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AUTOMATIC LADLE CONTROL WITH JOB DATABASE USING PLC-SCADA

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Abstract-The main objective of the proposed system is to introduce automatic ladle control pouring system with job database using PLC-SCADA. Factory manufacturing number of various types of products by the casting process. Now a days this casting process is manual. This manual process has many disadvantages. The aim of the project is to reduce human hazards, minimizing pouring time, minimizing spillage loss in order to achieve higher quality product.

Keywords: Casting, Human hazardous, Cost effective, Higher productivity, Quality casting

I. INTRODUCTION

The foundry is a factory which produces casting of metal. Casting is a manufacturing process in which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, then the liquid material is allowed to solidify that solidify part is known as casting which is forced out of the mold the entire process. But all work in foundries is processed manually. The main purpose of this Project is to suggest automatic ladle control a job database using the plc-scada system rather than manually pouring system. The manual process is time consuming. For creating a job, first metal is converted in molten from then pour that liquid form of metal in ladle the furnace. At that time required temperature of molten metal was 1400^0C-1500^0C. The capacity of the small ladle is 60-70 Kg. with the help of the two-worker ladder is carried to the mold then pour the liquid form of metal in it. Due to this manual system, industries and foundries faces number of problems. This system is time consuming and frequent reheating of metal is also risky. The casting molten metal has very high temperature; it is hazardous for workers to work in this high temperature. It may cause defects in casting and due to over pouring cost increases. Because of this high temperature pouring may occur over pour or short pour. Over pouring means more molten metal pour in the mold than required pour. Less pouring means less molten metal pour in the mold than required. Due to short pour and over pour not only increases faults in casting but also reduces the quality of the product. Number of times because of the laziness of the workers, companies/industries faces more loss. One of the losses is spillage loss. Production of series of defective, unacceptable products is rejected. It is necessary to remove this entire drawback.

To overcome all disadvantages in manual process one system is already developed that is mono rail system. In this process molten metal track in tundish from the furnace. The capacity of that tends to be 600 Kg and then this tends on the mono rail which is carried by manual process and then tilt is also by manually. This process also has a number of disadvantages. These are heavy workload to the worker, it is very difficult to carry tenders, difficult to carry tenders near to mold, when molten metal takes from a furnace then after few second pour into the mold it is a very difficult task. So, to overcome disadvantages of the both pouring systems we develop a system, automatic ladle control pouring system with job database using PLC-SCADA.

The purpose of this dissertation work is to Automize the system using a PLC. For implementing this system weight and metal is required. For reducing supervisor work, we are going to implement a database using HMI-Human Machine Interface. All the jobs completed in one year will be saved in personal computer daily.

II.LITRATURE SURVEY

Yuan P et.al discussed the work related to the temperature of molten metal which is used for casting. In ladle furnace, the prediction of the liquid steel temperature is always a hot topic for the research. Normally the molten metal temperature cannot be measured continuously, making it very difficult to realize precise controlling. They developed a new temperature module which measures the accurate temperature of the molten metal or steel. There are a number of parameters which are hard to obtain, so system is developed to improve the precision of mechanistic models. Intelligent methods have been used for predicting the temperature of the liquid steel in ladle furnace. The precision of liquid steel temperature model is satisfying in industrial production of ladle furnace. [1]

Prashant Tiwari et.al discussed the semiautomatic pouring system. The aim of this paper is to reduce human intervention, minimize pouring time & to achieve higher quality of casting. In this paper researcher have discussed the present system of the casting or pouring. There are a number of problem workers face in the present system, so semiautomatic pouring system is discussed. Now days the actual process is labors pour the molten metal from the furnace into a small ladle, then two labors carry the small ladle near to the mold. Molten metal has a temperature near about 1600^0C. So this work is also risky, using different sensors they have discussed the semiautomatic pouring system. [2]

Xiojun Wang et. al studied present accurate control of the steel temperature during ladle furnace method and data driven modelling algorithm are combined for obtaining a precise prediction model is presented on the basis of the proposed pruned bagging method. This method uses negative correlation learning to prune, so the result of this proposed ensemble-based

steel temperature predictor is able to provide a precise prediction with high accuracy and reliability. [3]

Huang G B et.al discussed the use of least square support vector machine (LS-SVM) and proximal support vector machine (PSVM) in the binary classification application. These both methods cannot be used in regression and multiclass classification application directly. This paper also shows that both LS-SVM and PSVM can be simplified further. Unified learning framework of LS-SVM, PSVM and other regulation algorithm referred to extreme learning machine can be built. ELM also works for generalized single hidden layer feed forward networks, but hidden layer in ELM need not be tuned. [4]

