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IMPLEMENTATION OF ARDUINO CONTROLLED AUTOMATED MODEL FOR AUTOMATIC PROCESSING OF MILK PACKETS IN DAIRY INDUSTRY

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ABSTRACT

In manual systems the level of service is dependent on individuals. Fault percentage will be high compared to automated system .In milk packaging and processing automation is the solution in all kinds of its product. In this work we present a model of automatic counting machine for milk packets of different weights and transferring of these packets to cold storage by using conveyer belts. This machine also detects faulty packets & detained it from processing. We used ArduinoMEGA2560 processor for system designing and Proximity sensor for counting the number of packets to be packed. The load cell (Weight sensor) is used for sensing the product weight. If required weight of pouch is correct then it allows putting milk pouches in to the bucket which is traveling on conveyor belt. Actuator & conveying belt is used for movement of milk carrying buckets to cold storage automatically. We tested milk packets of weight 1 lit, 500 ml, 250 ml, and 200 ml on this model. The output of the model count is 20 packets for 1lit, 40 packets for 500 ml, 80 packets for 250 ml & 100 packets for 200 ml.

Keywords: Automation, Proximity sensor, Arduino processor, Actuator, conveyor belt, milk pouches, Load cell.
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1. INTRODUCTION

In the past three decades engineering and technology has changed the nature of manufacturing in dairy industry. In dairy industry the packets are counted by manual method by labors. Due to that processing time and avoidable faults make the process slower. By using newly controller's automation can be done. Nowadays, people call for economical society. The market has the new request with the related package design. The economical packages

achieve the lowest cost and minimize resources consumption and maximize the benefits. Automation has allowed for companies to mass production of products at outstanding speeds and with great quality and low cost. Automation plays an increasingly important role in the world of economy and in daily life. Automation is the set of contol system and information technology to reduce need for human work in the production of goods and services [3].

Manual systems put pressure on people to be correct in all details of their work at all times, hence with manual systems the level of service is dependent on individuals. Here we implemented automated model for counting of milk pouches and transporting it to the store room. This model helps dairy industry by automated counting of milk pouch per buckets. Even this model is helpful for buckets to deliver the pouch to the store room. The automated counting machine not only counting the packets it also rejects the packets if the content of milk is not proper in the pouch.

This is often an area where significant money can be saved by automation. It takes more effort and physical space to keep dairy industry running at all time. Another impact of manual systems is on Customer service. Customer requirement can be difficult to respond at right time. Large ongoing staff training cost is required for accurate work. We are gating Speed, Repetition, Accuracy, Safety, and Adaptability with automated system. The automated system can be programmed to carry out different task [3].

2. EXISTING SYSTEM

The Indian dairy industry is contributing significant role in the country economy. A dairy is a place for handling milk and milk products. To understand the existing system we visited Hutatma Sahkari Dudh Utpadak Sangh Ltd, walwadist- Sangli, - 416313, Maharashtra, India. The photo of the same is shown in figure 2. The block diagram of existing system for milk packets counting and processing is shown in figure 1. The system contains different blocks as:-

2.1. Milk processing unit

It involves collection of milk from the villages, chilling the milk to 3-4 degree Celsius and transporting through the insulated pipe for packaging process.

2.2. Packaging process

In this section milk is packing in various types like cow, toned, standard and buffalo milks which are available in 200ml, 500ml, 1000ml etc.

2.3. Container feeding

This is is done in manual way where labors count the packets manually and put them in bucket. Then with the help of roller conveyer the bucket are transferred to the cold storage as shown in figure 2.

2.4. Cold storage

In this cold room the full feeded buckets are stored at 3-4 degrees. This milk is ready to customer. This milk is finally transport to several cities.

