A Study and Analysis on Sky Yoga and Its Impact on Blood Sugar and Blood Pressure

Dr.C. Nalini, Kanchana

Abstract: Yoga is essentially a spiritual discipline based on an extremely subtle science, which focuses on bringing harmony between mind and body. It is an art and science of healthy living. It includes a group of physical, mental and spiritual practices which originated in ancient India. As per Yogic scriptures, the practice of Yoga leads to the union of individual consciousness with that of the Universal Consciousness, indicating a perfect harmony between the mind and body, Man & Nature. In this paper we focused the two disorders in our human body blood pressure and blood sugar are commonly prevalent world over. We studied and analysis of vedathiri maharishi exercises and mediation. And how, the yoga exercises and meditation are reducing the disorders. For that, we are taken 25 persons for experimented with Simplified physical activity, Nadi suddhi pranayama, and full meditation on breathing. It is shown conclusive evidence of improvement in blood pressure and blood sugar conditions.

Keywords: Maharishi, Physical Exercises, Nadi Suddhi Pranayama, Mediation, Blood Sugar, Blood Pressure.

INTRODUCTION

Yoga is essentially a spiritual discipline based on an extremely subtle science, which focuses on bringing harmony between mind and body. It is an art and science of healthy living. The word 'Yoga' is derived from the Sanskrit root 'Yuj', meaning 'to join' or 'to yoke' or 'to unite'. It includes a group of physical, mental and spiritual practices which originated in ancient India. As per Yogic scriptures the practice of Yoga leads to the union of individual consciousness with that of the Universal Consciousness, indicating a perfect harmony between the mind and body, Man & Nature. According to modern scientists, everything in the universe is just a manifestation of the same quantum firmament. One who experiences this oneness of existence is said to be in yoga, and is termed as a yogi, having attained to a state of freedom referred to as mukti, nirvana or moksha. The practice of Yoga is believed to have started with the very dawn of civilization. The science of yoga has its origin thousands of years ago, long before the first religions or belief systems were born.

There were several studies in the past on Yoga and Maharishi's simplified physical exercises, and their positive impact on one's overall health. Blood Pressure and Blood sugar are two commonly prevalent condition world over.

The endeavour was to narrow down these two subjects:

1. To study the effect of Yoga and Maharishi's simplified physical exercises specifically on blood pressure and blood sugar on common individuals in real-life condition.
2. To demonstrate on minor modification in the life style doing regularity in yoga and exercises will have overall health benefits.
3. To demonstrate simple Pranayama combined with meditation will have significant benefits on body and mind. This paper is organized session 2 is giving details of blood sugar and how yoga is helping to prevent and recovery from this disorder. The session 3 is explained the blood pressure and how yoga is helping to control the blood pressure. The session 4 is giving experiment result and finally it concluded.

Dr.C. Nalini, Professor, Department of Computer Science and Engineering, BIST, BIHER, Bharath Institute of Higher Education & Research, Selaiyur, Chennai. E-mail: nalini.cse@bharathuniv.ac.in

Kanchana, Reseach Scholar, Department of Computer Science and Engineering, WCSC.Alliyar.

EFFECT OF YOGA ON BLOOD SUGAR

As we know, all asana will have positive effect on one or more endocrine glands and Blood sugar and blood pressure are regulated by the hormones. Endocrine system helps to maintain body's homeostasis (balance). Metabolism, growth, sexual development, mental growth, mineral balance, heart rate regulation, setting our sleep cycle, muscular and skeletal growth is the functions of endocrine gland.

Blood glucose is our main source of energy and comes from the food we eat and its subsequent digestion. Diabetes occurs when your blood glucose or blood sugar is either too high or too low. Insulin, a hormone made by the pancreas, helps glucose from the food get into your cells to be used for energy. Sometimes, your body doesn't make any/enough insulin or doesn't use it well. Glucose then stays in your blood and doesn't reach your cells. This leads to having excess glucose in your blood which causes various health problems.

There are three common kinds of diabetes:

Type 1: in which your body does not make enough insulin, the immune system attacks and destroys the cells in your pancreas that make the insulin.

Type 2: in which your body does not use the insulin well and glucose becomes an excess in the blood.

Type 3: also called Gestational diabetes which usually develops in some women when they are pregnant.

While diabetes may not have a complete cure, one can take steps to manage or control the blood sugar. This yoga sequence for diabetes demonstrates the sequencing of various yoga poses to activate different muscles and nerves in the body, since the muscles and nerves in the body are affected the most due to high/low blood sugar levels, over a period of time. The digestive system plays a very important role here and hence, in this yoga sequence, the various yoga poses are mostly related to the digestive system. This is done to make sure there is improvement in digestion while keeping the other organs of the body in mind like the kidney, pancreas, liver, reproductive organs, nervous system, and circulatory system. Emphasis is placed on breathing correctly as the nervous system and the circulatory system get affected the most due to blood sugar. Hence, various methods of *pranayama* are included and focus should be to stay longer with this practice. This helps to improve the flow of blood and the oxygen levels in the blood, which in turn helps to control the blood sugar levels.

