
Lit Lids: Smart Lid and Bracelet for Prevention of Drink Tampering

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Abstract

Drink tampering done with the intention of perpetrating sexual assault is unfortunately a prevalent problem in society today, and especially affects college-age women and other vulnerable communities [2]. There is no widespread solution for people who go out to bars, parties, or other social outings to detect whether or not their drink has been spiked or otherwise tampered with. While this is a significant safety issue, it has yet to be addressed in a convenient or affordable manner. We propose a tangible interface called Lit Lids that consists of a reusable smart lid and paired bracelet with light and vibrotactile feedback that alerts users to any interference with their drink.

Author Keywords

drink spiking; date rape; sexual assault prevention; smart bracelet; location tracking; wearable.

ACM Classification Keywords

H.5.2 [User Interfaces]: Haptic I/O, interaction styles, user-centered design; H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Introduction

Drink tampering is a known problem. In a study led by Suzanne Swan and published by the American Psychological Association (APA) journal *Psychology of Violence*, 7.8% reported being drugged, and 1.4% reported either having drugged someone or knowing a perpetrator [3]. The study also found that women were more likely to be targeted or suffer negative

consequences, with almost twice as many women as men reporting [6].

An Alcohol.org survey reports higher numbers, with 44% of men and 56% of women reporting having consumed spiked food and drink without their knowledge. Over half of such incidents occurred while in college, and 65% of women reported being “not confident” that spiking assailants would be found legally accountable [2].

We propose a solution called Lit Lids¹ that covers the opening of the drink completely, paired with a bracelet with GPS and alarm (vibration and light) functionalities. A tangible approach to the problem of drink spiking is beneficial because it is a better way to prevent the crime from happening, instead of just detecting it. It is also has a low intrusive element as the user should not have to do anything different than what they would do with a regular drink, besides wearing a bracelet and closing and opening a lid. This design is the easiest for a person to use to detect and prevent contamination in comparison to using testing strips or a regular lid that cannot tell you if it’s been taken off.

Related Work

Over 320,000 incidents of rape and sexual assault occurred in the United States in 2016 alone, and such incidents are underreported in all genders. 11.2% of college students experience sexual assault [2].

Many existing solutions focus on testing the drinks themselves for common “date rape” drugs and are not reusable, and also require specific conditions or time. They do not provide a sustainable solution that accounts for the fact that obscure substances could be slipped into beverages. They are also expensive for a college-age audience, making them unpopular or impractical for everyday use.

Products such as the Drink Safe coaster, KnoNap napkin, or Undercover Colors tester port test for specific drugs, which is ineffective considering that alcohol and a variety of tranquilizing prescription drugs are the most common substances used by assailants [9, 5, 12, 2]. They also provide feedback in the form of color change or lines, which is hard for the user to see in dim social settings such as clubs, house parties, or bars.

While a few reusable options do exist, such as smart straws or the Spikey, a plastic stopper meant to prevent pills from being slipped into bottles, they still do not account for the addition of liquids or powders as prevalent forms of tampering [11]. Assailants can easily bypass such mechanisms, leaving the user unaware of contamination.

Our solution is different in that it is not only reusable, but also alerts users to any sort of tampering that occurs to a drink when the user is away from it, and does not entail providing drops of the drink itself.

The attached location-detecting bracelet is inspired by related works on smart bracelets, such as a monitoring bracelet designed for the elderly that defines the aesthetics and functionalities of bracelets to account for physical or cognitive impairments [9]. This is relevant to our work because we must take into consideration accessible design in creating a wearable targeted for use by those who may be incapacitated or otherwise impaired by alcohol intake.

We also looked into Soter, smart bracelets designed for children’s safety, which uses similar GPS functionality as our bracelet incorporates, and a smart notification system that we hope to implement in the future [13].

¹ For a video demo, see: <https://youtu.be/Kz8LKS3hHQ8>

System Design

Design Principles

We design the lid to initially fit most common cup diameter of a solo cup (9.32 cm). The user wears a bracelet that the lid can detect the distance to. If the lid is opened very close to the bracelet, for example while holding the cup in that hand, the lid opens normally. If the lid is opened and the bracelet is not in the required distance the lid and bracelet will flash a red light and give vibrotactile feedback that can only be turned off by contact with the bracelet.

This serves the purpose of notifying the owner of the drink and people around that someone else has taken off the user's cup lid, regardless of what type of interference occurred. This accounts for all forms of tampering and allows the user to decide their next step. It is also meant to deter assailants away from the drink and the user, realizing that the flashing feedback may alert others to their identity or intentions.

