

**Laboratorio di Architettura degli Elaboratori**

**Elaborato SIS e Verilog**

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**Specifiche e scelte progettuali**

Il progetto realizzato prevede la gestione di partite di morra cinese.

Ogni partita si articola di più manche, con le seguenti regole:

* Si devono giocare un minimo di quattro manche e un massimo di diciannove, deciso dai giocatori al momento del reset, in cui le mosse valgono come stringa di bit da sommare a 4 (00100) per ottenere il numero di manche massime per la partita che sta per svolgersi.

Il numero massimo di manche viene anche settato al ciclo di clock in cui viene iniziata la partita, mettendo però il reset a 1 all’inizio di essa;

*nota progettuale*: nel momento in cui il reset è a 1 le mosse non vengono viste come mosse effettive, ma solo come stringa di bit per determinare le manche massime, di conseguenza non verrà poi conteggiata la manche in cui il reset è a 1.

* Vince il primo giocatore a riuscire a vincere due manche in più del proprio avversario, a patto di aver giocato almeno quattro manche;

o, nel caso di raggiungimento delle manche massime, vinche il giocatore che ha un vantaggio rispetto all’altro giocatore,

in caso non ci diano vantaggi, la partita termia in pareggio.

* Ad ogni manche, il giocatore vincente della manche precedente non può ripetere l’ultima mossa utilizzata (*nota progettuale*) solo per il ciclo di clock successivo.

Nel caso lo facesse, la manche non sarebbe valida ed andrebbe ripetuta (quindi, non conteggiata).

In caso di pareggio la manche viene conteggiata. Alla manche successiva, entrambi i giocatori possono usare tutte le mosse.

Il circuito comprende 5 bit di input che di dividono in 3 ingressi, così ordinati:

**[2 bit]** – mossa del giocatore 1

00 → nessuna mossa,

considerata come mossa non valida, invalida anche la manche

01 → sasso

10 → carta

11 → forbice

**[2 bit]** – mossa del giocatore 2

Le mosse hanno gli stessi codici del primo giocatore.

**[1 bit]** – reset

1 → riporta il sistema alla configurazione iniziale

e considera le mosse dei due giocatori come numero da sommare a 4 (00100) per settare il numero di manche massime della partita che si sta per svolgere.

*Nota progettuale*: all’avvio inserire il reset a 1 in modo da settare il numero di manche massime.

0 → la partita procede regolarmente.

Il circuito comprende inoltre 4 bit di output che di dividono in 2 uscite, così ordinati:

