LOAD CONVEYING BELT SUPPORTED BY SCORBOT ER V PLUS ROBOT AND CONTROLLED THROUGH ELECTRONIC CIRCUIT SUPPORTED BY LDR AND RELAY

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Abstract: *Mankind acts through his or her sense organs during his life. Signals coming from the senses are considered and logically processed and a behaviour or action is accordingly developed after the truest decision has been made. As for the automation system being in industry the motion detection duty belongs to sensors. In today's technology, all kinds of sensors are produced and submitted for the service of people. The aim focused in automation systems is to ensure the robot to perform the targeted work accurately and within the shortest time possible. Nevertheless, depending on the increase of requirements at the present day, it is among the aims of robots to carry out a true motion by making logical decisions in addition to this qualification. In this project, it is intended to lay down the load onto the requested point from 3 different points by classifying the load as per the size of the load through a logical algorithm by sensing the dimensions of load through sensors on the robot arm after having grabbed the load on the load convey belt through the robot arm "Scorbot ER V Plus" by creating of necessary control signals through sensors and relays.*
Keywords: *Robot, Load belt, LDR (Light dependent resistance), Relay, Automation.*

1. Introduction

In this simulation project, it is designed that a robotic arm enabling an automatic control system in light of technological improvements be able to take any loads on a passing belt without any external intervention and lay down such a load to a fixed point in accordance with the size of the load.

The application process consists of 3 phases. These are performed through;

- Scorbot ER V Plus Robot
- Designed Load Belt
- Circuit carts producing necessary signals for control.

1.1. Robot Set in Use

In execution of this designed project, the Scorbot ER V Plus Robot is used [6].

Figure 1. Scorbot ER V Plus

1.2. Materials Used in the Project

The materials being used and their prices are indicated on the Table 1 and Table 2.

Table 1. Materials used in project and their prices

Material Description	PCS
Scorbot Er V Plus Robotic arm	1
Relay	5
Resistance	28
1 N 4001 Diode	4
BC 107 Transistor	12

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LDR	4
Engine	3
Drill chuck	4
Pertnaks	2
Soldering	1
Soldering Iron Tip	1
Multimeter	1
Screw, Nail	1
Gear Pulley	1
Alligator Clip Set	1
12 volt power-supply source	1
8 volt power-supply source	1
5 volt power-supply source	1

Table 2. Prices of Materials Used In The Project

Material Description	Unite Price	Total
Relay	1,25	6,25
Resistance	0,05	1,4
1 n 4001 diodes	0,10	0,4
BC 107 transistor	0,25	3
LDR	0,50	2
Engine	3,50	10,5
Drill chuck	1,50	6
Pertnaks	1,00	2
Soldering	0,70	0,7
Soldering iron tip	8,50	8,5
Multimeter	15,00	15
Screw, nail	1,00	1,50
Gear pulley	0,25	0,25
Alligator clip set	2,5	2,5
Total	**60 TL**	

1.3. Parts Used in Application

The materials required for formation of a load conveying belt are detailed hereunder. (Figure 1 … Figure 12)

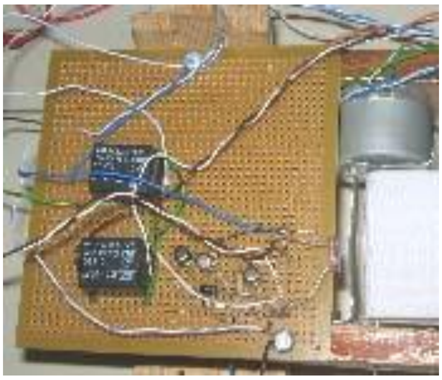


Figure 2. Control Circuit

Operation control circuit of the load conveying belt is represented on Annex-1.

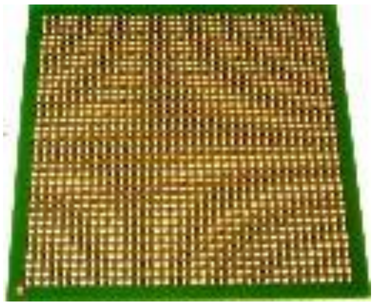


Figure 3. Pertnaks

Via pertnaks, circuit elements are mounted by using plummet and soldering iron instead of printed circuit.

