Sadiq Public School

Do the right, fear no man

Subject: Computer Science **Class: C3** **Saturday, 16th November, 2024**

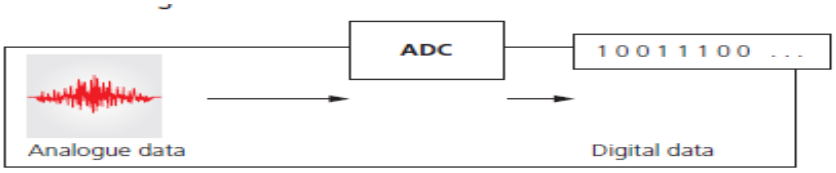
Lesson: This Lesson is about Sensors and Data storage

A: Inquiry

- Do you know what are sensors and why are they used? Write name of some sensors.
- Do you know what is meant by storage? Write name of some storage devices.

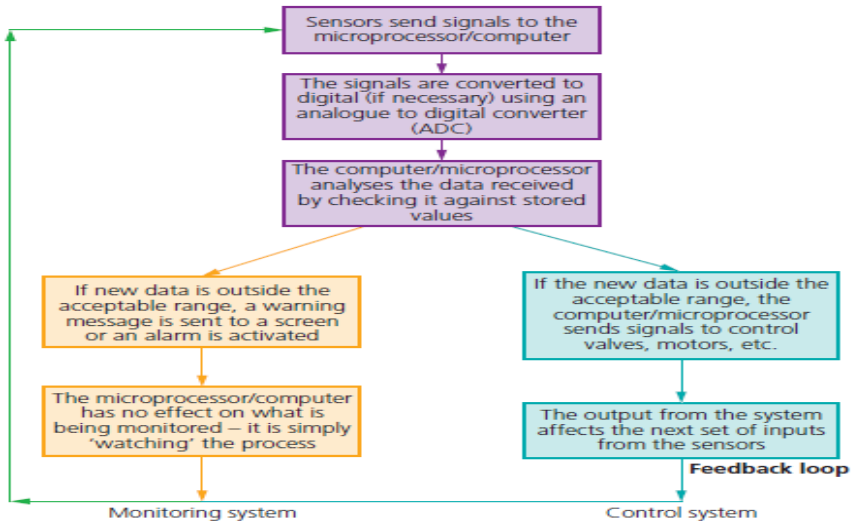
B: Information:

Sensors are input devices which read or measure physical properties from their surroundings. Examples include temperature, pressure, acidity level and length (there are many others). Real data is analogue in nature; this means it is constantly changing and doesn't have a single discrete value. computers cannot make any sense of these physical quantities so the data needs to be converted into a digital format. This is usually achieved by an **analogue to digital converter (ADC)**. This device converts physical values into discrete digital values.



