Large Scale Interactive AR Display Based on a Projector-Camera System

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ABSTRACT

School gymnasium, which has an important role in either physical or mental development of children, is a necessary facility for most schools. In recent years, considering the individual differences among students in terms of gender, age, developmental level or interest, many new forms of gymnasium activity have been developed to make physical education more flexible. In some cases, introducing new physical activity is accompanied by a requirement of drawing new contents on the floor of a gymnasium. Ordinary, this is done by using line-tape. However, contents created by line-tape need periodic maintenance that is costly and time-consuming. Moreover, overlapping lines for different purposes can make users confused. Furthermore, the most critical problem is that line-tape can represent only simple and static contents, thus, the variety of new physical education activity are greatly limited.

This paper proposes a projection-based AR system consisting of multiple projectors and cameras to deal with the problems described above. This system is aiming to provide extension functions to traditional school gymnasium by realizing not only representation of dynamic AR contents but also interactive display on the gymnasium floor.

Keywords
Augmented Reality; ProCam System; HCI; Gymnasium

1. LARGE SCALE PROJECTION-BASED AR

As shown in Figure1, our projection-based AR system is composed by multiple projectors and cameras (pro-cams). Each camera is installed on a projector. The pro-cams are installed on the ceiling of a gymnasium at regular intervals, and the orientation of the camera is adjusted to be approximately same as the corresponding projector. Although projections are aligned using a method similar to [1], multiple cameras, instead of a static one, are used so that the whole large projection area can be observed. Each pro-cam is calibrated by estimating three homography matrices: the homography H_{pc} between the 2D coordinate systems of camera and

Figure 1. Large scale projection-based AR system in a gymnasium

the projector, the homography H_{cf} between a camera and the floor and the homography H_{pf} between a projector and the floor.

We also developed an interactive interface basing on our large scale projection system which make user be able to create AR content on the floor easily. It is like sketch board application and can be run on a tablet pc with a stylus pen as the input device. Contents drawn on tablet are transmitted to system server and shown on the floor in real time. An example is shown in Figure 2.
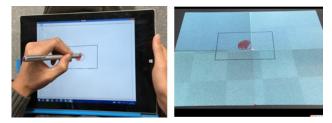

Figure 2. An interactive interface running on a tablet for creating contents(left), and the projection result(right)

Combing with other sensing technologies (e.g. video tracking), it is possible for our system to perform as a powerful education supporting facility. Contents that change interactively with students' actions can be projected on the floor around them. With the help of such a feature, it will be possible to develop AR-game-like physical education activities, and it can be expected that students will participate more enthusiastically.

2. REFERENCES

[1] Raskar, R., Baar, J.V., and Chai, J.X. 2002. A low-cost projector mosaic with fast registration. In *Proc. ACCV 2002,* pages 114-119,2002.