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An Automatic IVF Changer and Drip Rate Controller with Monitoring Of Vital Signs

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Abstract:
In the present scenario, lack of skilled care takers for the patients has aroused as a major issue in medical field. In this paper, an automatic IVF (Intra Venous Fluid) bottle changer has been designed, which avoids the necessity for the attendants to stay along with the patients. The main aim of the device is automatic change of saline bottles which in turn avoids the reverse movement of blood in case of delays and also monitors the vital signs of the patients. The IVF changer is designed to control the drip rate of intravenous saline fluid flow to the patients and also changes to the next bottle when previous saline bottle gets over. It also sends an emergency alarm signal in case of shivering and heartbeat abnormalities to the respective nurse via mobile application. The saline bottles can also be change based upon the priority as programmed before to the next bottle. Likewise, N number of bottles maybe connected in series so as to change the bottle as per requirement without any manual interaction

Keywords: Intra Venous Fluid (IVF), Saline, Drip rate., Vital signs

I. INTRODUCTION

In India, nurse: patient ratio is not balanced and getting worse day-by-day. In future there will be almost only one nurse for ten patients, this may lead to risk of patients health, as it will take more time if the victims to be attended are more. In order to change a saline bottle, the nurse has to manually change them. Automatic saline changer is to minimize the time delay and also avoid the reversal of blood. The main cause for the backflow of blood is the pressure difference. The backflow may also occur if the IVF is not properly injected to the patients. The reverse flow of blood may cause serious problems like loss of blood and even fatal, if it is not rectified soon. In military field, the sum total of convalescents is high where number of nurses to help them is low. In order to reduce time and treat patient without causing delay, this automated IVF changer is designed.

The level of saline and its flow rate is perceived by IR sensor and this data is sent as a message to the mobile phone through GSM transmitter and receiver pair. The heart rate of a person, body temperature and blood pressure are checked. But automatic change of saline bottles is not implemented [1].Various sensors are used to monitor the blood pressure, temperature, and heartbeat of the patients. The saline level in the bottle can also be monitored using level sensor and if the saline level outstretches the rated value then an alarm and information is passed to the hospital attendant using a GSM[2].In the hospitals ,the nurses and attendants have to keep an eye on saline level with regular time interval. This system is untimely for the nurses to monitor the saline level [3]. The patient's physiological conditions such as heart rate and temperature are monitored using various sensors. The saline level in the bottle can be measured using the Zig Bee [4]. IR sensor is used to measure the flow rate of the fluid in the saline bottle and the corresponding flow rate is

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sent as message to the mobile phone via GSM and the patient's physiological conditions are automatically checked [5].

In this paper, an automatic saline changer with drip rate controller is developed along with monitoring of vital signs such as blood pressure, heart rate, pulse rate and temperature. The IVF changer is used to control the intravenous saline fluid flow and also change the saline bottle when one gets over. It also sends an emergency alarm signal in case of shivering and heartbeat abnormalities to the respective nurse via a mobile application.

Here, an sensor based on Infra red is used to monitor the level of the fluid and when it goes below the minimum level, automatically the saline bottles change based upon the priority as programmed before to the next bottle. Likewise, N number of bottles maybe connected in series so as to change the bottle as per requirement without any manual change of saline bottles by the nurses. The vital signs like temperature of the patients is monitored continuously and the reports can be viewed. In case of any abnormalities, the IVF is stopped and an alarm signal is sent to the nurse so that manual administration can be done. On the whole separate equipment for measuring the vital signs is eliminated and the manual labor of the nurse to track everything separately is avoided. This is also a sterile method because it involves the placement of sensors outside the patient's body and the saline bottle as well. Thus, a completely automated monitoring system that can be attached directly to the patient's stretcher is created with a safety backup to change the pre-programmed values.

In this paper, section II deals with the survey and design and Section III discusses description of system. The experimental result is scrutinised in section IV and the conclusion is briefed in section V.

