The Ring Ring: Drawing Attention through Light

Lin Sun[1,3]
[1] University of Oslo
Problemveien 7
0313 Oslo, Norway
sunlin530@gmail.com

Simon T. Perrault[2,3]
[2] National University of Singapore (NUS)
Singapore, 117417
simon.perrault@nus.edu.sg

Eric Lecolinet[3]
[3]Télécom ParisTech – LTCI
CNRS UMR 5141
75013 Paris, France
eric.lecolinet@mines-telecom.fr

ABSTRACT
Smartphones provide more and more notifications that can be hard to convey for many reasons: user is in a mobility context, in a meeting. Light is well suited for notifications since it is silent and can be quite discreet. We present the Ring ring, a wearable device worn on the finger. We designed an experiment where we tried to catch users' attention with only blinking, in two different ambient light conditions, three tasks, and three light intensities.

Author Keywords
Light; notifications; LED; wearable computing; ring.

ACM Classification Keywords
H.5.2. [Information interfaces and presentation]: UIs.

INTRODUCTION
One of the ongoing challenges of a smartphone is its ability to overwhelm the user with a constant flow of notifications (messages, e-mails, phone calls, social networks…). Usually, smartphones send notifications using sound or vibration. Sound is quite popular, but can easily disturb other people. and hard to hear in a noisy environment. Vibrations are a good alternative, but disturbing and not persistent – reducing their ability to notify the user.

Light, on the other hand, can be used to send quiet and persistent notifications. But, depending on the ambient light, such alerts can be easily missed. This is not acceptable in an urgent or emergency situation (namely important phone calls), where it is imperative that a user is made aware of the incoming notification.

In this paper, we present the Ring Ring, a wearable device worn on the finger that uses light to deliver information and evaluate its potential use in real life scenarios.

THE RING RING
We wanted to design a wearable device that users would easily see while doing everyday life tasks. According to [3], the best location on the body was on the wrist. Because we also aimed for simplicity and convenience, we decided that our wearable device should be a ring. We printed an adapted ring pattern on a 3D printer, on which we added two 5mm RGB LEDs on top and a small button on the bottom.

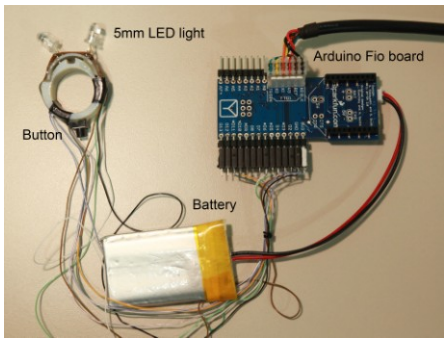

Figure 1. The Ring ring prototype.

USER STUDY
We wanted to design a ring that could transmit notifications to their wearer when the smartphone is not available. Some notifications require a reaction (e.g. phone calls) and have limited lifespan (20s. before voicemail).

Experimental design
In this study, we measured: (1) how many times they noticed the light and the time it took them to notice and (2) how many times they found the light annoying/disturbing.

We considered the following factors:

1. Task: (1) **sitting & typing**, (2) **sitting & talking,** (3) **standing & watching a video**
2. Ambient light: **indoor** environment (150 *lux*) and **outdoor** environment (2300 *lux*).
3. Intensity of light: **.8 cd, 2.4 cd and 4 cd**.

Procedure and Task
The experiment took place in a room with a large window and many lamps. Participants had to execute three kinds of tasks. Each task was tested under 2 ambient light conditions. 6 blocks of 10.5 mins (15 trials/block) were run (one per task × ambient light). One trial lasted for 42 seconds, and at a random time the ring would start blinking for 20 seconds. Participants were instructed to click on the ring button whenever they would see the blinking, and click again if they wanted to make it stop.

