International Journal of Emerging Trends in Science and Technology
5 (1), June 2019, 07-12
http://www.publishingindia.com/ijetst

Design a Signal Conditioning Unit for Chute Level Sensor and Automatic Control of the Cane Feeding System in the Sugar Industries

I. Aravindaguru[1*] and S. Kiruthika[2]
[1]Assistant Professor, Dept. of EIE, M. Kumarasamy College of Engineering, Karur, Tamil Nadu, India. Email: aravindagurui.eie@mkce.ac.in
2Assistant Professor, Dept. of EIE, M. Kumarasamy College of Engineering, Karur, Tamil Nadu, India. Email: kiruthikas.eie@mkce.ac.in
*Corresponding Author

Abstract: The operation of sugarcane feeding and level control in the chute for continuous feeding of sugarcane has to be automated. In earlier, the level of the chute is identified by using LED's indication and controls the sugarcane feeding manually. To design a signal conditioning unit for the conductivity type level sensor. The output of the signal conditioning unit is given to the controller. There are five level sensors in the five different levels in the chute. The output of the five-level sensor is given to signal conditioning unit to produce controller accepting input i.e., 4-20 mA. The advantage of this project is to reduce the cost effectively. It gives better accuracy because we use microcontroller to process the parameters.

Keywords: Chute, Sensor, Signal conditioning unit, Sugar mill.

I. Introduction

A sugar industry is an industry which processes the juice of the sugarcane juice to white refined sugar. Many of the sugar mills are producing raw sugar, which is still containing molasses, giving it more colour (and any associated nutrients) than the white sugar which is normally consumed in households and used as an ingredient in soft drinks. Kiruthika S *et al.* describes that the feeding of sugarcane and the level of the chute is measured manually, so the sugarcane processed in the chute is often get struck or jammed. Due to this the production of the sugar is get affected, to overcome this issue the feeding of sugarcane into the chute and the measurement of chute level has to be automated by using the sensor system to measure the level of the chute and by varying the speed of the conveyer in the Sugarcane feeding system [7].

Sugar Manufacture Process

In sugar manufacturing process, extract the juice from the cane and refine the sugar from the crystal.

Arun M *et al.* describes the objective of the Mill Speed Control is also to maintain a regular and constant Level in the Chutes so as to ensure uniform feeding to the Mill. The Mill Speed is varied in direct proportion with respect to Chute Level [1].

The Fig. 1 describes the sugar manufacturing process in the industries. The Fig. 2 describes the flowchart of the sugar manufacturing process. The Mill Speed is controlled in accordance with load on the Mill, which is reflected positively by the Chest Pressure in case of Steam Turbine, Load Current in case of DC / AC Drive or the Hydraulic Pressure in case of a Hydraulic Drive.

The idea behind the speed control is to maintain uniform loads on the Mill, i.e., an increase in load shall increase the Mill Speed thus bringing the load down to its normal, whereas a decrease in load shall decrease the Mill Speed thus restoring the load to its normal value.

The Mill Speed is controlled in accordance with load on the Mill, which is reflected positively by the Chest Pressure in case of Steam Turbine, Load Current in case of DC / AC Drive or the Hydraulic Pressure in case of a Hydraulic Drive. The overriding control for Mill Load is given by the Chute Level.

The flowchart of Sugar manufacturing process is given below in detail.