III. SYSTEM DESCRIPTION

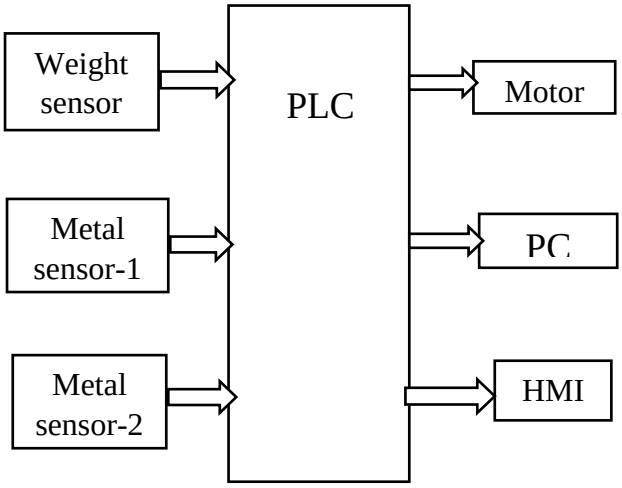

Fig.1 - Proposed Block Diagram

IV. SYSTEM COMPONENTS

The system components are divided into two categories. Software and hardware, they are classified as follows.

Software components

WPL soft 2.45

WPL soft 2.45 is PLC programming software this operating system is Windows XP/Vistal/7(32-bit/64-bit)/8/10 (64-bit). DVP series is supported in this software.

DOP Soft 2.00.06

DOP Soft 2.00.06 is used for HMI. HMI means Human Machine Interface.

Hardware components

PLC (Programmable Logic Controller)

DVP 10 SX 11 R

DVP - Series name
10 - Input/output points (4DI+2DO+2AI+2AO)
SX - SX Series
11 - DC Power input
R - Relay

PLC means Programmable Logic Controller, it is a digital computer used for automation of industrial electromechanical processes. PLCs are used in many machines, in many industries. PLCs are designed for multiple process of digital and analogue inputs and outputs. There are different types of PLC's like Siemens, Allen-Bradley, Delta, mitshubishi, Omron etc. fig shows delta PLC. This PLC has 2-CH 12-bit analog voltage or current input and 2-CH 12-bit analog voltage or current output are bipolar. It has 10-point PLC. That means total input and output pin is 10. Because of the following features select the delta PLC.

Fig.2: Delta DVP-10SX PLC

Features of Delta PLC:

- 4-Digital input, 2-Digital output.
- 2-Analog input, 2-Analog output.
- Power supply voltage -24Vdc.
- Input current-5mA.
- Responding time – 10 ms.
- 2-CH analog voltage/ current input and output are all bipolar.
- Built in 2-digit 7-segment display corresponds to internal resister directly to display PLC station or user-defined code.
- Expandable input/output.
- Compact in size.
- Input/output point indicators.
- Status indicator: power, run, ERROR, BATLOW.
- Ladder, SFC, instruction language.

Weight sensor:

A weight sensor that the change a load acting on it, into an electronic signal. This electronic signal can be converted in voltage, current or frequencies. This conversion depends upon which type of weight sensor and which circuit is used. The filling of the mold or cavity in the casting is determined by weight sensor. This weight sensor detects how much molten metal present in the ladle. When weight of the molten metal in ladle is not sufficient then ladle will be locked therefore we cannot tilt the ladle for filling mold.

Metal sensor:

A metal detector is an electronics device which generates an AC current that passes via a coil generating an alternating magnetic field. When a part of the metal is near to the coil, eddy current will be produced in the metal objects and a magnetic field is generated. This

sensor can also be used to detect the presence or absence of the object/ladle. We choose inductive proximity sensor which has 0.5-250mm sensing distance. One important features that is when it operates in harsh environment then very little negative effect. High sensitivity, reliability. Very good about ruggedness. Its operating voltage range is 6-40 Volt DC. This metal sensor has also inexpensive.

HMI (Human Machine Interface):

There are different names of HMI. Those names are User Interface (UI), Operator Interface Terminal (OIT), and Man Machine Interface (MMI). It is a hardware and software solution for exchanging information between machine and human operator. HMI enables control, management of device processes and can range from simple inputs on the touch display to control panels for highly complex industrial automation system.

Specification:

- Display type: 7" TFT LCD (65535 colours).
- Resolution: 800*480 pixels.
- Display size: 154.08*85.92.
- MCU: 32-bit RISC Micro-Controller.
- NOR flash ROM: 128MB.
- SDRAM: 64Mbytes.
- Backup Memory: 16 Mbytes.
- Operating range: 24V.

