# Design and Development of a Smart Anti Drift control System for Conveyor Belt

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**Abstract:**

Conveyors Belts are robust and dependable elements used in various industries for the transportation materials. Unfortunately, sometimes even the slightest movement or change in the conveyer can throw the belt off track. Traditional condition monitoring methods are difficult to achieve comprehensive and effective monitoring. In this paper a new design of the anti drift system is proposed. The design will depends on micro-controller, stepper motors and position sensor to work together as online monitoring and readjusting the belt conveyer.

**Keywords:** Belt conveyor, Belt drift, Microcontroller, Stepper motors.

## 1. Introduction:

Conveyor belts play a vital role in essential equipment utilized in production lines, supply chains, and mining industries, among others. The demand for the production and movement of products within manufacturing facilities, warehouses, and distribution centers is heavily reliant on these systems. The enhancement of conveyor belt systems has become a significant area of focus due to the rising demand from entrepreneurs for increased productivity. Traditional methods of operating and managing conveyor belts required consistent monitoring and maintenance schedules, which often resulted in unwanted downtimes and inefficiencies [1].

There are primarily two types of conveyor belts: flat and troughed. A flat belt is typically employed for handling bags, bottles, boxes, and other packaged materials; however, under specific conditions, loose bulk materials, such as soap, can also be effectively managed. A troughed belt allows for an increase in loading capacity of over 60% without the risk of spillage and is suitable for nearly any bulk material in dry, damp, or semi-wet conditions. The lifespan of a conveyor belt is influenced not only by its design and manufacturing quality but also by the care and attention it receives during storage and operation.[2][3].

Field testing has proved that a combination of friction and tension is the best way to put a belt back on track when the structure cannot be properly aligned. The proposed design uses a micro-controller as decision maker and process data, high torque stepper motor will use as an actuator and position sensor for position sensing, and the friction and tension method will use as solution method.

## 2. Main Faults of Belt Conveyor :

Mine belt conveyors typically utilize a trough structure, which primarily consists of a head (including motors, transmissions, rollers, etc.), a body (comprising rollers, racks, etc.), a tail, conveyor belts, and auxiliary devices (such as braking and cleaning devices). Among these components, roller and frame failures represent the predominant mechanical issues, accounting for over 60% of all failures. The idler roller is crucial to the belt conveyor›s structure, and its operational condition significantly influences both the conveyor belt›s lifespan and the overall functionality of the conveyor system. However, in real-world operational environments, contaminants like moisture and coal dust can corrode the idler roller›s bearing, hindering its smooth rotation. If material adheres to the idler roller›s surface, it can lead to uneven resistance distribution, potentially resulting in deviation failures. Furthermore, if the idler roller becomes stuck and ceases to rotate, the ongoing sliding friction can elevate temperatures, posing a risk of fire if the idler stops completely [4][5].

Conversely, the frame serves as the fundamental component of the belt conveyor, with its quality and installation process being critical to the safe and stable operation of the system. Rack failure primarily involves deformation, which can easily result in deviation faults, subsequently leading to secondary issues such as conveyor belt wear and slippage. Therefore, during coal mine production and transportation, inspecting the frame is an essential task. To ensure the safe operation and extend the lifespan of the belt conveyor, it is imperative to conduct regular maintenance and inspections of both the idler rollers and the frame. Additionally, the advancement of condition monitoring technologies tailored for belt conveyors, along with the early detection of failure signs and proactive warnings, are vital strategies for enhancing system stability and reliability. To sum up, only by fully paying attention to the operation status of these key components can the belt conveyor play its irreplaceable role in coal mine production [6][7].

## 3. Problem Statement:

Belt drift occurs by many reasons such as: Misalignment of rollers or pulleys, an incorrect splice, material builds up, slight bump by heavy machinery, high winds, frost, or change rabidly in load. The drift, if caught early and fixed, a mistracked belt does little damage to the conveyor. However, if it misused or left unfixed, this will lead to get some types of damage such as structure damage (Figure-1) or belt damage (Figure-2). Another result of drift; the material will disperse out of conveyer system which will cause material losses and environmental contamination (Figure-3).

