Up Down Counter

Special Assignment Report

Course: 2EC701CC23: Microcontroller and Interfacing

Submitted by:

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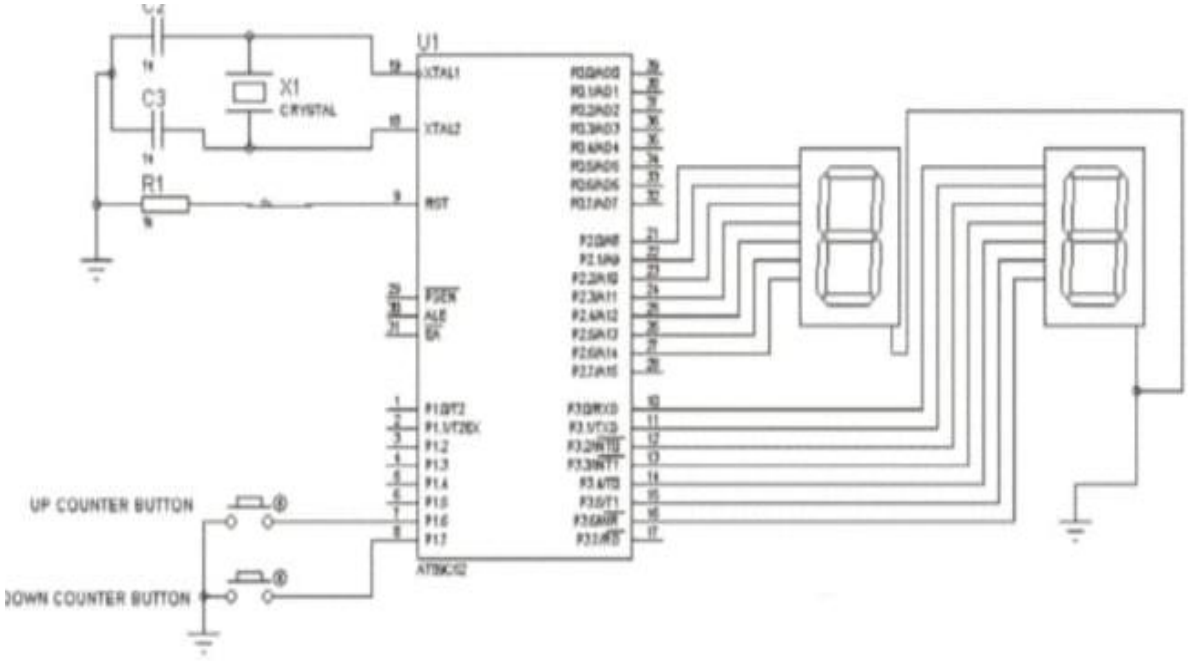
[April - 2025]

