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Proceedings of the 36<sup>th</sup> ISTEAMS Accra Bespoke Multidisciplinary Innovations Conference

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## System Testing and Evaluation of Undergraduate Intelligent Applications for Suicide Ideation Detection

Ezea, I. L, Agu, M. N, & Bakpo, F. S  
Department of Computer Science  
University of Nigeria  
Nsukka, Enugu State, Nigeria  
E-mail; ezeaikenna@yahoo.com  
Phone: +2348025107142

### ABSTRACT

Suicide is a global health issue that was considered in 2016 as the 3<sup>rd</sup> leading course of death in people between age 15-29. In 2013 it cost US Government \$58.4 billion (Shepard, et al. 2016). In the last ten years there has been a rising case of suicide among Nigerian Undergraduates. Most research on suicide prevention has been based on the analysis of Electronic Health Records (HER), Social Network Conversations, Suicide Notes, Clinical Interview, etc. The main issue with such approaches is that they are reactive and in some cases may fail due to the peculiarity of suicidal cases. One common thing about people or student's with suicidal inclination is that they tend to isolate themselves from lectures, friends, and other activities they formally enjoyed. The result of which affects their academic performance. The question is how can student's social interaction and academic activities aid in proactive detection of suicide ideation among undergraduate students. This question is important because students like social media and most of the students who exhibit suicidal behavior tend to confide more on social media community more than they can to their family and health care providers. This goes to say that a good understanding of student's social media disposition, academic performance, friends' network and social network conversations can help in proactive detection of suicide ideation. In addressing this issue several application has been developed to extract information that will aid suicide ideation detection. Such applications are social network application, academic applications and synchronization applications. This application have shown to function very well across different mobile, web browsers and operating system platforms.

**Keywords:** System Testing, Evaluation, Undergraduates, Intelligent Applications, risks, Suicide Ideation Detection

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#### Proceedings Citation Format

Ezea, I. L, Agu, M. N, & Bakpo, F. S. (2023): System Testing and Evaluation of Undergraduate Intelligent Applications for Suicide Ideation Detection Proceedings of the 36<sup>th</sup> ISTEAMS Accra Bespoke Multidisciplinary Innovations Conference. University of Ghana/Academic City University College, Accra, Ghana.  
31<sup>st</sup> May – 2<sup>nd</sup> June, 2023. Pp 309-330. <https://www.isteams.net/ghanabespoke2023>.  
[dx.doi.org/10.22624/AIMS/ACCRABESPOKE2023P29](https://doi.org/10.22624/AIMS/ACCRABESPOKE2023P29)

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## 1. BACKGROUND TO THE STUDY

Suicide is becoming a very serious issue among the undergraduates as most of them are being confronted by several social and economic vices that put them in serious depression. Sometime the depression manifest in a way of avoiding classes, friends, and things that usually give them pleasure. All this cumulates to poor academic performance. Several approaches has been used to address the issue of suicide of which the details has been highlighted.

Some of the past research work on suicide ideation detection share some common characteristics which is the fact that they rely on the following for suicide ideation detection: Electronic Health Records (EHR) (Hammond, Laundry, OLeary, & Jones, 2013; Walsh, Ribeiro, & Franklin, 2017; Tran, Phung, Luo, Harvey, Berk, & Venkatesh, 2013; Iliou, et al., 2016; Nguyen, Tran, Gopakumar, Phung, & Venkatesh, 2016), Suicide Notes, Social Media Contents (Robinson, et al., 2016; O'Dea, Wan, Batterham, Calear, Paris, & Christensen, 2015; Wang, Wan, & Paris, 2016; Shepherd, Sanders, Doyle, & Shaw, 2015; Huang, Zhang, Chiu, Liu, Li, & Zhu, 2014; Huang, Li, Liu, Chiu, Zhu, & Zhang, 2015), clinical interview and questionnaire (2011; Delgado-Gomez, Blasco-Fontecilla, Sukno, Plasencia, & Baca-Garcia, 2012; Harris, McLean, & Sheffield, 2014; Sueki, 2015).

The characteristics they share is that they detect suicide ideation based on a patient established suicidal behaviour or history. This means that the system works on preventing people who have already started exhibiting suicidal behaviour rather than targeting people who may develop depression or suicide ideation in the future. The research work conducted in (Cao, Zhang, & Feng, 2020; Cao, et al., 2019; Sawhney, Joshi, Flek, & Shah, 2021; Sawhney, Joshi, Gandhi, & Shah, 2020; Coppersmith, Leary, Whyne, & Wood, 2015; Masuda, Kurahashi, & Onari, 2013; Jashinsky, et al., 2014) on the other hand used deep learning approach for suicide ideation detection on social media, but such research efforts are constrained due to user anonymity in some social media platform, incomplete user information due to secrecy in divulging personal information and insufficiency of social media platform in capturing some suicide risk factors like emotional warmth due to parental rearing style (Cao, Zhang, & Feng, 2020) and lecturer to student relationship. Such limitations affect the use of only social media platform for suicide ideation detection. This thesis aims to perform a proactive undergraduate student's suicide ideation detection based on synchronization of students' academic undertaking with social network-based behaviour analysis (using deep learning).

To this effect the research on (Ezea, 2020; Ezea, 2019) of which this research complements intends to extract suicide risk factors from students' academic undertaking and social network activities and then perform a synchronization on the suicide risk factors for suicide ideation detection using a synchronization model. The application that this work tends to test and evaluate is made up of three sub applications: the attendance, the social network and the synchronization application. The application is web based and comprises of images, Cascading Style Sheets, JavaScript codes, etc. which are used for the user interface development. All these components enhances the user experience and at the same time impacts on the overall performance of the application. The application equally sends and receives data in and out of the database. All these components and database access impacts on the application user experience.

This paper will be testing the application and evaluating the performance using non-functional performance metrics like, performance, accessibility, best practices, Search Engine Optimization (SEO), data volume, etc. The testing and evaluation of the system against the above performance metrics is as explained in the section that follows. But before the explanation the methodology used for the system testing will first be discussed.

## 2. SYSTEM TESTING AND EVALUATION METHODOLOGY

The methodology used in testing and evaluation of the application are 1) chrome developer tool for testing the web application 2) Manual Testing using (Opera, Firefox, Chrome and MS Edge browsers) 3) and VM Ware for testing the Operating Systems.

### 2.1 Testing and Evaluation of Attendance Application

The evaluation metrics can be accessed using the lighthouse menu in the chrome developer tools. The metrics are as can be seen in figure 1 and they are Performance, Accessibility, Best Practices and SEO. The results for each of the metrics are 92% for Performance, 83% for Accessibility, 83% for Best Practices and 80% for SEO. The details of each of the metrics are as shown in the following subsection.

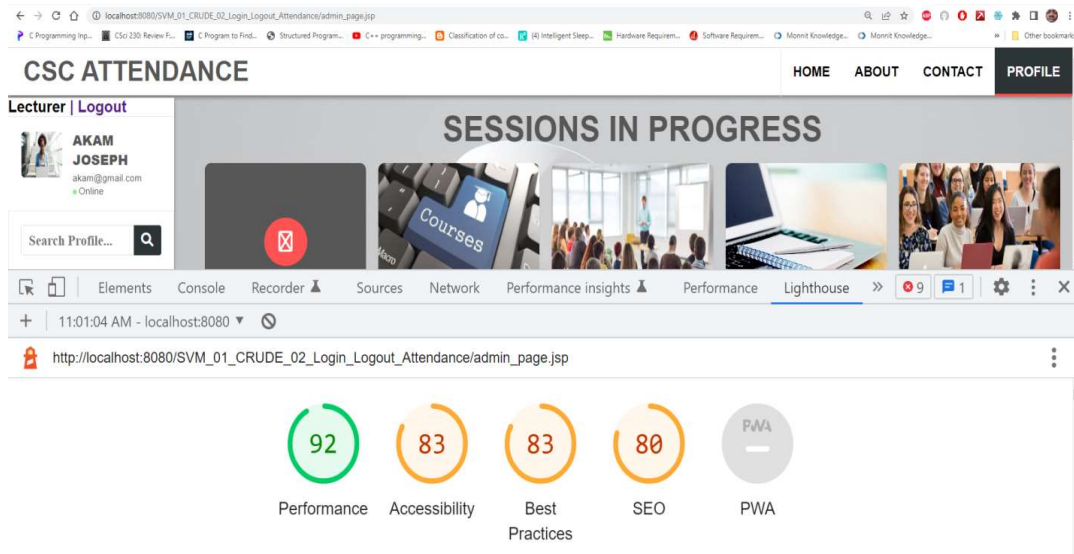


Figure 1: Display of the Attendance Application Performance

### 2.2. Performance

The performance measures the speed of loading a web page. It consists of the following metrics which can be seen in figure 2.

