

BUILDING AND ARDUINO BASED CONTROL OF CONVEYOR BELT FOR SORTING AND COUNTING THE OBJECTS

Malik Čabaravdić
Anel Husaković
Muhamed Podojak
University of Zenica
Fakultetska 3
Bosnia and Herzegovina

ABSTRACT

This paper is related to application-specific device, a prototype of a conveyor belt for sorting the packets by the size in bins and tracking the number of bins. The paper deals with the creation of physical model, using Arduino based embedded system for local control.

Keywords: Arduino, Algorithm, Local control, Conveyor, Bins, Positioning, DC motor, Stepper motor, H-bridge, Ultrasonic sensors, Simulation

1. INTRODUCTION

In this paper, the focus is on the terms of automation and belt conveyors as well as on the direct connection between these two terms. The need for transporting as much quantity of goods as possible under certain conditions of work, with the slightest loss in the quality of these goods during transport, has led to the development of a conveyor belt. The first such conveyors were quite primitive, and in a short time it was necessary to work on the development of these devices in order to achieve better results. However, in order to improve the operation of this conveyor as well as almost all of the others that are used today, it is almost irreplaceable the use of automation of individual processes. Using automation, the quantity of goods transported in time is directly increasing, the quality of transport itself, and also the number of employees is being reduced, what also reduces or completely eliminates the possibility of human error, what is also very important.

Belt conveyors have a special advantage because of their automation capabilities, and if their capacity is sufficiently used, they are a way ahead of competition from an economic point of view. However, there are some features in their use that require greater knowledge and research. The following problems were most commonly solved in these investigations:

- Control which is independent of the configuration of the transport network
- Elimination of danger of the drive drum slipping
- Work on the maximum extension of the lifetime of the use of the belt itself, in other words, ensuring the smallest possible tensile stress
- Detection of roller faults at the right time, in order to avoid their blocking and friction of the belt over the braked rollers [3].

In this paper, Arduino Mega will be used as a microcontroller to control the stepper and DC motors for running the conveyor belt, sorting and counting packets in different bins. Stepper motor will be responsible for the fine positioning of car which represents the moving part used for sorting. DC motor will be used for controlling the speed as well as a direction of conveyor belts. Speed is controlled by the user locally using joystick. Direction of the belt is controlled using H-bridge. Results of counting and sorting are obtained on LCD display.

2. MODEL OF CONVEYOR BELT

The conveyor belt system consists of:

- Sorting drive, which is responsible for positioning in the middle of the moving belt and moving along the transverse of conveyor belt in order to sort the objects in the bin,
- Moving belt as the drive mechanism and
- Control system.



Figure 4. 3D and physical model of the conveyor belt

2.1 Sorting drive

The moving part is connected from the outside to the rack, which is further connected to the stepper motor over the gear, allowing it to move in the left or right direction. The rack is rigidly coupled to the movable part and the movable part is, by the rack on one side and over the small extension on the other side, attached to the beams, allowing the proper positioning of the sorting drive inside the housing.

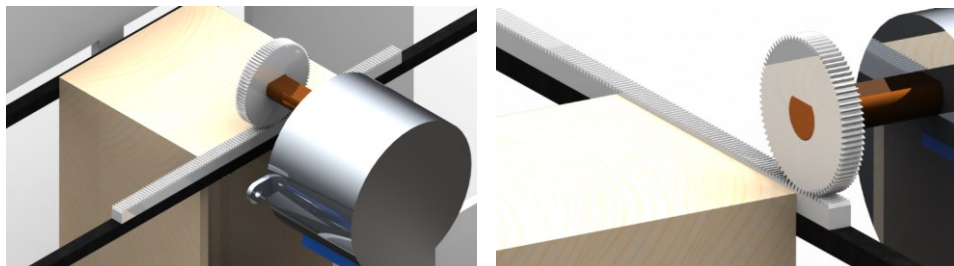


Figure 2. 3D model of the sorting drive

The size and position of the beams representing, in fact, the guides of the sorting drive, and the size and position of the sorting drive together with the rack are designed so that the sorting drive can occupy three positions: starting position (the sorting drive is centered in the middle and ready to take the first of the incoming packages), the right position of the sorting drive and the left position of the sorting drive. This part is also responsible for stopping of unprocessed packages.

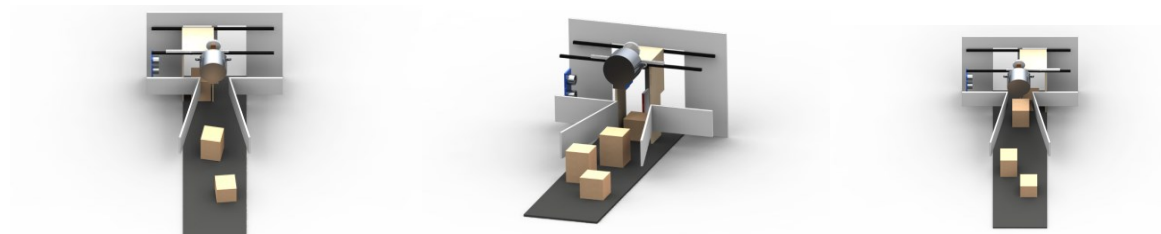


Figure 3. Sorting positions of a housing: left, middle, right

2.2 Moving belt

By moving the joystick in positive or negative direction, the DC motor movement is enabled, and the movement from the DC motor is transferred to the drive drum via the transmission system. The belt is

set over the drive drum and due to friction between the drive drum and the belt, this belt starts moving. In this way, packet transport is enabled in the desired direction.

