STEEL BLOOM MANUFACTURING FROM IOT BASED SCRAP MANAGEMENT & IRON ORE CONSUMPTION SYSTEM

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Abstract

The scrap based management of iron ore consumption system is mandatory for smooth operation of Steel Bloom manufacturing. In a conventional method as per the ministry of steel, the iron ore stock per the number of days is determined based on total steel and daily steel requirement,but the steel is measured only once. The total steel available is an approximation based on the orders placed. The idea is to place the Conventional sensor(weight sensor) at the Stacker of the steel plant where total iron ore is available before pulverization. The inputs for the Management system are total iron ore at stacker(manual entry can be provided if stacker is full and iron ore stack is necessary. The data in weight sensors at the stacker and before the Steel Bloom manufacturing is updated continuously to the data server using IoT. The algorithm also takes the values of orders already placed, and ongoing delivery for reliabilityand accuracy in the system. The algorithm gives the outputs like total stock available, order requirements in a specified periodical range(10days), a total number of working days of plant for available stock, and also alarms indicate when there is an outage in stock. It can also be automated for placing orders by verifying the costs and delivery time of listed stakeholders (companies). All the values are displayed in the output and the algorithm can also simulate the values before placing orders based on financial and alternative energy source considerations.

Keywords: - Internet of Things (IoT), Stack management, sensors, Aurdino.

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1. Introduction

The iron ore Stack management in steel Plant is mandatory for smooth operation and without outage in systems.
The huge amount of steel is usually supplied through railways. The process of weighing and saving it in the database can be made easier by implementing IoT procedures. This paper use IoT to make the process accurate, faster, simpler, and reliable.
A network of physical items makes up the Internet of Things (IoT). The term "Internet of Things" refers to a network that is expanding quickly and is equipped with built-in sensors to enable real-time data collection and exchange. The Internet of Things connects thermostats, autos, lighting, refrigerators, and other objects. Devices for the internet of things must be self-reporting in real time, efficient in operation, and capable of providing critical information to an item much faster than human involvement.Sensor data from IoT devices is gathered and transferred to an IoT gateway for analysis or to the cloud. These gadgets occasionally interact with other similar devices and take action based on the data they exchange.Most of the time, these machines operate without assistance from humans.
This project uses the Conventional sensor(weight sensor) at the stacker of the steel plant where total iron ore is available before pulverization. To make the whole setup precise and convenient IoT is included. It is difficult to connect the weight sensor from the stacker of the steel plant to the data processing unit through cables because it is far away. So, data at the stacker is updated to the server directly using IoT without the use of cables for connecting the data processing unit of the system and also for tracking the delivery of the order placed.
This project involves both software and hardware implementation. Software implementation involves coding in c in Arduino and the hardware implementation involves the connection of different components mentioned in the next chapter.
Under the challenging working conditions of steel factories, the weighing mode is conventional electronic weighing. The real-time control of routine procedures has subpar weighing accuracy. IoT-based weighing involves real-time monitoring that makes data handier at any moment for the management and it can be accessed from anywhere.
This whole setup involves a load cell that weighs the value of any object and the measured value will be sent to the load amplifier then the working of coding will be done i.e, it will give the desired outputs like the number of days left for the stack outage, etc. the data will be serialized and it will be sent to thing speak server which is set for the purpose of database base using Node MCU kit.

Arduino C Language

The Arduino Programming Language, or Arduino Language, is a language that is native to Arduino.
If you're not aware with it, p5.js is based on Processing, which is the foundation around which the Wiring development platform is built. There is a long history of projects expanding upon one another in a very open-source manner. The Processing IDE and the Wiring IDE are the foundations upon which the Arduino Integrated Development Environment is built.
In order to compile and load our Arduino programmes to a board linked to the computer, we frequently utilize the Arduino IDE, a tool that is available for all the major desktop operating systems (macOS, Linux, and Windows).
In essence, the Arduino Programming Language is a C++ foundation. You could argue that it isn't a true programming language in the sense of the term, but I believe this assists newcomers by preventing confusion. A sketch is the name for a programme created using the Arduino programming language. Typically, a drawing is stored with the ".ino" extension.