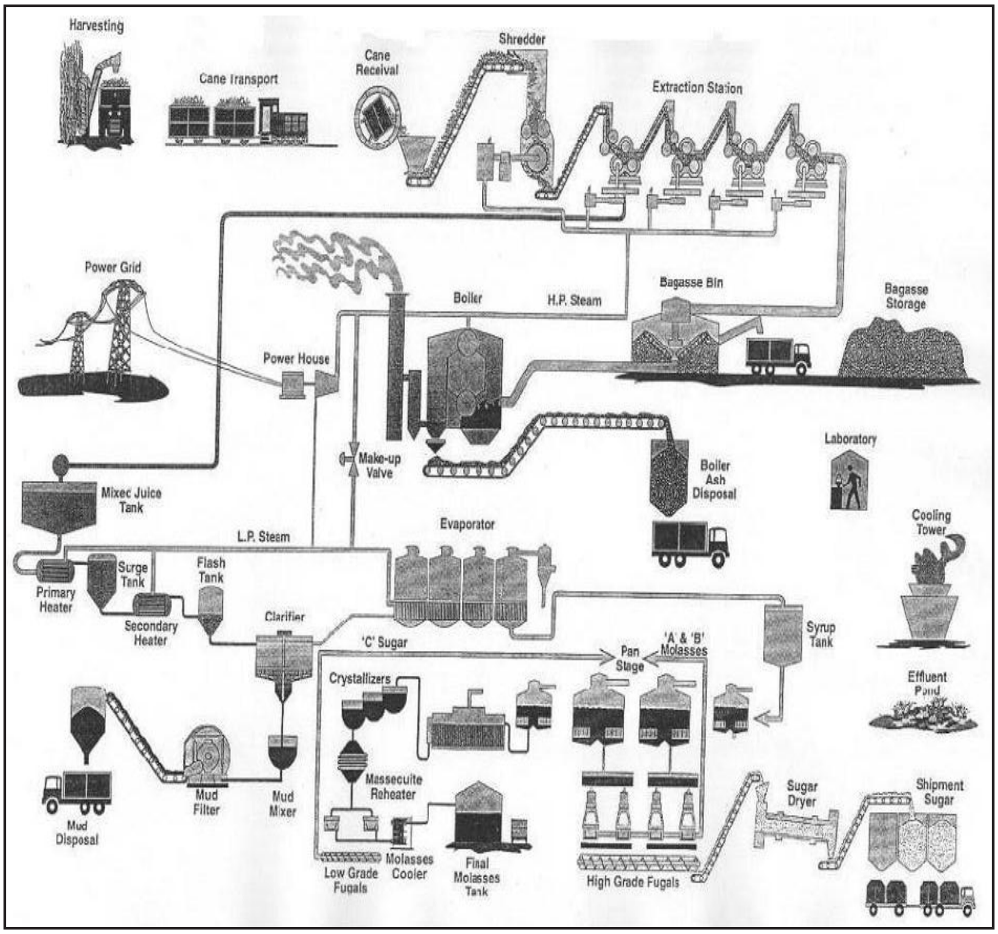

Fig. 1: Schematic Diagram of Sugar Manufacturing Process

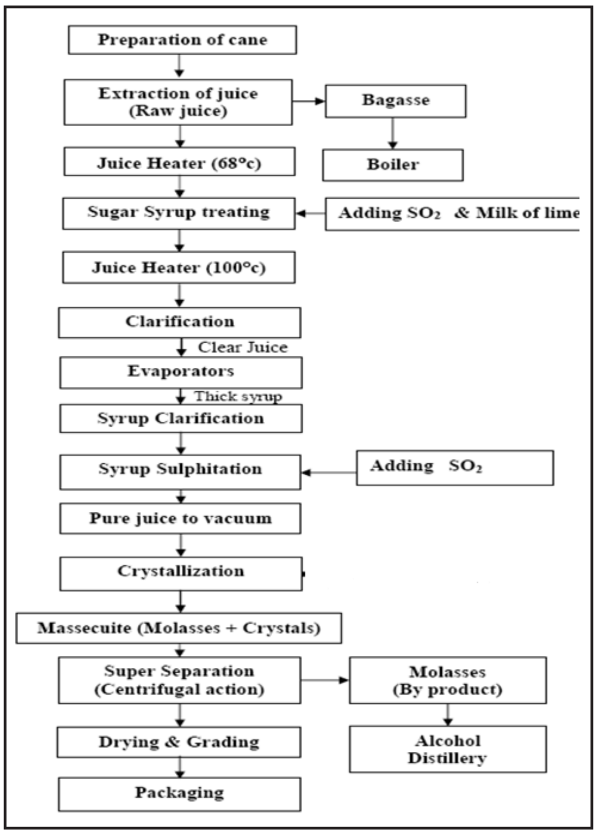

Fig. 2: Flowchart of Sugar Manufacturing Process

II. Existing Method

A. Introduction to Chute

Chute is to hold the bagasse and send the bagasse to next process it is in many forms of spiral and rectangular. In which rectangular is widely used in sugar industry as shown in Fig. 3.