Figure 4. LDR (Light dependent resistance)

The resistance value changes according to the intensity of the light dropping on the photosensitive resistance.

Figure 5. BC 107 Transistor

The transistor BC 107 is placed in a metal casing and equipped with collectors, bays and emitter tips. Stick tip is denominated as emitter, as for the tip contacting with metal casing, it is denominated as collector and the middle one is named as bays.

Figure 6. Resistances

A single control circuit contains resistances including 1kΩ of 4 pieces, 2, 7 kΩ of 1 piece, 2, 2 kΩ of 1 piece, 470 kΩ of 1 piece, 10 kΩ of 2 pieces.

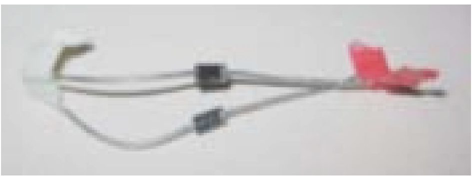


Figure 7. Diodes

A single control circuit contains 1n 4001 diode of one piece.

Figure 8. Relay

The relays used in circuits are operating like a switch. When the light coming to LDRs' is cut, the Relays changeover and transfer the signals coming from the common tip to the other ignition key which they are linked.

One relay is used for a single control circuit. However, 2 relays are used for the circuit board controlling the moving load belt. The reason of such a requirement results from the fact that one of the relays controls the DC tension coming to engines and the other one performs the function of notification by transmitting a signal to the control unit belonging to the Scorbot Robotic arm, when motion of conveying belt is ceased.

Figure 9. Engine and Drill Chuck

A simple engine is used to ensure the conveying belt to get moved. The drill chuck is fitted to the edge of the engine to rotate the belt.

Figure 10. Multimeter

The multimeters used in preparation of control cards provide great conveniences in controlling the connections and measuring the tensions.

Figure 11. Alligator Clip

Alligator is an English Word and means crocodile in Turkish. The purpose of using the alligator clips in this study is to connect some cables with grapples at their tips without using any soldering and soldering iron.

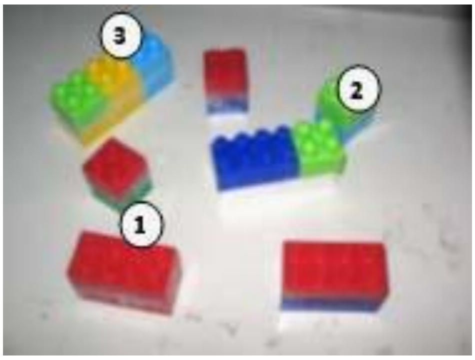


Figure 12. Lego Loads

The object aimed in the designed system is to take the load from 3 different dimensions seen on the figure and consecutively place it into determined coordinates from the smallest to the biggest.

2. Design Phase Of System

As for the load conveying belt, first of all, the woods chosen from among thin, light and solid ones have been combined as shown on the figure below and afterwards, the engines have been assembled on the framework of the conveying belt.

Figure 13. Combination of Woods

The engines have been properly fixed on the metal strip as seen on the figure.

Figure 14. Engine Mounting

While bonding the power connection of the engines, the DC tension with which engines could operate in the slowest level is preferred. On the other hand while the engines on the upper side are rotating forward, the engine on the lower side is ensured to rotate in adverse direction by being adversely polarized.

Figure 15. Engine - The Power Connection

Drill chucks screwed are fixed to tip part of engines to make the conveying belt to rotate.

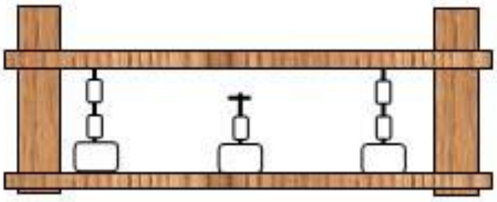


Figure 16. Assembly of Drill Chuck

3 engines are used in the system and a large gear pulley at the end of the middle engine and drill chucks at the other two engines are mounted in order to make the belt easier to rotate.

