BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE -
PILANI, GOA CAMPUS

A
Report On

Batch Weighing Machine

In partial fulfillment of the course MICROPROCESSOR PROGRAMMING AND INTERFACING

Prepared for:

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Batch 35

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We express our sincere gratitude to Dr. K. R. Anupama, for giving us this opportunity to work on such an amazing project. Such an application has helped us gain knowledge of the principles of microprocessor interfacing and hardware programming, which has been applied at various stages of development of this project.We would also like to thank Mr. Vikas for guiding us at various stages in this project.

We are also indebted to other instructors involved in this course for guiding us during the whole project. The project has given us a great insight into the depths of Microprocessor Programming and Interfacing. It helped us in practically applying the major principles of interfacing viz. memory interfacing, and I/O interfacing.

Finally we extend our thanks to friends for their continuous support and encouragement.

PROBLEM STATEMENT

A microprocessor system is to be designed as a batch weighing machine. The system is interfaced to three load cells by means of an 8 bit A/D converter. The conditioned output of the load cells is given by the equation: Vout = 0.025 x weight (Kgs.) The system monitors the output of the load cells and finds out the total weight by taking the average of the three values that are sensed by each load cell. This value is displayed on a seven-segment display. When this value exceeds 99 kgs, an output port, which is connected to a relay, is switched on to sound an alarm. Design the necessary hardware and software for implementing the above-mentioned task. Once the objects are placed on the load cell user presses a switch labelled weigh.

SYSTEM DESIGN

The Aim of the design assignment is to design a Microprocessor based electronic Batch Weighing system.
We have used 3 load cells used to measure the load. When the switch is pressed the load cells feed amplified analog voltage through an Instrumentational amplifier to Analog to Digital Converter (ADC-0808) whose clock of 1 MHz is provided by 8254 operating in mode 3 .The ADC is then Interfaced to the 8086 Microprocessor using 8255 and the microprocessor is also Interfaced to seven segment displays and a buzzer through another 8255.The seven segment displays the average of the weight and the Buzzer starts whenever the average weight crosses the limit of 99 kg. Memory is also interfaced to the 8086 Microprocessor. The ALP is written and tested on an emulator and simulated on proteus. The switch raises a Non maskable Interrupt to the 8086 processor.

COMPONENTS USED

Sr.no	Components Used	Quantity	Purpose
1	8086 Microprocessor	1	Central Processor
2	8255 Programmable Peripheral Interface	2	PPI for I/O
3	Analog to Digital Converter (0808)	1	ADC 8 channel 8 bit
4	Load Cell	3	Weight sensor
5	Relay	1	Ouptut Interface
6	Buzzer	1	Output status
7	Seven Segment Display	5	Output status
8	6116 (2kb) RAM	2	RAM for the memory
9	2732 (4kb) ROM	4	EPROM
10	74LS138 (3 to 8 Line Decoder)	3	Address Decoder
11	74LS373 (Latch)	3	Latchng the bus
12	74LS245 (Buffer)	2	BI-Directional Buffer
13	74LS244 (Buffer)	1	Buffer(Control signals)
14	Clock Generator (8284)	1	Clock
15	Crystal		Clock
16	8254	1	Clock
17	DPST SWITCH	1	Weigh(input)
18	Instrumentational Amplifier	3	Amplifiers

Assumptions

The user must flip the weigh switch to store the weight on each load cell into memory i.e user flips the weigh switch three times to store the weight at three different memory locations.

The resolution of the ADC 0808 is taken as 0.025 V by using a voltage reference of 6.4 V. So the conversion factor is 0.996.

Device Specifications

Load cell

Model 616 S-Type Load Cells

GRADE	E	F	G*	UNITS
Rated Capacity	100, 150, 200, 300, 500, 750, 1000			kg
Rated Output**	2 ± 0.10%			mV/V
Total Error***	1500	2000	3000	Divisions
Total Error	0.050	0.030	0.020	±% of Load
Creep at Rated Capacity / Zero Return After 30 Minutes	0.050	0.030	0.016	±% of Load
Zero Balance	10			±% of Rated Output
Temperature Range: Operating	-30 to +70			°C
Temperature Range: Compensated	-10 to +45			°C
Temperature Effect: On Output	0.0040	0.0015	0.0012	±% of Load / °C
Temperature Effect: On Zero	0.0080	0.0030	0.0027	±% of Rated Output / °C
Maximum Overload at the Center Loading Point	150			% of Rated Capacity
Ultimate Overload at the Center Loading Point	300			% of Rated Capacity
Excitation: Recommended	10			Volts AC or DC
Excitation: Maximum	15			Volts AC or DC
Input Impedance	385 ± 15			Ohms
Output Impedance	350 ± 3			Ohms
Insulation Resistance	>5000			Mega Ohms
Deflection at Rated Capacity	<0.4			mm
Weight	0.58			kg
Construction	Stainless Steel			
Cable	3 Meter, 6 Conductor, Polyurethane Jacket, Dual Floating Shield			
Environmental Protection	IP 67			
Approvals	OIML R60			

* G Class available on Model 616 > 300 kg only
** All accuracy specifications maintained when 150% of nominal load is applied for 3 mV/V output
*** Nonlinearity, hysteresis, repeatability, and output temperature effect according to OIML R60 and NIST H-44

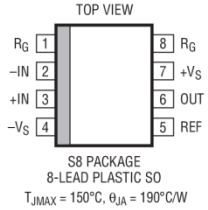
Capacity of the load cells = 300Kg each.

Excitation of load cells = 10 V
Output Voltage of load cells at 300 Kg load = 2 mV/V * 10 V = 20 mV

Note: This needs to be amplified to 6.4 V as input to ADC, thus an amplifier is used.