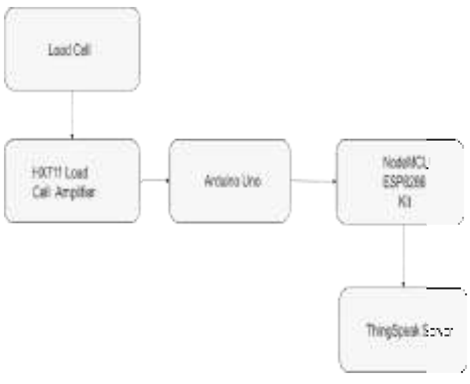

Figure: Block Diagram

ATMEGA328P is a super performance, low-power Microchip controller. An 8-bit microprocessor which is built on the AVR RISC architecture. As it is frequently used in ARDUINO boards, it is the most widely used AVR controller.

Similar to other controllers, ATMEGA328 is utilized. The only thing to do is programme. The controller just runs the programme we supply at any time. Controller does nothing when not programmed; it merely remains stationary.

As previously stated, programming the controller requires writing the proper program file into the ATMEGA328P FLASH memory. The controller runs this program code after it has been dumped.

Load Cell

An electrical signal which is represented by a load cell, a transducer which is directly related to the force being represented in the display. Hydraulic load cells, pneumatic load cells, and strain gauge load cells are a few of various types of load cells.

Wheatstone Bridges were the ancestors of the load cell. Four resistors are used in the structure's construction to create an electrical circuit. Sir Charles Wheatstone, an English physicist, popularized Wheatstone bridge in 1843. The load cell was a transducer that produced a voltage signal, usually measured in mill volts, whose strength was directly proportionate to the force being measured.

Load cells can be categorized into the following groups based on the direction in which loads are detected: tension, compression, alternating, and bending.

Load cells can be categorized as ultra-precision, precision, standard, or general-purpose depending on their level of accuracy.

Another way to think about load cells is as a form of sensor used to measure force and load. The force is transformed into an electrical signal by them. Depending on the type of load cell and the circuitry employed, this electronic signal may be a change in voltage, current, or frequency. Internal strain gauges are frequently used in load cells for this. The compression causes a response in the strain gauges, and the change in resistance causes a change in output.

It is a typical load cell that can measure weights up to 5 kg. Because the load cell's output is expressed in mill volts, a microcontroller cannot directly measure it. In order to produce the ADC with high resolution or an instrumentation amplifier, microcontroller can read the load cell's output.

High capacity load cells have a weight capacity of between 25,000 and 1 million pounds. Concrete batch factories, destructive and non-destructive testing in laboratories, pile testing, mooring testing, and rolling mills are examples of applications that use high capacity load cells.

Almost all modern electronic scales that measure weight rely on load cells to do so. They are used frequently because they can measure weight accurately.

Mill volts per volt (mV/V) of the differential voltage at the maximum rated mechanical load is the cell output rating. Hence, when activated with 10 volts, a 2.96 mV/V load cell will produce a 29.6 mill volt signal at full load. 1 to 3 mV/V are typical sensitivity values. Around 15 volts is the usual maximum excitation voltage.

Choose a load cell that is greater than your peak operating load to ensure you have the best capacity. Additionally take into account the additional factors that the load cell will encounter. Consider using a load cell with the appropriate fatigue rating if you utilise load cells in high-endurance applications.

HX711 Load Cell Amplifier Module:

The HX711 is one of the precision 24-bit Analog-digital converter (ADC) used for weighing scales and industrial control applications is interfaced directly with the help of a bridge sensor, used for amplifying signals from the cells and reporting them to another microcontroller.

A load cell amplifier breakout board for the HX711 IC, the HX711 module makes it simple to read load cells and measure weight. 24 HX711 high-precision A/D converter chips are used in this module.

It has two analogue input channels, an internal integration of 128 times, and a programmable gain amplifier that is specifically intended for the high precision electronic scale design. The input circuit is very accurate and reasonably priced, making it the ideal sampling front-end module. It can be designed to give a bridge type pressure bridge (for example, in pressure, weighing sensor mode).

With the IC HX711, you may quickly incorporate load cells into your project. Simply use this board and you can quickly link it to any micro-controller to measure weight without the need for any amplifiers or dual power supplies.

The two-wire interface (Clock and Data) is used by the HX711 for communication. HX711 has additional benefits over other chips, such as high integration, quick reaction, immunity, and other qualities that enhance overall performance and dependability. And finally, it's a great option for people who love electronics. The chip improves performance and reliability while lowering the cost

of the electronic scale.
Via TTL 232, the module communicates with the host computer.An HX711 chip with 24-bit accuracy for analog-to-digital conversion is part of the HX711 amplifier sensor.

