

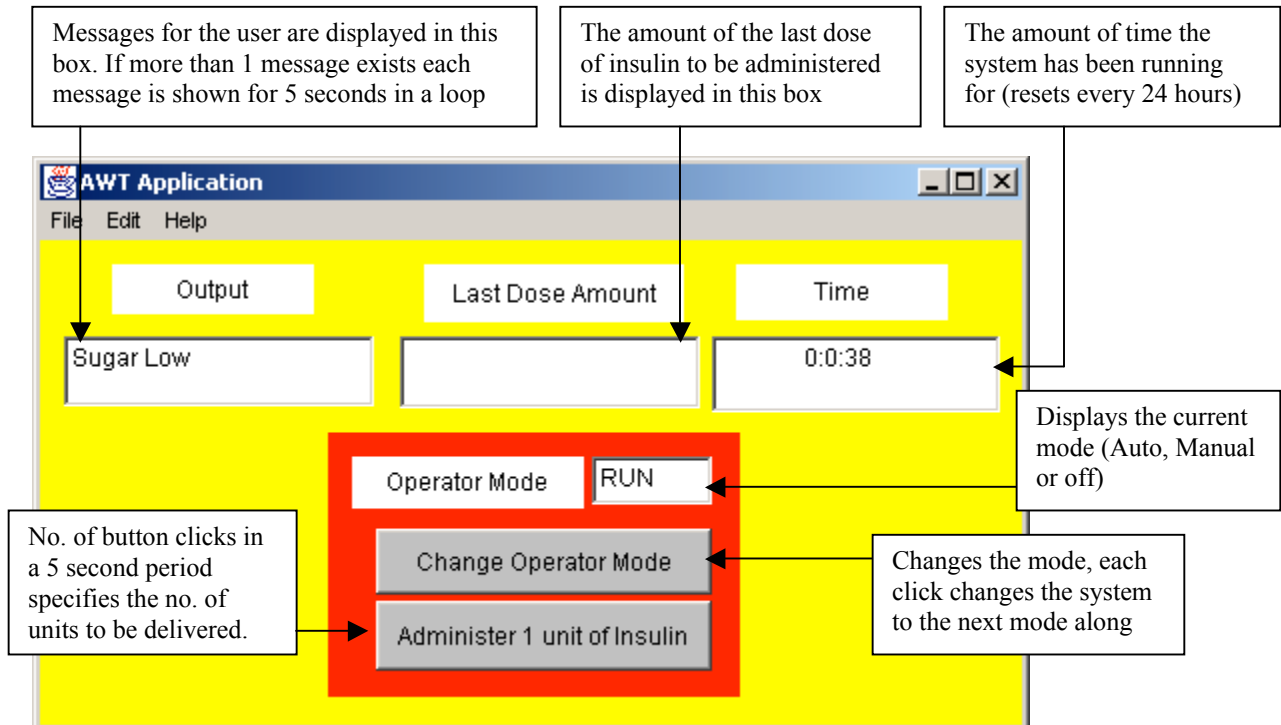
Insulin Pump System (and Simulator) User Manual

1 Introduction

The insulin pump system is a portable, automated insulin pump which is used by diabetics to administer insulin as and when they require it at regular, periodic intervals meaning the user doesn't experience any extreme drops and increases in their blood sugar level (as is often the case with the tradition method of injecting insulin). Maintaining a the blood sugar level within a safe range is important as long term exposure to high levels of blood sugar can have long-term complications such as kidney damage and eye damage. Also, in the short term, very low levels of blood sugar are potentially very dangerous. This user manual explains how to operate both the Insulin Pump software and the simulator provided with it. The simulator provides the opportunity to simulate real life usage of the insulin pump within a fraction of the time that would normally be required to test the machine. This document illustrates how to use both the insulin pump software and the simulator that is supplied with it.

2 How to use the Insulin Pump User Interface

The interface itself has been designed to be most importantly simplistic but also bright and colourful, because the user will have to wear the system constantly an attempt has been made to make it as aesthetically pleasing as possible. Also, the switch to alternate between different operator modes has been implemented as a button, allowing the user to simple toggle through the three modes with ease and also this method of implementing the switch greater facilitates the providing of a touch screen user interface than a 3 position switch.



