

Design and Production of Multiple drugs Counting and Dispensing Machine

*¹ W.A. Akpan , ² E.O . Usungurua ³ S.I. Beshel

^{1,2,3} Department of Mechanical and Aerospace Engineering, University of Uyo, Nigeria

*Corresponding author: whiteakpan@uniuyo.edu.ng

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Abstract

There are issues related to the quality of service delivered in public health facilities as well as drug retail outlets. In the aspect of counting and dispensing of drugs, patients complain about the poor level of attention that they get from such places. Patient attendants working under pressure as a result of a great number of patients to be attended to in a short period of time may make mistakes and errors in the number of tablets counted. This usually leads to packaging of either few or more pills which invariably leads to drug abuse. This research is concerned with the design and production of a drug counting and dispensing machine to solve these problems. The machine was successfully designed, produced and tested. The motor inertia torque was 0.88 kg m^2 , the RMS torque was 3.30 Nm with a peak acceleration and torque of 7.3435 Nm and 758.872 rad/sec respectively. The required voltage and ampere was 5V and 1 A respectively. The machine was able to dispense 5 tablets for 3.5 seconds or 0.7 second for a tablet for paracetamol, gelusil and vitamin C tablets respectively. The efficiency obtained was 78.5%. Further research should be carried out to improve on the dispensing rate higher than (78.5%). The development of this machine at a large scale production is required.

Keywords: Drugs counter, dispensing, mechatronics, machine, servo motor, 3D-printing.

I. Introduction

Counting has been part of human existence from antiquity to present age. People count the number of items they have, the population of people in their community, the number of animals in their possession and any other thing that is countable. The essence of counting is to determine the size of something for record purposes or for administration – as in the case of medicine. In traditional medicine, it is known that diseases can only be treated when the right substance is administered in the right dosage i.e. the right amount or quantity. This makes measurement vital in health care.

Modern medicine is administered in several ways namely; oral, intravenous injection, topical, sublingual and rectal. Oral administration is the most frequently used route of drug administration and is the most convenient and economical [1].

According to [2] “a tablet is a pharmaceutical dosage comprising a mixture of active substances and excipients usually in powder form, pressed or compacted from a powder into a solid dose”. Tablets vary in shape and differ greatly in size and weight, depending on the amount of medicinal substances and the intended mode of administration. It is the most popular form and 70% of the total medicines are dispensed in the form of tablet. All medicaments are available in the tablet form, except cases where there is difficulty in formulation or administration [3].

Before a tablet drug is dispensed for the treatment of an ailment, it is required that not only the right substance should be taken in to consideration. Also, the right dosage or amount should be taken into consideration. The number of patent medicine stores in Nigeria involved in the counting and dispensing of drug has been on a rapid increase over the years. However, the number of drugs stores (commonly called chemist) is not commensurate with the quality of healthcare that ought to be at the disposal of Nigerians [4]. The poor state of the healthcare system in the country cannot be attributed to inadequate infrastructure alone, but also to the quality of service provided at the pharmacies and other drug retail outlets.

Until 1970, tablet and capsule counting and dispensing was a highly time consuming manual operation and most times resulting in costly errors [5]. Advancements in electronics and computer technology have led to the development of electrochemical counting machines. Such machines reduce error in counting and save time in drug dispensing by ensuring that the correct quantity of drug is dispensed quickly.

In the conventional counting of using spoon and the plastic tablets top counter, the pills get in contact with the counter surface. Thus, there is a possibility that other drugs can get mixed with other drugs. In a study conducted by [4], it was discovered that "72% of patent medicine drug dealers use manufacturer's spoon. Also, that 2% shakes drugs out of their containers during dispensing, thus causing breakage of the tablets".

Sometimes, it is also possible for the medicine vendors to use their hand, paper or any other material for counting the drugs and this is totally unhygienic because it leads to drug contamination. Automated counting addresses such concern by preventing contact with the surface of the counter itself.

