

Microcontroller Based Blood Irradiator System

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Abstract

Irradiation of blood and blood products by gamma rays is a proven and safe method to inhibit T- Lymphocyte Proliferation and eliminate the risk of post transfusion graft versus host disease (T-GVHD). Transfusion-associated graft-versus-host disease (TA-GVHD) is a rare, but usually fatal, complication of transfusion. The risk associated with an individual transfusion depends on the number and viability of contaminating lymphocytes, the susceptibility of the patient's immune system to their engraftment and the degree of immunological disparity between donor and patient. This paper aims to acknowledge the importance of blood irradiator. The mainstay of prevention is gamma irradiation, which inactivates T lymphocytes whilst preserving the function of other blood cells. Leucodepletion by current filtration technology is inadequate [unproven] for this purpose. Gamma irradiation of cellular blood components is the best current technology to reduce the risk of T-GVHD to the recipients as confirmed by research and therefore being widely practiced world over in hospitals and blood banks as a life saving approach to this problem. Blood is usually irradiated in standard blood bags in dedicated blood irradiators using cobalt ⁶⁰ or caesium ¹³⁷ radioactive source. Thus this paper aims to contribute to the development of a control system is a based system microcontroller used for controlling the various input and output devices. The unit can be installed in a room without any additional shielding.

Index terms— transfusion, disease, individual, susceptibility

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7 MICROCONTROLLER

43 a) Blood Irradiator System lood irradiators are widely used for the irradiation of blood samples and also for
44 various research studies like mutation breeding, radiation sterilization etc. The compact self-shielded cobalt-60
45 gamma irradiators provide an irradiation dose of 9KGy/hr. The sample for irradiation is to be placed inside
46 the sample chamber. The motorized drive and its associated mechanism enable precise position of the sample
47 chamber at the centre of the radiation field inside the chamber. The recommended dose limit for blood sample
48 ranges from 15Gy to 30Gy b) Main Features of BI-2000

49 ? Safe and self shielded: No additional shielding is required. The radiation field on the external surface of the
50 unit is much below the permissible level.

51 ? Dose uniformity: Sample rotation mechanism and stationary source pencils symmetrically placed in a
52 cylindrical cage ensure good uniformity of radiation field within 25% variation or better.

53 ? Computerized calculations of dose and termination of irradiation based on time as well as dose modes with
54 Cobalt-60 source decay correction.

55 ? Sample chamber door inter lock for safety operation.

56 2 c) Blood Irradiation

57 Blood is a specialized bodily fluid that delivers necessary substances to the body's cells such as nutrients
58 and oxygen -and transports waste products away from those same cells. Blood consists of many components
59 (constituents). These include: Plasma, White Blood Cells, Red Blood Cells, Platelets, Lymphocytes,
60 Erythrocytes, Leucocytes and thrombocytes. Lymphocytes, Basophiles, Europhiles and Monocytes.

61 3 d) T-GVHD

62 Transfusion -associated graft versus host disease is a complication of blood transfusion in which the donor
63 T-Lymphocytes mounts an immune response against the recipient's lymphoid tissue. Donor lymphocytes are
64 identified as foreign and destroyed by the recipient's immune system.

65 These donor lymphocytes proliferate and damage target organs, especially bone marrow, skin, liver and
66 gastrointestinal tract. The risk associated with an individual transfusion depends on the number and viability
67 of contaminating lymphocytes, the susceptibility of the patient's immune system to their engraftment and the
68 degree of immunological disparity between donor and patient. However, in situation where recipient are immune
69 deficient such as cancer patients and those who are going organ transplantation are not able to destroy the
70 donor lymphocytes. This result in T-GVHD.T-GVHD is developing four to thirty days after transfusion When
71 blood is given to patients who are immuno-deficient such as cancer patients or patients being operated for
72 organ transplants, blood needs to be irradiated with low dose of radiation to inhibit T-Lymphocyte proliferation.
73 Without this, these Lymphocytes may tend to take over the immune system of the recipient and attack the healthy
74 organs resulting in T-GVHD or Transfusion induced graft versus host disease. This may lead to complications
75 and may be fatal. Even in the case of immuno sufficient patients, this can take place, if the donor happens to be
76 a close first degree relative due to the lymphocytes getting past the immune system of the recipient undetected

77 4 LCD

78 The user interface is developed through the LCD display.

79 ? Display various menus for the user.

80 ? Displays the parameters and different modes of operation the operator has selected.

81 ? Guide the user to interactively choose different menus and select different parameters for taking decisions.

82 5 Automation Devices

83 The automation system consists of a microcontroller (Atmel AT89C52 microcontroller) based fully automated
84 system. The peripherals are interfaced with the microcontroller and the communication is done through the IO
85 ports. Accurately adjusts the irradiation time and generating control signals for different input & output devices.

