CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S1402

Project Title

Quantum Random Number Generation by a Mobile Phone Camera Using Randomness of Photon Emission from a Light Source

Abstract

Objectives/Goals

Recently, security systems are based off of random number generators that do not truly generate ¡°random¡± numbers and are not completely secure. If random number generators are based off of random natural processes, especially those of quantum physics, they could produce better results. My objective was to analyze how quantum random number generation could improve this and in what aspects it was better than other forms of random number generation. I hypothesized that since photon emission is intrinsically random, quantum random number generators based off of photon emission should have much less bias and predictability in comparison to pseudo-random or hardware random number generators.

Methods/Materials

I held three different types of light – red laser, green laser, and white light – at a fixed distance from my Samsung Galaxy Note 3 camera and took pictures of each. The act of taking a picture ¡°measures¡± the location of photons and this creates random data since photons are emitted at completely random times. I then used ExifTool and other extractors to get binary data from the raw pixel data. The second part of my experiment was comparing the randomness of different types of random number generators (pseudo-random and hardware) with binary data I had for pictures from my phone. I created 1,000,000 digits of random numbers with each random number generator. I then analyzed data from all five different random number generators and found the distribution and standard deviation of the digits.

Results

All three of the quantum random number generators were the most ¡°random¡± and had the lowest standard deviations, while the pseudo-random number generator was the most predictable and had obvious bias.

Conclusions/Discussion

In conclusion, random numbers produced by photon emission processes were more truly ¡°random¡± and had less bias. Quantum random number generators should be implemented more in security systems in the future in order to create safer security systems.

Summary Statement

I explored how random number generation could be improved by using the natural randomness of photon emission to obtain quantum random numbers.

Help Received

Mom helped print and tape board