Designing of a Barcode Reader in the Perspective of Bangladesh Market

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Abstract

This paper presents a simple approach to design a barcode reader suitable for developing countries like Bangladesh. It first introduces the bar code technology. Its use with respect to Bangladesh in then explored. A detail description of how the bar code technology works is then discussed. At last the technique exploiting the availability of computer for using with a bar code reader is given.

Keywords

Mechatronics; Automation in Production; Barcode Reader

Introduction

The term *automatic data capture* (ADC), also known as *automatic identification and data capture* (AIDC), refers to the technologies that provides direct entry of data into a computer or other microprocessor controlled system without using a keyboard. One of the widely used ADC technologies is the bar code.

Bar codes provide a simple and inexpensive method of encoding text information that is easily read by inexpensive electronic readers. Bar coding also allows data to be collected rapidly and with extreme accuracy. A bar code consists of a series of parallel, adjacent bars and spaces. Predefined bar and space patterns or "symbologies" are used to encode small strings of character data into a printed symbol. Bar codes can be thought of as a printed type of the Morse code with narrow bars (and spaces) representing dots, and wide bars representing dashes. A bar code reader decodes a bar code by scanning a light source across the bar code and measuring the intensity of light reflected back by the white spaces. The pattern of reflected light is detected with a photodiode which produces an electronic signal that exactly matches the printed bar code pattern. This signal is then decoded back to the original data by inexpensive electronic circuits. Due to the design of most bar code symbologies, it does not make any difference if you scan a bar code from right to left or from left to right.

The basic structure of a bar code consists of a leading and trailing quiet zone, a start pattern, one or more data characters, optionally one or two check characters and a stop pattern.

Perspective Bangladesh

The author has identified several fields of application in Bangladesh. Bangladesh may serve as a model of a developing country and the applicability of the current analysis

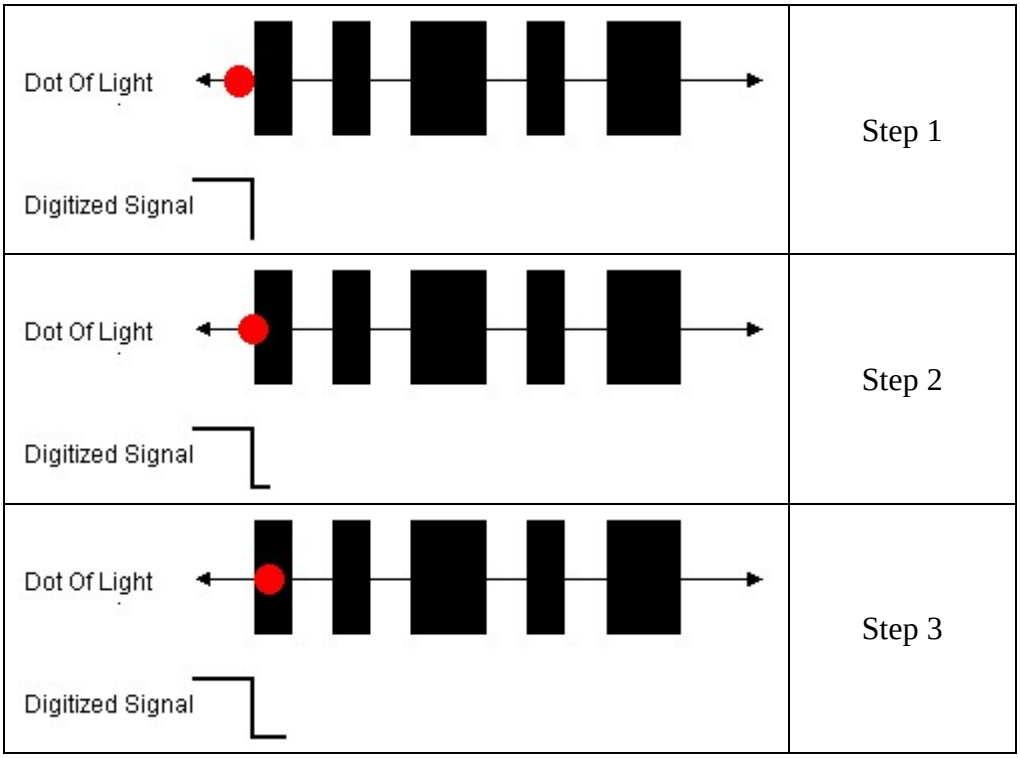
may extend to other third world countries. In such a country the fields of application are: Garment Industries – where a huge amount product in exported and imported, Pharmaceutical Industries, Large General and Specific Product shops. Moreover depending on the availability of bar code system Food and Beverage Industries, Publishing industries, Media Industries, Foot ware Industries, Electrical Equipment Industries, Ceramic Product Industries, etc. may be considered potential users. Use of bar code technologies in these industries is either absent or limited due to the scarcity of the system. But the technology is very simple to implement and very cheap to produce. Proper focus is not given in such mechatronics products which can improve and automate production systems.