Sensor	Description of sensor	Example applications
Temperature	measures temperature of the surroundings by sending signals; these signals will change as the temperature changes	• control of a central heating system • control/monitor a chemical process • control/monitor temperature in a greenhouse
Moisture	measures water levels in, for example, soil (it is based on the electrical resistance of the sample being monitored)	• control/monitor moisture levels in soil in a greenhouse • monitor the moisture levels in a food processing factory
Humidity	this is slightly different to moisture; this measures the amount of water vapour in, for example, a sample of air (based on the fact that the conductivity of air will change depending on the amount of water present)	• monitor humidity levels in a building • monitor humidity levels in a factory manufacturing microchips • monitor/control humidity levels in the air in a greenhouse
Light	these use photoelectric cells that produce an output (in the form of an electric current) depending on the brightness of the light	• switching street lights on or off depending on light levels • switch on car headlights automatically when it gets dark
Infrared (active)	these use an invisible beam of infrared radiation picked up by a detector; if the beam is broken, then there will be a change in the amount of infrared radiation reaching the detector (sensor)	• turn on car windscreen wipers automatically when it detects rain on the windscreen • security alarm system (intruder breaks the infra-red beam)
Infrared (passive)	these sensors measure the heat radiation given off by an object, for example, the temperature of an intruder or the temperature in a fridge	• security alarm system (detects body heat) • monitor the temperature inside an industrial freezer or chiller unit
Pressure	a pressure sensor is a transducer and generates different electric currents depending on the pressure applied	• weighing of lorries at a weighing station • measure the gas pressure in a nuclear reactor
Acoustic/sound	these are basically microphones that convert detected sound into electric signals/pulses	• pick up the noise of footsteps in a security system • detect the sound of liquids dripping at a faulty pipe joint
Gas	most common ones are oxygen or carbon dioxide sensors; they use various methods to detect the gas being monitored and produce outputs that vary with the oxygen or carbon dioxide levels present	• monitor pollution levels in the air at an airport • monitor oxygen and carbon dioxide levels in a greenhouse • monitor oxygen levels in a car exhaust
pH	these measure acidity through changes in voltages in, for example, soil	• monitor/control acidity levels in the soil in a greenhouse • control acidity levels in a chemical process
Magnetic field	these sensors measure changes in magnetic fields – the signal output will depend on how the magnetic field changes	• detect magnetic field changes (for example, in mobile phones and CD players) • used in anti-lock braking systems in cars
Accelerometer	these are sensors that measure acceleration and motion of an application, i.e. the change in velocity (a piezoelectric cell is used whose output varies according to the change in velocity)	• used in cars to measure rapid deceleration and apply air bags in a crash • used by mobile phones to change between portrait and landscape mode
Proximity	these sensors detect the presence of a nearby object	• detect when a face is close to a mobile phone screen and switches off screen when held to the ear
Flow (rate)	these sensors measure the flow rate of a moving liquid or gas and produce an output based on the amount of liquid or gas passing over the sensor	• used in respiratory devices and inhalers in hospitals • measure gas flows in pipes (for example, natural gas)
Level	these sensors use ultrasonics (to detect changing liquid levels in, for example, a tank) or capacitance/conductivity (to measure static levels (for example, height of water in a river) – note, level sensors can also be optical or mechanical in nature	• monitor levels in a petrol tank in a car • in a pharmaceutical process where powder levels in tablet production need to be monitored • leak detection in refrigerant (air conditioning)

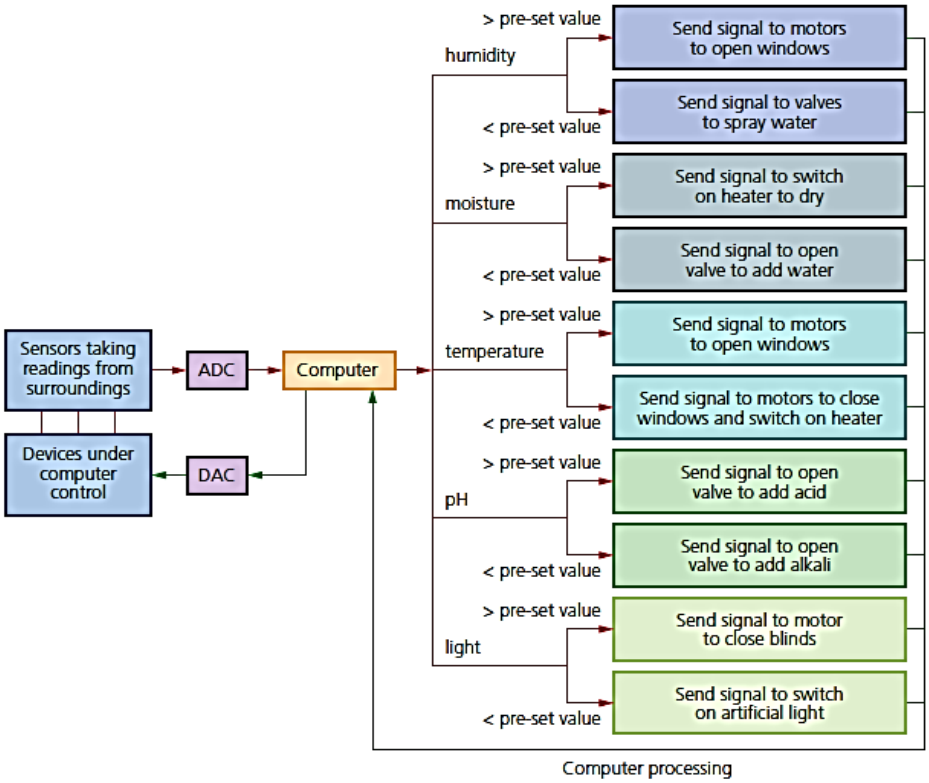
Sensors are used in both monitoring and control applications. There is a subtle difference between how these two methods work (the flowchart is a simplification of the process):



