# Digital Eye: An Augmented Eye Mounted Display assisted Laparoscopic Surgery

Sri Vignesh. I, and Vishal.K

***Abstract*—**This paper proposes the visual limitation of the laparoscopy. It is an attempt to produce the imagery from the laparoscope in a goggles augmented with a digital display with which the surgeon can visualize the inner organs straight from his eyes wherever/however he turns his head. By also acquiring depth information, the 3D images of the structures can be rendered from the laparoscopic camera in the Digital Eye display.

***Keywords*—**Visual limitation, goggles Augmented, 3D images.

## I. Introduction

THE success of laparoscopy as a surgical technique stems from its ability to give the surgeon a view into the patient's internal spaces with only small incisions in the skin and body wall. Surgery done through such minimally invasive techniques leads to reduced trauma, shorter hospitalization, and more rapid return to normal activity.

## II. Typical Laparoscopic surgery

Laparoscopic surgery also referred to as minimally invasive surgery describes the performance of surgical procedures with the assistance of a video camera and several thin instruments. During the surgical procedure, small incisions of up to half an inch are made and plastic tubes called ports are placed through these incisions.[1] The camera and the instruments are then introduced through the ports which allow access to the inside of the patient.

Fig 1. A Typical Laproscopic Surgery

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The camera transmits an image of the organs inside the abdomen onto a television monitor.[1] The video camera becomes a surgeon's eyes in laparoscopy surgery, since the surgeon uses the image from the video camera positioned inside the patient's body to perform the procedure as shown in the following Figure.

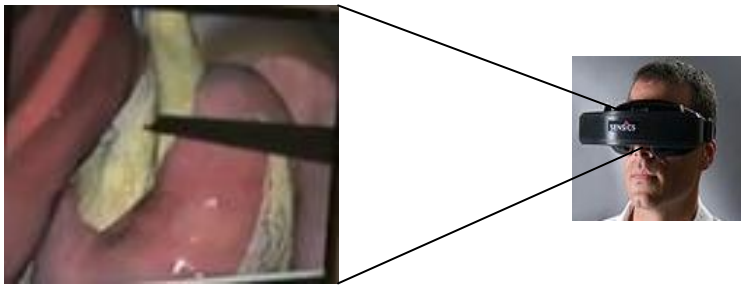
Laparoscopic surgery has transformed modern surgery and offers patients less pain, quicker recovery and shorter hospital stays, among other benefits.

But the following difficulties make this surgery very limited only to highly skilled surgeons.

- The surgeon can only estimate the depth of structures by moving the camera (to achieve motion parallax) or by physically probing the structures.
- The surgeon must frequently adjust the camera position and orientation, which requires skilled coordination with the assistant.
- The instruments' on-screen movements will not match the surgeon's hand movements. It requires experience and hand-eye coordination for a surgeon to adjust to this disparity.

## III. Digital Eye

Digital Eye, proposed in this paper, has the potential to reduce the problems caused by the visual limitations of laparoscopy. It is an attempt to produce the imagery from the laparoscope in a goggles augmented with a digital display with which the surgeon can visualize the inner organs straight from his eyes wherever/however he turns his head as shown in the following Figure.[2]By also acquiring information, the 3D images of the structures can be rendered from depth the laparoscopic camera in the Digital Eye display.



In Digital Eye, a high resolution virtual display will be provided[1]. This display is connected to a CCD camera of the laparoscope and the surgeon himself can mobilize the camera

with respect to the details in the visual field in his virtual display of the goggles.[1] The following is the overview block diagram of the project

The following key benefits are observed during the development of this project.

- It could reduce the average time for the procedures benefiting both physician and patient
- It will reduce training time for physicians to learn these procedures.
- It will increase accuracy in the procedures due to better understanding of the structures in question and better hand-eye coordination.

## IV. Benefits of Augmented Reality

Augmented reality (AR) refers to systems that attempt to merge computer graphics and real imagery into a single, coherent perception of an enhanced world around the user. Emerging AR technologies have the potential to reduce the problems caused by the visual limitations of laparoscopy. The AR system can display the resulting 3D imagery in the proper place with respect to the exterior anatomy of the patient.[2] By acquiring depth information and rendering true 3Dimages of the structures visible in the laparoscopic camera, the AR system gives the physician most of the depth cues of natural vision. (Exceptions include focus and visual acuity.) The display of the laparoscopic data is not limited to the current viewpoint of the camera, but can include data acquired from a previous camera location (perhaps subject to a limit on the length of time the data is considered \current"). Thus objects not currently within view of the camera can still be displayed by the AR system.[2] We want to emphasize that this technology is fundamentally direct than coupling a stereo laparoscope with a stereo display system. AR systems allow the surgeon to view the medical imagery from the natural viewpoint, use head-induced motion parallax (instead of hand-eye coordination and camera-induced motion parallax), allow the medical imagery to be visually aligned to the exterior anatomy of the patient, and incorporate proprioceptive (body-relative) cues. The lack of depth perception in laparoscopic surgery might limit delicate dissection or suturing [Durrani95]. An AR display presents objects in correct perspective depth, assuming that the geometry has been accurately acquired. With an AR guidance system, a laparoscopic surgeon might be able to view the peritoneal cavity from any angle merely by moving his head, without moving the endoscopic camera.[1] AR may be able to free the surgeon from the technical limitations of the imaging and visualization methods, recapturing much of the physical simplicity and direct visualization characteristic of open surgery.

## V. Conclusion

Digital Eye is definitely an innovative way to address the limitations in the current system of Laparoscopy.

This idea could be extended further as follows: Instead of display if we mount the camera and memory device on the goggle, this will find wide applications as spy devices in Defense and Detective Agencies.

## VI. Acknowledgement

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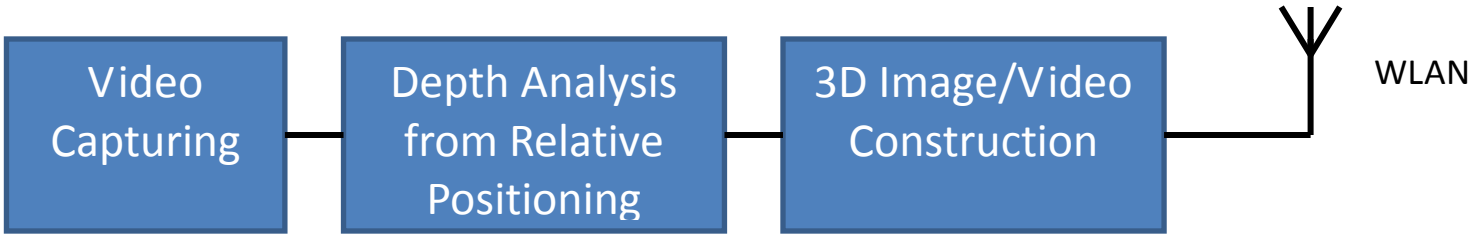
Patent Application Publication (10) Pub. No.: US 2013/0038707
US 20130038707A1
Pub. Date: Feb. 14, 2013
APPARATUS AND METHOD FOR USING
AUGMENTED REALITY VISION SYSTEM IN
SURGICAL PROCEDURES
Inventors: James S. Cunningham, Boulder, CO
(US); Peter M. Mueller, Frederick, CO
(US); James D. Allen, IV, Broom?eld,
CO (U S). H. Miller,

The following is an overview diagram of the complete project.

# Digital Eye – A System Overview

## Video Transmission Concept




## Video Reception Concept