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An Enhanced BRAZ (E-BRAZ) Android App for Monitoring PMS in Gas Stations

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Abstract—The usefulness of mobile devices has increased greatly in recent years allowing users to perform more tasks in a mobile context. This increase in usefulness has come at the expense of the usability of these devices in many areas of application. However, there are little or no user apps targeted towards improving users' experience in accessing information about Premium Motor Spirit (PMS). Generally, consumers of petroleum products have been experiencing a huge challenge in accessing information about the availability of the product, most especially, during intense scarcity. Access to this information has proved to be vital due to instability in the availability of petroleum products and volatility of its prices which is being experienced throughout Nigeria. These problems have caused consumers a hard time in managing and organizing their resources (time, motor able space and money). To solve this problem, we proposed in our previous work BRAZ, named after the authors, an application which can assist petroleum users to get real-time information about the happenings at gas stations. Our previous work was limited to Minna province of Niger State, Nigeria. Thus, in this paper, an improved version is presented herewith. Extension to the previous work include an increase in coverage area to include the 36 states in Nigeria, integration of USSD option for users without internet access, integration of Google map to guide visitors, who are not familiar with the environment, to the closest gas station. An advance BRAZ app is also proposed to provide real-time information, which is independent of petrol station admin, to users.

Keywords—petrol station; Android mobile app; GPS; mobile app gateway; SMS; USSD

I. INTRODUCTION

BRAZ, a mobile application for monitoring gas stations in Nigeria was first introduced in our previous work and limited to Minna town of Niger State, Nigeria [1]. Users of BRAZ app have some limitations which are listed as follows:

- Users of BRAZ app must have internet connectivity to access real-time information.
- BRAZ app usage is limited to Minna: the app has a low data base that is restricted to Minna environs. Hence, users that do not reside in Minna cannot make use of the app.
- Users of BRAZ app must be well acquainted with Minna town: users have to input their city and area to get information. Users who are not familiar with the

town will find it difficult to drive to the nearest gas station of their choice.

To solve the aforementioned problem, an improved version has been introduced. Therefore, the app can now be used from anywhere in Nigeria and irrespective of whether the user has internet access or not. Users can easily access the application on their android device and get information such as the nearest gas station, the product selling price and level of queue at the station. In the absence of internet access, users of E-BRAZ can still access real-time information with the provision of an SMS query and response system. The rest of this paper is organized as follows: Section II presents a brief review of some related works, while section III presents the system design. Implementation of the proposed system is discussed in Section IV, while obtained results are presented in section V. Conclusion and suggestions for further research is presented in Section VI.

II. RELATED WORKS

Going back to the history of mobile applications, [2] it can be clearly seen that all that came under the category of mobile applications were just a few Java games, monthly calendar or calculator. In 1993 the first smart phone by IBM was announced for general purpose usage with features like calculator, world clock, digital calendar and contact book. On the 3rd day of April 1973, [2] the first mobile phone call was made by Martin Cooper of Motorola to Dr. Joel S. Engel of Bell Labs. That device or instrument weighed 1.1 kg and measuring (23 x 13 x 4.45) cm. Subsequently, it took two decades of Research and development (R&D) to get the first mobile application for smart phones, and the credit goes to IBM Simon, who introduced to the world the first mobile apps for smart phones. According to a report, "There were 19 billion software developers across the world in the year 2014, and the number would grow to 25 billion by 2020" [3].

Nowadays, India, Russia and China are experiencing fast growth in the number of mobile app. Acceleration in the growth of mobile technology have enabled the development of a large scope of applications that can be used by people that are mobile. Sometimes, people who develop apps do not look at the fact that users on the move will want to interact with such devices. There are five characteristics of usability as seen by [4]. The International Organization for Standardization (ISO) had its own view on usability which is seen as "the level or rate that specified users can make use of a product to

