



**Training Module
on
Basics of Hardware Devices**

UIDAI

Unique Identification Authority of India

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Preface

This training manual introduces you to various types of devices that will be used by Enrolment Agencies during the enrolment process. The devices have been divided into two categories, Biometric and Non-Biometric. This module covers the devices in terms of function, type and operations.

Target Audience

- Enrolment Operators
- Enrolment Agency Supervisors
- Technical Support staff

Dependent or Related Modules

There are no directly related or dependent modules, but Enrolment Agency staff deployed at Enrolment centres should be familiar with the details given in this book.



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Objectives

At the end of this module, you will learn:

- The need for hardware devices in the enrolment process
- About the different types of Biometric Devices - Fingerprint Scanner, Iris Capturing Device & Digital Camera
- About the Non-biometric Devices – Computers, Printer, Scanner, Storage Devices, UPS, Barcode Readers, Focus Lights, Generator

Introduction

To overcome the deficiencies of systems introduced for identification of individuals, the entire approach of Aadhaar is based on technology.

Aadhaar avoids errors and duplicates, which was the bane of earlier systems, by linking an individual's identity to biometric information which is unique to the individual. Various devices and software are used to Capture and Store biometric information.

This module will introduce you to the devices which are used in gathering both demographic and biometric information at an Aadhaar Enrolment Centre.

It will also introduce you to other devices which help in storing the captured information and in generating the necessary documents to complete the enrolment process and transfer the information to the CIDR.

Quiz

1. What does Aadhaar depend upon to ensure unique identity of residents?
 - a. The Aadhaar
 - b. The PAN Number
 - c. Resident's Demographic and Biometric Information
 - d. Technology

Hardware Devices

The hardware devices required for the resident enrolment purpose can be classified into two groups:

1. Biometric Devices
2. Non-Biometric Devices.



Note:

These devices are used in conjunction with software components with which users interact directly or indirectly.

Biometric Devices are used to capture biometric details - fingerprints, iris patterns and facial photograph for each enrollee. The devices are:

1. Fingerprint Scanner – Used to capture the image of the fingerprint of a person
2. Iris Capturing Device – Used to capture the image of the Iris of a person
3. Digital Camera – Used to capture the facial features of a person

Non-Biometric Devices are:

1. **Computer** – A Laptop or Desktop machine to which the biometric devices are connected.
 - a. It includes software to enable automatic or manual operation of the devices.
 - b. It is used for entering demographic data of the resident and linking this information to the resident's biometric information.
 - c. It is used to store the data temporarily until successfully transferred to CIDR.
2. **Printer** – It is connected to the computer and is used for generating
 - a. Acknowledgment Slip (Enrollee's copy) and Consent for Enrolment Slip (Office copy) after the enrolment procedure has been completed.
 - b. It is also used for generating various types of reports required by the Registrar and UIDAI
3. **Storage Devices (CD/DVD/Pen Drive)** – The data collected at an enrolment centre has to be transferred to CIDR. This data is in electronic form and can be huge. CD/DVD/Pen Drives are used to store this data and transfer it to CIDR using the Postal system or Courier Services



Note:

A Pen Drive is also referred to as a Memory Stick.

4. **Barcode Reader** – Barcodes are used to represent information in a way that can be read by machines. For example, on Medicine or Soap boxes. A Barcode Reader can read such information and transfer the same to a computer system where it can be stored and further processed.
5. **Scanner** – is a device that can be used to convert printed matter into an electronic form and transfer this electronic form to a computer. Images of documents submitted by residents can be stored in the computer by scanning them.
6. **Photocopier** – also called 'Xerox' machine, is a combination of a printer and a scanner. It can be used to scan and print any document to get a true copy of the original.



7. **UPS** – Uninterruptible Power Supply (UPS) is used to provide power supply to the computer in case of power failure.
8. **Universal Serial Bus (USB) Hub** – A computer has a limited number of USB ports. The USB Hub provides the means to expand a single USB port and enable the connection of multiple USB devices.
9. **Focus Light** – Is a powerful light which is required while taking photographs inside a room (indoors) where Sun light is not sufficient.
10. **Electrical Generator** –In case of a power failure all activities in an Enrolment centre will come to a halt. Hence it is essential to have another source of electricity. A Generator can produce electricity by burning fuel like petrol, diesel or kerosene.

Quiz

1. A Scanner is an example of
 - a. Biometric Device
 - b. Non-Biometric Device
2. Which of the following Biometric devices are connected to the computer?
 - a. Digital Camera
 - b. Iris Scanner
 - c. Fingerprint Scanner
 - d. All of the above

Biometrics Devices

The three types of Biometric devices used in an Aadhaar Enrolment Centre are as follows:

1. Finger Print Scanner
2. Iris Capturing Device
3. Digital Camera

Fingerprint Scanner

The lines that you see along each of your fingers, which are caused by raised areas of the skin, can leave their impressions on certain types of surfaces. Such an impression is called a fingerprint.

