

Utilization Of Geolocation-Based Authentication on Online Exams

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ABSTRACT

In the industrial era 4.0, technology is utilised as much as possible to advance the welfare of life. One use of technology commonly used in education is online-based exams. In addition to saving paper, online-based exams can reduce operational costs in carrying out exams. Currently, many online-based exam models are used for various types of exams. Starting with the computer-based Test, CAT-based CPNS test, etc., researchers developed a method by utilising geolocation to run an online-based examination system. In this study, the author wants to utilise geolocation as one of the requirements for accessing needed resources; in this case, the online-based quiz system was adopted. Using geolocation in the online-based quiz system is expected to provide security for the examination system so that examiners can assess their students as best they can.

I. INTRODUCTION

In the industrial era 4.0, technology is utilised as much as possible to advance the welfare of life. One use of technology commonly used in education is online-based exams. [1]–[4]. In addition to saving paper, online-based exams can reduce operational costs in carrying out exams. Currently, many online-based exam models are used for various types of exams. Starting with the Computer Based Test, CAT-based CPNS test, etc. This shows the technology used to make the test more accessible and efficient. But in the world of computer science, the ease of accessing information is inversely proportional to the information system's security level. [5].

In Universitas Negeri Malang, an online quiz-based system has been introduced in one of its services called the Online Learning System (SIPEJAR). Several security steps have been taken for this service. One of them is Username and Password. However, various methods for guessing a password can be used, both technical and non-technical. Starting from guessing passwords, phishing, sniffing, and so on [6], [7]. Security using a username and password is very vulnerable to hacker attacks. [8]. Generally, these problems can be avoided by (1) making passwords that are very difficult to guess but can be very difficult to remember or (2) securing information systems. Generally, information security is done in hardware, which means that the security side is strengthened by the hardware that is around the hardware. Such as the use of firewalls, VPNs and others [9], [10].

Based on the explanation above, the researcher intends to develop a method by utilising geolocation to run an online-based examination system. In this study, the author wants to utilise geolocation as one of the requirements for accessing needed resources; in this case, the online-based quiz system was adopted. Using geolocation in the online-based quiz system is expected to provide security for the examination system so that examiners can assess their students as best they can. This study aims to evaluate the feasibility of GPS-based authentication for online quizzes and identify any associated limitations or challenges.

II. RELATED RESEARCH

Research on location-based services is abundant and continues to expand. [11], exploring their diverse applications and benefits across various domains. Such as the development of a web profile for Mulawarman University [12], web-based culture information system [13].

Research about using geolocation authentication systems has been applied in many fields. Yisa created a web-based Location-based Access Control (LBAC) to authenticate physical server management [14]. Morankar [15] and Ma'shum [16] research on attendance systems based on location. Authentication by geolocation is feasible for mobile banking applications [15]. These studies affirm the feasibility of location-based authentication within technological

frameworks, highlighting its practical implementation and efficacy in ensuring secure access, such as online quizzes.

III. RESEARCH METHOD

The research methodology employed in this study utilises the Software Development Life Cycle (SDLC) method, employing a combined model of waterfall and iterative approaches. SDLC is a structured process comprising various planned activities aimed at constructing software. It includes plans on building, maintaining, replacing, or enhancing specific software characteristics. [16]. The combination of the waterfall and iterative models is adopted because, in the waterfall model, once a process is completed, there is no pathway to return to the previous stages. The iterative model, on the other hand, involves repeating cycles. Iterative methods are explicitly used in the testing and analysis phases to allow researchers to adjust designs if testing results do not align with the initial designs. Based on this model, a workflow is designed as follows: (1) Planning & Requirement, (2) Analysis & Design, (3) Implementation, (4) Testing, and (5) Evaluation. Figure 1 illustrates the workflow employed in this research.

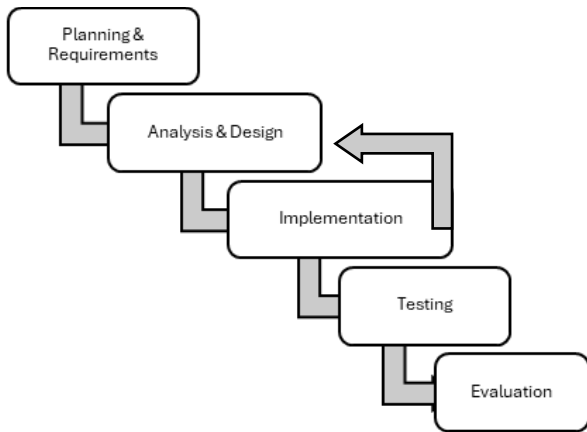


Fig. 1. Iterative Waterfall Model of SDLC

Because the system will be implemented in web services, the analysis and design will be done precisely to construct a web-based online quiz system. Then, the analysis will be carried out to implement geolocation security in the online quiz system. This web-based online quiz system utilises Google Maps API for device location information and constraints.