achieve desired goals with efficiency, effectiveness and satisfaction in a defined context of use” [5]. A number of issues that have been introduced by the advent of mobile devices was discussed by [6]. An augmented reality application was developed in [7]. This application enables users to find additional information about the work of art by simply just taking a photograph of an exhibit at an art gallery. In this fast growing world of mobile app, tourists have also benefitted from this advance especially as discussed in [8]. The use of maps is an old method of getting to a destination; thanks to the advent and integration of GPS sensor to mobile phone. This GPS has enabled researchers to find new ways of assisting users in getting to their destination. The use of tactile feedback to help guide users have been proposed by a number of systems [9],[10]. The system informs users, through the use of different vibration techniques, which direction to turn. The use of sound can also be used in place of vibration. A system, which is capable of guiding users to their destination was developed by [11]. A very important limitation of the proposed device is the small screen size found on mobile applications. This implies that only a small fraction of a document can be seen in detail. To address this issue, [12] have developed a Zoom able User Interface with Overview (ZUIO). With this improvement, users can zoom into small sections of a document, such as a map, while showing an overview of the entire document so that users can see where the overall documents are. This type of interface proposed by the authors for use in car systems is called audio interfaces [13]. The effectiveness of using audio interface can be limited by low quality of voice recognition technology. The performance of users of such systems can be improved with the use of multiple push-to-talk buttons [14]. There are other types of interaction models which include touch screens [15], pressure based input [16], spatial awareness [17] and gestures [18]. A number of researchers are also looking at alternative output modes as well as using these new input modalities such as sound [19] and tactile feedback [20]. Without the use of paper tickets, a system was designed by [21] to assist travelers to and fro an airport by train. A credit card is used instead of ticket for a journey to or from the airport. In [22], a study which made use of archival research to check the correlation between expert evaluations of quality of mobile phones, user experience and subsequent usage analysis was conducted. In [23], the authors used archival research to check the correlation between goal difficulty and performance. In [24], an object recognition system using Android app was proposed, while in [25], a city bus tracking and automatic ticketing system was proposed. In [26], a real-time respiration rate monitoring system using android app was proposed for rural Indian conditions. Similarly, in [27], an Indian Sign Language converting system using an android app was proposed. Thus, there is rapid expansion in the availability and range of mobile application being deployed on a daily basis. The increase in processing power available on these devices has allowed developers to increase the amount of services provided. Owing to these developments, an App, unlike Google Map is hereby proposed in this paper to provide PMS user with information about closest gas stations.

III. SYSTEM DESIGN

Figure 1 shows the data flow diagram of the E-BRAZ system, it primarily shows the flow of information in the system. The system consists of the User, Admin and Gateway App.

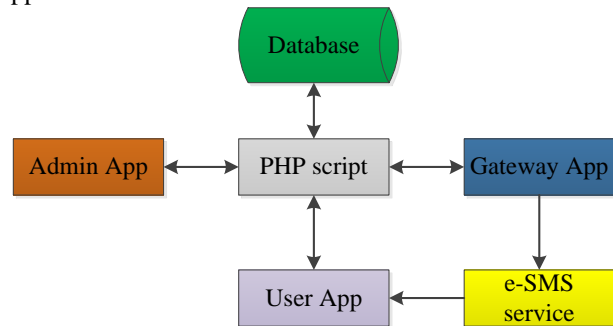


Figure 1. Block diagram of the Mobile App

The design stage of the system involves studying how the system needs will be met. This starts by using one of the enquiry tools in software project design which is the flowchart as seen in Figure 2.

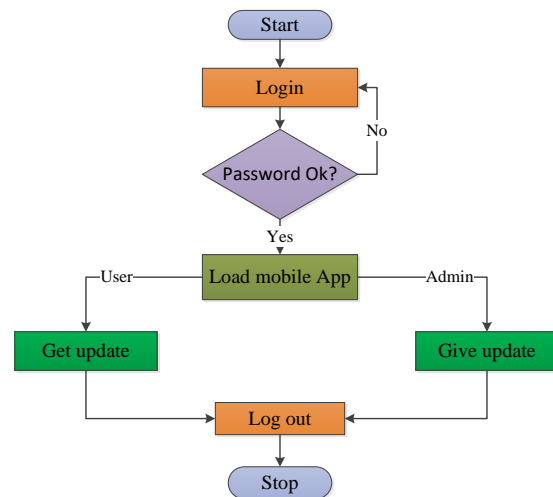


Figure 2. System flow chart

IV. SYSTEM IMPLEMENTATION

There are four (4) parts in which E-BRAZ Mobile Application consists of, they are:

- Web Scripts
- Gateway App
- Android App
- Data base

The development of the android app was achieved using the Eclipse IDE. It used Java Programming Language for the performance of its task and Extensible Mark-up Language (XML) for the Graphics User Interface (GUI) design. The web scripts used was Hypertext Pre-processor (PHP) and the database used was My Structured Query Language (MySQL). The Android App consists of three applications: Back-End

which is the administrator application, the Front- End which is the user application and the Gateway application.