Fingerprints have been accepted as one of the attributes of a person which uniquely identify her/him. Fingerprints can be easily digitized from the captured images through low cost technology using a digital scanner.

Sampling of the fingerprint is done through direct contact i.e. pressing the fingers against the platen of the fingerprint reader.

**Notes:**

The appearance of a person's fingerprint and therefore the digitization process depends upon

- Age - Fingerprints of a person may change as a person grows old.
- Presence of foreign matter on the fingers – like oil, dust, mud
- Cuts and wounds on the fingers
- Prominence of the patterns depending upon the occupation and the lifestyle of the person

Samples of digital fingerprint are shown in the following figures.



Figure 1: Samples fingerprints of four fingers on right hand



Figure 2: Sample fingerprints of four fingers on left hand



Figure 3: Sample fingerprints of both the thumb fingers

About Fingerprint Scanner

These fingerprints are captured through digital slap fingerprint scanner. In case of Slap Fingerprint Scanner **all the four fingers** of the hand are captured, **at a time**. The fingerprints of both the thumbs are then captured, simultaneously. The following figure indicates the different parts of Slap Fingerprint scanner.

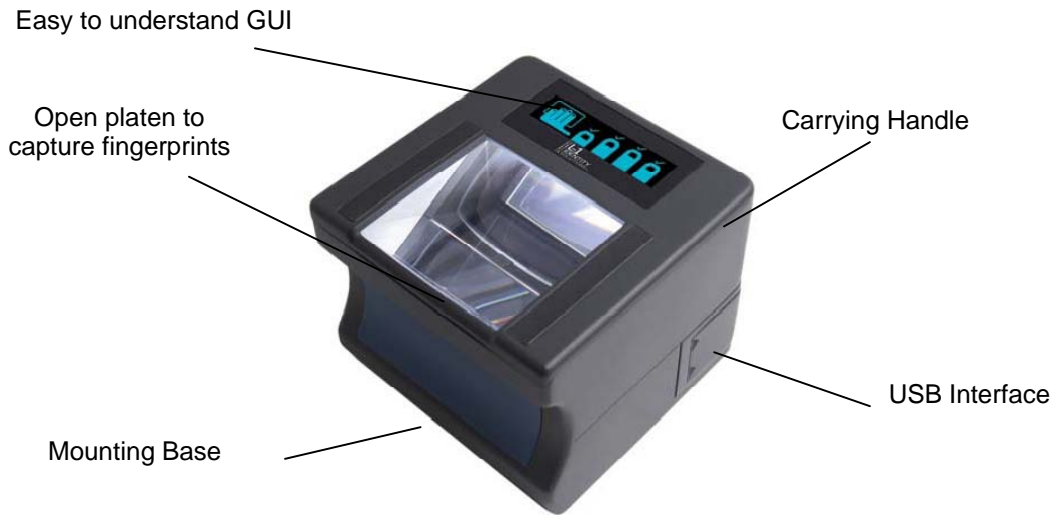


Figure 4: Slap Fingerprint Scanner

Procedure:

- The application software is placed in the fingerprint capture mode
- The fingers of the resident are placed on the areas indicated on the platen



Notes:

Ensure proper positioning of the fingers and application of adequate pressure.



Figure 5: Position of the fingers on the platen

- The image is transferred to the computer through the USB port
- The software processes the data and produces an image which is displayed on the screen.