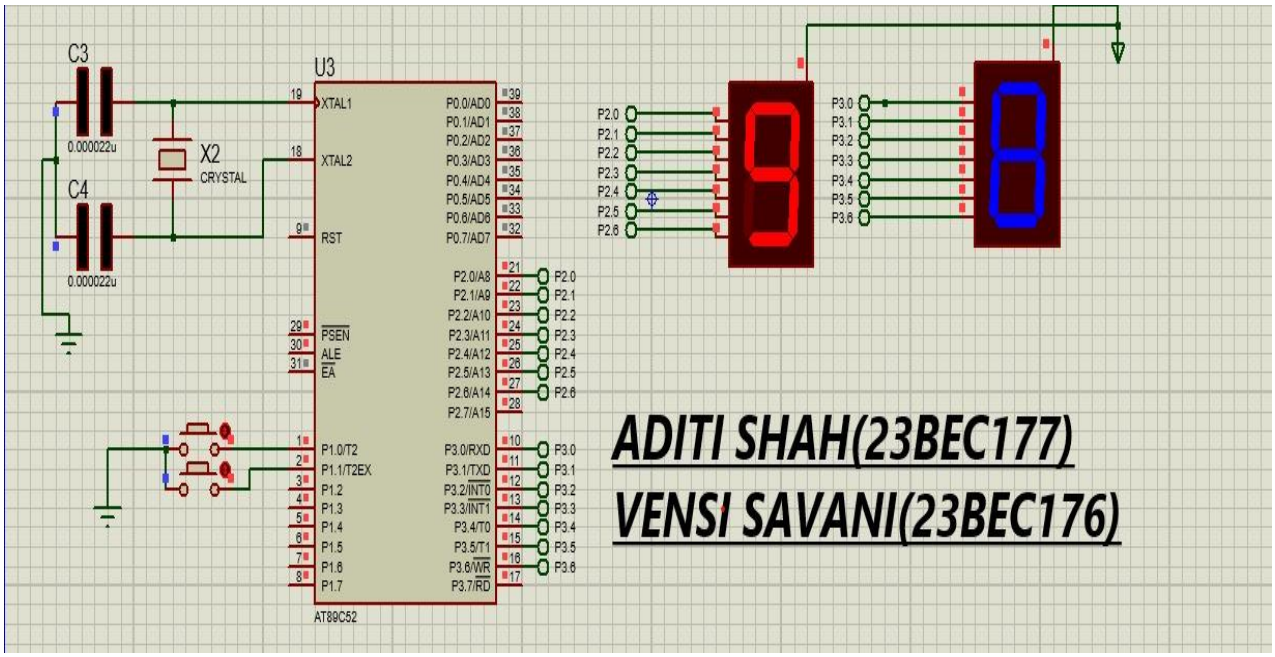
1. Introduction

The Up Down Counter is a digital circuit that counts numbers in either ascending or descending order, depending on devices the user wishes. Examples include digital clocks, event counters, and frequency meters. This project implements an Up Down Counter performance using the AT89S51 microcontroller, connected to two seven segment displays to visualize the count. In addition, the user can select the mode of the counter (up/down counting) using simple input push buttons.

