
IllumiMug: Revealing Imperceptible Characteristics of Drinks

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Abstract

Drinking is vital, but certain drinks can also harm human health and well-being. In this paper, we present IllumiMug, a concept for a content-aware, interactive cup. The IllumiMug concept is able to measure the temperature and the level of a liquid in a cup and can represent helpful information through ambient light. We discuss some initial design thoughts and illustrate the potential benefits of IllumiMug in two scenarios, i.e., the preparation of proper alcoholic drinks, where the alcohol concentration is measured and shown, and the brewing of safe tea, where the drink's temperature is indicated.

Author Keywords

Design; Prototyping; Ambient; Wearable; Light; Display

ACM Classification Keywords

H.5.2 [Information interfaces and presentation]: User Interfaces—*Prototyping*.

Introduction

Drinking is extremely important for human beings. A regular intake of water or other drinks is required to ensure a normal physiological functioning of the human body. Unfortunately, not all drinks are healthy, and specific drinks can even harm human health and well-being.

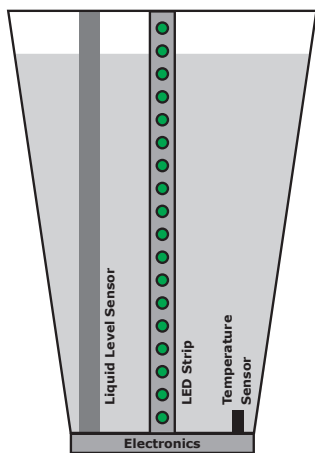


Figure 1: The IllumiMug concept is using the Arduino Lilipad, a temperature sensor, a liquid level sensor, and a LED strip.

For example, an extensive consumption of alcoholic beverages can lead to severe intoxications and is considered to be a major public health issue. Even for moderate drinkers it would be valuable to assess the consumed amount of alcohol, e.g., to self-estimate the remaining driving skills. Less known, but still risky, is the preparation of tea with non-boiling water, which is unable to kill microorganisms and which can lead to, e.g., nausea, diarrhea, and vomiting. Overall, many beverages come with certain risks, which are hard to assess with human senses only.

In this paper, we propose a concept for a content-aware cup, named *IllumiMug*, which provides the consumer with additional information about a drink's contents or its preparation. This information is presented through decorative, ambient light and clarifies about potential risks, which makes drinking safer than it is today. In the following, we summarize related work, illustrate our conceptual design, and sketch two potential applications for the mug: AlcAware and SafeTea.

Related Work

Ambient displays are well suited to realise aesthetic, abstract visualizations that are both, effective and efficient [6, 2]. Particularly *light* as modality offers a huge range of encodings, and can easily be displayed in an ambient way. Tarasewich et al. [7] showed that single LED, low-information rate displays are useful for supporting information awareness on mobile devices. They suggested to use colours to distinguish between different types or levels of information, e.g., red for "danger".

Indeed, single light sources are often used to raise awareness, warn, or remind a person by, e.g., lighting up or changing their colour. However, in general, ambient

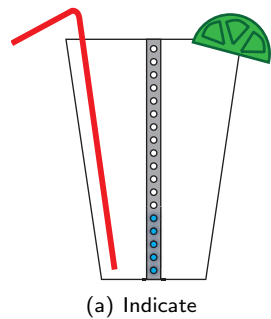
light allows for much broader applications, e.g., in navigation settings or in a health context [4, 3]. Although there are efforts to enhance kitchen appliances, e.g., [5], ambient light did not yet find its way into a mug.

IllumiMug Concept

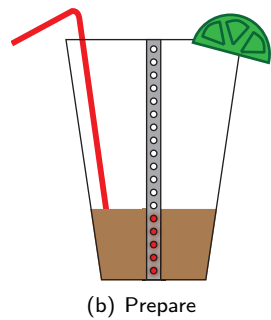
We began the creative process with the identification of common problems with today's drinks and beverages. We found that particularly a drink's alcohol concentration and its temperature are key parameters, which frequently are hard to assess and could potentially harm the personal health and well-being. Further, we identified which are the crucial parts of the preparation process and how these aspects can be measured with nowadays commercially available sensors. During the whole design process we kept in mind that liquids and electronics don't go well together, which motivated us to keep our designs and solutions as robust and reliable as possible.

For alcohol preparation we identified that the alcohol concentration of a drink would be good to know. However, we were unable to find a commercially available sensor, which can provide us with this value. Consequently, we identified a more abstract measure, i.e., level of a liquid, which allows to draw conclusions on the alcohol concentration. Temperature is a very important aspect for tea preparation. A tea needs to be prepared at certain temperatures to be safe and needs to brew for a certain amount of time. Consequently, the IllumiMug concept should come with a temperature sensor.

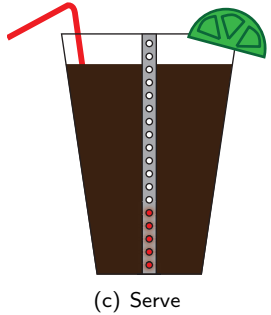
We conceptually based our system on the Arduino platform to emphasize the mobile character. We envision to use an Arduino Lilipad as a core component, whereby the round shape allows an assembly below the bottom of the cup, similar to the Mediacup [1]. The final IllumiMug



(a) Indicate



(b) Prepare



(c) Serve

Figure 2: The IllumiMug can assist a bartender in preparing a tasty Cuba Libre or other long-drinks. It indicates how much Rum should be poured. The visualization of actually poured alcohol is maintained until the drink is served to the customer.

concept comes with two sensors (see Figure 1). The temperature sensor measures the temperature of a liquid, and the liquid level sensor measures the level of a liquid within the glass. Here we identified the MAXIM DS18B20 digital thermometer to be a good component, providing a range from -55°C to 125°C . To measure the liquid level we identified the eTape Liquid Level sensor to be most suited, as it comes with a reasonable sensor length of 213 mm and has an almost linear sensor output. For visualization purposes we made good experiences with RGB lighting strips and therefore also plan to use it for the IllumiMug concept. All proposed components can be bought from common electronic suppliers.