Motor:

An electric motor is an electrical machine that conversion of electrical energy into mechanical energy. The Motor will be used in this project to tilt the steering for filling the mold of casting. We will use stepper motor because of this feature. Stepper motor is stable. This motor works also the position transducer. This motor is inexpensive related to the other motors. The main purpose of use of this motor is safe. If anything is breaks the motor will be stops. This motor has long life. It has excellent low speed torque. It can be drive many loads without gearing. It has excellent repeatability. It has automatic returns to the same location accurately.it has also self-overloading.

PC:

For storing all data PC will be used. Because of this we can check any data of any date.

V. RESULT

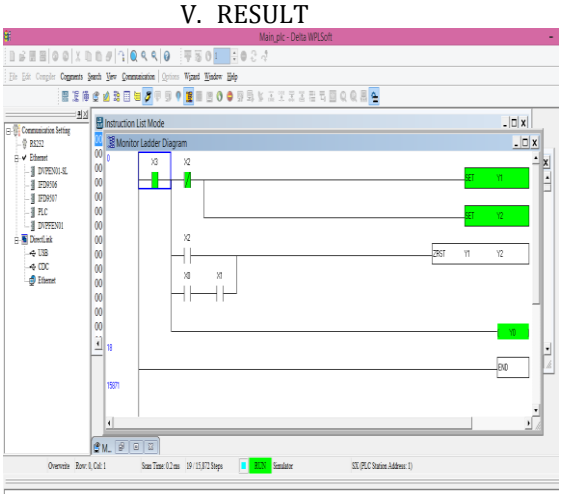

Fig 3: Ladder diagram for basic program

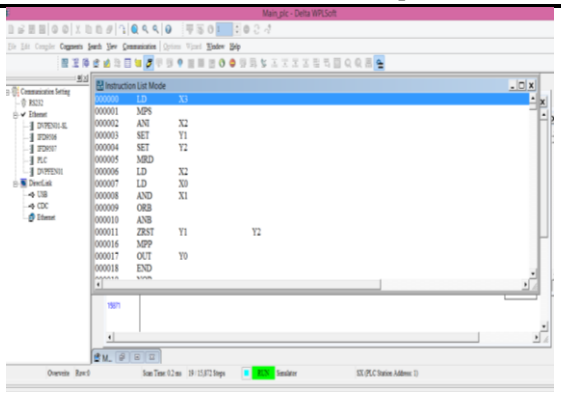

Fig 4: Instruction list mode

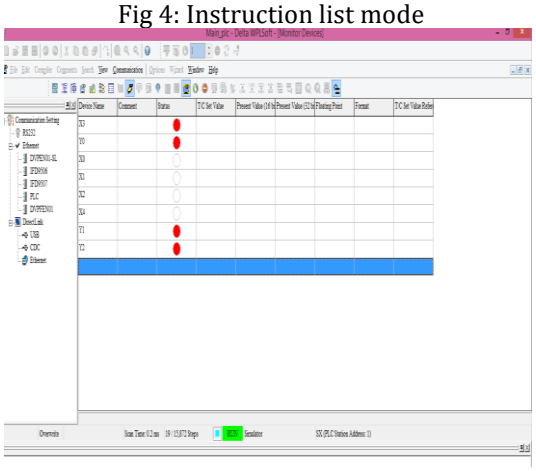

Fig 5: Output window of the program

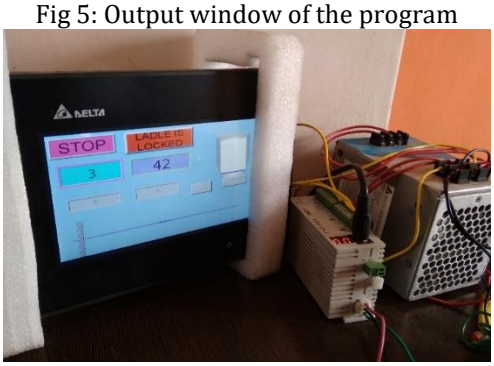

Fig 6: Interfacing between PLC and HMI

Fig.7: Interfacing between PLC and HMI

Fig 3 shows ladder diagram for basic program, fig 4 shows instruction list mode, fig 5 shows output of the program in delta WPL soft 2.45. This is a result of software.

Fig.6 & 7 indicates interfacing between Delta PLC and HMI. Fig.6 indicates ladle is locked that means molten metal is not sufficient for required one mold. Fig.7 indicates ladle is unlocked that means molten metal is sufficient for required one mold. These figure also indicates how many mold preparing.

CONCLUSION

Before the development of this system all the process were carried out manually by giving this human being were need to carry molten metal which is very high temperature so automation of this process is needed which is done here. The present system is to reduce time; decreases work effect of labor and eliminate the hazards to employees. It is a self-compensating and automatic system, which repeatedly and accurately fills the mold. This system increases efficiency and productivity to produce high quality casting. This system reduces the spillage loss. The present work reduces the hazardous to the worker.

VI. REFERENCES

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