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A statistical approach on experimental study for determining switching frequency of retro reflector sensor using PLC

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ABSTRACT

Automation is a multi disciplinary platform which involves controls and drives.Though drives aqnd controlers bilds automation together without sensors it is not possible.Sensors are the vital device which interact with the physical environment and response to the system in the form of input. These inputs are further processed based on the predetermined porgramming in controllers to give the respective output via drives. Industrial sensors are broadly classified as retro reflective sensor, capacitibve sensor, photoelectric sensor, ultrasonic sensor aqnd magnetic sensor. The reliability and switching frequency of the sensor is the key factor to determine the performance of the system. In this paper, a detailed study on one such key factor named switching frequency is taken for experimental study with retro reflective sensors. The significant study of the switching frequency and the comparion of the performance the statistical methods like descriptive statistics, correlation and chi-square test are used.

Keywords— *Switching frequency, PLC, Retro reflective Sensor, Correlation, Chi-square*

1. INTRODUCTION

Retro refelective sensor is a type of photoelectric sensor. The sensor used here is retro reflective type. It's non-polarizing without MSR function. The sensor can be called as transceiver and has single cylindrical stainless-steel housing. It is of prewired type with sensing range between 0.1 to 2m. The output from sensor in NPN. In particular in the form of retro reflective work without any physical contact and feedback. Retro reflective switches are contact less and thus allow for high switching frequency with high life cycle. In any industry the induction motor plays an important role due to its low cost and simplicity. By implementing a monitoring and control system for the speed of motor, the induction motor can be used in high performance variable-speed applications. When the stator winding of a three phase AC supply, a rotating magnetic field is established and rotates at synchronous speed. The direction of rotation of the field can be reversed by S. R. Venupriya et. al., (2015) [1] interchanging the connection to the supply of any two leads of a three phase induction motor. A statistical method of analysis have already been done by on inductve sensor data which was collected throguh various trials in experiments [2]. Another study was done on the application of PLC in seggreagation of waste materials [3]. High frequency voltage-fed inverter with phase- shift control for induction heating has been discussed by Mollov, S.V, et. al., [4].

A control method of reducing the size of the dc-link capacitors of a converter-inverter system was presented by Jung, J et. al., [5]. The main idea is to utilize the inverter operation status in the current control of the converter. This control strategy is effective in regulating the dc-voltage level. Determination of temperature recovery time in differential-pressure-based air leak detector focussed by Harus, L.G. et. al., [6]. Water pumping system with working conditions of such system in the three face motor driven and saving energey and design methodology was introducted by Abdallah. S et. al.,[7-8] . A Statistical study was made by Dr.R.Arumugam et.al., for the impact of Dengue fever in Thanjavur district [9]. Abdallah, S., et. al., [10] An experiment study was made to examine the effect using PLC based solar energy. The single-switch for the heating induction has been focussed by Shenkman A. et. al., [11]. A statistical study based on the SPSS has been made a work by Dr.R.Arumugam et. al., [12] for the transportation problem to minimize cost value and finally, R.Arumugam et. al [13] studied the production of crops at time of Gaja cyclone based on the statistical study. Even the dc-link capacitor is arbitrarily small and the load varies abruptly. In this method was proposed to accurately predict the minimum required temperature recovery, considering repeatability and accuracy of leak detector by investigating the relation between temperature recovery time and applied pressures using PLC system.

2. METHODS AND METERIALS

This sensor emits a photo beam from its light emitting diode. A reflective type photoelectric sensor can be applied to detect the photo beam reflected from target. The thrubeam sensors can measure the variation in light quantity caused by the target crossing the optical axis.

In this work, anovel method is used to capture this switcing frequency of retro reflective sensor using PLC at the various levels especially low, medium and high. Comparision of various frequencies at the various levels were made using Chi-square test, Correlation and descriptive statistics. These tools are statistically important the quality measure of varition of the particular test To check the several level statistical software SPSS used. This test was conduction at the Centre for training and research in Automation technology in Periyar Maniammai Institute of Science and Technology, Deemed to be university in Tamil Nadu, India.

2.1 Programmable Logic Controller (PLC)

Automation engineering has developed over time. Earlier maual interventions were made to control the system and later came electrical control based on relays. These relays allow power to be switched on and off without a mechanical switch. The use of relays to make simple logical control decisions was common then. The introduction of low-cost computer has brought the most recent revolution, the Programmable Logic Controller (PLC). Advantages of PLC include Cost effective for controlling complex systems; Flexible and can be applied to control other systems quickly and easily. The ease in computation abilities allow control that is more flexible, sophisticated; Troubleshooting aids make programming easier and reduce downtime; Reliable components make these likely to operate for years before failure.