2. Block Diagram



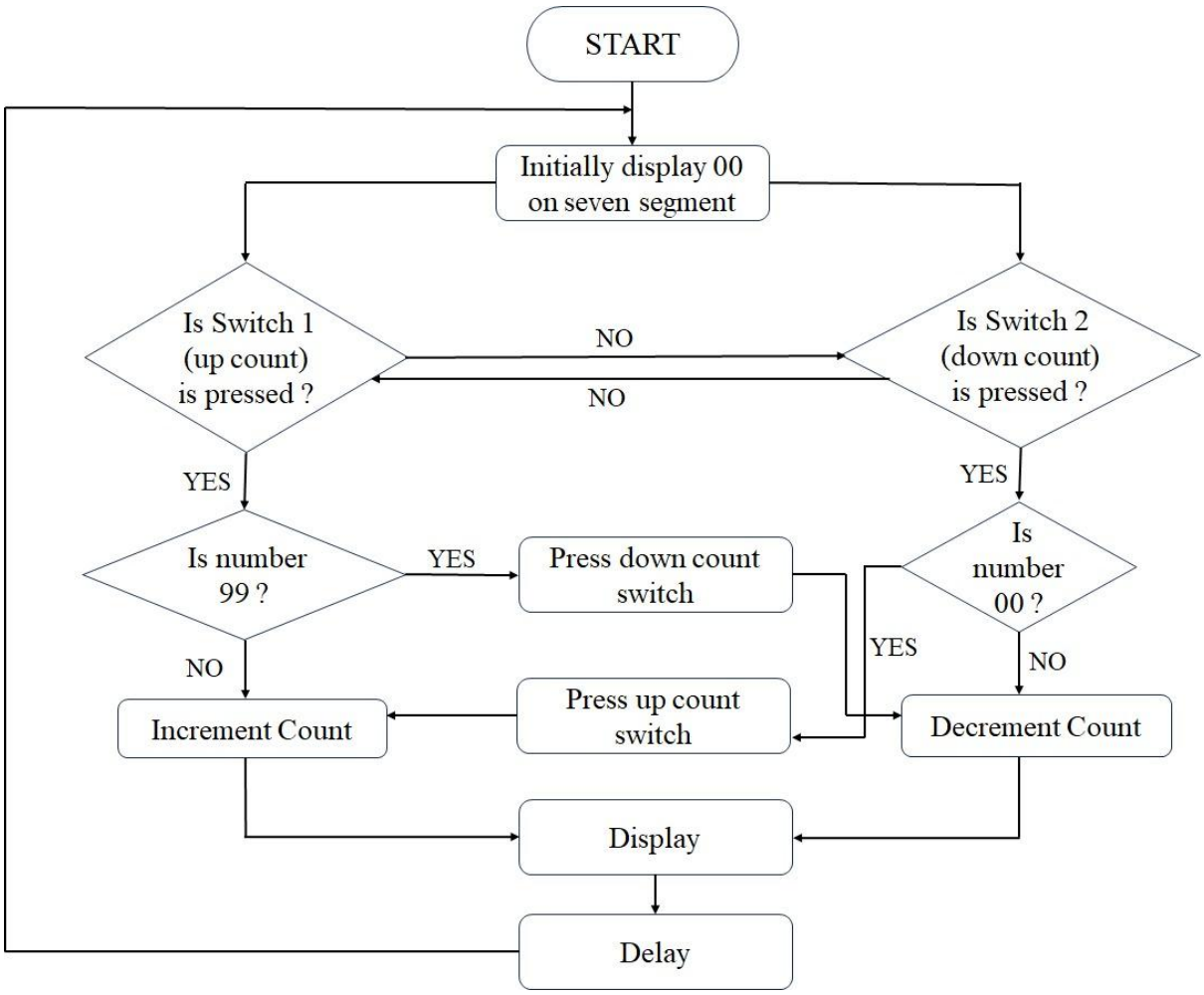
3. Circuit Diagram



4. Working

- The microcontroller AT89S51 is at the core of the circuit.
- A crystal oscillator (X2) and two capacitors (C3 and C4) each of value 22pF form the clock circuit to provide timing to the microcontroller.
- Two push buttons are connected to P1.0 and P1.1 which act as UP and DOWN controls.
- Two 7-segment displays are connected:
    - First display (tens place) is connected to Port 2 (P2.0 – P2.6).
    - Second display (units place) is connected to Port 3 (P3.0 – P3.6).
- Pressing the UP button increases the count; pressing the DOWN button decreases it.
- Count range: 00 to 99, wrapping back accordingly.

5. Flowchart


START
Initially display 00 on seven segment
Is Switch 1 (up count) is pressed ?
NO
NO
Is Switch 2 (down count) is pressed ?
YES
YES
Is number 99 ?
YES
Press down count switch
Is number 00 ?
YES
NO
NO
Increment Count
Press up count switch
Decrement Count
Display
Delay

6. Algorithm

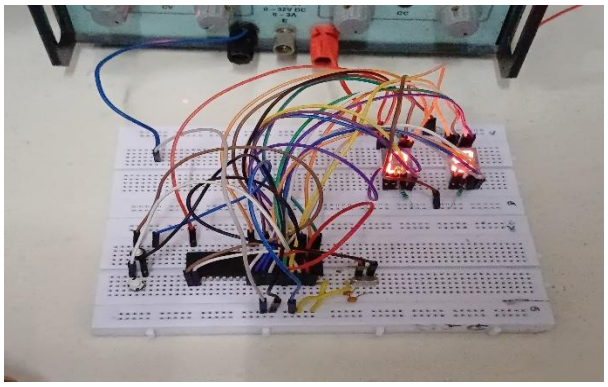
- Initialize:
    - Set Port1 as input (buttons).
    - Clear Port2 (tens display) and Port3 (ones display).
    - Set counter = 0.
    - Load 7-segment lookup table address.
- Main Loop:
    - Split counter into tens and ones.
    - Output segment patterns to Port2 (tens) and Port3 (ones).
    - Delay.
- If UP Button (P1.0) is pressed:
    - Debounce with delay.
    - Increment counter.
    - If counter > 99, reset to 0.
- If DOWN Button (P1.1) is pressed:
    - Debounce with delay.
    - If counter = 0, set to 99.
    - Else, decrement counter.
- Repeat loop.