A. E-BRAZ Admin App

In the Admin App, the Mobile App Administrator (MAA) gives access to various petrol station administrators (PSA) by administering username and password to them, the MAA can also add user to station, add petrol station, edit petrol station, remove petrol station, view stations, update gateway phone number, add city, add area and manage the activities carried out by the various petrol station administrators. The activities carried out by the PSA are; add petrol station, edit petrol station and also remove petrol station, give information about the fuel stations (such as the name of the petrol station, the location of the station by longitude and latitude, the price of petrol, and their status). The petrol station administrator (PSA) can edit and manage the information added hence there is privacy and security.

B. E-BRAZ User App

For the first time log-in, the user will register with a valid electronic-mail address and password, after which access is granted to the user to get update about each petrol station. The user is entitled to choose between the two search methods. The user can either search with location or search with GPS. When searching with location is selected, there are two connection modes which are: GPRS and SMS. The user fills in details such as state, city and area. Once the user has internet connectivity, he/she can search using GPRS, the user gets information like the petrol station name, location, price of fuel (petrol, kerosene and gas) and also its availability. Once the user does not have data, he/she can search using SMS and get updates like the petrol station name, location, price of fuel (petrol, kerosene and gas) and also its availability via SMS which has a service charge. The user is entitled to give comments about the information gotten from the mobile application and can also get direction to the location through Google map.

When searching with GPS is selected, there are two connection modes which are: GPRS and SMS. The user fills in details such as maximum gas station distance from the user, available options include 100m, 1km, 10km, 25km, and 50km. Once the user has internet connectivity, he/she can search using GPRS, the user gets updates which include the petrol station name, location, price of fuel (petrol, kerosene and gas) and also its availability. In the absence of internet connectivity, he/she can search using SMS and get updates like the petrol station name, location, price of fuel (petrol, kerosene and gas) and also its availability via SMS which has a service charge. The user is entitled to give comments about the information gotten from the mobile application and can also get direction to the location using Google map. Google Maps provides route planners under the 'Get Directions' button, there are about four modes of transportation available depending on the area: driving, public transit, walking, and bicycling. Just as other Google web applications, Google Maps uses Java Script extensively, when a user click on view Google map on BRAZ App, the user is linked to the Google map app available on the Android phone, where the location

of the user will be indicated by a blue navigation symbol on the map and indicates the direction from the location of the user to the location of the petrol station.

C. BRAZ Gateway App

An improvement to our previous version of BRAZ [1] is the introduction of USSD code option for users without smart phone or internet connectivity. The development of USSD code needs a USSD gateway which must be given by the service provider. The developer also need to apply for a WASP license with the local Telecommunication Regulator in order to get a USSD short code allocated to the application and to be able to deploy its services. The aforementioned procedure is required to activate the USSD code. In addition to this, an alternative means was also evaluated, which involves the use of E-bulk SMS service through the BRAZ gateway. E-Bulk SMS programs use short codes to send high volumes of text messages in a very short period. The user logs into the app which uses real time connection hence making the app accessible even without data once the user did not log out after his/ her initial login. The user clicks on SMS mode and the user gets the desired result. The BRAZ Gateway App is kept running continuously because that is the gateway for the SMS service as well.

V. RESULTS AND DISCUSSION

The results from the mobile Application are represented with pictures of each web page from the Mobile App and the results from the e-bulk SMS service are also represented with pictures. The results shown are from the user app, the admin app and the gateway app. It tells the step-by-step process of each of the app.

