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ORIGINAL ARTICLE

Design Laparoscopy Camera Vision System by Using Raspberry PI

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ABSTRACT

AIM: Design a laparoscopy camera system by using a small electronic board raspberry pi and including it with the appropriate programs to improve the doctor's image or video while using the device, in addition to the ease of carrying the device and transporting it in the workplace or training and with an efficiency that is no less than the traditional device available.

Methods: key component in this project is the 3-in-1 camera laparoscopy compatibility lens ,The light source with camera in front of the scope makes the training platform more realistic for the trainee .The design involves considering several important criteria, including the compromise with conventional one an Having enough workspace in the cameras field of view, easy Setup for users, making it more user-friendly and cost-effective for individual use by the trainee.

Results: evaluation of the overall system vision qualities , measurement , color of the video and image in hospital . The paper introduces an innovative viewing system that can be combined with a traditional laparoscope and provides the surgeon with a general view of the abdominal cavity.

Conclusion: Laparoscopy as a surgical technique has continue grow. The improvements to our video imaging laparoscopy system that is inexpensive, portable, and camera compact (Laparoscopy with Camera and Light (LDS) did not differ significantly from those obtained with conventional video laparoscopic.

Keywords: laparoscopic camera system , image vision ,raspberry pi **.**

INTRODUCTION

A. It is known that laparoscopy is the result advances in biomedical engineering**.**

The laparoscopic camera view was developed using open source resources. Laparoscopic surgery offers benefits for patients but presents surgeons with new challenges, including a limited field of view. [1], bringing it closer to open surgery conditions. Laparoscopic surgery uses a thin, tubular device called a laparoscope that is inserted into the abdomen through a keyhole incision to perform surgeries that previously required opening the body cavity to bring it closer to an open surgical condition.[2]

Laparoscopic surgery uses a thin, tubular device called a laparoscope that is inserted into the abdomen through a keyhole incision to perform surgeries that previously required opening the body cavity to bring it closer to open surgical conditions. The laparoscope itself is a long, rigid fiberoptic instrument that inserted into the body to view internal organs and structures. It is equipped with a miniature digital camera mounted at the end of the tube along with a light source. The operation is guided by the video close-up of such a camera and observed from the outside on a monitor.[3]

Camera laparoscopy offers surgeons a new perspective on the way surgical procedures are performed. Although they can adapt to most differences from standard surgery (eye-hand coordination, 2D vision, etc.)[4]

B. The use of laparoscopic surgery has become widespread in clinical practice, with acquisition of laparoscopic skills now essential for surgical trainees. However, the technical skills required are different from those required for open surgery; Depth perception is impaired by visualization on a two-dimensional screen, and tactile feedback is limited.

MATERIALS AND METHODS

ASystem Design

1 Hardware design

As shown in figure (1), the hardware was designed based on a Raspberry Pi 3 Model B and a laparoscopic camera (USP). A Raspberry Pi 3 is a miniature board computer (BC), an ARM processor-based embedded device that can be connected to any HDMI-supported LCD monitor or television (TV) Works with standard USB keyboard and - Mouse supported by USB devices or wierless. It boots from an attached standard memory card (SD).[5]

Raspberry Pi is made on integrated chips. It has its own random access memory (RAM), CPU, GPU, USB controller. We used it for its size, low cost, and ability to handle high-definition video. The camera is connected to the (BC) via a USB interface.[6]

These laparoscope are used in 5mm size and 2500mm length. The camera is attach to the top of a seamless, joint less stainless steel tube. The camera's cables connect to a USB connector mounted outside of the scope's mount. [7]

The system was powered by a 1200 mAh lithium polymer battery.