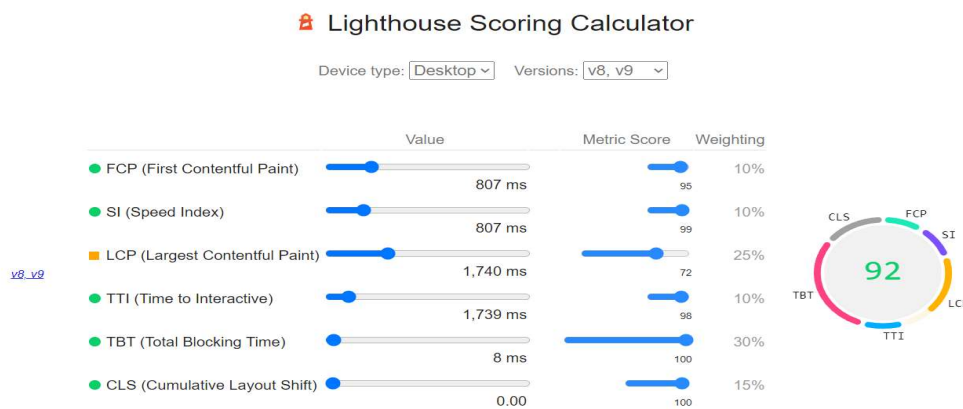


Figure 2: Display of the Attendance Application Performance Indices

The figure consists of six performance metrics that collectively added up to the 92%. The performance metrics are First Contentful Paint (FCP), Speed Index (SI), Largest Contentful Paint (LCP), Time to Interactive (TTI), Total Blocking Time (TBT) and Cumulative Layout Shift (CLS).

### **2.3. First Contentful Paint (FCP)**

The First Contentful Paint which has 807ms with metric score of 95 and weighting of 10% is the time it takes for actual content to be displayed for visitors on the web page.

### **2.4. Speed Index (SI)**

The SI with value of 807 ms, a metric score of 99 and weighting of 10% is the measure of how quickly a page is fully displayed for visitors to view.

### **2.5. Largest Contentful Paint (LCP)**

The LCP with value of 1,740 ms, a metric score of 72 and 25% weighting is the time it takes for the website to display the largest content.

### **2.6. Time to Interactive (TTI)**

This metrics measures the responsiveness of the page. It has a metric value of 1,739 ms, a metric score of 98 and a weighting value of 10%.

### **2.7. Total Blocking Time (TBT)**

This metrics measures the amount of time a page is blocked from responding to user input. It has a metric value of 8ms, a metric score of 100 and a weighting value of 30%.

### **2.8. Cumulative Layout Shift (CLS)**

This metrics measure the visual stability of a web page. It has a metric value of 0.00 ms, a 100 metric score and 15% weighting value.

### **2.9. Accessibility**

This metrics checks the accessibility issue and the overall accessibility score. It has a score of 83%.

### **2.10. Best Practices**

This ensures that the web application follows the best practices by ensuring that the web server allows external traffic from https only. It has a score of 83%.

### **2.11. Search Engine Optimization (SEO)**

SEO metrics gives a score that will help the developer improve the search parameters on the page so that users can search and easily get what they are searching. The SEO for this application is 80%.

## **3. TESTING AND EVALUATION OF SOCIAL NETWORK APPLICATION**

The social network application provides a medium through which students can interact and share information. For a good user experience the application needs to be optimized in terms of performance, accessibility, search engine optimization and finally follows the best practices. To evaluate this application in terms of the above mentioned metrics figure 3 shows the performance of the application in terms of performance (82%), accessibility (70%), best practices (75%) and Search Engine Optimization (70%).

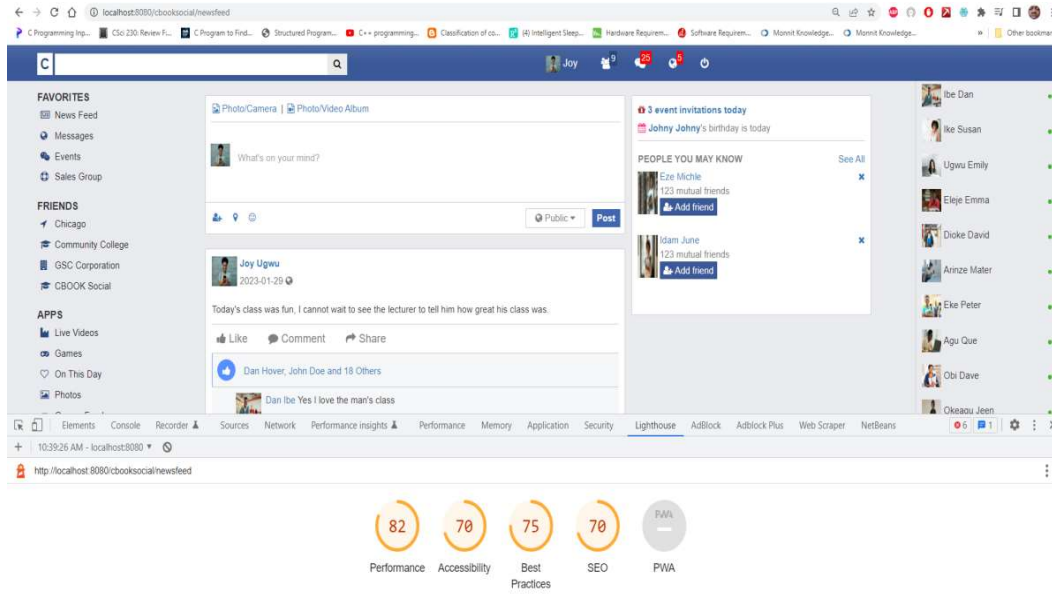


Figure 3: Display of the Social Network Application Performance

The components that make up the performance score can be shown in lighthouse scoring calculator in figure 4. The components are First Contentful Paint (FCP), Speed Index (SI), Largest Contentful Paint (LCP), Time to Interactive (TTI), Total Blocking Time (TBT) and Cumulative Layout Shift (CLS).

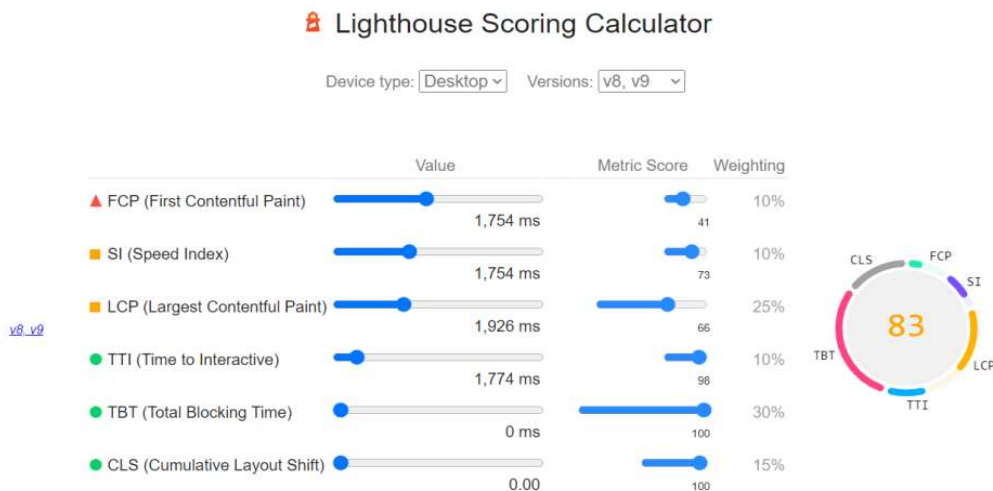


Figure 4: Display of the Social Network Performance Indices

#### 4. TESTING AND EVALUATION OF SYNCHRONIZATION APPLICATION

The synchronization application provides an interface through which the user can interact with the whole system to know which student is to be on suicide watch list. This interface needs to provide an optimum performance to enhance user operation. To achieve this it has proven to have high performance metrics of 98% performance, 87% accessibility, 92% best practices and 89% SEO. These metrics can be seen in figure

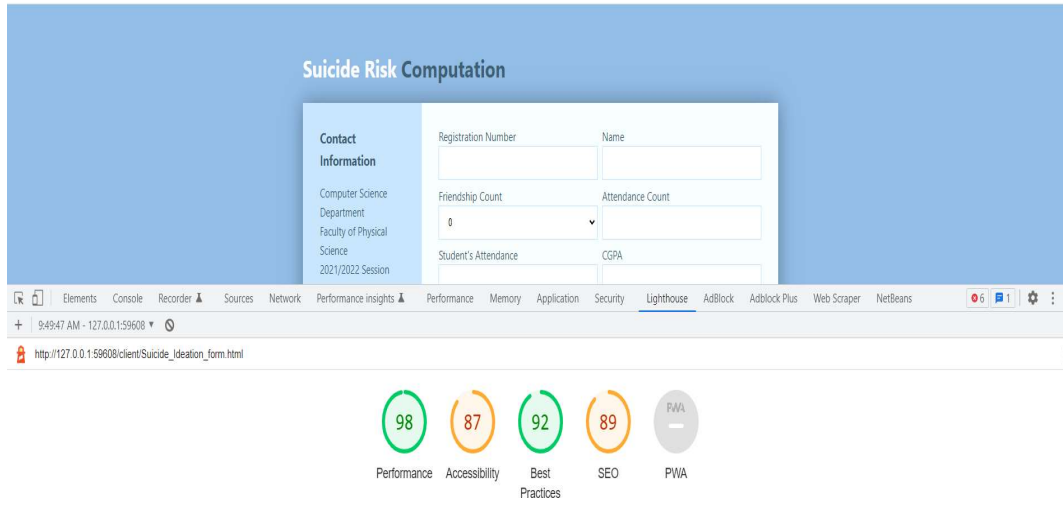


Figure 5: Display of the Suicide Synchronization Application Performance

The performance metrics has a collection of sub metrics that collectively contributes to form the overall score. The sub metrics which are components of the scoring calculator are First Contentful Paint (FCP), Speed Index (SI), Largest Contentful Paint (LCP), Time to Interactive (TTI), Total Blocking Time (TBT) and Cumulative Layout Shift (CLS). Each of the sub metrics as can be seen in figure 6 has scores that sum up to the overall performance value.

