Automation Of G.M. Counter Using Micro-Controller

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ABSTRACT : *In past years there is a vast growth recorded in the field of nuclear science. Also same growth is observed in nuclear devices around the world. The human body cannot sense ionizing radiation, but a large range of detection and measurement instruments are available. The main types used in radiation protection are listed as 'ionization chambers' 'proportional counters' 'Geiger counters' 'Semiconductor detectors' 'Scintillation detectors' The Geiger-Muller counter is one of them is a type of particle detector that measures ionizing radiation. It detects the emission of nuclear radiation: alpha particles, beta particles or gamma rays by the ionization produced in a low-pressure gas in a Geiger-Muller tube, which gives its name to the instrument. If we do work on the Geiger-Muller counter we have to spend 2 to 3 hours for manual reset and note the values again and again and after then we have to fill these values in computer or can be calculated by some other mean. So there was need to make an instrument which automatically calculates all reading's, send them on computer, resets the counter of instrument and then starts again to take next readings. Now these readings can be further copied to the 'Microsoft excel' to calculate the result.*

Keywords- *GM, DC filter, ASCII codes, etc*

I. INTRODUCTION

In 1908 Hans Geiger, with Ernest Rutherford at the Victoria University of Manchester, developed a device that would later be called the "Geiger counter [3]. This counter was only capable of detecting alpha particles. In 1928, Geiger and Walther Müller (a PhD student of Geiger) improved the counter so that it could detect more types of ionizing radiation. The fundamental of ionization mechanism used in a GM tube was discovered by John Sealy Townsend by his work and is known as the Townsend discharge.

GM counter is used to do some measurements in nuclear decay. A typical Geiger-Muller (GM) Counter consists of a GM tube having a thin end-window (e.g. made of mica), a high voltage supply for the tube, a scalar to record the number of particles detected by the tube, and a timer which will stop the action of the scalar at the end of a preset interval.

Any particle capable of ionizing a single atom of the filling gas of the tube will initiate an avalanche of electrons and ions in the tube. The collection of the charge thus produced results in the formation of a pulse of voltage at the output of the tube. The amplitude of this pulse, on the order of a volt or so, is sufficient to operate the scalar circuit with little or no further amplification. The pulse amplitude is largely independent of the properties of the particle detected, and gives therefore little information as to the nature of the particle. Even so, the GM Counter is a versatile device which may be used for counting alpha particles, beta particles, and gamma

II. ALGORITHM USED

In design of this instrument we have used the algorithm as explained follows
1. We have generated a delay of 1 minute with help of mat lab programming.
2. Secondly counter is then initiated to count pulses for one minute.
3. And that count value is sent serially to the computer by serial port.
4. The same count value is also halved to compare counts of further readings.
5. That halved value is done once on the first reading.
6. Then the counter starts to count the further readings and send them serially to the computer.
7. After taking 40 readings it compares the count value of 40th reading with the halved value of first reading that we have done earlier.
8. If value of 40th reading is less than the compared value the count time is doubled and if the value is more than it takes 5 more readings and compare again 45th reading with the halved value now same process repeats again and again if the compared value is more than the halved value.
9. Now the delay time is doubled (to 2 minutes) and counter starts again to take 20 readings and send them serially to the computer and same process (of comparing values) of previous step (step 8) is repeated again.

10. And then it starts taking readings for doubled delay time (to 4 minutes) from previous delay time and takes 10 more readings and same process for comparing values as explained earlier (in step 8).
11. After taking all reading for delay time of 4 minutes the counter stops working and starts waiting to press button to start counting for next experiment.
12. The serial transfer of data is done by converting the data (count values) into ASCII codes.
13. The data sent to computer is further copied to the 'excel sheet' and can be used for further calculations.

