INPUT DEVICES

Lecture 9

Input Device

Processor-
Central processing
Unit (CPU)

Storage Device

Output Device

Topics Covered in Last Lecture

- What is a Number System?
- Types of Number Systems
- Conversion to Other Bases
- Number Systems Relation to Computers
- Arithmetic in Other Bases

Today's Topics

- Input Devices
  - Learning Objectives
  - Input Devices and Their Uses
    - Manual Input Devices and their Uses
    - Sensors
  - Direct Data Entry (DDE) Devices
    - Magnetic Stripe Reader
    - Contactless Debit Card Readers
    - Chip and PIN Reader
    - Radio Frequency Identification(RFID) Readers
    - Optical Mark Recognition/Reader (OMR)
    - Optical Character Recognition(OCR)
    - Barcode Readers/Scanners
    - Quick Response (QR) Code Scanners (Readers)

Input and output devices

Learning objectives

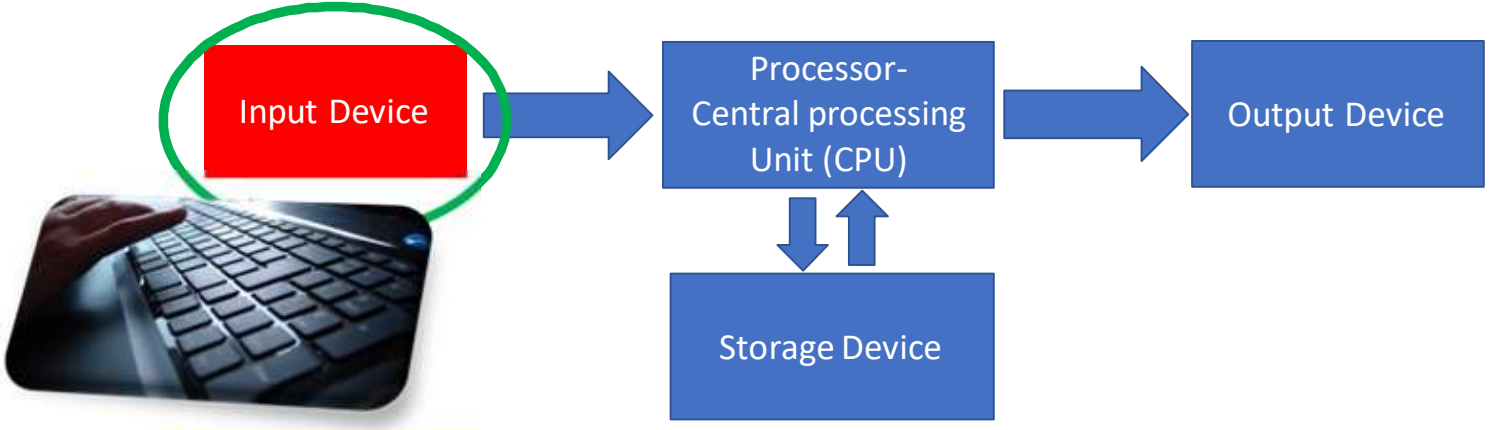
1. Understand the characteristics of input devices (like mouse, keyboards, microphones, etc.), their uses, advantages and disadvantages.

2. Understand the characteristics of Direct Data Entry (DDE) devices (card readers, RFID reader, OCR etc.), their uses, advantages and disadvantages.

Understand the characteristics of input devices (like mouse, keyboards, microphones, etc.), their uses, advantages and disadvantages.

Input Devices and their uses

- Hardware devices that enable or allow user enter data into a computer.



- Manual Input devices: Involves much human effort to enter data (e.g mouse, keyboard, remotes etc.)
- Direct Data entry devices: little human effort is needed, data is directly entered by a machine or device. Examples: barcode readers, etc.

Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Keyboards 	▪Most common and easy way to enter data into a computer ▪ Can be wired or wireless ▪ Virtual in tablets, mobile phones & some laptops	▪ Easy to use for most people ▪ Fast text entry into documents ▪ Easy to verify data during entry.	▪Slow data entry compared to direct data entry. ▪Device takes up desk space
Numeric keypads 	▪Mainly use for numeric data entry, some allow short text and symbols ▪Use for fast spreadsheet data entry ▪Use on mobile phones, ATMs, POS, chip and pin devices.	▪ Faster than keyboards for numeric data entry ▪ Very portable compared to standard keyboards	▪ Might be difficult to use in case of small keys ▪Difficulty in entering text especially on telephones

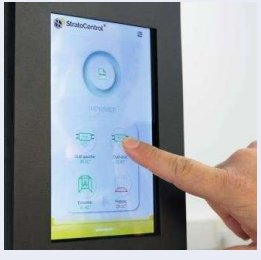
Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Mouse 	▪Moved around on a smooth surface to control a cursor on screen ▪ Can be wired or wireless ▪Use for opening, closing, minimizing software, editing etc.	▪Fast method for selecting, opening and closing apps, documents etc. ▪ Take little desk space compared to keyboards	▪Difficult to use if surface is not flat. ▪Easy to get damage, mouse easily get dirty.
Touchpad 	▪ Main pointing device on laptops ▪ Moving fingers on the surface and gently taping provides uses as in mouse above.	▪ No need for separate mouse and extra desk space, as it is part of the computer.	▪ Difficult to use by people with hand/wrist problems (RSI) ▪ Difficult to use compared to normal mouse

Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Tracker ball mouse 	• Same as normal mouse, but ball is on the top or side. • Suitable for users with RSI or to prevent it. • Use in industrial control to navigate process screens.	• Easier to use than a normal mouse • More robust than a mouse • More accurate position of pointer on screen	• More costly than normal mouse • May require training before use.
Remote control 	• Employs infrared technology to control other devices. • Use to control: ○ Televisions, DVD/CD players ○ Machinery in industry and robots.	• Easy to use • Can be operated from a considerable distance.	• Signals can easily be blocked • Might be difficult to use by some persons especially for advance controls

Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Joystick 	• Pointing device with similar uses to mouse and tracker ball • Use for gaming • Use for flight control simulations	• Easy screen navigation than keyboards	• Not usable for general-purpose tasks
Touchscreen 	• Screen is used to select/input options • Use on: ATMs, POS, mobile phones, tablets, interactive white boards etc.	• Faster entry options than using keyboard or mouse. • Very easy method for choosing options. • Often very user-friendly method	• User is limited to available input options. • Screen can get very dirty (public use)

Manual Input devices and their uses

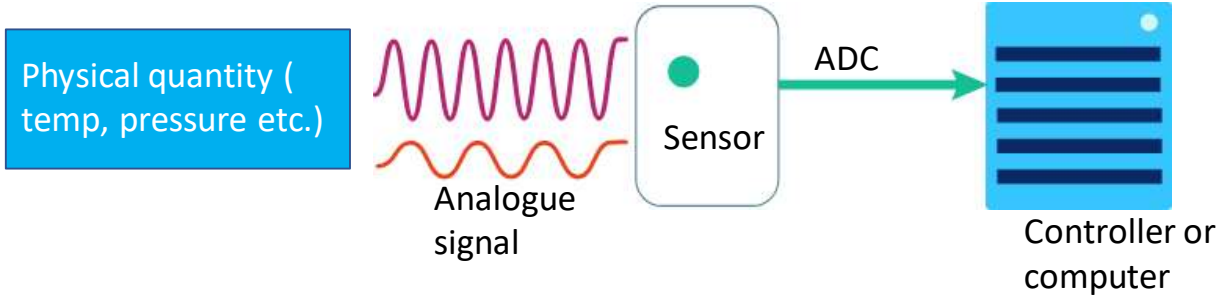
Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Light pens 	▪ Used with computers as input device. ▪ Use for selecting objects on CRT screens ▪ Use for drawing on screen	▪ Greater accuracy than touch screens ▪ Very handy in cases where space is an issue ▪ Easy to use technology.	▪ Lagging problems when drawing on screen ▪ Rather dated technology.
Scanners 	▪ Used to enter information from hard copy documents like text, photographs, barcodes etc.	▪ Scans information which can be stored in different formats, ▪ Faster information entry	▪ Limited quality depending on resolution of scanner used ▪ Fairly slow in high resolution scans

Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Digital Camera 	▪ Use for taking of photographs, video recording. ▪ Use in cars for data capture or visual aid when reversing.	▪ Produces better quality images than traditional cameras. ▪ Easier and faster to upload/transfer photographs/videos to computers	▪ User often requires proper training before use of device. ▪ Many artists are using it due to more features.
Microphones 	▪ Built-in or USB connected device use to input: speech, sounds, voice recoding. ▪ Use in mobile phones and computers for calls	▪ Faster text entry than typing with keyboard ▪ Aids in safety when used in voice activation or security systems.	▪ Sound files can use up more space ▪ Voice-recognition is not as accurate as manual typing.

Input devices and their uses
Sensors

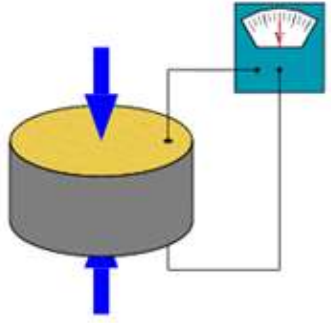
- A sensor is a device that reads and inputs measurement(s) of a continuously changing physical quantity into a computer.
- Most sensors are analogue, they collect continuously changing measurements (e.g temperature, moisture, etc).
- These analogue measurements must be converted from analogue to digital data (using ADC) for easy understanding by the computer.



Sensors: Types of Sensors

Piezoelectric Effect is the ability of certain materials to generate an electric charge in response to applied mechanical stress. The word Piezoelectric is derived from the Greek piezein, which means to squeeze or press, and piezo, which is Greek for "push".

A **piezoelectric sensor** is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge.



A piezoelectric disk generates a voltage when deformed (change in shape is greatly exaggerated)

Sensors: Types of Sensors

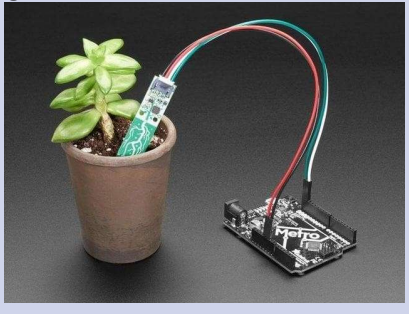
Type of sensor	Areas of applications
Temperature 	• Used for temperature monitoring in automatic washing machines, central heating systems, automated glasshouses, ovens etc.
Pressure	• Used to detect pressure changes in intruder alarm systems, robotics, environmental monitoring
Light 	• Used to detect light in automatic glasshouses, automatic doors, intruder alarm systems, street lighting control
Sound	• Used in intruder alarm systems, monitoring liquid and powder flow in pipes etc.
Humidity/moisture	• Used in automatic glasshouses, environmental monitoring, in factories where moisture levels are crucial (for example, manufacture of microchips, paint spraying)
Ph 	• Used to measure Ph levels in chemical processes, environmental monitoring, automatic glass houses.

Advantages

- More accurate readings compared to human readings
- More reliable especially as readings need to be taken continuously
- Most suitable for hazardous systems, they require little human intervention.