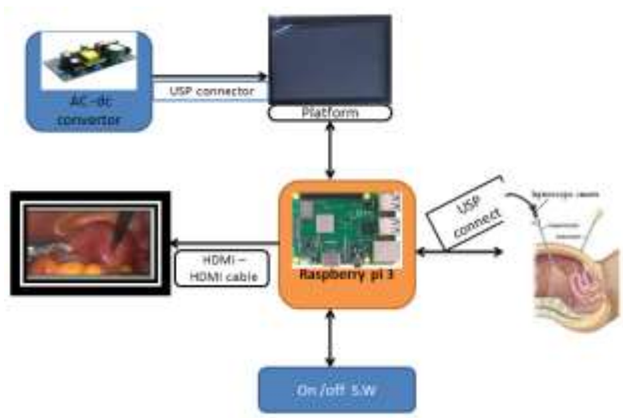

Figure 1: schematically system work and design .

2 the software part Software design includes: an Operating system program is Linux program (open source program) and Guvcview (GTK+ UVC)Viewer is a program that allows the camera to enhance the laparoscopic viewing, it is a graphical application for controlling a webcam accessible with Video4Linux (V4L2) and for recording videos and images[8]. It offers control over precise webcam settings such as exposure, brightness, contrast and frame rate. To run this version with USB cameras, use run: guvcview --cmos_camera=0 -d /dev/video0 -x 640x480 -r sdl -f yu12.[9]

As shown in Figure (2) System Configuration, enable the camera and program Download on the Raspberry Pi SD card.

B. Laparoscopic camera system vision: laparoscopic vision (LV) system clearly provided a view of the surgical scene, developed especially when the platform camera software provide very important filters like (mirror ,pieces, half mirror, particles, invert, sqrt lens, half invert, pow lens, negative pow2lens, mono, blur).[8],[10]

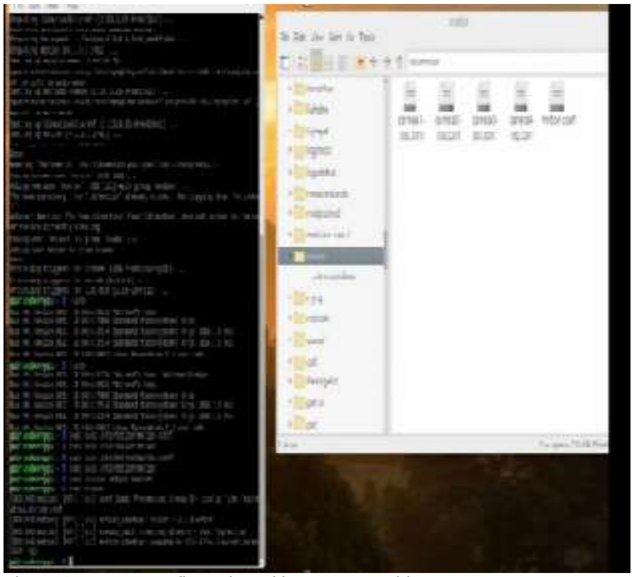
Figure 2: system configuration with camera enable

These filters are important and useful as they serve as an aid to the surgeon during the surgery, for example, they work to zoom in on the member's image and flip the image so that the display bug appears in front of the user. The abnormal is normal for the target organ, blue more than the rest of the colors, thus facilitating the contrast between the abdominal organs, half mirror This choice works to repeat one image twice to visit accuracy and focus, invert works on the heart of the member shown in the lower image to the top so that it is easier for the surgeon to focus More without movement of the surgical instruments inside the abdomen during endoscopy[10]. Half invert works to turn the top image down with the merger of the inverted and original images and works to bring the two images closer to the viewer to facilitate the required work. And his presentation to the surgeon, the pow2 lens brings the image closer together with the making of a water image so that the member appears as if it were in a basin of water, the mono works to filter the image from the colors so that It appears in black and white to show the edges of the target member.[11]


Figure3: training box and camera laparoscopy system device .

To evaluate how the device system works, we place a plastic liver in a boxing simulator as shown in figure (3).

The resulting image without activating any filters to enhance images and compare to the resulting image while activating one of the filters as shown in figure (4.a,b). The filter makes the image closer and clearer, which makes the job easier, saves the doctor's time and reduces the rate of errors when using the laparoscopy device.