**[2 bit]** – manche (fornisce il risultato dell’ultima manche giocata)

00 → manche non valida

01 → manche vinta dal giocatore 1

10 → manche vinta dal giocatore 2

11 → manche pareggiata

**[2 bit]** – partita (fornisce il risultato della partita)

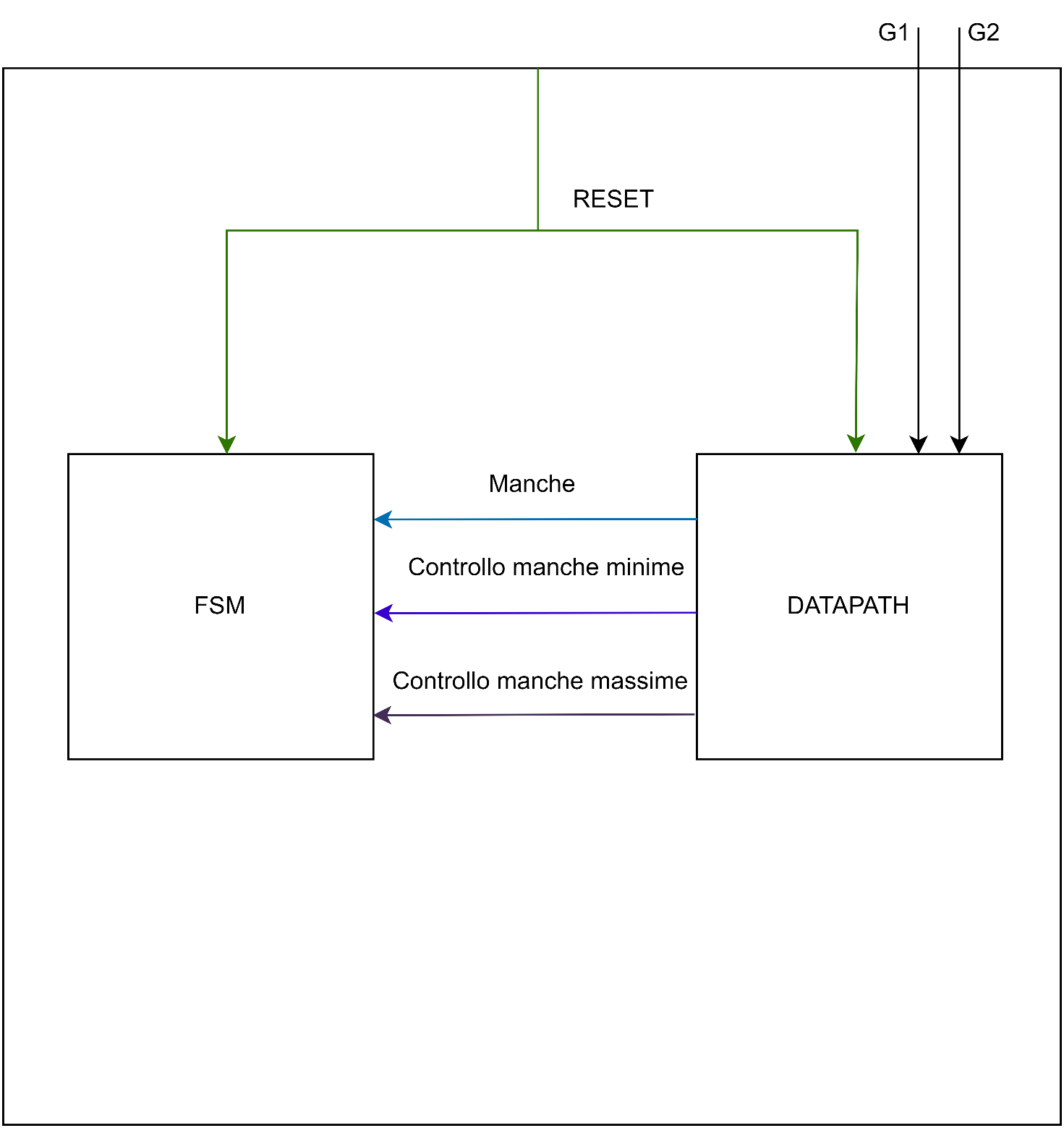
00 → la partita non è terminata

