Development of Digital Weighing Scale for Finding Adulteration & Cost Standardization

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Abstract— In today's scenario there are lot of advancement in digital weighing scale but there is no weighing scale that find the percentage of adulteration in food sample .Adulteration is big issue as fas as food samples are concern. Due to eating of adulterant food causing many diseges to human body .Childs are infected by this adulterant food very soon , So all this difficulties are solved with the help of new digital weighing scale . This scale is used to find not only weight of food sample but also it gives the percentage of adulterant in food sample with the help of machine vision camera.This scale is a complete solution for coustomer side.

Index Terms—Adulteration , Avrage deviation ,Image Sensor, Load Cell, Machine Visoion Camera , MPLAB software, PIC Microcontroller , ,.

1. INTRODUCTION

In the development process of weighing scale system, worldwide research is seem to be more focused on precision & accuracy. Besides this, research vision is towards pure delivery with proper cost. So, in accord with all of this the whole theme of the research is decided & designed. Starting with the benefits to Rural & Remote consumers, purity & standard cost matters for all consumers throughout the nation. With the further expansion in research work this system can be applied throughout world also. As number of weighing scale instruments are available with digital accuracies, no Weighing scale Machine is able to measure adulteration and deliver the pure form of consumer good within the same system at the retailing level. So there always a question marks for the consumer about the purity of good to be purchased. At local level generally on village side we always see the adulteries food sell in shop with same price as pure food. Due to all of this, testing of machines and testing of material needs to be done very frequently. But all these things cannot assure the delivery time issues. So to overcome all these issues, a perfect solution is to be needed to handle all these runtime and real time aspects, this system gives the hand of reliability and perfect solution for the consumer. So with all these extra ordinary features, this Embedded System based Digital weighing scale will prove to be great miracle for consumer.

2. MEAERMENT OF FOOD ITEM

Measuring weight is a vital and essential part of many industrial and commercial purposes. It is very difficult to measure weight with proper accuracy because of errors, so that it causes many losses like customers revenue.For accurate and errorless weight measurements are to use load cell. A load cell is a transducer that is used to convert a force into electrical signal. The sensor used in weighing scale which gives out digital output is load cell. This conversion is indirect and happens in two stages. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge measures the deformation (strain) as an electrical signal, because the strain changes the effective electrical resistance of the wire. A load cell usually consists of four strain gauges in a Wheatstone bridge Configuration. Load cells of one strain gauge (Quarter Bridge) or two strain gauges (half bridge) are also available. The load cell provides an output voltage depending on the load placed on it. This cell is one of the most important applications of a strain gauge (SG) in an industrial environment.

3. ADULTERATION

An **adulterant** is a substance found within other substances for e.g., food, beverages, fuels, although not allowed for legal or other reasons. The addition of adulterants is called *adulteration*. An adulterant is distinct from, for example, permitted food additives. The term "contamination" is usually used for the inclusion of unwanted substances due to accident or negligence rather than intent [11]. .Adulteration is one of the major physical contaminations. Adulteration is the mixing of inferior quality material or superior substance to the superior product, which reduces the nature, quality and originality in taste, color, odor and nutritional value causing ill effects to the health of the consumers. The word is appropriate only when the additions are unwanted by the recipient. Otherwise the expression would be food additive. Adulterants when used in illicit drugs are called cutting agents, while deliberate addition of toxic adulterants to food or other products for human consumption is known as poisoning.

Mixing of some adulterant in food sample like rice or wheat grains, then the food sample is contaminated. This is

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more hazardous for human being. The entire problem related to stomach cause by eating such type of adulteration food grains. So at the time of purchasing the food items from shop then there should be system that should indicate that this food item contains adulterant. It also gives percentage of adulterant in pure food item. So I try to make such system to solve all the above problems.

