

AuthoExam:

**A Browser Extension with Multi-Factor
Authentication for Proctoring Online Exams**

Special Problem 2 Presentation

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PREVIEW

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Background of the Study

BACKGROUND OF THE STUDY

- **Adoption of Blended Learning**
 - Face-to-face classes combined with online learning
- **Flexibility**
 - Online learning provided flexible options despite interruptions to face-to-face classes
- **Remote Online Assessments**
 - Remote online assessments raised concerns and problem:
 - Confirming the student's identity online and Students can access other online sources (Nurunnabi & Hossain, 2019;Reedy et al., 2021)
- **Significance**
 - There is a need for proctoring tool that provides information about students' online identity and browser activity during online exams



Objectives

MAIN OBJECTIVE:

To develop a proctoring tool that will help educational institutions monitor online assessments

SPECIFIC OBJECTIVES:

- Implement the use of Multi-factor authentication in verifying the identity of the student taking the online assessment
- Integrate the Browser Extension API to monitor browser student activity while taking the assessment to flag possible cheating
- Evaluate the usability of the proctoring tool using the System Usability Scale

SCOPE AND LIMITATIONS

- Multi-Factor Authentication
 - Knowledge-based and Risk-based factors
 - OAuth 2.0 and Firebase
- Proctoring
 - Chrome Extension API
 - Monitor student browsing during assessments
 - Cannot detect external activities
- Testing
 - Latest Version Chrome Browser
 - Google Education Suite

