THE UNIVERSITY OF TEXAS AT DALLAS

CS 6384 - Computer Vision

Mask Detection and Social Distance Evaluation

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Agenda:

- Motivation
- Design Spec
- Working
- Demo
- Conclusion

Motivation

- COVID-19 highlights mask-wearing and social distancing.
- System detects masks and assesses distancing for safety.
- Applicable to workplaces, schools, and transportation.

Objective

- Develop accurate mask detection model.
- Quickly determine if someone is wearing a mask from video stream.
- Alert triggered if person not wearing mask.
- Human detection algorithms integrated for social distancing.
- Calculate distance between individuals to ensure safety.

Specification

Pre-requisites:

- Python
- TensorFlow, Keras
- OpenCV
- Colab
- Yolo

Design: (mask recognition)

1. Split the data into test and train
2. Build a CNN model for mask recognition
3. Fit and save the model
4. Load the model
5. Read the image
6. Detect the face
7. Fit the region into the mask_recognition model

Design: (Social distancing)

1. Capture the input video stream
2. Load the pre-trained object detection model (YOLO)
3. Apply object detection to identify people in the frame
4. Calculate the Euclidean distance between the center point of Bounding Box
5. Check if the distance is less than recommended Social distancing threshold
6. If distance is less than threshold, draw a red line between two bounding box, else green

Methodology (Mask Recognition)

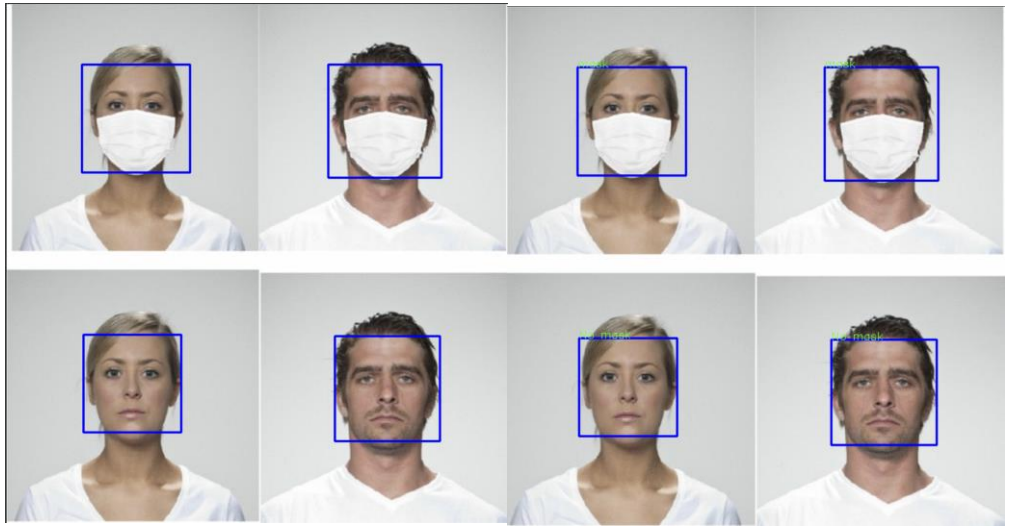
1. Split data into training/testing sets with 80-20 split.
2. Used **CNN** for mask recognition model with 2 conv/max pool layers.
3. **Relu** and **sigmoid** activation functions optimized model's performance.
4. Achieved 92% accuracy on testing set, saved model for future use.
5. Extract face region using **Haar Cascade** classifier to detect masks in image.
6. Pass face region into CNN model for analysis.
7. Label and draw bounding box around face region for mask presence/absence.

Methodology (Social Distancing)

1. Load YOLO **object detection** model.
2. Define **minimum** safe distance between individuals.
3. Capture video stream.
4. Detect objects in each frame using model.
5. Compute distance between object centers for each pair of objects detected.
6. If distance is **less than** minimum safe distance, trigger **alert**.
7. Repeat steps 4-6 for subsequent frames until video stream ends.