Disadvantages

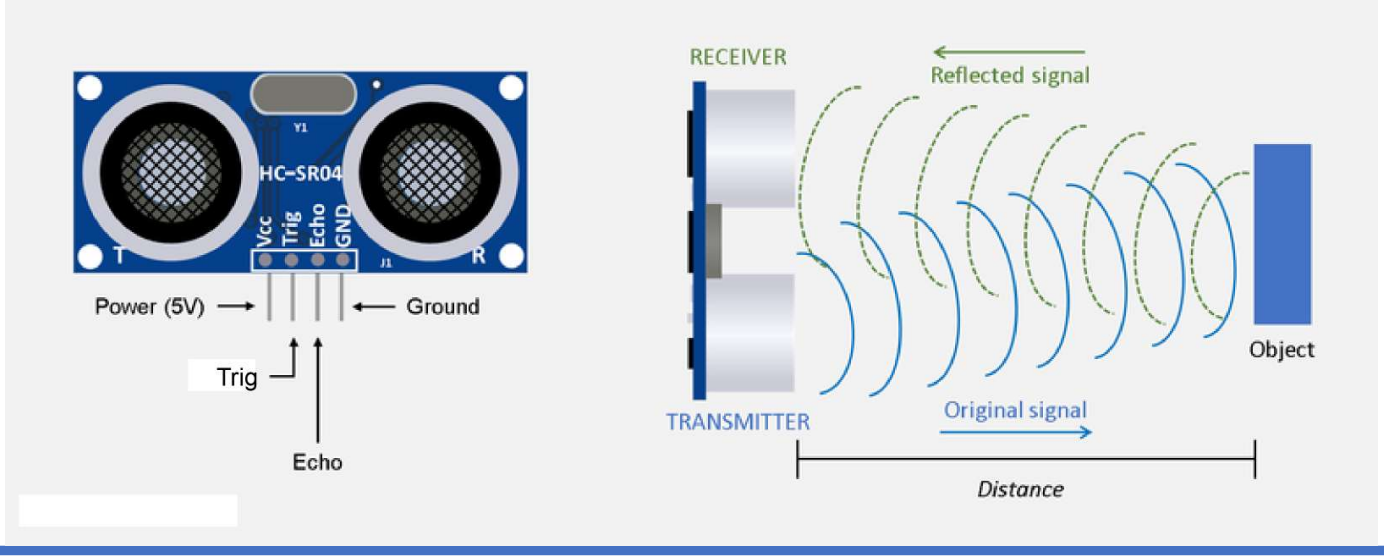
- Incorrect readings from sensors need human identification and corrections.
- Most sensors are analogue and often used an ADC which is additional cost.



Sensors: Types of Sensors

Ultrasonic Sensor:

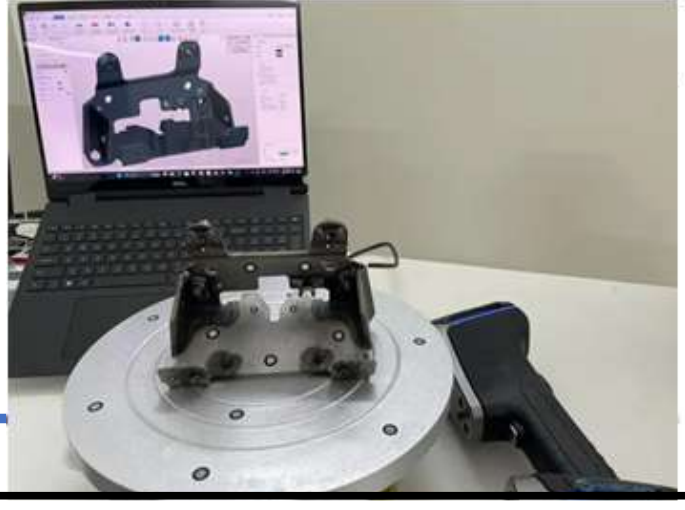
An electronic instrument that uses ultrasonic sound waves to measure the distance of the target object and the reflected sound is converted into electrical signal.

