HARDWARE-ORIENTED MICROPROCESSOR SIMULATOR (HOMS v.1B) OPEN-SOURCE PROJECT

Quick User Guide



Dr. Panayotis (Panos) Papazoglou

8/2024



You are free to:

Share — copy and redistribute the material in any medium or format

Adapt — remix, transform, and build upon the material The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:



Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.



NonCommercial — You may not use the material for commercial purposes.



ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.

No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

1. Executing a real program

For performing a program execution, the corresponding byte codes have to be stored in the memory module. When the system starts, the user selects the **Demo** or the **Upload** operation. When the **Demo** option is selected, then the instruction **MOV A,3** is loaded in the memory unit and can be immediately executed. On the other hand, the program can be developed within the GUI environment which is a computer-based application. After the program development, the corresponding byte codes are uploaded to memory unit through a USB connection.

Figure 5.4 shows the computer-based application where the program can be developed. The GUI is organized in sections based on the corresponding functionality.



Fig. 5.4 GUI environment for program development

2. Testing the demo instruction

The first thing to do after HOMS activation, is to select the demo execution or the upload from the PC. Fig. 5.5 shows the available options for preparing program execution. The first step for program execution is to load program instruction codes in memory unit.



Fig. 5.5 Starting from memory unit

According to fig. 5.6 the user has selected the **Demo** option, where the instruction **MOV A,3** will be loaded in memory.



Fig. 5.6 The instruction MOV A,3 will be loaded in memory

After instruction load, the control unit will be used for starting the execution process (fig. 5.7). The first step is to Reset all the HOMS registers. The initial value for all registers is FF (hexadecimal value) and after Reset, the new content will be zero (fig. 5.8).

RESET REGISTERS	10 J
Done! Program loaded? Start EXECUTION?	LCD Modu
next>>	2.4indi
	RESET REGISTERS Done! Program loaded? Start EXECUTION? next>>

Fig. 5.7 Starting the execution process

© Panayotis (Panos) Papazoglou HOMS v.1B Page 4





Fig. 5.8 Register Rest

3. Testing a program from PC

For a full demonstration of the HOMS v. 1B tool operation, an assembly program will be developed within the GUI environment and uploaded to the memory module. Table 5.1 shows the demo program (symbolic instruction, byte code and memory contents).

Demo program						
Instruction	Byte code	Address (content) (in decimal)				
MOV A, 4	(dec) 04 04, (hex) 04 04	00* (04), 01 (04)				
INC A	(dec) 10 00, (hex) 0A 00	02 [*] (10), 03 (00)				
MOV B, 7	(dec) 03 07, (hex) 03 07	04* (03), 05 (07)				
DEC B	(dec) 07 00, (hex) 07 00	06* (07), 07 (00)				
HALT	(dec) 17 00, (hex) 11 00	08 [*] (17), 09 (00)				

* Instruction starting address (PC content)

STEP 1 - GUI Application execution

After the PC application execution, the GUI environment will be activated (fig. 5.9).