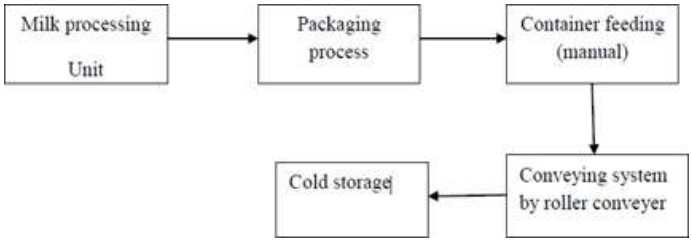

Figure 1 Block diagram of existing system

Figure 2 Photos of Existing system at Hutatma Sahkari Dudh Utpadak Sangh

3. SYSTEM ARCHITECTURE

To overcome the disadvantages of manual system we implemented automated model for counting of milk pouches and transferring it to the cold storage. This model helps dairy industry by automated counting of milk packets. Even this model is helpful to deliver the packets to the cold storage. The automated counting machine not only counting the packets it also rejects the packets if the content of milk is not proper in the packets. The block diagram of proposed system is as shown in figure 3[5].

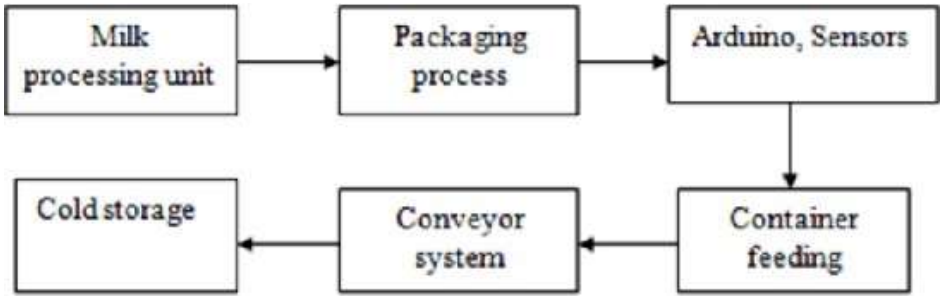

Figure 3 Block Diagram of System

It is a electromechanical systems which is broadly divided into six parts. The first two blocks are similar to manual system. We have done automation for counting, rejecting faulty packets and transferring packets to the cold storage by conveyor belt.

Milk processing unit: It involves collection of milk from the villages, chilling the milk to 3-4 degree Celsius and transporting through the insulated pipe for packaging process.

Packaging process: In this section milk is packing in various types like cow, toned, standard and buffalo milks which are available in 200ml, 500ml, 1000ml etc.

Laser and Photo detector: Laser and photo detector are face to face mounted .When milk pouches comes down at that time laser cut and photo detector can't detect the laser signal. How many times laser signal cuts down shows how many pouches produced by packaging machine.

After this process, pouch weight is measured by load sensor .Load sensor gives an actual information about weight of pouch. When

1. Pouch weight is approximately equal to desired (entered) weight then pouch feed into the bucket which is on the conveyor belt.
2. Pouch weight is not equal to desired (entered) weight then pouch flip out from this process and send to reprocessing system.

This parts plays an important role in this system.

Container feeding: DC motor is a component responsible for movement of containers. DC motor requires control signal and source of energy. Control signal may be electric voltage or current. The packed milk pouches are properly feed into the buckets in this section.

3.1. Conveying system

Elementary conveyor belts were used since the 19th century. In 1892, Thomas Robins began a series of inventions relating to conveyor systems, which led to the development of a conveyor belt used for carrying coal, ores and other products [12]. Now a day's Conveyor belt system are widely used in cement industries, power plant, food industries, production industries etc. So it is essential equipment for in house material transportation today. The modification and latest technologies or methodologies used in different applications to reduce failures, maintenance cost and equipment related a fatal accident occurs during operation [1]. In our design Conveying system is a way through which full feeded buckets send to cold storage by using conveyor belt.

4. SYSTEM SOFTWARE DESIGN

The system software design is explained with the help of flow chart as shown in figure 4. In automated machines the system has been initialized by start command in the panel and the average weight is set to the controller in 1000ml, 500ml, 250ml and 200ml. It also set the bad package limit. This information will display in the LCD panel. Now the packets will be counted by the laser cut by using proximity sensor .The system will check the weight of the packets in ml. If weight is correct the machine will count the packets and it will be putted on the conveyer belt. If the weight of packets is not correct it will be notified in the LCD panel and the package will go for recycling process.