We have not implemented the IllumiMug concept, yet, although we plan to realise an early prototype in the near future. Thus, we can not say anything about the appropriateness of the mentioned components, but would like to illustrate and discuss some potential applications and use cases.

AlcAware: Be Aware of Alcohol Intake

If not self-made, it will be hard to assess the alcohol concentration of long-drinks or cocktails. Typically, bartenders often prepare these drinks in a rush and mostly rely on their intention to pour the correct amounts of ingredients into the glass. In consequence, recipes are often not exactly matched, which affects the taste of the drink. If too little alcohol is poured, the consumer might be disappointed because the drink tastes too soft and wonders what the premium is paid for. If too much alcohol is poured, the drink might taste too strong and could lead to intoxication or even mental blackouts.

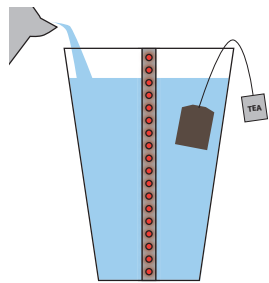
We envision that the IllumiMug can be programmed for certain drinks, e.g., a long-drink typically contains 4 cl of

alcohol. Thus, it can give the bartender visual indications how much alcohol should be poured into the glass (see Figure 2(a)). The IllumiMug concept comes with a sensor which is capable to measure the fluid level within the glass. Thus, it can measure and display how much alcohol was actually poured into the drink (see Figure 2(b)). This information could remain active when the drink is served to the consumer (see Figure 2(c)), allowing for a proper assessment of the alcohol concentration. Further, the indicator could serve as a warning for children or reformed alcoholics that this drink might be harmful.

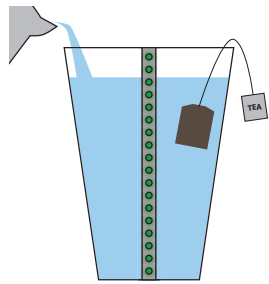
While designing this concept we came across several issues which need to be addressed in prototypes. First, the data sheet of the liquid level sensor states that the sensor is unsuited to measure solvents or corrosive liquids. It is unclear if and for how long the sensor will withstand alcoholic liquids. Further, the sensor provides a measure for the height of the liquid inside the glass. This needs to be matched to standard *cl*-units which are used in cocktail or long-drink recipes. Another problem is that the IllumiMug needs to differentiate between alcoholic and non-alcoholic liquids. We imagine that this can be done through button presses or intelligent sensors. Regarding the interaction concept it is unclear if and how various alcoholic liquids are considered, e.g., if a strong rum gets the same presentation as a weaker liqueur.

SafeTea: Prepare Safe Teas

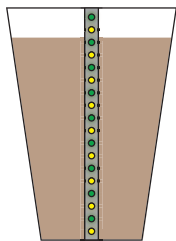
During growth tea leaves are often treated with insecticides and other chemicals to kill various microorganisms. Nevertheless, some microorganisms survive these treatments and find their way into the final tea products. If they also survive the brewing process, most likely because non-boiling water is used to prepare the tea, they can cause nausea, diarrhea, and vomiting



(a) Unsafe



(b) Safe



(c) Serve

Figure 3: IllumiMug can also assist in the preparation of safe tea. It shows whether the water temperature to prepare the tea is sufficient to kill dangerous microorganisms. Further, it can indicate when the tea has cooled down and therefore reached its ideal drinking temperature.

when consumed. Consequently, most tea bags state that they have to be prepared with boiling water to get a safe product. This, however, leads to another problem with tea preparation, i.e., that tea is sometimes consumed too hot which leads to painful scalds.

This second use case can also be handled by our IllumiMug concept. Because it comes with an integrated temperature sensor it can measure whether the water is hot enough or not. This information can be displayed in an ambient way immediately while the tea is prepared. Our initial ideas use a red colour to indicate that the water was not hot enough to safely kill all microorganisms (see Figure 3(a)); green illumination indicates that the water was hot enough and drinking the tea is safe (see Figure 3(b)). The latter visualization can adapt over time, e.g., by reducing its brightness or changing colours, to indicate that the water has cooled down a bit and the tea is ready for scald-free consumption (see Figure 3(c)).

Before further prototype development some more aspects should be considered. Most importantly, there exist a variety of different teas, of which some should be prepared with hot, but non-boiling water of a certain temperature. IllumiMug should be able to handle this requirement technically, but somehow needs to be aware which tea will be prepared. From a hardware perspective it would be difficult to implement both design concepts, AlcAware and SafeTea, in one cup as the liquid level sensor is not suited to exceed temperatures of 65 °C (150 °F). However, in practise nobody would likely enjoy teas and long-drinks from the same cup.

Conclusions

In this paper, we propose the IllumiMug concept, a cup with sensors and ambient light output, which can make

otherwise imperceptible characteristics of a drink visible. We sketch how the IllumiMug might be implemented and illustrate two scenarios how the cup can be used in relevant settings. We discussed potential interaction flows and highlighted key technical limitations which need to be addressed in the realisation of this concept. We argue that this paper can inspire fellow designers and developers and can provoke discussions on new domains and future applications.

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