Face tracking Camera System Project

Author: Oluwaseun Odusanya
SID no: 1016 3553
Supervisors: Karim shah and Mehmet Senturk

Coventry University Group

Introduction

Figure 1, Insta 360 flow pro(insta360, 2019)

Background info
The target audience is users who wish to film videos for social media without a need to manually orientate the camera similar products such as the insta360 flow pro.

Aim
Design and build a prototype of an automatic face tracking tripod for a phone camera that will be capable of being controlled as a response of tracking a person's movement.

Objectives
- Develop movement tracking software
- Assemble a stand with vertical and horizontal movement.
- Integrate the tracking system software with the hardware.
- Test the prototype to evaluate the performance of the tracking and optimise the system.

Methodology

Figure 2, (OpenCV, 2019)

Figure 3, (servo, 2019)

Figure 4, (servo, 2019)

Software development stages:
1. Use OpenCV to access libraries for detecting faces and hand gestures in python.
2. Use python to convert the coordinates of the tracked features to angles and create a user interface.
3. Program using C++ in the Arduino platform to relay the angles to the system embed and Initialise the servo motors to 90 degrees.

Hardware development:
- The hardware system consists of three 180 degree MG 996R servo motors, one for horizontal movement and two for vertical movement.
- A Robotics kit from Adeept has been modified to hold a mobile phone.
- Modifications include a tripod and mobile phone gripper.

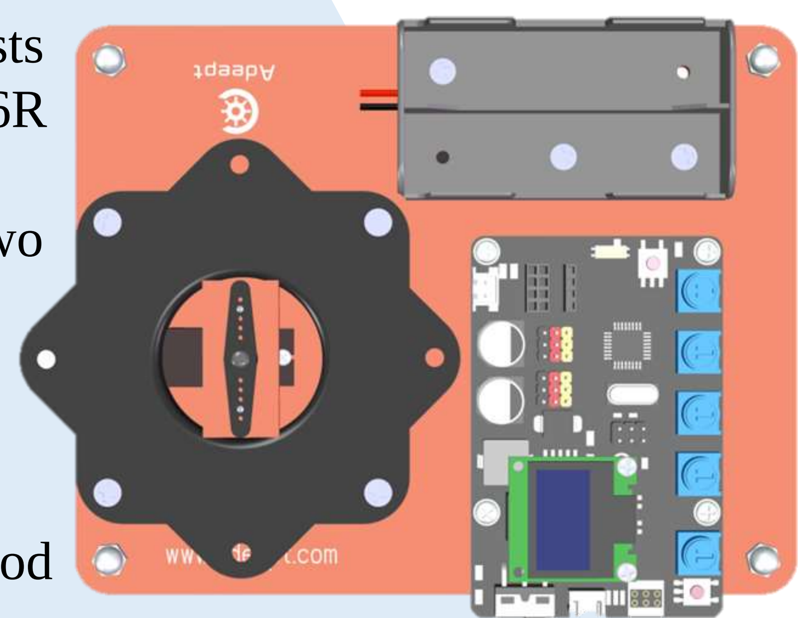

Figure 5, Adeept Robotics kit schematic (Hämäläinen, R. 2023)

Results

Face & Gesture tracking software
- Both tracking software modes show visual indicators of tracking and relay the data to the embed as seen in figure 6 Factors such as lighting can impact the quality of tracking .