The work was evaluated by doctors from Al-Diwaniyah General Teaching Hospital, who specialize in general surgery.

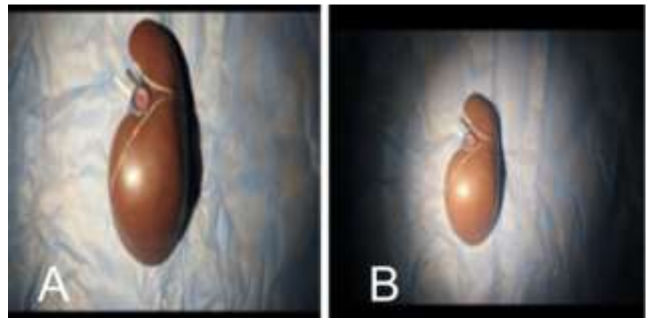

Figure 4: A. image with filter that clarify the image. B. image without any filter.[12]

DISCUSSION

As shown in figure (5) plastic (liver) organ approximate measurements is taken in the measuring ruler for the length and width of the organ to compare that measurement with captures of the same organ taken in box training with use the camera design system as in figure (6).Also the colors compare red, orange, yellow, green, blue and violet to image with laparoscopy camera and without . the images were capture on same devices making the same movements and orientation changes.


Figure 5: approximate measurements of plastic organ (liver) .

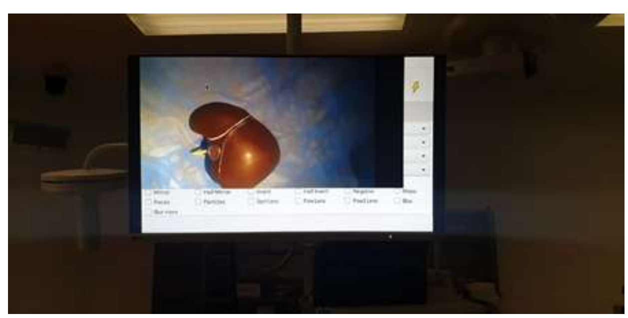
Figure 6: System design image .

In order to standardize the resolution of the image, the United States Air Force resolution test card (Edmund Industrial Optics, Barrington, NJ) is use to group vertical and horizontal lines in different measurements and the resolution is calculat as the smallest group of elements than can be clearly visualize (lines/ mm); [13]

the result Images are take to medical program for image compared and rotate at some positions on X axis ,Y axis and Z axis.where x and y ,z show coordinate of image . The pictures below in figures (7) show closeness in colors , sizes and measurements after analyzing in X Y Z axes and the measuring ratio is approximat 97%.

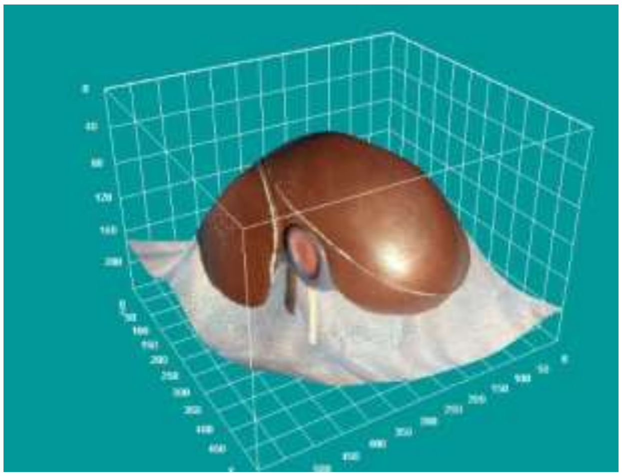

Figure 8: shows coloures, dimensions of organ the width and length of liver from X,Y,Z axis .

CONCLUSION

In order to be comparable with other existing conventional , an inexpensive and portable device was developed and improve the laparoscopic basic camera Skills of residents and surgeons, and comparison of the dimensions and color of the image generated by the camera, after the system is connected to special programs to enhance the images, in addition to comparing measurements.

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