

Playing with SenseCam

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ABSTRACT

Here we present SenseCam, a wearable device combining a digital camera with a number of sensors. The sensors are used to trigger the capture of digital photos at opportune times, and in addition the sensor data is saved alongside the images for subsequent analysis and presentation. SenseCam was conceived with practical applications in mind, largely around the notion of memory augmentation, and we are now in the planning stages of clinical trials with memory-loss patients. However, in testing various prototype versions of the device, it is clear that SenseCam also has the potential for a wide range of playful uses, and we therefore propose to explore this potential within a subgroup of the “Playing with Sensors” workshop. In keeping with the focus on exploiting the uncertainty in sensor technologies, we describe some ways in which SenseCam’s behaviour deviates from “ideal” with the hope that these deviations can be harnessed to playful effect. At the workshop, we will bring along two or more working SenseCams for participants to play with in order to stimulate the flow of ideas.

Keywords

Sensors, digital photography, passive capture, ubiquitous computing, play

INTRODUCTION

SenseCam is a small, truly¹ wearable device that combines a digital camera with a number of sensors, including motion, light level and composition, passive infrared, sound, and ambient temperature. The sensors are used to trigger pictures at “good” times, and the sensor data itself is captured to facilitate indexing and retrieval. SenseCam was initially conceived largely as a memory aid, both for everyday forgetfulness and for clinical application with memory-loss patients. However, in positing applications in tourism such as automatically generating blogs from festival visits, and in simply experimenting with images and data captured from prototype devices, it is clear that SenseCam

has potential for more playful applications. In this position paper we describe the construction and behaviour of SenseCam, give some examples of its use including ways in which its behaviour exposes seams in the underlying technology, and propose some general areas of play to which it might be applied.

SENSECAM



Figure 1- SenseCam prototype

The SenseCam prototype is the size of a pager and is attached via a neck strap or clip to the front of the user’s body. The hardware is based on a PIC microcontroller with sensor inputs from a 2-channel accelerometer, digital light sensor, temperature sensor, sound level monitor, and passive infrared sensor for detecting living beings. A commercial camera module is interfaced to the microcontroller and photos are triggered by sensor data and/or time interval.

PIC 16F876 8 bit microcontroller
I2C bus interfaces sensor/peripheral devices to the microcontroller
ADXL210 2 channel accelerometer – 2-axis motion and tilt
Passive infrared sensor (Seiko)– detects heat from a person at up to 2.5m
Digital Light Sensor (TCS230) – records overall and RGB intensities.
Electret Microphone – records audio level
Temperature sensor (LM75) - 0 to 70C
Real time clock – to record calendar data of time of image
RS232 serial interface (for loading data to PC)
MMC Card 64 MB (for sensor data)
Camera module 128 MB – various commercial modules used
Edmunds Optics lens – 2.2mm, f2, ultra wide angle (132 degrees)
2 x AA NiMh cells for recharging after 12 hours.

Table 1 - SenseCam hardware specification

¹ Most “wearable” cameras, e.g. those in [1,2], are based on a backpack-worn computer with wired sensors and are therefore not amenable to real-world use.

We record sensor data to the MMC card every second whether or not an image capture was triggered. Captured images are stored in the camera module FLASH memory, capable of storing approximately 2000 VGA images. The collected images and sensor readings can then be downloaded to a PC. We have built additional features for the MyLifeBits personal archive system [3] which plots the sensor values in relation to images and allows the viewer to see the day's images as a scrollable movie.

Present Design Features

In order to catch what the wearer sees without their having to think consciously about taking the picture, we use a 2.2mm ultra wide-angle lens to provide 130 degrees of view, and have tested wider-angle lens up to 180 degrees to capture a fish eye view. The advantage of a very wide-angle lens is that most or all of the forward view is captured with a large depth of field, and the wearer's hands and attention are left free. However the captured images all suffer from spherical distortion. Also, as the lens is at a fixed focus, the definition is not good enough to read anything but the biggest text in an image. We are presently working to correct both these issues, but perhaps some playful use could be made of the present features?

We have developed SenseCam to take images at what we consider 'good' times. Presently this is at a regular time interval, when there is a significant change in light level or sound level (e.g. during transitions between rooms, outdoor spaces, etc), when a person passes in front of the camera, and also when explicitly triggered by the wearer. (If the wearer passes their hand across the camera, the resulting change in light level triggers an image to be taken, and the capture lag means the hand is not the subject of the picture.)

There may be other 'good' times for SenseCam to capture images depending on the application for which it is used, and the device is easily reprogrammable to trigger on new sensor combinations. For instance, SenseCam can also detect ambient temperature changes and by making use of the tilt sensor, can detect transitions of a person's state, i.e. standing up, lying down, walking etc.

Other Issues

The initial prototype camera used for SenseCam had no infrared filter, yielding images with somewhat washed out colours and where living plant material appeared whitish and ghostly. This will be corrected in deployed versions, but could be made optional for playful purpose.

Blurred images were cut from 50% to less than 10% by using the motion sensor to ensure stability before capture. This adds a few 10s of milliseconds delay between trigger and capture. It may be that continuous movement of the camera could prevent images being taken. Alternatively, it may be desirable to keep and capture the blurred images if they could play a role in some application.

At present, SenseCam will power down when the camera is left horizontal and still on a flat surface, and wakes up again when tilted. Powering down and powering up the camera again takes approximately 5 seconds each, and could lead to potential image holes. There are also associated time lags between a trigger sensor reading and image capture, as used for explicit capture by hand gesture. Could these seams be exploited in other ways for play?

PLAYFUL APPLICATIONS

The type of scenarios which originally motivated SenseCam center on personal and clinical memory augmentation. On a more playful theme, tourism seems another obvious application area, and we are in discussion with various groups about using SenseCam as a means of automatically generating photo-blogs for visitors to attractions such as museums, theme parks, and festivals. Other playful application areas we might explore at the workshop include:

- Augmenting traditional games – SenseCam hide and seek? A cue's eye view in pool? ...
- Other wearers – what do your pets/children/cars really see?
- Collaborative or competitive SenseCam use
- SenseCam Art
- FridgeCam – we have initially trialed this, leading to interesting images and a decreased consumption of chocolate biscuits in the lab!
- Privacy – This is an issue often raised about SenseCam and about covert digital photography in general. But are there situations where we could exploit invasion of privacy as a basis for play?

CONCLUSION

We have presented the details of SenseCam, a sensor-triggered wearable camera, and suggested some possible ways it might form the basis of play. This paper is, of course, just a touchstone for what we hope will be a productive workshop session to develop playful applications in this domain.

REFERENCES

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