User Manual on Augmented Reality for Installation and Maintenance of the V-Brakes System of a Mountain Bike

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Abstract

Until now most traces of AR in applications related to mechanic and maintenance tasks has been performed in very specific systems which could be regarded as quite complex in the field they have been applied to (aircrafts, military equipment, etc.) In this paper we intend making this technology approachable for task and applications more common to everybody. We propose making one of the most frequent maintenance tasks in mountain bikes which is the installation of the brakes system and cartridge shoes as well as adjustment of the tension cable. They are not difficult tasks but making them the first few times may be quite tough for the average user. Therefore, we propose an easy interface based on augmented reality which fitted to the bike handlebars will guide the user step by step through installation of the V-brakes system, change of cartridge shoes and adjustment of tension cable. Interface is based in several cards containing markers with codified sequences based in 3D models for performing maintenance. User will use a mobile phone with camera or a head mounted display (HMD) connected to a PC so he may visualize the animated 3D models of pieces and tools needed for this operation. Virtual objects will be superimposed over the real ones so positions of each piece can be identified by the user before handling them. Final target is including the markers interface with the bike or brakes in their original purchase or making it available for download from a PC via web or as a mobile application.

Categories and Subject Descriptors: H.5.1 [Information interfaces and presentation]: Multimedia Information Systems—Artificial, augmented, and virtual realities.

1. Introduction

One of the most promising technologies actually is augmented reality (AR). In technical terms, AR is an amalgam of computer graphics, vision and multimedia, which enhance the user's perception of the real world through the addition of virtual information.

AR technology progresses towards collaborative systems which are highly interactive comprising integration of devices able to perform 3D registry in real time. Computers are more sophisticated and powerful each time allowing virtual objects being more realistic so devices which are becoming lighter and more ergonomic helping augmented reality applications integration with PDAs or smartphones including cameras.

There are few contributions where augmented reality technology is applied to machines mounting and maintenance. In less accessible fields like aerospace, applications have been developed for supporting maintenance staff performing their tasks [RWTH08] [HM07] [Mac05].

Schwald [ScLa03], introduces two AR systems for training & assistance in maintenance of complex industrial equipment using an optical see-through head mounted display.

ARMAR project, has developed, designed, implemented and tested on users a beta version of an AR application for support of army mechanics during routine maintenance tasks inside an armored vehicle turret [HeFe07] [HeFe11].

Actually, mechanics from the army and manufacturers like Boeing use AR glasses when staff works on vehicles, glasses show repairs step by step, target necessary tools including textual instructions. This kind of experience supports learning as well training of specific tasks. I+D department of automotive giant BMW[1] (through BMW research project), include among their working lines development of an AR application supporting mechanics while performing maintenance, diagnose and repair of any fault. A recently published study has also applied AR technology for maintaining photovoltaic solar installations equipment. [BZBBT10].

Following bibliographic references, it could be figured out that use of AR technology in repair and maintenance fields is subject to complex systems although that's not the case because it's actually available to anyone. A few years ago, AR apps demanded specialized equipment which wasn't portable. Nowadays applications for laptops and smartphones merge digital information into the real world quick and easily. Design of easy apps makes communication between people and computers more natural each time allowing those who are not used to computers can interact with the system.

Use of augmented reality can be extrapolated to nearer and common environments to anyone. In this paper, we propose an example of AR use for support, repair and maintenance of a standard mountain bike brakes system.

[1]http://www.bmw.com/com/en/owners/service/augmented_reality_workshop_1.html

2. Project target

This project seeks design and implementation of an augmented reality system for supporting repair and maintenance tasks of a V-brakes system in a mountain bike. Secondly, it focuses on making the AR system useful as training for all bicycle users targeting substitution of the troublesome maintenance manuals and assembly instructions. This idea is extensible to all electronic devices, vehicles, home appliances, etc as they are all provided of user manuals for configuration or installation and usually understanding their instructions becomes a tough task. The possibility of creating those manuals in augmented reality as assistance during training, configuration and installation of those equipment could make learning how to use them much easier.

3. Generic Augmented User Manual for maintenance of mountain bike brakes.

Project consisted in developing a "magicbook" or augmented book with instructions of steps for installing the brake lever, V-brakes and replacement of the cartridge shoe providing also assistance for adjusting the cable's tension. Augmented book is presented in spiral binding so it can be leant over the mountain bike's handlebar. Each page has a marker that belongs in AR to every task that must be accomplished. The application requires accurate position and orientation tracking in order to register virtual elements in the real world and so we have used a marker-based method. Therefore, the system requires a webcam for capturing the real world. The captured image recognizes virtual objects on the visible markers. 3D modeling of the parts manipulated during tasks was performed using Autodesk Inventor 3D software. Besides, textual information is added about tools used in every step. 3D graphics are animated so user can understand gestures that should be carried out.

