



## The Concept of Object Recognition

**Astha Gautam**  
CSE Department  
Bahra University  
India

**Anjana Kumari**  
CSE Department  
LRIET Solan  
India

**Pankaj Singh**  
ME Department  
Bahra University  
India

**Abstract:** Object recognition is a process of detecting the object present in an image or a video sequence, with the help of some recognition technique or methods. Object recognition is one of the techniques of digital image processing where we can process any image by applying some of the operation. It actually depends on human perception that what sort of output he needs, based on that, one can apply a particular technique.

**Keywords:** Digital Image Processing, Object Recognition, Analogue, Discrete, Enrolment.

### I. INTRODUCTION

Before understanding the concept of object recognition the very first thing is to understand the concept of an image. Image is actually a two-dimensional signal and it can be represented mathematically as  $F(x, y)$  where  $x$  and  $y$  are two coordinates, horizontally and vertically. Actually, the particular point i.e.  $F(x, y)$  is the value of the pixel. The very basic term includes in an image is a pixel i.e. a smallest element constitutes in an image and the point  $F(x, y)$  represents the particular value of the pixel. [1] Pixel can store a value that is proportional to the intensity of the light at a particular location.

As image is a two dimensional visual signal, we can define signal as the quantitative measurable item over the time and space. Thus, it can be one-dimensional, two-dimensional, three-dimensional or higher dimensional too and can be analogue or discrete.

Object recognition includes the very basic concept of image processing which is actually the manipulating of an image with the help of algorithms, depends on human perception [2]. Therefore image processing can simply be defined as a method to first convert an image into digital form and then perform some of the operations to manipulate the image. The entire work on an image is actually depends on the smallest element of an image that is a pixel. Each pixel corresponds to any one value and the value of each pixel corresponds to the intensity of light photons striking. The pixel value denotes the intensity of an image that is also known as gray level [4]. Simply the purpose of image processing can be considered as to observe the objects that are not visible (Visualization), to create a better image (Image Restoration), to retrieve the information from an image (Image Retrieval), to measure various objects in an image (Measurement of Pattern), to distinguish the objects in an image (Image Recognition) and so on [5]. For recognizing the object in an image, the points has to be extract from the image and that is known as the key points of an image which is very important and valuable. These points have many applications in an image processing like object detection, object and shape recognition, image registration and object tracking. By extracting the key points, we can use them for finding objects in the other images. [3]

#### A. Analogue Signals

These are continuous signals and can be measured with respect to time. They can be defined over independent variable and hence are difficult to analyze and they do carry a huge number of values. They do have very large sample values and thus are very much accurate. They can be denoted by Sine waves and does require an infinite memory for storage purpose.

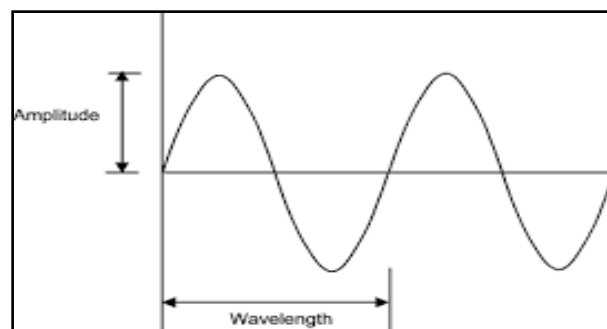


Fig.1 Continuous Signal

If there is a concept of image processing then we can say that analogue image processing can be done on analogue signals. In such type of processing images are manipulated by varying the electrical signals.

Example: Human Voice, when we speak, the voice produced travels through a medium (say the medium is air) in the form of pressure waves and thus belongs to a mathematical function, having independent variables of space and time.

### B. Digital Signals

They are discontinuous signal and are very easy to analyze as compared to the analogue signals. They do require a specific value for representing any sort of information. They only use binary values that are 0 and 1 and can be denoted by square waves:

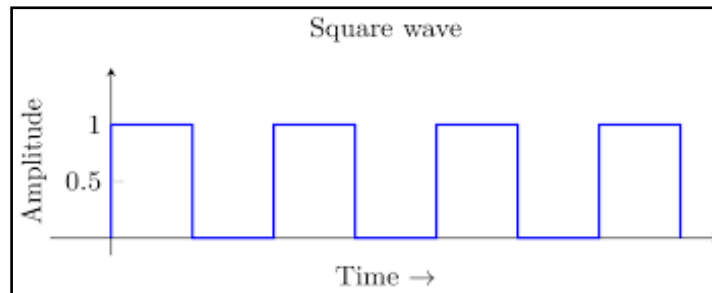


Fig.2 Digital Signal

Digital image processing can be done on digital signals. It first requires converting analogue signals into digital signals and thus operations can be performed on digital images. Generally, the word digital stands for discrete values and hence it means that they use specific values to represent any information.

