

# Input Devices

O level Computer Science (2210)

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**An input device is a piece of hardware that is used to enter data into a computer.**

There are many different kinds of input devices. They are divided into two categories

- (1) Manual input devices (devices that need human involvement to input data)
- (2) Automatic input devices (devices that do not need human involvement to input data)

Manual Input Devices are:

- (i) Keyboard
- (ii) Pointing Devices
- (iii) Scanner
- (iv) Digital Camera
- (v) Microphone
- (vi) Musical Keyboard
- (vii) Remote Control

In the first section, we will discuss manual input devices while in the next section we will discuss automatic input devices or automatic data capture devices.

## Keyboard

**The keyboard is the most common and widely used input device.**



**It is made up of buttons called 'keys'.** The keys are arranged into sections:

- Alphabet keys
- Function or F keys (F1, F2, F3)
- Numeric keys (one set above the alphabet keys and a numeric keypad on the right)
- Arrow keys
- Command keys (insert, delete, home, end, page up/down)

Most keyboards are called 'QWERTY' keyboards. This name comes from the first six letters on the top row of the alphabet keys.

Using a keyboard for too long can lead to health problems such as repetitive strain injury (RSI).

To try to overcome this, different styles of keyboard have been developed, for example, the ergonomic keyboard. They are supposed to put your hands into a much more natural position than a traditional keyboard.

Advantages of keyboards	Disadvantages of keyboards
Most computers come with a keyboard supplied	It is easy to make mistakes when typing in data
People are used to using keyboards to enter data, they need very little training	If you can't touch type, it can be time consuming to enter data
A skilled typist can enter data very quickly	Keyboards are not suitable for creating diagrams
Specialist keyboards are available e.g. ergonomic, gaming keyboards	Disabled people often find keyboards difficult to use
	Excessive use can lead to health problems such as repetitive strain injury (R.S.I.)

### Concept keyboard

**A concept keyboard is a flat board that contains a grid of buttons. Each button can be programmed to do whatever you want. An overlay sheet with pictures or symbols is placed on the grid so that the user can tell what pressing on different areas will do.**

Concept keyboards are particularly useful for people who would find using an ordinary keyboard difficult. It is also very handy in locations where an ordinary keyboard might be damaged e.g. by spillage or dust.

Concept keyboards are excellent where there is a limited set of things to select and it needs to be done fast e.g. fast food store, pub, skating and other recreation events.

Advantages of concept keyboards	Disadvantages of concept keyboards
Much faster for making non-text selections such as menu choices on the till of a fast-food outlet.	Poor for text or numeric input - although some keyboards do include a numeric keypad so the operator can enter the amount sold.
The keyboard is waterproof which can be useful where there is dirt or the risk of splashes	Limited to the options shown on the keyboard.

## Numeric Keypads

**Numeric keypads are used for entering numbers to a computer system (numeric means number).** Some keypads also allow to enter simple text and symbols.

### Uses of Numeric Keypads

<b>ATM (Automatic teller machines) -</b>	Entering <b>personal identification numbers (PIN)</b> into an ATM to allow us to access our cash.
<b>Withdrawing from ATM -</b>	Keying in <b>how much money</b> you would like to <b>withdraw</b> from an ATM.
<b>Telephones -</b>	These use numeric keypads to allow us to <b>enter phone numbers</b> .
<b>Chip and Pin devices -</b>	These have numeric keypads to allow users to <b>enter PIN numbers and payment amounts</b> when we buy goods and products.

<b>Advantages</b>	<b>Disadvantages</b>
<b>Faster</b> than QWERTY keyboards when used for entering numbers.	People with <b>large hands</b> can find them <b>hard to use</b> because of their <b>small keys</b> .
Numeric keypads are <b>small</b> so they can easily fit on smaller devices like mobile phones.	<b>Difficult</b> (but not impossible) to <b>enter text</b> information.

## Pointing Devices

**Pointing devices are input devices that are used to control a pointer (cursor) on a screen.** Pointing devices are frequently used with Graphical User Interface (GUI) to input commands by selecting icons.

