For this challenge, I decided to disassemble the Nintendo DS. The reason for choosing this system was because there are still homebrew software developers making games for the system, and knowing the hardware helps understand its limitations. I also have some experience servicing the system, and I didn't know much about how the system worked. After researching many identifiable parts, I now have a greater understanding as to how the system works.

There are many components that interact with the system, both on and off the system. The CPU consists of a 66MHz ARM946E-S and 33MHz ARM7TDMI processor, the same seen on Nintendo's Game Boy Advance. The ARM9 CPU handles the majority of video generation, while the ARM7 handles the I/O, wireless communications, sound, and GBA Mode. When using DS software, a First-In, First-Out (FIFO) unit is used for both CPUs to interact with one another. When using GBA software, the ARM9 CPU stops, and the ARM7 CPU slows to a 16.67MHz clock speed to match the original system. Once you enter GBA Mode, you must reboot the system to run DS software.

Speaking of software, all software was distributed on Game Cards, as the system does not have any non-volatile writable memory. These cards featured a Macronix mask ROM ranging from 8 to 512 Megabytes in size, with an access time of 150ns. Many titles also used an ST Microelectronics EEPROM, with a variable size, to store save data. Game Cards are not memory-mapped, so the game must be inserted before startup. If it is removed, the game will stop and the user must turn off the DS. Software could also be downloaded to the system's 4MB of pseudo-static RAM, but as this is volatile memory, the game would be erased when the system is powered off. These can either be demos, or Single Card multiplayer games.

Nintendo DS systems communicate over 802.11 WiFi using proprietary protocols, which prohibits other systems from communicating with the DS. This enabled the DS to feature a built-in messenger named PictoChat. This allows up to 16 systems in a limited range to send text messages and images. During Local Play, all systems communicate in a mesh network. Online play was enabled with Nintendo WiFi Connection titles, but the service was shut down in 2014.

In the end, there were no TI chips, as most were from NEC, Mitsumi, and Nintendo. Most of the identifiable chips were clearly labeled and covered most of the system functions. Through this experiment, I learned more concerning how the CPUs handle their workload, the system's memory map, and how inputs like the touch screen work. This also explains why games always stopped suddenly on my system and why I couldn't play demos after my battery depleted. While this system is now discontinued by Nintendo, this helped me see how even an embedded system works. With this, I can see the innovation that can spawn from a limited amount of resources.

Figure 1 - The Nintendo DS with the wrist strap and stylus.

