



By Hurley Research LLC <http://droidles.com> [jay@hurleyresearch.com](mailto:jay@hurleyresearch.com) 831.251.5389

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## Droidles

Open Source Robotics Toy and Product Development Platform

**Droidles** is a three-component system consisting of cute little **robots**, mobile **apps**, and a cloud service and **website**.

Droidles is fun out of the box for all ages. For engineers, Droidles is a rich open source development environment. This document centers on the appeal to developers.

**The Robot:** the little Droidles robots are compact and feature packed, remote controllable and programmable over Bluetooth.

1. Nordic nRF51822 Bluetooth Smart multi-protocol System-on-Chip, built around ARM® Cortex™ M0.
  - a. Droidles communicate with mobile and desktop apps over Bluetooth Low Energy.
    - i. Remote Control.
    - ii. Wireless programming of scripts and complete firmware.
2. Invensense MPU9150 Motion Processor.
  - a. 3 axis accelerometer
  - b. 3 axis gyroscope
  - c. 3 axis magnetometer
3. Lattice ICE40LPXX FPGA
  - a. The FPGA is used primarily to generate asynchronous high resolution accurate PWM signals that relieve the CPU to conduct higher level tasks.
    - i. motor control
    - ii. colored LEDs
    - iii. range finder output and control waveforms
    - iv. musically pitch accurate tones
4. Motors / Drivers
  - a. Two independent bi-directional motor H-driver circuits.
5. Range Finder
  - a. Custom IR LED range finder circuit design accurate from 2 inches to 6 feet
6. Peer Range and Direction Beacon
  - a. Custom IR based beacon
    - i. Droidles know the direction and distance to peer Droidles.
7. Audio
  - a. Audio amplifier



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- b. On board speaker
- 8. USB Charging System
  - a. On board long-life battery charges over USB
- 9. Color LEDs
  - a. Red, Green, and Blue LEDs to mix any color through difuser
- 10. PCBA
  - a. All together on one compact PCB with mostly surface mount components.
  - b. Designed for low cost volume manufacturing, yet still includes...
  - c. Debug and expansion headers.
- 11. Open Source
  - a. All design files including schematic, gerbers, pick and place data, and bill of materials, etc. are open source and available to developers.

**The Software:** the Droidles system is comprised of four code bases.

- 1. Device Firmware - All Open Source
  - a. Drivers for hardware features
    - i. Range Finder
      - 1. Interfaces to FPGA to continuously manage range finder hardware and makes range-by-angle mapping data available to program interpreter and firmware.
    - ii. Audio tone generator
      - 1. Interfaces to FPGA to set simple synthesized sounds and musical tones.
    - iii. MPU 9150
      - 1. Talks TWI/I2C to MPU and continuously updates local data sets with all mpu data.
      - 2. Maintains averaged and filtered data for easy consumption by firmware and interpreter.
    - iv. Bluetooth LE robotics services and characteristics.
      - 1. Maps Bluetooth 4.0 characteristic writes to a simple command set by which the host BLE device can...
        - a. Remote Control the Droidle in real time
        - b. Download interpreted Droidle programs
        - c. Update low level firmware over the air including BLE soft device.
        - d. Allow communication between multiple Droidle robots through the host.



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- e. Allow communication between multiple Droidle robots over the internet using the host BLE device as an internet bridge.
      - v. Motor controls
        - 1. Interfaces to FPGA to generate high resolution pwm signals to the motor drivers
    - b. Droidles Program Interpreter
      - i. Droidles run scripts in their own simplified language. The on board interpreter is also open source.
      - ii. Droidles programs are generated by
        - 1. Users using a simple mobile app interface
        - 2. Users using a PC app
        - 3. Other Droidles
        - 4. The Cloud Service
    - c. PID motion controller
      - i. Included PID controller uses MPU data to manage motor driver PWMs to accurately maintain speed and heading.
    - d. Music Engine
      - i. A musical system is included that allows Droidles to sing melodies and improvise within standard jazz theoretical rules.
      - ii. The fundamentals of Jazz Theory are known to the Droidles.
      - iii. Allows Droidle A to send a radio message to Droidle B saying: "Here's my song, sing along with me."
      - iv. And then also say, "Now sing along with me using 3rds harmony, and my song is in the key of E minor". etc.
  - 2. Droidles Programs - Super Open Source
    - a. Super Open Source because every program that runs on a Droidle is automatically posted to the Droidle's own web page at [droidles.com/serial-number](http://droidles.com/serial-number) for use by other Droidles and all users.
    - b. The Droidles program language allows sophisticated programs behaviors to be built by users of all ages.
    - c. Gives access to all low level firmware features.
  - 3. Mobile Apps - All Open Source
    - a. iOS and Android apps exercise all Droidles features and provide examples so app developers can build new apps that create all new unforeseen behaviors quickly and easily.
  - 4. Cloud Service and Website - Open API



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- a. The droidles.com website and cloud services are open API so that mobile app developers can take advantage of the programs and other Droidles data stored in the cloud.
- b. Product Developers can now easily create sophisticated M2M applications using the Droidles platform and their devices will inherently have a home on the internet.
- c. The Cloud Service includes simulation and machine learning systems that analyze Droidle robot sensor data and generate Droidles programs that are then available to the Droidles for use in solving problems.

**The IP:** The Droidles concept and network are in the process of being protected so that developers can have confidence that products built on the Droidles platform will have lasting support.

1. The term DROIDLE has a pending trade mark application filed with the USPTO in a broad category of robots including personal use, educational and industrial.
2. The Droidles network is patent pending under provisional application titled "Infrastructure for Society of Autonomous Machines". The patent covers thoroughly how the Droidles network and overall system allows for evolution of intelligent autonomous machines. Any product built on the Droidles platform will be able to share code with the network and benefit from code built elsewhere in the network by human users, the cloud service, or other Droidles based products.