

Smart Bleeding Detector Using Computer Towards Better Healthcare

Mohamed Y. E. Simik, Feng Chi, Randa S. I. Saleh, and Abdeldime M.S. Abdelgader

Abstract—This paper presents smart bleeding detector using computer towards better healthcare, which consists of bleeding sensor, bleeding detector unit, RF transceiver, GSM alarm system and computer. When the medical gauze is wet with blood, the resistance between the spaced fine conductors falls below a pre established value, the bleeding detector being operative. Consequently, RF transceiver sends a wireless signal to the GSM alarm system, then GSM system sends signal to the computer (Healthcare applications) to switch on a warning informing intended persons that such bleeding is occurring.

Index Terms—bleeding detector; RF transceiver; GSM door sensor; mobile call GSM alarm system; SMS; Computer.

I. INTRODUCTION

Bleeding is blood escaping from the circulatory system. The complete loss of blood causes death. Stopping bleeding is an important part of both first aid and surgeries. It can refer to blood loss in the body (internal bleeding) or blood loss outside of the body (external bleeding). This paper presents an automated bleeding detector and alarm system integrated with computer using an advanced RF transceiver, GSM system and computer gateway to gives an alarm on the detection of bleeding in the medical gauze. The bleeding sensor consists of an elongated pair of fine conductors positioned between the layers of a medical gauze in a region liable to witness bleeding. The end of the sensor protrudes from the upper front portion of the medical gauze and terminates at pressing studs. A bleeding detector unit and RF transmitter are adapted to be easily coupled to the protruding end of the elongated sensor and configured to monitor the electrical resistance between the spaced fine conductors of the detector. When the medical gauze is wet with blood, the resistance between the spaced conductors falls below a pre established value. Because of this, RF transmitter sends a wireless signal to the RF receiver and GSM system forwards the signal to the computer application to produce the alarm informing intended persons

bleeding is occurring [1],[2],[3],[4].

There are several commercial products and research prototypes aiming to solve this issue, such as Dia-Care system, it includes intelligent blood detection to provide the haemodialysis user with highly improved safety. However Dia-care is expensive and appropriate for specific cases.

Also, a blood-pressure-monitoring system with an alarm/alert system may impede the movement of the patient[5],[6]. Conducting a simple survey in Sudan, we found that many women have predictable and possibly life-threatening abnormal bleeding after a delivery, especially during the night. We believe bleeding can be treated more quickly when medical attendants are informed early, but there are few existing solutions for bleeding detection, moreover the differences between previous ideas and ours are the integration between GSM alarm system and computer applications (Healthcare System).

This paper is organized into four sections. After this brief introduction, general definitions of RF transceivers, GSM alarm systems and wet detectors are presented in Section II. The proposed alarm system is described in Section III. The results and conclusions are presented in Sections IV and V, respectively.

II. SYSTEM COMPONENTS

A. Wireless Remotes using TX- RX Modules

The RF transceiver is composed of a simple wireless transmitter and receiver used to carry signals between two parties[7]. This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission. The basic operation of the RF system is depicted in Fig. 1. The RF module is characterized by scalability, simplicity, light weight, low cost and small size. In this paper, we will utilize four-channel system to transfer the signal from the diaper to the GSM alarm system through the GSM door sensor[8],[9].

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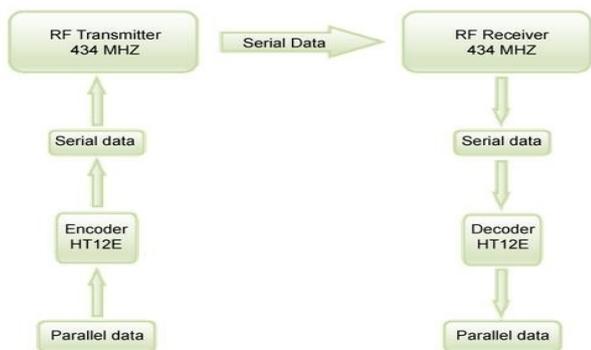


Fig. 1. RF Based Wireless Remote using RX-TX Modules

B. Mobile Call GSM Alarm System

The mobile call GSM alarm is an integrated system of digital speech, mobile messaging and multiple modes of wireless coding for long-distance home appliance control, SMS messaging, and other technologies[10, 11]. When the alarm is triggered, it will automatically notify users via mobile network about a possible break-in using either voice calling or SMS. The mobile-call GSM alarm system can store six phone numbers for voice calls and three SMS numbers. The device also has remote-control arm, disarm, monitor, and intercom features, which can be used for many other purposes and applications. It is stable, reliable and safe. In this paper, we use the GSM system to transmit the wireless signal to the Computer network through gateway such as (API) Application Programming Interface to make integration between GSM alarm system and Computer to connect the Healthcare Application, in addition to that the GSM alarm produces alarm calls and messages to the intended person when moisture is detected, as shown in Fig.2, [11],[12],[13].