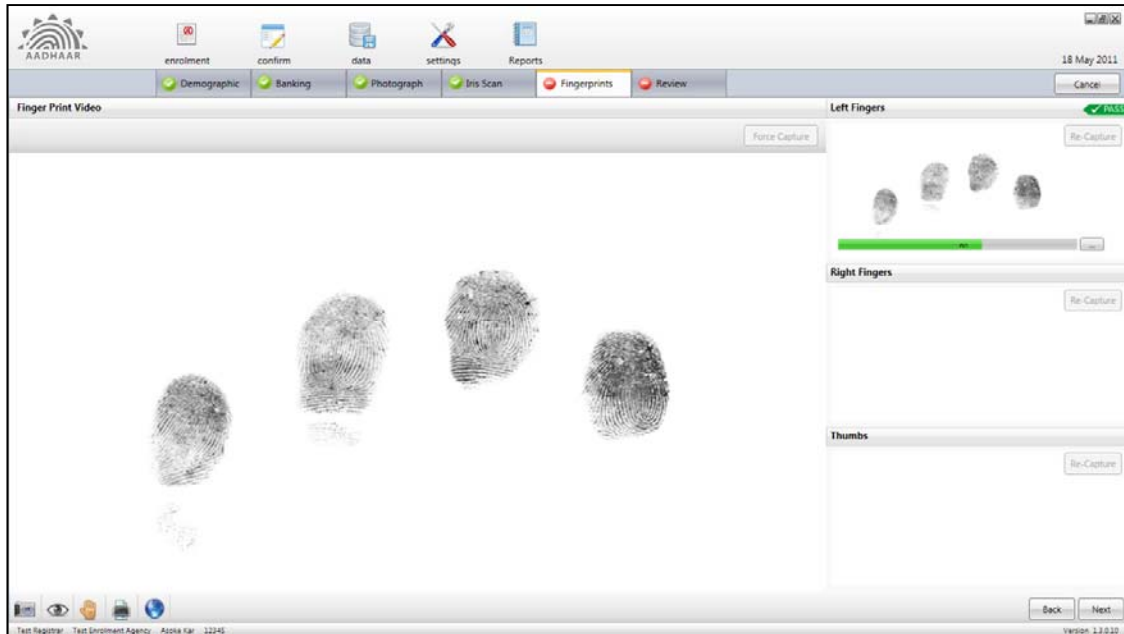


Figure 6: Fingerprint capture in software screen

- If the patterns are clearly distinguishable by the software, the image is stored and a successful capture is indicated
- In case the patterns are not clear due to
 - presence of foreign matter
 - inadequate pressure applied by the residentthe software gives a suitable indication to the operator.
- The process can be re-attempted by
 - Washing the hands with soap and water to remove any foreign matter and drying the hands (**Do not use wet hands**)
 - Applying more pressure on the capture area of the scanner



Figure 7: Showing how to apply pressure on the platen

- In case the image is still not clear, the software will require the operator to manually intervene and 'force' a capture.
- The device is powered by **USB** itself and does not require any external power supply.

Quiz

1. A fingerprint scanner which can record 4 fingers simultaneously is called
 - a. Step Scanner
 - b. Slap Scanner
 - c. Slot Scanner
 - d. Kick Scanner
2. Good quality fingerprint image capture can be prevented by
 - a. Insufficient finger pressure
 - b. Dirty fingers
 - c. Deformed fingers
 - d. Thickness of fingers
3. The fingerprint scanner draws power from
 - a. Batteries
 - b. Wall Power Outlet
 - c. From the Computer
 - d. Does not require power

4. The fingerprint scanner transfers data to the computer through the
- USB Port
 - SUB Port
 - BSU Port
 - None of the above

Iris Capturing Device

Iris is the coloured and most visible part of human eye which surrounds the Pupil (see the following figure). The iris controls the amount of light that enters into the eye.

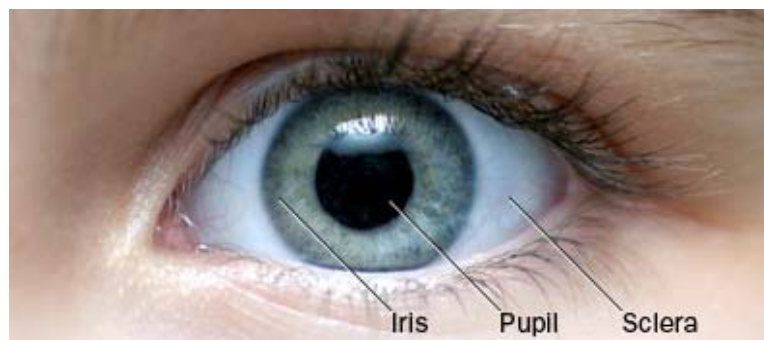


Figure 8: Position of Iris in Eye

The Iris has a distinct structure that forms a pattern which can be photographed. The patterns form randomly and are highly complex. The salient features of Iris recognition and pattern matching are as follows:

- The patterns do not change with time except maybe due to injuries.
- No two individuals Iris patterns are similar - not even those of an individual's left and right eye.
- Spectacles and Contact Lenses rarely affect the quality of image capture.
- Amongst other biometric technologies this method has the least number of persons who cannot be covered.
- The comparison of patterns with existing patterns is the fastest.

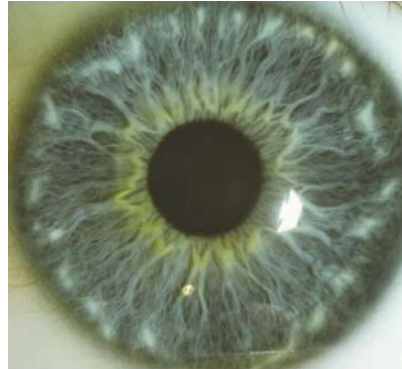


Figure 9: Iris and its Intricate Patterns

Iris is an inner part of our eye. Therefore the iris faces very little chance of damage. So it can be used as an 'always available' proof for verification for most individuals over their lifetime.



Notes:

In most cases iris patterns of a blind person can also be captured. The iris recognition technology used by the iris capturing device captures details based on iris pattern. As long as the pattern is visible in a blind eye, its details can be captured.

About Iris Capturing Device

Iris Capturing Device is a biometric device. It scans the intricate patterns (discussed in previous section) in the iris and produces a digital image. Most of the modern Iris Capturing Devices use infrared light, which is not visible to the human eye, to illuminate the iris without causing any harm to the eyes.

