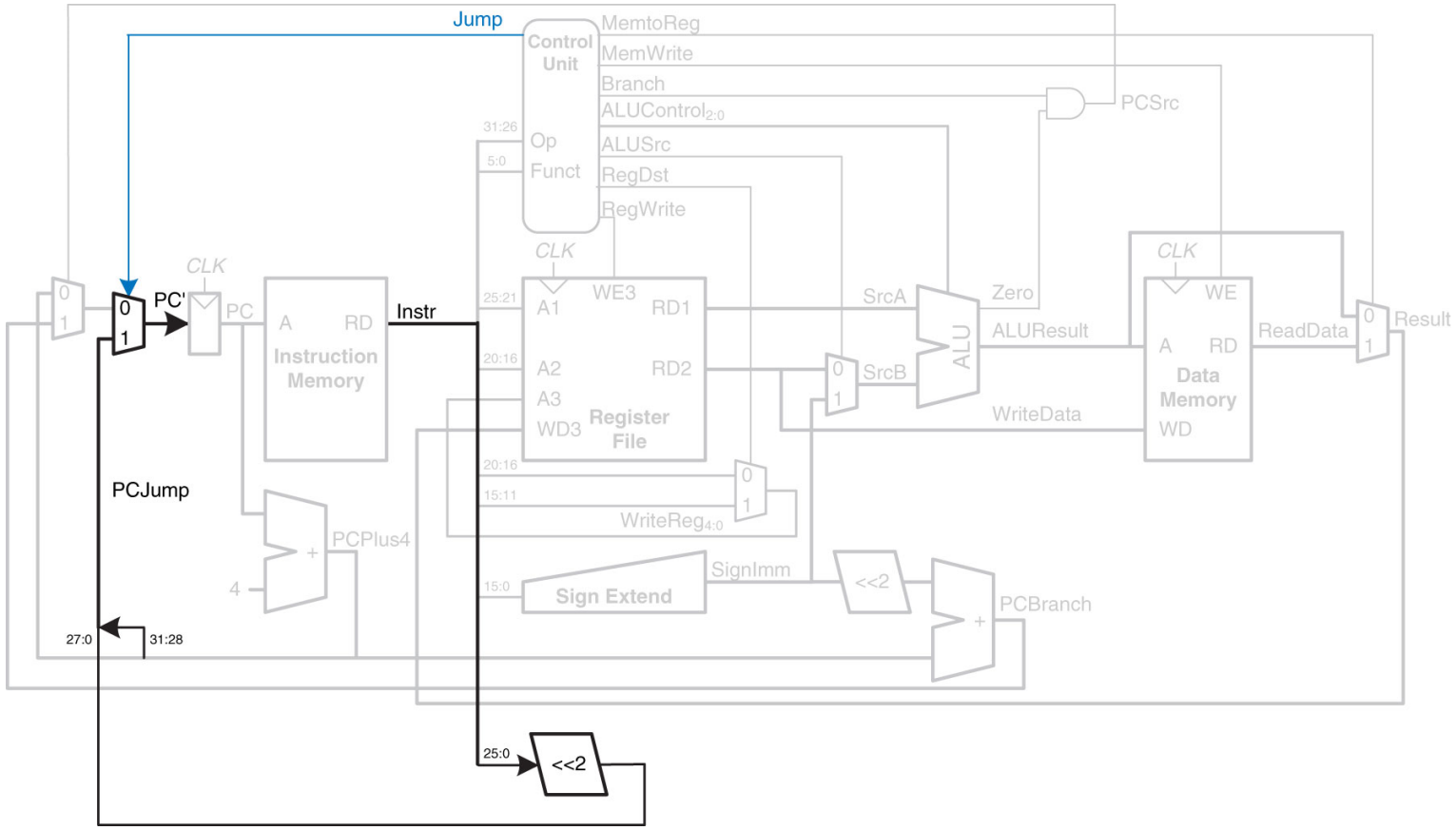

Figure 7.14 Single-cycle MIPS datapath enhanced to support the j instruction

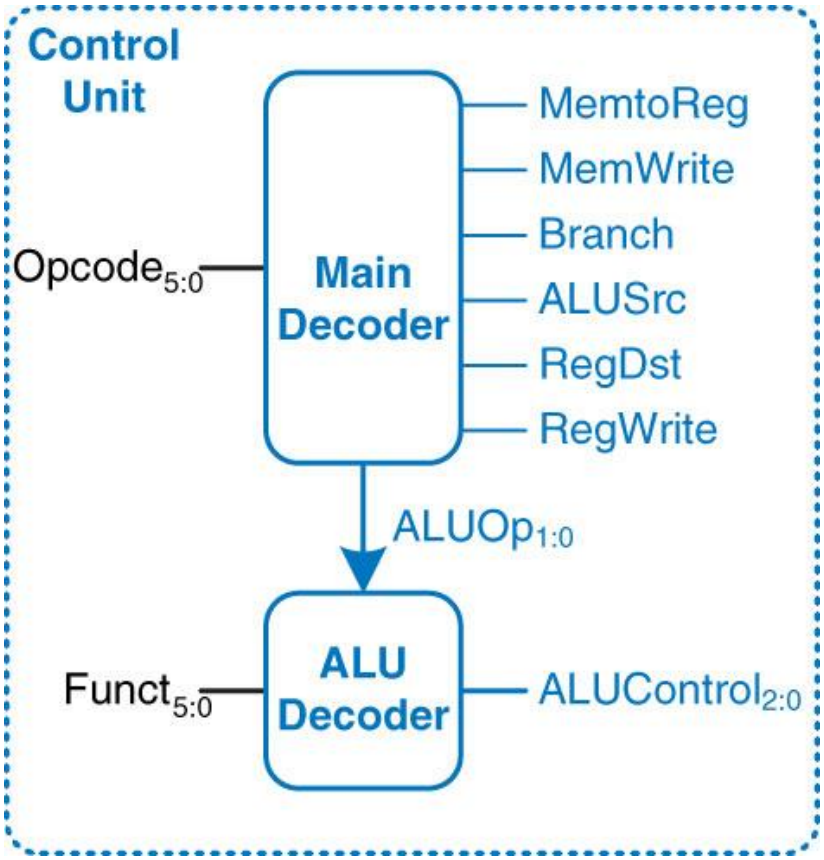

Figure 7.12 Control unit internal structure

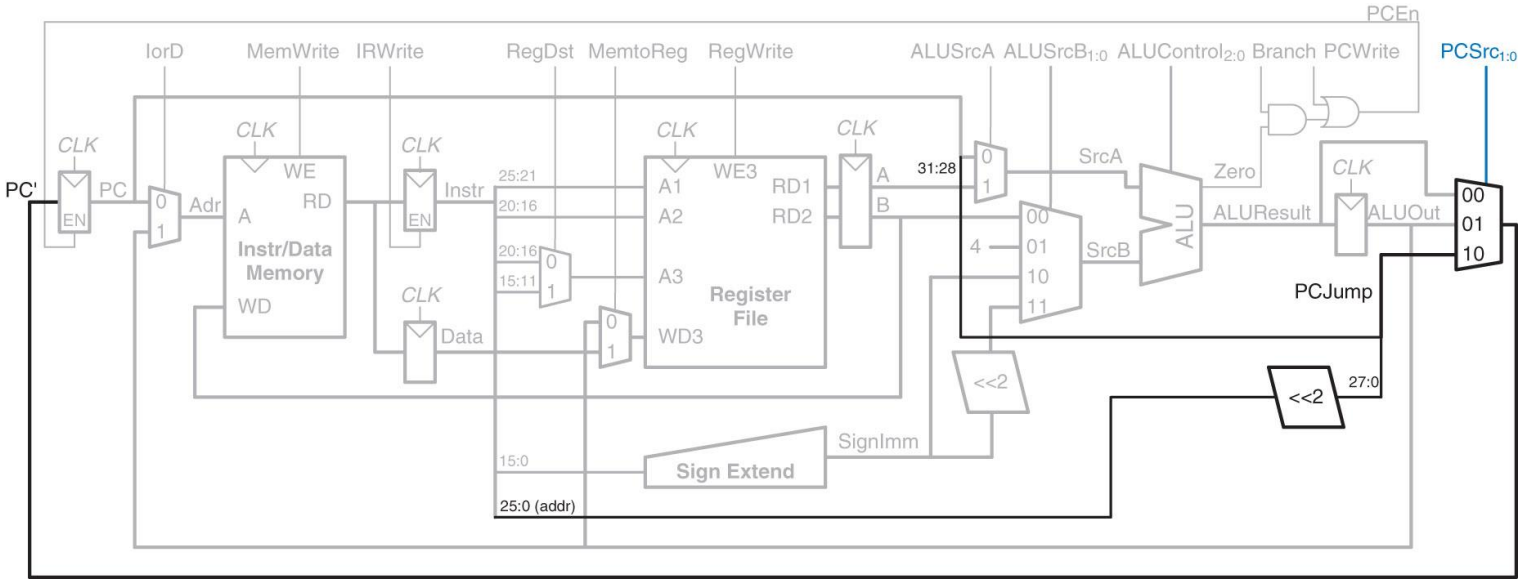

Figure 7.41 Multicycle MIPS datapath enhanced to support the j instruction

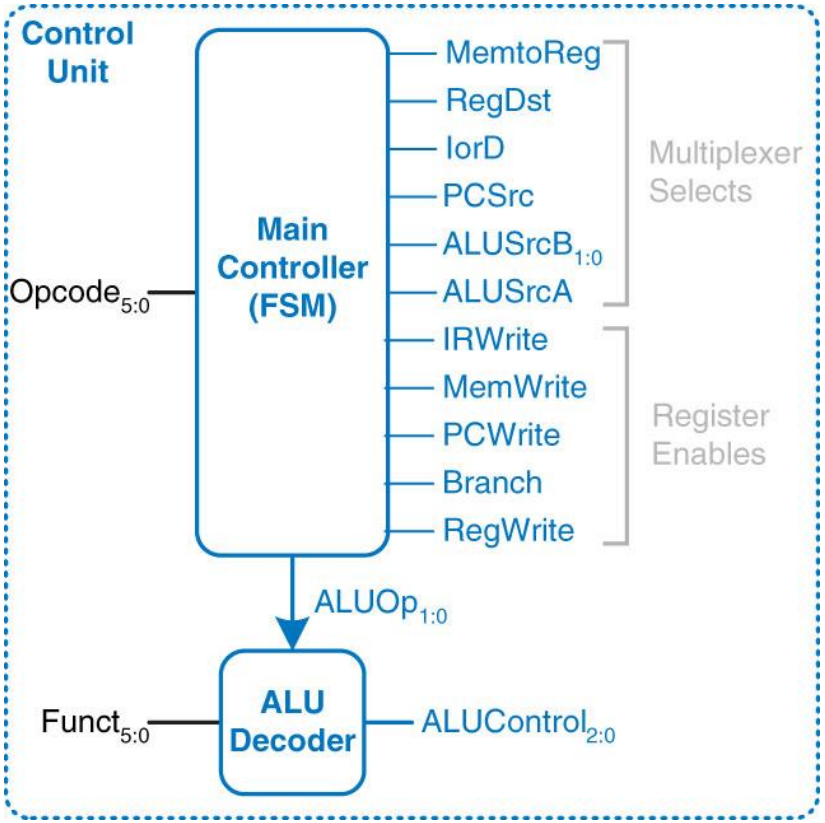

Figure 7.28 Control unit internal structure

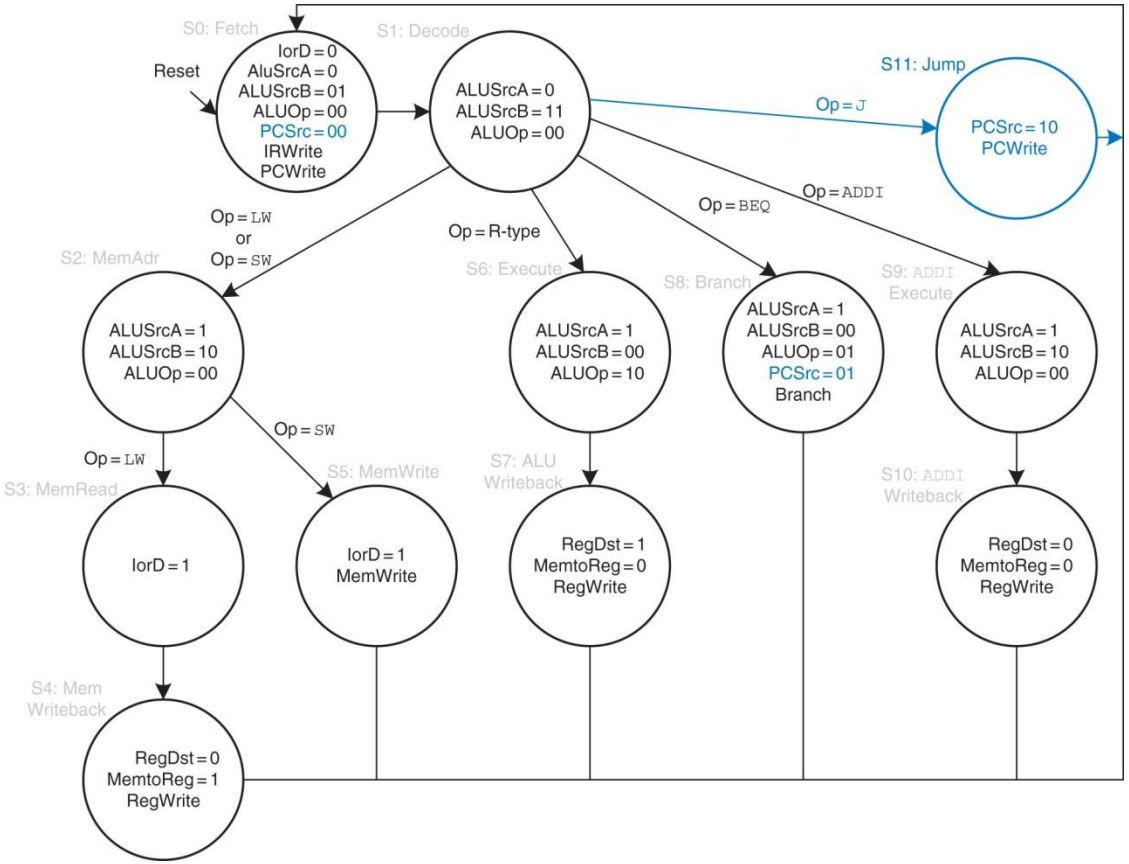

Figure 7.42 Main controller state for j

