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Implementation of the SN04 Roko metal sensor on a 5.56 mm caliber portable magazine feeder

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ABSTRACT

Roko SN04 Metal Sensor technology and equipment are evolving and growing more advanced with time. One type of equipment that needs to consider both the user's safety and the equipment's development and safety is technological equipment used in the military. The soldiers can shoot and do so with skill. As a result, soldiers must be able to move swiftly against the enemy and vigilant when utilizing combat equipment to ensure that it is used correctly and for its intended purpose. Nevertheless, there are still several fighting tools in the military that require a lot of physical labor, making them exceedingly inefficient for the user. One such tool is the portable magazine for 5.56-millimeter ammunition. This study employed the 4D methodology, which stands for Define, Design, Develop, and Disseminate. Development research is a part of this methodology. A device for loading magazines has been created to make it easier for soldiers to move in situations where loading bullets by hand is still risky and impractical. The Roko SN04 sensor is used in the construction of this tool. One sensor that can be used as a metal detector is the Roko SN04. This magazine refill gadget uses a DC motor as a mechanic and an Arduino as a control to randomly arrange ammunition. This study's success rate was 96.67%.

Keywords: 5.56 mm caliber portable magazine; Roko SN04 sensor; development and safety

1. INTRODUCTION

The evolution of combat equipment is a major source of concern in the military community, starting with the equipment's security and that of its users. As a result, supplementary equipment must be developed, particularly for the military. One of them is using bullets that are both safe and don't present the user with any challenges [1]. To complement their primary responsibilities as soldiers, TNI ADs need to be proficient shooters. The military uses portable magazines with a 5.56 mm caliber as one of its fighting instruments [2]. Using technology is essential for managing firearms and ammo. Ammunition has always been loaded into weapon magazines manually, which involves placing the rounds one at a time with your hands [3]. One sensor that can be used to detect metal is the Roko SN04 metal sensor [4]. Prior studies are pertinent and share commonalities when addressing the issues to be explored. For determine if the ammunition loading mechanism in the SS2-V4 weapon magazine can operate as intended, this research serves as information for consideration and reference.

The amount of ammo that can be loaded into the storage rail can be determined by using the FC-51 infrared sensor. Depending on how much ammunition data has been input via the keypad, the loading procedure for ammunition operates efficiently and precisely. The ROKO SN04 inductive metal sensor, a type of inductive metal sensor, is employed in this study. The sensor includes three cables: one for communication and one with two power supply pins (positive and negative) [5]. The

NATO civilian commercial ammunition and the 5.56 mm caliber portable magazine are comparable in size [6]. 5.56 rounds have a thicker brass core than bullets used by civilians [7]. A civilian rifle chambered in 233 may not fire as accurately when a 5.56 bullet is used. While combining these two types of ammunition is not hazardous, it is best to use them according to the appropriate caliber standards [8]. This makes the creation of a tool essential to enhance and optimize the process of loading ammunition. This tool can help soldiers with their jobs and save time.

2. METHOD

The 4D method—also known as the needs analysis stage—was employed in this study. The second step, known as design, is creating the framework needed to carry out development in line with the requirements analysis. Product testing takes place throughout the third stage of development, which is called development. The fourth step is the dissemination stage, which involves putting the findings into practice by offering guidance or socializing regarding the developed instruments [9] and included into studies on development. An illustration of the phases of development research is shown below.

Define

Establishing and defining the needs for research and development is the first step in analyzing research needs. As a first phase in the study process, the researcher conducted three stages of analysis about the development of the 5.56 caliber magazine filler device: initial analysis, design analysis, and objective specification.

Design

In the design stage, tasks are undertaken to build a design that addresses current issues and enables the construction of a 5.56 caliber magazine-filling tool that is both aesthetically pleasing and functional. There are multiple stages in which all of the designs that need to be completed before moving on to the equipment deployment stage are included in the initial design. The 5.56 caliber magazine feeder's design is optimized using a variety of editing programs. An initial tool design will be created at this stage of the design process.

Development

This phase entails having design specialists validate the 5.56 caliber magazine feeder design, making necessary adjustments in response to their advice and critiques, and doing a small number of field tests. The tool's results have been verified by experts in design, and after modifications, it will be put to the test on soldiers to ascertain its practicality and efficacy.

Disseminate

The deployment or dissemination of the tools that have been created, tested, and improved in response to advice and comments from both design professionals and actual users of weapons constitutes the last phase of this research. A chart of the 4D research model is shown in Figure 1:

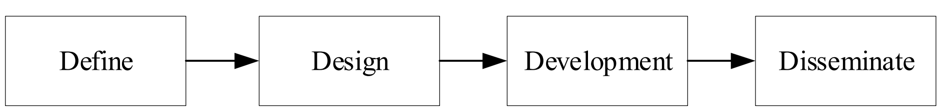

Figure 1. Research model chart

The 5.56 mm caliber magazine loading tool was developed to determine how accurate and quick the tool is for military requirements. Creating a research design was the first step in putting this development research into practice. When research design is used to create a study or gather information to address an issue [10].

