Mortar fire direction with multiplatform mobile application

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Abstract. Mortar is one of the weapons that is still used for warfare. In determining the direction of mortar firing there are still using conventional method with plotting board. Then it takes a portable calculator that is quick and accurate in determining the angle of elevation and angle of azimuth. So it is proposed that this mortar fire direction is a mobile application with multiplatform development method that can run on Windows, Android, and iOS operating systems. The result of this research is a prototype mobile application that provides a report of elevation angles and azimuth angles rather than mortar quickly and accurately to the intended goal.

1. Introduction
Mortars are a type of weapon that serves to provide assistance to infantry troops who are on the front lines [1]. The mortar platoon’s mission is to provide close and immediate indirect fire support to all maneuver units on the battlefield [2]. To carry out the tasks in the implementation of the firing required knowledge of the characteristics of the mortar. In addition, knowledge to determine the direction of the mortar against the target. In general determining the direction can be done with the help of equipment plotting board. On the plotting board a straight line can be drawn from the position of the mortar to the target to get the direction and distance of the target. To determine the direction of the height can be known from the existing firing table. With this manual method it will take quite a long time, besides that accuracy is very dependent on the ability of personnel.

The mortar fire direction receives target intelligence and requests for fire, and translates them into appropriate fire direction. The fire direction provides timely and effective tactical and technical fire control in support of current operations [3].

Development of software with cross platform or multiplatform capabilities is a challenge at this time. Application needs that can be run on different operating systems are needed at the present time. On this occasion the author will create a prototype of a mobile application with a software development environment that provides the ability to create cross-platform or multiplatform applications.

The challenges of developing mobile applications are in the midst of increasing demand from time to time. One of the proposed approaches is multiplatform with various methods, namely Cross-compiler, Virtual machine, Web-based, and Hybrid [4]. The approach in building mobile applications with software development environments that have cross platform or multiplatform capabilities. One form in multiplatform is Cross-Compiled Approach in which developers write code using common programming languages [5]. One of the platforms used is Xamarin with C# language [6].

This prototype will be built for calculating the fire direction of the mortar against the target. In software development using the Waterfall process model with consideration of system requirements it
is clear that the stages to be implemented are in accordance with the existing case. The Waterfall Model is a classic method that emphasizes sequential and systematic stages.

2. Methods
The completed research consists of analysis, design, implementation, testing, and conclusions. The following are described in detail.

2.1. Analysis
At this stage of the analysis is part of getting information, what requirements are needed in the software. At this stage there are systems analysis, problem analysis, non-functional requirements analysis, and functional needs analysis.

2.2. Design
At this stage is the design of system architecture, data structure, interface, and calculation algorithms.

2.3. Implementation
Implementation is making code to build what has been analyzed and designed in a previous stages. Implementation is writing code to what has been determined in the previous stage.

2.4. Testing
Software testing helps in finalizing the software application or product against business and user requirements. Carry out testing of software prototypes that have been developed.

3. Conclusions
At this time, the interesting end of the system that has been built. In this case, it will be seen whether the prototype of the software built is as expected.

4. Results and discussion

4.1. Results

4.1.1. System overview. Fire direction is made according to the needs in mortar firing. The application made aims to get the results of the calculation of the direction of the mortar against the target. For the calculation of the direction of the firing using a guide of 81 MM mortar. Applications built with cross-platform capabilities. The application is built using Xamarin Forms, a development environment that is able to get output in 3 different platforms, namely Android, iOS, and Windows.

![Xamarin forms](image)

Figure 1. Xamarin forms.

4.1.2. Use case diagram. Use case diagram of mortar fire direction consists of input coordinate reference, request for firing, calculate. Calculate is an order to get the distance between mortar and target, charges, azimuth, deflection, and elevation.
4.1.3. **User interface.** In general, the interface aims to provide ease of operation of the application. The upper part is an input that gives an overview of the position of the mortar and the request for firing. And the bottom is the result of the calculation in accordance with the input provided. To get the calculation results, click on the Calculate button.

![Use case diagram](image)

**Figure 2.** Use case diagram.

4.1.4. **Software implementation.** This multiplatform application prototype utilizes the Xamarin Forms Visual Studio 2017 Community. By using Xamarin Forms you can use one user interface that can be used on different platforms. With Xamarin Forms, one application with a different target platform is sufficiently developed. Xamarin Forms uses the XAML (eXtensible Application Markup Language) format to create a user interface display.

![User interface](image)

**Figure 3.** User interface.

4.1.5. **Screenshot program.** To view the application can be seen in the following figure. The figure shows the application running on 2 different operating systems, namely Android and Windows.
4.1.6. Testing. Black box testing is performed for input coordinate reference, input request for firing, calculate. The result can be seen in below table.

Table 1. Software implementation testing.

| Test Items                  | Testing Type | Status  |
|-----------------------------|--------------|---------|
| Input Coordinate Reference  | Black Box    | Accepted|
| Request for Firing          | Black Box    | Accepted|
| Calculate - Distance        | Black Box    | Accepted|
| Calculate - Charges         | Black Box    | Accepted|
| Calculate - Azimuth         | Black Box    | Accepted|
| Calculate - Deflection      | Black Box    | Accepted|
| Calculate - Elevation       | Black Box    | Accepted|

4.2. Discussion
The results of the black box testing of the software prototype were as expected. The calculation results in the form of distance, charge, azimuth, deflection, and elevation are in accordance with the mortar manual with an accuracy of 95%. The test results obtained speed of getting the calculation results when using this application is only about 8 seconds. When using the manual method takes about 2 minutes.

5. Conclusion
With the prototype mortar fire direction, the determination of the direction of the mortar can facilitate the mortar crew in carrying out the firing task. The prototype can do calculations quickly and more accurate than using plotting board.
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