

Digitalize Power System in Telecommunication Network Environment - (A case study of Telecom companies in Ghana)

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Abstract

Power system is a grid of electrical apparatuses used to supply and transmit power [1].

Telecommunication is the use of telephone to send traffic from a source to destination through transmission media.

A happy customer is a returning customer. When customers are not satisfied with the network services they pay for or do not get value for their money, they will not want to patronize such services. In this research, we will design and develop a web-based software call digitalize power system in telecommunication network environment. In this research, our approach to the research will be qualitative and interview as a research instrument will be adopted in collecting data. A prototype model will be applied in developing the system. The system will periodically send Short Message Service (SMS) notification on power status at cell sites, minimize the transportation fare to cell sites and boost revenues from such cell sites.

Keywords

Digitalize, Cell Sites, Base Station, Power System, Network, Telecom.

I. Introduction

The power system provides sources of power to the telecom cell sites and without it there will be no network services. The primary power system is network that comprises devices which generate, distribute and transmit power [2]. Cell site also refer to as base station is part of access network that provide services for subscribers. The mobile station or mobile phone interfaces with the base station to provide such services. The base station has transceiver which transmit and receive traffic and signal.

A. Problem Statement

Lack of automated system to provide daily power status at cell sites is a major problem in telecom industries. Cell sites go out of service when there is no unit at the primary source of power meters installed at cell sites or when fuel on the generator sets get exhausted. If this happen, customers find it difficult to access network services and this also affect revenues.

B. Objectives of the study

1. To periodically send Short Message Service (SMS) notification on power status at cell sites
2. To reduce transportation cost to cell sites
3. To boost revenues from cell sites.

C. Importance of the Research

The system will help to prevent network equipment from going out of service due to power failure, improve customers satisfaction because cell sites will always be in service and boost revenues from such cell sites.

D. Scope of Study

The research focuses on power system in telecommunication industry. Cell sites management, stakeholders management, project management and spares management are outside the scope of the web based digitalize power system.

II. Literature Review

For telecom subscribers to have regular access to network services, there must be constant supply of power to the equipment and without the power supply, services are affected [3].

Telecommunication enhances economic growth in any country. Decision making processes are very slow when information that is required to make decision is not available when needed.

Telecommunication industry should adopt innovations and reposition of its organization for transformation using ICT [4].

In Ghana, the power system is provided and managed by the government through Electricity Company of Ghana (ECG), GRIDCo and Northern Electricity Distribution Company of Ghana (NEDCo) which is a subsidiary of Volta Rivers Authority (VRA). NEDCo current operations covers over 64% of geographical area of Ghana include the Northern parts of Volta, Ashanti and Western Regions [5]. GRIDCo performs the transmission of electricity from wholesale suppliers (generating companies) to bulk customers, which include the Electricity Company of Ghana (ECG), Northern Electricity Distribution Company (NEDCo) and the Mines [6]. ECG performs distribution of power in parts of Accra, Volta, Eastern, Central, Western and Ashanti regions. Telecom base stations or cell sites are powered by the government provided power system which is the primary source of power and the secondary source is generator which is provided by telecom network providers. IP55 system does a switchover between the primary power source and the secondary power source whenever any of the power source fails but there is no automated system that sends periodic credit balance of the primary source of power and quantities of fuel in generator tank of the secondary power source to mobile phone as SMS.

Subscribers cannot access network services if there is problem in the network due to power outage at cell sites. In this study, a web-based system call digitalizes power system in telecom network environment will be designed and develop to bridge this gap.

III. Methodology

Our approach to the research will be qualitative and interview will be adopted in collecting data because the research instrument provides comprehensive awareness into issues [7].

A. Prototype Model

The system will be developed using the Revolutionary Prototype Model.

A prototype model is a test version of final product. The development life cycle phases are repeated until the final product is developed. The model allows interaction with the users. Below fig. below displays the various types of phases of the model.

