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Enhancing Low Cost Camera Laparoscopic System Based on Embedded Systems: Raspberry Pi and Development a Platform Performance Quantitative

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Abstract---*A laparoscopic camera is a device used to view internal organs in the abdomen when a laparoscopic camera is inserted through a small incision in the abdomen. We use an embedded system to develop a low-cost laparoscopic camera and refine and evaluate the whole system. Small size production using various parameters to evaluate the usefulness of a portable, low-cost, camera-less laparoscopic simulator for training laparoscopy in abdominal surgery and the inexpensively of hospital environment constraints. Characterization of Raspberry Pi Embedded Compact system with perfect camera and image processing system. Design and compact, low-cost laparoscopic camera system and performance evaluation by hospital staff.*
Keywords---*camera laparoscopy, enhance vision, platform performance, raspberry pi*

Introduction

a) Laparoscopy is a surgical diagnostic procedure to examine the abdominal organs. This is a low-risk that only requires small incisions. In laparoscopy, an instrument called a laparoscope is used to look at the abdominal organs. The laparoscope is a long, thin tube with a high-intensity light source and a high-resolution camera in front of it. The instrument is inserted through an incision in the abdominal wall. When you move, the camera sends images to the video monitor. Laparoscopy allows the doctor to look inside the body in real-time without open surgery (Boutelle et al., 2019). The name of the surgery comes from the instrument used to perform the procedure, the laparoscope. This medical instrument is equipped with a small backlit video camera. The surgeon makes small incisions and inserts the laparoscope into the body. The surgeon can look at the display to see what is problem (Jawale et al., 2019).
b) A laparoscopic camera allows the doctor to look inside the body with Illumination of the operational field. The spectrum of the emitted light is similar to daylight. A small part of the infrared component allows for avoiding tissue burns and optical system overheating. In laparoscopic cameras as with standard definition endoscopy systems, most HD Camera Heads acquire image data from the telescope (Chen et al., 2016). Image quality, however, will depend on the camera acquisition standard that's been put on a given HD system, Pulling back the telescope slightly can make amends for losing in vertical field of view. Another positive effect is the fact that a telescope positioned further in the site of surgical interaction catches less debris and smoke on the front window, improving image quality (Ali et al., 2018). All cameras need White balancing, Focus manual /auto and Some cameras have options of Zooming useful for finer dissection. Digital enhancement provides sharper images (Omote et al., 1999; Kourambas & Preminger, 2001).
c) The laparoscopy camera is an innovative vision system that can be combined with a traditional laparoscope, and provides the surgeon with a global view of the abdominal cavity, bringing him or her closer to open

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surgery conditions. The first experiments performed on attest bench mimicking a laparoscopic setup: demonstrate an important time gain in performing a complex task consisting of bringing a thread into the field of view of the laparoscope (Lazarus & Ncube, 2021).

d) The absence of visibility of the entire surgical scene in laparoscopic surgery can lead to unforeseen intraoperative complications. An Enhanced Laparoscopy Vision System (ELViS) was developed to eliminate the *blind spots* of the traditional endoscope by providing a broad view of the surgical scene from a distance, thanks to two additional images. This was assessed whether the broad view provided by the Enhanced Laparoscopic Vision (ELV) helped the surgeon to detect and react to an unexpected intraoperative adverse event (simulated hemorrhage) occurring while performing a standard task (Cartucho et al., 2021).
e) Minimally invasive surgical techniques (MISTs) could have tremendous applications and benefits in a low-resource environment. These include but are not limited to a short hospital stay, reduced cost of care (pain medications, etc.), and reduced morbidity, especially related to postoperative infections (Gheza et al., 2018).

Materials and Methods

System design

1) Hardware design

As shown in figure (1) the hardware was dsigned based on a Raspberry pi 3 Model B and a USP laparoscopy camera.The Raspberry Pi is a controller that can act as a computer CPU, much like a desktop computer CPU. It also has USB ports, an HDMI port for connecting to a monitor, a memory card (SD) slot for storing the operating system and other programs or data. It also uses a wireless mouse and keyboard to control the system , the laparoscopy are available in 5, 8 and 10 mm sizes. The camera is installed at the top of the seamless joint free 5mm, 8mm and 10mm stainless steel tubing. Camera cable connected to the USB connector on the outside of the scope mount. The scope mount is ready made of heat-resistant polymer . Thermoplastic used in precision parts that require high rigidity, low friction and excellent dimensions Stability. The focal length is 2 to 20 cm, and white balance, shutter, aperture and colors are automatically adjusted Camera (Lian et al., 2013). The system is fed with electrical energy by a USP portable charger that has a high capacity external battery and dual output with LED status indicator.