A. BRAZ User App

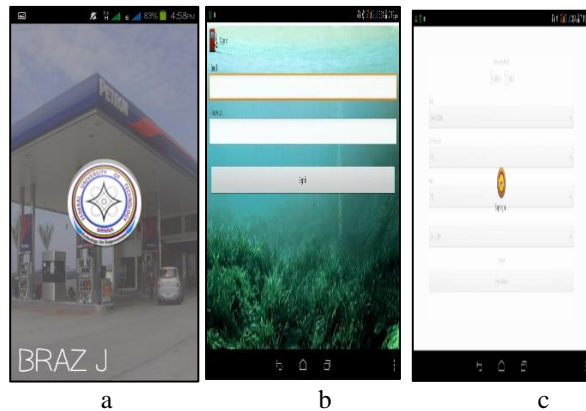


Figure 3. Login page (a & b), Response page (c)

Once the user clicks the sign in button, the credentials entered are sent online to a PHP script on a server. The PHP script confirm the user's credential by checking the username and password on the server MySQL database. If successful, a message is sent to the phone via the PHP script to grant access to the user, otherwise, it displays the wrong user name or password error as shown in Figure 4.

The results for user searching with location when GPRS connection mode is enabled are shown in Figures 4 and 5 respectively.

The results for user searching with location when SMS connection mode is enabled is shown in Figure 7.

The results for user searching with GPS when GPRS connection mode is enabled are shown in Figures 8 and 9 respectively.

The results for user searching with GPS when SMS connection mode is enabled and the stages are shown in Figure 10.

B. E-BRAZ Admin App

The Mobile App Admin can gain access into the app as an Admin with a password. The MAA will be directed to an interface to update station data, update gateway phone number, view stations, add city, add area, assign user to station, add, edit and also remove petrol Station as shown in Figure 11.

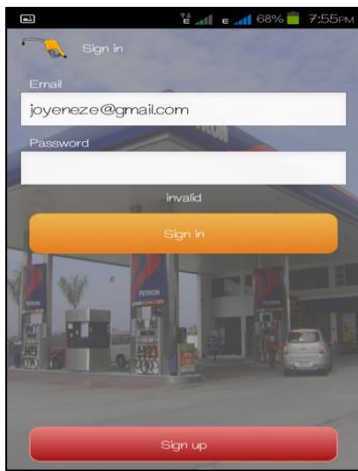


Figure 4. Snapshot showing response after a wrong password was entered



Figure 6. (a) GPRS connection mode enabled, (b) result for GPRS connection

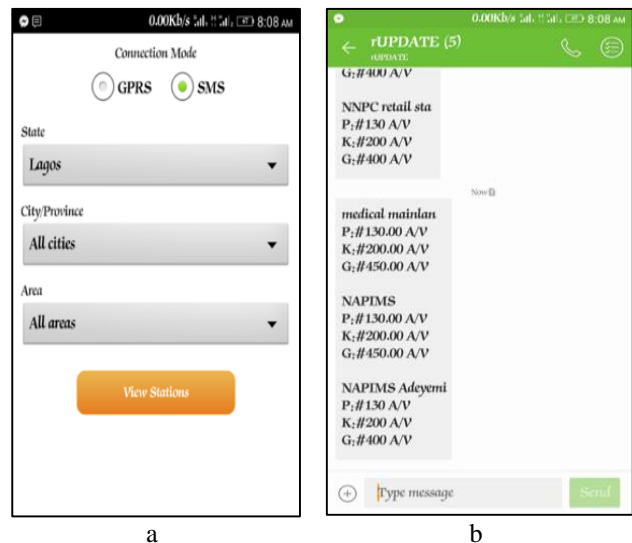


Figure 7. (a) SMS connection mode enabled, (b) result for SMS connection mode

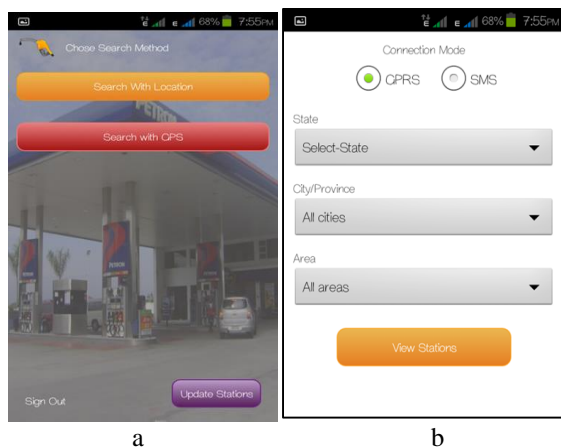


Figure 5. (a) Interface showing the various Search method, (b), searching with location homepage

