

# BLOOD GROUP DETECTION USING FIBER OPTICS

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**Abstract**–The fiber optic system plays a major role in modern electronic communication system. The principle of fiber optics is also used in many modern medical electronic fields like endoscopy devices. The optical property variation paves the way for selecting the fascinating project titled “Blood group detection using fiber optics” in determining the various blood groups of a human body. The analog input actuates a LED. The light pulses from the LED are allowed to fall on blood samples by using optical fiber cables. The other end of the optical cable is coupled to a pin-photo diode, which acts as a photo detector. Due to the optical variations of different blood groups there will be corresponding voltage variations in the output of the photo detector. Thereby we can identify the blood group easily.

## 1. Introduction

Determination of blood groups of a human being is a vital factor. Man by nature has any one of the blood groups namely A, B, AB and O. The blood group “AB” is called the “Universal acceptor” and the people with the “O” group are called “Universal donors”. During blood transfusion any mismatch can lead to the death of a person. Hence it is of utmost importance for every person to identify his/her blood group.

Blood grouping done so far is a manual process. As far as hospitals and blood banks are concerned, a number of blood samples have to be identified within a short span of time. The manual process is a laborious and time-consuming one. Hence we have to devise a new instrument cum method which eliminates all types of problems associated with conventional methods. The better choice is fiber optics.

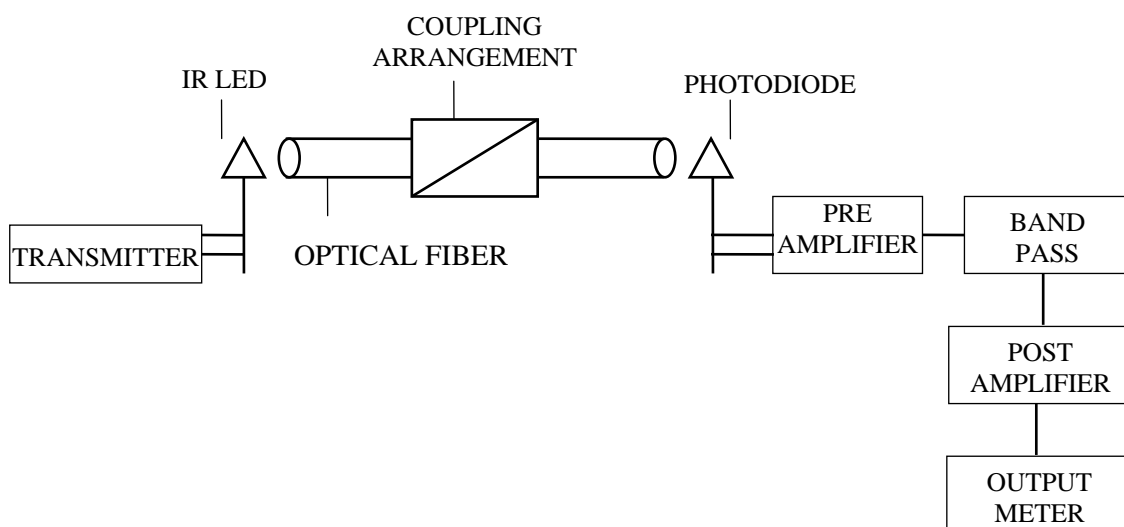
Fiber optics is a very important constituent of modern technology. The medical electronics finds numerous applications in the fiber optics field. In this project, we employ an optical fiber sensor that modulates the measured and yields variations in the electrical output for various blood groups. This variation is sufficient for the identification of blood groups.

In this paper, we have explained the use of fiber optic sensors to determine various blood groups. As said by Arthur C. Guyton [1], the principle “Optical properties of various blood groups are different” has been the basic underline for the development of this work. Bishnu P. Pal, Cherin and Keiser have stated the advantages of optical fibers when used as sensors [2-4]. These sensors convert the optical variations into electrical variations, which can be calibrated to identify the blood groups.

## 2. Overall operation

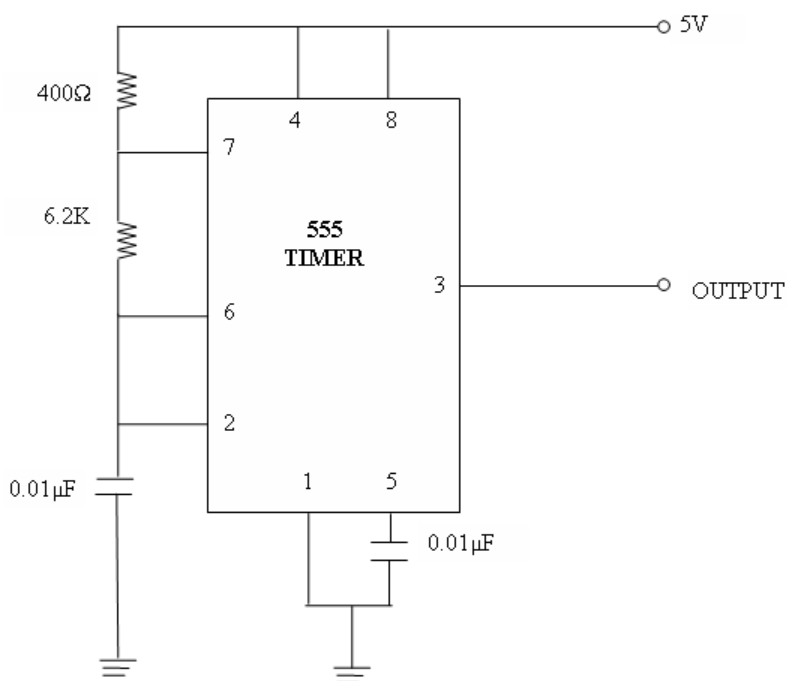
Figure 1 shows the block diagram of fiber optic sensor. The transmitter generates pulses of frequency 10 KHz. These pulses are amplified and fed to the LED, which converts the electrical variations into optical variations. The optical signals are launched into the fiber. They pass through

the blood sample and are received by the receiver which converts optical variations back into electrical variations. These electrical signals are amplified, filtered, rectified and then fed to a capacitor filter which changes to a voltage which is different for various blood groups.



