CS2310 Course Project Final Report

Lei Zhao
Lez21@pitt.edu

Link to demo: https://youtu.be/Lwe8vQIrHPU

Introduce

In this project I developed a gesture based health care system that can monitor patient's health conditions by using the web cam of a typical computer. The whole system's schematic view is shown in Figure 1, the green areas are those I have implemented in this project. There are two kinds of gestures that the sensor (web cam) can detect, representing two different level of emergences. Based on the condition of the patient, the emergence manager can issue corresponding commands to home staff, so that the patient can be treated in time.

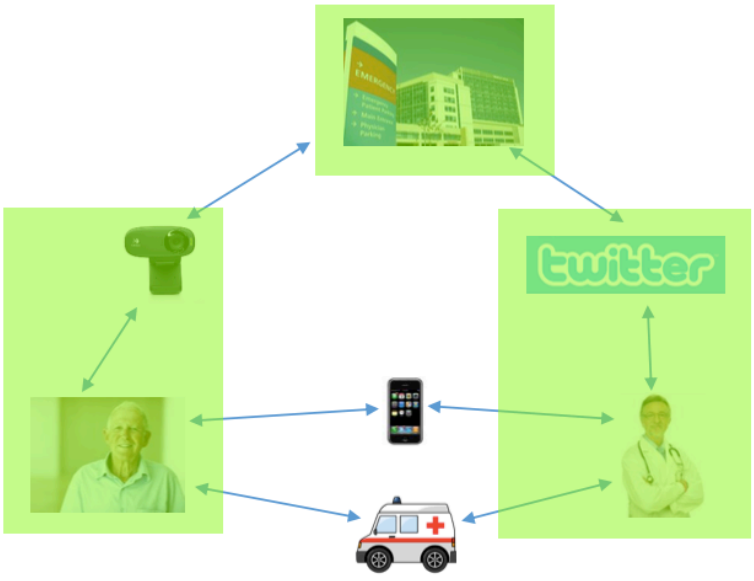

Figure 1. Schematic view of the system

Design

There are altogether three parts of the whole system – sensor, emergence manager and home staff. The work flow of the system is show in Figure 2.

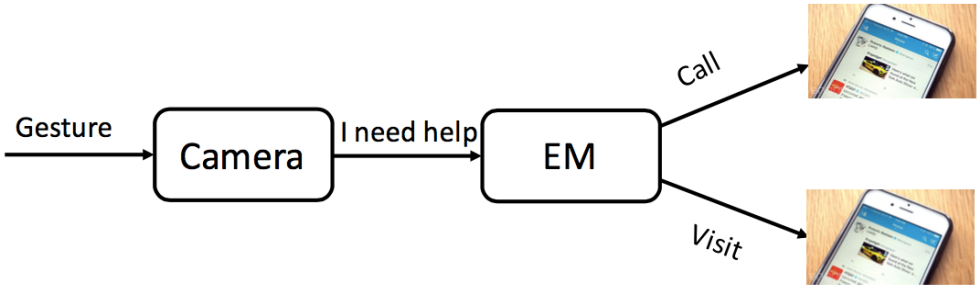

Figure 2. Work flow of the system

First the sensor (web cam) detects the gestures from the patient, and send "I need help" message to the server. The emergence manager checks the frequency of the messages, and issue different commands to the home staff accordingly.

Sensor

I choose to use the commonly seen web cams as the sensors to detect gestures based on the following reasons:

1. Web cam is one of the most common device that can be seen in daily life, and it is easy to extend the web cams into typical secure cameras that have already been widely used in houses to watch children and elderly people.
2. Internet and personal PCs are already an indispensable part of life for almost anyone. The likelihood that illness occurs to elderly people when they are using computers is very high.

The implementation of this part is also the most difficult one in the whole system. Since the web cams are not primarily designed to this task, I have to capture the video stream and extract the hand gestures by myself. I used OpenCV to do this task. The detailed implementation of this algorithm is listed as follows:

Step 1. The program will save the first frame from the stream as a background image.

Step 2. The following frames from the stream is compared with the background image. And the regions that the pixels are different from the background image are obtained. Note, in order to avoid noises, the regions with small areas are not considered.

Step 3. Check all the regions from step 2, get the top vertexes of the region (the red dots in Figure 3). If it has 5 such dots, it is recognized as a hand. Note, currently the program only recognizes the palm hand with five fingers open.

Step 4. Then check the movement of the hand region, if the distance of the movement is larger than 70 pixels, it is recognized as a waving hand gesture and sends an "I need help" message to the emergence manager.

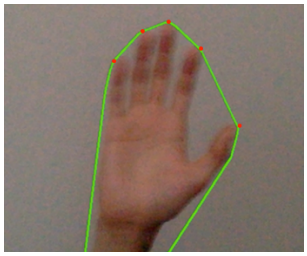

Figure 3. Hand region in the stream

Emergence Manager

The emergence manager is the first component to start in the system. When this component starts up, it opens a port and waits for the sensor to connect. Once connected, it listens to the port for new sockets. If it receives an "I need help message", it will send a "call" command to the home staff. If two consecutive messages are received within 5 seconds, it means the patient is keeping on waving hands, then the emergence manager will send a "visit" command to the home staff.

Home Staff

In order to make this system closer to reality. I employ the twitter app as the home staff component. So when the emergence manager sends commands to home staff, it actually posts a corresponding twitter message on twitter.

Limitations and Future Work

The limitation is mainly in the sensor part. Because the detection is based on the pixel comparison with the background image, although I eliminated small regions to avoid noise, there will still be a lot of regions detected to be different from the background image especially when there are a lot of moving objects in the camera. Second, because of the detection of hand region is based on counting the top vertexes, currently only palm hand is recognized as a hand, if we want to

recognized different hand gestures, such as a fist, the algorithm need to be redesigned.

Conclusion

In this course project, a web camera based health care system is developed. It can monitor the patient's health condition continuously. When the patient is in emergent situations, he only needs to wave his hand to the web camera to contact with the home staff. Also, the longer the patient keeps waving his hand, it means more dangerous situation the patient is suffering. The demo of this project can be found in https://youtu.be/Lwe8vQIrHPU.