User provided with a mobile phone including camera will lean the augmented book over the bike's handlebar where an included adapter should be set. Through the phone's screen he can see virtual parts superimposed over the real ones (displaced respecting marker). Besides seeing animated components on the real environment, user will also be able to listen to a recorded voice which will guide him through every task following instructions accordingly.

Most accessible and common device suggested is mobile phone although an AR glasses with earphones included could also be used. Traditional user manual will be substituted by several markers and AR application would be available for download from the product's website.

4. Conclusions

This study introduces a simple augmented reality system seeking incorporation of this technology to home appliances and usual vehicles for providing help in their configuration or maintenance. An AR system can substantially improve quality of maintenance services while saving costs as the same AR system can be used for different versions of several products (for example, V-brakes is standard for many bikes models).

This kind of apps can be extended for setup and installation of electrical appliances (TV recorder and programmer, Hi-fi systems, home cinemas, game consoles, etc).

We propose substitution of the usual user manual for setup and maintenance of home appliances or devices for AR based portable applications. User may access product's website from his mobile device (iPhone, smartphone) for download and installation of the AR application.

5. Acknowledgements

The Spanish Ministry of Innovation and Science, through the "Not oriented Fundamental Investigation Projects" ("Improvement for spatial reasoning and visualization through technologically developed tools" Project ref. TIN2010-21296-C02-02) partially supported this work.

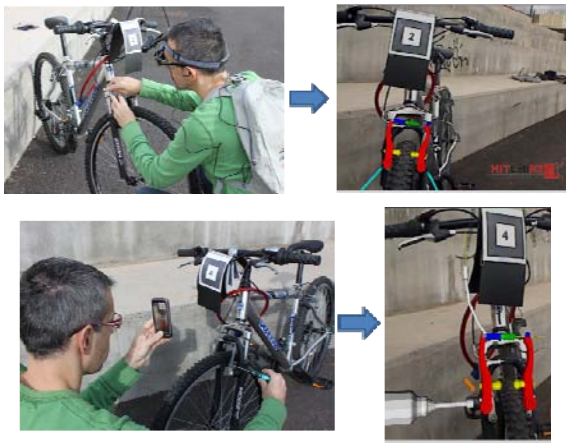

Figure 1: *3D augmented scenes with HMD and Smartphone.*

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ABSTRACT

Until now most traces of AR in applications related to mechanic and maintenance tasks has been performed in very specific systems which could be regarded as quite complex in the field they have been applied to (aircrafts, military equipment, etc.) In this paper we intend making this technology approachable for task and applications more common to everybody. We propose making one of the most frequent maintenance tasks in mountain bikes which is the installation of the brakes system and cartridge shoes as well as adjustment of the tension cable. They are not difficult tasks but making them the first few times may be quite tough for the average user. Therefore, we propose an easy interface based on augmented reality which fitted to the bike handlebars will guide the user step by step through installation of the V-brakes system, change of cartridge shoes and adjustment of tension cable. Interface is based in several cards containing markers with codified sequences based in 3D models for performing maintenance. User will use a mobile phone with camera or a head mounted display (HMD) connected to a PC so he may visualize the animated 3D models of pieces and tools needed for this operation. Virtual objects will be superimposed over the real ones so positions of each piece can be identified by the user before handling them. Final target is including the markers interface with the bike or brakes in their original purchase or making it available for download from a PC via web or as a mobile application.

PREVIOUS WORKS

TEXTUAL TAGS AND 3D MODELS AUGMENTED INFORMATION

HENDERSON S., FEINER S.: Augmented Reality for Maintenance and Repair (ARMAR). *Technical Report AFRL-RH-WP-TR-2007-0112*, United States Air Force Research Lab.

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SCHWALD, B., FIGUE, J., CHAUVINEAU, E., AND ET AL.: Starmate: Using augmented reality technology for computer guided maintenance of complex mechanical elements. *eBusiness and eWork Conference*, e2001, pp.196-202.

CONCLUSION

This study introduces a simple augmented reality system seeking incorporation of this technology to home appliances and usual vehicles for providing help in their configuration or maintenance.

An AR system can substantially improve quality of maintenance services while saving costs as the same AR system can be used for different versions of several products (for example, V-brakes is standard for many bikes models).

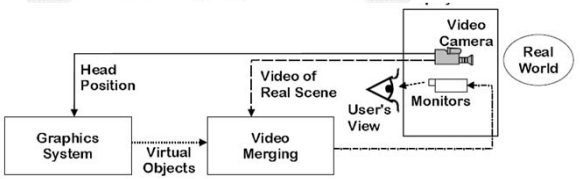
This kind of apps can be extended for setup and installation of electrical appliances (TV recorder and programmer, Hi-fi systems, home cinemas, game consoles, etc).