Amplifier

The Amplifier used is LT1789-1



The input voltage is 20mV and require output voltage is 6.4V. This leads to an amplifaction of 6.4V/20mV = 320.

The variable gain of this amplifier is given by

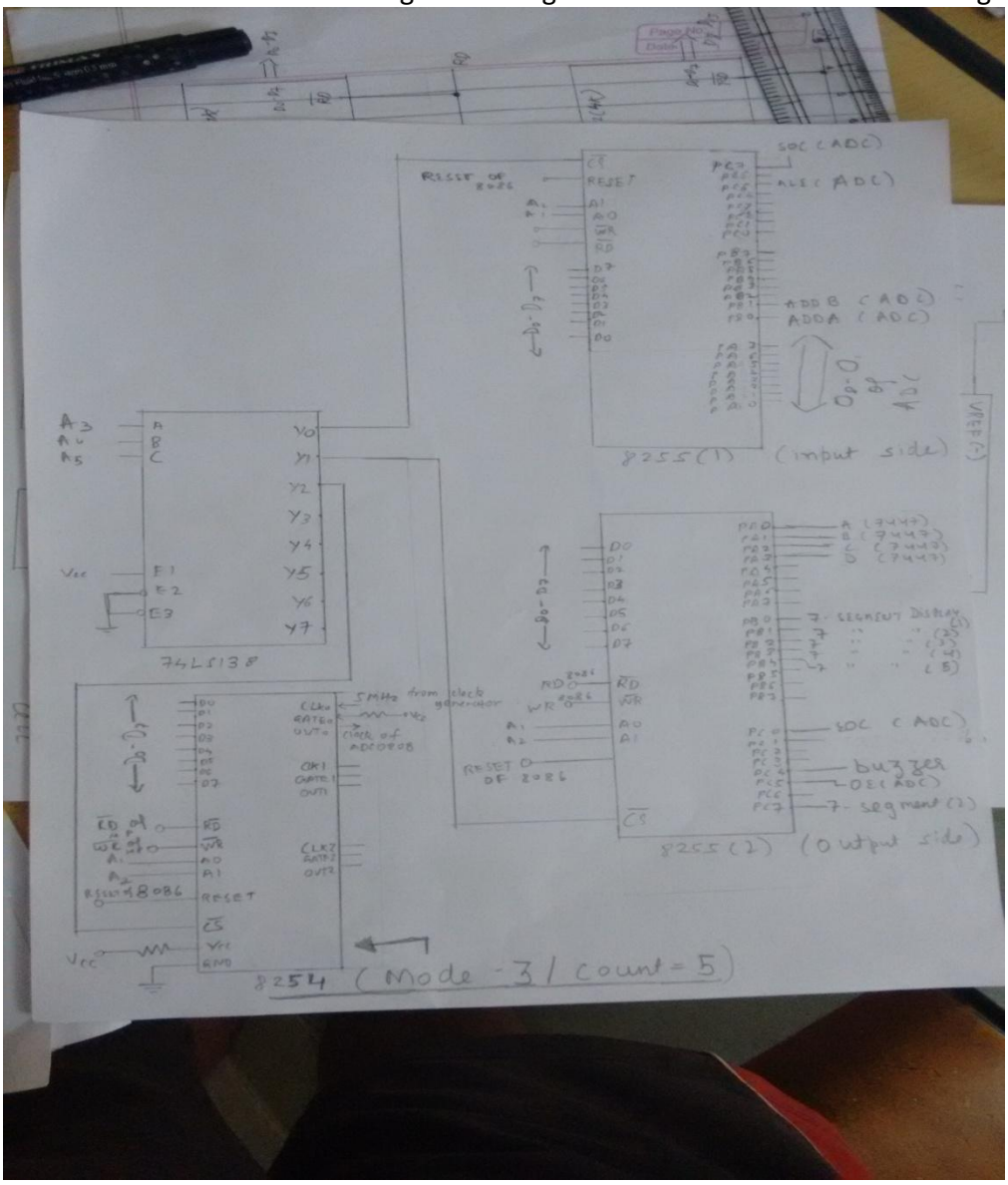
G = 1 + (200k/RG)