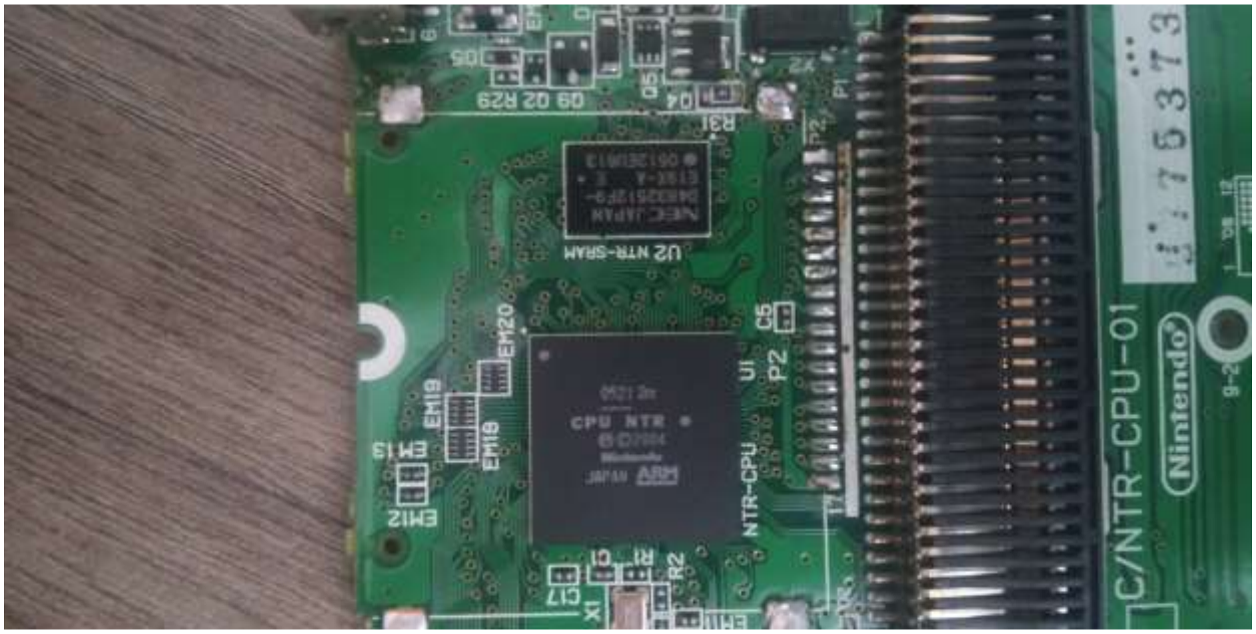

Figure 2 - The NTR-CPU and 4K PSRAM underneath the Game Card slot.

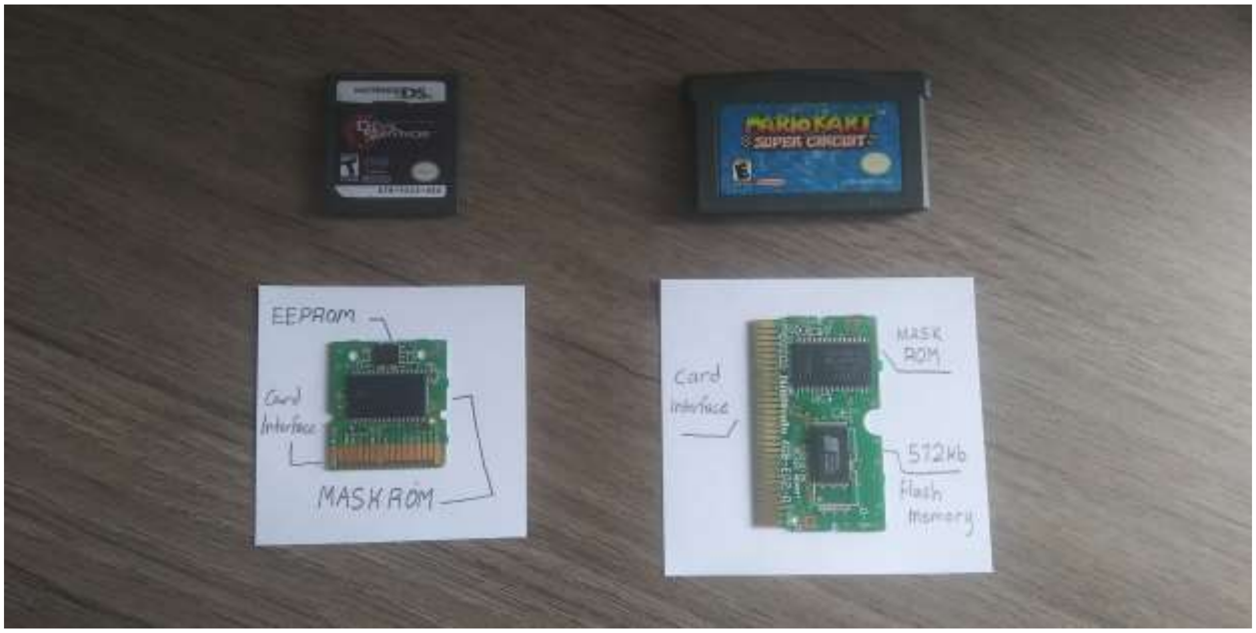

Figure 3 - A Nintendo DS Game Card and Game Boy Advance Game Pak.