Following are some important pointing devices:

- Mouse
- Touchpad
- Trackball
- Joystick
- Touchscreen
- Graphic Tablet
- Light pen

**Mouse is a pointing device that controls the movement of the cursor or pointer on the display screen (monitor or LCD) of computer system.**

A mechanical mouse usually has two buttons, a right and left one and a rubber ball under it to detect the movement.

An optical mouse has two buttons and it uses light-emitting diode (LED) and optical sensor in place of rubber ball to detect the movement.



Advantages of mice	Disadvantages of mice
Ideal for use with desktop computers	They need a flat space close to the computer
Usually supplied as part of a new computer system	Older style mice which have roller balls can become clogged with grease and grime and lose their accuracy until cleaned.
Most computer users are familiar with them and require little training	Excessive use can lead to health problems such as repetitive strain injury (R.S.I.)
Works well in conjunction with a keyboard for data entry	If the battery wears out in a wireless mouse, it cannot be used until it has been replaced

**Touchpad is a pointing device found on most laptops and used instead of a mouse since it takes up less space. The user moves a finger across the touch pad and this movement data is sent to the laptop. Usually used to control the pointer in a GUI.**



Advantages of touchpads	Disadvantages of touchpads
Useful for laptops when using a mouse isn't practical	Takes practice and skill to control the position of the cursor using the touchpad
The pad's position is fixed compared to the keyboard, unlike with a traditional mouse	Gloves cannot be worn i.e. in a clean room or industrial environment where gloves need to be worn.
Very short finger movements are required to move the cursor	Moist, sweaty or calloused fingers can disrupt the signals picked up by the sensors.

**This pointing device is not moved about like a mouse, instead it has a large ball that the user spins. Data about which direction the ball is spun is passed to the computer.**  
Tracker balls are often used by people with **limited movement** (disabled).



**Joysticks used to be popular with gamers but have slowly been replaced by other types of game controller.** Joysticks can also be used for controlling machines such as cranes, trucks and powered wheelchairs.



Advantages of joysticks	Disadvantages of joysticks
They give a better gaming experience for racing or flying styles of computer games	Some people find joysticks more difficult to control than a traditional mouse.
	Joysticks are not particularly robust and can break easily if too much force is used on them.

**A touch screen is the only device which works as both an input and an output device.** You view the options available to you on the screen (output) and you then use your finger to touch the option that you have chosen (input).

**Touch screens** are easy to use and are often found in public places such as cashpoints at banks, ticket collection terminals at theatres or airports, information centers at museums.

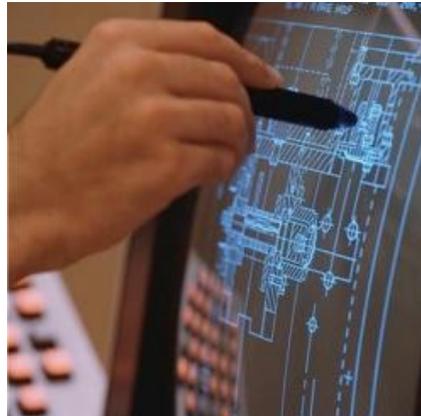
Advantages of touch screens	Disadvantages of touch screens
Easy to use - intuitive, don't need much training	Not suitable for inputting large amounts of data
No extra peripherals such as a mouse are needed	Not very accurate - selecting detailed objects can be difficult with fingers
Software can alter the screen while it is being used, making it more flexible than a concept keyboard which has a permanent overlay.	Tiring to use for long periods
Touch screen is the main interface on smart phones and tablet computers	More expensive than alternatives such as a mouse (unless it is part of the computer \ smartphone in any case)
Can make use of finger gestures to make sophisticated actions such as zooming and selecting.	Less useful as a control input to a standard computer that makes use of the mouse \ keyboard combination e.g. laptop, desktop pc
Excellent for selecting and controlling 'apps' (applications) that have been designed with a touch screen in mind.	

