A Quality Watch Android Based Application for Monitoring Robotic Arm Statistics Using Augmented Reality

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Abstract - *As Industry 4.0 being the current trend of automation and data exchange taking charge over the industrial way of working. The introduction to Internet of Things in industry has led to many other requirements for the smart industry to move towards automation. Smart industries have felt a need of having an augmented reality based android application to track the status of robotic arms used in the smart industry. An intelligent system for android platform based on augmented reality to show the status of robotic arm which include details like total number of products processed, number of defective product processed and its percentage, error percentage, correctness percentage, etc. The automation will help in enhancing the efficiency of the robotic arm and keeping a real time watch on the complete process. Firstly, the android application will open camera to capture real time view and detect the robotic arm which will be needed to process further. Google vision API will be used to recognize the image of robotic arm which will be shown as high signification description. The result will be passed on to the server site to process and return the complete analysis stored at the server i.e. number of defective glasses, total number of glasses etc.*

***Key Words*: Cloud Computing, Android Application, Augmented Reality, Industry 4.0, Robotic Arm, Data Virtualization.**

1. INTRODUCTION

Traditionally human beings in the industries have crucial role for the growth of the industry in terms of mass production. The role played was the major one but nowadays human intervention is less. The major part is automated and the system can be monitored in real time enhancing the production and also efficiency is maximized. Production systems are complex structures composed of entities coming from different technological areas, such as mechanical engineering, electrical engineering and information technology (IT). They are continuously evolving to fit current market circumstances to allow production companies to remain competitive.

The objective of this paper is to describe the experiences with development of an AR application for augmentation of an industrial robot. The paper focuses on the description of the application requirements and prototype implementation [1].

Augmented reality blends the real world elements with the virtual elements that are generated by the computer [2]. The virtual elements generated by the computer are basically intended to engage, entertain and completely immerse the user into the system. The augmented reality concentrates on creating a system where user can view the world in a completely different manner. This increases the chance of getting a better feel for the users who love playing games and application related to gestures. Mobile phones and video games are the prior elements which led to the enhancement of augmented reality. Augmented reality focuses on creating an environment where user would not find any difference between the real world and the virtual elements.

The term "Android" is known to all either from science fiction or from their smart phones or tablets. "Android" in science fiction means a robot having a human appearance while "Android™" is an open source and Linux based operating system for tablets and smart phones. Today it can be said that a major population of smart phone users use Android phones and hence this app is based on Android to reach out to maximum people.

Data visualization is a general term that describes any effort to help people understand the significance of data by placing it in a visual context. Patterns, trends and correlations that might go undetected in text-based data can be exposed and recognized easier with data visualization software.

Data visualization software also plays an important role in big data and advance analytics projects. As businesses accumulated massive troves of data during the early years of the big data trend, they needed a way to quickly and easily get an overview of their data. Visualization tools were a natural fit.

2. CLOUD COMPUTING

2.1. Overview of the Cloud Computing Technology

It provides also the cloud computing definition, discusses available cloud architectures as well as service-driven and deployment models. Moreover, it provides an introduction to the edge cloud solution that is able to support services with strict requirements in terms of low latency.

2.2. Cloud Computing Deployment Model:

Cloud Computing Deployment Model Based on its deployment, Cloud computing architecture in the fig below shows the arrangement of services to be used by which authority.

Android Application: End User (At Application layer).

Java Platform: Software Developer (At Platform Layer).

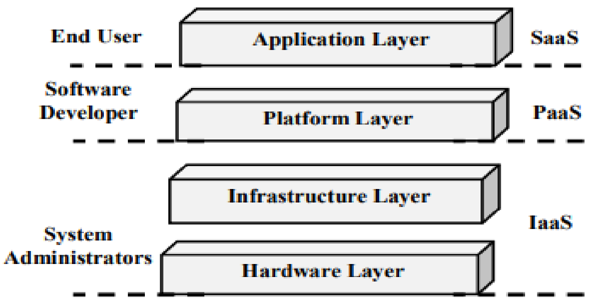

Fig -1: Cloud Computing Architecture

3. EASE OF USE

Android application is very easy to use and efficient. Data is fetched in the backend .The unique id of the robotic arm allows the user to get the specific details about the specific arm. The efficiency is calculated online and displayed. The records of the last five operations is shown as per user's requirement. The human machine interaction is essential component of the industry [3] [4].

