Abstract

Problem Selection : Automation Society Security Task (ASST)

Understanding of the problem chosen

a. **Understanding of the Problem :**

With increasing risk of robberies and the deadly virus mutating in the country, it is important for the housing societies to get smart technology in action and stay safe. The promise of contactless delivery by most essential services workers will truly be served if every housing society could ensure that none of the affected/symptomatic people enter the society. The ASST will ensure every person entering the society is authenticated through facial recognition and is asymptomatic in terms of temperature from the novel coronavirus.

b. **Most Challenging aspect :**

1) Integration - Integrating the hardware devices like the cameras and sensors with deep learning models would be a tough challenge.
2) Spoofing - Any unidentified person can use photos of the registered visitor for facial recognition this can be countered by using passive liveness detection.
3) 2D facial recognition won't work in the dark with accuracy. For this purpose we will use thermal imaging cameras which may be a little difficult to train.

c. **Reason for Choosing this problem :**

Fear of robbery and the availability of ever-cheaper cameras have accelerated the trend even more. Additionally, the unfolding global coronavirus scare has made it essential to detect the temperature of an individual. The temperature would lead us to the knowledge whether the individual has started to show symptoms pertaining to the virus. This problem statement deals with both the concerns mentioned above, and that is why it has been our choice.

Structure of the plan to approach the problem chosen

a. Approach :

Our approach involves a combination of hardware and software. We would use Raspberry Pi module for the purpose of checking temperature through an FLIR camera, which takes live feed and also checks temperature.

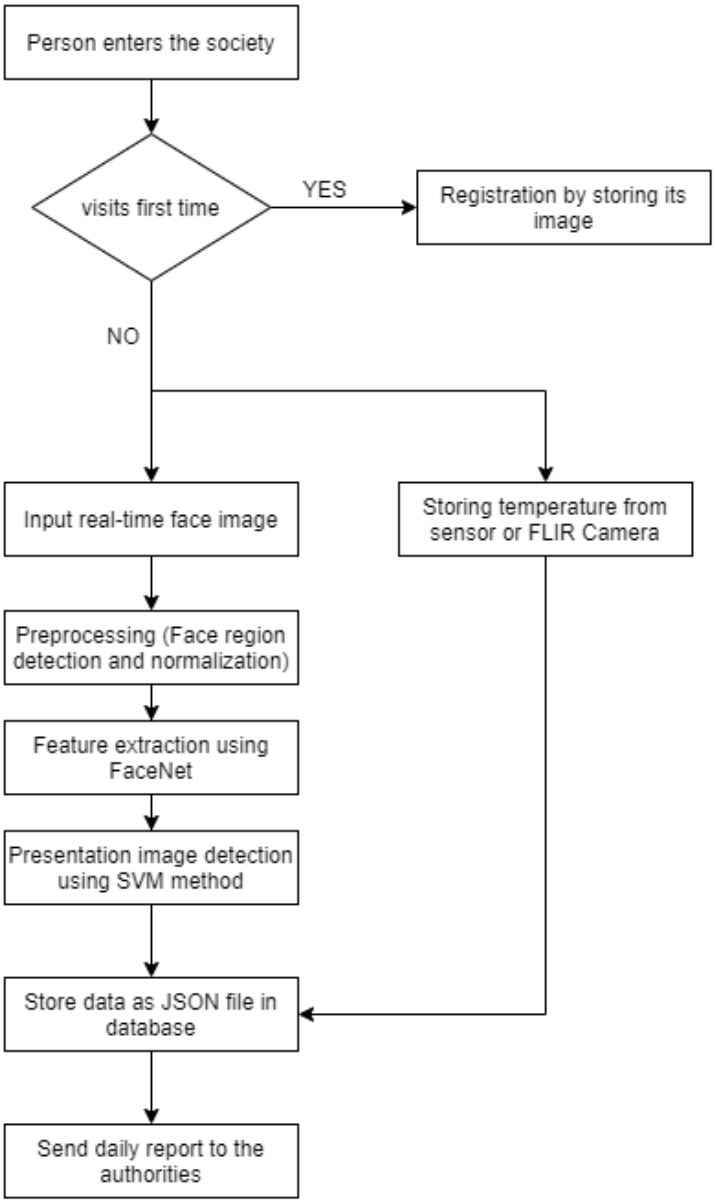
We use a pre-trained model, as training a model explicitly on a Rpi shall be computationally very expensive. FaceNet employs one shot learning based on Euclidean embedding and DCNN, and will be modified for our requirements.

For the part of spoofing, we plan to use eye blink detection to detect if the person is human or not.

For checking temperature, our solution makes use of a FLIR (forward looking infrared) camera which will be a contactless way of checking the person's temperature through their heat radiations. It is an effective way to check EBT (Elevated Body Temperature) and is used at places like Airport and Factories. It's tolerance range under normal conditions is 5%.

After recording the person's identity and temperature through the above mentioned methods, we combine the output in a json format and write it into our database which can be then sent to the security personnel at the end of every working day.

Approach Diagram



b. Platform/Coding Language/Framework :

- Python with OpenCV on an RPi to take live video feed of the surroundings
- Keras with Tensorflow backend for building and deploying the model

c. Database :

MongoDB for storage

d. External Tools :

- Google Collaboratory
- MongoDB Compass

e. Fortnightly targets :

1. Dataset Preparation and Preprocessing
2. Model Building: Use FaceNet and add additional layers tuned to data captured by FLIR
3. Training the data using Transfer Learning.
4. Hypertuning: Try different hyperparameters and optimizers.
5. Circuit Integration: Connect FLIR Camera and/or sensor to the RaspberryPi Module.
6. Deploy ML Model on RPi.
7. Evaluation of results
8. Building of server side to save information obtained from different algorithms.

<u>Why do we think our team will be able to implement a winning solution?</u>

a. We have worked as a team in several projects and have worked in the field of Deep Learning, which is a prerequisite for this problem statement. Our previously undertaken projects include :
    - Alzheimer Detection using CNN
    - Art Generation using Neural Style Transfer
    - Trigger word Detection
    - Learning Aid for children suffering with ADHD.
    - Digital Agriculture using IoT and Android

b. Team Strengths :

- The four of us have been part of the Computer Society of India and have taken part in and managed several events for the same. So we have good teamwork and know each other's strengths and weaknesses.
- Through the course of projects undertaken by us we have inculcated invaluable skills like:
    i. Problem solving tactics
    ii. Conceptual knowledge
    iii. An organised approach to tackling the problems.

c. Team Achievements :

- We have published papers on well-established scientific journals:
    a. Decentralized Energy Trading using Blockchain
    b. Aid for Children with Learning Disability
- Deep Blue Finalist for Season 5 (Aishwarya Sahoo)
- As a team, we have participated in numerous intra-college and inter-college hackathons.

d. Personal Motivations :

In this pandemic era, this problem actually hits home, as all of us live in apartment complexes and have different people moving in and out of our buildings. We aim to ease the security process so that the efficiency of contactless delivery and tenants of the apartments is not compromised.

Wide range of applications adds up the motivation towards developing such a system. Not only limited for housing societies, the system could also be used for schools, offices and hospitals.

We understand that with increasing cases of covid and robbery in India, this system will be a necessity for housing societies in near future.