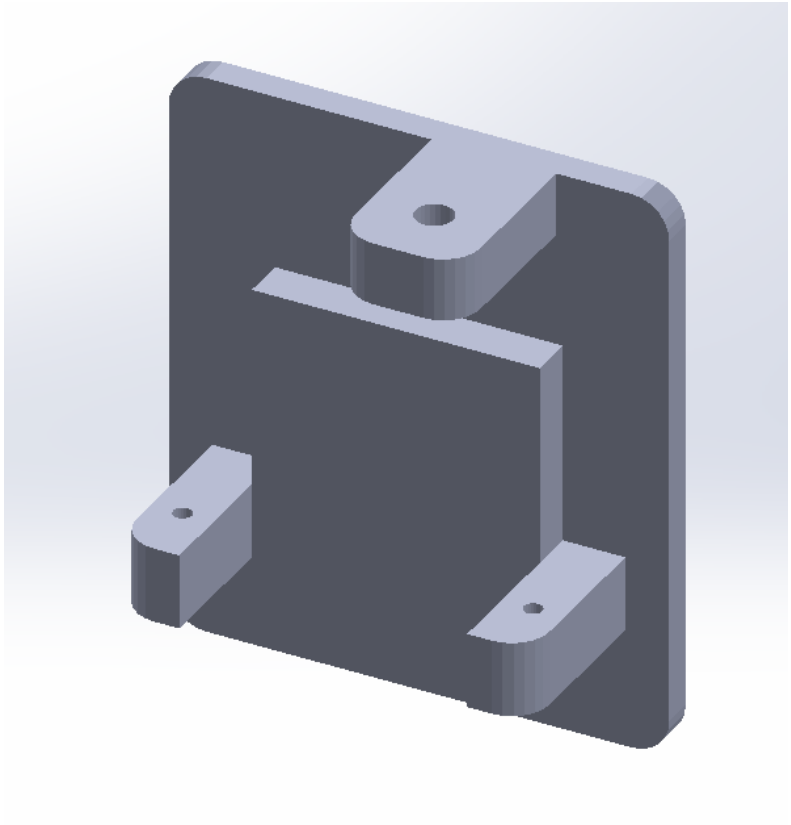


Servo base for pan mechanism