User can authenticate the id and perform the operations like create user, update user, find user by id, find by email, delete users and get details of user as the administrator. The flexibility is provided in terms of availability of the data for the robotic arm .The data is available 24x7 as it is on the cloud.

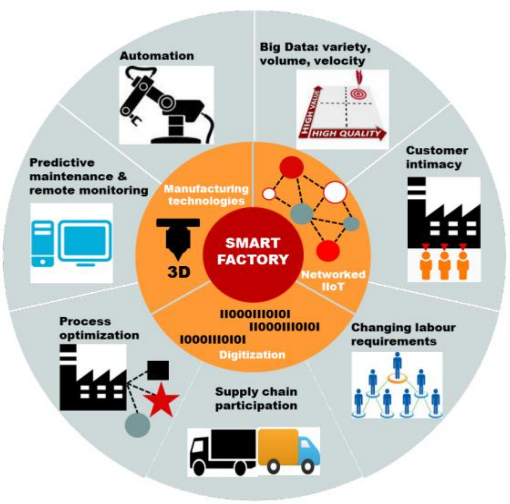

Fig -2: Industry 4.0 with its optimal efficiency

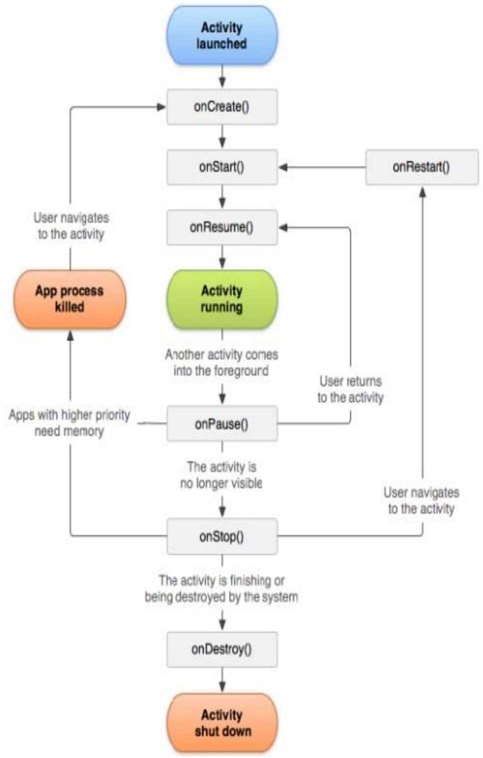

Fig -3: Android: Lifecycle of activity

4. REQUIREMENTS AND ARCHITECTURE OF AR APPLICATIONS FOR INDUSTRIAL AUTOMATION

Typical tasks in Industry 4.0 environments need to combine several aspects:

- The distance of the augmented object from the user can vary from several centimeters to several meters.
- The augmented object can vary in size from several centimeters to several meters and can have various shapes and materials.
- The tasks that the user is performing may require usage of one or both hands, or require user attention for some time.
- Support the observation and analysis of the user interaction via data collection.
- Take into account data complexity of real manufacturing processes for high fidelity prototyping.
- Allow prototyping and possibility for iterative development.

Based on these aspects and requirements, a basic AR application structures designed. The AR application comprises 3 fundamental layers forming a client-server structure. The client layer involves client AR applications running on devices like smart phones or tablets, depending on the task requirements like free hands or size of display. These client AR applications provide the visualization of AR data to the user, and based on the type of display, they may allow also the user input (e.g., touch interaction in case of mobile phones and tablets). A specific type of client AR applications is the evaluation client, that should be implemented as PC application due to the performance reasons. The evaluation client should allow control of the task flow during experiments and data collection that is important for understanding of AR application issues. The second layer consists of a server providing mainly synchronization of data among clients. Additionally, the server layer communicates with the third layer, which represents external data sources like inputs/outputs from the CPS that is being augmented. This helps researchers to make task believable and improves the quality of the evaluation.

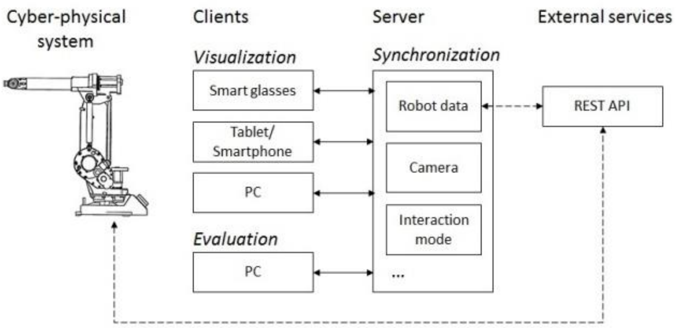

Fig -4: Design of Multilayer architecture of developed AR Application.

