BIO-INSPIRED GLUCOSE CONTROL IN DIABETES BASED ON AN ANALOGUE IMPLEMENTATION OF A- βCELL MODEL

ABSTRACT:

Embedded systems are commonly found in consumer, cooking, industrial, automotive, medical, commercial and military applications. Telecommunications systems employ numerous embedded systems from telephone switches for the network to cell phones at the end-user. Computer networking uses dedicated routers and network bridges to route data.

Consumer electronics include personal digital assistants (PDAs), mp3 players, mobile phones, videogame consoles, digital cameras, DVD players, GPS receivers, and printers. Household appliances, such as microwave ovens, washing machines and dishwashers, include embedded systems to provide flexibility, efficiency and features. Advanced HVAC systems use networked thermostats to more accurately and efficiently control temperature that can change by time of day and season. Home automation uses wired- and wireless-networking that can be used to control lights, climate, security, audio/visual, surveillance, etc., all of which use embedded devices for sensing and controlling.

This paper presents a bio-inspired method for in-vivo control of blood glucose based on a model of the pancreatic $beta $-cell. The proposed model is shown to be implementable using low-power analogue integrated circuits in CMOS, realizing a biologically faithful implementation which captures all the behaviors seen in physiology.

This is then shown to be capable of glucose control using an in silicon population of diabetic subjects achieving 93% of the time in tight glycemic target (i.e., [70, 140] mg/dl) . The

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proposed controller is then compared with a commonly used external physiological insulin delivery (ePID) controller for glucose control. Results confirm equivalent, or superior, performance in comparison with ePID. The system has been designed in a commercially available 0.35 $mu {rm m} $CMOS process and achieves an overall power consumption of 1.907 mW.

PROPOSED SYSTEM

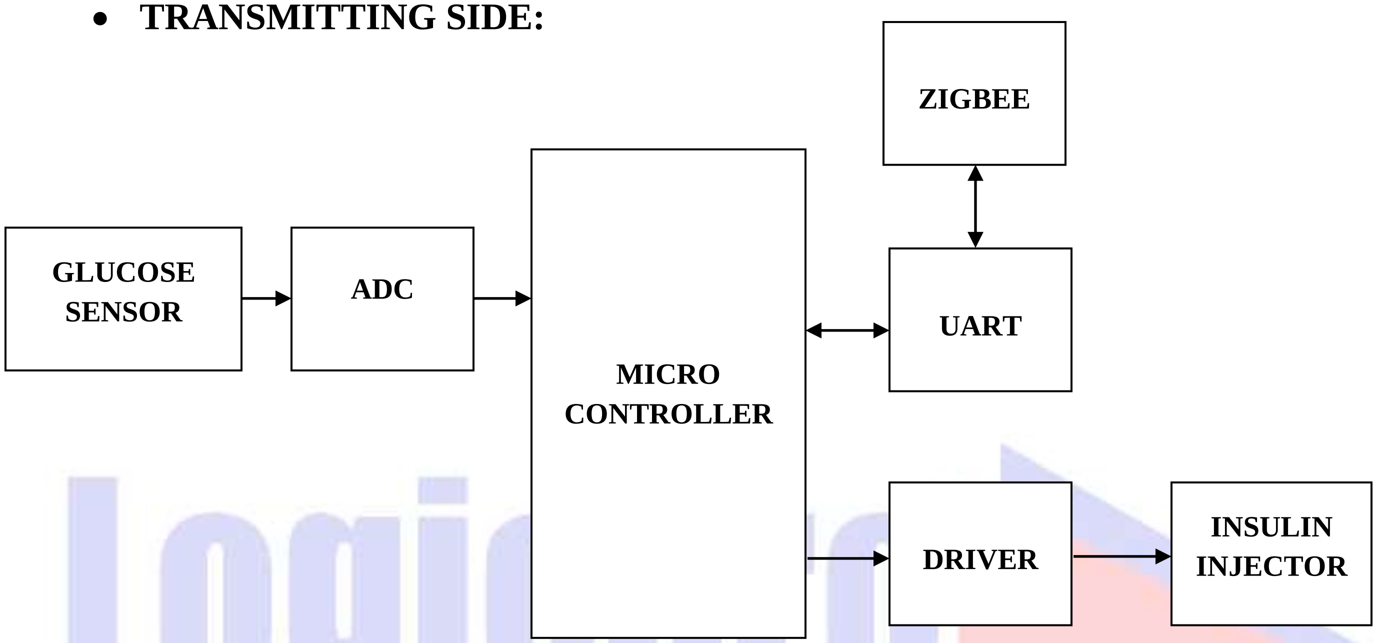
A continuous blood glucose sensor which is connected to the body either subcutaneously or intravascular. An insulin pump that delivers insulin either subcutaneously or intravenously. The Microcontroller device runs a control algorithm to relate the rate of delivering insulin with blood glucose level. The glucose input of the model, with a typical range of glucose levels variations from 0 to 500 mg/dl, is mapped as the voltage input of the circuit with a range of 0 – 500 mV and drives the trans-conductor which mimics the response of $M\infty$. Then, the signal is processed as indicated by the block diagram of the circuit, and ends up producing an output in the range of 0–6 nA corresponding to real insulin secretion values of 0–60µg/min.

ADVANTAGES

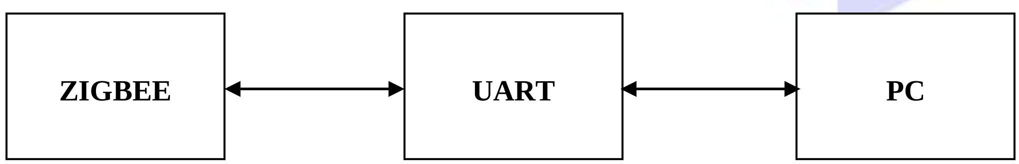
- Easy installation
- Data accuracy compact
- Wearable and light-weight
- Measures glucose continuously

BLOCK DIAGRAM

- **TRANSMITTING SIDE:**



- **RECEVING SIDE:**



HARDWARE REQUIREMENTS

- MICROCONTROLLER
- ADC
- GLUCOSE SENSOR
- INSULIN INJECTOR
- UART
- ZIGBEE
- DRIVER
- PC

SOFTWARE REQUIREMENTS

- MICROCONTROLLER COMPILER
- PROTEUS SOFTWARE

Microcontroller may be ATMEGA, 8051,PIC or Arduino