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Development of Hand Framing Camera for Field Monitoring

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ABSTRACT

This paper describes a device developed to aid farmers shooting images in fields for the monitoring of crops without any button manipulation. The device, referred to as the Hand Framing Camera, allows users to quickly switch between shooting and field work because with this device, it is not necessary to take off gloves or get the camera out of a bag or pocket. Users can take pictures by forming the shape of a picture frame around the target with their hands. The result of a field test suggested that users could easily and quickly take pictures of plants while they were at work in the field.

Keywords: Field monitoring, growth information images, Hand Framing Camera, Japan.

1. INTRODUCTION

Increasing the value of agricultural products requires high quality and consistency. Field monitoring devices (Hirafuji *et al.*, 2005; Kobayashi *et al.*, 2012; López Riquelme *et al.*, 2009; Morais *et al*., 2008; Sun *et al*., 2009; Díaz *et al*., 2011; Matese *et al.*, 2009; Garcia-Sanchez *et al.*, 2011; Honda *et al*., 2009) as well as work logging systems (Sugahara *et al.*, 2008) that automatically collect physiological and environmental data to monitor differences including in quality, size and appearance of products (Motonaga *et al*., 2004) have been developed. However, it is difficult to monitor the variation in crop growth by using such fixed point monitoring systems, because the cost of installation and maintenance of many monitoring devices in a field is high.

We developed a device to aid farmers shooting images in fields for the monitoring of crops without any button manipulation. The device allows users to quickly switch between shooting and field work because with this device, it is not necessary to take off gloves or get the camera out of a bag or pocket. Users can take pictures by forming the shape of a picture frame around the target with their hands. The developed device can be used to achieve an overall observation of the field by allowing farmers to take pictures while they are at work.

2. HAND FRAMING CAMERA

The developed Hand Framing Camera includes a laptop PC, a USB camera, and AR markers. The AR markers are square shaped small thin papers with black and white markings, which are attached to the back of the users' gloves. The users put on a backpack which contains the PC and wear a cap with an attached camera. The camera is always searching for the markers, and it saves a framed picture when the users make a hand frame with the markers facing the camera. The system makes four short sounds on finding the markers and a picture is taken after the forth sound. Users can easily cancel the shooting by putting their arms down so that the markers go out of the camera view.

The picture is automatically processed and saved as two different versions; a picture with the frame drawn around the target and a picture cropped at the edges of the frame. The processed pictures allow viewers to easily observe crop statuses from the viewpoint of the farmer.

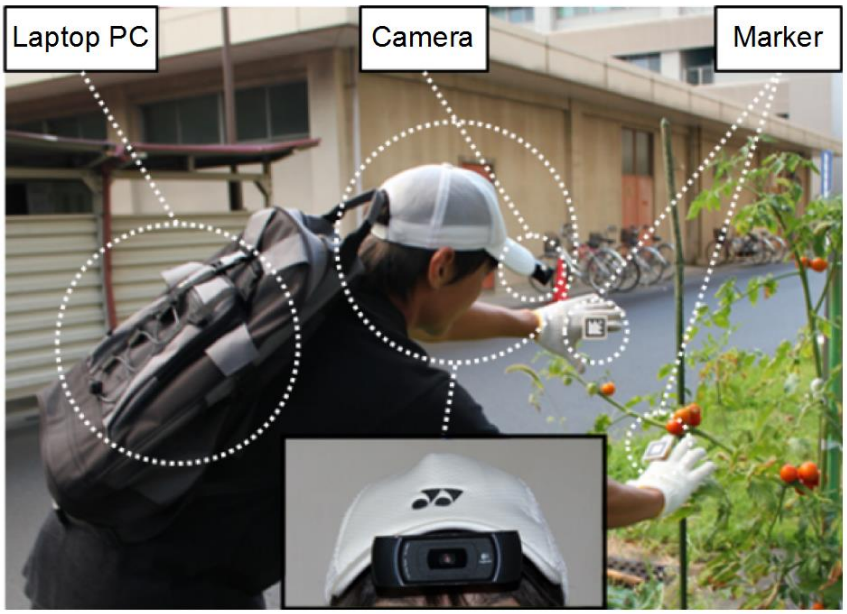

Figure 1. Parts of Hand Framing Camera

3. EXPERMENT

We performed an experiment to confirm the feasibility of the developed device in an outdoor environment. A participant put on the backpack with the laptop PC and the cap

with the camera. He took pictures of tomatoes that are grown outside in a small garden at Shinshu University.

The participant took pictures by making a hand frame five to ten centimeters away from the targets. A shorter distance between the markers and the target lessens the difference in the viewpoint between the user's eyes and the camera. Although he deliberately let his hands approach the target, he always had a natural posture when he took a picture.

