Fatal Attraction: Identifying Mobile Devices Through Electromagnetic Emissions

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ABSTRACT

Smartphones are increasingly augmented with sensors for a variety of purposes. In our paper, we show how magnetic field emissions can be used to fingerprint smartphones. Previous work on identification relies on specific characteristics that vary with the settings and components available on a device. This limits the number of devices on which one approach is effective. Our primary insight is that we present a fingerprinting method that is common to all electronic devices. We base our study on a physical phenomenon: the flow of electricity generates a magnetic field which can be measured with the widely-distributed magnetometer.

To test the usefulness of the magnetic field as an identifier, we followed two approaches, first, we conducted an in-the-wild study over four months and collected mobile sensor data from 175 devices. This dataset, composed of Android devices from 41 manufacturers, showed that the electromagnetic field reported by AndroidâĂŹs API is composed of the internal bias of the phone and the measure of the environmental magnetic field. Figure 1 shows the classification F-Score for increasing number of input measurements. Ultimately, using 1,000 measurements (approximately 1.6 minutes) of the bias, we were able to identify devices with an accuracy of 98.9%. We found that the value reported as the bias is independent of the battery consumption of the phone (i.e., the voltage) as well as the brand and model of the phone and the location of the measurement. We also measured the bias over a period of 77 days and concluded that the signal, while not static (i.e., there is some variation) is stable over time.

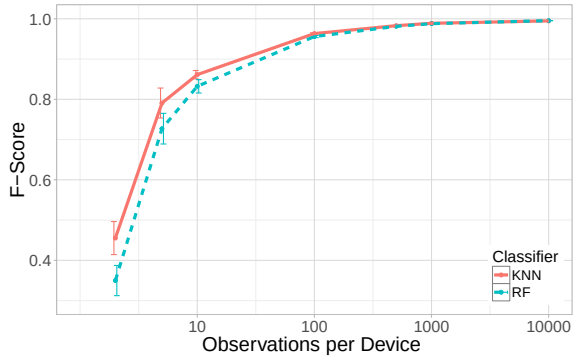

Figure 1: Classification F-Score for increasing observations per device for 175 devices.

The second approach to understanding the magnetic field emitted by phones was to use an external device to measure the emissions of the target. We achieved this by placing a sensor in close proximity (approximately 20cm) to the phone we were attempting to identify. This dataset consists of 30 devices measured over 30 minutes, and unlike the first dataset, the devices used for this experiment included Apple and Windows devices in addition to Android ones. Each volunteer participant was allowed to freely use their device for the duration of the data collection. Figure 2 shows the classification F-Score as a function of the size of the training observations used for each phone. We find that 8 minutes of data is enough to discriminate between the 30 devices with an accuracy of 96.7%, and longer training periods increased the accuracy of the prediction.

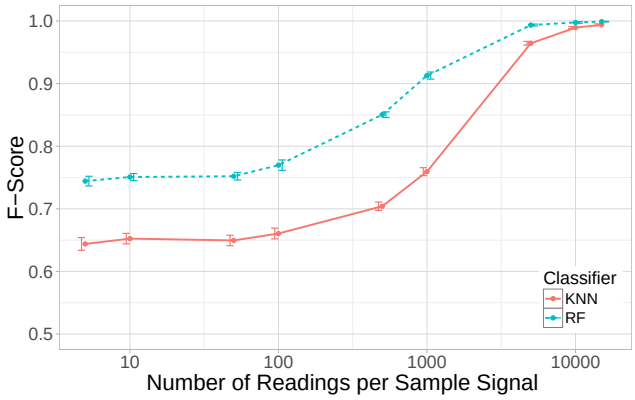

Figure 2: Classification F-Score for external measurement.

While we are confident of the results of the first approach, the limitation of this method is twofold. First, it relies on the target phone having a magnetometer available to collect the measurements and second, it requires the API to report the value of the bias. However, if these conditions are fulfilled, we are confident of the results presented. Comparatively, the results presented in the second approach require further study. The foremost limitation being the proximity between sensor and device as well as the interference generated by surrounding devices. However, with this paper we have presented the feasibility of using the magnetic field of a phone as a means to uniquely identify a device.

This work was published and presented at the 12th ACM Conference on Security and Privacy in Wireless and Mobile Networks [Perez et al. 2019].

REFERENCES

B. Perez, M. Musolesi, and G. Stringhini. 2019. Fatal Attraction: Identifying Mobile Devices Through Electromagnetic Emissions. In *WiSec'19*.