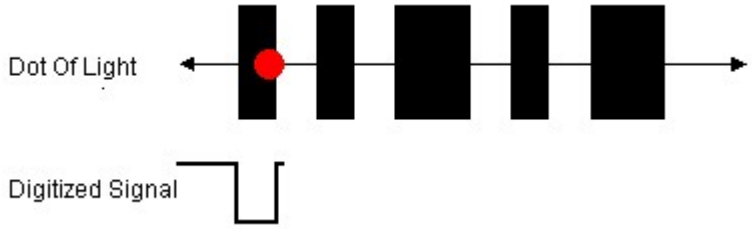
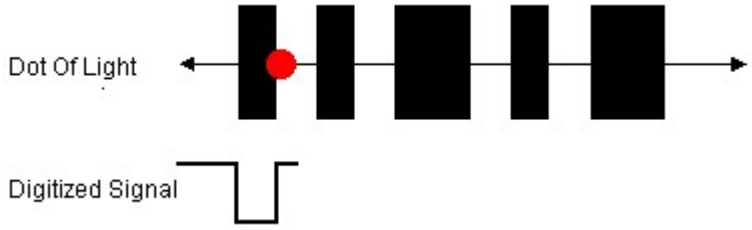
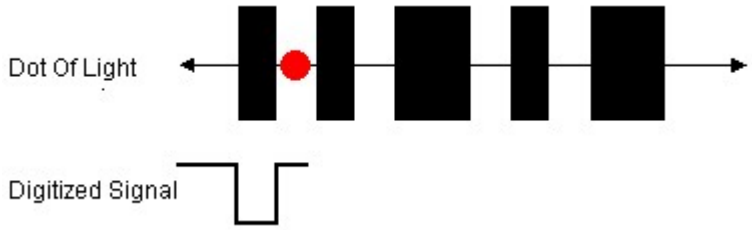
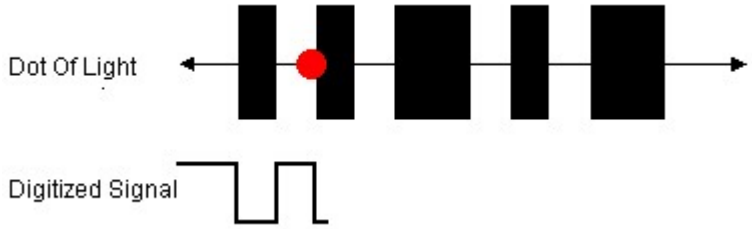
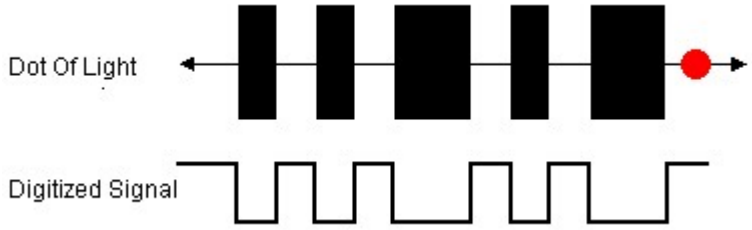
How a barcode reader works

There are currently four different types of bar code readers available. Each uses a slightly different technology for reading and decoding a bar code. There are pen type readers (e.g. bar code wands), laser scanners, CCD readers and camera-based readers.

