

MRSD Individual Lab Report 09

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1. Individual Progress

For this week's progress review, I have completed extracting the person with April Tag from a multi-people frame, and sent the image of the April Tag person's face to IntraFace for detecting his or her facial expression only, without disturbance of other people in the frame. And then click the photo of the entire scene with the smiling person after he or she has smiled for more than 2 seconds.

1.1 Extracted the person with April Tag from the entire frame

The general idea of solving multi-people problem is that how we can detect the person from beginning to the end of the process without switching the person. As we can not change the core code of IntraFace, the idea we've come up is that extract the frame of the person with April tag and send this image message to IntraFace, so that there will be only 1 person's face for IntraFace to detect his or her facial expression.

The position of the frame with the April Tag person is one problem. In x direction, I assume that the x coordinate value of the person's face is the same with x coordinate value of April Tag. So I used April Tag's x position as the center of the person's face. And I adjusted the size of the frame according to the distance from the camera to the person. As the turtlebot will stop at 1 meter away from the person with April Tag, so I tried different parameters, and at last I've found 200 pixels size in x direction shows the best performance.

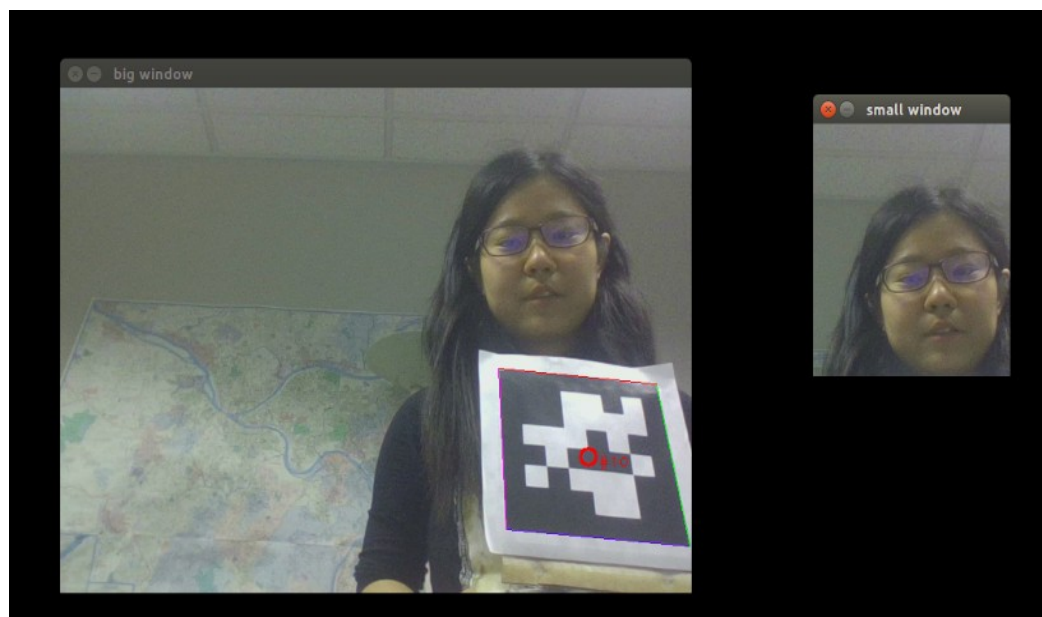


Figure 1a: Extracting the face of the April Tag person from entire frame

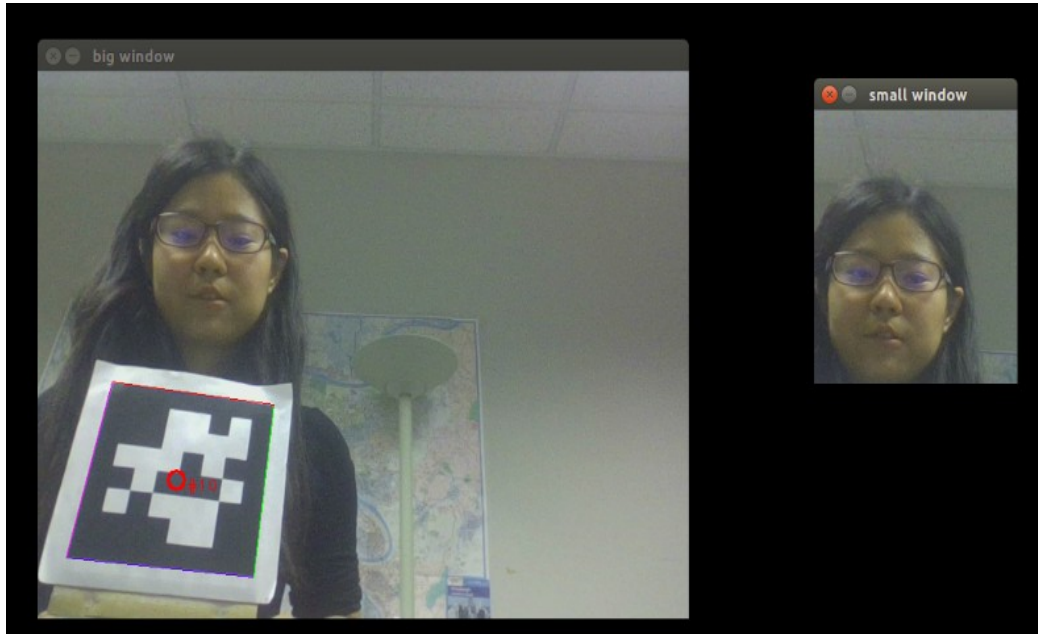


Figure 1b: Extracting the face of the April Tag person from entire frame

As can be seen in Figure 1a and Figure 1b, the person's face above April Tag will be extracted from “big window” frame to “small window” frame. Because the position of the “small window” only determined to the position of April Tag. In this way, even if there are multi-people in the “big frame”, there will be only 1 person that with April Tag will be extracted. And when I move from the left to the right, the position of my face in “small window” frame almost doesn't change.

```
cv::Rect roi(-7 * tag_msg.x + im.cols / 2 - 100, 0, 200, im.rows / 2);
cv::Mat image_roi(im, roi);
cv::imshow(OPENCV_WINDOW2, image_roi);
