VIRTUAL INSTRUMENTATION

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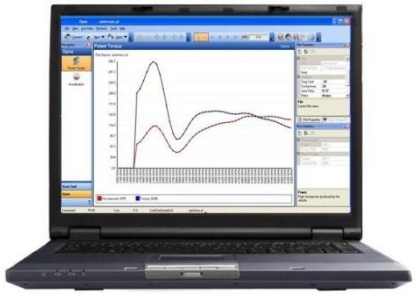
CONTENTS

Virtual Instrumentation-Introduction

Virtual Instrumentation is the use of customizable software and modular measurement hardware to create user-defined measurement systems, called virtual instruments.



Computer

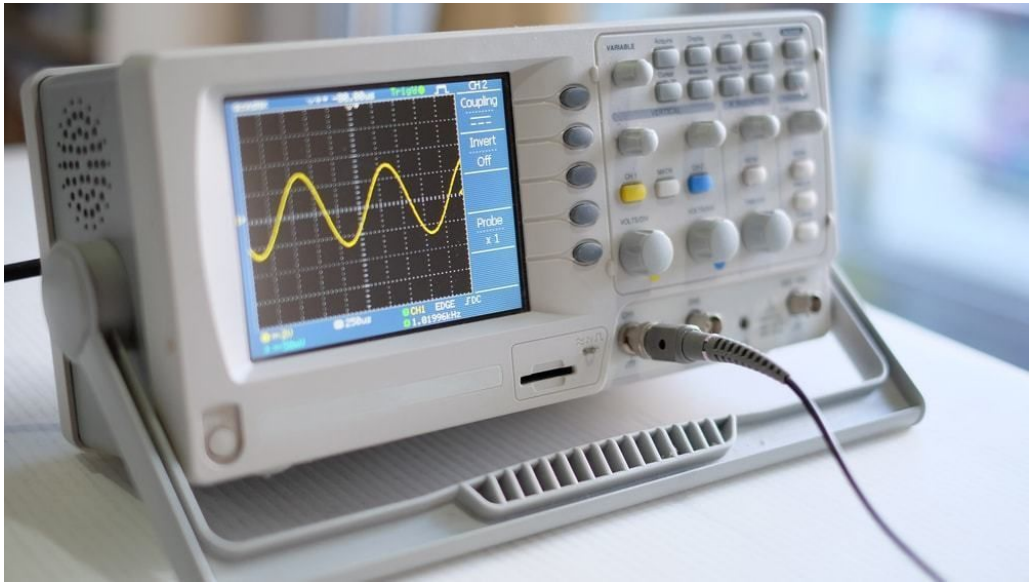
Software

Hardware

- **An instrument** is a device designed to collect data from an environment , or from a unit under test and to display information to a user based on the collected data.
- The term instrument may also be defined as a physical software device that performs analysis on data acquired from another instrument and then outputs the processed data to display or recording devices.