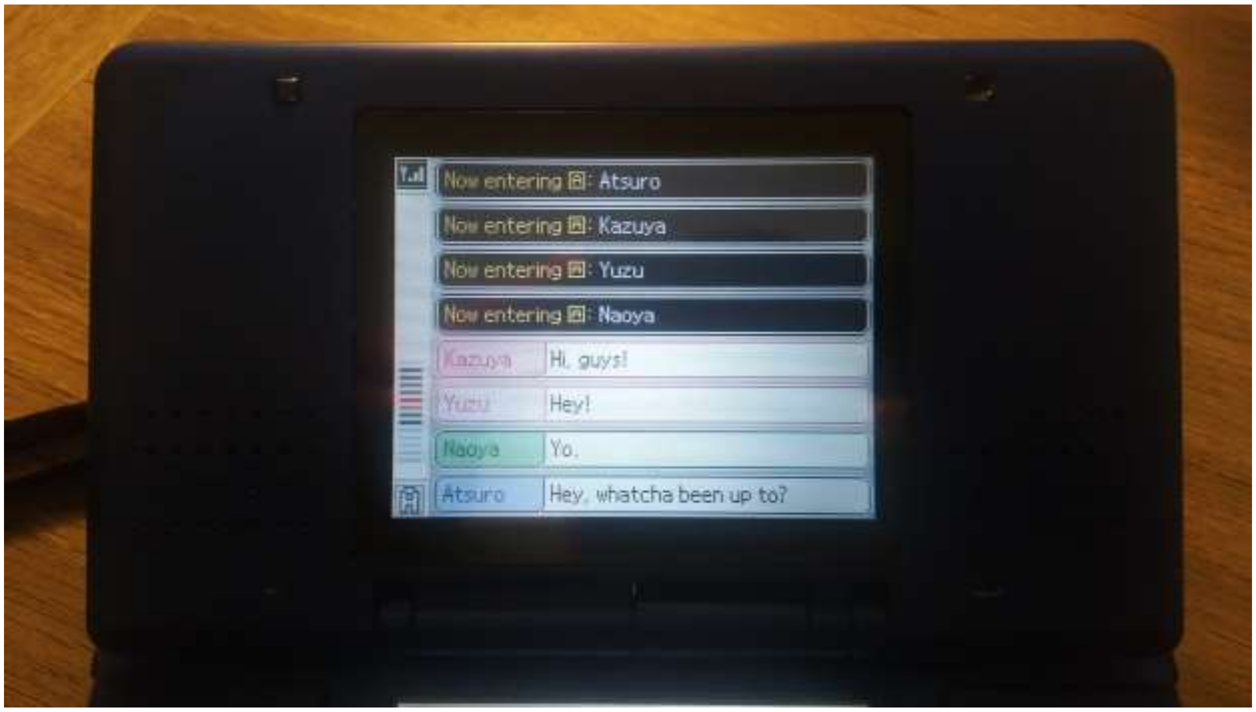
Now entering Ⓐ: Atsuro
Now entering Ⓐ: Kazuya
Now entering Ⓐ: Yuzu
Now entering Ⓐ: Naoya
Kazuya Hi, guys!
Yuzu Hey!
Naoya Yo.
Atsuro Hey, whatcha been up to?

Figure 4 - PictoChat running in one of four rooms (Room A), along with the chat history.

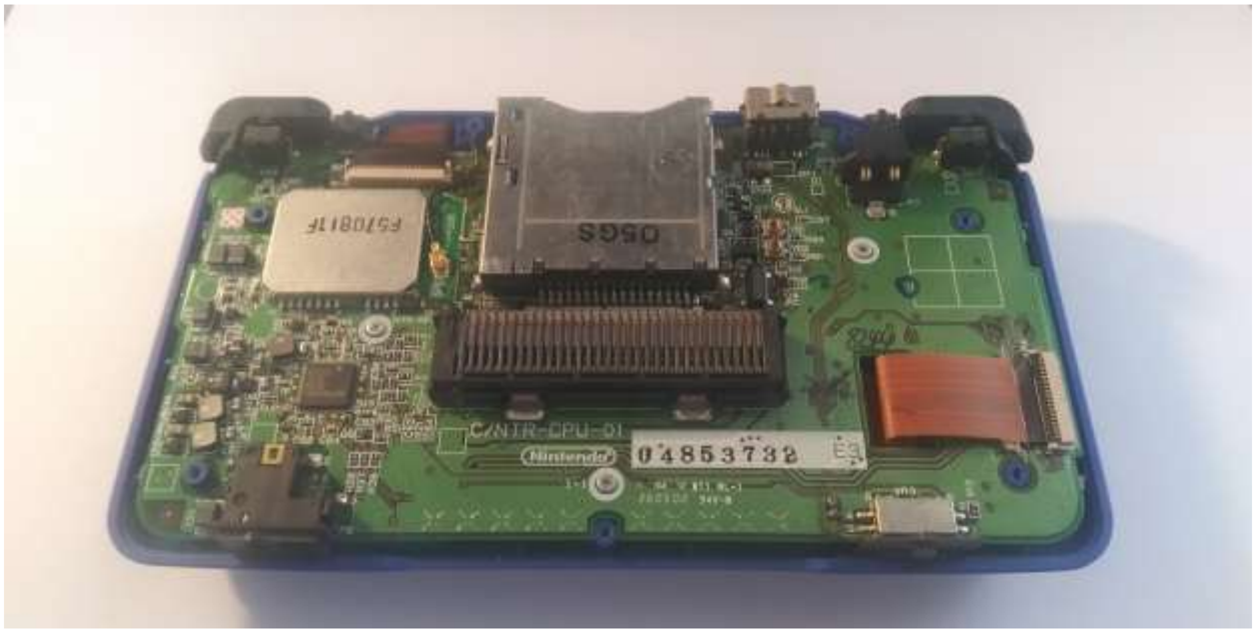
Figure 5 - The Nintendo DS motherboard after removing the back cover.