Example: Computer Keyboard, when key is pressed from the keyboard, an appropriate electrical signal is sent to a keyboard controller that is containing ASCII values for a particular key. For example, electrical signal that is generated when keyboard key 'a' is pressed, it carries the information of digit '97' in the form of 0 & 1, which is ASCII value of character 'a'. [1]

## II. A PARTICULAR SYSTEM

Normally, a system is defined as which takes the input, process it and gives the output. Here in the case of signal or images, normally the images are continuous signal but for the purpose of manipulation or we can say for the purpose of processing with the help of computer we need to convert the analogue signal into digital signal because computer only understands the machine language in the form of binary numbers. Thus, a conversion system is used for converting the signals from analogue to digital signals.

In digital signal processing, sampling is the process of breaking up a continuous signal to a discrete signal. A common usage of the process is the analog to digital conversion of a sound signal. Even though the signal has discrete values in x axis now, the signal is half continuous and cannot be correctly represented digitally. In order to achieve a completely discrete signal, a second step of discretization is carried out. In digital signal processing, quantization is the process of mapping a larger set of values to a smaller set. The best example is rounding the numbers to make them manageable.

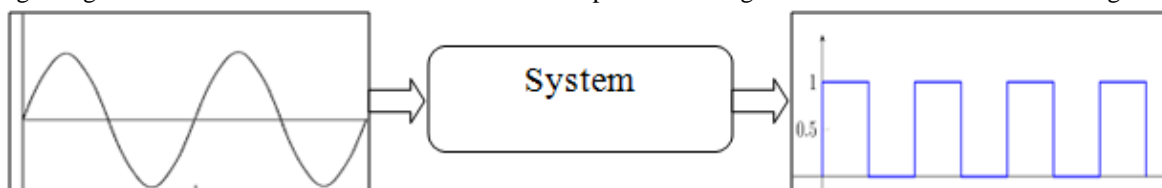


Fig.3 A DIP System

Generally, the output of most sensors is a continuous voltage waveform whose amplitude and spatial behavior are related to the physical phenomenon being sensed. To create a digital image, we need to convert the continuous sensed data into digital form. This involves two processes: sampling and quantization.

The conversion of analogue signal to digital signal involves the process of sampling and quantization. In general sampling can be defined as taking of the samples and it is done on an independent variable over x-axis. So as quantization can be defines as dividing into quanta and it is done on dependent variables on y-axis.

For the purpose of processing the function of an image  $F(x, y)$  must be digitized both spatially and amplitude. Normally a digital camera is used for digitizing the image and the transition between continuous values of the image function (brightness) and its digital equivalent is called quantization. For having fine details in an image, the number of quantization levels should be high. The sampling rate determines the spatial resolution of the digitized image, while the quantization level determines the number of grey levels in the digitized image. A magnitude of the sampled image is expressed as a digital value in image processing.

As the storage of analogue signals requires infinite memory to store a signal and for the purpose of manipulating or performing the operation in an image with the help of computer it is required to convert the analogue signal to digital signal, which requires two processes that is Sampling and Quantization. Thus, the part that deals with the digitizing of co-ordinates is sampling and the part that deals with digitizing the amplitude is quantization. [1]

### III. DIGITAL IMAGE PROCESSING (DIP)

Digital image processing is to perform the operations on a digital image for a particular output and object recognition is one of the processes of image processing. DIP deals with the manipulation of the image with the help of computer.

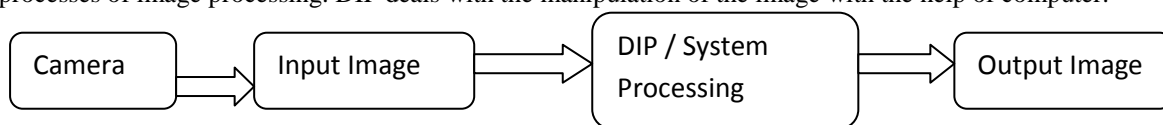


Fig.4. DIP System

Here, in this image input is a digital image that is taken by the camera and some operations are performed or we can say that the manipulation of an image is done which provides the output or processed image.

**Camera:** The acquisition of an image is depends on the camera quality.

**Input Image:** Input image might be analogue or digital; it has to be in digital form when given to the system. The input is also known as excitation.[1]

**System Processing:** System is defined as the type of input and output it deals with. The operations are performed here for manipulating the image. As we are dealing with signals so our system would be a mathematical model, piece of code or any physical device, whose input is signal and it performs some processing on that signal and output is again a signal.[1]

**Output:** After the operation performed on an image the processed image is the output. The output is also known as response.

Object recognition, as its name is specifying, recognizing the object in digital images or videos. There are number of algorithms and techniques are available for object recognition such as feature based techniques, appearance based techniques, pattern recognition algorithms, texture recognition etc. and we simply can say object recognition rely on these algorithms and techniques.