Calculating RG = 626.96 ohms

INTERFACING

8255 INTERFACING

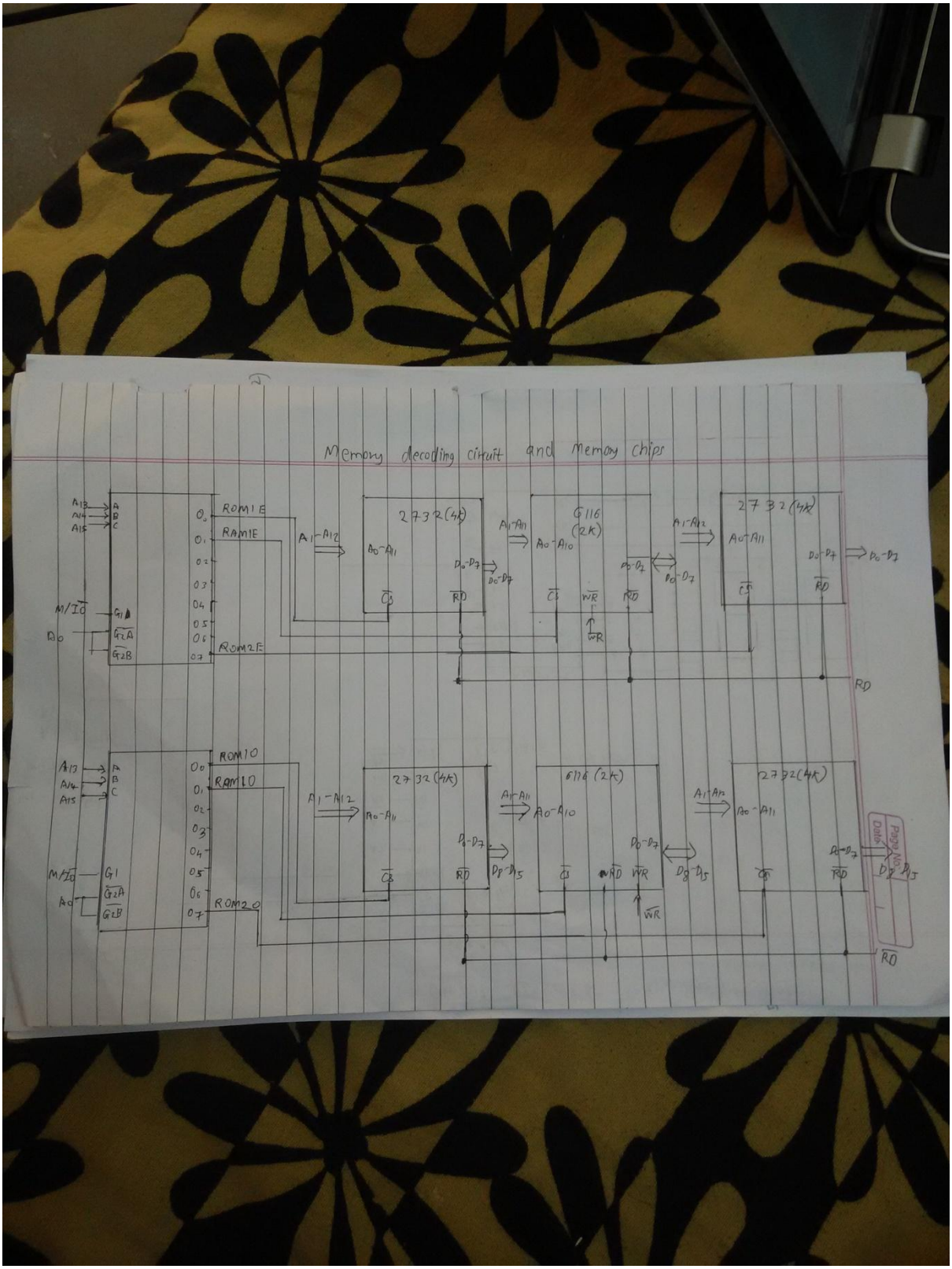
The addresses used are 00-06H ,08H-0EH, 10_H-16_H for 8255(1), 8255(2) and 8254 respectively. The RESET is connected to RESET of 8086. A_1, A_0 are connected to A_2, A_1 of the address bus. Two 8255 and 8254 are selected using a decoding circuit and incremental addressing



MEMORY INTERFACING

ROM1: 00000H - 01FFFH (size-8k)
ROM2: FE000H - FFFFFH (size-8k)
RAM1: 02000H - 02FFFFH (size-4k)
ROM1 (8k) is divided into ROM1 even (4k) and ROM1 odd (4k). Similarly ROM2 (8k) is divided into ROM2 even (4k) and ROM2 odd (4k). RAM1 (4k) is divided into RAM1 even (2k) and RAM1 odd (2k). So a total of four 2732 (4k ROM chips) and two 6116 (2k RAM chips) are

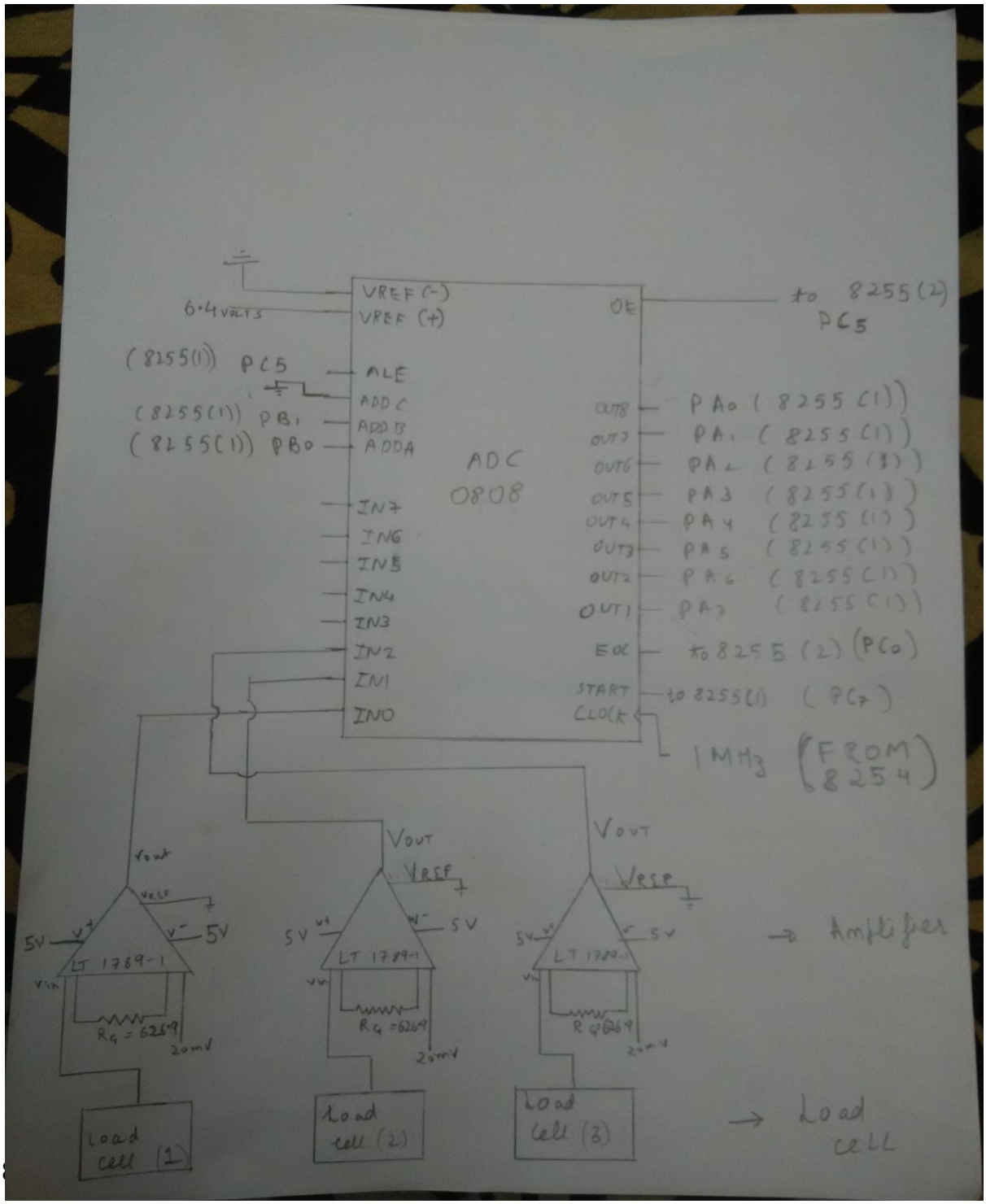
required. The ROM2 is used because when the microprocessor starts, it starts from the address FFFF0H. Even and odd banks are distinguished using two decoders. Incremental addressing is used for sending chip select signals to the chips used.



