

Mobile Field Service Engineer Application

Akash Budholia¹, Rishit Mehta^{2*}, Murtaza Godhrawala³ and Zaheed Shaikh⁴

^{1, 2*, 3, 4}Department of Computer Engineering, K J Somaiya College of Engineering, Mumbai

www.ijcseonline.org

Received: Jan /24/2016

Revised: Feb/07/2016

Accepted: Feb/19/2016

Accepted: Feb/29/2016

Abstract: The mobile devices of this generation are head to head with high-end desktops in terms of processing power, memory management schemes, overall usability etc. It won't be surprising to see the industries do away with desktops or even laptops and employ mobile devices given the promise these devices have shown in the last few years. Automation is the need of the hour, and these mobile devices go a long way to help achieve that. These mobile devices can also be employed at places where saving time helps to increase productivity such as maintenance of power plants. Also, an access to real-time data helps the engineer get a much detailed view of the overall working and extent of the problem, if any. Hence to simplify the overall procedure, in this paper, we present a mobile solution to help the Field Engineer automate the task of carrying out the maintenance activity even when connectivity is limited, with the help of mobile device and related technologies which help to transfer data from one end to another.

Keywords: SAP-PM (Plant Maintenance), Android Application, SQLite, Web Services

I. INTRODUCTION

Power plants are major sources of electricity, but even these have to undergo maintenance regularly to function efficiently. These activities have to be carried out on-site, but major issue is that the entry into the SAP systems can only be done if network connectivity is available and as most of the power plant is devoid of connectivity, due to which the field engineer has to get an access to a desktop with network availability so that entry can be made into the system, which is far-off from the actual site, which wastes precious time. SAP-ERP has a dedicated module for creation of maintenance schedules but carrying the laptops to the actual site is hectic and hence the mobile devices come to the fore. Most of the applications that offer automation fail when network connectivity is limited; therefore this solution might help increase the overall efficiency. Dependability and Security will be a major aspect of the application [1].

Facilities that will be provided:

- Manage large number of pending maintenance schedule for preventive maintenance. A Field Engineer can have more than one maintenance schedule to carry out at a time, which can simplify the work if systematic approach is followed.
- View all the pending notifications of equipment for breakdown maintenance. Breakdown maintenance is applicable when there is a sudden breakdown of a equipment. In this case a 'notification' is generated specifying the details about the equipment, reason of

breakdown as well as the information about the engineer who is to carry out the activity is mentioned.

- Availability of the Permit-to-work for improved safety of the field engineer. Many a times some sites are prone to hazards, in these cases a permit from the concerned authority is required to carry out the task.
- Storage of the data on the local database of the Mobile Device for effective use during the activity the engineer can store the maintenance schedule on the local device using SQLite database and can carry out the activity even when connectivity is limited.
- Track the location of the field engineer using GPS. GPS is used to validate the work done by the engineer and track the location.

Implementation of SSL for encrypted data transfer for enhanced security data to be transferred to and fro is sensitive; hence an added layer of security in the form of SSL will be implemented.

II. METHODOLOGY

There are basically two types of maintenance pertaining to a power plant.

Preventive maintenance: wherein maintenance is carried out after regular intervals.

In case of preventive maintenance, a maintenance schedule is provided to the maintenance engineer along with the necessary permits to carry out the activity. The maintenance engineer downloads the schedule, carries out the activity and synchronizes the data back to the server on availability

of connection. Data will be stored locally on the device in SQLite database which is default database available with android application. SQLite Database is better at handling relational data which is what we require for the application [2,3].

Breakdown maintenance: sudden breakdown which needs to be addressed quickly in case of breakdown maintenance.

A notification is generated in case of a breakdown .The field engineer has to login into the SAP system with user id and password. The field engineer gets the list of notifications and pending work orders on the mobile device itself. The field engineer can download the schedules on the device with the help of a 'download' button provided in the application. He/she can carry out the maintenance activity without worrying about the network connectivity. As soon as the activity is completed, the field engineer clicks on the 'sync' button. As soon as network connectivity is available the data is synchronized with the Backend SAP server.

III. WORKFLOW

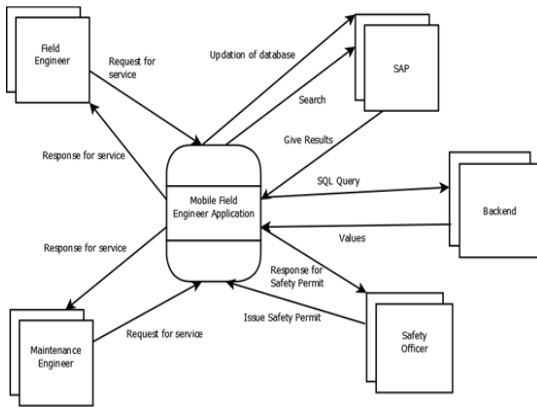


Figure 1: Context level DFD

Figure 1 represents the interaction of different entities with the application. The entities request for the required services to the application and the application responds to them. The **Field Engineer** generates notification and/or tags/untags equipments which is updated in SAP through web services. The **Maintenance Engineer** generates notification and/or carries out activities such as permit return and work completion. The **Safety Officer** ensures the additional safety parameters and issues the safety permit. All the activities performed in the application are updated in **SAP**. Also, the retrieval is done from **SAP**. **Backend** is used for accessing queries such as searching for keywords and SQLite database is used for this purpose.

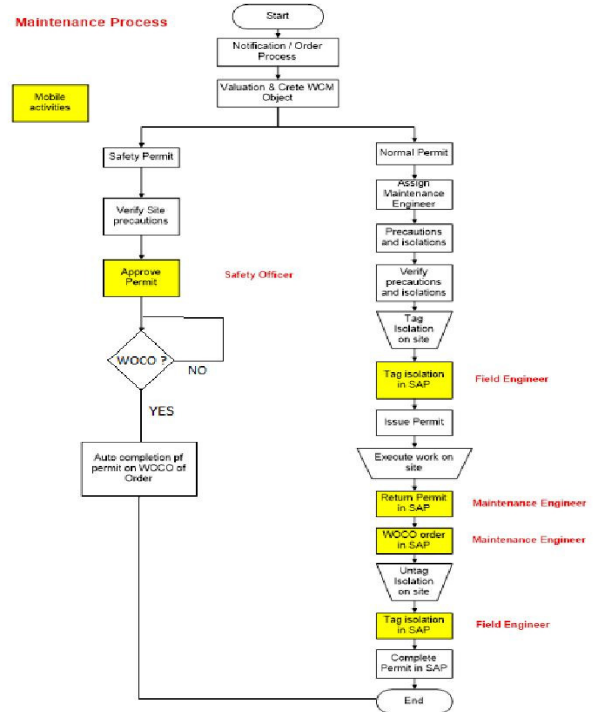


Figure 2: Real-time workflow

Figure 2 represents the real time workflow of the power plant maintenance. The notification/order is generated by either maintenance engineer or field engineer. WCM (Work Clearance Management) is created and work permit is generated. A maintenance engineer is assigned. Precautions are looked upon by the field engineer. The field engineer tags the part of equipment and the tagging is updated in SAP. At times, additional safety permit is required in case the work location is in a danger area such as at a certain height or near fire prone area. The safety officer oversees these precautions and approves the safety permit accordingly. The permit is issued to the maintenance engineer. The maintenance engineer works on the site. Once the work is done, the permit is returned by the maintenance engineer according to business policies and updated in SAP. The WOCO (Work Completion) is done by the maintenance engineer and updated in SAP.

Meanwhile the safety permit keeps checking for WOCO in SAP. If WOCO is done, the safety permit is automatically returned. The field engineer comes on site and checks the tagged equipment. If the work done is proper, the field engineer untags the part of equipment and is updated in SAP. The permit is completed in SAP.

IV. TECHNOLOGIES USED

1. Software Development Kit (SDKs) pertaining to respective operating systems will be used to develop

the mobile application.(Android SDK for Android and iOS SDK for iOS) and deploy the SQLite database.

2. Java Programming Language Will be Deployed for Development of Web Services which will help the client (Application) and Server (SAP-ERP) to communicate over the internet.
3. ABAP (Advanced Business Application Programming), a 4th generation programming language will be used to develop a BAPI(Business Application Programming Interface) which is basically an API to the SAP server.
4. SSL will be deployed for enhanced security over the network while transferring the information.
5. A hand-held device (Depending upon the platform for which the application is developed) with high-end configurations so as to provide faster data processing.
6. Arduino UNO to simulate the DCS(distributed control systems) which gathers then readings from the equipment and for testing purpose before deploying into the real world. A simple thermistor has been used to generate temperature readings from the surroundings and a BTH sensor is used to calculate pressure over a period of time. These readings are then converted to digital signal which are then passed to the database historian where it is stored and analysis can be done on this data by generating charts or generating reports via the MIS.
7. Web services: Now connection is to be established with the remote server from time to time wirelessly. Java RESTful web services are an efficient way of transferring data over the network, because it supports different data formats such as plain text, HTML, XML and JSON as compared to SOAP protocol which supports only XML parsing. Also, RESTful services are more reliable as compared to SOAP services as they inherit security measures from underlying transport. Web services will be required to establish wireless connections to the SAP Back-end server to load the maintenance schedule on the device.
- 8.