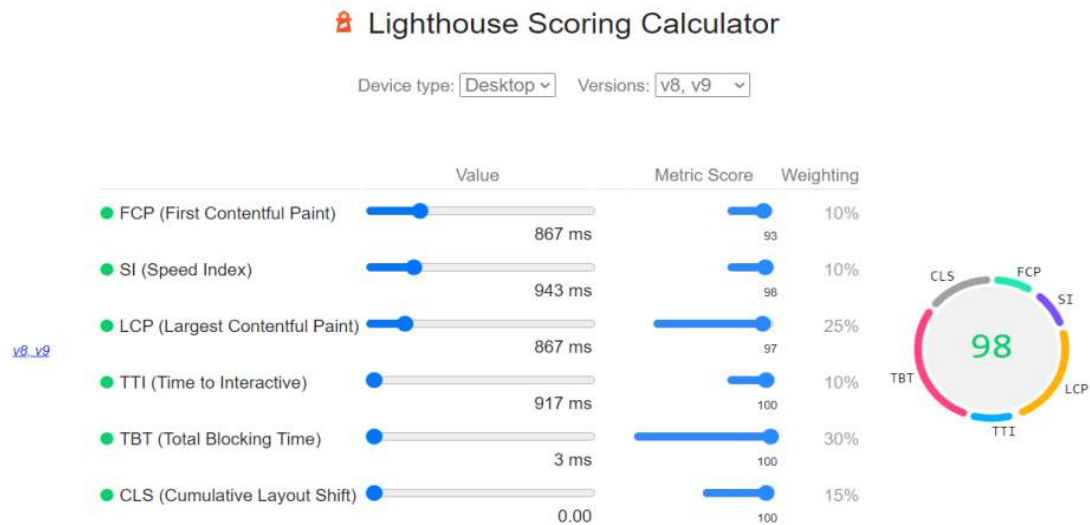


Figure 6: Display of the Suicide Synchronization Application Performance Indices

## 5. APPLICATION RESPONSIVENESS ON MOBILE DEVICES

This section report the result of the application responsiveness across different mobile devices. This is to ensure that it is usable not just to laptop users but also to others with different mobile devices. This is the reason why the application was tested with a variety of mobile devices like iPhone 12 Pro, Samsung Galaxy S8, iPad Mini, and Galaxy Fold.

### 5.1. Testing Application on iPhone 12 Pro

An iPhone 12 Pro is a mobile device with vertical screen resolution of 390 x 844 and horizontal screen resolution of 844 x 390. The display of the application on this device was perfect as can be seen in figure 7 (the vertical display) and figure 8 (the horizontal display).

Figure 7: Vertical Screen Display of Suicide Synchronization Interface

Figure 8: Horizontal Screen Display of Suicide Synchronization Interface

## 5.2 Testing Application on Samsung Galaxy S8 Plus

A Samsung Galaxy S8 Plus is a smart phone device with a screen dimension of 360 x 740. It uses android operating system with a screen resolution of 1440 x 2960 pixels, 18.5:9 ratio. When it was used on the application the display is as shown figure 9 and figure 10. Figure 9 shows the vertical display with dimension 360 x 740 while figure 10 shows the horizontal display with dimension 740 x 360. Even though the display was adjusted to suit the resolution the functionality of the application did not change.

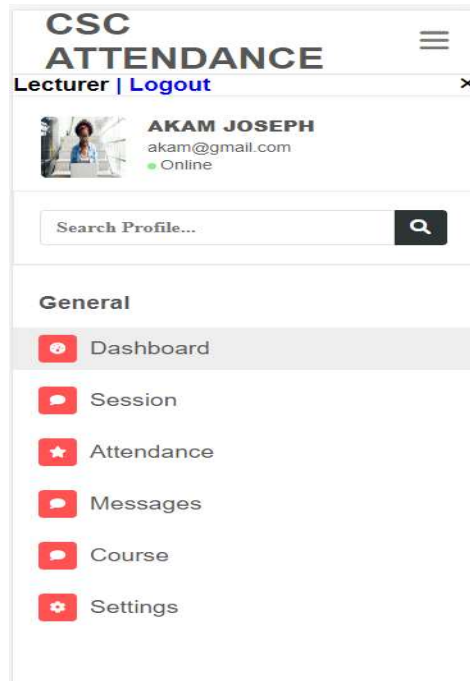


Figure 9: Vertical Screen Display of Galaxy S8 Plus

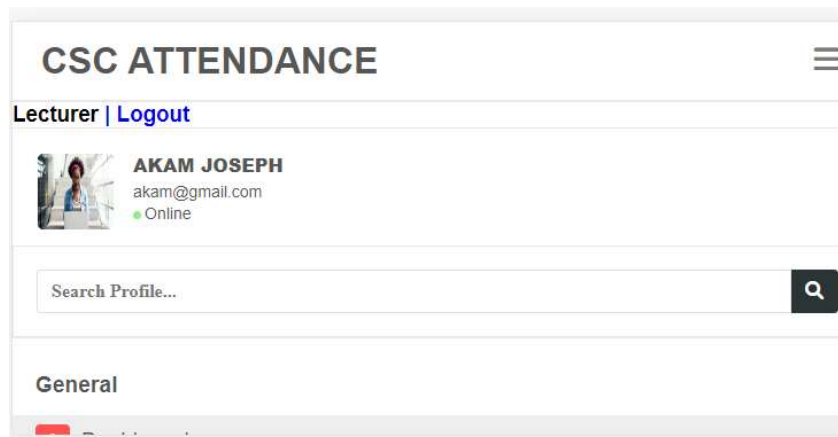


Figure 10: Horizontal Screen Display of Galaxy S8 Plus

## 5.3 Testing Application on iPad Mini

An iPad Mini is a table computer that is manufactured by Apple Inc. It has a screen resolution of 768 x 1024 pixels on the vertical axis and a screen resolution of 1024 x 768 pixels on the horizontal axis. It uses iPadOs as the operating system. The display of the application on the device can be shown in figures 11 to figure 12.





Figure 11: Vertical Screen Display for iPad Mini

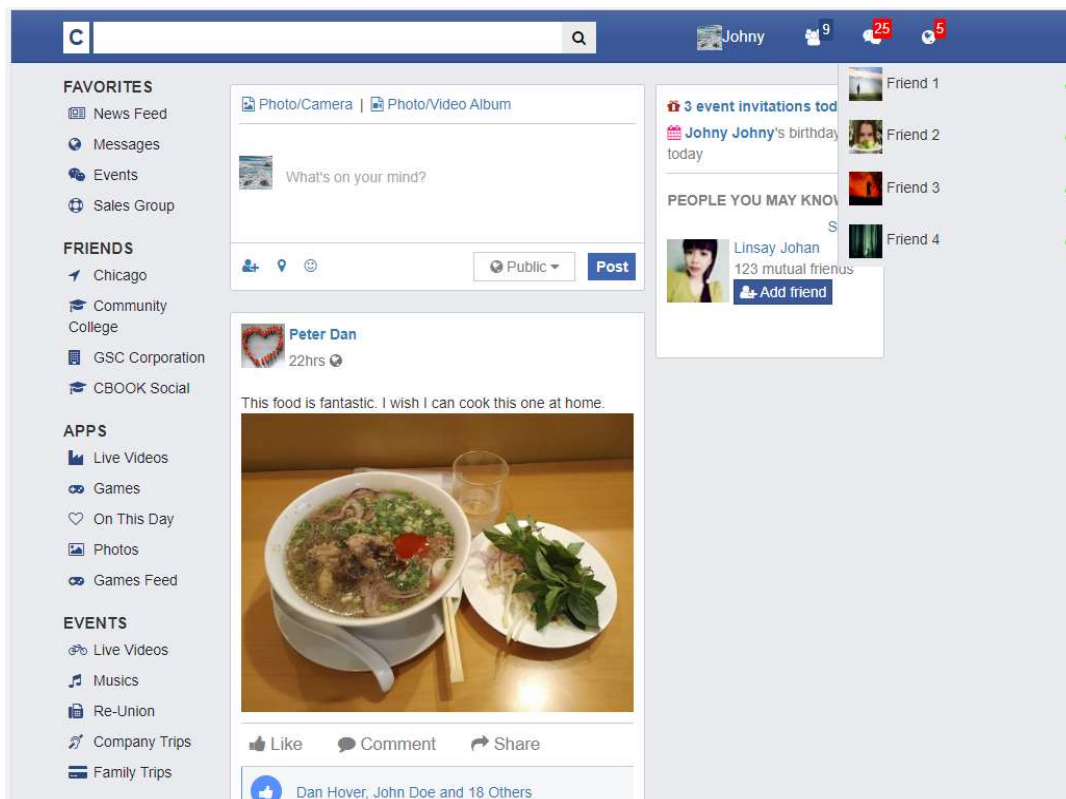


Figure 12: Horizontal Screen Display for iPad Mini

## 6. CROSS BROWSER COMPATIBILITY TEST

A browser is an application program that enables the user to interact with an application on the internet. There are many browsers available such as Microsoft Internet Explorer, Google Chrome, Safari, Opera, Firefox, Microsoft Edge etc. the choice of a browser depends on availability, individual choice and location.