cv::waitKey(3);
```

Figure 2: Main code for April Tag person extraction

The main code of the algorithm is shown in Figure 2. The biggest challenges for me are: 1. I seldom used openCV before so it took me some time to learn the functions. 2. It took me a long time to find out the best parameters. tag_msg.x is the position of the April-tag, and its unit is centimeter. However, for other values in openCV are all in pixel. So I have to convert the unit according to the size of April Tag and the distance between the person to the camera.

In y direction is relatively easier. As I hope to send the face image to IntraFace, so I extracted the upper half image from the entire image, which will be the person's face above April Tag.

1.2 Sent the extracted image message to IntraFace and finished photo clicking with the smiling person with April tag

The second part of my individual progress is that I need to send the extracted frame image message to IntraFace so that IntraFace will only detect corresponding person's facial expression without the disturbance of other people in the frame.

Originally, the IntraFace would subscribe from “video_input” topic, which will be the image from the web_cam. And the original core code is shown in Figure 3a.

```
// subscribers
image_transport::Subscriber image_sub = image_transport.subscribe("video_input", 1, &imageCb);
```

Figure 3a: Original code for IntraFace to subscribe image

And what I need to change is that publish the image message from april_tag_node.cpp to intraface_node.cpp. In this way, april_tag_node.cpp will be the publisher, and intraface_node.cpp will be the subscriber.

```
image_transport::Publisher pub;
pub = it_.advertise("robo", 1);
```

```
sensor_msgs::ImagePtr msg = cv_bridge::CvImage(std_msgs::Header(), "bgr8", image_roi).toImageMsg();
pub.publish(msg);
```

Figure 3b: Updated code for April_tag_node.cpp to publish image

Figure 3b shows how April_tag_node.cpp publishes the extracted image message, and the topic is called “robo”.

```
// subscribers
// image_transport::Subscriber image_sub = image_transport.subscribe("video_input", 1, &imageCb);
image_transport::Subscriber image_sub = image_transport.subscribe("robo", 1, imageCb);
```

Figure 3c: Updated code for IntraFace to subscribe image

Figure 3c shows how IntraFace subscribes the message in the topic “robo”.

