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Representing Parameters of Die Casting Machine in Graphical Model

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Abstract: ***Die casting machines, widely used in manufacturing industry; consume a significant amount of energy. To reduce energy consumption, the primary task is to accurately characterize and evaluate the current performance. The ability to access energy-related data and, more importantly, effectively analyze these data to obtain key indicators is critical. In this paper, an Internet of Things (IoT) enabled method is proposed to stream online energy data for energy analysis of a die casting machine. Die casting machine is placed with the sensors named pressure transducer, temperature controller and velocity sensor. The parameters such as intensification pressure, metal temperature, die temperature, high pressure, plunger velocity, intensification pressure holding time, accumulator pressure values are read from the sensors and stored in the database. The graphical model is obtained based on the data stored in database through android application. The graphical model is analysed and for any abnormal values the notification will be sent to the Plant Head, the Supervisor and the Maintenance, thus action will be taken to control the machine.***

Keywords: IoT, Sensors, Database, LAN, Ethernet, Die Casting Machine, IoT kit, PLC machine, Android application

I. INTRODUCTION

Die casting is a metal casting process that is characterized by forcing molten metal under high pressure into a mold cavity. The Die casting machine is used to produce complex metal parts from the molten metals like zinc, aluminium, magnesium and other metals of low temperature. The die casting machine is associated with PLC (Programmable Logic Controller) machine which controls the functions of the machine. IoT has been used to sense the values from sensors and stores in the server. The android application provides all the parameter values of sensors placed in the Die Casting Machine through graphical model and it can be accessed from anywhere.

II. LITERATURE SURVEY

Watkins MF, et al. (2013) proposed a paper in which, the sustainability characterization methodology was used to evaluate the sustainability of die casting unit manufacturing process. More specifically, a way to theoretically model sustainability based on energy use was investigated. Using the fundamentals of die casting processes, corresponding input-outputs were first mapped in terms of sustainability parameters and later equations to theoretically calculate the energy used in a die casting machine were identified. This methodology looked to examine the key performance indicators of a die casting process and determine analytics that can be used to calculate the energy consumption of a die casting machine. The energy and material flows were mapped to the sub-processes of the die casting process and theoretical energy equations were identified and formulated for the process. Salonitis K, et al. (2016) presented a detailed study of the energy consumption of casting processes is analyzed and areas were great savings can be achieved are discussed.

Lean thinking is used to identify waste and to analyse the energy saving potential for casting industry. In the paper the challenges for optimizing the casting processes with regards their energy efficiency were also discussed. CRIMSON process as an alternative was presented.

Lenz J, et al. (2017) presented a research in which component substitution measurements have been performed for more efficient electrical motors, cutting fluid pumps, compressors vs. controlled compressors and start-stop hydraulic power packs. The stand-by energy analysis is similar to the component energy analysis and reveals the potential for setting some components to sleep mode during stand -by.

Examples of analysed sleep mode components are chip disposal, cutting fluid pump, pneumatic and hydraulic system. As a result the energy usage can be displayed and visualized in various ways such as energy per part, energy per time or energy per shift. These results are also be displayed online on mobile devices. Weipeng Liu (2018) proposed an Internet of Things (IoT) enabled method is proposed in this paper to stream online energy data for energy analysis of a die casting machine. The energy data captured by digital power meters and PLCs was transferred to a central server using real-time Ethernet. A set of indicators including energy per

part and energy per action were developed to interpret the data and to evaluate the performance of a die casting machine. In this paper, an IoT-enabled method is presented. Power data were captured by power meters, and operation data by PLC to evaluate the energy consumption of die casting machines. Machine actions were used to segment a die casting process. Some indicators were proposed to reveal the performance of a die casting machine. Then, energy data acquisition and analysis is conducted to support the calculation of these indicators. Through a case study, the feasibility of the method was demonstrated.

III. SYSTEM ARCHITECTURE

Initially the parameter values of Die Casting machine such as Intensification pressure, Metal temperature, Die temperature, High pressure, Plunger velocity, Intensification pressure holding time, Accumulator pressure, Cycle time were sensed using sensors such as Pressure transducer, Temperature controller, Velocity sensor. The parameter values are stored in the server database through IoT Kit. LAN (Ethernet protocol) is implemented to transfer the data from IoT kit to server. Finally the values were retrieved from the server and shown as a graphical model through Android application.