**A graphics tablet consists of a flat pad (the tablet) on which the user draws with a special pen. As the user draws on the pad the image is created on the screen.** Using a graphics tablet a designer can produce very accurate on-screen drawings as if they were drawn on paper. Graphics tablets are often used by graphics designers and illustrators.



Advantages of graphics tablets	Disadvantages of graphics tablets
It is much more natural to draw diagrams with a pencil type implement (the stylus) rather than with a mouse	Not really suitable for general selection work such as pointing and clicking on menu items
A great level of accuracy can be achieved	Graphics tablets are much more expensive than a mouse

**A light pen is a device used as a pointing device or to 'write' on the screen of a computer.** It is connected with computer system through a cord which makes it awkward to be used. Light pens are **rarely used** today since graphics tablets and high-quality touch screens provide similar functionality.



## Scanners

**Scanners can be used to convert images or text on paper into a digital format that can be used by the computer.** A scanner works by shining a beam of light onto the surface of the object that you are scanning. This light is then reflected back onto a sensor that detects the colour of the light. This is then used to build up the digital image.

Advantages of scanners	Disadvantages of scanners
Flatbed scanners are very accurate and can produce reasonably high quality images.	Images produced by the scanner can take up a lot of memory space.
Any image which is digitised by the scanner can then be included on electronic documents.	Images lose some quality in the scanning and digitising process.
Images once digitised can be enhanced with a graphics application.	The quality of the final image is dependent on the quality of the original image .
Specialist scanners can convert old material such as 35mm negatives into digital files.	Emotional value - is there value in the original image?
Can accurately capture an image, but the original source may be more important than the scanned image.	

## Digital Camera

**A device that captures digital photographs. Most digital cameras do not directly input data into a computer - they store photographs on memory cards.** The photographs can later be **transferred** to a computer.

A modern digital camera can capture 10 Megapixels or more per photograph - that's 10,000,000 coloured dots (pixels) in every photo.



**A webcam is short for 'web camera'. A webcam is an input device because it captures a video image of the scene in front of it.** It is either built in to the computer (e.g. laptop) or it is connected through an USB cable. It is used in video chatting (video calling) over the Internet and sometimes used for security purposes as well.



## Microphone

**A microphone can be used to input sound. The sound is detected by the microphone and an electrical signal is transmitted to the computer. Special hardware is used to convert this analogue data into digital data so it can be stored and manipulated.**

In the last few years a number of voice recognition systems have been developed. These packages let the user dictate the text into a computer and then convert the speech to text. Dictating like this can be much quicker than typing but the software isn't perfect and it can interpret a word incorrectly.



## Remote Control

**A remote control is a hand-held device which is used to control a machine from a short distance away.** Remote controls need line-of-sight in order to send their signals to the receiving device, obstacles such as furniture or walls can block the signal.

Examples of use for remote controls:

- Televisions
- Music systems
- Lighting systems
- Heating systems



## Automatic Data Capture Devices

By using these devices, data is captured without the human involvement. Important Automatic Data Capture Devices & Methods are listed below:

1. OCR and OMR readers
2. MICR Reader
3. Barcode Reader
4. RFID tag reader
5. Magnetic strip reader
6. Smart card reader
7. Biometric data capture devices

### OCR and OMR Readers

**Optical Character Recognition (OCR)** is a software which extracts the text from the image of scanned document. OCR software compares the shape of each possible text character in the image data with sample (template) for each character stored in computer. When it recognizes a character then adds it in the output data sequence.

**Advantages:**

1. It is quicker to extract text from a document and to use it via word processor.
2. It is useful for people with visual impairments because after extracting text from document, a text-to-speech software can be used to read it aloud.

**Disadvantage:**

1. The text recognized by OCR software is not always accurate.

**Optical Mark Reading (OMR)** software is used to detect the presence of marks (shaded regions) in certain positions on a paper form. Unlike OCR, it cannot detect the characters. OCR software is used to extract marked answers in multiple-choice questions, survey results, votes in elections etc.