Two types of Iris Capturing Device are available –

- Single Iris Capturing Device– Can capture one eye at a time
- Double Iris Capturing Device – Can capture both eyes at a time

Based on make and model these devices can be

- Hand-held
- Tripod-mounted



Figure 10: Double Iris Capturing Device with USB Connector (Model 1)



Figure 11: Double Iris Capturing Device with USB Connector (Model 2)

The Iris Capturing Device is a lightweight device. When the device is placed properly, it is able to automatically focus the iris. It can also adjust to various lighting conditions automatically.

The Iris Capturing Device has a USB port. A USB connector cable connects the device with a computer. The device gets power supply from the computer through the same USB connector.

The Iris Capturing Devices are fast and accurate. They can capture picture automatically without any user intervention. But, their accuracy can be affected by objects obscuring the eye. Also they may not be appropriate for persons having cataract.

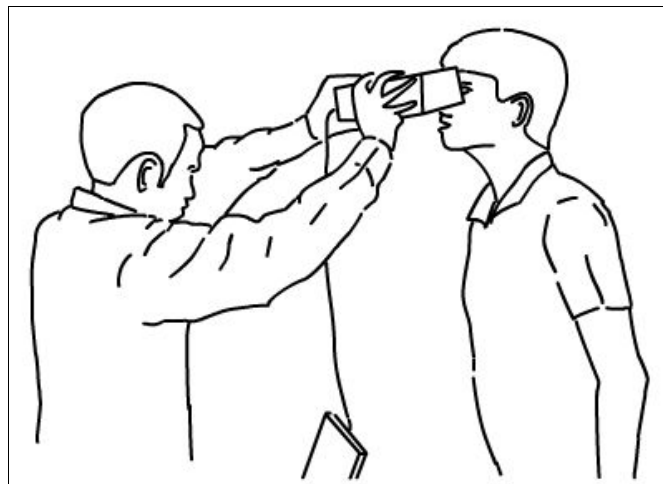


Figure 12: Capturing Iris Image

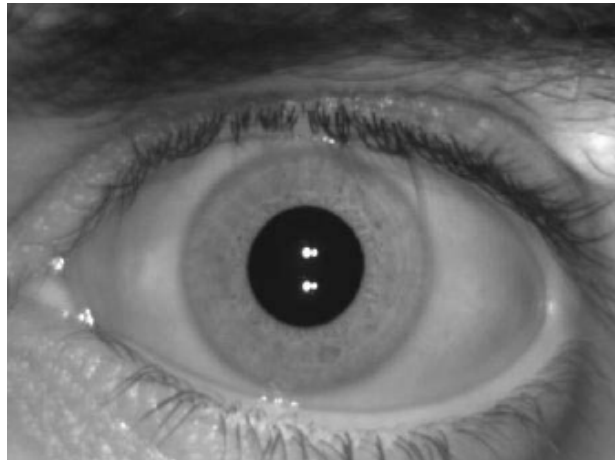


Figure 13: Picture of Left Eye Captured by Iris Capturing Device Automatically

Digital Camera

Photographs of a person's face are quite commonly used in various types of Identification systems. Face recognition system is the least intrusive type of biometric sampling which does not require any direct contact. The facial biometric can be extracted from photographs, videotapes or other image sources.

A face needs to be well illuminated for automated face authentication system to work. The features of a face are not ideal attributes for establishing unique identity. Even a smile can alter the features sufficiently and affect the system. Hence a neutral facial expression is required for correct verification. Generally, facial authentication is a good biometric identifier for small scale verification.

The following figure shows the digital photograph captured through Digital Camera for facial authentication.



Figure 14: Sample of Digital Photograph

About Digital Camera

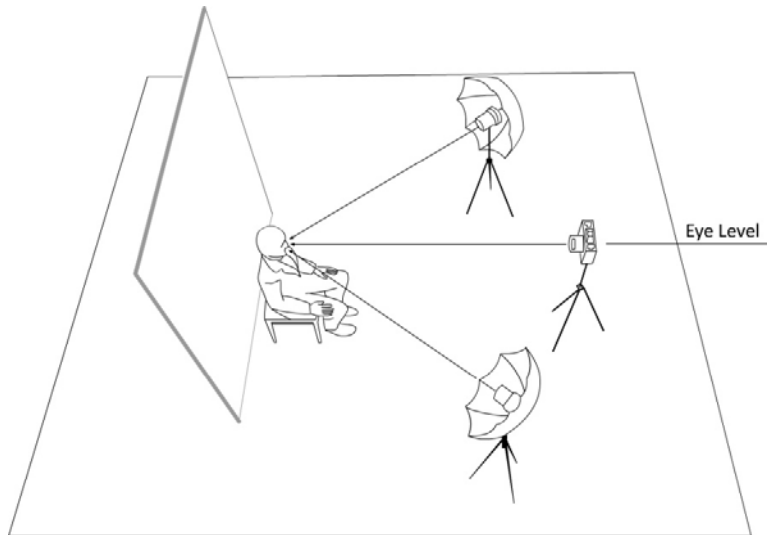
A digital camera is used to capture photographs in a digital format. It uses electronic device instead of a film to capture and store the image. It can also display images immediately after capturing them. Normally digital cameras have an 'Auto-focus' feature and they can also automatically adjust to the lighting.

