Grassffiti: Drawing Method to Produce Large-scale Pictures on Conventional Grass Fields

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Abstract
We propose a drawing method to create large-scale pictures in public space. We use a property of anisotropic reflection to show images on the grass field. We created a prototype of roller type device which can control the angle of grass. We observed that our system entertains people in public exhibition.

Author Keywords
Grass field; BRDF; Interactive Surface.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Public displays are very important to show information for many people at the same time. One of the common displaying method is LCDs display but it consumes electric power. On the other hand, projection-type displays are suitable for public purpose. Accordingly, the environment does not require large-scale modifications. In addition, it is possible to switch the projection rapidly and project colorful images. However, projectors have disadvantages. For example, the projected images are hard to see in a bright room.

Moreover, the electricity costs due to the continuous projection are quite high.

We propose a display technology that utilizes the phenomenon whereby the shading properties of grass change as the fibers are raised or flattened (Figure 1). There are many places where a grass has been laid such as soccer field, golf field, park and so on. The property is in accordance with Bidirectional Reflectance Distribution Function (BRDF). In our pervious study, we have proposed display technology that utilizes these material properties in fur objects such as carpets [7]. In this work, we apply these techniques to show largescale images on grass fields.

Our method doesn't require to use any ink and electric power to keep patterns. In addition, our technology can turn these ordinary objects into computer displays without requiring or creating any non-reversible modifications to the objects.

Figure 1: GraffitiGrass can converts grass fields into large canvas.

Related Work

We are not the first to display information by manipulating the shape of "existing" physical materials or controlling their reflectance. Rice paddy art is an attempt to create large-scale drawings in a farm space over a long period of time, by planting seeds that have buds of various colors[1]. Karesansui is a Japanese traditional culture method of drawing patterns in a garden with stones[2]. A modern version of this art form, Lazy man Zen garden, is able to draw a pattern automatically in sand [4]. Large patterns can also be drawn by walking on the snow[3]. Hanna's Water Calligraphy device is attached to a bicycle and dispenses water from a hose array to draw Chinese characters on the streets over [1]. A lawn mower can be used to draw striped and circular patterns on grass fields.

The BRDF displays have been proposed in computer graphics and art fields [3][5]. Hullin et al. proposed a method to change the reflection of an object on a water surface by creating and controlling waves on the surface at a high speed [2]. Ochiai et al. proposed a method to project images on the back of a vibrating soap bubble to create a membrane screen [6]. Wooden Mirror is an artwork that is drawn from reflected light by controlling an array of wooden blocks [8]. Our method is advantageous because it is possible to use existing objects in the environment (e.g. standard carpet) as BRDF displays without making any permanent modifications to them.

1 http://www.cbc.ca/strombo/news/living-artworks-in-japans-rice-paddys.htm

2 http://en.wikipedia.org/wiki/Japanese_rock_garden

3 http://www.viralnova.com/simon-beck-snow-art/

Roller Type Device

We leverage the phenomenon that raised fur looks different from flattened fur. Fur fibers have a natural growth direction, and one can flatten the fur by sweeping the surface in that direction and raise it by sweeping the surface in the opposite direction. Since raised and flattened regions of fur have different reflectance properties, one can visually distinguish them. In general, flattened fur reflects more light and looks brighter than raised fur.

Figure 2: Principle of drawing method.

The hardware consists of 16 fur-raising components attached to the bottom of the roller as shown in Figure 2. Each component consists of a rod and a servomotor that lowers and lifts the rod. When the rod is lowered, it raises the fiber as the user moves the roller (Figure 3). In addition, a rotary encoder is mounted on the wheel shaft to measure the horizontal movement of the roller. The rotary encoder and servomotors are controlled by an Arduino Mega ADK microcontroller. The system lowers and raises the rods according to the measurements of the rotary encoder to leave patterns on the grass.

Drawing process with the device is as follows. The user first measures the size of the canvas and prepares a binary dot matrix of appropriate size using an application program. Our current application program provides four methods to prepare the dot matrix.

