

Gastrointestinal Wireless Capsule Endoscope for Diagnosis and Therapy

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Abstract— This paper describes about capsule technology in medical field. Capsule endoscope is a device which allows the physician to visualize GI tract. Diagnosis and therapy plays an important role in medical field. This device consists of camera and sensors for real-time visualization of GI tract. Sensors such as thermistor and flow sensor used to sense temperature and blood flow rate in GI tract. By using projectile motion and switching circuits along with motors, targeted drug delivery is achieved. Gastrointestinal wireless capsule endoscope has been designed and demonstrated with the help of electronics. In near future, this technology can extend to tissue sampling and this can implemented using nanotechnology.

Key words: Projectile motion, Camera, Sensors, Capsule

I. INTRODUCTION

Traditional endoscopy was a non-surgical procedure which helped the physician to view person's digestive tract. In this traditional method, a flexible tube with light and camera affixed in it, was inserted into patient's body to examine digestive tract. Traditional endoscopic method failed to view the extremities of intestines and so capsule endoscopy technology evolved.

Earlier wireless capsule endoscopes are used for detecting and diagnosing the GI tract diseases such as crohn's disease, small intestinal tumours and obscure gastrointestinal bleeding. Initially wireless capsule endoscope was designed as non-invasive drug delivery method at the targeted region of human body, it also helps to get the information of drug absorption in intestinal tract [2]. In order to obtain the better result, tracking of capsule endoscope was developed [6]. It has used the magneto resistive sensors for tracking of capsule endoscope. Later digital based low power IC was designed, which was enclosed within the wireless capsule, so that power can saved up to 46% [5]. Tracking of capsule endoscope was further developed to controlled navigation and it was achieved by magnetic shell [1]. Targeted drug delivery can be achieved by two novel subsystems such as micro positioning and holding mechanisms [4]. Lately, the first holding mechanism of GI tract natural peristalsis was developed by the exploitation of mechanical components like micro actuators and conventional manufacturing techniques, which occupies 9% of total volume [3].

This paper gives the description about the emerging capsule technology along with electronic and sensor parts. Electrical part consumes less power and it becomes the advantage in this paper. Sensor is an additional support in this paper and it help us to sense and measure the temperature and blood flow rate at the extremities of intestine. The description also comprises of projectile mechanism and holding mechanism of capsule electronically and also the real time videos are saved for further study. Targeted drug delivery is achieved by using DC gun along with driver circuits.

II. BLOCK DIAGRAM

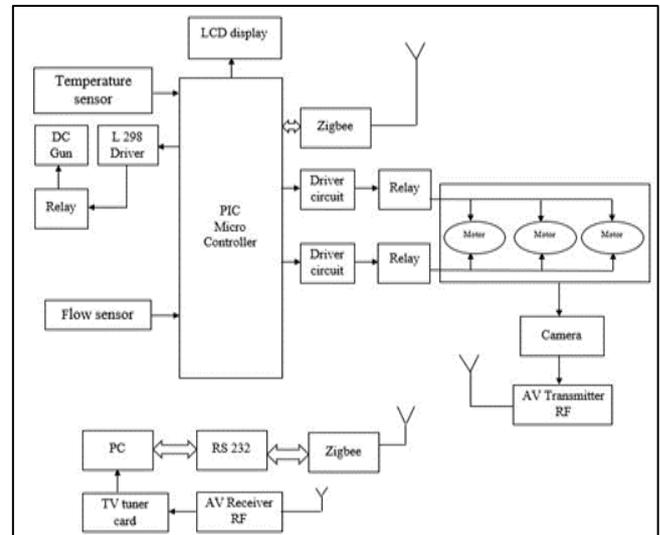


Fig. 1: Block diagram

PIC microcontroller is a central processing unit and controls the entire process occurring within the module which has an erasable and rewritable memory. DC Gun is used to deliver the drug with a help of preprogrammed L298 driver. Zigbee is used to collect data between PC and hardware module. Driver circuit is used to control other components. Relay is a switching circuit. Here two relays are used. If one relay is in the OFF state then the other will be in the ON state and vice versa. Relay is coupled with a motor which produces to and fro movement. RS232 is a serial port, which connects PC and hardware module. New data can fed through this port and can receive data. Camera is used to record the process and can be viewed later by using PC. In order to view the image, the frequency is adjusted by using TV tuner card. Temperature and flow sensors are used to measure changes in temperature and blood flow in GI tract by using LCD display. RF transmitter and RF receiver are used to track the location of the capsule.

