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Augmented Reality Application for Machine Maintenance

M.Anitha[1], D.Kalaimani[2], A. Anto Libertina[3], S.AbiramaSundari[4], S.Senthamizhselvi[5]
[1, 2, 3, 4, 5,] *CSE Department, Panimalar Engineering College*

Abstract: Augmented Reality is a technology which can superimpose 2D or 3D objects in real time for users view. Augmented Reality for maintenance is solely for reducing the time required for maintenance operation. The user of the system has to point his Smartphone camera over the machine and the image is recognized and then the user can view the details of the machine. Then the components of the machine are labeled in real time and the user views demo videos in real time if required. The main aim of this system is to make maintenance operation easier and to reduce the cost of the operation. Due to the intervention of Augmented Reality in a maintenance operation, the cost and the time required for maintenance is reduced and the intractability and the work efficiency is increased.

Keywords: Machine maintenance, Augmented Reality, Mobile Solution

I. INTRODUCTION

Augmented Reality is a technology which superimposes 2D or 3D objects over users view to create a dynamic experience. The present era is the dawn of the Augmented Reality. The application of Augmented Reality is extended to various fields such as traveling; Defense, Manufacturing, Construction and Maintenance. Augmented Reality can also be used for Education. Consider the scenario where students are able to interact with their study material. Augmented Reality can be extended to various fields. The applications of Augmented Reality are boundless. The capabilities of Augmented Reality have been so impressive that various fields are now adopting Augmented Reality. Augmented Reality provides a framework through which users can interact with their day to day objects in a different manner through which the task can be achieved in a more efficient way. In this present age, Augmented Reality is mainly by core industries whose fields are manufacturing. The industries in the manufacturing sector have performed a lot of maintenance tasks in order to prevent any interruption of their manufacturing process. Maintenance tasks include routine services or some tasks that are carried to the machine. In order to perform these tasks, the operators of the machine have to train. This is usually done by experts. But the cost of this approach is too expensive. The experts have to be brought to the site every time training is needed. This may add up the maintenance cost. This is where the application of augmented reality comes into play. Using augmented reality the training can be done in a more interactive. But Augmented Reality does not stop with training. It can be extended to the field of the maintenance. The maintenance operation requires a lot of operations that is performed on the machine. These tasks have to be done on a periodic basis in order to achieve the production goal. To perform these various steps have to taken. The maintenance operators have to refer maintenance logs, checklist and user manuals. But this is a tedious process. A lot of time is consumed by referring the manuals. An augmented reality solution can be used to perform maintenance. This solution can help the mechanics to label the parts of a machine in real time and then enable the users to perform tasks without much effort.

II. RELATED WORK

Ulrich Neumann et al [1] describes the cognitive abilities of human in manufacturing process using Augmented Reality. Ulrich Neumann identifies the potential benefits as reduced error like hood enhanced motivation and concurrent training and performance. Ulrich Neumann details that using Augmented Reality novice users can also acquire the talent of experts without much experience or training as acquired by experts. Using this approach training may not be done as a distinctive process but it can be done as a concurrent process with the job.

Dirk Reiners et al [2] presents augmented reality as a technology which can be used to represent virtual object in real world. This approach describes that Augmented Reality can be used to channel the digital information in a constructive way to reduce product cycles and help people who handle fast-changing products. This approach uses Augmented Reality to reduce the training complexity. This approach uses CAD hence it can be integrated with existing infrastructure

Vijaimukund Raghavan et al [3] describes an interactive tool to evaluate assembly line sequences using augmented reality. In traditional assembly sequences, the completion of a seduce in an assembly is hard to evaluate. This approach describes an efficient alternative in which virtual objects are mixed in real world to create augmented reality interface. This approach can be complex in

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Industrial assemblies as they involve hundreds of parts. Bernd Schwald et al [4] emphasizes that Augmented Reality is an excellent field of application for Complex Assembly and maintenance tasks. This approach uses a head mounted display a tracking system and a stand for installation. This approach provides solution for user who has to perform demanding process and complex assemblies. This approach can also be used to increase the skill of the workers. The main aim of this approach is to bring all the information need by user at the required time and perform the process seamlessly.