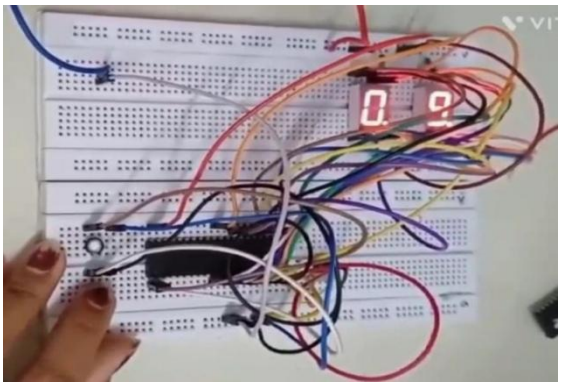
7. Code

```
ORG 0000H

MOV P2, #0H      ; Clear Port 2 (Tens display)
MOV P3, #0H      ; Clear Port 3 (Ones display)
MOV P1, #0FFH    ; Set Port 1 as input (for switches)

MOV DPTR, #SEG_TABLE ; Point to lookup table
MOV R6, #0       ; Counter (0-99)

MAIN_LOOP:
   MOV A, R6     ; Load counter value
   MOV B, #10
   DIV AB        ; A = Tens, B = Ones

   MOVC A, @A+DPTR ; Get segment pattern for Tens
   MOV P2, A     ; Output to P2(Tens display)

   MOV A, B
   MOVC A, @A+DPTR ; Get segment pattern for Ones
   MOV P3, A     ; Output to P3 (Ones display)

   CALL DELAY    ; Small delay

   ; Check UP Button (P1.0)
   MOV A, P1
   JB ACC.0, CHECK_DOWN   ; If P1.0 is HIGH, skip

   INC R6        ; Increment counter
   CJNE R6, #100, DISPLAY
   MOV R6, #0    ; Reset to 00 if 100

DISPLAY:
   CALL DELAY
   SJMP MAIN_LOOP

CHECK_DOWN:
   MOV A, P1
   JB ACC.1, MAIN_LOOP ; If P1.1 is HIGH, skip

   DEC R6        ; Decrement counter
   CJNE R6, #0FFH, DISPLAY
   MOV R6, #99   ; Reset to 99 if below 00

   CALL DELAY
   SJMP MAIN_LOOP

; 7-Segment Display Lookup Table (Common Anode)
SEG_TABLE:
   DB 0C0H ; 0
   DB 0F9H ; 1
   DB 0A4H ; 2
   DB 0B0H ; 3
   DB 99H  ; 4
```

```
    DB 92H  ; 5
    DB 82H  ; 6
    DB 0F8H ; 7
    DB 80H  ; 8
    DB 90H  ; 9

; Simple Delay Subroutine
DELAY:
   MOV R3, #200
D0: MOV R7, #200
D1: MOV R5, #12
D2: DJNZ R5, D2
    DJNZ R7, D1
    DJNZ R3, D0
RET

END
```

8. Photographs





9. Bill of materials

Sr. no.	Component	Quantity	Price (Rs.)
1	IC AT89S51	1	100
2	7 - segment display	2	15
3	Push button	2	30
4	Crystal Oscillator	1	15
5	Resistors	4	5
	Total	10	165

10. Applications

- Digital clocks and timers
- Event or object counters
- Scoreboards
- Elevator floor indicators
- Production line automation
- Auto reversing Mechanisms
- Preventing Overflow/ Underflow

11. Summary

This project shows how to implement an Up Down Counter using the AT89S51 microcontroller. The counter can be incremented or decremented using external inputs and the count value is displayed using 7-segment displays. The project provides an application of interfacing peripherals in a microcontroller and control logic design.

12. Questions

1. What is the purpose of the crystal oscillator in this project?
2. Why do we use delays after button presses?
3. How are 7-segment displays interfaced with ports?
4. What changes are needed to extend the count beyond 99?

13. References

[1] https://www.engineersgarage.com/up-down-counter-using-8051-microcontroller-at89c51/

[2] https://www.engineersgarage.com/up-down-counter-using-8051- microcontroller-at89c51/

[3] https://www.geeksforgeeks.org/pin-diagram-of-8051-microcontroller/

[4] https://www.electronicsforu.com/resources/7-segment-display-pinout-understanding