
| **RESEARCH ARTICLE**

Analysis of Applications Principles of Barcode Technology in Product Cost Estimation and Identification

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| **ABSTRACT**

Bar codes are a technology for automatic identification which has found application in many business sectors. As we know that, bar codes have many applications; they have been mostly used in segments of the retail grocery as well as consumer goods industries. They use computers for barcode detection. A bar code has a self-contained message whose information is encoded in the geometry of its printed bars and spaces. When a bar code is read, the patterns of light and dark contained in the bars and spaces are translated into patterns of ones and zeros, which the reading computer interprets as numeric or alphanumeric data. In a simple barcode system, bar codes are read by passing a wand containing a light source and a photo-diode across the code to be read.

| **KEYWORDS**

Technology, Barcode, Matrix, Linear and Application.

| **ARTICLE INFORMATION**

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1. Introduction

Barcodes have globally been used in supermarkets and industries and are of different types; they operate in a single fundamental principle from a series of black and white binary number zeros and ones by using reflected light. Increases volume document imaging systems are efficiently capture, store, manipulate, and retrieve thousands of document images. The computer system that capture code contains white stripe that reflect light, while the black stripe reflect hardly light at all. In this system, important equipment is not being used at its rated human labour, and capacity is being used to achieve tasks that a system could do faster and accurately. The scanner is used to interpret the computer software once the barcode entered.

This fundamental principle bright about the development of the way we are able to transform data and the way different kinds of business operators keep record-keeping. A barcode is an automated machine that read the representation of information or data to a virtual or physical object to which it is attached. The first development towards barcodes came in 1948 by Bernard Silver, which he have an idea about automatically read information about products during checkout. Araulo (2010), his new idea was to use ultraviolet ink. This method encountered the challenge of ink faded and was very expensive. After some period of research, he came up with another new idea of linear barcode. Barcodes are a pattern of bars and spaces of varying width that represent digits, letters or other punctuation symbols to identify an item or object. Barcode by itself is not a system but an identification tool that provides accurate and timely support of data requirements for sophisticated management systems. The

Association of American Railroads in the late 1960s invented the first barcode and used it in an industry by Kar Trak Automatic Car identification (KTACI) and General telephone and electronic which as to do with placing coloured stripes in various combination on a steel plated which were affixed to the sides of railroad rolling (Mckinsey, (2015).

In the early 1970s, Barcode scanning emerged. Anil (2002) explained that it is the situation of improve to achieve accuracy, time saving of users, reduce overall cost, make stock verification an easy process, Improve operational efficiency and data entry to a computer. A Barcode scanner is a device used to extract information optically from the barcode. Barcode scanners are of various types. These may be hand held or fixed type. Barcode symbols consist of a series of vertical dark bars separated by light spaces. When illuminated, reflected light is detected by electro optical sensor. The intensity of reflected light from the dark bars is less than that of spaces (white lines). The reflected light is converted into electronically voltage signals. The used of barcode enable clerks to keep track of every goods sold in the supermarket. A device known as a barcode scanner reads this code (Araulo, 2010).

2. Statement of Problem

Over decades in supermarket activities, people have wondered about the technique behind the symmetric lie of supermarket products costs. Some people felt that the operators of supermarkets usually due cheated them. This long standing situation prompts the study. The study aimed to employ the arithmetical principles behind the symbols in the barcode to decode the information the code contain to identify and predict the actual cost of the product bearing by the codes. In a manual system, it is difficult to ascertain whether a particular good is issued or not and hence, reserving a goods becomes a cumbersome job. Such problems do not exist with the computers. The database is always ready for any query. Thus, with ease, the entire operation can take place without any loss of information and control.

3. Aim and Objectives

The aim of this study was to analyzer the applications principles of barcode technology in product cost estimation and identification. The following objectives were considered;

1. Investigate the patter of combining numbers and letters, number and symbols in a barcode.
2. Investigate number representation pattern in a barcode
3. Design a pattern of combining numbers and symbols in a barcode.
4. To test run a dry test on the technique of extracting information from numbers, letters and symbols in a barcode

This study will revealed the techniques behind the science or technology of Barcode computing used in supermarkets and companies. This situation is necessary because products in supermarkets are known to be cash and carry. This knowledge will go a long to satisfy customers of supermarkets.

4. Methodology

The method adopted in this work was the incremental algorithm model. The incremental build model is a method of software development where the product is design, implemented and tested incremental until the product is finished. It involves development and maintenance. Based on customers' feedback, a plan is developed for the next increments, and modifications are made accordingly. This process continues, with increments being delivered until the complete product is delivered. The incremental philosophy is also used in the agile process model pressman (2010). The information contained in the barcode was incrementally decoded to arrive at the overall information expected from the barcode.

