POSTER

NoFaceContact: stop touching your face with NFC

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Exploring wireless systems.

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Poster: *NoFaceContact* – Stop Touching Your Face with NFC

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ABSTRACT

Coronavirus disease 2019, known as COVID-19, has spread rapidly and infected millions of people around the world. In addition to respiratory droplet spreading, a common mode of contraction of this virus is when individuals touch their face after coming into contact with a contaminated surface. In this poster, we leverage near-field communication (NFC) and propose a system design, *NoFaceContact*, which can promptly warn users when they attempt to touch their face with the aim of helping to reduce the spread of COVID-19 and improve overall hygiene. A proof-of-concept experiment shows that *NoFaceContact* can achieve an average communication distance of 8.07 cm and can potentially detect a wide range of face touching poses.

CCS CONCEPTS

• **Human-centered computing** → *Ubiquitous and mobile computing*.

KEYWORDS

RSSI, Near-field Communication

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1 INTRODUCTION

Since identified in December 2019, COVID-19 has propagated rapidly, infecting millions of people worldwide and drastically impacting people's lives. While COVID-19 spreads mainly through respiratory droplets from a patient's coughing and sneezing, individuals may also get infected by touching a contaminated surface and then their face. Indeed, several viruses and bacteria spread in this manner.

However, even with appeals from doctors and scientists to not touch one's face, people are accustomed to involuntarily touching their face around 23 times per hour [9]. In this poster, we seek to build a warning system which can promptly monitor users' wrist position and raise an alert when they attempt to touch their face, in order to stifle the propagation of COVID-19 (and potentially other viruses and bacteria) and protect people from infection.

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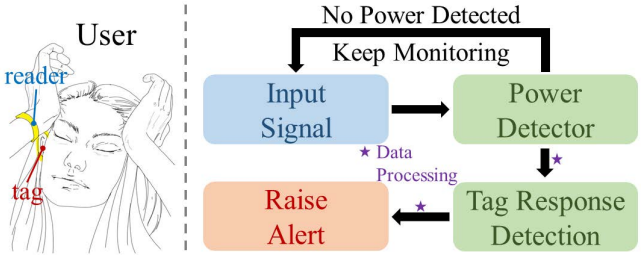

Figure 1: *NoFaceContact*'s workflow.

Closest to our work is a recent attempt [8] that uses a smart watch's inertial sensors to detect a potential face-touch movement. This is an indirect approach that infers the wrist's horizontal position and its tilting angle using motion sensors, which have known problems due to integration errors [12]. In this poster, however, we seek a direct proximity sensing approach that exploits NFC technology, an incorporated function on most modern phones and smart watches today.

Near-field communication (NFC) has already been widely used in daily life, for access control [1], attendance monitoring [2] and contactless payments [3]. NFC exploits the magnetic inductive coupling effect between two antennas working at the 13.56 MHz ISM band. The reader's magnetic field induces a voltage on the tag's antenna, and the tag's magnetic field would, in turn, have its impact on the reader's antenna as well. The reader and tag can thus communicate and exchange important information, such as ID, by modulating the voltage.

This poster proposes *NoFaceContact*, a system that leverages near-field communication (NFC) technology to directly detect an approaching hand towards users' face. *NoFaceContact* has two main components: (a). An NFC tag at the user's face (e.g., attached on earrings or legs of glasses); (b). An NFC reader at the user's hand (e.g., a smart watch around wrist). When the user raises his/her hand, the distance between the reader and the tag is significantly reduced, leading to a detectable change in signal strength. A proof-of-concept experiment in Sec. 3 shows that *NoFaceContact* can achieve an average communication distance of 8.07 cm, making it feasible to detect a wide range of face touching poses.

URL: https://www.witechlab.com/nofacecontact.html

2 APPROACH AND DESIGN CHALLENGES

As shown in Figure 1, at user end *NoFaceContact* has an NFC reader at user's wrist as well as an NFC tag attached around user's ear. The NFC reader actively monitors received signal strength. If the signal power goes beyond a certain threshold, *NoFaceContact* performs further signal processing to detect NFC tag response. A valid tag response will finally trigger an alert to warn the user not to touch his/her face.