Methodology

METHODOLOGY

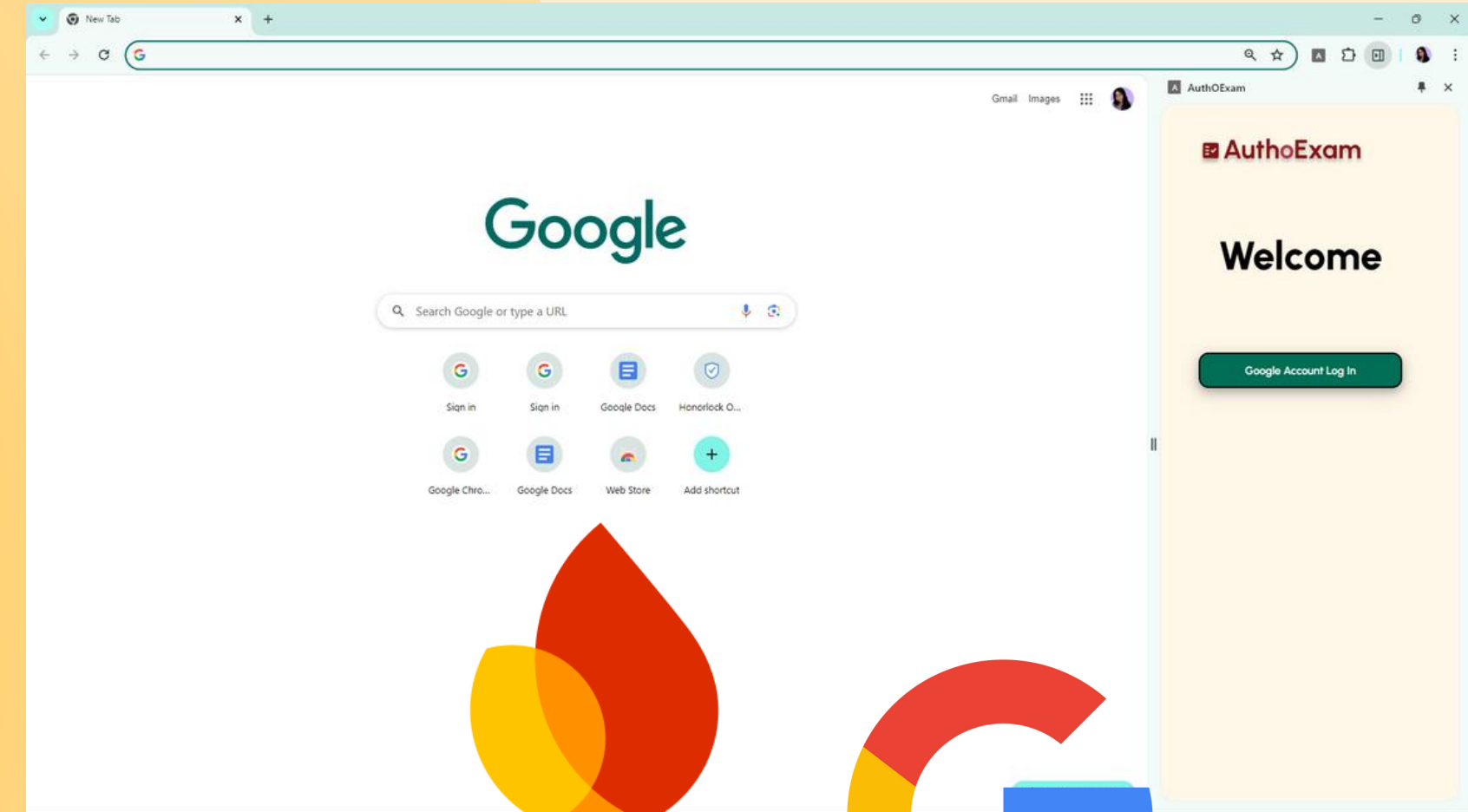
Browser Extension API

- Chrome Extensions API which can be installed on Chrome browsers

Multi-factor Authentication

Knowledge-based factors which are then authenticated by Firebase:

- Institutional email account (OAuth 2.0)
- Student Identification Number
- Exam Access Code



Firestore



METHODOLOGY

Multi-factor Authentication

Risk-based Factors

- Gather digital identity attributes such as:
 - Geolocation
 - IP Address
 - System Display
 - System CPU
 - Operating System
 - Browser
- Gathered upon Student Registration and upon taking the online exam



METHODOLOGY

Multi-factor Authentication

Weighted Risk Scoring (Wiefling et al., 2020, 2022)

Student Digital Identity Attribute	Weighted Score
Geolocation	5
IP Address	4
System Display	3
System CPU	2
Operating System	1

$$AuthRiskScore = \frac{Total\ Weight\ of\ Attributes\ Matched}{Total\ Weight\ of\ Attributes}$$

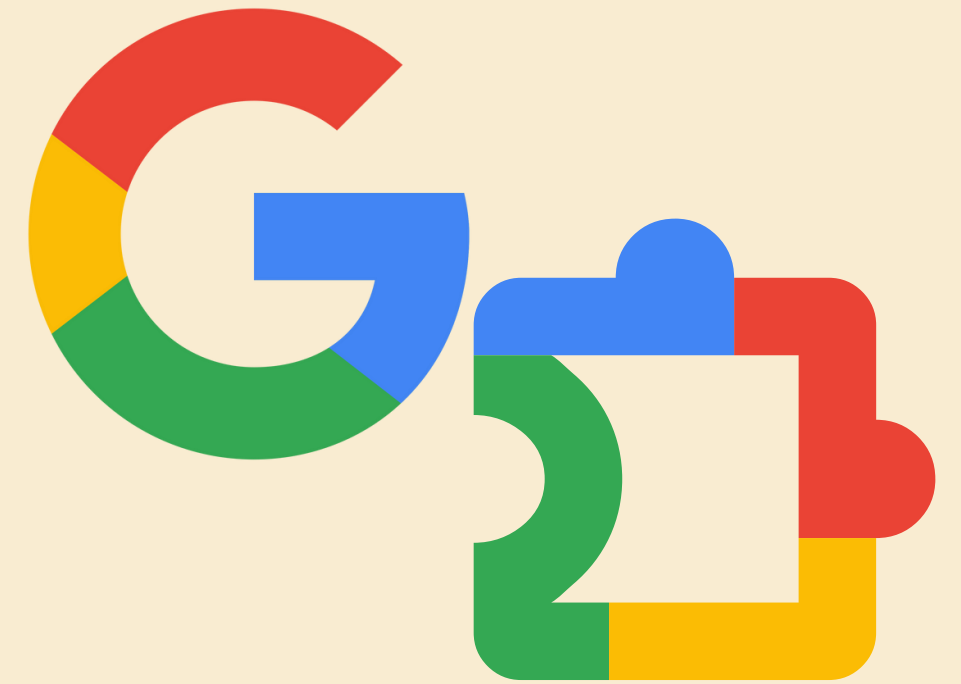
- If the result from computing the Weighted Risk Score is less than 0.90,
The student will still be allowed to take the exam but will be flagged as a suspicious attempt.