Rational For Selecting Yoga Asana for Diabetes Cure

For Diabetes cure, Yoga Asana was selected that have focus on stretch and twist in lower thoracic and upper lumbar region, where pancreas is located. These asana are believed to increase the blood supply, massage the respective organs, activate their cells and thereby cause an stimulate and increase insulin secretion, eventually reducing high blood sugar. Following are the key features considered in Yoga asana:

- There are evidences that regular practice can significantly reduce body weight, which is particularly important to keep diabetes under check.
- It regenerates/rejuvenates pancreatic cells during abdominal stretching
- It enhances enzymatic process and also may increase utilization and metabolism of glucose in peripheral tissues.
- Helps in muscular relaxation, enhance muscular development and improve blood circulation to muscles. All these may improve insulin receptor expression and causes increase in glucose uptake by muscles and help in reduction of blood sugar.
- It can directly stimulate pancreas by enhancing circulation in the meridian of pancreas and rejuvenates its insulin producing capacity
- It can improve sensitivity of b-cells of the pancreas to glucose signal and insulin sensitivity. This may result in better glucose uptake and reduction of blood sugar.
- Many Studies have confirmed that practicing specific Yoga Asana such as Dhanurasanam, Halasana squeezes and compresses the abdomen area. It helps stimulate the pancreatic secretions which cause more insulin to rush into blood.
- Bandhas in yoga are neuromuscular locks that stimulate endocrine secretions in the body. It also realigns and improves the functioning of the organs and the glands that are generally affected by diabetes conditions
- Diabetic symptom generally gets worse due to increase in blood pressure. Asana like corpse pose, bridge pose child pose and relaxation has been seen controlling hypertension.

EFFECT OF YOGA ON HIGH BLOOD PRESSURE

Numerous studies establish the potential positive effects of yoga on depression, stress, and anxiety. While there are many therapeutic avenues available for stress and depression, consistent yoga practice has been shown to improve depression as well. Yoga can lead to significant increases in serotonin levels, paired with decreases in the levels of monoamine oxidase, an enzyme that breaks down neurotransmitters and cortisol and is used in the treatment of depression. A 2010 study showed that women who practiced yoga recovered from stress more quickly than women without a regular practice. Studies show yoga offers tremendous benefits in the area of stress relief, which helps in all other areas of the body. The chemicals and hormones that are associated with a physical and mental sense of well-being and happiness, including antioxidants, were increased in all subjects in studies. Stress is often called the "silent killer" as it can lead to high blood pressure, heart disease, and a lowered immune system. Yoga is an effective stress killer.

Yoga can be a very beneficial therapy for controlling and lowering high blood pressure naturally. The gentle, soothing practice of yoga asanas settles both mind and body and reduces stress—a leading cause of hypertension. Used correctly, yoga can be a great therapy for high blood pressure.

A healthy artery is made up of semi-flexible tissues and muscle, and it stretches just like elastic when blood is pumped through it. The higher the force of the blood, the more the arteries stretch and allow blood flow. When the force of the blood flow is constantly high, the tissues that make the wall of the arteries stretch far beyond their healthy limit, and therefore, get damaged. This creates a whole lot of problems, such as an increased workload on the circulatory system, scarring of the vascular organs, weakness of the heart, an increased risk of blood clots, plaque build-up, and blocked arteries. The only way to know if you have high blood pressure is by getting it tested.

Systolic	Diastolic	Blood pressure condition
Less than 90	Less than 60	Low blood pressure
90 – 120	60 – 80	Normal
120 – 129	80 – 89	Elevated (Pre-hypertension)
130 – 139	90 – 99	High blood pressure (Hypertension stage 1)
140 – 180	100 – 109	High blood pressure (Hypertension stage 2)
180 or more	110 or more	High blood pressure crisis

Fig. 1: Range of Blood Pressure

How Can Yoga Help Reduce Your Blood Pressure?

Any physical activity is known to lower blood pressure, so yoga already qualifies as a treatment. But apart from being a mere physical activity, it also has a meditative effect on the body. It reduces stress and stimulates each and every gland and organ in the body. Yoga relaxes the mind and the body and balances out the nervous system that controls certain autonomic functions, including the pumping of the heart. All of this positively affects high blood pressure and successfully reduces it.

EXPERIMENTAL SETUP AND RESULT

The participants were all volunteers and they were all interested in yoga. Parsn Renascence apartment and Palm apartments were approached and 21 participants were enrolled – 11 from Parsn Renascence and 10 from Palm Fern apartments. 3 from Radha nagar also joined later adding the total to 24 participants. The participants were split into two groups: yoga experimental group with regular participants and yoga experimental group with irregular practice group. Yoga is combined with Simplified physical activity, Nadi suddhi pranayama, mindful meditation on breathing.