Pen Type Readers and Laser Scanners

Pen type readers consist of a light source and a photo diode that are placed next to each other in the tip of a pen or wand. To read a bar code, you drag the tip of the pen across all the bars in a steady even motion. The photo diode measures the intensity of the light reflected back from the light source and generates a waveform that is used to measure the widths of the bars and spaces in the bar code. Dark bars in the bar code absorb light and white spaces reflect light so that the voltage waveform generated by the photo diode is an exact duplicate of the bar and space pattern in the bar code. This waveform is decoded by the scanner in a manner similar to the way Morse code dots and dashes are decoded.



	Step 4
	Step 5
	Step 6
	Step 7
	Last Step

Laser scanners work the same way as pen type readers except that they use a laser beam as the light source and typically employ either a reciprocating mirror or a rotating prism to scan the laser beam back and forth across the bar code. Just the same as with the pen type reader, a photo diode is used to measure the intensity of the light reflected back from the bar code. In both pen readers and laser scanners, the light emitted by the reader is tuned to a specific frequency and the photo diode is designed to detect only this same frequency light.

Pen type readers and laser scanners can be purchased with different resolutions to enable them to read bar codes of different sizes. The scanner resolution is measured by the size of the dot of light emitted by the reader. The dot of light should be equal to or slightly smaller than the narrowest element width ("X" dimension). If the dot is wider than the width of the narrowest bar or space, then the dot will overlap two or

more bars at a time thereby causing the scanner to not be able to distinguish clear transitions between bars and spaces. If the dot is too small, then any spots or voids in the bars can be misinterpreted as light areas also making a bar code unreadable. The most commonly used X dimension is 13 mils (roughly 4 printer dots on a 300 DPI printer). Because this X dimension is so small, it is extremely important that the bar code is created with a program that creates high resolution graphics (like B-Coder). For a good description of the different graphic file formats that are commonly used to create bar codes see: Raster vs. Vector Graphics

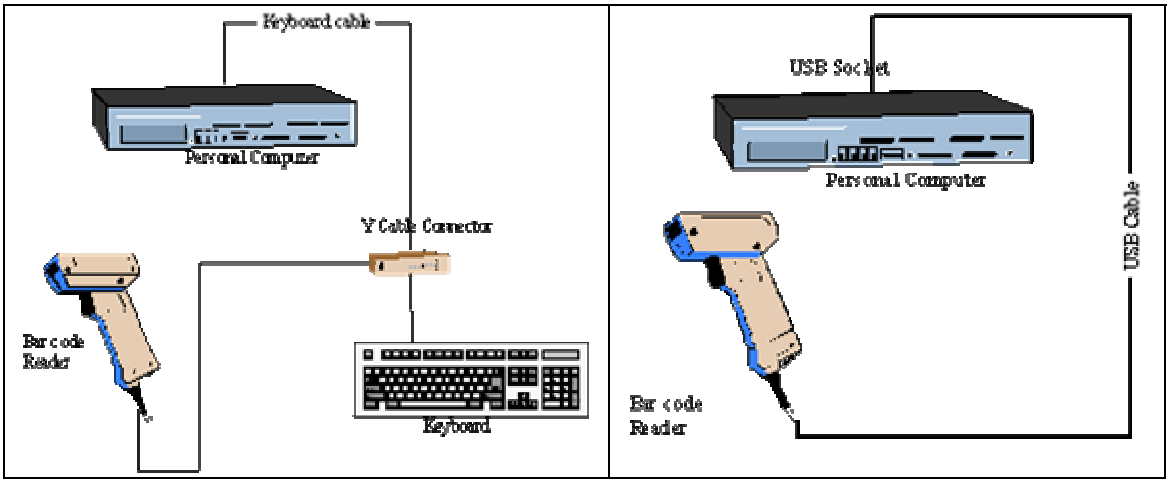
CCD Readers
CCD (Charge Coupled Device) readers use an array of hundreds of tiny light sensors lined up in a row in the head of the reader. Each sensor can be thought of as a single photo diode that measures the intensity of the light immediately in front of it. Each individual light sensor in the CCD reader is extremely small and because there are hundreds of sensors lined up in a row, a voltage pattern identical to the pattern in a bar code is generated in the reader by sequentially measuring the voltages across each sensor in the row. The important difference between a CCD reader and a pen or laser scanner is that the CCD reader is measuring emitted ambient light from the bar code whereas pen or laser scanners are measuring reflected light of a specific frequency originating from the scanner itself.

