Pairstone: A wearable device to gamify meeting new people

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ABSTRACT

We present the Pairstone, a new wearable device designed to encourage spontaneous interactions between strangers. This gadget detects other similar devices within the nearby population and prompts the users to physically pair with them, encouraging face-to-face interaction. We also discuss how the device's capabilities can be augmented when synchronized with social networks. The results of a formative study show promising results, and the strengths and weaknesses of the device are discussed in detail.

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2018. This is the author's version of the work. It is posted here for your personal use. Not for redistribution. The definitive Version of Record was published in *Proceedings of CHI 2019 (GLASGOW'2019)*, https://doi.org/10.1145/nnnnnnn.nnnnnnn.

Figure 1: The finished prototype

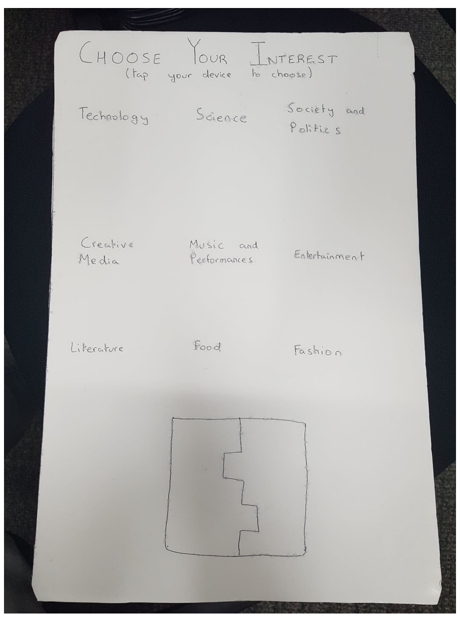

Figure 2: Our template idea for a configuration board

KEYWORDS

Wearable computers; Human-centered computing; Social interaction; Gamification; Interconnection; Human Computer Interaction(HCI)

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INTRODUCTION

Loneliness in university campuses is a well-known problem commonly associated with depression and anxiety [6]. To try to tackle it, we have developed a wearable device that is designed to encourage spontaneous, face-to-face interaction between strangers. This device, that we have named *Pairstone*, detects other similar devices nearby and warns the user with haptic and visual (RGB LED) feedback, thus prompting the user to find the owner of the other device and "pair" with them.

Our initial hypothesis was that this pairing process would provide an opportunity for the users to start a conversation with a person they might not have met before. A formative study carried on using our current prototype has provided favorable evidence towards that hypothesis, specially after additional incentives were added into the process – such as the ability to use the device to indicate which topics the user would be interested in talking about.

Development persona

While the device should be usable in a variety of scenarios – from high schools to workplaces – we have developed the current prototype with a clear user in mind. This persona is a young adult that has just moved in to a different city in order to start university, and does not have too much knowledge about its city, university campus or the people in it. They have not made any new friends yet, and are already feeling homesick and missing their friends and family back home. However, they do want to meet new people and are looking forward to the year ahead.

For that reason, the design and evaluation process of the device was contained within an university campus with students providing the most feedback towards it. We will also be using this persona as a prototype user for the device's walk-through, as it provides a very good example of the device addressing a known problem in a real situation.

Related work

The idea of wearable devices that can interconnect with each other is not new. We have studied and tried to imitate and improve upon previous proof-on-concept designs, including [3] and [7]. The

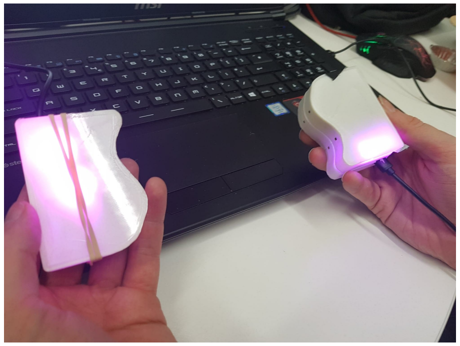

Figure 3: When pieces are nearby they flash at a faster rate

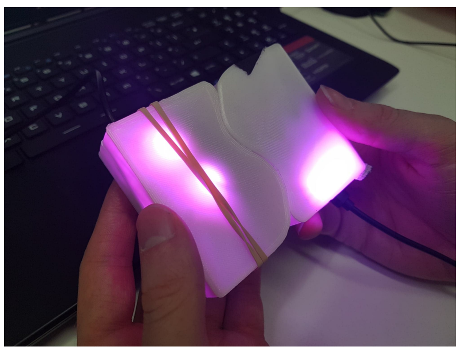

Figure 4: The colours of the pieces merge into one after snapping together

idea of using Bluetooth for distance measurement and inter-device communication comes from [4]. Distance measurement can be made very reliable when the measurements are post-processed using Machine Learning techniques, with the error being around 10 cm maximum, as shown in [2]. During the design and development of our device, we tried following a Human-Centered design philosophy with a special focus on how this device could help youths suffering from exclusion, depression and anxiety. To that end, we followed guidelines and advice outlined in [5].