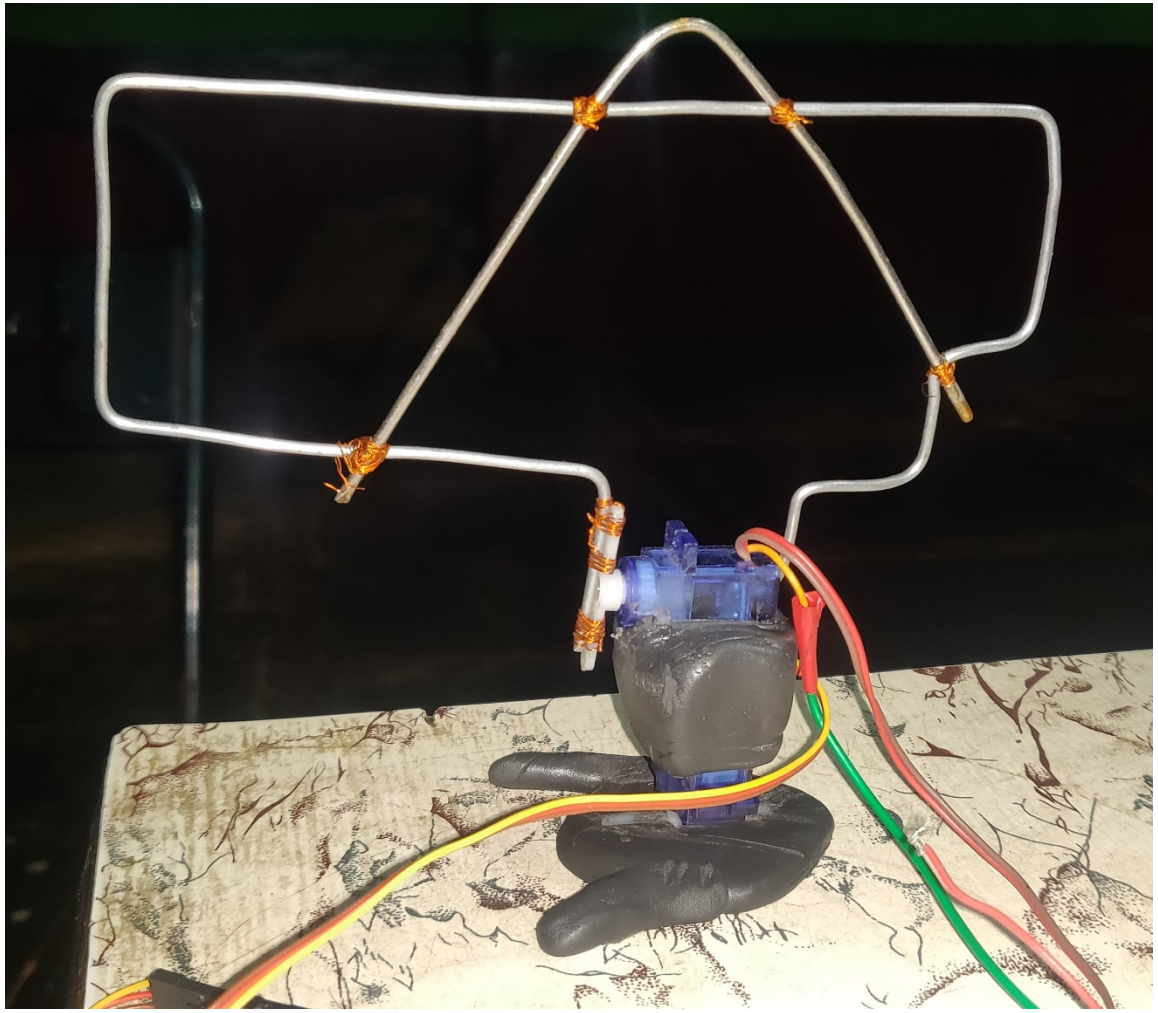


Tilt mechanism servo holder

