



BATCH WEIGHING MACHINE

Submitted by Group 4

Group Members

Hrithik Jayasankar(2020AAPS1018G)

Ishita Kumari(2020AAPS1045G)

Ansh Lalchandani(2020A7PS0088G)

Shubhi Bhandari(2020AAPS1422G)

Monit Agarwal(2020A7PS0120G)

Amod Nijasure(2020A7PS1005G)

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User Requirements & Technical Specifications

Design a batch weighing machine that measures the weight of an object on 3 different load cells and displays the average weight in kg. If the average weight crosses 99kg a buzzer is switched on which can be turned off by a switch. The whole process of reading weights is started of when a read weight switch is pressed.

Our design has only a 2 decimal accuracy in display of weight and a weight constraint of 500 kg. Also, the process starts only when a switch is pressed till when the microprocessor is waiting for the interrupt given by the switch (polling state).

Assumptions & Justifications

Justification

- As we are using this to measure everyday objects the maximum weight our load cell can measure is 500kg.

Assumptions

- It is assumed that the weights will be lesser than 500 kg
- It is assumed that after the display is shown/buzzer is stopped the machine is reset again by the user (by switching off the whole device).
- It is assumed that there is no time delay in switching the object between load cells.

Components used:

- **8086** - Used as the central processor for the design. This can be seen as the master of the whole design through which all other components are linked.
- **8284** – This clock generator IC is used to provide clock frequency, ready and reset signal to the 8086/8088 microprocessor.
- **ADC 0808** – This is an 8-bit analog to digital converter. The load cells are directly connected using an amplifier, and output is taken. It has eight analog inputs with voltage varying from 0-5 V.
- **Common anode seven segment display** – four of these are used to display the average weight (two integers, two decimal).
- **7447** – This is a BCD to common anode seven segment converter. It is used as all values will only be numeric values.
- **8255** – This is a programmable peripheral interface used to interface I/O devices to the microprocessor. We use 2 of these in this design. 8255(A) is connected to the four displays and a buzzer, while 8255(B) is used for the ADC.
- **8254** – This is a programmable counter/timer chip designed for use as an intel microcomputer peripheral. In this design, we use it to provide the ADC clock.
- **8259** – This is a programmable interrupt controller. We use it for the interrupts provided by the READ weight switch and STOP buzzer switch.
- **2716** – 4 of these ROM chips are used. The smallest ROM chip available is 2k, and we need to have an even and odd bank. Moreover, ROM is required at the reset address which is at FFFF0H and 00000H – where IVT is present.
- **6116** – 2 of these RAM chips are used. The smallest RAM chip available is 2k, and we need to have an even and odd bank. We need RAM for stack and temporary storage of data.
- **LS138** – 2 of these decoders used for memory and I/O interfacing.
- **7 segment anode display**
- **74LS245** – To latch address lines
- **74LS373** – buffer for data lines
- **OR gates wherever required**
- **Load cells, relay, buzzer and push button switches**

Load Cell

Load cell performs the job of measuring the force and outputs the force in form of electrical signal. A load cell consists of four strain gauges in a Wheatstone configuration. The output of the load cell is connected to the input of the ADC.

Load cell used: **RS PRO Stainless Stall Steel S Beam Tension Load Cell Model 616.**

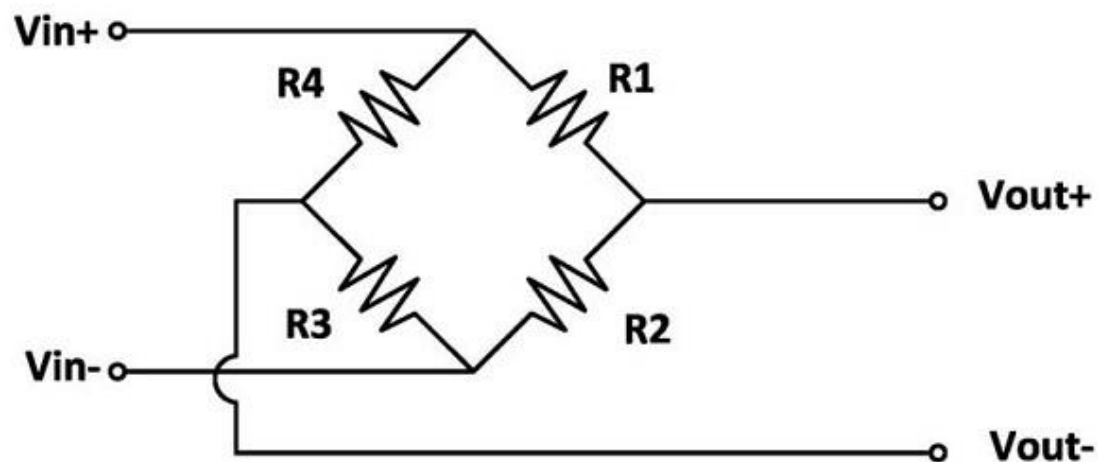
Capacity of the load cell used: **500kg**

Excitation of Load Cell: **10 V**

Rated output of the load cell at this capacity: **2m V/v**

Output Voltage of Cells = (Rated Output) * (Excitation value)

Output Voltage of cells = $2\text{m(V/V)} \times 10 = 20\text{ mV}$



Relay

A relay is **an electrically operated switch**. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals.

We have used Solid State Relay(SSR) to interface with the buzzer. A Solid State Relay (SSR) is **a relay that does not have a moving contact**. In terms of operation, SSRs are not very different from mechanical relays that have moving contacts.

Buzzer

Buzzer is used to detect if the average weight goes above 99kg.

Note: All component data sheets and circuits have been attached in the end.