01 → la partita è terminata, ed ha vinto il giocatore 1

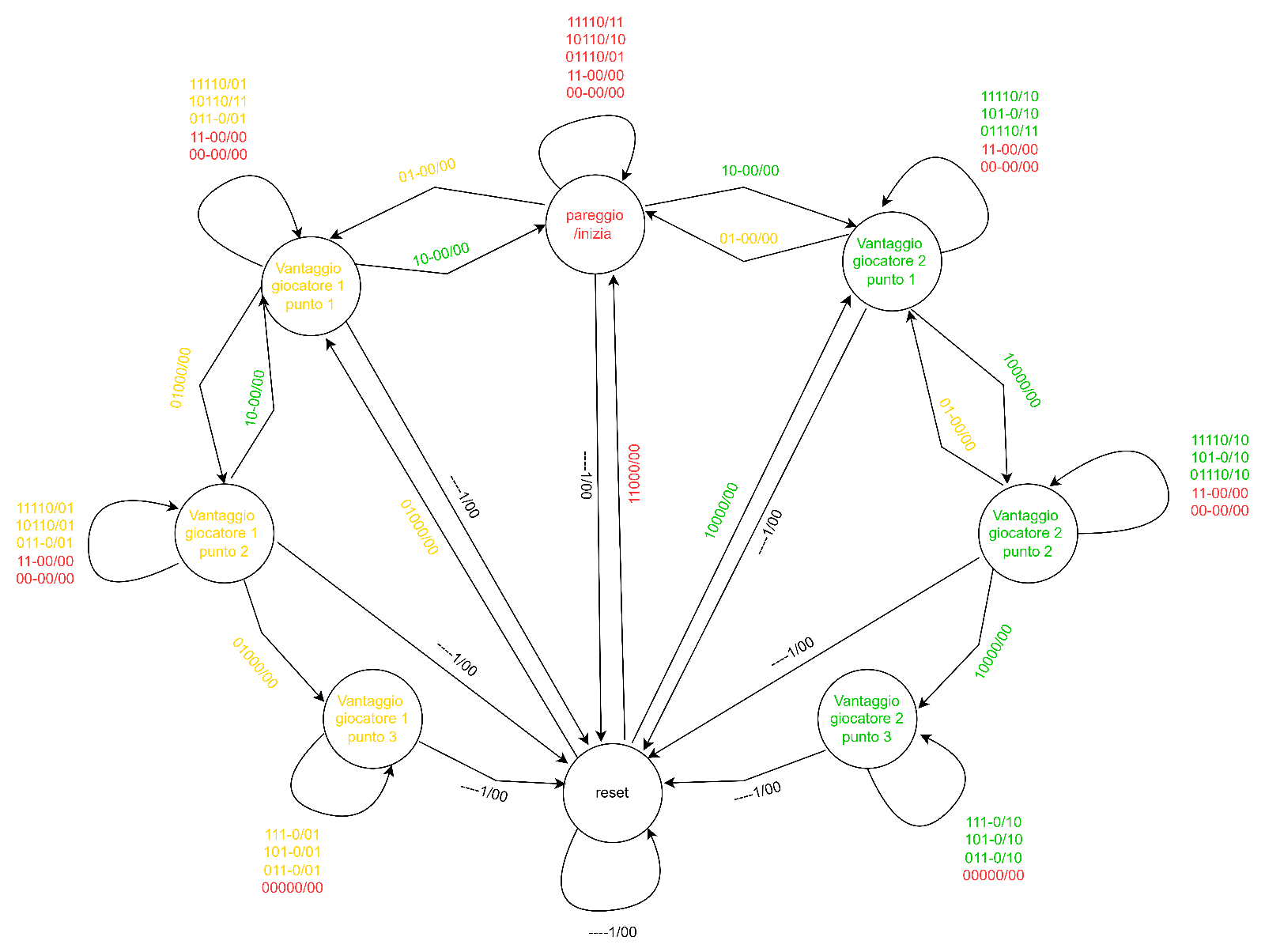
10 → la partita è terminata, ed ha vinto il giocatore 2

11 → la partita è terminata in pareggio

**Architettura generale del circuito – FSMD**



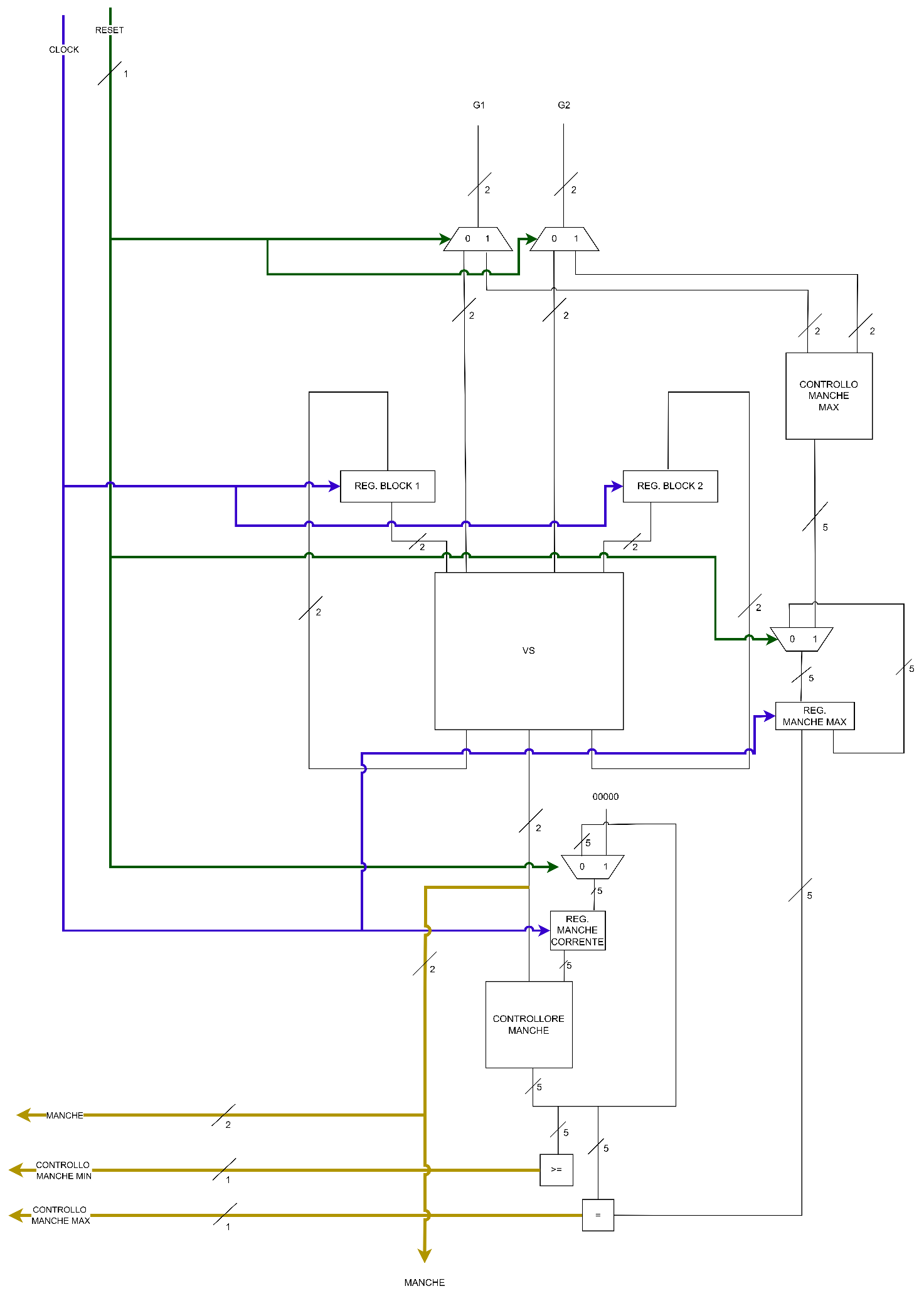
**Diagramma degli stati del controllore – STG – FSM**