Figure 17. Gear pulley and Drill Chuck

3 LDR being one of the important parts of the system, they are fixed into the slots prepared within the wood. These LDR’s, according to the obstruction degree of the light over the objects before them, change the positionsof the relays on the control circuits on which they are cennected.

Figure 18. The LDR Slots

A metal barrier is fixed at the end of LDR slots for purpose of preventing the possibility of collision of the load to opposite circuit. The wide rubber is used as belt in the operation of conveyance. During mounting of the wide rubber, it should be fixed with middle tension, not too tense or too loose.

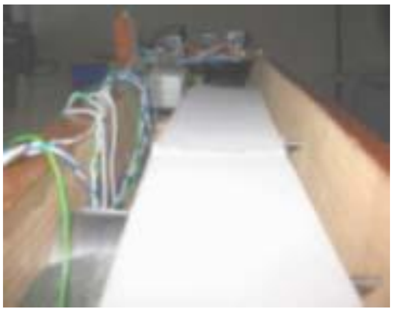


Figure 19. Conveying Belt

Figure 20. Support Nails

In order that the weight not to affect the belt while moving on the conveying belt, bending of the belt due to the weight of the load is prevented by driving nails to the wood at the level of the wide rubber.

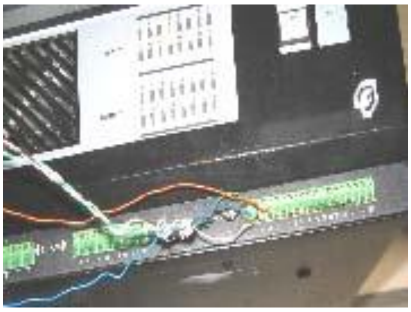


Figure 21. Scorbot-ER V Plus port and leds

Scorbot-ER V Plus control unit ports response against the 5 volt electric signal. When a 5 volt is applied to any input port, the led indicator belonging to that port produces signal.

The information related to the operation of the belt is connected to port no: 4 of the scorbot control unit.

Figure 22. Operation Situation of the Belt

The information related with the operation of the first LDR is connected to port no: 1 of the scorbot control unit.

Figure 23. LED No: 1

The information related with the operation of the second LDR is connected to port no: 2 of the scorbot control unit.

Figure 24. LED No: 2

The information related with the operation of the third LDR is connected to port no:3 of the scorbot control unit.

Figure 25. LED No: 3

3. Operation Principle of the System

The system operates according to the intensity of light coming upon LDRs. The objective is to differentiate the coming objects according to their three different sizes. 4 LDRs are used in the system.

Figure 26. Conveying Belt

While the first LDR is used to control the operation of the belt, other three LDRs are used with the aim of sending signal to the scorbot control unit according to the size of the object coming on the belt before them.

Figure 27. LDR Control Panel

As seen from the figure, when the object, coming on the belt, comes to the end of the belt, the control circuit stops the belt by turning off the light of the LDR belonging to the belt control circuit.

Figure 28. The Operation of LDR

The LDRs over which the light is coming is cut among three LDRs placed into the wood near the load send signal to the control cards to which they depend on and therefore 5 volt signal is transmitted to the scorbot control unit by means of the relay in the control card.