Fig. 2. The Mobile Call GSM Alarm and Computer Network used in the Proposed System

C. Bleeding Detector (Wet Detector)

Electronic wetness detectors are well known and are used in many applications such as water level detection, rainfall detection, soil-moisture detection and flood-warning alarms[14],[15],[16],[17]. Many different available circuits can function as a moisture detector. The purpose of the bleeding detector is to give a positive response in the presence of moisture[1],[14].

III. THE PROPOSED ALARM SYSTEM

The proposed system consists of four main parts. The first part includes fine conductors, the bleeding detector, an analogue switch, and an RF transmitter. This part will be coupled to the medical gauze through the pressing studs, except that the fine conductors are integrated into medical gauze and discarded with the soiled gauze. The fine wires are coupled to the detector circuit using simple pressing stud as shown in Figs 5. The second part consists of an RF transceiver, an analogue switch, and a GSM door sensor. The third part consists of a mobile-call GSM alarm system as shown in Figs 2. This part will be fixed somewhere in the hospital. The fourth part consisting of a gateway technology in Computer network such as (API) Application Programming Interface to make integration between GSM alarm system and Computer to connect the Healthcare Application. The overall block diagram of the system is shown in Fig. 2, and summarized in Fig. 3.

A. Circuit Description of the Wetness Detector

The detector units are composed of two parts, a pair of spaced, fine wires embedded inside the medical gauze and a simple electronic circuit illustrated in Fig. 5. The fine wires are coupled to the detector circuit using simple pressing studs as shown in Figs. 5. In operation, the electrical resistance between conductors, L2, falls when the wires are in contact with blood or other wetness in the medical gauze. In turn, current is conducted through resistors R1 and R2. The resulting voltage drop across resistor R2 applies a forward bias to transistor TR1 and forces it to conduct. With transistor TR1 conducting, power is supplied to the analogue switch to turn it on. The spaced, fine conductors inserted between the medical gauze layers are shown in Fig. 5. They are positioned between the layers of the medical gauze to detect the wetness (blood bleeding). One end of the each conductor extends along the medical gauze and terminates at a pressing stud at the front upper end of the medical gauze as shown in Fig. 5. A square flexible thin plastic box carries the electronic detector, analogue switch, RF transmitter circuitry, and watch battery is fixed on the exterior upper-front portion of the medical gauze as demonstrated in Figs. 5. [1].