METHODOLOGY

Proctoring Browser Activity

Chrome Extension API

- Track browser activity such as:
 - websites visited in the current session
 - number of newly opened tabs
 - number of switches from another Chrome window to another
 - number of copy and paste action



The background features a light cream color with a horizontal band of pale yellow. On the left and right sides, there are vertical bars of orange and yellow. Scattered throughout are various geometric shapes: a large yellow circle in the top right, a yellow ring in the top left, a yellow ring in the bottom center, and several rounded rectangular shapes in yellow and orange.

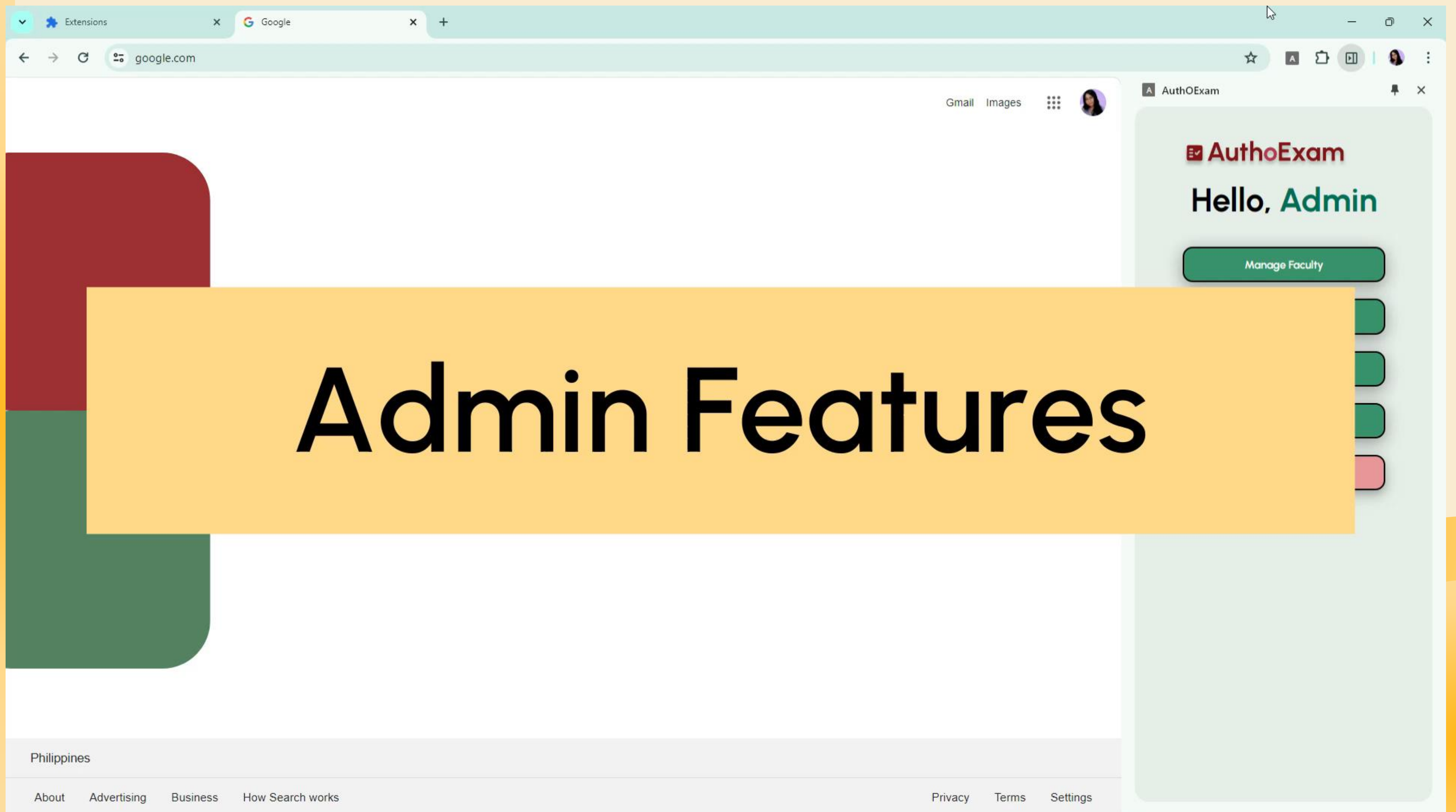
Results and Discussion

RESULTS AND DISCUSSION

Features

- Developed browser extension for proctoring exams using:
 - JavaScript, CSS, HTML for UI
 - Chrome's sidePanel API
- Three roles can access the proctoring tool:
 - Admin: Add Faculty, Add courses, Upload Class lists, Schedule Exams, Viewing Proctoring reports
 - Faculty: Schedule exams for their classes and View proctoring reports
 - Student: Receive automatic emails, Take the online exam using the provided link, and Generate a proctoring report

Admin Features



RESULTS AND DISCUSSION

In verifying the identity of the student taking the online assessment, Multi-factor authentication was implemented with:

- Firebase Authentication
- Google Identity using OAuth 2.0 tokens for institutional Gmail accounts

Additional layer of authentication:

- Weighted Risk Scoring model comparing digital identity attributes before and during the exam

RESULTS AND DISCUSSION



Authentication | with Identity Platform

Users | Sign-in method | Templates | Usage | Settings | Extensions

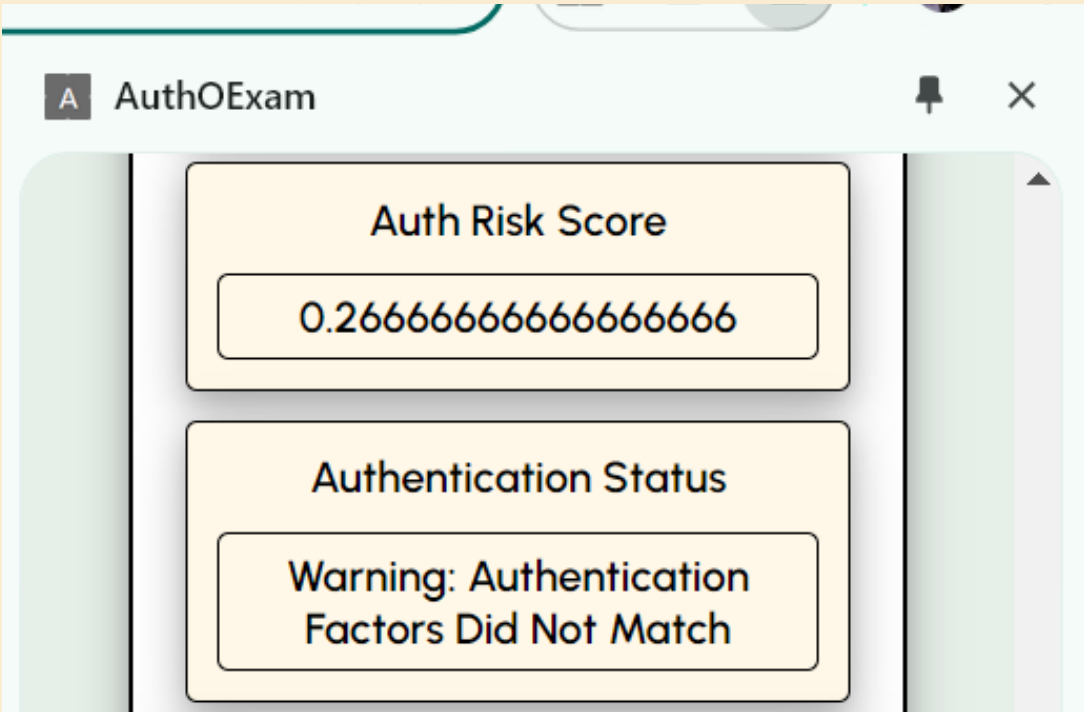
Protect your Authentication resources from abuse, such as billing fraud or phishing