2.2 Working prinicple

Mounting the photoelectric sensor on to the elevation compensation and complete the electrical connections. The target material consists of both refelective and non refelective material (as shown in figure 2 in the form of circle attached to the motor. Once the motor is on, the circle (target) rotates and hence forth the on and off of the retor reflective sensors happens at variable speed which is purely depended on the speed of the motor.

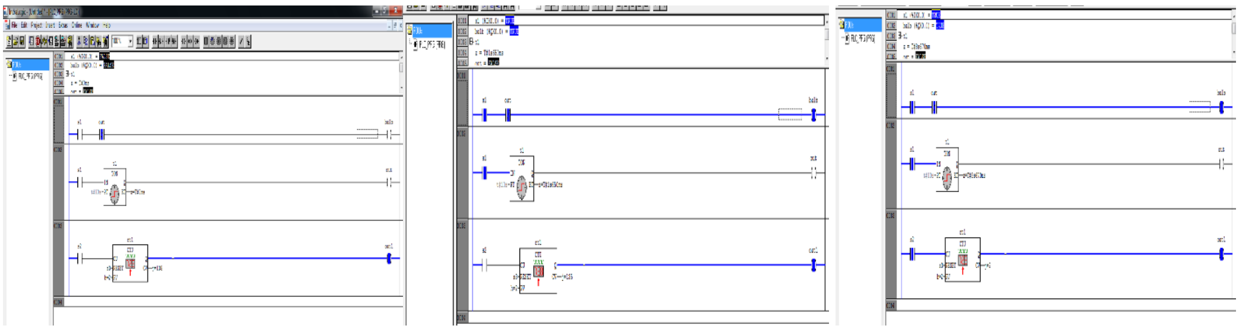

Fig. 1 Ladder Diagram for Determining The Switching Frequency of Retro reflective

The signal output received from sensor is fed as input to the PLC program which has the virtual counter. This counter counts the number of times the sensor switches on as shown in figure 1.

2.2 Target

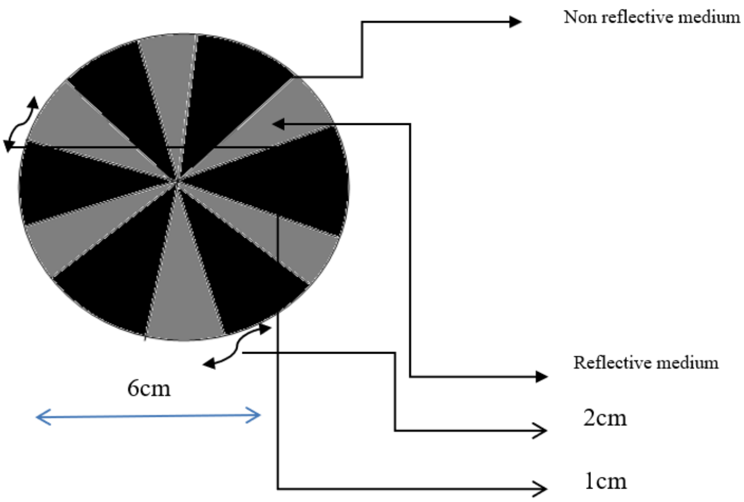

Fig. 2: Showing the Target arrangement (reflective and non reflective medium slots arranged cascade manner on circle)

Distance between disc and sensor:1mm
Disc diameter: 6cm
Number of metal pcs in disc: 6pcs

Fig. 3: BOSCH Rexroth PLC kit

Fig. 4: Reading RPM using tachometer

Table 1: Descriptive statistics for low frequency

		Trial	Low1	Low2	Low3	Low4	Low5
N	Valid	7	7	7	7	7	7
	Missing	0	0	0	0	0	0
Mean			638.00	664.29	646.14	675.86	660.57
Std. Error of Mean			445.087	490.255	476.538	504.870	490.727
Median			230.00[a]	208.00[a]	200.00[a]	200.00[a]	206.33[a]
Mode			1[b]	2[b]	3[b]	4[b]	210
Std. Deviation			1177.591	1297.092	1260.800	1335.761	1298.341
Variance			1386719.6	1682448.2	1589617.476	1784257.476	1685690.619
Skewness			2.610	2.623	2.624	2.627	2.627
Std. Error of Skewness			.794	.794	.794	.794	.794
Kurtosis			6.861	6.913	6.918	6.926	6.927
Std. Error of Kurtosis			1.587	1.587	1.587	1.587	1.587
Range			3299	3598	3497	3696	3595
Minimum			1	2	3	4	5
Maximum			3300	3600	3500	3700	3600
Sum			4466	4650	4523	4731	4624
	75		287.50	247.50	232.50	40.00[c]	231.75