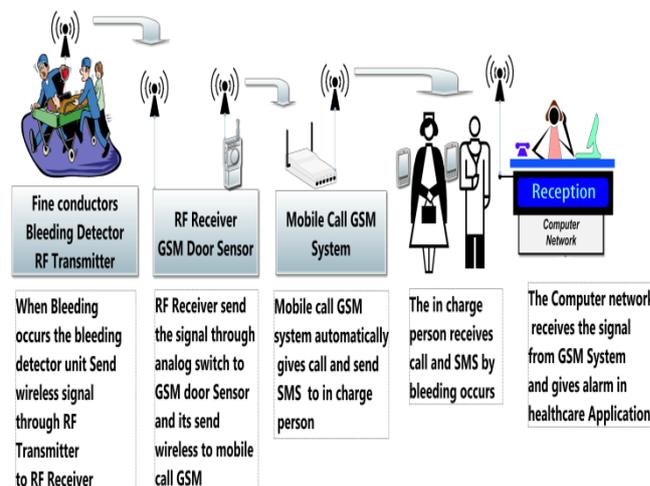


Fig. 3. System Block Diagram

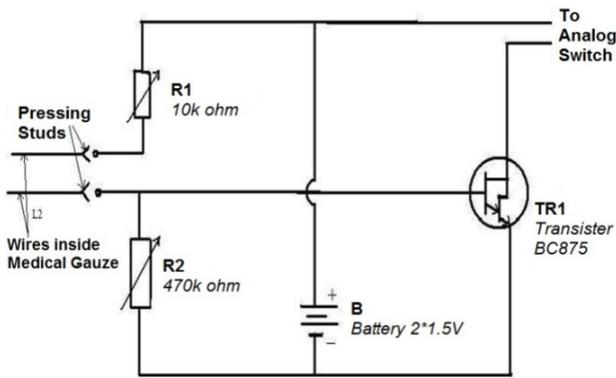


Fig. 4. Wetness Detector Circuit

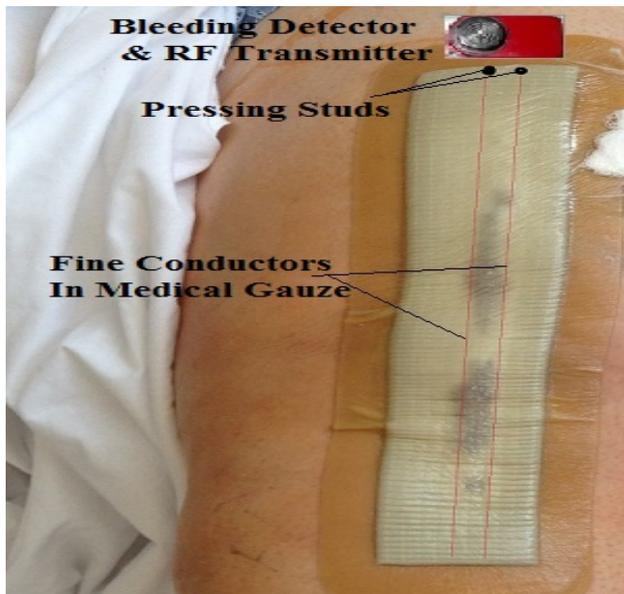


Fig. 5. Bleeding Detector Unit & RF Transmitter

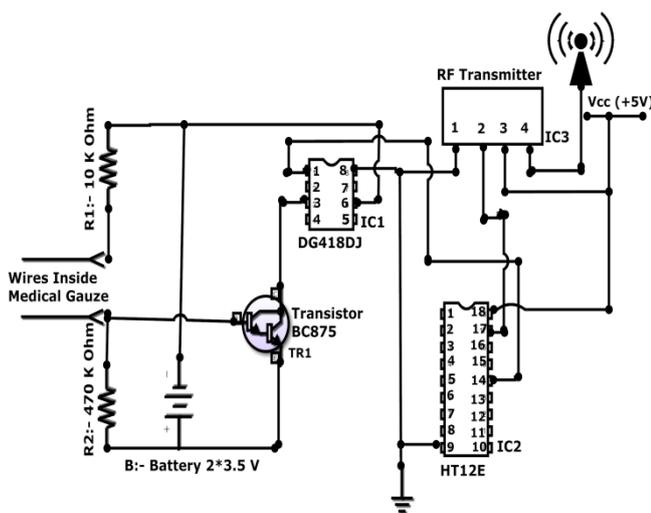


Fig. 6. Wetness Detector and RF Transmitter Electronic Circuit Diagram

B. Circuit Description of the Wetness Detector and Transmitter

The bleeding detector consists of the wetness detector,

analogue switch DG418DJ, encoder HT12E, and the RF transmitter (Fig. 6). The wetness detector implemented by the authors for testing purposes. As described in the previous subsection, any wetness in the medical gauze leads to a signal at pins 3 and 6 of the analogue switch, IC1 (DG418DJ). The output of DG418DJ, pins 1 and 8, is connected across pins 9 and 14 of the encoder, IC2 (HT12E), which becomes active when pin 14 is grounded (active low) and the signal is transmitted by IC3 to the receiver side[1].

C. Circuit Description of Receiver and GSM Parts

Fig. 7, illustrates the RF receiver, Decoder HT12D, analogue switch DG418DJ, GSM door sensor, and the mobile-call GSM alarm system. The RF signal transmitted by IC3 will be received by the IC4 RF receiver, which activates the decoder, IC5 (HT12D). The output of the decoder pin 10 is programmed to be high when HT12D is active. This output is connected to the input of IC6 (DG418DJ). The output switch of IC6 activates the GSM door sensor, which transmits a signal to the base unit of the mobile-call GSM alarm system. The GSM alarm system, upon receiving the signal from the door sensor forward it to the Computer network through gateway such as (API) Application Programming Interface to make integration between GSM alarm system and Computer to connect the Healthcare Application, in addition to that the GSM alarm produces alarm calls and messages to the intended person when moisture is detected[1].