Search by email address, phone number, or user UID

Identifier	Providers	Created ↓	Signed In
edu.ph	G	May 28, 2024	May 28, 2024
edu.ph	G	May 28, 2024	May 28, 2024
edu.ph	G	May 28, 2024	May 28, 2024
du.ph	G	May 27, 2024	May 27, 2024
.edu.ph	G	May 25, 2024	May 27, 2024
.ph	G	May 23, 2024	May 27, 2024
.ph	G	May 23, 2024	May 29, 2024
edu.ph	G	May 22, 2024	May 23, 2024
du.ph	G	May 22, 2024	May 27, 2024
du.ph	G	May 22, 2024	May 27, 2024
du.ph	G	May 22, 2024	Jun 1, 2024
du.ph	G	May 22, 2024	Jun 3, 2024

RESULTS AND DISCUSSION

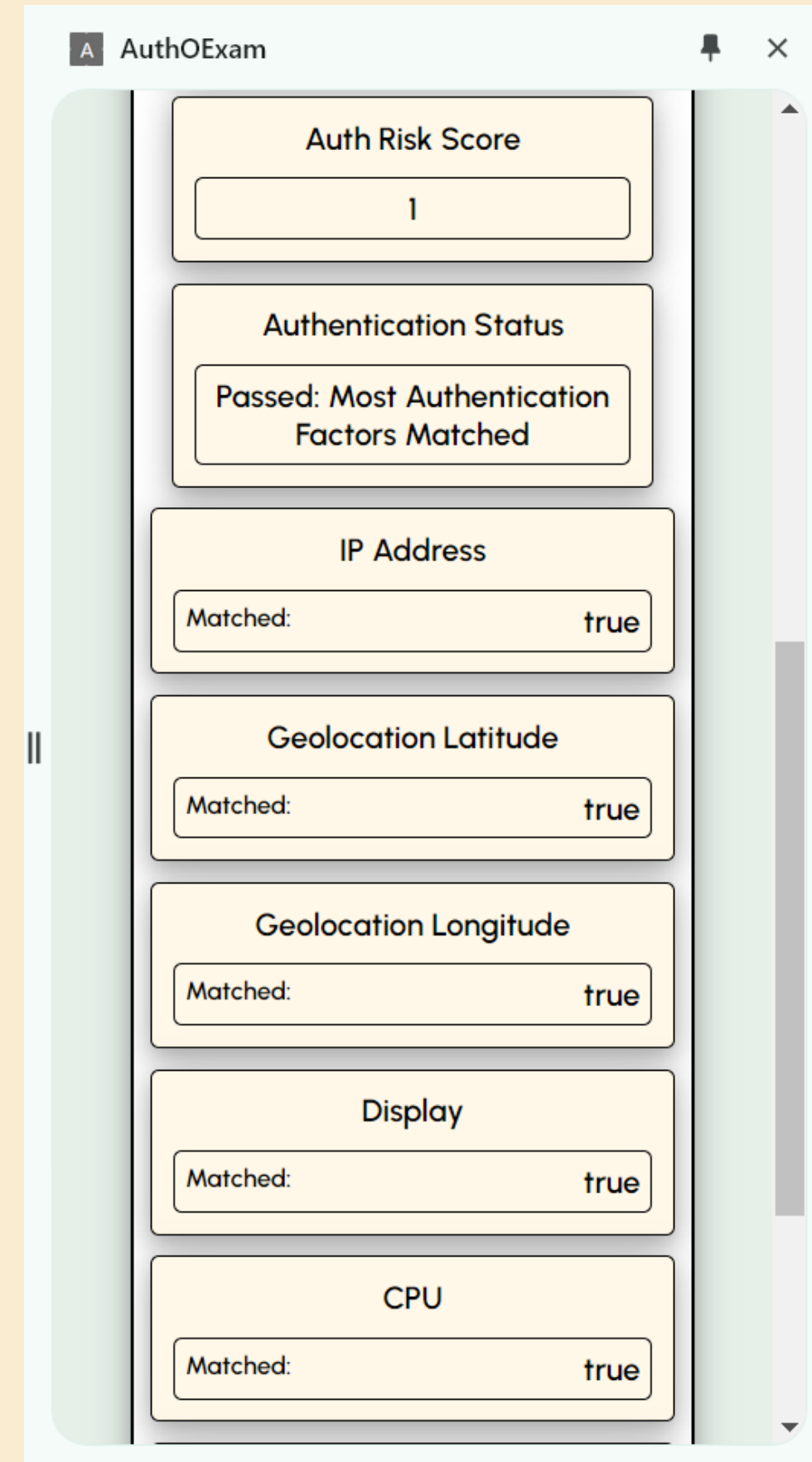
Auth Risk Score < 0.90



IP Address	
Matched:	false
Geolocation Latitude	
Matched:	false
Geolocation Longitude	
Matched:	false
Display	
Matched:	true
CPU	
Matched:	false
Operating System	
Matched:	true
Browser	
Matched:	true

