



# Automatic Speed Control of Conveyor using Strain Gauge in Coal Mining Industries

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## Abstract:

In the production industry of raw materials and products have compelled to be transported from one producing stage to a different. The conveyor system may be used of straightforward handling of transportation while not human effort. This project aims to automate the speed control of the conveyor system based on the load which carries by the system in coal mining industries. The developed product may be ready to handle any form of materials similarly as its most loading capability so as to confirm quick, continuous and economical movement. By victimization strain gauge the loads of the materials are calculated which converts the analog to digital signal which again sends to microcontroller. Depends on the signal by the strain gauge the speed of the conveyor are controlled. It conjointly aims to scale back the facility consumption of conveyor system in comparison to existing conveyors. By victimization completely different masses the Uno for management of conveyors.

## I. INTRODUCTION

The transportation of materials in production industry is sophisticated now a days. The conveyor systems are the medium of materials handling for the transportation. The implementation of the conveyor systems through varied industries create them to unendingly improve the accuracy and speed at that product may be touched through the conveyor. Transporting materials from one place to a different in producing are completely depend upon the speed, height and weight of the materials to be transported. In the production industry of raw materials and products have to be compelled to be transported from one producing stage to a different. The conveyor system may be used of straight forward handling of transportation while not human effort. This project aims to debate concerning the calculation of speed of conveyor, roller diameter, power and drive unit. The developed product may be ready to handle any form of materials similarly as its most loading capability so as to confirm quick, continuous and economical movement. By victimization strain gauge the load of the material are calculated, supported the load the speed of the conveyor are controlled. It conjointly aims to scale back the facility consumption of conveyor system in comparison to existing conveyors.

### *Conveyor systems*

There are two types of conveyor systems, curved conveyors and straight conveyors. Curved conveyor belt is curved in shape. In comparison to straight conveyor belts the curved conveyor belts in fact have various advantageous. Curved conveyor belts can run through any kind of curve, and most of the conveyor belts come with a curve shape of 45, 90, or 180 degrees. The belts are normally built in a flexible mode. These belts are mainly employed in agricultural and industrial purposes. Curved conveyor belts can be mostly segregated into vertical and horizontal conveyor belts. vertical curved conveyor belts are

more in demand. The vertical curved conveyor belts are held between two cases and are primarily employed for large weight material or unit carrying applications. Horizontal curved conveyor belts are usually built on the platform and are used for the carrying heavy materials. The functioning of a conveyor belt is pretty straightforward. In fact an Array Of Conveyor Belts Are Required For The Proper working of conveyor belts. The essential part of conveyor belt tool is the splicing kit. Besides, heat measuring or controlling devices and different types of slitters form a central part of conveyor belt tools. In this project we are used the belt conveyors, the type plays the major role in manufacturing industries, the belt used In this is very flexible and can able to withstand the high load, it is made up of rexine materials an artificial leather, the weighing scale with the 10kg weighing capacity is used for calibration of the weight. The PWM drive which is used to amplify the signals from the strain gauge and it sends the signal to the controller.

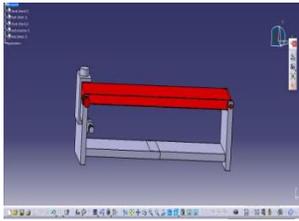
## II. SYSTEM DESCRIPTION

**Catia design:** CATIA offers an answer to form design, styling, egress work flow and image to form, modify, and validate advanced innovative shapes from industrial style to Class-A egress with the ICEM egress technologies. CATIA supports multiple stages of product style whether or not started from scratch or from 2nd sketches(blueprints)

### *Systems Engineering*

The CATIA Systems Engineering answer delivers a novel open and protractible systems engineering development platform that totally integrates the cross discipline modeling, simulation, verification and business method support required for developing advanced 'cyber-physical' product. Fig. 1 shows Catiadesign of conveyor system .It permits or generations to judge requests for changes or develop new product or system

variants utilizing a unified performance-based system engineering approach. the answer addresses the Model primarily based Systems Engineering (MBSE) wants of users developing now a day's.



