Individual Contribution Report

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Personal contribution to group project

My contributions to the project were:
(1) initial coding of the background subtraction.py for the Intruder Detection module,
(2) Initial coding of the face recognition.py for the Face Recognition module,
(3) initial coding of the Twillio SMS alert.py for the Background Services module,
(4) writing, compiling, editing, formatting, and proof-reading the final report, and
(5) coding of the hough transform.py for the Intruder Detection module.

Summary of my contributions

Working on this Capstone project has enable me to gain a deeper hand-on understanding of creating a production-ready product that incorporated what I had learnt throughout my MTech (IS) course. What I did in this project stretched what I had learnt in class and challenged me to gain new skills in other areas not covered in the MTech (IS) programme. Here is a summary of the tasks that I had completed for the project.

Coding of the hough transform.py & background subtraction.py

Starting with the Intruder Detection module, I was assigned the task of detecting when an intruder came too near to the Smart City Demo asset. A person who came too near to the asset might damage it or take some pieces from it e.g., a small car. A virtual restriction zone had to be constructed because a physical barrier around the asset was deemed to be aesthetically unpleasing.

The first approach to coding the intruder detection functionality used hough transformation to identify lines surrounding the asset in real-time video-stream. These lines serves as the virtual restriction zone that detect objects i.e., people passing through it. When a person walk through the virtual “lines”, this create a “break” in the line that signals intrusion into the restricted zone. However, this approach was abandoned for the project because the technique was extremely sensitive to illumination that triggered false positive signals in the absence of intruders. It was unable to learn to adjust and account for changes in lighting.

Instead, I use the background subtraction technique which is a statistical signal processing method for intruder detection. This method is able to learn the characteristics of the background and adjust its parameters to fit the gradual changes in its environment e.g., illumination. Thus, it is not static and fixed like the hough transformation approach and gave better performance.

Background subtraction separates the background from the foreground, making the static background pitch black while turning any moving foreground object white when viewed on a screen. The technique is extremely sensitive to slight movement and thus

suitable for intruder detection as it can foil attempt at using slow movement to trick it. My initial code was successful at detecting intruder in the restricted zone, and thus I passed my code to other teammates for their further action of system integration.

Coding of the face recognition.py

The next piece of task that I worked on was to put a bounding box over faces for the Face Recognition module. My initial code relied on the Dlib library and Ageitgey's codes. It successfully placed a bounding box over faces and it also additionally identified faces of known individuals. This set of codes was passed to other teammates for their enhancements and integration with the rest of the system.

Coding of the Twillio SMS alert.py

I also worked on the Backend Service module, specifically for the SMS alert mechanism. My approach uses the cloud communication services of Twilio to send SMS to office staff when intruders are detected. I coded the python script that send a API request to Twilio to alert the staff using SMS. I passed my code to other teammates for their action to integrate it with the other modules.

Works done for the final report

The final report was a task that I had worked on. In this area, I handled the compiling, editing, formatting, and proof-reading of the final report. I also did the writings for the sections on physical limitations, future improvements and conclusion. My writing task also extended to the presentation slides, particularly the sections on background subtraction and SMS alert.

<u>What I had learnt</u>

Although it was a shame that the hough transformation approach didn't pan out in the final project, it was a great learning experience nonetheless to understand how it worked and how it was unsuitable for the project. The big takeaway lesson, however, was learning how appropriate background subtraction was for the task of detecting people in restricted zone. The robustness of this approach makes it a default method that I will consider for detecting intruders in future projects.

Working with the codes of face_recognition.py had taught me the finer points of how to write python codes to implement a face recognition system. More importantly, I now understand the basic concept of transfer learning because I had used the pre-trained weights that the author had trained the model on, instead of performing my own training on the model. Because the author had done a good job in training the model, the script's performance on face recognition was quite high without needing much training from the team.

Making APIs call/request using python script was a task that I have never done before prior to the Capstone project. I definitely learnt new things about the nature of APIs and how to worked with them. This experience will aid me in future APIs related tasks encountered in my job.