Table 2: Descriptive statistics for medium frequency

		Medium1	Medium2	Medium3	Medium4	Medium5
N	Valid	7	7	7	7	
	Missing	0	0	0	0	
Mean		2907.43	2915.29	2457.57	2472.57	2883.71
Std. Error of Mean		2682.365	2697.703	2240.700	2254.866	2669.619
Median		268.00[a]	260.00[a]	261.00[a]	260.00[a]	257.00[a]
Mode		1[b]	2[b]	259	4[b]	5[b]
Std. Deviation		7096.871	7137.452	5928.334	5965.814	7063.147
Variance		50365584.619	50943216.571	35145143.28	35590939.95	49888050.238
Skewness		2.645	2.645	2.644	2.644	2.645
Std. Error of Skewness		.794	.794	.794	.794	.794
Kurtosis		6.996	6.996	6.994	6.994	6.996
Std. Error of Kurtosis		1.587	1.587	1.587	1.587	1.587
Range		18999	19098	15897	15996	18895
Minimum		1	2	3	4	5
Maximum		19000	19100	15900	16000	18900
Sum		20352	20407	17203	17308	20186
Percentiles	10	52.20[c]	50.20[c]	52.80[c]	51.80[c]	
	25	258.75	246.25	248.25	241.00	
	50	268.00	260.00	260.00	257.00	
	75	281.50	279.00	278.25	271.00	

Table 3: Descriptive statistics for high frequency

		High1	High2	High3	High4	High5
N	Valid	7	7	7	7	7
	Missing	0	0	0	0	0
Mean		5842.71	5820.71	5820.14	5834.57	5791.86
Std. Error of Mean		5776.229	5763.227	5763.321	5777.582	5734.701
Median		79.67[a]	57.00[a]	56.00[a]	59.00[a]	57.00[a]
Mode		72	2[b]	3[b]	4[b]	5[b]

Std. Deviation		15282.464	15248.066	15248.313	15286.046	15172.594
Variance		233553711.238	232503522.238	232511055.810	233663188.286	230207604.810
Skewness		2.646	2.646	2.646	2.646	2.646
Std. Error of Skewness		.794	.794	.794	.794	.794
Kurtosis		7.000	7.000	7.000	7.000	7.000
Std. Error of Kurtosis		1.587	1.587	1.587	1.587	1.587
Range		40499	40398	40397	40496	40195
Minimum		1	2	3	4	5
Maximum		40500	40400	40400	40500	40200
Sum		40899	40745	40741	40842	40543
Percentiles	10	11.40c	11.40c	13.00c	12.60c	12.60c
	25	56.17	47.50	49.25	46.00	46.00
	50	79.67	56.00	59.00	57.00	57.00
	75	103.25	92.50	93.50	91.75	91.75