INSTRUMENTS

Oscilloscopes



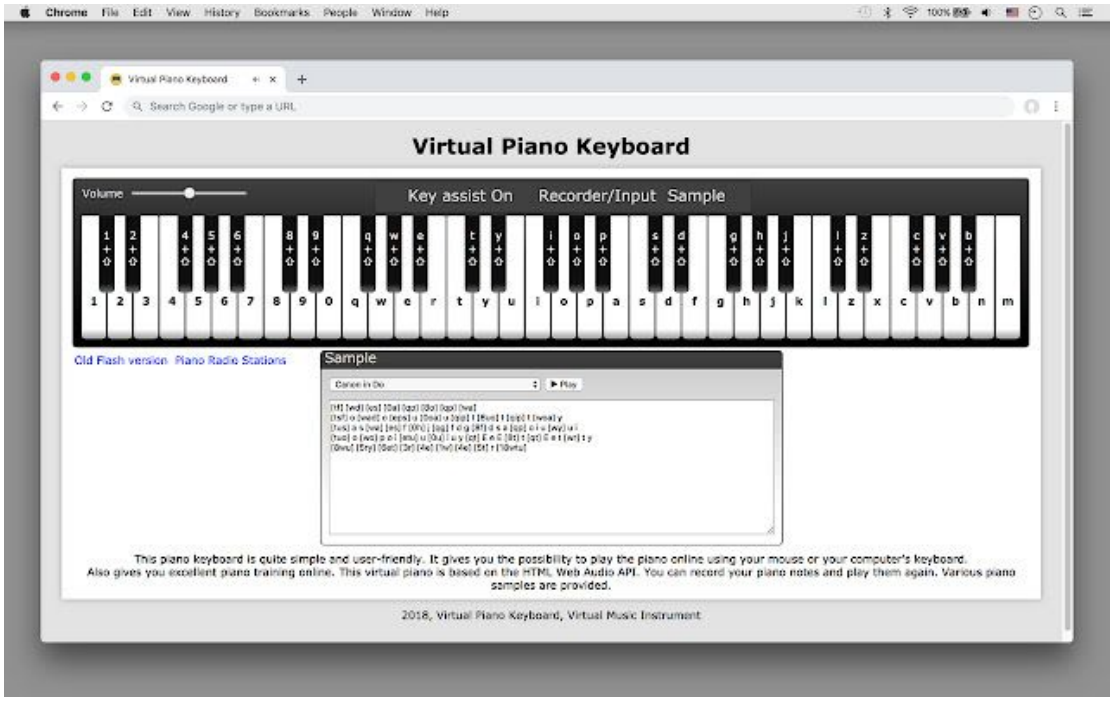
Musical Instrument-Piano

Digital Multimeter

Voltmeter

Example

Traditional Instrument-Piano



Virtual Instrument-Piano

- **Virtual instrumentation** is an interdisciplinary field that merges sensing, hardware and software technologies in order to create flexible and sophisticated instruments for control and monitoring applications.

- Flexibility is possible as the capabilities of a virtual instrument depend very little or dedicated hardware-commonly, only application specific signal conditioning module and the analog-to-digital converter used interface to the external world.

- Increasing number of biomedical applications use virtual instrumentation to improve insights in to the underlying nature of complex phenomena and reduce costs of medical equipment and procedures.