Nella FSM avviene la gestione del vantaggio dei giocatori.

La partita termina nello stato in cui si trova.

**Architettura del Datapath**

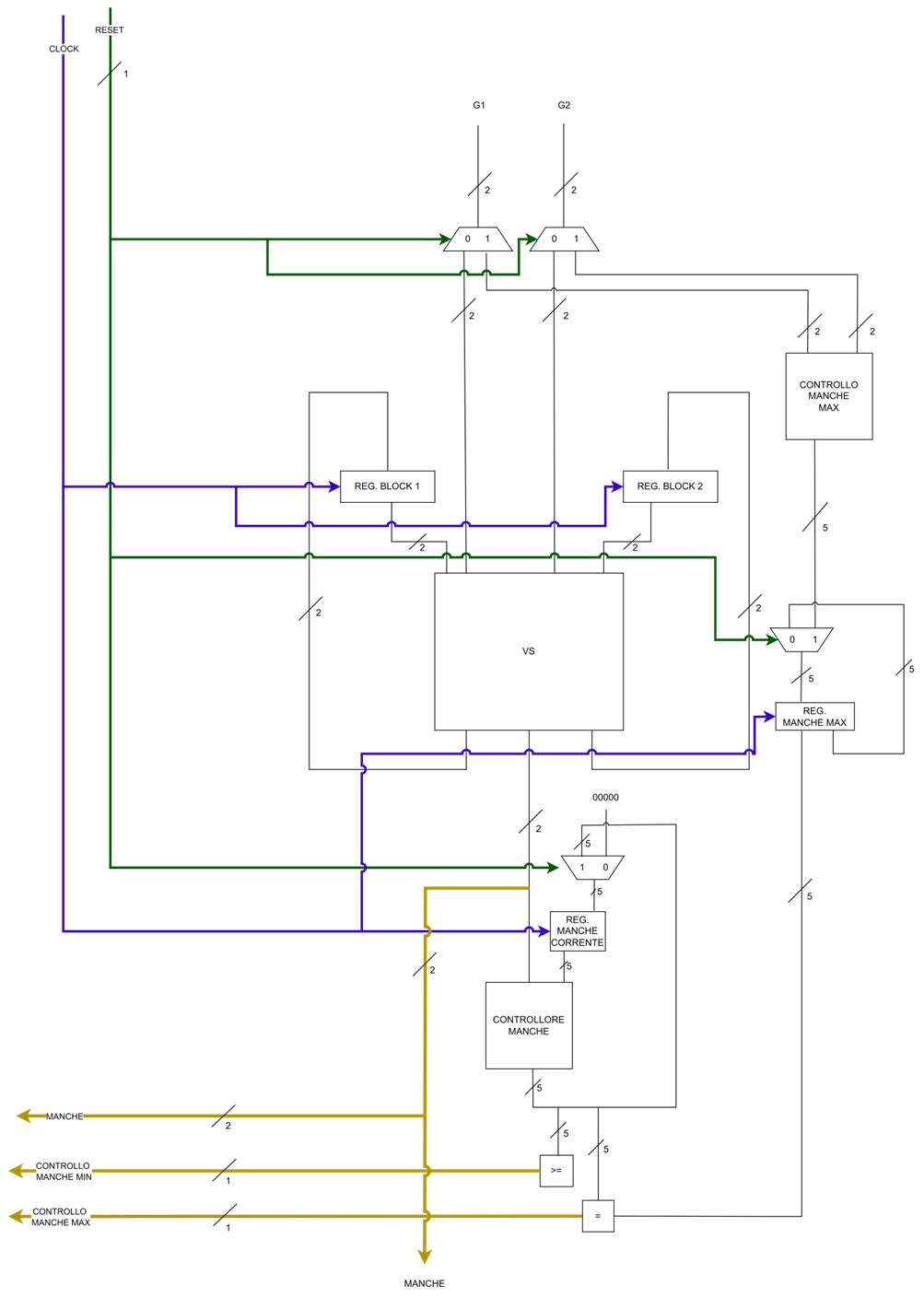
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**Immagine che contiene schermata, diagramma, testo, Piano

