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CONCEPTUAL DESIGN OF DEVELOPING A MOBILE APP FOR DISTRIBUTED INFORMATION SERVICES FOR CONTROL SYSTEMS (DISCS)*

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Abstract

Due to involvement of different engineering disciplines, tools and methodologies in design, construction and operation of an experimental physics facility (EPF), an integrated information system is needed to efficiently manage data. DISCS is a framework developed to address this need which includes multiple modules and services that provide web-based management tools and APIs to access EPF related information stored in various databases like Controls Configuration Database (CCDB) and Cables Database (CDB). In this paper we propose a conceptual design of a mobile application that can easily be used by technicians working at EPFs to access their required data. The proposed application would use QR code and Augmented Reality (AR) to enhance user experience. It can also be used as a means to create a collaborative environment by providing social networking features helping technicians to share their knowledge from different facilities worldwide.

INTRODUCTION

Mobile phones and other portable devices have become an integral part of our everyday life. People are getting used to various applications that help them with handling their personal and professional tasks. Technicians and other employees at an experimental physics facility may need to access multiple databases to gain the information required for their ongoing tasks, a mobile application can be used as a user-friendly tool to meet their needs.

An integrated information system is needed to manage the data and computation of an EPF. Distributed Information System for Control Systems (DISCS) is a framework for integrating, managing and accessing information base and other necessary computation [1].

European Spallation Source (ESS) is an under construction facility that will be the world's most powerful neutron source for research which is built in collaboration of 17 European countries. ESS has been cooperating in DISCS, one of the products of this collaboration is the development of CCDB which will be used to store data about control system components and some additional metadata [2].

DISCS is partitioned into smaller subsystems called modules based on user requirements, functionality, and cohesion among the data sources. Development of DISCS is kept decentralized and it consist of two main groups: the first is the Module Team that is responsible for development of a module and for its all deliverables like services, API, schema and applications. The second group named Collaboration Board is a group of stakeholders responsible for governance and architecture of the system, each module should be approved by the Collaboration Board before it is published as a part of DISCS [3].

Each module consists of one or more applications, services and databases. Applications and services within a module can access data directly or through some layers but user applications must access module's data only through its service API, the system is made up of a collection of collaborating modules as shown in figure 1 [1].

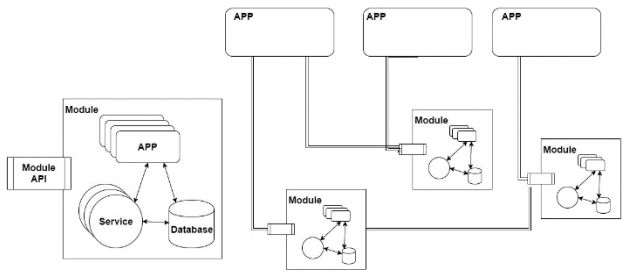

Figure 1: Collaborating modules.

CONCEPTUAL DESIGN

Comparing Different Approaches

There are three different approaches that can be used for the development of a mobile application for DISCS.

A naïve approach for providing access to the CDB via mobile application would be the developing of an app that runs the Cables module web application through an embedded web browser like android WebView [4].

Using this approach we can rapidly create a mobile application to access the cable information but in fact this would be just an alternative way of using the previously existing module's web application. The negative point of this approach is that the database is not accessed directly and new features cannot be added.

A major problem of this approach is that the application cannot be used if the web service is down or corrupted.

The other approach to design the application may use the API services provided by previously existing modules.

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In this situation the application can send different requests to the services provided by the other DISCS modules then process and display data in a compatible manner.

This approach makes the development of the app fast and secure but its disadvantage is that the developers are bound to the framework of these APIs and cannot run custom and complex queries and it is difficult to add new features in this method.

The third approach which is used in our proposed conceptual design is that we develop the mobile application as a part of an independent module which later can be added to DISCS. In this method the developer team would create a new module including mobile application and it's required APIs and database schemas so that they can easily run custom queries and add new features.

Application Architecture

Presented module consist of developing different mobile applications to support both iOS and Android operating systems. These applications would use custom defined APIs to connect the CDB and module's Social Network Database (SND) which will store technicians and other employees profile information and their shared messages using a NoSQL database engine.

It will use the Role Based Access Control (RBAC) [5] module to perform authentication and authorization actions for the application security. Authentication is the process of verifying the user's identity to prevent undefined users to access RBAC protected resources. When a user is authenticated and wants to do an action authorization will be granted or denied based on the user's role and permissions. Authorization to write to an EPICS IOC's is determined by role and/or IP address of the user and the state of the machine [6]. The module structure is shown in figure 2.

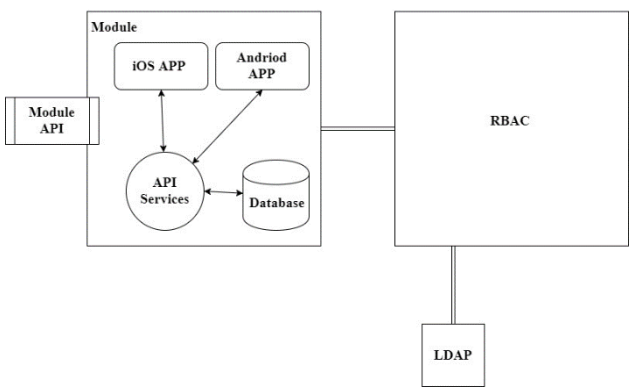

Figure 2: Module Architecture.