Start date 19th November 2018; End date 18th December 2018.

Total 30 days of consistent Yoga practice

Session Working Days

Monday to Friday is the yoga session conducted and Saturday and Sunday were given holiday for the session. From 19th November 2018 to 18th December 2018, there were 8 weekend days all together, so the sessions were conducted for 22 days.

Food Habits

No separate food diet was followed during the 30 days yoga session. Every participant in the program followed their routine and regular food pattern.

Fees

No fee collected in any way for this study from the participants. The participants purely volunteered the yoga session.

Behavioural survey

Behavioural survey was taken at the end of the program as part of filling in the feedback form about stress, sleep, anger management. This was done more for general observation and not used for the study.

Gender

All participants were females. Did not approach any male candidates for the program.

Participants

Participants in this study were individuals between the age group of 32 and 61 has voluntaries from Parsn and Palm residence. Another 3 from Radha nagar. Total of 24 participants were part of this study. Out of these 4 participants discontinued during the course of the 30-day session.

a) Methodology

Explain the format of the study adopted and the reasons behind the various exercises selected for this method.

• Nadi suddhi

Explains how Nadi suddhi will be helpful in blood pressure and blood sugar management, how it was done during the session.

• Meditation

Explains the effect of meditation on the study parameters, how the participants followed it during the session.

• Simplified Physical Exercises

Explains all the 9 simplified physical exercises of Vethathiri Maharishi and its effect on body and how it was done by the participants and its effect on blood pressure and blood sugar.

• Asanas

Explains the 21 selected Asanas in detail, how each of these are helpful on blood sugar and blood pressure, challenges faced by the participants and suggested variations provided in the posture.

TADASANAM (Mountain pose), EKAPADASANAM (One leg pose) and Vrksasana (Tree Pose), CHAKRASANAM - SIDEWAYS (Half waist wheel pose), NAVASANAM (Boat Pose), PASCHIMOTHASANAM (Seated forward bend pose), *BADDHAKONASANAM (Bound Angle pose) (Cobbler Pose),* DANDASANAM (Staff Pose), VAJARASANAM (Thunderbolt Pose), SUKASANAM (Easy Pose), JANUSIRASASANAM (Seated Head to knee forward bend Pose), GOMUKHASANAM (Cow Face Pose), Supine Pose Asanas, PAVANAMUKTASANAM (Wind relieving pose), UDDHANA PADASANAM (Raised Leg Pose), VIPARITAKARANI (Legs up the wall pose), SAVASANAM (Corpse Pose), Prone Pose Asana, SALABHASANAM *(Locust Pose),* DHANURASANAM *(Bow pose),* NAUKASANAM (LOCUST Pose), MAKARASANAM (Corpse Pose). Post this, all the data collected during the 30-day study are analyzed and presented across several parameters, followed by conclusion and potential future enhancement of this study.

Blood Pressure Data

| S.N | Participant | Participant name | A | Existing Health condition | Blood Pressure | | | |
| | | | | | Before | | After | |
					Category	Reading	Category	Reading
1	Participant 1	Meera S	54	High BP	High	121/91	Normal	134/84
2	Participant 2	Amudha A	61	Normal BP	PreHypertension	141/94	PreHypertension	151/97
4	Participant 4	J. Muthulakshmi	41	PreHypertension	Normal	124/88	Normal	122/84
7	Participant 7	A. Bhuvaneswari	38	Normal BP	Normal	94/71	Normal	85/56
8	Participant 8	K.S.Vijayalakshmi	45	PreHypertension	PreHypertension	135/81	PreHypertension	131/89
9	Participant 9	V. Mathuram	37	Normal BP	Normal	118/79	Normal	99/75
10	Participant 10	B. Poornima	34	Normal BP	Normal	113/87	Normal	115/90
11	Participant 11	D. Srikanthi	37	Normal BP	Normal	85/61	Normal	80/60
12	Participant 12	Gayatri Guru	44	PreHypertension	PreHypertension	134/90	Normal	119/103
13	Participant 13	Suganya Perumal	39	Normal BP	Normal	110/82	Normal	112/82
14	Participant 14	A. Ezhilaraasi	32	Normal BP	Normal	95/77	Normal	86/67
15	Participant 15	Swetha Mahesh	41	Hypothyrodism	Normal	112/78	Normal	114/79
16	Participant 16	P. Sasikala	40	Low BP	Normal	105/74	Normal	95/63
17	Participant 17	S. Krithikalakshmi	43	Neck Pain	Normal	99/75	Normal	99/71
18	Participant 18	S. Srilakshmi	32	Normal	Normal	102/80	Normal	118/82
19	Participant 19	K. Suneetha	31	Normal	Normal	115/92	Normal	95/71
20	Participant 20	S. Jayanthi	50	Normal	Normal	110/84	Normal	120/73
21	Participant 21	S.N. Fathima	39	Knee Pain	Normal	104/75	Normal	103/77
23	Participant 23	Lakshmi	38	C Section	Normal	114/90	Normal	112/90
24	Participant 24	N. Yazhini Isaiyarasi	35	Normal BP	Normal	104/67	Normal	92/70