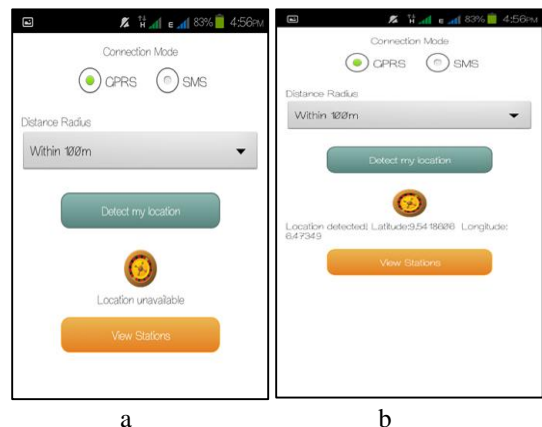


Figure 8. (a) Searching with GPS homepage, (b) GPRS connection mode enabled

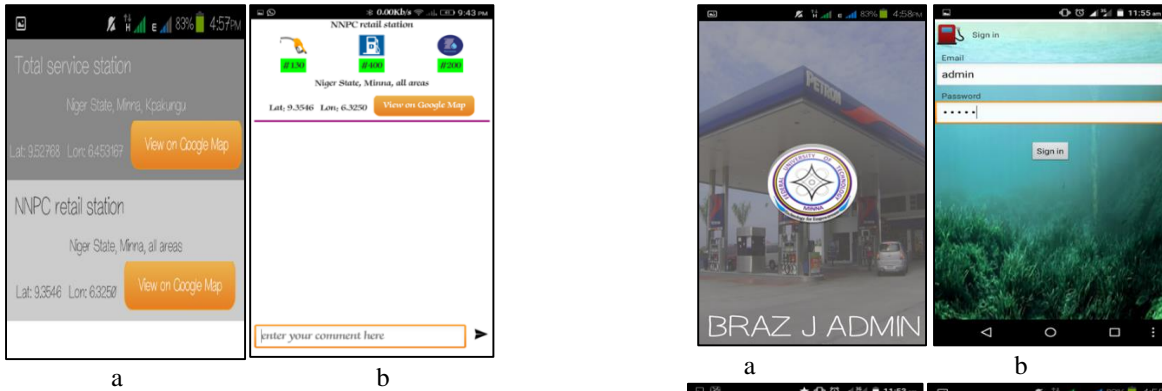


Figure 9. (a) Result when searching with GPRS connection mode, (b) final result for GPRS connection mode



Figure 10. (a) SMS connection mode enabled (b) result for SMS connection mode

The update gateway selection is where the admin can assign a gateway phone number for the selected stations, all the petrol station information can also be seen as well. For the add city button, it helps to add cities of choice, any city within Nigeria can be added. 'Add area' button is where a particular area can be added, the assign user to station selection is where the Mobile App Admin can register the Petrol Station Admin with the station name as the username and a password will be assigned. The password is needed to sign-in into the account. For the add petrol station selection, the Mobile App Admin can add, edit, and remove petrol station as shown in Figures 12 and 13 respectively.

The Petrol Station Attendant can log-in to app with the username and password registered by the Mobile App Admin. When Petrol Station Attendant login they can carry out some duties which are to add their petrol stations with the required information as shown in Figure 14, Petrol Station Attendant can also edit their information and remove their petrol station as shown in Figure 15.

C. E-BRAZ Gateway

The user without internet access can send query information (search command) to the gateway device, the gateway then uses internet to get the required information from the online database and sends it back via SMS to the querying user. The result is shown in Figure 16.