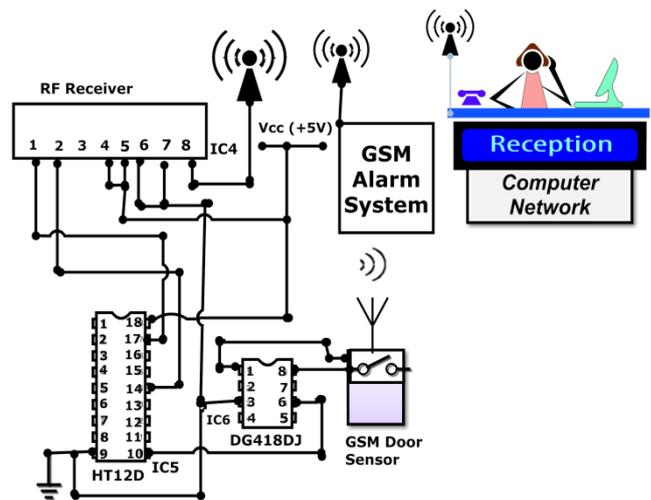


Fig. 7. RF Receiver, GSM Alarm and Computer Circuit Diagram

IV. RESULTS AND DISCUSSIONS

The viability of the designs of the bleeding sensor system was tested in real diaper with speaker, a clear sound is heard from the buzzer. The circuit was powered by 3 V dc source. To evaluate the performance of the proposed system, we conducted an experimental test of the blood detector, using it as a simple wetness detector, as shown in Fig. 8. To adjust the sensitivity and test the operation of the bleeding detector, different volumes (1ml, 2 ml, 3ml, 4 ml and 5ml) of high-density tap water are prepared to simulate blood. The resistance of R2 is varied from max resistance to low

until a sound is heard from the buzzer. The value of R2 is measured and used as a fixed resistor in the other four medical gauze pads. After performing the test, the blood detector gave a good response.

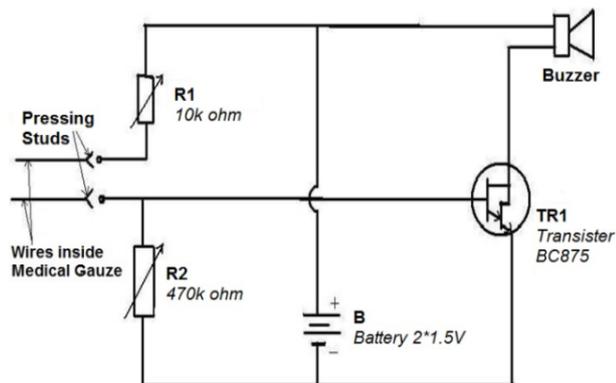


Fig. 8. Bleeding Detector Circuit Design with Buzzer

The tests show that the bleeding detector can be adjusted to detect any level of wetness according to the requirements of the detection situation. The bleeding detector, which also includes the batteries and buzzer, is connected to the medical gauze using pressing studs. The detector can be removed and reused when bleeding is detected and the gauze must be changed. The detector unit can be reused more than 100 times before the battery must be changed. Battery life can be improved in the future by using high-capacity batteries[1].

V. CONCLUSION

A new wireless sensor system suitable for smart bleeding detector towards better healthcare, the simplicity of the circuit and low power consumption in the sensor plays a major role in the reducing the cost of the sensor system, this wireless sensor system could be adapted to other automated monitoring applications. The designed bleeding detector has been tested in real diaper with a speaker. A clear sound is heard from the buzzer. The analogue switch, encoder, RF transceiver, decoder, GSM door sensor and mobile-call GSM alarm system and gateway (API) Application Programming Interface are already tested and working with many applications and circuits. The designed system is not costly, the two fine conductors plus the pressing studs may cost maximum from 0.1 to 0.2 USD. In addition, the bleeding detector unit is decoupled from the pressing studs for reuse. The costly parts of this system are the mobile-call GSM system, but the other parts are very cheap. In today's mobile environment, a GSM alarm system has become very necessary for hospitals because it is used in fire detection and surveillance. Therefore, the GSM alarm system can be used for many purposes beyond this system.

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