Automatic Parcel Sorting System based on PLC

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Abstract

The objective of this research paper is to explain the process of PLC based sorting of different parcels in companies. Automatic parcel sorting systems are essential for courier companies with a high distribution capacity and short time-to-deliver and courier companies need to increase the quality and reliability of their services as the Customers demand quicker deliveries of goods. In many courier companies parcel sorting and placing on their particular location is done manually which seems complex and takes time so we have decide to provide ease to courier companies by implementing a system which does all these work without the interference of human being. Our proposed project automatic parcel sorting system based on PLC is one of the useful projects for couriers companies; we used the technique of RFID for the identification of different parcel the solution that we are providing to the courier companies

Keywords: RFID, PLC, reliability, short time delivery

I.   Introduction

Many sorting companies today are still use the manual sorting process to sort the parcels for production process. By using the manual sorting process, it can take a long time to finish the work which will cause a delay in delivery time because human will usually feel bored and tired to do the same task repetitively. This situation will result to inefficient work condition for the worker. The repetition of these works over long period of time can expose the workers to experiencing lower back pain and in some cases, this type of injury will cause the operator to be paralyzes. Efficiency is also crucial for courier companies, which routinely trade on their ability to process and deliver a package more quickly than any of the alternatives [I].

By the project of Design and Development of PLC based Automatic Sorting System application, all problems that being mentioned earlier hope can be eliminated. With this project the sorting process can be done faster and perfect than before while use the manual sorting system. This is because the automatic sorting system will be doing the correct sorting process by Microcontroller based RFID detection and PLC controlled Pneumatic pushers. This will result in higher parcel handling efficiency [IV].

The main purpose of modern automation is to increase the production in limited time with high accuracy. Automated system can be designed for a high sorting capacity and short time-to- deliver. This project based on "PLC and Microcontroller" to automate Sorting System. This sorting system can sort and place packages to the right destination efficiently and accurately [II]. In this project detection of parcel address is done by RFID. RFID send this information to Microcontroller for further process. PLC (Programmable logic controller) sorts the parcel by using pneumatic cylinders [III].

In our project RFID (radio frequency identification) and PLC (Programmable Logic Control) play a vital role in our project as RFID treat s input of PLC and PLC is vital in controlling the all the pneumatic system of our project.
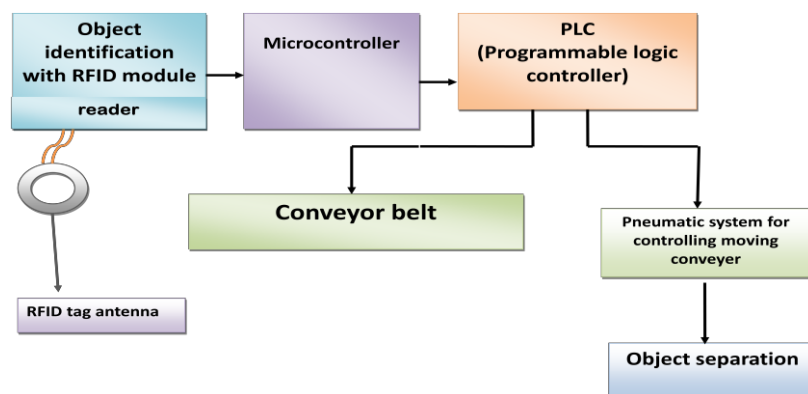

Figure 1: Block diagram of PLC based Sorting System

II.   DESIGN METHODOLOGY

Once the RFID card has shown against an RFID Reader, the card transmits a code back to RFID Reader. The process is known as Backscattering. RFID Reader receives a code (represented in hexadecimal) transmits it to the microcontroller for authentication. If the code is verified with the code stored in External Memory, Microcontroller will send it to the PLC (Programmable Logic Controller). Otherwise no signal will be generated from microcontroller. After receiving the signal from microcontroller, PLC will operate the pneumatic cylinders. We can also see tag on LCD (liquid crystal display). If the wrong card has shown against an RFID Reader, the Microcontroller will show an 'unauthorized access' on LCD.

