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AUTOMATICALLY TAG WHITEBOARD AUTHORS

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AUTOMATICALLY TAG WHITEBOARD AUTHORS

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ABSTRACT

Techniques are provided for identifying and tagging authors of whiteboard content. A neural network is used to detect the most likely person or persons currently drawing on the whiteboard. The neural network works together with face recognition or other methods to tag and save the authors of each stroke in the whiteboard metadata.

DETAILED DESCRIPTION

Techniques are described herein to track who created and edited whiteboards for future reference. This allows users to determine who created or edited a specific whiteboard when viewing its snapshot later. An algorithm is described that is able to determine the author of particular strokes on a digital whiteboard and add this information to an author list in the whiteboard metadata. This is done in real time. The data can be used to enhance the whiteboard user experience at the endpoint and remote participants, and/or in the cloud. The algorithm uses visual cues and whiteboard drawing data to determine who is the most likely current contributor, and thereafter identify them with face recognition and/or other available information and add them to the author list.

In one example, a method for author identification is provided. The person/people drawing are usually in the camera Field of View (FOV) and their face is visible. A person who is currently drawing on the whiteboard is robustly identifiable because there is activity on the whiteboard (e.g., somebody is drawing) and strong visual cues (e.g., the person behaves in a distinguishable way when drawing that can be modeled and/or learned). The visual cues may include the author's posture and attention (e.g., eye gaze, upper body and arm placement, etc.), the position of the author in the camera image relative to the position of the drawing on the whiteboard, or the author's face is color-casted by the screen due to the proximity to the endpoint (e.g., favorable color information).

One possible implementation of the author classification algorithm is to train a neural network. The neural network may classify a given input as "author" or "not author." The input may include the image area containing the face and upper body of a detected participant provided by the face detection, coordinates of the located face on the camera image, and coordinates of the active strokes on the whiteboard and other metadata.

After the "Author/Not Author" classification, the identity information provided by the face recognition or other methods is used to add the author identity to the author roster. This method is not necessarily limited to a single author. Multiple authors can be identified simultaneously in the case that multiple participants are drawing on the board simultaneously. Thereafter the digital strokes can be assigned to the correct person using some positioning heuristics.

The neural network may be a normal one shot Convolution Neural Network (CNN). It can however be extended to a Recursive Neural Network (RNN) that is able to analyze several temporal frames of video and whiteboard events to better model author behavior.

Training data may be collected directly using recordings of video from the main camera and whiteboard metadata. Whiteboard events may be synced to the video. Several possible scenarios may be present in the data.

Figure 1 below illustrates a first scenario in which nobody is drawing and the participants are identified. The neural network may identify when no author is present in case the author is outside of the FOV of the camera.

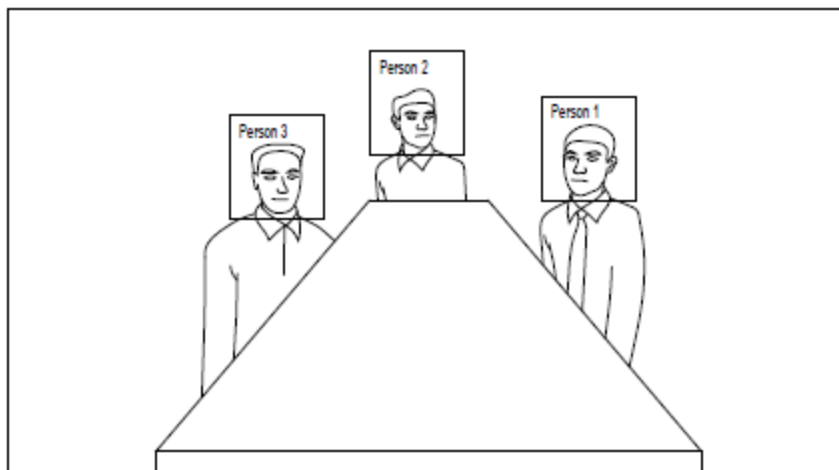


Figure 1

Figure 2 below illustrates a second scenario in which one person (identified as Person 1) is drawing and several people are present in the background.

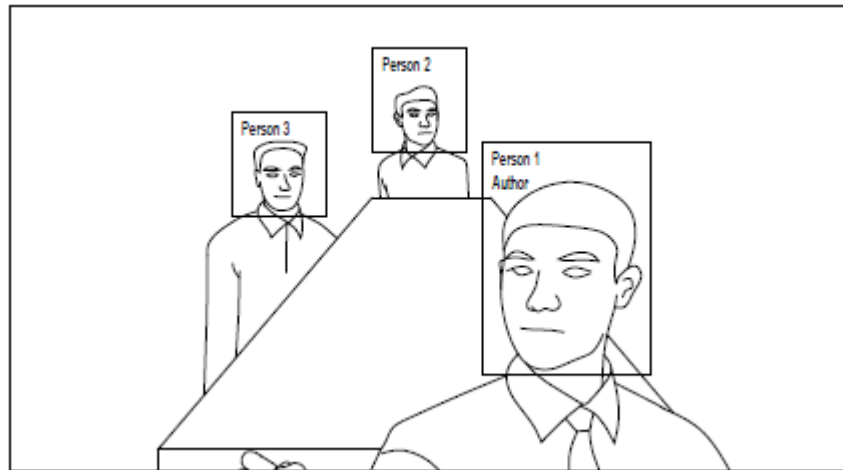


Figure 2

Figure 3 below illustrates a third scenario in which one person is drawing and two participants are at a similar distance as the author from the whiteboard.

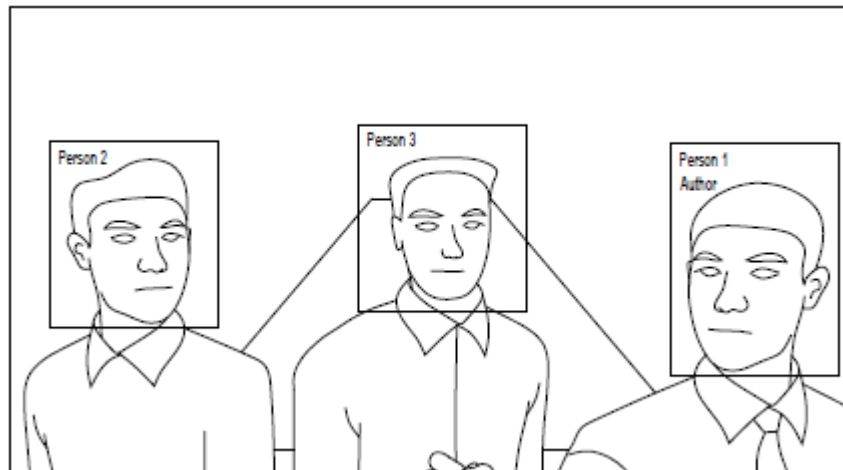


Figure 3

Figure 4 below illustrates a fourth scenario in which two authors are drawing simultaneously.

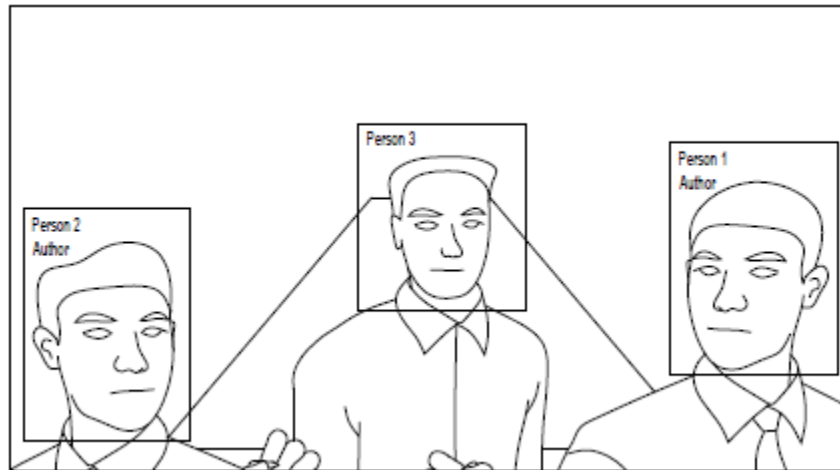


Figure 4

A manual labeling task may be performed thereafter to label authors and non-authors and draw bounding boxes to indicate which image areas to consider. Whiteboard events and metadata can be ignored when training the initial versions of the neural network, which makes it depend only on image data. Later, the model can be extended to incorporate whiteboard metadata, such as the position of strokes and others to increase its accuracy.

The following pseudocode demonstrates one example method.

- IDENTIFY and TRACK user identities in the meeting (face recognition, proximity and/or other methods)
- IF whiteboard event detected:
 - CROP and FEED images of detected participants to detection neural network
 - COMBINE author/authors detections with user identities
 - COMBINE whiteboard data heuristics to prune false detections and improve accuracy
 - ADD authors to "author roster list"
 - DISTRIBUTE author metadata for cloud availability

The user interface may update the action locally and for the remote participants.

In a meeting, users may be identified while drawing on a whiteboard, as described above, for live tagging of the whiteboard. This makes it easier for users in the meeting to

follow who is speaking and/or drawing. This is especially valuable for participants on the remote side or participants using clients with small screens.

By identifying users while drawing on a whiteboard, as described above, an overview of whiteboard activity may be created and published or shared after the meeting. This may be a visual representation of authors and contributors from the stored whiteboard session.

In summary, techniques are provided for identifying and tagging authors of whiteboard content. A neural network is used to detect the most likely person or persons currently drawing on the whiteboard. The neural network works together with face recognition or other methods to tag and save the authors of each stroke in the whiteboard metadata.