RESULTS AND DISCUSSION

Auth Risk Score > 0.90



The image shows a screenshot of a web application window titled "AuthOExam". The window displays a vertical list of authentication results. The first item is "Auth Risk Score" with a value of "1". The second item is "Authentication Status" with the text "Passed: Most Authentication Factors Matched". The following three items are "IP Address", "Geolocation Latitude", and "Geolocation Longitude", each with a "Matched: true" status. The last two items are "Display" and "CPU", also with "Matched: true" status. The window has a standard browser-like interface with a title bar, a close button, and a scrollbar.

Field	Value
Auth Risk Score	1
Authentication Status	Passed: Most Authentication Factors Matched
IP Address	Matched: true
Geolocation Latitude	Matched: true
Geolocation Longitude	Matched: true
Display	Matched: true
CPU	Matched: true

RESULTS AND DISCUSSION

Proctoring tool tracked:

- Websites visited during browser session
- Number of newly opened tabs and URLs
- Window switches and minimizations
- Copy-paste actions

RESULTS AND DISCUSSION

AuthOExam

Time Started

May 27 2024 1:58:44 pm

Time Submitted

May 27 2024 2:00:17 pm

Flagged Activity

0 found

Browser Window Changed

0 time(s)

Tab Switched

0 time(s)

Copy Action Detected:

0 time(s)

Paste Action Detected:

Paste Action Detected:

0 time(s)

Tabs Open During Session:

[Mock_Exam 1](#)

[singly linked list - Google Search](#)

[SP_AuthoExam_Testing_-_Google Drive](#)

New Tabs Opened:

Authentication Report

RESULTS AND DISCUSSION

AuthOExam

Flagged Activity

3 found

Browser Window Changed

1 time(s)

Tab Switched

4 time(s)

Copy Action Detected:

0 time(s)

Paste Action Detected:

0 time(s)

Tabs Open During Session:

[Mock_Quiz 1](#)

New Tabs Opened:

Tabs Open During Session:

[Mock_Quiz 1](#)

New Tabs Opened:

[python? - Google Search](#)

[Python Comments](#)

[Mock_Quiz 1](#)

Authentication Report

RESULTS AND DISCUSSION

Generated reports:

- Browser activity and authentication review for each student
- Summary report for each exam with:
 - Total number of examinees and submissions
 - Flagged activities
 - Matching and non-matching authentication factors based on digital identity

RESULTS AND DISCUSSION

AuthOExam

Flagged Activity

3 found

Browser Window Changed

1 time(s)

Tab Switched

4 time(s)

Copy Action Detected:

0 time(s)

Paste Action Detected:

0 time(s)

Tabs Open During Session:

[Mock_Quiz 1](#)

New Tabs Opened:

AuthOExam

Auth Risk Score

1

Authentication Status

Passed: Most Authentication Factors Matched

IP Address

Matched: true

Geolocation Latitude

Matched: true

Geolocation Longitude

Matched: true

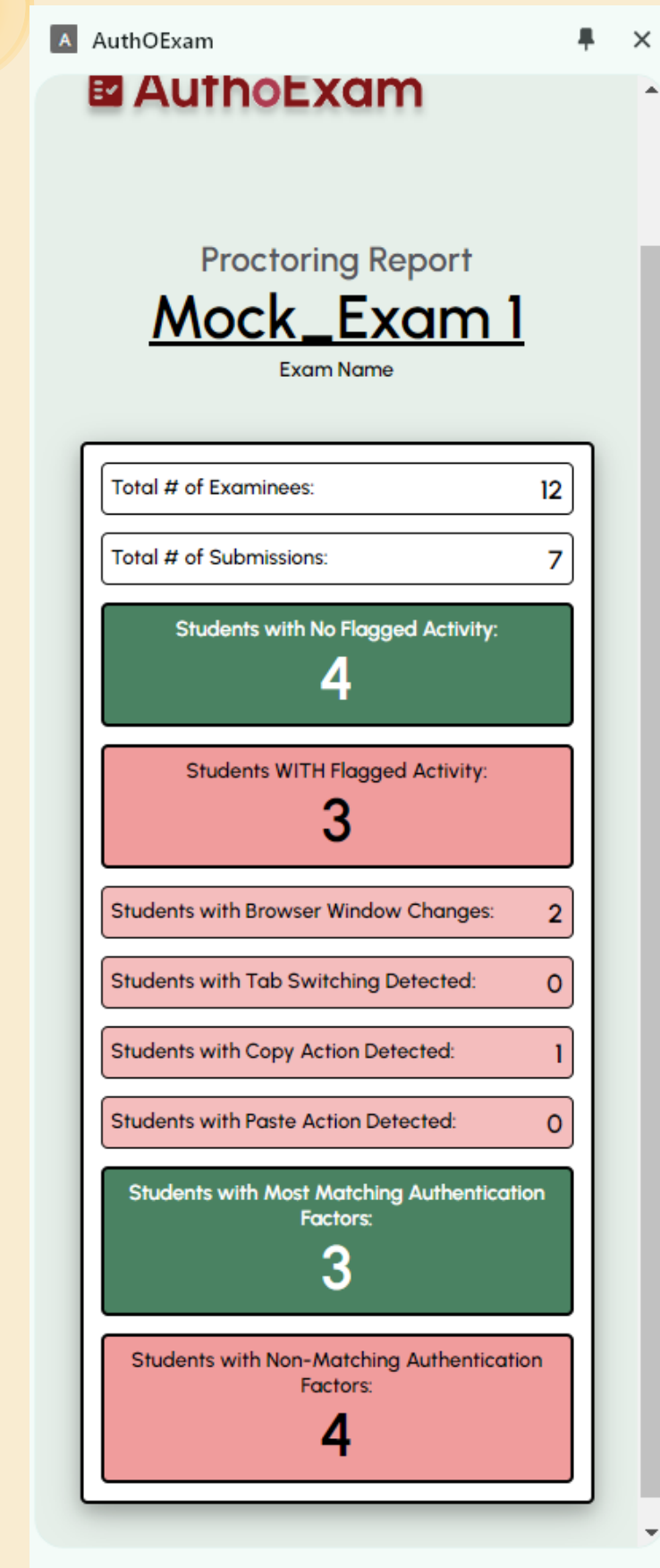
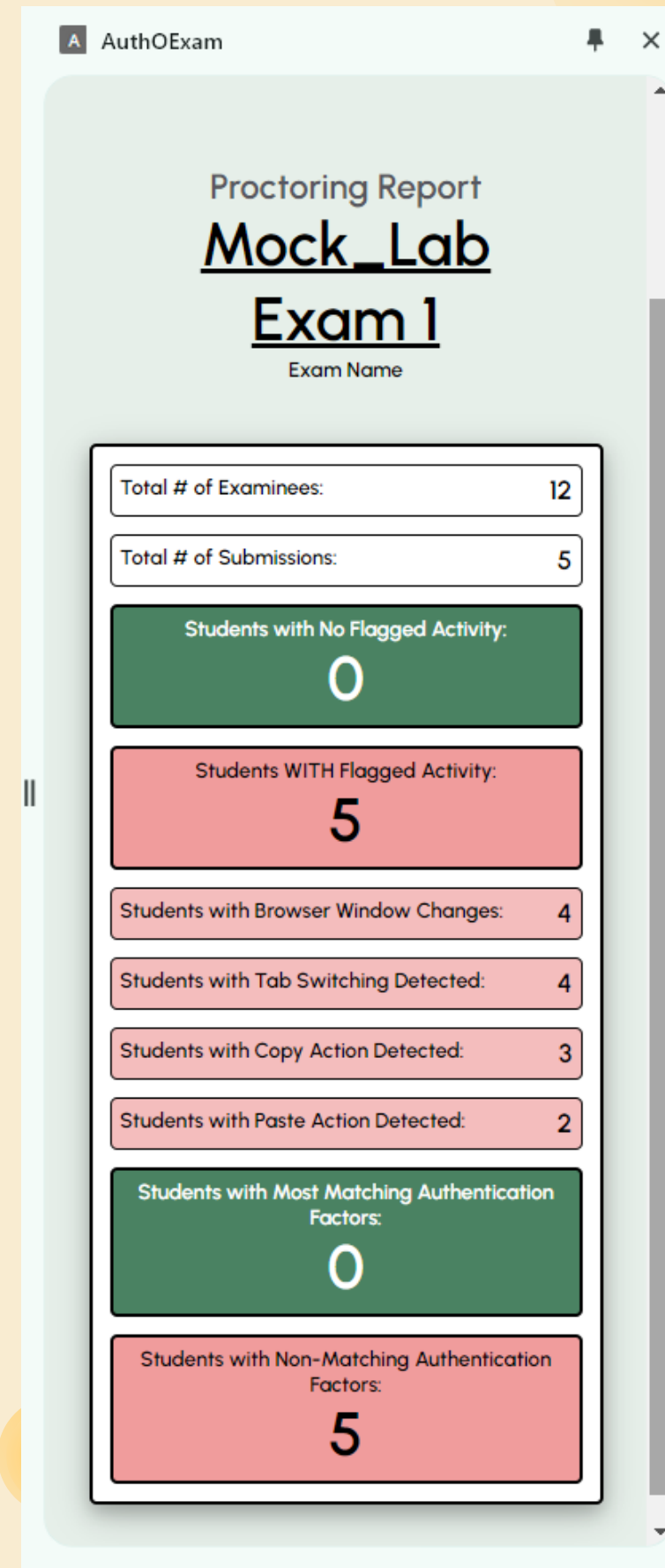
Display