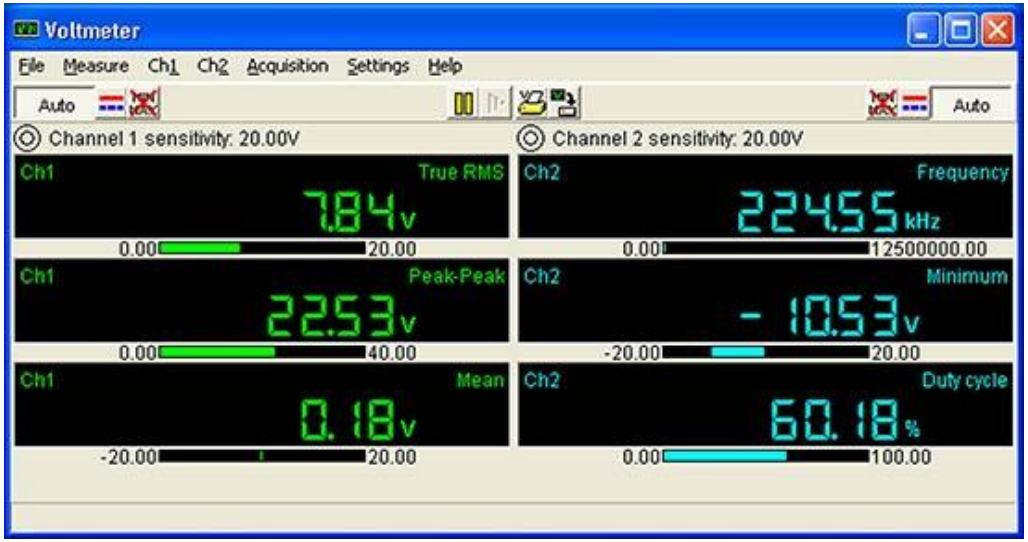
DEFINITION

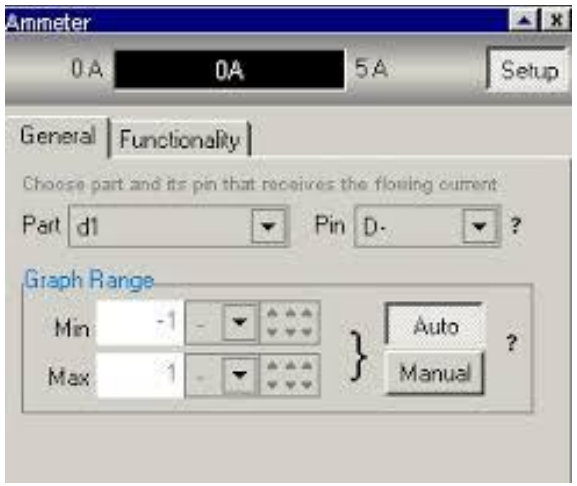
- A virtual instrumentation is a software that is used by the user to develop a computerized test and measurement system for controlling an external measurement hardware from a desktop computer and for displaying test or measurement data on panel in the computer screen.

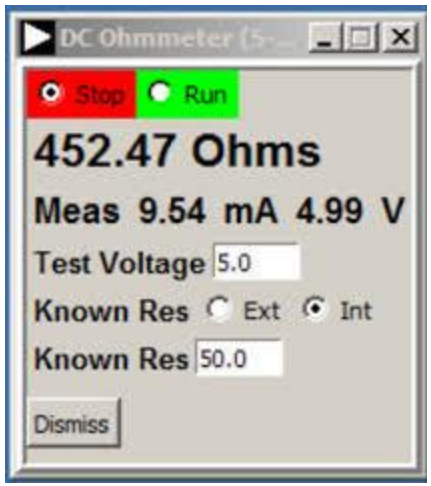
- The test and measurement data are collected by the external device interfaced with the desktop computer.