**Advantage:**

1. It is extremely fast and accurate because shaded regions are simple to detect.

**Disadvantages:**

1. Paper forms can be read accurately only if they are lined up properly.
2. The dirty marks on the paper can be read by OMR as well which leads to wrong results.

### MICR (Magnetic Ink Character Recognition)

**MICR software** scans documents for numerals and symbols printed in magnetic ink. The use of magnetic ink makes documents harder to copy. MICR is mostly used by bank cheque-processing systems for input of printed items on the bottom of each cheque.

**Advantages:**

1. It is highly accurate to recognize numerals and symbols even if they are overprinted by visible marks.

**Disadvantages:**

1. MICR readers are expensive and only detects magnetic ink characters.

### Magnetic Stripe Reader

**Magnetic stripe readers** are used to read the magnetic strips usually printed on the back of debit cards, credit cards, library cards etc. The magnetic stripe has 3 independent parts that can store different types of information. It can only store a small amount of data but this is sufficient for many purposes.

**Advantages:**

1. Putting a magnetic stripe on the cards is not expensive.

**Disadvantages:**

1. It is easy to write fresh data on the magnetic stripe so someone can easily alter the data on the card with a magnetic stripe writer.
2. Someone can easily clone a card by entering the duplicate information on magnetic stripe.

## Smart Card Reader

**A smart card** is a plastic card with a built-in microprocessor, used typically to perform financial transactions. It resembles a credit card in size and shape. While making a payment, a smart card is inserted in the smart card reader. The user enters a four digit Personal Identification Number (PIN) to access the data stored in card. The smart reader communicates with the built-in processor of card to match the PIN with already stored PIN and also authenticates that card is not expired.

### Advantage:

1. It is not easy to clone or to copy a smart card.

### Disadvantage:

1. If the PIN is shared or seen then someone can misuse it easily by stealing the card.

## Barcode Reader

**A barcode** is a set of parallel lines in contrasting colours usually black lines on a white background. Barcodes are used to identify items of merchandise, resources, membership cards or documents. A barcode may represent numeric digits or alphanumeric characters. A barcode only tells about the manufacturer and product only. A barcode reader is usually used at Point-of-Sale (POS).

**A barcode reader** is a combination of scanner hardware and software. The scanner captures the image of barcode while software decodes the barcode in captured image.

**At POS**, a barcode reader consists of a scanner wand or a LASER scanner fixed at the operator's computer. In these dedicated scanners a suitable processor and a decoding software are built-in the scanner. It sends signals of decoded barcode to the computer for further processing.

### Advantages:

1. Codes can be entered much faster than keyboard.
2. Codes can be entered more accurately than a person.

### Disadvantage:

1. Barcode is difficult to read or may be misread by barcode reader if it is obscured.

## RFID Tag Reader

**A Radio Frequency Identification (RFID) tag reader** reads an ID code from a small tag using short range wireless signals.

The ID code is stored in RFID tag. An RFID tag consists of Read Only Memory (ROM) to store code, a small processor and an antenna to transmit and receive signals. The size of RFID tag is very small in millimeters usually.

### Applications:

1. Used in inventory management systems.
2. Used for parking and toll charges

3. Used with hotel room keys
4. Used with pets and farm livestock

**Advantages:**

1. It is fast
2. Efficient
3. Accurate

## Biometric Data Capture Devices

**Physical characteristics** or behavior of people is known as biometric data. It can be used for the purpose of authentication rather than using a PIN.

**A Fingerprint Reader** captures the print of a finger placed on it and a pattern-matching software is used to match the received fingerprint with already stored fingerprint to identify a particular person. This software must cope with an image that may be incomplete, rotated or distorted as compared to the already stored image.

**A specialized camera** by using Infrared (IR) illumination can capture the image of retina or iris in a person's eye. A pattern-matching software is used to match the received image of iris or retina with already stored image to identify a particular person. This software must cope with an image that may be rotated or distorted as compared to the already stored image.

**A microphone** is used to capture voice of a person. A pattern-matching software is used to match the incoming voice with already stored samples of voice to identify a person. This software must cope with a voice that may be loud or may be changed due to blocked nose.