WALKTHROUGH

At the start of each University year it is common for new students to be provided with a box of promotional goods. Our idea, shown in Figure 1, has been designed with the intent of it being part of this collection. Once the user has obtained the device they will need to configure it. This is done by finding an interest board (Located in a common area or University building) similar to Figure 2 and using the Pairstone to interact with it, by tapping the Pairstone on a relevant interest. The device will then start glowing with a certain colour. Each interest on the board has a unique colour associated with it. This means that one should be able to easily identify the interests of other people who own a similar device provided their device is also visible. This would hopefully incentivise users with similar coloured devices to make conversations with one another.

There are three stages to the Pairstones detecting one another as a means to inform other people that the device is nearby. In the current prototype, those start at approximately 5, 2 and 1 meters. When a Pairstone is 5 meters apart or higher from any other it will not show any light or vibration. When it detects another Pairstone(usually at a distance of 5 meters) an LED on the device will start blinking its colour, as set up in the interest board. The rate of this blinking will increase once the distance is approximately less than 2 meters. When the devices are near each other – less than 1 meter away – the blinking on the device will again increase and it will start vibrating too.

In the event that two people have made conversation with one another they have the option to connect their devices together, or "pair" them. If this happens the built in magnets of the device cause them to snap together and an LED pattern showing the 2 colours merging together should appear on both devices as illustrated in Figures 3 and 4. In addition to the visual feedback, on a successful pairing the devices will also vibrate with a distinctive pattern.

Reasons behind certain choices

The interactive boards mentioned at the start of the walkthrough should be found in the main common room of the university residence halls and campus building, and we would expect them to become even better hubs for social interaction thanks to those boards and the Pairstones. This hypothesis has been tested and is discussed in a further section in the paper.

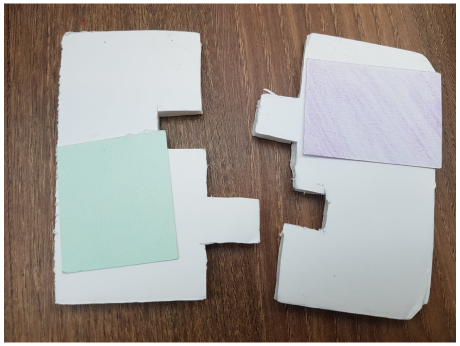

Figure 5: initial prototypes for our cardboard study

When it comes to the process of two users wearing a Pairstone finding each other, we have considered other ideas for the way the Pairstone communicates and provides feedback to its user. An example would be using the haptic feedback from the first time when a Pairstone detects another one nearby. We believe this is an area that warrants user testing before the next iteration is produced.

PROTOTYPE DESIGN

Cardboard prototype study

In early development we carried a small formative study to test the core concept of the Pairstone. This was done using cardboard cutouts to resemble the devices as shown in Figure 5 and a cardboard board (Figure 2) to resemble the board used to configure the device. Coloured paper was used to show the colour that the LEDs of the device would show in this situation.

The user was initially given a device and was presented with the configuration board. Testers were able to figure out what to do with their device on the board. After they tapped it we added a colour to their device and presented them with a scenario where they would see two people wearing the same device nearby, one with the same colour and one with a different one. While people generally understood that the devices should snap together (due to the jigsaw snap of the design) and tended to pair with the person whose device had the same colour at theirs, the pairing process would make some testers feel awkward due to its "penetrative" nature. As a result of this we decided to change the shape of the side which snaps together to resemble more of a wave. Some testers also mentioned wanting a better confirmation that the devices had paired properly. Thus in the next iteration we added magnets to aid with the pairing process and also provide an additional confirmation, as now there is an audible click when pairing.

Hardware

To facilitate both distance sensing and the possibility of exchanging data with other devices such as smartphones, it was decided that the Pairstone should be build around a Bluetooth module. The Nordic nRF52 chip family was used due to them being low power and also having a full ARM CORTEX-M4 CPU with which to control the logic of the device. Peripheral output was done using RGB LEDs of the WS2812/Neopixel family, along with a haptic vibration motor.

For a production device, these would have to be integrated into a single small circuit board. These units would have to be very inexpensive in order to be able to be cost-effectively distributed for free, fortunately the nRF52832 can be bought in volume for as little as £2 per unit[1]. The production device would also require a lithium polymer battery and charging circuit, and an NFC antenna for interaction with the setup board.

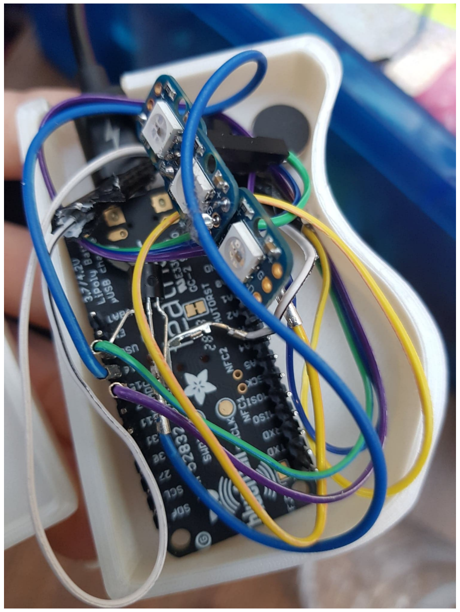

Figure 6: Inner wiring of the device

Figure 7: A popular modeling clay design

The prototype was contained within a 3D printed plastic case (as illustrated in Figure 6). This was designed to be white and translucent in order for the LED lights to be visible. In the production device, special care would have to be taken to the recyclability of the case material, as it is likely many of the devices would not be used by the students they were given to.

Software

The software design was based on the Adafruit NRF52 library implementation of Central-Peripheral dual mode Bluetooth UART. This was used as a starting point because it already had device scanning/filtering code and a way to transmit data between devices (via the Bluetooth UART).

This was modified to detect and act upon the RSSI of the compatible devices. While with more time a solution derived from the work by Ghose et. al. [2] would be preferable, it was found that naïvely acting on the raw RSSI was acceptably accurate for the prototype. The RSSI was divided into 4 bands by experiment, and then the peripheral output of the device (RGB LEDs and haptics) was adjusted based on which band the RSSI fell into – as detailed in the walkthrough.

FORMATIVE STUDY

Once two functional prototypes were built, we ran a formative study involving ten subjects, who interacted with the device both individually and in pairs through a three-stage process. The study was carried on following the University of Bristol's ethical guidelines.

Firstly, we wanted to find out potential shapes for future iterations of the Pairstone. To that end, we explained the device purpose and then gave each subject two pots of modelling clay. We saw many designs, including some asymmetrical ones – for example, one Pairstone being shaped like a face, while the other being shaped with a hat. However, the design that was most popular and that people reported to find most intuitive was that of a Ying-Yang, with each Pairstone being one half of it.

Secondly, we walked the participants through the set-up process using the board prototype. We wanted to find out how intuitive the process was, with positive results. Tapping the board with the Pairstone to physically choose topics of interest was what 8 out of 10 subjects did, while the other two offered different approaches but interesting nonetheless: they would link the board and the Pairstone together, using their finger to choose the topics in the board. One of them though they should log in into the board using their university card.

For the third stage, the participants were observed while they used their device to try to pair with the other participant and they interacted after that. Again, the observed results were positive.

Those results were confirmed by a short questionnaire carried out after the third stage: most study participants positively rated the quality of their social interactions and said that the Pairstone had been at least somewhat useful in greasing it. Nearly all of them found it intuitive that the colour of the device was related to the interests they chose, and that feature received positive feedback – the choice of topics and the Pairstone itself tended to be the central points of focus for the conversation. The understanding of vibration was more controversial, with a nearly perfect split between those who believed the device vibrated when there were other users nearby to pair and those who believed vibration meant a successful pairing. For the prototype showcased here, both were correct.

FUTURE WORK

The device showcased in this paper is just a proof-of-concept. A future prototype should be smaller and more portable, further showcasing the advantages of a wearable computer. That would require the design of a custom micro-controller that would carry on the same functions as the generic-purpose one used in the current prototype. It would also be shaped as a Ying-Yang half, as that was the design found to be most popular and intuitive during the formative study.

In addition to its current features, future iterations should be able to store past interactions in some kind of long-lasting memory, and have the ability to sync them with social networks to find other people the user has paired with. They may also experiment with other ways of users interacting with them, and user studies should be done to test alternatives.

Finally, a functional prototype for the interest board should be made. During user testing its concept proved to be a driving force and a focus point for the conversations initiated. It would be important to analyze its impact in more detail.

Going beyond the hardware, it would be interesting to store more data about the users and the quality of their interaction. That data could then potentially be used to recommend certain pairings over others and to find potential natural groupings with similar characteristics.

CONCLUSION

In this paper we have presented the Pairstone, a wearable device designed to tackle loneliness in university campuses. We have described the current prototype in concept, design and implementation. Finally, we mentioned the results of a formative test of that prototype, and discussed what future iterations of the Pairstone should try to improve upon. We believe this work showcases a functional solution that warrants more work, and hope that it can be improved upon in the future.

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