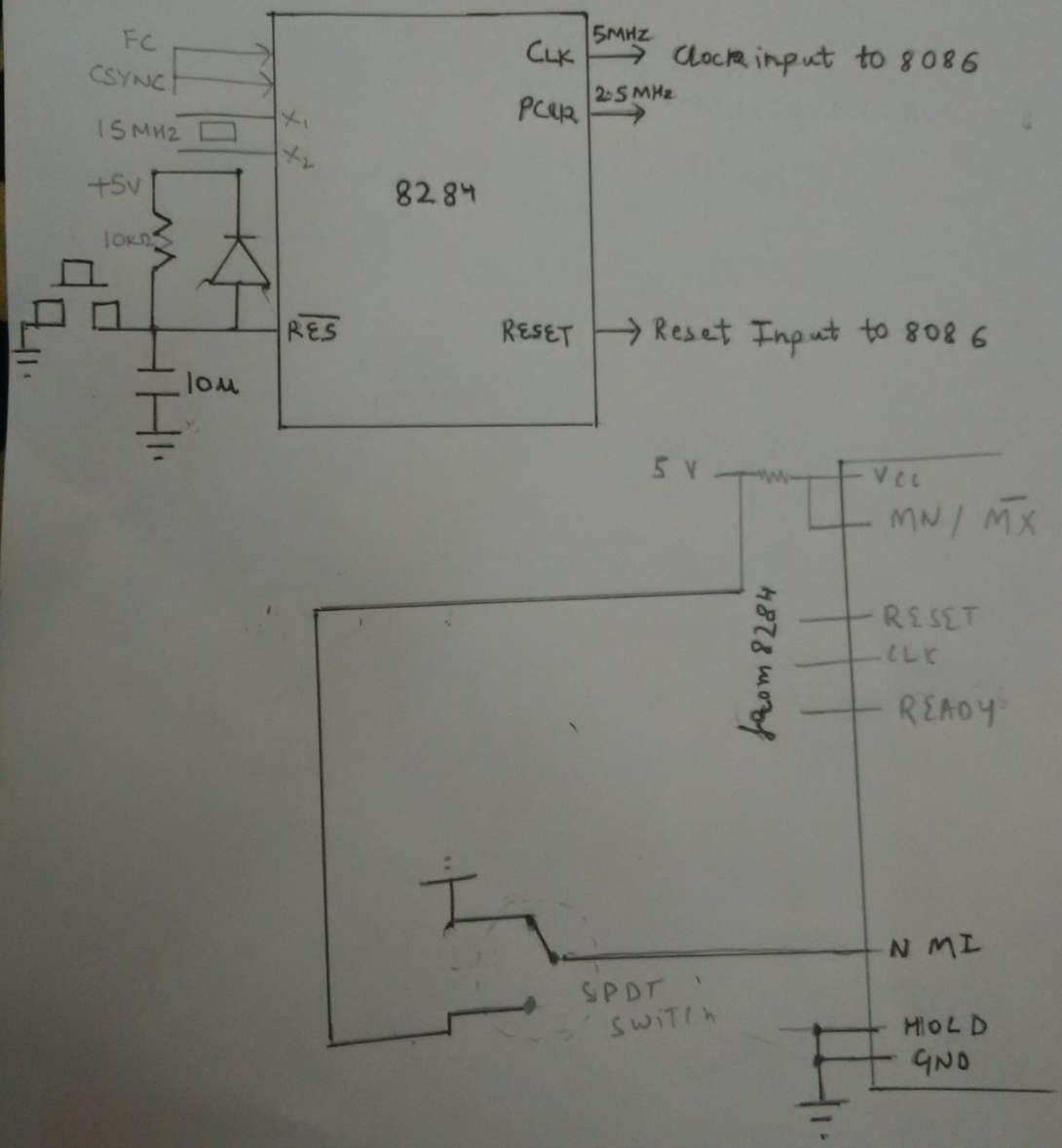
LOAD CELL INTERFACING

Load cells are connected to the system through ADC 0808 and 8255. ADC 0808 is an 8-bit ADC with 8 analog inputs and three address pins to select the analog input. The digital output is then