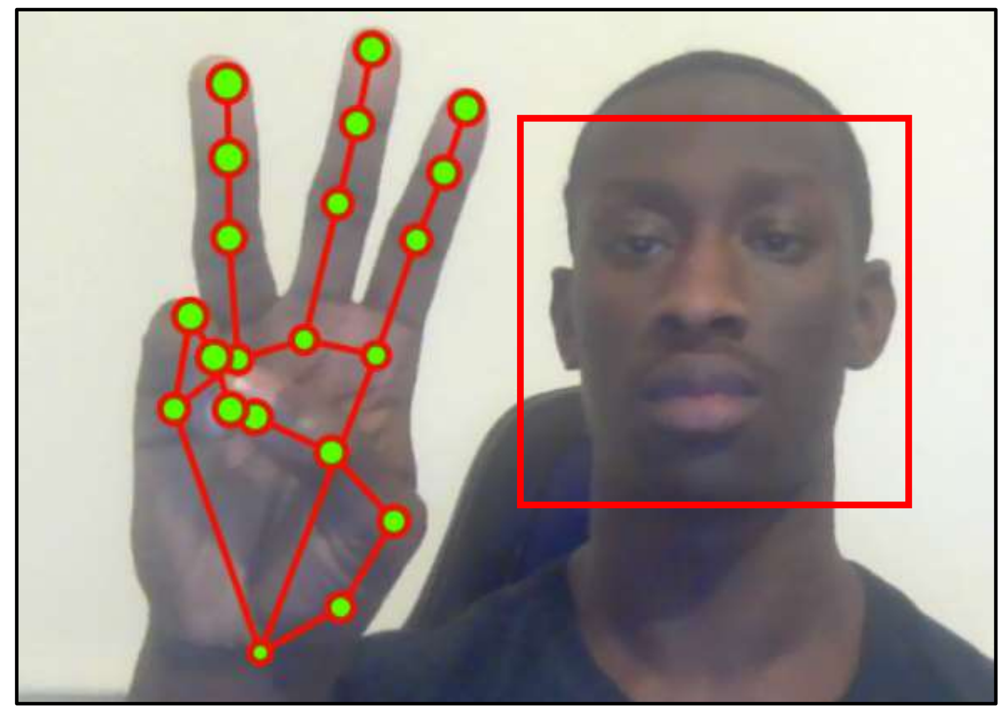

Figure 6, Object Tracking Display

GUI and manual control development.
- Python's Tkinter library has been used to develop a user interface including buttons for manual control.

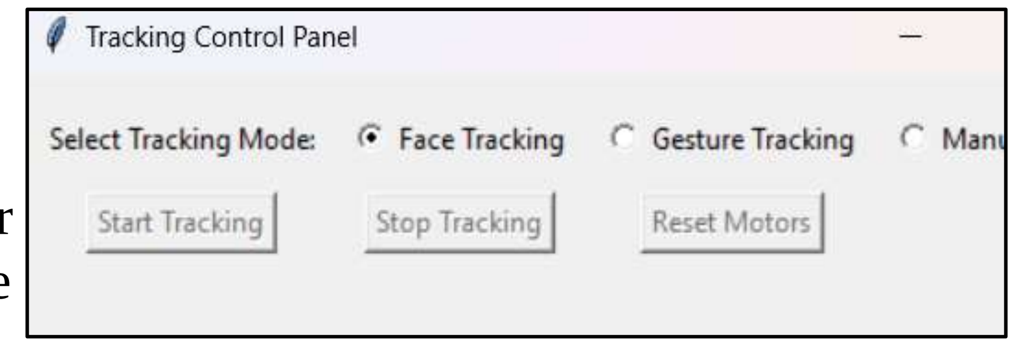

Figure 7, Project GUI

Hardware implementation Failure
- The horizontal and vertical rotation of motors is accurate however, due to the load and bending involved the joint for the vertical motor highlighted in figure 8 became unstable and is no longer operational.