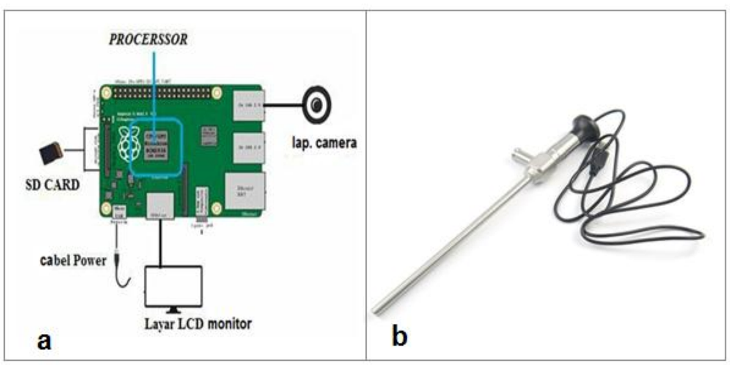


Figure 1. A –schematic shape of system component and connection. B –USP laparoscopic camera

2) The software part

Software design includes: the development of programs for embedded systems and the development of programs for applied systems using databases. The embedded system program was developed according to the features of the hardware system, which mainly focuses on hardware control. The program was loaded into the PIC microcontroller. Linux program, which is a multiplatform programming language. Therefore, the system configuration is run directly on the Raspberry Pi as shown in figure (2). The software can be downloaded directly. Guvcview is a camera program (application system program development) that is use, this package provides various views to video different aspects of the controls, such as how they are managed and how they appear on specific client software, control the resolution, frame rate, type of camera that use and camera output like MJPG-MOTION-JPEG.

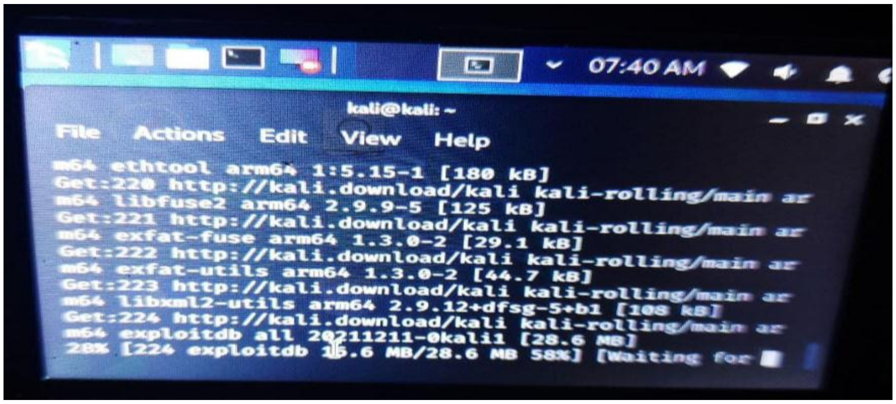


Figure 2. System configuration

3) Systems work

In the system block diagram shown in Figure (3) below, the imaging system consists of three main modules:(Laparoscope, Illumination, Camera)compact part, Controller, and data acquisition. The laparoscope module consists of a standard 10mm surgical laparoscope with a zero degree field of view, a 4mm laparoscope with a length of 2500mm, and a compact light guide, a 659x494 pixel GigE color camera, and a 405- nm blocking filter.