Address Map

a) Memory map

ROM 1: 00000_h – 00FFF_h [4k]

A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1

ROM 2: 01000_h – 01FFF_h [4k]

A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1

RAM 1: FF000_h – FFFFF_h [4k]

A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Each RAM & ROM chip is 2k. It is split in the above way for even & odd banking.

b) I/O Mapping

i) 8255(1): 80_h – 86_h

Port	Port address	Mode	Input/Output	Connected to
A(PAO-PA2)	80h	0	Output	Add A,B,C
B	82h	0	Input	OUT 1-8
C: PC0 PC1 PC2	84h			EOC ALE START/SOC
Control register	86h			

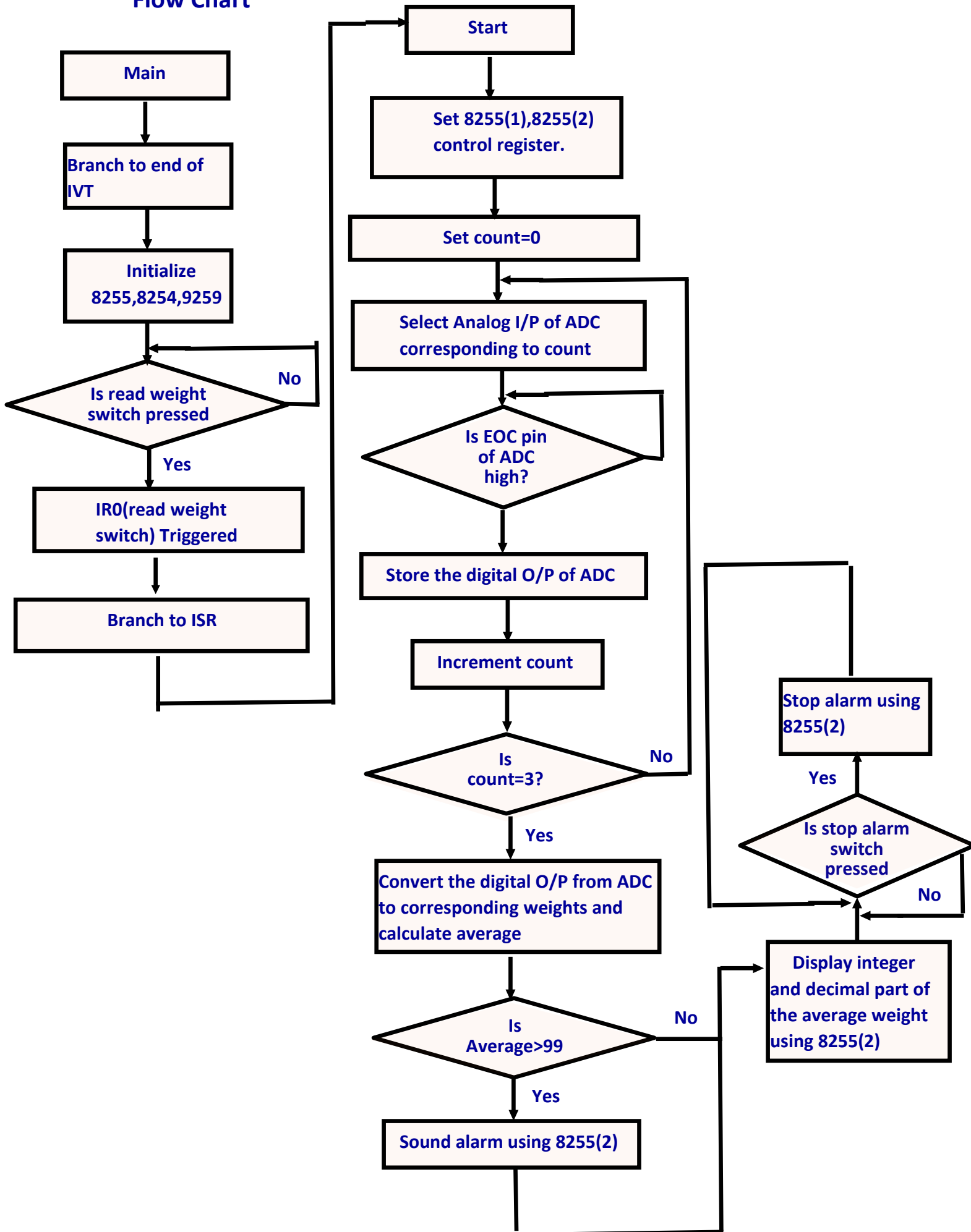
ii) 8255(2): 90_h – 96_h

Port	Port address	Mode	Input/Output	Connected to
A	90h	0	Output	2*(BCD to 7 seg decoder)
B	92h	0	Output	2*(BCD to 7 seg decoder)
C- PC5	94h		Output	Buzzer
Control register	96h			

iii) 8259: A0_h – A2_h(provides 3 interrupts)

iv) 8254: B0_h – B6_h

Flow Chart



Appendix

Contains list of all data sheets of all components.

Load cell

<https://docs.rs-online.com/0252/A700000007176385.pdf>

Relay

<https://docs.rs-online.com/8ec1/0900766b80db86c6.pdf>

Buzzer

<https://www.e-radionica.com/productdata/1956696.pdf>

8255

<https://www.datasheet-pdf.info/attach/1/5514326703.pdf>

8254

<https://www.scs.stanford.edu/10wi-cs140/pintos/specs/8254.pdf>

ADC 0808

<http://www.da.isy.liu.se/vanheden/pdf/adc0808.pdf>

8284

<https://www.datasheets360.com/pdf/-5916563377562544203>