Fig. 2: Details of Participant - Blood Pressure

Blood Sugar

| S.N | Participant | Participant name | A | Existing Health condition | Blood Sugar | | | | | |
| | | | | | Before | | | After | | |
					Fasting	PBBS	Category	Fasting	PBBS	Category
1	Participant 1	Meera S	54	High BP	167	244	High Blood Sugar	103	159	High Blood Sugar
2	Participant 2	Amudha A	61	Normal BP	216	280	High Blood Sugar	171	258	High Blood Sugar
4	Participant 4	J. Muthulakshmi	41	PreHypertension	146	202	High Blood Sugar	137	210	High Blood Sugar
7	Participant 7	A. Bhuvaneswari	38	Normal BP	85	93	Normal	88	132	Normal
8	Participant 8	K.S.Vijayalakshmi	45	PreHypertension	111	118	Prediabetes	97	114	Normal
9	Participant 9	V. Mathuram	37	Normal BP	101	130	Prediabetes	97	112	Normal
10	Participant 10	B. Poornima	34	Normal BP	79	106	Normal	72	101	Normal
11	Participant 11	D. Srikanthi	37	Normal BP	83	108	Normal	82	117	Normal
12	Participant 12	Gayatri Guru	44	PreHypertension	89	100	Normal	87	109	Normal
13	Participant 13	Suganya Perumal	39	Normal BP	96	110	Normal	94	112	Normal
14	Participant 14	A. Ezhilaraasi	32	Normal BP	78	101	Normal	91	118	Normal
15	Participant 15	Swetha Mahesh	41	Hypothyrodism	104	126	Prediabetes	106	143	Prediabetes
16	Participant 16	P. Sasikala	40	Low BP	72	108	Normal	77	101	Normal
17	Participant 17	S. Krithikalakshmi	43	Neck Pain	84	87	Normal	78	108	Normal
18	Participant 18	S. Srilakshmi	32	Normal	86	114	Normal	78	119	Normal
19	Participant 19	K. Suneetha	31	Normal	94	112	Normal	99	118	Normal
20	Participant 20	S. Jayanthi	50	Normal	96	120	Normal	92	136	Normal
21	Participant 21	S.N. Fathima	39	Knee Pain	92	118	Normal	82	108	Normal
23	Participant 23	Lakshmi	38	C Section	96	104	Normal	95	111	Normal
24	Participant 24	N. Yazhini Isaiyarasi	35	Normal BP	83	114	Normal	95	110	Normal

Fig. 3: Blood Sugar data

b) Analysis of data

Following analysis was done based on the data gathered during the study.

1) Blood Sugar data and analysis

The below chart shows that the Blood sugar levels on participants 1, 2, 8 and 9 showed good improvement. Out of these, participants 2, 8 & 9 are in the higher BMI category. Also, their attendance data indicates that they were very regular to the sessions. Refer to Blood sugar data in the above section.
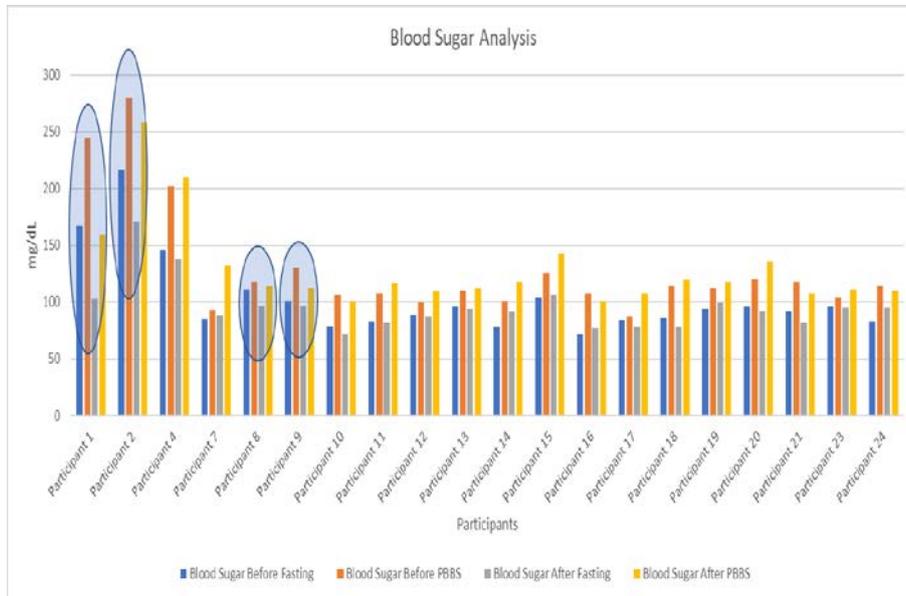
Fig.4: Blood sugar data and analysis

The below chart gives the representation of blood pressure of the participants. While there are many like participants 4, 7, 8, 9, 10, 11 showed improvement (decrease) in blood pressure, there were also participants like 1 and 2 who saw increase in pressure. Specifically, participant 2 was in higher weight / BMI category. Attendance record indicated regularity in the participation for participant 2. Refer to Blood sugar data in the above section.