Figure 2 shows the pictures taken in the experiment. Figures 2(a) and (b) show the markers on the thumbs, while figures 2(c) and 2(d) show the markers on the forefingers. Taking pictures was easy regardless of the fingers used. The figure confirms that he obtained the expected result because every target is framed in red as intended. This shows users can easily take framed pictures of targets in their vision while at work in the field.

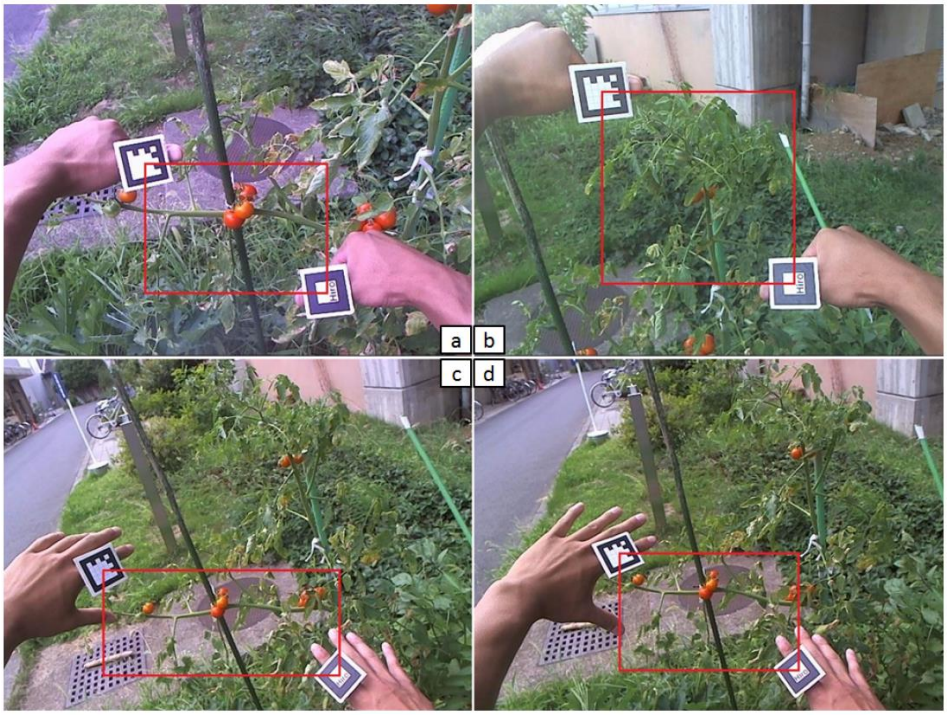

Figure 2. Results of the field experiment

4. DISCUSSION

The results of the field experiment showed the developed hand framing camera was feasible and was able to take pictures determined by the hand frames of users. Although

pictures with similar user determined framing/targeting can be achieved by ordinary commercial digital cameras, they require users to take off their work gloves because the gloves interfere with the pushing of buttons and may make the camera dirty. In contrast, the proposed method provides a non-contact interface so that users can take pictures easily and quickly when they are at work in the field.

A similar study, Ubi-Camera (Furuyama *et al*., 2012), also used the hand framing method. The device provides an intuitive user interface for taking a picture. Users attach a small device to their finger and push a button to take a picture while making a hand frame. Although the concept is similar to that of our study, the Ubi-Camera requires a button based manipulation and it is difficult to use at work in a field. Contactless interaction like our developed Hand Framing Camera is a more suitable device for use in the field because it does not interrupt the work of the farmers.

An application of the Hand Framing Camera that is useful to farmers is making image based activity logs including recording the name of the agricultural chemicals they use or the appearance of the trees they prune or engraft. In addition, such image based work logs will provide a good way for farmers to refine skills and share knowledge of agricultural technology.

One of the limitations of the Hand Framing Camera is that it requires bulky equipment. At this stage of the study, we used a laptop PC because the system provides feedback sounds and requires adequate computational resources to process AR marker detection. A promising solution will be the use of smart phones. They can provide sound feedback, build-in cameras for marker detection, and an Internet connection. Smart phone based Hand Framing Cameras will be possible if they can detect AR markers in real time.

5. CONCLUSION

In this paper, we developed a device to aid farmers shooting images in fields for the monitoring of crops without any button manipulation. The device was named the Hand Framing Camera and allows users to quickly switch between their work and shooting because it is not necessary to take off gloves or get a camera out of a bag or a pocket. We performed a field experiment and the result suggested that users could easily and quickly take pictures of plants while they are at work in the field. In the next step of our study, we will implement the hand framing picture taking in smart phones to achieve higher mobility and feasibility.

6. ACKNOWLEDGEMENT

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