Fistbump: a wearable to facilitate easy sharing of social data

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ABSTRACT

By focusing on easy and interesting ways to help people form social fabrics, this paper presents Fistbump, a wristband designed to intuitively transfer social media information between individuals through fist bumping. Utilizing Arduinos, accelerometers, and a client-server architecture, our prototype demonstration of Fistbump shows that the system can successfully transfer social media information using a simple gesture.

KEYWORDS

Gesture Recognition; Wearable Interface; Accelerometer; Client-server Architecture

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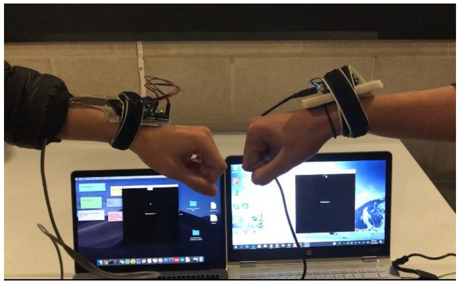

Figure 1: This image shows the prototype in use.

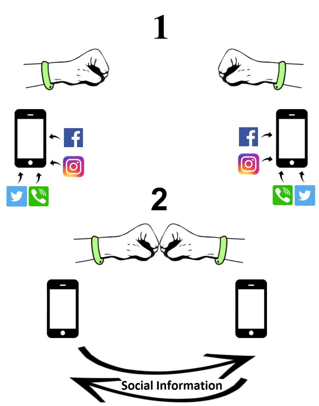

Figure 2: This diagram shows interaction of users.

INTRODUCTION

In noisy and crowded environments, it can be inconvenient, or even anti-social, to stop and exchange social media and contact information. Night clubs tend to be underground, which can result in poor signal and no internet connection.

In this paper, we propose Fistbump, a gesture-detecting wearable wristband that allows two users to exchange social media information instantaneously. This approach is not only more natural and friendly, but it is also much quicker than usual approaches, for example, actually writing down the other person's social media user accounts on paper.

The integrated technique of gesture recognition and a client server architecture is a novel contribution to the community.

WALKTHROUGH

We imagine this wristband to be distributed in a place where we want to facilitate communication between individuals. For example, two individuals meet at a night club and they get along well. Before they leave, person A asks person B if they want to exchange social information. Person B agrees, they fist bump and social data is exchanged.

Prior to the exchange, users of Fistbump would have to install its application and enter their social details that they wish to share with other users. Users can also use the application to view and manage previous exchanges easily. This process is shown in Figure 2.

RELATED WORK

Gesture Recognition

"A study on Human Activity Recognition Using Accelerometer Data from Smartphones" [1] proposes a system that can be used to recognise the type of physical activity performed, using a low-pass filter. The filter isolates and projects the acceleration data from body movements, and sends the results to the users smartphone. The paper also presents a detailed view on the types of classifiers for classification of activities based on accelerometer data and concludes how one type of classifier is better than the other based on a detailed sampling of the data collected.

iBand

Marije Kanis et al present iBand [2], which is a bracelet that exchanges information when one user shakes hands with another. This project was aimed at networking events between professionals. The device is fairly bulky, due it relying on IR sensors for the exchange. The device only supports handshake gestures due to its design, whereas our device will support any gesture which can be cleanly separated using a classifier. Our device also only utilises common sensors, so could be integrated as part of an existing smartwatch.

Smartphone-based Solutions

The discontinued mobile app Bump[3] allows the use of gestures to exchange data. It reduces the work of client by introducing a central server, and thus significantly increases the flexibility of the system.

Android Beam can be used to share data between devices, using Near Field Communication (NFC). This could be used to share social media information by opening a social media app and then bumping the phone against another phone.

In practice, Android Beam doesn't work particularly well as a lot users tend to keep NFC turned off to avoid excess consumption of battery life. Android Beam also needs to be turned on explicitly in using a switch in the NFC settings, which users who do have NFC on are unlikely to do due to lack of awareness of the feature. Due to the need to open the social app, the fact that this only works between two Android devices, and the possible need to explain to another person what to do, this isn't a user-friendly solution.

