بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of graduates studies

Design of Anti Drift System for Belt Conveyer in Industrial Field

تصميم نظام مانع إنزلاق سيور النقل في المجال الصناعي

A Thesis Submitted in Partial Fulfillment for the Requirements of the Degree of M.Sc. in Mechatronic Engineering

Prepared by:

Muhy eldeen Mohammad Ataelfdeel Jafer

Supervised by:

Dr. Mustafa Osman Ali

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Abstract

An industrial material transportation takes high priority and any disturbance can affect the process, the belt conveyer system considers as the main element in the transportation system. Unfortunately, sometimes even the slightest movement or change in the conveyer can throw the belt off track, in this study 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.

مستخلص

عملية نقل المواد الخام في الصناعة هي عملية ذات اهمية قصوي، وفيها تمثل السيور الناقلة العنصر الاساسي في معظم انظمة النقل ؛ وفي هذه العملية يمكن لتغيير بسيط في حركة النقل او عوامل التشغيل ان يحدث انحرافاً مؤثراً يخرج سير النقل عن مساره . هذا البحث يبرز تصميماً جديداً لنظام لتقويم انحراف السير الناقل . وذلك عن طريق استخدام متحكمة دقيقة ومحركات الخطوة وحساس الموقع للعمل معاً كنظام مراقبة واعادة ضبط الانحراف طوال زمن التشغيل .

الآية

قال تعالي :

بسم الله الرحمن الرحيم

عَالِمِ إِلَى وَسَتُرَدُّونَ وَالْمُؤْمِنُونَ اللَّهُ عَمَلَكُمْ وَرَسُولُهُ فَسَيَرَى اعْمَلُوا (وَقُلِ

تَعْمَلُونَ) كُنتُمْ بِمَا وَالشَّهَادَةِ فَيُنَبِّئُكُم الْغَيْبِ

صدق الله العظيم

التوبة (105)

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My sincerely thankful goes to Allah Almighty through inspiration the right direction to make this research possible for me and to accomplish this project.

After Allah, what we can do without our family, friends, teachers and colleagues, for all of them no word is suffice to describe my gratitude, I hope to be there when you need me.

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Chapter 1: Introduction

1.1 Foreword

In all industrial material, transportation take high priority and any disturbance in it can affect the process. The belt conveyer system considers as the main member in the transportation system. It has many advantages as low cost, practical, flexibility in size, type and length. When the operation is working at full speed trying to move product or fulfill orders, the last thing he need to worry about is the conveyer system belt. Unfortunately, sometimes even the slightest movement or change in the conveyer can throw the belt off track. Misalignment of rollers or pulleys, an incorrect splice, and material build up are just a few things that can get the belt off track. Sometimes a slight bump by heavy machinery, or even the weather – high winds, frost, and even sunshine - can interrupt belt's path. This can cause belt damage, running down time, material losses, environment contamination and safety issues. To solve this problem qualified mechanical and electrical team needs to readjust any belt conveyer after drift happened manually and monitor the new adjusts for some time before the belt runs on duty again.

1.2 Problem Statement

Most of belt conveyers systems suffer from belt drift (mistracking) problem, the main target of this research is to design an auto anti drift system, The proposed system should monitor belt position and set an auto readjusting in case of belt drift.

1.3 Proposed Solution

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.[1]

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.

1.4 Contribution

This research offers a new technique to act as anti-drift device depend on micro-controller, this technique provides online readjusting system and gives more flexibility and reliability for belt conveyer system.

1.5 Thesis Layout

Chapter one is introduction contains problem statement and proposal solution. Chapter two is literature review contains the popular drift solution methods and devices. In chapter three is the electrical and mechanical design. The code and the result in chapter four will contain variable, flow chart and simulation for different operation cases using prutuos program to show the reader research result and prototype devices shown in this chapter. Chapter five contains research conclusion and future recommendations.

Chapter 2: Belt Conveyor System

2.1Belt Conveyor System

A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors:

- General material handling such as those moving boxes along inside a factory.
- Bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more.

The belt consists of one or more layers of material. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called a carcass and an over layer called a cover. The carcass is often a woven fabric having a warp and weft. The most common carcass materials are polyester, nylon and cotton. The cover is often various rubber or plastic compounds specified by use of the belt. Covers can be made from more exotic materials for unusual applications such as silicone for heat or gum rubber when traction is essential.

2.2 Drift (Mistracking)

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
- Sunshine
- Change rabidly in load

2.3 Drift:

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 following:

2.3.1 Structure Damage

When belt drift does not catch early it will hit the structure, while running this will cause different types of damage as shown in figure (2.1).

Figure (2.1) Structure Damage

2.3.2 Belt Damage

While drift the belt can bend over itself or cut, also belt edge can damaged as shown in figure (2.2).

Figure (2.2) Belt Damage

2.3.3 Material Losses And Environment Contamination

Another result of drift; the material will disperse out of conveyer system which will cause material losses and environmental contamination as shown in figure (2.3).

Figure (2.3) Material Losses and Environment Contamination

2.3.4 Cost

To fix any drift problem; we need to stop the conveyer system and used maintenance staff this of the course will increase running costs.

2.3.5 Running Downtime

To fix any drift problem; we need to stop the conveyor system.

2.3.6 Safety Issues

Materials which disperse out of the conveyor system can be very safety bad issues.

2.4. Common Anti-drift Solution

To prevent and solve drift problems, many methods are followed, here is a collection of the main methods:

2.4.1. 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 as shown in Figure (2.4) and Figure (2.5).

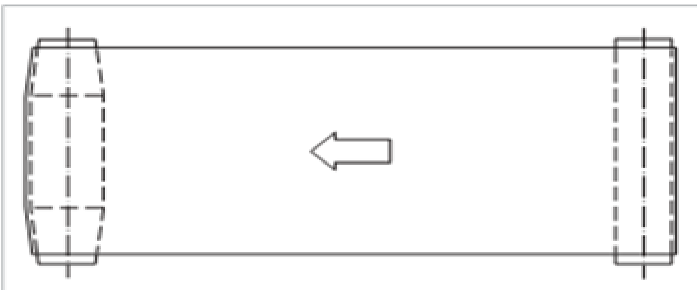


Figure (2.4) Cylindrical-Conical

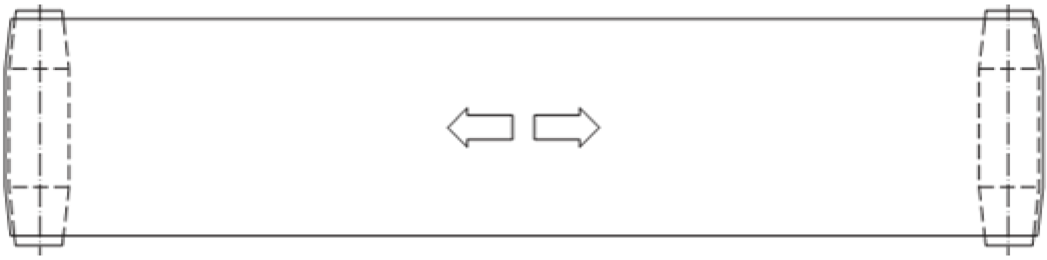


Figure (2.5) Cylindrical-Conical two side

2.4.2. Guiding Pulleys:

Unlike cylindrical-conical pulleys, adjustable cylindrical rollers are not self-tracking. 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[2] figure (2.6) show the guiding pulleys

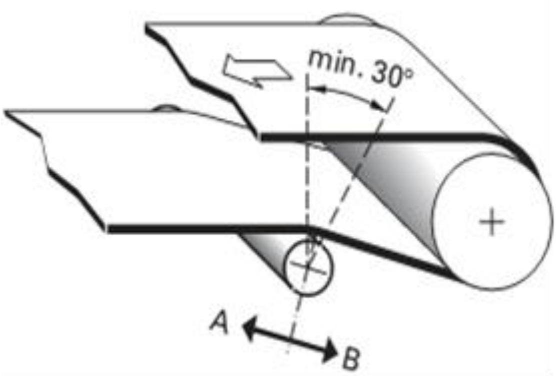


Figure (2.6) Guiding Pulleys

2.4.3. 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) as shown in figure (2.7).

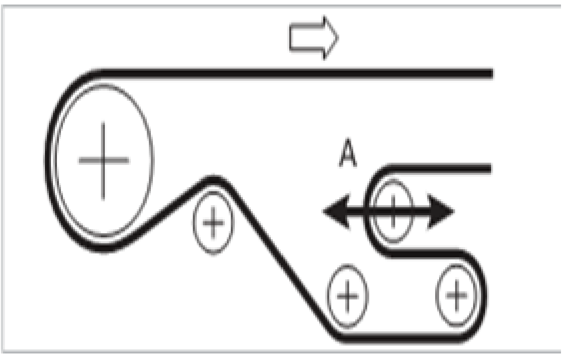


Figure (2.7) Group of Guiding Pulleys

2.4.4. Rollers On The Return Side

The tracking effect of inclined rollers on the returning side is maximized if they are fitted to the running on the side in front of the tail pulley for head drive and in front of the driving pulley for tail drive.

The positioning of rollers under the belt on the conveying side of the belt produces a good tracking effect due to the higher coefficient of friction as shown in figure (2.8), however, possible tracking marks on the belt cover must also be taken into consideration[3]

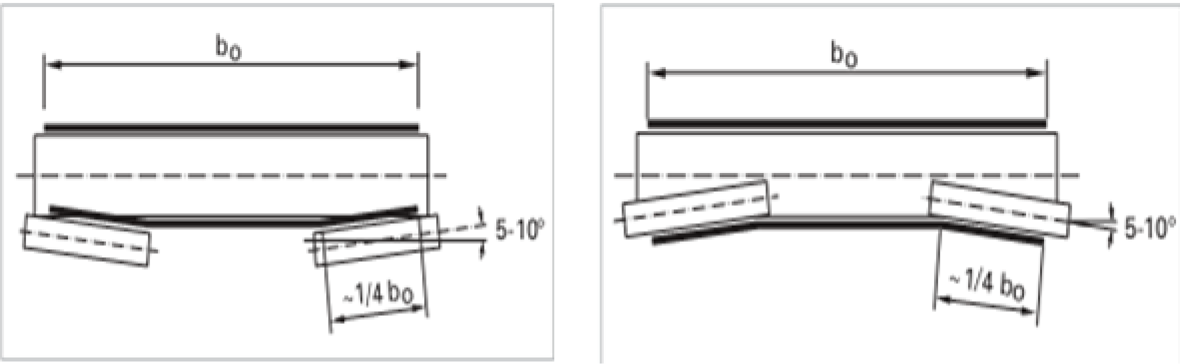


Figure (2.8) Rollers On The Return Side

2.4.5. Pivotable Carrying Rollers

Carrying rollers, on the conveying and return side, can also be installed for pivoted action as shown in figure (2.9), but as belt contact is minimal, the tracking effect of these adjustable rollers is limited.