**Fig. 1.** Block diagram of fiber optic sensor.

## 2.1. Transmitter



**Fig. 2.** Transmitter circuit.

The main function of optical transmitter is to convert electrical signal to an optical signal. Any time varying electric current can be used to modulate an optical source such as a LED or laser diode to produce an optical power output. The optical signal coming out of the transmitter “1” is represented by the optical power of duration  $T_b$ , where “0” is the absence of any light pulse for the time  $T_b$ . The transmitter circuit is shown in Fig. 2.

## 2.2. Receiver

The design of an optical receiver is more complicated than that of an optical transmitter because the function of a receiver is to detect weak and distorted signals and to determine the nature of a signal whether it is analog or digital. The source generally used in optical fiber communication system is a two level binary digital system consisting of “1” and “0”. Each has a time slot duration  $T_b$ . This time is known as the “bit period”. One of the simplest methods of such data is an amplitude shift keying [5-8].

In amplitude shift keying method the voltage level is switched between two values, which are usually “on” and “off”. The resultant voltage signal waveform consists of a voltage pulse of amplitude  $V$  relative to zero voltage level. When the amplitude is  $V$ , then a binary “1” occurs and it is transmitted, so that a voltage pulse of amplitude  $V$  and of duration  $T_b$  occurs at the output. When a “0” is sent, the signal voltage remains at zero for the period  $T_b$  at the output.

The optical signal emitted from the light source is coupled to one end of a fiber, and it gets attenuated and distorted as the light pulse reaches the other end of the fiber. The optical signal is detected in the receiver with the help of either a P-I-N photo diode or an avalanche photodiode which converts the optical signal back to the original electrical signal. Of course, the original signal is further attenuated and distorted in the detector. Then the signal coming out of the detector is amplified and filtered (Fig. 3).

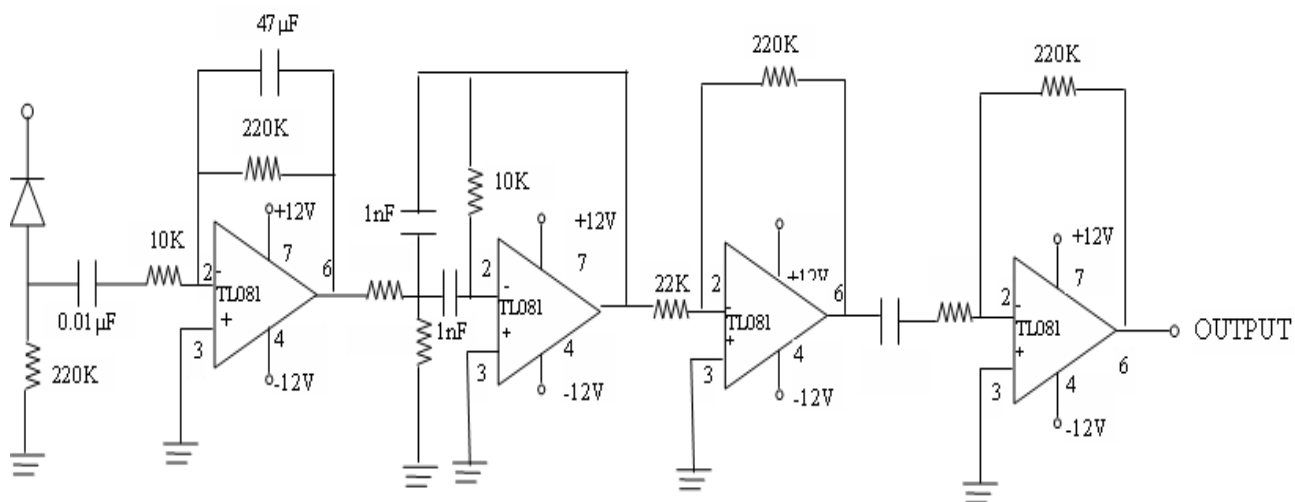


Fig. 3. Receiver circuit.

A decision circuit compares the signal in each time slot  $T_b$  to a certain level, which is known as a threshold level, a “1” is said to have been received. If the received signal is less than the threshold level, a “0” is assumed to have been received.

In a digital receiver the amplified and filtered signal coming from the equalizer is compared to a threshold level once per unit time slot to determine whether or not a pulse is present at the photodetector in the time slot. In an ideal case the output signal would always exceed the threshold

voltage when a “1” is present and would be less than the threshold voltage when no pulse was sent. But in actual systems, there are deviations from the average value of output signal. These deviations are caused by various noises, interference from adjacent pulses and conditions wherein the light source is not completely extinguished during zero pulse [9-11].

### 3. Conclusion

The developed instrument was tested in hospitals for various blood samples. The voltage levels that were shown for various persons are noted. The blood group detected by the instrument was compared with that of the conventional method. Therefore, the voltage levels that are fixed for various blood groups are:

Voltage level (V)	Group
0.2–0.6	A
0.9–1.2	O
1.5–1.9	B
1.4–1.5	AB

Reference voltage is equal 5 V

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