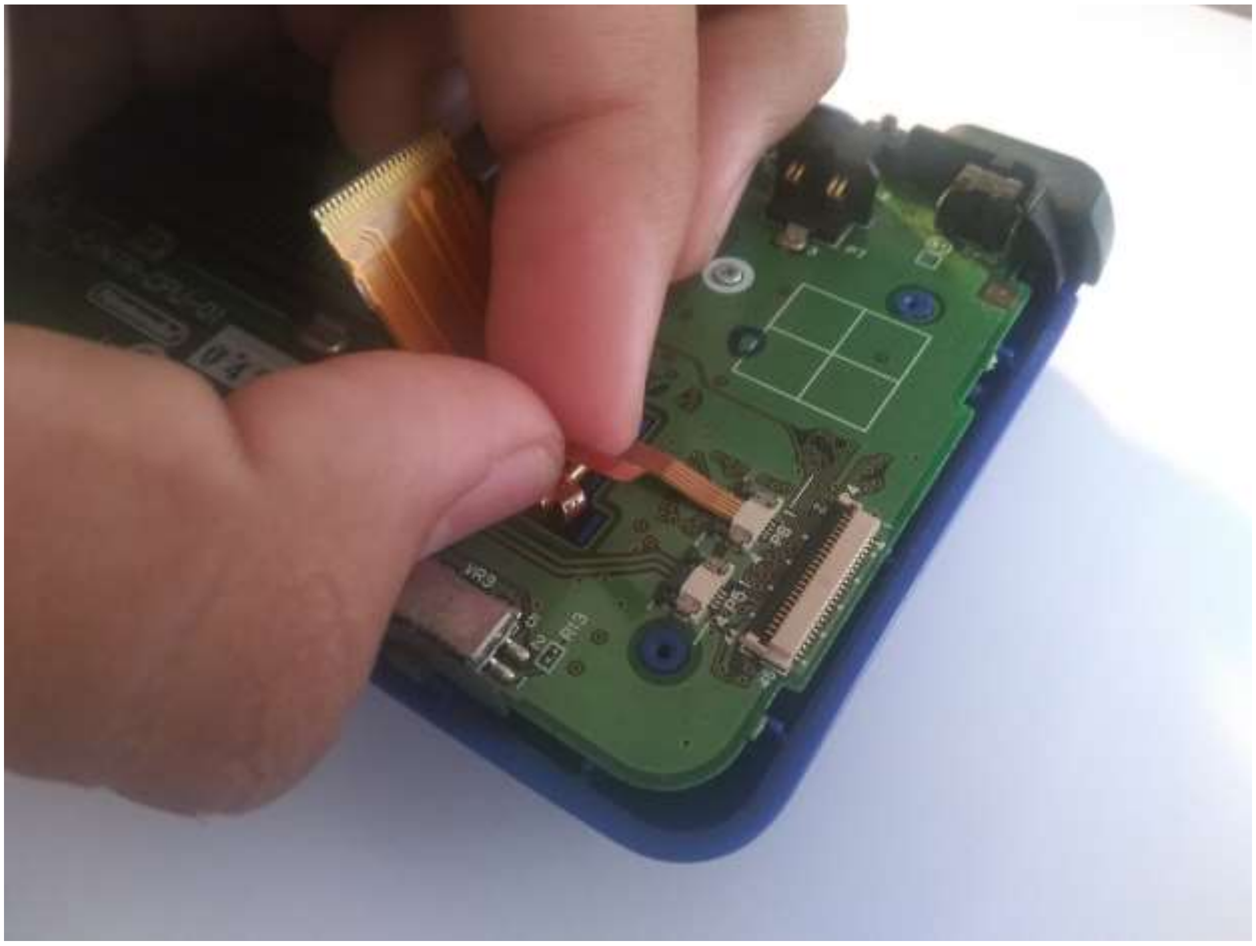
Figure 6 - The cables used for the screen digitizer and bottom TFT screen.