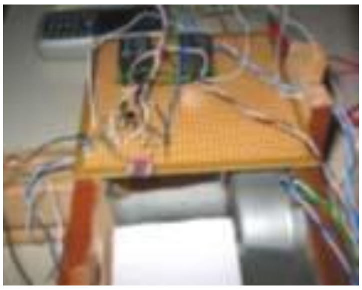
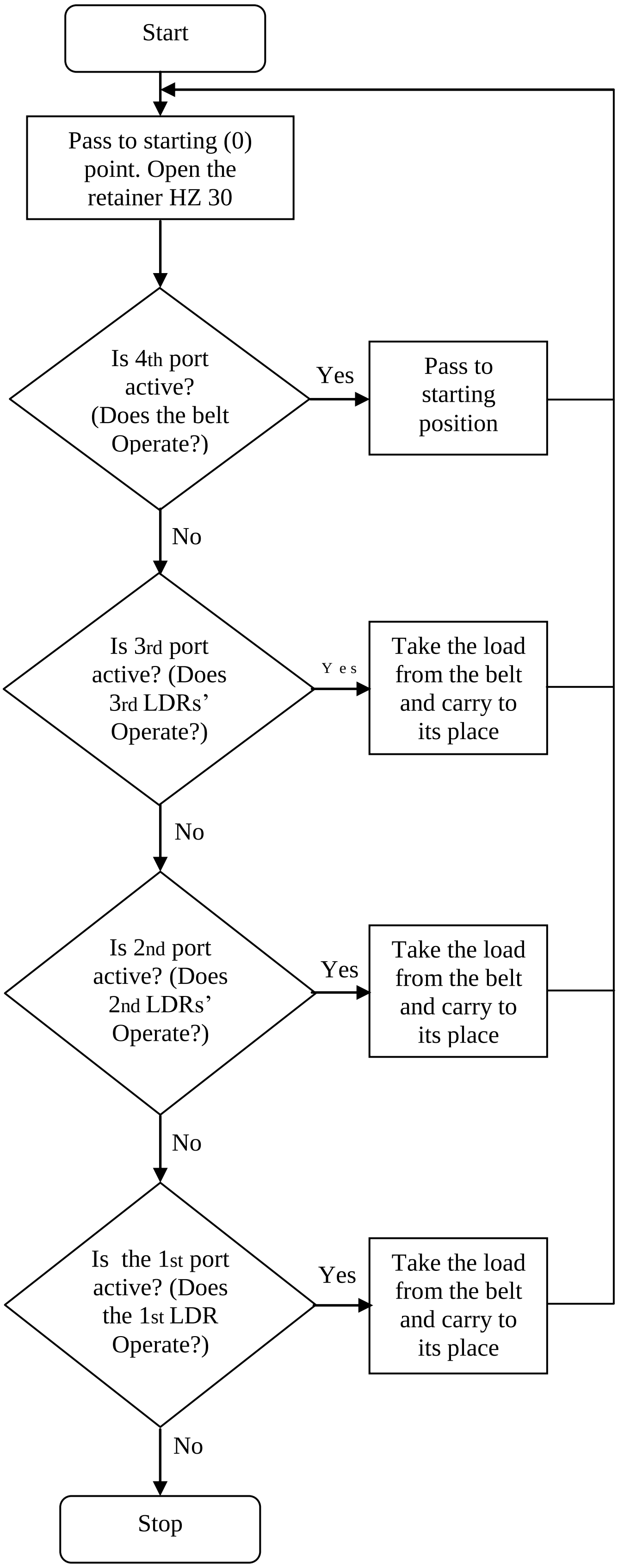


Figure 29. Signal Transmission

3.1. Algorithm of the Program



3.2. Program Codes

```
LABEL 5
MOVED 0
OPEN
SPEED 30

IF IN[4]=1
GOTO 5
ENDIF

IF IN[3]=1
GOTO 3
ENDIF

IF IN [2]=1
GOTO 2
ENDIF

IF IN [1]=1
GOTO 1
ENDIF

LABEL 3
MOVED 5
MOVED 6
CLOSE
MOVED 7
MOVED 8
MOVED 25
MOVED 26
OPEN
MOVED 27
CLOSE
MOVED 28
MOVED 29
MOVED 30
SPEED 10
MOVED 31
SPEED 30
MOVED 32
GOTO 4

LABEL 2
MOVED 3
MOVED 4
CLOSE
MOVED 7
MOVED 8
MOVED 9
MOVED 10
OPEN
MOVED 11
CLOSE
MOVED 12
MOVED 13
MOVED 14
SPEED 10
MOVED 15
SPEED 30
MOVED 16
GOTO 4

LABEL 1
MOVED 1
MOVED 2
CLOSE
MOVED 7
MOVED 8
MOVED 17
MOVED 18
OPEN
MOVED 19
CLOSE
MOVED 20
MOVED 21
MOVED 22
SPEED 10
MOVED 23
SPEED 30
MOVED 24
GOTO 4

LABEL 4
MOVED 0
GOTO 5
END
```