4.1 Basic Requirements for Barcode Application

Implementing barcodes in library applications following hardware and software are required:

1. Inventory Control
2. Barcode Scanner
3. Decoder
4. Printer
5. Printing Software
6. Communication Software;
7. Database of supermarkets Holdings
8. Personal Computers

4.2 Representation of Information in a Barcodes

Barcodes are a pattern of graphic, bars, text, numbers and spaces of varying width to identify an object or item. There are different barcode representation methods while are known as Symbologies.

4.3 Symbologies

The mapping between messages and barcode is called a symbology. The symbology is a language used to represent or arrange the bars and spaces. It defines the technical d particular type of barcode: the width of the bars, character set, method of encoding, checksum specifications, etc. The specification of a symbology includes the encoding of the single digit character of the message as well as to start and stop markers into bar and space (BhaskarRaj, 2005).

4.4 Type of Barcodes

The barcodes are classified into two categories which are:

1. Linear
2. Matrix

Linear Barcode: this is the first barcode that which made up of linear and space of various widths that create specification patterns. Therefore is the oldest dimensional barcode. Figure one below shows linear barcode.

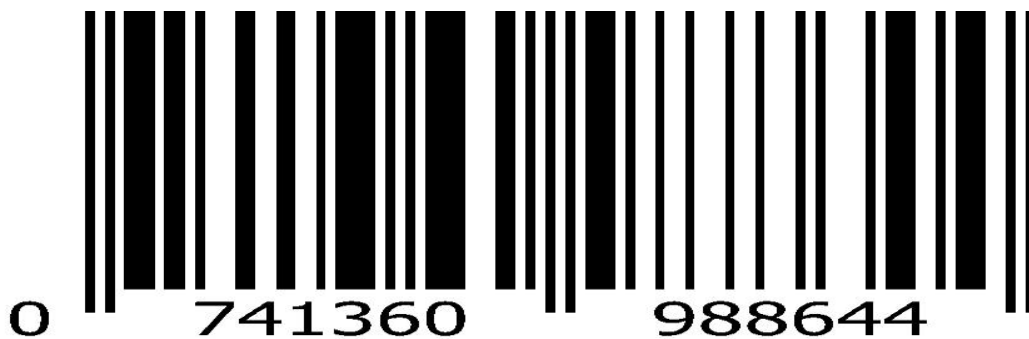


Figure 1. Linear barcode (Google, 2023)

According to Gample et al. (2003). Linear symbologies can be classified into two types, namely:

1. Continuous versus discrete
2. Two width versus many widths

Continuous versus discrete: In this type of linear symbologies, characters in discrete are composed of n-bars and n-1 spaces. Therefore, an additional space between characters, but it does not convey information and may be any width as long as it is not confused with the end of the code.

Two widths versus many widths: A two width, also called a binary barcode, contains bars and spaces of two widths wide and narrow

Matrix Barcode: this type of barcode has two dimensional way of representing information; it is similar to a linear code but can represent more data per unit area.

4.5 Representation of Barcode Numbers

Every digit in the barcode is represented by seven units. To represent any of the numbers from 0-9, the 7 units will be coloured with different patterns of black and white stripes. The numbers are represented by colouring two white stripes, two black stripes, two white, and one black stripe.

There are four types of lines. The thinnest line has a value of one. As they get thicker, the value become four, the first bar and the last three bars form 101, or thin black, thin white and thin black to mark the beginning and the end of a code, and a sequence of 01010 marks the middle of the code and looks like five thin lines alternating white and black down the rest of lines in the code.