A Digital Camera has the following specifications:

- **Resolution** – A photograph is made up of a large number of 'dots' or a 'Pixel'. Resolution depends upon the number of 'pixels'. Higher numbers of pixels mean greater detail and therefore better quality of photographs. For example 3.2 Megapixels which means about 3200000 pixels
- **Aperture** – Is the size of the opening which permits light to enter the camera and fall on the image sensor. The aperture size can be adjusted manually or automatically depending upon the type of camera. The adjustment will depend upon amount of light falling on the person or object being photographed
- **Shutter Speed** – Determines the time duration for which the aperture is open. This feature can also be set manually or automatically depending upon the type of camera.
- **Focal Length** – Is the distance between the lens and the surface of the image sensor. It can also be set manually or automatically depending upon the type of camera. The focal length determines the magnification or 'zoom' of the image
- **Image Sensor** – Could be CCD (Charge Coupled Device) or CMOS (Complementary Metal Oxide Semiconductor). CCD image sensors are considered better than CMOS sensors
- **Flash** – Is used to ensure balanced illumination of the subject. It eliminates shadows caused by uneven ambient light



Figure 15: Digital Camera



The camera can be mounted on display unit of a laptop/desktop computer. It is connected to the computer through a USB port. The camera is powered through the USB port.

To capture the 'face' as a biometric attribute, digital camera has to be used in proper lighting condition.

Figure 16: Lighting Arrangements for Capturing Facial Image

Non-Biometric Devices

Non-biometric devices are Computer, Printer and Storage Device like CD, DVD, and Pen Drive. The client enrolment software is installed in the computer for collecting the demographic and biometrics data. Biometric devices (finger print scanner, iris capturing device and digital camera) are connected to the computer through the USB port.

The printer is used to print the Acknowledgement Slip (Resident copy) and Consent for Enrolment Slip (Office copy) after the completion of enrolment process.

The storage device is used to physically transfer the enrolment data from the enrolment centre to the Central Identities Data Repository (CIDR).

Computer

There are two types of computers that could be used in an enrolment centre

- Desktop
- Laptop

Desktop

The Desktop computer is suitable for a permanent setup, where the machine need not be moved around frequently. It is less expensive than a laptop and easier to maintain but takes up more space.

It consists of separate units including

- Cabinet – which houses
 - The Power Supply Unit, also called as Switched Mode Power Supply (SMPS)
 - The Motherboard – Which is a circuit board comprising of
 - Central Processing Unit (CPU) which is a Microprocessor
 - Random Access Memory (RAM) Modules which is the main memory of the computer
 - Interface circuitry for connecting peripheral devices like
 - Video Display Unit or Monitor
 - Keyboard
 - Mouse
 - Printer, Scanner and other devices
 - Storage Devices
 - Audio Devices – Microphone, Speakers
 - Slots for inserting add-on cards like
 - High-end Graphics Cards
 - Network Interface Cards
 - Storage Devices like Hard Disk, CD/DVD Drives
- Video Display Unit or Monitor
- Keyboard
- Mouse



Figure 17: Components of Desktop

Laptop


A laptop functions like a desktop computer, but it is compact, light weight and suitable for mobile use. Laptop gets power from a rechargeable battery placed inside the laptop. Hence the laptop can be used even in the absence of an external power source.

Components of a Laptop

A laptop has the following components that you can see from outside:



Figure 18: Components of a Laptop

- **LCD Display:** In laptops LCD (Liquid Crystal Display) is used as display device. It is a thin and clear flat panel display.
- **Keypad:** Every laptop has a keypad. The layout of the keypad is same as that of a keyboard in a desktop computer.
- **CD/DVD Drive:** Laptops normally have a built-in CD or a DVD Drive.
- **Touchpad:** The touchpad is a common feature of laptop. It is used as a pointing device and works like a mouse does for a desktop computer.
- **USB Ports:** Normally a laptop has 2 to 4 USB ports. They are used to connect various devices like pen drive, printer, scanner etc. with laptop.
- **Network Port:** This port is used to connect the laptop to a network
- **Audio Port:** Normally laptop has inbuilt speaker. To connect external speaker, these jacks are used.
- **Power on Button:** This button is used to switch on the laptop. Normally the button has a symbol which looks like 

- **Power Supply Jack:** Through this jack the internal rechargeable battery is charged using an AC power adaptor and power cord.