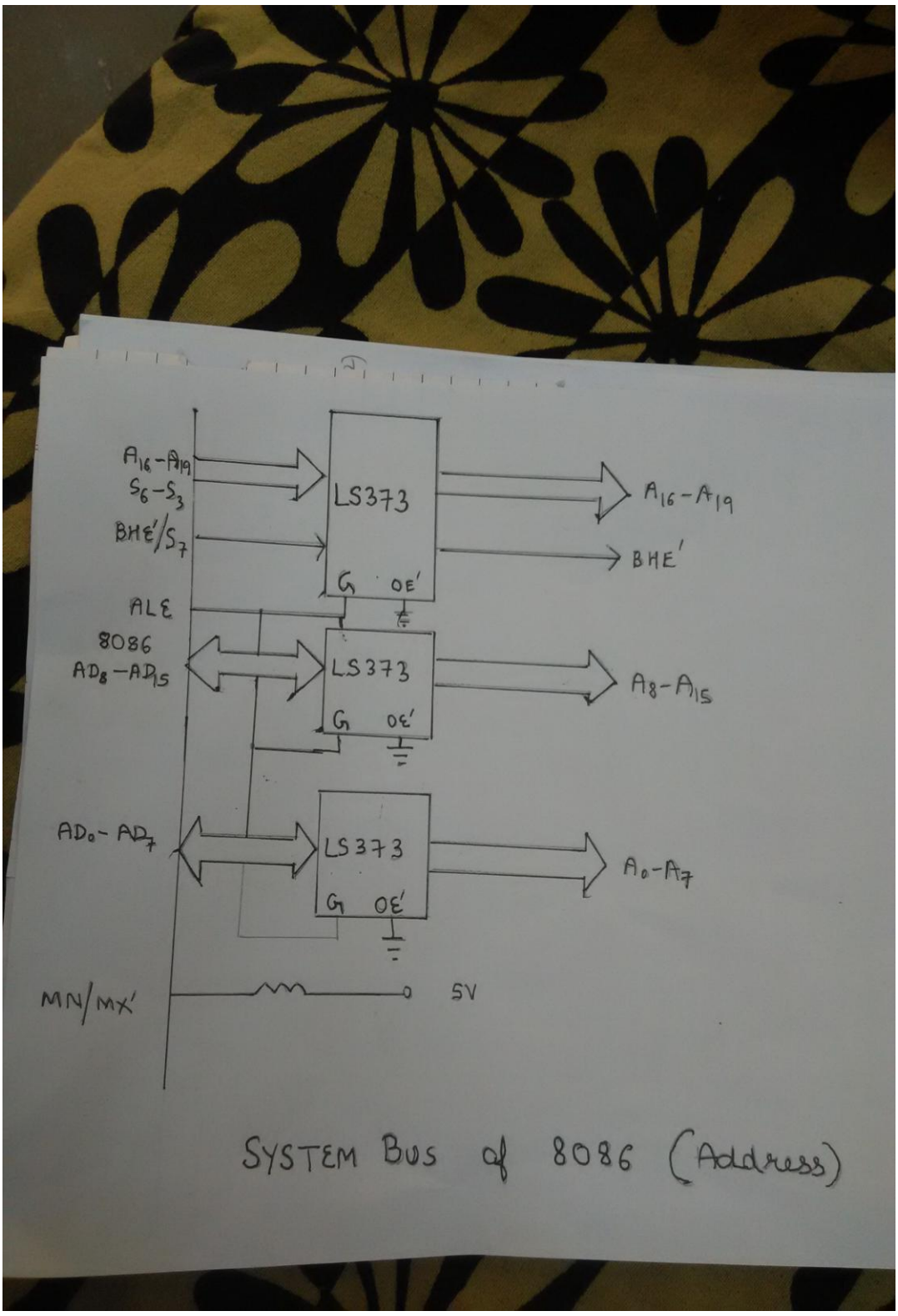
stored into memory by using 8255(1) portA. Three are three load cells and these are directly connected to the analog inputs of the ADC 0808. Resolution of the ADC0808 used is .025 V.

