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A Mobile Phone-based Self-Screening and Recovery Tool for Internet Addiction Disorder in Persons

Fidelis I. Onah [1*] and Samuel Ekong[2]
Department of Computer Science,
University of Cross River State, Calabar, Nigeria;
E-mail: ikonah80@yahoo.com, samuelekong@yahoo.com

ABSTRACT
This research paper implements a simple interactive browser-based, mobile friendly web application which screens persons of all age groups for Internet Addiction and prescribes a recovery therapy for severe symptoms. Data on socio-demographic indicators, Internet usage, psychosomatic symptoms and quality of life of the user are automatically collected as the user fills-in the self-administered questionnaire based on Young's Internet Addiction Test (YIAT) and the 5-point Likert scale. Object oriented design methodology is required to support applications for devices like cell phones, pagers and personal digital assistants. Since the Android mobile application development is based on Java language codes, therefore, normal Java Integrated Development Environments (IDEs) and Google-enabled Android Java libraries were used to render services on the mobile devices. Other development tools used are Google forms for presenting the Internet Addiction questionnaire to the users; Spreadsheets for retrieving the data collected from the Google forms and generate a score based on user response; and Gmail for the medical team to automatically generate the test results and send as mail to the users. The research work includes a trusted recovery therapy which addicted individuals can access as email at the comfort of their homes. The work further incorporates a means of printing out a record of progress after a user's session. In these periods of the global pandemic, an online screening, evaluation and therapeutic care can save you time and money; and even improve your mental health.

Keywords: *Diagnostic Questionnaire, Healthcare, Internet Addiction, Mobile App, Self-Care, Screening, Therapeutic Care, Web App*

INTRODUCTION
With the continued economic melt down in many countries of the world today, vast majority of people now find relief from the excitement of the Internet as a way of escaping from the tension and troubles of their daily and social lives. This increasing dependence on

Internet have heightened the level of anxiety in individuals' social quality of life; thus impairing their psychosocial well-being. The periodical self-assessment for Internet Addiction (IA) symptom status of individuals has thus increased in importance in recent times and shows promising relevance in today's technological dependent age. Recognizing the prevalence of Internet Addiction in persons is the first step to healing and bringing succor to their mental health.

At a period of global pandemic (such as the COVID-19 pandemic) when hospital visits are restricted, mobile phones can readily be an ideal platform for accessing accurate and reliable user regulated healthcare information anytime, anywhere with negligible additional costs and potentially higher quality results (P. Smutny and P. Schreiberova, 2020; Naciri et al., 2020). This has steadily been gaining popularity as the computational powers, sensing abilities and communication capabilities of smartphones, tablets and new mobile technologies continue to increase.

The current study aimed to develop a mobile-enabled web-based application for self-screening and recovery of persons with Internet Addiction Disorder. Web-based Self-Screening and Recovery tool can be executed as third party software using smartphones (e.g., Google Android Mobile phone devices) rather than computers/laptops. Android is preferred to iPhone because its source code is set open source. This allows developers to have full access to replace and reuse core application components on system level of the Mobile Operating System (MOS). The extensive set of application programming interfaces (APIs) provided by Google Android SDK (Software Development Kit) can permit mobile devices to share text, audio or video information among one another and also access shared resources securely on the system. Android applications are written in Java programming language; and run in a custom (Google-enabled) Android Java libraries. The standard Java byte code (source code) is automatically converted and executed by Java virtual machine instruction set called Dalvik. The interpreted Dalvik VM is

then optimized and packaged together with other application resources (e.g., UI (user interface) layouts, localization and a manifest file defining the structure of the application) in order to render desired services on mobile devices (Suhas Holla and Mahima M. Katti, 2012; Thomas Blasing et al, 2010). The desktop SMS application was developed using Java programming concept because of its portability. The backend of the system was interfaced with the GSM network through USB port of a PC and GSM modem.

Review of Related Literature

Internet addiction is conceptualized as an individual's inability to control his/her use of the internet, thus causing marked distress and/or functional impairment (Georgious Kormas et al, 2008). Not only do addictive tendencies stimulate symptoms of depression, it may also compound pre-existing behavioural and social maladjustments present among old and young people (Mehment Sahin, 2014). The American College of Emergency Physicians Foundation (n.d.) had expressed concern over rising number of emergency room cases involving mobile phone users who walked into lampposts, tripped on sidewalks, or entered the street into oncoming traffic (Websense TRITON, 2013). This was the reason why GSM was nicknamed "General State of Madness" in Nigeria (Fidelis I. Onah and Amaechi Eze, 2021).

The literature on mobile applications (apps) development is still quite young. The streams of research on the criteria to be considered when designing, developing, and deploying mobile apps as a screening tool in medical and healthcare systems is still highly inconsistent and fragmented (Ailie K.Y. Tang, 2019). Existing research have focused mainly on recommending the features and potential of the applications rather than developing and deploying them (Razieh Rezaee et al, 2024). A web application is essentially a program stored on a remote server and delivered to the user via a browser on desktop or mobile. It is similar to a website, but not entirely. Web apps need an active internet connection in order to run. They do not need to be

downloaded or installed as a separate application on the desktop. But web app developers have access to templates. There is no standard software development kit for building them. However, they may be built using JavaScript, CSS, HTML, and Python. Web apps do not require app store approval, and will update themselves. This means that they can be launched quickly. (CareerFoundry, 2023). The concept of self-care was first introduced in 1959 by Orem as the "Nursing care deficit theory of self". Self-care is a conscious, learned, and purposeful practice in which each person uses his acquired abilities and skills in such a way that he can take care of himself personally and independently (Razieh Rezaee et al, 2024).

MATERIALS AND METHODS

The methodology adopted in this study is the Object oriented design methodology which readily supports applications for devices like cell phones, pagers and personal digital assistants. Various software program structures are supported to facilitate branching, repetitive processing and decision making. The application also employed the use circuit switched GSM network to send and receive sms messages over the modem interface, and thus supports an extended AT command set for sending and receiving SMS messages according to defined specifications (Audestad J. and Jonathan Brown, 1992). The system database contains the contact information of each user such as usernames and mobile phone numbers, diagnostic test scores, and Internet Addiction level. This would be created by making use of MySQL and then installed to run on the server which would house the application program. When the application starts execution, the system checks and fetches Google-generated questionnaires, user responses and YIAT assessment scores; it also forwards constructed email messages to the GSM module for sending to users or the medical team for therapeutic care.

Data Collection

The instrument used by this system for detecting a user's Internet Addiction level is the diagnostic questionnaire on Internet addiction developed by Kimberly S. Young.

Table 1: Internet Addiction Test

S/N	Test Questions	0	1	2	3	4	5
1	How often do you find that you stay online longer than you intended?						
2	How often do you neglect household chores to spend more time online?						
3	How often do you prefer the excitement of the Internet to intimacy with your partner?						
4	How often do you form new relationships with fellow online users?						
5	How often do others in your life complain to you about the amount of time you spend online?						
6	How often do your grades or school work suffer because of the amount of time you spend online?						
7	How often do you check your email before something else that you need to do?						
8	How often does your job performance or productivity suffer because of the Internet?						
9	How often do you become defensive or secretive when anyone asks you what you do online?						
10	How often do you block out disturbing thoughts about your life with soothing thoughts of the Internet?						
11	How often do you find yourself anticipating when you will go online again?						
12	How often do you fear that life without the Internet would be boring, empty, and joyless?						
13	How often do you snap, yell, or act annoyed if someone bothers you while you are online?						
14	How often do you lose sleep due to being online?						
15	How often do you feel preoccupied with the Internet when offline, or fantasize about being online?						
16	How often do you find yourself saying "just a few more minutes" when online?						
17	How often do you try to cut down the amount of time you spend online and fail?						
18	How often do you try to hide how long you've been online?						
19	How often do you choose to spend more time online over going out with others?						
20	How often do you feel depressed, moody, or nervous when you are off-line, which goes away once you are back online?						

