Unconventional Mechanisms for Biometric Data Acquisition via Side-Channels

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Our Hypothesis

Devices intended for non-biometric purposes may contain **sensing capabilities from which biometrics can in fact be derived** without a user’s knowledge. Such unconventional biometric acquisition methods may be implemented by a hacker wishing to steal biometric information. It is therefore important to discuss how such biometrics could be obtained in order to attempt attack mitigation.
Conventional Biometrics

- Conventional biometrics are considered those that are collected from sensors placed for the intended purpose of biometric collection. For example...
  - Fingerprints from fingerprint scanners on mobiles
  - Facial information from cameras for mobile device unlock

- Conventional biometric acquisition mechanisms are the most widely used type of biometric collection techniques and have begun to replace PINs/passwords. This makes biometrics a valuable resource.

- Unconventional biometric acquisition mechanisms are defined as those that are collected from sensing capabilities that are not intended for biometric data collection.

- This presents a security risk to systems using conventional biometrics because an attacker may obtain the user's biometrics via unconventional means.
Security and Privacy Concerns of Biometrics

• Capturing a user’s biometrics poses both a privacy risk and a security risk.

• Biometrics can be used to tell information about a user they may wish to keep private (such as personal behaviours/habits).

• Furthermore, the security risk of replay/spoofing attacks from biometrics captured by an attacker presents a very real security risk. For example, on mobile devices successful attacks have spoofed fingerprints and faces.

via: https://visagetechnologies.com/face-anti-spoofing-face-recognition/
Side-Channels

Non-conventional attack channels that occur due to the way in which a system is implemented.

- Timing
- Acoustic emanation
- Thermal properties
- Electromagnetic radiation
- Optical emission
- Power usage
- Fault analysis
Our Previous Research


Feasibility of Attack

Theremin's “great seal bug” given to US ambassador in Moscow, a 1940s passive eavesdropping device.
Feasibility of Attack

There’s no shortage of smart devices with a variety of sensors and connectivity.
Hardware Hacking Examples

LEDs used as sensors. Source: https://www.sparkfun.com/news/2161
Collecting Biometrics in Unexpected Ways

Developing a Low Cost Capacitive ECG via Arduino and Single Board Computer Interfaced with Capacitive Electrodes for Prevention and Security Aspects

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Biometric Gait Authentication Using Accelerometer Sensor
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Using Light Emitting Diode Arrays as Touch-Sensitive Input and Output Devices
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Acoustic Emanation of Haptics as a Side-Channel for Gesture-Typing Attacks
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Future Security and Cyber Defence,
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The Visual Microphone: Passive Recovery of Sound from Video
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We Can Hear You with Wi-Fi!
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Hard Drive of Hearing: Disks that Eavesdrop with a Synthesized Microphone
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²Zhejiang University
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Some capabilities are more obvious than others.
### Table 1: Summary of popular components of smart devices and the biometric patterns they might collect.

<table>
<thead>
<tr>
<th>Physical</th>
<th>Behavioural</th>
<th>Soft-biometrics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fingerprint</td>
<td>Facial</td>
</tr>
<tr>
<td>Microphone</td>
<td>x</td>
<td></td>
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<tr>
<td>Camera</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>LEDs</td>
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<tr>
<td>Radio</td>
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<tr>
<td>Thermometer</td>
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<td>x</td>
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<tr>
<td>PIR</td>
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<tr>
<td>Accelerometer / Gyroscope</td>
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<td>x</td>
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<tr>
<td>Capacitance sensor</td>
<td>x</td>
<td>x</td>
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<tr>
<td>GPS</td>
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<tr>
<td>Ambient light sensor</td>
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<tr>
<td>Network traffic</td>
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</tbody>
</table>

Summary of sensor capabilities identified in the literature.
Future Work

• Build a full ontology of potential side-channels

• Explore the susceptibility of consumer hardware to remote subversion of hardware behaviour

• Develop a mechanism for consumer awareness of device capabilities (e.g. nutritional facts label)
Conclusions

• There are significant overt capabilities in modern consumer devices

• Lack of public awareness

• There exists the opportunity and motivation for eavesdropping via these unconventional channels

• Countermeasures are possible in some circumstances
Any Questions?

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