Table 1 Code table of decimal number to ASCII code

| CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX
[NUL]	0	00		32	20	@	64	40	`	96	60
[SOH]	1	01	!	33	21	A	65	41	a	97	61
[STX]	2	02	"	34	22	B	66	42	b	98	62
[ETX]	3	03	#	35	23	C	67	43	c	99	63
[EOT]	4	04	$	36	24	D	68	44	d	100	64
[ENQ]	5	05	%	37	25	E	69	45	e	101	65
[ACK]	6	06	&	38	26	F	70	46	f	102	66
[BEL]	7	07	'	39	27	G	71	47	g	103	67
[BS]	8	08	(	40	28	H	72	48	h	104	68
[HT]	9	09	)	41	29	I	73	49	i	105	69
[LF]	10	0A	*	42	2A	J	74	4A	j	106	6A
[VT]	11	0B	+	43	2B	K	75	4B	k	107	6B
[FF]	12	0C	,	44	2C	L	76	4C	l	108	6C
[CR]	13	0D	-	45	2D	M	77	4D	m	109	6D
[SO]	14	0E	.	46	2E	N	78	4E	n	110	6E
[SI]	15	0F	/	47	2F	O	79	4F	o	111	6F
[DLE]	16	10	0	48	30	P	80	50	p	112	70
[DC1]	17	11	1	49	31	Q	81	51	q	113	71
[DC2]	18	12	2	50	32	R	82	52	r	114	72
[DC3]	19	13	3	51	33	S	83	53	s	115	73
[DC4]	20	14	4	52	34	T	84	54	t	116	74
[NAK]	21	15	5	53	35	U	85	55	u	117	75
[SYN]	22	16	6	54	36	V	86	56	v	118	76
[ETB]	23	17	7	55	37	W	87	57	w	119	77
[CAN]	24	18	8	56	38	X	88	58	x	120	78
[EM]	25	19	9	57	39	Y	89	59	y	121	79
[SUB]	26	1A	:	58	3A	Z	90	5A	z	122	7A
[ESC]	27	1B	;	59	3B	[	91	5B	{	123	7B
[FS]	28	1C	<	60	3C	\	92	5C			124	7C
[GS]	29	1D	=	61	3D	]	93	5D	}	125	7D
[RS]	30	1E	>	62	3E	^	94	5E	~	126	7E
[US]	31	1F	?	63	3F	_	95	5F	[DEL]	127	7F