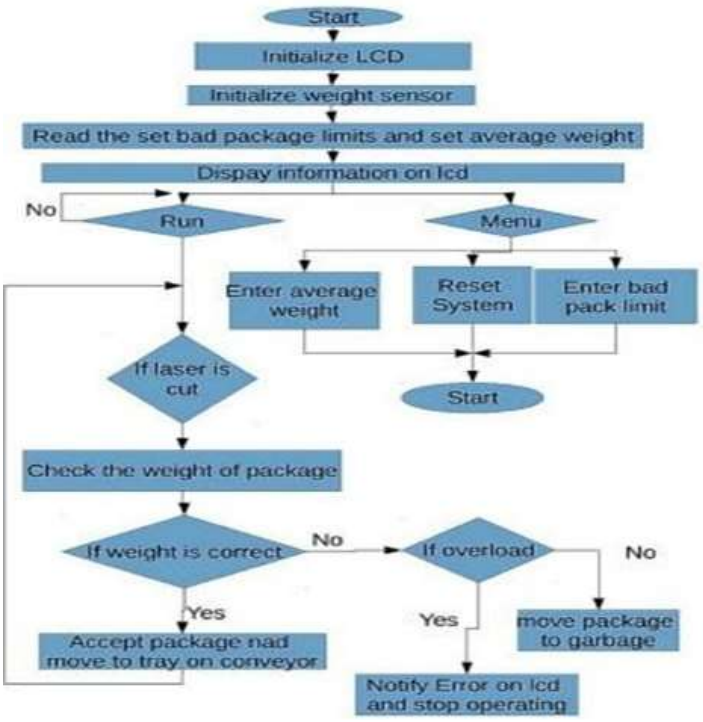

Figure 4 Flow chart of system

5. SYSTEM HARDWARE DESIGN

The model we present for automatic processing of milk packets in dairy industry is shown in figure 5.This model contains both electronic and mechanical part. The electronic part contains:-

1. The Laser module (Tx/Rx) for counting of packets.
2. The load cell sensor for measuring weight of packets
3. High torque DC motors for moving packets
4. Arduino controller for controlling above operations

The mechanical part deals with design of the model for movement of milk packets and also

Conveyor belt to transfer the packets to cold storage. The model is nothing but conveyor-based automated material handling Systems [2]. Some of the design calculations are given below.

Figure 5 Automation Model

6. DESIGN CALCULATION

A belt is a loop of flexible material used to mechanically link two or more rotating shafts, most often parallel. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel. In a two pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel snails), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts).As a source of motion, a conveyor belt is one application where the belt is adapted to continuously carry a load between two points [9].

6.1. Angle of sheet for system [6][8]

If angle of sheet for slope is less than (30°- 40°), then movement of milk packet is very slow and which is not essential for the movement of packages. If angle is greater than (30°- 40°), then movement of milk packet is very fast. Hence efficient angle for slope is lies between (30°- 40°).

6.2. Design consideration for motor

6.2.1. Motor selection for flapper [7][8]

Torque applied on the flip = weight × height

$= 3\cos 30° \times 7$

$=2.59 \times 7$

$= 18.18$kg.cm

The motor available of stall torque = 15-20 kg.cm. Required minimum speed for flapper = 60 RPM.

6.2.2. Motor selection for lever [7][8]

When the product strike in motion to the lever then product applies more weight to lever than original weight of product

The weight of package = 1 kg

By assuming (*fs*)= 1×3

= 3 kg

Where *fs is the factor of safty* = $failureload/workingload$ = 6/2 = 3 Torque required when package strike is given by,

Torque = $3\cos 30° \times 6$

= 15.58 kg.cm

The motor available for stall torque = 15-20 kg.cm. Required minimum speed for lever = 60 RPM.