In general, users of the online quiz system log into the quiz website and then do the quiz online. In this study, an additional process was carried out to check locations. Location checks are carried out to ensure students taking the quiz are in their designated positions. The position is determined by the quiz owner or admin appointed to determine the position where the quiz should take place. The flowchart of the process is illustrated in Figure 2. Figure 2 shows that two roles must be fulfilled to run a geolocation-based online quiz system. The users consist of the Admin / Quiz Owner and the Students. The role of the Quiz Owner is (1) to create quizzes and (2) to register exam locations. Meanwhile, the students are asked to take quizzes online in the designated locations.

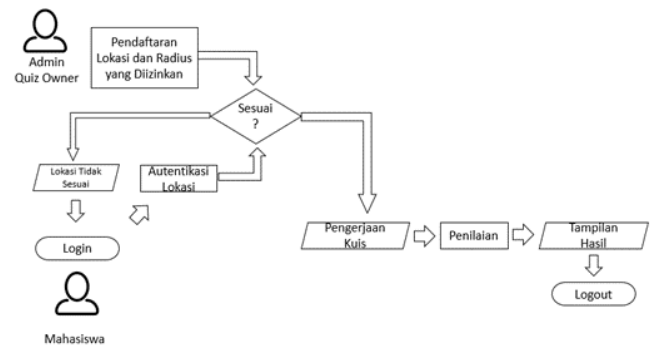


Fig. 2. Geolocation-Based Online Quiz System Flowchart.

Based on Figure III.1, the researcher created a temporary prototype to register locations and detect whether students using this application are currently within the exam area. The prototype was developed to facilitate research reporting. This application does not require a map display. The Quiz Owner only needs to create quizzes. When quiz creation is done, the application will store the location of the Quiz Owner - which is technically invisible because it is done automatically through the system. Students can only take quizzes using this application. The location detection and entry process will be performed in the background, so it will not be visible to users (Quiz Owners or Students).

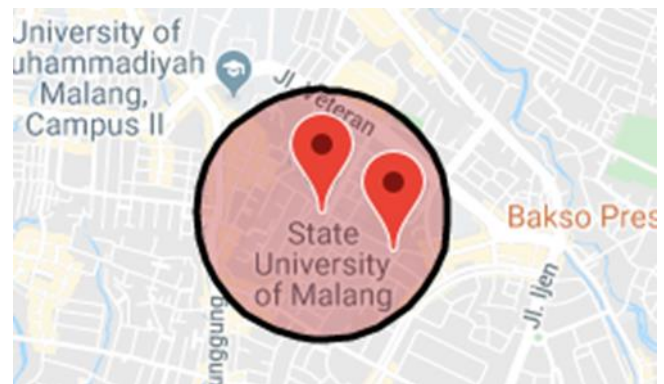


Fig. 3. Illustration of Scenario 1

The difference in the use of geolocation lies in the stage after login. The system will authenticate the location based on the location registration made by the Quiz Owner. The quiz can be run if the location is within the specified radius or range. But if not, a notification will appear that the location is not within a radius and return to the login page. The use of range occurs because of the diversity of hardware (Laptops, Mobile Phones), which can result in differences in the level of accuracy of each device. The test will simultaneously use students' devices and the same wireless network. With the access radius, quiz users can also be around the quiz determination area.

In this study, two scenarios were conducted. Following are the results of experiments from 2 different scenarios: Students are at the test site, and Students are outside of the test site

1. Students are at the test location

In this scenario, students conduct a trial by taking an online quiz that can be accessed through a web browser. Students can

choose what devices are used to access the quiz web page. This test aims to determine if such authentication based on the student's/test taker's location can be done specifically in a specific location.

This online quiz will be based at Malang State University, at latitude -7.961259000000005 and longitude 112.705282625. The maximum distance from that point is 500 meters. Users will run an online quiz on the B12 Building in Electrical Engineering at the State University of Malang.

2. *Students are outside the test location*

In this scenario, a student simulation will be conducted to access web pages from outside the area permitted by the system. This test aims to determine if students/test takers can still access the quiz from different points of designated test locations. Students will remain indoors in Building B12 Electrical Engineering State University of Malang to run the quiz. In contrast to scenario 1, the central location of the online quiz is transferred to a different point from the testing position in Singapore. The location has a latitude of 1.3553794 and a longitude of 103.86774439999999, with the maximum distance from the point being 500 meters. Users access the online quiz web page. If that does not work, it proves that the limitation of online quiz access based on location was successful.



Fig. 4. Illustration Scenario 2

IV. RESULTS AND DISCUSSION

Based on scenarios (scenario one and scenario 2), students can access the web pages on their devices without limitations. The information about the device and the user's location is stored in the database—an online quiz conducted in the Database II course. The online quiz is made with ten questions and has multiple-choice questions. Multiple choice is done to simplify the system in assessing exam results. The distribution of tools from experiments by students is as follows.