Descrizione generata automaticamente**

**- reset / gestione mosse**

All’inizio c’è un primo controllo che in base al reset decide come gestire le mosse: se vederle come stringa da sommare o come mosse effettive.



**- settaggio e memoria delle manche massime**

CONTROLLO MANCHE MAX

Questo componente prende i la stringa di bit in entrata (quando il reset è a 1) dedicata alle mosse e la somma a 4 (00100) per ottenere il numero di manche massime da poter fare nella partita.

MANTENERE IN MEMORIA LE MANCHE MASSIME DA POTER FARE

A ogni ciclo di clock, se il reset è a 0 viene ributtato dentro il registro MANCHE MAX il valore precedente che determina le panche massime della partita in corso.

Se invece il reset è a 1 (reset) entra nel registro il valore delle nuove manche massime da poter fare, calcolato dal componente del CONTROLLO MANCHE MAX.  
**Immagine che contiene schermata, diagramma, Piano, Rettangolo

Descrizione generata automaticamente**

**Immagine che contiene schermata, diagramma, testo, Piano

Descrizione generata automaticamenteImmagine che contiene schermata, diagramma, testo, Piano

Descrizione generata automaticamente**

**![Immagine che contiene schermata, diagramma, testo, Piano

Descrizione generata automaticamente](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAACLcAAAw8CAMAAABupFCHAAAAAXNSR0IArs4c6QAAAARnQU1BAACxjwv8YQUAAAASUExURQAAAAAAAAAAAAAAAAAAAAAAAOArGaIAAAAFdFJOUwBJtcnUfGRXNwAAAAlwSFlzAAAh1QAAIdUBBJy0nQAAG2pJREFUeF7t2kFuhDAQAMFdNvz/y2EJKDeLE6alqouFzQNao3kBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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**- gestione manche**

VS

Questo componente ha 4 entrate:

* 2 sono le mosse effettive dei giocatori
* 2 due sono le mosse bloccanti, salvate nei registri che tengono in memoria la mossa del giocatore vincente dal ciclo di clock precedente

REG. BLOCK 1 – 2

Qui viene salvata la mossa del giocatore vincente, che poi al ciclo di clock successivo verrà confrontata con la mossa del rispettivo giocatore, per verificare se può giocare una la mossa.

In caso di pareggio, manche non valida o il giocatore perda la manche, nel suo rispettivo registro verrà salvato 00 (jolly).