**Figure.1. Catia design**

smart product and systems and contains the subsequent parts, necessities Engineering, Systems design Modeling, Systems Behavior Modeling & Simulation, Configuration Management & Lifecycle Traceability, Automotive Embedded Systems Development (AUTOSAR Builder) and Industrial Automation Systems Development (Control Build). Fig 3.4 shows the design projections.

**Frame**

The conveyor system has a square shaped aluminum frame and the total setup is made by welding the frame in to a required dimension. The bearing is fit in to the bearing holder and makes weld on it for required dimensions. The bearing holder is welded parallel to each other. And the roller is interfaced with bearing, when rollers are fitted, and anther end of the roller setup is adjustable it is made only for belt tightness and make the objects to travel on straight without slippages.



**Figure.2. Square aluminum tube**

The aluminum frame consists of square shaped and with the dimensions of (100\*35\*15)cm length, breadth, and height respectively. Fig. 2 shows the square aluminium tube. It can able to withstand high loads and strain resistances while comparing to other frames. The cutting machine is used to cut the square tube for required dimensions.



**Figure.3. Ball bearing**

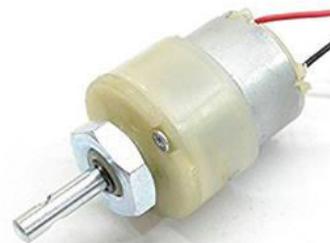
Most rolling bearings contains rings with raceway (inner ring and outer ring), rolling parts (either balls or rollers) and cage. Fig 3 shows the bearing. The cage separates the rolling parts at regular intervals, holds them in situ at intervals the inner and outer raceways, and permits them to rotate freely. The raceway of bearing is named "raceway washer", the inner ring is named the "shaft raceway washer" and therefore the outer ring is named the "housing raceway washer".

**Conveyor Belt**

A conveyer belt consists of two pulleys or shaft is directly coupled with motor, with a nonstop loop of fabric - the transporter - that rotates regarding them. One or each of the pulleys area unit powered, moving the belt and therefore the material on the belt forward. The powered pulley-block is named the drive pulley-block whereas the unpowered pulley-block is named the do-nothing. There area unit two main industrial categories of belt conveyors; Those normally material handling like those moving boxes on within a manufacturing plant and bulk material handling like those accustomed transport industrial and agricultural materials, like grain, coal, ores, fines and lumps material. Conveyors area unit sturdy and reliable components employed in automatic distribution and storage. together with computer-controlled pallet handling instrumentation this enables for a lot of economical retail, wholesale, and producing distribution. it's considered a labor-saving system that permits massive volumes to maneuver speedily through a method, permitting corporations to ship or receive higher volumes with smaller space for storing and with less labor expense.

**DC Motor**

A DC motor is any motor inside a category of electrical machines whereby electricity electric power is reborn into mechanical power. Most often, this kind of motor depends on forces that magnetic fields turn out. despite the kind, Fig.4 shows the double-gearred DC motors, that have some quite internal mechanism, that is electronic or mechanical device. In each cases, the direction of current flow partly of the motor is modified sporadically. The speed of a DC motor is controlled employing a variable provide voltage or by dynamic the strength of the present inside its field windings. whereas smaller DC motors are ordinarily utilized in the creating of appliances, tools, toys, and automobile mechanisms, like car seats, larger DC motors are utilized in hoists, elevators, and electrical vehicles. A 12v DC motor is tiny and cheap, nevertheless powerful enough to be used for several applications. during this project we tend to used the 100rpm brushed gear motor to supply the high force that makes the conveyor to hold the specified weight.



