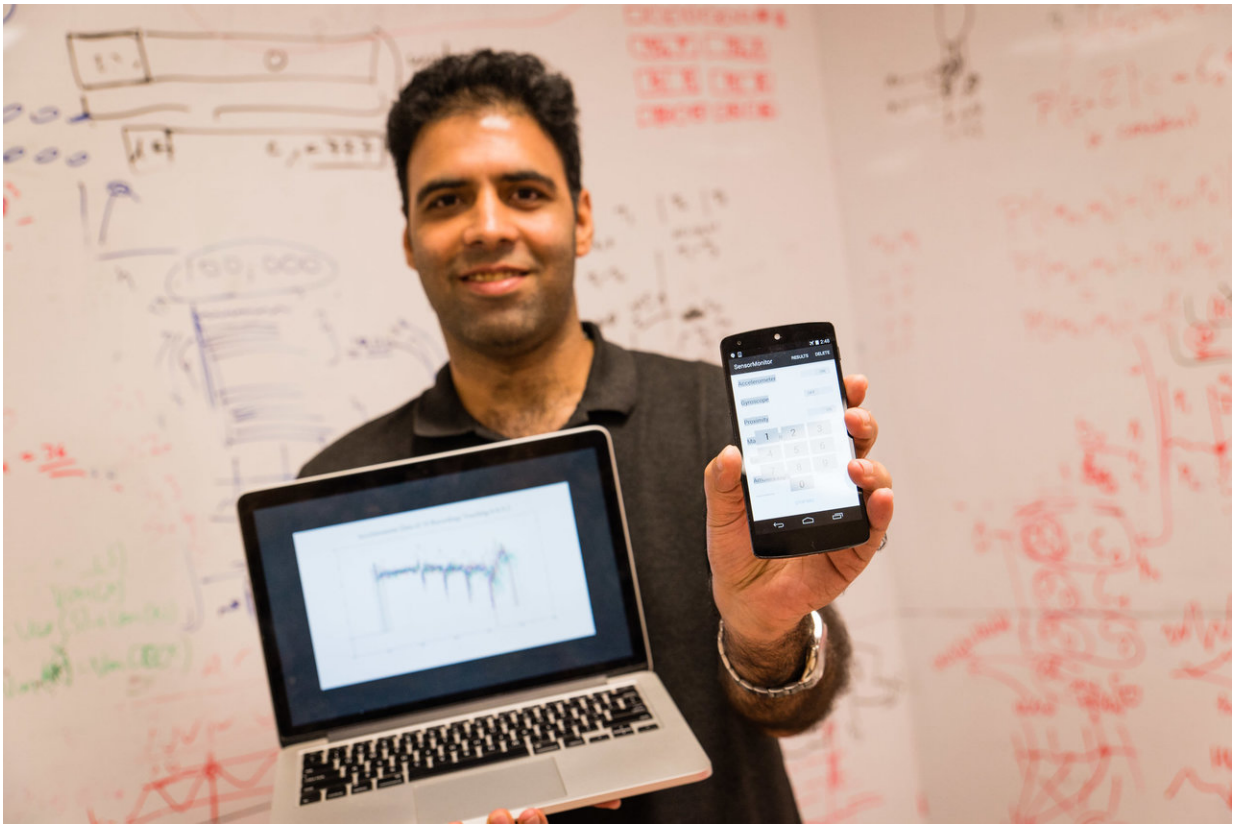
Study finds that hackers could guess your phone PIN using its sensor data

December 27 2017



NTU scientist Dr Shivam Bhasin holding a laptop with the deep learning software and a mobile phone with their custom app. Credit: NTU Singapore

Instruments in smart phones such as the accelerometer, gyroscope and proximity sensors represent a potential security vulnerability, according

to researchers from Nanyang Technological University, Singapore (NTU Singapore), whose research was published in the open-access *Cryptology ePrint Archive* on 6 December.

Using a combination of information gathered from six sensors found in smart phones and state-of-the-art machine learning and deep learning algorithms, the researchers succeeded in unlocking Android smart phones with a 99.5 percent accuracy with only three tries, when tackling a phone that had one of the 50 most common PIN numbers.

The previous best phone-cracking success rate was 74 percent for the 50 most common pin numbers, but NTU's technique can be used to guess all 10,000 possible combinations of four-digit PINs. Led by Dr Shivam Bhasin, NTU senior research scientist at the Temasek Laboratories at NTU, researchers used sensors in a smartphone to model which number had been pressed by its users, based on how the phone was tilted and how much light was blocked by the thumb or fingers.

The researchers believe their work highlights a significant flaw in smart phone security, as the sensors within the phones require no permissions to be given by the user, and are openly accessible for all apps.

The researchers installed a custom application on Android phones that collected data from six sensors: the accelerometer, gyroscope, magnetometer, proximity sensor, barometer, and ambient light sensor.

"When you hold your phone and key in the PIN, the way the phone moves when you press 1, 5, or 9, is very different. Likewise, pressing 1 with your right thumb will block more light than if you pressed 9," says Dr Bhasin, who spent 10 months with his colleagues, Mr. David Berend and Dr. Bernhard Jungk, on the project.

The classification algorithm was trained with data collected from three

people who each entered a random set of 70 four-digit pin numbers on a phone. At the same time, it recorded the relevant sensor reactions.

Known as deep learning, the classification algorithm was able to give different weightings of importance to each of the sensors, depending on how sensitive each was to the numbers being pressed. This helps eliminate factors judged to be less important and increases the success rate for PIN retrieval.

Although each individual enters the security PIN on their phone differently, the scientists showed that as data from more people is fed to the algorithm over time, success rates improved.

So while a malicious application may not be able to correctly guess a PIN immediately after installation, using machine learning, it could collect data from thousands of users over time from each of their phones to learn their PIN entry pattern and then launch an attack later when the success rate is much higher.

Professor Gan Chee Lip, Director of the Temasek Laboratories at NTU, said this study shows how devices with seemingly strong security can be attacked using a side channel, as sensor data could be diverted by malicious applications to spy on user behaviour, to access PIN and password information, and more.

"Along with the potential for leaking passwords, we are concerned that access to phone sensor information could reveal far too much about a user's behaviour. This has significant privacy implications that both individuals and enterprises should pay urgent attention to," said Prof Gan.

Dr Bhasin said it would be advisable for mobile operating systems to restrict access to these six sensors in future, so that users can actively

choose to give permissions only to trusted apps that need them.

To keep mobile devices secure, Dr Bhasin advises users to have PINs with more than four digits, coupled with other authentication methods like one-time passwords, two-factor authentications, and fingerprint or facial recognition.

More information: eprint.iacr.org/2017/1169.pdf

Provided by Nanyang Technological University