The Mill Speed is controlled in accordance with load on the Mill, which is reflected positively by the Chest Pressure in case of Steam Turbine, Load Current in case of DC / AC Drive or the Hydraulic Pressure in case of a Hydraulic Drive.

Legend:

CT / PT: Current / Pressure Transmitter

DCLT: Donnelly Chute Level Transmitter

TRL: Top Roller Lift Transmitter

MSC: Mill Speed Controller

RPMT: RPM or Tacho Transmitter

TR: Top Roller

The Fig. 3 portrays schematic diagram of the the chute level sensor and automatic.

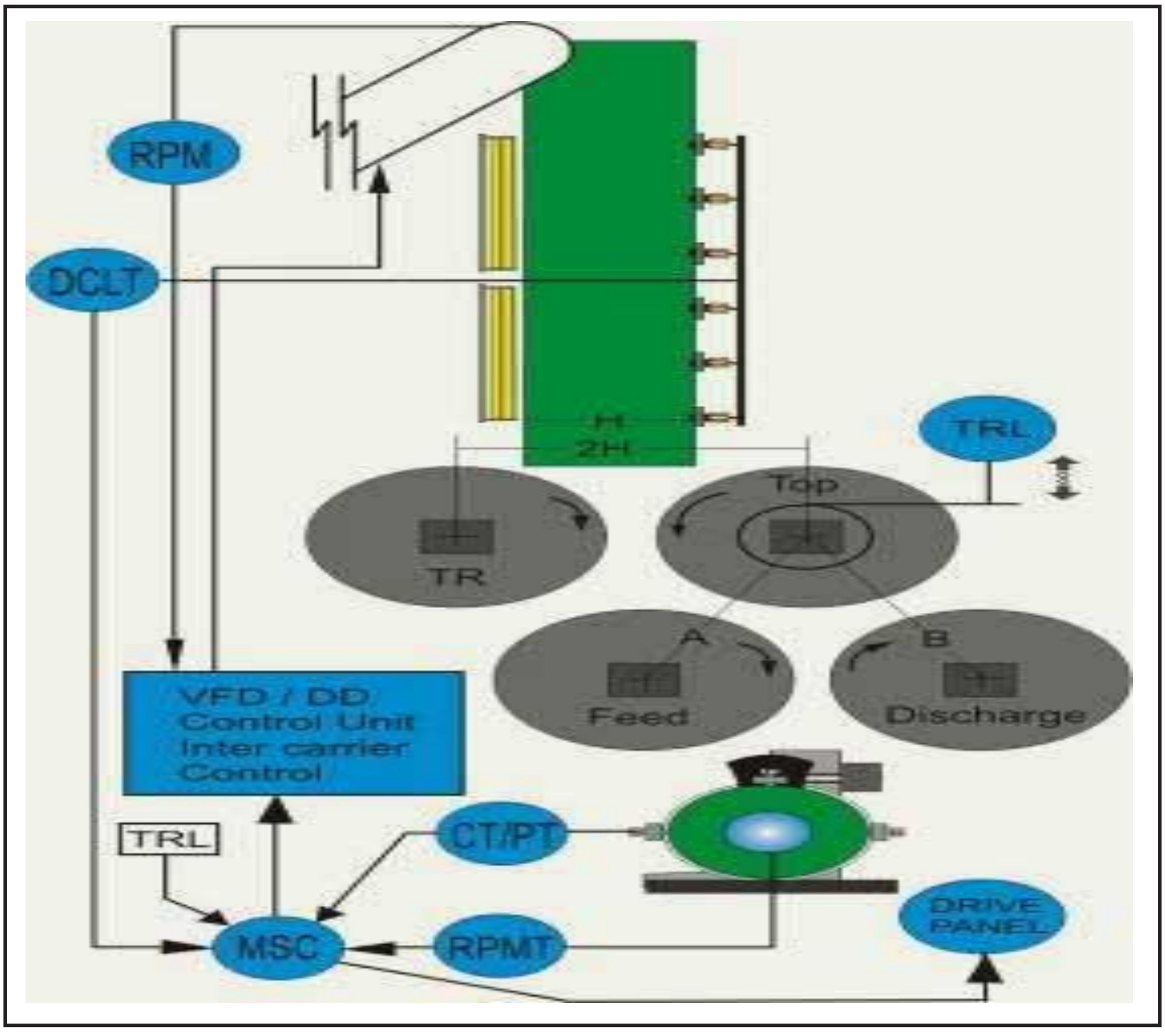

Fig. 3: Single Chute

B. Signal Conditioning Unit

Canesin C A *et al.* describes that in the signal conditioning of chute level sensor relay is used as the switch and some error occurs in the chute [3]. When the output resistance from the chute is below 2k also the sensor has to sense it and it has to control the conveyer motor to control the feed of sugarcane.

The Existing method of signal conditioning unit for chute level sensor in sugar industry is shown in Fig. 4.

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

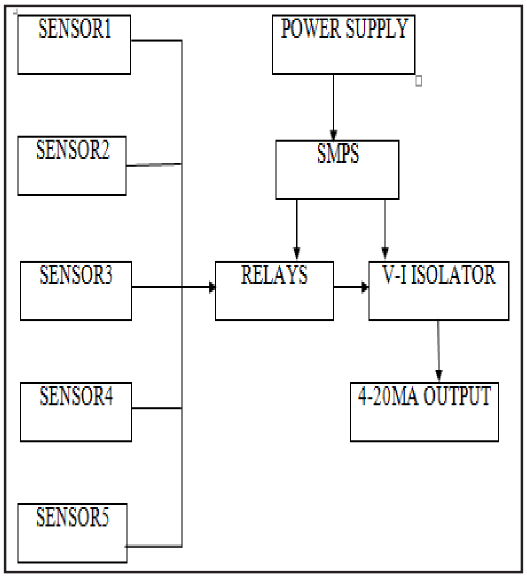

Fig. 4: Block Diagram of Signal Conditioning Unit

III. Proposed Method

In the proposed method the opto isolators has used to make the process more sensitive. In electronics, an opto-isolator, also called an optocoupler, photocoupler, or optical isolator, is a component that transfers electrical signals between two isolated circuits by using light. Barboni L *et al.* describes the Opto-isolators prevent high voltages from affecting the system receiving the signal. Commercially available opto-isolators withstand input-to-output voltages up to 10 kV and voltage transients with speeds up to 10 kV/μs [2].

The use of opto-couplers in the signal conditioning unit of the chute level sensor is better than the V/I Isolator and relay.

A. Introduction to Conductivity Sensor

Conductivity is just the capacity of a fluid to conduct electricity, which is connected straightforwardly to the convergence of particles in the fluid. While pH is concerned explicitly with hydrogen particles, conductivity does not separate.

Conductivity is the opposite of obstruction and estimated in Siemens/cm. normally units are milli-Siemens or small-scale Siemens relying upon the range. If you somehow happened to take an out-dated multi-meter and turn around the obstruction scale so zero is on the left. Straightforward conductivity sensors utilize two or four anodes with a known surface region that are put in the fluid or incorporated with a cylinder or vessel a predetermined separation separated. On the off chance that conductivity is low (high resistivity), the cathodes will regularly be near one another. On the off chance that conductivity is high, they can be more distant separated. While this is a successful methodology, it is inclined to mistakes if there is silt or air pockets that adequately protect some portion of a terminal. Also, anode in the arrangement is liable to erosion if the item is forceful.