Source: *Dr. Kimberly S. Young, Center for Internet Addiction Recovery, P. α Box632, Bradford, PA16701, 2002.*

The questionnaire consists of 20 statements which are based on compromised social quality of life, individual quality of life, usage of the Internet, academic and careers, time control and excitatory usage of the Interne as shown in Table 1 above. The YIAT specifically evaluates the degree of preoccupation (e.g., "How often do you feel preoccupied with the Internet when off-line, or fantasize about being on-line?"), compulsive use (e.g., "How often do you try to cut down the amount of time you spend on-line and fail?"), behavioural problems (e.g., "How often do you snap, yell, or act annoyed if someone bothers you while you are on-line?"), emotional changes (e.g., "How often do you feel depressed, moody or nervous when you are off-line, which goes away once you are back on-line?"), and impact upon functionality consequent to Internet utilization (e.g., "How often do your grades or school work suffer because of the amount of time you spend on-line?"). The 20 items in the Young's Internet Addiction Test (YIAT) provide calibrated response scores ranging from 0 to 5, where a score of 0 is defined as "never" or "not at all"; 1 is defined as "rarely"; 2 represent "occasionally"; 3 is defined as "frequently"; 4 represent "often"; and 5 represent "always" respectively. The user is prompted to select (0, 1, 2, 3, 4, 5), for each item in the questionnaire, which best describes him at one attempt only. Hence, the total YIAT score may range from 0 to 100 (Kimberly S. Young, 2022).

The cut-off points below were applied to evaluate the occurrence of problematic internet use:

0 – 30 Normal,
31 – 49 Mild,
50 – 79 Moderate,
80 – 100 Severe.

Activities of the System

Activity represents a single screen with a user interface. The operation of the system follows the series of stages highlighted by the diagram below (Figure 1): Database servers are specially designed multiprocessor computers, with RAID disk arrays used for stable storage. Hardware database accelerators connected to one or more servers via a high-speed channel can also be used in large volume transaction processing environments.

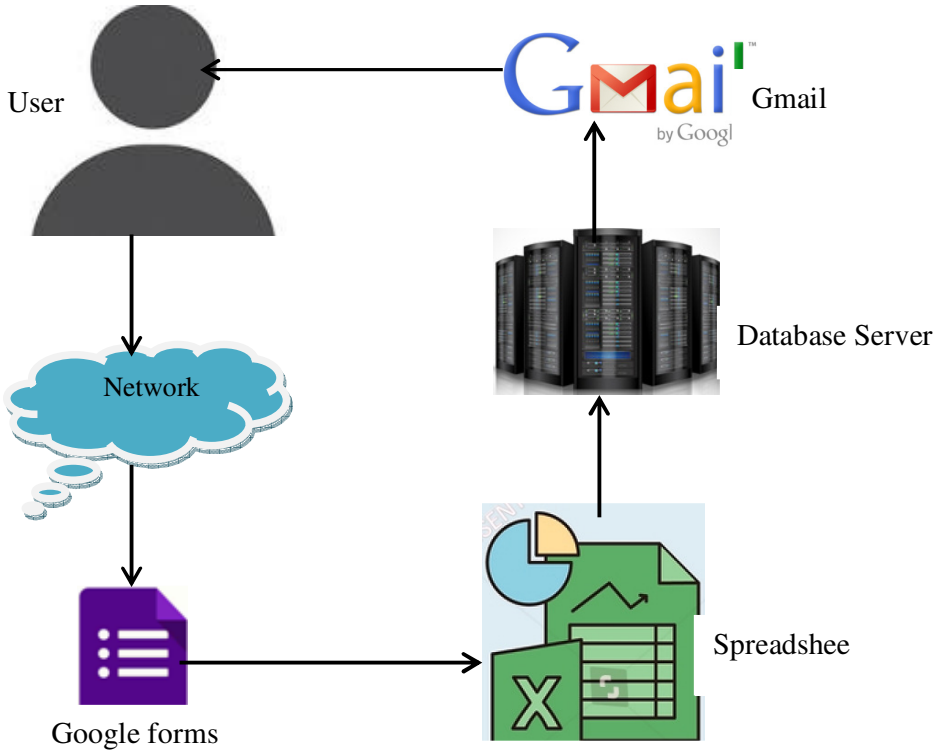

Figure.1 System Activity Life Cycle

System Architecture

The architecture of the proposed system consists of two sides namely: the presentation tier and the data tier (Figure 2).

The presentation tier (or user side) of the application provides the user interface where you can send your contact email address and responses to the Internet Addiction tests. It is basically a smart phone

owned by the person taking test. The user side or front-end requires telephony and internet services before the system can function.

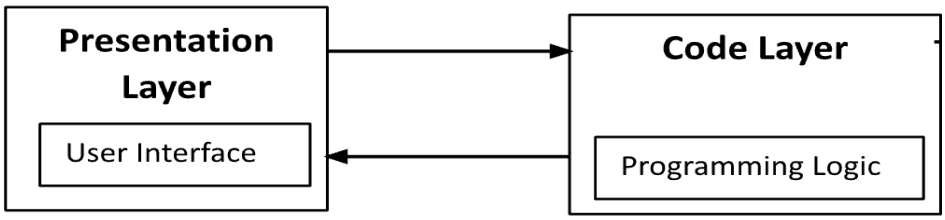

Figure 2 Architecture of the Proposed System in terms of tier

The logic layer is the data or backend tier of the application consists of the server, the database, and the code that interacts with them to send the messages to the front-end side, get user test results and store data locally. It is basically a dedicated device or an android smartphone owned by the admin/medical team.

Use Case Diagram of the system

The use case diagram of the system visualizes the admin and user privileges as shown in Figure 3 below:

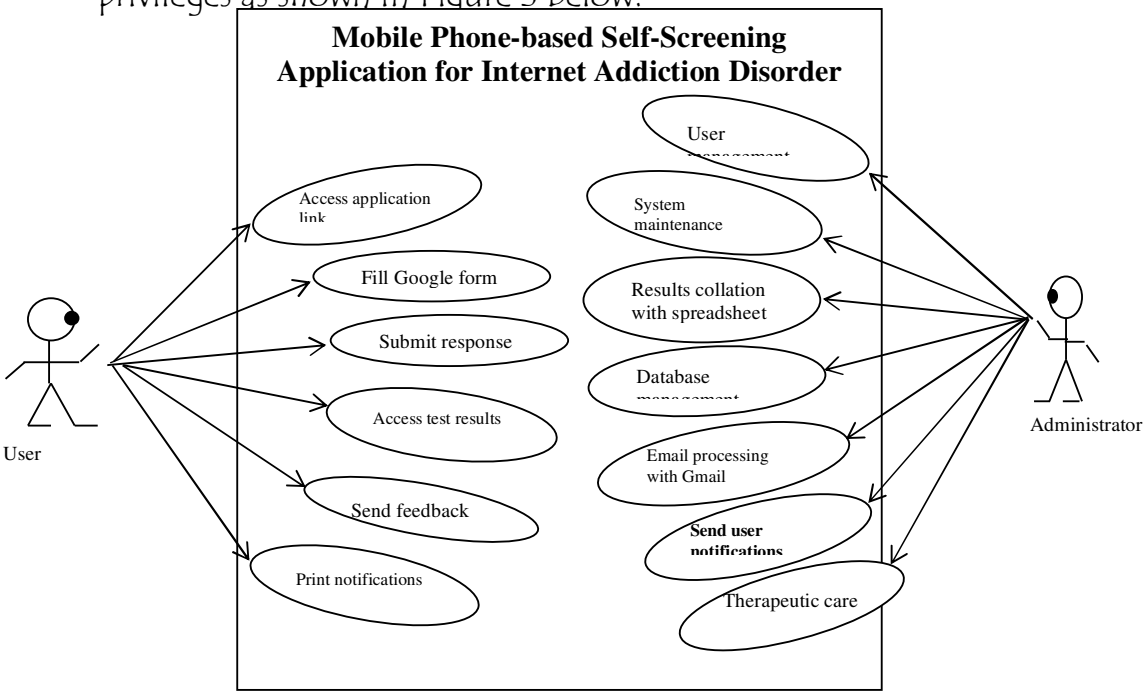

Figure 3 Use case Diagram for Web-based Self-Screening Application

Data Flow Diagram of the System

The data flow of the system starts from the backend of the system with the initialization of the system. After this, the system stays on standby awaiting input of data from the interface. The data from the user depending on the request goes to the backend of the system for processing. After processing, the result of the data goes back to the interface as shown in Figure 4.

