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# A Self-Learning Support System for Drawing Actual Human Body Model by Pose Estimation

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**Keyword:** Drawing, Pose estimation, Image processing, Learning support

This research proposes a learning support system for drawing on actual human body model. For beginners at drawing picture, it is not easy to grasp the human body ratio of the model and to draw a picture in accordance with the skeletal structure. In order to draw a picture close to the reality, it is important to draw while looking at an actual model. When targeting an actual model, it becomes difficult to understand the ratio and draw the structure. In other words, by practicing drawing actual models, it will lead to drawing with consciousness of the three-dimensional feeling, sense of distance, and the structure of the object. Similarly, even when drawing a human, it is important to understand the structure of the human body. It is also important to keep one's motivation while learning something. Motivation can be maintained by receiving evaluation from others on the drawn paintings. When a beginner learns drawing alone, there is a problem that he/she cannot understand what is wrong with his/her drawn picture. On the other hand, some people who cannot draw a picture well have resistance to showing their paintings to others. Therefore, a system that points out poor picture can improve one's motivation and drawing efficiently. In addition, motivation can be improved by using a favorite object as a target. The proposed system can present hints onto an actual human body model. Therefore, one's favorite figure doll can also be modeled, and the learner's motivation would be maintained.

This system provides following two kinds of support for learners. The first support performs posture estimation with a monocular camera. For posture estimation, we use OpenPose library. First, the system extracts posture information from an actual human body model and generates skeleton line segments. Then, the system superimposes the skeleton line segments on the actual model using a transmission type display. We made this display by remodeling a commercial liquid crystal display. This mechanism helps learner's understand for the skeletal structure. The second support gives an evaluation focused on the skeleton, using the posture data obtained by posture estimation from the drawn picture. The system evaluates the picture based on the cosine similarity between the skeleton of the model and

that of the drawn picture. The similarity is calculated by comparing the angle and the length of each corresponding skeletons. In the evaluation, firstly the skeleton of the model and the drawn picture are superimposed on the screen, and then the comments on the mistaken points are displayed. Finally, the similarity score and a comment on the picture is shown to the learner. The learner consciously notices the mistaken parts, and this may raise the efficiency of self-learning.

Two experiments were conducted to verify the effectiveness of the system. The first experiment verified the effectiveness of the skeleton superimposition. Three groups, "groups not supporting anything", "groups that assist viewpoint fixation", and "groups superimposing skeletons" were asked to draw five pictures for various models. As a result, it is confirmed that superimposing the skeleton is effective as a support for drawing. In the second experiment, we examined a possibility of more effective learning support by "superimposition of skeleton" and "evaluation of painting drawn". We asked four groups, "Group without system," "Group with only evaluation", "Group only with overlapping skeleton", "Group with both skeleton superposition and evaluation", to draw four pictures of various models. For the first and final drawing, we asked to draw without using the system. As a result, we confirmed that the member of the group using the system greatly improved his/her drawing skill. However, we cannot sweepingly say which supporting method is most effective, because the required support is different from individual to individual.

In conclusion, we confirmed that the system improves skeletal cognitive ability and drawing skill, and is suitable for more practical drawing. This system also can handle any objects you like, such as favorite figures, so the further improvement of your motivation is expected.

In the future, we plan to improve the system based on the user opinions. First, a diagnosis function of an outline, which is the most required function should be implemented. Next, we will examine the real time evaluation method for the skeleton. We expect that this can be implemented by applying a thinning algorithm. In addition, the user interface improvement and drawing guidance will increase the effectiveness of the system.

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