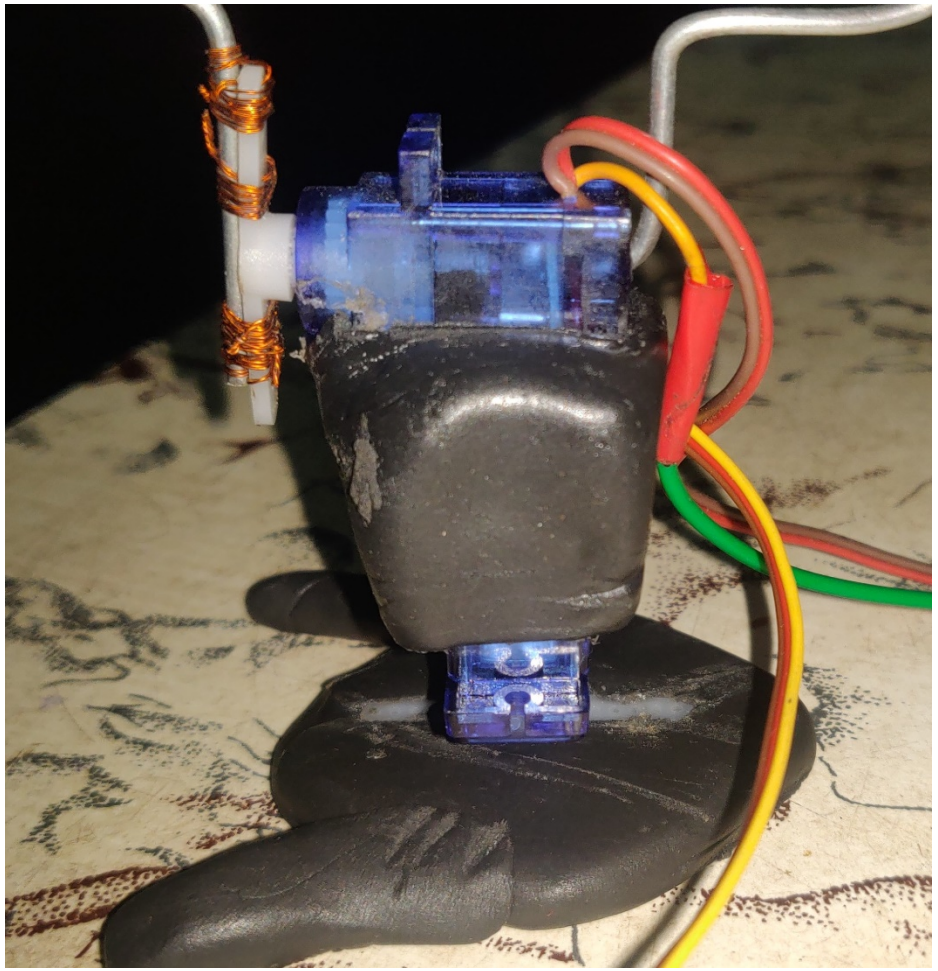
Design of Pan and Tilt mechanism:



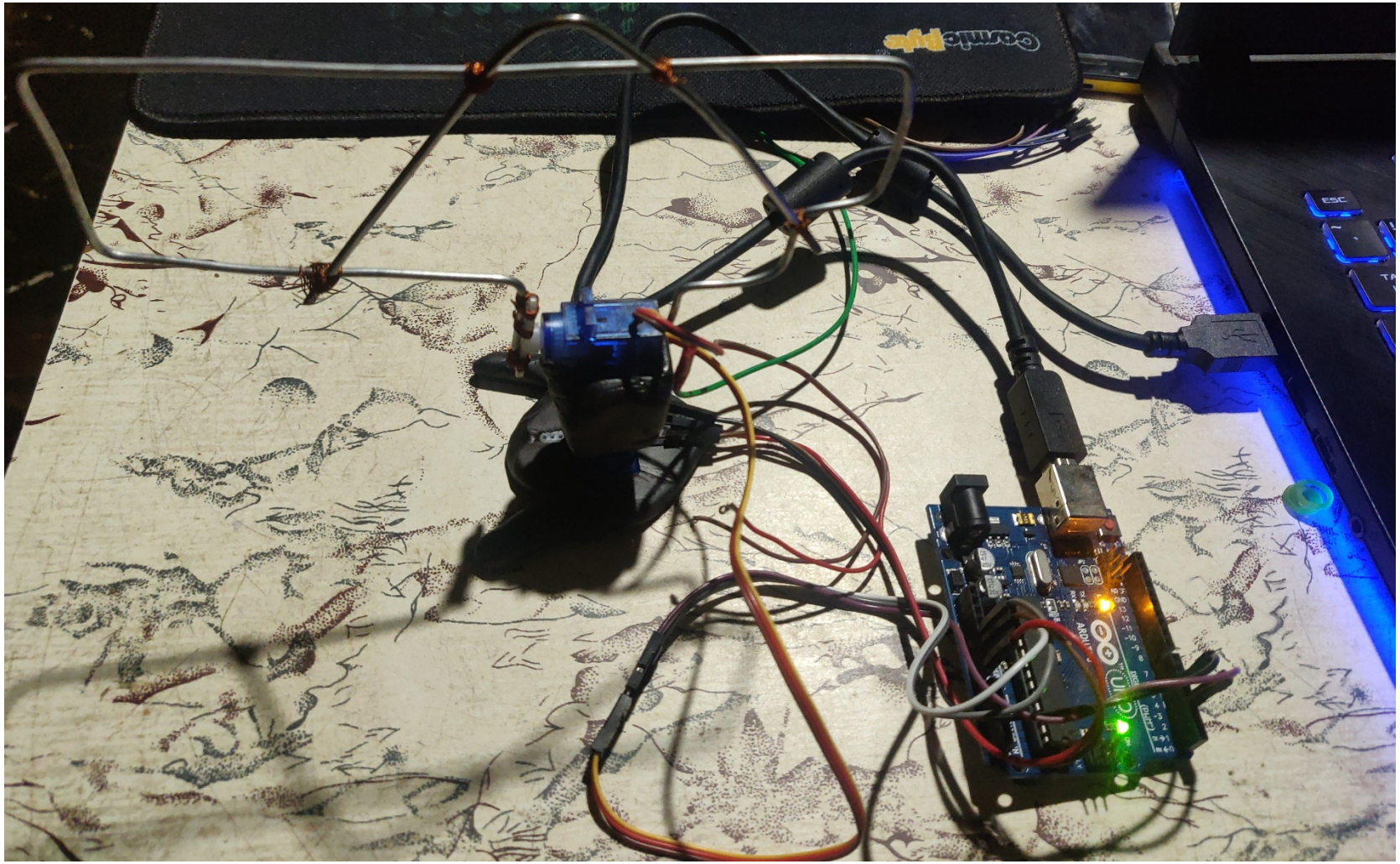
Camera holder



Pan tilt mechanism using epoxy resin



Closer view of the structure



Gimbal mechanism with various subsystems connected

Viola Jones Algorithm:

Viola jones algorithm for face detection:

- It is the best algorithm for detection of face with less false positives.
- It is already available as image processing module in Matlab.

Viola Jones Algorithm:

Algorithm:

1) Set the port of arduio Eg: COM5
2) Define the arduino pins for sending error signal i.e. D3 and D5
3) Define variables as pan,tilt and error.
4) Initialize the video input device using imaqhwinfo function.
5) Put the video frame into the CascadeObjectDetector() module.
6) CascadeObjectDetector()module detects the object and it's position in the frame.
7) Show the detected object in a separate window using vision.VideoPlayer.
8) Amplify the error signal Ex: error*2
9) Write the amplified error signal to the Arduino pins
10) Repeat the steps from step 4.

Results

Case 1: Testing the pan mechanism holding the camera(Mobile phone)

- The weight of the camera(Mobile phone) is more than the servo lifting capacity so the pan action is restricted to 20 degree from the vertical plane.
- Without the camera the pan action is able to reach 180 degree rotation.

