ROUND COUNTER FOR MILITARY APPLICATION BALLISTICS PROJECTILES

Datta M. Waghmare, Varsha K. Harpale, Vinay Sharma

1 Student, VLSI and EMBEDDED ME, PCCOE, Nigdi, Pune, Maharashtra, India
2 Professor, VLSI and EMBEDDED ME, PCCOE, Nigdi, Pune, Maharashtra, India
3 Director-Technical, Nilogic Pvt. Ltd., Pune, Maharashtra, India

ABSTRACT

Recent military trends adapted latest technology for growing battle power. As results need of smart electronic tools to help out in better performance of weapons. Various weapons achieve good performance with technical support. Working life, maintenance, soldier shooting training performance, information relating weapons is major issue can solve with technology. Widely major weapon comes in projectiles ballistic mode. The digital counter popular device used for counting. Nowadays, digital counter plays crucial role where input changes frequently. For tremendous analogous type application smart sensing devices used. Hence, to develop a hardware plus firmware for counting the number of round fired of ballistics projectiles. The armaments like rifle, gun and big cannons require to count the number of round fire and process the data for various analytical purpose. The proposed work will design and develop a round counter, which can display remaining round in magazine, and also can store the round fired in local memory. This can be sent to PC via serial interface and can be processed for research purpose for military requirement.

Keyword: *- Arduino nano, OLED, I2C*

1. INTRODUCTION

Nowadays technology growing rapidly. So, technology affects on various application domain like hospital, educational, social, military level etc. military domain is one of the essential domain of any country to survive. As result there must be mandatory growth in technology with military. The major weapons used for battle field is ballistics projectiles. This weapon is mostly used to war field. So, there is need to maintenance, performance, working life of weapons which will definitely help in improvement.

1.1 Significance of Technology in Military

In military area recently many technology are going to work. Various maintenance, supporting equipment are exist like GPS, microphone, laser etc. are used to improve performance by military. Armaments are the major equipment which carries by soldier. So, thing are related to armaments are very important. These are maintenance, performance analysis of weapon, shooting performance of soldier. In 1964 there was developed small caliber round counting system which is based on optical methodology. In that accuracy quite low dew to long time delay in counting logic.[2] To increase the overall things to do correctly we need to analysis of operation of weapon are very important. As we the weapon works base on various situations like in war field, training center, civil area[1].

While working with magazine weapons we often not know the how many round is remained in our magazine and this depend on situation where user doing his job. For working weapon to ensuring how many round remain in gun magazine can be detected by attaching round counter system to our weapon. This will result in user will know what to take next position with safety rounds in magazine. User will be safe and contact further.

When the candidates working at weapon shooting training center round counter will remark on candidate performance. In round counter for microcontroller plays role as CPU. Whole processing is executed in digitally. So, it become easy to find time parameter where consequent round fire. These analysis
gives best firing timing interval case, worst timing firing case, average timing firing case.

1.2 Generalized Idea of Project

As year passes there are various maintenance issues arise regarding working of weapon. As round counter act as speedometer for specific weapon like cannon. This will help in repairing, diagnosis of weapons. Memory interface can be done very efficiently with microcontroller unit so, whole data can save on PC for keeping history backup of weapon.

This device will be very handy, detachable to weapon. Detachable battery operable for reliable use and very light in weight. This result in user can work freely with weapon. Sensor and the counter are the major part of this design, to assure compatibleness among those controller is efficient platform. Controller have very efficient facilities to fulfill the project requirements like less weight, fast performance, more peripheral control, off chip memory interface, timer, counter, less power, less size etc. as well as controller have good design matrix properties (like cost, size, speed, performance).

Low power, less weight, minimum size and strictly time constrained are major aspect of this project. Add on feature can be added like device set up orientation, display contras, counting management, managing display, sensor type.

2. SELECTION OF SYSTEM COMPONENTS

2.1 Arduino nano board

For this work Arduino IDE platform is used. Arduino is an open-source electronics platform based on easy-to-use hardware and software. The complete overview of arduino nano is shown in figure 1. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED. The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3.x).

2.2 Accelerometer

Accelerometers are devices that measure acceleration, which is the rate of change of the velocity of an object. Details shown in figure 2.To get next stage of accelerometer application should know the information related to logic level, SPI communication, I2C communication, pulse width modulation (PWM), analog to digital conversion. Accelerometers are generally low-power devices. The required current typically falls in the micro (µ) or milli-amp range, with a supply voltage of 5V or less.

2.3 OLED Display

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted is OLEDs are emissive display that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight). Along with Improved image quality - better contrast, higher brightness, fuller viewing angle, a wider color range and much faster refresh rates, Lower power consumption, Simpler design that enables ultra-thin, flexible, foldable and transparent displays, Better durability.