Manual Administration of Insulin

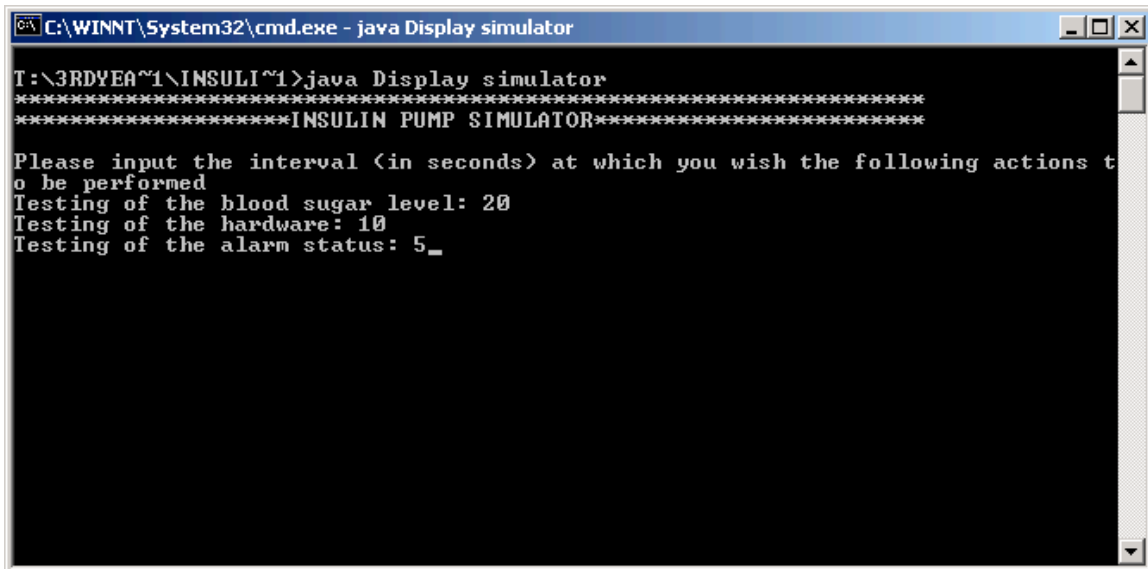
If the user decides that they require insulin immediately they can manually override the automatically delivering system in favour for determining the dose of insulin they require themselves. If the user does opt for this control style, they specify how much insulin to administer by pressing the appropriate button the amount of times they require within 5 seconds. If the operator mode isn't set to Manual the button to administer the insulin is unusable. Also, the user is strictly prevented from administering too much insulin, whether that be throughout the day or in a single dose.

System Warning Messages to the user

Message	Description	Action to be taken
No Needle Unit	The delivery needle has been removed.	Replace the delivery needle.
No Insulin Remaining	Either the insulin reservoir is not present or there isn't enough remaining insulin to suffice the next dose	Fit a full insulin reservoir.
Low Insulin Level	Informs the user that level of insulin in the reservoir is low.	Replace the insulin reservoir with a new full reservoir.
Low Battery	The voltage of the battery has fallen to less than 0.5V.	Replace the battery.
Pump Failure	The self test of the pump has resulted in an error	Replace the delivery pump.
Needle Failure	A delivery failure has occurred	Remove and replace the delivery needle.
Sensor Failure	The self test of the sugar sensor has resulted in an error	Replace the sugar sensor.
Sugar Low	The blood sugar level is below the safe minimum value.	Consume sugary foods and Drinks to increase blood sugar level.