86 6 Power supply

87 This unit will supply the various voltage requirements of each unit. A variable regulated power supply is used
88 to continuously adjust the output voltage to the requirements. This unit consists of transformer, rectifier, filter,
89 regulator and power LED. Transformer rating is 30VA (2A current rating).

90 Rectifier will be center tap rectifier. Filter value is 2200?F. Regulator is 7805.

91 7 Microcontroller

92 ? The automation system consists of a microcontroller (Atmel AT89C52 microcontroller) based fully automated
93 system.

94 ? The peripherals are interfaced with the microcontroller and the communication is done through the IO
95 ports. ? Generates control signals for different input & output devices to precisely place the sample to the centre
96 of the source.

97 ? Automatically removes the sample after irradiation for the calculated time.

98 ? It is programmed to read the dose rate of the sample then calculate the exact irradiation time.

99 **8 M Motor drive Mechanism**

100 ? The motorized drive mechanism is a D.C Motor whose speed is 100 r.p.m and its associated drive mechanism
101 enables precise positioning of the irradiation chamber at the centre of the radiation field inside the sample
102 chamber.

103 ? This becomes an important mechanism as the position of the chamber should be accurate such that the
104 sample is accurately exposed to the radiations. These radiations should accurately fall on the sample chamber
105 in order to remove the impurities.

106 ? Stationary source pencils, symmetrically placed in a cylindrical cage ensure good uniformity of radiation field
107 in the sample chamber. In addition a mechanism is also provided for rotating/stirring samples during irradiation.

108 ? Sample chamber door interlocks are provided for safety operation such that during the irradiation time the
109 doors should not open as they may hamper the whole process and also expose the harmful gamma radiations to
110 the environment and the operator.

111 The DC motor that we have used serves the following purpose:-

112 ? For controlling the position of the sample in the gamma chamber we use to interface dc motor with
113 microcontroller to a port which will give high or low logic to rotate the motor in any of the direction.

114 **9 b) Orcad package**

115 OrCAD is a proprietary software tool suite used primarily for electronic design automation. The software is used
116 mainly to create electronic prints for manufacturing of printed circuit boards, by electronic design engineers and
117 electronic technicians to manufacture electronic schematics and diagrams, and for their simulation.

118 **10 c) Operation**

119 The control system is built for controlling the irradiation time for a sample as per required. The keypad provided
120 is use to control the process as denoted on screen. When we switch on the circuit following screens are displayed
121 in a sequence:-

122 ? The first screen will display the title of the project is display

123 ? In the second screen we have to enter the dose rate which we have to give according the quantity of the
124 sample. The following operations are performed by the key as they are pressed. Increment the values when "UP"
125 Key is press similarly when "DOWN" Key is press it will decrement the values and store the values invariable.
126 Move the cursor right or left according to the direction of key pressed. "OK" key is used to store the data and
127 go to next operation.

128 ? Here to lower the sample in to the chamber we use to convert the angular motion of motor in to liner motion.

129 ? For controlling the vertical motion of actuator we have use to limit switch know as upper and lower limit
130 switch.

131 ? The rating of the motor is 24V/1A.

132 ? Rating of microcontroller 5v/10mA a) Embedded (Keil) C

133 The use of C language to program microcontrollers is becoming too common. And most of the time it's not
134 easy to build an application in assembly which instead you can make easily in C. So it is important that you
135 know C language for microcontroller which is commonly known as Embedded C. As we are ? In the third screen
136 we have to enter the dose rate which we have to give according the quantity of the sample. The above operations
137 will be performed by the key as they are pressed

138 ? Calculate the time of irradiation by formula $\text{Time} = (\text{initial activity}/\text{dose rate}) * 60$

139 ? After calculating the time the dc motor will rotated in clockwise direction and as the mechanical link the
140 sample holder will move in up direction. As the sample holder is move up, place the sample and press "OK" key
141 to move to next operation. As the key is pressed the dc motor rotated in anti-clockwise direction and as the
142 mechanical link the sample holder will move in down direction. Here as the sampled is loaded to the irradiation
143 chamber the controller will ask the user whether to start the irradiation then press "OK" Key after a delay of
144 few millisecond the controller will go to next screen.

145 ? As soon as the sample is loaded irradiation starts and the calculated time is displayed on the screen. The
146 time is display and start decrementing as down counter first sec followed by min. This countdown can be stop by
147 pressing "OK" key in mid of time As the irradiation time hit zero this screen appear indication that irradiation
148 completed and after pressing "OK" key the dc motor will rotated in clockwise direction and as the mechanical
149 link the sample holder will move in up direction. Now after the irradiation time is completed the buzzer will be
150 ON to indicate irradiation is complete. Now the sample can be removed. ^{1 2 3}

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²© 2011 Global Journals Inc. (US)

³November © 2011 Global Journals Inc. (US) going to use Keil C51 Compiler, hence it is called as Keil C.



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Figure 2: Fig

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Figure 3: Fig

INTRODUCTION

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Figure 5: