

iCanDraw? : A Methodology for Using Assistive Sketch Recognition to Improve a User's Drawing Ability

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ABSTRACT

When asked to draw, most people are hesitant because they believe themselves unable to draw well and are unsure of what adjustments are needed when drawing to make their sketch look right. This poster presents work on an application, iCanDraw?, that guides a user in drawing a human face through assistive sketch recognition. The major contributions are a methodology for an application to process and guide from a reference image as well as nine design principles for assistive sketch recognition.

ACM Classification: H.5.2.e Evaluation/Methodology

General terms: Design, Human Factors, Experimentation

Keywords: Assistive sketch recognition, improving drawing ability, corrective feedback

INTRODUCTION

Many have adopted the idea that they are simply unable to draw well, and can be quick to confess this belief if asked to put pen to paper [6]. iCanDraw? is the first drawing application to use sketch recognition to assist a user in creating his/her rendition of a photo with the intent of improving the user's ability to draw. We can build a methodology by using the human head as a basis to teach from and to evaluate against. First, [2] and others pointed out that the student learning to draw desires to achieve realism or to make it look right before venturing elsewhere. We propose that realistically sketching an actual person from a photo is a task many would like to achieve. Second, the human head is seen everyday yet most will make common mistakes when sketching it (e.g. drawing eyes too high on the head when they should be in the middle), thus improvement is noticeable. Third, step-by-step instructions, corrective feedback, and simple evaluative metrics can be created from the universal proportions shared by the features on the human face (e.g. sides of the mouth should fall in line with the pupils) [2,3]. Lastly, positional data for the facial features in a photo can be determined using face recognition, generating a template for the sketch recognition to use.

USER INTERFACE

The drawing area (Figure 1) has these actions: draw free-hand stroke; draw stroke with straight-edge tool; mark stroke as reference line by right angle gesture; erase stroke

by scribble gesture; undo any action by rollback gesture. Erased strokes look similar to strokes erased on paper by leaving a faint resemblance, serving as feedback when re-drawing a stroke. They gradually fade out to clean up the drawing area. To assist with long straight reference lines (rendered in blue), a user can drag a horizontal or vertical straightedge tool into the drawing area, mimicking a pencil and ruler. A right angle gesture marks the last stroke as a reference line (also in blue).

The reference photo is manipulated for each step to help the user see and focus on what to draw. When the step calls for a reference line, a corresponding red reference line is shown on the photo. When a facial feature is called for, it is spotlighted on the image by dimming the others.

The user has three options (bottom left of Figure 1). The only one available at first, "Check My Work" performs sketch recognition on the user's drawing and verifies whether what was drawn meets what was asked for in that step. Congratulatory feedback is provided as text. Corrective feedback is provided as text and visual guidelines. If the attempt fails any constraints against the template, the application will state what is wrong (e.g. "the nose is too wide"). For ambiguous feedback (i.e. "my left eye is too small"), the strokes referred to on the drawing are temporarily highlighted. The second option, "Show Suggestions", becomes available when there are visual guidelines to

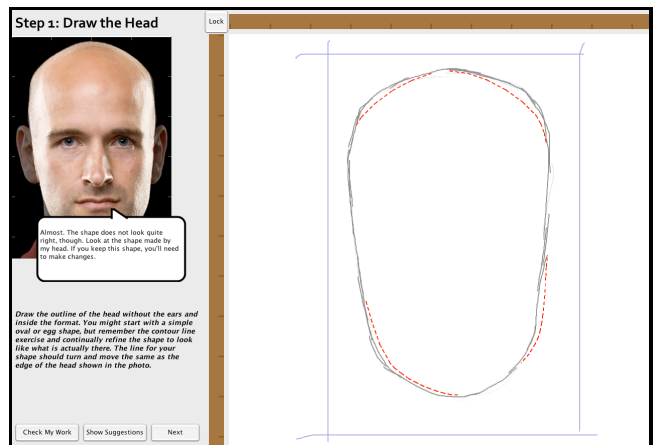


Figure 1: User is drawing the head (gray strokes) and is shown corrective feedback as text (comment bubble) and visual guidelines (red dashed lines). Blue lines are reference lines. Brown bars are straight-edge tools.

show. For a reference line correction, a visual guideline would be a red line in the proper location on the drawing. For a facial feature, the proper shape is generated from the template, from a copy of the user's strokes that satisfies the constraints, or is not provided. These guidelines are removed after a new stroke and do not leave a mark. The user can click "Next" to advance a step anytime after "Check My Work".

IMPLEMENTATION

To generate the template for sketch recognition, the reference photo undergoes processing through a face recognition library [4] to obtain 40 points for the facial features. An additional 13 points are manually added to represent an ideal case (e.g. ears). A B-spline is fit to certain features (e.g. head) to gain a better representation for shape matching. A grid is superimposed on empty spaces of the template (e.g. forehead, cheeks) to define areas for the sketch recognition to ignore. This hidden template of labeled data points is scaled to the user's drawing after the first two steps are completed.

To allow the user to draw anywhere but still only select the strokes desired when checking constraints of a feature, the application reclassifies all strokes on a "Check My Work" request through a k-Nearest-Neighbor (kNN) classifier using the points of the template. To classify a drawn stroke, its endpoints and center sample point are matched to the closest points on the template via Euclidean distance and then placed into its appropriate "pool" of similar strokes. For example, if all three points of a stroke are matched with data points for the head contour from the template, it is put into the pool for the head. The pool for the feature asked for by the current step then passes through constraints against its corresponding piece in the template. For reference lines, the location and end points of the user's line are checked for coincidence at an 80% confidence level with the corresponding data points on the template. For a facial feature, the proportions and alignment of the user's shape are checked against the template piece by comparing the bounding boxes using an 80% confidence level. For features with ample data points (i.e. head, mouth), the user's shape and template piece pass through elastic matching. The simple algorithm scans along the re-sampled points of the user's shape and finds regions that vary greatly between it and the template piece. Those in need of correction are returned as part of the visual guidelines shown to the user. This simple algorithm is invariant to the direction, start and end points, and over-tracing so that the user is not required to draw in a particular manner. For facial features without sufficient data points from the face recognition library, the user's shape is reused and fitted to the constraint or no visual feedback is provided.

PRELIMINARY RESULTS

There has been a user study on 5-6 professed non-drawers for both iterations of development. For the latter, noticeable improvement was seen across the participants' drawings

and shown by a simple numerical score calculated by hand by comparing proportions of each drawing and reference photo. Nine design principles for assistive sketch recognition were gained:

1. A formal process must exist to determine error in an example template.
2. To limit the user's subjectivity when perceiving an object, the system should help them process and "see" it.
3. When creating subjective content, the user should explicitly trigger recognition so the application does not interrupt or thwart the learning process.
4. Corrective feedback must clearly show what is being asked for and why it is being asked.
5. Previous or "erased" strokes must be temporarily visible as a form of corrective feedback.
6. Sketch recognition must be adaptive to some deviation from an example template.
7. A larger drawing area is advantageous to the user creating subjective content.
8. Using more image analysis on the reference photo to gain information for sketch recognition is advantageous.
9. Sketch recognition should incorporate other drawing principles such as symmetry and light/dark values.

CONCLUSION

Our ultimate goal is a standalone application that is ready to process any image and guide a user through drawing it. Imagine if users could take their own picture and then learn to draw themselves! The methodology and principles outlines here are the first steps toward this, and any computer application that improves the user's drawing ability.

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