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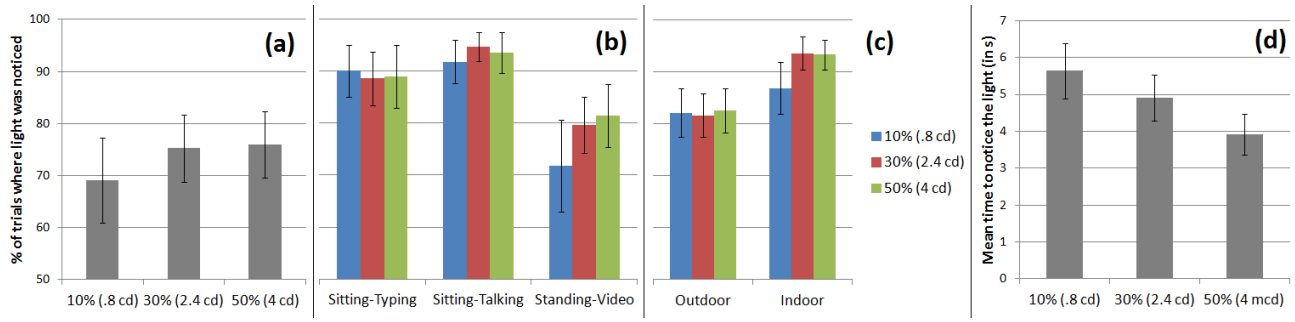

Figure 2. Percentage of trials where the blinking was noticed depending on (a) light intensity, (b) tasks and (c) ambient light (for each level of intensity); (d) Time to notice the blinking depending on light intensity. Error bars are .95 confidence intervals.

Since we wanted the participants to act as natural as possible, we did not tell them the real purpose of the experiment and explained to them that the experiment was about quantifying their attention while doing different tasks and that the ring was here to measure some vital signs. We did that to prevent them from biasing our results by looking too much at the ring. In summary, each participant performed (3 tasks × 2 ambient light conditions × 3 light intensity × 5 repetitions =) 90 trials.

Participants and Apparatus

We recruited 14 participants (7 females, all right handed) aged 22-28 (mean 25.6). Participants wore the ring on the ring finger of their non-dominant hand.

Results

Concerning the number of times participant would notice the light, we found the following effects:

Effect of *light intensity* ($p=.01$; $F_{2,26}=4.9$) for noticing the blinking (Figure 2-a), with .8 cd intensity being significantly harder to notice.

Effect of *task* for noticing the blinking (Figure 2-b), with "standing-video" harder to notice.

Effect of *ambient light* ($p<.01$; $F_{1,13}=29.8$) as seen on Figure 2-c.

Interaction between *task* and *light intensity* ($p=.03$; $F_{4,52}=2.98$), because *intensity* only has a noticeable effect in the "standing-video" task.

Interaction between *ambient light* and *light intensity* ($p<.01$; $F_{2,26}=6.46$), suggesting light intensity is not bright enough for outdoor.

About the time needed to notice the blinking, we found significant effect of light intensity ($p<.01$; $F_{2,26}=11.34$, Figure 2-d), with 4 cd intensity being significantly faster to notice (3.91s vs. 5.27; Tukey HSD's $p<.01$). There were also effects of the *task* ($p<.01$; $F_{2,26}=9.9$) and *ambient light* ($p<.01$; $F_{1,13}=23.7$).

Participants were instructed to double click on the ring button if they found the blinking annoying. We measured the ratio **r** = trials users were disturbed / trials blinking. We found a significant difference ($p<.01$; $F_{2,26}=12.98$) between .8 cd intensity (r=32.1% on average) and 2.4 & 4 cd intensity (r=41.3%) confirmed by a TukeyHSD test ($p<.05$).

To explain the poor performance of the "standing-video", we interviewed participants and found out that for this task, they would only see the light when it was strong enough to be reflected on furniture or on the computer screen; this is why the .8 cd intensity is significantly harder to perceive (Figure 2-a).

We also asked our participants if they perceived different light intensities during the experiment, for both indoor and outdoor ambient light levels. For the indoor condition, 5 participants perceived different levels, but only 2 of them correctly distinguished 3 levels. For the outdoor condition, only 2 participants perceived different levels of intensity, but both thought there were only 2. Light intensity has already been suggested to encode priority of notifications, but we would recommend being very careful while using this property, since users do not seem to perceive it efficiently in real life situations.

APPLICATIONS

We designed the Ring ring so that it could be simple yet useful in many scenarios. Drawing attention for important notifications was the main feature we envisioned, but there are many other: it could help users find their phone when they forget its location (in a crowded room), also as shown by previous works [1, 2, 4], a single LED can be used to carry very rich information. Finally, a ring could be paired to exchange information or even for lovers, since ring usually carry a strong emotional value.

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