Build Your Own Data Logger: Module 1

Terminology Starter Guide

Useful Reference: https://www.techopedia.com/dictionary

Device	A hardware device is physical unit or piece of equipment that provides one or more computing functions. Eg. data logger
Hardware	Hardware, in the context of technology, refers to the physical elements that make up a computer or electronic system and everything else involved that is physically tangible.
Software	A general term used for computer programs. A computer program is a planned, step by step set of instructions that directs the computer what to do and how to do it. Generally speaking, software can be categorized as: (1) System Software (2) Application Software.
System Software	System software are the programs directly related to the computer hardware which perform tasks associated with controlling and utilizing hardware. System software does not solve a specific problem for the user, rather it helps to solve a problem. It's usually stored in a non-volatile memory such as Read Only Memory (ROM) or Flash memory.

Application Software (Application)	In this context, an application is software that permanently resides in an industrial or consumer device (eg. a data logger, mobile phone). It provides some type of control function and/or user interface. It's usually stored in a non-volatile memory such as Read Only Memory (ROM) or Flash memory.
Embedded System	A system comprising of a computer processor, associated peripherals, and software on a device used for a particular purpose (eg. a data logger). These systems often have no operating system where the hardware is accessed directly or a minimal operating system. Contrast with more 'general' systems such as a computer or laptop which is multi-purpose. In that case, an embedded device is considered "single-purpose".
Embedded software	Software in the embedded system include the libraries, drivers and application. Embedded software is often considered "low-level" meaning it either accesses hardware directly or is very close to the hardware. This can be contrasted with something like Windows software which is many layers removed from the hardware.
Integrated Development Environment (IDE)	An application for building other applications. IDE's combine common developer tools into a single graphical user interface (GUI). An IDE typically consists of: Source code editor: A text editor that can assist in writing software code with features such as syntax highlighting with

	visual cues, providing language specific auto-completion, and checking for bugs as code is being written. Local build automation: Utilities that automate simple, repeatable tasks as part of creating a local build of the software for use by the developer, like compiling computer source code into binary code, packaging binary code, and running automated tests. Debugger: A program for testing other programs that can graphically display the location of a bug in the original code. **Note**: The Arduino IDE does not have a built-in debugger.
Application Programming Interface	An Application Programming Interface (API) is software which allows other software to communicate with each other. It defines the kinds of calls or requests that can be made (to a database for example), how to make them, the data formats that should be used, the conventions to follow, etc.
Command Line Interface (CLI)	A user interface where the user types text commands to trigger actions to be performed. Common command line interfaces are the Linux or MacOS terminal, Windows DOS shell, or python command line interface.
Compile	Converting code into machine code to produce an executable programme that can be run on hardware.
Library	Software that interfaces between the application and drivers so the application can access and control the hardware. A kind of 'friendly API'.

	Includes the driver, and additional functionality and processing.
Driver	Low-level software that controls a piece of hardware. Drivers often configure and initialize the hardware. They also provide an API for users to control the hardware so the user does not need to understand the register-level details. An example of this is the DHT11 sensor driver included in the DHT11 library. We only need to call the function readTemperature() to get the temperature without knowing any of the details about how the temperature is retrieved.
HARDWARE	
Peripheral	A piece of hardware that interfaces with the real world, and connects to the circuit board. Peripherals send data to the CPU (input) or receive data from the CPU (output). Eg microphone (input), speakers (output), temperature / humidity sensor (input), camera (both), I2C (both), Analogue-to-Digital Converter (ADC - both)
Accessory	A 'passive' piece of hardware that attaches to the circuit board. eg. antenna, solar panel, battery case.
Circuit Board (Printed Circuit Board, PCB)	A printed circuit board is a physical piece of technology that allows for the assembly of electrical circuits on a horizontal layer of material.

Block diagram	A diagram of the circuit board showing key parts and functions, and how they're connected to each other.
Chip, Integrated Circuit (IC)	An assembly of electronic components such as transistors, put together as a single electrical circuit, often with a specific purpose.
Electronic Component (component)	An electrical component is a small, physical piece of hardware such as a resistor, transistor, diode, which affects or alters the electrical current in a circuit.
Central Processing Unit (CPU) or Processor	The main chip on the circuit board that executes instructions from the software.
Microcontroller (MCU)	A single integrated circuit containing the CPU plus memory, and peripherals. Usually used in devices which have single or limited purpose and used in embedded applications. eg. Data logger.
Microprocessor (MPU)	A computer processor that incorporates the functions of a central processing unit on a single (or more) integrated circuit. Used in desktops and laptops. Nb. Raspberry Pi itself is an embedded computer, or an SBC (single board computer). The processor on the Raspberry Pi is somewhat of a hybrid between a microprocessor and microcontroller. It is actually a SoC (system on chip).
Module / Breakout board	A module is an independent circuit board or piece of hardware that plugs into the main circuit board, and extends the functionality. In the WildLogger kit, the DHT11 temperature and humidity sensor

	board is considered a "sensor module". Examples of other modules are a GPS module.
Random Access Memory (RAM)	A type of volatile data storage that can be written into and read from quickly. In embedded systems, especially Arduino, RAM is considered a precious resource and used to store data that can possibly change such as variables, tables, and text strings.
Flash memory	A type of non-volatile data storage that can be written into and read from quickly. It's used to store data that won't change. Application software is often stored in flash memory. Configuration data and text data that doesn't change can also potentially be stored in flash memory to save on RAM.
Volatile	Temporary memory that deletes the data when the system is turned off. Eg. stores the variable values in our application code. On a PC, RAM is volatile so anything in RAM disappears once the computer is turned off.
Non volatile	Permanent memory that keeps data when system is turned off. Eg. stores the application, drivers and libraries. On a PC, the hard drive is non-volatile so even if the PC is turned off, the hard drive data is still intact.
Input/Output (I/O)	Any software or hardware device that is designed to send /receive data to / from a computer hardware component. Sensors and pushbuttons are considered input devices because they send data into the system. LCD displays and LEDs are considered output devices because they take data from the system.