V. PROTOTYPE

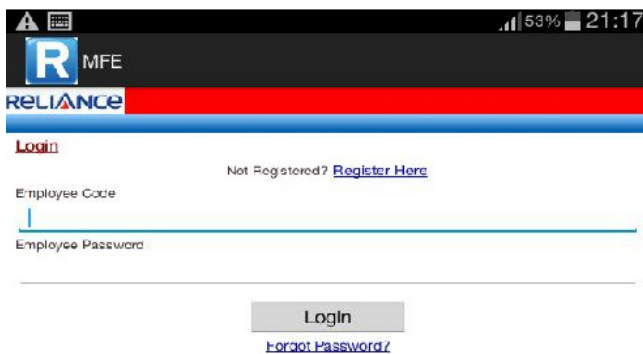


Figure 3: Login page

Figure 3 shows login activity .the SAP user id and password are to be used in this case which is unique for each and member associated with the power plant.

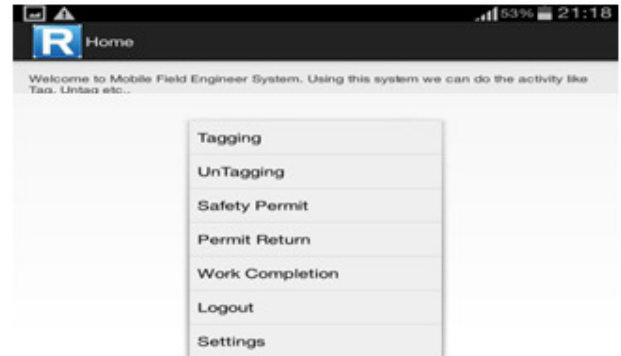


Figure 4: Menu of Activities

Figure 4 shows the various activities that a field engineer has to carry out. The engineer then selects the activity that he/she has to perform.

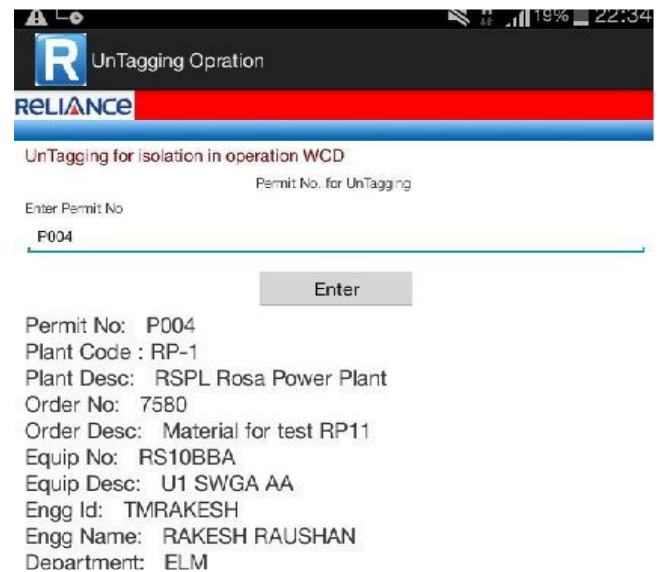


Figure 5: Untagging Operation

Figure 5 shows untagging activity .The engineer has to enter the permit number that will be provided to him via a message ,then he can get the details regarding equipment id, plant code, plant description ,the details regarding the engineer who has been assigned the task, engineer id and department to which the engineer belongs. These details normally are a part of an untagging document. A provision has to be made to download the document on the device itself by which the activity can be carried out offline. This document will be available in the form of PDF file.

```

Temperature =2860.66 C
Pressure = 841.03 Bar
Enthalpy = 9011.09 joules

Temperature =2860.66 C
Pressure = 841.03 Bar
Enthalpy = 9011.09 joules