**A camera** can be used to capture the image of a person's face. A pattern-matching software is used to match the incoming image of a face with already stored images of different faces so that a particular person can be identified. This software must cope with variation in brightness and colour of lighting, different facial expressions of a person, person wearing makeup, person shaved, person having beard, having a spot or cut etc.

## What is a sensor?

A **sensor** is a device that **converts a real-world property** (e.g. temperature) into **data** that a computer can **process**.

A sensor measures a specific property data and sends a signal to the computer. Usually this is an **analogue** signal so it needs to be converted into **digital** data which is used by the computer to process (usually incoming value is matched with a preset value) and perform various operations. This is done using by an **Analogue-to-Digital Converter (ADC)**.

ADC takes an analogue signal as input and converts it to digital signal that is used by the computers and other digital devices for various purposes.

Sensors are used extensively in monitoring / measuring / data logging systems, and also in computer control systems.

## Types of Sensors

1. Temperature Sensor
2. Pressure Sensor
3. Light Sensor
4. Infrared Sensor
5. Humidity Sensor
6. Gas Sensor

### Temperature Sensor

**A temperature sensor** detects the temperature from its surroundings and produces a signal that is sent to the computer for processing.

#### Uses/Applications:

1. Used in electronic thermometers
2. Used in heat systems to control the temperature automatically

### Pressure Sensor

**When a pressure sensor** is exposed to pressure then it generates signals that are sent to the computer for processing purpose.

#### Uses/Applications

1. It is used in automatic blood pressure monitoring device.
2. Used to control the pressure of gas or liquids in a chemical reaction vessel.

### Light Sensor

**A light sensor produces** a signal that depends on the intensity of light falling on it. This signal is sent to the computer for processing.

#### Uses/Applications:

1. Used in cars to control the headlights automatically.
2. Used in streetlights to turn on/off automatically

### Infrared Sensor

**An infrared sensor** produces a signal that depends on the level of invisible IR radiation falling on it. All objects (unless they are extremely cold) emit significant IR radiation.

#### Applications:

1. Used in railway safety system
2. Heating & night visions

3. Flame detection

### Humidity Sensor

**A humidity/moisture sensor** produces a signal that depends on the amount of water vapors in the atmosphere.

#### **Applications:**

1. Used in controlling automated irrigation systems
2. Used in controlling a heating, ventilating and air conditioning (HVAC) system.
3. Used to maintain sufficient humidity in a greenhouse.
4. Can be used to measure humidity for weather forecasting.

### Gas Sensor

**A gas sensor** produces a signal depending on the concentration of a particular gas or vapors.

#### **Applications:**

1. Use for an inflammable gas to monitor the atmosphere.
2. Used in process control of chemical industry.
3. Environmental Monitoring of air pollution.

## Practice Questions

**Question 1:** List down the names of three input devices that may be used at ATM machine along with their purpose.

Device 1:

Purpose:

Device 2:

Purpose:

Device 3:

Purpose:

**Question 2:** List down the names of three input devices that may be used at Point-of-Sale (POS) along with their purpose.

Device 1:

Purpose:

Device 2:

Purpose:

Device 3:

Purpose:

**Question 3: (May/June 2013, P11, Q1)**

Name a suitable sensor for **each** of the following applications.  
Choose a **different** sensor in each application.

- (i) control of a central heating system

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- (ii) operation of automatic doors

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- (iii) detection of intruders

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- (iv) monitoring of a greenhouse environment

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**Question 4: (May/June 2013, P11, Q5)**

Name a suitable hardware device to enable automatic data capture in each of the following applications. Each device must be different.

Application	Hardware device
automatic stock control system in a supermarket	
keeping track of the livestock on a large farm	
input data into a computer using speech recognition	

**Question 05: (May/June 2014, P11, Q10)**

You have been asked to write a report on the use of the following communication methods:

- mobile phones
- video conferencing
- emails

Describe a benefit and a drawback of each of the above communication methods.

**mobile phones**

Benefit .....

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Drawback .....

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**video conferencing**

Benefit .....