Figure-1: Structure Damage

Figure-2: Belt Damage

Figure-3: Material Losses

## 4. Existing Anti-drift Solution:

To prevent and solve drift problems, many methods are followed, here is a collection of the main methods [8][9][10]:

### 4.1. Cylindrical-Conical:

Pulleys with this shape exert a self-tracking effect. If there is a variable run-off tendency, or a reversal in running direction, the belt is centered without the need to adjust the axis. Detailed information on cylindrical Belt tracking conical pulleys in simple two-pulley conveyors with the defined running direction it is usually the head pulley that is the driving pulley. It is designed in cylindrical-conical shape.

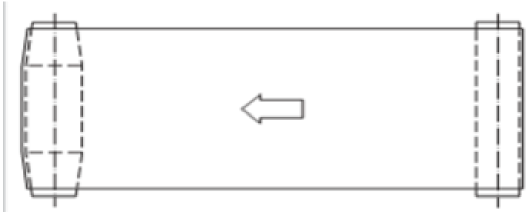

Figure-4: Cylindrical-Conical

**4.1. Guiding Pulleys:**

Unlike cylindrical-conical pulleys, adjustable cylindrical rollers are not selftracking. This means when belt running direction changes; the pivoted position of cylindrical pulleys must be reset. As this is not practicable, the use of adjustable cylindrical rollers for belt tracking is not recommended for reverse single operation.

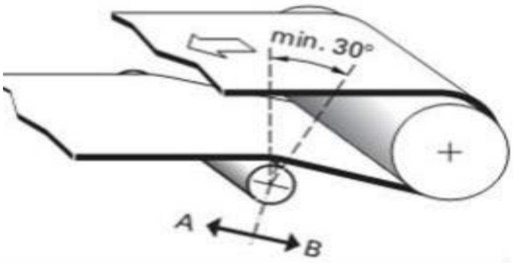


Figure-5: Guiding Pulleys

Group of Guiding Pulleys

In a group of pulleys and the rollers, one of that the belt first makes contact with the larger tracking effect (in the adjacent example roller A).

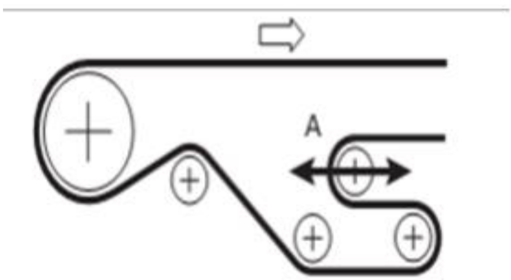


Figure-6: Group of Guiding Pulleys

## 5. Proposed System

General proposed system contains two parts: electrical and mechanical design. The design shape is shown in figure-7

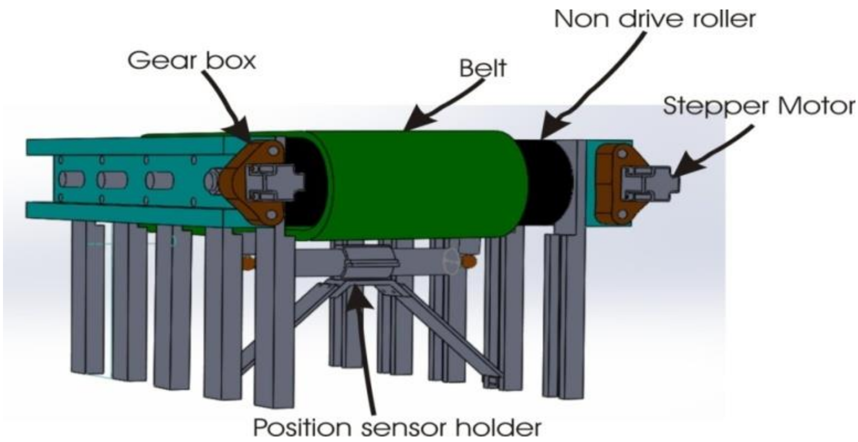


Figure-7: Proposed system

### 5.1. Electrical Design

This design contains all electrical and electronic components used in this system such as microcontroller (Atmega 16), key switch (XT-12P), two pole three way rotary switch, Linear Variable Deferential Transformer (LVDT) position sensor and stepper motors. This design is shown in figure-8