Pivoted cylindrical rollers are not self-tracking as is the case with cylindrical-conical pulleys. This means that when the run-off tendency or running direction changes, the pivoted position must be reset. As this is not practicable; the use of pivotable cylindrical rollers for belt tracking is, in general, not suitable for reversing operation

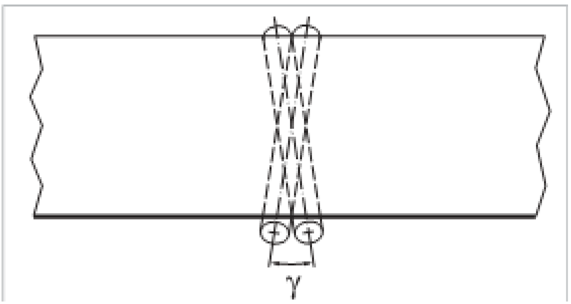


Figure (2.9) Pivotable Carrying Rollers

2.4.6. Guiding Pro Files

Guiding profiles are usually V-shaped, welded or glued onto the running side of the conveyor belt as shown in figure (2.10).

Rectangular and semicircular profiles are also used at times, because of the relatively high production costs and their limited effectiveness guiding profiles are not recommended as a general belt tracking measure. Particularly not suitable are guiding profiles in applications with high speed, as they have a tendency to be forced out of the groove allowing the belt to continue to run off

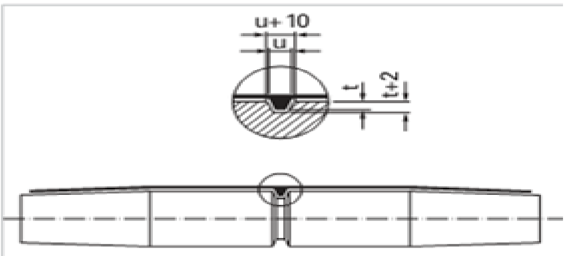


Figure (2.10) Guiding Pro Files

2.4.7. Automatic Belt Control

Automatic belt control can solve even the most serious belt tracking problems which shown in figure (2.11). However, it is a comparatively expensive option and, therefore, used where belt tracking behavior is either highly critical and/or where other belt tracking methods have proven ineffective chronic build up contaminating rollers/pulleys.[4]

Automatic belt control works by sensing the edges of the belt, either by means of non-contact sensors or by mechanical means. The signal is sent to a control mechanism, which actuates a guiding pulley which accurately centers the belt.

1. Optical scanner (photocell, light barrier)
2. Pneumatic sensor (air jet)
3. Electrical sensor (capacitive sensor)
4. Mechanical sensor (microswitch, stylus)
5. Control mechanism: electrical (servo drive), pneumatic or hydraulic (pressure cylinder)
6. Guiding pulley

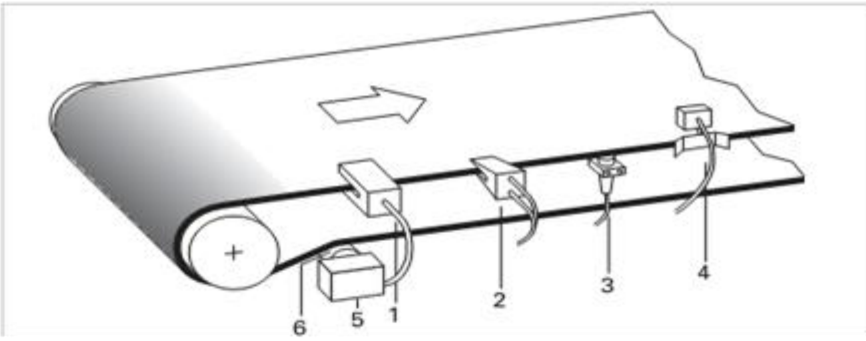


Figure (2.11) Automatic Belt Control

2.4.8. Additional Belt Wrap

In areas where local transverse forces occur, tracked belts will be kept in place by additional belt wraps. The effect can be enhance by covering the additional pulleys as shown in figure (2.12).

Running-off belts can be tracked by adjustable rollers Horizontal adjustment (A) is suitable for one running direction only Vertical adjustment (B) will also track the belt for reversing operation.

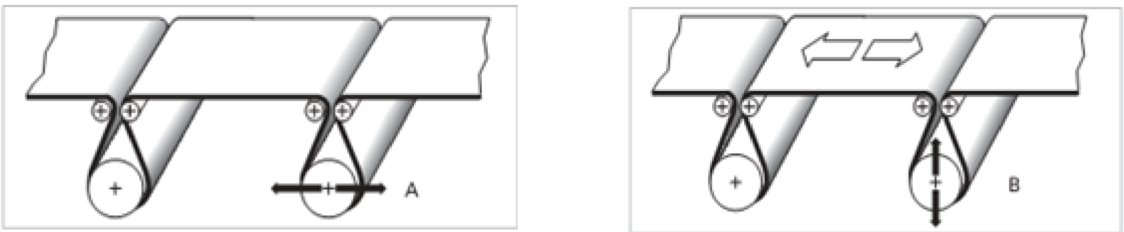


Figure (2.12) Additional Belt Wrap

2.4.9. Carrying Rollers With Adhesive Cover

Local transverse forces can also be deal with by installing multiple carrying rollers with friction cover as shown in figure (2.13). This method is suitable both for installations with slider bed and carrying rollers. With rollers adjusted exactly perpendicular to the belt running direction, the tracking will also work for reversing operation.

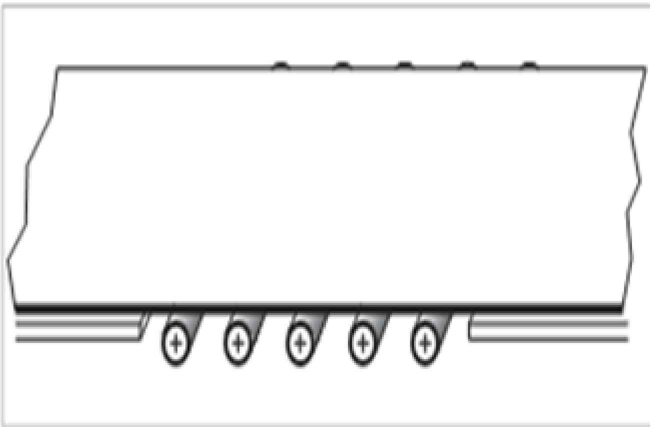


Figure (2.13) Carrying Rollers With Adhesive Cover

2.4.10. Pivoted Rollers On The Carrying Side

This method is not recommended to be used with thin belts of low transverse rigidity. Since the belt does not only run on the rollers but also slides, friction exists and thus increases belt wear. This tracking method centers the belt only in the running direction as shown in figure (2.14). This method is only effective for centrally located and uniformly distributed conveying goods

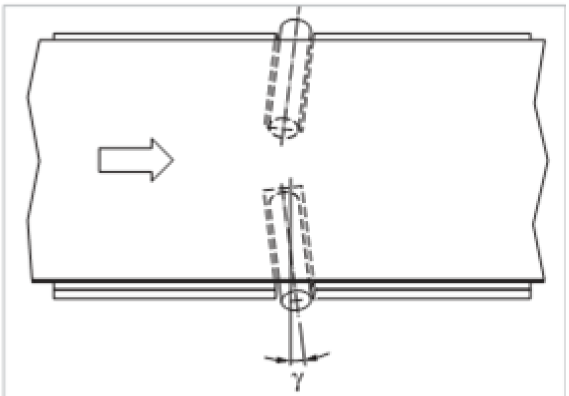


Figure (2.14) Pivoted Rollers On The Carrying Side

2.4.11. Belt Sensing Combined With Pivotable Carrying Roller

This tracking device is use for heavy belts and for belts with high lateral stability. Specialty manufacturers' supply these units, which can also be equipped with adjustable sensors that substantially reduce belt edge wear. This tracking method works only in one running direction as shown in figure (2.15).

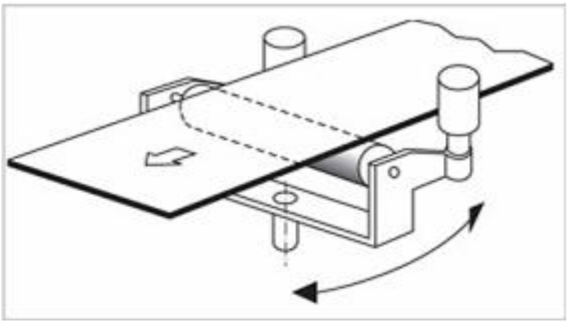


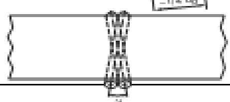
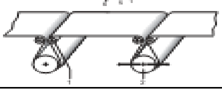
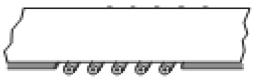
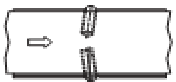
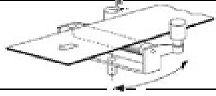
Figure (2.15) Belt Sensing Combined With Pivotable Carrying Roller

2.4.12. Lateral Guide Strips And Guide Rollers

This tracking measure is only possible for the belts with sufficient lateral rigidity and edge integrity, however belt edge wear will increase. Guide rollers are preferable to lateral wear strips in this respect, the tracking measure will also work for reversing operation. Edge guide strips are best suited for relatively clean conveying operations as debris may become lodge between the belt and guide strip causing singe cant belt damage and other performance problems.

The entrance of edge guide strips must be reduced in order to minimize potential edge damage the belt edges can be abrasive themselves. It is an advisable, therefore, to consider using durable low friction materials for edge guide strips stainless steel, phenolic.