Features

QR Scanner

By labelling each cable with a QR code that contains the cable identifier or number we are able to use a QR scanner in the proposed application so that the cable information can easily be retrieved from CDB. This feature as shown in figure 3 can query the cables database just with a tap of the finger. This eliminates the need for typing several numbers in a web application to find the relevant cable information.

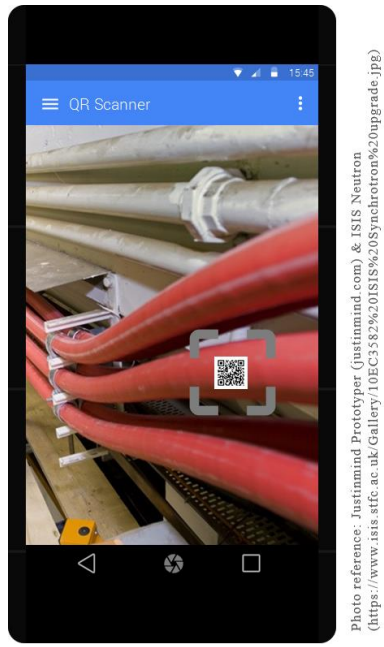

Figure 3: Finding cable information using QR code labels.

This feature will also prevent getting incorrect information by mistake, since there is no need for typing the cable numbers.

Augmented Reality

Using the QR code labels, we can show cables information on the screen and the user can do several actions like finding detailed information by pointing to the real cable and the application would detect the event and display the corresponding information in responsive view. As shown in figure 4, the cable's detail information is shown in a table adjusted to screen size of the device.

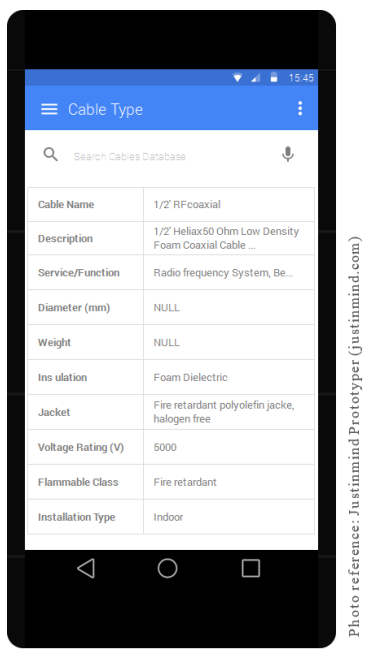

Figure 4: Finding cable information using QR code labels.

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E-logging

By connecting the application to an available e-logging system, technicians can report a fault or malfunction and describe the situation. They can also record a voice message instead of writing the report to save time. These reports then will be stored at the e-logging database.

Social Networking

This application can create an opportunity for technicians and employees from different experimental physics facilities to share their information and knowledge.

Each employee who installs this application will have a professional profile visible to other in house staff and also available to others from various facilities worldwide this feature is shown in the figure 5. Users can create groups based on their professional activities and interests and they can share photos, voice messages and the data with sharing permission.

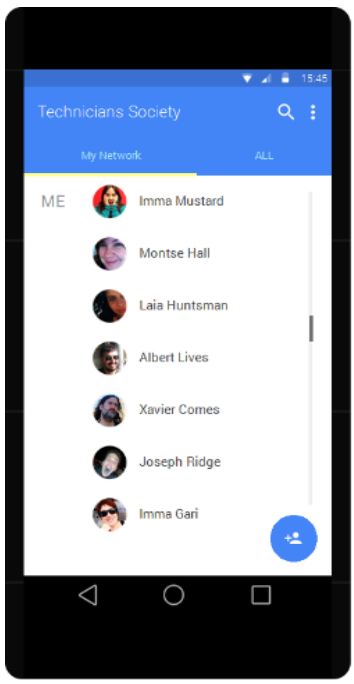

Figure 5: Shows employee's profiles in social network

Location based Security

Most of the smart phones and mobile devices are equipped with GPS. This can be used as a complement for RBAC to provide location based security.

We can track the movements through different facility areas and also we can restrict some features to work only in the facility.

CONCLUSION

Here we proposed a conceptual mobile application design which can be a part of independent module to provide user-friendly interface for searching DISCS databases like Cables Database. We introduced several new features that can enhance user experience, collaboration and security.

With augmented reality feature technicians can find detailed information about any cable just by pointing to it. They also can record voice messages and store them in e-logging database. Social networking feature provides an opportunity to create a collaborative environment for the technicians in different facilities worldwide to share their opinions and knowledge and create professional groups based on their expertise and interests. Since the mobile devise are equipped with various sensors and devices they can be used to improve system's security, location based security was mentioned as a good example for this topic.

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