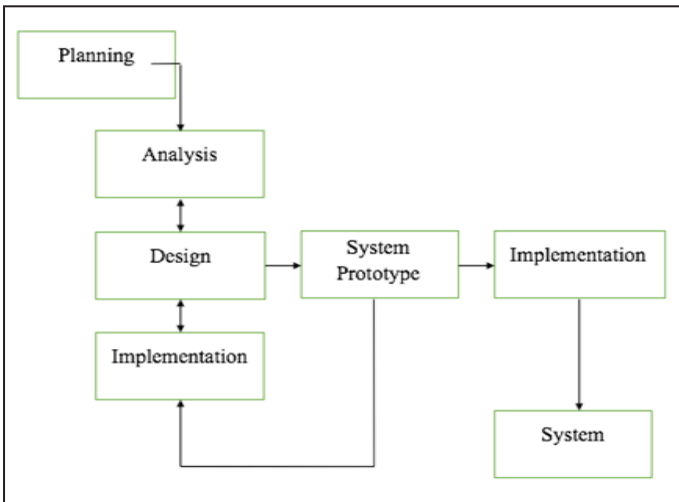


Fig. 1: Prototype Model Diagram

B. Advantages of Prototyping

1. It allows the software developer to interface with the user of the application on regular basis.
2. Time and cost of development is minimized because problems are easily detected at early stage.
3. There is quick feedback from the users.

C. Use Case Diagram

A use case diagram is used to illustrate the interaction or relationship between the system and users. The following depicts their use case diagram:

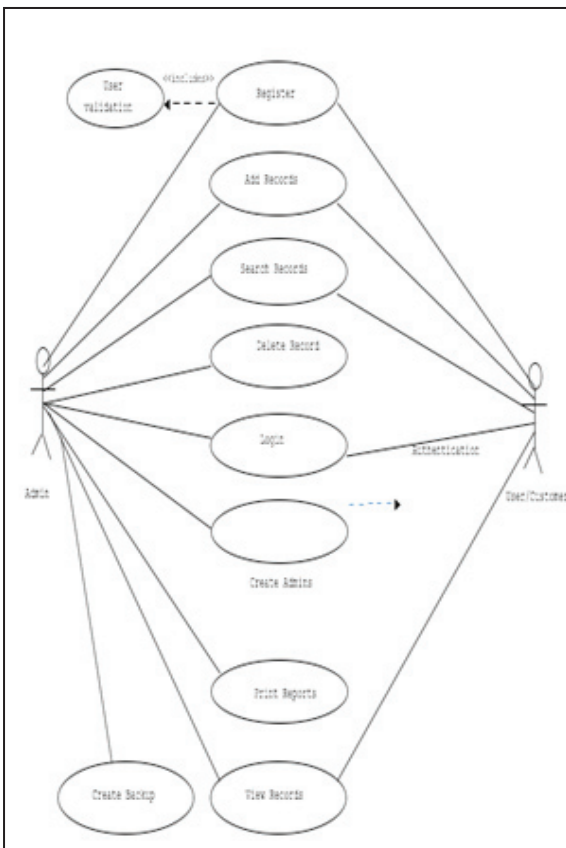


Fig. 2: Use Case Diagram

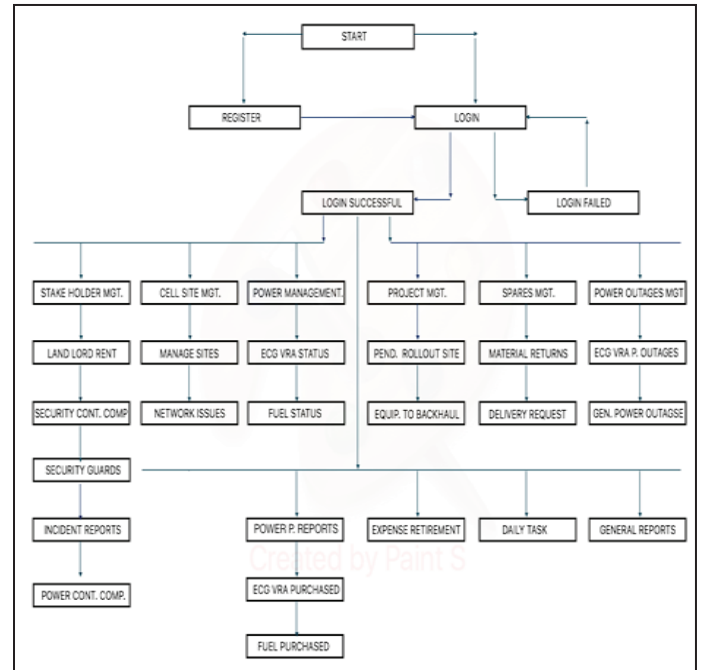


Fig. 3: Flowchart Diagram illustrates the logical flow and pictorial representation of the system.

D. Programming Development Tools

The following programming tools were used in the development of the system: PHP, HTML, MySQL, WAMP, Javascript and Sublime text Editor.

```

    128 <script src="ladda-bootstrap-master/js/ladda.jquery.js"></script>
    129 <script src="ladda-bootstrap-master/dist/spin.js"></script>
    130 <script src="ladda-bootstrap-master/dist/ladda.min.js"></script>
    131 <!--script src="ladda-bootstrap-master/dist/prism.js"></script-->
    132
    133 <script src="iziToast/dist/js/iziToast.js"></script>
    134 <script src="alertconfirm/src/webToasts.js"></script>
    135 <!--script src="js/main.js"></script-->
    136
    137 <script type="text/javascript" src="box/iz.js"></script>
    138 <script>
    139     $(function(){
    140
    141     $(".login").click(function(){
    142     var l = Ladda.create( document.querySelector( '.ladda-button' ) );
    143     const username = $(".username").val();
    144     if(username == ""){
    145     iziToast.info({
    146     title: 'Alert!!',
    147     message: 'Please enter the verification code',
    148     position: 'topCenter'
    149     });
    150     //swal("Info Message", "\n\n", "info");
    151     return;
    152     }else{
    153     // }
    154     }
    
```

Fig. 4: Fuel Database Table Showing the Structure of the Database of the System

#	Name	Type	Attributes	Null	Default	Comments	Extra	Action
1	id	int(11)		No				AUTO_INCREMENT
2	name	varchar(255)	utf8_unicode_ci	No				
3	type	varchar(255)	utf8_unicode_ci	No				
4	site_type	varchar(255)	utf8_unicode_ci	No				
5	region	varchar(255)	utf8_unicode_ci	No				
6	site_location	text	utf8_unicode_ci	No				
7	emp	varchar(255)	utf8_unicode_ci	No				
8	last_visit_date	varchar(255)	utf8_unicode_ci	No				
9	gen	varchar(255)	utf8_unicode_ci	No				
10	gen_capacity	varchar(255)	utf8_unicode_ci	No				
11	city_units	varchar(255)	utf8_unicode_ci	No				
12	consumedPerhour	int(11)		No				
13	fuel_bis	varchar(255)	utf8_unicode_ci	No				
14	fuel_gwh	double		No				
15	fuel_available	int(11)		No				
16	end_date	varchar(255)	utf8_unicode_ci	No				
17	status	varchar(255)	utf8_unicode_ci	No				
18	remain_days	int(11)		No				
19	user_id	varchar(255)	utf8_unicode_ci	No				
20	mobile	varchar(15)	utf8_unicode_ci	No				

Fig. 5: ECG/VRA Database Table Showing the Structure of the Database of the System

Table 1: Admin Table

Attributes	Data Type	Description
Admin_id (PK)	Int (10)	identifies an admin (not null, unique)
username	Varchar (50)	username (null)
Email	Varchar (50)	Admin's email address(null)
Password	Varchar (20)	admin password (null)

