The MediaCup: Awareness Technology embedded in an Everyday Object

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Abstract. The MediaCup is an ordinary coffee cup augmented with sensing, processing and communication capabilities, to collect and communicate general context information in a given environment. In this project, coffee cups are computerized to integrate them and the information they hold—where the cup is, how it is handled, and whether it's hot or cold—as context into surrounding information ecologies.

1 Introduction

Computerization of everyday objects is a promising approach toward weaving computer usage into the fabric of our everyday lives. Many examples have been developed in which everyday objects are computerized to integrate them into specific computer supported tasks, including popular scenarios such as intelligent meal preparation with computerized kitchen gadgets, and personalized coffee consumption aided by smart coffee cups [4].

Beyond such scenarios and specific applications, we are concerned with how everyday objects can be integrated more generally into surrounding information ecologies. We propose augmentation of everyday objects with information technologies to obtain general context information, available to any application within a given environment. As an example, we have developed the MediaCup, a coffee cup augmented with sensors, processing, and communication to collect and broadcast context information obtained from ordinary use of the cup. The obtained context information—where the cup is, how it is handled, and whether it's hot or cold— has for example been used for colleague awareness.

The work we present is related to research on computerization of ordinary things, such as for instance carried out by the Things That Think consortium [4]. However a distinguishing notion is the consideration of everyday objects and of the information that can be obtained from them as general context in an information ecology. The MediaCup that we have prototyped makes a coffee cup and related information available as context, broadcast in some real or virtual environment, such as the workplace, or a multicast group on the Internet. The MediaCup work is also related to research on location- and context-awareness in smart environments, which has yielded for example active badges [5] and smart badges [1] attached to people and

things to collect and communicate location information and possibly other context. In these efforts, new devices are introduced into an environment to make it smart. In contrast, in the MediaCup project context-awareness technology is built almost invisibly into already existing everyday objects, transparent to their everyday use.

2 MediaCup Implementation

The MediaCup hardware comprises sensors for temperature and acceleration, a PIC 16F84 microcontroller, an infrared diode for communication, and a standard Lithium battery (3V, 120mAh). To track movement, we have integrated the two-axis acceleration sensor ADXL202AQC of Analog Devices, which can measure both dynamic and static acceleration. The sensor uses 0,6 mA and is turned off between measurement cycles to save power. For temperature sensing we have integrated the DS1621 Dallas Semiconductor chip measuring from –55 to +125 °C, with 1µA standby current, and 400µA communication current. The microcontroller has 1792 Byte Flash RAM for programs, 68 Byte RAM, and 13 I/O ports used for control of temperature chip, accelerometer, and infrared diode. With 4 MHz, power consumption is below 2mA, and in sleep mode below 1 µA. With the Lithium battery, the MediaCup can be powered for approximately 2-3 weeks.

Sensor readings are taken every 50ms for acceleration, and every 3 seconds for temperature. The raw sensor data is processed on the MediaCup, applying heuristics to obtain cues regarding handling and situation of the coffee cup. Acceleration sensor data is mapped to three distinct cues: cup is stationary, drinking out of the cup, and fiddling around with the cup. Temperature data is mapped to the cues: filled up, cooled off, and actual temperature.

Cues are communicated every 15 seconds via a low-powered 3mm infrared sender SFH 409-s, using IrDA physical layer coding. In the MediaCup environment, transceivers already present in desktop and laptop computers can be used to receive cup IDs and cues. In addition we have built an overhead transceiver infrastructure into our office environment to connect MediaCups, and to track their location. We have used HP's HSDL 1001 IrDA Transceiver with 15 ° range, and about 1m² footprint.

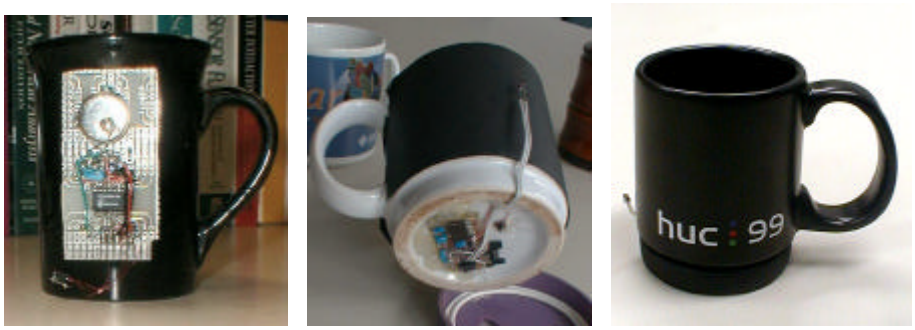

Fig. 1. MediaCup prototypes.

Transceivers are connected via serial line to a computer that distributes cues in the MediaCup multicast group.

Figure 1 illustrates the evolution of MediaCup prototypes. The first version served for initial data collection but obviously was not fit for day-to-day use. With the second prototype, we embedded the MediaCup hardware in a non-obtrusive way at the bottom of a coffee cup. The third prototype now has the hardware mounted in the rubber base of the HUC99 coffee cup, allowing removal so that the cup can be dish-washed.

3 Application Experience and Future Work

We have used the MediaCup in colleague awareness applications. In a study of *Ambient Telepresence*, MediaCups and other devices in an office environment were used to track everyday activity which was then communicated to a remote workplace where it was rendered as subtle background noise, to promote a sense of remote presence in a non-obtrusive way [2]. In another colleague awareness application the MediaCup was used in conjunction with other environment based sensors to log user activity for production of a kind of comic strip of recent activity, accessible to co-workers [3].

MediaCup use in the described applications showed the utility of embedding awareness technology in everyday objects, however it also revealed shortcomings in our first prototypes. Cue recognition did not work reliably for similar cues, in particular for the cues drinking vs. playing with the cup. This is primarily due to the low frequency of accelerometer readings, a design decision to save power.

The next MediaCup implementation will be based on a PIC 16F877 or 16F876, with 14336 Byte Flash RAM to enable more sophisticated processing of sensor readings. To improve tracking of cup movement, we will integrate a 3-axis accelerometer, AMP ACH-04-08-05 of Measurement Specialities. For power management we plan to experiment with GoldCaps. Finally, we also consider integration of IrDA transmitters for two-way communication, for MediaCup uses beyond collection of sensor-based context information.

References

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