```

```

Temperature =2851.52 C
Pressure = 838.35 Bar
Enthalpy = 8982.28 joules

```

Figure 6: Readings from Arduino UNO

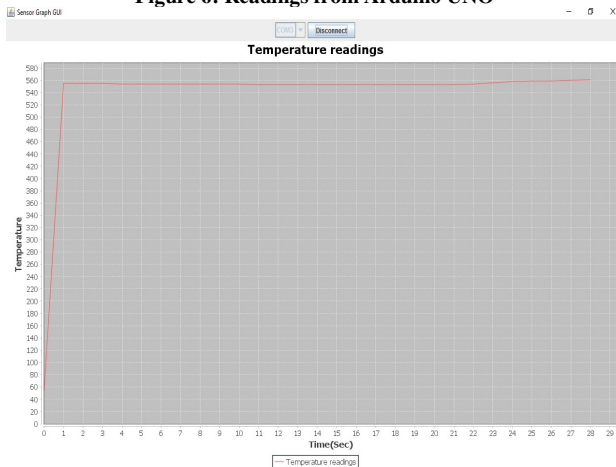


Figure 7: Temperature v/s Time

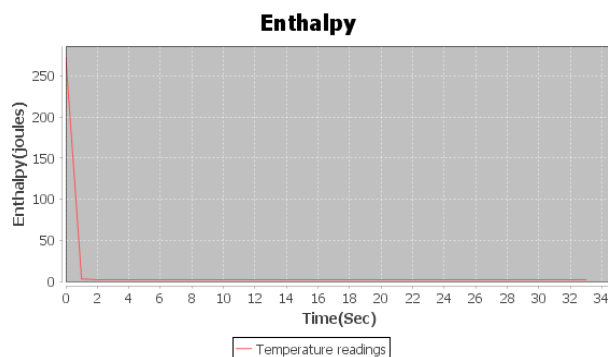


Figure 8: Enthalpy v/s Time

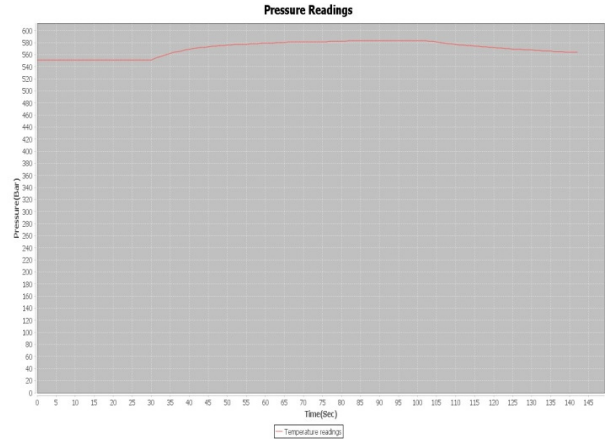


Figure 9: Pressure v/s Time

Figure 7, Figure 8 and Figure 9 represent the graphs plotted by the IVGI module (Integration and Visualization of Generation Information) using Java Chart Library (jCharts) from the readings shown in Figure 6 using an arduino. This is a separate module which deals with the data generated from the sensors like pressure, temperature, enthalpy, ash content etc. which needs to be monitored very minutely. If the field engineer has access to online generation parameters on his mobile device, he/she can get clear-cut idea of what exactly is the status of the particular equipment and how it is affecting the power generation. For example, if the temperature of the boiler is decreasing drastically, then it draws a conclusion that there is an issue with steam generation (quality of the steam). But to get access to these services, a web service has to be written in the native programming language so that communication between the server and the android app API can be carried out. These values are for reference purpose only and will be stopped if network connectivity is unavailable. Graphs are generated on the basis of the readings from the sensors, which helps the engineer to analyze the situation better. Data from the DCS (Distributed Control Systems) is stored into a database called 'Historian'. Whenever the values are to be obtained, a refresh button can be clicked and synchronization with database will result in data loading onto the screen.

VI. FUTURE WORK

- Various resources can be utilized to make the system more fruitful and advanced.
- Providing compatibility to other mobile operating system such as iOS and Windows.
- Providing GPS facility to help track the activities of the engineer as soon as he logs in to the system.
- Providing reference manuals, SOPs (Standard Operating Procedure) to help the engineer in-case he faces difficulty.

- Optimize the Application to be battery efficient and use minimum resources.

VII. CONCLUSION

Thus, we can use this method as a possible solution related to interconnectivity of devices whenever connectivity is limited. We implemented a module with the help of Arduino to demonstrate how the IVGI module works and how the information will be displayed with the help of charts. We also implemented module to show how maintenance schedule is loaded on the device. The mobile devices seem to have potential to alleviate the level of efficiency at a power plant or any manufacturing plant. Information available at hand while performing activity is always of help as the engineer can work without worrying about the connection issues.

ACKNOWLEDGEMENT

We would like to express our special thanks of gratitude to Mr. Pragnesh Patel, Dy.G.M.(SAP),Reliance Power for providing guidance.

REFERENCES

- [1] Markus Aleksy, Bernd Stieger, Gerhard Vollmar, "Case Study on Utilizing Mobile Applications in Industrial Field Service" , Seventh IEEE International Conference on E-Commerce Technology (CEC'05), ISBN: **978076953755-9** Page No (**333-336**), July **20-23, 2009**.
- [2] Welderufael B. Tesfay, Markus Alesky, Karl Anderson, Marko Lehtola, "Mobile Computing Application for Industrial Field Service Engineering: A Case for ABB Service Engineers", Local Computer Networks Workshops (LCN Workshops), 2013 IEEE 38th Conference on, Sydney, NSW, ISBN: **978147990539-3**, Page No (**188-193**), Oct **21-24, 2013**.
- [3] How to write a technical paper [Online] Available: www.emcs.org/acstrial/newsletters/summer10/TechPaperWriting