Using phones directly like in the above solutions may not be appropriate in particular contexts. In addition, there is the risk that the phone is knocked and damaged in a busy environment.

DESIGN

Prototype

Our prototype has a few simplifications to make development easier. Instead of a smartphone, the wearable device is connected to a computer using a wire. The wearable itself does not contain any information, instead the social data is stored on the laptop.

The computer has two processes running on it which are a gesture detector and a client, respectively.

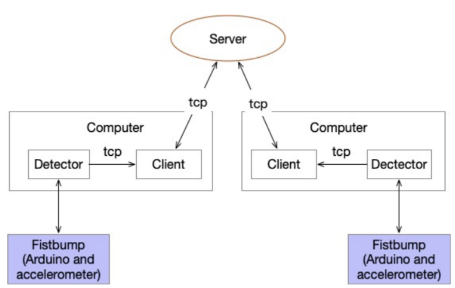

Figure 3: Architecture of the system

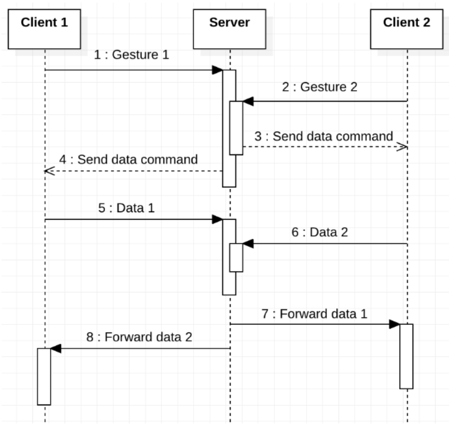

Figure 4: Sequence diagram for communication protocol between devices

The detector constantly reads accelerometer data from the serial port and then decides if a fist bump gesture is being performed. If so, the detector sends the detection result to the client through a local tcp port. The client then forwards the data to a remote server. Once the server finds that there are two clients performing fist bump at the same time, it tells the clients to send the data to exchange it and forward the data to each other.

Fistbump server acts as a median to help clients exchange data. It relies on Redis. More specifically, a sorted set is used to store the identity of the client and the timestamp at which the client sends a gesture detection result. The key of the sorted set is the gesture type. There are three main advantages of the approach. Firstly, Redis is an in-memory database which responds as quickly as milliseconds. Secondly, it scales well which is ideal as the user base grows. Finally, setting gesture type as the key allows for future extension of new gestures.

Gesture Recognition

Initially, ESP software was used[4], but it failed to recognise gestures correctly. Therefore, we turned to build our own gesture recognition software by calling its underpinning library GRT [5] directly. It failed too somehow after several days of trial. But we still believe if multiple gestures are to be supported, machine learning techniques should still play an important role in our system.

We finally decided to adopt a simple threshold algorithm because both previous approaches involved machine learning techniques and required model training which takes a lot of time and is error-prone. Specifically, the algorithm checks if there is a dramatic change in one single axis of the accelerometer. Since we only need to detect the fist bump gesture, it works fine after tuning the threshold properly.

STUDY AND EVALUATION

Mini Study

As an initial starting point, a mini study plan was conducted to investigate the acceptability of a device that shared social media information between two users. The purpose of this mini study plan was to collect feedback from users for various preferred gestures and the type of data / information the users preferred to transfer via hand gestures.

The most common and natural gesture among people was fist bump, more than 70% of them preferred this gesture over the remaining gestures that were thumbs up, handshakes and high-fives. As for data transfer, most of the participants were concerned about sharing their personal information, such as phone numbers and photographs, but were willingly open to share their Facebook/Twitter Account IDs.