Changzhi Ke et al [5] presents a prototype in augmented reality for training and assisting in maintain equipment. This approach states that augmented reality can experience users visual experience, expand their vassal system, and help users to achieve their tasks in a more natural way but interact with the machines normally.IN traditional approach if the users do not know how to fix the problem lasts long and causes loss. This approach uses augmented reality to tackle the problems by allowing the users to interact with the machine in a more natural way.

Steven J. Henderson et al [6] defines an approach to investigate the feasibility of devolving AR systems that can be used in flight line maintenance. In traditional maintenance techniques, the experts have to switch their focus between the equipment and the manual. This causes a lot a time. This approach denies a way in which the information can be presented at real time to perform the task. This approach is specifically used for training. This approach has the following advantages such as reduced time for repair sequence transitions, Real-time collaboration, Historical documentation.

Bjorn Schwerdtfeger et al [7] describes an approach using HMD and Augmented Reality to support order picking process. Earlier systems used pick by light and pick by voice approaches. But this requires mental effort as the workers need to remember what has been said. The results showed that the users were 5% faster. The users took 4.341s for picking the arrow and 3.581 s seconds for the frame and 4.096s for the tunnel

Steven J. Henderson et al [8] describes an approach to develop an application which uses augmented reality and can be used by, military mechanics who conduct regular maintenance tasks to military equipment.The maintenance tasks in the military are procedure based.Physically navigating these procedures is a difficult task.These tasks cannot be navigated concurrently. This approach describes an application which uses augmented reality to impose a 2D object and 3D object to help mechanics to maintain a turret. Vincent Gay-Bellile et al[9] describes an approach in which SLAM is used to recognize objects in augmented reality. This approach defines an application using augmented reality which can be used to automotive field. This approach states that the process and sale in automotive field can be improved using augmented Reality.IN this approach SLAM technique is used to pinpoint objects in real time. This approach defines an application which can be used in automobiles maintenance and repair.

Luis Eduardo Garza et al [10] describes an approach to test the impact of augmented reality in industrial applications. If the pump is shut down it may take four hours to process. This approach describes an application using augmented reality to reduce the time required for maintenance. This approach uses a library to display 3D images on mobile devices. The application developed tends to be used in both in industry and workshop directly in field

III. PROPOSED SYSTEM

The proposed system uses the Smartphone camera to recognize the machine pointed by the user. In this, no image is captured or the image being captured is stored in the drive. The user needs to have a constant internet connection. The user can see the labeled components of the machine using his Smartphone and if required the user can select a demo video to know how to perform some operation on the machine. In this CraftAR SDK is used to recognize images and to label components in real time. In this, the system is used to give the augmented Reality description of the machine and functional features

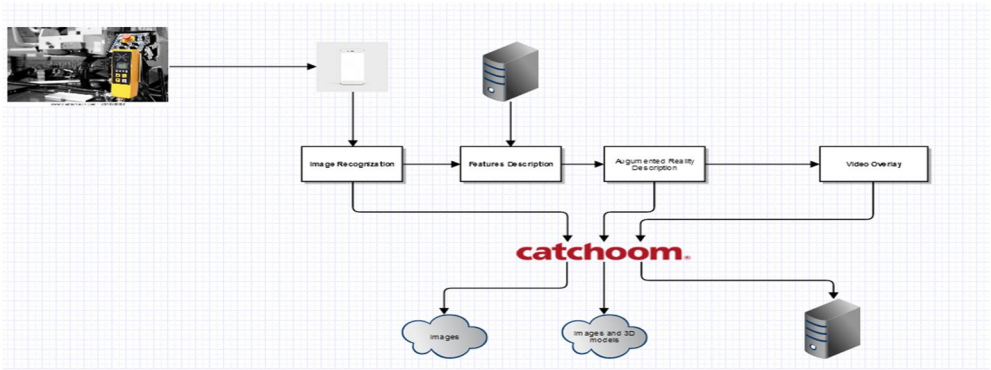

Fig. 1 Architecture Diagram

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A. The proposed system has following modules

1) *Image Recognition:* Image Recognition is to recognize the images to identify what for what machine maintenance is required. In order to recognize images, CraftAR SDK from Catchoom is used. The image is recognized without being stored in memory or after being captured and stored on the device storage. The images are stored in the cloud and the user needs to focus his Smartphone towards the machine and the machine to be maintained is recognized within a fraction of seconds. The image is recognized if it covers at least twenty percentage of the scene.