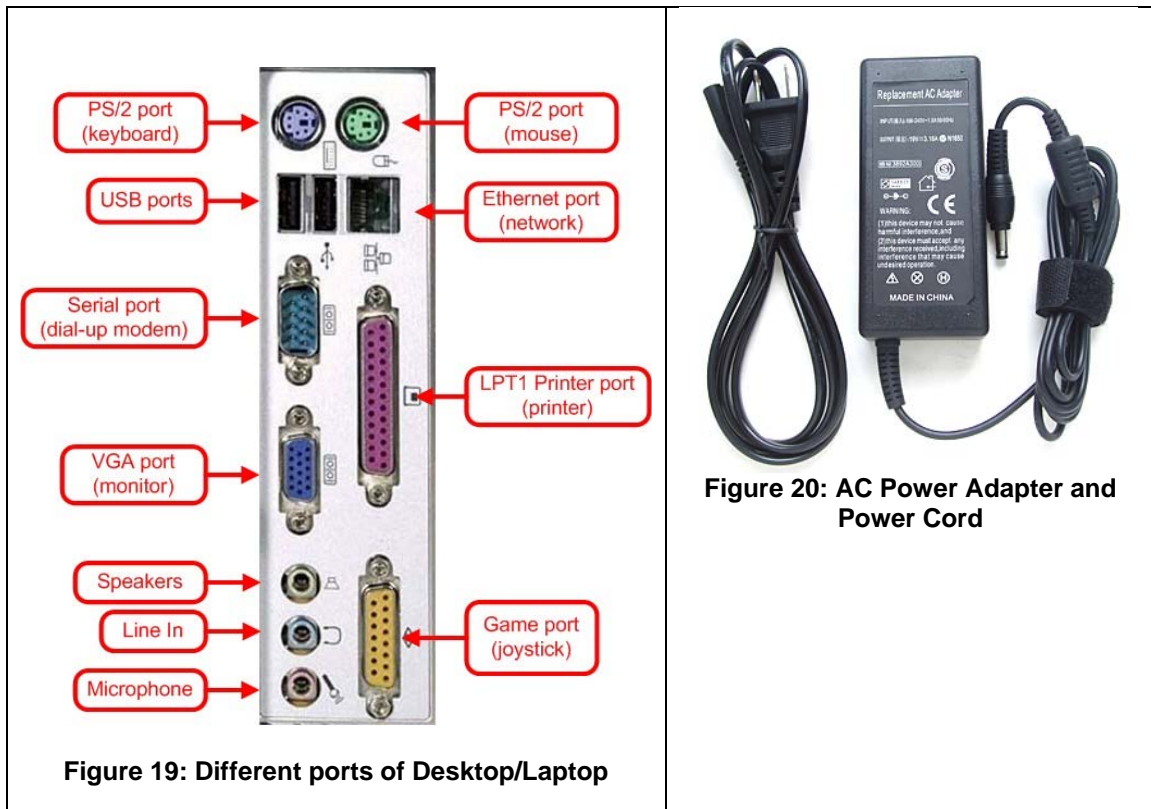


Figure 20: AC Power Adaptor and Power Cord

Software

A computer consists of hardware and **software**. Typically the following software are installed on a computer.

Operating System (OS)—It manages the hardware and hides the complexity of the machine from the user. The user interacts with the computer directly or by using Application software (like the Aadhaar Enrolment Client) which in turn use the services provided by the OS.

Examples of OS: Windows XP, Windows Vista, Windows 7, UNIX, MAC OS

Antivirus – Viruses prevent the normal operations and functions of a computer. They can slow down the operations of a computer, corrupt data, destroy information stored on the computer and cause the entire system to ‘crash’ (become unusable). To prevent such ‘virus’ from infecting the system Anti-virus software is used.

Examples of Antivirus – McAfee, Symantec, Quick Heal

Anti-spam– Spam is unwanted messages that are received when the computer is connected to the Internet. Spam can slow down the enrolment operations in an Enrolment centre.

Example – McAfee Anti-spam, Comodo

Applications – Like Office suites, Web Browsers, eMail Clients, etc.

Printer

A Printer is a peripheral device connected to a computer and is used to generate a paper copy or hard copy (permanent readable text and graphics). Generally the printer is connected to the computer by a USB cable. Printer is powered from an external power outlet.

The following figure shows the different components of a printer.



