Bile Pigments Detection via IR Sensor

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Abstract— **Since the jaundice disease first detected, there were increases in percentage every year with newborn babies usually on the second and third day. This disease caused by the abnormal bilirubin level in the blood. Jaundice is a condition in which a person's skin and the whites of the eyes are discolored yellow due to an increased level of bile pigments in the blood resulting from liver disease. Therefore, it is essential to detect this disease earlier to avoid more chronic disease in future. There are many ways to detect the jaundice that include one of the newborn screening (NBS) test which are by see the physical of baby and by measure the bilirubin level in baby's blood. This paper presents a portable and economical bilirubin meter that successfully measure the bile pigments level via IR sensor. By using PIC microcontroller, the system effectively detects three conditions which are normal, mild and critical jaundice. The complete system is described and several methods including the best treatment are also outlined.**

Keywords: Bilirubin meter, newborn screening, IR sensor, PIC microcontroller

I. INTRODUCTION

BABIES, sometimes, are not born normal or healthy due to various conditions occur. In most countries, these conditions can be detected through a certain test called Newborn screening (NBS) test. NBS is the process of screening newborn babies for metabolic disorders, genetic diseases, endocrine, treatable genetic, hematologic diseases or blood diseases [1][2]. It is also called Infant Screening Test, Neonatal Screening test [3] or Guthrie Test [4]. There are over 30 rare disorders can now be detected by this test and it is include the jaundice disease.

There are various ways of detecting jaundice. According

to [5], there are four steps to detect jaundice physically, before getting immediate medical assistance if symptoms exist. Firstly, check the skin for yellowish or brown staining. Press your finger gently on the face or nose. If the skin looks yellow where pressed, jaundice is likely. It is usually most notable in the face, but can also be detected on the chest, abdomen, arms and legs. Secondly, check the whites of the eyes for the same yellowish or brown staining. Thirdly, notice listlessness, sluggishness and difficultly waking. These can be signs of severe jaundice. Lastly, check the gums and inner lips for yellowish discoloration. This is especially important for people with darker skin color as yellowish discoloration may be harder to detect on skin.

There is a non-invasive method which is Transcutaneous bilirubinometer (TcB) are used currently, where it measures the transcutaneous bilirubin level of the infants [6]. It is an alternative besides visual examination before getting blood tests, if needed. Furthermore, most hospitals use this meter as total bilirubin concentration; a useful tool to monitor neonatal jaundice [7].

Another method which provides accurate and promising results is through blood tests. In this test, there are procedures and steps to follow. In this paper, the bilirubin [8] detection via IR sensor was used at the second step of testing, which is after centrifugation process (having blood serum and corpuscle from the baby's blood).

II. PROJECT DEVELOPMENT

The block diagram for the development of Infant Bilirubin Meter (IBM) is shown in figure 1. The input for PIC microcontroller is an infra red sensor which receives the lights that reflects from the sample. The light is passed through the sample inside the black box in order to have persistence of lights. The outputs are LCD display, LEDs (green and red) and buzzer that will demonstrate the condition of the disease.
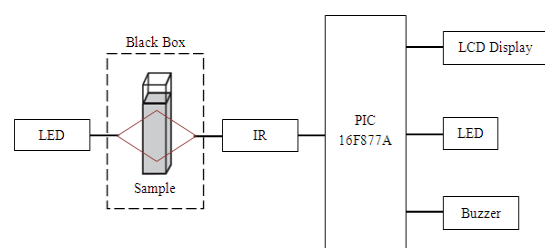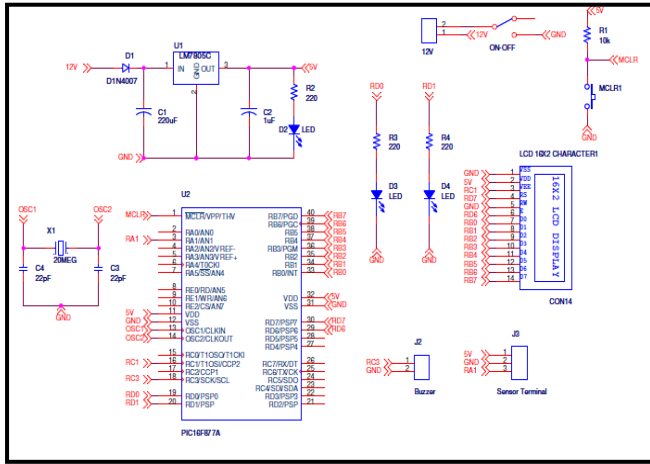
Figure 1: IBM Block Diagram

Figure 2 shows the full schematic circuit used in this IBM which consist of power supply, sensor (LED and IR receiver) and microcontroller circuit (include LCD, LED and buzzer).