4. MACHINE VISION CAMEARA

In our work we are using the machine vision camera with ZM 0.3 Mpixel serial JPEG still camera. This camera uses the technology which is highly integrated, so as to meet a lot of embedded system's acquisition imaging that is JPEG compressed format and it's more convenient data transmission in the low-speed channel condition.

4.1 Image Sensor

Adopting the advanced version of Omni Vision CMOS VGA colour sensor on-board making overall unit a low powered consumption, and good quality of image via RS232, RS458,

TTL, etc. serial interface attached external host system's

UART port etc. In our work I use this camera to capture images of food sample & compare it with reference sample to correlate the grade of adulteration. The ZM 0.3 Mpixel serial JPEG still camera module compact size, low power consumption, more stable operation. 5.0V DC Supply. UART: Up to 115200bps for transferring JPEG images. The advanced Omni Vision OV7725 VGA colour sensor JPEG CODEC for different resolutions. With down sampling, clamping and windowing circuits for VGA, QVGA, and without external DRAM required. The flowchart in Fig 1 of explains the working of Machine vision camera in brief. Percentage of adulteration can be finding in this research work with the help of this camera [3]

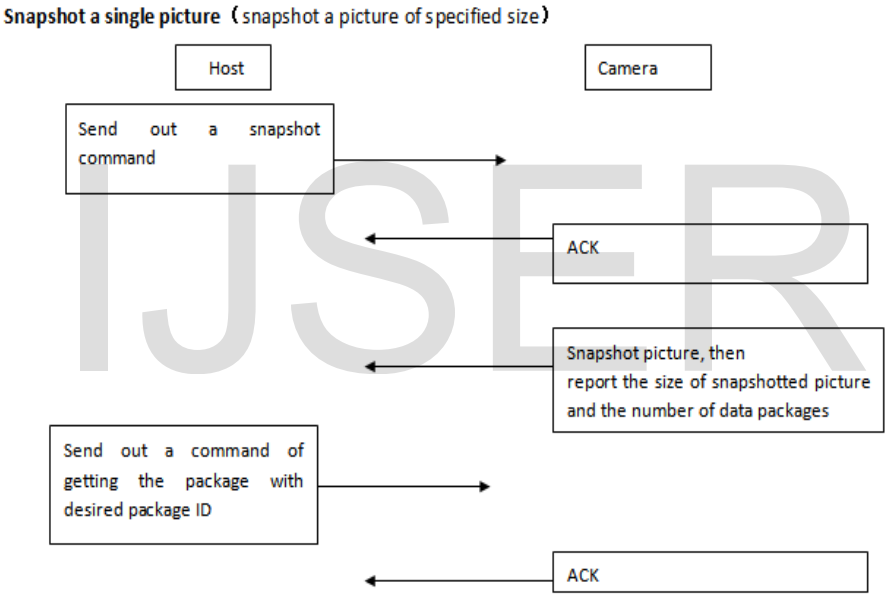


Fig.1 Flowchart for Machine Vision Camera for Image capturing

5. PROTOTYPE DEVELOPMENT

In this research work I used two microcontroller .One of these is PIC18F252 and other is PIC 18F452.The PIC 18F252 is the 28 pin IC, having 10 bit inbuilt A/D converter with five input channels. Operating frequency is DC-40MHz, 32k bytes program memory and data memory is of 1536bytes. In this Port A is used for the KEY inputs, port B is used as output port for the LCD Display and on Port C there are 3 pins used for push-button and other 2 pins are used for the LED indication and 20MHz crystal has been used in the oscillator. UART is the major protocol used for communicating different serial modules including machine vision camera.

PIC18F452 is the 40 pin IC, having 10 bit inbuilt A/D converter with five input channels. Operating frequency is DC-40MHz, 32k bytes program memory and data memory is of 1536bytes. In this PortA, PortC, PortE is used for the KEY inputs, port B is used as output port for the Mux connection and on PortD there are 8 pins used for data pins for 7Segment and 20MHz crystal as been used in the oscillator. UART protocol here used for communicating wireless serial modules.