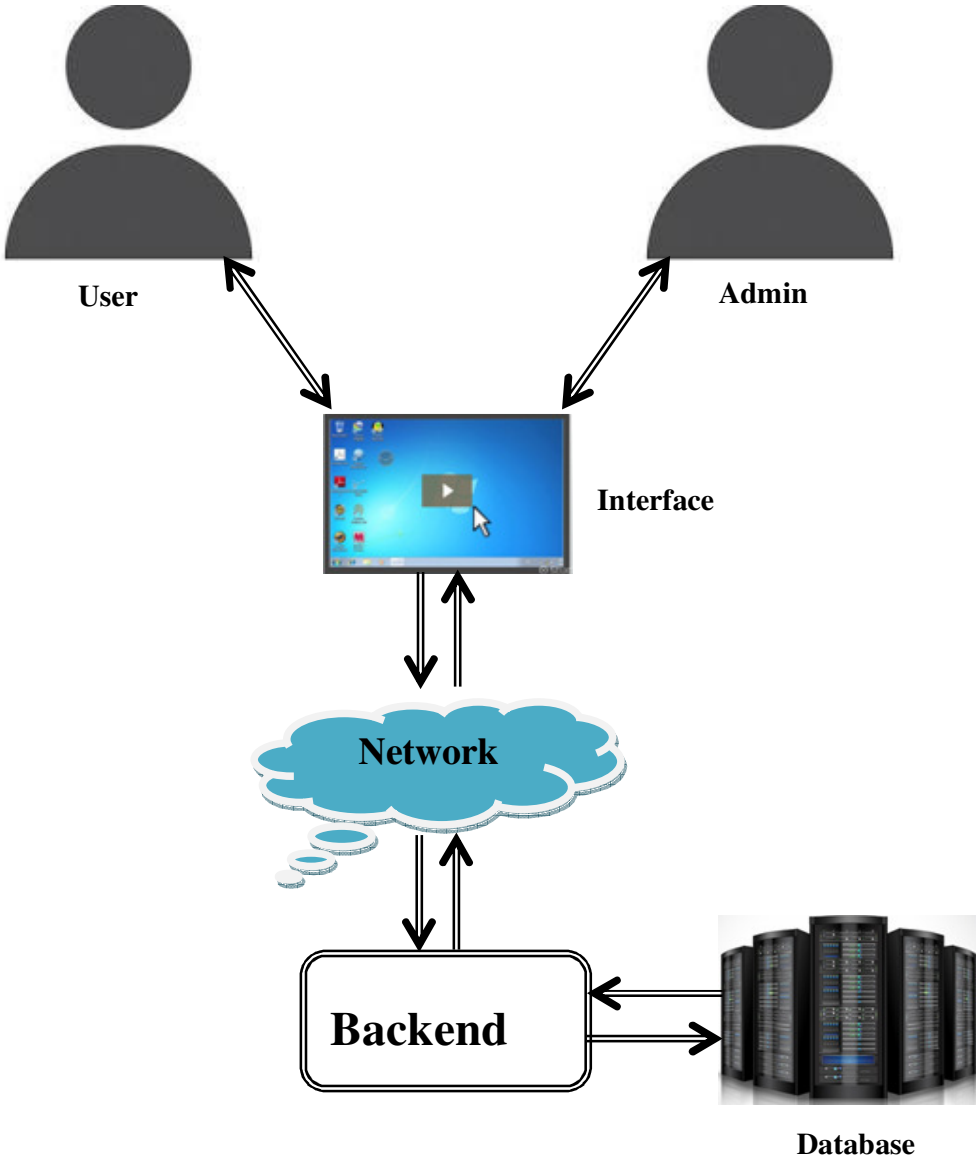

Figure 4 Data Flow Diagram of the system

The back-end is the code that runs on the server that receives requests from the clients, and contains the logic to send the appropriate data back to the client. The back-end also includes the database, which will persistently store all of the data for the application. The detailed business processes, inputs and outputs of each process, and how data moves through the system is depicted in Figure 5 below:

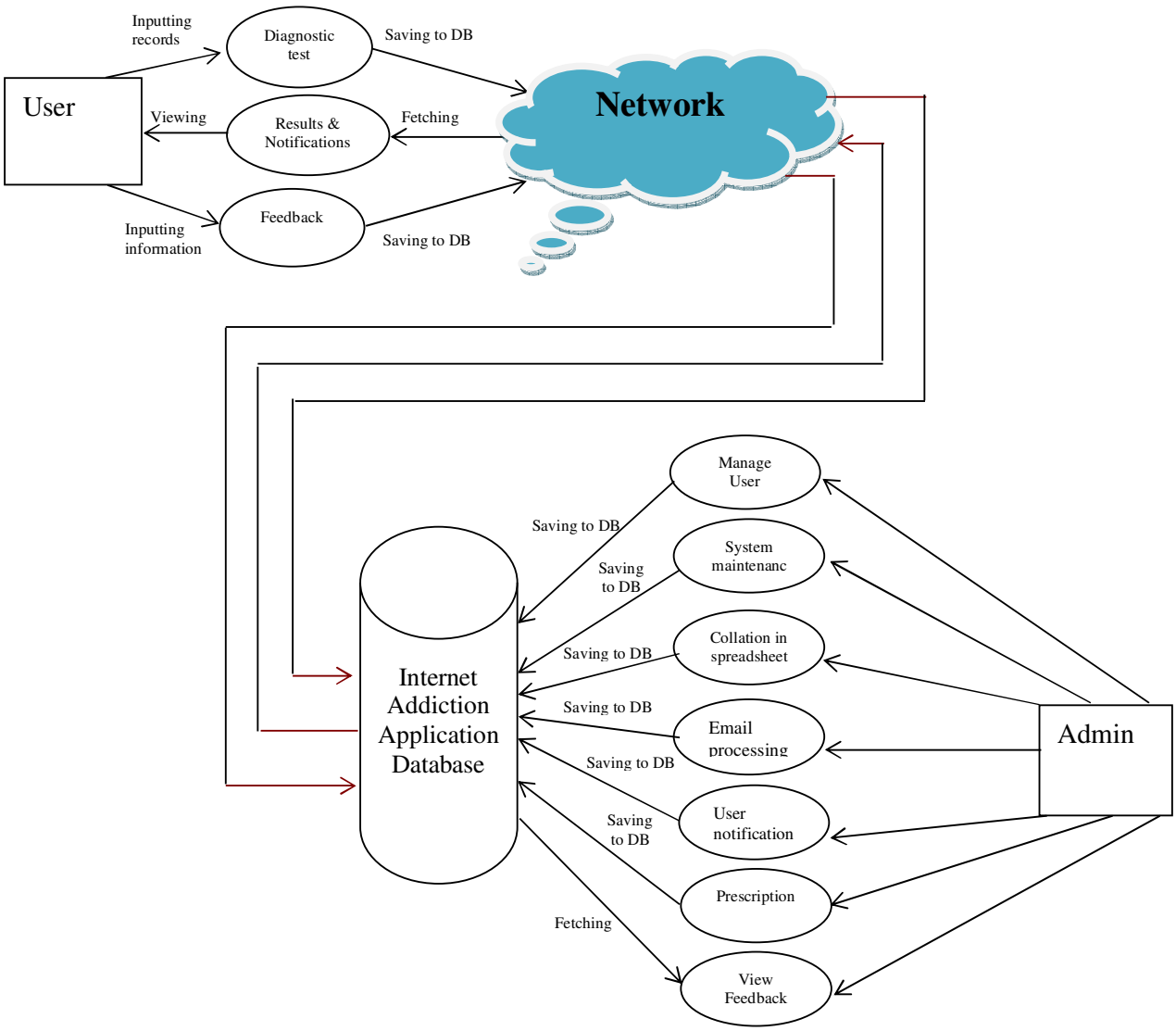

Figure 5 Data Flow Diagram of the System

Program Specification

This describes the modules and sub modules in the application and their roles in the entire system. Some of the modules in the process of Medical billing are as follows:

1. **Login module:** This is the link: https://forms.gle/eT6RZjXqHsR1xjgr6 - which the user clicks to access the Google-generated Diagnostic Questionnaire on Internet addiction after supplying his/her valid email address.
2. **Forward/Submit:** This module enables user to submit all responses to the Internet addiction test questions and store user data in database.
3. **Reply:** This provides the opportunity for the user to give a feedback when he/she requires therapeutic advice.
4. **Deliverability:** This module informs the user whether his/her feedback was sent, not sent (delivered), or archived.
5. **Print:** This enables a user to print out a report after a user's session at the computer.
6. **Delete:** This module allows the user to delete notifications and sessions with the system.
7. **Help:** This is a link to the medical team for an expert recovery therapeutic advice, or allows you to get help on specific item when clicked on.
8. **Exit:** Used to close the running app or shut down, abort, or log off the system.

Application Processing Algorithms

The algorithm for the Web-based Self-assessment Tool for Internet Addiction (IA) disorder was segmented thus:

Main Menu

1. Take Diagnostic Test Algorithm
2. System Authentication Process
3. Server Processing Algorithm
4. Data Flow process
5. Publish Screening score and results
6. Send therapy

7. Exit

Screening Algorithm

1. Click link to take test
2. Fill-in valid email address
3. Take the Google-generated IA test
4. Submit response to the network.
5. Collation and YIAT Scoring
6. Publish Test Results
7. Recommend therapy and send notifications
8. End process

Authentication module

1. Send an authentication request to the tag
   Tag completes and sends record to the server through the reader
2. Server verifies authenticity of tag? Send an authentication request to the tag
   2.1 If the tag is invalid, then
   Authentication does not pass: Abort traffic; display error messages
   Go to Step 7
3. Server updates the secret key and sends the response record to the tag via the reader.
4. Tag verifies whether the reader is legal?
   4.1 If the reader is illegal, then
   Authentication does not pass;
   Isolate the user and display error message
   Go to Step 7
5. Authentication pass: Allow user access to the network (Access to the network is granted)
6. Tag updates key value.
7. End process

Processing Algorithm

1. User sends http get and post requests to the server.
2. API layer parses request, formulate the test and send it to the http layer
3. Get the response string from the http layer, parse the string, extract necessary fields and send it to the data layer
4. Fetch data, cache, log and validate.
5. Store data dependent on the platform.
6. Send data to the UI layer
7. End process

Evaluation: YIAT Scoring and Collation Algorithm

The system scoring and collation process follows the pseudo code below:

```
// Take Test
total score = 0
for k = 1 to 20
score = 0

Select ans

Select case ans
    case A
    screenscore = score + 0
    case B
    screenscore = score + 1
    case C
    screenscore = score + 2
    case D
    screenscore = score + 3
    case E
    screenscore = score + 4
    case F
    screenscore = score + 5
    case else
```

```
    Print "Not Applicable"
end select
total score = score + screenscore
next k
print total score

// Report Addiction Level from YIAT total screening score
select total
case 0 TO 30
Print "Your Internet Addiction level is normal."
case 31 TO 49
Print "Your Internet Addiction level is mild."
case 50 TO 79
Print "Your Internet Addiction level is moderate."
case 80 TO 100
Print "Your Internet Addiction level is Severe. See a therapist!"
case else
Print "Not Applicable."
end select
```

Notification E-mail Alerts (from sender to receiver)

1. URL→ Filename translation (Send http request to the server via port 80)
2. Authentication and access checking
   Did the server receive data sent by the http client (user)?
   If No, go back to Step 1.
3. Check MIME (Multimedia Internet Mail Extension) type
4. Any fixups?
   4.1 If yes, abort traffic and go to Step 8
5. Process the data included inside the http request
6. Send response back to the client
7. Any feedback?
   7.1 Process feedback
8. Log the request
9. End process

Graphical Representation of the Proposed System

A simplified graphical representation of the overall process in this application is shown (Figure 6).

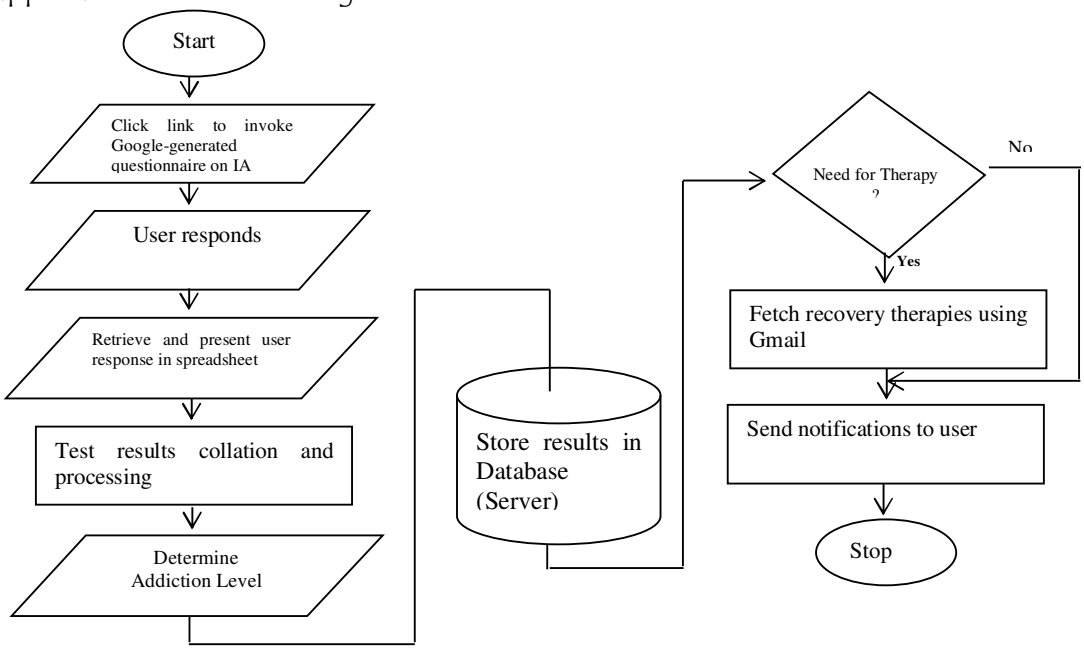

Figure 6 Graphical representation of the overall process in the application

Database Specifications

The information required to be stored in the database in order to maintain the proper management of data flow in the system is specified in Tables 2 and 3 below:

Table 2: User's Database

Field Name	Field Type	Field Size	Field Description
User# (PK)	numeric	11	User ID
Username	char	20	Username of user
Email	alphanumeric	25	E-mail address of user
PhoneNo.	numeric	15	Phone number of user
Week_day	alphabetic	10	Day of the week
Date	Date	8(dd/mm/yy)	Date of screening
Time	Time		Time of screening
Source_address	alphanumeric	40	IP Address of user
Feedback	alphanumeric	200	User's feedback

Table 3: Admin (Medical Team) Database

Field Name	Field Type	Field Size	Field Description
Admin# (PK)	numeric	11	Admin ID
Username	alphabetic	30	Username of admin
Email	alphanumeric	25	E-mail address of admin
PhoneNo.	numeric	15	Phone number of admin
Week_day	alphabetic	10	Day of the week
Date	Date	8(dd/mm/yy)	Date of screening
Time	Time	12	Time of screening
Port_address	alphabetic	40	Port Address of admin
Deliverability (Y/N)	alphabetic	15	Whether message was sent
Reply	alphanumeric	40	Reply message
Score%	numeric	8	YIAT assessment score
Cut-off	alphanumeric	10	Screening cut-off point
Test_Questions	alphanumeric	500	Screening question
Addiction_level	alphanumeric	100	Internet addiction level

Input/Output Specifications

The application was used to input user email address, click on the link: https://forms.gle/eT6RZjXqHsR1xjgr6 and fill the Young's Internet Addiction Test (YIAT) as text messages. The results were hosted online and can be viewed as text messages with any android phone as the outputs from the system.

RESULTS AND DISCUSSION

The user logs into the system by clicking the link shown in the application home page below (Figure 7) and supplies his username and email address to take the diagnostic test:

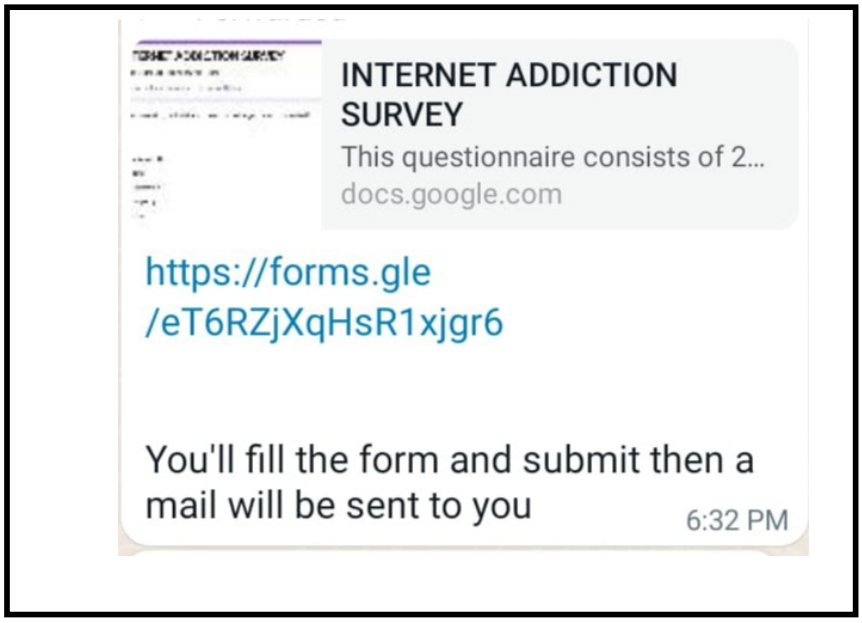

Figure 7 Application Home

The system uses the built-in Java Randomize Timer function to randomly display each of the 20 calibrated items. The user is brought into active dialogue with the computer, which provides him with situations in his social life, evaluates his responses and guides him to the next situation. Data on socio-demographic indicators, Internet usage, psychosomatic symptoms and quality of life are automatically collected as a user fills-in the self-administered questionnaire. *The 20 calibrated items are based on the six Internet Addiction constructs namely: Social quality of life, individual quality of life, usage of the Internet, academic and career achievement, time control and excitatory usage of the Internet.*

Figures 8 to 13 shows screenshots of the outputs captured when the system was executed.