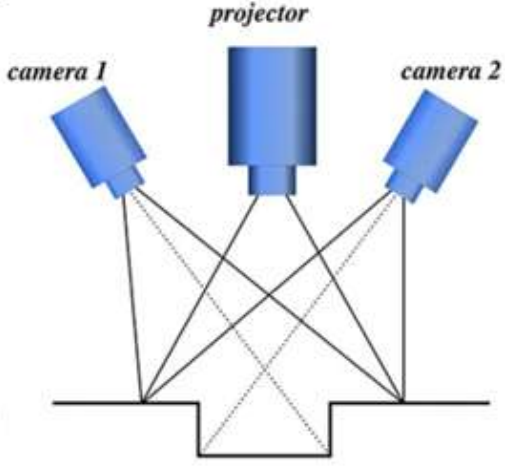


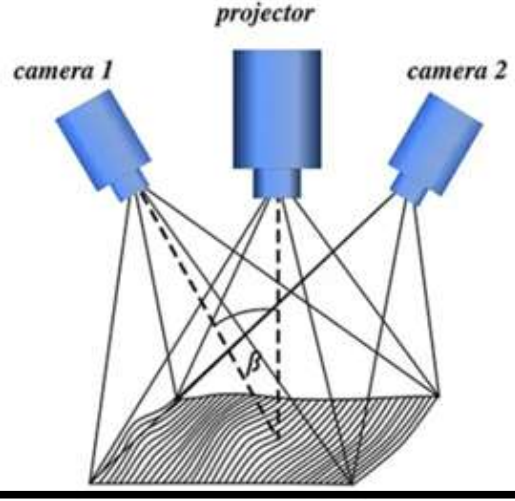
Sensors: Types of Sensors

3D Scanner:

3D scanners work by projecting light onto an object and capturing its reflection. By measuring the time it takes for the light to return, the distance of each point can be determined, which are then collectively used in the form of XYZ coordinates to digitally reconstruct a 3D representation of the object.







Sensors: Types of Sensors

Some Important Concepts

Photogrammetry: Uses multiple 2D images from different angles and processes them to create a 3D model.

Time of Flight (ToF): Measures the time it takes for a laser or light pulse to travel to an object and back, calculating distance based on speed of light.

Resolution and Accuracy: Defines how precisely the scanner captures fine details. Higher resolution means more points captured per unit area, leading to greater model detail.

Point Clouds: A 3D scanner generates a "point cloud" – a collection of data points that represent the scanned object's surface in space.

Sensors: Types of Sensors

A **3D laser scanner** sends out laser beams in different directions, measuring distances to objects by calculating the time it takes for the emitted laser pulses to bounce back.

These scanners are equipped with high-resolution cameras, aiding in capturing colour and texture details. By utilising multiple scans from different positions, a comprehensive 3D point cloud can be created, which represents the scanned area.

Understand the characteristics of Direct Data Entry (DDE) devices (card readers, RFID reader, OCR etc.), their uses, advantages and disadvantages.