Below table (2.1) will show comparison between anti-drift methods available in market

Method		Basic tracking Measures	Additional tracking measures	For reversing operation	For absorbin local transverse f
Cylindrical-conical or crowned pulley		**P**	**p**	**p**	×
Guiding pulley		×	**p**	o	×
Inclined rollers on the return side		×	**p**	o	×
Pivotable carrying rollers		×	**p**	×	×
Guiding profiles		×	**p**	**p**	**p**
Automatic belt control		O	**p**	o	×
Additional belt wrap		×	**p**	o	**p**
Carrying rollers with adhesive cover		×	**p**	**p**	**p**
Pivoted rollers on the carrying side		×	**p**	×	×
Belt scanning combined with pivotable carrying roller		×	**p**	×	×
Lateral guide strips and guiding rollers		×	**p**	**p**	0

p : Well applicable, 1st priority

O : Applicable depending on the application or under observation of specific limitations

×: Not recommended

Chapter 3: Electrical and Mechanic Design

3.1. Design the proposal Device

The design contains three parts, software, electronic design and eletromechanical design, this chapter concentrates on electronic and mechanical design, the software of proposed device have been mentioned in the previous chapter, the figure (3.1) below shows the design block

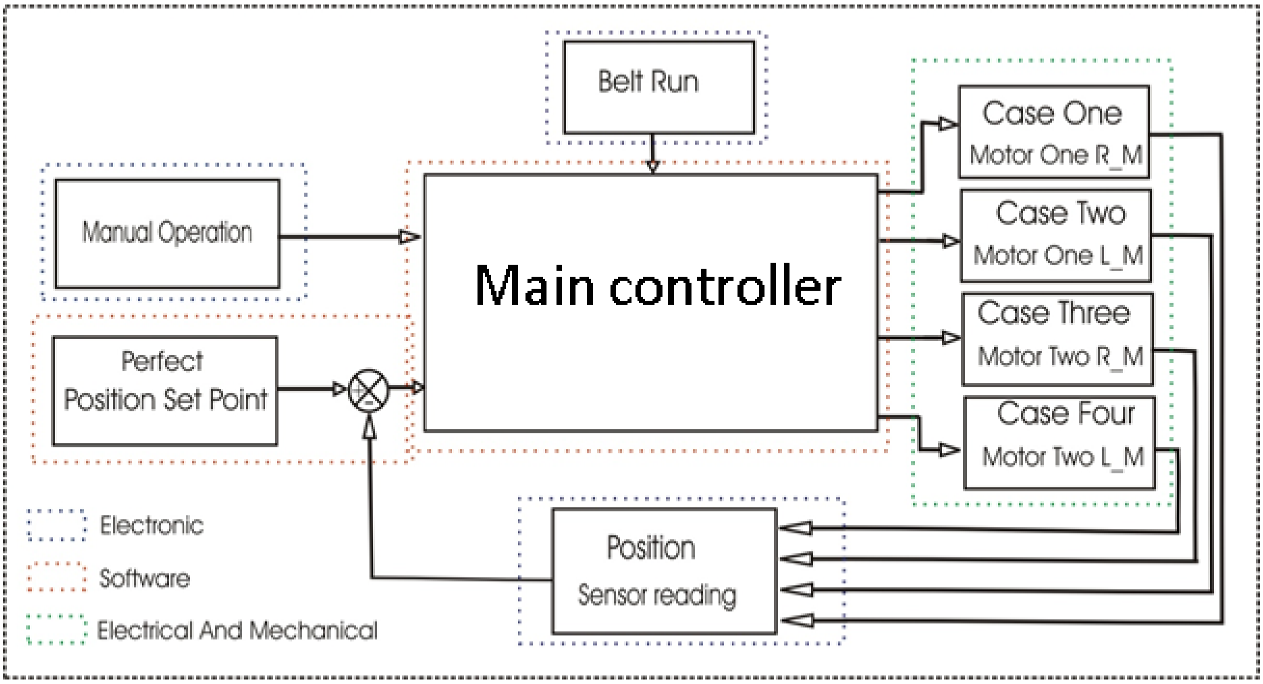


Figure (3.1) The proposal design block

3.2. Electrical Design

The electrical design contains all electrical and electronic parts used in the device, each part will discuss in the simulation environment and prototype design, some part will change in real device also will discuss.

3.2.1 Power Supply

The power supply has 220 VAC as input and two outputs channels 5VDC/1.1Amp. One channel for control and micro-controller and the other channel (5VDC/1.1Amp) for motor drive circuit this power supply is suitable for prototype in Practical design channel two must match stepper motor reacquired and his circuit drive.

3.2.2 Micro-controller

Atmega 16 shown in figure (3.2) have been used in both design (Prototype and Practical design) to avoid any damage in micro-controller due to soldering micro-controller holder has been used.

Figure (3.2) Micro-controller Atmega 16

3.2.3 Key Switch

There are two type of switches used in this design and both can be use in prototype design and Practical design:

- One pole two way switch (XT-12P):

This type of switch shown in figure (3.3) has been use to input operation condition as motor selection and direction selection, in prototype design one switch used to act as a relay for belt run signal

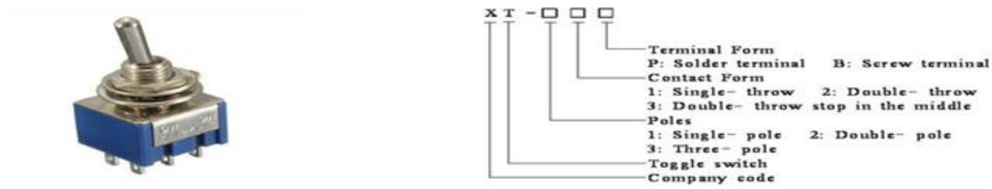


Figure (3.3) Key switch

3.2.4 Two Pole Three Way Rotary Switch

This type which shown in figure (3.4) used for the selecting operation mode which is auto or manual

Figure (3.4) Two Pole Three Way Rotary Switch

3.2.5 Position Sensor

Change resistant method will be used, prototype which is two kilo-ohm potentiometer have been use shown in figure (3.5)

Figure (3.5) Position sensor

In Practical design, linear variable differential transformer (LVDT) sensor which shown in figure (3.6) has been used, the sensor will be fixed to belt by special support

Figure (3.6) linear variable differential transformer (LVDT)

3.2.6 Stepper Motor

Stepper motor which shown in figure (3.7) used to apply the decision maker by micro-controller, in the prototype small stepper motor has been used (28byj-48) to show the movement, it specification in table (3.1) .

Table (3.1) stepper motor specification for prototype

Motor Type	Unipolar stepper motor
Connection Type	5 Wire Connection (to the motor controller)
Voltage	5-12 Volts DC
Frequency	100 Hz
Step mode	Half-step mode recommended (8 step control signal sequence)
Step angle	Half-step mode: 8 step control signal sequence (recommended) 5.625 degrees per step / 64 steps per one revolution of the internal motor shaft Full Step mode: 4 step control signal sequence 11.25 degrees per step / 32 steps per one revolution of the internal motor shaft
Gear ratio	Manufacturer specifies 64:1. Some patient and diligent people on the Arduino forums have disassembled the gear train of these little motors and determined that the exact gear ratio is in fact 63.68395:1. My observations confirm their findings. This means that in the recommended half-step mode, we will have:64 steps per motor rotation x 63.684 gear ratio = 4076 steps per full revolution (approximately).
Wiring to the ULN2003 controller	A (Blue), B (Pink), C (Yellow), D (Orange), E (Red, Mid-Point)

Figure (3.7) Stepper motor

In a prototype device stepper half-step switching sequence has been used as a below in table (3.2):

Table (3.2) stepper half-step switching sequence

Lead wire color	CW direction switching sequence							
	1	2	3	4	5	6	7	8
4 orange	■	■						■
3 yellow		■	■	■				
2 pink				■	■	■		
1 blue						■	■	■

In Practical design motor size and properties will depend on belt size and torque needed to release or tight re-adjustable nut

3.2.7 Stepper Motor Drive Circuit

The ULN2003 stepper motor driver board shown in figure (3.8) used to control the 28BYJ-48 stepper motor from a micro-controller, One side of the board has a 5 wire socket where the cable from the stepper motor hooks up and 4 LEDs indicate which coil is currently powered,. In the middle of the board, the ULN2003 chip. At the bottom are the 4 control inputs that should connect to four micro-controller digital pins.

Figure (3.8) Stepper Motor Drive Circuit

In Practical design stepper motor drive circuit Specifications will depend on motor voltage and current will draw, this change in voltage and current will effect in power supply Specifications.

3.3. Mechanical Design

The mechanical specifications of the conveyer system will not discuss in details over this thesis. But general description will be browsed here to provide an explanation for the whole system and the position of the sensor and actuator

3.3.1 Position Sensor Holder

In Practical design LVDT sensor need to be fixed and contact with target belt, the design in figure (3.9) shows general design dimensions depend on the belt size, in contact point between the belt and LVDT cylinder has been used which will roll with a belt to elimination Friction.

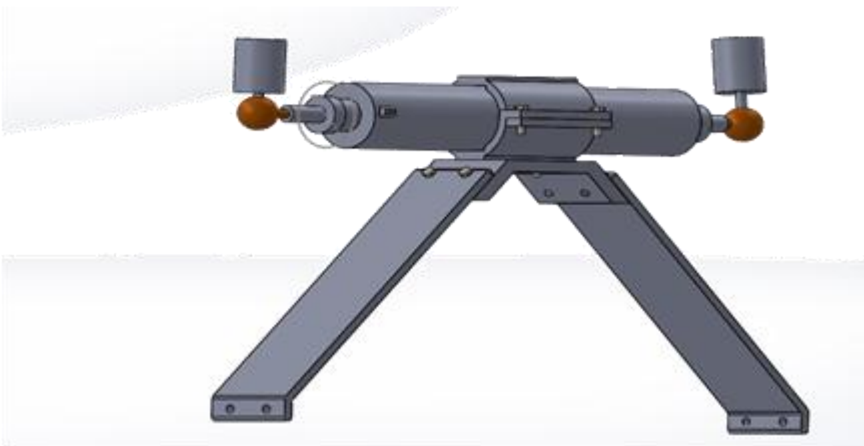


Figure (39.) Position Sensor Holder

3.3.2 Gear Box

When considering a gearbox, there are many types, but for this design planet gearbox suggested, the planet gear box have many advantages like:

- Planet gear system could be used to secure higher gear ratio in a compact space
- For similar gear ratio planet gear system will have light weight as compared to traditional gearbox.
- Power transmission efficiency will be quite good compared to traditional gearboxes.
- Planet gear system will have higher torque transmission capability and will have lower inertia.
- Driving member and driven member are concentric and therefore driving and driven equipment could be installed in the same line which will result space saving.
- Service live will also be quite good if compare it with traditional gearboxes service life for similar load.