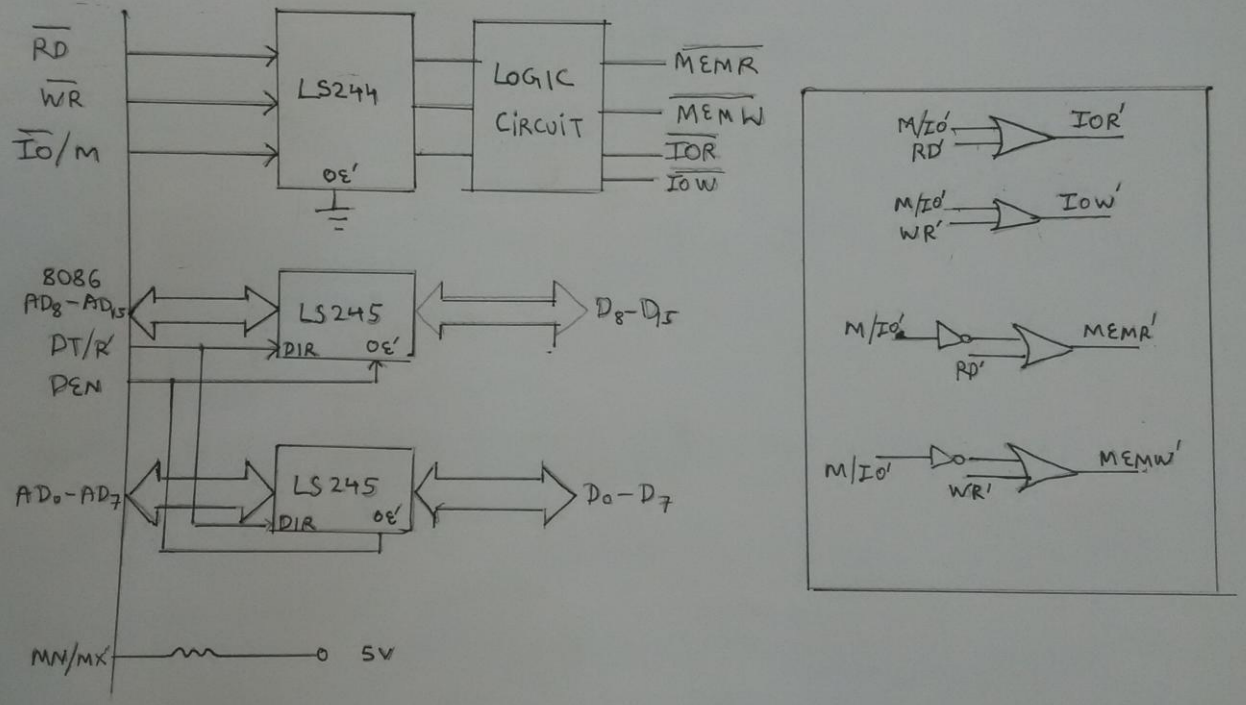


8086 INPUTS


FC
CSYNC
15MHz
X1
X2
+5V
10KΩ
10μ
8284
CLK
5MHz
Clock input to 8086
PCLK
2.5MHz
RES
RESET
Reset Input to 8086
5 V
Vcc
MN / MX
RESET
CLK
READY
from 8284
NMI
SPDT
switch
HOLD
GND