If we talk specifically about image then object recognition refers to identify the objects presented in the image. But the very basic question arises here that why we need to recognize the objects in an image or is it a complex task? The answer is yes! If we give an image to a human being, he is very surely able to recognize the objects in an image as human being is one of the intelligent creatures in the world. But, if we go little deep and try to find out how actually humans able to recognize the things or objects in an image, in simple manner we can say that, when he is visualizing the image or trying to recognizing the object in an image, his brain is working at the back end and his nervous system is sending the signal to the brain and obviously human being is intelligent too, to recognize the objects. But, what if we want the machine to work for same? It is quite difficult for machine to work same as that of human being and so, the intelligence is in-occurred in machines is termed as artificial intelligence that is actually based on database recognition techniques and methods..

Thus, there are number of object recognition technique and algorithms are available for performing such tasks.

Generally, object recognition problem can normally be defined as labeling the problem based on number of models of the objects which are known priory.

### IV. DIFFERENT COMPONENTS OF OBJECT RECOGNITION

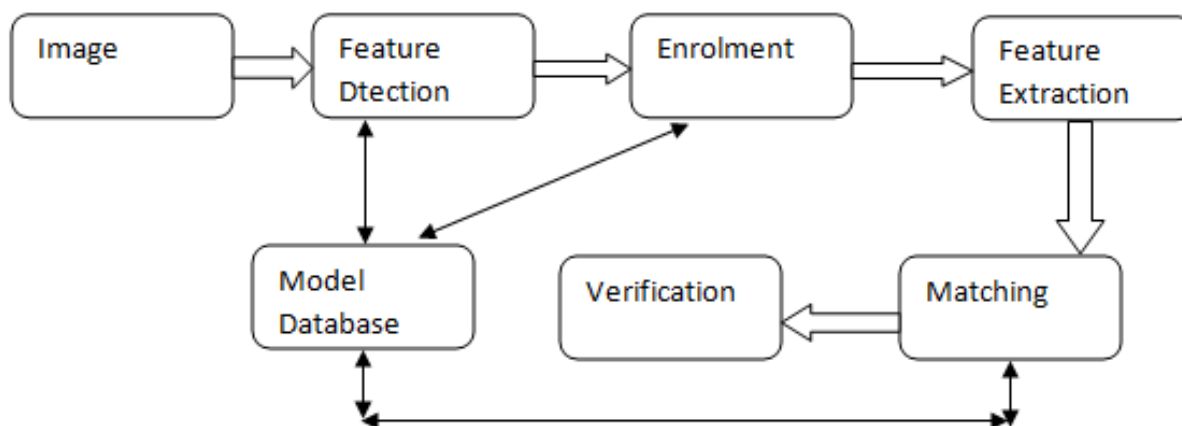


FIG.5. Object Recognition Components

To perform a particular task, an object recognition system must have some process components as:-

1. Input image
2. Database
3. Enrolment process
4. Feature detection
5. Feature extraction
6. Matching process
7. Verification process

The above block diagram shows the interactions among the components and the flow of information among them.

The database consists of the entire models that are known to the system. [2] This model or database actually consists of the information based on the recognition technique and approach applied. If the method for object recognition is based on features then it may consist of the techniques of determining the size, shape, color etc.

It is not sure that the system always uses the same techniques but it depends on the type of object that has to be recorded in an image. [3] Hence appropriate tools and techniques must be selected by the system for the object recognition.

- 1) Database or Model Representation: The very basic concept here is that how the object should be presented in the database. It actually depends on the important attributes and features of the object in the image. In some images colour can be the best feature, for some size would be the best one, for some shape would be the best one or so on.
- 2) Feature Detection: It is simply related to the concept of finding some of the interesting points or we can say features in an image and on the basis of that we can make local decisions at the point of every image.
- 3) Feature extraction: It deals with the representation of the interesting points for the purpose of comparing them with that of the other interesting point in an image.
- 4) Matching Process: Once the image is captured, the features of the object in an image are detected and extracted; now we have to recognize the actual object present in the image. For this, the process is done that is matching. Now the interesting points or the features that have been extracted are matched with the database model.
- 5) Verification: The result of the matching process is verification. If the interesting points are matched then the output is a verified image.

Example: face recognition, retina recognition, finger print etc.

The concept of such recognitions is actually a bio-matrix authentication. If the finger print is matched then the person is verified and hence has the authentication for accessing the information etc.

## V. CONCLUSION

With the help of object recognition concept we can simply identify the objects present in an image or a video sequence. There are a number of techniques and methods that can be applied for having the desired result. As humans can simply identify the object and even can recognize, but for a machine it is not an easy task, hence the work can be done with the help of the concept of artificial intelligence.

## VI. FUTURE WORK

As object recognition is the concept of identifying the object in an image or video. It can be used for specific applications for enhancing the features of an application for example, machine vision, and industrial vision and so on. It can be a milestone in the future especially in industries to reduce the human work and increase the efficiency and speed of the work.

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