Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics or features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

1. Importing the image via image acquisition tools;
2. Analysing and manipulating the image;
3. Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

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| **Analogue Image Processing** | **Digital Image Processing** |
| The analogue image processing is applied on analogue signals and it processes only two-dimensional signals. | The digital image processing is applied to digital signals that work on analyzing and manipulating the images. |
| Analogue signal is time-varying signals so the images formed under analog image processing get varied. | It improves the digital quality of the image and intensity distribution is perfect in it. |
| Analogue image processing is a slower and costlier process. | Digital image processing is a cheaper and fast image storage and retrieval process. |
| Analogue signal is a real-world but not good quality of images. | It uses good image compression techniques that reduce the amount of data required and produce good quality of images |
| It is generally continuous and not broken into tiny components. | It uses an image segmentation technique which is used to detect discontinuity which occurs due to a broken connection path. |

1.3.1.2 Background subtraction

Background substraction is another conventional method used in object isolation. In vehicle detection a image of the background is taken when there are no vehicles present this is then substracted with an image where vehicles are present resulting in a picture where there is only the vehicles. This would not leave perfectly substracted image, there will be noise present and this noise can be cut down using filters. The drawback of this system is that the background image qualities would vary with the weather condition leading to much more noise. Hence the background image needs to be updated frequently but this becomes an issue since there would be hardly any time without vehicles at an intersection to capture a image of the background only.

Thread

In computing, a **process** is an instance of a computer program that is being executed. Any process has 3 basic components:

* An executable program.
* The associated data needed by the program (variables, work space, buffers, etc.)
* The execution context of the program (State of process)

A **thread** is an entity within a process that can be scheduled for execution. Also, it is the smallest unit of processing that can be performed in an OS (Operating System).

In simple words, a **thread** is a sequence of such instructions within a program that can be executed independently of other code. For simplicity, you can assume that a thread is simply a subset of a process.

**Thread Control Block (TCB)**:

A thread contains all this information in a **Thread Control Block (TCB)**:

* **Thread Identifier:** Unique id (TID) is assigned to every new thread
* **Stack pointer:** Points to thread’s stack in the process. Stack contains the local variables under thread’s scope.
* **Program counter:** a register which stores the address of the instruction currently being executed by thread.
* **Thread state:** can be running, ready, waiting, start or done.
* **Thread’s register set:** registers assigned to thread for computations.
* **Parent process Pointer:** A pointer to the Process control block (PCB) of the process that the thread lives on.

**Multithreading**

Multiple threads can exist within one process where:

* Each thread contains its own **register set** and **local variables (stored in stack)**.
* All thread of a process share **global variables (stored in heap)** and the **program code**.

**Multithreading** is defined as the ability of a processor to execute multiple threads concurrently. single-core CPU, it is achieved using frequent switching between threads. This is termed as **context switching**. In context switching, the state of a thread is saved and state of another thread is loaded whenever any interrupt (due to I/O or manually set) takes place. Context switching takes place so frequently that all the threads appear to be running parallely (this is termed as **multitasking**).

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. [Arduino boards](https://www.arduino.cc/en/Main/Products) are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. Arduino board designs use a variety of [microprocessors](https://en.wikipedia.org/wiki/Microprocessor) and controllers. The boards are equipped with sets of digital and analog [input/output](https://en.wikipedia.org/wiki/Input/output) (I/O) pins that may be interfaced to various expansion boards ('shields') or [breadboards](https://en.wikipedia.org/wiki/Breadboards) and other circuits. The boards feature serial communications interfaces, including [Universal Serial Bus](https://en.wikipedia.org/wiki/Universal_Serial_Bus) (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers can be programmed using [C](https://en.wikipedia.org/wiki/C_(programming_language)) and [C++](https://en.wikipedia.org/wiki/C%2B%2B) [programming languages](https://en.wikipedia.org/wiki/Programming_language). In addition to using traditional [compiler](https://en.wikipedia.org/wiki/Compiler) [toolchains](https://en.wikipedia.org/wiki/Toolchains), the Arduino project provides an [integrated development environment](https://en.wikipedia.org/wiki/Integrated_development_environment) (IDE) based on the [Processing](https://en.wikipedia.org/wiki/Processing_(programming_language)) language project.

Most Arduino boards consist of an [Atmel](https://en.wikipedia.org/wiki/Atmel) 8-bit [AVR microcontroller](https://en.wikipedia.org/wiki/AVR_microcontroller) (ATmega8, ATmega168, [ATmega328](https://en.wikipedia.org/wiki/ATmega328), ATmega1280, ATmega2560) with varying amounts of flash memory, pins, and features. The 32-bit [Arduino Due](https://en.wikipedia.org/wiki/Arduino_Due), based on the Atmel [SAM3X8E](https://en.wikipedia.org/wiki/Atmel_ARM-based_processors#SAM_3) was introduced in 2012. The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple and possibly stacked shields may be individually addressable via an [I²C](https://en.wikipedia.org/wiki/I%C2%B2C) [serial bus](https://en.wikipedia.org/wiki/Serial_bus). Most boards include a 5 V [linear regulator](https://en.wikipedia.org/wiki/Linear_regulator) and a 16 MHz [crystal oscillator](https://en.wikipedia.org/wiki/Crystal_oscillator) or [ceramic resonator](https://en.wikipedia.org/wiki/Ceramic_resonator). Some designs, such as the LilyPad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions.

Arduino microcontrollers are pre-programmed with a [boot loader](https://en.wikipedia.org/wiki/Boot_loader) that simplifies uploading of programs to the on-chip [flash memory](https://en.wikipedia.org/wiki/Flash_memory). Boards are loaded with program code via a serial connection to another computer.