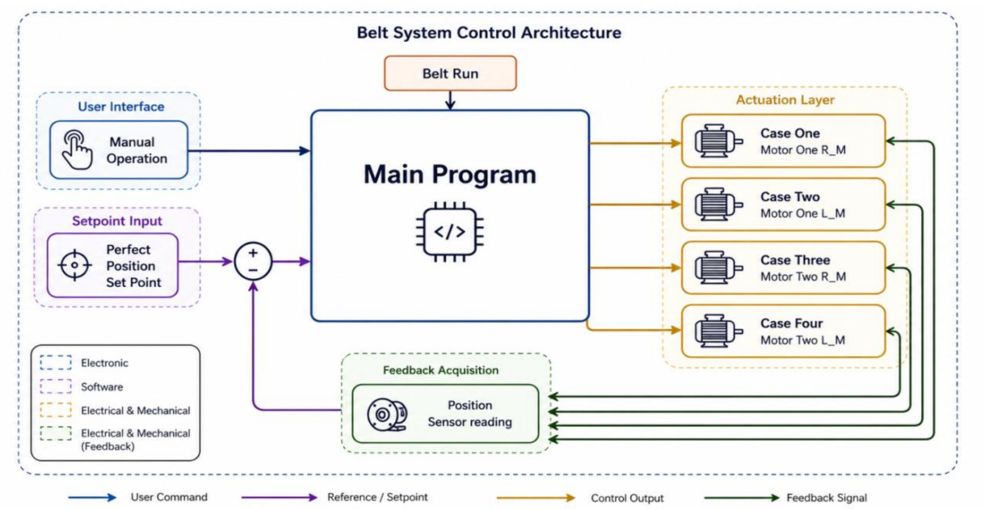


Figure-8: Electrical Design

Proteus program version (7) used to simulate the design, electronic circuit components

- Power supply 5VDC and 12VDC.
- Micro-controller (Atmaga 16).
- Unipolar stepper motor.
- Drive circuit ULN 2003.
- Position sensor (light sensor).
- Switches.

Figure -9 shown circuit component

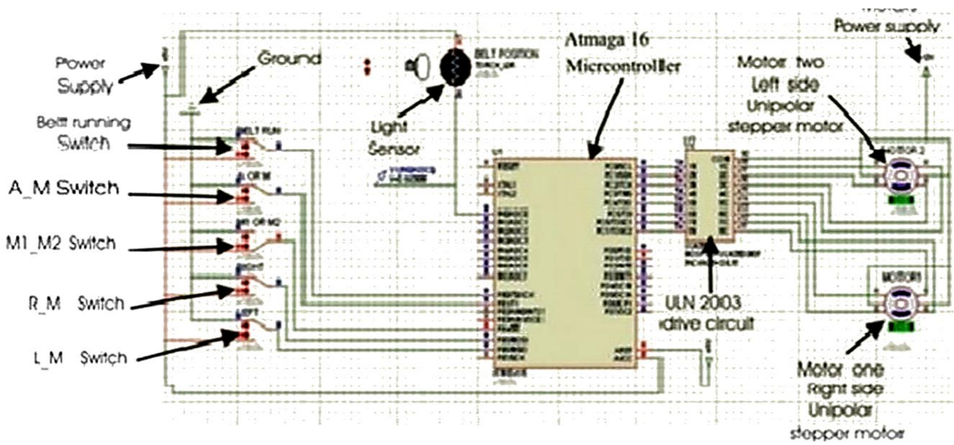


Figure-9: Circuit Components

Mechanical Design

This design contains all mechanical components such as position sensor holder and gearbox. This design is shown in figure-10

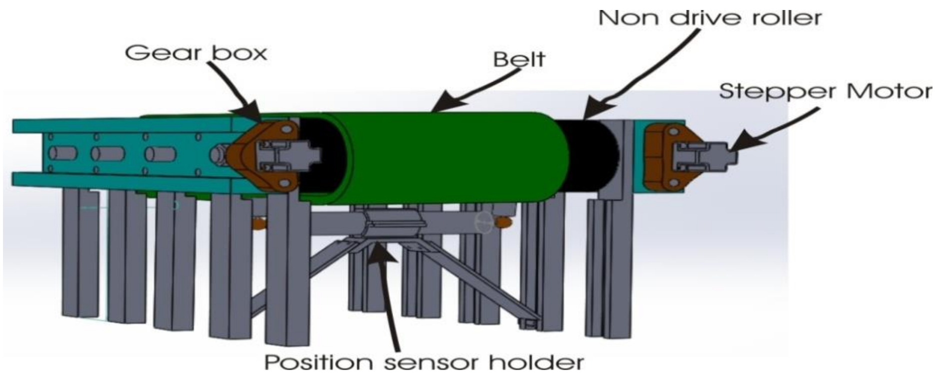


Figure-10: Mechanical Design

## Results and Discussions:

In this system, the belt position will be sensed by position sensor, set point for the perfect position calculation by dividing position sensor range by two. The result will be the set point; the set point value will subtract from the sensor reading value; subtract result tell if belt drift right, and left or un-drift depends on that micro-controller will take action.