II. Survey and Design

In all the existing system, many complicated modules have been employed which increases the cost of the product. In our model, nurse to patient ratio have been reduced to a greater extent and even the non expert person can operate the product. The vital signs like temperature of the patients is monitored continuously and the reports can be viewed simultaneously. In case of any abnormalities the IVF is stopped and an alarm signal is sent to the nurse so that manual administration can be done. Analysis of drip rate cannot be done with human eye, so accuracy in drip rate flow is achieved through this method. Thus, a completely automated monitoring system that can be attached directly to the patient's stretcher is created with a safety backup to change the pre-programmed values via mobile application is installed.

Figure.1 manifests the basic block diagram of the Automated system. The saline bottles provisions are fixed with IR sensor and LED. The LED blinks when the bottle is full and once if the liquid reaches a critical level, LED and solenoid valve of that corresponding bottle turns off. The status of all the bottles are sent to controller and it initiates the relay control to turn on the next bottle and the process continues. Along with the bottle changing process, the drip rate can also be adjusted according to the category of patients and parameters such as temperature, drip rate and blood pressure are monitored and displayed. For patients in intensive care unit, n number of bottles can also be fixed and hence the need for manual change and monitoring can be reduced.

In figure 1, three saline bottles are connected in series and each saline bottle provision and automatic saline control valves are built. The drip rate is calculated using equation 1.

$$\frac{\text{Volume(ml)} \times \text{Dropfactor(gtts/ml)}}{\text{Time(min)}} = \text{Driprate(gtts/min)} \qquad (1)$$

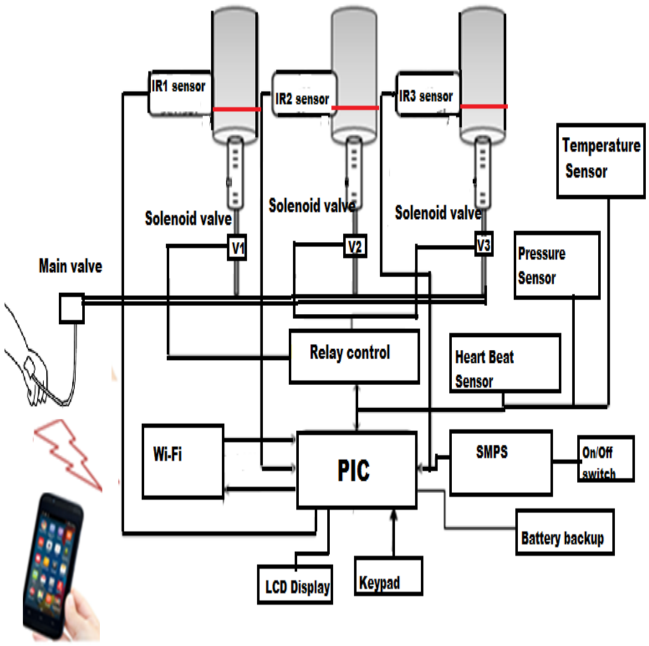

Fig.1. Basic Block Diagram of the Automated System

III. Description of the System

PIC16F887 microcontroller is used for fail-safe clock monitoring during critical conditions and clock mode switching, during operation for low-power operation. The PIC compiler includes pro-level optimization and the largest library of built-in functions, pre-processor commands. With the aid of in built program, the controller controls SMPS, Relay circuits and all the sensors. Power supply is obtained either from mains or from battery backup.

When the valve 1 is open the drip rate of the first bottle is sent to the html page continuously through Wi-Fi module and the *corresponding LED light blinks as shown in figure 2*. When the valve 2 is open the drip rate of the second bottle is sent to the html page continuously through Wi-Fi module and the corresponding LED light blinks and so on.

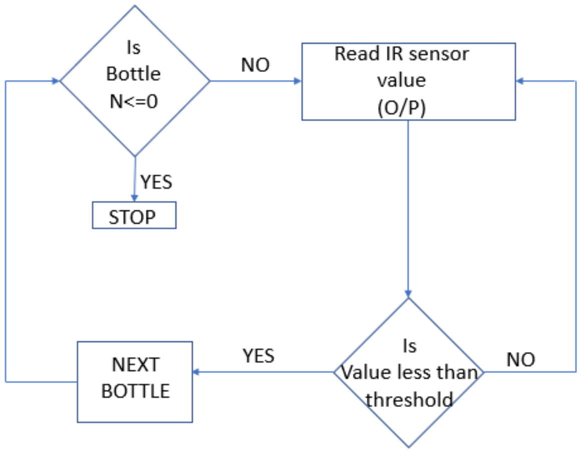

Fig.2 Flow diagram of the IR sensor

When the IR sensor detects no liquid, it creates a signal which is amplified and filtered. This signal is sent to SMPS. Then the voltage is converted into 12V dc using pulse transformer which also powers the temperature sensor and TTL that acts as an interface between microcontroller and Wi-Fi module.