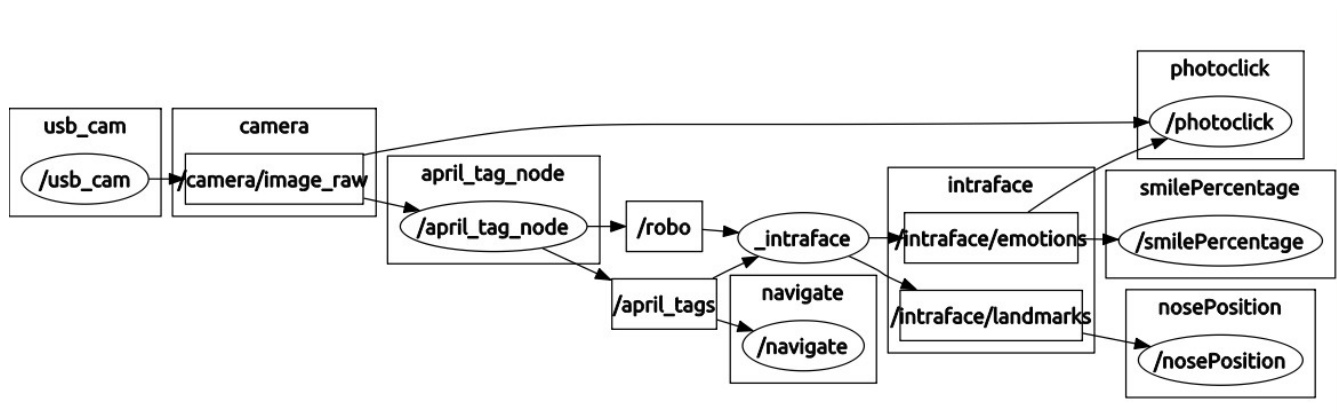


Figure 4: rqt graph of the updated detection system

Figure 4 shows the rqt graph of our updated detection system. And “robo” topic has been published from “april_tag_node”, and subscribe for “Intraface”.

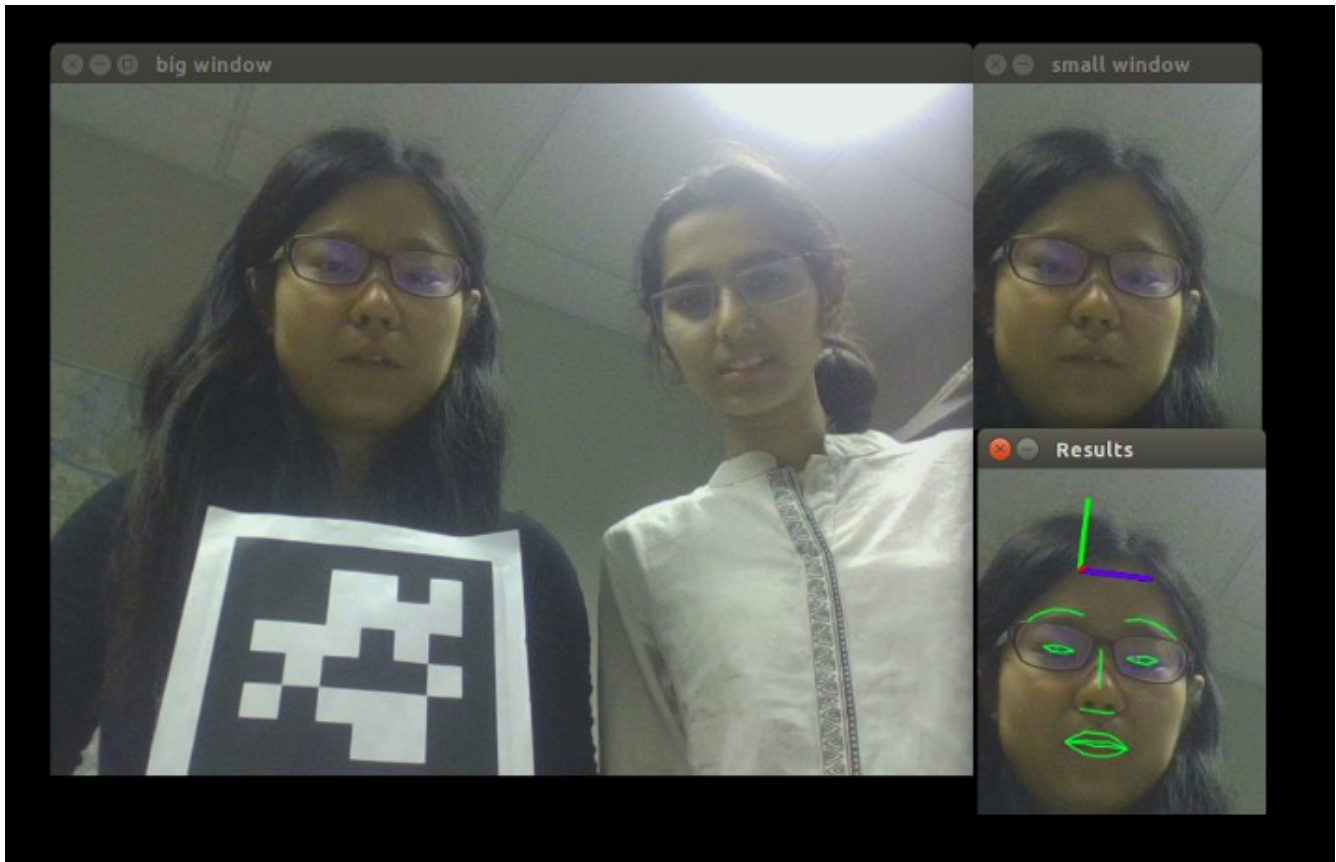


Figure 5: IntraFace detects the person's facial expression with April Tag

The result of the detection system can be seen in Figure 5. I was with the April Tag and Gauri was without April-tag. And the whole frame can be seen in “big window”. And the “small window” frame shows the human face above the April Tag. In this way, Gauri will not be extracted. And “Results” frame shows the IntraFace detection situation, which is the image message that “small window” shows. So that Intraface will only detect my face because I was holding April Tag.