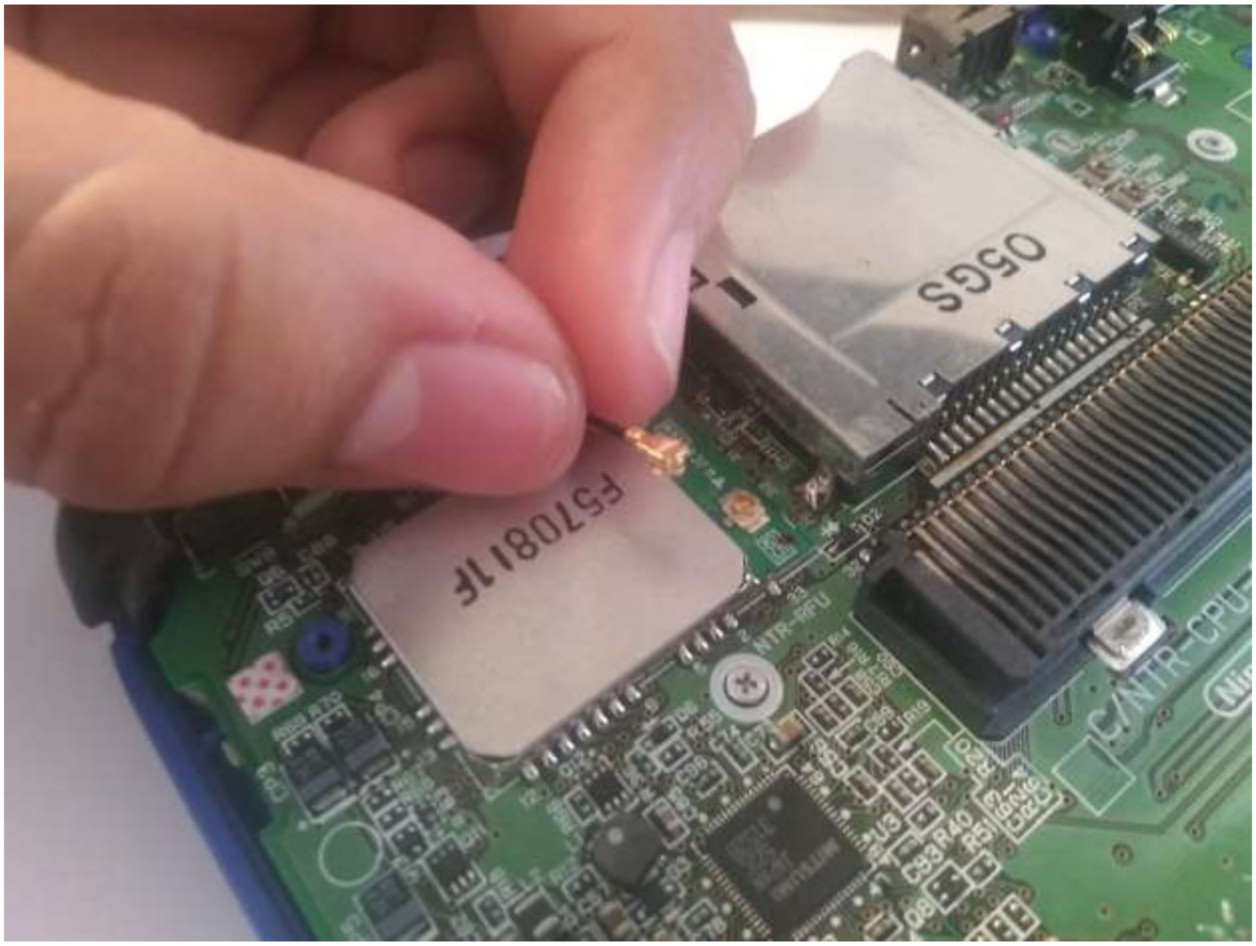

Figure 7 - Disconnecting the cable for the Mitsumi WiFi Adapter.