IV. Results

A. Source codes of the system

Figs. 6 and 7 represent some of the source codes of the system

```

195 <div class="sliders main" style="width:100%;border:solid 1px #eee;e;padding:15px;height:auto;overflow-y:scroll">
196
197 <table id="ml" class="table table-bordered table-hovered table-striped" width="100%">
198
199 <thead>
200 <tr>
201 <th data-field="state" data-checkbox="true">#NO</th>
202 <th data-field="id">SITE ID</th>
203 <th data-field="id">SITE TYPE</th>
204 <th data-field="id">SITE TYPE</th>
205 <th data-field="id">SITE TYPE</th>
206 <th data-field="id">SITE TYPE</th>
207 <th data-field="id">SITE TYPE</th>
208 <th data-field="id">SITE TYPE</th>
209 <th data-field="id">SITE TYPE</th>
210 <th data-field="id">SITE TYPE</th>
211 <th data-field="id">SITE TYPE</th>
212 <th data-field="id">SITE TYPE</th>
213 <th data-field="id">SITE TYPE</th>
214 <th data-field="id">SITE TYPE</th>
215 <th data-field="id">SITE TYPE</th>
216 <th data-field="id">SITE TYPE</th>
217 </thead>
218
219 </table>

```

Fig. 6: Source Codes

```

79 <!-- Sidebar -->
80 <div class="border-right" id="sidebar-wrapper" style="background-color:#e9ecef">
81 <div class="sidebar-heading" style="color:white;font-weight:bold;position: absolute; top: 0; left: 0; width: 100%; padding: 5px 0 0 0;">
82 <div class="list-group list-group-flush">
83
84 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
85 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
86 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
87 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
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91 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
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95 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
96 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
97 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
98 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
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103 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">
104 <a href="#" id="dashboards" class="list-group-item list-group-item-action btn-info" style="background-color:#f5f5dc">

```

Fig. 7: Source Codes

B. System testing

Table 2: shows tests performed and results

TEST	CONDITION	ACTION	RESULTS
Test Case 1	Some form fields are left empty eg. Siteid	Add site command Was issued on a button click	Form input added successfully. Fields can be null
Test Case 2	Enter verification code to authenticate	Verify command was issued on a button click	System responded with verification successful
Test Case 3	Form input are filled with data	Cancel command was issued on a button click	Cancel command revoked successfully.
Test Case 4	Receive SMS from ECG/VRA and fuel unit	New ECG/VRA status was added	SMS was successfully sent to the admin successfully
Test Case 5	Staff name and Staff ID valid	Add Staff button initiated	Error: please all fields are required

C. Systems Interfaces

The figs. 7, 8, 9, 10, 11, 12 and 13 represent different interfaces of the system

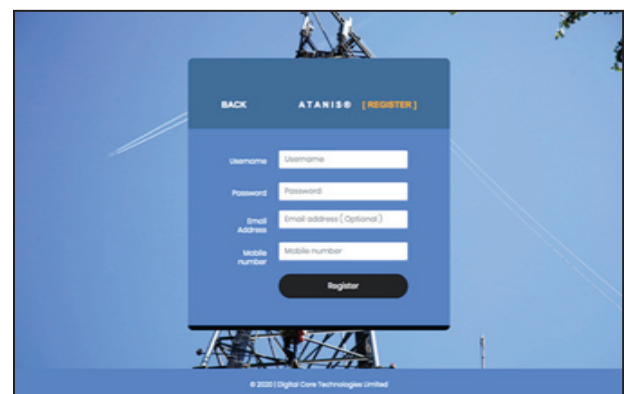


Fig. 7: Registration Page Where System Users Can Create Login Credentials



Fig. 8: Login Page Where Users Enter Login Credentials to Gain Access to System



Fig. 9: Home Page Where Users can Navigate to other Interfaces of the System.

