SPECIAL FEATURE

Visual Question Answering system.

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Dark Energy and Dark Matter…

What if someone told you that matter, as we currently know it, consisting of atoms (also called 'baryonic' matter) constitutes only about 5% of the Universe? The rest of it appears to be in dark energy and dark matter form, which seems incredulous. It was believed that the fabric of the universe is galaxies amidst vast amounts of empty space, and that galaxies are made up of billions of stars, which are in turn all made up of matter. When stars die, new matter is created, and seeded over various parts of the universe - hence the saying 'we are all stardust'!

The conundrum lies in the fate of the universe. The expansion of the universe, according to the currently accepted 'big-bang' theory, is happening at an accelerated pace and not slowing down. Gravity is a force of attraction, as opposed to electric and magnetic forces, which can be attractive or repulsive depending on the polarity. Based on that premise, ultimately things should slow down and perhaps even come closer because of gravitational attraction. However, all observations suggest a rapid increase in the expansion of the universe since about 7.5 billion years ago, and stellar objects are flying apart a lot faster than expected. Astronomers hypothesize that some mysterious dark 'anti-gravity' force is behind this, continuing to propel things apart.

The relevant phrase that crops up is 'dark energy', to account for this invisible force. Albert Einstein had something to say about this, of course. Space is not really empty space, it can have energy of its own; this was proposed in his version of general relativity with the Cosmological Constant. As more space comes into existence, more energy (the so called energy-of-space) is created and this results in the dispersion of galactic bodies at a rate faster than expected. There is also another idea emanating from the quantum theory of matter which states that virtual particles appear and disappear and energy is created in this process, which may be the source of dark energy. However, calculations have not been able to validate this hypothesis.

Dark matter, entirely unrelated to dark energy, is somewhat different. Dark matter is not the galaxies, stars and planets that we can observe. It is not antimatter either, because when antimatter and matter interact and destroy each other they result in signature gamma rays that are not observed in large scale. It is also not galactic sized black holes, as the significant gravitational lensing which happens as light travels through the vicinity of such massive objects, is not observed. So what exactly is this elusive dark matter? The most viable candidate for it appears to be WIMPs (Weakly Interacting Massive Particles), electromagnetically neutral particles that do not emit light.

It is currently believed that about 68% of the universe is comprised of dark energy, 27% of dark matter and the rest, a measly 5%, of atomic matter. These are educated conjectures, not concrete facts - a lot of it is unknown, unchartered territory. The exciting part is unraveling the myriad of mysteries the universe presents, and the quest can sometimes be more thrilling than the ultimate goal.

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Image Captioning Using CNN and RNN

Abstract : *In Artificial Intelligence (AI), the contents of an image are generated automatically which involves computer vision and NLP (Natural Language Processing). The neural model which is regenerative is created. It depends on computer vision and machine translation. This model is used to generate natural sentences which eventually describes the image. This model consists of Convolutional Neural Network (CNN) as well as Recurrent Neural Network (RNN). CNN is used for feature extraction from image and RNN is used for sentence generation. The model is trained in such a way that if an input image is given to the model, it generates captions which nearly describes the image.*

Keywords: Visual Question Answering System, YOLO Model, Object detection, Natural Language Processing, Convolution, Neural Network

I. INTRODUCTION

The image is an important entity of our digital system. It contains much useful information like an image of a receipt, an image taken from CCTV footage etc. We can surely say that an image tells a unique story in its way. In today's digital world, one can perform or gather a large amount of information or facts just only after analyzing a digital image. When we are dealing with digital images, we have to gather what every part of it wants to contain. For that, we should extract every part with optimal care and extract information of that particular region and then gather the whole information to reach out to a conclusion. Here we need to get what the picture has like objects, boundaries, and color etc. features. Here, we need an accurate description of an image and for digital images, we need an efficient and accurate model that could give accurate annotations of every region of that image and can provide a rich sentence form, so that we can understand what's happening in that image [1-6].

