Name: Ogundimu Oluwatobi Daniel
Matriculation Number: 18/ENG04/058
Department: Electrical/Electronics Engineering

EEE319 Assignment

1. Sensors are transducers that serve the purpose of reading a physical quantity and converting it to an electric signal for processing. It is generally used for measurement in control systems, where the measurand is an important physical quantity, like temperature, that would affect the operation of the system. In biomedical applications, they are used for measuring quantities like blood pressure, heart rate, blood flow rate, and heart electric pulse. Examples of sensors in biomedicine is the hall effect blood flow sensor, and the pulse oximeter.

   The Hall Effect sensor makes use of a uniform magnetic field over the blood vessel, causing the positive and negative ions to move to opposite sides of the vessel, creating a detectable potential gradient using an electric potential sensor. Pulse oximeters make use of light sources and sensors to estimate the oxygen saturation in the blood at the peripherals of the body.

   Actuators are output transducers that control systems use to affect the environment that it (the system) controls. Actuators are considered output devices as they provide an outward relationship from the computer to the environment. In biomedicine, blood pumps and pacemakers are common actuators.

   A blood pump adds pressure to the blood flow in the circulatory system. It is used to either pump blood through a dialysis machine or to pump blood through the circulatory system when the heart is unable to do so. On type of blood pump is the centrifugal blood pump, which pumps by the use of a spinning rotor to pump blood through centrifugal action through an outlet at the circumference of the pump. The artificial pacemaker regulates the heart pumping dynamics through a series of output electric signals that the stimulate the cardiac muscles of the heart.

2. A basic measuring instrument consists of three components, which are the primary sensing element, the immediate transfer device, and an indicator or recorder.

   The primary sensing element is a transducer that converts the measurand quantity to another energy form that can be processed by the instrument. In most cases, the primary transducer converts the measurand quantity to an electric signal with a varying voltage parameter. But this is not the case for all instruments. In the pulse oximeter, the light sensor serves as the primary sensing element, converting light passed through the blood vessel to an electric signal.

   The intermediate transfer device consists of the variable conversion element and variable manipulation element. It performs signal conditioning operations on the output of the primary sensing element so that it can be output as a measurement. In a pulse oximeter, the signal from the light sensor is processed by the internal circuitry of the oximeter, where the oxygen saturation is calculated using a preprogrammed equation.

The data presentation element (indicator, recorder, or storage) simply takes the output of the instrument and produces an output which may be displayed for human reading, or as a feedback for a control system. Most pulse oximeters make use of a screen to display digital output.