	Address	OpCode	Full Instruction			C	lear Prog	
,						СОМ		
						Selec	tion	
								-
							Upload	
							Close	
		Coloct In	struction		Solo	at Addross		
	lo Operation) RY	Select In	struction		Sele	ct Address	i.	
NOP (N MOV A	No Operation), BY A, i => (A = Integer	Select In TES:00 00 (coo r i), BYTES:04)	struction de 00) (X (code 04)		Sele 0 2	ct Address	i.	I
NOP (N MOV A MOV E	No Operation), BY A, i => (A = Integer B, i => (B = Integer	Select In TES:00 00 (coo r i), BYTES:04) r i), BYTES:03)	struction de 00) (X (code 04) (X (code 03)		Sele	ct Address	π.	I
NOP (N MOV A MOV E NC A	No Operation), BY A, i => (A = Integer 3, i => (B = Integer (A = A + 1), BYTE	Select In TES:00 00 (coo r i), BYTES:04) r i), BYTES:03) S: 10 00 (code	struction de 00) (X (code 04) (X (code 03) 10)		0 2 4 6	ct Address		I
NOP (M MOV A MOV E NC A NC B	No Operation), BY A, i => (A = Integer B, i => (B = Integer (A = A + 1), BYTE (B = B + 1), BYTE (B = 0, 1 = 1)	Select In TES:00 00 (coo ri), BYTES:04) ri), BYTES:03) S:10 00 (code S:05 00 (code S:05 00 (code	struction de 00) XX (code 04) XX (code 03) 10) 15) de 08)		Sele 0 2 4 6 8 10	 ct Address	2	I
NOP (N MOV A MOV E NC A NC B DEC A	No Operation), BY $A_i => (A = Integer)$ $A_i => (B = Integer)$ (A = A + 1), BYTE (B = B + 1), BYTE => (A = A - 1), BY => (B = B - 1), BY	Select In TES:00 00 (cot r), BYTES:04) r), BYTES:03) S:10 00 (code S:05 00 (code YTES:06 00 (cod YTES:07 00 (cod	struction de 00) (X (code 04) (X (code 03) 10) 10) 25) de 06) de 07)		Sele 0 2 4 6 8 10	ct Address	1	I
NOP (N MOV A MOV E NC A NC B DEC A DEC B	No Operation), BY $A_i => (A = Integer A_i => (B = Integer (A = A + 1), BYTE (B = B + 1), BYTE (B = B + 1), BYTE => (B = B - 1), B^3,B => (A = A + B)$	Select In TES:00 00 (coo r), BYTES:04) r), BYTES:03) S:10 00 (code S:05 00 (cod YTES:06 00 (co YTES:07 00 (co , BYTES:01 X)	struction te 00) (X (code 04) (X (code 03) 10) 10) 10) 10) 10) 10) 10) 10		Sele 0 2 4 6 8 10	ct Address	1	I
NOP (M MOV A MOV E NC A NC B DEC A DEC B ADD A HALT	No Operation), BY $h_{i} = > (A = Integer A_{i} = > (B = Integer (A = A + 1), BYTE (B = B + 1), BYTE (a = A - 1), B' (B = B + 1), B' (B = A - 1), B' (B = A + B) => Halt Program,$	Select In TES:00 00 (coo ri), BYTES:04) i), BYTES:03) S:10 00 (code S:05 00 (code S:05 00 (code TTES:06 00 (co TTES:07 00 (co), BYTES:17 00 (struction te 00) (X (code 04) (X (code 03) 10) 15) 15) 15) 15) 15) 15) 10) 10) 10) 10) 10) 10) 10) 10		Sele 0 2 4 6 8 10 Ir	ct Address	mory	I
NOP (N MOV A MOV E NC A NC B DEC A DEC B ADD A HALT	No Operation), BY $i_{i} := > (A = Integer A = A + 1), BYTE (B = B + 1), BYTE (B = B + 1), BYTE (A = A - 1), BYTE (A = A + A), BY => (B = B - 1), BY A, B => (A = A + B) => Halt Program,$	Select In TES:00 00 (coc ri), BYTES:04) i), BYTES:03 3 S:10 00 (code YTES:06 00 (coc YTES:07 00 (co), BYTES:01 XX) BYTES:17 00 (struction de 00) (X (code 04) (X (code 03) 10) 15) de 06) de 06) de 07) (code 01) code 17)		Sele 0 2 4 6 8 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ct Address	mory	I

Fig. 5.9 The GUI environment

STEP 2 - Inserting the program

The program can be entered step by step, but we will use the **Demo Prog** option for automatic program insertion. When the button **Demo Prog** is pressed, the program table area is populated with the preinstalled demo program (fig. 5.10).

	Address	OpCode	Full Instruction		1	C	ear Prog
	0	4	MOV A, i => (A = Inte	ger i), BYTES:04 XX (o	code 04)	-	3
	1	4	4			СОМ	
	2	10	INC A (A = A + 1), BY	TES:10 00 (code 10)		Selec	tion
	3	0	0				~
	4	3	MOV B, i => (B = Inte	ger i), BYTES:03 XX (d	code 03)		
	5	7	7				
	6	7	DEC B => (B = B - 1),	BYTES:07 00 00 (cod	le 07)		
	7	0	0				Upload
	8	17	HALT =>Halt Program	HALT =>Halt Program, BYTES:17 00 (code 17)			
	9	0	0				Close
	10	0	NOP (No Operation),	BYTES:00 00 (code 00	0)		
	11	0	0				
_		Select In	struction			Address	
OP (N OV A OV E IC A IC B EC A EC B DD A	No Operation), f A, i => (A = Integ (A = A + 1), BY (B = B + 1), BY (A => (A = A + 1), BY (A => (A = A - 1), B => (B = B - 1), A, B => (A = A +	BYTES:00 00 (co ger i), BYTES:04 3 ger i), BYTES:03 3 TES:10 00 (code TES:05 00 (code BYTES:06 00 (co BYTES:07 00 (co B), BYTES:01 X3	de 00) XX (code 04) XX (code 03) 10) 05) 050 060 00) vde 07) X (code 01)		0 2 4 6 8 10		I
IALT	=> Halt Program	m, BYTES:17 00	(code 17)		Ins	ert in Mer	nory
~							
CO	or B	Iack W	nite		Demo Proc		URL