ESP8266 12–E NodeMCU Kit :
The ESP-12E module for the NodeMCU ESP8266 development board contains the ESP8266 chip with a Tensilica Xtensa 32-bit LX106 RISC microprocessor. This processor consists of an adjustable clock frequency range of 80 MHz to 160 MHz and flexible RTOS. To store data and programs, NodeMCU also it has 4MB of Flash memory and 128 KB of RAM.
It is suitable for IoT projects consisting high processing power, built-in Wi-Fi and Bluetooth, and Deep Sleep Operating capabilities.

There is an open-source firmware called NodeMCU. There are open-source designs for prototype boards. Node and MCU are combined to form the moniker "NodeMCU" (micro-controller unit). The term "NodeMCU" technically refers to the firmware than development kits. Both the firmware and prototyping board designs are free source. A Micro USB jack and VIN pin can be used to power the NodeMCUESP8266 and NodeMCU (External Supply Pin). Interfaces such as UART, SPI, and I2C are supported. The Arduino IDE is easy to programme in the NodeMCU Development Board.
With the Arduino IDE, NodeMCU programming must not take more than 5 to 10 minutes. The NodeMCU board itself, the Arduino IDE, and a USB cable is required.
It is an ESP8266-based open-source platform that connects items and enables data transfer using the Wi-Fi protocol. Additionally, it is equivalent and takes almost the microcontroller functionalities, including GPIO, PWM,ADC, etc.
The Amica (based on the typical narrow pin-spacing) and LoLin (based on the wider pin-spacing and larger board) are the two most popular NodeMCU types. The fundamental ESP8266's open-source design allows for the market to continuously develop new NodeMCU iterations.
Installing the correct driver depends upon the Operating System that is used with the NodeMCU. The CP2102 chipset is typically recognized by Windows 10 right away, however the CH340G might need to be installed separately.
The Hardware components involved in this project are Arduino Uno, Load cell, HX711 Load cell Amplifier, and Esp8266 NodeMC kit.

The load cell amplifier is first attached after the load cell wires have been checked. The Arduino Uno board is then linked to the load cell amplifier. A USB-B cable is then used to link this to the Arduino software. A Micro USB cable is used to connect the ESP8266 NodeMCU Wi-Fi module to the Arduino software. The following section can go into greater depth about this.

Hardware Implementation
The Wheatstone bridge concept can be used to verify the load cell wires. The opposite corners of the Wheatstone bridge must first be determined. With a multimeter, you may determine that by checking the resistance between the wires. The load cell must be connected to the Hx711 load cell amplifier after the opposing corners have been determined.
Attach the white wire to the A- inputs of the HX711 module and the green wire to the A+ inputs.

Attach the HX711 module's VCC to the Arduino 5V pin and GND to the Arduino's GND.
Attach any of the Arduino's digital IO pins to the DT and SCK of the HX711 module.

Arduino Uno board and NodeMCU ESP8266 kit connected. The 17 GPIO pins on the ESP8266 NodeMCU can be programmatically allocated to a variety of tasks, including I2C, I2S, UART, PWM, IR remote control, LED light, and button. Each GPIO that supports digital signals are managed to high impedance, internal pull-up, or internal pull-down..

The data is sent in the form of a JSON object created in Arduino at pins(9,10), and sent to the(05,06) of the node MCU.
i.e, the D5, and D6 pins of NodeMCU are connected to D9, and D10 pins of the Arduino board where the serialization of dataoccurs.

Internet of Things (IOT)
The concept of the "Internet of Things" refers to the existence of many objects that can interact with one another via wired and wireless connections. The IoT's quick development from the traditional Internet opens up a wide range of utility sectors that were previously inconceivable. Finally, in order to guarantee the security of the transmitted data, an asymmetric secure pipeline is established between the communicating entities. Between a specific device and its device management, mutual authentication is required. IoT is criticised for not taking into account the huge security concerns it is bringing along with the legislative changes it necessitates as it expands so quickly.
IoT security must be tackled by first comprehending all of its constituent parts.

Operation

The load cell is connected to the HX711 load amplifier, which affects how this model operates. An electrical signal is measured in standards and is produces, when the force, such as tension, compression, pressure, or torque are applied to the load cell. An electrical resistance set that changes as a force is applied to a load cell's metal core make up the device. Yet when the force is gone, it goes back to how it was. The quality and accuracy of the load cell are dependent on this material's reversibility. The force is applied to the load cell and is increased then the electrical signal changes directly. It measures the mechanical force, specifically for weighing the objects. The electronic signal is either a voltage change, current change, or frequency change that depends on the type of load cell and a particular circuit used.To use a load cell, first one need to calibrate and also can increase or decrease the error factor units to receive an accurate weight with a microcontroller or microprocessor. Here we use Arduino Uno with an ATmega328p processor used as a microcontroller.