**Immagine che contiene schermata, diagramma, testo, Piano

Descrizione generata automaticamente-** **contatore**

MUX – REG. MANCHE CORRENTE

In caso di reset (1) lascia passare una stringa di 0 che andrà a resettare il registro delle manche correnti, altrimenti lascia passare il valore dele manche correnti, che andrà salvato nel registro.

CONTROLLORE MANCHE

Se la manche è valida aggiunge 1 al conteggio delle manche correnti, se non è valida manda in output lo stesso numero di manche correnti.

**Immagine che contiene schermata, diagramma, Piano, testo

Descrizione generata automaticamente**

**- segnali di stato**

MANCHE

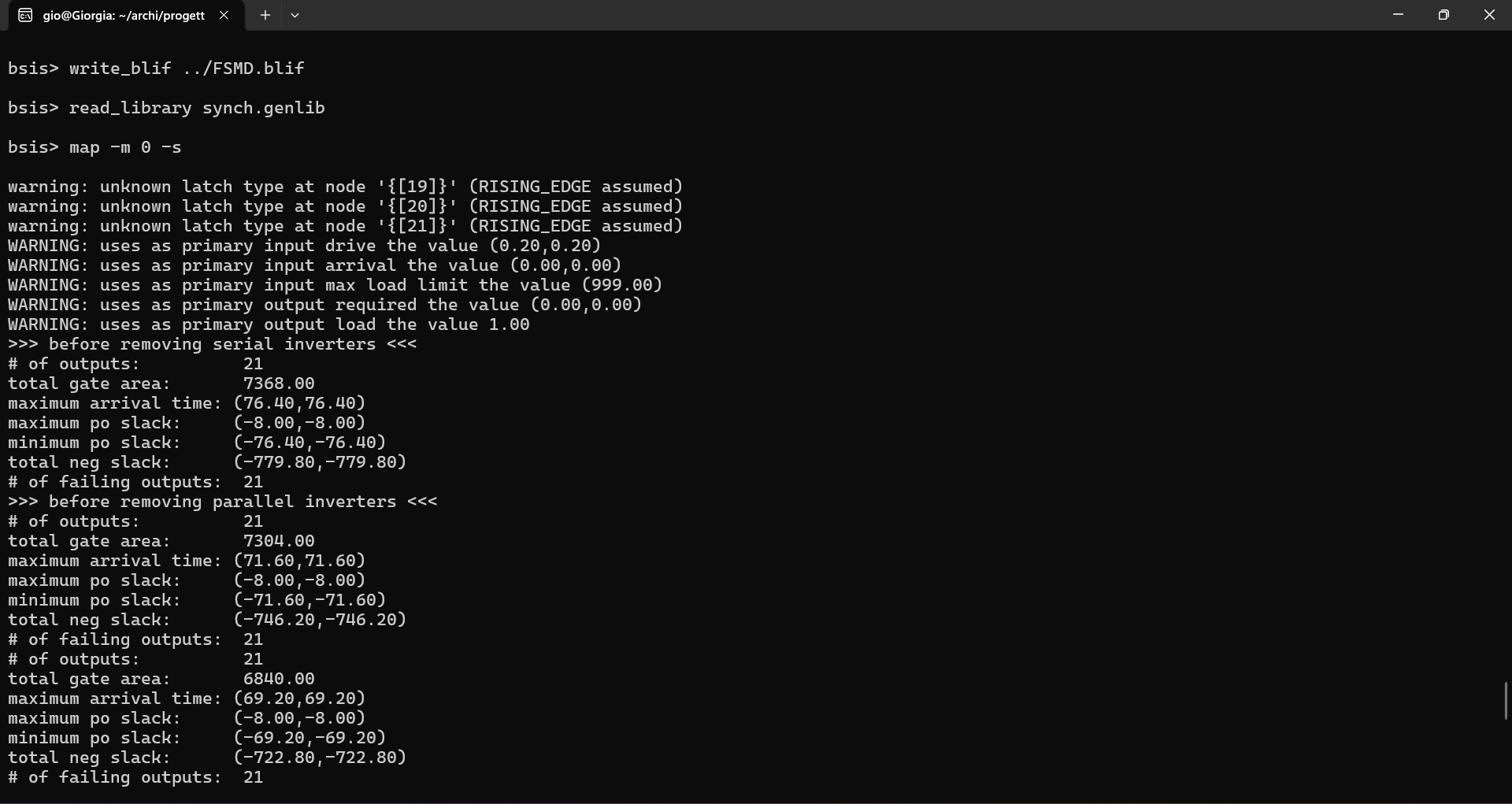
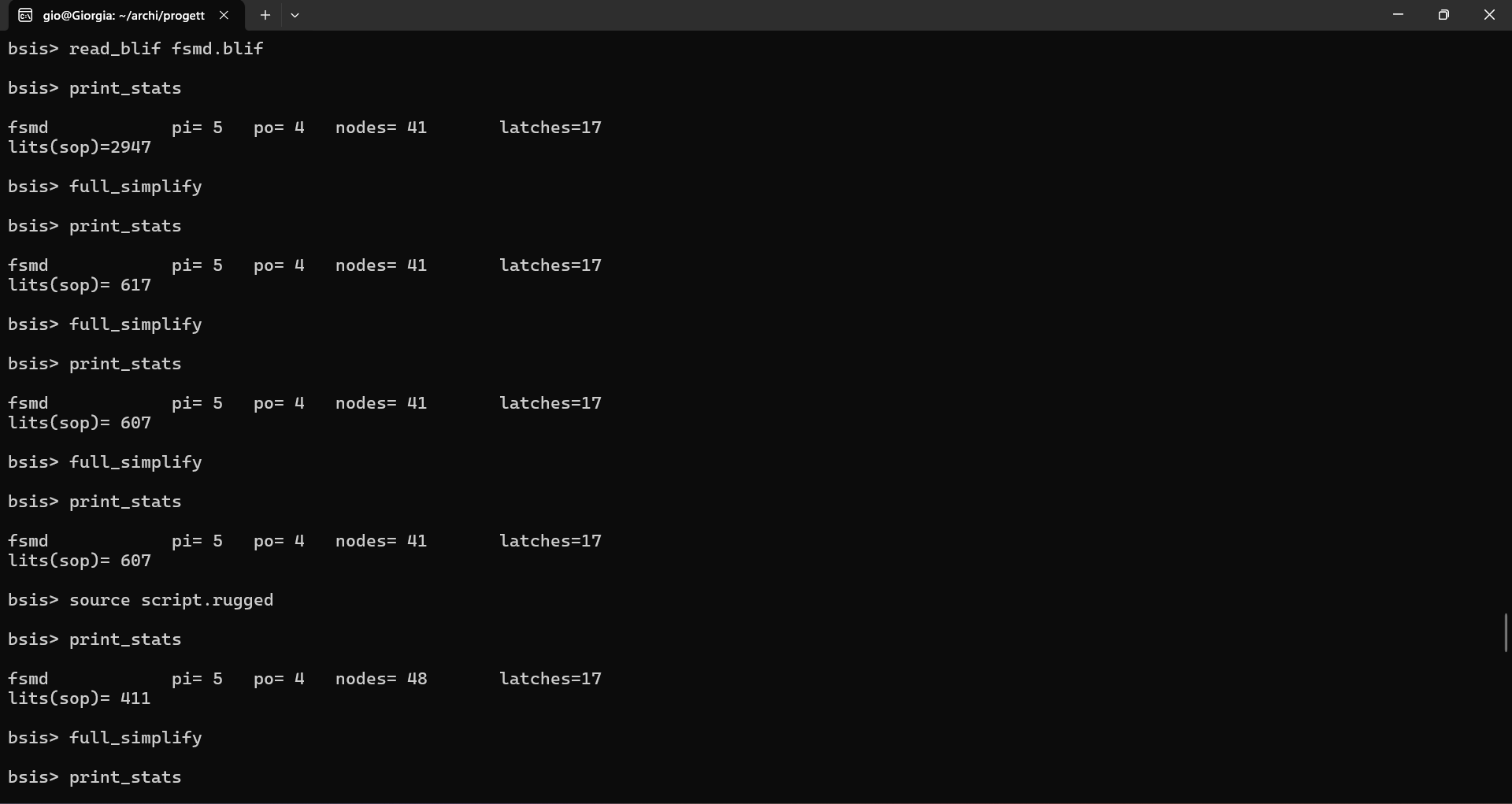
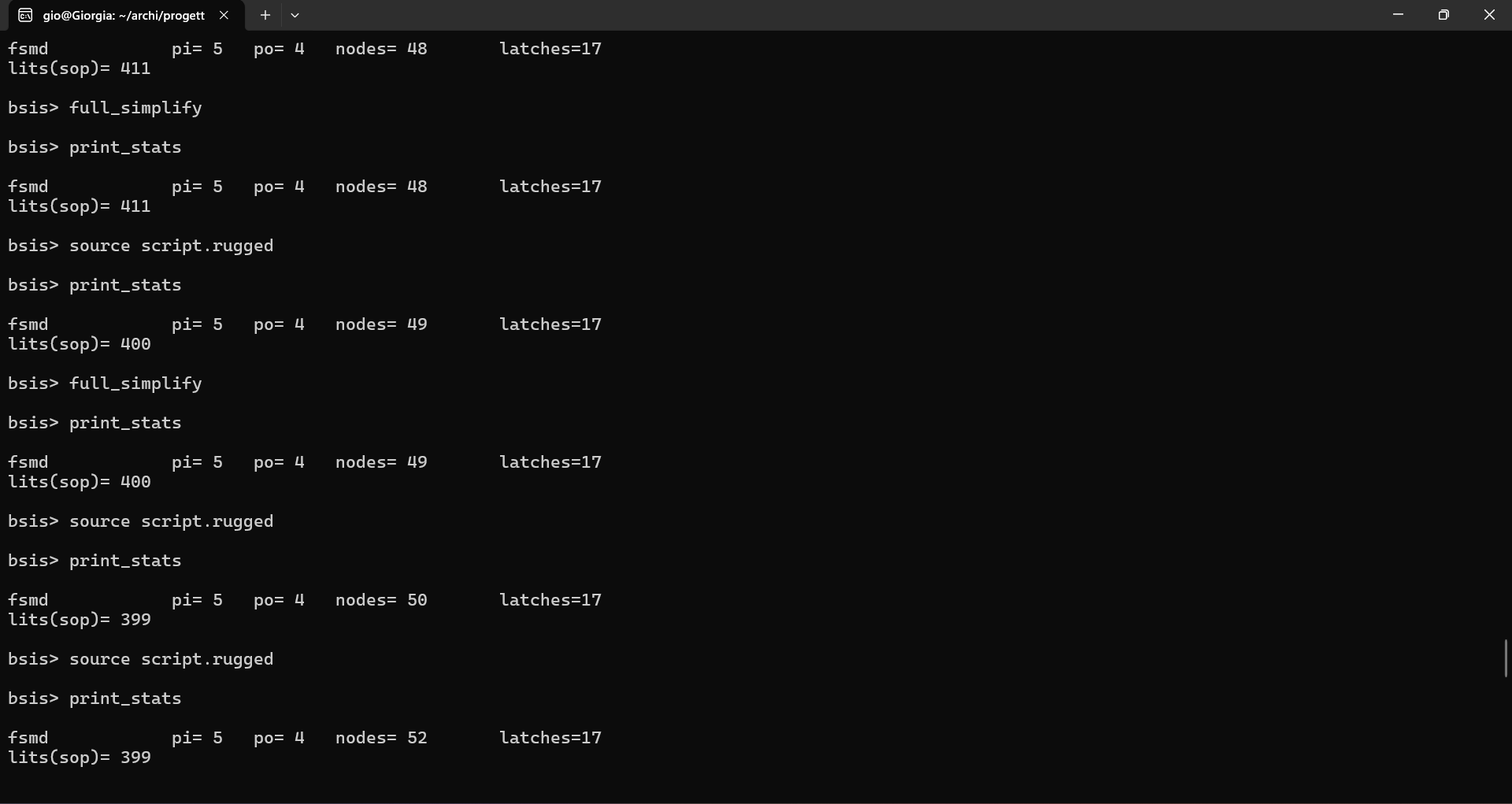
Output del componente VS che determina lo stato della manche e in caso chi la vince.

>= → MIN

Controllo per verificare se si ha raggiunto il minimo di 4 manche valide.

= → MAX

Controllo per verificare se si ha raggiunto il numero di manche massime impostato dai giocatori all’inizio della partita.

******Ottimizzazione**

**Technology mapping**

Immagine che contiene testo, schermata

Descrizione generata automaticamente

Immagine che contiene elettronica, testo, schermata, computer

Descrizione generata automaticamente**Confronto degli output Sis-Verilog**