3. METHODOLOGY

3.1 Adopted Methodology

To develop round counter prototype there must be a certain methodology must have incorporate. Methodology deals with certain steps to accomplish goal of proposed work. It give general idea about to understand the concept of project and clearly give guideline to implement. Below figure 1 methodology explorer the proposed work of round counter to incorporate counting of ballistics projectiles.

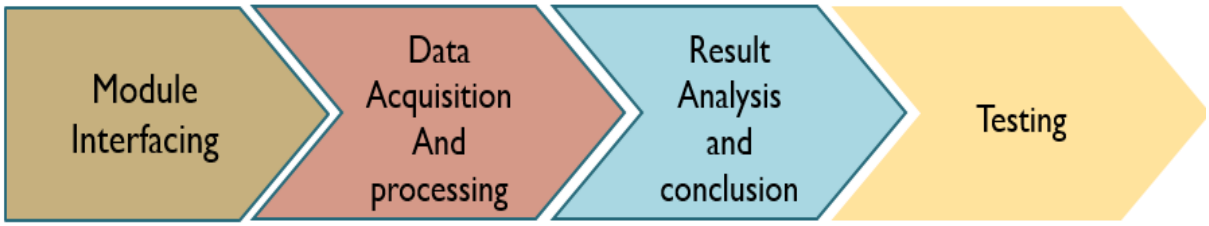

Fig -1: **Adopted Methodology**

3.2 Proposed Block Diagram

The design flow is adopted to analyze round counting of gun showing in figure 2. The method used in this paper is combination of accelerometer sensor, microcontroller and display modelling[3]. The digital acceleration of gun position is measured in positive and negative axis and it convert into possible floating readings. digital accelerometer is used which gives accurate readings of gun position in 3 dimension direction. Getting reading from accelerometer is proceed to microcontroller to processing. Arduino nano is best suited to this work because having analog input pins, less weight, good power consumption, breadboard friendly and small in size. Arduino nano have various library to extend working scope of project[8]. OLED is used for displaying the output of overall system. OLED is organic light emitting display which have various good advantages than LCD in contras of backlight, power

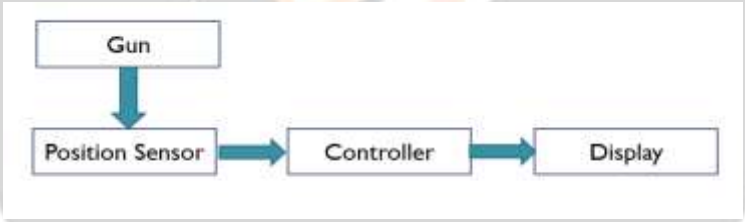

Fig -2: **Proposed Block Diagram of Round Counter**

consumption and image quality.

Accelerometer, OLED model having function library with arduino nano board. This library model is then checked for bugs and vulnerability by specified properties. These properties include Safety properties check to ensure that nothing bad will ever happen e.g. missing connection of accelerometer with arduino which tells to check the connections. e.g. resetting the range of accelerometer; for better communication SPI or I2C protocol will ensure by this library. If any communication protocol, connection fails then arduino nano will generate trace automatically and we can find reasons of failures.

3.3 Interfacing Diagram.

Figure 3 shows overall proposed system by interfacing module of ADXL345 accelerometer sensor, SSD1306 OLED display with Arduino nano board. With the reference of previous result proposed system is in working mode. By that base platform various data acquisition, data analysis, data processing can be done. At the last by the achieving required objective proposed system can be conclude.

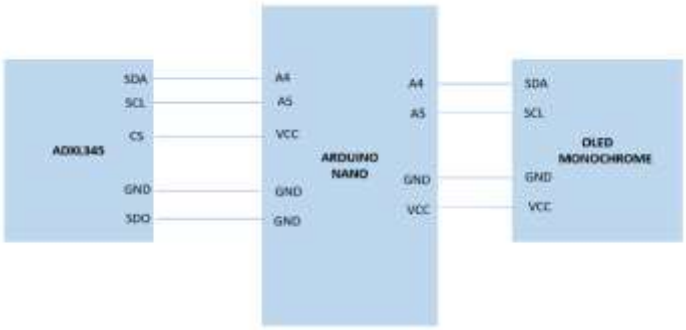

Figure 3 : Interfacing Diagram for Proposed Round Counter System

The sensor was connected to arduino nano board via I2C protocol. Arduino software having inbuilt library of ADXL345 and SSD1360 OLED Display. Input range of accelerometer is detected by microcontroller. Range from sensor is detected and filter out as per required fired position of gun. This input rane is captured by writing C code for reading the analog port data and checking this data for a legal position of gun. This is required to reduce the unwanted range of sensor position which may attribute to false reading correspond to wrong fire position of gun. Before connecting the actual hardware set-up the debugging was carried out using the serial monitor, an in-built functionality for Arduino IDE.