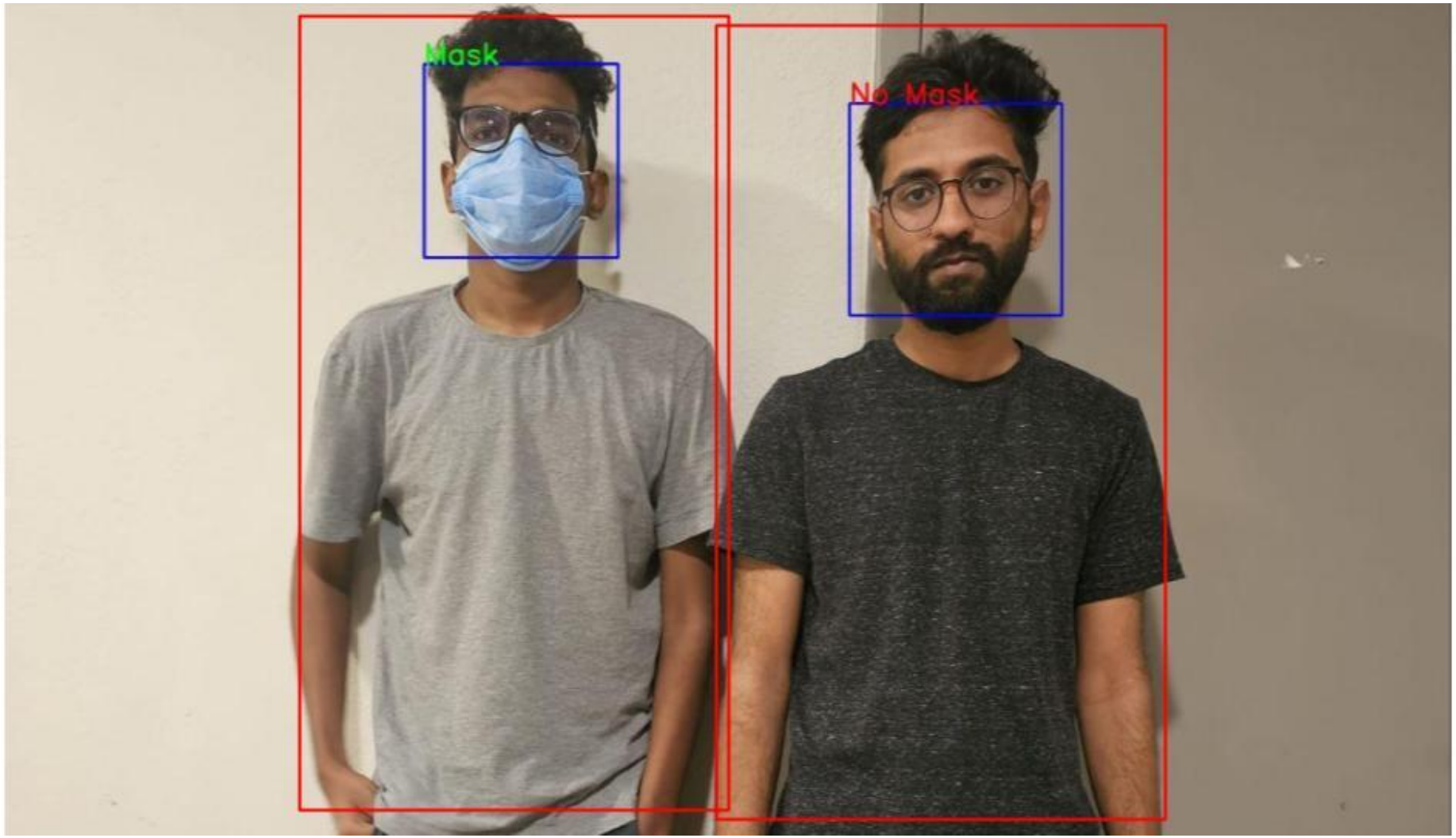
Result (Mask Recognition)

```
Epoch 1/10
202/202 [==============================] - 12s 15ms/step - loss: 10.1985 - accuracy: 0.6669
Epoch 2/10
202/202 [==============================] - 3s 13ms/step - loss: 0.4769 - accuracy: 0.7846
Epoch 3/10
202/202 [==============================] - 3s 13ms/step - loss: 0.3694 - accuracy: 0.8493
Epoch 4/10
202/202 [==============================] - 3s 13ms/step - loss: 0.3129 - accuracy: 0.8776
Epoch 5/10
202/202 [==============================] - 3s 13ms/step - loss: 0.2291 - accuracy: 0.9137
Epoch 6/10
202/202 [==============================] - 3s 14ms/step - loss: 0.1815 - accuracy: 0.9449
Epoch 7/10
202/202 [==============================] - 3s 14ms/step - loss: 0.1216 - accuracy: 0.9597
Epoch 8/10
202/202 [==============================] - 3s 14ms/step - loss: 0.1223 - accuracy: 0.9600
Epoch 9/10
202/202 [==============================] - 3s 13ms/step - loss: 0.0919 - accuracy: 0.9715
Epoch 10/10
202/202 [==============================] - 3s 13ms/step - loss: 0.1187 - accuracy: 0.9685
<tensorflow.python.keras.callbacks.History at 0x7f3fc00b62e0>
```



Result (Social Distancing)

Result (No Social Distancing)



Conclusion

- Detect mask-wearing in images from video stream.
- Track individuals with human detection algorithms.
- Determine social distancing using distance calculations.
- Achieved 97% accuracy for face mask recognition model.
- Cost-effective and easily integrates with existing systems.
- Contributes to controlling spread of COVID-19 and other diseases.

Future Work

- Combine social distancing features with mask detection
- Trigger alerts through hardware integration when a person is not wearing a mask
- Explore adding face recognition with mask detection for enhanced security and safety measures

References

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