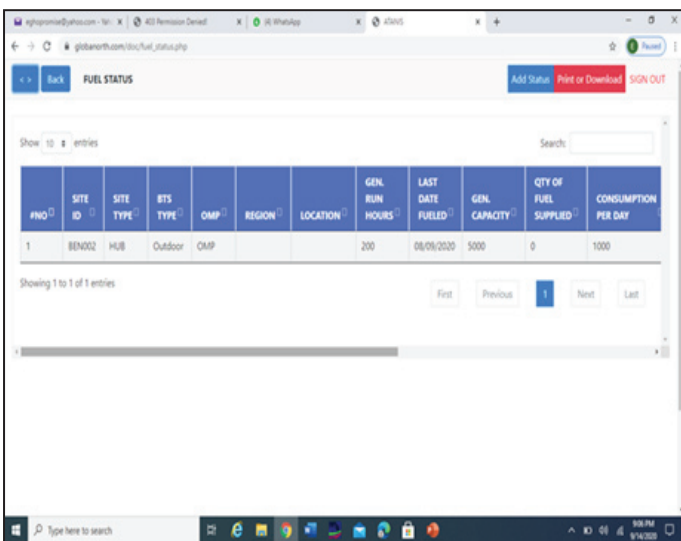


Fig. 10: Fuel power status. It shows the cell site ID, site type, BTS type, contractor name, region, location, generator run hours, last date fueled, generator capacity, quantity of fuel supplied to the site, consumption per day, consumption per hour, end date of the fuel, remaining days of the fuel, fuel available, status and user ID.

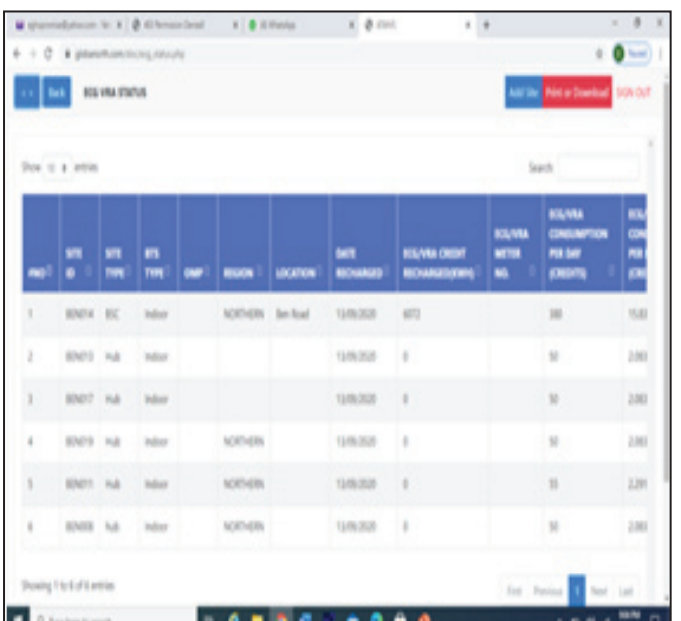


Fig. 11: ECG/VRA status. It displays site ID, site type, BTS type,

contractor name, region, location, date of recharge the meter with units, credit amount recharge, meter number, consumption per day, consumption per hour, end date of the units, remaining days, credit balance and status