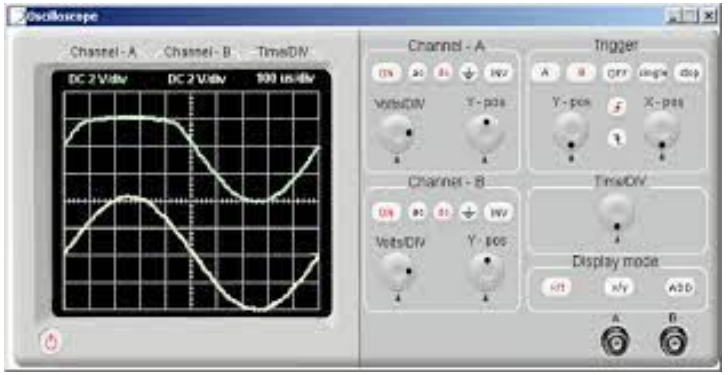
VIRTUAL INSTRUMENTS

- Voltmeter
- Ammeter
- Ohmmeter
- Oscilloscope









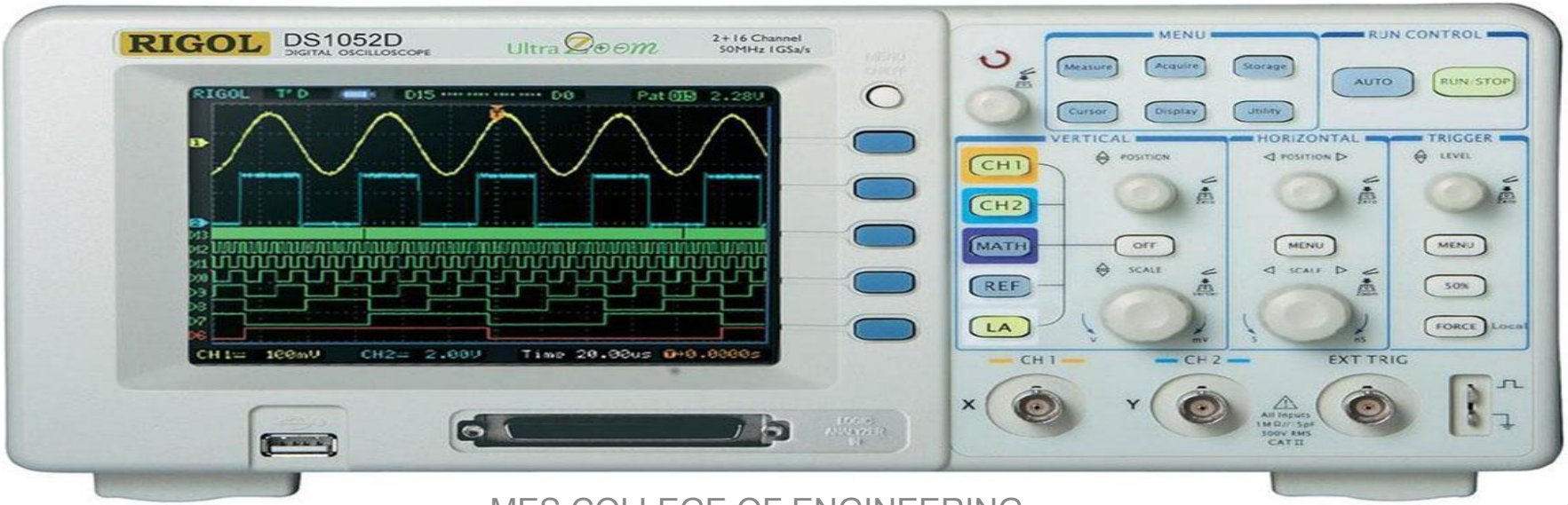
HISTORY OF INSTRUMENTATION

- Concept of virtual instrumentation was born in late 1970s.
- Instrumentation system originated in the distant past, with measuring rods, thermometers, and scales.
- Chemical process control applications employed until the 1980s
- A history of virtual instrumentation is characterized by continuous increase of flexibility and scalability of measurement equipment.

INSTRUMENTATION PHASES

The first phase:

- It is represented by early "pure" analog measurement devices, such as oscilloscopes etc.
- They were completely closed dedicated systems



The Second phase

- It started in 1950s, as a result of demands from the industrial control field.
- Instruments started to digitalise measured signals, allowing digital processing of data.

The Third phase:

- Measuring instruments become computer based.