The actual prototype of system looks like as shown in fallowing fig.2 and fig.3 In this prototype system, I weigh the three

samples and find out their percentage of adulteration. Therefore as shown in fig.2 there is arrangement of three display unit of seven segments, but in this research paper I give only one observation table of one food Item A only.

Fig. 2 : Prototype of Display System

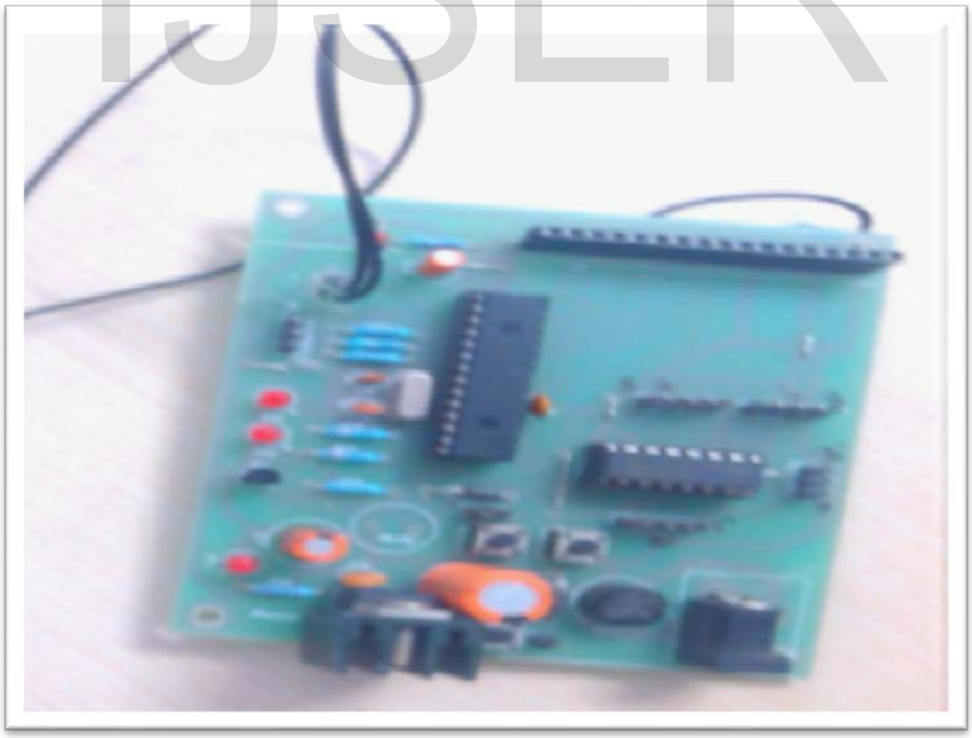


Fig.3.System Controller & Monitoring Unit

5.1 Software Implementation

For the programming of PIC microcontroller, I used MPLAB IDE. The latest information on Microchip MPLAB IDE v7.21, the Windows(R) Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.

The Flash-based, power-managed, LCD PIC microcontroller family meets low power design requirements including driving the LCD display in Sleep mode while maintaining desired functional features. With the ability to select from an array of available LCD PIC microcontrollers, a designer can provide additional value by creating scalable designs and products. This gives the designer flexibility to offer different solutions based on the demand of varying market segments all from a single design.

The actual prototype of Weighing Scale system works as fallows, first of all system read the cost and quantity of Item A/B/C set by government authority. Then weigh the weight of Item A/B/C. A Machine vision camera take snapshot and color index of an item. The price read for Item A/B/C/ from PIC microcontroller. After this doing some mathematical calculations, calculate the actual price of the food Item A/B/C without adulteration. This price will save and display. With the help of flowchart can understand the actual working of system software as shown in Fig.4.