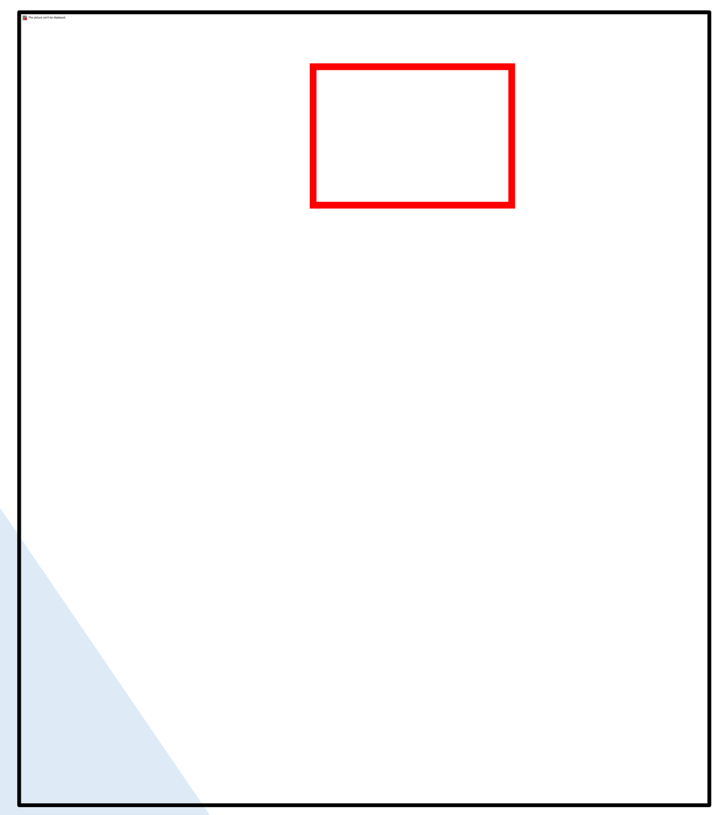

Figure 8, Completed Project Hardware

Discussion

Tracking Software success
- The face tracking and gesture tracking software operate as intended, utilising the haar cascade available with computer vision to resultantly turn the tracked coordinates to angles.

Motor control responsiveness success
- The amount of bending force applied to the vertical rotation could be a result of factors such as arm length, power supply and torque. Applying an additional servo motor has not been enough.

Cost Analysis

Table 1, Cost Analysis

Component name	Cost(£)
Adeept Embed	
3 X MG 996R servo motors	
Adeept Robotics kit	
Tripod attachment	
Total cost(£) =	

Conclusion

Summary of Findings
- Successfully developed face and gesture tracking software that effectively utilises OpenCV integrated with motor control.
- Designed and assembled a functional prototype capable of autonomous camera orientation.
- Identified limitations in the hardware, particularly in joint stability under load.

Limitations
- Inexperience in hardware testing led to overlooked load-bearing issues in the design.
- MG996R servo motors were insufficient for the system's weight requirements.
- Limited time allocated to testing the complete system hindered early identification of hardware failures.
- Clothing such as hats or poor lighting can disrupt the tracking.

Recommendations
- Upgrade the motor from a MG 996R motor which has a torque of 11 kg/cm to a motor such as the ANNIMOS Coreless Digital Motor with 35kg/cm; However, this would increase the total cost by £32
- Change the system's resting position to face upwards, reducing strain on joints.
- Future researchers should explore materials and joint mechanisms to enhance structural robustness and minimise bending.
- Test alternative computer vision software to improve tracking.

Figure 9, ANNIMOS Motor(ANNIMOS, 2024)

Figure 10, Project improved position

References

Arm, R. (2017). *Adeept Robotic Arm Drive Board V3.0 - Compatible with Arduino UNO R3 MEGA328P*. Adeept. https://ozrobotics.com/shop/adeept-robotic-arm-drive-board-v3-0-compatible-with-arduino-uno-r3-mega328p/

Hurmalainen, R. (2023). Motion study of a robotic arm.

Torque is **a measure of the force that can cause an object to rotate about an axis**

References

- OpenCV logo: http://learnitworld.com/index.php/2020/02/20/introduction-to-opencv/
- Python logo: https://www.logo.wine/logo/Python_%28programming_language%29
- Arduino logo: https://logotyp.us/logo/arduino/
- Adeept embed: Arm, R. (2017). *Adeept Robotic Arm Drive Board V3.0 - Compatible with Arduino UNO R3 MEGA328P*. Adeept. https://ozrobotics.com/shop/adeept-robotic-arm-drive-board-v3-0-compatible-with-arduino-uno-r3-mega328p/