By using following techniques we complete our project:

IIa.   Identification of parcels:

For parcels identification we use RFID (radio frequency identification system) system. We use low frequency RFID system whose range is134.2kHz.we use TMS3705 reader IC in our project [V]

III. RFID (Radio Frequency Identification)

RFID consist of small chip and antenna and is capable of carrying 2000 bit data. Since these were better than barcodes, they started to replace barcodes. Radio frequency is emitted from the tagged object and hence RFID technology has variety of application [VI].

1. Access Control

2. Product Tracking

3. Tracking of person and animals

4. Human identification

IIIa. Taking decision

The RFID reader sends the detected ID to the microcontroller that compares this ID with the already defined IDs and activates the respective output. For this we use AT89C52 microcontroller [VII] in our project as it is cost effective and applicable in our project. RFID reader schematic diagram figure 2.
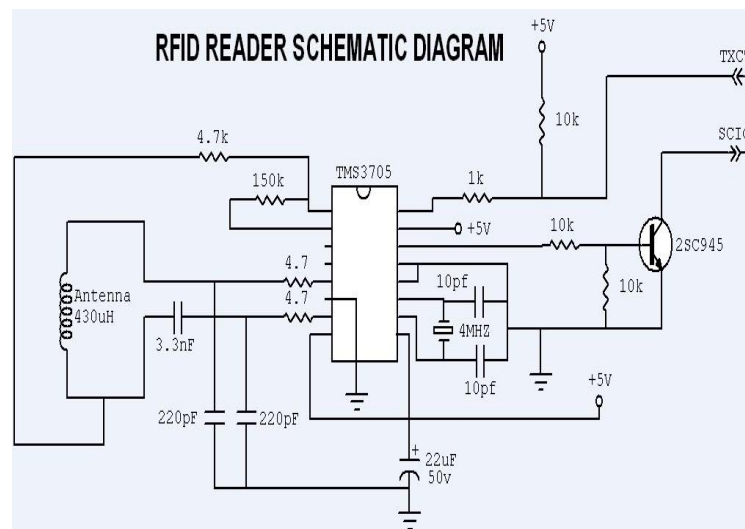

Figure 2: RFID reader schematic diagram [VIII]

In our project we use RFID tag detection system. For this we use RFID reader TMS3705 IC. This is the reader IC with coil that gets information from tags through their radio waves generated by its antenna coil and the tags which we use is read/write passive tags. Passives tags means it activate through the RF signal came from reader.

TMS3705 is the low frequency RFID reader I.C. allows the production of RFID reader for low power application. In TIRIS setup there are one or more transponders or readers. Normally reader contains:

5. Reader antenna.
6. RF module.

a. Controlling

In first step RFID reader get the RFID tag information that place on parcel and send the received, information to microcontroller.

Microcontroller compare that valve and activate its relative output that output connected with the input of PLC there are 3 outputs came from microcontroller 1st output activate when the parcel is of Karachi second activate when parcel is from Lahore and third when parcel came from Islamabad through these three outputs microcontroller active the input of plc. Now PLC gets the signal from one of its input. Let suppose the detected is of Karachi so the 1st input of PLC activate and perform its function i.e. move the cylinder of Karachi, when parcel was reached to the cylinder, for push it into the bin. The position of parcel is detected by IR sensors.

We use 3 IR sensors. Each sensor is placed before the cylinder or detection that whether the parcel reach or not.

For controlling the pneumatic cylinders we use PLC (programmable logic controller) . The PLC that we use in our project is Delta DVP-14ss2 [8] having 8 inputs and 6 outputs. PLC inputs depend upon the outputs [8] and decision of microcontroller. With the activation of particular input PLCoperates the respective cylinder. Instead of this PLC also controls the position of parcels through IR sensors [IX].

Figure 3: Relay Printed Circuit Board (PCB) [VII]

The reason for choosing delta PLC is that it has several advantages over other PLC as compare to cost. It is easy to use and it is easy to handle. It is cost effective. It is better because it slim and 2nd generation of DVP series .We are using delta sS2 PLC module with 8 digital input and 6 digital outputs. Our project depends on 6 inputs and 4 outputs in which all are the digital input. Delta plc has advantage of cost, internal input relay, internal output relay, internal timer, internal counter, built-in function and data register. The power input type for DVP-sS2 module is AC input. When operating DVP-sS2 module the range of the input voltage should be 24vdc and the output is 250v.