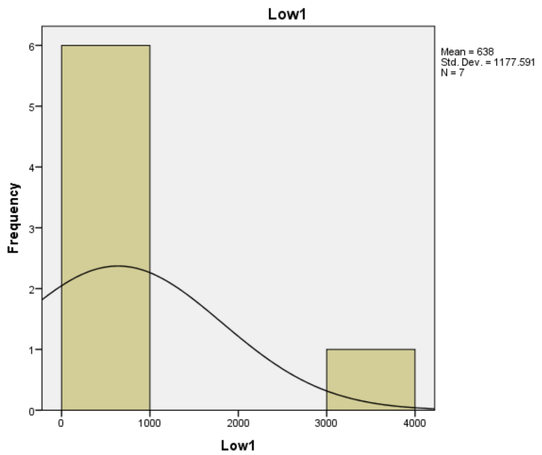

Fig. 5: Low frequency –First trial

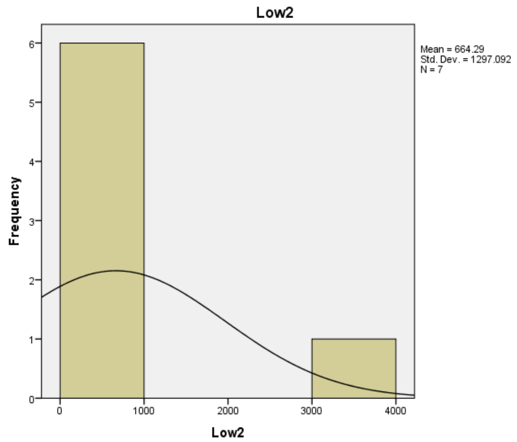

Fig. 6: Low frequency –Second trial

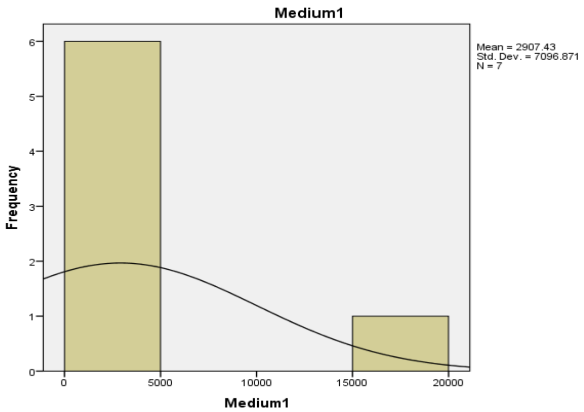

Fig. 7: Medium frequency –First trial

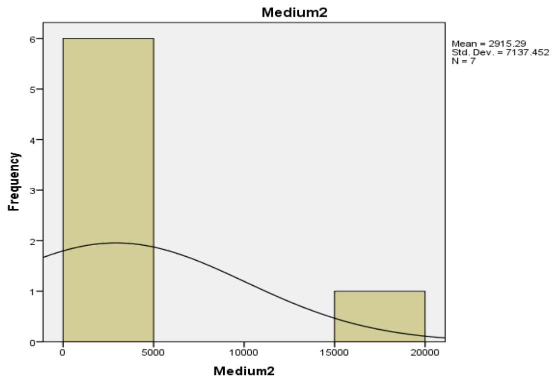

Fig. 8: Medium frequency –Second trial

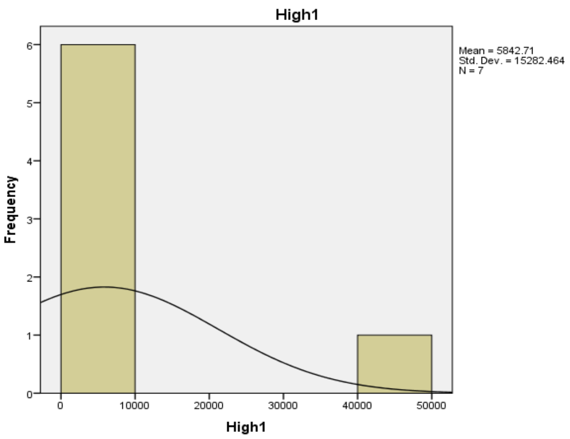

Fig. 9: High frequency –First trial

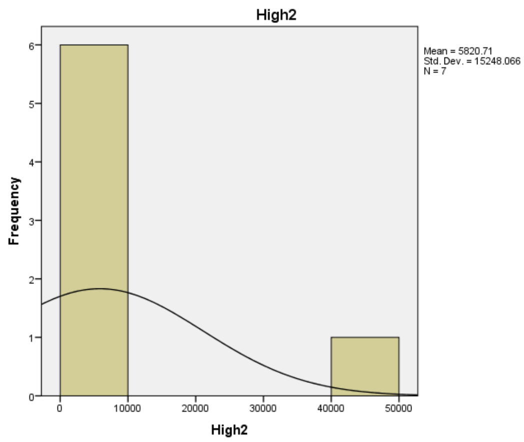

Fig. 10: High frequency –Second trial

Table 4: Chi-Square test for low frequency

			Low1	Low2	Low3	Low4	Low5
Chi-Square			.000[a]	.000[a]	.000[a]	.000[a]	.714[c]
df			6	6	6	6	5
Asymp. Sig.			1.000	1.000	1.000	1.000	.982
Monte Carlo Sig.	Sig.		1.000[b]	1.000[b]	1.000[b]	1.000[b]	1.000
	99% Confidence Interval	Lower Bound	1.000	1.000	1.000	1.000[b]	1.000
		Upper Bound	1.000	1.000	1.000	1.000	1.000

