RESEARCH ARTICLE OPEN ACCESS

Pharmacy Automation-Pill Counting Design

Omer Mohamed Adam Adlan[1], Abdelrasoul Jabar Alzubaidi [2]
[1]PHD candidate
[2]Sudan University of science and Technology- Engineering College- Electronics Department

Abstract
Dispensing medications in a community pharmacy was a time-consuming operation. The pharmacist dispensed most prescriptions that were in tablet or capsule form with a simple tray and spatula. Many new medications were being developed by pharmaceutical manufacturers at an ever-increasing pace, and the prices of those medications were rising steeply. A typical community pharmacist was working longer hours and often forced to hire additional staff to handle increased workloads. This extra workload did not allow the time to focus on safety issues. This new factor led to the concept of using a machine to count medications.
This paper introduces a design based on using microcontrollers for counting tablets and capsules . A production flow is build to automate the whole operations
Keywords : medication, dispensing pharmacist , automation , microcontroller, tablets, capsules.

I. INTRODUCTION

The original electronic portable digital tablet counting technology was invented in the early seventies of the last century. These early electronic counters were designed to help pharmacies replace the common (but often inaccurate) practice of counting medications by hand.

A simple to operate machine had been developed to accurately and quickly count prescription medications. One of the first commercially available tablet counters in use was the KL7and KL8 models. The substantial investment in new technology was a major consideration for many pharmacies. Eventually the pharmacy community adopted the use of a counting machine as a superior method to hand-counting medications. These devices became known as tablet counter, capsule counter, pill counter, or drug counter.

These counters aided the pharmacy industry with time-consuming manual counting of drug prescriptions. A counting machine was found to consistently count medications accurately and quickly. A system of pharmacy automation was quickly adopted, and innovations emerged every decade to meet the needs of the pharmacy industry to deliver medications quickly, safely, and economically. Modern pharmacies have many new options to improve their workflow. This requires them not only to use the new technology, but to work out how to choose intelligently from the many options available .These industrial units were designed to be fast and simple to operate, yet remain small.At the turn of the technical advances saw the design of a new breed of counters with a verification system . With an onboard computer, displaying photo images of medications to assist the pharmacist or pharmacy technician to verify that the correct medication was being dispensed. In addition, a database for storing all prescriptions that were counted on the device.

Today’s pharmacy industry recognizes the need for heightened vigilance against medication errors across the entire spectrum. Prescription dispensing safety and accuracy in the pharmacy are an essential part of ensuring the right patient gets the right medication at the right dosage. A trend in pharmacy is to place a greater reliance on technology and pharmacy automation to minimize the chance of human error and speed up the process of dispensing.

II. METHODOLOGY

Constant developments in Technology make the dispensing of prescription medications safer, more accurate, hand free and more efficient .This paper is concerned with tablets , pills and capsules counting . The counter design includes; tablets feeding , and an electronics counting mechanism .The paper also includes dealing with different sizes of tablets, pills and capsules.

Initially the pan is fed with tablets to be counted by the counter in the microcontroller, and the count is displayed on the screen of the LCD. Two mechanisms can be adapted for the tablets counting mechanism:

The first mechanism is based on counting the tablets one by one with the aid of a continuous solenoid valve activation and de-activation.

The second mechanism adapts the principle of opening the solenoid valve for a predetermined period of time and then closing it. The tablets count is proportional to the opening period of time of the solenoid valve.

The tablets availability is sensed by an optical sensor. If the tablets are no more available an alarm will be activated and the process will be stopped. The processing will be restarted once the tablets pan gets fed with tablets . During the counting process , an alarm plus display message is displayed on the LCD for any malfunction .

III. SYSTEM LAYOUT

The aim of the hardware and software design is to automate the tablets counting operation..The electronic devices required to construct the system include a personnel computer, microcontroller, sensors, solenoid valves, LCD, siren, plus interconnection links and lab link cables. The block diagram of the hardware implementation of the entire system is shown in Figure (1) below.