3.3.3 General Design Look

General design shape is shown in figure (3.14) to explain design parts for reader such as gear box, belt, non drive roller, stepper motors and position sensor holder position

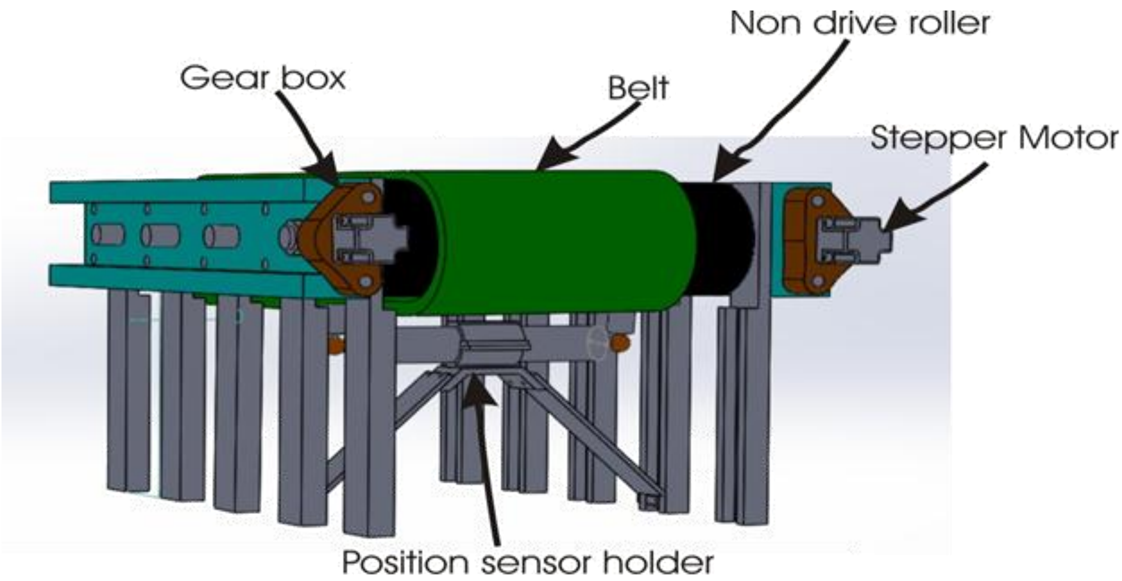


Figure (3.10) General design look

Chapter 4: The Code and Result

4.1. Solution Method

As mention before field testing has proved that a combination of friction and tension is the best way to put a belt back on track, the proposal design program will depend on this method to readjust and solve drift problem

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

4.2. Program Flow Chart

The program contains two types of variable digital variable and analog variable, depend on their values the program will be executed.

The digital variable connected to micro-controller in port B (B_0,B_3,B_4,B_5,B_6) which will connected to a switch or relay, micro-controller pin B_0 read signal from a relay which will give one if the belt running and zero in case of the belt stop this variable will named as (Belt), system operation mode signal come from selector switch operated by human to select between two mode auto or manual this variable named as A_M and will take value one when human select manual mode and zero if he select auto mode, the A_M connected to micro-controller in pin B_3, the other digital variable used in manual mode as M1_M2 which use to select between right side motor and left side motor, when M1_M2 one motor two is enable and when zero motor one is enable, this variable connected to pin B_4 in the micro-controller, there are two another signal need in manual mode which is R_M and L_M, the R_M signal connected to pin B_5 when one the right direction will be enabled for motor which select by M1_M2, the same thing can say about L_M which is connected to pin B_6, When A_M signal zero the system will run in auto mode this mode need to monitor the belt position all time, the position sensor provides through analog input to micro-controller in pin A_1 (Port A) named as(P), all other variable in this program it depends on these six variables.

Port C act as output connected to stepper motors through drive unit, the lower four digits used for motor two and the upper four digits for motor one, another output is pin D_1 in port D act as an indicator to show error when max tension or release reach, the set point represents the perfect position and it depends on belt dimension table (4.1) will define all variable briefly.

Table (4.1) explains the variable

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	

4.2.1 Main Program

The figure (4.1) shows the flow chart for the proposed design main program and manual mode.

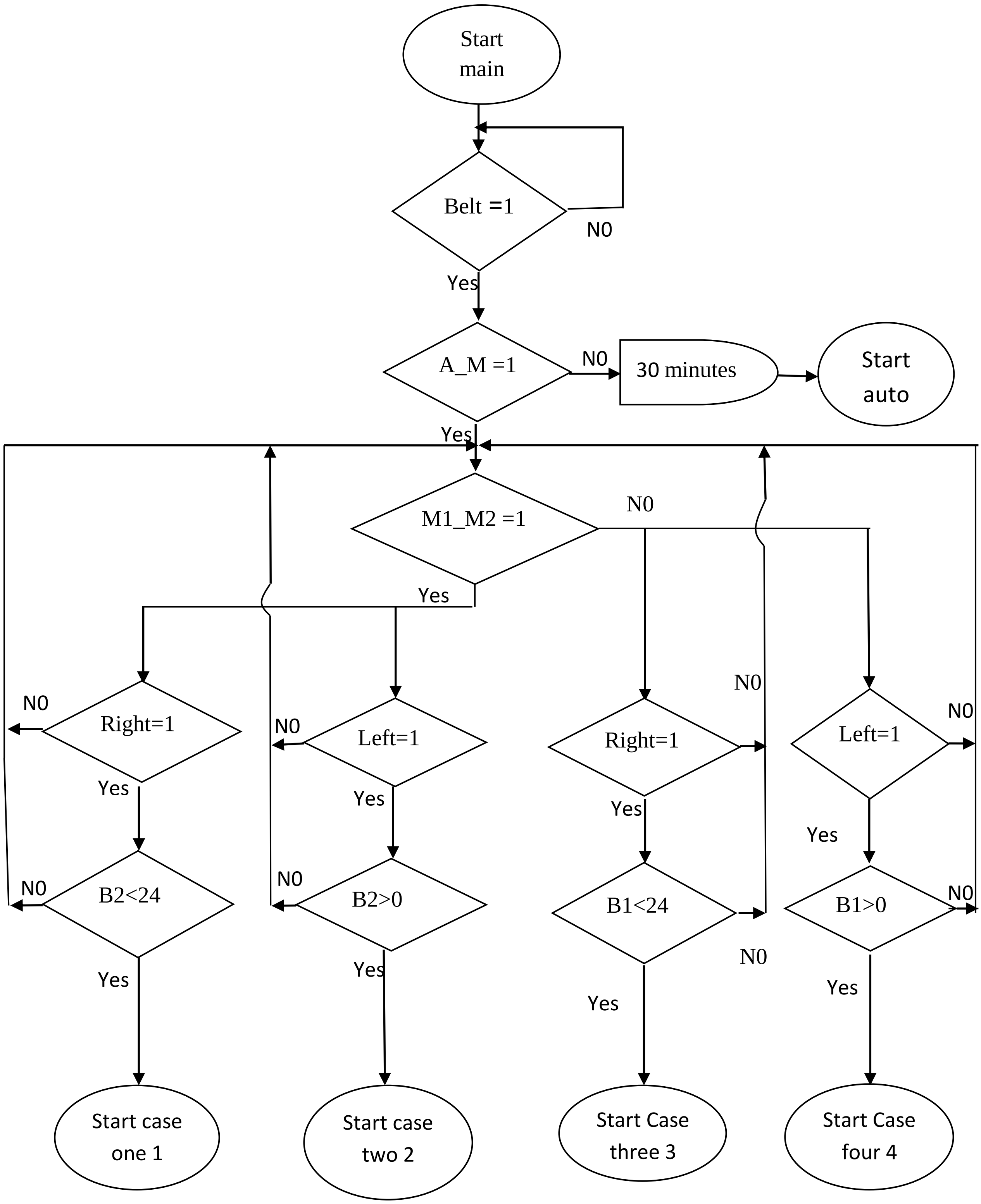


Figure (4.1) Main Program

4.2.2. Auto System Program

The figure (4.2) shows flow chart for the proposed design in auto system mode.