▲ **Figure 3.50** Monitoring and control systems using sensors

Greenhouse environment control

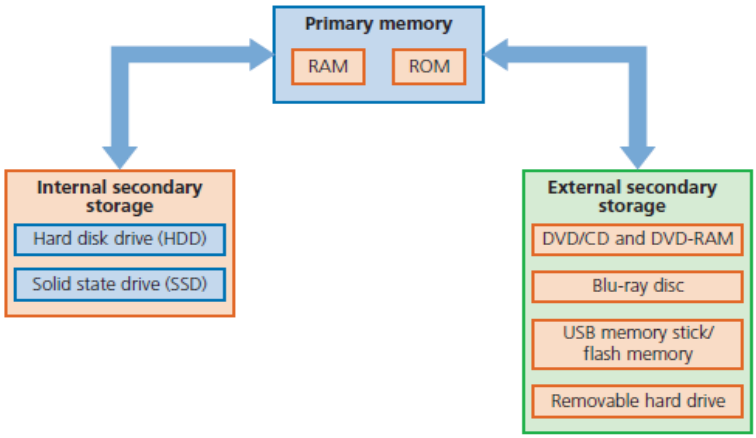
Five different sensors could be used here to control the greenhouse environment, namely: **humidity**, **moisture**, **temperature**, **pH** and **light.**



- Please read what your text book says about types of sensors and there use. (Topic 3.1.5 Page#111-118)
- Please watch the brief youtube video https://www.youtube.com/watch?v=XI49uFm5HRE https://www.youtube.com/watch?v=ehOZF2UUb44&t=1s

Data Storage :

All computers require some form of memory and storage. Memory is usually referred to as the internal devices used to store data that the computer can access directly. Memory and storage devices can be split up into two distinct groups: » primary memory » secondary storage



Primary memory

Primary memory is the part of the computer memory which can be accessed directly from the CPU; this includes **random access memory (RAM)** and **read only memory (ROM)** memory chips. Primary memory allows the CPU to access applications and services temporarily stored in memory locations.

Random access memory (RAM)

All computer systems come with some form of RAM. These memory devices are not really random; this refers to the fact that any memory location in RAM can be accessed independent of which memory location was last used.

There are currently two types of RAM technology:

» dynamic RAM (DRAM)

» static RAM (SRAM).

Dynamic RAM (DRAM)

Each DRAM chip consists of transistors and capacitors. Each of these parts is tiny since a single RAM chip will contain millions of transistors and capacitors. The function of each part is:

» capacitor – this holds the bits of information (0 or 1)

» transistor – this acts like a switch; it allows the chip control circuitry to read the capacitor or change the capacitor's value .

Static RAM (SRAM)

A major difference between SRAM and DRAM is that SRAM doesn't need to be constantly refreshed.

It makes use of **flip flops**, which hold each bit of memory. SRAM is much faster than DRAM when it comes to data access (typically, access time for SRAM is 25 nanoseconds and for DRAM is 60 nanoseconds).

- Please read what your text book says about storage devices and types of memory. (Topic 3.3 Page 119-123)
- Please watch the brief youtube video https://www.youtube.com/watch?v=3Wo3W2atvJw

C: Absorbing the information:

- Write your own summary notes about types of memory and there differences?