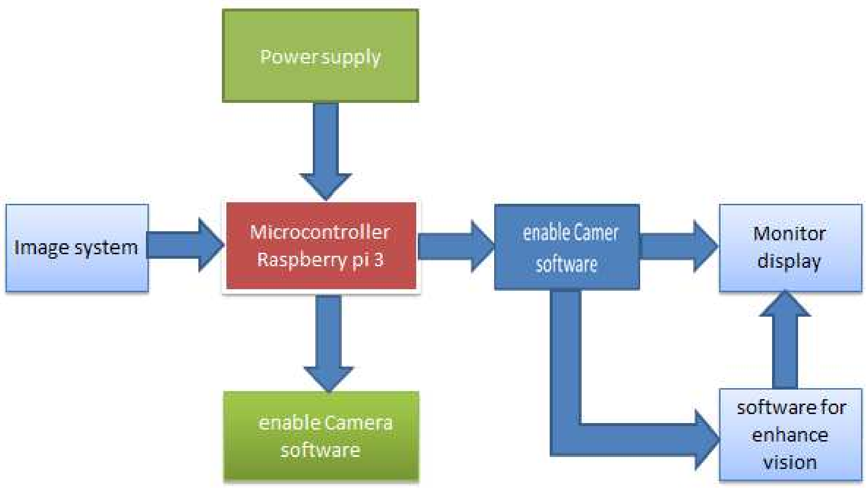


Figure 3. Block diagram of system work

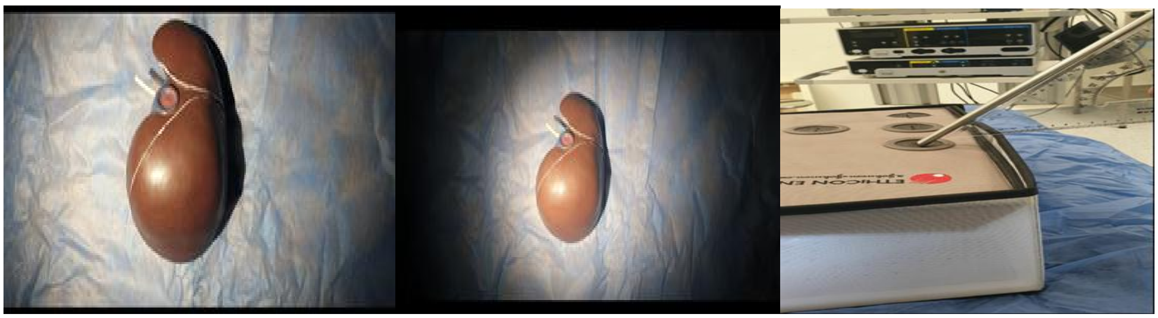
Discussion

1) Camera image and video display enhancing

The Raspberry Pi is a small, low-cost computer that allowed the easy, real-time recording of the three video feeds (laparoscope camera) for the experiments. The cameras' system orientation in angle was maintained similar to that of the laparoscopic conventional in the hospital since it was rigidly fixed to the trocar. The Enhanced laparoscopic vision (ELV) system clearly provided a wider view of the surgical scene, especially when the platform camera software provides very important filters like (mirror, pieces, half mirror, particles, invert, sqrt lens, half invert, pow lens, negative pow2lens, mono, blur) (Huettl et al., 2020).

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 (Amin et al., 2021). 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 (Trilling et al., 2020; Sharpe et al., 2005; Morgan Jr & Rader, 1992; Bahsoun et al., 2013).

The image below in figure (4) was obtained using a simulator with an inexpensive laparoscopic system with a camera and activated filters for the image enhancement system. to evaluate the operation of the device we take a plastic liver in a boxing simulator.



A B C

Figure 4. A .image that enhances when choosing the filter that clarifies the image .B. image without a filter. C.laparoscopic camera in box trainer

Once the template was produced, it was time to integrate all the development work to make a complete interface. These configuration controls are to be displayed to the doctor that uses them. The software package provides various views to video different aspects of the controls, such as how they are managed and how they appear on specific client software, control of the resolution, frame rate, type of camera that use, and camera output like MJPG-MOTION-JPEG. The finally available version of the laparoscopic system can solve 2 main tasks. The program's interface, as in figure (5), has an LCD screen that allows you to control its operation with the "Resolution" button, video controls, and options (Gettman et al., 2002; Gettman et al., 2004; Vilos et al., 2007).

System work and control options and their benefit were evaluated by doctors at-Diwaniyah General Hospital.

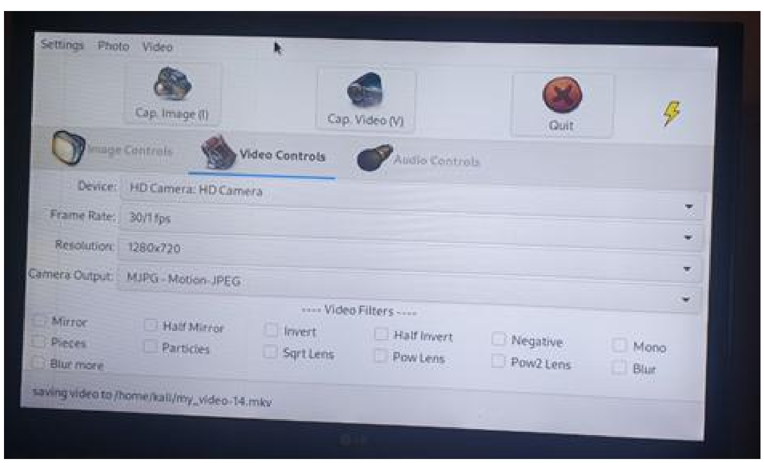
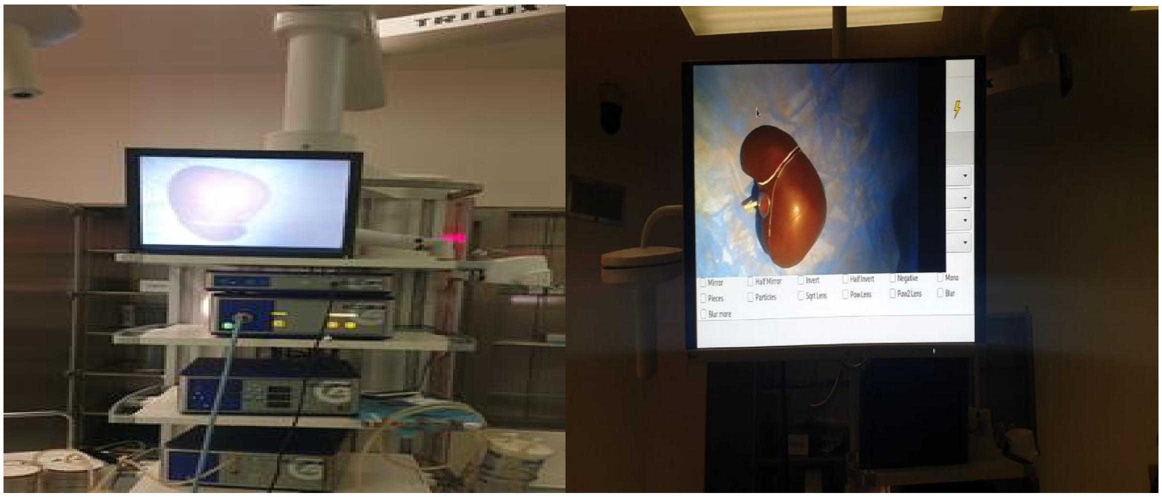