Increasingly complex sensors kill genuine fluid to sensor contact by utilizing a couple of independent curls situated around an area of non-conductive tubing. One loop has a present going through it. Conductive fluid passing through the energized curl turns into a transformer auxiliary, which turns into an essential for the second curl. The measure of current in this manner actuated in the subsequent curl shows conductivity. While that is a basic clarification of the innovation, the preferred position is that there is no anode presented to the fluid, which dispenses with those related downsides referenced before. This plan can be designed as a test or worked as a spool area of pipe which can be put in the process stream.

As appeared in Fig. 5 conductivity can be utilized to decide the centralization of a solution, as in length as the broke down substances are known. In any case, since it is in discriminant, the sensor can't differentiate among corrosive and soluble base. At times, this isn't an issue. For instance, conductivity sensors are standard gear with CIP (clean set up) frameworks in sustenance and pharmaceutical handling plants.

Fig. 5: Conductivity Sensor

B. Signal Conditioning Unit

The signal conditioning unit accepts input signals from the analog sensors and gives a conditioned output of 0-10v dc corresponding to the entire range of each parameter.

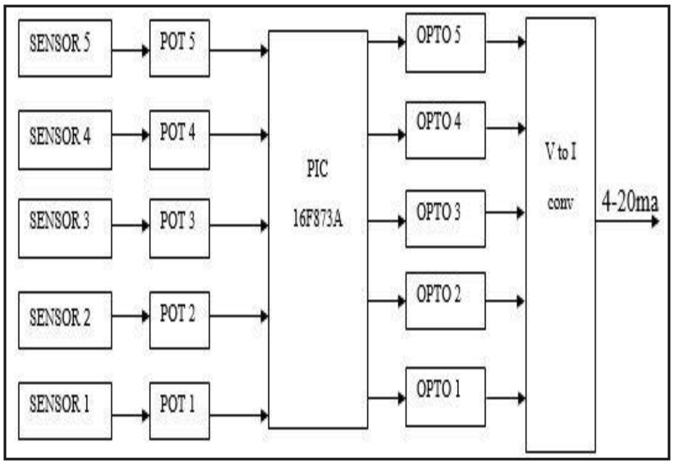

Fig. 6: Block Diagram of Signal Conditioning Unit

The Fig. 6 portrays the block diagram of signal conditioning unit of chute level sensor. This unit also accept 0-10v dc the inputs and gives outputs in 4-20 mA. The output the five sensors is given to the PIC microcontroller. Depends on the input of the sensor it selects opto-isolator. There are five opto-isolator in which each able to produce five different voltage. Canesin C A *et al.* describes that the output of the opto-isolator is in the range of 0–10v [3]. The output of the opto-isolator is given to V-I converter which produce 4-20 mA output.

IV. Result

The Fig. 7 portrays the prototype of the signal conditioning unit.

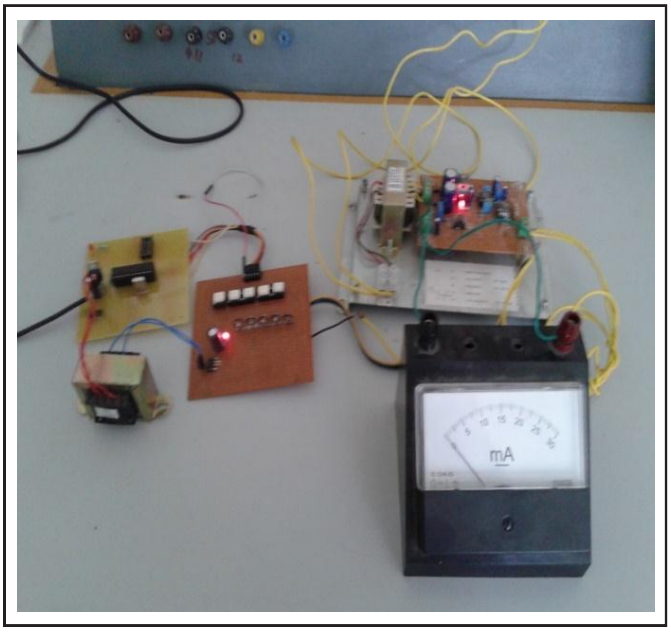

Fig. 7: Prototype of Signal Conditioning Unit

Thus the above prototype was successfully done. The results are verified and the above design accepts the input of the sensor and produce the 4-20 mA output depends on the level of the chute.