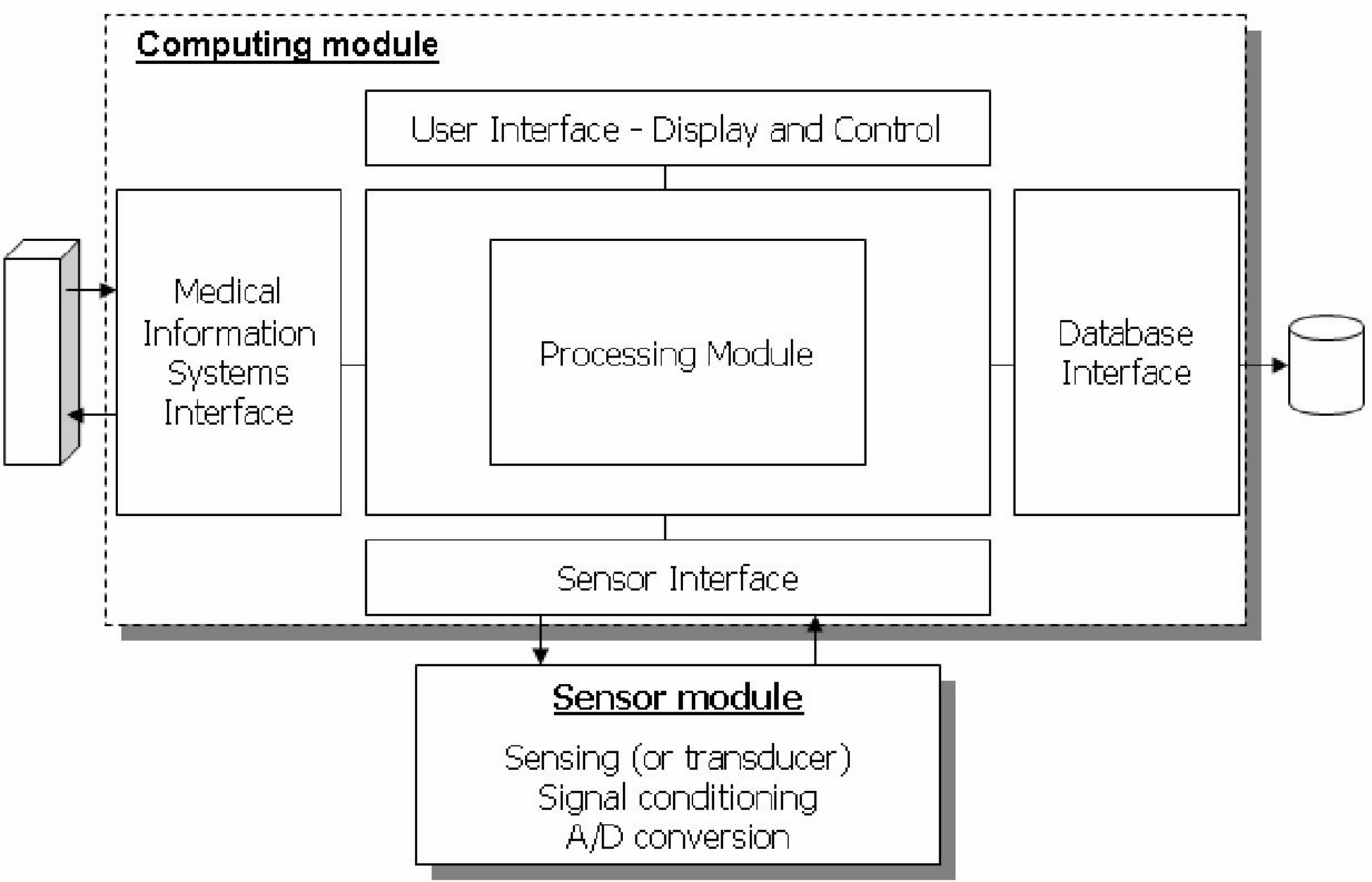
- They began to include interfaces that enabled communications between the instrument and the computer
- As a result, virtual instrumentation made possible decrease in price of an instrument.
- As the virtual instrument depends very little on dedicated hardware, a customer could now use his own computer.

WHY VIRTUAL INSTRUMENTATION IS NECESSARY

- It delivers instrumentation with the rapid adaptability required for today's concept, product, and process design, development, and delivery.

- Only with virtual instrumentation can engineers and scientists create the user-defined instruments required to keep up with the world's demands.

VIRTUAL INSTRUMENTATION ARCHITECTURE



VIRTUAL INSTRUMENTATION ARCHITECTURE

Virtual instrument is composed of the following blocks:

- Sensor module
- Sensor Interface
- Information System Interface
- Processing module
- Database Interface
- User Interface

SENSOR MODULE

- Performs signal conditioning.

  (transforms it into a digital form for further manipulation)

- The digital can be displayed, processed, compared, stored in a database, or converted back to analog form for further process control.

- It interfaces a virtual instrument to the external analog world

- A sensor module principally consists of three main parts:
  - Sensor
  - The signal conditioning part
  - The A/D converter

SENSOR

- Sensor (transducer)detect the physical signals and convert it in to electrical signals(non electrical to electrical forms).