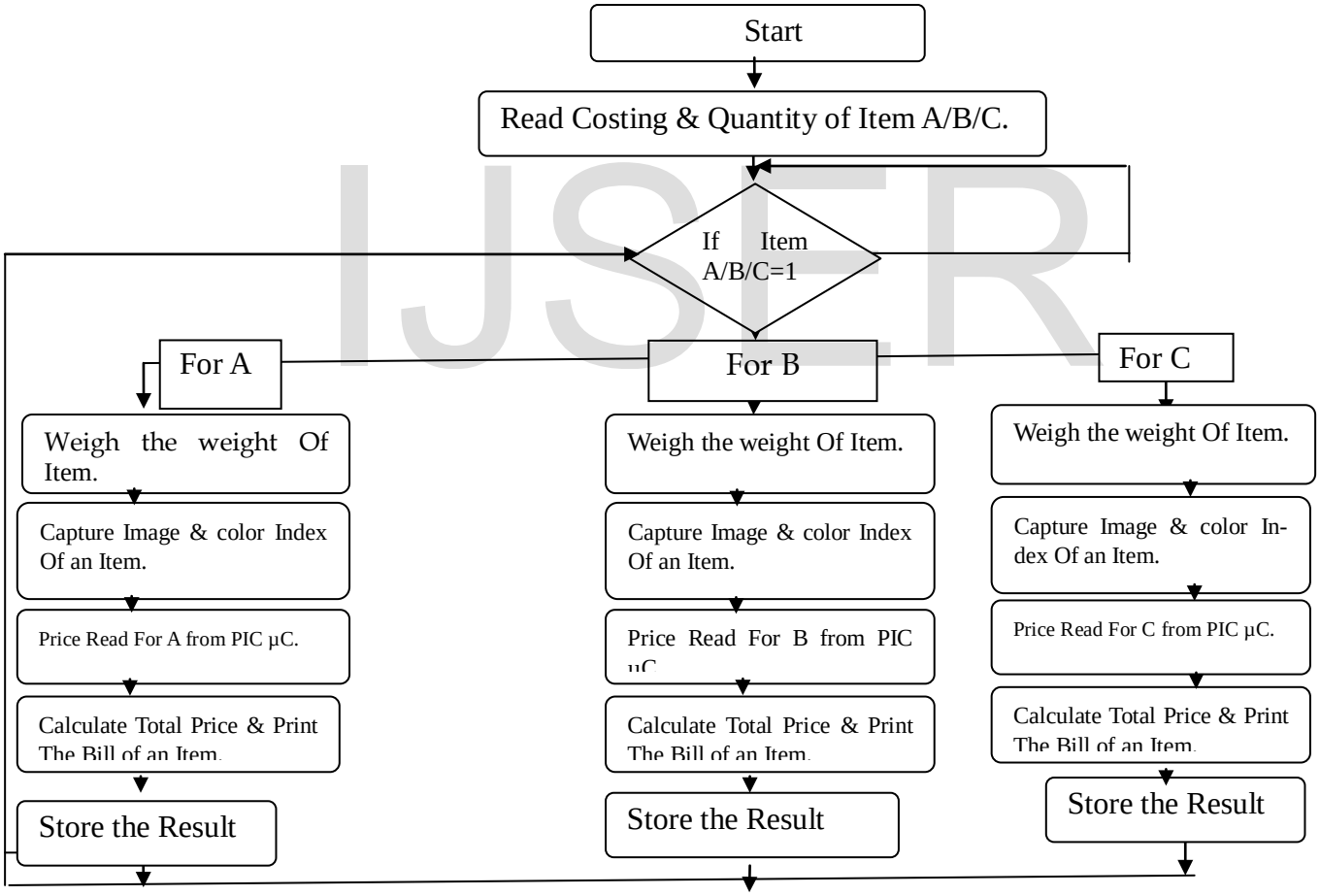


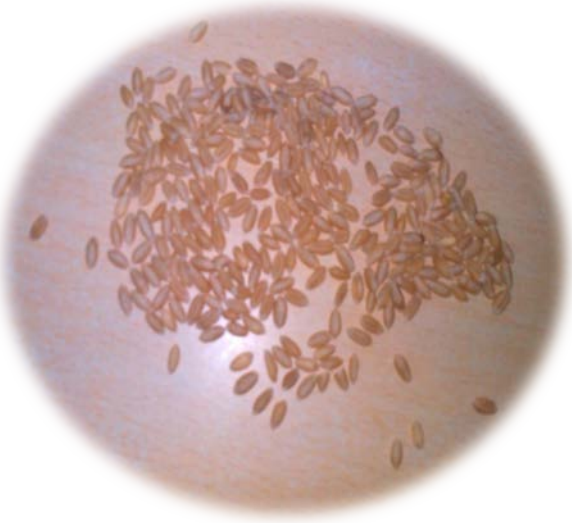
Fig.4 Flowchart of System Workflow.

6 OBSERVATION

Machine Vision Camera taking snapshot of particular food item of sample 1 and sample 2. as shown in Fig.5 (a ,b)Then Camera give size of snapshot picture and no. of data packages The Variation in data packages depend upon the quality of food samples .the fallowing observation Table 1 gives 80 readings for each item.In this research paper I only give observation table of Item A as mentioned earlier.

Therefore according to variations of data packages, Percentage of Deviation can be find with the help equation (1)

(a)



(b)

Fig 5.(a) Sample1 of Item A (b) Sample2 of Item A

$$\% \text{ Deviations} = \frac{Sample1 - Sample2}{Sample2} \times 100 \qquad \text{eq. (1)}$$

Table 1

Observation from Machine Vision Camera

Camera Sampling For Item A				
Sr. No	Sample1 (No of Data Package)	Sample2 (No of Data Package)	Difference	%Deviation
1	112	110	2	1.4
2	118	113	5	4.6
3	45	44	1	3
4	89	92	-3	-3.8
5	74	73	1	1.4
6	93	99	-6	-6.3
7	78	74	4	4.6
8	44	43	1	3
9	10	10	0	0
10	98	102	-4	-3.8
11	65	62	3	4.6
12	55	58	-3	-6.3
13	83	82	1	1.4
14	165	160	5	3
15	53	52	1	1.4
16	55	57	-2	-3.8
17	89	85	4	4.6
18	77	76	1	1.4