Table 5: Chi-Square test for medium frequency

			Medium1	Medium2	Medium3	Medium4	Medium5
Chi-Square			.000[a]	.000[a]	.714[c]	.000[a]	.000[a]
df			6	6	5	6	6
Asymp. Sig.			1.000	1.000	.982	1.000	1.000
Monte Carlo Sig.	Sig.		1.000[b]	1.000[b]	1.000[b]	1.000[b]	1.000[b]
	99%	1.000	1.000	1.000	1.000	1.000	1.000
	Confidence Interval	1.000	1.000	1.000	1.000	1.000	1.000

Table 6 Chi-Square test for high frequency

			High1	High2	High3	High4	High5
	Chi-Square		.714[c]	.000[a]	.000[a]	.000[a]	.000[a]
	df		5	6	6	6	6
	Asymp. Sig.		.982	1.000	1.000	1.000	1.000
Monte Carlo Sig.	1.000[b]		1.000[b]	1.000[b]	1.000[b]	1.000[b]	1.000[b]
	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 7 Correlation coefficient

		Low1	Low2	Low3	Low4	Low5	Medium1	Medium2	Medium3	Medium4	Medium5	High1	High2	High2	High4	High5
Low1	Pearson Correlation	1	1.000**	.999**	.999**	.999**	.998**	.998**	.998**	.998**	.998**	.997**	.997**	.997**	.997**	.997**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	8320318.000	9160377.000	8902929.000	9431476.000	9168193.000	50030465.000	50315871.000	41797494.000	42060080.000	49788282.000	107650309.000	107405437.000	107406960.000	107672013.000	106873336.000
	Covariance	1386719.667	1526729.500	1483821.500	1571912.667	1528032.167	8338410.833	8385978.500	6966249.000	7010013.333	8298047.000	17941718.167	17900906.167	17901160.000	17945335.500	17812222.667
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Low2	Pearson Correlation	1.000**	1	1.000**	1.000**	1.000**	.999**	.999**	.999**	.999**	.999**	.998**	.998**	.998**	.998**	.998**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	9160377.000	10094689.429	9811961.714	10394362.286	10103494.857	55164406.143	55476580.429	46084018.857	46375204.857	54898114.571	118716801.571	118448323.571	118449309.714	118742380.857	117860934.286
	Covariance	1526729.500	1682448.238	1635326.952	1732393.714	1683915.810	9194067.690	9246096.738	7680669.810	7729200.810	9149685.762	19786133.595	19741387.262	19741551.619	19790396.810	19643489.048
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Low3	Pearson Correlation	.999**	1.000**	1	1.000**	1.000**	.999**	.999**	.999**	.999**	.999**	.998**	.998**	.998**	.998**	.998**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	8902929.000	9811961.714	9537704.857	10104240.143	9821360.429	53625923.571	53929418.714	44799073.429	45082401.429	53367775.286	115406036.286	115144975.286	115146082.857	115431075.429	114574195.143
	Covariance	1483821.500	1635326.952	1589617.476	1684040.024	1636893.405	8937653.929	8988236.452	7466512.238	7513733.571	8894629.214	19234339.381	19190829.214	19191013.810	19238512.571	19095699.190
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Low4	Pearson Correlation	.999**	1.000**	1.000**	1	1.000**	.999**	.999**	.999**	.999**	.999**	.998**	.998**	.998**	.998**	.998**