In general, improvement was shown and trend looks encouraging.

- Sugar levels also shown improvement trend broadly based on regularity in participation
- Participant 1 and 2 have significant drop in blood sugar levels. Participant 1 about 64 points. Participant 2 about 45 points
- Participant 14 had increase in blood sugar level (from 78 to 91 fasting sugar level)
- Participants 8, 10, 18 and 21 have reasonable reduction in sugar levels (between 7 and 14 points)
- Others have sustained the level after the session
- In Summary, participants who are regular to the session have seen improvement in blood sugar levels. A trend around this could also be arrived at.

2) Blood Pressure Data and Analysis
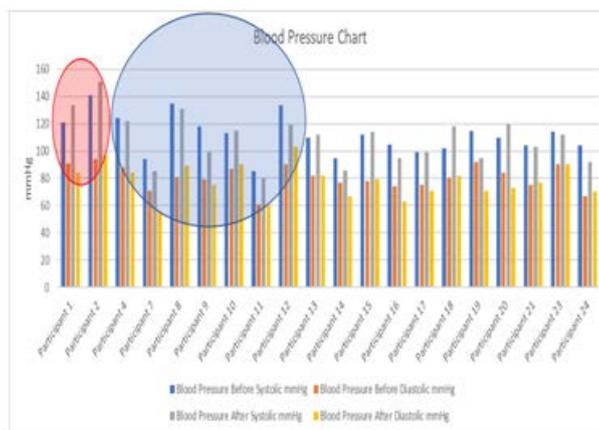
Fig. 5: Improvement of Blood Pressure

- Broadly blood pressure for all the participants were maintained well during the course of the sessions.
- Participants 7, 11, 14 and 17 started off with low blood pressure (Systolic under 100). But they continued around the same range and did not show any fatigue symptoms during the sessions.
- Participant 2 and 8, had higher Systolic to begin with. They also sustained around this level during the sessions and also at the end of the session.
- Participants 1, 2, 9, 12, 16, 18, 19 and 20 had changes 10 or above points during the session.
- Specifically, for participants 18 and 20, pressure went up but to a normal level of 120.
- In summary, while there is a general improvement in blood pressure levels, a direct co-relation to the regularity of the participants could not be drawn.

c) Finds

1) Blood Sugar

- 6 Participants had reduction in blood sugar level in both Fasting and post prandial measurement

	Blood Sugar			
	Before		After	
Participant ID	Fasting	PBBS	Fasting	PBBS
Participant 1	167	244	103	159
Participant 2	216	280	171	258
Participant 8	111	118	97	114
Participant 9	101	130	97	112
Participant 10	79	106	72	101
Participant 21	92	118	82	108

Another 10 Participants had reduction in blood sugar levels either in Fasting or in Post Prandial measurement.

	Blood Sugar			
	Before		After	
Participant ID	Fasting	PBBS	Fasting	PBBS
Participant 4	146	202	137	210
Participant 11	83	108	82	117
Participant 12	89	100	87	109
Participant 13	96	110	94	112
Participant 16	72	108	77	101
Participant 17	84	87	78	108
Participant 18	86	114	78	119
Participant 20	96	120	92	136

- 4 Participant did not show any improvement.

	Blood Sugar			
	Before		After	
Participant ID	Fasting	PBBS	Fasting	PBBS
Participant 7	85	93	88	132
Participant 14	78	101	91	118
Participant 15	104	126	106	143
Participant 19	94	112	99	118

2) Blood Pressure

- 8 participants had reduction in both Systolic and Diastolic measurement.

| | Blood Pressure | | | |
| | Before | | After | |
Participant ID	Systolic mmHg	Diastolic mmHg	Systolic mmHg	Diastolic mmHg
Participant 4	124	88	122	84
Participant 7	94	71	85	56
Participant 9	118	79	99	75
Participant 11	85	61	80	60
Participant 14	95	77	86	67
Participant 16	105	74	95	63
Participant 19	115	92	95	71
Participant 23	114	90	112	90