A certain group of people in a given location might choose one browser over another. So for an application to be usable across many users one need to ensure that it can work with the most popular browsers. On that note the application has been tested on the major browsers such as Chrome, Edge, Firefox, and Opera. The test has shown that the application can function very well across the above mentioned browsers. A screenshot of the testing is shown in subsection 6.1 to 6.4.

### 6.1. Testing Application on Chrome Browser

Chrome is one of the browsers that was used for testing the application. The result shows a very functional view with good user experience. The figure in 13 (the display for the social network application), figure 14 (the display for the synchronization application) and figure 15 (the display for the attendance application) shows the screenshots of how the three applications are displaying on chrome browser.

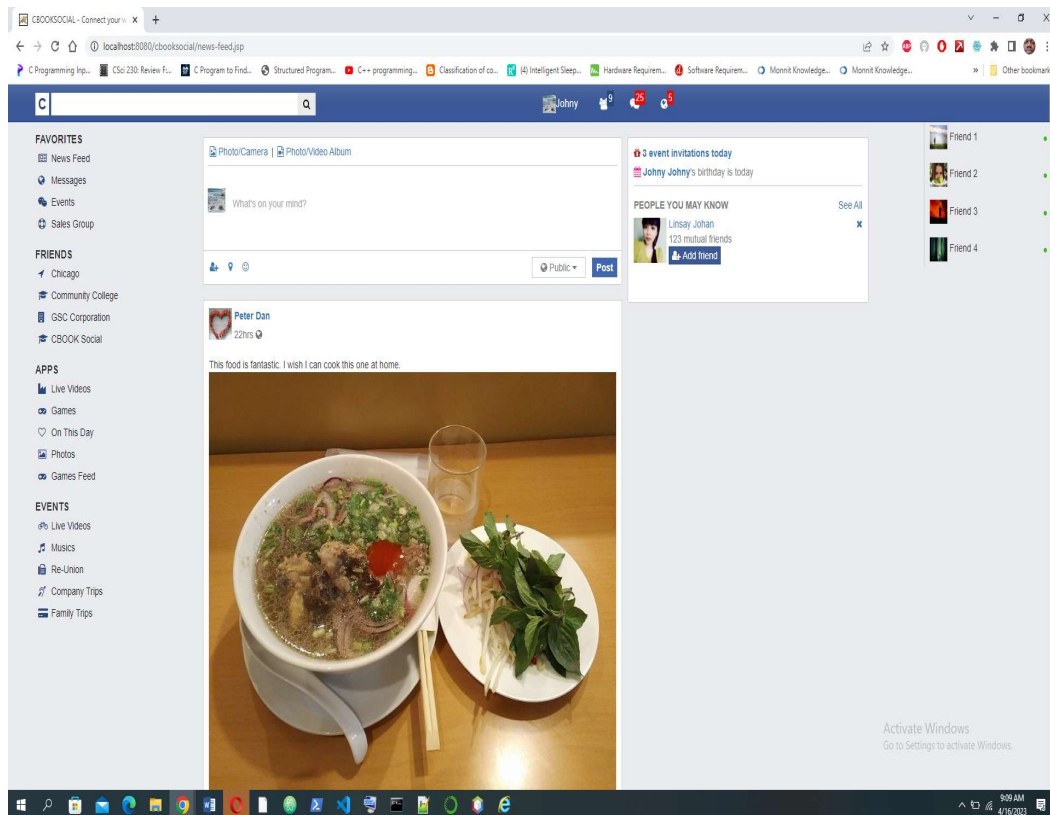


Figure 13: Chrome Browser display of Social Network Application

Figure 14: Chrome Browser display of Suicide Synchronization Application

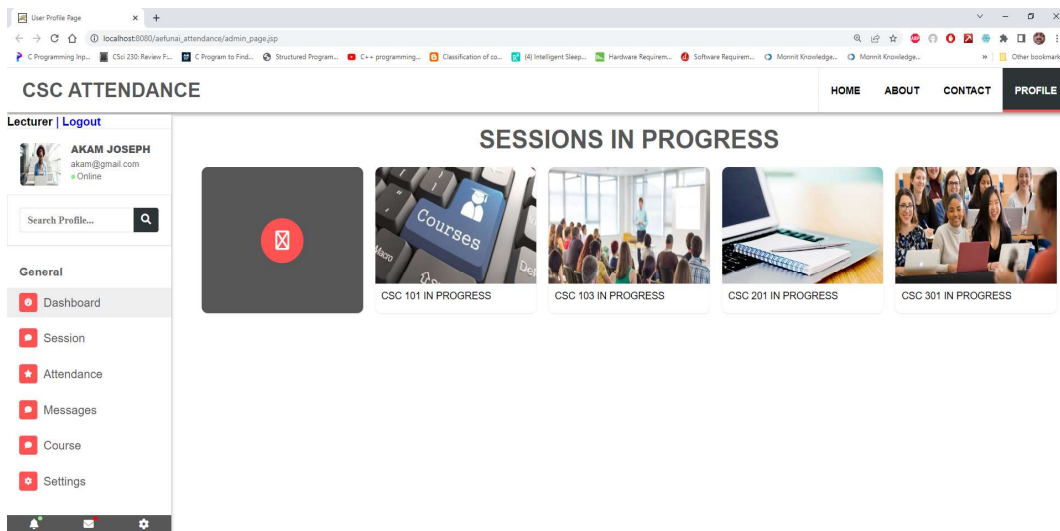


Figure 15: Chrome Browser display of Social Network Application

## 6.2. Testing Application on Opera Browser

The testing was equally conducted on opera browser and it gave a very good user experience and functionality. The screenshot of the testing is as shown in figures 16 (the display for social network application), figure 17 (the display for synchronization application) and figure 18 (the display for the attendance application).