Figure 2: Full schematic circuit of IBM

III. RESULTS AND DISCUSSIONS

The IBM measures bilirubin concentration by utilizing the entire spectrum of visible light (380 to 760 nm) reflected by the blood serum. This spectrum was received by the IR receiver sensor and sent to PIC microcontroller in voltage form. The PIC analyzed accordingly as in table 1 and the conditions applied are normal, mild and critical jaundice. In this study, the sample of blood serum is replaced by a yellow liquid with different concentration.

Table 1: Range of conditions

Condition	Serum concentration	Voltage range
Normal	0< thick <10mg/dl	4V – 6V
Mild	11< thick <19mg/dl	2V – 4V
Critical	Thick>20mg/dl	0V – 2V

The measurement had taken four times to ensure the results were accurate and reliable. Figure 3 indicates the voltage values in different concentration of sample that has been received from the IR sensor. This encouraging results has proven that IBM successfully specified all three jaundice condition.
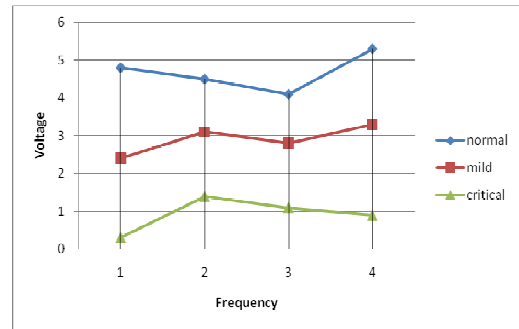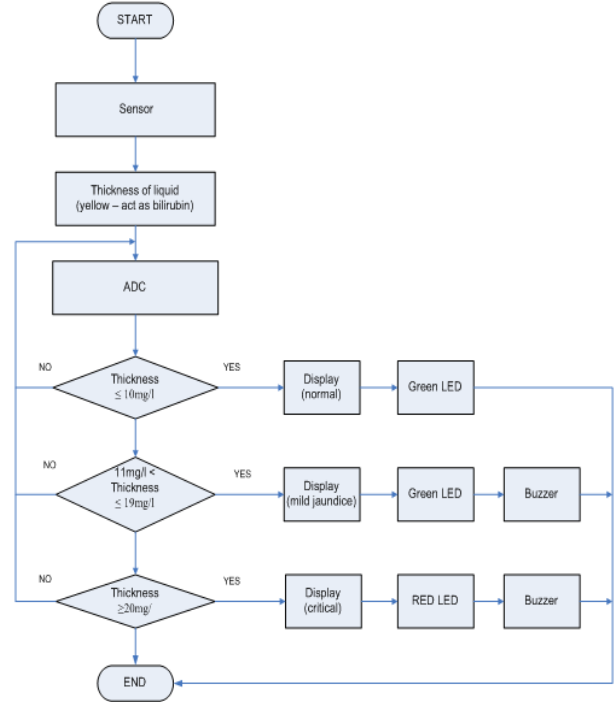

Figure 3: Voltage in different concentration

Figure 4: Flowchart of output results

Referring to figure 4, the output of the IBM depends on the input of IR receiver sensor. The green LED will light up when PIC detects both normal and mild conditions. However, the red LED is for critical condition. A buzzer act as a warning alarm and it applied only to both mild and critical conditions. These conditions will appear at the LCD display including the range of bilirubin level.

The main and best treatment used to treat jaundice is phototherapy [9]. This treatment applied to both mild and critical condition. However, for the critical level, probably an exchange blood transfusions may occur depends on the age and health status of the newborn [10][11]. High level of bilirubin can be affected the hearing and baby brain [12]. There are also other ways of treatment for the mild level, which is leaving babies in the early morning sunlight for an hour. But, it is unadvisable to expose to the direct sunlight for prolonged period where it might get sunburn [9].

There are also an alternative treatment for this disease which is through natural home remedies [11][13]. Normally, it helps to prevent the disease for early discharged infants and moreover, it usually uses traditional way which has been practice for a long time ago.

IV. Conclusion

Severe diseases usually attack most of newborn babies, depending on health status in current state. In fact, jaundice disease is one of the most occur within days after born due to high level of bilirubin in blood. Therefore, a system that detects the bile pigments via IR sensor has been developed. The results successfully indicates the three conditions of jaundice; normal, mild and critical level. The IBM is said to be economical and portable tool as to be a reliable machine for future development especially in medical field.

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