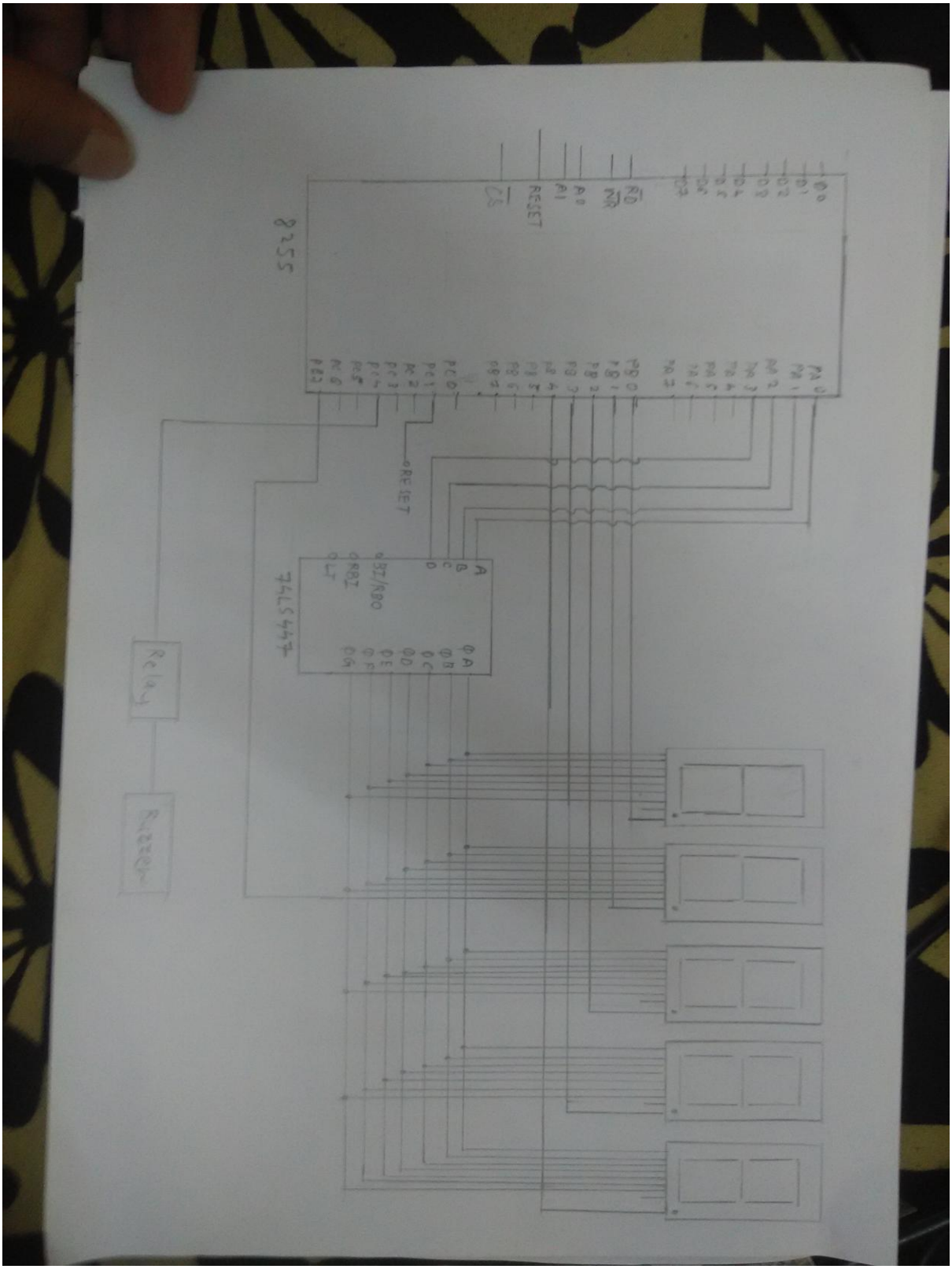
DEMULTIPLEXING CIRCUIT



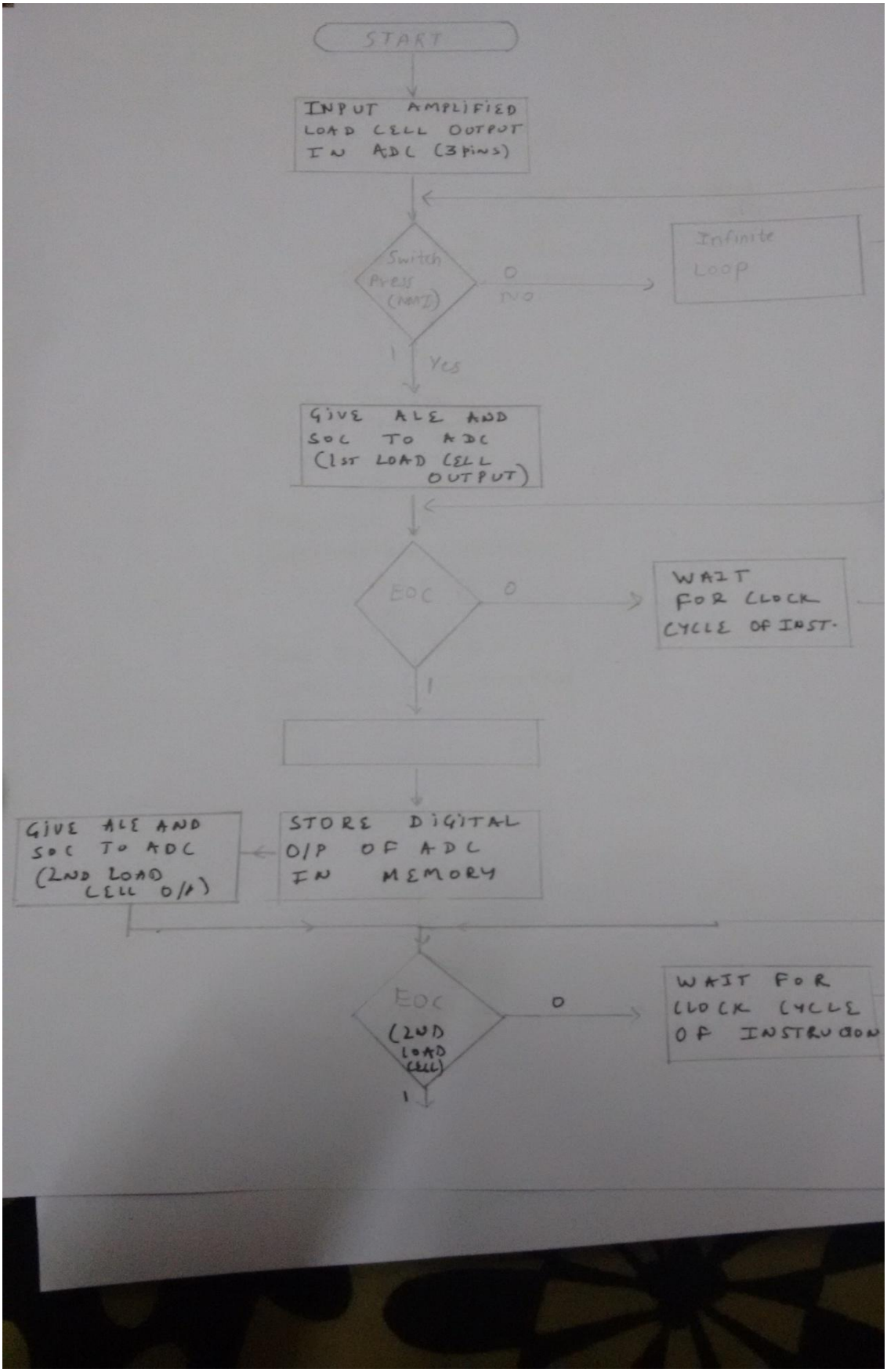


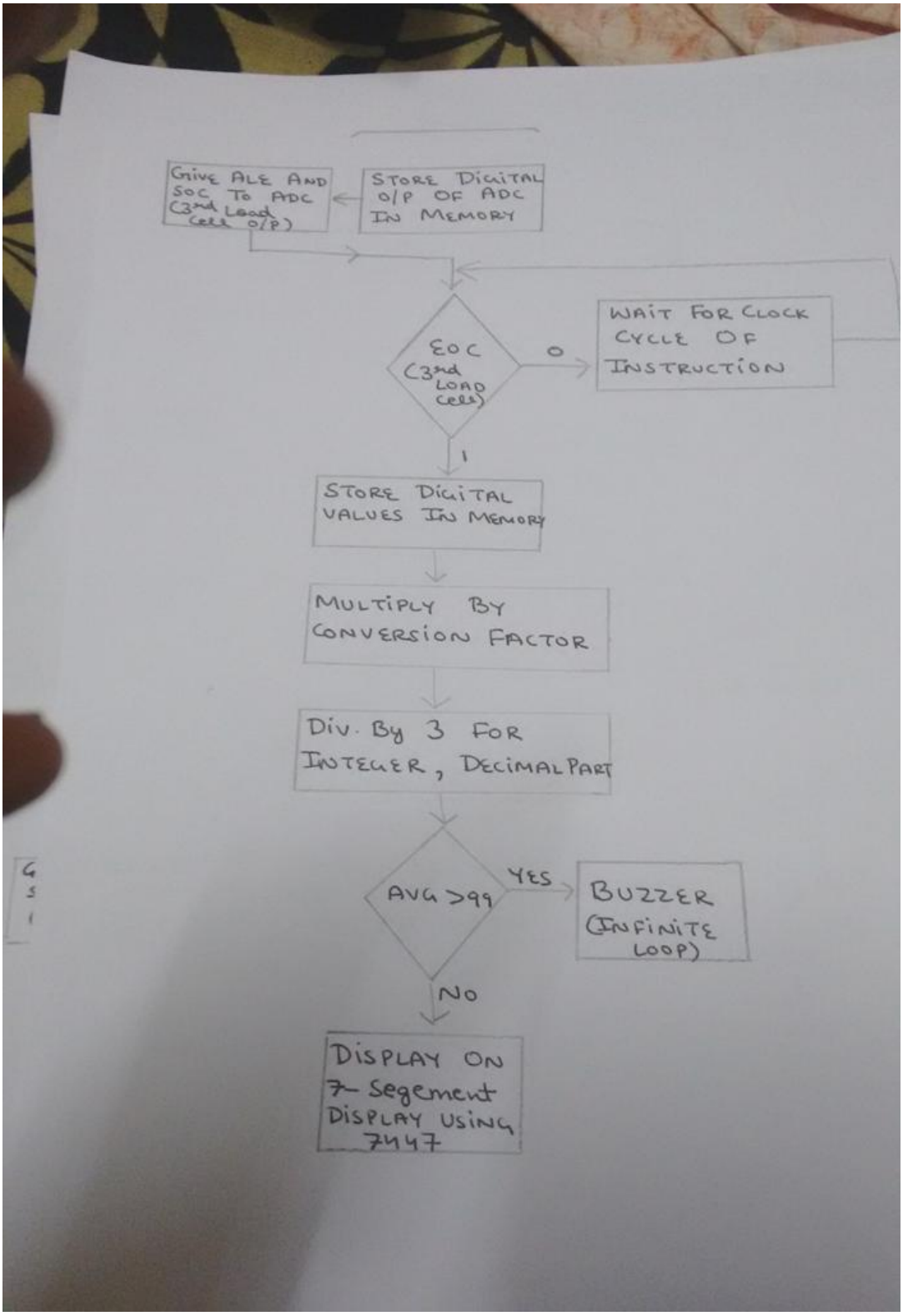
SYSTEM BUS of 8086 (Data + Control)

8255s and seven segment display



Flow Chart


START
INPUT AMPLIFIED LOAD CELL OUTPUT IN ADC (3 pins)
Switch Press (NAI)
0
NO
Infinite Loop
1
Yes
GIVE ALE AND SOC TO ADC (1ST LOAD CELL OUTPUT)
EOC
0
WAIT FOR CLOCK CYCLE OF INST.
1
STORE DIGITAL O/P OF ADC IN MEMORY
GIVE ALE AND SOC TO ADC (2ND LOAD CELL O/P)
EOC (2ND LOAD CELL)
0
WAIT FOR CLOCK CYCLE OF INSTRUCTION
1


GIVE ALE AND SOC TO ADC (3rd Load Cell O/P)
STORE DIGITAL O/P OF ADC IN MEMORY
EOC (3rd LOAD Cell)
0
WAIT FOR CLOCK CYCLE OF INSTRUCTION
1
STORE DIGITAL VALUES IN MEMORY
MULTIPLY BY CONVERSION FACTOR
Div. By 3 FOR INTEGER, DECIMAL PART
AVG >99
YES
BUZZER (INFINITE LOOP)
NO
DISPLAY ON 7- Segement DISPLAY USING 7447

APPENDIX

The appendix contains the list of all datasheets of all the chips used.

8086
http://www.datasheet-pdf.com/datasheetdownload.php?id=544568