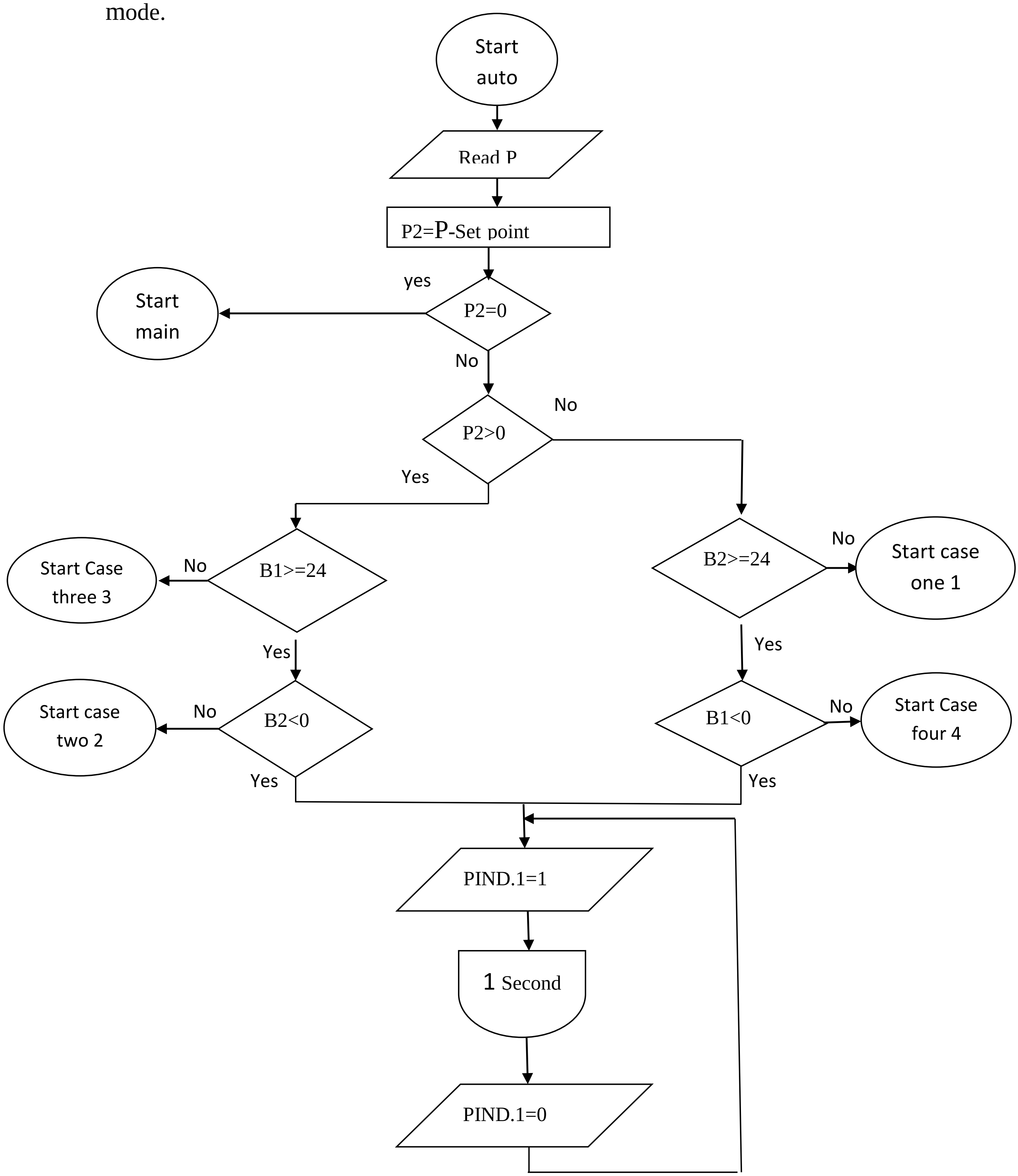


Figure (4.2) Auto System Program

4.2.3. Case One (Motor One R_M)

Figure (4.3) shows the flow chart for first case, which is subroutine for motor number one spins to the right direction for one cycle in the end subroutine will go back to start the main program .

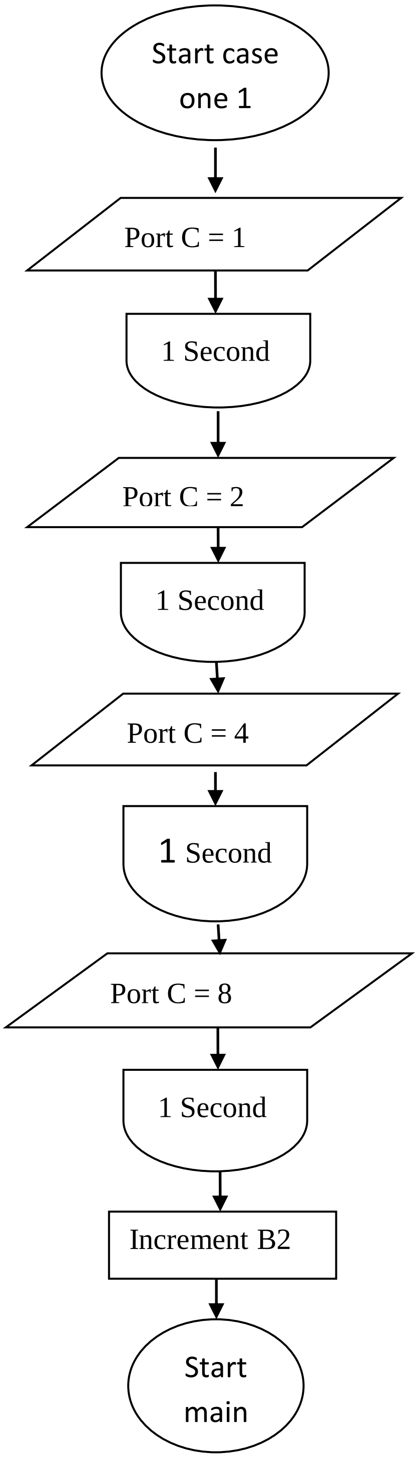


Figure (4.3) Case One (Motor One R_M)

4.2.4 Case Two (Motor One L_M)

Figure (4.4) shows the flow chart for second case, which is subroutine for motor number one spins to the left direction for one cycle in the end subroutine will go back to start the main program.

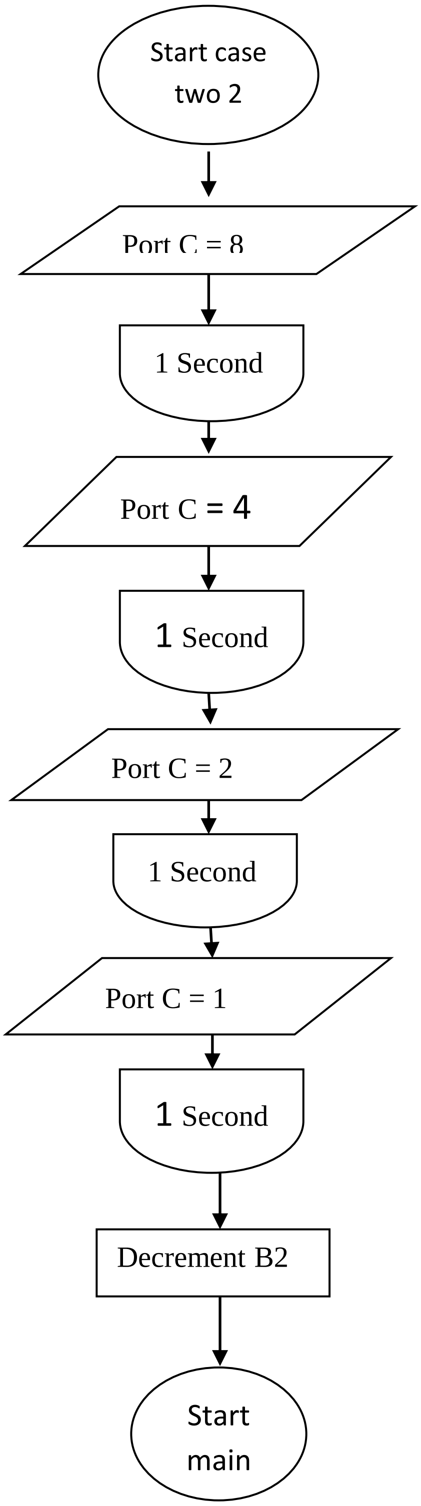


Figure (4.4) Case Two (Motor One L_M)

4.2.5 Case Three (Motor Two R_M)

Figure (4.5) shows the flow chart for third case, which is subroutine for motor number two spins to the right direction for one cycle in the end subroutine will go back to start the main program.

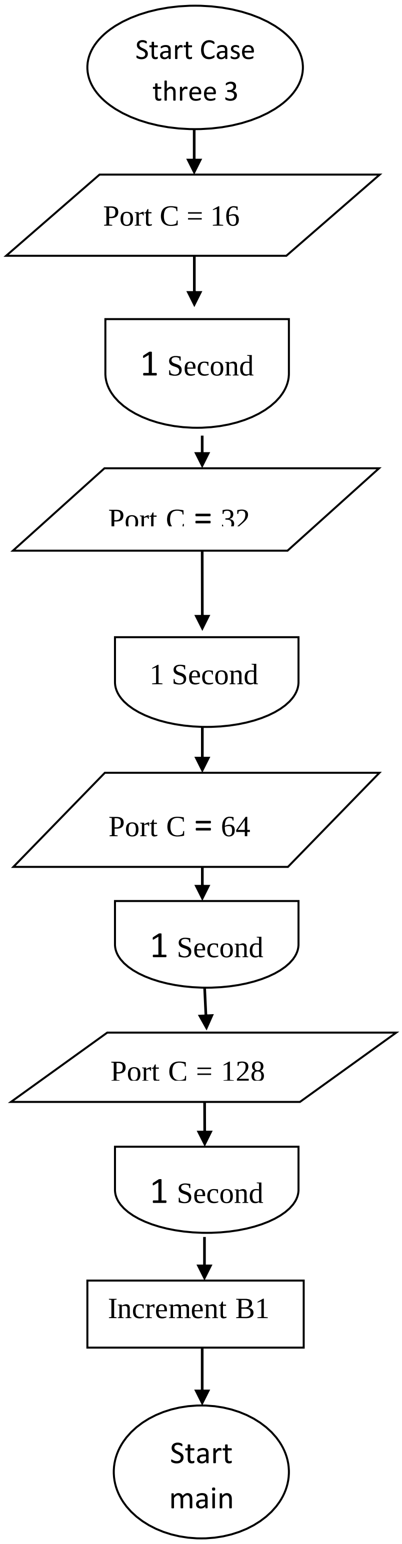


Figure (4.5) Case Three (Motor Two R_M)

4.2.6 Case Four (Motor Two L_M)

Figure (4.6) shows the flow chart for fourth case, which is subroutine for motor number two spins to the left direction for one cycle in the end subroutine will go back to start the main program.

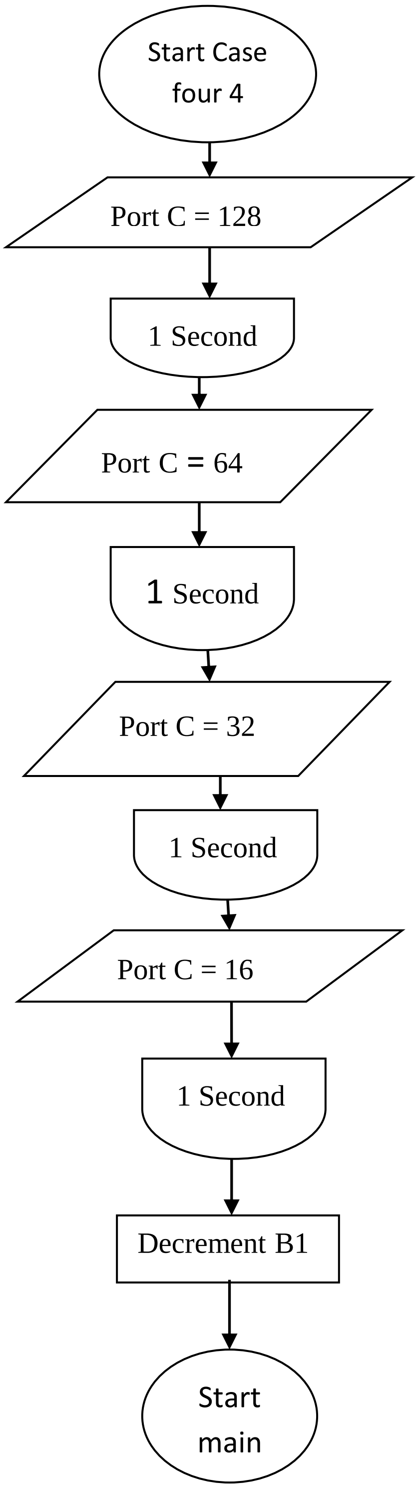


Figure (4.6) Case Four (Motor Two L_M)