The factors that make a bar code readable are: an adequate print contrast between the light and dark bars and having all bar and space dimensions within the tolerances for the symbology. It is also helpful to have sharp bar edges, few or no spots or voids, a smooth surface and clear margins or "quiet zones" at either end of the printed symbol.

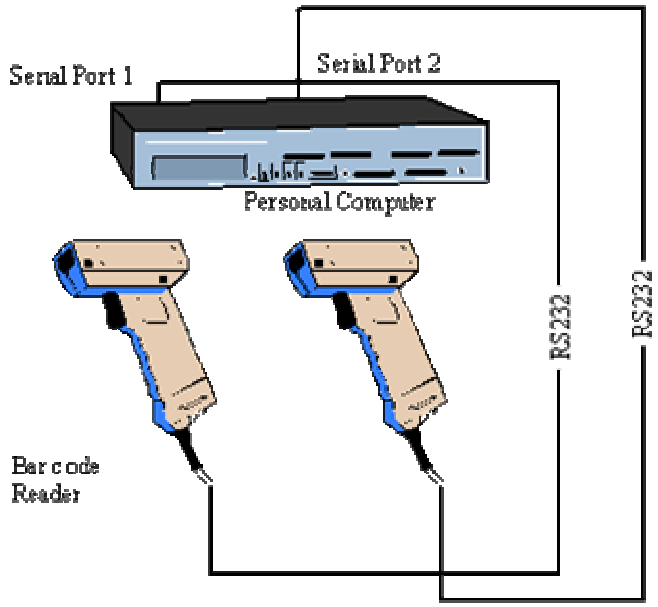
Interfacing a bar code reader to a PC

All application programs support bar code reading as long as you have the right equipment. Bar code readers are available with two types of output - either "keyboard wedge" output or RS232 output. The bar code readers with keyboard wedge output plug directly into the keyboard port on your PC and they also provide a pigtail connector so that you can plug in your keyboard at the same time. When you scan a bar code with the keyboard wedge bar code reader, the data goes into the computer just as if it were typed in on the keyboard. This makes it extremely easy to interface the bar code reader to any application that is written to accept keyboard data.

The keyboard wedge interface is extremely simple however it has a few drawbacks. If you swipe a bar code, the cursor has to be in the correct input field in the correct application otherwise you end up reading bar code data into whatever application has the focus. This can cause all sorts of potential problems as you can imagine. The keyboard output also is limited in that you cannot modify the data in any way before sending it into the program that is to receive the data. For example, if you needed to parse a bar code message into multiple pieces or remove some of a bar code message or add in a date or time stamp you would not be able to with a normal keyboard wedge reader.



The other possible output option is to get a bar code reader with an RS232 or "Serial" interface. With these types of bar code readers, you connect the reader to an available serial port on the back of your PC. You would then need a program called a "Software Wedge" to take the data from the bar code reader and feed it to the application where you want the data to go. The disadvantage to this approach is that it is a little more complex however you gain much more control over how and where your data ends up when you read a bar code.



Bar Code Symbologies

Bar codes are like a printed version of the Morse code. Different bar and space patterns are used to represent different characters. Sets of these patterns are grouped together to form a "symbology". There are many types of bar code symbologies each having their own special characteristics and features. Most symbologies were designed to meet the needs of a specific application or industry. For example the UPC

symbology was designed for identifying retail and grocery items and PostNET was designed to encode Zip Codes for the US Postal Service.