Direct data entry devices-DDE

- **little human effort needed to enter data.**

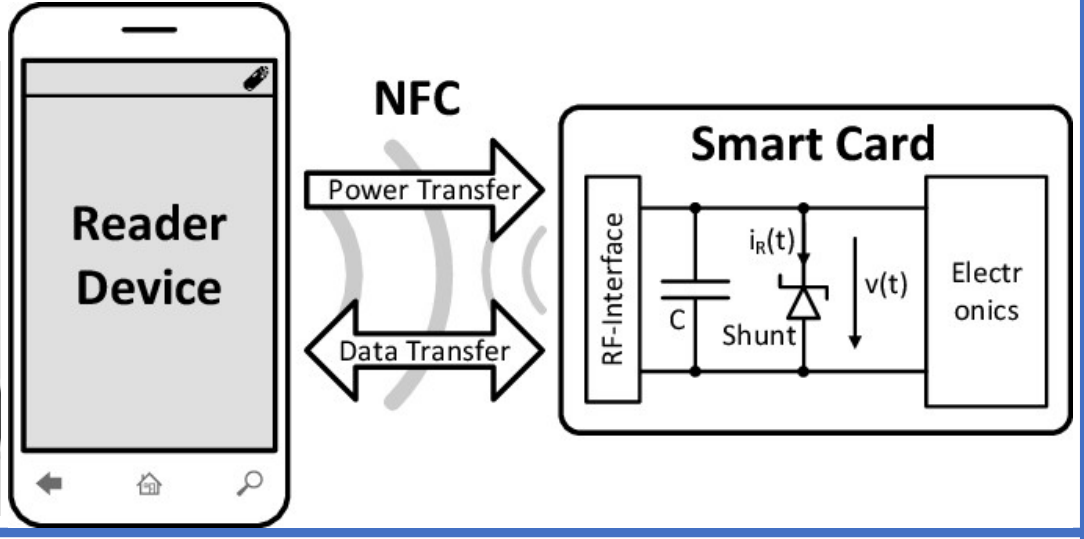
Direct data entry (DDE) devices

Magnetic Stripe Reader

DDE device	Description/Use	Advantages	Disadvantages
Magnetic stripe readers 	▪Reads data from magnetic stripe found on the back of debit cards or credit cards. ▪The magnetic strip carries information like: account details, login details to security system. ▪Use in electronic fund transfer at point of sale (EFTPOS) terminals. ▪ Security device in buildings, hotel rooms etc.	▪Fast data entry compared to using keyboards or keypads. ▪ Error free; no typing involve ▪Secure form of data entry ▪Robust device; no moving parts, Resistant to most common liquids and moisture.	▪ Damage on magnetic strip can lead to data loss ▪ Needs close contact to work ▪Strong magnetic fields can lead to data corruption and loss.

Direct data entry (DDE) devices cont..

Contactless transactions are powered by either radio frequency identification (RFID) or near-field communication (NFC) technology. When making a purchase, these radio waves share your bank account, contactless card, or phone app details with the merchant's payment reader.



Direct data entry (DDE) devices cont..

Contactless debit card readers

DDE device	Description/Use	Advantages	Disadvantages
Contactless debit card readers 	▪Reads data off a chip that emits radio waves. This chip is found on debit cards and enable payments for varied amounts. ▪Allows for payments of items at EFTPOS terminals.	▪Fast transactions; within seconds ▪ Error free; no typing involved	▪More expensive than standard credit/debit cards. ▪Might be easy to hack without users notice.

Direct data entry (DDE) devices cont..

Chip and PIN reader

DDE device	Description/Use	Advantages	Disadvantages
Chip and PIN reader 	▪Has a slot, screen and keypad. The card is inserted into the slot, the user then enters a PIN using a keypad, instructions are displayed on small screen. ▪Used in restaurants, supermarkets, travel agencies etc. ▪Mostly used at EFTPOS terminals.	▪More secure than contactless card systems. ▪More robust system than magnetic strip readers	▪ PIN can easily be stolen when typing it. ▪PIN can easily be forgotten

Direct data entry (DDE) devices cont..

Contactless debit card readers are more popularly used compared to **Chip and PIN readers.**

1. **Speed and Convenience:** Contactless Transactions are much faster since users only need to tap their card or device, with no need to input a PIN.
2. **Hygiene and Safety:** During the COVID-19 pandemic, contactless payments grew in popularity due to reduced physical interaction.
3. **Security Concerns:** Chip and PIN transactions require a PIN, adding an extra layer of security, particularly for higher-value purchases.
4. **Wear and Tear:** Physical cards and readers can wear out over time due to the constant insertion and removal of cards.

Direct data entry (DDE) devices cont..

Optical mark recognition/reader (OMR)

- Device which reads marks written in pen or pencil on special places or positions on paper/forms.
- Mostly used to read questionnaires, MCQ-marking, voting papers etc.

Advantages of OMR	Disadvantages of OMR
▪ Very fast way of inputting results into a computer ▪ More accurate than manually keying in data ▪ More accurate than OCR	▪ Forms must be carefully designed and positions accurately place for marks to be made for easy recognition. ▪ Marks can be difficult to read if not done with good ink or pencil

Direct data entry (DDE) devices cont..

Optical Character recognition(OCR)

- An OCR device converts text on hard copy documents into electronic form.
- Special OCR software further converts this electronic data to a form compatible for other applications.
- Used in airports for processing of passports
- Used to convert documents to electronic form.

