Securing the Timestamping of Sensor Data from Wearable Healthcare Devices

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An ageing population, coupled with increasing prevalence of chronic diseases, is placing unsustainable demands on current healthcare systems. Home-based medical monitoring, supported by wearable sensors for heart-rate, ECG, blood pressure, blood glucose, blood-oxygen saturation, etc., has the potential to alleviate the growing burden on hospitals. Timestamping data from such sensors accurately is important for correlating and reconstructing events of medical significance, and to increase trust in the context associated with the data. Unfortunately, reliable timestamping is non-trivial, and cannot be left entirely to the sensor (too resource constrained), the gateway (can be tampered by user), or the datalog server (too far from the medical device).

Timestamps on data from medically-approved wearable devices available in market can be easily altered. For example, with the Fora Diamond Cuff BP, we found that we could tamper the timestamps of measurements simply by changing the time on the smartphone clock while taking the blood pressure. We could similarly tamper with timestamps of readings from the Withings Pulse O₂ device. Even in the case when the app keeps its own clock (rather than the smartphone’s clock), it is relatively easy to tamper the timestamp by hacking the app using tools such as Apktool, Androguard, Cydia, Clutch, Hopper, and iRET. We used Apktool to decompile, modify, and recompile the Android apps for the iFora BP [1] and Withings heart-rate [2] devices, and these modifications are detected neither by the device nor by the data logging servers.

Wearable sensors, although reliable, cannot timestamp data independently as their local clock is relative to their boot time and does not know the absolute time; further, they are resource constrained and cannot run time synchronization protocols like NTP. Smartphone apps cannot be trusted to timestamp data reliably, as they can be hacked (shown above). Servers are too far removed from the wearable sensors, and unpredictable network latencies make the timestamping inaccurate; moreover, data might arrive to the server in bursts due to buffering in device or the smartphone app.

We propose a new solution to the timestamping problem.

1. REFERENCES


This work is funded by Australian Research Council’s Discovery Grant DP150100664.