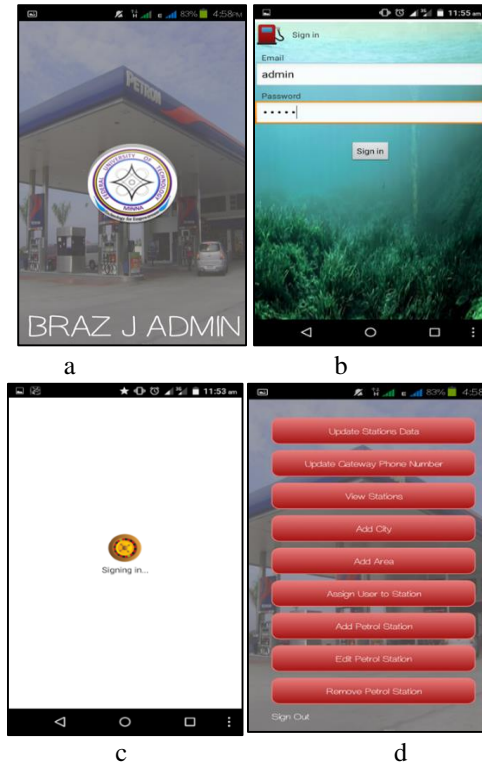


Figure 11. Access granted to the MAA (a, b, c, and d)

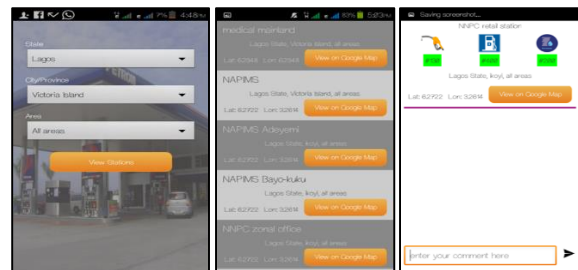


Figure 12. Three points of interconnection for viewing Station on E-BRAZ Admin

VI. AN ADVANCED BRAZ APP

In spite of the new features introduced in the BRAZ app for monitoring gas stations, the BRAZ app still depends on the petrol station admin to update their stations information. Thus, information might not be provided in real-time, or information could be bias. Consequently, an approach for providing the app users with real-time information which is independent of the petrol station admin is proposed. The proposed approach uses digital image processing approach to process image captured from the station arena, processes it and update the database in real-time. The block diagram of this advanced version of BRAZ app is as shown in Figure 17.

The IP camera is positioned to capture incoming and outgoing cars. This information is used to determine the rate of traffic at the gas station. Once determined, the BRAZ database is updated automatically without human intervention.

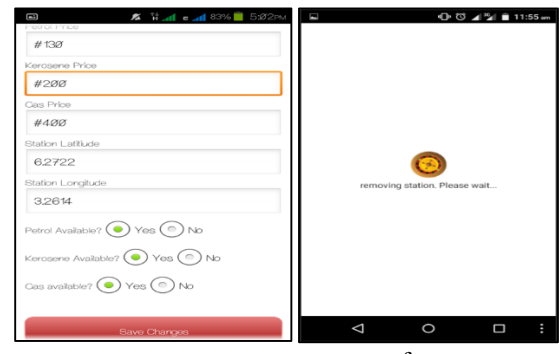
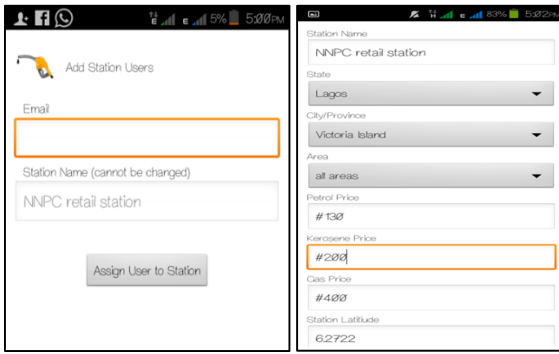
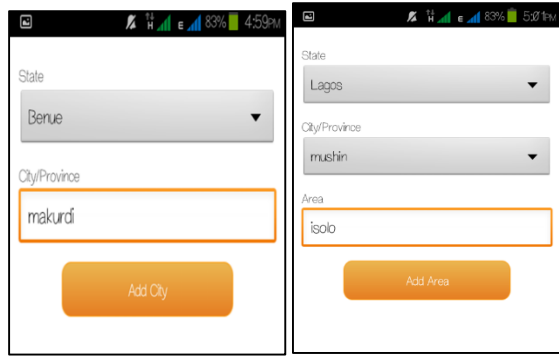


Figure 13. (a) page to add city, (b) page to add area (c) page to assign user to station, (d) page to add petrol station, (e) page to edit petrol station, (f) page showing petrol station being removed.