Results

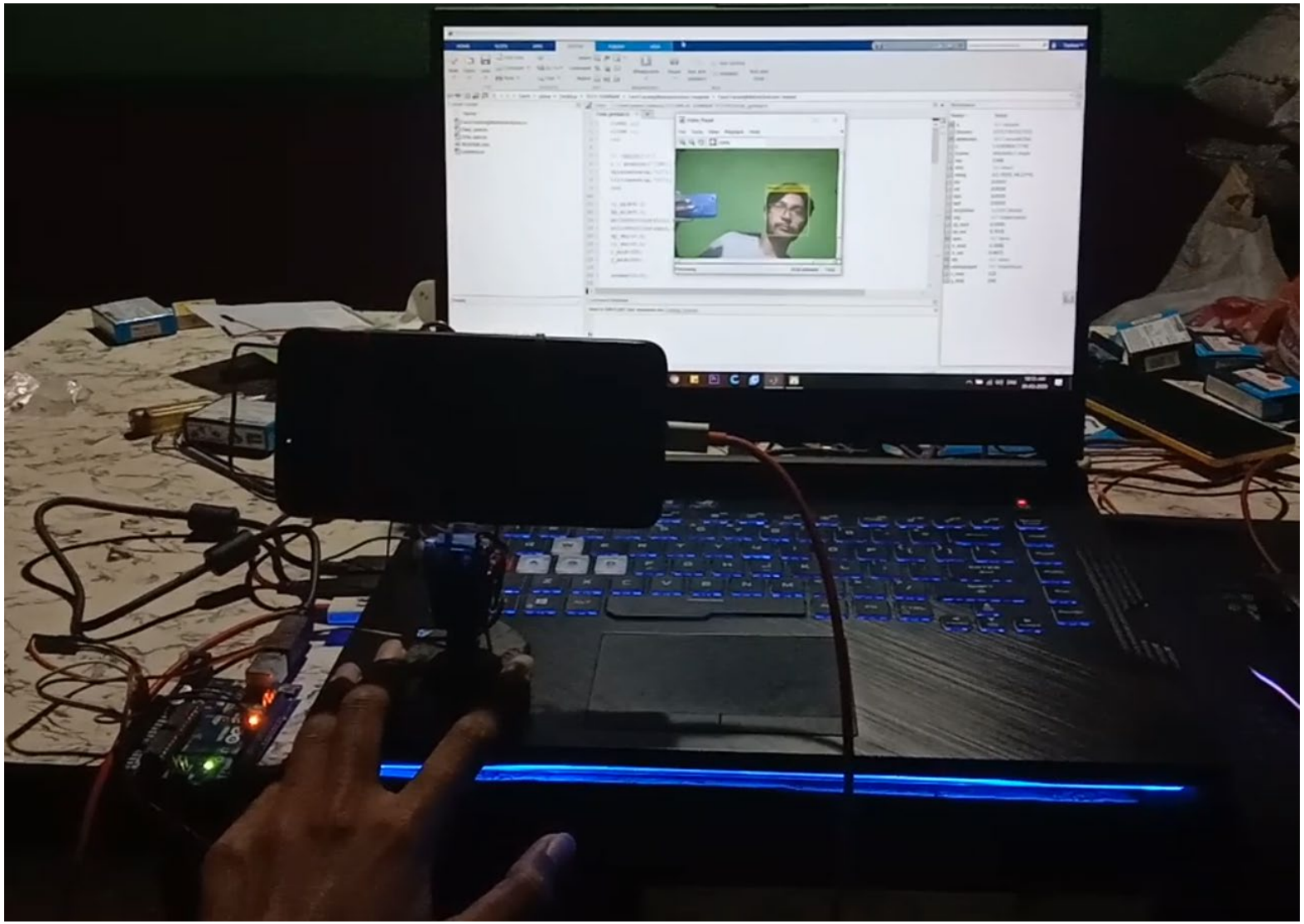
Case 2: Testing the tilt mechanism with camera(Mobile phone) fixed on it

- The tilt servo reached total of 180 degrees rotation with and without holding the Camera (Mobile phone).
- The base of the tilt servo is not sufficient to hold the camera in a stable position.

Results

Case 3: Response of the servos based on the gain multiplied with error signal

- The gain of 12 percent yielded smooth response.
- The gain of 30 and above made the system oscillate.
- The gain <3 percent was not able to move the servos.



Object detecting Gimbal using camera(Mobile phone)

Conclusion:

- The main objective of the work was to design and develop a 2 axis gimbal.
- This design can cover 360 degree angle.
- The object detection module can track the object by detecting the face.

REFERENCES:

[1] Alex G. Kendall, Nishaad N. Salvapantula, Karl A. Stol.” On-Board Object Tracking Control of a Quadcopter with Monocular Vision,” 2014 International Conference on Unmanned Aircraft Systems (ICUAS). Orlando, FL, USA, May 27-30, 2014

[2] Rita Cunha, Miguel Malaca, Vasco Sampaio, Bruno Guerreiro.” Gimbal Control for Vision-based Target Tracking,” https://www.researchgate.net/publication/335882470, September 2019

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