- Another 7 participants had reduction in either Systolic or Diastolic levels

| | Blood Pressure | | | |
| | Before | | After | |
Participant ID	Systolic mmHg	Diastolic mmHg	Systolic mmHg	Diastolic mmHg
Participant 1	121	91	134	84
Participant 8	135	81	131	89
Participant 12	134	90	119	103
Participant 17	99	75	99	71
Participant 20	110	84	120	73
Participant 21	104	75	103	77
Participant 24	104	67	92	70

- 5 Participant did not show any improvement

| | Blood Pressure | | | |
| | Before | | After | |
Participant ID	Systolic mmHg	Diastolic mmHg	Systolic mmHg	Diastolic mmHg
Participant 2	141	94	151	97
Participant 10	113	87	115	90
Participant 13	110	82	112	82
Participant 15	112	78	114	79
Participant 18	102	80	118	82

CONCLUSION

Vethathiri Maharishi's simplified physical exercise stands out of the lot, due the fact that it can be easily followed by most age groups (age 8 to 80). Simplicity of these exercises, yet with pronounced benefits will encourage everyone to make it part of the life, in a more incremental and sustained manner. While more sample size and duration, combined with more pronounced condition would have shown conclusive evidences of improvement in blood pressure and blood sugar conditions, even the study of this small scale showed improvements, although minor. More importantly, the improvement trend and general feeling amongst the participants is very encouraging. For future enhancement of this study Increase the number of participants, Increase the age diversity of the participants ,have more participants with pronounced condition of blood sugar and / or blood pressure ,have the session for a longer duration – at least for 3 months. 6 months would be ideal.

REFERENCES

[1]   Udayakumar, R., Khanaa, V., & Saravanan, T. (2013). Analysis of polarization mode dispersion in fibers and its mitigation using an optical compensation technique. *Indian Journal of Science and Technology*, *6*(6), 4767-4771.

[2]   Udayakumar, R., Kumaravel, A., & Rangarajan, K. (2013). Introducing an efficient programming paradigm for object-oriented distributed systems. *Indian Journal of Science and Technology*, *6*(5S), 4596-4603.

[3]   Mageswaran, S.U., & Sekhar, N.G. (2013). Reactive power contribution of multiple STATCOM using particle swarm optimization. *International Journal of Engineering & Technology*, *5*(1), 122-126.

[4]   Giri, R.K., & Saikia, M. (2013). Multipath routing for admission control and load balancing in wireless mesh networks. *International Review on Computers and Software*, *8*(3), 779-785.

[5]   Padmapriya, G., Manikandan, A., Krishnasamy, V., Jaganathan, S.K., & Antony, S.A. (2016). Spinel NixZn1− xFe2O4 (0.0≤ x≤ 1.0) nano-photocatalysts: synthesis, characterization and photocatalytic degradation of methylene blue dye. *Journal of Molecular Structure*, *1119*, 39-47.

[6]   Vijayaragavan, S.P., Karthik, B., Kiran Kumar, T.V.U., & Sundar Raj, M. (2013). Analysis of chaotic DC-DC converter using wavelet transform. *Middle-East Journal of Scientific Research*, *16*(12), 1813-1819.

[7]   Lokesh, K., Kavitha, G., Manikandan, E., Mani, G.K., Kaviyarasu, K., Rayappan, J.B.B., ... & Maaza, M. (2016). Effective ammonia detection using n-ZnO/p-NiO heterostructured nanofibers. *IEEE Sensors Journal*, *16*(8), 2477-2483.

[8]   Abraham, A.G., Manikandan, A., Manikandan, E., Vadivel, S., Jaganathan, S.K., Baykal, A., & Renganathan, P.S. (2018). Enhanced magneto-optical and photo-catalytic properties of transition metal cobalt (Co2+ ions) doped spinel MgFe2O4 ferrite nanocomposites. *Journal of Magnetism and Magnetic Materials*, *452*, 380-388.

[9]   Kennedy, J., Fang, F., Futter, J., Leveneur, J., Murmu, P.P., Panin, G.N., & Manikandan, E. (2017). Synthesis and enhanced field emission of zinc oxide incorporated carbon nanotubes. *Diamond and Related Materials*, *71*, 79-84.

[10]   Teresita, V.M., Manikandan, A., Josephine, B.A., Sujatha, S., & Antony, S.A. (2016). Electromagnetic properties and humidity-sensing studies of magnetically recoverable LaMg x Fe 1− x O 3− δ perovskites nano-photocatalysts by sol-gel route. *Journal of Superconductivity and Novel Magnetism*, *29*(6), 1691-1701.

[11]   Caroline, M.L., & Vasudevan, S. (2009). Growth and characterization of pure and doped bis thiourea zinc acetate: Semiorganic nonlinear optical single crystals. *Current applied physics*, *9*(5), 1054-1061.

[12]   Jayalakshmi, V., & Gunasekar, N.O. (2013). Implementation of discrete PWM control scheme on Dynamic Voltage Restorer for the mitigation of voltage sag/swell. *International Conference on Energy Efficient Technologies for Sustainability*, 1036-1040.