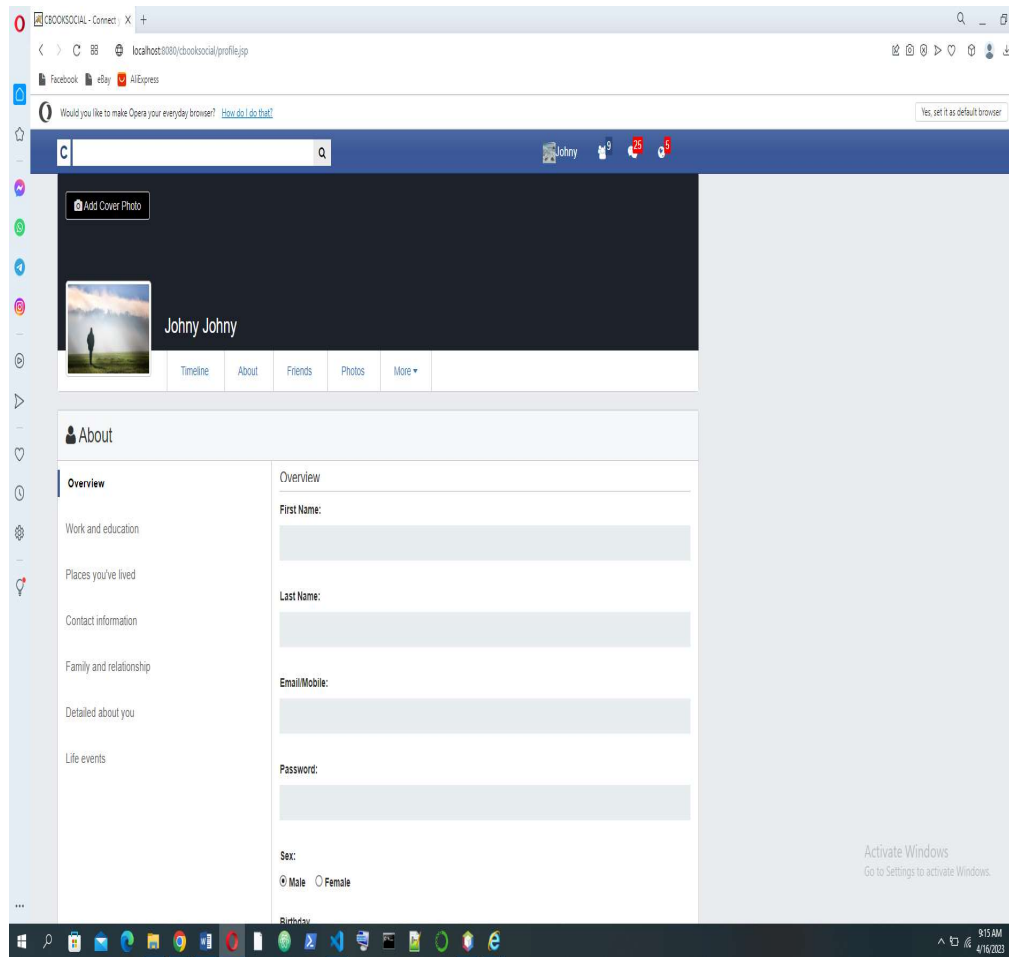


Figure 16: Opera Browser display of Social Network Application

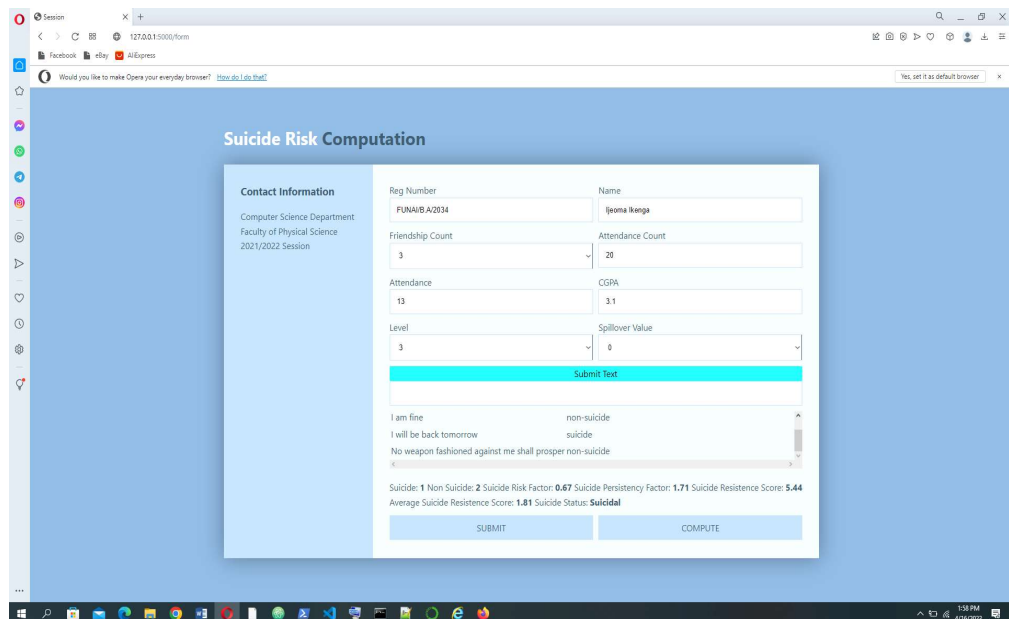


Figure 17: Opera Browser display of Suicide Synchronization Application

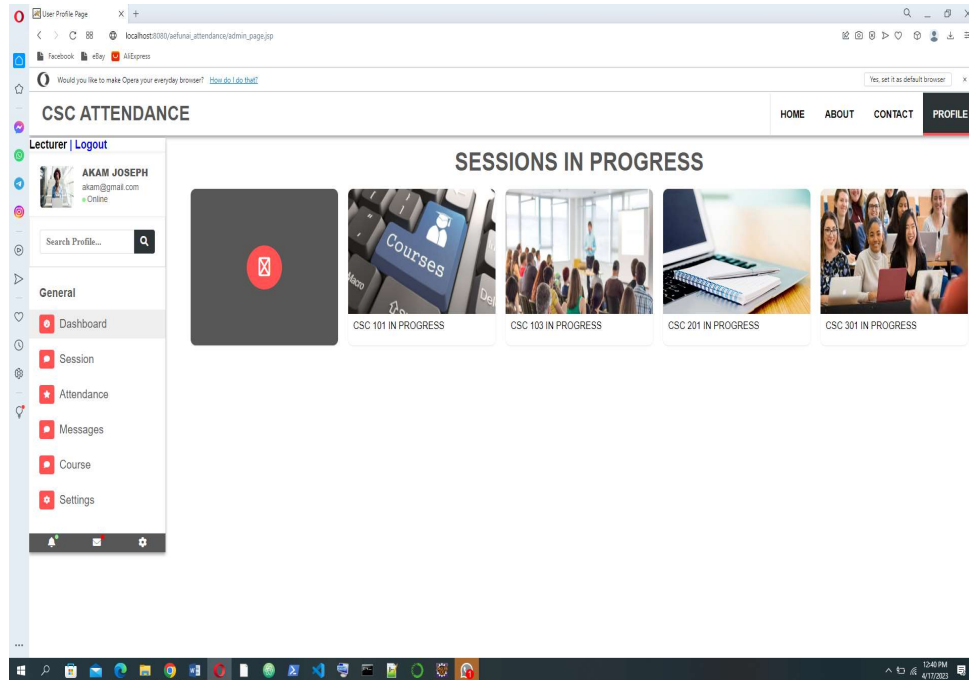


Figure 18: Opera Browser Display of Students' Attendance Application

### 6.3. Testing Application on Microsoft Edge Browser

The third browser used for testing the application is Microsoft Edge. The result shows a good user interface with functional Cascading Style Sheet (CSS) and JavaScript. The screenshot in figure 19 (the display for the social network application), figure 20 (the display for the synchronization application) and figure 21 (the display for the attendance application) are the result of this test.

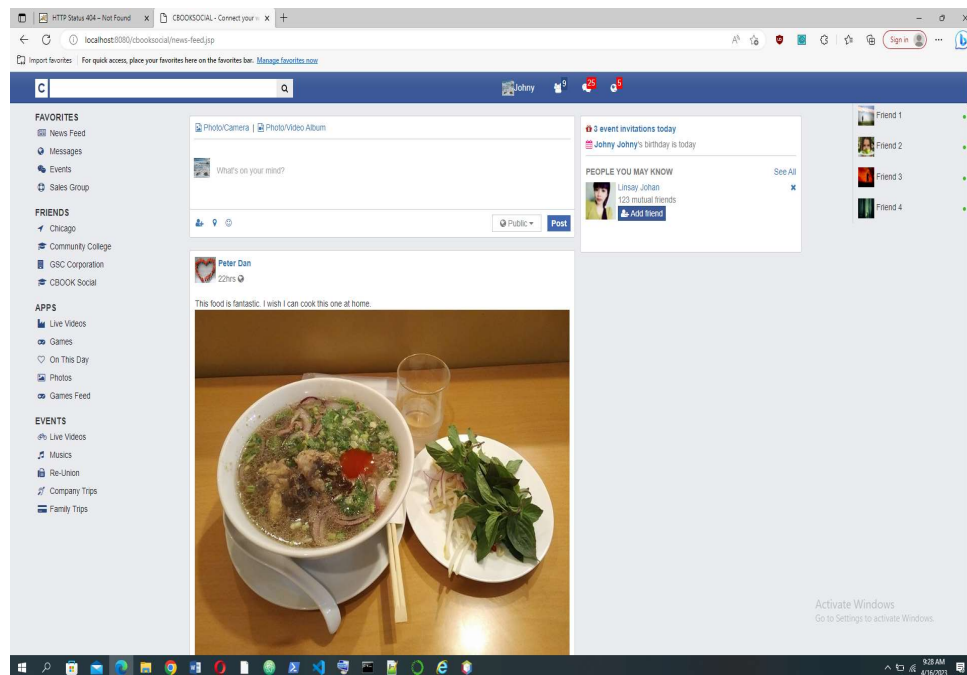


Figure 19: MS Edge Browser display of Social Network Application

**Suicide Risk Computation**

**Contact Information**  
Computer Science Department  
Faculty of Physical Science  
2021/2022 Session

Reg Number: FUN415321  
Name: Ido Nnaemeka

Friendship Count: 3  
Attendance Count: 20

Attendance: 12  
CGPA: 4.0

Level: 3  
Spillover Value: 0

**Submit Text**

**Text**  
I am fine today, I pray I can go to school tomorrow non-suicide  
Tomorrow is another day, and I will be glad in it non-suicide

**Status**  
non-suicide

Suicide: Non Suicide: 2  
Suicide Risk Factor: 1.00  
Suicide Persistency Factor: 1.33  
Suicide Resistance Score: 9.02  
Average Suicide Resistance Score: 3.01  
Suicide Status: **Non-Suicidal**

**SUBMIT COMPUTE**

Figure 20: MS Edge Browser display of Suicide Synchronization Application

**CSC ATTENDANCE**

HOME ABOUT CONTACT PROFILE

Lecturer | Logout

AKAM JOSEPH  
akamj@gmail.com  
Online

Search Profile...

**General**

- Dashboard
- Session
- Attendance
- Messages
- Course
- Settings

**SESSIONS IN PROGRESS**

CSC 101 IN PROGRESS

CSC 103 IN PROGRESS

CSC 201 IN PROGRESS

CSC 301 IN PROGRESS

Figure 21: MS Edge Browser display of Student's Attendance Application

#### 6.4 Testing Application on Firefox Browser

The last browser that was evaluated is Firefox and like every other browsers the functionality and user experience was the same. The result of the testing is as shown in the screenshots of figures 22 (display of the social network application), figure 23 (the display of the synchronization application) and figure 24 (the display of the social network application).