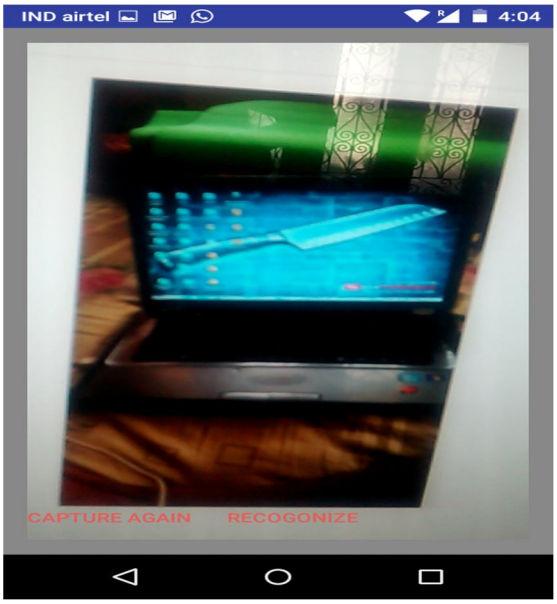

Fig 2 Image Recognization

In Fig 2 the image is recognized. After the image is recognized the image capture is stopped.

2) *Features Description:* Once the image is recognized the make and manufacture of the machine are displayed. The features of the recognized machine are displayed to the user. Along with this information, the plant area and the plant code and the line in charge and the operator of the machine is displayed. The maintenance routine of the machine is fetched and displayed to the user. Then the remarks during the last maintenance check are displayed. Then the operations to be carried out in the current maintenance task are displayed. Then the remarks of the current maintenance task are updated. All this information is available and updated in the server present in the intranet of the organization.

Fig.3 Maintenance and Features Description

Fig.4 Name and Manufacturer Information

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Fig 4 specifies the name and the manufacturer of the machine. The make refers to the country from which the machine is made and the manufacturer refers to the company that manufactured the machine