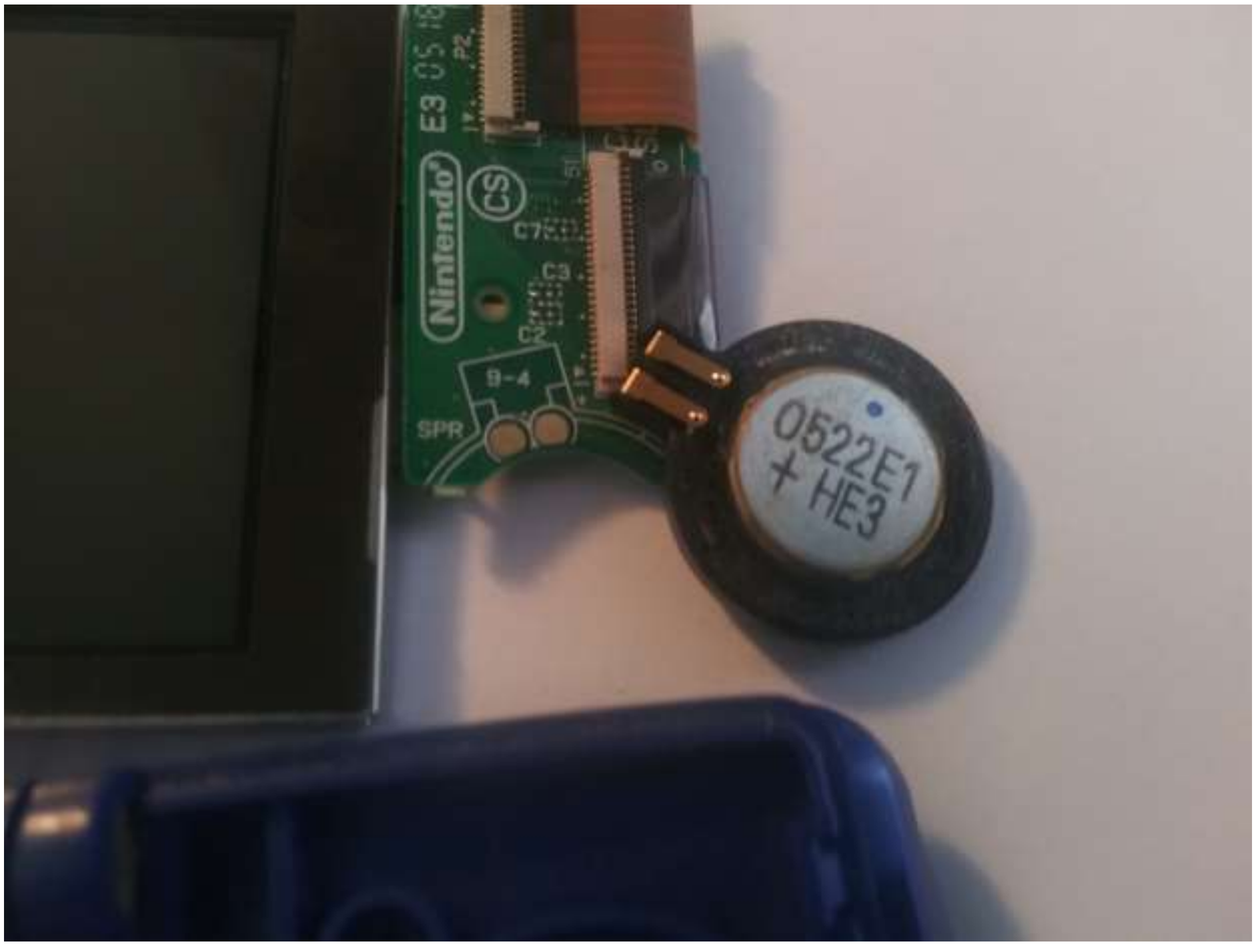

Figure 8 - A daughterboard used to connect both screens and the right speaker.