19	136	132	4	3
20	84	80	4	4.6
21	42	45	-3	-6.3
22	156	151	5	3.2
23	221	211	10	4.6

24	116	111	5	4.6
25	85	90	-5	-6.3
26	55	52	3	6.2
27	67	64	3	4.6
28	96	93	3	3
29	52	55	-3	-6.3
30	142	140	2	1.4
31	230	219	11	4.6
32	48	50	-2	-3.8
33	75	80	-5	-6.3
34	69	66	3	4.6
35	55	52	3	6.2
36	44	43	1	3
37	117	110	7	6.2
38	55	54	1	1.4
39	36	34	2	6.2
40	79	77	2	3
41	65	61	4	6.2
42	212	209	3	1.4
43	55	52	3	6.2
44	55	57	-2	-3.8
45	46	45	1	1.4
46	69	65	4	6.2
47	79	75	4	4.6
48	80	75	5	6.2
49	40	38	2	4.6
50	79	74	5	6.2
51	99	96	3	3
52	63	59	4	6.2
53	33	33	0	0
54	90	93	-3	-3.8
55	59	55	4	6.2
56	222	212	10	4.6
57	189	177	12	6.2
58	155	150	5	3
59	199	196	3	1.4
60	221	207	14	6.2
61	111	106	5	4.6
62	156	166	-10	-6.3
63	178	170	8	4.6
64	166	164	2	1.4
65	185	182	3	1.4
66	111	104	7	6.2
67	163	158	5	3
68	145	143	2	1.4
69	179	176	3	1.4
70	152	158	-6	-3.8
71	163	153	10	6.2
72	144	142	2	1.4
73	156	162	-6	-3.8
74	174	166	8	4.6
75	168	166	2	1.4
76	239	254	-15	-6.3
77	213	203	10	4.6
78	46	45	1	1.4
79	132	128	4	3.0
80	185	179	6	3.2
Average Percentage Deviation				1.92

From the observation table 1 ,the fallowing two graphs are drawn. From fig.6 plot the data packages of sample 1 & 2 against different readings, or simply comparison. Fig.7 gives average deviation for item A.

