# An augmented dining experience through the use of visual patterns decorating tableware objects

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## ABSTRACT
We present a prototype system that recognizes visual markers, which are aesthetically designed to fit into a broader user experience. The demonstrator uses a set of custom designed tableware to enhance dining within a restaurant setting. A mobile application recognizes visual markers embedded in decorative patterns on the tableware and printed material in the restaurant to trigger interactive content to augment the experience. The demonstration showcases the design of the patterns and the use of the application to augment the experience.

## Categories and Subject Descriptors
H.5.2 [Information Interfaces And Presentation]: User Interfaces - Interaction styles

## General Terms
Design, Human Factors

## Keywords
visual markers, dining experience, novel interaction

## 1. DETAILS OF THE APPLICATION
There has been a widespread use of visual codes, from barcodes to QR codes and AR glyphs, with mobile applications. However, such codes raise challenges, notably that they stand out from their surroundings and can be aesthetically problematic. Consequently, it is only appropriate to place a small number of such codes in a few selected locations, restricting the sort of applications they can be used for.

We have been exploring the creation of attractive visual patterns that encode links to digital interactions but can also enhance the appeal of a wide variety of objects and surfaces. We have undertaken a lengthy and iterative process of design between ceramic designers and computer scientists developing recognition software and apps for mobile devices. We chose to work with ceramic designers and focus on creating patterns for tableware because we felt that working with solid everyday objects, including relatively flat surfaces such as plates, would be a tractable starting point.

To explore the practical application of our approach and reveal issues concerned with interacting with our patterns, we have worked with a restaurant chain called Busaba to design a set of 'trackable tableware' for them. Based on the results from a participative design session with Busaba staff, we developed an associated mobile app to enhance the dining experience for customers.

## 2. DESCRIPTION OF THE DEMOSTRATOR
Our demonstrator shows the placement of patterns at four different locations – restaurant entrance, menu, placemat and plate - interaction with which enhances different stages of the dining experience. Fig. 1 shows the patterns on the plate and placemat.


**Figure 1: plate and placemat with our pattern design**

The pattern at the restaurant entrance supports arrival and queuing. When the customer scans this pattern with their phone, they can see how long the estimated waiting time is and judge whether it is worth walking to another location (fig. 2 top left). The customer is also given the option to view the menu and place their order.

Scanning the menu pattern activates functionality related to choosing and ordering. Customers can see additional information, which changes regularly, such as specials and weekly recommendations (e.g., the top 10 dishes). Items on the menu can also be added to the customer's order (fig. 2 top right).

When the pattern on the placemat is scanned, the mobile app provides a number of options related to the status of the customer's meal. This includes calling the waiter, "eye on the kitchen" (live video feed into the kitchen), initiating paying, and exploring the culture of Busaba (fig.2 bottom left).

Finally, the pattern on the plate is linked to information relating to the dish that is served on the plate. This includes the recipe, dish background (where it comes from and its history), music track (recommended music track for this dish to listen too later on or perhaps play at home when cooking this) and an option to rate and comment on this particular dish (fig. 2 bottom right).