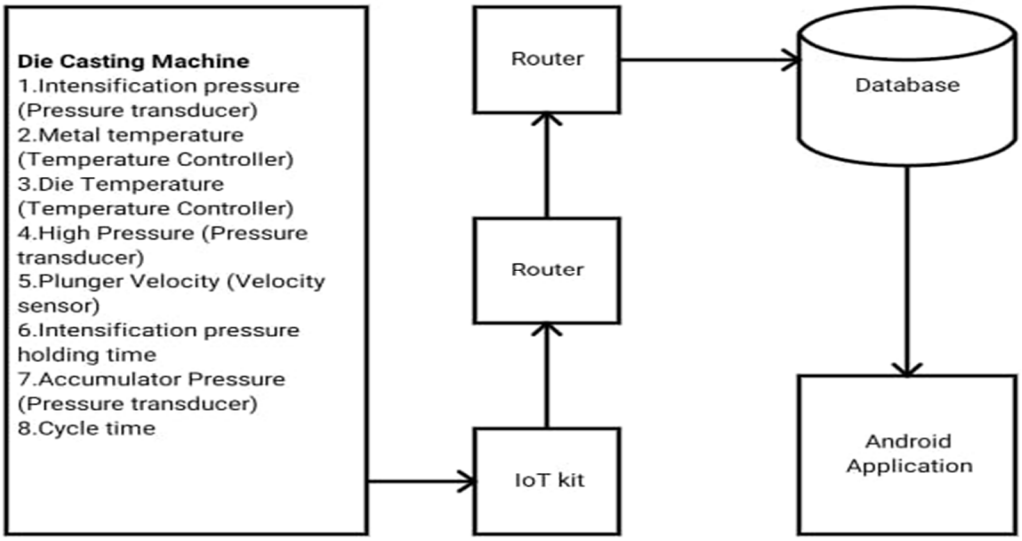

Fig. 1 System Architecture

The features and characteristics of the components used are given below

A. Die Casting Machine

Model – Cold chamber die casting machine, Tonnage – 250T.

B. PLC Machine

Model – Siemens S7 200 .

C. Temperature Controller sensor

It is used to sense the temperature values such as die temperature, metal temperature.

D. Pressure Transducer sensor

It is used to sense values such as intensification pressure, high pressure, accumulator pressure.

E. Velocity sensor

This sensor is used to sense the value of plunger velocity.

F. Server

The server model used in this project is Windows 2008 r2(SQL).

G. Router

The router used in this project is TP-LINK(TL-WR1043ND).

H. IoT Kit

It is used to transform the sensed data to server.

I. Mobile Device

Here android mobile device is used to represent the graphical model.

By using the above mentioned components the data of parameter values such as Intensification Pressure, Metal Temperature, Die Temperature, High Pressure, Plunger Velocity, Intensification Pressure Holding Time, Accumulator Pressure, and Cycle Time sensed by the sensors such as pressure transducer, temperature controller, velocity sensor positioned in the Die Casting machine were stored in the server database through an IoT kit. The IoT kit transforms the sensed data from sensors to server through LAN(Ethernet Protocol). In Android application, one has to select the machine name, date, time and required parameter to view the graph. The graph will be viewed for the given input. In contact us, the details of the company has been provided. In help module, the website for the company has also been provided. Likewise, the Android application has been developed. The graph will be generated for the parameter values of Die Casting machine stored in the database based on user's input in android application. One can view the graph for separate parameters. For any abnormal values in the database, the details of machine name, parameter value will be sent as a notification to the Plant Head, the Supervisor, and the Maintenance to control the machine.

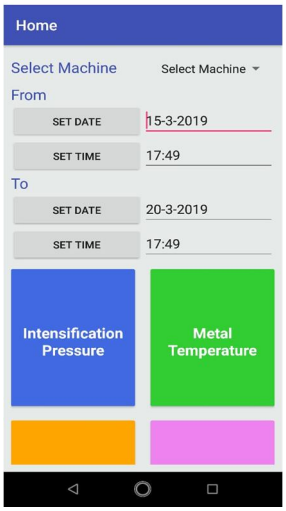

Fig. 2 Input

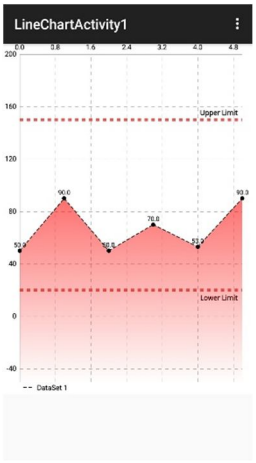

Fig. 3 Generated graph

IV. CONCLUSION

In this project the problem of how to view the current status of the Die Casting machine has been investigated. Comparing with the previous researches which focuses on representing the parameter and energy values of Die Casting machine through web pages, our approach focuses on graphical representation through Android application. Through analysis and experimental, we validate the efficiency of the proposed system. First, the user who is an employee of the organization views the graphical representation of the parameter values of Die Casting machine through logging in and provided machine name, date, time and parameter values. Second, the notification also will be sent to the appropriate personals for any abnormal values.