After single fire of bullet sensor generate position sensor range in three dimensional i.e. X, Y, Z axis. While firing gun X, Y axis position is minor direction and Z axis is major direction. Position sensor reading is more identical in Z direction. Required Range for bullet counting is between -9.35 to -10.35. here ADXL345 sensor rage is used up to +/- 16 g.

4. RESULT

4.1 Actual Setup

Figure 4 shows actual set up of proposed round counter with dummy gun. The position of round counter box should be visible to user to monitor display of round counter. Due to not availability of actual gun here dummy gun used. For reloading bullet on the mark upper part of dummy should be free so, round counter box is attached with gun as per shown figure 4.

Figure 4 : Actual Setup for Proposed Round Counter System

Figure 5 By attaching round counter on right side of gun taken sample of fire. calculated maximum position of x, y, z axis on serial monitor window. By the values of x, y, z calculating average and setting accurate threshold value to count fire of round.

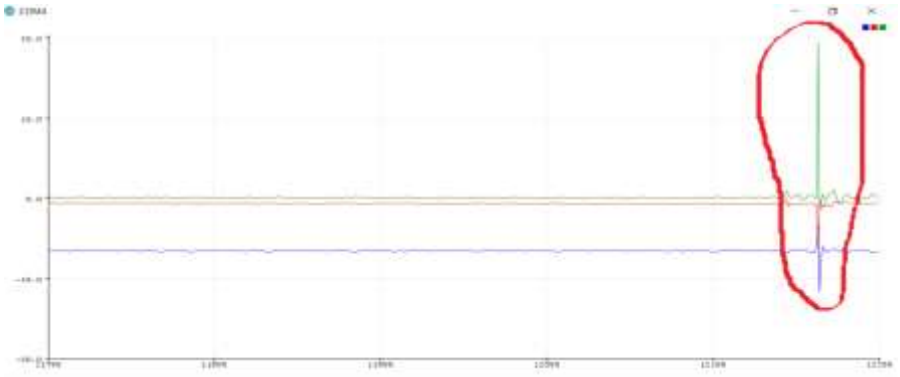

Figure 5 : x, y, z axis with fire of gun with respect to experimental setup

4.1 Gun Logbook Status

Figure 6 shows logbook history explore the every gun up to status of rounds left in magazine, total magazine fired, total rounds fired with respect to particular gun select. Gun history give details about gun parameter with add on feature current angle of gun.

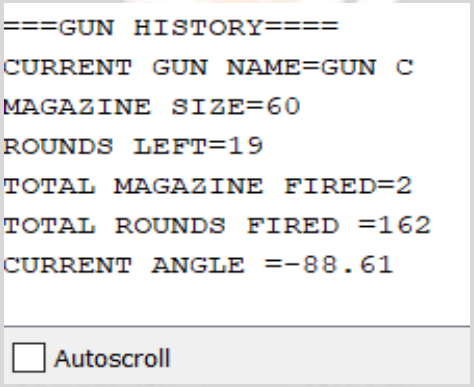

Figure 6 : Gun C logbook status

4. CONCLUSIONS

The proposed portable round counter system design assembly tested on dummy gun. Performance parameter of gun fired rounds, fired magazine, total fired rounds efficiently store and retrieve from segmented memory. Logbook history can store on PC for further analysis of weapon. By the retrieving data from proposed round counter system it is become simple to comment on gun lifespan and gun parts. Proposed ballistics round counter design can be effectively use for round fire.

Fixing of proposed round counter system on weapon is major issue and for that need calibration of accelerometer. Proposed system required military type system components.

5. REFERENCES

[1]. Curtis D. Johnson, Hai E. Weidner, “Round Counter” , United States Patent, Jan. 11, 1977.

[2]. Elspeth Huss, Michael Potorty, ”Small Caliber Weapon Round Counter System” ,US R&D lab, 1982.

[3]. Cotter W. Sayre, “Electronic Ammunition Counter”, United States Patent, Apr. 18, 1995.

[4]. Kenneth L. Brinkley, “Fire Arm Monitoring Device”, United states Patant, Oct. 22, 1996.

[5].Ying-Wen Bai and Hsiu-Chen Chen,"Design and Implementation of Low-Power Tablet PCs", IEEE, 2006.

[6]. Raul Delgado Acarreta, "Counting Device", United States Patent Application Publication, Apr. 30, 2015.

[7]. Raul Delgado Acarreta, “Counting Device”, United States Patent Application Publication, Apr. 30, 2015.

[8]. Deepiksha Yadav, Punit azad, “Design and implementation of robust low cost and low power prototype for generic counting system”, International Conference on Computing, Communication and Automation (ICCCA2017), IEEE 2017.