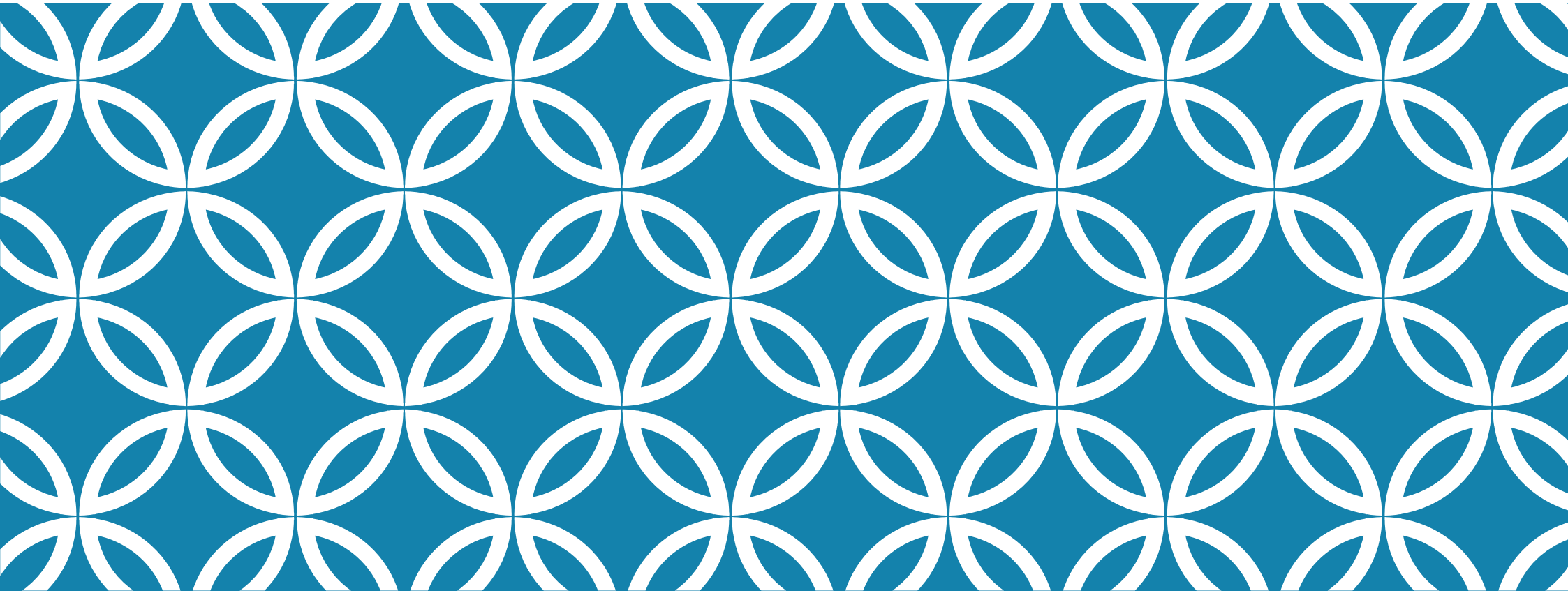


INPUT AND OUTPUT DEVICES

INPUT DEVICES

- Barcode scanners
  - It is a series of dark and light lines of varying thickness
  - 0 – 9 can be represented with different pattern of lines
- So what happens when a barcode is scanned?
  - the barcode is read by a red laser or red LED (light emitting diode)
  - Laser reflects on the white area
  - the reflected light is read by sensors (photoelectric cells)
  - as the laser or LED light is scanned across the barcode, a pattern is generated, which is converted into digital data – this allows the computer to understand the barcode

The section of barcode to represent the number 5 4 3 0 5 2 would therefore be:

for example: the digit '3' on the left generates the pattern: L D D D D L D
(where L = light and D = dark),
this has the binary equivalent of: 0 1 1 1 1 0 1
(where L = 0 and D = 1).

INPUT DEVICES

- Barcode is usually found at the checkout in supermarkets, but there are also other devices

Input/output device	How it is used
keypad	to key in the number of same items bought; to key in a weight, to key in the number under the barcode if it cannot be read by the barcode reader/scanner
screen/monitor	to show the cost of an item and other information
speaker	to make a beeping sound every time a barcode is read correctly; but also to make another sound if there is an error when reading the barcode
printer	to print out a receipt/itemised list
card reader/chip and PIN	to read the customer's credit/debit card (either using PIN or contactless)
touchscreen	to select items by touching an icon (such as fresh fruit which may be sold loose without packaging)

INPUT DEVICES

- Automatic stock control, using barcodes
  - the barcode number is looked up in the stock database (the barcode is known as the key field in the stock item record); this key field uniquely identifies each stock item
  - when the barcode number is found, the stock item record is looked up the price and other stock item details are sent back to the checkout
  - the number of stock items in the record is reduced by 1 each time the barcode is read
  - this new value for number of stock is written back to the stock item record
  - the number of stock items is compared to the re-order level; if it is less than or equal to this value, more stock items are automatically ordered
  - once an order for more stock items is generated, a flag is added to the record to stop re-ordering every time the stock item barcode is read
  - when new stock items arrive, the stock levels are updated in the database