Matched: true

CPU

Matched: true

RESULTS AND DISCUSSION



RESULTS AND DISCUSSION

The System Usability Scale (SUS)

- used to measure the usability of the proctoring tool
- consists of 10 statements with a five-point scale that ranged from "Strongly Disagree" to "Strongly Agree."
- Individual scores were calculated after the survey completion and were converted to scores within the 0-100 range.

AND D

The System Usability Scale (SUS) - Computation

Respondent		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Odd	Normalized Odd	Total Even	Normalized Even	Total Value	SUS Score
1		5	1	5	1	5	1	5	1	5	2	25	20	6	19	39	97.5
2		5	1	5	1	5	2	5	1	5	1	25	20	6	19	39	97.5
3		5	1	5	1	5	1	5	2	5	1	25	20	6	19	39	97.5
4		5	3	5	1	5	1	5	1	5	1	25	20	7	18	38	95
5		5	2	5	2	5	1	4	1	5	2	24	19	8	17	36	90
6		5	1	5	1	4	1	5	1	5	1	24	19	5	20	39	97.5
7		4	2	5	2	5	2	4	1	5	1	23	18	8	17	35	87.5
8		5	2	4	1	4	1	5	1	4	1	22	17	6	19	36	90
9		4	1	5	1	4	2	5	1	4	1	22	17	6	19	36	90
10		5	3	4	3	5	2	5	2	4	3	23	18	13	12	30	75
Mean SUS Score		91.75															

RESULTS AND DISCUSSION

The System Usability Scale (SUS)

- The average SUS score computed for this was 91.75, which is classified as Above Average (Sauro, 2011)
- Excellent and Acceptable according to the descriptive scale (Bangor et al., 2009).
- Users with experience in taking or scheduling online exams found the proctoring tool to be usable, meaning it was effective, efficient, and satisfactory to use.

Conclusion

CONCLUSION

- AuthoExam employs multi-factor authentication (MFA) for student identity verification.
 - using knowledge-based factors like ID numbers and access codes
 - Implements risk-based authentication by computing for the Weighted Risk Scoring to verify student digital identity
- Integrates Chrome Extension API for real-time monitoring.
 - Flags browser activity such as window minimization, tab switching and copy-pasting.
- Usability assessed using System Usability Scale (SUS), yielding an Above Average score of 91.75.

FUTURE WORK

- Recommend making the proctoring tool compatible with other browsers
 - Use a different multi-factor authentication and authorization method
 - Include additional MFA factors like One-time passwords or Inherence-based factors (e.g., keystroke dynamics)
- Feature Requests
 - Add "Auto Submit" to automatically submit and generate a report after an exam

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<https://doi.org/10.1145/3546069>

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Thank You