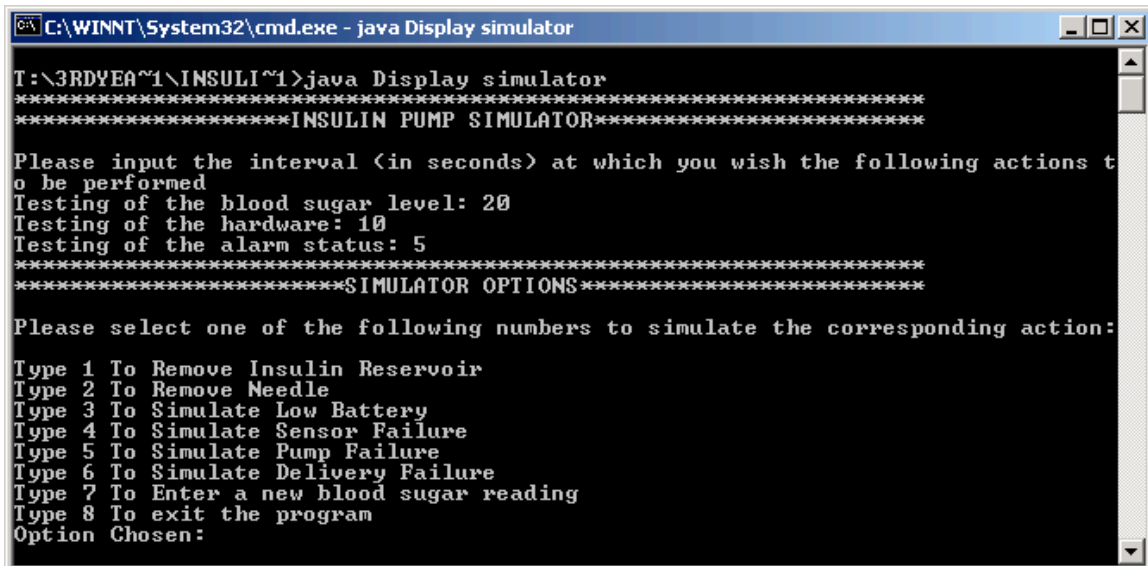
Simulator User interface

When the simulator software is started the insulin pump software doesn't immediately begin to run. Firstly, it waits for the user to input the values (in seconds) that the periodic actions (such as testing the blood sugar level and running the hardware self test) should take place at.



```
C:\WINNT\System32\cmd.exe - java Display simulator
T:\3RDYEA~1\INSULI~1>java Display simulator
*****
*****INSULIN PUMP SIMULATOR*****
Please input the interval <in seconds> at which you wish the following actions t
o be performed
Testing of the blood sugar level: 20
Testing of the hardware: 10
Testing of the alarm status: 5_
```

Once these values have been entered the clock begins and the automated actions are performed at the intervals specified by the user. Also, after the insulin pump software begins to run, the simulators functionality is made available:



```
C:\WINNT\System32\cmd.exe - java Display simulator
T:\3RDYEA~1\INSULI~1>java Display simulator
*****
*****INSULIN PUMP SIMULATOR*****
Please input the interval <in seconds> at which you wish the following actions t
o be performed
Testing of the blood sugar level: 20
Testing of the hardware: 10
Testing of the alarm status: 5
*****
*****SIMULATOR OPTIONS*****
Please select one of the following numbers to simulate the corresponding action:
Type 1 To Remove Insulin Reservoir
Type 2 To Remove Needle
Type 3 To Simulate Low Battery
Type 4 To Simulate Sensor Failure
Type 5 To Simulate Pump Failure
Type 6 To Simulate Delivery Failure
Type 7 To Enter a new blood sugar reading
Type 8 To exit the program
Option Chosen:
```

The simulators functionality is provided by selecting one of the above 7 options.

Functionality provided by the simulator

Hardware state manipulation options:

- Option 1: Simulates the removal of the insulin reservoir
- Option 2: Simulates the removal of the needle
- Option 3: Simulates the battery's voltage falling below 0.5volts
- Option 4: Simulates the sensor failing
- Option 5: Simulates the insulin pump failing
- Option 6: Simulates a failure with the delivery of the insulin

These options can be categorised together because each of them (when selected) simulate some form of hardware failure occurring. Each piece of hardware these options relate to has two possible states it can be in, a functionally satisfactory state or an unsatisfactory state. If an option is selected, the piece of hardware related to it will enter a functionally unsatisfactory state and therefore the option changes, allowing the user to set the piece of hardware back to a satisfactory state:

```
C:\WINNT\System32\cmd.exe - java Display simulator
Please select one of the following numbers to simulate the corresponding action:
Type 1 To Replace Insulin Reservoir
Type 2 To Replace Needle
Type 3 To Replace Battery
Type 4 To Repair Sensor
Type 5 To Repair Pump
Type 6 To Simulate Delivery Failure
Type 7 To Enter a new blood sugar reading
Type 8 To exit the program
Option Chosen: 6
*****SIMULATOR OPTIONS*****
Please select one of the following numbers to simulate the corresponding action:
Type 1 To Replace Insulin Reservoir
Type 2 To Replace Needle
Type 3 To Replace Battery
Type 4 To Repair Sensor
Type 5 To Repair Pump
Type 6 To Ensure Delivery
Type 7 To Enter a new blood sugar reading
Type 8 To exit the program
Option Chosen: 
```

Hardware manipulation options have changed to allow the respective piece of hardware to be put back into a satisfactory state.