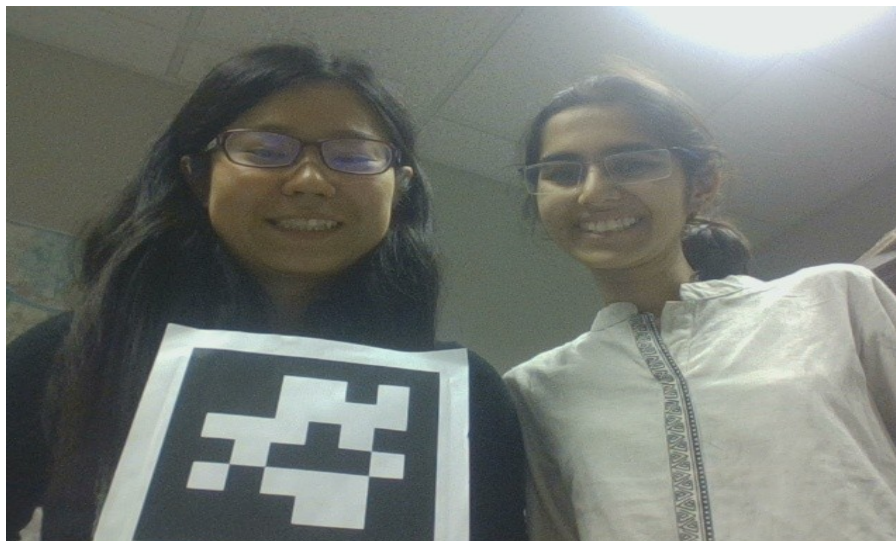


Figure 6: Final photo clicked: the whole scene

As shown in Figure 6, although Intraface only detect the person with April Tag, the camera will still shoot the whole scene as final photo. Because it will be strange if there is only human face in the photo.

2. Challenges

2.1 Tried to find out the optimal parameters to extract the 1-person frame

As there are many factors may affect how large the extracted image is or the position of the extracted image out of the original image. For example, the distance between the April Tag to the camera, the size of April Tag, the parameters of the camera, etc. So I tried many parameters and temporarily use 1 April Tag and the distance set to 1 meter. And for our SVE, I may change the parameters because we may use different camera and different April Tag.

2.2 Intraface delays when subscribing image message from April_tag_node

At first, I create a publisher every time when update the frame, and it took relatively long time, so that Intraface would not detect person's facial expression real time. And After I've found this problem, I created the publisher only at the very beginning, and only sent the message everytime without creating the publisher each time. In this way, the problem of Intraface delay solved.

3. Team Work

This week, I mainly worked on solving the problem of multi-people in the frame. Rohit mainly manufactured pan-tilt unit, and Tiffany used the new pan-tilt unit for the Arduino and motor for human face tracking. Gauri and Jimit worked on Rocon for multi-master communication for facial expression data, so that the camera with highest smiling percentage will shoot the photo.

There are 3 main contributions of our team this week:

- (1). Set up distributed system with Rocon for smiling percentage data communication between different master computers
- (2). Set up new pan-tilt unit system
- (3). Solved the problem of mult people in the frame and extracted 1 person with April tag

4. Future Plan

For next PR, we are trying to show the 2 subsystems: navigation subsystem and detection subsystem. Navigation subsystem is mainly flocking part of project, including self-collision avoidance and global map setup. Detection subsystem will be the photo clicking of the person with april-tag with highest smiling percentage among 3 turtlebots.

What I will do: Detection subsystem integration. In details, integration of April-tag detection, person with April-tag extraction, Intraface facial expression recognition, pan-tilt unit face tracking, smiling percentage comparison between different master computers, as well as photo clicking.

5. References

(1). Image subscribing and publishing

http://wiki.ros.org/image_transport/Tutorials/SubscribingToImages

http://wiki.ros.org/image_transport/Tutorials/PublishingImages

(2). Extract Region-of-Interest from the original image

<http://answers.opencv.org/question/10364/set-roi-in-cvmat/>

(3). Basic openCV function study

http://docs.opencv.org/2.4/modules/highgui/doc/user_interface.html