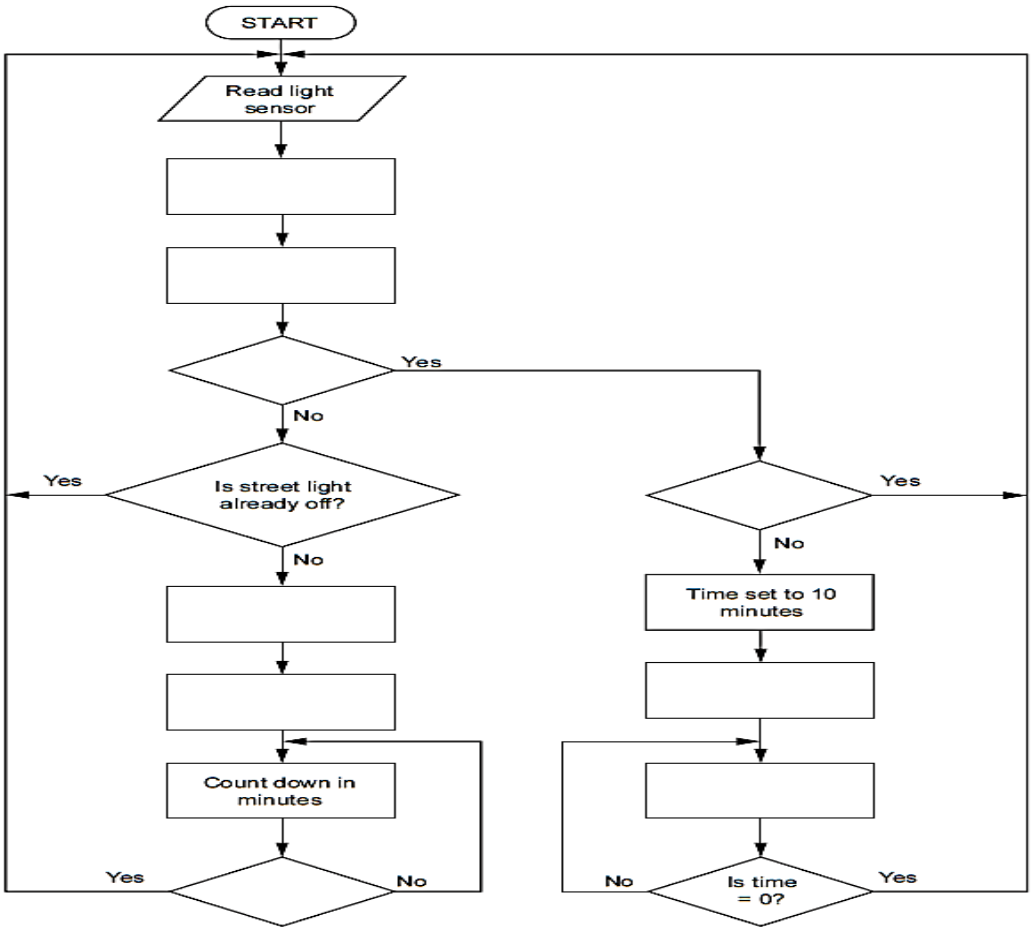
D: Practicing

Q1. a) Street lighting is controlled automatically. A light sensor and a microprocessor are used to decide when to switch each street light on or off. Describe how the sensor, microprocessor and light interact to switch the street light on or off. Include in your answer how the microprocessor stops the street lights being frequently switched on and off due to brief changes in the light intensity.
(b) Name **three** different sensors (other than light and pH) and describe an application for each of these sensors. A different application is needed for each sensor.

Q2. (a) Name an application which makes use of the following sensors. A different application should be used in each case.
Temperature Magnetic Temperature Motion Temperature

(b) The flowchart on the opposite page shows how a light sensor and microprocessor are used to switch a street lamp on or off. When the sensor reading is <= 50 light units, the lamp is turned on automatically.
Several of the instructions have been omitted from the flowchart. Using **item numbers only** from the list below, complete the flowchart:

Item number	Instruction
1	Count down in minutes
2	Is light reading <= 50?
3	Is street lamp already on?
4	Is time = 0?
5	The microprocessor compares the sensor reading with stored values
6	The sensor reading is sent to the microprocessor
7	Switch the street lamp off
8	Switch street lamp on
9	Time set to 10 minutes



Q3. A security system is installed in a house. A hexadecimal number is entered to activate or deactivate the alarm.

(a) The alarm code is set to hexadecimal number **2 A F**

Show how this number would be stored in a 12-bit binary register. [3]

(b) Identify **two** sensors that the security system could use to detect intruders. Describe how each sensor could be used in the security system. Write name of two sensors and there description.

Q4. Describe how ROM and RAM chips could be used in the following devices:

- microwave oven
- refrigerator
- remote-controlled model aeroplane; the movement of the aeroplane is controlled by a hand-held device

- Write your answers into an email message and send it to your teacher.

Students: *if you have any questions about the topic, anything you didn't understand, please send an email to your teacher*

Class	Teachers' Name	Teachers' Abbreviation	Teachers' Email Address	Instructions
C3A	Junaid Fayyaz	MJF	junaidfayyaz6@gmail.com	C3A students will send their home assignments to their subject teacher (MJF) for checking and getting feedback.
C3D	Junaid Fayyaz	MJF	junaidfayyaz6@gmail.com	C3D students will send their home assignments to their subject teacher (MJF) for checking and getting feedback.
C3GA	Bilal Mustafa Khan	BMK	bilal.rohaila@gmail.com	C3GA students will send their home assignments to their subject teacher (BMK) for checking and getting feedback.
C3GB	Bilal Mustafa Khan	BMK	bilal.rohaila@gmail.com	C3GB students will send their home assignments to their subject teacher (BMK) for checking and getting feedback.