Advantages of OCR	Disadvantages of OCR
▪ Faster data entry system than manual methods ▪ Less error; no manual typing or data entry	▪ Difficulty in reading some handwritings or data ▪ Still not very accurate as needed

Direct data entry (DDE) devices cont…

Comparison between OMR and OCR

Optical Mark Reader (OMR)	Optical Character Recognition (OCR)
• More accurate data reading method than OCR	• More accurate than manual typing, but issues of recognizing all hand writings still exist
• Easier and faster to complete forms	• Less easier to complete forms compared to OMR forms
• Simply detects marks on page and compares position with stored template.	• Detects written characters; reading can be difficult if writing is not very clear.
• Good for use in marking multiple-choice examination papers.	• Good for converting documents to an editable electronic form

Direct data entry (DDE) devices cont…

Barcode readers/scanners

- The scanner is used to scan and read information from barcodes on various categories of products (food, books, electronics etc.)
- Used in supermarkets for product identification, tracking and billing.
- Use to keep track of books in libraries.

Advantages of barcode systems	Disadvantages of barcode systems
▪ Faster than manually keying in data ▪ Reliable technology ▪ Allow automatic stock control	▪ Relatively expensive system ▪ System can be tricked if barcodes are swapped on products. ▪ Barcodes can be easily damaged compared to RFID tags or magnetic strips

Direct data entry (DDE) devices cont…

Quick response (QR) code scanners (readers)

- Made up of a matrix of filled-in dark squares on a light background.
- These matrix filled-in (light and dark) squares carry information that can be used to get access to an app, website, product etc.
- Can hold up to 4296 characters compared to 30 digits in barcodes.
- Used for product advertisements, access to systems, website access etc.

Advantages of QR codes	Disadvantages of QR codes
▪ Faster and easier to read compared to barcodes ▪ QR codes can be encrypted giving them better protection than barcodes. ▪ Hold much more information compared to normal barcode.	▪ Multiple QR formats exist ▪ The ease of access to different apps to generate QR codes means QR Can easily be used to transmit malicious codes.

Case Study: Ultrasonic Sensor in Robot

Scenario:

A small mobile robot is designed to move along a path inside a warehouse. To avoid collisions, the robot is equipped with an **ultrasonic sensor** at the front.

The ultrasonic sensor works by sending **ultrasonic sound waves** toward an object. The waves bounce back, and the sensor converts the reflected sound into an electrical signal to calculate the **distance**.

The robot follows this rule:

- If the distance to an obstacle is **less than 30 cm**, it must **stop immediately**.
- If the distance is **greater than or equal to 30 cm**, it continues moving forward.

During a test, the sensor detected an obstacle at **25 cm**.

Case Study: Ultrasonic Sensor in Robot

Questions:

1. **Explain how the ultrasonic sensor detects the obstacle**
2. **Decide what the robot should do** when the sensor reading is 25 cm, according to the given rule.
3. **Briefly discuss one advantage** of using an ultrasonic sensor for collision avoidance compared to relying on manual human supervision.

Case Study: Ultrasonic Sensor in Robot

Answers:

1. **Working Principle**

- The ultrasonic sensor emits **ultrasonic sound waves**.
- These waves hit an obstacle and are **reflected back**.
- The sensor converts the reflected sound into an **electrical signal**, which is processed to calculate the distance.

Case Study: Ultrasonic Sensor in Robot

Answers:

2. What the robot should do

- Rule: Stop if distance < 30 cm.
- Sensor reading = 25 cm.
- Since 25 cm is **less than 30 cm**, the robot must **stop immediately** to avoid collision.

Case Study: Ultrasonic Sensor in Robot

Answers:

3. Advantage of Ultrasonic Sensor

- The sensor allows **automatic and continuous detection**, so the robot can avoid obstacles **without human supervision**.
- This makes the system more **efficient and safer**, especially in environments like warehouses where humans cannot monitor every robot at all times.

Summary

In this lecture, we covered essential input devices.

Input devices, like keyboards and RFID readers, facilitate data entry, while direct data entry tools such as barcode scanners and OCR systems streamline information capture.

Thank You !