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Remote Healthcare Data Generation For Security Studies

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Homeland Security Challenge

Ransomware and data breaches are an issue we all face, and we sought to investigate remote monitoring and telehealth which requires private healthcare information data to be transmitted over public networks in a secure fashion. In order to generate viable data, our challenge was to first design a circuit that measures a heartbeat with an electrocardiogram with the purpose of transmitting over a wireless network.

Motivation and Goals

According to the HIPPA Journal, hacking and IT incidents accounted for 73% of the healthcare data breaches reported in April 2022 alone, and 97% of the month's breached healthcare records. 2,098,390 individuals were affected by those hacking incidents and may have had their protected health information stolen or sold.

Twenty-two of the fifty-six data breaches in April occurred when a network server was compromised. We wanted to incorporate this information into our research to create an electrocardiogram device that measures a user's heart rhythm to be transmitted to a remote location.

Approach / Methodology

More than 454,000 hospitalizations with A-Fib as the primary diagnosis happen each year in the United States. Heart arrhythmia is an irregular heartbeat that occurs when the heart's electrical signals fire incorrectly. This can cause the heart to begin beating irregularly, too slow, or too fast. Figure 2 shows six common abnormal heart arrythmias and their characteristic ECG signals.

A normal heart rhythm was generated digitally by the ECG circuit connected to a microcontroller. (Figure 3) The circuit design utilized a differential amplifier, notch filter, and low pass filter with electrode sensors and an Arduino MKR 1010 with Wi-Fi connection.

Outcomes / Results

Figure 1: Normal heart rhythm measured by electrocardiogram circuit (below in figure 3) designed in lab

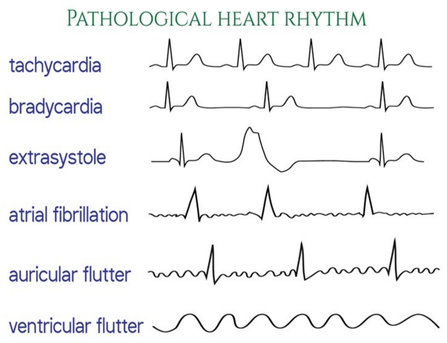

Figure 2: Example of common abnormal heart rhythms

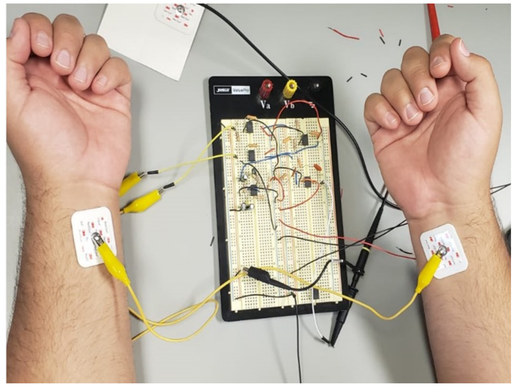

Figure 3: Electrocardiogram circuit with electrode sensors

Conclusions

We were able to produce a live stream ECG signal and were partially able to transmit the signals remotely via Wi-Fi to study its quality and security issues with remotely monitored healthcare data such as an ECG signal.

The significance of this project is that it provided us with the hardware and software needed to generate healthcare data and to further study security issues regarding remotely monitored healthcare data. Future studies will include security investigation and analysis related to healthcare data information and critical infrastructure.

References

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