3.3. Operation Principle of the Program

Program consists of 5 item labels. The program starts to operate from the 5th label, the first code of the operation. At 5th label, robotic arm opens the support bar by taking itself to the starting point. Then, the ports are controlled respectively from the 4th port to the first port. If the 4.th port is active, the program turns to the 5.th label and the robot continues to stay in the initial position. If the 3.rd port is active, the program operates the necessary codes by moving to the 3.rd label and moves back to the 4.th label. The program turns to the 5.th label by passing to the initial position in 4.th label.

In this way, the program continues to operate by going back to the initial position within a limitless cycle after operating the necessary codes by controlling both 2.nd and 1.st ports.

3.4. Scorbot ER V Plus Robotic Arm

Scorbot ER V Plus Robotic Arm is a robot set which has 5 free motion capabilities. DC servo retainer, parallel moving fingers, rough grasper and Advanced Terminal Software Version 1.9 program which provides control with computer are available. The distance that the grasper can grasp is externally 75 mm and internally 65 mm. This robot has a maximum 2 kg load lifting capacity [2].

Figure 30 - Scorbot ER V Plus

3.5. Control Panel

Scorbot ER V Plus robotic arm is controlled by means of the push buttons on the control panel [2].

Figure 31 - Scorbot ER V Plus Control Panel

The buttons on the control panel are;

- Base (X+ and X-)
- Shoulder (Y+ and Y-)
- Elbow (Z+ and Z-)
- Pitch
- Roll

Base (X+ and X-): It enables the robotic arm to turn around its own way in 300 degree distance.
Shoulder (Y+ and Y-): In the event that the robotic arm is similar to the human arm, it provides shoulder moving.
Elbow (Z+ and Z-): In comparison to the human arm, the robotic arm provides elbow moving.
Pitch: The robotic arm performs wrist movement in human arm that is the wapper.
Roll: The robotic arm performs the wrist movement in a right-left way.
Other control push buttons that are used;
Open/Close: It enables the retainer to close and open in the rate of hundred percentage.
Record Position: The position record is performed by using this button after placing the robotic arm in the intended position. The position is given by using number buttons on the control panel. Then, these positions are used in ATS program by Move [Position] instruction.
Go Position: This button also provides positioning to the positions registered by Record position button, by using the control arm.

3.6. Programming of the Robotic Arm

ATS (Advanced Terminal Software) program is used to programme the robotic arm[3]. To start ATS program while in DOS operating system;

C:\>cd ats
C:\ats>ats

Instructions are given respectively. In order to take the robot in initial position *"home"* instruction is used. While, in the program editor;

➢ **home**

by pressing enter key after writing *"home"* the robot comes to the initial position. Codes and coordinates of each position are recognized in "edit" menu to enable the robotic arm to move in an intended way .In order to enter the edit menu;

➢ **edit [program_name]**

is written.

Coordinates of the robot in axis of movement can be given in edit menu by writing codes, and can also be given by using the control panel in figure 31 [4].

The movement of the robotic arm is provided by operating the program with *"Run"* instruction after determining axis of movement of the robot [7].

➢ **run [program_name]**

3.7. Operation Images of the Robot

Robotic arm starts to operate from the initial position. The movement of the belt stops after the load moving on the conveying belt is sensed by LDR and the robotic arm takes action to get the load waiting on the belt. The robotic arm senses the size of the object by signals coming from LDRs and grasps it from the right middle point according to the size of the object.

Figure 32. Movement of the robotic arm

The load should be left in necessary field according to the size after being taken from the conveying belt by robotic arm.

Figure 33. Taking Load

In order to make room for the future loads with the help of the robotic arm, the load is pushed forwards from the point where it is taken after the load is left in necessary field.

Figure 34. Leaving load

3 different positions where the loads are placed according to their sizes are seen in the figure.

