Pulse Triggered Automated Defibrillator

Mrs. A. Martina Jenitha[1] Feba Marin Babu[2] T. Kayalvizhi[3] T. Kohila[4]
[1]Assistant Professor
[1,2,3,4]Department of Biomedical Engineering
[1,2,3,4]Adhiyamaan College of Engineering, Hosur – 635109, India

Abstract— In a complex; dynamite world where population seems to decrease due to the intense proliferation of heart disease, Automated External Defibrillator has been developing as a minor relief. The premeditation of this paper mainly eliminates the few downers. An integration of both heart rate and pulse rate assessment promises a more accurate delivery of result. In addition to this, it clearly eradicates the presence of doctor or a physician, as in displaying the aggregated shock relative to the heart disease. This is mainly achieved by the Atmega 328 microprocessor along with 555 timer and pulse sensor. 555 timer is mainly used to measure the heart rate of the patient.

Key words: 555 Timer, Atmega 328

I. INTRODUCTION

Cardiovascular disease literally relates to many factors such as heart and blood vessel aliments, inappropriate blood flow etc. Cardiovascular diseases accounts for nearly 801,000 deaths in US about 2,200 Americans die of cardiovascular disease each day that estimate to one death every 40 seconds [1]. In collation, units providing cardiopulmonary resuscitation, 15 of 107 persons experiencing definite cardiac arrest survived to hospital discharge. In the units providing cardiopulmonary resuscitation plus defibrillator response, 30 of 128 victims of definite cardiac arrest survived to discharge [2]. The outcome has become more predictable showing a cut contrast image of past and present range of defibrillation. This paper mainly focuses on diseases related to abnormal heart rates. In a box, atrial fibrillation is a quivering or irregular heart beat that can lead to blood clots, stroke, and heart failure [3]. Atrial flutter is a very rapid series of two contractions combined in a heartbeat [4]. Ventricular fibrillation is a heart rhythm problem that occurs when the heart beats with rapid erratic electric impulses [5]. Ventricular tachycardia is a very fast rhythm that begins in the two lower chambers of ventricles [6].

II. OBJECTIVE

The main objective of the paper is to technologically renew the basic version of defibrillator. It acts to it pulse rate sensor along with the heart rate timer to make this whole more judicious. For every minute that passes without defibrillation, survival decreases by 7 to 10 percent [7]. Defibrillator is a medical device that functions to liberate an aesculapian shot to the heart so as to receive it back to its conventional state. They are used during elevated medical emergency conditions as mentioned above. This novel is concerned in making the actual concept of defibrillator functioning more conscientious. In this theory, the operation of defibrillator is based on two surmises- heart rate and pulse rate. Heart rate is the speed of the heart beat measured by the number of contractions of heart per minute. Pulse is the rhythmical throbbing of the arteries as blood is propelled through them. This step completely annihilates the need of a doctor or a physician. Heart rate measurement is attained by a 555 timer which is programmed to periodically assess the given range of beats per minute. Pulse sensor acts as a supplement to the overall instrumentation which attributes to its incisiveness. Atmega 328 acts as a major motherboard of the instrument and controls the activities of the rest.

III. FEATURES

A. ATMEGA 328

Embellishing RISC architecture frame Atmega is a low power CMOS 8-bit microcontroller. Bringing to fruition feedbacks into a single clock cycle, the Atmega achieves input transfer the near to IMIPS per MH3. Thus the system designer is legitimised to modify the device for bi benefits i.e. power consumption reduction and processing speed.

1) Core Features

a) Advanced RISC Architecture
– 131 Powerful Instructions
– Most Single Clock Cycle Execution
– 32 x 8 General Purpose Working Registers
– On-chip 2-cycle Multiplier

b) High Endurance Non-volatile Memory Segments
– 32K Bytes of In-system Self-Programmable FLASH Program Memory
– 1Kbytes EPROM and 2Kbytes Internal SRAM
– Programming Lock for Software Security
– Data Retention- 20 years at 85C/100 years at 25

c) Special Microcontroller Features
– Power-on Reset and Programmable Brown-out Detection
– Internal Calibrated Oscillator
– External and Internal Interrupt Sources
– Six Sleep Modes: Idle, ADC Noise Reduction, Power-save

d) I/O and Packages
– 23 Programmable I/O Lines
– 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF

1) Operating Voltage
– 1.8 – 5.5V

2) Temperature Range
– -40 C to 105 C

3) Speed Gate
– 0 - 4MHZ @ 1.8 – 5.5V
– 0 – 10MHZ @ 2.7 – 5.5V
– 0 – 20MHZ @ 4.5 – 5.5V

4) Power Consumption at 1MHz, 1.8V
– Active Mode: 0.2Ma
– Power-down Mode: 0.1µA
– Power-save Mode: 0.75µA

2) Peripheral Features

- Two 8-bit Timer/counters with separate Prescaler and Compare Mode.
- One 16-bit Timer/Counter with Separate Prescaler, Compare Mode and Capture Mod.
- Real Time Counter with Separate Oscillator
- Six PWM Channels
- Two Master/Slave SPI Serial Interface
- One Programmable Serial USART
- One Byte-oriented 2-wire Space Serial Interface
- One On-chip Analog Comparator
- Interrupt and Wakeup on Pin Change.

IV. METHODOLOGY

Heart rate and pulse rate are measured in a collaborative way, thus retaining accuracy. Defibrillator follows the directions of display before which the output from both the sensor is guided by the microcontroller which in turn sends its output to the display. The display is a venue for projecting the heart rate, pulse rate, heart disease name and simultaneous shock to be delivered.

A. Block Diagram

The block diagram for designing the pulse triggered automated defibrillator is shown below.