II. PROPOSED METHODS

A. CNN (Convolution Neural Network)

Convolution Neural Network or CNNs were designed to map image data to an output variable. They have proven so effective that they are the go-to method for any type of prediction problem involving image data as input. The benefits of using CNNs is their ability to develop an internal representation of a two-dimensional image [7-8].

B. RNN (Recurrent Neural Network)

RNNs in general and LSTMs, in particular, have received the most success when working with sequences of words and paragraphs, generally called natural language processing. This includes both sequences of text and sequences of spoken language represented as time series. They are also used as generative models that require a sequence output, not only with text but as an application such as generating handwriting [9].

III. WORKFLOW

Our model produces accurate annotations and also the sentence expresses the scene of the image, along with information about all objects and stuff in that image.

The contributions of this work are as follows:

a) Image feature extraction is done using robust CNN technique, which produces features based on color, texture, and position of objects and stuff in the image.

b) The common representation contains all gathered information in layers and cells of the LSTM model and then based on input, hidden layers and then final output from output layers are obtained.

c) For language modelling, we used an n-gram model, so that accurate and rich form of a sentence is generated.

d) The BLEU metric is used for the analysis of efficiency and robustness of our method. And the comparison of various previous models with our model.

Equations

All recurring connections are transformed to feed-forward connections are transformed to feed-forward connections in the unrolled version. In more detail, if we denote by 'I' the input image and by S = (S0,..., SN) a true sentence describing this image, the unrolling procedure reads:

$$x_{-1} = CNN(I) \quad (1)$$

$$x_t = W_e S_t, \quad t \in \{0 \ldots N-1\} \quad (2)$$

$$p_{t+1} = LSTM(x_t), \quad t \in \{0 \ldots N-1\} \quad (3)$$

where we represent each word as a one-hot vector St of dimension equal to the size of the dictionary. Note that we denote by S0 a special start word and by SN a special stop word which designates the start and end of the sentence. In particular by omitting the stop word the LSTM signals that a complete sentence has been generated. Both the image and the words are mapped to the same space, the image by using a vision CNN, the words by using a word embedding We. The image 'I' is only input once, at t = −1, to inform the LSTM about the image contents. We empirically verified that feeding the image at each time step as an extra input yields inferior results, as the network can explicitly exploit noise in the image and overfits more easily.

The LSTM function above can be described by the following equations:

$$f_t = \sigma_g (W_f * x_t + U_f * h_{t-1} + V_f \circ c_{t-1} + b_f)$$

$$i_t = \sigma_g (W_i * x_t + U_i * h_{t-1} + V_i \circ c_{t-1} + b_i)$$

$$c_t = f_t \circ c_{t-1} + i_t \circ \sigma_c (W_c * x_t + U_c * h_{t-1} + b_c)$$

$$o_t = \sigma_g (W_o * x_t + U_o * h_{t-1} + V_o \circ c_t + b_o)$$

$$h_t = o_t \circ \sigma_h(c_t),$$

x_t : input vector to the LSTM unit

f_t : forget gate's activation vector

i_t : input/update gate's activation vector

o_t : output gate's activation vector

h_t : hidden state vector

c_t : cell state vector

Our loss is the sum of the negative log likelihood of the correct word at each step as follows:

$$L(I,S) = -\sum_{t=1}^{N} log\ p_t(S_t) . \quad (4)$$

The above loss is minimized w.r.t. all the parameters of the LSTM, the top layer of the image embedder CNN and word embeddings W_e.

Methodology

a. Data Collection

There are many open-source datasets available for this problem, like Flickr 8K (containing 8K images), Flickr 30K (containing 30K images), MS COCO (containing 180K images), etc.

But for this project, we have used the Flickr 8K dataset for data cleaning and training.

This dataset contains 8000 images each with 5 captions (all captions being relevant simultaneously).

These images are bifurcated as follows:

- Training Set - 6000 images
- Dev Set - 1000 images
- Test Set - 1000 images

b. Data Cleaning

When we deal with text, we generally perform some basic cleaning like lower-casing all the words (otherwise "hello" and "Hello" will be regarded as two separate words), removing special tokens (like '%', '$', '#', etc.), eliminating words which contain numbers (like 'hey199', etc.).

c. Data Preprocessing - (Images)

Images are nothing but input (X) to our model. As you may already know that any input to a model must be given in the form of a vector.

We need to convert every image into a fixed-sized vector which can then be fed as input to the neural network. For this purpose, we opt for transfer learning by using the Xception Model proposed by Francois Chollet.

This model was trained on Imagenet dataset to perform image classification in 1000 different classes of images. However, our purpose here is not to classify the image but just get a fixed-length informative vector for each image. This process is called automatic feature engineering.

d. Data Preprocessing - Captions

We must note that captions are something that we want to predict. So, during the training period, captions will be the target variables (Y) that the model is learning to predict.

But the prediction of the entire caption, given the image does not happen at once. We will predict the caption word by word. Thus, we need to encode each word into a fixed-sized vector. However, this part will be seen later when we look at the model design, but for now, we will create two Python Dictionaries namely "wordtoix" (pronounced - word to index) and "ixtoword" (pronounced - index to word).

Stating simply, we will represent every unique word in the vocabulary by an integer (index). As seen above, we have 1652 unique words in the corpus and thus each word will be represented by an integer index between 1 to 1652.

e. Models

We have tested three models for the dataset. The models differ in their image extraction capabilities.

Model-1 used features from a pre-trained model on VGG16 (ImageNet dataset).

Model-2 used features from a pre-trained model on ResNet50 (ImageNet dataset).

Model-3 used features from a pre-trained model on Xception (ImageNet dataset).

The decoder consists of an embedding layer and an LSTM as the recurrent unit. Before feeding the word vector, the model does embeddings on the target and source words. The vocabulary is calculated from the annotations provided with the data that contains all the words from the image captions. The embedding weights are learned during training. The decoder consists of one LSTM layer and is recurrent in the RNN. An image with five initial captions and the final predicted caption is shown in fig. 1.

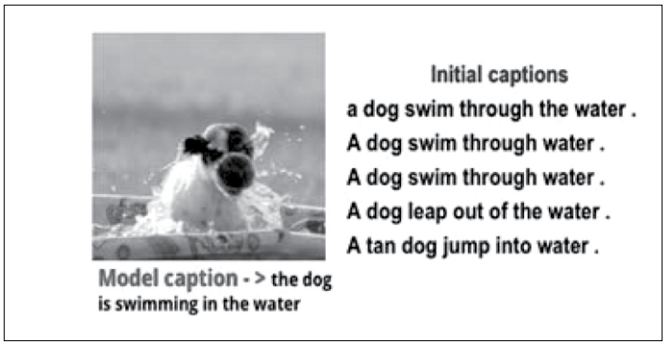

Fig.1 An image with five initial captions and the final predicted caption.

f. Training

In this section, we present results from the two different models (Greedy and Beam) investigated for this project. The models differ in the method used to extract features from the images. Fig.2 shows the results from the variation of training error, and also the validation error with the increase in the number of epochs. It is visible from the figure that the simulation becomes stagnant after 3-4 epochs in both the models. Greedy performs much better invalidation accuracy with values reaching below ≈ 4.0 compared to Beam in which values stay above ≈ 4.0. In table 1, we present the BLEU metric for the two models and comparison with the benchmarks set by other models [9-13].

g. Caption Generated

The captions generated from Greedy and Beam are approximately similar and does not provide any qualitative difference. So, in this section, we focus on results generated from Beam. fig.1 shows the captions predicted by the model along with the five initial captions. In this case, the model accurately predicts the major features in the image such as the "dog", and "water".The relationship between these features also depicts the image appropriately. However, if we look at Fig.2 the primary feature of the image is captured accurately. It captures the major feature which is "the girl" but fails to depict minor features and incorrectly predicts features like the "blue shirt" and "grass". Also, to the limitations in capturing these minor details, the model fails to describe the exact relationship between the image and the caption. This shows the limitations of our model and highlights the necessity for future improvements in the model. Finally, we also predict the caption for a completely random image taken from Iowa state web page and is shown in the figure below. This image was not present in the Flickr8K dataset and would serve as the test for generalization, which is a serious limitation for traditional approaches like "template matching" or "ranking based retrieval". In this scenario, our model (both Greedy and Beam) can predict the caption describing the person in the red shirt and the street in the image. However, it fails to detect the building and people walking on the street. The image dataset had ≈ 500 instances of "building", ≈ 3000 instances of "dog", ≈ 6000 instances of "water" and ≈ 1000 instances of "street". We think this difference in numbers is somewhat responsible for the inaccurate description of the images and to accurately predict "dog", "water" and "street" but failing to recognize the