Figure 35. Placing Loads

4. CONCLUSION

In this project, conveyance of the load on conveying belt in 3 different sizes is provided by separating them according to their sizes by providing a smooth communication of conveying belt, robotic arm, LDR and relays with each other.

Robotic sciences and services developing fast thanks to the modern-day technologies facilitate human life considerably [5].

With this system, in load transfer, not only conveyance is performed according to the load size but also different types can be produced for different services and objectives.

5. REFERENCES

[1] SCORBASE Level 5 for SCORBOT-ER 5 and 7 ACL Version REFERENCE GUIDE

[2] ATS Advanced Terminal Software Version 1.9, References Guide for controller-A Catalog #100084 – Rev. B., ESHED ROBOTEC

[3] SCORBOT-ER V plus User's Manual, Catalog #100016 – Rev. B., ESHED ROBOTEC

[4] Teközgen E. "Elektronik Deneyleri ve Projeleri", Özkan Matbaacılık-Gazetecilik San. Tic. Ltd. Şti., Ankara, 1992

[5] Varol, A. "Robotik", Milli Eğitim Basımevi, İstanbul, 2000

[6] Varol, A., Bağçacı, F.: Robot Kolu Kontrollü Taşıma Bandı ile Yük Nakli Otomasyonu, Türkiye'de ve Dünyada Otomasyon, Aylık Elektrik Elektronik Makine Bilgisayar Dergisi, Cilt No:112498-2007/05, Mayıs 2007, Sayı 179, Sf: 90-100

[7] Bağçacı, F., Gürol, M., "Robot Automation Preparing And Serving Cocktail Drink", ISSN:1306-3111 e-Journal of New World Sciences Academy 2009, Volume: 4, Number: 2, Article Number: 2A0022, Page:242-255.