To move the belt to the right tension in left side must increase or release right side, both actions will give the same result, but the maximum tension or release must be considered while adjusting the belt, to move the belt to left tension in right side must be increased or release left side. Table:1 shows variables and execution depends on value.

Taible-1: Variables descriptions

| Variable | value | |
|---|---|---|
| | Zero | one |
| Belt | Belt stopping | Belt running |
| A_M | Auto system enable | Manual system enable |
| M1_M2 | Motor NO. one | Motor NO. two |
| R_M | Disable right direction | Enable right direction |
| L_M | Disable left direction | Enable left direction |
| P | Analog input from position sensor | |
| Set point | Constant value refers to perfect position | |
| P2 | The result of subtracting set point from p | |
| B1 | Counter up or down depends on motor NO. one rotation direction | |
| B2 | Counter up or down depends on motor NO. two rotation direction | |

Figure 11 shows the flow chart for the proposed system

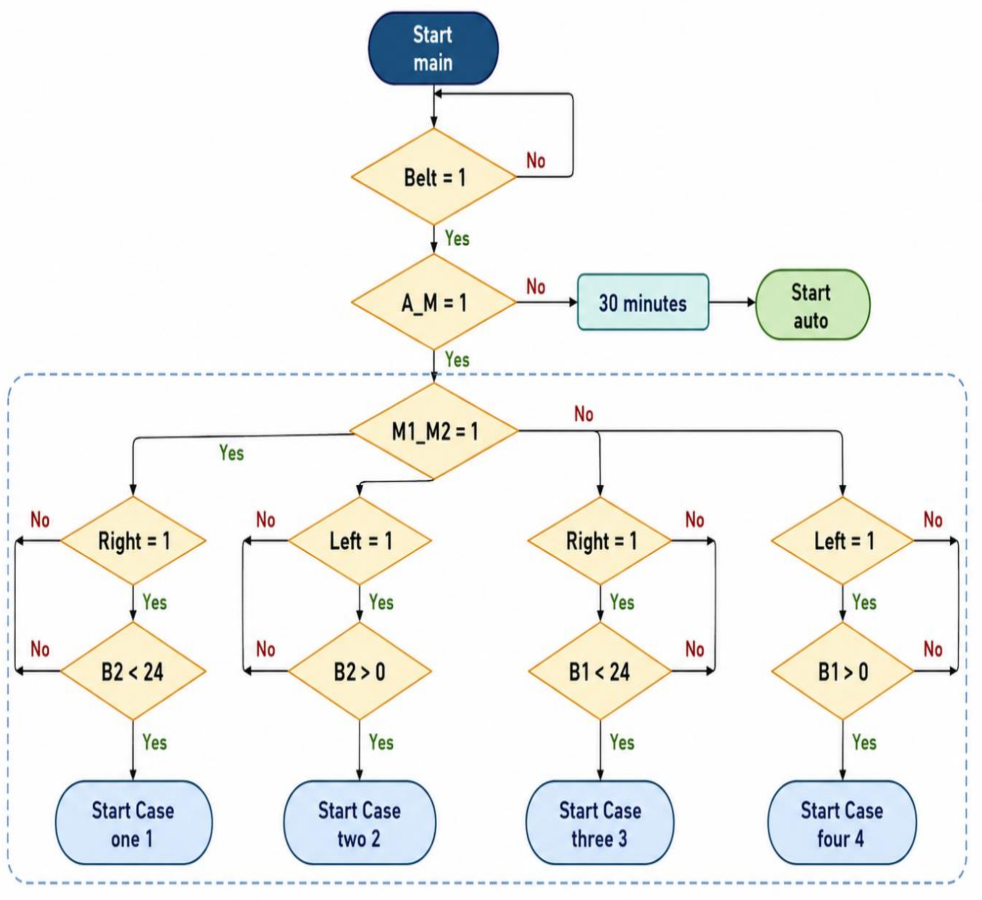


Figure 11: system flowchart

As shown in figure11, Flowchart has four cases:

Case 1: in this case motor number one (M1) spins to the right direction for one cycle and go back to start the main program.