Conceptual Design

The concept of the extension of the body through objects from Danielle Wilde, Thecla Schiphorst, and Sietske Klooster's Move to Design / Design to Move: A conversation About Designing for the Body strongly impacted the design of the Lit Lid user interface [4]. The Lid Lid is designed to be an effortless extension to the user's awareness of their drink at a party. The user will not have to consciously keep track of who is by their drink because the Lit Lid will alert them when someone attempts to tamper with it. The bracelet is the most impacted by this paper as it's purpose to measure the distance between itself and the lid to determine who is opening the lid, should be unnoticed by the user. The bracelet should only be noticed when it is alerting the user of possible contamination. Furthermore, the Lit Lid system is embedded into the users drinking habit because as long as the user wears the bracelet, they are able to interact with the lid without interference.

Thus the only change in their routine is the physical act of placing the lid, removing the lid, and attaching the lid to the bottom of the cup.

Based off of Albrecht Schmidt, Uni Karlsruhe, Kristof Van Laerhoven, and Starlab Research's How to Build Smart Appliances, our pressure and distance sensors in the Lit Lid are designed to maximize unobtrusiveness of the Lit Lid's lid and bracelet [1]. Thus the user's interaction with the wearable and the lid is meant to be an unobtrusive way to incorporate better drink protection and spiking prevention into their drinking routine.

Implementation

The Lit Lid is a plastic circular lid with a ring of red LED lights along the top border of the lid. The LEDs light up red to indicate to the user that the lid was open by someone other than the user and is thus possible contamination (Fig. 1).

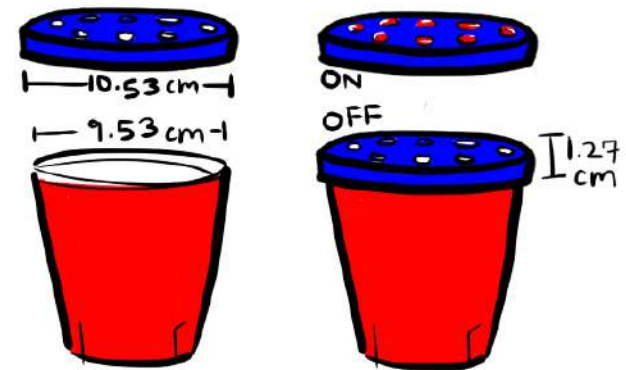


Figure 1: Lid relative to cup (left), activated vs. deactivated LED lights on lid (right).

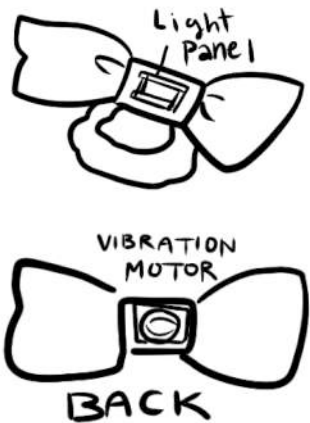


Figure 3: LED panel (top) and alarm on bracelet (bottom)



Figure 4: Alternative bracelet design, side and front view.

The lid uses pressure and motion sensors that line up with the underside rim of the lid, to determine when the lid is taken off and on. The underside of the lid has a silicone adhesive that enables the lid to snap to the bottom of the glass (Fig. 2), for placement when the user is drinking from their cup.

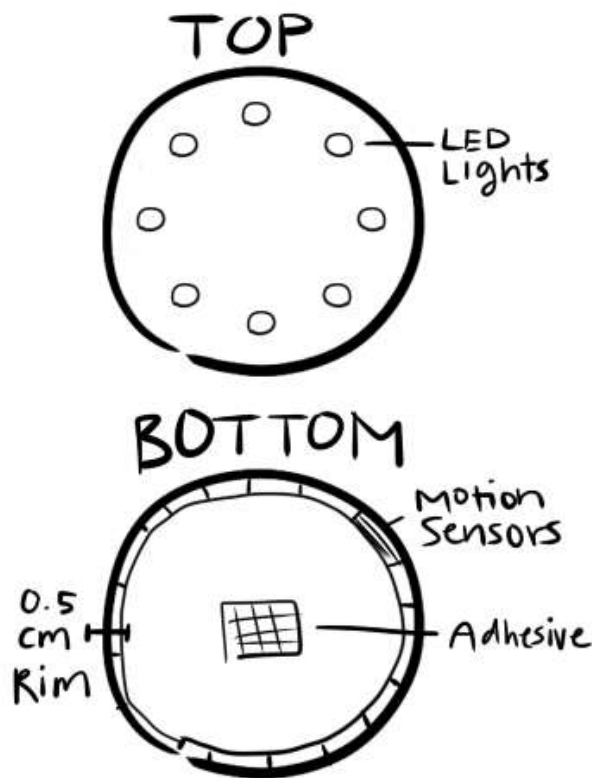


Figure 2: LED light display on lid (top), sensor functionality in rim and silicone adhesive on underside of lid (bottom).