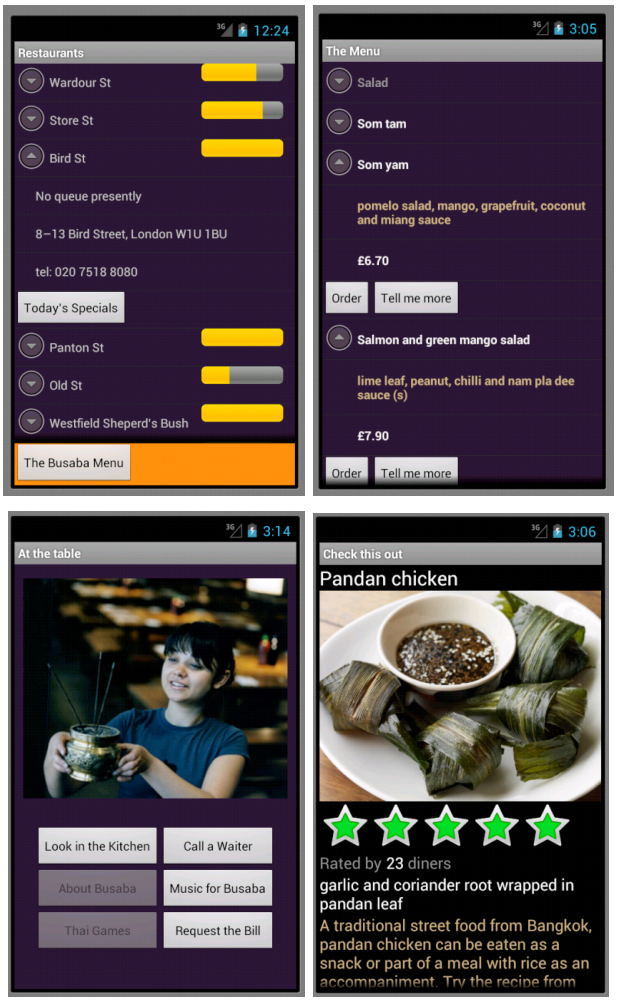


**Figure 2. Mobile app interfaces**

## 3. TECHNOLOGIES USED

The demonstrator involves a Java mobile app developed for Android phones and a cloud based server running on Amazon's EC2 infrastructure. The mobile app recognizes the codes and passes these to the server. It also creates the interface for Busaba customers with functionality as described in the previous section.

The server provides both an HTML REST API to the mobile application and a web configuration and control interface to administrators. This allows the mapping between marker code and marker meaning to some extent to be dissociated from the mobile app where change has a higher management overhead. In addition the cloud server provides a nexus through which actions arising from code scanning in the app can be directed (such as by interfacing to waiting staff or EPOS systems).

The visual patterns decorating the restaurant and the tableware objects is the key innovative feature of this demonstration. These are a form of d-touch[1] topological fiducial markers. We chose the d-touch system because it specifies a set of drawing rules or constraints for creating markers. We felt that this drawing-based approach would naturally fit with the way in which visual designers work.

[1] http://www.d-touch.org/

We then extended the original d-touch rules with several stricter structural constraints. These served to make detection more robust in the face of the difficult lighting conditions encountered on ceramics (specular reflection) and in restaurants (restricted lighting, extensive shadowing) and eliminate misrecognition of codes. A significant part of the iterative development process involved developing, clarifying and refining these constraints and rules with the ceramics designers to ensure they could produce appealing designs while working within them.

A key innovation involved moving from single codes to extended patterns that contain repeated codes. This allowed us to increase reliability through redundancy and deal with specular reflections and dirty plates, unavoidable problems in our setting. We also experimented with different physical glazes for plates but the most effective solution proved to be repeating codes within a pattern and amending d-touch to recognize multiple codes and then take the most popular.

## 4. LESSONS LEARNED

### From codes to patterns

Embedding multiple codes into a pattern also opens up new interactional possibilities beyond redundancy. For example we might pan the camera across a larger surface or zoom in and out in order to recognise different codes and so trigger a sequence of interactions. In our Busaba application such a narrative panning pattern (figure 3) could be included on the placemat, so that a story about the Busaba culture and history is unfolded as the pattern is scanned horizontally.

**Figure 3. A horizontally panning pattern with 3 distinct codes**

While being able to create extended patterns that contain multiple codes opens up exciting new possibilities, it also raises significant new challenges, not least of which is how people can be expected to interact with them. By embedding codes into patterns in may no longer be clear to users where they are or that they are even present, and so interacting with them will become difficult.

We envisage two general approaches to this. One is to tweak the pattern to subtly reveal where the codes are to be found, but without overly compromising its aesthetic. For example, we might use subtle variations in colour to reveal the boundaries of the codes within a pattern so that the user can see how to align the camera in order to recognize them.

An alternative approach is to extend the interface to the app. For example, we could put a 'mask' on the camera view that suggests to the user the shape or nature of the pattern they are looking for. Thus, an 'oval' shaped mask would suggest looking for an oval shape area within the pattern.

## 5. ACKNOWLEDGMENTS

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