III. FLOW CHART
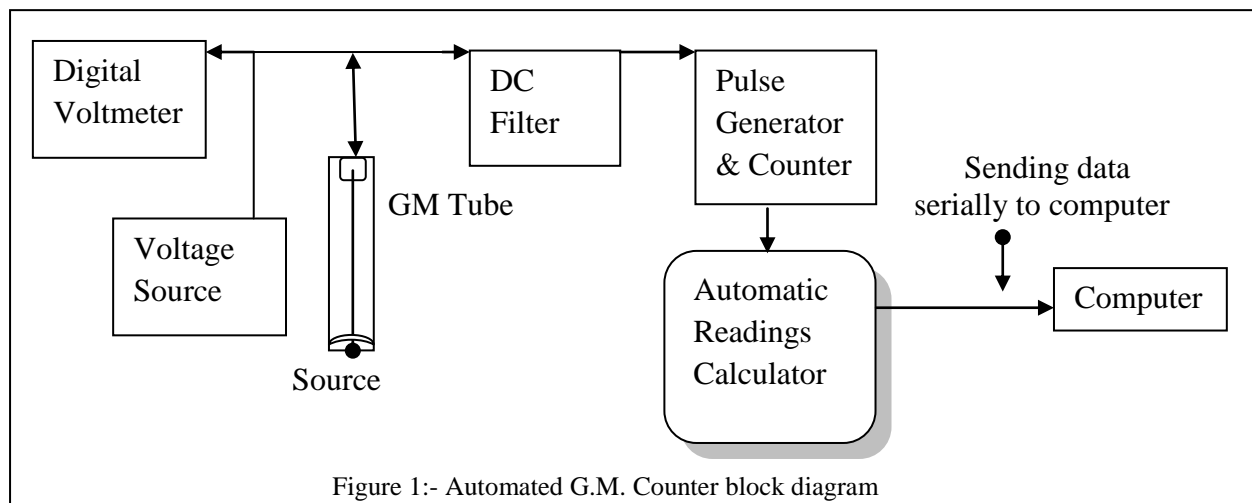
Figure 1:- Automated G.M. Counter block diagram

IV. RESULTS AND DISCUSSION

The Automation of G.M. counter here in this is done by using programming on 8051 microcontroller which takes readings and reset counter after every reading and take 40 readings for 1 minute each, 20 readings for 2 minutes each, 10 readings for 4 minutes each. The readings are serially transferred to the computer by using HyperTerminal with baud rate 4800. The readings received at the computer are as shown below in picture and all readings are in hexadecimal numbers, which are to be copied to the Microsoft Excel and converted in decimal number using formula "HEX2DEC" command. So in this way the readings can be automatically taken and stored in computer. Hence the automation is done for G.M. counter as readings are automatically taken and send them in computer on HyperTerminal in real time. This instrument can take minimum of 70 readings and maximum of 256 readings, and maximum count for each reading can be $(FFFF)_{16}$ or $(65536)_{10}$.

The readings which we receive at the HyperTerminal can be copied by selecting them and copying then past them to the Microsoft Excel spreadsheet.

In this figure 3 the data containing Number of 'minutes' and 'counts' that are separated by a space are copied to the one column and we can separate them in different columns by setting delimiter as space, with this the numbers before space remains in the same columns and number after space are transferred to the next column now we get the 'minutes' and 'counts' separated as in separate columns

Now we have the count value in the form of hexadecimal number so we will convert these numbers in decimal form by using formula "=HEX2DEC(*Column number*)" as shown in figure 4 below. Now we get the count value separated and in form of decimal numbers.

