**Part 1**

**DECLARATION:**

**The following system that I have implemented upon is a continuous Glucose System. I would also like to declare that the work being presented below is of my own and solely my own work done by myself (Sheariff Moustafa).**

**Description:** The continuous glucose systems is a device used by diabetics when their blood sugar is high, glucose consumed by people that have diabetes cannot be broken down in there system as their pancreas doesn’t work so that they cannot release insulin to break down the glucose in there system. Glucose can be found in everyday foods from fruit like oranges, apples to carbohydrates such as pasta, rice and bread and sugary foods such as chocolates and sweets usually containing high glucose.

**General Specification**

The continuous glucose system is a small device that is about the size of a person’s hand , the device has a power button that is responsible with turning the device on and off , it has a monitor that displays the reading of the blood glucose level continuously in real time, it has a glucose cartridge that allows the host to insert a glucose stick as well as an insulin cartridge that stores the insulin the host may require thorough out his day, there is a strap that can be used to hold the device in place on to the hosts arm or leg depending on where it may be more suited.

The system has an enzyme based electrochemical sensor, this sensor is responsible with monitoring blood sugar of the patient continuously, when a threshold has been reached or surpassed. The electrochemical sensor has its signal transmitted to the pump every 5 minutes with each transmission the signal is sent to the pump, within the pump a calibration will take place that will analyse the signal received and then a meter value will be taken. The value for the meter will occur when a when an algorithm has been carried out on the signal that was sent to the pump. The algorithm is responsible with converting the signal received into a glucose concentration from that point onward within the system. The system takes the signal and allows the signal received to be directly proportional to the concentration level of glucose in the bloodstream of the patient. A glucose stick is inserted into the device and constantly monitors the glucose signal signals value if a threshold a threshold has been detected then a signal is sent to the monitor which then displays a reading of the glucose level at that moment and depending on the reading from the signal received and alert can be sent depending on whether the reading is dangerously high. Once all the reading take place a pump will then pump insulin into the blood stream the amount of insulin that is pumped by the actuator that is responsible for pumping the insulin into the blood stream is determined by the signal and the glucose stick reading , another algorithm will then take place that will calculate the amount of insulin that is required by the patient and then will be pumped into the blood stream, the electrochemical sensor then takes another reading and sends a signal back to the pump to take another reading of the glucose in the blood to see if the glucose levels have dropped in the patient, this is done because the patient may still be eating and his glucose level make rise again as he has not completed his meal so another dose of insulin may be required until the glucose level in his blood is below the threshold.

**Implementation Specification**

The sub-system I plan on implementing and designing is the electro chemical sensors processes within the overall system and its relationship with the pump. I will be implementing the method in which the electrochemical sensor breaks down glucose in the blood into simpler chemicals in the system that is then sent as a signal, to be a bit more specific I will be implementing how the enzyme on the sensor breaks down the glucose in the blood stream into a simpler chemical that will then be used to create a current that will be equal to the persons glucose level in the blood, when this current is measured there will be a signal that is sent to the pump with the current reading. There will be also a requirement to implement a current sensor that will read in the current value that has been produced this sensor will be required to detect a very low current this sensor will send the current readings to the transmitter so be sent to the pump so that these reading can be displayed on the monitor.

A pressure senor will then be used proportionally with the electrochemical sensor to check blood pressure in order to insure that the hosts blood pressure doesn’t rise to high which can be highly dangerous for the patient or doesn’t fall too low that may cause similar damage such as causing the patient to faint, high blood pressure may cause heart attacks. The pressure sensor is important because it may be a sign of high glucose in the blood and can allow the system to act at a slightly quicker rate to detect higher blood glucose levels. The pressure sensor will also work simultaneously with he insulin pump so that the motor will be able to successfully pump the insulin into the patients body, depending on the pressure present in the blood the pump may need to administer the insulin into the body at a higher pressure so that the insulin can be able to entered into the body and break down the glucose if the pressure is too little then there could possibly be a instances where the pressure is too high in the blood and the pressure being exerted by the pump can possibly not be high enough in order to be able to inject insulin into the patient. This is in place because the injection of insulin into the body has to be as painless as possible for the patient, if the pressure used to inject the insulin into the patient is too high and the patients blood pressure is low then the patient may feel a painful sensation when the injection has taken place so allowing the pressure to suitable enough so that its just over the blood pressure is important so each injection will be done without the patients notice. The motor will receiver signals from the pressure sensor, when this happens the motor will increment the pressure being exerted slightly over the blood pressure so the insulin will be injected efficiently.