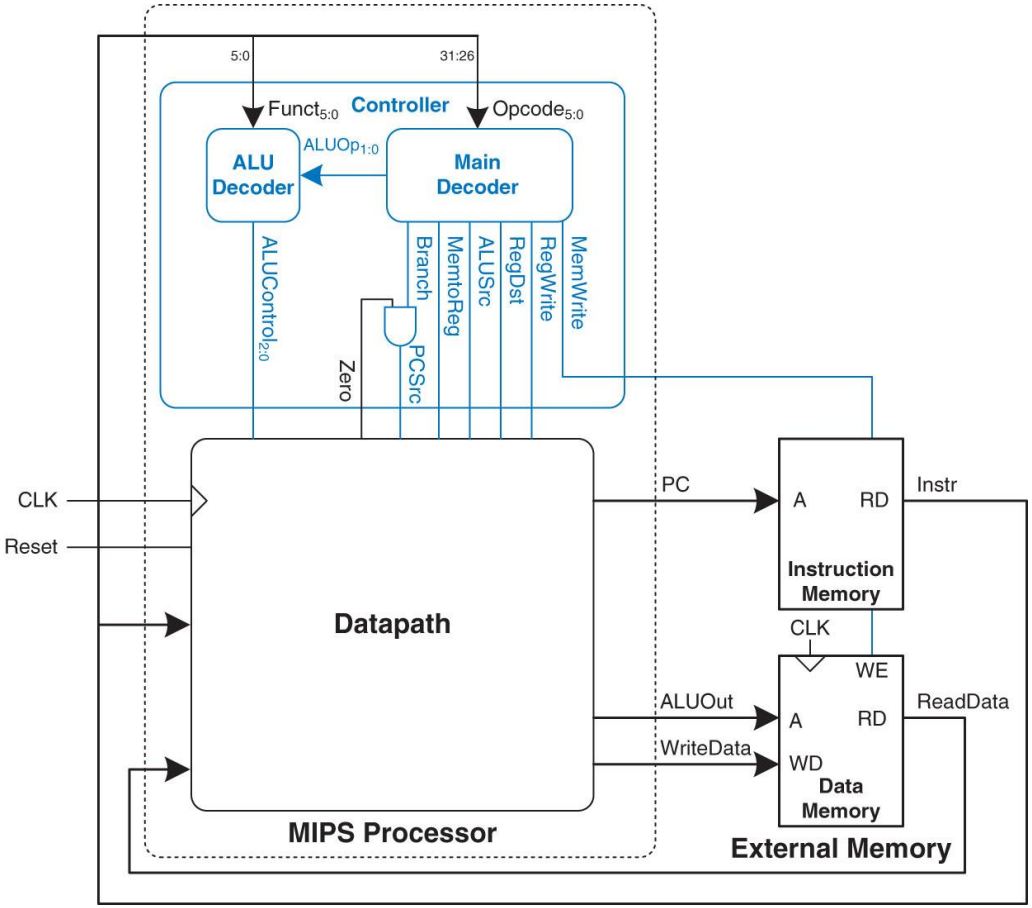

Figure 7.59 MIPS single-cycle processor interfaced to external memory

```
#          Assembly              Description                Address    Machine
main:      addi $2, $0, 5        # initialize $2 = 5        0          20020005
           addi $3, $0, 12       # initialize $3 = 12       4          2003000c
           addi $7, $3, -9       # initialize $7 = 3        8          2067fff7