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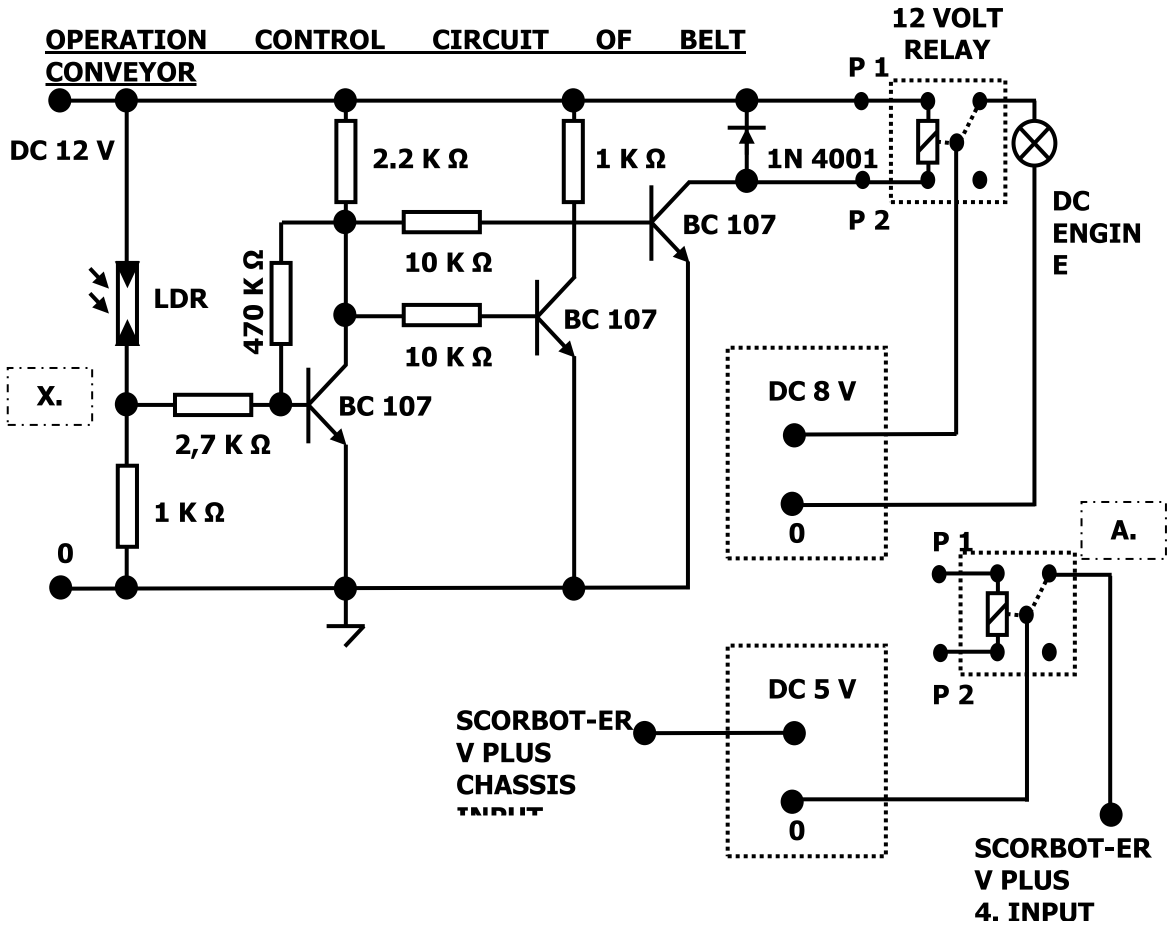
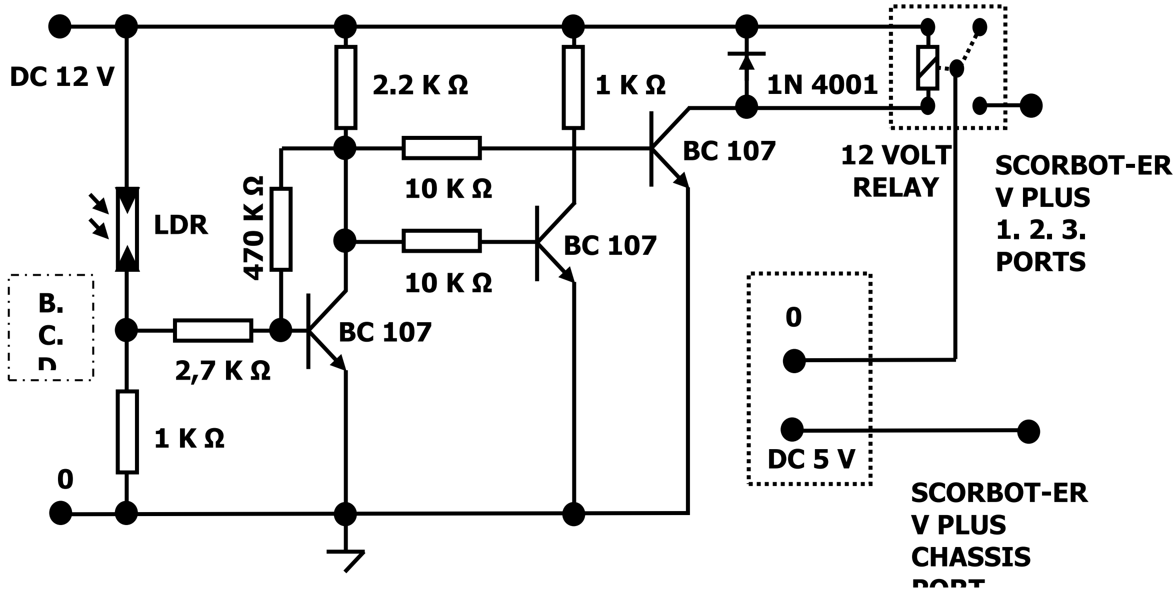
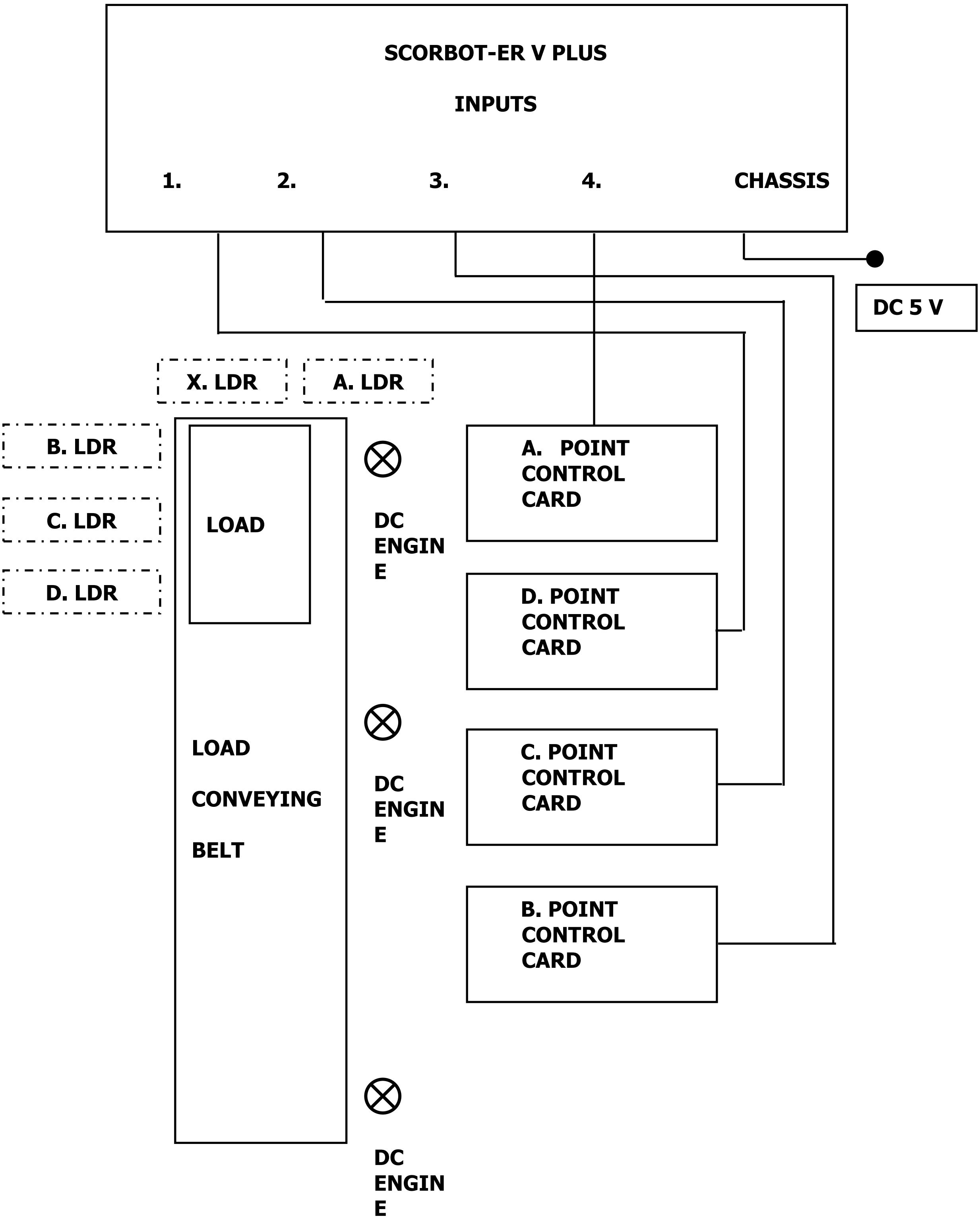
Annex-1

OPERATION CONTROL CIRCUIT OF BELT CONVEYOR



CIRCUIT TRANSMITTING SIGNAL TO SCORBOT ER-V PLUS (3 ITEMS)




SCORBOT-ER V PLUS
INPUTS
1.
2.
3.
4.
CHASSIS
DC 5 V
X. LDR
A. LDR
B. LDR
C. LDR
D. LDR
LOAD
LOAD CONVEYING BELT
DC ENGINE
DC ENGINE
DC ENGINE
A. POINT CONTROL CARD
D. POINT CONTROL CARD
C. POINT CONTROL CARD
B. POINT CONTROL CARD