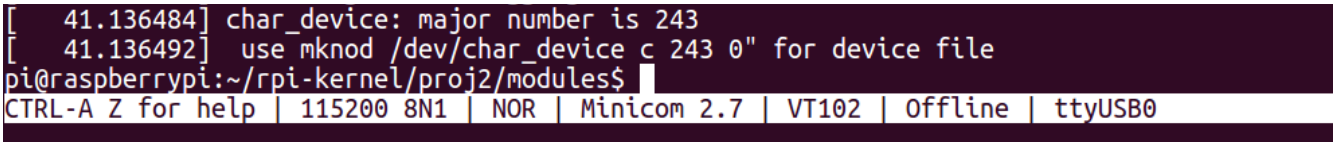
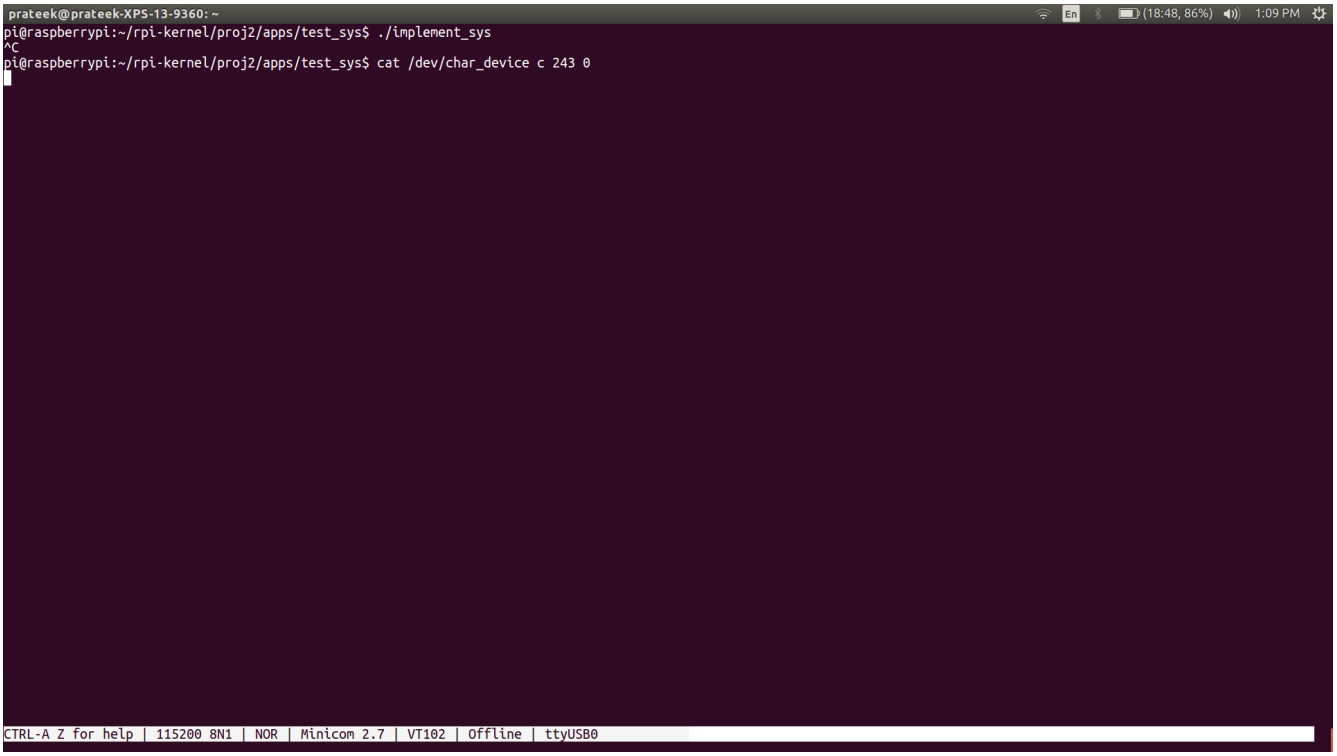
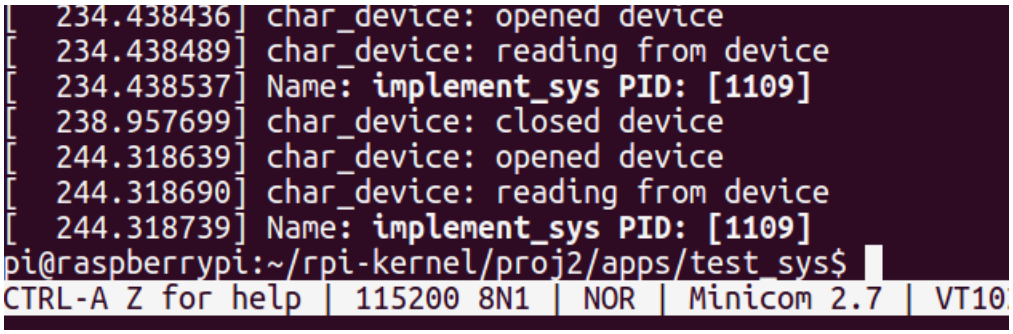
4.2 : Kernel Module:







Problem 1:

Concurrency and Parallelism are interrelated concepts. Concurrency means that 2 tasks A and B need to execute independently of each other. For instance if A starts executing, then B must start before A has finished its execution.

Parallelism is a way of accomplishing concurrency. Parallelism can be multiple CPUs working on different tasks at the same time. However, concurrency can also be accomplished by task switching. Task A can execute for a certain period and then the CPU can switch to another task 'B' and then switch back and forth between the two tasks. If the time slices spent in executing both tasks are small enough, it may appear to the user as if both tasks are being executed simulateously.

Problem 2:

a.) No data points are lost in overhead as points are generated at intervals of 10^{-3} seconds and the total overhead time taken to copy and make switches between kernel space and user space is $0.2*10^{-3} + 10^{-8}$ seconds which is less than the time it takes for the arrival of the next point.

b.) Total time taken to read a point = $2*100*10^{-6} + 10*10^{-9}$

Capacity of syscall (i.e maximum number of points it is able to read per second) = $1/2*100*10^{-6} + 10*10^{-9} = 4999.75$

Points generated per second = 100,000.

Therefore, points lost per second = 95000.249987501 = 95.000249988% or .95000249987501

c.) A point arrives every 10^{-5} seconds, and the buffer waits $10^{-5}*1000$ seconds to fill up. It takes a total of $2*100*10^{-6} + \underline{1000}*10*10^{-9}$ seconds to transfer data which causes it to miss 20.001 points. (1000 data points in buffer takes 1000*10ns to copy)

Therefore in $10^{-5}*1000 + 2*100*10^{-6} + 1000*10*10^{-9}$ seconds, it misses 21 points and reads 1000 points.

In one second,

it misses = 95454.545454545 points
Ratio of missed to total points = 0.954545455

d.) The implementation can be improved by having a secondary buffer storing data points while one buffer transmits data to user space. The size of the buffer that transmits the data however has to be optimized since there is a tradeoff in terms of the time increase in copying the data point value as the size increases. Thus, a secondary buffer/memory space along with an optimized transmission buffer is an optimal solution.

NOTE: PLEASE USE ARCH AND CROSS_COMPILE FLAGS WHILE COMPILING char device driver with makefile.