8255
http://www.alldatasheet.com/datasheet-pdf/pdf/66100/INTEL/8255A.html

8259

http://www.alldatasheet.com/datasheet-pdf/pdf/66107/INTEL/8259A.html

8253
http://www.alldatasheet.com/datasheet-pdf/pdf/66098/INTEL/8253.html

ADC0808
http://html.alldatasheet.com/html-pdf/8097/NSC/ADC0808/38/1/ADC0808.html

Load Cell
http://uk.rs-online.com/web/p/load-cells/4140865/

Buzzer

https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&ved=0ahUKEwigosD_tqPMAhUUBY4KHZEaBIgQFggwMAY&url=http%3A%2F%2Fwww.euroworker.no%2Findex.php%3Fdispatch%3Dattachments.getfile%26attachment_id%3D1203&usg=AFQjCNHJj_CiNIwWSOEPqkUU4jR8nlX7Mw&sig2=qp8JNDXA5BjcNvubtabSUg&bvm=bv.119745492,d.c2E&cad=rja

LS138
http://www.alldatasheet.com/datasheet-pdf/pdf/46206/SLS/LS138.html

74373
http://www.alldatasheet.com/datasheet-pdf/pdf/192081/TI/LS373.html

74245
http://www.alldatasheet.com/datasheet-pdf/pdf/44472/SIEMENS/BF245.html

Amplifier

http://cds.linear.com/docs/en/datasheet/1789fc.pdf