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A Mobile Application Architecture for Measuring Shaft Misalignment

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Abstract – Shaft alignment task is one of the important issues in manufacturing maintenance particularly to personnel who daily facing misalignment problem. The importance increase as shaft alignment needs high accuracy and precise measurement will reduces bearing and seal damage, minimizes energy loss, and reduces production downtime. Thus, in this paper we present an architecture in developing mobile application for shaft alignment that could saves the user the arduous task of using dial gauges. The aim is to solve engineering maintenance problem that runs on a Personal Digital Assistant (PDA) and brings the solution straight to the user's fingertips. This would shorten processing time, provide reliable and better accuracy analysis and as a medium for data sharing thus increase communication level within a manufacturing plant.

Keywords: Shaft Alignment, Mobile Architecture, Mobile Application, Maintenance

INTRODUCTION

Generally, shaft of driven and driven machinery were connected by mean of coupling. When rotating equipment is started, the shafts will begin to move to another position and for that reason, shaft misalignment occurs whereby the centerlines of rotation of two (or more) machinery shafts are not in line with each other [2]. It saves time and money when performing correct shaft alignment and is the first step in reducing unnecessary vibration, reducing maintenance costs, and increasing machine uptime. Shaft alignment is an essential component of plant maintenance and once all misalignment can be exhibited at the coupling, the misalignment can be measured. The methods to measure misalignment vary widely.

The two most popular methods to measure misalignment are dial indicator alignment and laser alignment. Alignment by dial indicator requires much more training and will take much longer to complete but able to perform an excellent shaft alignment. However, using a laser alignment system to measure misalignment is extremely accurate, versatile, and easy to set up, and provide results fairly free of human error [12].

Mobile and wireless technologies are growing without bounds. People percentage having access to mobile devices is rapidly increasing. These devices are used to receiving mails, managing businesses, taking information, playing games, etc. and this change the way people live and operate businesses [19]. In order to surf this new wave of media and taking advantage of flexibility, mobility and functionality, we aim to utilize the advances of electronic mobile technology as a tool to solve engineering maintenance problem. We used it to operate manufacturing maintenance whereby it has the ability to perform precision shaft alignment on site. The hypothesis of the project is that utilization of electronic mobile technology as an engineering problem-solving tool would shorten processing time, provide reliable and better accuracy analysis and as a medium for data sharing thus increase communication level within a manufacturing plant.

The rest of this paper is organized as follows. Section 2 is devoted to related work. Section 3 describes the mobile application architecture. Section 4 is concluding remarks.

RELATED WORK

Shaft alignment is an important technique during installation and maintenance of rotating machinery. Proper alignment is critical to the lifespan of the machine and coupling wear or failure, bearing failures, bent rotors or crankshafts, plus bearing housing damage are all common results of poor alignment [14]. Precise alignment occurs when the centerlines of rotation of two shafts are essentially collinear with each other. The degree to which two machines are misaligned can be determined by examining the amount of offset and angularity that exists between them. Offset is the distance between the two

rotational centerlines, and angularity is the angle between the centerlines created by the misalignment of the two centerlines [10]. Over the years, because of the need to improve on techniques and ways of working more efficiently, various types of alignment methods have evolved.
The traditional precise shaft alignment method is dial indicator alignment, and its two most popular methods are the rim and face method and the reverse indicator method [1]. Reverse dial indicator alignment method is widely acknowledges as the "preferred method", however the scale graphical approach in problem solving prone to error in mathematical calculation and modeling [22, 23]. Thus, they have developed shaft alignment procedures based on reverse dial alignment method to reduce downtime and perform shaft alignment correctly using spreadsheet application which is readily constructed and it is relatively simple to use.