SIGNAL CONDITIONING

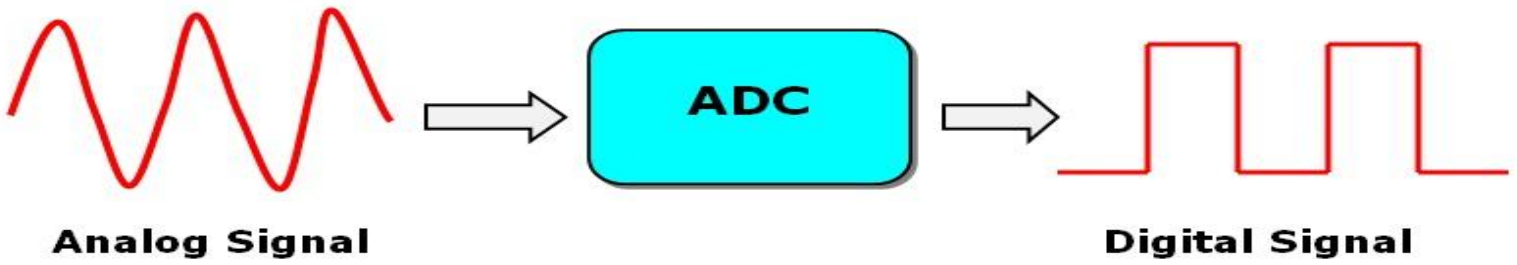
- It is the techniques used o convert immeasurable or unworkable signal into useful or functional form.

Example:

- Some sensors give signal in micro volts which needs to be amplified in order to use in the circuit.
- If the signal has high amplitude then it needs to be attenuated in order to use it.

ANALOG TO DIGITAL CONVERTER

- Real world data is then converted in digital from by using ADC.
- Analog data is converted in the form which a computer can easily understand.



SENSOR INTERFACE

- There are many interfaces used for communication between sensors modules and computer
- According to the type of connection, sensor interfaces can be classified as wired and wireless.

  - Wired Interfaces are usually standard parallel interfaces, such as General Purpose Interface Bus
  - Wireless Interfaces are increasingly used because of convenience.

PROCESSING MODULE

- It allows flexible implementation of sophisticated processing functions.

  - Analytic processing
  - Artificial Intelligence techniques

DATABASE INTERFACE

- Computerized instrumentation allows measured data to be stored for off-line processing, or to keep record
- There are several currently available database technologies that can be used for this purpose