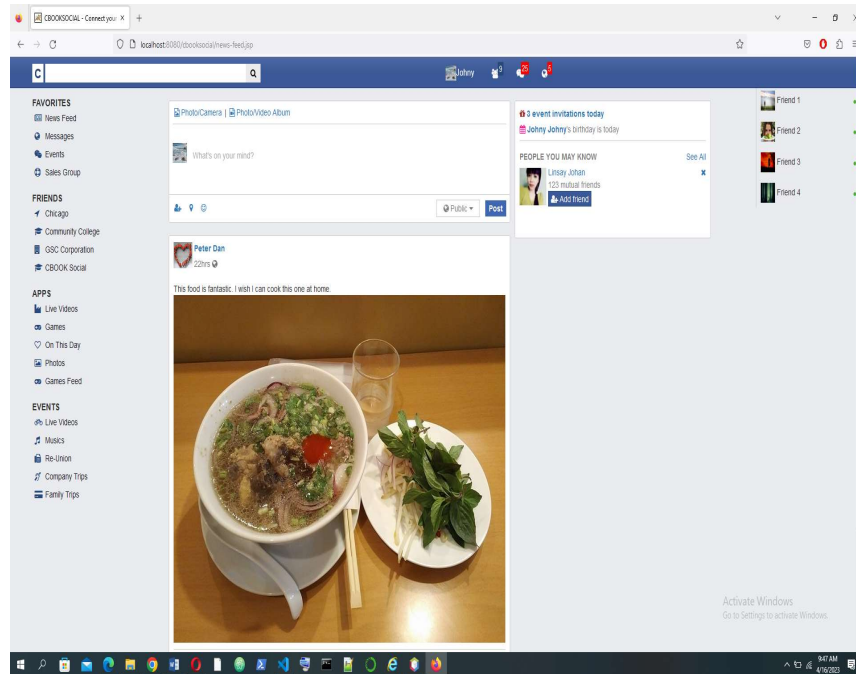


Figure 22: Firefox Browser display of Student's Attendance Application

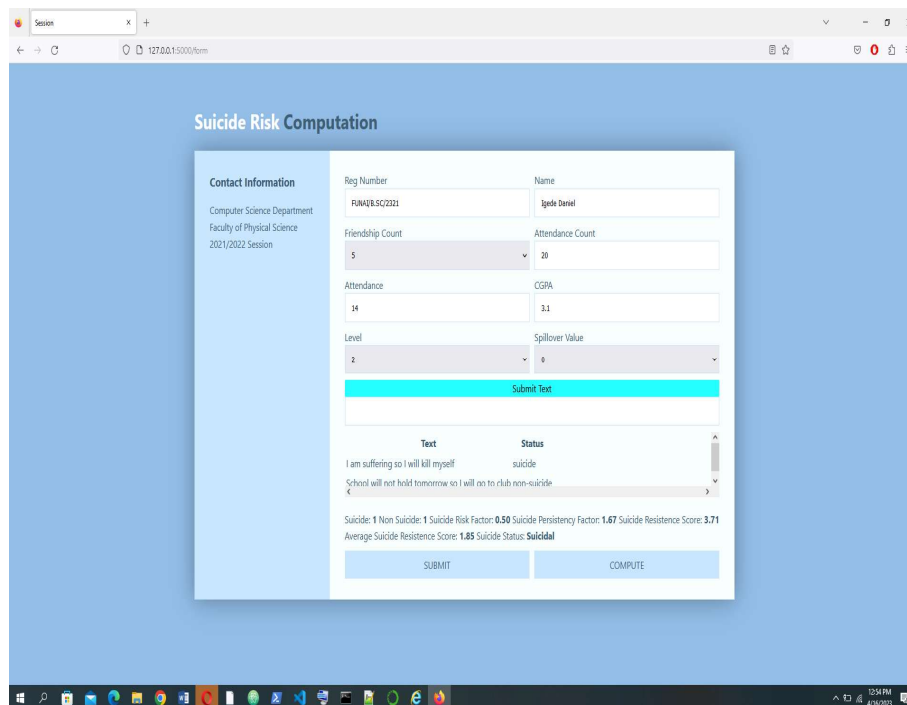


Figure 23: Firefox Browser display of Suicide Synchronization Application

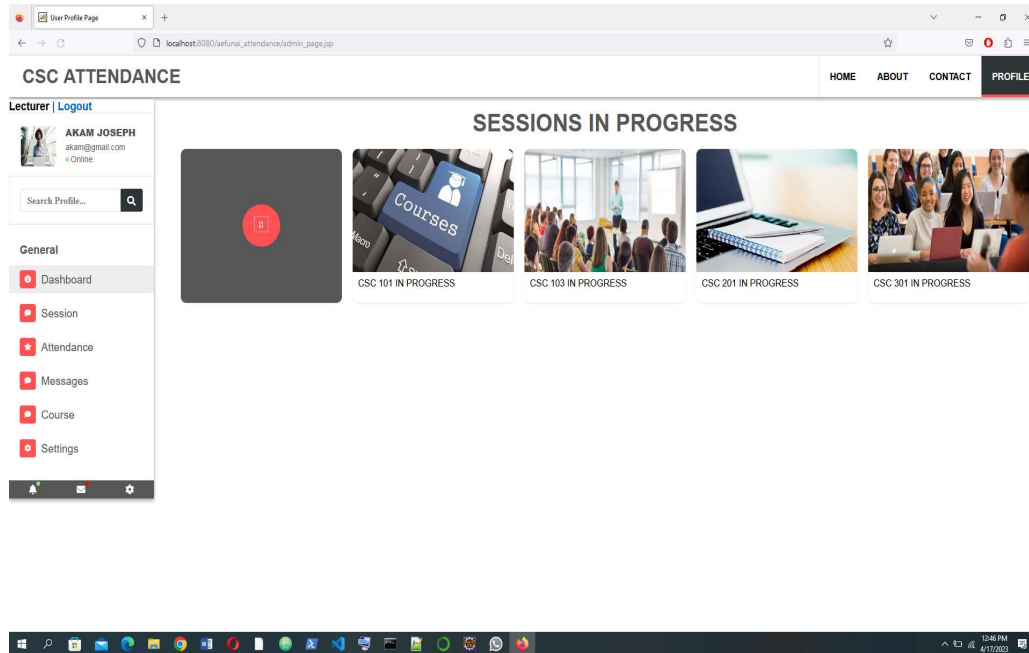


Figure 24: Firefox Browser Display of Social Network Application

## 7. WINDOWS COMPATIBILITY TEST

The functionality of the application with regard to different operating system is important. This is the reason why even though the application was developed with windows 11 it was tested in other operating systems like windows 8, and 10. The whole result of the testing cannot be visually represented though the screen shots of the major test can be shown figure 25 to figure 30.

### 7.1. Testing Application on Windows 8.0

Windows 8.0 is a variant of Microsoft Operating System that was released in 2012. It is an upgrade of windows 7. It is a popular operating system that are being used by most Personal Computer users. To ensure user acceptability it is very important we test to ensure that the application can work with this variant of OS. When it was tested we got all the function of the application working very well. The output of the application is as shown in figure 25 (the display of social network application), figure 26 (the display of synchronization application) and figure 27 (the display of the attendance application).