Fig -5: AR application run on Android smart phone

5. RELATED WORK AND RESEARCH GAPS

In this section, existing work related to the cloud computing in the context of industrial automation is presented in detail. Many of the current research projects, such as [11] , draw attention to the migration of services from the factory floor level to the cloud domain so that more control over the production plant from a remote site can be achieved. In this section, the investigation of existing works is categorized and presented on the basis of framework development and requirements of Industrie 4.0

VR and AR applications may be used with many types of displays, such as head-mounted displays (HMD), handheld displays, spatial see-through displays or projectors. A comprehensive list of current technologies is provided by Bimber [12] and van Krevelen [13]. HMD and see-through glasses allow AR/VR data visualization while preserving empty hands. Moreover, they can be used in stereoscopic mode, which allows better illusion of 3D augmented visualization in space. Hand-held displays require that at least one hand holds the display. Spatial displays are similar to hand-hold displays or see-through glasses, but they are usually bigger and attached, so no hands need to be used to hold them. On the other hand, their usage is limited by their position. Projectors are used for projection of augmented data on real objects that are then perceived by users.

In the majority of projects related to industry environments, the main type of AR display used is HMD. A comprehensive overview of projects using AR in industry was presented by On et al. and up-to-date research was also done by Garcia et al. One of the projects that focused on the development of AR applications in industry is ARVIKA project [14]. The goal of the project was to develop AR technologies and applications to augment real-world field of view of various professions in automotive and aerospace industries, power and processing plants and machine tools and production machinery. Over 30 prototypes of AR applications were developed in usability engineering and user-centric approach. In Rainers et al. investigated the usage of AR and VR for assembly of door lock in automotive industry. Specifically in aerospace industry, De Crescenzio et al. showed how maintenance tasks can be improved by augmented reality.

This literature review shows that current approaches focus mainly on AR or VR applications in environments where the user is typically staying or sitting at specific places. In this work, the focus is on experiments with AR/VR applications that are used in environments where the user is moving around a real or virtual object that is being augmented or visualized by the application.

Existing System:

The RFID are attached to the machines (robotic arm) which provides unique identity to it. In industries it is not followed on mass still there is large population which runs manual process of glass glazing .This must be automated on large scale to enhance the production and the quality.

6. EVALUATION CRITERIA

In this section, we describe the final score formula and the procedure used to assign grade. Workflow integration: we rated each presented system with respect to integration to a well-defined industrial procedure. We consider the fact that the industrial problems are well defined and that the input data and output result can easily be integrated in a global process. This is important as the closer to the industrial process the system is the easier it will be to understand underlying problem and non-trivial solutions.

- **Scalability:** We judged the selected systems depending on their re-usability and their applicability to the real-life full size scenario. This considers the technology used, not only the raw cost but also the installation, maintenance, removal cost. This is an important aspect as it has a direct impact on AR broader applicability.

- **Cost beneficial:** we rated the cost benefit aspect of the presented solution. This is not meant as a full scale analysis at it would fall out of the scope of this paper. It mainly evaluates the arguments (if any) given by the authors to justify the benefit of their system in comparison to current (non AR) practice.

- **Out of the lab:** we evaluate the state in which the current system was with respect to the idea that they should ultimately leave the lab and be used in the real industrial context. This assesses if the scenario used realistic data and is used the target application environment. For us, this is a major quality for a system to have as it allows an end-user to properly evaluate it.

7. ADVANCEMENT OF EXISTING SYSTEM

AR can be used to make robotic arm more efficient and faster. Industry 4.0 is the current trend [5].It is requirement for efficient management [6]. AR can be embedded using the android application which makes use of your phone's camera. The database is stored using AWS which can be retrieved anytime the user needs it.

8. CONCLUSION AND FUTURE WORK

This paper describes the development of an AR application that augments an industrial robot for shop floor tasks like maintenance or cooperative work of human and robot. The app will not run on other mobile operating systems other than Android Operating system, i.e., the app is OS-dependent. It provides solution for the all kind of industries i.e. small, medium and large scale.

Future work is devoted to perform further qualitative and quantitative evaluation in environments where an AR application is connected to the robot controller, so that the visualization can properly visualize robot states and position. Vuforia SDK and Unity 3d can be used in different and emerging ways for the augmented reality applications [8].

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