           or   $4, $7, $2       # $4 = (3 OR 5) = 7        c          00e22025
           and  $5, $3, $4       # $5 = (12 AND 7) = 4      10         00642824
           add  $5, $5, $4       # $5 = 4 + 7 = 11          14         00a42820
           beq  $5, $7, end      # shouldn't be taken       18         10a7000a
           slt  $4, $3, $4       # $4 = 12 < 7 = 0          1c         0064202a
           beq  $4, $0, around   # should be taken          20         10800001
           addi $5, $0, 0        # shouldn't happen         24         20050000
around:    slt  $4, $7, $2       # $4 = 3 < 5 = 1           28         00e2202a
           add  $7, $4, $5       # $7 = 1 + 11 = 12         2c         00853820
           sub  $7, $7, $2       # $7 = 12 - 5 = 7          30         00e23822
           sw   $7, 68($3)       # [80] = 7                 34         ac670044
           lw   $2, 80($0)       # $2 = [80] = 7            38         8c020050
           j    end              # should be taken          3c         08000011
           addi $2, $0, 1        # shouldn't happen         40         20020001
end:       sw   $2, 84($0)       # write mem[84] = 7        44         ac020054
```

Figure 7.60 Assembly and machine code for MIPS test program

```
20020005
2003000c
2067fff7
00e22025
00642824
00a42820
10a7000a
0064202a
10800001
20050000
00e2202a
00853820
00e23822
ac670044
8c020050
08000011
20020001
ac020054
```

Figure 7.61 Contents of memfile.dat