With the traditional technique, the measurement results must be graphed out manually and the calculations must yield the corrections required. With the laser alignment system all these are done automatically. Real time alignment values are displayed as the machine moves. The laser alignment system cuts the measurement time at each coupling by 50% compared to the previous method of taking 16-point rim and face dial readings [4]. The laser alignment system has been adopted [8,13,15,16,17,18,20,21] to change traditional manual way of shaft alignment and to make the measurement easier and more accurate. Jiao et. al. has designed a high-precision laser alignment system with dual PSDs (Position Sensing Detector) which is comprised of two small measuring units (laser transmitter and detector) and a PDA with measurement software whereby angular values and shim adjustment values are clearly displayed on the PDA screen. Both horizontal and vertical values are shown "live", so that it is easy to adjust the machine [21]. For that reason, a handheld computer with reverse dial calculations in memory is a must for job efficiency.

Handheld computers used at work have molded over time into a variety of form factors, including SmartPhones on the low end, handheld PDAs, Ultra Mobile PCs, Tablet PCs, and even notebook computers. Traditional collaboration paradigms, in which users interact using their desktop computers, are too rigid to provide adequate support for novel environments, in which mobility has become ubiquitous. The importance of supporting mobility of users has also been argued recently whereby there are many mobile frameworks/architectures has been proposed and introduced in mobile computing for adaptive groupware applications [7], adaptive mobile applications [6], mobile commerce application [9], mobile web services [11], and mobile business transactions [19]. The work should be possible anywhere the users are (coffee table, walls, desktops, etc.) rather than users having to work on a standard desktop [5]. In other mobility work, Belloti and Bly argue that CSCW systems must be designed to support and accommodate mobility, the device must be robust to suit plant environment where people work at a local site; rather than seek to eradicate it via desktop collaboration tools [3]. Litiu et. al. has presented DACIA, simplifies building of groupware applications in which clients are mobile [7]. The ideal architecture of the system depends on the available computing and network resources.

TECHNICAL INFORMATION

In this section we describe the mobile architecture that is composed of 3 basic components for developing mobile application see Fig. 1.

A. Web Server

Apache represents the core of system communications. It functions as interface among mobile devices and other components whereby it has PHP configured to execute the business processes and integrate with data management module for accessing database server.

B. Database Server

A MySQL database stored all information needed to calculate shaft misalignment for reporting and recording purposes. The server interacts with the mobile application (in PHP script) by using data management module that implements the process in aspect of data accessing and storage.

C. Mobile Device

Mobile Device: Execute the client by using mobile browser, which provides the user interface and some part of the application logic (java application client) whereby the values for shaft alignment are clearly displayed (mobile user interface) and is easy to adjust the machine.

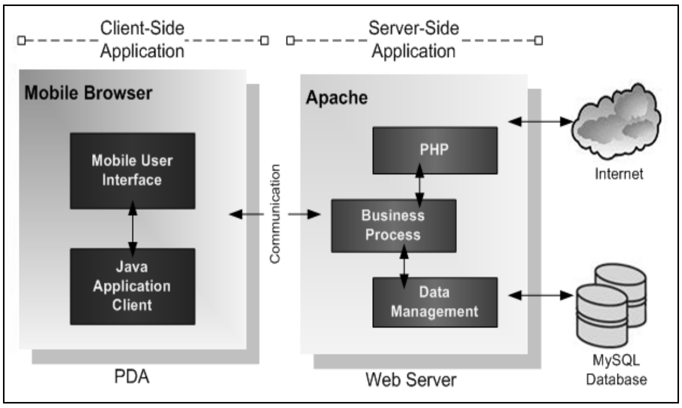

Fig. 1 Mobile Application Architecture

In this mobile architecture, each component integrates as client-server application by communicating between client-side and server-side applications. Mobile browser installed in PDA as client-side application and Apache web server as server-side application by using PHP. We are developing the components of a flexible and general-purpose runtime infrastructure to facilitate the rapid development and deployment of such mobile applications.

CONCLUSION

Mobile computing is a relatively new field. This paper presents the architecture for such mobile applications. We motivated the architecture by classifying likely mobile applications and identified common properties. The architecture intends to be more general with 3 basic components; web server, database server and mobile device. We will develop various pieces of the overall architecture and collected some preliminary experience with mobile applications. Architecture for mobile applications allows a mobile user to keep working productively in an environment in which mobile computing devices are used and presents implementation strategies on site.

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