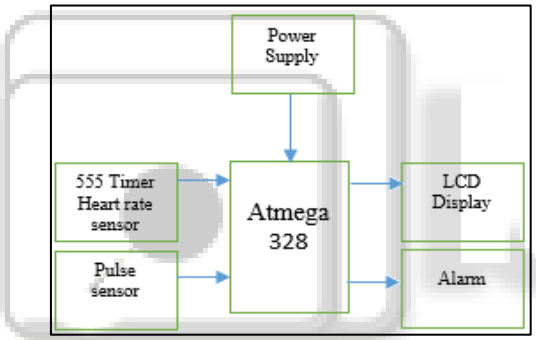

Fig. 1: Pulse Triggered Automated Defibrillator

B. Block Description

1) Pulse Sensor

Under the selection of ranges LM35 has been chosen for this project. It is constructed so as to fit a finger and uses the amount of infrared light reflected by the circulated blood. The sensor consists of a emitter and detector mounted side-by-side. When the heart contracts, the blood pressure is surged to its peak value which leads to the reflected light to the detector from the emitter being increased. The detector passes more current when it receives more light, which in turn causes a voltage drop to enter the amplifier circuitry. Here operational amplifier are used to establish a steady baseline for the signal, emphasize the betas and filter out noise. The op-amp output clean but weak signal which is amplified by the transistor before output.

2) Heart Rate Sensor

Normal heart rate varies from person to person. It is normally defined as the number of times heart beats per minute. During the present era with much contamination in air, a regularity in the heart rate may symbolise a heart defect.

555 Timer is designed for one minute which is used to enable the clock to the count for one minute. The program is set such that the timer calculates for one minute and produces the output to the microcontroller.

V. DISEASE ANALYSIS

A. Atrial Fibrillation

A harbinger to variety of diseases including blood clot, stroke, heart failure and other heart related complications. Atrial fibrillation is the unstratergic tremulations in heartbeat.

B. Ventricular Fibrillation

The ventricle becomes the centre for the ailment catch. It tremors in such a way that heart is disabled to pump blood causing cardiac arrest. Native to this disease the heart's electrical activity is disrupted which later on leads to circulation collapse.

C. Ventricular Tachycardia

Makes a minor presence known, and is a minute quaver that is not paid heed to. It causes a uproar of very fast heartbeat arising from the ventricles twisting the heart's electrical coordination. It is the specific vanguard to ventricular fibrillation.

D. Atrial Flutter

The electrical signal circuits along a pathway within the right atrium signified when the atria beats faster than the ventricles in a trained circular motion. It equals atrial fibrillation, but is known for its congruous pattern.

VI. OUTPUT

A compendium of the received output from the heart rate sensor and pulse sensor is standardised by the microcontroller which converts into epitome values and feeds into the Liquid Crystal Display. The LCD exhibits an array of summarised calculations which include heart rate, pulse rate, disease name and amount of shock to be delivered. The buzzer acts as a tocsin when the sensed inputs turns heteroclite.

- The normal heart beat: 60 – 75 beats per minute.
- The normal pulse rate: 60 – 80 pulses per minute.

The following tabular column depicts particular diseases that we have chosen for the project and their range of pulse rate and heart rate along with defibrillator voltage to be delivered.

Disease Name	Pulse rate	Heart rate	Defib. voltage
Atrial fibrillation	100-140 ppm	126 bpm	120-200 J
Ventricular fibrillation	250-290 ppm	277 bpm	360 J
Ventricular tachycardia	180-240 ppm	213 bpm	200 J
Atrial flutter	ppm	295 bpm	100J

Table. 1: Disease name, Heart and pulse rate along with defibrillator voltage.

VII. FUTURE SCOPE

As health issues becomes more complicated in a twisted life style submerged by strain, stress, pollution etc., heart diseases have marked the top of the graph. To the portal of this situation introducing a defibrillator that depends not only on the heart beat but also on pulse rate that has proven to be the last signs of life. This project enlists only a few diseases that forms the part of the whole ailment sphere, but when infused

in a large scale this model promises to be beneficial during adverse intervals.

ACKNOWLEDGMENT

This research was supported by Adhiyamaan College of Engineering. We thank our colleagues from various institutions who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations of this paper.

We thank Dr. T.S. Udhaya Suriya, M.E., Ph.D., Head of the Department of Biomedical Engineering for her most valuable guidance, advice and encouragement.

REFERENCES

[1] Benjamin EJ, Bhaha MJ, "Heart diseases and stroke's statistics 2017 at a glance".
[2] Mary F. Hazinski, RN, Ahamed H. Idris, Richard E. kerber, Andrew Epstein, Dianne Atkins, Wanchun Tang, et al, "Lay Rescuer Automated External Defibrillator", June 21, 2005.
[3] Johan E.P. Waktare, "Atrial Fibrillation", July 2, 2002.
[4] Juan Granada, William Uribc, Po- Huang Chyou, Karen Maassen, Robert Vierkant, Peter N. Smith, et al, "Incidence and Predictors of Atrial Flutter in the General Population" Vol. 36, No. 7,2000, published Elsevier Science Inc in 2000.
[5] Paul M. Zoll, Arthur J. Linenthal, William Gibson, Milton H. Paul and Leona R. Norman, "Termination of Ventricular Fibrillation in Man by Externally Applied Electric Countershock", published in April 19, 1956.
[6] Hein JJ Wellens, "Ventricular Tachycardia: Diagnosis of Broad QRS Complex Tachycardia" published in 2001.
[7] Larsen M P, Eisenberg M S, Cummins R O, Hallstrom A P," Predicting Survival From out – of –hospital Cardiac Arrest: a graphic model" published in November 22, 1993.