To improve the quality of service delivery to customers in the most cost effective way without jeopardizing standards and contamination concerns, this project was carried out.

The use of medication is nearly as old as man. There are several reasons why people get ill. When they do, it becomes necessary to find solutions to the anomaly in health. Traditional medicines are administered orally, topically (i.e. on the skin) and through enema. By these means, individuals have administered or received treatments from time immemorial. In the modern society however, the mode of administering treatment has expanded to include intravenous injection and various forms of radiotherapy [1].

The difficulty in swallowing pills was a main cause of concern in the early years of development of pills. Significant effort had been made to make them go down easier. In medieval times, people coated pills with slippery plant substances. In the 19th century, the approach was to gild them in gold and silver; although it often meant that they would pass through the digestive tract with no effect. In the 1800s, sugar coating and gelatin coating was invented [6]. In 1843, the British painter and inventor, William Brockedon was granted a patent for a machine capable of "shaping pills". The invented machine was capable of compressing powder into tablet without the use of an adhesive [7].

With the advent of William Brockedon's machine, the necessity of counting of drugs became crucial for record purposes and for administration purposes. At the initial stage, counting of drugs was done using the conventional spoon and the plastic tablets top counter. However, using this traditional method for counting drugs, the drugs get in contact with the counter surface. Sometimes, it is also possible for the medicine vendors to use their hand, paper or any other material for counting the drugs and this is totally unhygienic [8].

Until now, some of these early counting devices for drugs are in use in some areas. However, this simple way of counting was difficult to use for large counts because of their awkward nature. The methods were used until the invention of the mechanical counting device.

Counting involves determination of the number of items or the rate at which something happens. Counting is often done to determine the magnitude, or the size of a certain number of items. The determination can be done by hand or by the use of a manual or automatic machine - depending on what is counted and the expected counting rate. Digital counters are also in use today. A digital counter is a device that generates binary numbers in a specified count sequence. The counter progresses through the specified sequence of numbers when triggered by an incoming clock waveform, and it advances from one number to the next only on a clock pulse[9].

Even before humans could read or write, they needed to count. First, they used their fingers, but when they had to deal with numbers over ten, a counting device became necessary. Pebbles and bits of wood arranged on the ground were used to count goods and to figure prices. These were the predecessors of the abacus.

So it is no wonder that such boards cannot be found. Other early counting devices include; salamis tablet, slide rule, Napier's bones and arithometer [10].

The first counting device - a mechanical "Calculating Clock" was invented by William Schickard in 1624, but was forgotten for a long time. So the man usually credited with inventing the first mechanical calculator is Blaise Pascal in 1642 [10].

Tablet Counters have been designed to facilitate effective counting of tablets administered to patients. There are two main types of tablet counters, namely: manual tablets counters and automatic tablets counters.

Manual tablet counters employs the use of conventional spoon (spatula) and the plastic top counter for counting of drugs. In this method, the pills get in contact with the counter surface. Sometimes, it is also possible for the medicine vendors to use their hand, paper or any other material in place of spatula for counting the drugs and this is totally unhygienic [11].

The tablet counter aided the pharmacy industry with time-consuming manual counting of drug prescriptions [8].

The counting machine consistently counted medications accurately and quickly. This aspect of pharmacy automation was quickly adopted, and innovations emerged every decade to aid the pharmacy industry to deliver medications quickly, safely, and economically. Modern pharmacies have many new options to improve their workflow by using the new technology and can choose intelligently from the many options available [12]. These early electronic counters were simple to operate machines designed to help pharmacies replace the common (but often inaccurate) practice of counting medications by hand [8].

Between 1982 and 1983, two separate facilities for fabricating the drug counter machine had been created. In America, overseen by Rodney Lester; and in England, overseen by the Kirby brothers [8].

In the late 1980s and early 1990s there was more technological advancement and this led to the development of high-speed machines for counting and bottle filling [13]. Like their pharmacy based counterparts, these industrial units were designed to be fast and simple to operate, yet remain small and cost

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