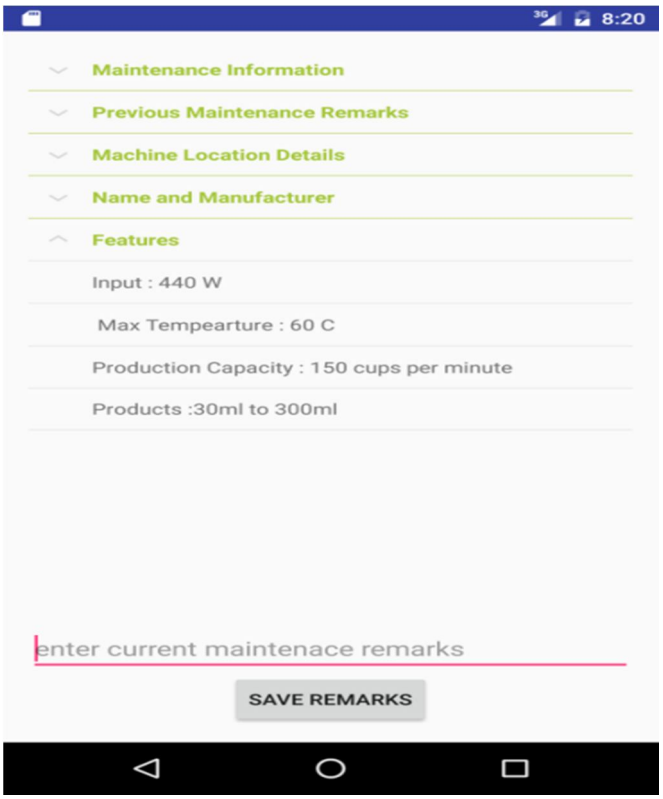

Fig 5 Features Description

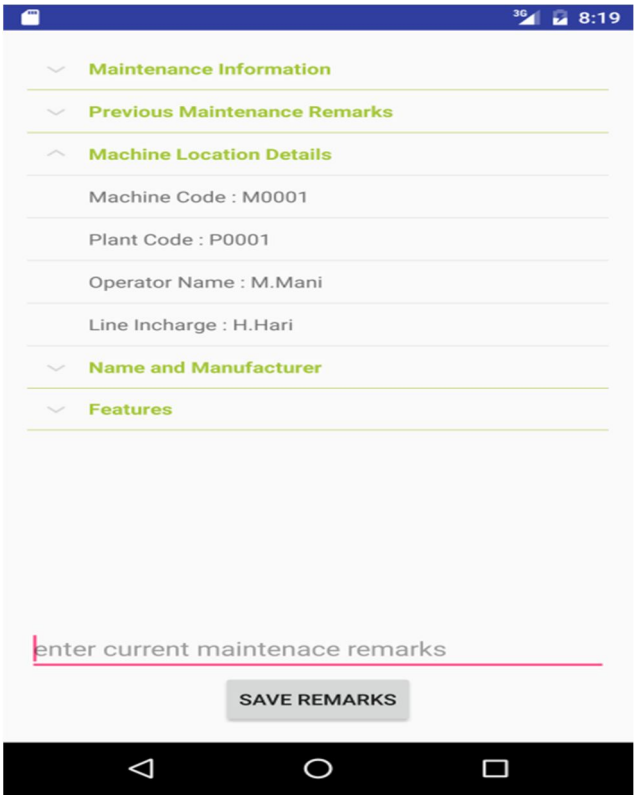

Fig.6 Machine Location Details

Fig 5 displays the features of the machine. The features include the production output of the machine and amount of power needed. Fig 6 displays the operator name and the plant area and plant code and the line in charge of the machine.