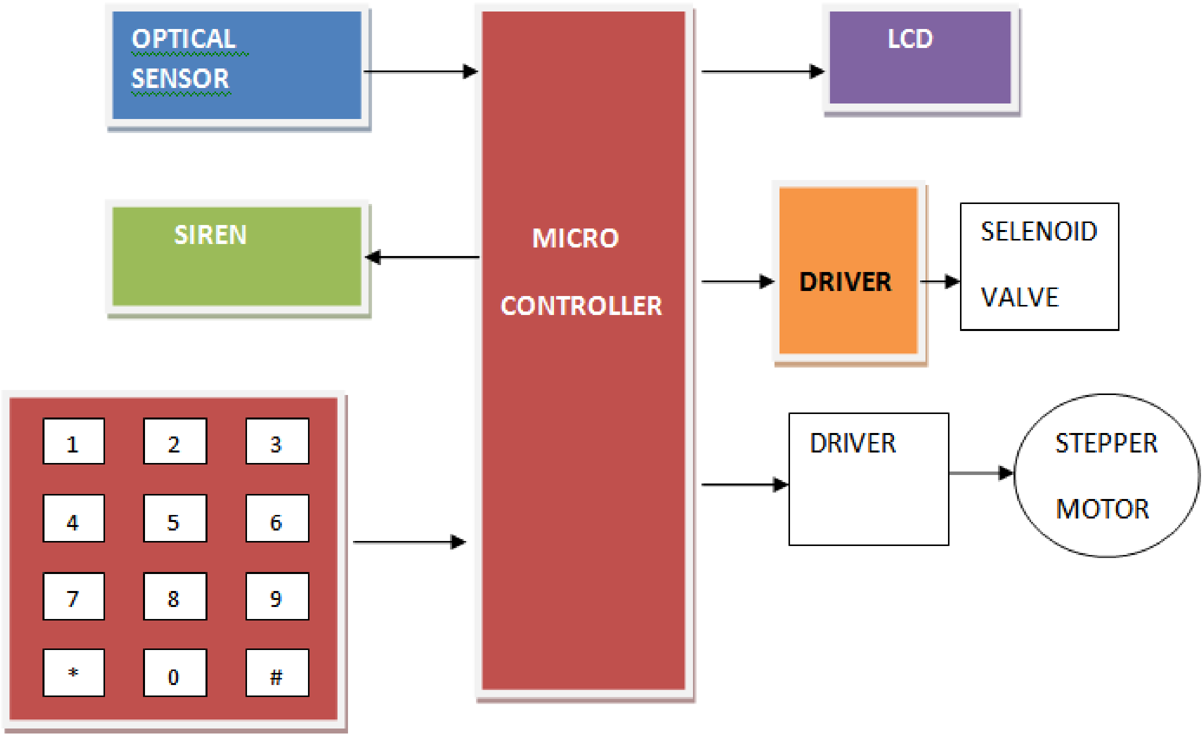

Figure (1) Block diagram of the system

The input system consists of sets of electronic blocks. Each set consists of an electronic device dedicated to perform a specified task.
The hardware components are:

- Personnel computer (PC):

A PC furnished with parallel ports is used for programming the microcontroller.

- Lab links :

Lab links are sort of cables that connects the computer port to external electronic devices. They are used for programming the microcontroller.

- Microcontroller :

Atmega 32 microcontroller captures data acquisition from the sensors .It controls the solenoid valves, and drives the stepper motors.

- Stepper motor :

A five wires stepper motors will be used .One wire is for power supply to the stepper motor and the other four wires are connected to the windings of the stepper motor . Equation (1) gives the step angel of the stepper motor.

$$\text{Step angle} = \frac{360 \text{ Degrees}}{200 \text{ Steps / revolution}} = 1.8 \text{ Degree / Step} \quad \ldots\ldots\ldots(1)$$

- Twelve keys matrix keypad:

The keypad is connected to the ATmega 32 microcontroller .It represents data entry to the microcontroller .

- LCD :

LCD is used to display the data entry and the real time data during the system processing.

- Solenoid valve :

It is used to open or close the way to the tablets .

- Driver (ULN2803):

It is used as driver to the stepper motor and the solenoid valve. Its driving output current equals 500 mA..

- Siren:

It is used to initiate an alarm.

IV. PROGRAMMING

To achieve an automation procedure for the tablets counting, we need to go through the following steps:

- Step one is developing a Bascom program in the microcontroller.

- Step two is downloading the (.Hex) file into the microcontroller using Pony prog program.