III. HARDWARE DESCRIPTION

Hardware includes electronic components interconnection, which used for operation of analog or logic on received data and stored information to produce as an output. This section describes about the major parts used in the module such as sensor, transmitter and receiver, drug delivery, display and camera.

A. Sensors:

Two types of sensors are used namely temperature sensor and flow sensor. The purpose of using temperature sensor is to measure the present temperature in the GI tract and flow sensor is to measure the blood flow rate at the targeted region.

B. Transmitter and Receiver:

Zigbee is used to collect the data from sensor parts and send to processing unit. In general, Zigbee plays a major role in data transmission and receiving. RS232 is a standard serial port for data communication between the hardware module and PC. New data can be fed to the hardware module through RS232.

C. Drug Delivery:

Targeted drug delivery is achieved by using DC gun with a pre-programmed L298 driver. It works on the principle of projectiles. The to and fro motion of the DC gun will deliver the drug at the targeted region in the GI tract.

D. Camera:

Camera is used for real time imaging and the images can be viewed in PC with the help of RF transmitter and receiver.

E. Display:

LCD and PC are used to view the result. Also real time imaging of GI tract is possible and can be viewed in PC. This visualization of image can be saved for further study.

IV. SOFTWARE DESCRIPTION

Visual basic is used for embedded works. Visual basic 2008 – 4.0, 4.5 primo framework are used for biomedical applications. It is a basic programming language which will arrange and control the components in the form based.

The VB coding initiate ports and capture devices followed by initializing integers for making all inputs null. Then the form is designed with text box, label box, combo box, picture box and buttons. All the external components have to be connected to get the input and instructions were given to operate the module through PC for getting the output.

V. RESULT

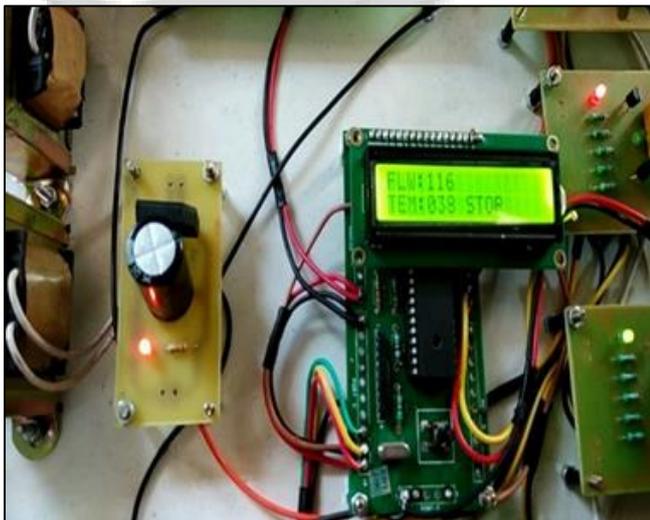


Fig. 2: LCD display

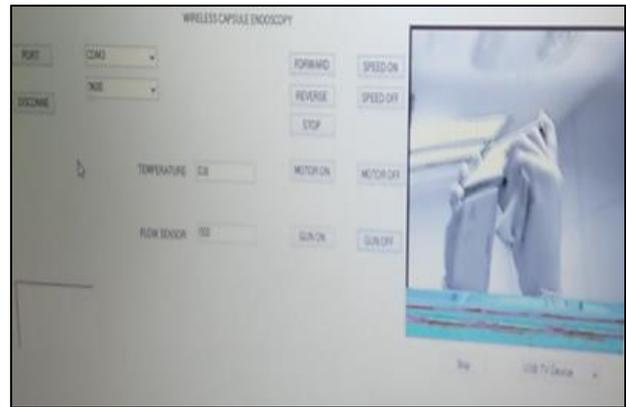


Fig. 3: PC display

The temperature, blood flow rate and motor conditions were displayed in the LCD display, further the drug delivery to the targeted site was sensed using DC gun. Also the output can be viewed through PC and it can be saved for future study.

VI. CONCLUSION

In this paper we designed about targeted drug delivery in GI tract and also measured the parameters like temperature and blood flow. Low power consumption and reliability makes this project efficient and also it reduced the working time. In the future, this idea can be extended to tissue sampling and this can be implemented in nanotechnology to compress the size of the capsule endoscope.

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