Figure 21: Components of a Printer

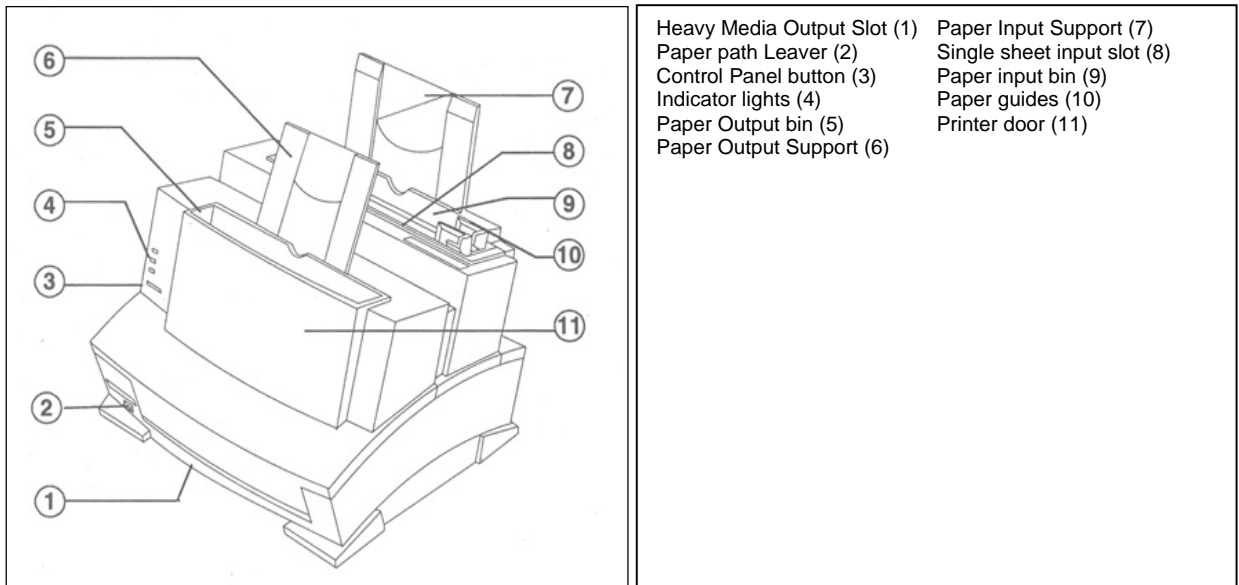


Figure 22: Different Components of Printer

The printer is used to print an Acknowledgement Slip (Enrollee's copy) and Consent for Enrolment Slip (Office copy) after successful completion of the entire enrolment process.

Storage Devices

Storage Devices are used to store data from a computer, externally. The various types of storage device differ in terms of data storage capacity, data access time, and the physical shape. CD, DVD, Pen Drive are the example of storage device.

CD



CD stands for Compact Disc. The CD is used for long-term storage of data. CDs are available as read-only or CDR and CD Re-Writable or CD-RW. CDRs allow data to be written only once. This data can only be read. It cannot be deleted or modified. CD-RWs allow data to be Written and Read, Deleted and Modified whenever required.

Data access time for CD Drives is considerably slower than for a hard drive. CDs normally hold 700MB of data.

Figure 23: Compact Disk (CD)

DVD

DVD stands for Digital Video Disc or Digital Versatile Disc. The data storage mechanism of DVD is different from CD. DVD can store much more data than a CD. A normal DVD can store up to 4.7 GB of data.



Figure 24: DVD

There are various types of DVDs available in the market. They have different storage capacity as shown in the following table.

Table 1: Types of DVD

DVD Type	Format Name	Storage Capacity (in GB)
Single-sided, single-layered	DVD-5	4.7
Single-sided, dual-layered	DVD-9	8.5
Double-sided, single-layered	DVD-10	9.4
Double-sided, dual-layered	DVD-18	17

Pen Drive



Pen drive is a data storage device integrated with a USB (Universal Serial Bus) interface. They are very small in size and weight. Pen drives are available in various shapes and in various storage capacities (1 GB, 2 GB, 4 GB etc). Pen drives can store huge volume of data as large as 256 GB.

Once they are plugged into a USB port of a laptop/PC they show up like another hard drive on your laptop/desktop computer. You can copy files to and from the Pen Drive just like copying to a hard disk drive.

Figure 25: Pen Drives of Different Shapes and Sizes

Barcode Reader

A barcode is an optical machine-readable representation of data, which shows certain data on certain products. Barcodes can be read by optical scanners called barcode readers, or scanned from an image by special software.

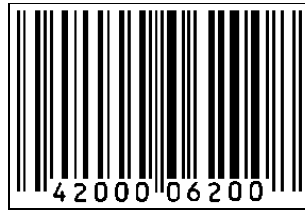


Figure 26: Sample Barcode

Barcode Reader Device

A barcode reader is a hand-held or stationary input device used to capture and read information contained in a bar code. A barcode reader consists of a scanner, a decoder (either built-in or external), and a USB cable used to connect the reader with a computer.



Figure 27: Barcode Reader



Figure 28: Reading of Barcodes using Barcode Reader

Because a barcode reader simply captures and translates the barcode into numbers and/or letters, the data must be sent to a computer so that a software application can make sense of the data.

Different types of Barcode Reader

There are five basic kinds of barcode readers

- Pen Wands
- Slot Scanners
- Charge-Couple Device (CCD) scanners
- Laser Scanners

Pen Wands: A pen wand is the simplest barcode reader. It has to remain in direct contact with the bar code, must be held at a certain angle, and has to be moved over the bar code at a certain speed.