The alarm is sent to the mobile application when any deformity is detected in the blood pressure, pulse rate and body temperature of the patient. Drip rate, priority of bottles, blood pressure, and temperature can be monitored through mobile app. More than one patient's parameters can be screened simultaneously.

Fig.3. LED blinks when IVF bottle is FULL

The features are as follows

- Automated drip rate controller.

- Temperature monitoring along with sensing a kind of shiver in the patients reporting alarm in case of abnormalities.
- Heartbeat is monitored so as to keep track of the individual.
- Control can be done from anywhere by the respective nurses.
- Saves time and labor.
- Simultaneous control for various patients.
- Spontaneous monitoring and action when abnormalities are sensed.
- Different modes of operation for people from different groups.

IV. Experimental Result

The performance of the proposed system is checked and the results are verified practically. The automatic fluid changer and the measurement of vital parameters of patient is verified .The comparison of our system with existing vital parameter measurement system shows no major difference. Figure 3 shows the Real time hardware model of the automatic vital sign monitor. The instrument can be operated depending upon the age of the patients by adjusting the either of the two modes.

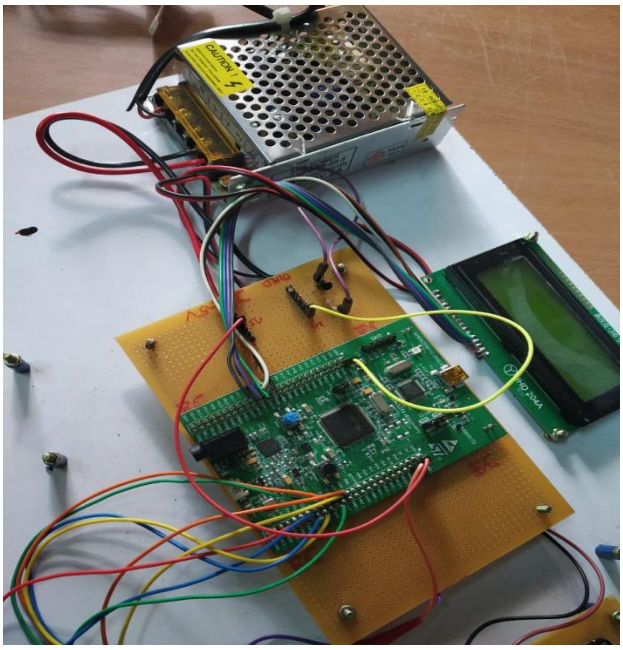

Fig.4. Real time hardware model

The vital sign levels vary for the children and adults. So there are two different modes of operation in this system:

A. Child Mode

In case of the child mode the normal vital sign Parameters are as follows:

Body temperature : >97.6 F and <100.5 F
Blood pressure : 102-120/61-80
Pulse rate :

Children 3 to 4 years old : 80 to 120 bpm.
Children 5 to 6 years old : 75 to 115 bpm
Children 7 to 9 years old : 70 to 110 bpm.

V. Adult Mode

In case of adult mode, the normal vital signs are as Follows:

Body temperature : >97 F to <99 F
Blood pressure : 120/80-140/90
Pulse rate : 60 to 100 beats per minute

VI. Conclusion

The proposed system aims mainly about the safety of the patients.It also aids in complete automation of the system so that simultaneous operation and monitoring of various patients are possible. Man power for monitoring the patients can be decreased as multiple patients can be handled from the same place during any emergency condition. The ambience felt by the patient is quite large when compared to the existing models. Precision of the device is high and risk is completely eliminated. Various numbers of fluids can be handled and switched between them without manual change. This switching helps in reducing the wastage of medical fluids. All vital signs of patient are combined to form a single monitoring system.

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