Case 2: in this case motor number one (M1) spins to the left direction for one cycle and go back to start the main program.

Case 3: in this case motor number two (M2) spins to the right direction for one cycle and go back to start the main program.

Case 4: in this case motor number two (M2) spins to the left direction for one and go back to start the main program.

The system always read values from position sensors, make difference between them, and then make decision to readjust belt if drift occur (difference not zero). Figure 12 and figure 13 shows the motion of motors M1 and M2 left or right to adjust the belt.

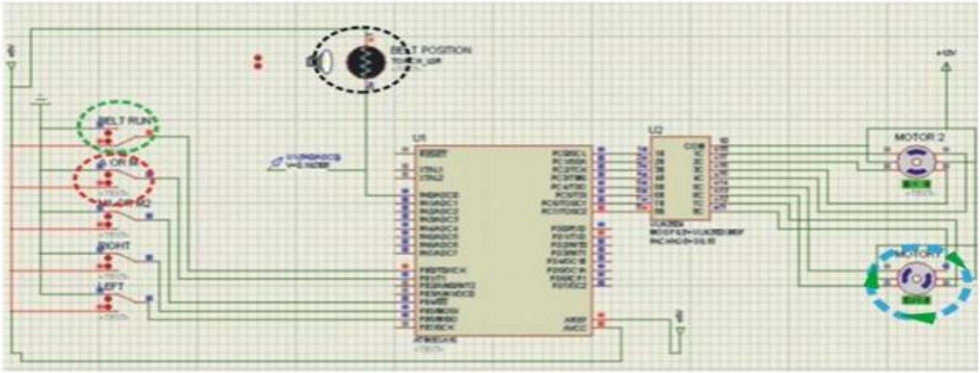


Figure 12: Readjusting by M1

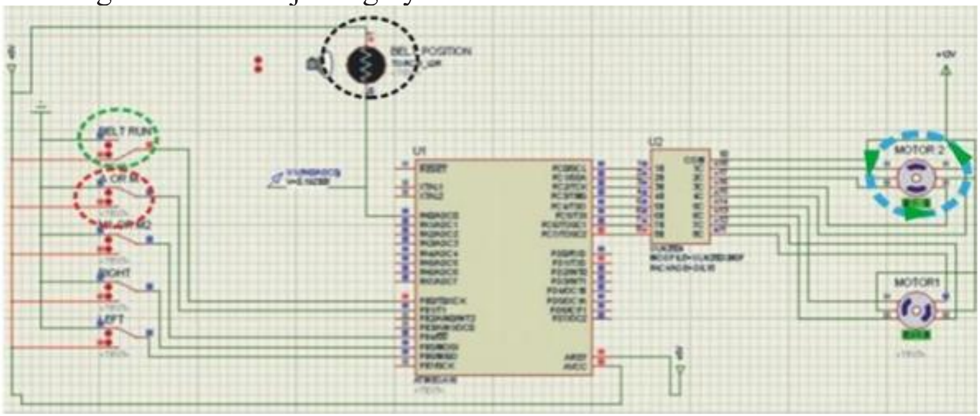


Figure 13: Readjusting by M2

**Conclusions:**

In conclusion, utilizing intelligent systems in conveyor belts represents a contemporary method for automating industries that boosts the efficiency of conveyor operations. By employing Arduino and positional sensors, it can enhance management processes, maintenance, and optimize conveyor functions. The sophisticated anti-drift belt conveyor system promotes effective operation, improves safety, and minimizes both downtime and operational costs. For researchers, examining such enhancements should highlight the importance of further developing and refining AI models as well as more integrated strategies to further optimize the efficiency of structures. This insight can facilitate the application of Artificial Intelligence in conveyor systems, resulting in improved productivity, performance, and better resource management for practitioners. Implementing AI in conveyor belts is likely to strengthen the dependability of industries and pave the way for future innovative advancements.

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