USER INTERFACE

- These part is used for the communication with the user

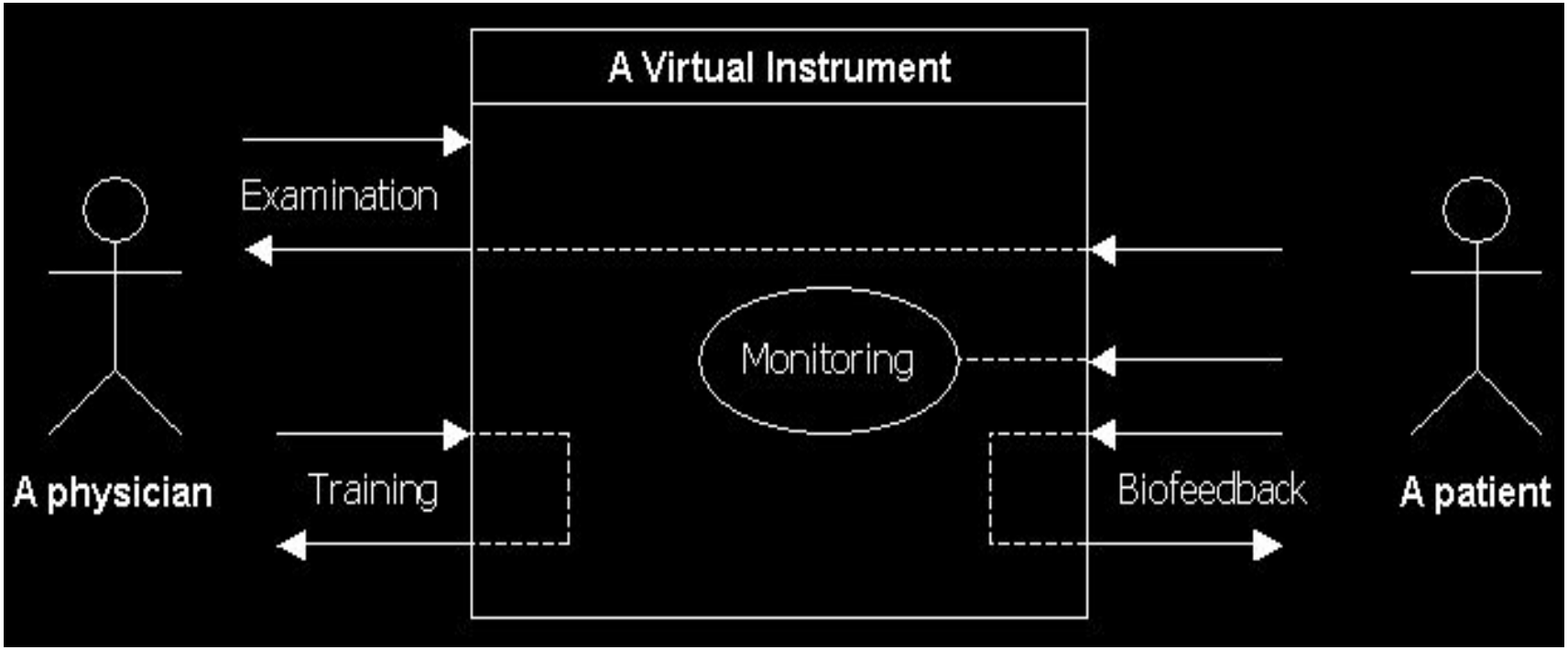
APPLICATIONS

1. BIOMEDICAL APPLICATIONS

Virtual instrumentation has been increasingly accepted in the biomedical field. In relation to the role of virtual instrument, we may broadly classify biomedical applications of virtual instrumentation into four categories:

- Examination
- Monitoring
- Training and education
- Biofeedback

APPLICATION OF VIRTUAL INSTRUMENTATION IN BIOMEDICAL FIELD



2. IN THE FIELD OF ELECTRICAL INSTRUMENTATION

- Understanding the frequency response of multimeter.
- Designing resistive and inductive bridge circuits with high sensitivity
- Getting acquainted with a digital oscilloscope.
- RC and RLC response in sinusoidal steady state

HOW IS IT DIFFERENT FROM A TRADITIONAL INSTRUMENT

Traditional	Virtual Instrument
Vendor-defined	User-defined
Low quality	High quality
Expensive	Low-cost, reusable
Closed, fixed functionality	Open, flexible functionality
It requires displays,knobs etc	It uses computer for all control and interactions.
It uses IC for data processing	It uses software for data processing
High development and maintenance costs	Minimizes development and maintenance costs

ADVANTAGES

- Lower cost of instrumentation
- Easy-to-use graphical user interface
- Portability between various computer platforms
- Increase the utility of computer
- Flexibility

DISADVANTAGES

- Security

  Sensitive information may be accessible to public users

- Power Consumption

  Virtual Instrumentation demands that may devices run simultaneously and can consume a lot of power.

  Each computer will consume a large amount of power in addition to any external hardware.

CONCLUSION

Virtual instrumentation brings many advantages over “conventional” instrumentation.Virtual instruments are realized using industry standard multipurpose components, and they depend very little on dedicated hardware. Generally, virtual instruments are more flexible and scalable as they can be easily reconfigured in software. Moreover, standard interfaces allow seamless integration of virtual instruments in distributed system. Virtual instrumentation significantly decreases the price of an instrument based on mass-produced general-purpose computing platforms and dedicated sensors for a given application. We expect an increased number of hardware and software modules designed for the virtual instrumentation market. They will provide building blocks for the next generation of instrumentation and measurement. It would not be surprised if the prefix virtual soon disappear, as virtual instrumentation becomes commonplace.

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THANK YOU