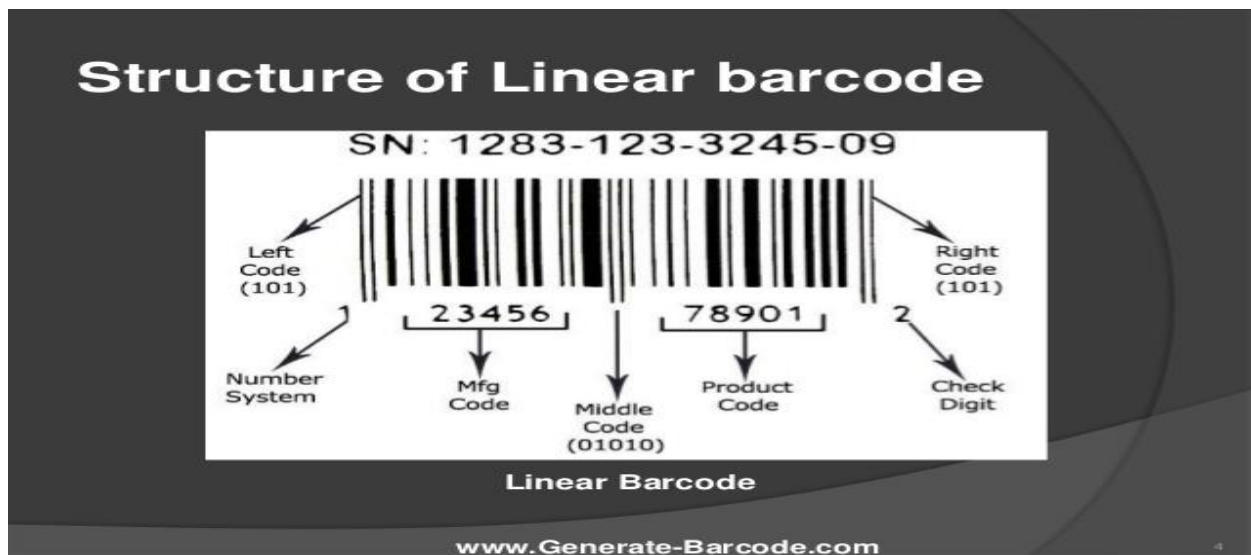


Figure 2. Structure of linear barcode (Google, 2023)

4.6 Principles of Barcode Technology

A Barcode scanner is a device used to extract information optically from the barcode. Barcode scanners are of various types. These may be hand –held or fixed type. Barcode symbols consist of a series of vertical dark bars separated by light spaces. When illuminated, reflected light is detected by electro optical sensor. The intensity of reflected light from the dark bars is less than that of spaces (white lines). The reflected light is converted into electronically voltage signals. If you look at the surface of a scanner in the checkout lane, you will see a lot of criss-crossed lines of light; the pattern was chosen as the most reliable and least demanding on a particular package.

To make a scanner that works without touching the code require a light source that will be remain in an arrow, a bright beam over a longer distance; the best source is a laser scanner that require human action used a wand to do

the scanning with very simple light source using several inches or more from the scanner and the actual scanning action can then take place inside the scanner.

There are three basically functional parts of the barcode scanner (Howel, 2016).

1. The illumination system
2. The converter/sensor
3. The decoder.

The Barcode scanner start by illuminating the code with a red light. The converter/sensor will now detect the reflected light from the illumination system and generates an analog signal with varying voltage that represents the intensity of the reflection. The converter changes the analog signal to a digital signal, which is fed to the decoder.



Figure 3. The decoder (Google, 2023)



Figure 4. Decoder and printer (Google, 2023)

4.7 Computational Principles in Barcode Evaluation

Barcode reading computationally is achievable when you understand the numbers represented in the barcode. To compute the barcode arithmetically, we analyze the following algorithm below:

1. First digit indicate the type of the product
2. Digits two to six are the manufacturer identification numbers
3. The manufacturer creates digits seven to eleven to differentiate its products from other manufacturers products

4. The last digit is the check digit, which corrects erroneously keyed barcodes. To check the validity of the hand keyed barcode, the cashier uses a multiplication algorithm to get a sum equal to the check digit.

The main purpose of a barcode is to identify something by labeling the goods with a barcode containing a unique number or character string. In a barcode, the bars represent one, and the space represent zero (Howel, 2016)

4.8 Algorithm for Barcode Principles Computing

Mathematically, the following steps below are used to calculate the check digit in barcode:

Step One: Sum up the numbers in the odd positions and then multiply by three.

Step Two: Sum up the numbers in the even positions and add the result with the previous step.

Step Three: Find the next largest number that is evenly drivable by ten.

Step Four: Subtract the result in step two from result in step three.

Step Five: the result from step four is the check digit.

Dry Test Result of the above Algorithm

Figure 5 below shows the barcode of a Morning fresh Dishwashing Liquid Bottle.

The information in the barcode is extracted as shown below.



Figure 5. Barcode (Google, 2023)

Barcode Digits: 0741360988644

Step One: $7+1+3= 11 \times 3 = 33$

Step Two: $4+6+9+8+8+6+4+4 = 49$

Step Three: $33+49 = 82$

Step Four: $82- 49 = 33$

33 (multiplied by 10 gives 330 = cost of the Morning fresh Dishwashing Liquid Bottle in Naira)

Barcode is the code used to automatically identify data associated with the product. Using barcode it will bring many advantages and benefit to all product purchasing customer in the supermarket. Its merit ranges from fast processing time save cost to useful system identification of products and information associated with products.

5. Conclusion

Implications of automated and barcode technology is one of the best techniques to minimize the time taken at supermarkets. Bar-coding by itself is not a system but an identification tool that provides accurate and timely support of the data requirement for sophisticated management systems. Barcode usage increases accuracy in the data collection, save time for the users and the staff and improves efficiency in various supermarket operations. Every supermarket needs the application of new technology to develop its existing methods. This time thus saved

can be utilized for developing advance and additional techniques in the supermarket. It minimizes errors and increases the efficiency at the supermarket desk. It also reduces the operational cost by eliminating goods cards. Bar-coded labels with both accession and call numbers on it can also be used as a goods tag. The contribution of barcode technology with computer and application software improves performance and efficiency in various supermarket operations.

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