4.3. Result and Discussion

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

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

The pictures are screenshots from Proteus program screen shown the circuit part and different operation odds

Figure (4.7) shown circuit component

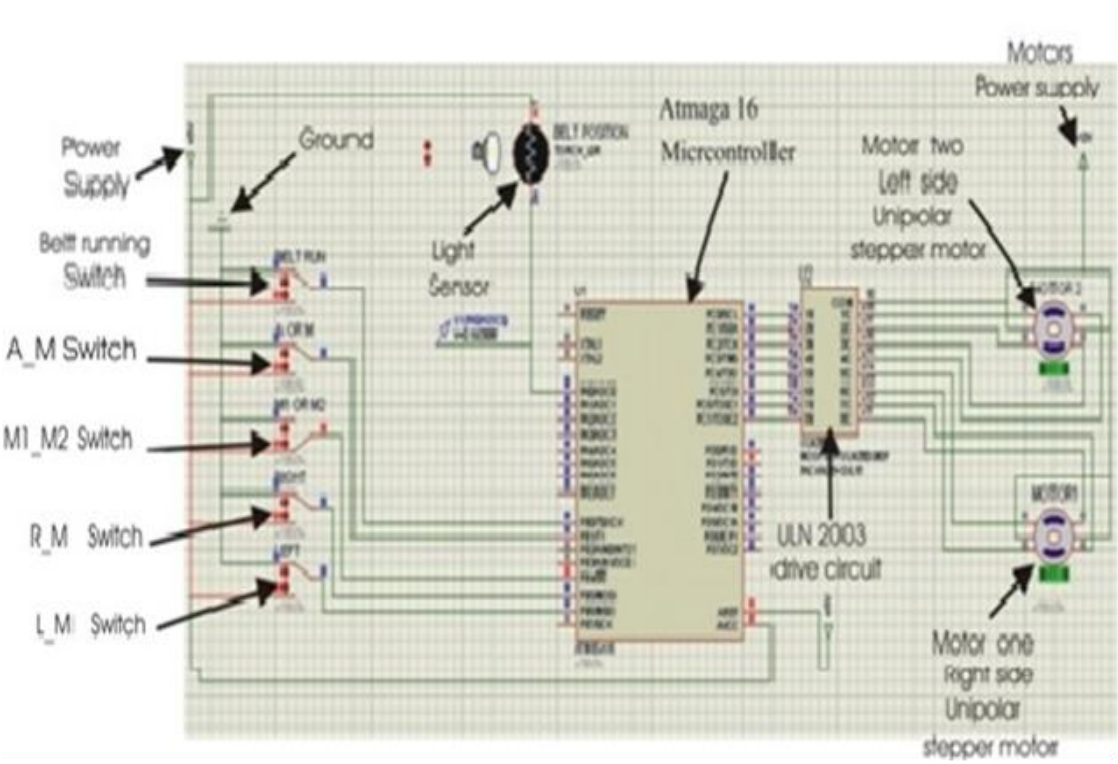


Figure (4.7) circuit part

- **In case of Belt stop and system in auto**

This case as shown in figure (4.8) will be active when belt conveyer stop which will make pin B_0 zero, the program will go in loop to check pin B_0 and no any action will happen, the auto signal and all other control signals will be ignored, figure (4.8) shows this case:

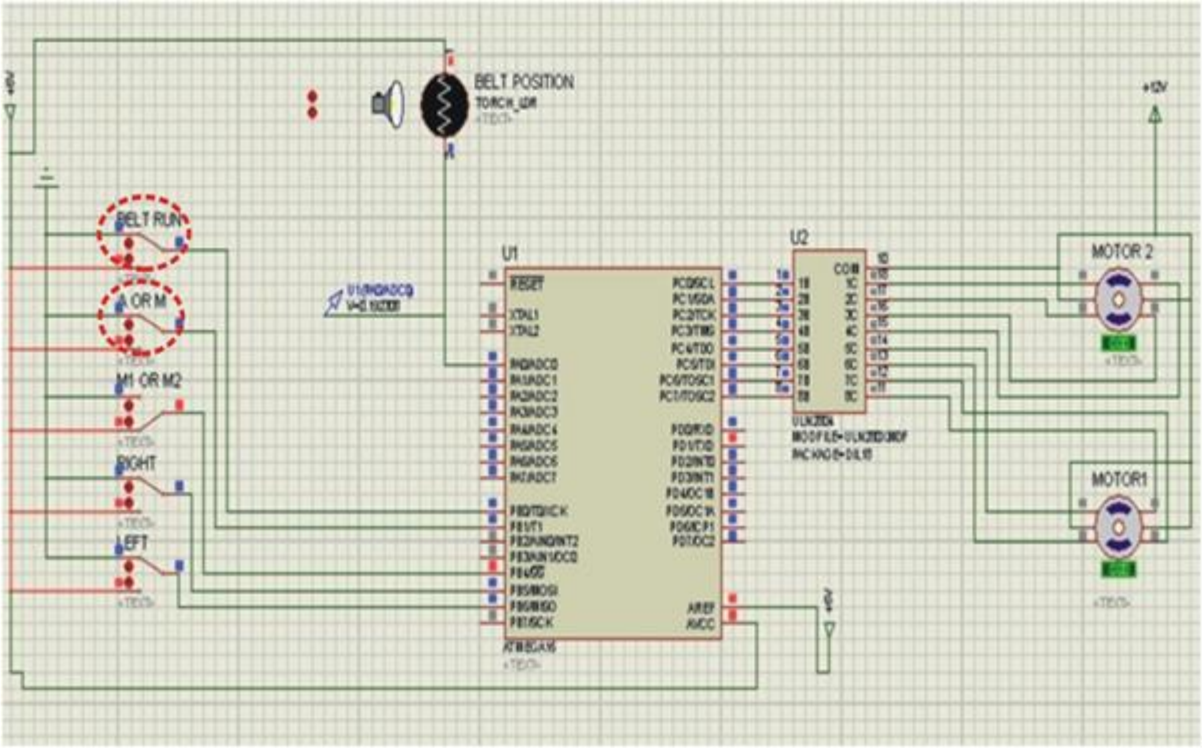


Figure (4.8) In case of Belt stop and system in auto

- **In case of Belt stop and system in manual**

This case as shown in figure (4.9) will be active when belt conveyer stop which will make pin B_0 zero, the program will go in loop to check pin B_0 and no any action will happen, the manual signal and all other control signals will be ignored,

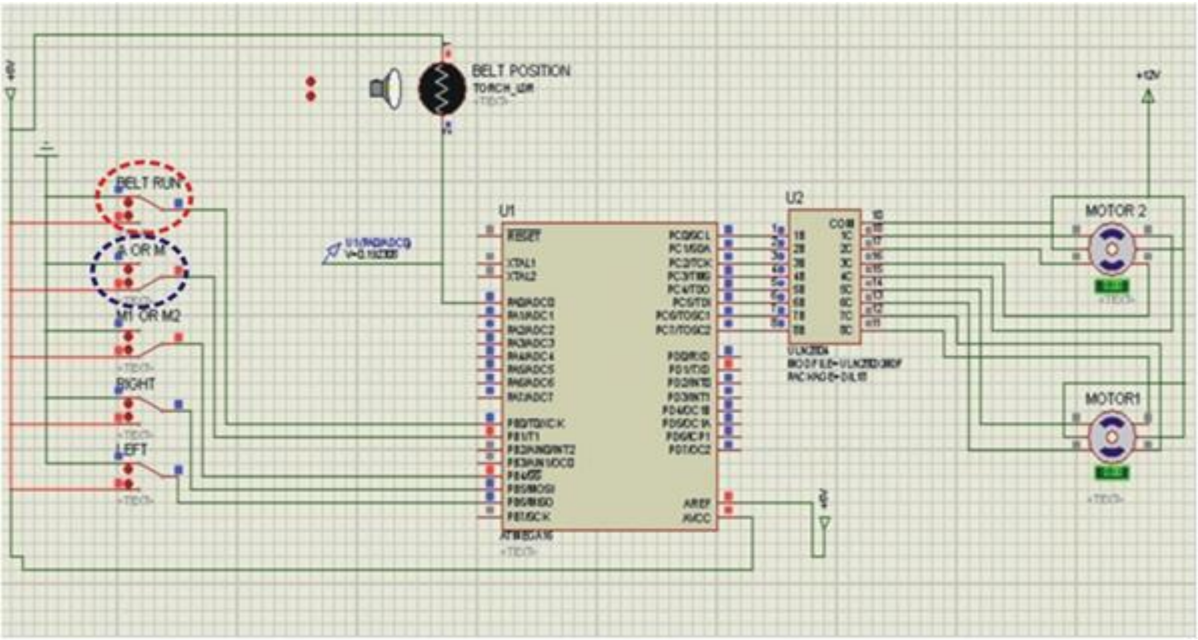


Figure (4.9) In case of Belt stop and system in manual

- **In case of Belt running and system in auto**

When belt conveyer runs the system move from waiting to one of two choice auto or manual depend on A_M (auto -manual) value if it's zero system will go into auto mode and if it's one system will go to manual mode.