Arduino Uno is the main part here, which senses the weight and calculates the required output.

Figure: IoT Based iron ore stack Management system

Firstly,it is necessary to "calibrate load cell with HX711 with Arduino" .In Arduino Uno, a program will be written for calculating the weight of the load and for calculating the number of days left for the stock availability based on the daily consumption.Between the load cell and Ardunio, The HX711 load amplifying module is connected. This will amplify the signals from the load cell. It will measure the data out from the load cell.
The HX711 is a narrow 24-bit Analog-to-Digital Converter (ADC) used for bridge sensors in measuring weights of scales and in controlling speed at industrial applications. It is particularly used to enrich cell signal and report the data to another microcontroller. A regulated power supply, is an on-chip clock oscillator, and also other peripheral devices and circuits are integrated into the HX711 chip, which are having benefits of high integration, quick response, and robust anti-interference. Weighing scales are frequently designed with these two components: load cells and load cell amplifiers. The load cell

Figure : Aurdino output

is an amplifier that senses weight, feeds the HX711 Load Amplifier Module with an electrical analogue voltage. The output of the HX711 is then translated into weight values by the Arduino using this increased value.
A NodeMCU ESP8266 kit is connected to the Arduino Uno board. The open-source platform builted on the ESP8266 connects all the items and ensures Wi-Fi protocol data transfer. Here a micro USB port is available for power, programming, and debugging. Improved hardware IO APIs can significantly lessen the extra labour involved in configuring and working with devices. You can use the Arduino IDE or the straightforward and effective LUA programming language to programme the ESP8266 Wi-Fi module.Here we write a program for serializing the data from the Arduino. It converts the data into the JSON object

and will be sent to the external database. Here we use different types of libraries like Hx711_ADC.h, ESP8266WiFi.h,WiFiClient.h,ThingSpeak.The Hx711 is acts as an arduino for the HX711 24-bit ADC for measuring weghing scales. Data retrieval from the HX711 is done without blocking the MCU, also on the 10SPS rate setting, and with Multiple HX711s for the performance of conversions parallelly. Tare function also functions without blocking MCU.

Software is a set of libraries that has a serial network communicated with digital pin instead of serial port. It consists of multiple software serial ports which can handle speeds up to 115200bps. With the help of Wi-Fi module Arduino board is connected to the network. It either acts as an acceptor or a receiver. softwareserial.h,

This is a real-time monitoring process and we use a baud rate of 5700 baud. After serialization starts, the data will be sent to an external database. Here we use a server called "ThingSpeak" to display the data which is received through serialization. We can access the different data from the JSON object once it is created. The Node MCU sends the data to the thingspeak serves using the write API key. It uses the library of wificlient.h and thingspeak.h. The Wi-Fi isinitialized by using thepassword and SSID.The data is pushed to thingspeak created channel.

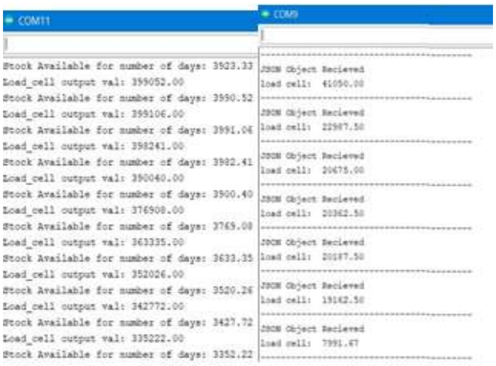

Figure: Output in Thingspeak server

2. Conclusion

The project " IoT Based Coal Stack Management System" is designed such that to improve the system reliability and for the accurate operation of coal measurement and management.
The prototype is designed and verified. It has integrating features by the use of hardware components. module's existence is carefully arranged, for the help of the unit functionto work properly. The project is implemented successfully using integrated circuits and the with the help of developing technologies.
This IoT-based project of coal stack management is designed to implement the IoT in the place of a human interface to minimize errors and improve system reliability. The algorithm written is flexible and can be modified. The idea is to place the Conventional sensor(weight sensor) at the stacker of the power plant where total coal is available before pulverization. To make the whole setup precise and convenient, as IoT is involved. It can also provide flexible operation

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