A Glucose sensor will be used after the electrochemical sensor has detected glucose and broken it down, the function of the glucose sensor is to change the current received back into a proportional glucose value, this sensor works with the glucose stick cartridge that the patient would insert into the system every so often when the glucose stick has been used up. The glucose sensor will take in the current reading and turn it into a an actual glucose concentration the glucose cartridge will take a sample and do a check to make sure that there is a high glucose concentration in the blood once this is done a single will be sent to the monitor with the value of the glucose level in the blood and after an algorithm has taken place to identify the glucose to insulin ratio, once this is done a specific quantity of insulin will determined for to injection into the body. This will be sent as a signal from the space the glucose cartridge analysis will be taken place in.

**General diagram of system for implementation**

A close up of a map

Description automatically generated

**A close up of a map

Description automatically generatedSystem diagram of system for implementation**

**HRT-HOOD design**

**A screenshot of a cell phone

Description automatically generated**

A screenshot of a cell phone

Description automatically generated

A screenshot of a social media post

Description automatically generated

A picture containing screenshot

Description automatically generated

A screenshot of a cell phone

Description automatically generated

**Diagram of processes (or tasks) for the system**

A close up of a map

Description automatically generated

Processes explanation

The startup spawns the 6 processes p1,p2,p3,p4,p5,p6

DataModule holds the data that will be referenced by the 6 processes

DataArea holds the process ids of all the process p1 to p6

p1 is responsible for blood analysis and pressure analysis and sending a single to process 2 and process3. P2 receives the voltage value and p3 receives the pressure value

p2 is responsible with doing the glucose analysis by converting the voltage received and into glucose concentration and then sending the glucose conversion value to the pump

p3 determines the threshold of glucose and pressure has or hasn’t been met and sends a message as an alarm to p6

p4 accessing the data area to receive the shared data received from process one needed to display the glucose and pressure values on the monitor

p5 monitors the insulin quantity left within the insulin cartridge

p6 this process is responsible with injecting insulin into the host depending on the message received from p3

**Further evaluation questions (you must refer to your project):**

**1. Referring to your project, evaluate your decisions regarding the programming structures required for sensors.**

* The decisions I took when implementing the sensors in my code mainly in process1 and process 2 were based on how I wanted my sensors to read in the information from the external environment.
* I wanted my sensors in process1 to be continuously active so that it’s can always update the system if any changes occur that could be dangerous for the patient.
* The glucose sensor in process 2 must always be active so that the voltage conversion to glucose is continuously active so that any sudden changes in blood sugar can be detected immediately.
* This system requires a real time monitoring various properties at all time so when the sensors are initialised, they are initialised outside any loop and all functionality with sensors are done inside the while loops.

**2. Referring to your project, evaluate your decisions regarding the programming structures required for actuators.**

* only one actuator is used in the system itself and it’s the motor in process6 that is responsible for performing the insulin injection upon the patient.
* The actuator waits idly initialised outside the while loop and is used inside the while loop to perform any functionality concerning injecting the patient with insulin
* depending on the message received the motor actuator would decide to pump insulin into the patient with diabetes
* the actuator has its values set inside the while loop just after process6 receives a message containing character alerts that determine if the actuator should pump insulin or not.

**3. Appraise the QNX real time operating system and C programming environment for your project.**

* All though I was unable to program the system inside the actual QNX programming environment, Codeblocks was a substitute.
* QNX Real time operating system has a multitude of advantages that allows For secure and reliable Real Time Development some advantages are :
* uncompromising reliability: Fault-Tolerance, intelligent recovery, and high availability for critical systems
* Predictable real time performance: deterministic response times, both at application level and the subsystems that may reside within.
* The c coding environment was not suitable for real time development as real time libraries such as RTDisplay , sensors , actuators are not supported, parent and child processes are not supported either, logic was difficult to test as there was any why to trial and error the code so there was a high reliance on previous coding intuition.
* The only benefit of the C coding environments used was the ability to detect syntax errors

**4. Appraise the ADA programming environment for your project.**

* Codeblocks was also used to write up ada code
* Ada itself is very flexible and can be adapted to satisfy the needs of the system I was developing, ada is well know for this and is the reason why is the military use it to develop software for their jets fighters and other military vehicles
* Ada is highly reliable.
* easy to produce efficient code so the environments used was of no help as error checking wasn’t available as codeblocks isn’t familiar with the ada language.
* Ada code is free from complexity other coding languages my possess
* overall the ada language is very efficient and useable, learnability is high also but the environment was heavily effecting logic and error detection.