3. CONTROL

System starts with automatic positioning on the middle of the belt. This is enabled using one of two ultrasonic sensors which continually tracks the position of the drive. One needs to put the packets on the conveyor belt and to start the belt by pressing the joystick which will run the belt with starting predefined speed. Currently, in order to control this system only local control is enabled using joystick and because of two position of joystick there are only two speed modes. Packets are stopped and processed by the drive system on which is attached another ultrasonic sensor which measures height of the object. Depending on the algorithm, control unit will send command to stepper motor to sort the object in one of two possible bins. After sorting, status of counting number of objects is showed on LCD display and the drive is again positioned on the middle of the belt waiting for another object to process. There is also RGB led attached to the front of the drive in order to signalize to the user the status of sorting/counting process.

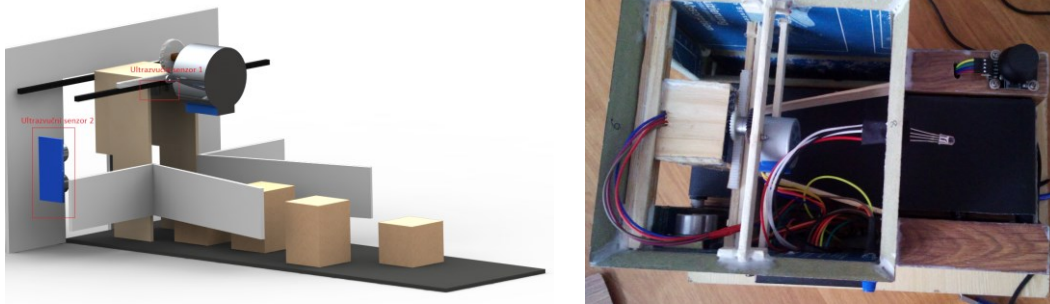


Figure 4. Conveyor belt control system

Arduino MEGA is a microcontroller based on the Atmega1280 database. It has 54 digital input / output ports (where 14 can be used as PWM outputs), 16 analog inputs, 4 UART connectors (hardware serial ports), 16 Mhz crystal oscillator, USB access, power connector, ISCP support (ISCP- in circuit serial programming, it is possible to program the unit while it is connected to the complete system), and reset-key. It contains everything needed to support one microcontroller. It is possible to power this unit with USB via a computer, via an AC-DC adapter, or via a battery. Other features of the Arduino MEGA unit are:

- Operating voltage: 7 V
- Input voltage (recommended): 7-12 V
- Input voltage (limit): 6-20 V
- DC current per input / output terminal: 40 mA
- DC current for 3.3 V connection: 50 mA
- Flash memory: 128 kB of which 4 kB was used for the Bootloader
- SRAM: 8 KB
- EEPROM: 4kB
- Microprocessor speed: 16 Mhz



Figure 5. Arduino MEGA [4]

The Arduino unit contains all the parts that make it a complete structure. Therefore, it is not necessary to add any additional hardware components for its functioning, nor should it require any additional programming language. It is necessary just to connect the unit to the PC, run the standard Arduino programming language, and it is ready to use. Some of the important advantages of the Arduino microcontroller are low cost, ease of programming and accessibility of accessories.

4. CIRCUIT SCHEME

Circuit scheme consists of two independent power supply 9V power supply for DC motor via H-bridge and stepper motor via stepper motor driver, and USB 5V power supply for Arduino Mega, sensors and display. DC motor speed is controlled with PWM signal via H-bridge and stepper motor is controlled using driver.

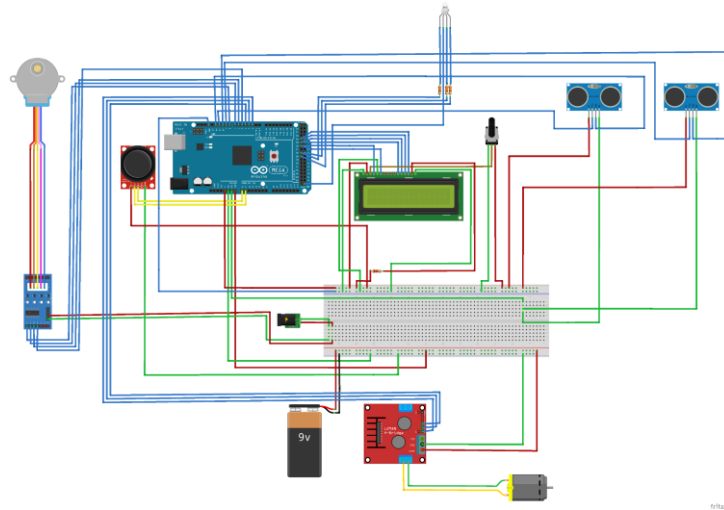


Figure 6. Breadboard circuit

5. CONCLUSIONS

Automatic control of the process of the conveyor belt is nowadays of such importance that many of the processes today in the transport without automation would be almost impossible to realize. In addition to explaining the basic concepts of automation and conveyor belt, the purpose of this paper is to illustrate how one concrete example, that links these two terms together with the use of certain hardware and software, can be realized. A way, in which the individual transport processes can be simply managed through microcontrollers and additional components is shown. Therefore, it is possible to implement such system using the Arduino platform. However, the described system also has some disadvantages. One of these disadvantages is the unreliable operation of the ultrasonic sensor when it is expected to be more precise (when the tolerance in range of several millimetres is allowed). For larger dimensions where a tolerance of several centimetres is allowed, this sensor can function reliably. In addition, it should be noted that the use of the battery for the power of this system is also unreliable because there is a possibility that the battery cannot deliver sufficient power to the DC motor.

It can be concluded that, with the application of some simple hardware and software components, which are properly connected, it is possible to create a system of automatic control of individual transport processes, thus facilitating transporting, increasing the efficiency of conveyors, as well as making the processes such as counting and sorting of the certain amount of cargo considerably simpler.

6. REFERENCES

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