[13]   SenthiyaPrabha, P. (2014). Design of Energy Efficient Hierarchical Routing Protocol using ACO for WSN. *International Journal of System Design and Information Processing, 2*(2), 45-49.

[14]   Kanimozhi, N., & Dr.Singaravel, G. (2018). Combining Image Security and Authentication Using Sift and Zernike Moments. *Bonfring International Journal of Networking Technologies and Applications, 5*(1), 17-20.

[15]   Dubled, M., and Kim, Y.B. (2017). Numerical Analysis and Modelling of Solar Still with Granular Activated Carbon. *Bonfring International Journal of Power Systems and Integrated Circuits, 7*(2), 13-18.

[16]   Anand, R., & Gupta, H. (2014). Unlocking the Wireless Smartphone Charging Potential. *International Scientific Journal on Science Engineering & Technology,* 17(10), 935-938.

[17]   Kumar, M., & Purohit, R. (2014). A Compact UWB U-Shaped Slot MSA with B and Dispensation Characteristic for Communication. *International Scientific Journal on Science Engineering & Technology, 17*(10), 964-969.

[18]   Wang, H., Chiang, W.H., Chou, C.W., & Chang, D.T.H. (2014). Dynamic Simulation of Electric Bus Vehicle. *The SIJ Transactions on Computer Science Engineering & its Applications, 2*(4), 57-64.

[19]   Mizuno, J., & Takahashi, S. (2014). Electrical Chock Dangerous for Human in Flooding Situation. *The SIJ Transactions on Computer Science Engineering & its Applications, 2*(4), 82-85.

[20]   Jayapratha, S., & Dr.Pabitha, P. (2018). Topic Categorization based on User behaviour in Random Social Networks Using Firefly Algorithm. *Bonfring International Journal of Software Engineering and Soft Computing, 8*(2), 11-15.

[21]   Ramyadharshni, S.S., & Dr.Pabitha, P. (2018). Topic Categorization on Social Network Using Latent Dirichlet Allocation. *Bonfring International Journal of Software Engineering and Soft Computing, 8*(2), 16-20.

[22]   Streit, A.G., & Rodriguez, C.K.D.S. (2015).Proposing a Bit Torrent-Like Protocol for Efficient Interactive Multimedia Streaming Applications. T*he SIJ Transactions on Computer Networks & Communication Engineering (CNCE), 3*(1), 13-22.

[23]   Udayakumar, R., Khanaa, V., & Kaliyamurthie, K.P. (2013). Optical ring architecture performance evaluation using ordinary receiver. *Indian Journal of Science and Technology*, *6*(6), 4742-4747.

[24]   Udayakumar, R., Khanaa, V., & Kaliyamurthie, K.P. (2013). Performance analysis of resilient ftth architecture with protection mechanism. *Indian Journal of Science and Technology*, *6*(6), 4737-4741.

[25]   Saravanan, T., Srinivasan, V., & Sandiya, V.P. (2013). A two stage DC-DC converter with isolation for renewable energy applications. *Indian Journal of Science and Technology*, *6*(6), 4824-4830.

[26]   Sundarraj, M. (2013). Study of compact ventilator. *Middle-East Journal of Scientific Research*, *16*(12), 1741-1743.

[27]   Thema, F.T., Manikandan, E., Gurib-Fakim, A., & Maaza, M. (2016). Single phase Bunsenite NiO nanoparticles green synthesis by Agathosma betulina natural extract. *Journal of alloys and compounds*, *657*, 655-661.

[28]   Sathyaseelan, B., Manikandan, E., Sivakumar, K., Kennedy, J., & Maaza, M. (2015). Enhanced visible photoluminescent and structural properties of ZnO/KIT-6 nanoporous materials for white light emitting diode (w-LED) application. *Journal of Alloys and Compounds*, *651*, 479-482.

[29]   Gopalakrishnan, K., Prem Jeya Kumar, M., Sundeep Aanand, J., & Udayakumar, R. (2013). Analysis of static and dynamic load on hydrostatic bearing with variable viscosity and pressure. *Indian Journal of Science and Technology,* 6(6), 4783-4788.

[30]   Prabhu, M.R., Reji, V., & Sivabalan, A. (2012). Improved radiation and bandwidth of triangular and star patch antenna. *Research Journal of Applied Sciences, Engineering and Technology*, *4*(12), 1740-1747.

[31]   Arumugam, S. and Ramareddy, S. (2012). Simulation comparison of class D/ Class E inverter fed induction heating. *Journal of Electrical Engineering*, 12(2), 71-76.

[32]   Udayakumar, R., Khanaa, V., & Kaliyamurthie, K.P. (2013). High data rate for coherent optical wired communication using DSP. *Indian Journal of Science and Technology*, *6*(6), 4772-4776.