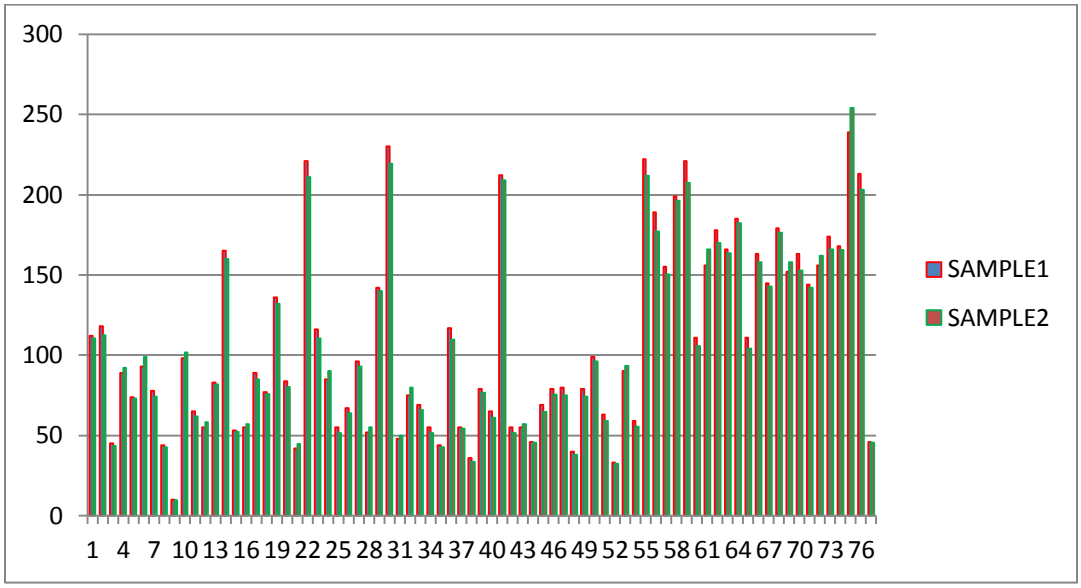


Fig.6 Comparisons data packages readings for Sample 1 & 2

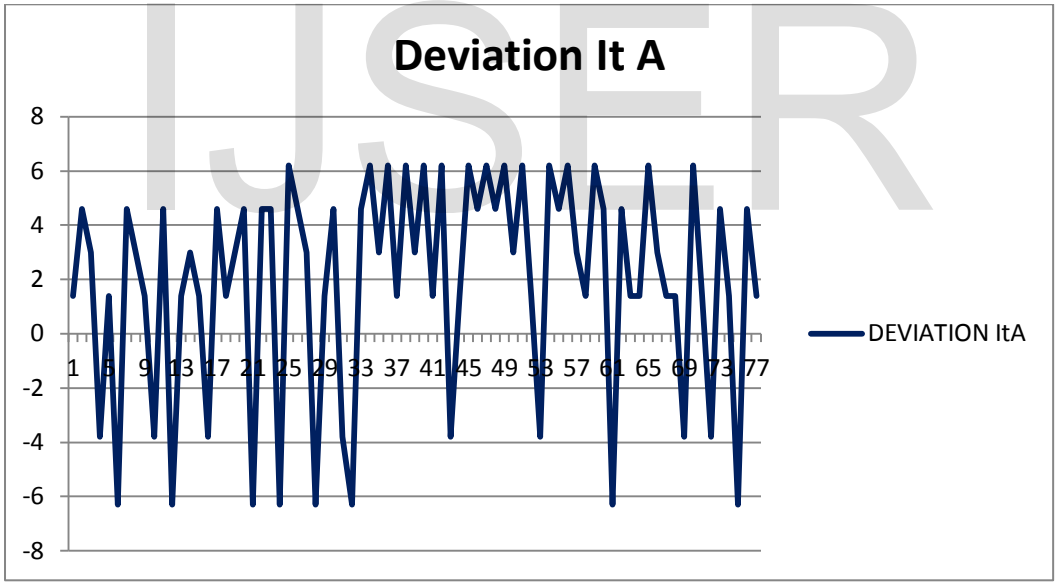


Fig.7Average Deviation Item A

7. RESULT

7.1 Weigh

A weighing system was configured and built to allow testing and experimentation on acquiring the weight of items placed on the carriers pan. This system has been basically crated for predicting the weight and give error less result. The real world testing involves load cell carrier pan is interfaced with the amplifier digitizer ,and serial output data came from amplifier /digitizer send to the PC via RS232 port connector. The readings came from load cell appered on PC compared with the slandered reading ,are most probably the same .some calibrations is required to improve the performance of the weighing system ,improve the accuracy and reliability. Analysis using the averaging values shows that an increase of error 0.1%. But if the error increased by 0.1% then that because of disturbances in the system. So to avoid the disturbances in the system, load cell carrier pan system should be placed far long from the main system. Fallwoing Table 2 shows result are at the time of tesing the load cell with digital weigh scale

Table 2

Testing With Load Cell For Digital Weigh Scale System

Sr. No.	Calibration Point(gm)	Value On Standard(gm)	Value On UCC(Kg)
1	100	100.0201	0.1
2	200	199.9358	0.2
3	400	399.8525	0.3
4	500	499.923	0.5
5	1000	1000.3	1
6	2000	1999.8	2
7	3000	3000.1	3
8	5000	4999.93	5
9	10000	9994.999	10
10	15000	14994.499	14.99
11	19000	18994.3946	18.99

7.2 Adulteration

In this work I proposed weighing machine with unique feature that it has the machine vision camera with colour sensor technology to find out adulteration identification in food sample. From the observations table, it contained 80 readings (data) of sample 1 and Sample 2 of Item A, this data send by a machine vision