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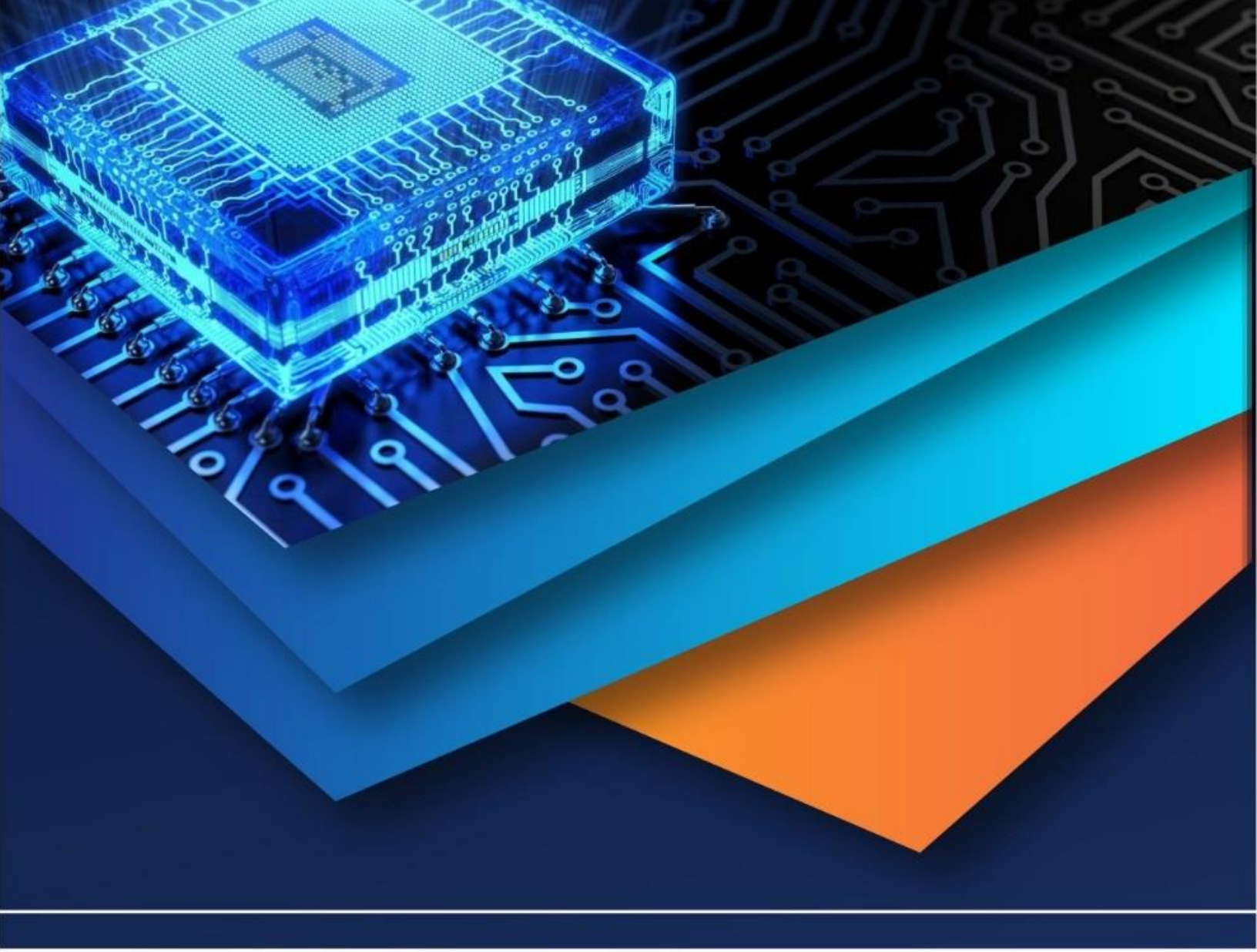

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