The algorithm contains two subroutines for mechanism-1 and mechanism-2 as follows;

Start Feed:
… Rotate the stepper motor 10 steps for feeding the pan.
Count:

… If (keypad input = 1) then call subroutine mechanism-1.
… If (keypad input = 2) then call subroutine mechanism-2.
… If the pan is empty then go to feed.
… If (keypad input = *) then go to terminate.
Go to count.
Terminate:
End
subroutine mechanism-1:
… Open solenoid valve .
…. Delay 0.3 seconds.
… Close solenoid valve .
Return

subroutine mechanism-2:
… Open solenoid valve .
…. Delay 15 seconds.
… Close solenoid valve .
Return.

V. RESULTS

. Equation (2) gives the solenoid valve timing for passing one tablet (mechanism-1) .

$T_{\text{solenoid valve opening}} \ \alpha \ \text{Constant} \times (\text{TABLET})_{\text{thickness}}$ …………………….. (2)

Where ;

$T_{\text{solenoid valve opening}}$ = time duration for the solenoid valve opening (seconds).

$(\text{TABLET})_{\text{thickness}}$ = Thickness of the tablet or capsule (millimeter).

Consider the $(\text{TABLET})_{\text{thickness}}$ = 5 mm. . Now implementing the system design , it is found that the resultant time ($T_{\text{solenoid valve opening}}$) per one tablet is :

$T_{\text{solenoid valve opening}}$ = (solenoid valve opening time + solenoid valve closing response time) X $(\text{TABLET})_{\text{thickness}}$

$T_{\text{solenoid valve opening}}$ = (0.06 sec. + 0.01 sec.) X (5 mm.) = 0.35 second

For increasing the productivity , we need to speed up the time interval for opening the solenoid valve. .It is found that speeding up the operation results in malfunction of the system .The optimum timing recorded is equal (0.35 second) for counting one tablet.

. Equation (3) gives the solenoid valve timing for passing the tablets (mechanism-2) .

$(\text{NUMBER})_{\text{tablets passing}} \ \alpha \ (T_{\text{solenoid valve opening}})$ …….. (3)

Where ;

$(\text{NUMBER})_{\text{tablets passing}}$ = Number of tablets passing .

$T_{\text{solenoid valve opening}}$ = time duration for the solenoid valve opening (seconds).

Assuming that the time for solenoid valve opening ($T_{\text{solenoid valve opening}}$) = 15 seconds . Now implementing the system design , it is found that the resultant number of tablets passing ($(\text{NUMBER})_{\text{tablets passing}}$) is equal :

$(\text{NUMBER})_{\text{tablets passing}}$ = Constant X ($T_{\text{solenoid valve opening}}$)

$T_{\text{solenoid valve opening}}$ = (3.4) X (15 seconds) = 51 tablet

VI. CONCLUSION

Tablets counting automation is the application of an electronics means to accomplish processing and control operations .Two counting mechanisms are used. In drug counting ,we need to go through a series of precise steps to accomplish the operation. This paper suggested a design based on using a microcontroller for processing . The microcontroller performs processing and control of the peripheral devices in the system. The processing is sequential and repetitive for tablets feeding and counting operations.

REFERENCES

[1] John Kirby Filed 8 September 1970 (3 July 1974). *COUNTING MACHINES - Patent GB1358378(A)*. DTI Data Networks LLC. Retrieved 18 March 2010.

[2] United States Patent Office (29 January 1974).. *RELATING TO COUNTING*

MACHINES. Freepatentsonline.com. Retrieved 6 March 2010.

[3] *"An Efficiency Analysis of the Kirby Lester KL16df Automatic Tablet and Capsule Counting System*". *Pharmacy Automation*. The Thomsen Group Inc. 2004. Retrieved 5 March 2010.

[4] "*An Efficiency Analysis of the Kirby Lester KL16df Automatic Tablet and Capsule Counting System*". *Pharmacy Automation*. The Thomsen Group Inc. 2004. Retrieved 5 March 2010.

[5] Christopher J Thomsen (9 November 2004). *"Pharmacy Automation-Practical Technology Solutions for the Pharmacy*". *Business briefing : US Pharmacy review 2004*. The Thompson Group. Retrieved 5 March 2010.