Additionally, the lid connects via Bluetooth to a bracelet the user wears. The bracelet contains a plastic square piece that holds LEDs, vibration, and discrete button (Fig. 3, 4). The Bluetooth from the lid sets off the LEDs and vibration in the bracelet to communicate to the user immediately when the lid is opened by someone other than them. The user can turn off their bracelet indicators by pressing on the plastic piece. To determine who is opening the lid, the lid contains GPS tracking to the bracelet to find the distance between them. When the lid is farther than 20 centimeters away from the bracelet, the lid set off its LEDs and sends an alert to the bracelet which sets off its LEDs and vibration.

Furthermore, a user wearing the bracelet can take off the lid without setting of the alarm because the bracelet is close enough. To turn off the LEDs on the cup, the user takes off the lid with the bracelet at maximum 20 centimeters away from it. We believe this design is ideal because it is minimally invasive to the normal drinking habit of the user. When used correctly, meaning the user opens the lid only when wearing the bracelet, the only upset to their normal habit is the act of placing and removing the lid on the cup. Besides this, the user is only impacted in their routine when the lid and bracelet notifies them of possible contamination by someone else removing their lid.

The use of LEDs and vibration in the notification system enables auditory and tactile notification to the user. The alerts on both the lid and bracelet gives multiple notification paths to the user. Additionally, it also communicates to others that there might be something wrong, increasing the awareness and leading to a greater chance of preventing drink spiking.

Proof of Concept

The wearable is a soft, flexible, and fashionable band designed to augment to any wrist size. The wearable has a small button interface with lights embedded on

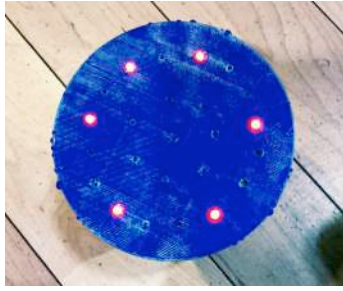


Figure 6: Top view of LED light display on lid prototype.



Figure 7: Side view of lid prototype on top of solo cup.

the top that flashes when the user's lid has been removed when the user has stepped away from their drink (Fig. 5). The bracelet and the lid both use batteries to stay powered up. The user can replace the batteries in the bracelet by unclipping the bracelet to open it up and reveal a small section that keeps the batteries.



Figure 5: Bracelet prototype with LED panel and flexible fabric material, with aesthetic bow design.

The bracelet has an embedded Bluetooth Arduino that connects with a small Bluetooth Arduino that is connected to the user's designated lid. The Bluetooth Arduino has GPS tracking that allows it to know when the user has stepped a certain range away from their cup. The bracelet has a small vibration device that can be turned off when the user clicks the button interface at the top of their bracelet.

The Lit Lids lid is a 3-D printed cup lid embedded with lights along the top and the rim. The lights will flash red when removed when the user is far away from the lid (Fig. 6, 7). The lid (10.53 cm diameter) is created to fit a standard Solo Cup (9.53 cm diameter). When the user is within a certain distance of their cup, the lid will automatically turn off its safety setting and will allow the user to remove the lid without any additional feedback. Essentially the user will only receive feedback from their device when someone is potentially

tampering with it, otherwise the user can comfortably move away from their drink.

Future Work

The current Lit Lids lid model can be placed on any standard Solo Cup, but the lid will eventually be transformed to fit most, if not all, circular surfaces. The lid will have an adjustable piece on the side that allows the user to change the diameter based on the glass or cup that they are covering.

A future version of the Lit Lid will fasten airtight onto the cup that it is placed on to make it more difficult for another person to remove the lid once the user steps away from their drink. The bracelet linked to the lid will also link to a mobile app, and be able to count the number of drinks the user has had and potentially even be able to calculate the user's blood alcohol content [8]. This type of app will count the number of drinks that the user has had and inform the user with specialized light, vibration, and app notification to let them know that they should slow down or stop drinking [13].

We wish to incorporate a social network into the smart bracelets, so that they are capable of interacting with each other the way that the Hello bracelet, a concept of bracelets communicating with nearby presences, does [10]. This way, users can distinguish between each other's lids and also add a "designated driver" friend who will also receive notifications.

Finally, the future version of this device will have lid customization to prevent different lids from being mixed up when in a party setting. The lid will unlock and flash green lights on top of the lid and on the bracelet to let the user know that they have reached their cup in the case as an addition to the visual feedback from the lid customization. This device will seamlessly integrate into the user's experience when they are out and about by allowing the user to move

about the way they wish without having to finish their drink quickly or carry their cup everywhere.

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