INPUT DEVICES

- Advantages to the management of using barcodes
  - much easier and faster to change prices on stock items
  - much better, more up-to-date sales information/sales trends
  - no need to price every stock item on the shelves (this reduces time and cost to the management)
  - allows for automatic stock control
  - possible to check customer buying habits more easily by linking barcodes to, for example, customer loyalty cards.
- Advantages to the customers of using barcodes
  - faster checkout queues (staff don't need to remember/look up prices of items)
  - errors in charging customers is reduced

INPUT DEVICES

- Quick response (QR) codes
  - It is another type of barcode is the quick response (QR) code.
  - A QR code consists of a block of small squares (light and dark) known as pixels.
  - It can presently hold up to 4296 characters (or up to 7089 digits) and also allows internet addresses to be encoded within the QR code
  - The three large squares at the corners of the code function as a form of alignment
- Because of modern smartphones and tablets, which allow internet access on the move, QR codes can be scanned anywhere. This gives rise to several uses:
  - advertising products
  - giving automatic access to a website or contact telephone number
  - storing boarding passes electronically at airports and train stations

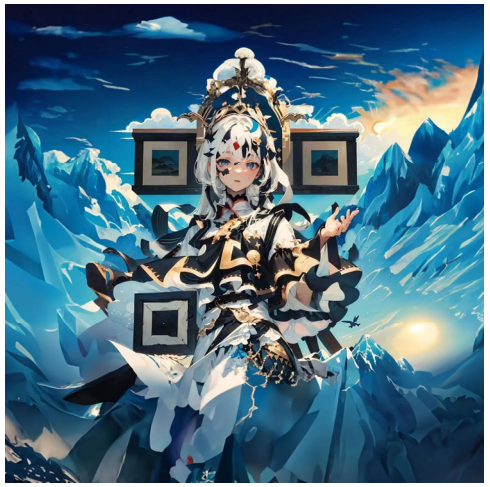
▲ **Figure 3.17** Sample QR code

▲ **Figure 3.18** Sample boarding pass

▲ **Figure 3.19** Frame QR code

INPUT DEVICES

- Steps in mobile app
  - point the phone or tablet camera at the QR code
  - the app will now process the image taken by the camera, converting the squares into readable data
  - the browser software on the mobile phone or tablet automatically reads the data generated by the app; it will also decode any web addresses contained within the QR code
  - the user will then be sent to a website automatically (or if a telephone number was embedded in the code, the user will be sent to the phone app)
  - if the QR code contained a boarding pass, this will be automatically sent to the phone/tablet.



INPUT DEVICES

Advantages of QR codes compared to traditional barcodes

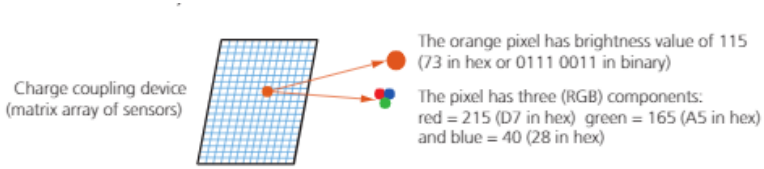
- They can hold much more information
- There will be fewer errors; the higher capacity of the QR code allows the use of built-in error-checking systems
- QR codes are easier to read; they don't need expensive laser or LED (light emitting diode) scanners like barcodes – they can be read by the cameras on smartphones or tablets

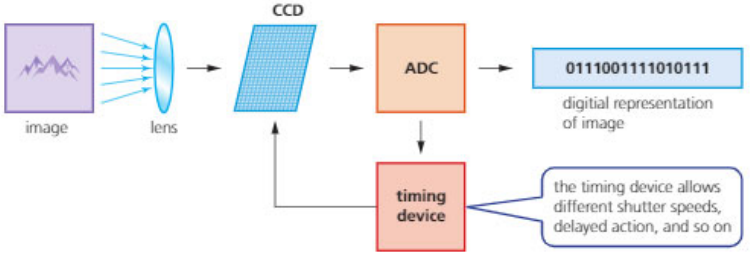
Disadvantages of QR codes compared to traditional barcodes

- More than one QR format is available
- QR codes can be used to transmit malicious codes The user could also be sent to a fake website, or it is even possible for a virus to be downloaded..