Figure 2:- Readings sent serially to the computer using HyperTerminal
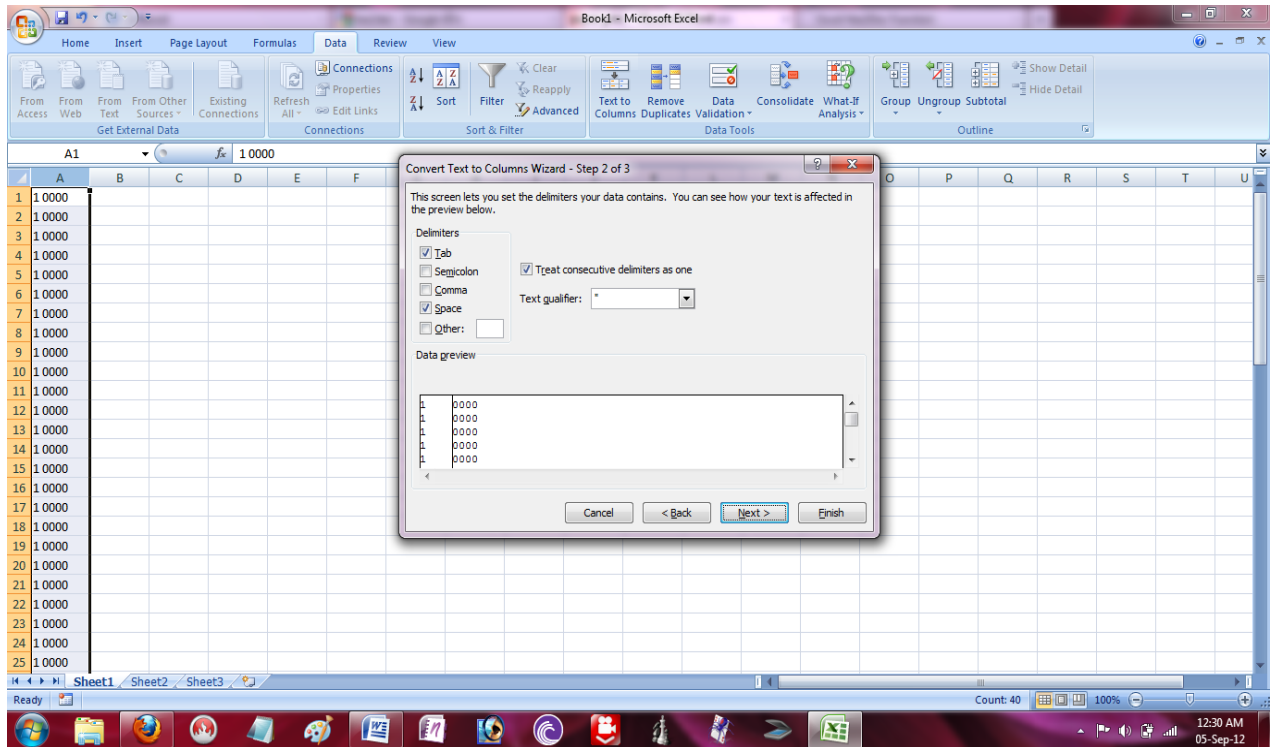
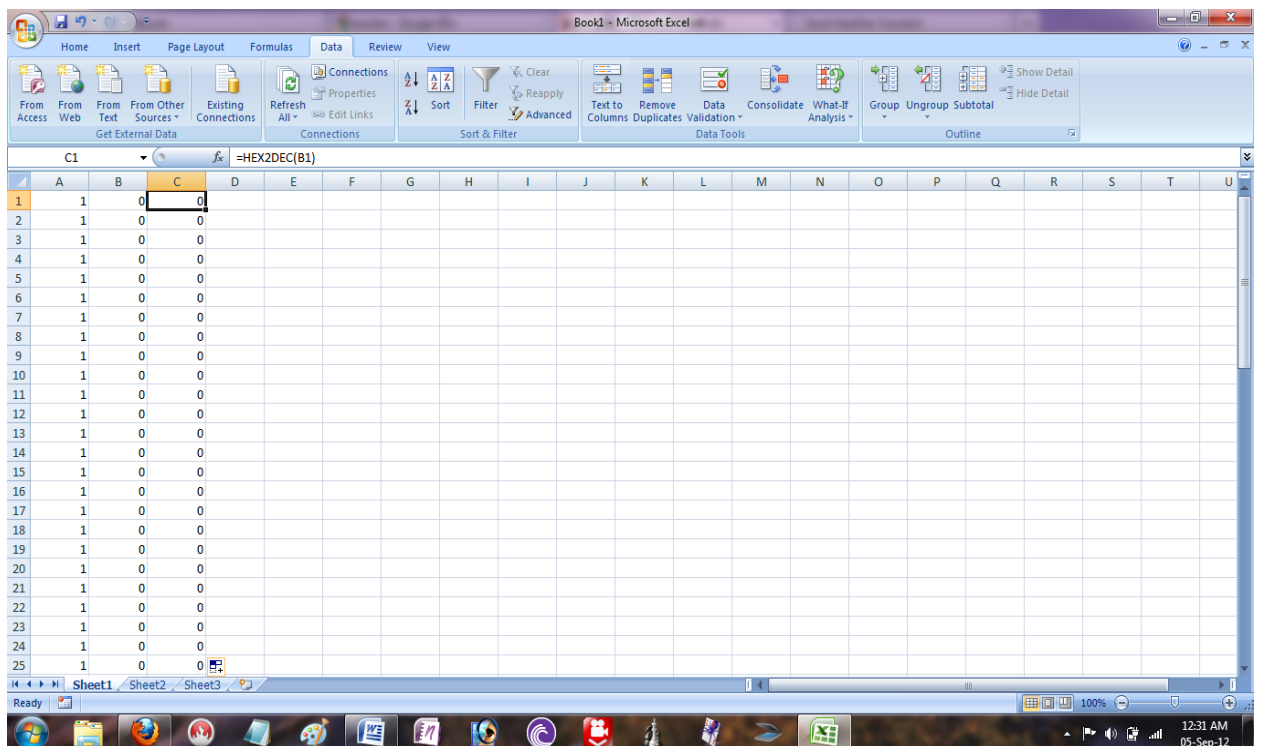Figure 3:- Readings copied to the "Excel spreadsheet"

Figure 4:- Hexadecimal to decimal conversion of numbers

IV. CONCLUSION

In the G.M. counter we had to spend 2-3 hours and regularly reset the counter after pre defined time and after note down the reading each time and then calculate the half count value for 1st reading and comparing them with the next count value after some readings and after taking all reading fill them manually in excel sheet for further calculations. So in this we waste a lot of time which changes the count value that depends on the decay times of the radioactive substances. So there is some delay for manually note the readings and resetting the counter this delay is approximately 20 -30 seconds. Now by doing the automation of the G.M. counter the microcontroller saves the readings send them serially to the computer and reset the counter in approximately 2 milli seconds(ms) so it will acts as continuously taking the readings rather than delay for manual calculation.

V. ACKNOWLEGEMENT

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