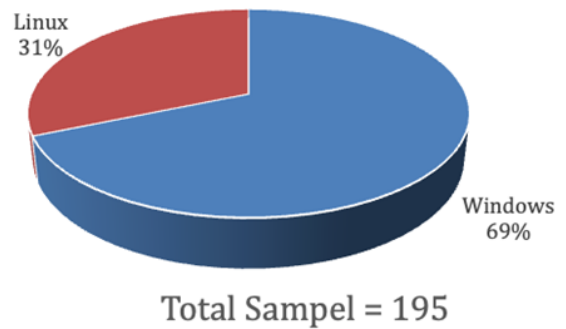


Fig. 5. Online Quiz Test Samples

Figure 5 illustrates the demographics of students using devices to work on online quizzes. The total sample of using this webpage is 195. Of the 195 users, 61 use a device with the Linux-Android operating system (from now on, it is called a smartphone). At the same time, 134 other users use the device with the Windows operating system (which will hereafter be referred to as Laptop Users). Based on the data above, it can be concluded that students are more comfortable using a laptop as a medium to do quizzes online. The preference for using laptops over smartphones is supported by previous research. [17].

In this study, two scenarios were conducted. Following are the results of experiments from 2 different scenarios.

Testing Scenario 1: Students are at the Test Site

In this scenario, students access online quizzes in the test area. By the design of the test, testing is carried out at the location of Malang State University. Figure IV.2. describe the results of the experiments that have been carried out

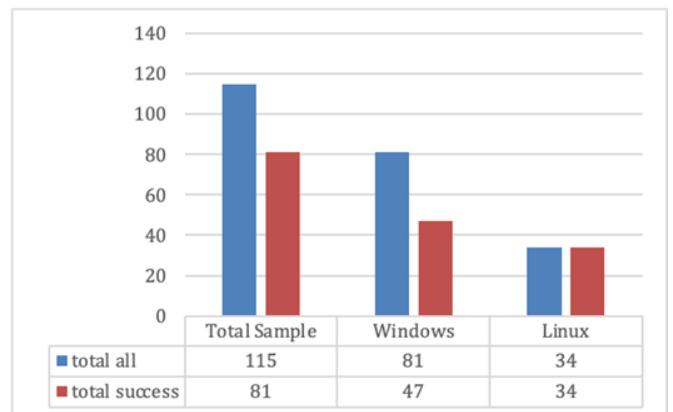


Fig. 6. Scenario 1 Test Results

In Figure 6, it was shown that as many as 115 users took online quizzes. These users are 81 Laptop users, while 34 users use Smartphones. Based on the test results, the success rate of testing scenario 1 is 70.4%. The contribution of system failure occurs in the Windows operating system. This has occurred because most laptops are not integrated with a built-in Geolocation Positioning System (GPS), unlike mobile devices, which cannot detect location precisely. The primary purpose of using GPS is to know accurately where we are now. At the same time, smartphones currently use geolocation as one of their

essential features (such as maps, etc.). So, the GPS on a Smartphone is a necessity. Based on the test results, it can be concluded that the success of Windows devices in accessing geolocation-based online quiz services is currently utilising Geolocation. So, the GPS on a Smartphone is a necessity. Based on the test results, it can be concluded that the success of Windows devices in accessing geolocation-based online quiz services is 58.02%.

Testing Scenario 2: Students are outside the Test Site

In this scenario, students access online quizzes from outside the test area. This tests whether the system can deny access outside the specified area. By the design of the test, testing is carried out at the location of Malang State University. But what's different is the test location in the country of Singapore. Figure 7 describes the results of experiments that have been carried out. In scenario 2, by testing 65 samples, it can be concluded that the system can detect 100% that the user is not within the permissible online quiz area. This is because the locations allowed to do online quizzes are far from the user.

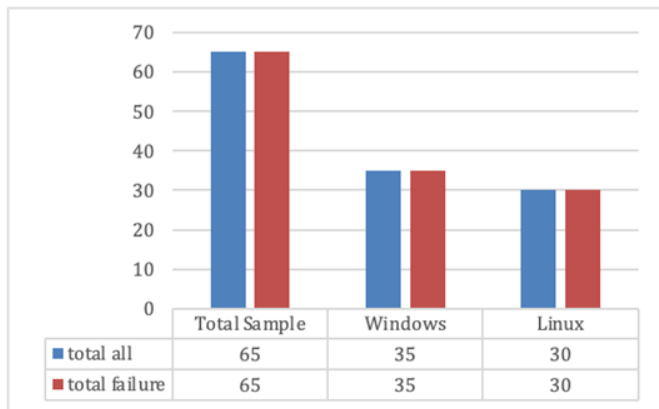


Fig. 7. Scenario 2 Test Results

V. CONCLUSION

Based on the Results and Discussion, it can be concluded that:

A geolocation-based online quiz system can be made by utilising web-based technology, such as Google Maps, as a mediator to verify location. Using Google Maps requires an API Key to use the service. Based on application testing, it can be concluded that 70.43% of online quiz systems have successfully authenticated users' location in the test location. In addition, it can be concluded that the system can detect 100% when the user is outside the test location. The reduced level of success of the system in detecting the location of online quiz system users is due to differences in the ability of the device to detect location based on the Global Positioning System (GPS) of the device used. The use of Laptop devices has a lower success rate compared to the use of Smartphone devices in accessing geolocation-based online quizzes. This is evidenced by the percentage of successful use of Laptop devices at 58.02%. At the same time, the percentage of successful use of Smartphone devices is 100%.

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