Fig. 5.10 The program is inserted

STEP 3 - Activating HOMS Tool and Upload option

The USB cable is plugged from PC into the memory unit (fig. 5.11) and the option UPLOAD is chosen (fig. 5.12a, 5.12b).



Fig. 5.11 USB connection







fig. 5.12b Memory unit is waiting to receive from PC

STEP 4 - Uploading from PC

Firstly, we select the COM port where the memory unit (Arduino) is connected (1). The next step is to press the **Upload** button (2). The upload process is confirmed through the green bar (3). Figure 5.13 shows the above steps.

	Address	OpCode	Full Instruction		Clear Prog	
i.	0	4	MOV A, i => (A = Integer i), BYTES:	04 XX (code 04)		
	1	4	4		СОМ	
	2	10	INC A (A = A + 1), BYTES:10 00 (co	ode 10)	Selection	
	3	0	0	СОМ9		
	4	3	MOV B, i => (B = Integer i), BYTES:			
	5	7	7	3)		
	6	7	DEC B => (B = B - 1), BYTES:07 00			
	7	0	0		Upload	
	8	17	HALT =>Halt Program, BYTES:17 0			
	9	0	0	Close		
	10	0	NOP (No Operation), BYTES:00 00			
	11	0	0			
		Select Ir	struction	Sele	 ect Address	
NOP MOV MOV NC A NC E DEC	(No Operation), I A, $i \Rightarrow (A = InterB, i \Rightarrow (B = InterA (A = A + 1), BYB (B = B + 1), BYA => (A = A - 1),B => (B = B - 1),$	BYTES:00 00 (co ger i), BYTES:04 ger i), BYTES:03 TES:10 00 (code TES:05 00 (code BYTES:06 00 (co BYTES:07 00 (co	de 00) XX (code 04) XX (code 03) 10) 05) ode 06) ode 06)	0 2 4 6 8 10	I	
DD A, B => (A = A + B), BYTES:01 XX (code 01)						

Fig. 5.13 Upload process

If the program upload is successful, then the corresponding bytes will be appeared on the TFT display of the memory unit (fig. 5.14).



Fig. 5.14 Upload successful

STEP 5 – Program Execution through the Control Unit

Now, the uploaded program can be executed step by step using the on-display instructions at the control unit.

The execution steps inside the HOMS tool are described in the following table.

Table 5.2 shows as an example, how the instruction **MOV A,4** is executed.

		Sution Ste	ps ior in	Struction	WOV A,	4			
Register									
	1	2	3	4	5	6	7		
PC	00								
MAR		00		01		DE			
MBR			04		04	ECO			
A							04		

 Table 5.2

 Execution steps for instruction MOV A,4

As shown in table 5.2, the instruction *MOV A*,*4* is executed as follows:

STEP 1: The PC shows the starting address of the instruction to be executed (MOV A,4)

STEP 2: The starting address of the instruction is stored in MAR register

STEP 3: The first instruction byte is fetched and is stored in MBR register

STEP 4: The MAR address is increased by one, in order to point to the next address where the second byte of the instruction is stored (parameter)

STEP 5: The second instruction byte is fetched and is stored in MBR register

STEP 6: The control unit decodes the instruction bytes and starts to execute the instruction

STEP 7: The content of register A is now 04

The above steps can be now confirmed inside the real HOMS tool environment.

Important note: please visit the web site of the HOMS project for viewing the corresponding videos.

© Panayotis (Panos) Papazoglou HOMS v.1B Page 9

Website

https://homs.panospapazoglou.gr/

