MODEL CARD
# MediaPipe Hands

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MODEL DETAILS

Two lightweight models (palm detector, hand landmark model) to detect palm and predict hand landmarks within an image on a smartphone. Palm detector returns bounding boxes for each palm and hand landmark model predicts keypoints for each hand from cropped image.

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MODEL SPECIFICATIONS

**Model Type**
- Convolutional Neural Network

**Model Architecture**
- Palm detector: Adapted SSD with a custom encoder
- Hand landmark model: regression model

**Inputs**
- Image (possibly a video frame) resized to 256×256 pixels

**Output(s)**
- Palm bounding box coordinates with 7 Palm 2D keypoints (illustration)
- 21 3D hand keypoints
- Detection confidence score

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DATE
Unavailable

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DOCUMENTATION
**Blogpost:**
Google AI blog post 19 Aug 2019
**Example usage** included as part of the open source MediaPipe example documentation hosted at"
http://github.com/google/mediapipe

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# Intended Uses

### ⠿ APPLICATION

Detecting prominently displayed hands within images or videos captured by a smartphone camera. This front-facing camera model focuses on relatively large hands.

### ⠿ DOMAIN & USERS

Mobile AR (augmented reality) applications.

### 🗩 OUT-OF-SCOPE APPLICATIONS

Not appropriate for:
- Counting the number of hands in a crowd
- Detecting hands with gloves or occlusions
- Detecting hands too far away from the camera (e.g. further than 2 meters)

# Limitations

### ⚙ TRAINING

The models have been trained on limited dataset and are meant for experimental usage.

### 📱 PERFORMANCE

The models have not been tested in "in-the-wild" smartphone camera conditions, including low-end devices, low light, motion blur etc., that can affect performance.

# Ethical Considerations

### ⊞ DATA

This model was trained and evaluated on images of people using a mobile AR application captured with smartphone cameras in various "in-the- wild" conditions.

### ☺ HUMAN LIFE

The model is not intended for human life-critical decisions. The primary intended application is for research and entertainment purposes.

### 🤖 AUTOMATION BIAS

Educate end users on model limitations to discourage overreliance ('automation bias').

# Key Principles*

*Based on [Google's AI Principles](#) that are most relevant to this model.

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| **Potential Research & Social Benefits** | <ul><li>Useful for finding relevant images/video frames in content that is laborious to sort manually</li><li>Could potentially be extended for human accessibility applications like gesture detection</li></ul> |
| **Bias** | <ul><li>As with many human sensing tools, performance may vary across skin tones, gender, age, and potentially other sensitive demographic characteristics.</li><li>The current experimental version of the model uses a preliminary dataset that is set to be expanded in the future to address diversity more thoroughly. It can be used for building experimental setups but is not ready for being published in wide-audience consumer-facing apps until a newer version of the model is released. Google acknowledges that there is a potential for bias due to the limited nature of the dataset but takes no responsibility for it in this initial version of the model.</li><li>Users should remain alert to fairness concerns in use, and in particular, the potential impact of false negatives (failure to detect a hand) on individuals or groups.</li></ul> |
| **Safety** | <ul><li>Consider any potential safety implications of false-positives (detecting a hand where none is present) and/or false negatives (failure to detect a face) for the use case.</li><li>This model is not appropriate for safety-critical applications.</li></ul> |
| **Privacy** | <ul><li>Hand detection is not hand recognition; the model does not identify the owner of the hand or store a uniquely identifying hand representation.</li><li>Users should remain alert to privacy risks; hand detection combined with metadata associated with the image/video could expose personally identifying information.</li></ul> |

# Definitions

AUGMENTED REALITY (AR)
**Augmented reality,** a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view.

KEYPOINTS
**Hand "keypoints"** or "landmarks" are (x, y, z) coordinate locations of hand features.

## Instructions

- **Max 3 columns** per table
- Tables grow **left to right and top to bottom**
- **Remove table outline** before including sections
- **For questions** about existing sections, custom sections and icons, reach out to the dmc team.

# Evaluation Dataset Disaggregating Factors

| DATA Describe any disaggregating factors for consideration in the data. If your model has multiple significantly-different factors, add a row below and duplicate this cell. [max columns: 3] | RESULTS Describe any disaggregating factors for consideration when perusing results. If your model has multiple-significantly different factors, duplicate this cell. [max columns: 3] |
|---|---|

# Metrics

## Assessment Details

| MODEL PARAMETERS Please describe any model parameters that affect the presented results. If the model has multiple significantly-different parameters, duplicate this cell. [max columns: 3] | MODEL OUTCOME TYPES Please describe any model outcome types in the presented results. If the model has multiple significantly-different outcome types, duplicate this cell. [max columns: 3] | UNCERTAINTY MEASURES Please describe approaches to quantifying uncertainty in the presented results. If the model has multiple significantly-different uncertainty measures, duplicate this cell. [max columns: 3] |
|---|---|---|

## Error Metrics

| FAIRNESS INDICATOR Please describe any fairness indicators that are applicable to the presented model results. If your model has multiple significantly-different fairness indicators, duplicate this cell. [max columns: 3] | ERROR METRIC Please describe any error metrics that are used when presenting model results. If your model has multiple significantly-different fairness indicators, duplicate this cell. [max columns: 3] | ERROR METRIC Please describe any error metrics that are used when presenting model results. If your model has multiple significantly-different fairness indicators, duplicate this cell. [max columns: 3] |
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# Evaluation Datasets

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|---|---|
| EVALUATION DATASET | EVALUATION DATASET - 2 |
| Briefly describe the evaluation dataset used. Include both quantitative and qualitative descriptions. Link to source where possible.<br><br>Duplicate this cell for multiple evaluation datasets. [max columns: 3] | Briefly describe the evaluation dataset used. Include both quantitative and qualitative descriptions. Link to source where possible.<br><br>Duplicate this cell for multiple evaluation datasets. [max columns: 3] |

# Evaluation Results

Briefly summarize and link to evaluation results.

## Type of Analysis - Geographic, Fairness, etc.

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|---|---|---|
| EVALUATION CRITERIA | EVALUATION BASELINE AND METRICS | EVALUATION RESULTS |
| Please describe any fairness indicators that are applicable to the presented model results.<br><br>If your model has multiple significantly-different fairness indicators, duplicate this cell. [max columns: 3] | Please describe any error metrics that are used when presenting model results.<br><br>If your model has multiple significantly-different fairness indicators, duplicate this cell. [max columns: 3] | Please describe any error metrics that are used when presenting model results.<br><br>If your model has multiple significantly-different fairness indicators, duplicate this cell. [max columns: 3] |

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