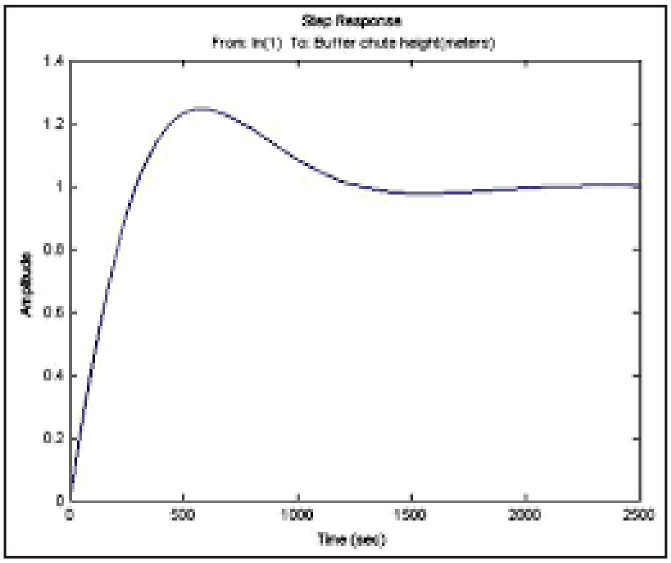

Fig. 8: Open Loop Step Response of Crushing

The Fig. 8 describes the open loop step response of crushing of sugarcane in sugar industries.

V. Conclusion

The output of the signal conditioning unit of sensor is given to the controller. The automation process in chute is introduced for better efficiency in the sugar production. Man power is certainly decreased, thus the entire process is controlled and monitored using DCS. In this project the output from the signal conditioning unit is given to the controller. In future the output from the signal conditioning unit is given to the controller through wireless.

References

[1] M. Arun, C. Mathanraj, A. K. Kumaraguru, S. Lakshanakumar, and S. Suresh, "Introducing telescopic chute to control dust emission in bagasse stacking," *International Journal of Science and Engineering Research*, vol. 3, no. 3, 2015.

[2] L. Barboni, R. S. Dahiya, G. Metta, and M. Valle, "Interface electronics design for POSFET devices based tactile sensing systems," in *Proceedings of the 19th IEEE International Symposium in Robot and Human Interactive Communication*, vol. 10, pp. 686-690, Viareggio, Italy, 2008.

[3] C. A. Canesin, F. A. S. Goncalves, and L. P. Sampaio, "Simulation tools of DC-DC converters for power electronics education," *2009 13th European Conference on Power Electronics and Applications*, IEEE, 2009.

[4] M. P. Fargues, and D. W. Brown, "Hands-on exposure to signal processing concepts using the SPC toolbox," *IEEE Transactions on Education*, vol. 39, no. 2, pp. 192-197, 1996.

[5] B. J. Hosticka, "Analog circuits for sensors," in *Proceedings of the 37th European Solid-State Device Research Conference*, vol. 7, pp. 97-102, Munich, Germany, 2007.

[6] H.-W. Huang, *PIC Microcontroller: An Introduction to Software & Hardware Interfacing*, *Course Technology*, vol. 4, pp. 7-9, 2009.

[7] S. Kiruthika, and P. Sakthi, "Automized molasses feed control using programmable logic controller," *International Journal of Pure and Applied Mathematics*, vol. 118, no. 8, pp. 197-200, 2018.

[8] A. Massa, and M. Barr, *Media Programming Embedded Systems with C and GNU Development Tools*, vol. 2, pp. 2-3, O'Reilly, 2006.

[9] M. A. Mazidi, R. McKinlay, and D. Causey, *PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC 18*, vol. 3, pp. 37-40, Pearson, 2008.

[10] http://www.engineersgarage.com/microcontrollers