The conveyor belt is designed such to meet the requirement of the machine. Conveyor belt requirements are as follows:

1. Length, Lb: 1.57m
2. Width, wb: 0.25m
3. Slope, α: 30 Degree
4. Load: Bucket of milk package
5. Total load weight, W:10 kg
6. Belt Speed: 12 rpm (assume)

7. CIRCUIT DIAGRAM

The schematic electronic section is shown in figure 6. The heart of the system is microcontroller board of Arduino Mega 2650. Nowadays, there are available a great variety of Arduino boards with different processors, sizes and connectivity features. The Arduino hardware has become cheap and easy to acquire. Regarding the software to program Arduino, the same IDE (Integrated Development Environment) is used for all boards, and it is available for different OS (Arduino, 2015). This IDE is open and free, as well as easy to get, start and use. C/C ++ is used as programming language, which enables user to create from a simple program based on procedures in an single file, to a complex object-oriented program in multiple files. Other relevant aspect of the Arduino platform is the big amount of information available about it, ranging from the basic documentation in the official web site, to full books for different application fields [10]. Arduino is especially popular in education on Electronics, Automatic Control or Robotics [11]. We use Arduino Mega 2560. This Arduino is characterized by having many I/O lines, which is essential to interact with all the elements like keypad, LCD, weight sensor, proximity sensor & DC motors as shown in figure.

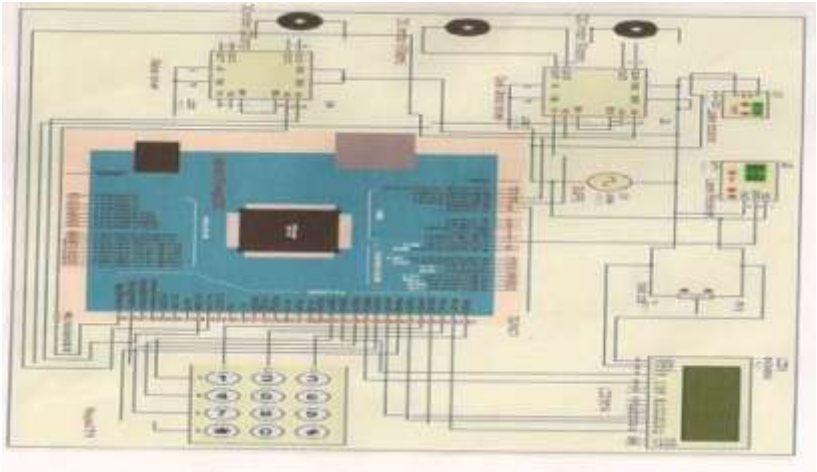

Figure 6 Schematic of Electronic section

8. COMPONENT LIST

The Table 1 shows the list of component along with its bills which are used for designing the model.

Table 1 Bill of Material

Sr No	Hardware Name	Quantity (in no.)	Cost (in Rs.)
1	Micro-controller board(Arduino Mega)	1	750
2	Load cell sensor(10kg)	1	815
3	Load cell driver	1	300
4	Laser module(Rx/Tx)	1	989
5	SMPS(300w power supply)	1	350
6	High torque DC motor	3	1800
7	DC Motor drives	3	1450
8	LCD(16*4)	1	540
9	Key pad (4*5)	1	130
10	Steel rod square with cutting and process	3	2000
11	Steel sheet with sheet metal process	1	1800
12	Conveyor roller rod,belt	1	600
13	Bearing (20mm,35mm)	2	200
14	Bering(10mm)	5	200
15	Steel rod(M.S 20mm*450mm)	1	200
16	Steel rod (M.S 25mm*450mm)	1	200
17	Steel solad plates(1000*100*5mm)	1	150
18	Wires,connectors,nuts,bolts	-	750
19	Conveyor belt (3feet)	1	1200
20	Mounting bearing(25mm)	2	500
	TOTAL		14834

9. RESULT

We have tested the model for different milk packets and got the results as shown in figure.

Table 2 Output results

Milk package	No of package per minute
1 lit	20
500 ml	40
250 ml	80
200 ml	100

10. CONCLUSION

Our automated machine overcome problem of difficulties in manual method in dairy industry in low cost .It eliminates the labour cost and handling cost. It minimize material handling time and leakage problem in packaging [4]. Hence the product cost reduces. By outputs results and the rejection of faulty milk packets by our automated machine make the system more efficient than manual method. This is often an area where significant money can be saved by automation. It takes more effort and physical space to keep dairy industry running at all time. Another impact of manual systems is on Customer service. Customer requirement can be difficult to respond at right time. Large ongoing staff training cost is required for accurate work. We are gating Speed, Repetition, Accuracy, Safety, and Adaptability with automated system. The automated system can be programmed to carry out different task.

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