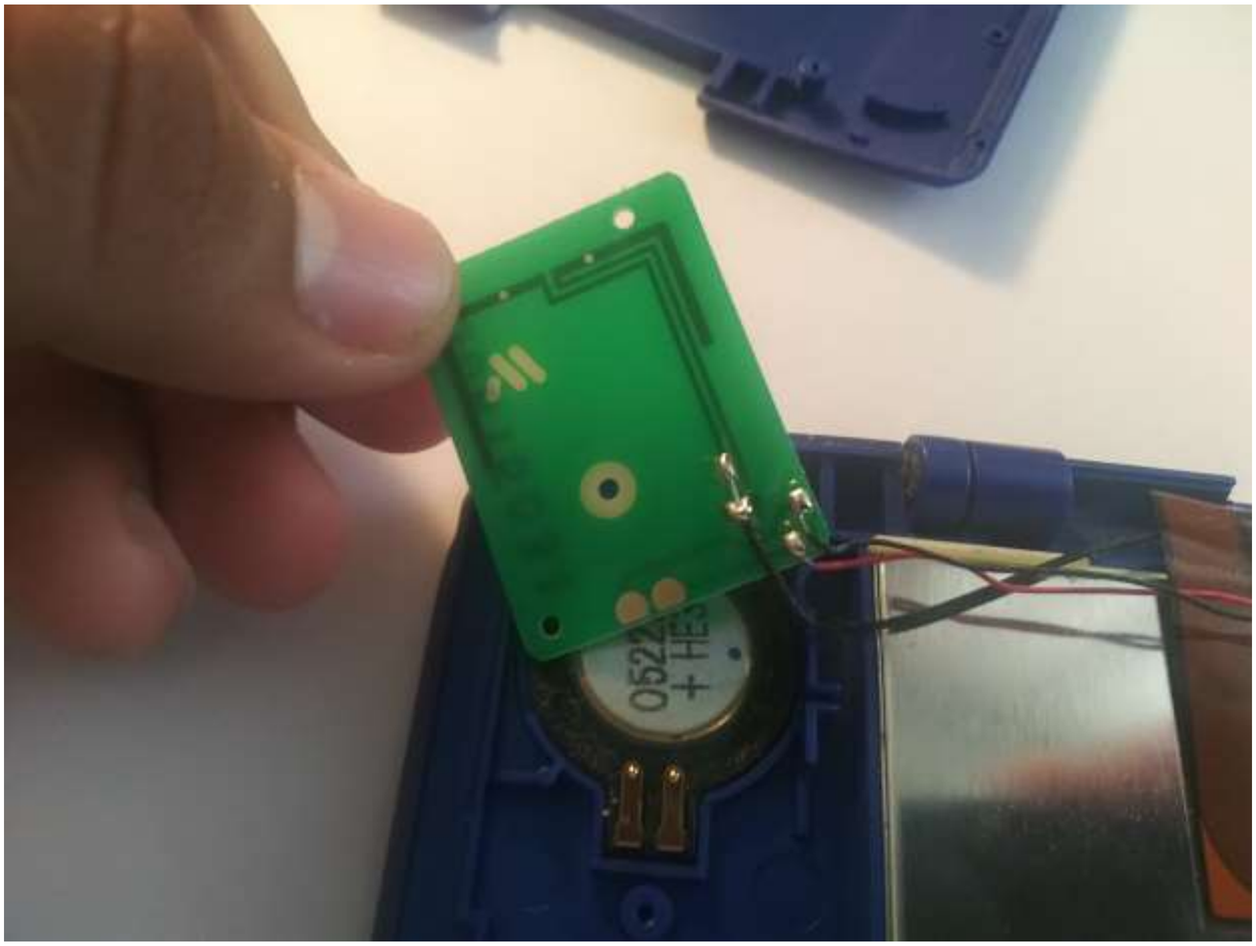

Figure 9 - The WiFi antenna, also serving as a passthrough for the left speaker.