camera when it takes the snapshot of Food Sample . Now the comparison between readings (data) of sample 1 and sample 2 of Item A of observation table after the analysis of this readings ,get the average percentage deviation. The average percentage deviation of Food Sample A is 1.92.In this process from the analysis of those readings of food sample it is clear that the average deviation percentage of adulterations is within the limit set by authority..

From the above discussion of all the parameter, the customer paid the money only of pure sample that was weigh by load cell without adulterant .This is calculated by the fallowing formula ,with this examples.

For the Item A Average Percentage Deviation is 1.92.

For Ex. If I weigh a food sample of 5kg ,its cost as per rate is Rs.50/kg then I would pay Rs.250 but average percentage deviation play a very important role that it is 1.92, so the calculation is as follows:

5kg*1.92/100=0.096 this is adulterant in food sample

So now

(Original+ adulterant) Weight – (adulterant Weight) = Original weight

Therefore

5.000Kg – 0.096Kg =4.904 Kg

Now 4.906 × Rs.50/kg= Rs. 245.20

Therefore the customer has to be paying Rs.245.20 and not Rs.250.

From above discussion it is said that, this is the biggest Advantage of this weighing systems. How much amount of pure food sample is in load cell carrier pan that much amount of money costumer has to pay.

In future, with the help of Wireless Technology if the percentage of adulteration is increased by set limit by the authority then server sends indication to the authority. Then authority takes necessary action on that shop where our weighing machine is installed. This system in future can be implemented with wireless Technology like ZigBee and GSM to improve its performance and capability and make it strong Digital Weighing Scale System.

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