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I/O Port or Interface (port/interface)	*Has different meanings depending on the context. In our hardware context it:* Connects two pieces of hardware together and allows them to communicate. The input/output port is a memory address used by software to communicate with a piece of hardware. Alternatively referred to as I/O address, I/O port, and I/O port address.
I/O Pins	A pin on the circuit board that physically connects peripherals to the chip on the circuit board.
Digital I/O Pin	A digital input / output pin is a board pin which can send a signal that is high (on - 3.3v or 5v) or low (off or 0v).
Analogue I/O Pin	An analogue input / output is a board pin which can send any value in the voltage range, eg. between 0v and 3.3v or 5v.
Analogue (Analog) to Digital Converter (ADC)	An analogue-to-digital converter is a system that converts an analogue signal, such as a sound picked up by a microphone or light entering a digital camera, into a fixed value. e.g. On the Wildlogger system, using the 3.3V power supply as the analog reference, a voltage of 1.65V (half of 3.3V) corresponds to an ADC value of 512. A maximum value of 3.3V corresponds to an ADC value of 1024 (or 2^10) which is the maximum value of the Arduino's 10-bit ADC.
Interrupt	An interrupt is a signal in the circuit board that when triggered, prompts the system to stop everything else and do whatever task is required by the interrupt.

Serial interface	A serial interface is a communication interface between two digital systems that transmits data as a series of voltage pulses down a wire.
I2C	I2C is a way of allowing multiple devices (most often low-speed, peripheral integrated circuits) to communicate with each other over a single pair of wires.

I2C is a very useful serial communications protocol.

It is ideal for small, low-power-consumption settings, and is used to interface sensors and controls with embedded devices and microcontrollers such as the Arduino and the Raspberry Pi. |
| SPI | Sometimes pronounced "spy". It's another serial protocol commonly found on sensors and modules and supported by the Arduino. It is faster than I2C but uses more pins and cannot communicate with multiple devices over the same pair of wires. A common device that uses the SPI interface is the microSD card. |
| Realtime clock / calendar (RTC) | A real-time clock is a digital clock, usually in the form of an integrated circuit that is solely built for keeping time.

It counts hours, minutes, seconds, months, days years, and in the case of the RTC on Wildlogger, centuries.

This is very useful in devices that require time such as for timestamping purposes, or to conserve power by setting alarms to wake up on a specific schedule. |
| PIR Sensor | A Pyroelectric Infrared Sensor. This is what most people call an infrared motion sensor. It has the white bulb-like lens and can be found on many camera traps. |

Resistor	A common component on circuit boards used to control the amount of electricity flowing in a circuit. You can think of it like a water pipe. The larger the resistor, the smaller the diameter of the water pipe (ie: it will restrict water flow more). Only in the resistor case, it will restrict current flow.
Capacitor	A common component on circuit boards that store charge. You mainly won't need to know much about them unless you're designing the circuit.
Surface Mount	A method of mounting a component directly on to the surface of a printed circuit board. It does not go through holes in the circuit board but attaches directly to the surface via solder.
Through Hole	A method of mounting a component to a circuit board by inserting the component legs into pre-drilled holes in the circuit board. The holes are then filled with solder to form an electrical and mechanical connection.
Electricity	
Current	An electric current is a flow of electric charge in a circuit. It does the actual work in a circuit such as lighting an LED. Eg. the movement of positive or negative electric particles (electrons) in a circuit.
Voltage	Voltage, electric potential difference, electric pressure or electric tension is the difference in electric potential between two points.
Sleep mode	When all the peripherals are powered in the circuit, but they're not doing anything. This is a special low power state in many devices to conserve as much power as possible.

	Eg. In between waiting to take a reading at a certain time, the Wildlogger system will often be in sleep mode.
Active mode	When all the peripherals are connected to the circuit, and are or ready to be doing things. Eg. Taking a reading.
Multimeter	A multimeter, also known as a volt-ohm meter, is a handheld tester used to measure electrical voltage, current (amperage), resistance, and other values. Multimeters come in analog and digital versions and are useful for everything from simple tests, like measuring battery voltage, to detecting faults and complex diagnostics.
Ampere (A)	The unit that current is measured in.
Ampere Hour (1Ah = 1A · 1hour)	One ampere-hour is the electric charge that flow in electrical circuit, when a current of 1 ampere is applied for 1 hour.
microAmps (µA)	One millionth (10^{-6}) of an ampere, abbreviated as µA.
milliAmps (mA)	One thousandth (10^{-3}) of an ampere, abbreviated as mA.
Software	
ASCII	A character encoding standard. ASCII codes represent text in computers, telecommunications equipment, and other devices.
CSV (Comma Separated Values)	A delimited text file that uses a comma to separate values.

	Commonly used in embedded devices (like a data logger) because it doesn't take up much memory.
JSON (Javascript Object Notation)	A lightweight format for storing and transporting data on the web. Uses more memory than CSV.