Shooting Swimmers Using Aerial and Underwater Drone for 3D Pose Estimation

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ABSTRACT

Methods of 3D pose estimation using RGB cameras have been studied in recent years. They are used for sports to improve athletes' abilities and techniques by providing visual feedback. However, they still can be difficult to be used for swimming. This results from several problems, such as the difficulty of camera installation or tracking and the disturbance of bubbles and other optical issues due to the characteristics of water. To address these issues, we propose a method for shooting videos of swimmers using multiple drones. We aim to realize 3D pose estimation by using videos shot from the top and under the water with aerial and underwater drones.

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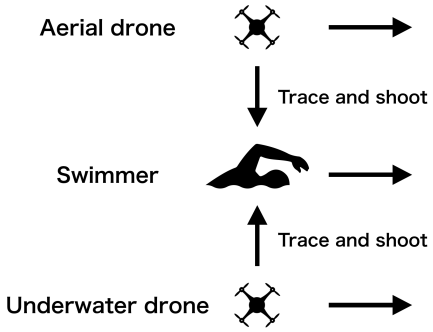

Figure 1: The system to shoot a swimmer using aerial and underwater drones.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; • **Applied computing** → **Computers in other domains**.

KEYWORDS

Sports Assistant, Pose Estimation, Aerial Drone, Underwater Drone

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INTRODUCTION

3D pose estimation is an important approach and technique for analyzing human motions.

Methods of 3D pose estimation with RGB cameras have been studied in recent years and presented remarkable results by using monocular cameras [2, 3].

Although these techniques for 3d pose estimation using RGB cameras have been used in the field of sports, using them for swimming may still be difficult. This results from several problems, such as the difficulty of camera installation or tracking and the disturbance of bubbles and other optical issues due to the characteristics of water. Therefore, motion capture techniques using sensors or markers have been used for 3D pose estimation of swimmers [4]. However, when a swimmer wears sensors or markers on their body, it may produce resistance of water. Furthermore, preparing such as motion capturing equipments are difficult in general (e.g. expensice or requires large equipments to be installed). To address these issues, we propose a method for taking videos of swimmers using multiple drones and to estimate the 3D pose.

Applications of using a drone for sports and pose estimation have been investigated in recent years.

Higuchi et al. proposed a system for a drone to autonomously track the target, and to capture athletes' external visual imagery to support soccer and other sports [1]. Flycon is a method for environment-independent estimation of human poses in real-time with aerial vehicles [5]. Swimoid is an underwater buddy robot to support a swimmer by following them and to present visual feedback with a display [6].

We aim to take videos of the swimmer from the top and from under the water using the aerial and underwater drones. Figure 1 shows the overview of the proposed system we propose. By using these videos, we can acquire 3D pose for swimming activities.

Figure 2: An image of a swimmer from the top using DJI Spark.

Figure 3: An image of a swimmer from under the water using GoPro HERO 6.

METHOD

As a pilot study for using two drones to take videos of swimmers, we took videos of the swimmer from the top using a drone and from under the water using an action camera installed at the bottom of the swimming pool. We used a DJI Spark and its integrated camera to take videos from the top and GoPro HERO 6 installed at the bottom of a pool to take videos from under the water. Figure 2 shows an image shot from the top of a swimmer using DJI Spark and Figure 3 shows an image shot from under the water using GoPro HERO 6.

DISCUSSION

Swimmers can observe themselves from external point of views by using drones for video shooting. Moreover, drones allow swimmers to see themselves from an unusual perspective such as from directly above them. This may help swimmers to perceive some amendable flaws which are not detected in the ordinary workout. On the other hand, there are some problems to shoot videos using drones. The sensors on the drone may be disturbed due to the fluctuation of the water face.

FUTURE WORK

Tracking the Swimmer

Currently, we control the drone manually to trace the swimmer. For future work, by using a swim cap or a swimsuit as a marker for the tracking, we can track a swimmer without specific equipment. Using this system, swimmers can shoot their swimming style by themselves.

Using an Underwater Drone

In our pilot study, we use an action camera installed at the bottom of the pool to shoot the video from under the water. However, a fixed camera may only shoot a swimmer for a short duration when they pass through the camera. Therefore, we consider to use an underwater drone to shoot the video from under the water so that they can trace a swimmer moving through a pool.

Feedback to the Swimmer

We also plan to apply 3D pose estimation to videos shot by aerial and underwater drones. By using 3D poses, we can present and visualize the differences between themselves and experts. Accordingly, swimmers can understand how they should fix their swimming styles.

CONCLUSION

We propose an approach to shoot videos of a swimmer from the top using an aerial drone and from the bottom using an underwater drone. By using drones to shoot a swimmer, they can observe themselves

from an external point of view and check their swimming styles. Moreover, multi-view videos shot by aerial and underwater drone may be used for 3D pose estimation and this allows us to estimate 3D pose in swimming using RGB cameras without specific equipment such as sensors or markers.

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