Figure 5. Show camera control system

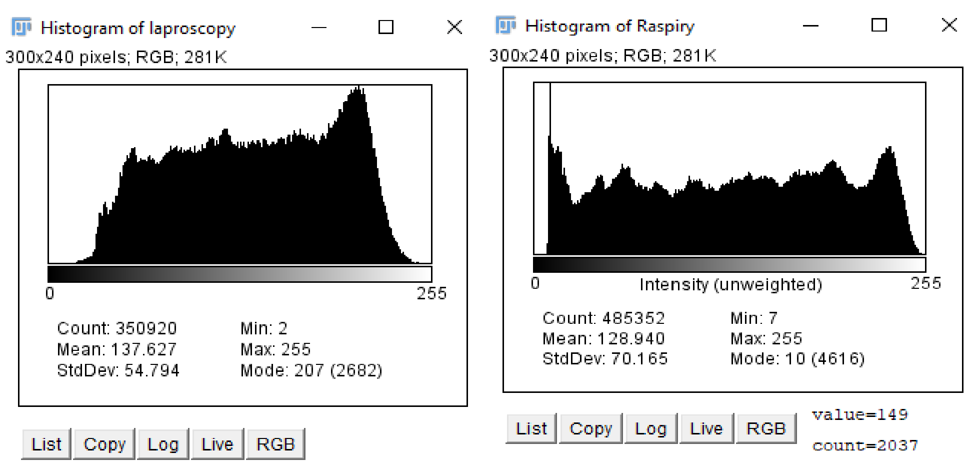
2) Camera image

The image quality of individual cameras is an approach to that produced by a traditional single-camera laparoscope, that by comparing the color tones of the image displayed on the monitor with a hospital laparoscopic system and image enhanced camera system, this image is shown in figure (6.a,b) (Watras et al., 2020). A histogram is a plot that lets us represent data points that lie in a range of values called classes or bins creating a frequency distribution of a continuous set of data. This allows for the inspection of the data for its underlying distribution (e.g. normal distribution), outliers, etc. Being one of the seven basic tools of quality control it is one of the most widely used ways to represent any data for statistical analysis. histogram, a diagram similar to a bar chart, but which represents a set of continuous, rather than discrete, data that benefit, in this is useful in our research to get a continuous chart of the image data in same pixels and compare shown in Figure (7.a,b).



A **B**

Figure 6. Camera image with: A. traditional laparoscopic camera in hospital. B. enhanced laparoscopic camera system



A **B**

Figure 7. Histogram of the liver image with A. conventional laparoscopy camera in hospital. B. low-cost camera system

Conclusion

Laparoscopy has been around for over a century, but there are still many areas that need improvement. In this work, a Raspberry Pi-based device in combination with its Usp Camera was successfully used as a low-cost laparoscopic system. This underscores the need to reduce the cost of the laparoscopic camera in low-income communities and provide most of the equipment needed for training while maintaining imaging and operational efficiencies New and innovative solutions to improve the laparoscopic camera are expected to continue to be developed. This article highlights some of the notable recent developments in laparoscopic technology, from imaging systems to camera improvements. To date, developments have been made for the laparoscopic viewing system, including improvements in viewing angle and field of view, and image sharpness (Eubanks et al., 1999; Pincay & López, 2022; Muliarta, 2016). Future research should continue to work towards increasing the surgeon's experience and skill where they will exert less effort.

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