The auto system mode depends on the position sensor value to make a decision, the system will read the position sensor value and try to readjusted belt position to make the difference between sensor reading and set point to zero, figures (4.10) and (4.11) show the system try to readjust belt when position sensor shows the micro-controller belt drift to the right side (P2<0) using motor one (flow chart case one) as in figure (4.10). When motor one retch max adjusts the system will continue readjust the belt using motor two (flow chart case four) as in the figure (4.11) below

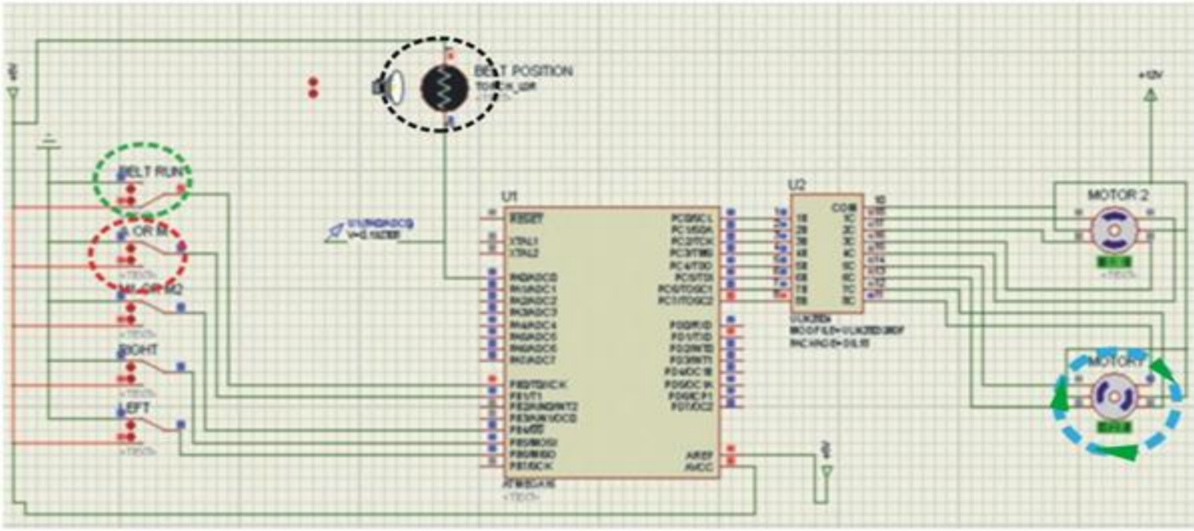


Figure (4.10) system in auto mode readjusting by motor one

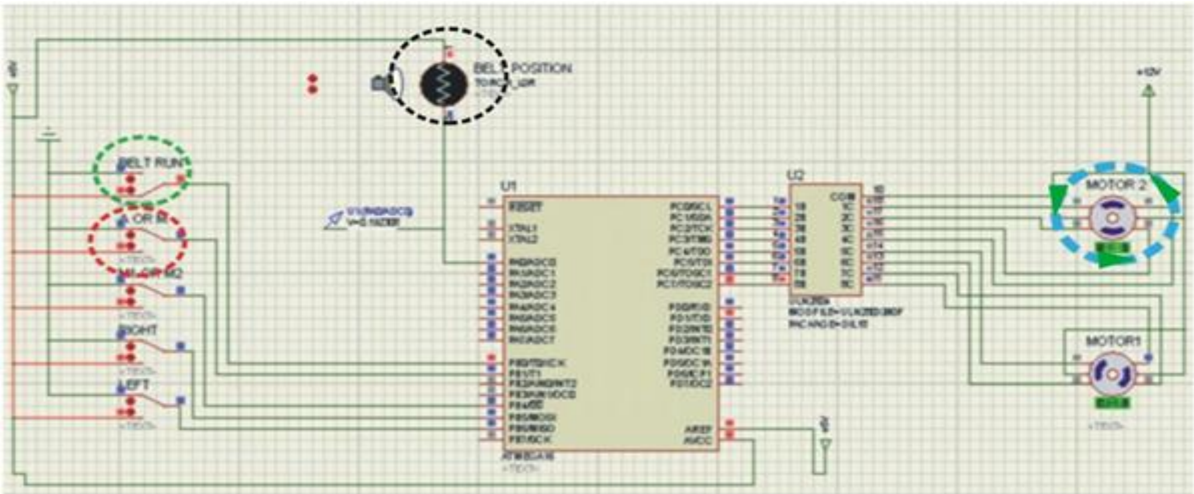


Figure (4.11) system in auto mode readjusting by motor two

- **In case of Belt running, system in manual, motor one enable and no direction enable**

In case when A_M value one the manual mode will be enable, operation in manual mode depends on human operator, the operator must select which motor and which direction needed to correct the position if the operator select any motor and did not select any direction as in figure (4.12) below no any action will happen.

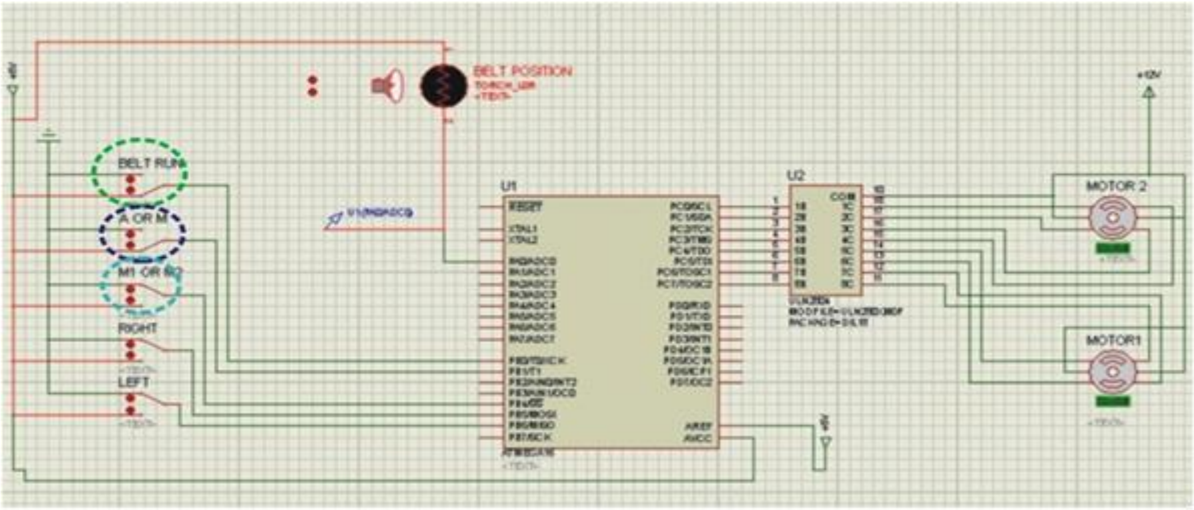


Figure (4.12) Belt running, system in manual, motor one enable and no direction enable

- **In case of Belt running, system manual, motor one enable and right direction enable (R_M)**

In case if direction right(R_M) and motor one are enabling the motor one will run anticlockwise as in figure (4.13) and human operator will decide when must stop

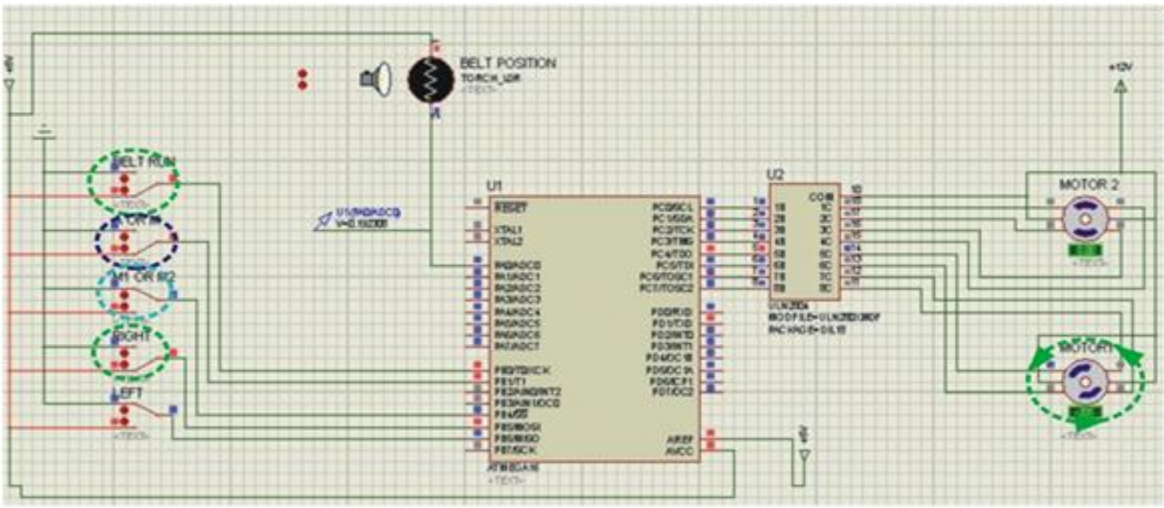


Figure (4.13) Belt running, system manual, motor one enable and right direction enable (R_M)

- **In case of Belt running, system manual , motor one enable and left direction enable**

Also human operator can select left direction (L_M) in this case motor one will run clockwise as in figure (4.14) below

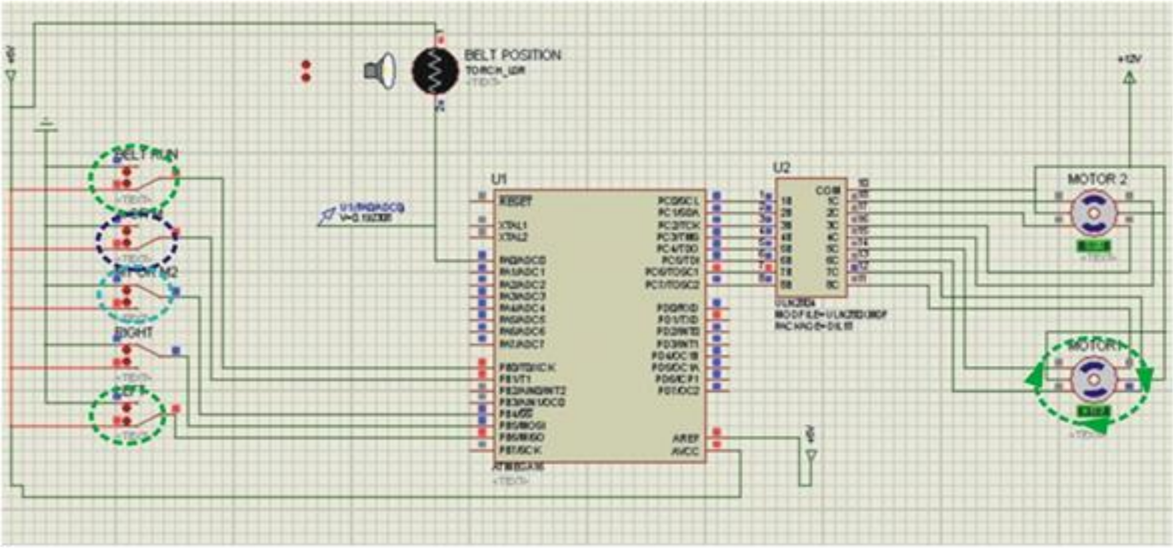


Figure (4.14) Belt running, system manual, motor one enable and left direction enable