Slot Scanners: A slot scanner remains stationary and the item with the bar code on it is pulled by hand through the slot. Slot scanners are typically used to scan bar codes on identification cards.

Charge-Couple Device Scanners: A CCD scanner has a better read-range than the pen wand and is often used in retail sales. Typically, a CCD scanner has a "gun" type interface and has to be held no more than one inch from the bar code.

Laser Scanners: A laser scanner, either hand-held or stationary, does not have to be close to the bar code in order to do its job. It uses a system of mirrors and lenses to allow the scanner to read the bar code regardless of orientation, and can easily read a bar code up to 24 inches away.

Scanner

A scanner is a device that captures images from photographs, posters, magazine pages, and similar sources. The captured image can be displayed and edited. Scanners can be used to scan black-and-white and color documents.



Figure 29: Scanner

Types of Scanner

- Drum Scanner
- Flatbed Scanner
- Film Scanner
- Hand Scanner
- Document Scanner

Photocopier

A photocopier is a machine that makes copies of documents and other visual images quickly and cheaply. It is also known as a copier or copy machine.



Figure 30: Photocopier (Image 1)



Figure 31: Photocopier (Image 2)

UPS

In case there is a power failure, an Uninterruptible Power Supply (UPS) can be used to provide an instant backup power source to the computer system. Typically, a UPS keeps a computer running for several minutes after a power failure, enabling you to save data and shut down the computer gracefully.

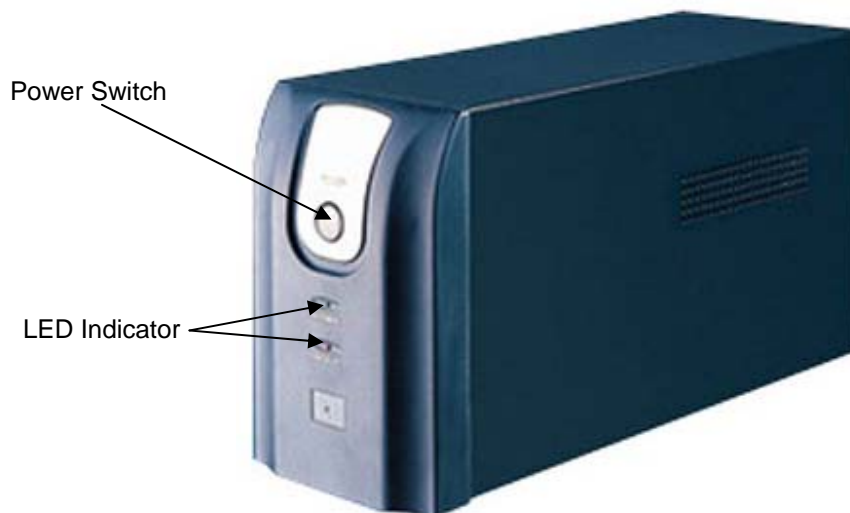


Figure 32: UPS

Basically there are two types of UPS

- Standby power systems (SPS)
- On-line UPS systems

Standby Power Systems: An SPS monitors the power line and switches to battery power as soon as it detects a problem. The switch to battery, however, can require several milliseconds, during which time the computer is not receiving any power. Standby Power Systems are sometimes called Line-interactive UPS.

On-line UPS System: An on-line UPS avoids these momentary power lapses by constantly providing power from its own batteries, even when the power line is functioning properly. In general, on-line UPSs are much more expensive than SPS.

USB Hub

A USB hub is a device that expands a single USB port into several so that there are more ports available to connect devices to the system. When there are many devices using USB ports, there is a need for USB hub as laptop and computer have limited USB ports.



Figure 33: USB Hub

Focus Light

Focus light can be used while capturing facial image of the enrollee. When there is insufficient lighting condition in the room or there is any shadow on the face of enrollee, proper focus light should be used. Enrolment operator must ensure that the enrollee's face is uniformly illuminated before capturing the facial image.

There are various types of continuous focus lights used while capturing facial image. Some of the examples are shown below.



Figure 34: Focus Light (Model 1)



Figure 35: Focus Light (Model 2)



Figure 36: Focus Light (Model 3)



Figure 37: Focus Light (Model 4)

Electrical Generator



An electrical generator is a device that generates electricity from a motor that runs on fuel like petrol or diesel.

If there is a power failure in enrolment centre, the Generator can be used to provide the backup of electricity. Electricity might not be available in enrolment centre in some remote locations. There generator can be used to provide electricity to carry out the enrolment process.

Figure 38: Electrical Generator



Abbreviations/Acronyms

Term	Definition
UIDAI	Unique Identification Authority of India
CIDR	Central Identities Data Repository
Aadhaar	Unique Identification
Gol	Government of India
USB	Universal Serial Bus