One of the widely used symbology is described below:

CODE 39 (Normal and Full ASCII versions)

The Normal CODE 39 is a variable length symbology that can encode the following 44 characters: 1234567890ABCDEFGHIJKLMNOPQRSTUVWXYZ-. *$/+%. Code 39 is the most popular symbology in the non-retail world and is used extensively in manufacturing, military, and health applications. Each Code 39 bar code is framed by a start/stop character represented by an asterisk (*). The Asterisk is reserved for this purpose and may not be used in the body of a message. B-Coder automatically adds the start and stop character to each bar code therefore you should not include them as part of your bar code message. If you select the NORMAL version of CODE 39 and your bar code text contains lower case characters, B-Coder will convert them to upper case. If your bar code message contains any invalid characters, B-Coder will prompt you with a warning message (if the Enable Invalid Warning Messages option is selected in the Preferences menu).

Code 39 optionally allows for a (modulo 43) check character in cases where data security is important. The health care industry has adopted the use of this check character for health care applications.

Another feature of Code 39 allows for concatenation of two or more bar codes. It is sometimes advantageous to break long messages into multiple shorter messages. If the first data character of a Code 39 symbol is a space, some readers will store the remainder of the symbol in a buffer and not transmit the data. This operation continues for all successive Code 39 symbols with a leading space, with each message appended to the previous one.

When a message without a leading space is read, it is appended to the previously scanned data in the buffer and the entire buffer is transmitted as one long message.

The FULL ASCII version of Code 39 is a modification of the NORMAL (standard) version that can encode the complete 128 ASCII character set (including asterisks). The Full ASCII version is implemented by using the four characters: $/+% as shift characters to change the meanings of the rest of the characters in the Normal Code 39 character set. Because the Full ASCII version uses shift characters in combination with other standard characters to represent data not in the Normal Code 39 character set, each non-standard character requires twice the width of a standard character in a printed symbol.

Note: Because all of the characters used to implement Full ASCII Code 39 are part of the Normal Code 39 character set, readers that do not support Full ASCII Code 39

will still read Full ASCII Code 39 symbols. The barcode reader will output shifted characters as if they were normal Code 39 characters.

Comparison of symbologies
In studies conducted by the University of Ohio, common bar code symbologies were tested to determine real life accuracy. The worst bar code for data accuracy in the test proved to be one of the most common - the UPC. The UPC had a worst-case error rate of 1 error in 394K characters. The best-tested symbologies were the DataMatrix and PDF417, with a worst case error rate of 1 error in 10.5M characters. All the results from the University of Ohio study are listed below.

Taken from Lincoln's Log Vol 1-00

Symbology	Worst Case	Best Case
DataMatrix	1 error in 10.5M	1 error in 612.9M
PDF417	1 error in 10.5M	1 error in 612.4M
Code 128	1 error in 2.8M	1 error in 37M
Code 39	1 error in 1.7M	1 error in 4.5M
UPC	1 error in 394K	1 error in 800K

A Solution for Current Scope
Keeping Bangladesh market in mind a cheap but useful solution would be a simple visible laser diode and a light detecting resistor (LDR). The user or the production system may “move” the bar code in front of the reader. It will emit the light and detect the change in resistance in the LDR which will then be fed directly to a computer. A module running in the computer would capture, analyze and produce the code directly from the input. As a computer is involver no microcontroller or PLC is required in this process. Most of the application requiring a bar code reader also requires a software to manipulate the data obtained from the barcode reader. In this case, a little burden in the software will reduce the manufacturing cost of the barcode reader hardware. A little advanced solution will be to use a array of light and sensors for reading the entire bar in one pass.

Conclusion
Although no practical project has been undertaken the practicability is not well justified for this project. As a cheap and easy solution can survive Bangladesh market longer, it can be said that this approach to barcode design has a good future in Bangladesh.

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