- **In case of Belt running, system manual , motor two enable and right direction enable (R_M)**

If operators, select motor two and right direction motor two will run anticlockwise as in figure (4.15) below

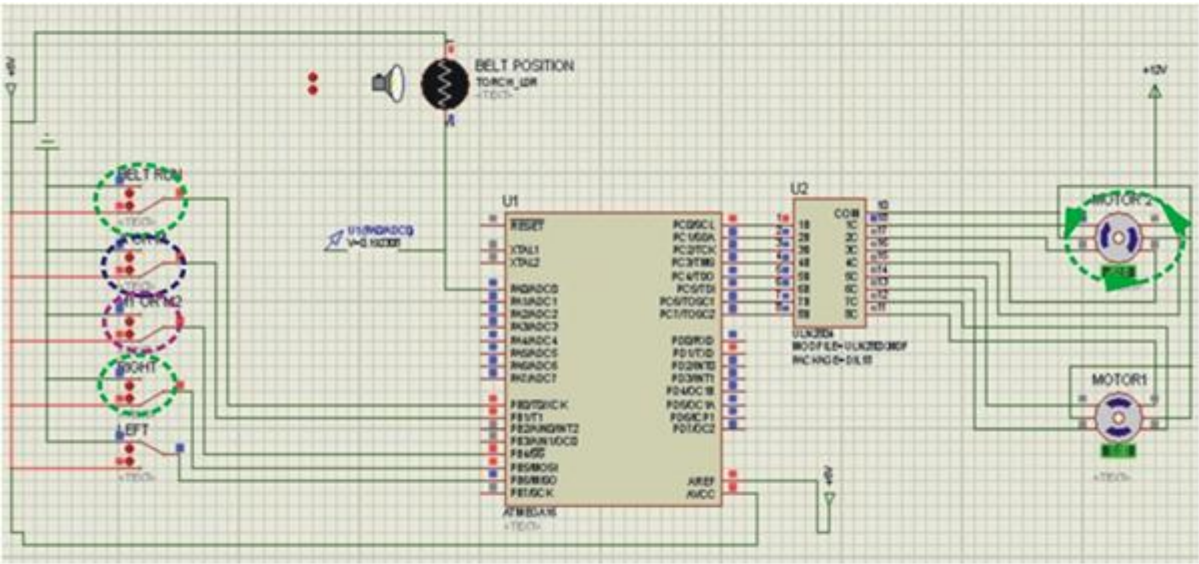


Figure (4.15) Belt running, system manual, motor two enable and right direction enable (R_M)

- **In case of Belt running, system manual , motor two enable and left direction enable (L_M)**

If the human operator selects left direction the motor two will run clockwise as in figure (4.16) below that main motor two tide up the result for that tension will increase and belt will slip to another side

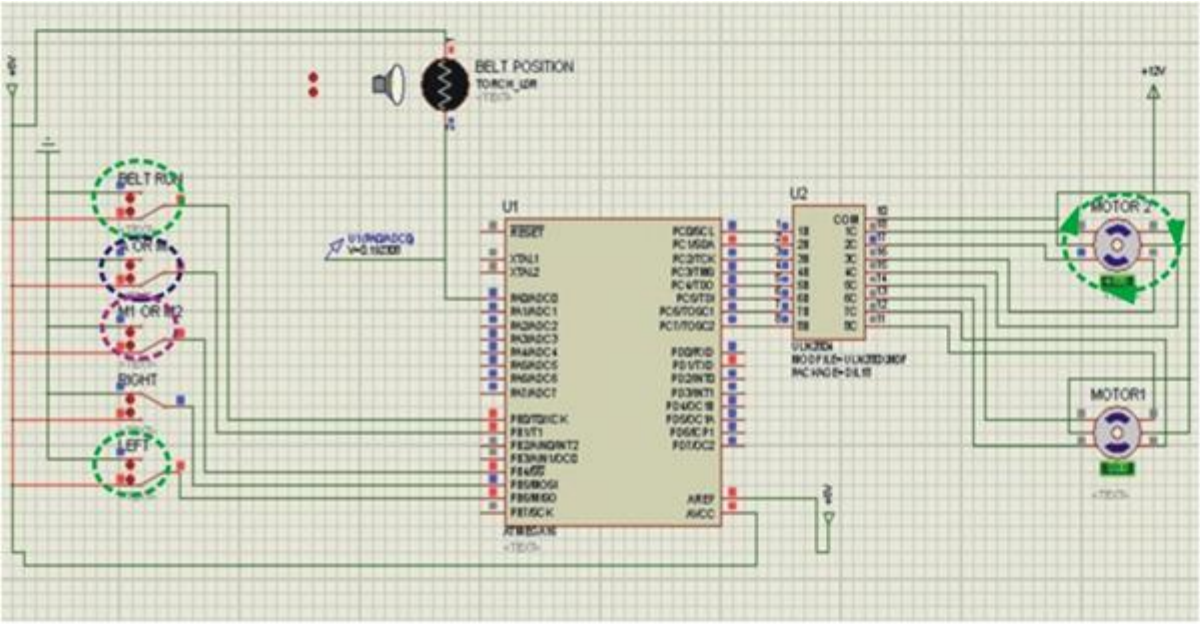


Figure (4.16) Belt running, system manual, motor two enable and left direction enable (L_M)

4.4. Prototype Device

To add more clarification to proposed design a prototype device has been fabricated in small size, just to show operation and component homogeneity between etch another, in prototype software some modification have been made to make it more suitable for the user, the figure (4.17) show the prototype device

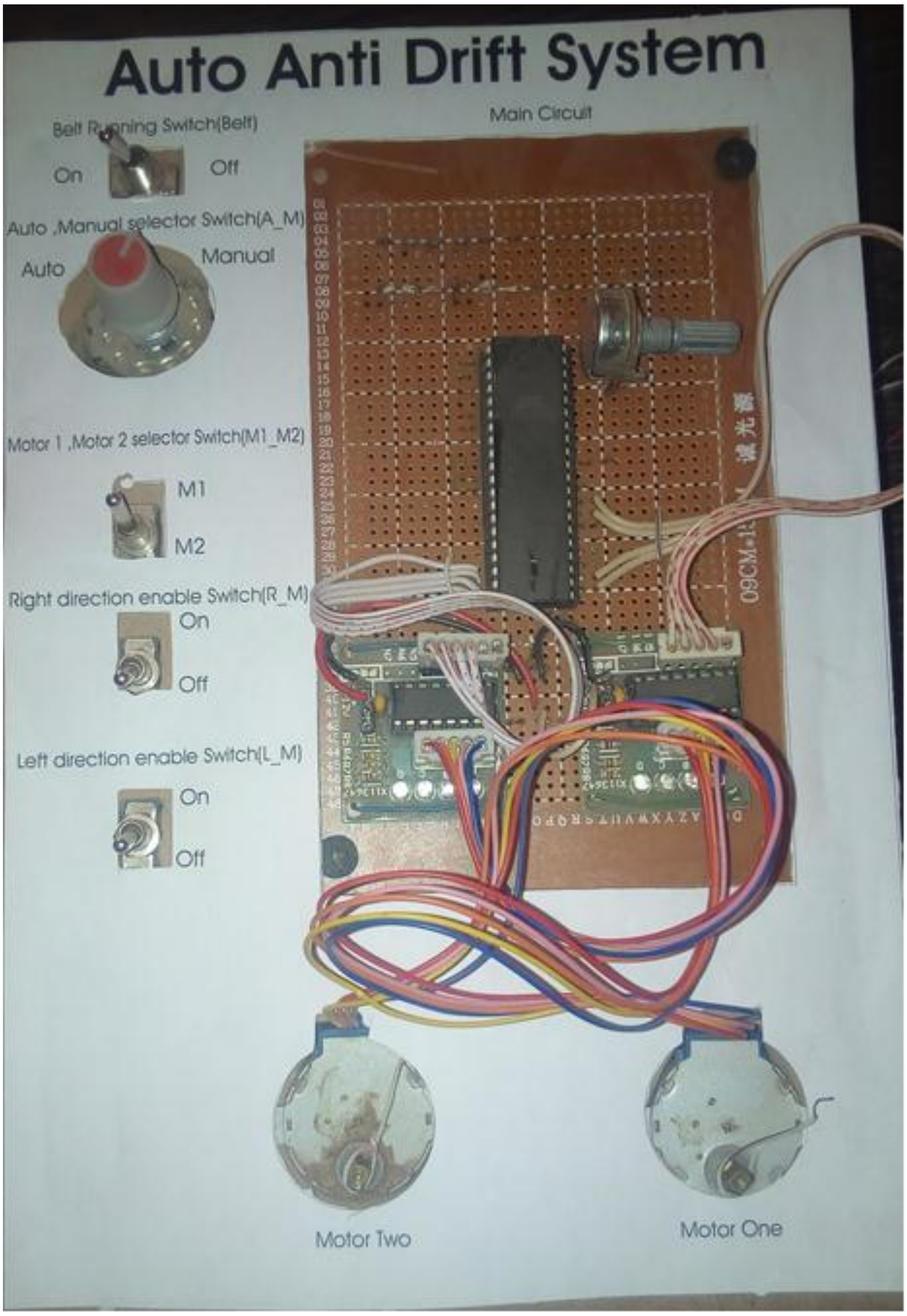


Figure (4.17) Prototype Device

Chapter 5: Conclusion and Recommendations

5.1Conclusions

The proposal shows a new method to solve belt drift problem using micro-controller, stepper motors, switches and position sensor

This proposal design can adjust the belt position using manual mode by human or auto by monitoring belt position and compared with reference position both operation modes will reduce maintenances cost and time

Program and electronic circuit fix for any size of belt conveyer, but stepper motor size and gearbox must be modified depending on the belt size .

So from all above points we can say these researches open a new promising way to deal with the belt drift problem.

5.2 Recommendations

Using micro-controller and analog signal allow in the future transfer the position readings to central control room, this step will allow keeping history record, also after field testing small modification maybe needed.

Reference:

This research relies on technical catalogue and experience people as reference below some technical catalogue:

1- Ammeraal Beltech, Tracking and tension ,january2007

2- Flexco, Technical Solutions For Belt Conveyor Productivity ,2011

3- Habasit, Fabric Conveyor Belts Engineering Guide ,media No 6039

4- Metso, Trellex Belt Guiding System ,2010

5- Atmel Corporation, Atmel, 2010