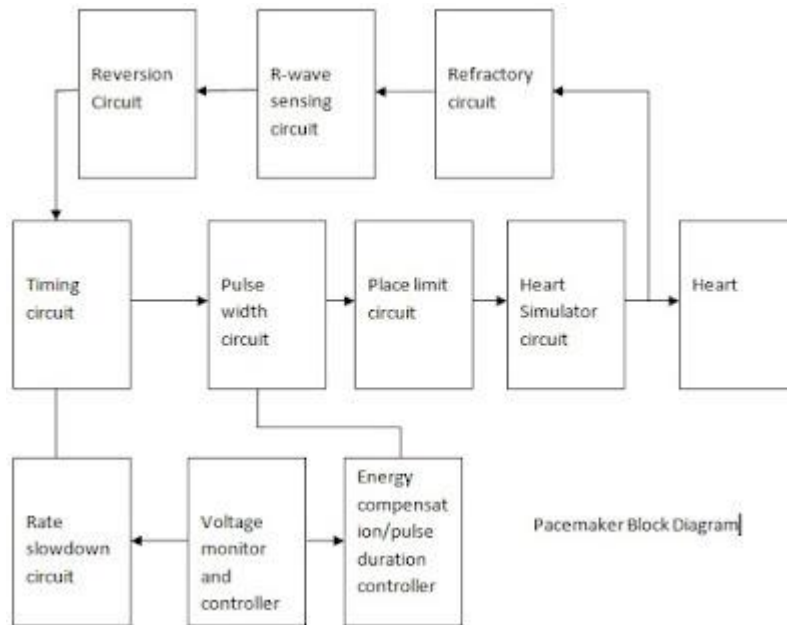


PACEMAKER

INTRODUCTION:

An artificial pacemaker is **real time embedded system** with hermetically sealed titanium encapsulation that delivers a synchronized rhythmic electric stimulus to the heart muscle in order to maintain an effective cardiac rhythm for long periods of time. Pacemaker system consists of device and leads.

BLOCK DAIGRAM:



1) Timing circuit:

The timing circuit determines the basic timing rate of the pulse generator. It consists of an RC network, reference voltage source, a comparator etc.

2) Pulse width circuit:

The stimulating pulse duration is determined by the pulse width circuit. It is triggered by the output from the timing circuit. The pulse width circuit is also an RC circuit as the timing circuit. The output of the pulse width circuit is fed into the pace limiting circuit.

3) Pace limiting circuit:

The function of pace limiting circuit is to limit the pacing rate. The maximum pacing rate is usually selected as 120 pulses per minute. The pace limit circuit limit the pacing rate by disabling the comparator for a preset interval of time.

4) Heart stimulator circuit:

This is also called output circuit since it provides the proper input pulse to stimulate the heart and hence called heart stimulator circuit.

5) Refractory circuit:

This circuit provides a period of time following an output pulse or sensed R-wave. During this time the amplifier will not respond to outside signals.

6) R-wave sensing circuit:

The function of R-wave sensing circuit is to detect or sense a spontaneous R-wave and to reset the oscillator when the pulse is not needed.

7) Reversion circuit (Return circuit):

It allows the amplifier to detect a spontaneous R-wave. In the absence of R-wave, this circuit again allows the oscillator to generate pulses at its preset rate. This circuit is called reversion or return circuit since it allows to return the oscillator to its active state.

8) Voltage monitor and controller:

This circuit continuously monitors the battery voltage. As the pacing rate is depending on the efficiency of battery, it has to be monitored regularly. If the battery voltage is decreased, it triggers the energy compensation and pulse duration controller circuit.

9) Energy compensation/ Pulse duration controller circuit:

If the battery voltage is decreased the energy compensation circuit increases the pulse duration so that the pulses delivered to the patient are not affected by the battery charge loss.

10) Rate slow down circuit:

It is a special circuit which slows down the heart rate during certain conditions such as cell depletion. So the cell depletion is monitored by the voltage controller circuit, and whenever cell depletion occurs, the voltage monitor/controller circuit activates the rate slow down circuit. This circuit slows down the rate by limiting the current to the basic timing network.

FUNCTIONS:

An artificial pacemaker is real time embedded system with hermetically sealed titanium encapsulation that **delivers a synchronized rhythmic electric stimulus to the heart muscle in order to maintain an effective cardiac rhythm for long periods of time**. ... Similarly information is transferred from heart to the device.

APPLICATIONS:

This pacemaker is an embedded device which uses electrical impulses which are delivered by electrodes contacting the heart muscles and so regulates the beating of the heart. A typical pacemaker consists of the computer part and the pacing wire. The computer part has the required electronic components and the battery for the power supply.

ADVANTAGES:

A more complex pacemaker is the biventricular pacemaker that not only regulates the pace of the heart pumping blood throughout the body, but also helps improve heart pumping efficiency in patients who have had lower heart damage resulting from heart failure. The biventricular pacemaker works to ensure the ventricles and atria are working together. This is called cardiac resynchronization therapy.

DISADVANTAGES:

With any surgical procedure, there are risks. **Though the implantation of a pacemaker is considered a minor surgical procedure, according to the Mayo Clinic, it does pose several risks, although less than five percent of patients experience these [1](#). The risks include infection at the surgery location.** Patients may be allergic to the anesthesia and experience swelling and bruising. More extreme risks include a collapsed lung or damage to blood vessels or nerves near the pacemaker implantation.

PURPOSES:

A pacemaker **signals the heart to beat when the heartbeat is too slow or irregular**. A pulse generator is a small metal case that contains electronic circuitry with a small computer and a battery that regulate the impulses sent to the heart.

CONCLUSIONS:

Low power consumption is a crucial constraint in implantable pacemaker. Hence instantaneous Current consumption by hardware and software must be minutely considered. Cost and time to market of modern VLSI based implantable pacemaker design will be more. Especially, values for software related current/energy components i.e. base and inter instruction cost were presented, analyzed and discussed. The work is aimed towards development of low power processor based implantable pacemaker and estimation of software related current/ energy consumption.