

# AR tooth brushing system to promote oral care habits of children

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## I. INTRODUCTION

It is needed to be careful about the places where bacteria can accumulate while brushing teeth [1]. But it is difficult to teach young children to brush their teeth properly. By the way, the system about hand-washing for children that superimposes bacteria illustrations on the route of contact infection has been proposed in our laboratory [2]. In this study, we propose new AR system to promote oral care habits of children. It detects tooth areas easily soiled in real time using machine learning technique first, and superimposes bacteria illustrations to show easily soiled areas. It is expected that children learn good tooth brushing habit.

## II. SYSTEM CONFIGURATION

In our proposed system, mouth and teeth image is taken by a front camera of PC first. Then teeth are detected and extracted, especially molars, the areas between a tooth and gum, the areas between a tooth and another tooth, and the area behind a front tooth. Bacteria illustrations are superimposed there.

Machine learning library YOLOv3 [3] was used as follows, (1) to learn areas where teeth are easily soiled using 1523 images that may include other than mouth, (2) to learn areas where teeth are easily soiled using 944 images that include only mouth, and (3) to learn mouth areas using 1216 images that include other than mouth. The  $f$  values are 0.340, 0.453, and 0.980 respectively. The method detecting tooth after detecting mouth is better than that detecting tooth from face image directly. However, if mouth area can not be detected from face image, teeth are tried to be detected directly. The height size of superimposed bacteria illustration is twice as large as the height of the area, and it dose not overlap with each other. If the system detects too large area to be tooth area, then does not show an illustration.

## III. EXPERIMENT

It was confirmed that the bacteria illustrations were superimposed appropriately (Fig. 1). The refresh rate is 2.04 fps. Two elementary school students and their parents used this system (Fig. 2), and answered a questionnaire. Some impressions were obtained as; (1) it was helpful to promote oral care habits of children, (2) it encouraged them to brush their teeth every day,



Fig. 1. Appearance of experiment



Fig. 2. Bacteria illustration

and (3) it was interesting because the bacteria were displayed on their tooth. The result showed that the system was so valid that children learn good tooth brushing habit.

## IV. CONCLUSION

In this paper, we proposed new AR system to promote oral care habits of children. The bacteria illustrations were superimposed on appropriate tooth positions on camera image. As future works, first, we would like to improve the system refresh rate. Second, dark tooth images should be learned, because the system may not detect tooth correctly when it is dark. Third, additional experiments are expected for more homes and nurseries to confirm usefulness.

## V. ACKNOWLEDGEMENT

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