1. Convert the following C code which calculates the number of times the value b is found within an array of size 256 into a high level FSM. Define the components in the datapath and draw the control FSM. Show connections between the two.

```c
inputs: byte a[256], byte b, bit go;
outputs: byte freq, bit done
while (1){
    while(!go);
    done=0;
    i=0;
    freq=0;
    while (i<256){
        if (a[i]==b){
            freq=freq+1;
        }
        i=i+1;
    }
    done=1
}
```

2. The system has two single-bit inputs U and D each coming from a button, and a 16-bit output C, which is initially 0. For each press of U, the system increments C. For each press of D, the system decrements C. If both buttons are pressed, the system does not change C. The system does not roll over; it goes no higher than the largest C and no lower than C=0. A press is detected as a change from 0 to 1; the duration of that 1 does not matter.

Define the HLSM, determine the components that go into datapath, draw the control FSM, and define the connections between datapath and control.

3. The system counts the number of events on a single bit input B and always outputs that number unsigned on a 16 bit output C, which is initially 0. An event is a change from 0 to 1. Assume the system count rolls over when the maximum value of C is reached.

Define the HLSM, determine the components that go into datapath, draw the control FSM, and define the connections between datapath and control. Implement the control using minimum number of gates and D-FFs.
4. If a single input $b$ is 1, the device stores the data from a 32 bit signed input $I$, referring to this as an offset value. If $b$ is 0 and another input $e$ is 1, the device encrypts the input $I$ by adding the offset value to $I$ and outputs the encrypted value over a 32 bit signed output $J$. If another input $d$ is 1, the device decrypts the data on $I$ by subtracting the offset value before outputting the decrypted value over $J$.

Define the HLSM, determine the components that go into datapath, draw the control FSM, and define the connections between datapath and control.