Thermopile Infrared Sensor based Posture Recognition:
Deep Reinforcement Learning for Image Noise Filtering

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I. Motivation

Researchers have implemented many posture recognition systems using cameras. However, they are not well accepted by the users for a real-life long-term applications. The main reason is that the camera-based systems are privacy invasive for long-term applications. We developed a device-free, non-privacy invasive indoor human posture recognition system using low-resolution infrared sensors. The system uses thermopile infrared sensors to recognize postures. Our system has already demonstrate high recognition accuracy. Meanwhile, there are several challenges to deploy the system in real-world scenarios.

The accuracy of posture recognition highly depends on the quality of the input images. Generally, clearer images produce higher recognition accuracy. However, the images produced by 8*8 resolution IR sensors are very fuzzy and full of noise. Therefore, we need a solution to preprocessing the image to make it more clear before feeding into recognition models.

II. Research Requirements

There are many existing solutions to filter out the image noise. However, these solutions can not automatically tune parameters, such as background color depth. In addition, the noise and people in IR images are dynamic. Caused by the varying temperature, the background colors change even if the people stands still in the area. We need a solution to tune the noise filtering parameters dynamically and automatically.

III. Tasks

In this project, the student is required to process the IR images using deep reinforcement learning solution. We will use a basic color depth solution to filter out the background noise. The parameters used for filtering out background noises must be automatically adaptive to the mobility of people in the room by DRL solution.
To finish the project, the student must at least implement the follows work steps.

1. Select color-depth filtering solution for processing the image. The output of the processing must be able to improve the accuracy of posture recognition (compared with the previous IR-posture-recognition work).

2. Build DRL model for image processing.
   a. Select the parameter that DRL model acts to make image processing. For example, the low bound and high bound of the color filter can be used.
   b. The reward could be the similarity between the filtered IR image and the filtered posture shape from RGB image.

3. Set up hardware system. Compared with the previous IR-posture-recognition work, this system needs to set up a RGB camera beside every IR sensor in the training process. The posture shape from RGB image is the evaluation environment in DRL model.

4. In the deployment experiments, IR sensors (without RGB cameras) are used to capture the image. The processed posture images must be able to improve the accuracy of posture recognition.