**Figure.4. DC geared motor.**

**Arduino Uno** is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.



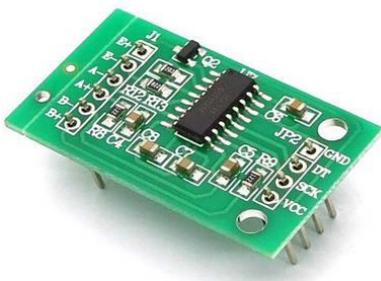
**Figure.5. Arduino Uno**

**ADC Drive**

Based on Avia Semiconductor's proprietary technology, Fig.6 may be a HX711 drive that may be a exactitude 24-bit analog-to-digital convertor (ADC) designed for weigh scales and industrial management applications to interface directly with a bridge device. The input electronic device selects either Channel A or B differential input to the low-noise programmable gain electronic equipment (PGA). Channel A may be programmed with a gain of 128 or 64, like a complete differential input voltage of  $\pm 20\text{mV}$  or  $\pm 40\text{mV}$  severally, once a 5V offer is connected to AVDD analog power offer pin. Channel B contains a mounted gain of 32. On chip power offer regulator eliminates the requirement for associate degree external offer regulator to supply analog power for the ADC and also the device. Clock input is versatile. It may be from associate degree external clock. When exploitation internal analog provide regulator, the dropout voltage of the regulator depends on the external semiconductor device used. The output voltage is capable

$$VA_{VDD} = V_{BG} * (R1 + R2) / R1.$$

This voltage ought to be designed with a minimum of 100mV below VSUP voltage. If the on-chip analog provide regulator isn't used, the VSUP pin ought to be connected to either AVDD or DVDD, counting on that voltage is higher. Pin VFB ought to be connected to Ground and pin BASE becomes NC. The external zero.1uF capacitance shown on Fig. one at the VBG output pin is then not required.



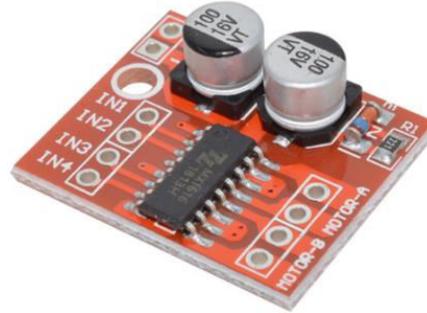
**Figure.6. HX711 drive**

A crystal, or the on-chip oscillator that does not require any external component. On-chip power-on-reset circuitry simplifies digital interface initialization. There is no programming needed for the internal registers. All controls to the HX711 are through the pins.

**PWM Drive**

The TL594 PWM Controller incorporates all the functions needed within the construction of a pulse breadth modulation

(PWM) management circuit on one chip. Designed primarily for power-supply management, this device offers the systems engineer the flexibleness to tailor the power-supply management electronic equipment to a particular application. Fig.7 is a TL594 PWM Controller contains 2 error amplifiers, Associate in nursing on-chip adjustable generator, a dead-time management (DTC) comparator, a pulse-steering management flip-flop, a 5-V regulator with a exactitude of one.5%, Associate in Nursing under voltage opposition feedback loop, and output management circuitry.



**Figure.7. H bridge**

The error amplifiers have a common-mode voltage vary of -0.3 V to VCC-2 V. The DTC comparator incorporates a mounted offset that gives approximately five-hitter dead time. The on-chip generator are often bypassed by terminating RT to the reference output and providing a saw-tooth input to CT, or it are often accustomed drive the common electronic equipment in synchronous multiple-rail power provides. The uncommitted output transistors offer either common-emitter or emitter-follower output capability. every device provides for push-pull or single-ended output operation, with choice by suggests that of the output-control operate. The design of those devices prohibits the chance of either output being periodical doubly throughout push-pull operation. The under voltage opposition feedback loop locks the outputs off till the inner electronic equipment is operational. The TL594CD, CN, CDTB square measure characterized for operation from -40C to 85C.