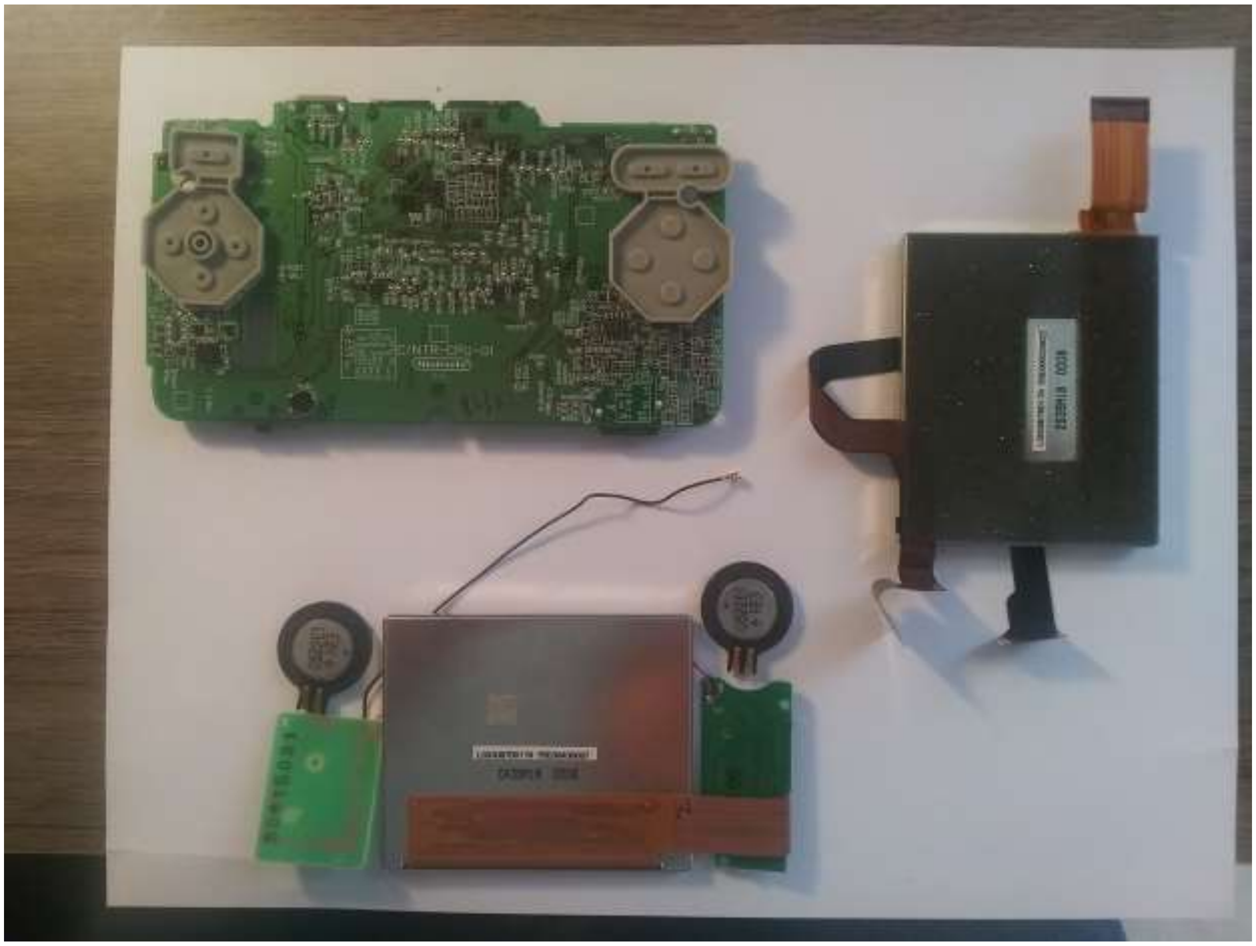

Figure 10 - The system after a full disassembly, separated by what parts are installed in each area.

Part list (Identifiable parts)

ARM956E-S 66~67MHz CPU
ARM7TDMI 33MHz CPU
NEC 4 MB Pseudo-Static RAM
Mitsumi 802.11 WiFi Adapter

ST 45PE20VG EEPROM (Game Card)
Macronix MX23J51208 Mask ROM (Game Card)