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Drawback .....

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**emails**

Benefit .....

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Drawback .....

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**Question 06: (May/June 2014, P12, Q3)**

(a) Name two items of software needed to run video conferencing. In each case, explain the purpose of the software.

software item 1 .....

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purpose .....

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software item 2 .....

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purpose .....

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(b) The table below has three statements. Each of them is about video conferencing.

One or more of these is a benefit of using video conferencing.

Tick (✓) each statement that is a benefit.

statement	benefit
It is possible to hold meetings at any time.	
There is no problem with time zones.	
Reduces the "hidden cost" of employees being away from the office.	

(c) A student made the following two statements. Each of them is about video conferencing hardware.

Explain why **both** statements are incorrect.

*"microphones are used so that delegates can hear what is being said"*

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*"webcams record the images and then transmit them to the other meeting room"*

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(d) Describe **two** drawbacks of using video conferencing.

1 .....  
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2 .....  
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**Question 07: (May/June 2014, P12, Q12)**

Camilo works as a hotel inspector. He travels to hotels in his own country and overseas. He visits the hotels and then sends back a report to his head office after each hotel visit.

(a) Name **three** modern electronic devices that Camilo could use to help him with his work. Give a different reason for your choice of **each** device.

device 1 .....  
reason .....  
.....  
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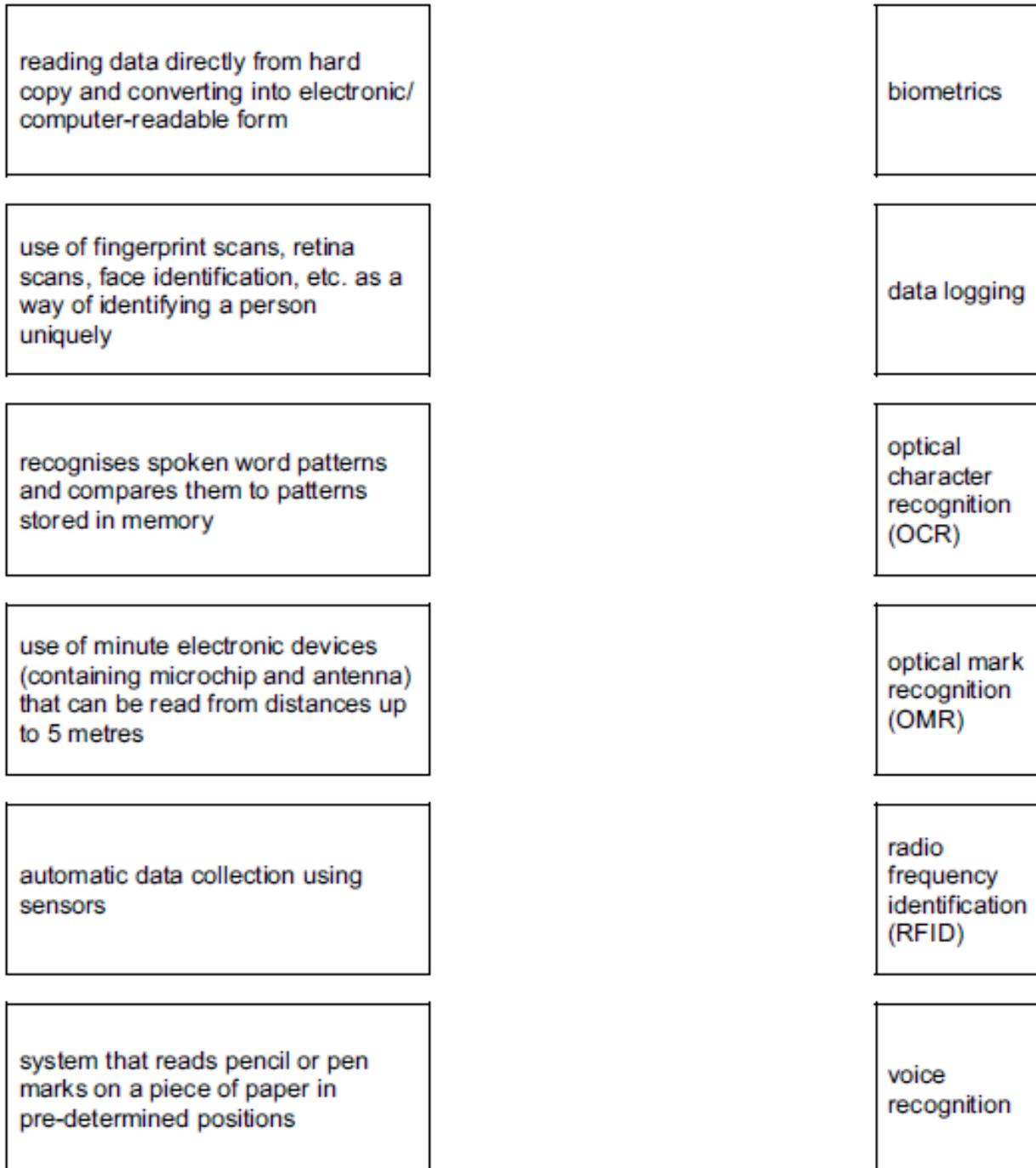
device 2 .....  
reason .....  
.....  
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device 3 .....  
reason .....  
.....  
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**Question 08: (May/June 2014, P12, Q6)**