Two different data types were employed in this study: primary and secondary data. Secondary data about this research was acquired from other pertinent periodicals. For example, the 5.56 mm caliber magazine, the journal about the SN04 Roko metal sensor, and the variable components used in this study. Furthermore, the amount of ammunition to be used and the time it takes to put ammunition into the device are two examples of related variables that are used to obtain main data.

This research also includes a flowchart, which is a simplified process for a system designed to be readily understood and discussed [11]. Figure 2 flowcharts use specific symbols to represent the detailed process sequence and the connections between individual operations within software.

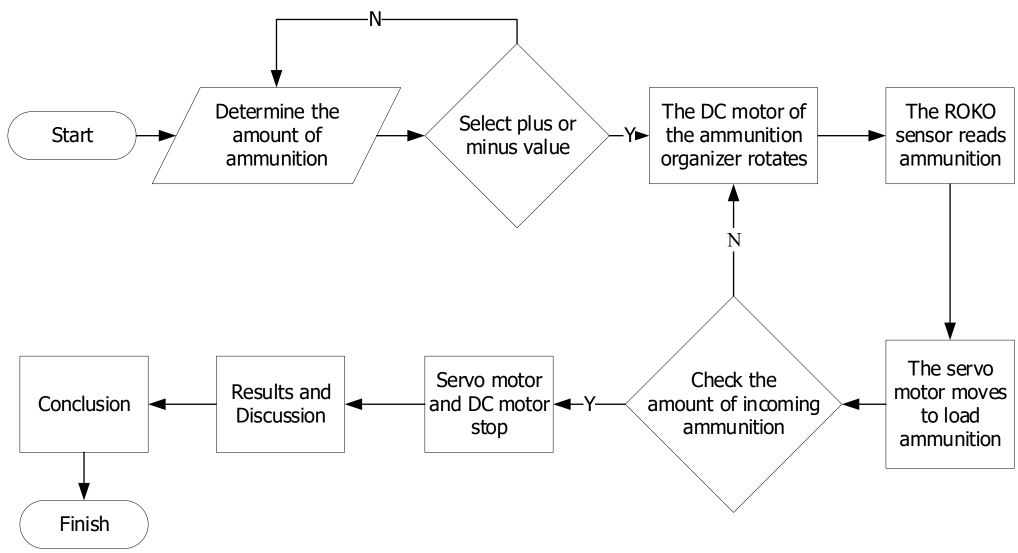

Figure 2. Flowchart

The system block diagram shows how a tool will function overall after it is made. where lines connect the components or functions represented by blocks to illustrate the relationship between one block and another [12].

3. RESULTS AND DISCUSSION

Design planning

The outcomes of the caliber magazine filling tool's development and innovation are as follows. Here's a tool design in Figure 3.

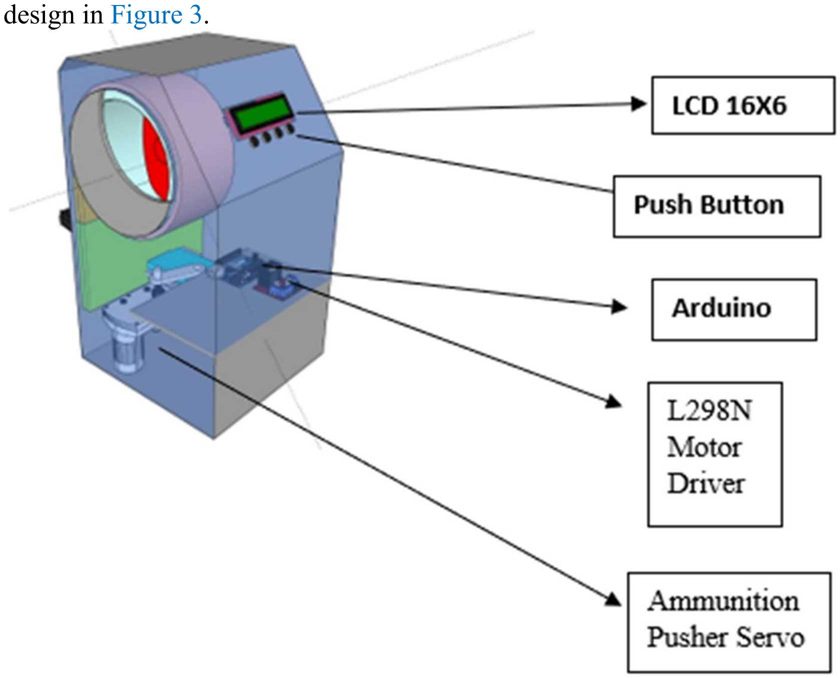

Figure 3. Tool design.

Random ammunition is fed into the ammunition organizer's mechanical component. The ammo travels down the descending line from the mechanical ammunition organizer container to the mechanical ammunition pusher component.