	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	9431476.000	10394362.286	10104240.143	10705544.857	10405256.571	56823189.429	57145167.286	47470334.571	47770703.571	56550290.714	122291219.714	122014324.714	122016004.143	122317817.571	121410155.857
	Covariance	1571912.667	1732393.714	1684040.024	1784257.476	1734209.429	9470531.571	9524194.548	7911722.429	7961783.929	9425048.452	20381869.952	20335720.786	20336000.690	20386302.929	20235025.976
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Low5	Pearson Correlation	.999**	1.000**	1.000**	1.000**	1	.999**	.999**	.999**	.999**	.999**	.998**	.998**	.998**	.998**	.998**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	9168193.000	10103494.857	9821360.429	10405256.571	10114143.714	55231621.286	55545243.857	46140959.714	46432531.714	54966703.143	118864982.143	118595855.143	118597328.429	118890891.714	118008472.571
	Covariance	1528032.167	1683915.810	1636893.405	1734209.429	1685690.619	9205270.214	9257540.643	7690159.952	7738755.286	9161117.190	19810830.357	19765975.857	19766221.405	19815148.619	19668078.762
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Medium1	Pearson Correlation	.998**	.999**	.999**	.999**	.999**	1	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	50030465.000	55164406.143	53625923.571	56823189.429	55231621.286	302193507.714	303920447.143	252434750.286	254030800.286	300756546.857	650697474.857	649230450.857	649240680.571	650846867.286	646016245.429
	Covariance	8338410.833	9194067.690	8937653.929	9470531.571	9205270.214	50365584.619	50653407.857	42072458.381	42338466.714	50126091.143	108449579.143	108205075.143	108206780.095	108474477.881	107669374.238
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Medium2	Pearson Correlation	.998**	.999**	.999**	.999**	.999**	1.000**	1	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	50315871.000	55476580.429	53929418.714	57145167.286	55545243.857	303920447.143	305659299.429	253878045.857	255482473.857	302476389.571	654421069.571	652945204.571	652955907.714	654571202.857	649713104.286
	Covariance	8385978.500	9246096.738	8988236.452	9524194.548	9257540.643	50653407.857	50943216.571	42313007.643	42580412.310	50412731.595	109070178.262	108824200.762	108825984.619	109095200.476	108285517.381
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Medium3	Pearson Correlation	.998**	.999**	.999**	.999**	.999**	1.000**	1.000**	1	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	41797494.000	46084018.857	44799073.429	47470334.571	46140959.714	252434750.286	253878045.857	210870859.714	212203816.714	251234864.143	543541043.143	542314907.143	542323791.429	543665428.714	539630491.571
	Covariance	6966249.000	7680669.810	7466512.238	7911722.429	7690159.952	42072458.381	42313007.643	35145143.286	35367302.786	41872477.357	90590173.857	90385817.857	90387298.571	90610904.786	89938415.262
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Medium4	Pearson Correlation	.998**	.999**	.999**	.999**	.999**	1.000**	1.000**	1.000**	1	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	42060080.000	46375204.857	45082401.429	47770703.571	46432531.714	254030800.286	255482473.857	212203816.714	213545639.714	252823283.143	546978228.143	545744521.143	545753397.429	547103571.714	543043063.571
	Covariance	7010013.333	7729200.810	7513733.571	7961783.929	7738755.286	42338466.714	42580412.310	35367302.786	35590939.952	42137213.857	91163038.024	90957420.190	90958899.571	91183928.619	90507177.262
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Medium5	Pearson Correlation	.998**	.999**	.999**	.999**	.999**	1.000**	1.000**	1.000**	1.000**	1	1.000**	1.000**	1.000**	1.000**	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000
	Sum of Squares and Cross-products	49788282.000	54898114.571	53367775.286	56550290.714	54966703.143	300756546.857	302476389.571	251234864.143	252823283.143	299328301.429	647610240.429	646150134.429	646160649.286	647759589.143	642951922.714