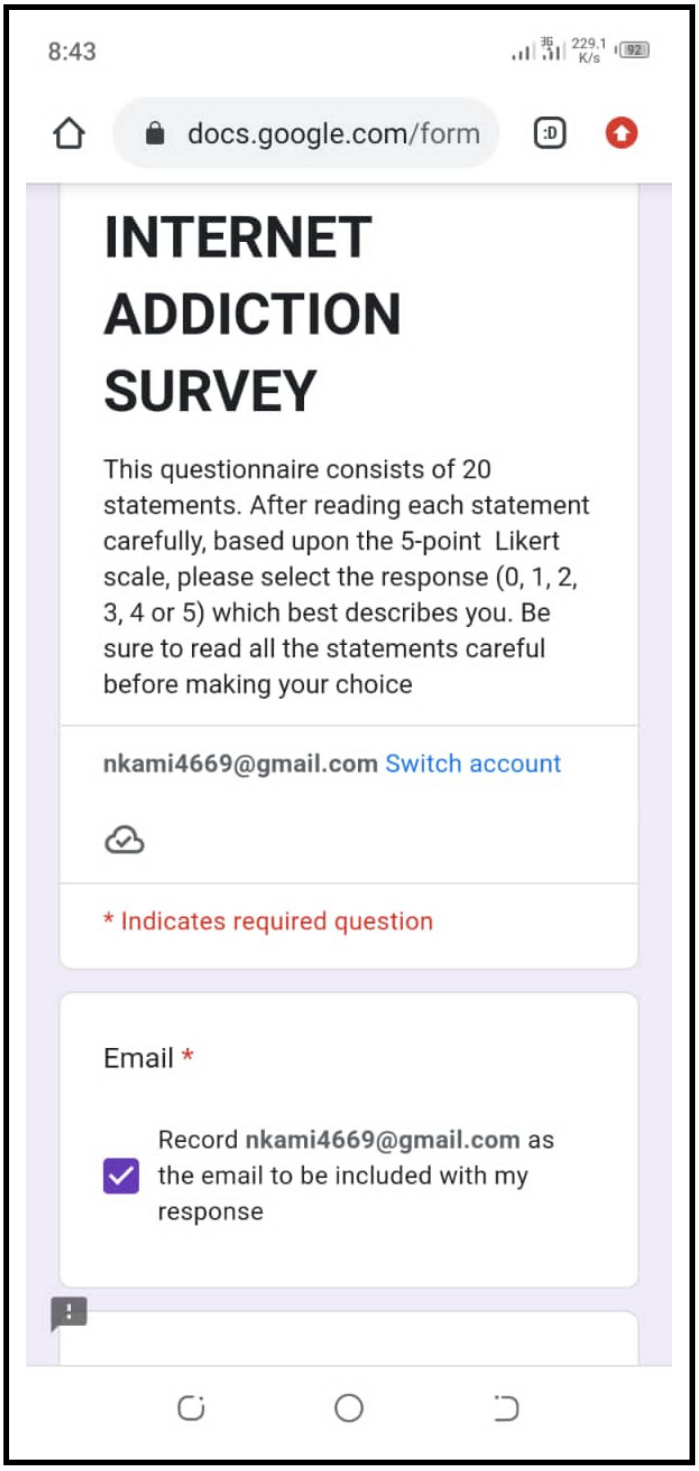

Figure 8: Supply username and email to take test

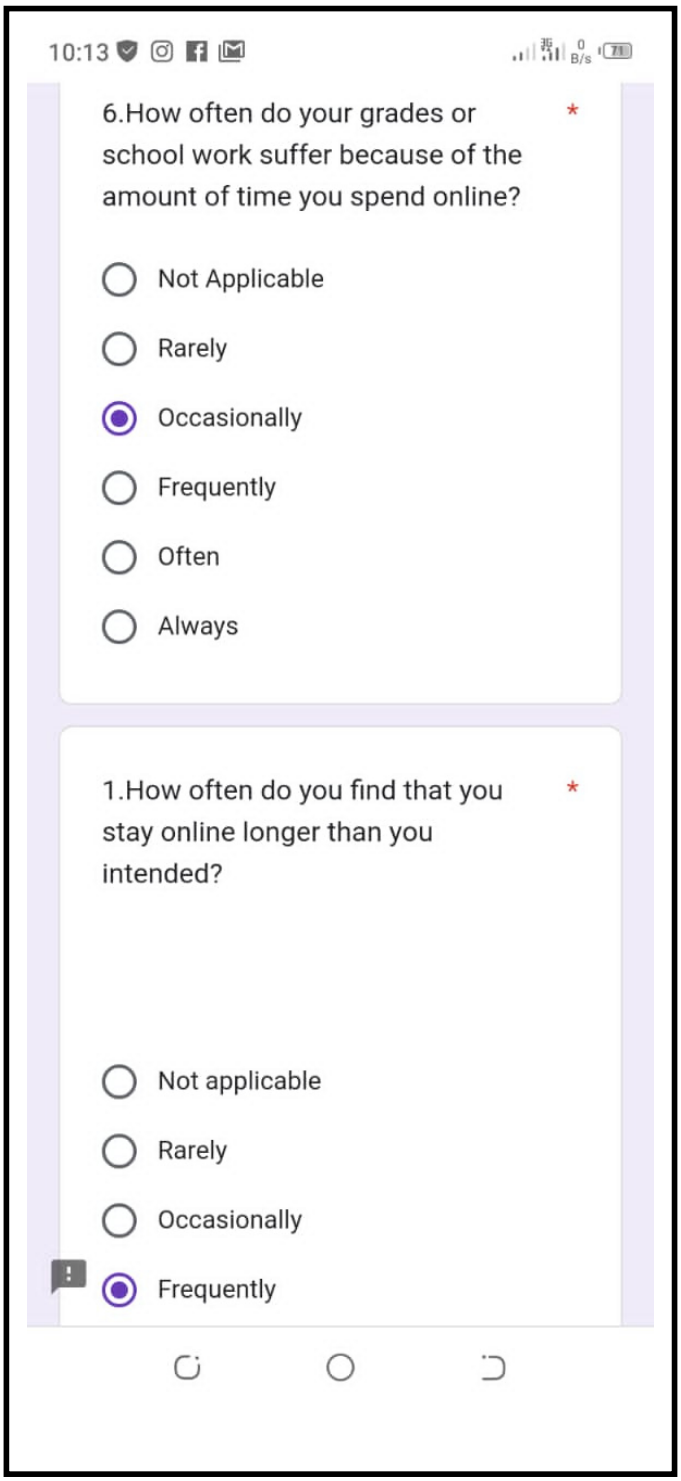

Figure 9: Test Questions 6 and 1 displayed randomly

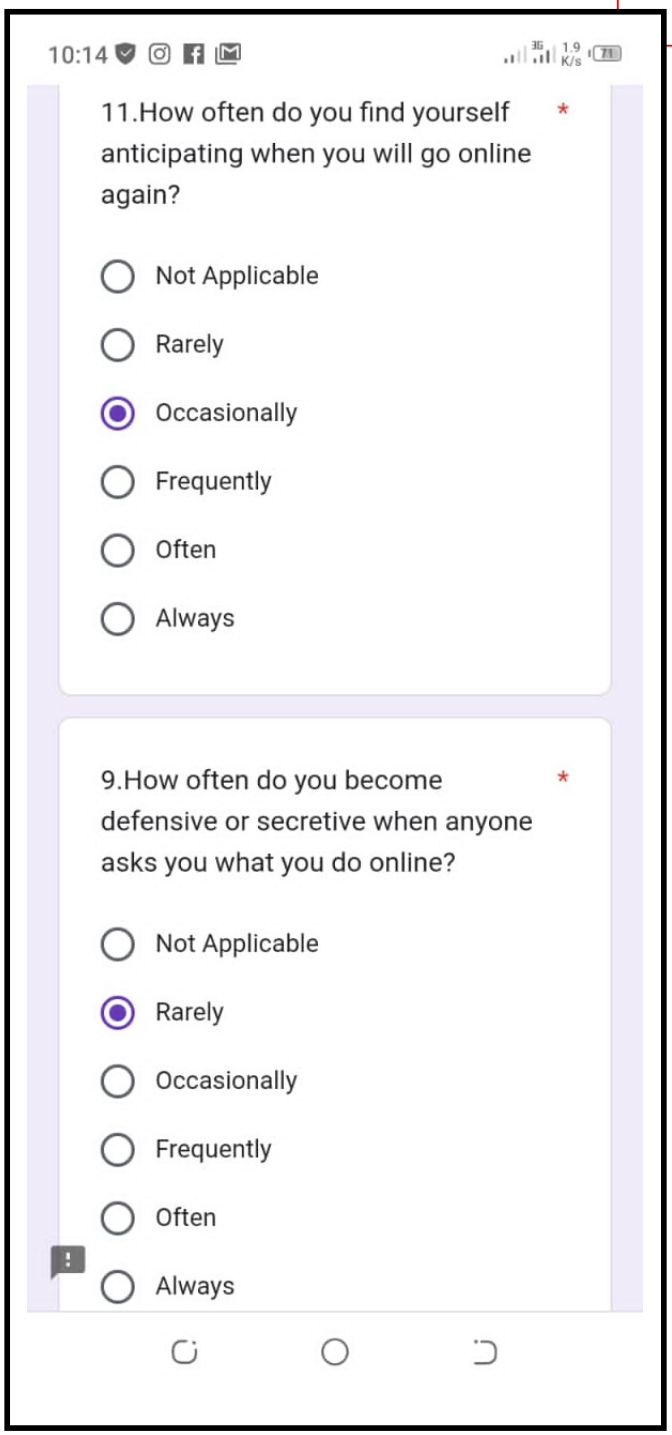

Figure 10 Test Questions 7 and 9

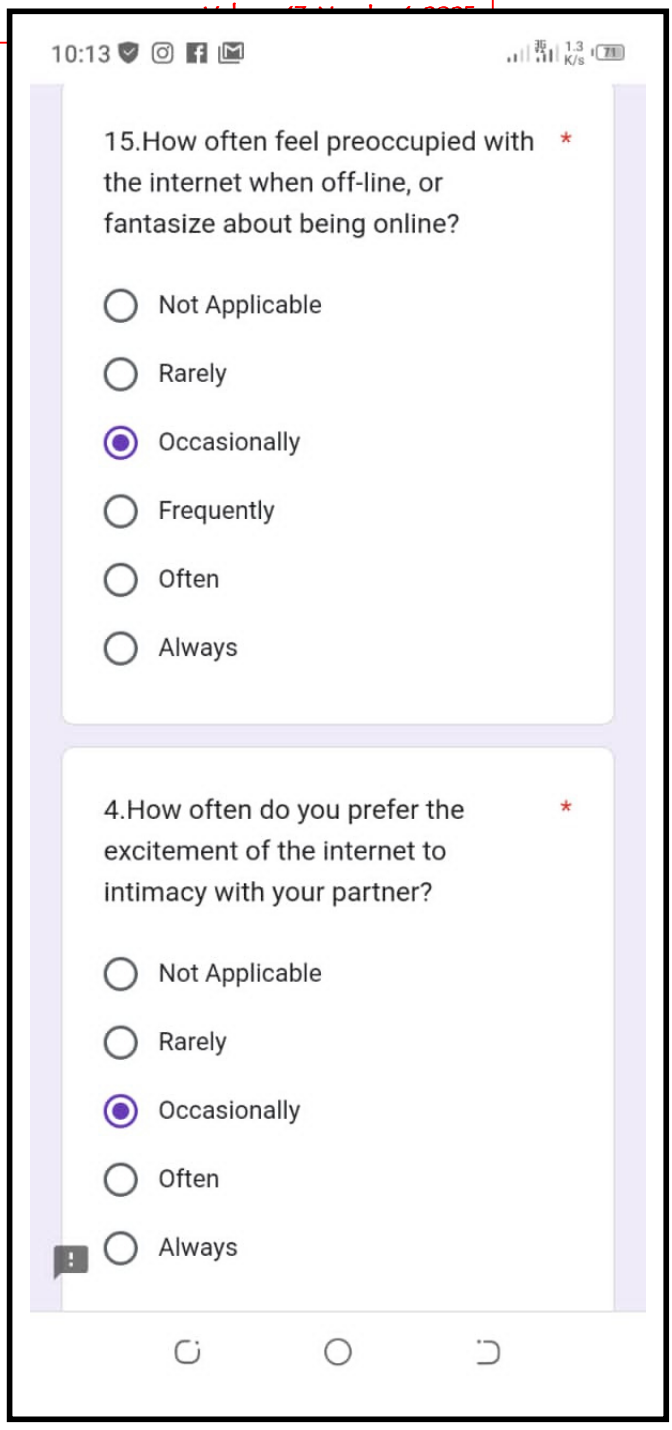

Figure 11 Test Questions 15 and 4

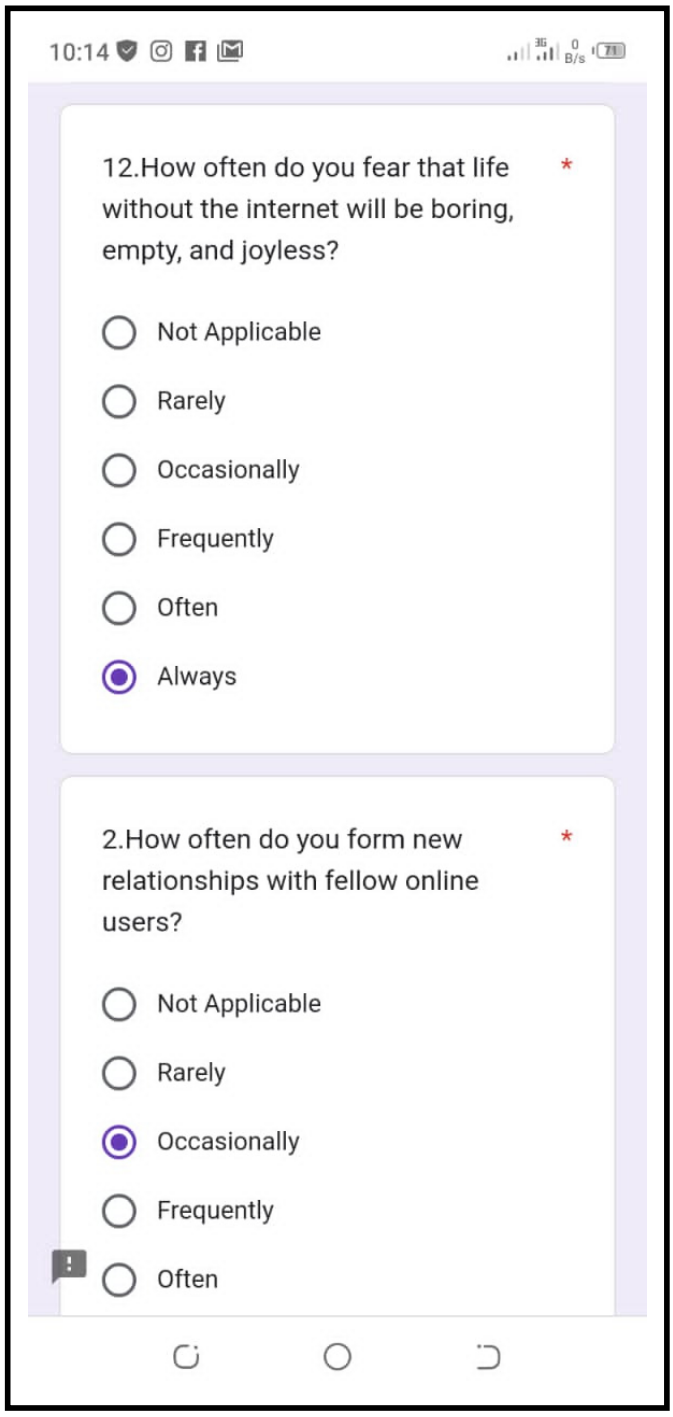

Figure 12 Questions 12 and 2

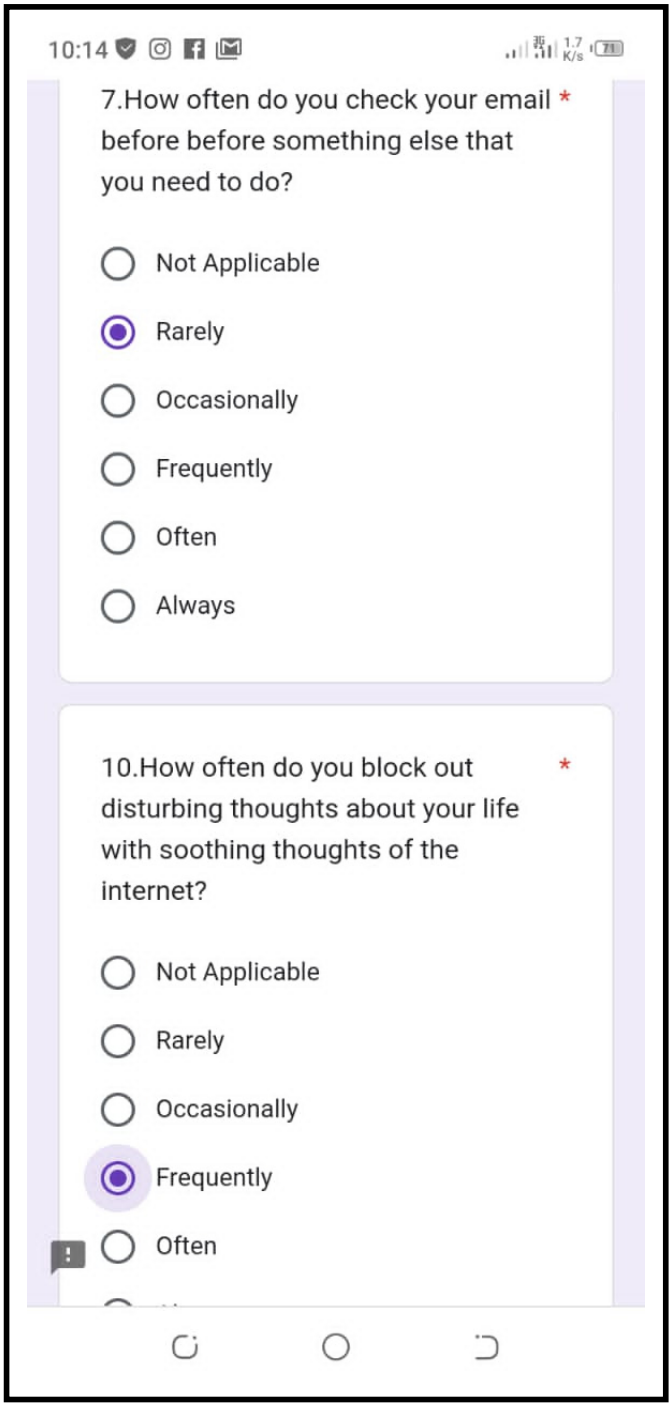

Figure 13 Questions 7 and 10

User responses are sent to the web server through a browser using the internet. After receiving the responses, the server collates and scores his responses to give the overall YIAT score. The cut-off points are applied to this total value; the addiction level is determined automatically from the YIAT total screening score. The results are later sent from the web application server to the email address of the person taking test. Curative guidelines are provided to addicted persons with severe cases to get an expert treatment advice or even consult professional therapists by email from the comfort of their homes. This can save them the time off their working day to physically see a therapist. The system incorporates a means of printing out a record of users' interaction with the computer. Sample outputs captured after the screening tests are shown in the Figures 14 to 17 below:

Figure 14 Test Result for Effanga indicating 45% (mild dependence on internet)

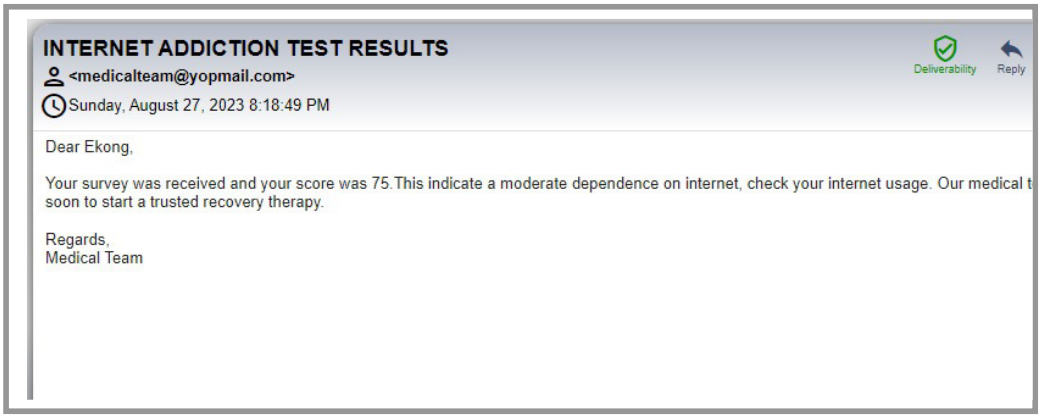

Figure 15 75% Test Result for Ekong indicating moderate dependence on

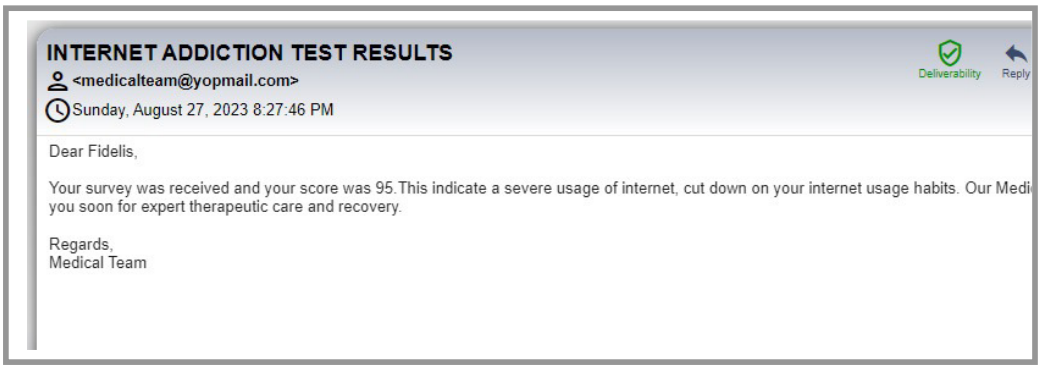

Figure 16 95% Test Result for Fidelis indicating severe usage of internet

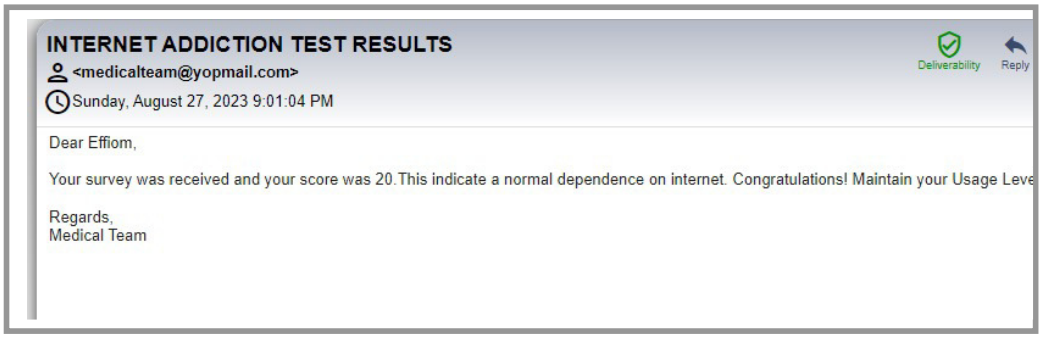

Figure 17 Test Result for Effiom indicating 20% (normal dependence on internet)

Future Research

This conversational application can be modified and extended to incorporate other assessment tools: demographic information; Internet gambling practices; history and frequency of Internet use; characteristics of Internet use; and the Strengths & Difficulties Questionnaire (SDQ) (Goodman R., 1999). The SDQ is utilized to assess the emotional and psychosocial adjustments consequent to Internet use7. The SDQ consists of 25 questions with calibrated response scores ranging from 0 to 2. The SDQ is comprised of five components (corresponding to 5 questions per component) that may each range between 0 – 10. The calibrated component scores are:

1) Emotional symptoms Scale (e.g. "I am often unhappy, down-hearted or tearful.")
Normal: 0 – 5; Borderline: 6; Abnormal: 7 – 10;
2) Conduct Problems Scale (e.g. "I get very angry and often lose my temper.")
Normal: 0 – 3; Borderline: 4; Abnormal: 5 – 10;
3) Hyperactivity Scale (e.g. "I am easily distracted, I find it difficult to concentrate.")
Normal: 0 – 5; Borderline: 6; Abnormal: 7 – 10;

4) Peer Problems Scale (e.g. "I am usually on my own. I generally play alone or keep to
myself.")
Normal: 0 – 3; Borderline: 4 - 5; Abnormal: 6 – 10;
5) Prosocial Scale (e.g. "I usually share with others (food, games, pens, etc.")
Normal: 6 – 10;Borderline: 5; Abnormal: 0 – 4; (Artemis Tsitsika et al, 2010)

With the exclusion of the Prosocial Scale, the sum (range 0 – 40) of the remaining SDQ component scores was derived in order to generate the Total Difficulties Score (Normal: 0 – 15; Borderline: 16 - 19; Abnormal: 20 – 40). Scores within the abnormal difficulties range are implicated with an increased likelihood for mental health disorders (Goodman R., 1999).

Another practical value in this finding lies in its prospect for increasing research drive in a variety of other mHealth solutions. The approaches used for designing and developing the mobile application in the current study could provide a basis for developing other mobile applications for relevant interventions and people's improved self-care. Mobile self-assessment tools, mobile quiz applications and mobile health Information Systems are typical examples of other research paths or directions (Fotis Lazarinis et al, 2017).

CONCLUSION

With the increasing capabilities of mobile devices, the use of mobile applications (apps) to develop self-screening and mobile learning aids anytime, anywhere is becoming more and more relevant by the day. This will obviously gain more relevance due to COVID-19 (Naciri et al, 2020). In this research work, a mobile web-based screening and recovery application for Internet Addiction Disorder was implemented. It enables users to fill the Yong Diagnostic Questionnaire for Internet Addiction on the computer, get diagnosed for addiction symptoms, and subsequently alerted of their status. The symptoms checked by this application are the degree of preoccupation, compulsive use, behavioural problems, emotional changes, and diminished functionality associated with Internet use and misuse. The study has the potency to incorporate other assessment tools and also open up new breakthroughs and research advances in the development of other mHealth solutions, mobile quiz (learning) applications, etc in the technology-driven society of today.

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