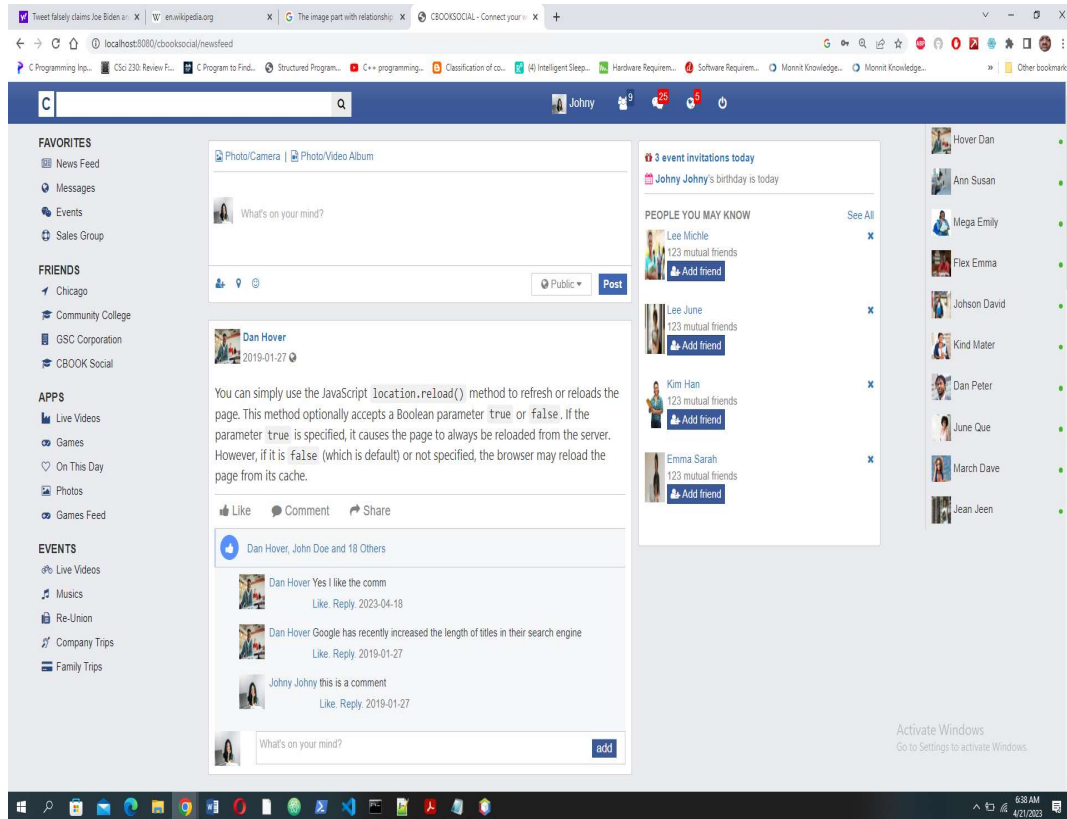


Figure 25: Windows 8.0 display of Student's Attendance Application

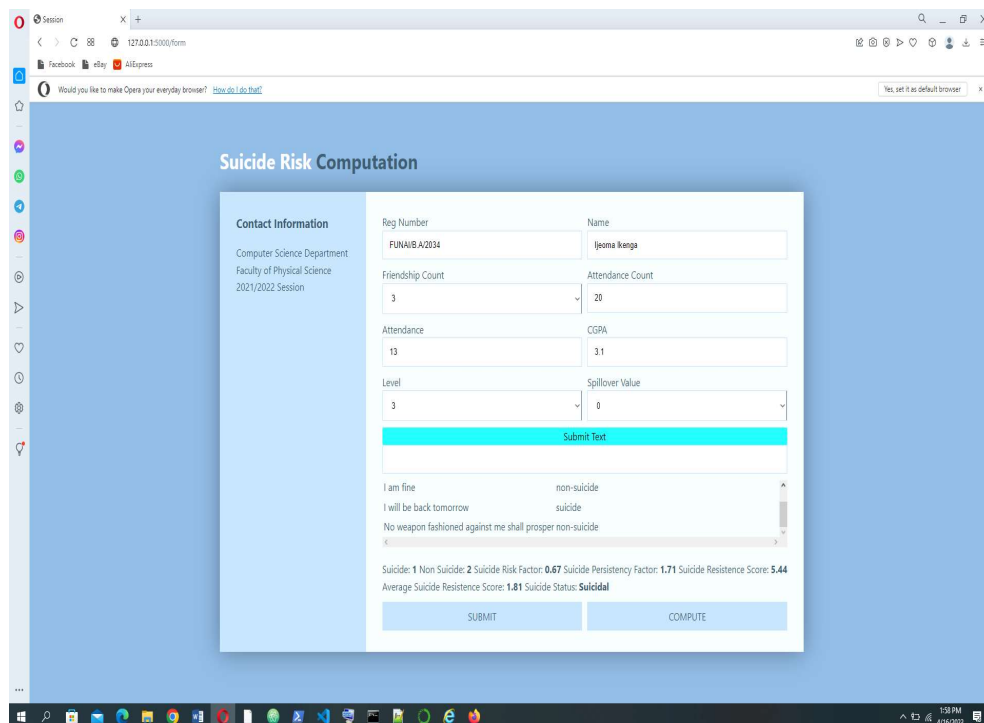


Figure 26: Windows 8.0 display of Suicide Synchronization Application

ID	First Name	Last Name	Reg Number	Course Code	Course Duration	Lecture Date	Lecture Time	Status	Time In	Time Out	Time Spent	Programme	Session
1	Odo	Iteany	FUNAMB SC/211	CSC 201	2	13/5/2022	2:30PM	Present	2:30PM	3:30PM	1hr	Computer Science	2019/2020
2	Kenneth	Nduka	FUNAMB SC/212	CSC 203	2	13/5/2022	2:30PM	Present	2:30PM	3:30PM	1hr	Computer Science	2019/2020
3	Igwe	Oryebuchi	FUNAMB SC/213	CSC 204	2	13/5/2022	2:30PM	Present	2:30PM	3:30PM	1hr	Computer Science	2019/2020
5	Igoma	Ikenga	FUNAMB SC/201	CSC 201	3	16/2/2021	4:00PM	Present	4:11PM	5:11PM	1hrs	CSC	2019/2019
6	Ikenna	ezza	funaib.sc/202	CSC 202	2	2022/2/2	11:00AM	Present	10:18:11	8:14:45:200	undefined	Computer Science/Informatics	2021/2022
7	Ikenna	ezza	funaib.sc/202	CSC 303	2	2022/2/2	11:00AM	Present	10:25:45	7:38:21:600	undefined	Computer Science/Informatics	2021/2022
8	Ikenna	ezza	funaib.sc/202	CSC 407	2	17/06/2022	10:00AM	Present	10:38:21	5:05:408	undefined	CSC/Informatics	2021/2022
9	Stan	Igwe	FUNAMB SC/202	CSC 407	2	17/06/2022	10:00AM	Present	10:47:42	15:36:06:100	undefined	CSC/Informatics	2021/2022
10	Stan	Igwe	FUNAMB SC/202	CSC 202	2	2022/2/2	11:00AM	Present	10:48:40	3:37:310:900	undefined	Computer Science/Informatics	2021/2022
11	Stan	Igwe	FUNAMB SC/202	CSC 407	2	17/06/2022	10:00AM	Present	10:50:04	4:36:06:100	undefined	CSC/Informatics	2021/2022
12	Stan	Igwe	FUNAMB SC/202	CSC 303	2	2022/2/2	11:00AM	Present	10:58:14	3:42:78:500	undefined	Computer Science/Informatics	2021/2022
13	Stan	Igwe	FUNAMB SC/202	CSC 407	2	17/06/2022	10:00AM	Present	11:03:10	5:31:336	undefined	CSC/Informatics	2021/2022
14	Stan	Igwe	FUNAMB SC/202	CSC 202	2	2022/2/2	11:00AM	Present	11:06:42	3:25:81:340	undefined	Computer Science/Informatics	2021/2022
15	Stan	Igwe	FUNAMB SC/202	CSC 345	2	17/06/2022	1:00PM	Present	12:13:36	9:01:930	undefined	Computer Science/Informatics	2021/2022
16	Stan	Igwe	FUNAMB SC/202	CSC 303	2	2022/2/2	11:00AM	Present	12:18:31	3:01:14:940	undefined	Computer Science/Informatics	2021/2022

Figure 27: Windows 8.0 display of Social Network Application

## 7.2. Testing Application on Windows 10

This windows is another variant of Microsoft Windows that succeeded Windows 8.0. It was released in 2015. After the release it has like other MS Operating System gained wide user acceptance. To this point it is vital to test any application on this windows to ensure the program usability. On this note this application was tested on this OS and it has proved to work very well. The display of the testing is as shown in figure 28 (the display of social network application), figure 29 (the display of synchronization application) and figure 30 (the display of the attendance application).

**Login to AEFUNAI NETWORK**

[Forgotten password?](#)  
[Signup for AEFUNAI NETWORK?](#)

Figure 28: Windows 10 display of Student's Attendance Application

**Suicide Risk Computation**

**Contact Information**  
Computer Science Department  
Faculty of Physical Science  
2021/2022 Session

Reg Number: FUNAIB/A2034  
Name: Ijoma Iwanga  
Friendship Count: 3  
Attendance Count: 20  
Attendance: 13  
CGPA: 3.1  
Level: 3  
Spillover Value: 0

**Submit Text**

I am fine  
I will be back tomorrow  
No weapon fashioned against me shall prosper

non-suicide  
suicide  
non-suicide

Suicide: 1 Non Suicide: 2 Suicide Risk Factor: 0.67 Persistence Factor: 1.71 Suicide Resistance Score: 5.44  
Average Suicide Resistance Score: 1.81 Suicide Status: **Suicidal**

**SUBMIT** **COMPUTE**

Figure 29: Windows 10 display of Suicide Synchronization Application

**CSC ATTENDANCE**

HOME ABOUT CONTACT **PROFILE**

Lecturer | Logout

**AKAM JOSEPH**  
akam@gmail.com  
Online

Search Profile...

**General**

- Dashboard
- Session
- Attendance**
- Messages
- Course
- Settings

**EDIT ATTENDANCE LIST**

Delete	Id	First Name	Last Name	Reg Number	Course Code	Course Duration	Lecture Date	Lecture Time	Status	Time In	Time Out	Time Spent	Programme	Session	Edit
Delete	1	Theophilus	Chukwuka	FUNAIB/SC/001	CSC 274	2 Hours	5/2/2022	2:00PM	Present	2:15PM	3:15PM	1 Hour	Computer Science	2021/2022	Edit
Delete	1	Theophilus	Chukwuka	FUNAIB/SC/001	CSC 274	2 Hours	5/2/2022	2:00PM	Present	2:15PM	3:15PM	1 Hour	Computer Science	2021/2022	Edit
Delete	1	Theophilus	Chukwuka	FUNAIB/SC/001	CSC 274	2 Hours	5/2/2022	2:00PM	Present	2:15PM	3:15PM	1 Hour	Computer Science	2021/2022	Edit
Delete	1	Theophilus	Chukwuka	FUNAIB/SC/001	CSC 274	2 Hours	5/2/2022	2:00PM	Present	2:15PM	3:15PM	1 Hour	Computer Science	2021/2022	Edit
Delete	1	Theophilus	Chukwuka	FUNAIB/SC/001	CSC 274	2 Hours	5/2/2022	2:00PM	Present	2:15PM	3:15PM	1 Hour	Computer Science	2021/2022	Edit
Delete	1	Theophilus	Chukwuka	FUNAIB/SC/001	CSC 274	2 Hours	5/2/2022	2:00PM	Present	2:15PM	3:15PM	1 Hour	Computer Science	2021/2022	Edit

Figure 30: Windows 10 display of Social Network Application

### 7.3. Testing Application on Windows 11

This is the most recent release of MS windows that succeeded Windows 10. Though still new but many users have started adopting it as a working tool. With time this operating system will dominate the market and every application that cannot work with it might lose its usability value. So on this note this application was tested on it to ensure it is functional.