**Strain Gauge**

Strain gauges are sensors that convert a mechanical variable into associate electrical signal, sometimes a voltage. They work with totally different mensuration principles. These are specially shaped electrical conductors that are insulated by means that of an acceptable material. Fig.8 shows the strain gauge. The strain gauges are hooked up to the essential part, a specially shaped spring body, by friction protection. Underneath the influence of a weight force F, the spring body is malformed and as a result the strain gauge deforms elastically. Because of the amendment within the external form of the strain gauge, the electrical phenomenon of its conductor additionally changes. The highest left and bottom right strain gauges are compressed, their resistance films are shortened and also the electrical phenomenon is reduced consequently. The highest right and bottom left strain gauges are stretched, their resistance films are extended and also the electrical phenomenon is exaggerated. For every strain gauge, a minimum of four strain gauges are connected together to create an entire bridge. The stretched or compressed strain gauges are connected in order that the positive or negative resistance changes are additional along to create a complete imbalance within the bridge.

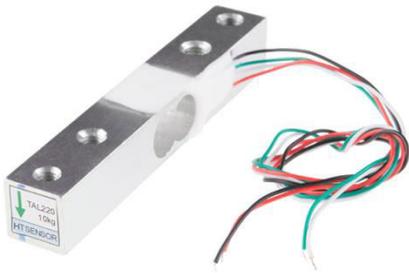


Figure.8. Strain gauge

### III. SYSTEM IMPLEMENTATION

The conveyor system is interlinked with Arduino Uno, strain gauge, PWM drive and 100rpm dc motor. These are connected by using connecting wires as per the setup we made. When the system is ON the weight on the strain gauge is calibrated and sends the analog signal in to Analog to digital signal converter. The PWM drive manages the input and output voltage and Arduino Uno plays important role in automatic control of the conveyor system. When the signal from the PWM, based up on the frequency of the signal the voltage is regulated and sends to the motor to rotates in required rpm. And the motor is coupled with the shaft extended from the roller of the conveyor setup, which makes the conveyor to rotate. Then we may change the weight frequently, based up on the weight ,the motor's speed either increases or decreases , in case the weight is high the torque produced by the motor is high to carry the weight, and speed of the conveyor gets slow. In another hand the weight is very low the less torque is required and the speed of the conveyor is high.



Figure.9. Shows the total setup of the conveyor system

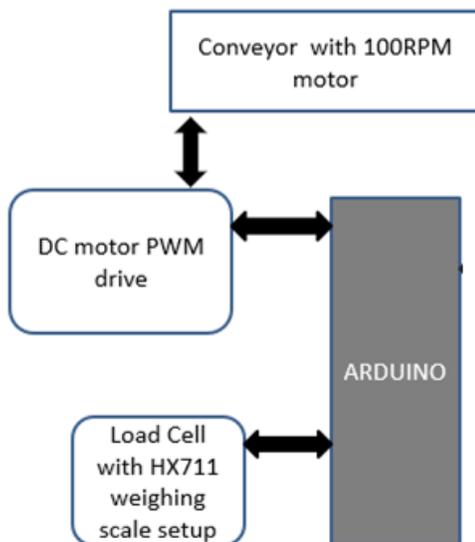


Figure.10. Flow chart of conveyor system

### IV. RESULT

In this design, we used strain gauge to detect the amount of weight of the material on the conveyor. The strain gauge produce the signal which is detected by the controller. The controller controls the speed of the conveyor motor through the motor driver. the speed of the motor changes with respect to the mass of the material. Thus the system achieves the required needs.

### V. CONCLUSION

The main purpose of developing this product to automate the belt conveyors, which is depends upon the load carried through the conveyor. The analog signal is converted in to digital using ADC. Then the signal sends to controller, the total process is controlled by Arduino Uno. This system having a simple structure and reduced number of parameters in the design process. We mainly focus on power consumption during conveying. The control signal is generated from the strain gauge and it is connected to driver for analog to digital conversion. Then the signal sends to controller, the total process is controlled by programming in the Arduino. This system helps to move the conveyor on different speeds with respect to the loads. The weight of the conveyor increases, torque increases and speed decreases, incase weight of the conveyor decreases and the torque decrease, speed gets increased.

### VI. FUTURE WORK

The future work is to implement further sensors such as image processing to determine the appropriate weight of the material before it reaches the conveyor. The weight of the material can be determined and monitored through the image processing sensor to increase the efficiency of the motor.

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