AUGMENTED REALITY TECHNOLOGY. CONCEPT AND PURPOSE.

Augmented Reality refers to the incorporation of virtual computer graphics objects into a real three dimensional scene. Azuma [Az95] defines three characteristics that are integral to an augmented reality interface:

- It Combines real and virtual.
- It is interactive in real time.
- It is registered in three dimensions.

Augmented Reality (AR) technology emerges as a nice resource which is accomplished to the latest developments in technology and entertainment. Looking forward to introduction of new tools and technologies we thought about developing a users' guide based on augmented reality for maintenance and configuration of devices and appliances of common use which may be available to everybody.



USER GUIDE AUGMENTED.

SCENE 1 & 2 USING HMD

SCENE 3 & 4 USING SMARTPHONE

AndAR

HIT LABNZ

REFERENCES

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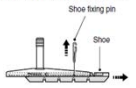
[AndAR] http://code.google.com/p/andar/

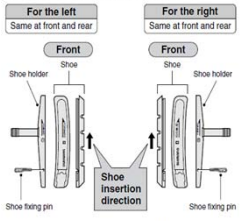
[Build_AR] http://www.hitlabnz.org/BuildAR

Replacement of the cartridge shoe

1. Remove the shoe fixing pin, and then slide the shoe along the groove to remove it from the shoe holder.



2. There are two different types of shoe and shoe holder to be used in the left and right positions respectively. Slide the new shoes into the grooves on the shoe holders while taking note of the correct directions and pin hole positions.

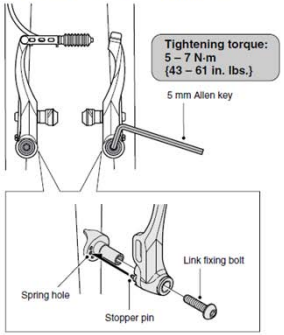


3. Insertion of shoe fixing pin is very critical to keep shoe properly fixed in place.

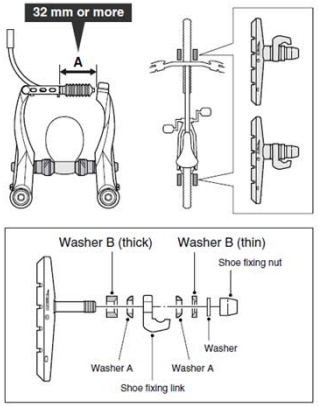
TRADITIONAL USER GUIDE

Installation of the V-BRAKE brake

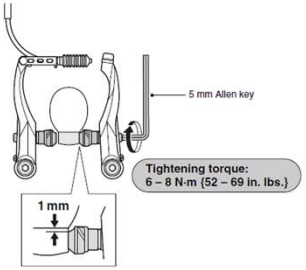
1. Insert the stopper pin of the brake body into the center spring hole in the frame mounting boss, and then secure the brake body to the frame with the link fixing bolt.



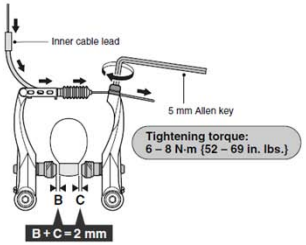
2. While holding the shoe against the rim, adjust the amount of shoe protrusion by changing over the washer B (thick or thin) so that dimension A is kept at 32 mm or more.



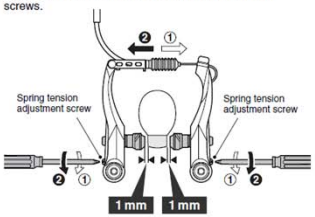
3. While holding the shoe against the rim, tighten the shoe fixing nut.



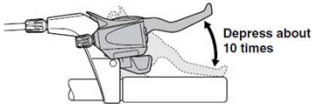
4. Pass the inner cable through the inner cable lead, and after setting so that the total of the clearances between the left and right shoes and the rim is 2 mm, tighten the cable fixing bolt.



5. Adjust the balance with the spring tension adjustment screws.



6. Depress the brake lever about 10 times as far as the grip and check that everything is operating correctly and that the shoe clearance is correct before using the brakes.



Installation of the brake lever

Use a 5 mm Allen key to install the brake lever.

Use a handlebar grip with a maximum outer diameter of 32 mm.

Tightening torque:
6 – 8 N·m {52 – 69 in. lbs.}

In the case of carbon handlebars, it may be necessary to lower the tightening torque in order to prevent damage to the handlebar. Please consult the bicycle or handlebar manufacturer regarding the appropriate level of tightening torque for carbon handlebars.