If the full recovery of signal is required from the tag, the reader circuit needs a bandwidth that is at least twice the data rate [9] i.e. for 132.2 KHz data rate FSK (÷10) is 13.22 KHz therefore

Bandwidth = 13.22×2 = 26.44 KHz

b. **Quality Factor (Q):**

Q of the signal is

$Q = f_0 /BW$
Q= 134.2 / 26.44= 5.07
Inductance for the circular coil is determined by the following equation:

$$L = \frac{0.31\ (a\,N)^2}{6a+9h+10b}$$

Where,
L is in micro Henries.
a is average radius of the coil in cm
h is the height of the coil (in cm).
b is winding thickness (in cm).
N is the number of turns.
We have selected the optimal values for our antenna design. Therefore selected values are: a=1.5cm, h=0.25cm and estimated b=0.018 cm. Using the equation 4.3, we calculated the coil to need approximately 102 turns.
Therefore the inductance of the coil is,

L = 7256.79/11.43 = 634.887Uh

IV. Conclusion

From the final output of this project we achieved a lot of conclusions. We can conclude sorting was done much efficiently and accurately. Context is very broad and could be sensed in various ways. The time and human effort can be reduced by much extent by implementing such type of project in industries like courier. In courier

companies it requires short time to deliver and counting of the packages could also be done easily.
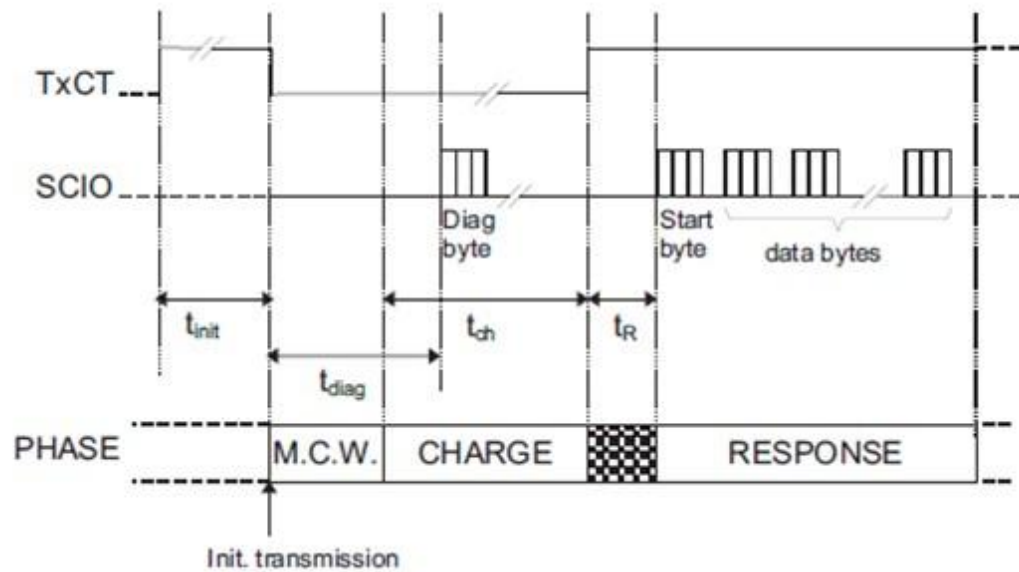

Figure 4: Radio Frequency Identification (RFID) tag reading timing diagram [3]

V. Future Enhancement

The final output we've achieved is what we had set for. But still there is room for lots more enhancements and additional facilities. Some of these enhancements are listed below.

1. We can develop database server of our sorting system so that information can be received by computer or whole networks of pc. Database network will be helpful for the whole record of packages.

2. The whole system can be made more secure to ensure that the data is only available to the authorized person.

3. By using the NV RAM we can store the data of sorted parcels that can be helpful at any stage.

4. The automatic loading and unloading feature can be added in this project. This will increase the speed of process.

5. We can add more conveyors for more precise sorting.

6. We can develop the RFID gates at loading and unloading terminals. This will very helpful for tracking the parcels.

VI. Acknowledgement

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