[33]   Nagarajan, C., & Madheswaran, M. (2012). Experimental Study and Steady State Stability Analysis of CLL-T Series Parallel Resonant Converter with Fuzzy Controller using State Space Analysis. *Iranian Journal of Electrical and Electronic Engineering*, *8*(3): 259-267.

[34]   Gopalakrishnan, K., PremJeya Kumar, M., SundeepAanand, J., & Udayakumar, R. (2013). Thermal properties of doped azopolyester and its application. *Indian Journal of Science and Technology*, *6*(6), 4722-4725.

[35]   Kumaravel A., Meetei O.N. (2013). An application of non-uniform cellular automata for efficient cryptography. *Indian Journal of Science and Technology*, *6*(5): 4560-4566.

[36]   Kumaravel, A., & Pradeepa, R. (2013). Layered approach for predicting protein subcellular localization in yeast microarray data. *Indian Journal of Science and Technology*, *6*(5S), 4567-4571.

[37]   Kaviyarasu, K., Manikandan, E., Kennedy, J., & Maaza, M. (2016). Synthesis and analytical applications of photoluminescent carbon nanosheet by exfoliation of graphite oxide without purification. *Journal of Materials Science: Materials in Electronics*, *27*(12), 13080-13085.

[38]   Mathubala, G., Manikandan, A., Antony, S.A., & Ramar, P. (2016). Photocatalytic degradation of methylene blue dye and magneto-optical studies of magnetically recyclable spinel NixMn1-xFe2O4 (x= 0.0–1.0) nanoparticles. *Journal of Molecular Structure*, *1113*, 79-87.

[39]   Manikandan, E., Kennedy, J., Kavitha, G., Kaviyarasu, K., Maaza, M., Panigrahi, B.K., & Mudali, U.K. (2015). Hybrid nanostructured thin-films by PLD for enhanced field emission performance for radiation micro-nano dosimetry applications. *Journal of Alloys and Compounds*, *647*, 141-145.

[40]   Kumaravel, A., & Meetei, O.N. (2013). An application of non-uniform cellular automata for efficient cryptography. *IEEE Conference on Information & Communication Technologies*: 1200-1205.

[41]   Langeswaran, K., Gowthamkumar, S., Vijayaprakash, S., Revathy, R., & Balasubramanian, M.P. (2013). Influence of limonin on Wnt signalling molecule in HepG2 cell lines. *Journal of natural science, biology, and medicine*, *4*(1), 126-133.

[42]   Srinivasan, V., & Saravanan, T. (2013). Analysis of harmonic at educational division using CA 8332. *Middle-East Journal of Scientific Research*, *16*(12), 1768-73.

[43]   Josephine, B.A., Manikandan, A., Teresita, V.M., & Antony, S A. (2016). Fundamental study of LaMg x Cr 1– x O 3– δ perovskites nano-photocatalysts: sol-gel synthesis, characterization and humidity sensing. *Korean Journal of Chemical Engineering*, *33*(5), 1590-1598.

[44]   Saravanan, T., Saritha, G., & Udayakumar, R. (2013). Robust H-Infinity Two Degree of Freedom Control for Electro Magnetic Suspension System. *Middle-East Journal of Scientific Research*, *18*(12), 1827-1831.

[45]   Rajasulochana, P., Dhamotharan, R., Murugakoothan, P., Murugesan, S., & Krishnamoorthy, P. (2010). Biosynthesis and characterization of gold nanoparticles using the alga Kappaphycus alvarezii. *International Journal of Nanoscience*, *9*(05), 511-516.

[46]   Slimani, Y., Güngüneş, H., Nawaz, M., Manikandan, A., El Sayed, H. S., Almessiere, M. A., & Baykal, A. (2018). Magneto-optical and microstructural properties of spinel cubic copper ferrites with Li-Al co-substitution. *Ceramics International*, *44*(12), 14242-14250.

[47]   Kaviyarasu, K., Manikandan, E., Kennedy, J., Jayachandran, M., & Maaza, M. (2016). Rice husks as a sustainable source of high quality nanostructured silica for high performance Li-ion battery requital by sol-gel method–a review. *Adv. Mater. Lett*, *7*(9), 684-696.

[48]   Ilayaraja, K., & Ambica, A. (2015). Spatial distribution of groundwater quality between injambakkamthiruvanmyiur areas, south east coast of India. *Nature Environment and Pollution Technology*, *14*(4), 771-776, 2015.

[49]   Sharmila, S., Rebecca, L. J., Das, M.P., & Saduzzaman, M. (2012). Isolation and partial purification of protease from plant leaves. *Journal of Chemical and Pharmaceutical Research*, *4*(8), 3808-3812.

[50]   Rajakumari, S.B., & Nalini, C. (2014). An efficient cost model for data storage with horizontal layout in the cloud. *Indian Journal of Science and Technology*, *7*(3), 45-46.