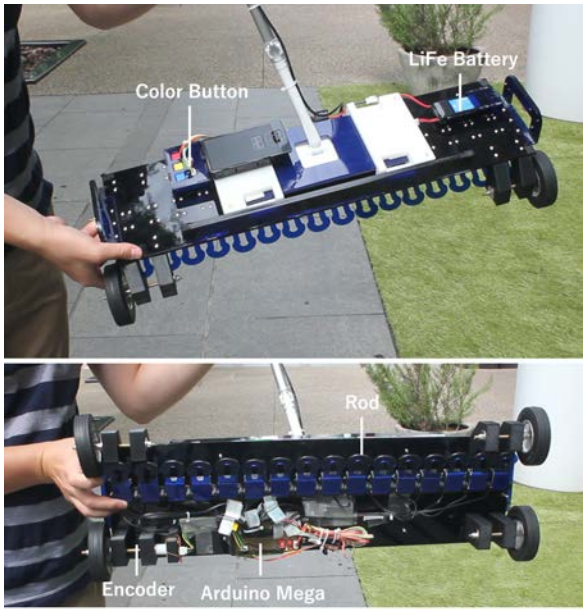

Figure 3: Overview of roller type device.

Figure 4: Patterns can be erased by grand roller.

Second, the user transmits the dot matrix data to the device and starts drawing the pattern on the fur surface by moving the device over its surface in the direction opposite to the fur growth direction. The surface needs to be fully flattened by hand before drawing. The user

presses the red button on the device to initiate drawing. If the dot matrix consists of a single row, the drawing finishes after a single sweep. If the user continues the sweep, the pattern will be repeated. When the dot matrix consists of multiple rows, the user needs to repeat sweeps multiple times. The system indicates the end of a sweep with an LED mounted on it, and the user starts the next sweep by pressing the red button. To assist the user in aligning the starting point of the sweeps, the system leaves a tick mark at the beginning of each sweep. The user aligns the starting point by pressing the red button and placing the roller so that the mark on the roller aligns with the tick mark. Pressing the yellow button lets the user repeat the same row. The user can move the roller backwards to erase the pattern already drawn. In this case, all the rods are lowered automatically. The blue button clears the drawing data.

The horizontal and vertical extents of a dot are 25 mm and 31 mm, respectively, assuming that the roller moves horizontally. The main limiting factor is the size of the servo motors and capability of the rotary encoder. The drawing speed is constrained by the speed of the servomotors. In our current implementation, the maximum speed of the roller sweep is 15 cm/sec, and the device fails to generate an appropriate pattern if the user sweeps the device faster than this limit. Erasing a pattern can be done by a ground roller (Figure 4).

Result and Demonstration

As a result, we were able to draw not only images but also words. Figure 5 shows a welcome message drawn on the grass which can be used as a message at the entrance of facilities such as parks. Figure 6 shows an image that is drawn with multiple sweeps.

We exhibit our prototype system in a public demonstration space. Grass has been laid in the public space.

Figure 5: Displaying welcome message.

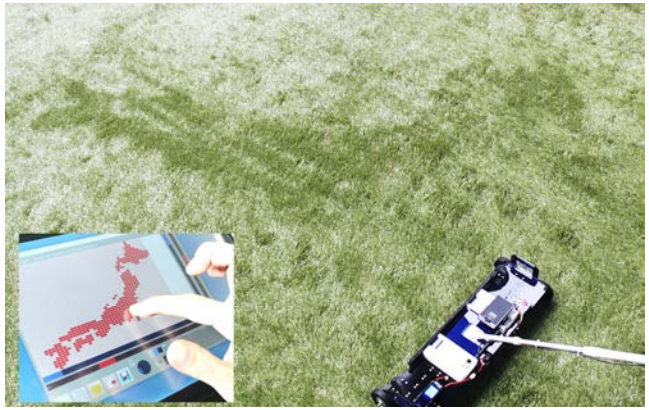

Figure 6: Large-scale can be drawn by divided into multiple segments.

Limitation and Future Work

Compared to the other displays, our method takes time to display an image. Therefore, our system intends to display still image rather than animations. Also, with our system, full color images cannot be displayed.

However, by controlling the angle of the fur, the darkness of the image can be changed so for the future work we plan to draw grayscale image with our method.

Concussion

We proposed a method to draw large-scaled images on the grass field. We use a property of anisotropic reflection to show images on the grass field which require neither ink nor electricity. We created a prototype and observed that our system could draw large-scale images on the grass field to entertain people in public exhibition.

Acknowledgements

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