Design and applications of a beer mat for pub interaction

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ABSTRACT
We describe the design of an interactive beer mat for the support of entertainment activities in pubs. The mat uses a gravity sensor to sense motion and orientation in space and a pressure sensor to sense the weight resting on it. Care was also taken to preserve its original functions, such as absorbing superfluous liquids and providing advertising space. We present a number of activities supported by the mat and show how it can improve the profit of the pub and the mood of the crowd simultaneously.

Keywords
beermats, sensors, embedded interaction, pub games

INTRODUCTION
The instrumentation of everyday artifacts with sensors and computing capacity has made it possible to interact with them in new ways. Research in embedded interaction is concerned with forms of interaction which are embedded into everyday activities as well as interaction with computers which are embedded into everyday objects.

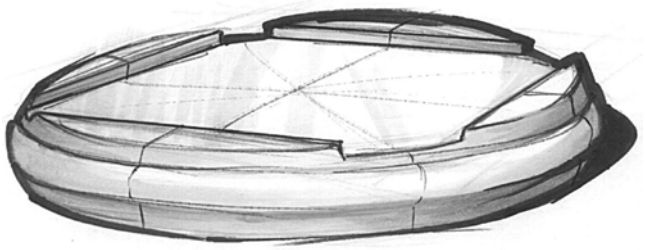
A classic in this field is the MediaCup [1] which embeds gravity, weight and temperature sensors in the bottom of a coffee mug. By determining the spatial context and individual states of several of these mugs, it is possible to derive additional information automatically. Multiple warm and full mugs in the same room, for example, signal the beginning of a meeting.

Our work builds on these ideas and uses hardware from the SmartIts toolkit [2] developed by the same group, but in addition to implicit interaction which is embedded into everyday actions, we also use explicit interaction. We show how the instrumentation of an everyday object (if a beer mat can be considered this) opens opportunities for new forms of interaction beyond context sensing.

PHYSICAL DESIGN
The physical design of the beer mat followed a number of requirements which were established by observation and field studies in the target environment. Beer mats were found to serve two main purposes intended by their manufacturer, as well as a number of additional purposes invented by their actual users. The intended purposes are:

- Absorbing superfluous liquid dripping from the glass
- Providing space for advertising

Both of these requirements were found to be perfectly met by the cardboard beer mats common in many parts of the world. Advertising is mostly done by beer manufacturers or third parties paying for this advertising space and thereby sponsoring the production of the beer mats. After an initial exploration of the design space, the following design of the interactive beer mat was developed:



It consists of a flat cylindrical body containing the electronics and a rectangular recess on the top side which holds a conventional rectangular beer mat. This design preserves both the capability to absorb liquids and the advertising space of the original beer mat without impairment. The material strength in the recess is such that it will slightly bend under the weight of a glass, allowing the pressure sensor to work from inside the case. The fact that the corners of the mat stand out over the cylindrical body makes it possible to use a rather strong clamping force to hold the mat and prevent it from falling out accidentally, while it is still easy to take it out manually after its intended period of use. This design idea was then refined to a 3D construction of three plastic parts suitable for mass production by die-casting, which provide a liquid-proof and shock resistant case for the electronics.

HARDWARE DESIGN
The electronics of the beer mat consist of a SmartIts particle board [2] which reads out the measurements of an acceleration sensor along the cylinder axis of the device and a pressure sensor for the weight of the glass. These values are sent over an RF link to a base station connected to a host computer. Beyond this, no computation is done locally on the mat. All sensor readings are currently analyzed on the host computer which then recognizes the

spatial orientation of the mat (upside down or normal), the activity of flapping the mat in the air or on the table, and the weight of a glass or other object standing on the mat. Admittedly, the recognition of these activities will have to be implemented on the mat itself in order to free the radio link from streaming sensor data and to allow the simultaneous use of hundreds of mats.

PROTOTYPE

The prototype of the beer mat was built from the 3D construction using a milling cutter. The case contains a SmartIt particle board and the sensors.

The device weighs 110 grams and works several hours on a single battery charge. Hardware cost is currently about 100 US$ per device, but can be expected to go down below $10 in larger quantities. Batteries can currently be charged only after disassembling the device, but this can be solved by inductive transmission through the plastic case when the mat is stored over night.

APPLICATIONS

The mat can be used as a voting device in different voting processes. While simply raising the glass is usually associated with a positive reaction, a negative vote can be given by raising the glass and explicitly turning the mat upside down. Both votes are easily detected by a harsh drop in the weight measurement and distinguished by the direction of the gravity measurement a short time after this drop. Mats which still contain glasses are counted as abstentions.

Voting can be used in song contests to determine the vote of the audience or in karaoke bars to give immediate feedback to the singer already during performance. In sports bars, the decisions of the referee on the big TV screen are often cause of discussion, and the collective voting can here convey the average opinion of the local pub crowd, thus creating an additional level of interactivity for watching sports in a group. As a side effect of the voting technique, the pub can influence to a certain extent the frequency of their customers raising their glasses. One might speculate that this will result in higher consumption and thereby make the investment in the beer mat pay off. The fact that glasses are also raised just for drinking without intending a vote (which by the sensor reading triggers a positive vote) shifts the overall probabilities towards positive votes. While this defies exact voting results, it can be argued that it creates a positive atmosphere, which guests as well as pub owners might appreciate.

The second activity, picking up the mat and flapping it with the hand, can be used to signal another order to the waiting staff. The amplitude of the acceleration sensor data can be understood as the urgency of the order and by simultaneous manipulation of several mats (shaking a stack of them in one hand) also the number of ordered drinks can be expressed. This creates a surprisingly rich interaction vocabulary for the relatively simple beer mat, which is particularly well suited to noisy environments.

CONCLUSIONS AND FUTURE WORK

We have presented the design of an interactive beer mat, which preserves all of the intended properties of a classical beer mat, while adding functionality for entertainment in a pub. We have shown how its electronics can be constructed from ready-made particle boards and have discussed its application for voting and ordering. For large scale deployment of our interactive beer mats, the technical improvements mentioned in the previous parts (i.e., sensor evaluation on the mat and inductive recharge), have to be implemented and the unintended positive votes have to be accounted for statistically. One important direction which needs further investigation is the large body of drinking games which has developed in certain cultures, and how they can be supported using our beer mat.

ACKNOWLEDGMENTS

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Key Visuals for the Poster (beyond those in the paper)