INPUT DEVICES

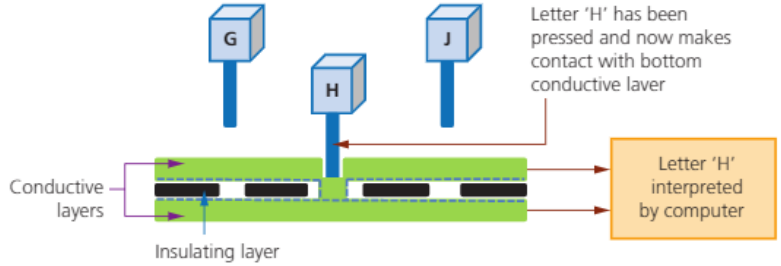
- Digital camera
  - What happens when a photograph is taken?
  - the image is captured when light passes through the lens onto a light-sensitive cell called CCD
  - each of the sensors are often referred to as pixels (picture elements) since they are tiny components that make up the image
  - the image is converted into tiny electric charges which are then passed through an analogue to digital converter (ADC) to form a digital image array
  - most cameras use a 24-bit RGB system
  - for example, a shade of orange could be 215 (red), 165 (green) and 40 (blue) giving a binary pattern of 1101 0111 1010 0101 0010 1000 (or D7A528 written in hex)



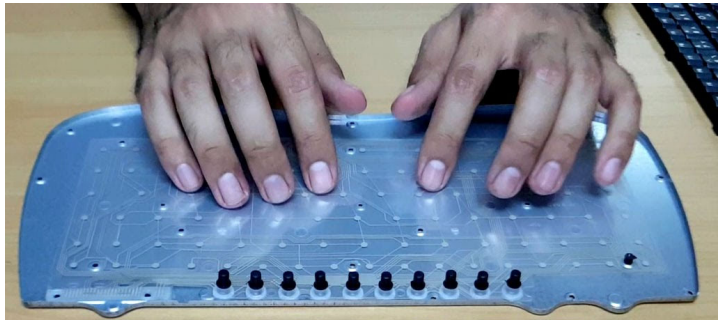


INPUT DEVICES

- Keyboard
- how the computer recognises a letter pressed on the keyboard
  - There is a membrane or circuit board at the base of the keys
  - In Figure 3.25, the 'H' key is pressed and this completes a circuit as shown
  - The CPU in the computer can then determine which key has been pressed
  - The CPU refers to an index file to identify which character the key press represents
  - Each character on a keyboard has a corresponding ASCII value

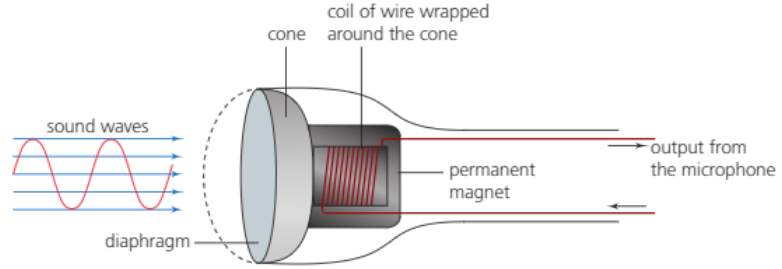


▲ **Figure 3.25** Diagram of a keyboard



INPUT DEVICES

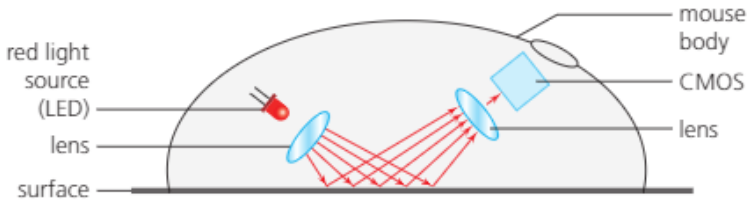
- Microphones
- How does microphones work?
  - When sound is created, it causes the air to vibrate.
  - When a diaphragm in the microphone picks up the air vibrations, the diaphragm also begins to vibrate.
  - A copper coil is wrapped around the cone which is connected to the diaphragm. As the diaphragm vibrates, the cone moves in and out causing the copper coil to move backwards and forwards.
  - This forwards and backwards motion causes the coil to cut through the magnetic field around the permanent magnet, inducing an electric current.
  - The electric current is then either amplified or sent to a recording device. The electric current is analogue in nature.
  - https://youtu.be/6qjclXaE7gc?t=780



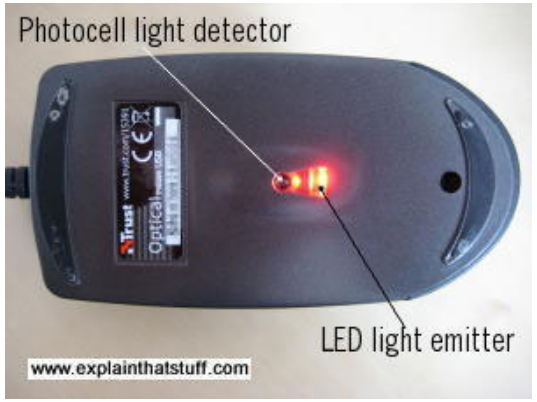
▲ **Figure 3.26** Diagram of how a microphone works

INPUT DEVICES

- Optical mouse
- How does it work?
  - A red LED is used in the base of the mouse and the red light is bounced off the surface and back to CMOS (image sensor)
  - CMOS generates a pattern of image
  - When mouses move the pattern of the image also changes
  - The motion of pointer on the screen will be moved according to the data from mouse



▲ **Figure 3.28** Diagram of an optical mouse



Interpreting differences in image fingerprints can be translated to movement of the mouse