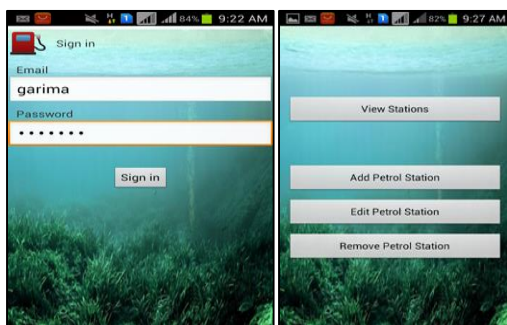


Figure 14. Page showing sign-in and Petrol Station Admin interconnection

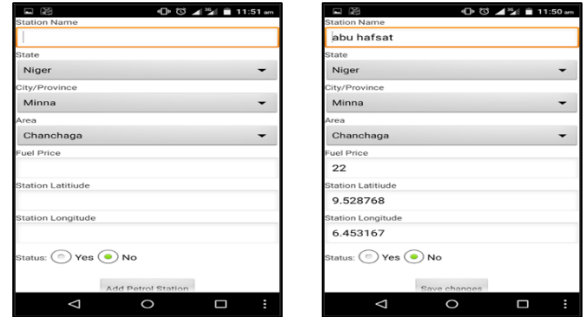


Figure 15. Page showing the Adding and Editing of Petrol Station by the Petrol Station Attendant

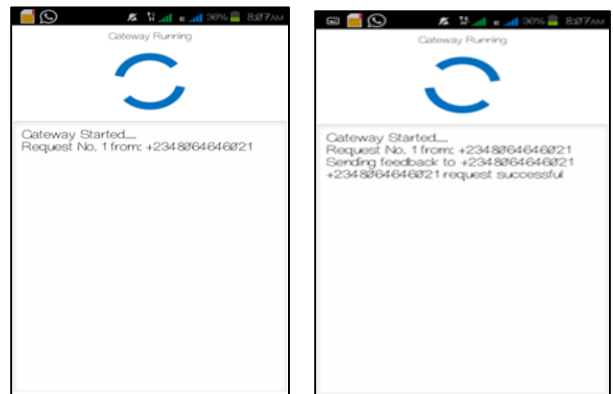


Figure 16. Web page showing gateway running, request received and feedback sent to user.

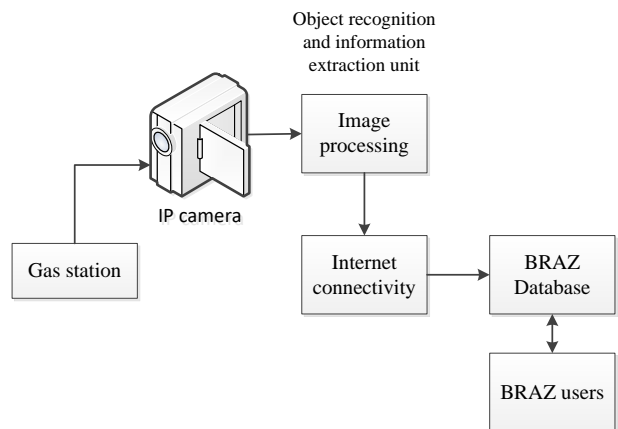


Figure 17. Real-time information providing unit using IP camera and digital image processing

VII. CONCLUSION AND RECOMMENDATION

In conclusion, the mobile app BRAZ has been enhanced. It has an increased database to cover the 36 states in Nigeria, it can be accessible even without internet service via SMS and can be query based on the coverage distance of interest. Visitors who are not use to the town can be guided to their gas station of choice via Google map. The BRAZ app is unlike the traditional Google map app as it can tell the user the availability

of the product as well as traffic level at the station. Our future work include integration of the real-time information provider system to the BRAZ database, developing an iPhone operating system (IOS) and windows version of the mobile app BRAZ.

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