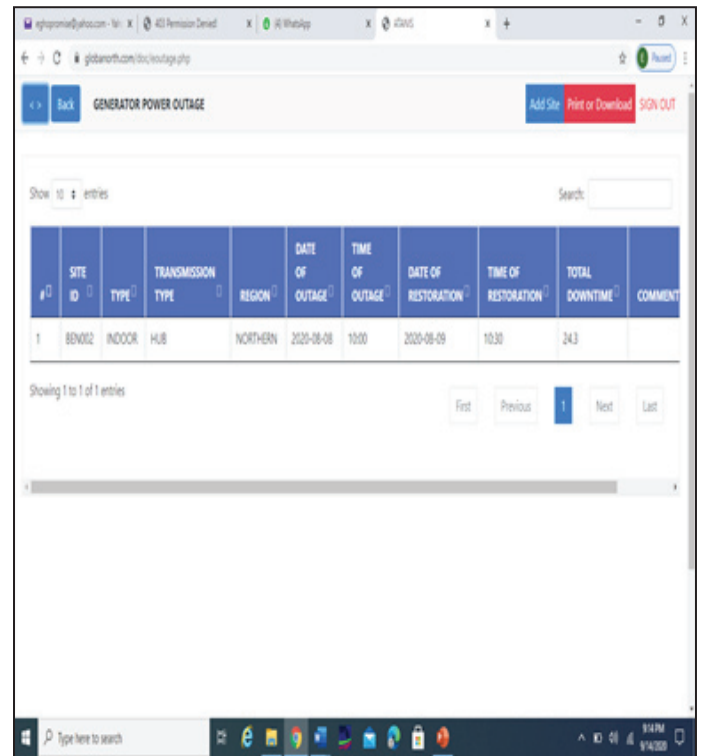


Fig. 12: Generator Power Outage

The figure 12 above show the site ID, site type, transmission type, region, date of outage, time of outage, date of restoration, time of restoration, total downtime in hours and comments.

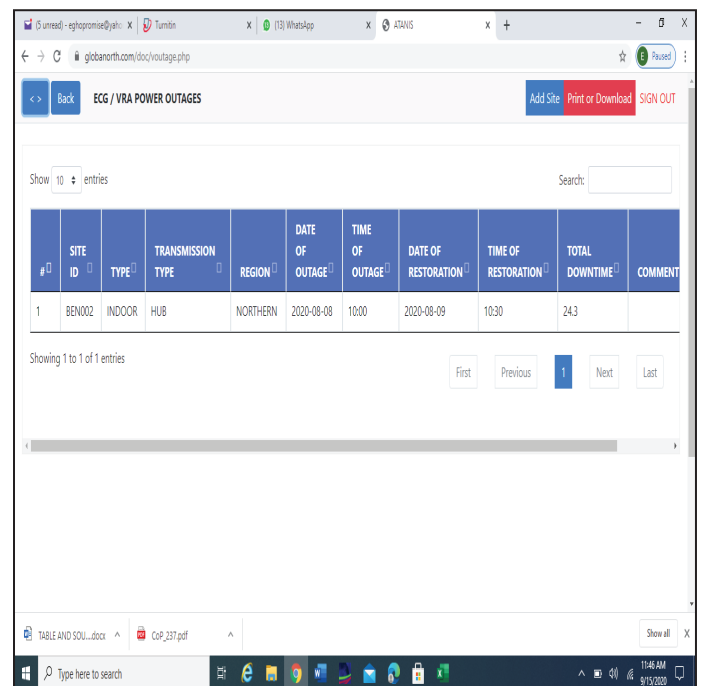


Fig. 13: ECG/VRA Power Outage

The fig. 13 above shows the site ID, site type, transmission type, region, date of outage, time of outage, date of restoration, time of restoration, total downtime in hours and comments.

V. Conclusion and Recommendation

A. Conclusion

We have successfully designed and developed a web-based system call digitalize power system in telecom network environment that periodically send Short Message Service (SMS) notification on power status at cell sites, minimizes cost of transportation fare to base station thereby boosting revenues from such base stations. The system also provides information about power outages at the cell sites.

B. Recommendation

We recommend that the system should be deployed in telecommunication companies because of its numerous benefits mentioned above.

Perpetua pursue for perfection is the mother of innovation and creativity. Based on this statement of fact, we suggest further research work to be done in digitalizing base stations management, stakeholder management, project management and spares management in telecom environment so as to improve telecom subscribers satisfaction.

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