The following diagram shows six descriptions of automatic data capture methods and six terms

Draw lines to connect each description to the correct term.



**Question 09: (Oct/Nov 2013, P13, Q6)**

Patients in a hospital are monitored for vital signs (for example, heart beat and temperature) by sensors and a computer system. Results are displayed on a monitor in the form of numbers and graphs.

(a) Describe how the sensors and computer system are used to monitor the patients and to alert doctors and nurses of a possible problem.

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(b) Give **two** advantages of using this system rather than 24 hour monitoring by nurses.

1 .....

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2 .....

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(c) Why is the output shown in both graphical and numerical form?

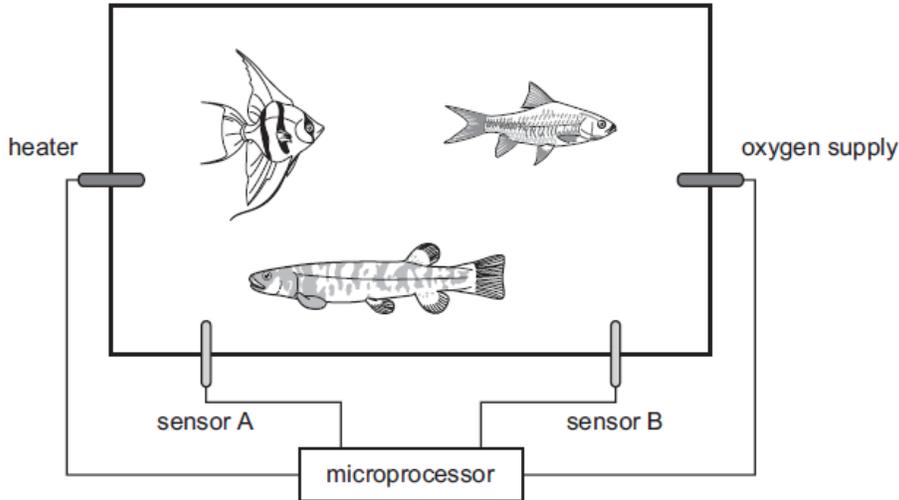
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**Question 10: (Specimen Paper 2015, Q6)**

The conditions in a fish tank are being controlled using sensors and a microprocessor. To keep the fish healthy, the temperature must be at 25°C and the oxygen content needs to be 20 ppm (parts per million). The tank contains a heater and an oxygen inlet controlled by a valve.



(a) Name the **two** sensors used in this application.

Sensor A .....

Sensor B .....

(b) Describe how the sensors and the microprocessor are used to maintain the correct conditions in the fish tank.

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(c) What safeguards are needed to stop the fish tank temperature rising too high?

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