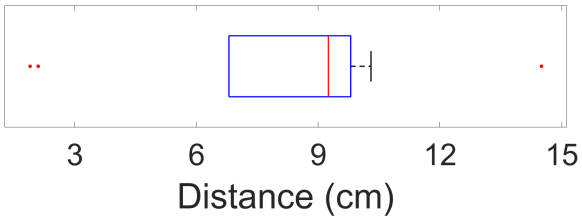

Figure 2: *NoFaceContact*'s communication distance.

In the rest of this section, we touch upon three important questions that impact *NoFaceContact*'s design.

Does NFC provide a proper range? NFC systems are known capable of providing a security guarantee due to the fact that the power of NFC reader falls out rapidly with distance. Hence, the reader is unable to trigger a tag to respond unless they are in close vicinity. This fortunately helps limit false alarms for *NoFaceContact*. In fact, we show in Sec. 3 that the movement of touching one's face is sufficient to trigger the level of proximity needed for NFC, which enables *NoFaceContact*'s detection. Indeed, we show that our approach generalizes for different face touching postures.

Is an NFC tag small enough? Today's micro NFC tags can already be made smaller than a quarter coin [5] and even be programmable at this size [6]. Thus, it is possible that these tag stickers can be attached on glasses or earrings without affecting users' daily life. In our experiments, we considered an NFC tag attached to the user's ear.

Are *NoFaceContact* readers portable? For *NoFaceContact*, an NFC reader that is available at the user's smart watch would be ideal. Indeed, this is a feasible solution since we already have NFC modules built in today's smart phones and watches. While many smart watches support emulating NFC tags, many do not have the software support needed to behave as an NFC reader, primarily due to the lack of applications for such an approach. However, we hope that NFC's potential in limiting the spread of COVID-19 will lead to software updates that open this feature up for more smart watches. We further note that by nature, NFC is much more energy efficient than other radio technologies (WiFi, Bluetooth, etc.) owing to its limited range and would therefore minimally impact battery. We further add that commercial NFC reader modules like [7] are relatively small and can be attached to other wearables such as fitness bands and rings.

3 EVALUATION

We perform a proof-of-concept evaluation on *NoFaceContact*'s feasibility. In our experiment, as NFC reader we use one USRP software-defined radio, which allows us to make precise range measurements. We use a customized coil loop antenna and a LNA component [4] for the USRP's antenna port. We use a 64-bit Dell laptop as backend and transmit within FCC regulations. We choose Mifare Classic tags [11] as our NFC tag.

As summarized in Figure 2, our experiment shows that with a single antenna *NoFaceContact* can achieve an average distance of 8.07 cm, with a maximum distance of 14.5 cm. Its average performance is able to handle a wide range of face touching poses. In Figure 3, we show several face touching poses that fall into *NoFaceContact*'s detection range. The yellow regions mark *NoFaceContact*'s two main components.

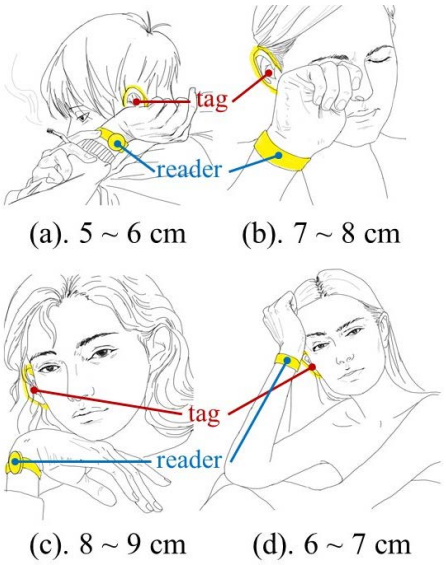

Figure 3: Several face touching poses.

4 CONCLUSION

In this poster, we propose *NoFaceContact*, a novel system that leverages NFC technology to promptly warn users not to touch their face frequently in response to the COVID-19 pandemic. Our proof-of-concept experiment shows that *NoFaceContact* has the potential to detect a wide range of face touching poses. We hope this can encourage core-NFC adoption in future wearables. We will continue developing *NoFaceContact* Apps and we aim to make our documentation and source code openly available in the interest of public benefit [10].

ACKNOWLEDGMENTS

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