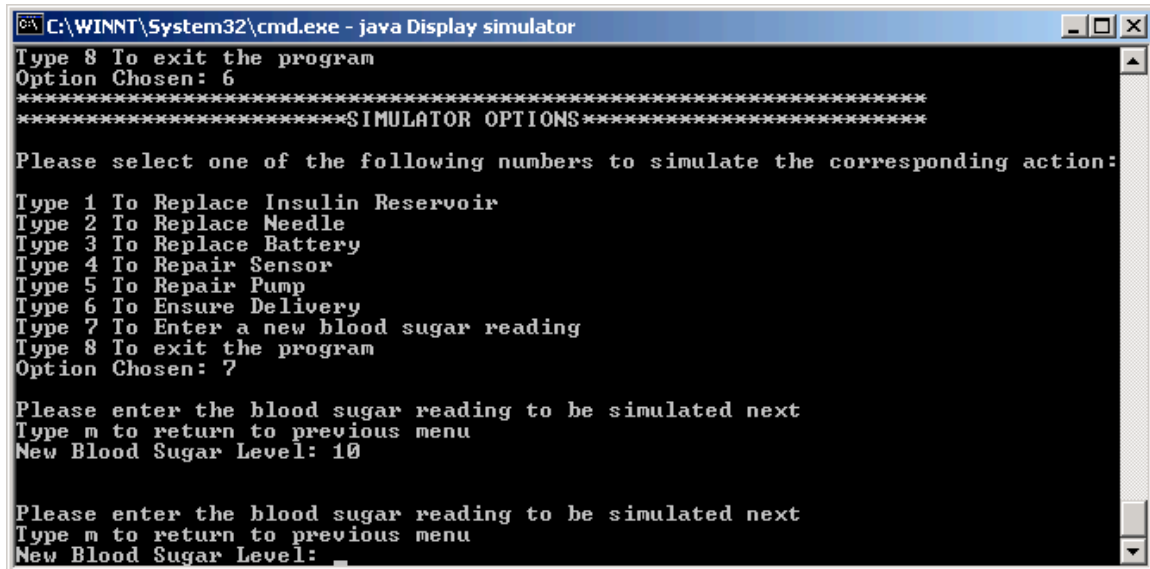
New options made available:

- Option 1: Simulates the replacing of a full insulin reservoir
- Option 2: Simulates the replacing of the needle
- Option 3: Simulates the replacing of a new battery
- Option 4: Simulates the sensor being repaired
- Option 5: Simulates the insulin pump being repaired
- Option 6: Simulates the delivery being guaranteed

Blood Sugar Reading option

Option 7: Provides the user with the functionality to input blood sugar readings

This option allows the user to specify blood sugar values in-order to test the insulin pump software's reaction to varying blood sugar readings, to permit thorough testing of the software without the need for real life field tests. Once the option has been selected the user is provided with the functionality to continually select values for the next reading to be set at until they wish to return to the main menu.



```
C:\WINNT\System32\cmd.exe - java Display simulator
Type 8 To exit the program
Option Chosen: 6
*****
*****SIMULATOR OPTIONS*****
Please select one of the following numbers to simulate the corresponding action:
Type 1 To Replace Insulin Reservoir
Type 2 To Replace Needle
Type 3 To Replace Battery
Type 4 To Repair Sensor
Type 5 To Repair Pump
Type 6 To Ensure Delivery
Type 7 To Enter a new blood sugar reading
Type 8 To exit the program
Option Chosen: 7
Please enter the blood sugar reading to be simulated next
Type m to return to previous menu
New Blood Sugar Level: 10
Please enter the blood sugar reading to be simulated next
Type m to return to previous menu
New Blood Sugar Level: _
```

Option 8, the final option, simply closes the simulator program down.

Running the software

When attempting to run the software there are two options available, either:

Run the insulin pump software on it's own for functioning in a real world simulation. Running the software like this requires all the necessary hardware to be in place.

At the command prompt type: *Display run*

Or

Run both the insulin pump and the simulator software and generate inputs for the insulin pump software using the simulator (rather than needing the hardware).

At the command prompt type: *Display simulator*