Software design

The Arduino IDE programming language is used in the software design of this 5.56 mm caliber magazine filler, which is designed for the Arduino mega 2560 pro small. Since Arduino software is open source, it is available for free download.

The primary components of an Arduino electronic circuit include an AVR-type microcontroller chip made by Atmel [13]. With this software, programs may be created and added to Arduino devices [14]. Since Arduino has been created to be simple to learn, newcomers can begin learning microcontrollers with Arduino, unlike conventional microcontrollers, which have different stages [15]. The Arduino Mega 2560 Pro Mini's reading of the Roko SN04 metal sensor will result in a command to operate the stepper motor on the 5.56 mm caliber magazine refill system.

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Object testing

Three different types of items are utilized in this test, each with a predetermined distance and varying dimensions: 10 cm, 20 cm, 30 cm, and 40 cm. The distance that is greater than the 40 cm threshold is the distance that the sensor is unable to detect. Reviewing the outcomes of the entire set of tests, the accuracy of reloading was tested ten times using varying loads of ammunition, including five, ten, fifteen, twenty, twenty-five, and thirty rounds. Table 1 displays the findings from the acquisition of accuracy testing data.

Table 1**.** Results of testing accuracy of magazine filling.

No.	Charging (Item)	Trial Stage									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	5	5	5	5	5	5	5	5	5	5	5
2	10	10	10	10	10	10	10	10	10	10	10
3	15	15	15	15	15	15	15	15	15	15	15
4	20	20	20	20	20	20	20	20	20	20	20
5	25	25	25	25	25	25	25	25	25	25	25

Data indicating that filling with a magazine filling tool was considered accurate was acquired based on Table 1 tests on the accuracy of filling the magazine. Five rounds of ammunition were used in the first test, which was conducted ten times. The sensor read each cartridge and the magazine was filled with it. The second test involved loading the magazine ten times with ten rounds of ammo each, all of which were detected by the sensor. In the third test, the magazine was filled with 15 rounds of ammo that were read by the sensor ten times over. The fourth test involved loading the magazine ten times with twenty rounds of ammo, each of which was detected by the sensor.

Because the ammunition fell and did not pass through the sensor, only 19 rounds were read in the third test. Only 24 rounds were read in the second trial because the ammo did not travel through the sensor, but the sensor read 10 times in the fifth test, totaling 25 rounds of ammunition that were put in the magazine. In the sixth examination, ten This time, the sensor detected all 30 rounds of ammo, which were then loaded into the magazine. Because the ammo did not pass through the sensor, only 29 rounds were read, except for the second attempt. Through testing, the accuracy of filling is evaluated about the data acquired, which indicates if filling the magazine with input from the keypad is appropriate. It is possible to compute the percentage of errors that occur:

$$Error = \frac{Jnumber\ of\ Successful\ Attempts - Numb\quad of\ Attempts}{Number\ of\ Trials} \times 100\% \qquad (1)$$

$$Error = \frac{58 - 60}{60} \times 100\% = 3{,}33\%$$

An inaccuracy of 3.33 percent was found in the 60 trials that were conducted. Using a comparison of the times discovered from multiple tests, ranging from 10 rounds in one magazine to 30 rounds in three magazines. The accuracy of filling and filling time is among the research findings that show the advantages of the magazine filler tool over the manual method. First, the tool uses a stepper motor with a torque of 3N/Cm as a pusher, which allows for a constant speed during filling, while the manual method uses your hands to fill the magazine one at a time, with filling speeds that vary depending on the individual filling the magazine. To determine the success of this research, a formula equation is used: $Y= f(X_1,X_2,\ldots,X_4)$

$$Success = 100\% - 3.33\% = 96.67\%$$

Based on the outcomes of the simulations and analyses, installing the Roko SN04 metal sensor on a magazine feeder with a 5.56 mm caliber resulted in notable performance gains in several areas. The rate at which magazines are filled can be increased by using loading tools equipped with metal sensors. This can result in an increase from 50 magazines per minute using conventional tools to 70 magazines per minute using tools with metal sensors. Accurate metal identification and dependable charging have also been significantly enhanced. The metal sensor's whole magazine detection time is only two seconds, as opposed to three seconds for traditional systems. These findings demonstrate the enormous potential that metal sensors have for enhancing the effectiveness and functionality of magazine feeders in 5.56-millimeter guns.

4. CONCLUSION

Data gathered from testing in terms of filling time indicated that filling with a magazine filler tool was more efficient than inserting each one by hand. Incorporating metal sensors into magazine feeders offers benefits beyond enhanced speed and precision; it also creates opportunities for new technologies and applications. In tactical scenarios where magazine reload speed is crucial, military operations and combat training can benefit from more dependable and efficient loading systems. Furthermore, a broad variety of weapon calibers can be accommodated by expanding the application of metal sensor technology in weapon loading mechanisms, allowing for the customization of weapons with various specifications. As a result, the addition of metal sensors to magazine feeders not only advances technology but also offers a workable and efficient way to meet the requirements and demands of using current weapons.

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