	Covariance	8298047.000	9149685.762	8894629.214	9425048.452	9161117.190	50126091.143	50412731.595	41872477.357	42137213.857	49888050.238	107935040.071	107691689.071	107693441.548	107959931.524	107158653.786
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
H1	Pearson Correlation	.997**	.998**	.998**	.998**	.998**	1.000**	1.000**	1.000**	1.000**	1.000**	1	1.000**	1.000**	1.000**	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000
	Sum of Squares and Cross-products	107650309.000	118716801.571	115406036.286	122291219.714	118864982.143	650697474.857	654421069.571	543541043.143	546978228.143	647610240.429	1401322267.429	1398167942.429	1398190681.286	1401650289.143	1391247302.714
	Covariance	17941718.167	19786133.595	19234339.381	20381869.952	19810830.357	108449579.143	109070178.262	90590173.857	91163038.024	107935040.071	233553711.238	233027990.405	233031780.214	233608381.524	231874550.452
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
H2	Pearson Correlation	.997**	.998**	.998**	.998**	.998**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1	1.000**	1.000**	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000
	Sum of Squares and Cross-products	107405437.000	118448323.571	115144975.286	122014324.714	118595855.143	649230450.857	652945204.571	542314907.143	545744521.143	646150134.429	1398167942.429	1395021133.429	1395043594.286	1398495618.143	1388115911.714
	Covariance	17900906.167	19741387.262	19190829.214	20335720.786	19765975.857	108205075.143	108824200.762	90385817.857	90957420.190	107691689.071	233027990.405	232503522.238	232507265.714	233082603.024	231352651.952
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
H3	Pearson Correlation	.997**	.998**	.998**	.998**	.998**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1	1.000**	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000
	Sum of Squares and Cross-products	107406960.000	118449309.714	115146082.857	122016004.143	118597328.429	649240680.571	652955907.714	542323791.429	545753397.429	646160649.286	1398190681.286	1395043594.286	1395066334.857	1398518309.429	1388138623.143
	Covariance	17901160.000	19741551.619	19191013.810	20336000.690	19766221.405	108206780.095	108825984.619	90387298.571	90958899.571	107693441.548	233031780.214	232507265.714	232511055.810	233086384.905	231356437.190
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
H4	Pearson Correlation	.997**	.998**	.998**	.998**	.998**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1	1.000**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000
	Sum of Squares and Cross-products	107672013.000	118742380.857	115431075.429	122317817.571	118890891.714	650846867.286	654571202.857	543665428.714	547103571.714	647759589.143	1401650289.143	1398495618.143	1398518309.429	1401979129.714	1391573673.571
	Covariance	17945335.500	19790396.810	19238512.571	20386302.929	19815148.619	108474477.881	109095200.476	90610904.786	91183928.619	107959931.524	233608381.524	233082603.024	233086384.905	233663188.286	231928945.595
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
H5	Pearson Correlation	.997**	.998**	.998**	.998**	.998**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
	Sum of Squares and Cross-products	106873336.000	117860934.286	114574195.143	121410155.857	118008472.571	646016245.429	649713104.286	539630491.571	543043063.571	642951922.714	1391247302.714	1388115911.714	1388138623.143	1391573673.571	1381245628.857
	Covariance	17812222.667	19643489.048	19095699.190	20235025.976	19668078.762	107669374.238	108285517.381	89938415.262	90507177.262	107158653.786	231874550.452	231352651.952	231356437.190	231928945.595	230207604.810
	N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

4. DISCUSSION AND RESULT

The objective of this work was to suggest an innovative method of reading the switching frequency of Retro reflective sensor(a type of Photoelectric sensor) by doing experimental trials and also to statistical analyze the collected experimental data .PLC programming as shown in the results of the above figures 1, 2, 3 and 4.

First table represents that the descriptive statistics for low frequency for the given five trials, the mean values are 638, 664, 646.14, 675.86 and 660.57 respectively. In the mode there is no change and the standard deviations are 1177.59, 1297.09, 1260.8, 1335.76 and 1298.34. Here, skewness all the five levels are less than 3 ($\beta_1 < 3$) ie., positive skewness and the kurtosis are greaterthan 3 ($\beta_2 > 3$). Therefore, all the trials the kurtosis are leptokurtic. Similardly, the second and third table show that the descriptive statistics for medium and high frequencies in all the trials.

Fifth and sixth figure demonstrates that the low frequencies of the first and second trial with mean values are 638, 664.29 and standard deviations are 1177.58 and 1297.09. Similarly figure seven and eight foucussing the level based on their mean and standard deviations at the medium level and figure nine and ten illustrates the same in the high level.

Fourth table explain that the chi-square test for low frequency in the five levels, it is representing there is no changes in all the trial because it is significant at 5% level (ie p = 1.000). Monte carlo method is also predicting the same at 5% level. Similary fifth and sixth table the same at the medium and high frequencies.

Seventh table represents the relations among the low, medium and high frequency values in the Pearsons correlation coefficients. In this case correlation coefficient in the low level is 1.0, medium level is 0.998 and high level is 0.997. Therefore, all are perfect positive correlation, it is representing we have some positive relation among the three levels.

5. CONCLUSION

The switching frequency of retro reflective sensor (a type of Photoelectric sensor) is studied by varying the frequency at three different level under dynamic conditions. From the Chi-square table of the above and the Pearsons's correlations of this paper we are focusing that the significant level of changes the reading of switching frequencies of 5 trials with various levels and also represents the relationship among the given three level of frequencies. The proposed statistical study of the system successfully represents the real behavior of **Swiching Frequency Of Retro Reflective Sensor using PLC** system and frequency control based on the SPSS.

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