Table 1: The results of our main study. True Positive, False Negative, False Positive. $F_1 = \frac{T_P}{T_P+F_N+F_P}$

Trial#	TP	FN	FP	F1 Score
1	2	2	0	0.50
2	1	1	0	0.50
3	1	2	0	0.33
4	2	0	0	1.00
5	1	0	0	1.00
6	1	0	0	1.00
7	2	0	1	0.66
8	1	0	0	1.00
9	2	0	0	1.00
10	2	1	0	0.66
11	3	2	0	0.60
	18	8	1	0.66

Demo Observation and Study

A more detailed study was carried out that analysed both quantitative and qualitative aspects of the device on a sample of eleven students and lecturers at the University of Bristol.

For the first part of the study, two participants at a time were asked to wear the device and perform the 'fist bump' gesture. A record of how many times the system correctly detected (True Positive), falsely detected (False Positive), and falsely not detected (False Negative) was noted. From this information, we generated an F1 score - a statistical measure of accuracy.

The second part was to ask the participants to fill out a questionnaire, focusing on the idea behind Fistbump, whether this device would let them communicate with other students easily and what other features they'd like on the device.

Evaluation

Results from the quantitative study show that our system detects gestures with an F1 score of 0.66. A perfect score would be 1, and the lowest possible score would be 0. Further results can be seen in Table 1. This is not a particularly good score, but the reasons behind the low score are explainable.

The majority of incorrect outcomes were from the first few attempts at the bump. Once users were able to perform a fist bump, they were then more likely to perform it correctly the next time. This was predominantly due to users performing the gesture to a different way than anticipated, which highlights a potential problem of intuitiveness. It was very common for one participant to keep their hand still, whilst the other moved to do the bump. This would result in a false negative, as the required gesture was not performed. It could be a good idea to choose another gesture where both users would be required to do the same gesture, as one user keeping their fist still is still technically a fist bump.

As for the qualitative study, participants had a positive reaction to the device. We had 15 responses to the questionnaire, and of these 67% said that they think Fistbump would improve communication with other students, 53% stated that they would use it frequently, and all participants thought that, in general, people would learn how to use the device quickly.

FUTURE WORK

The Fistbump prototype developed as part of this project, demonstrates the ability to use accelerometers to identify and use human gestures as a mean to transfer data. As this project was primarily aimed at demonstrating the gestures detection, data-transfer was implemented using wired connections to laptops and the internet. This concept could be expanded to replace the computers with smart phones that can be remotely connected to the wristbands using bluetooth, and the transfer would happen over an NFC handshake. More feedback on the device would be needed, for example using LEDs.

As only simple components such as an accelerometer and NFC chips are used, this technology could be incorporated into existing hardware like the Apple Watch. This has the benefit of gaining widespread distribition and then adoption.

In our prototype, only fist bumps where supported; however, this concept could further be expanded to include other gestures ranging from friendly high-fives or hugs to formal handshakes. This, we believe, can be achieved by the training of machine learning models. As mentioned in the Evaluation, other gestures may prove less ambiguous to detect and result in a higher degree of accuracy.

We are well-aware of the safety and security aspects that need to be considered for data sharing devices. The sharing of data could be limited by only sharing through the app installed on the users' smartphones. The fist bump would only exchange a fistbump-specific user ID, and then users would be able to opt to share their media information later using the app. Additionally, we could add the feature of colour changing LED indicators on the wristband to alert the user on the status of the data transfer.

CONCLUSION

This paper, aimed at developing a wearable prototype, Fistbump, is promising to build up on and to be developed into a fully functional wearable device. The ideas and concepts detailed under the future work section shows that there is huge potential to expand the art of combining wearable technology with networking on social media, and the potential of using the technology in existing devices.

The traditional way of writing down contact details on a piece of paper is soon becoming a thing of the past. Similarly, with the latest advancements in technology, sharing of personal details or identifiers of social networks may need to be made simpler and trendier. The idea of combining wearable technology to social media data and using data sharing media such as the one used in Fistbump will slowly but steadily lead to faster and simpler means to share networking data with minimal human effort.

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CONTRIBUTION WEIGHTING

Andrew 25% | Areej 25% | Durga 25% | Ren 25%

(All team members contributed to an equal degree)