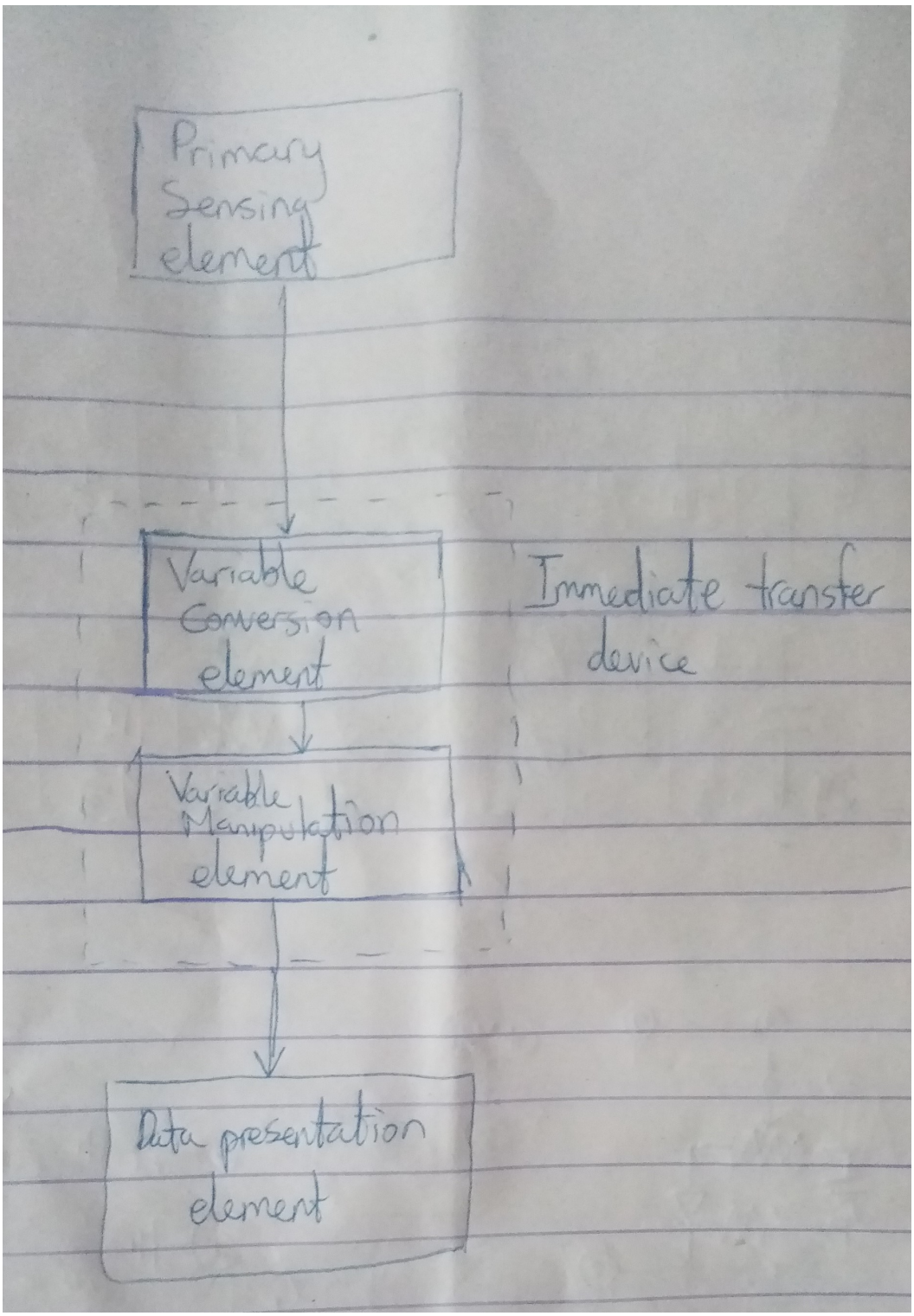

Illustration 1: Functional elements of a measuring instrument

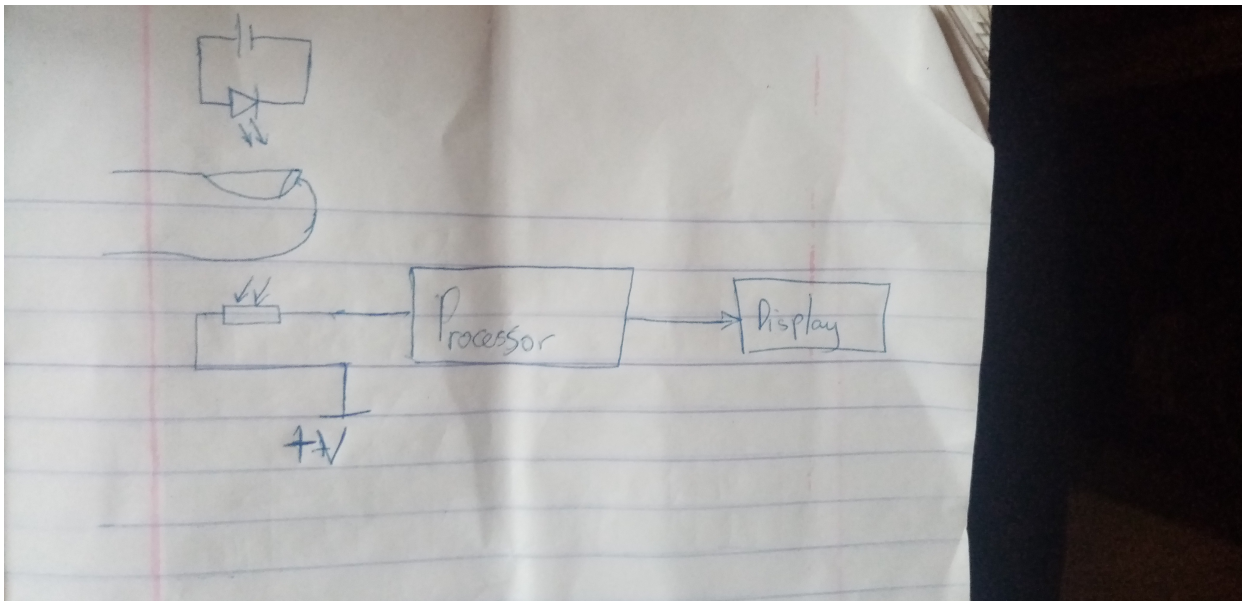

Illustration 2: Block diagram of a pulse oximeter

3. The Electrocardiogram is a non invasive method of diagnosing some heart conditions. It works by placing electrodes on certain points on the chest. As the pacemaker sends signals to the cardiac muscles, it changes the electric potential across the chest. The electrocardiogram machine reads the potential difference across the electrodes and plots them as a function of time.

   The electrodes are connected to a voltmeter. The voltmeter output is processed by a computer, which plots the voltage against time. In the electrocardiogram, the voltmeter acts as the primary sensing element, the processor acts as the immediate transfer device, the screen is the indicating device.

   The pulse oximeter is a non invasive device used to estimate the blood oxygen saturation as well as the pulse rate. It works by passing light through an arteriole in the body periphery such as a finger. The light is then detected by a light sensor, whose frequency provides information about the pulse rate, while the colour and intensity is used to estimate the blood oxygen saturation. The in-built computer then uses the given data to estimate the pulse rate and blood saturation, which is then displayed on a screen.