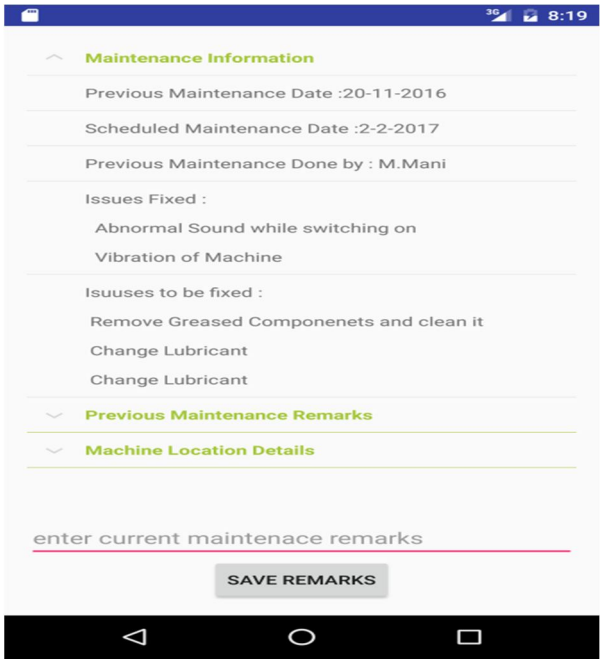

Fig.7 Maintenance Manual

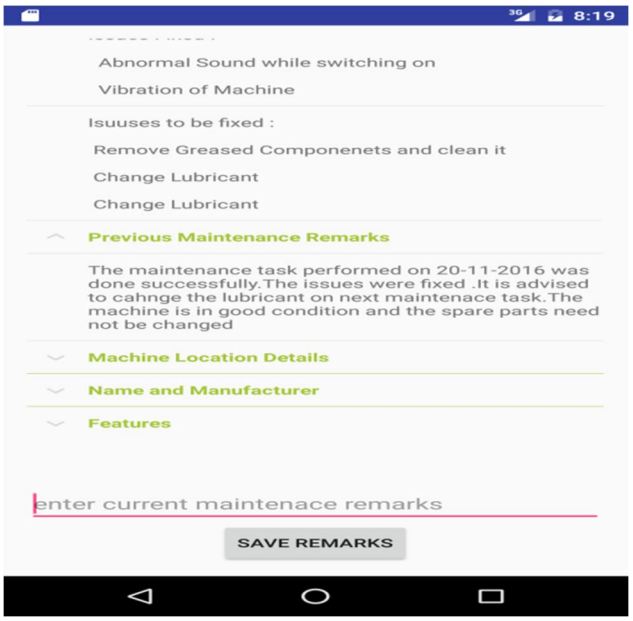

Fig.8 Maintenance Remarks

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Fig 7 displays the maintenance routines carried out and the remarks. In Fig 8 represents the maintenance task to be performed

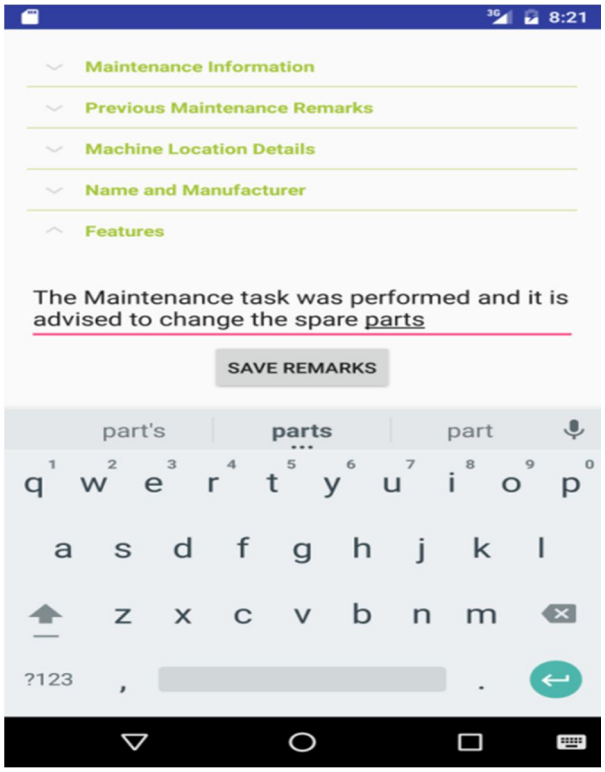

Fig 9 Present Maintenance Remarks

Fig 10 Augmented View of Components

3) *Augmented Reality Display:* The components of the machine recognized during Image Recognition are labeled in real time using Augmented Reality. The parts of the machine are superimposed over the image in users Smartphone camera. The user can view the steps to be performed on the machine in real time using Augmented reality. This download the 3D models from the server in the intranet of the organization and it superimposes the objects in real time. The steps are already predefined. The user can also rewind to see the steps again.

Fig 11 Real time Video Tutorial

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4) Video Overlay: Fig.11 shows the video loaded at real time In order to get a clear picture of how to perform a maintenance operation, the user can select a video from the category. The selected video will be fetched from the server and it will be played in real time in order to perform a maintenance operation. The video can be paused and played in real time. The video will be paused if the machine under maintenance is away from focus.

IV. CONCLUSIONS

With this AR System, the maintenance routine is optimized. The time required to perform maintenance operation is considerably reduced and the cost of the maintenance operation is reduced. The present AR system can reduce the time required for training. Ice the intractability is improved the maintenance task will be easy and it will be less easy. The results of this set are impressive. Fresh users are able to operate the machine with a fraction of knowledge. The future scope of the project is overwhelming. By using Machine Learning and Artificial Intelligence the system can learn about the machine with similar features and guide its users. The future system can learn on its own and it can provide augmented description of the machine by learning the components of the machine on its own.

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