The screenshot of the testing is as shown in figure 31 (the display of social network application), figure 32 (the display of synchronization application) and figure 33 (the display of the attendance application).

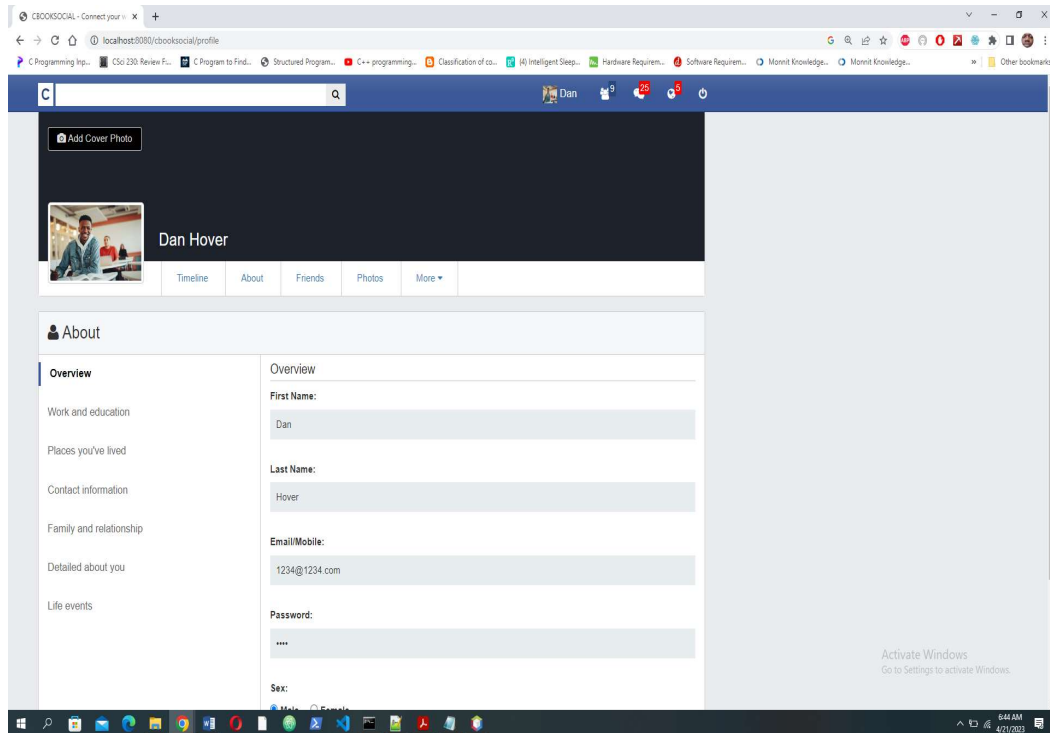


Figure 31: Windows 11 display of Student's Attendance Application

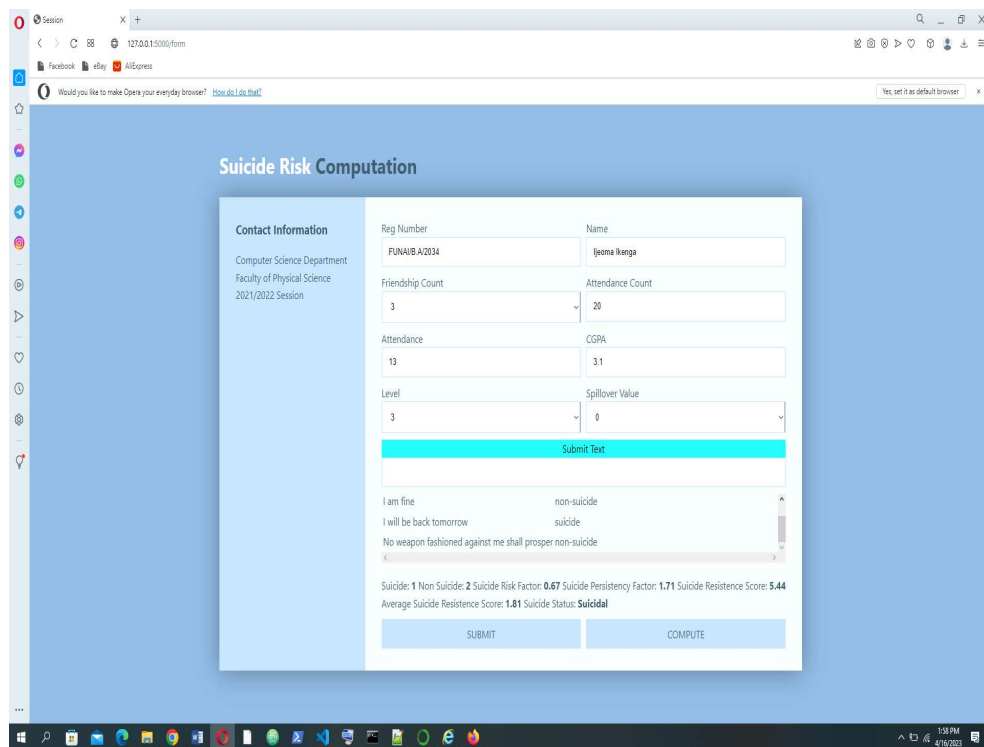


Figure 32: Windows 11 display of Suicide Synchronization Application

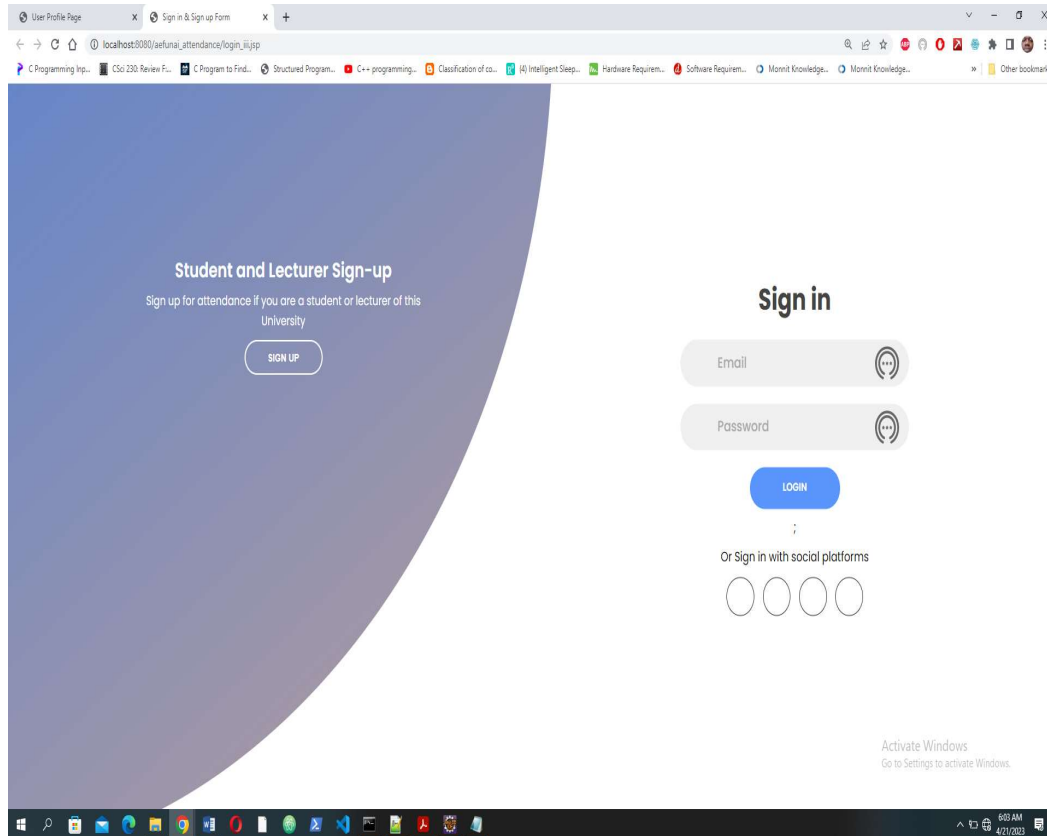


Figure 33: Windows 11 display of Social Network Application

## 8. CONCLUSION

This paper is an extension of (Ezea, 2020) which developed a mathematical model that was used to synchronize the machine learning prediction result from students' network application with their daily academic routine. This paper tested and evaluated the application developed in (Ezea, 2020) the result of which showed that the application can work very well across different mobile devices, Operating System, and Web browsers. This paper has proved that the application can be deployed and used across many mobile devices and operating systems.

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