"building" and the group of people. We are confident that a much larger and unbiased dataset would resolve these issues, and our model would accurately describe the relationship between images and its caption even for random image sets.

h. Deployment

Finally, we created the docker file of our Image Captioning model in Amazon Web Server then we got API by accessing it. We finally hosted our project in Amazon EC2 web service.

We used the public DNS address of the Amazon EC2 instance to view the web page in a web browser.

IV. RANKING RESULTS

While we think ranking is an unsatisfactory way to evaluate description generation from images, many papers report ranking scores, using the set of testing captions as candidates to rank given a test image. The Comparison of Validation Loss of Vgg16, ResNet50 and Xception Model up to Epoch = 10. We tested three popular pre-trained models for our Project, the results of Validation Loss is shown in Fig. 2.

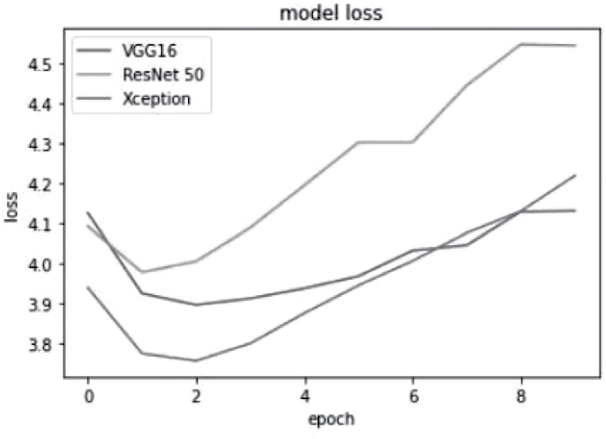

Fig.2 The Comparison of Validation Loss of Vgg16, ResNet50 and Xception Model up to Epoch = 10. We tested three popular pre-trained models for our Project and tested them on Validation Loss Metric.

V. RESULTS/ OUTCOME

We have compiled all aspects of the image caption generation task, discussed the model framework proposed in recent years to solve the description task, focused on the algorithmic essence of different attention mechanisms, and summarized how the attention mechanism is applied. We summarize the large datasets and evaluation criteria commonly used in practice.

Although image caption can be applied to image retrieval, video caption, and video movement and the variety of image caption systems are available today, experimental results show that this task still has better performance systems and improvement.

We have presented NIC, an end to end neural network system that can automatically view an image and generate a reasonable description in plain English.

WORD	NEIGHBORS
Car	van, cab, suv, vehicle, jeep
boy	toddler, gentleman, daughter
street	road, streets, highway
horse	pony, donkey, pig , mule
computer	computers, pc, crt, chip

Some Examples of Nearest Neighbors of words

It is clear from these experiments that, as the size of the available datasets for image description increases, so will the performance of the model increase. Comparing BLEU Score: We use BLEU score It is an algorithm, which has been used for evaluating the quality of the machine-translated text. We can use BLEU to check the quality of our generated caption. BLEU is language independent. It lies between [0,1]. Higher the score better the quality of the caption.

Metric	Greedy	Beam
BLEU	0.4649973	0.4805377

Comparison Between Models

The outcome for the generated caption differs on its approach as we have a different BLEU score and working purpose of our model.

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REFERENCES

[1] A. Mathews, L. Xie, and X. He, "SemStyle: learning to generate stylised image captions using unaligned text," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, Salt Lake City, UT, USA, June 2018

[2] S. Hochreiter and J. Schmidhuber. Long short-term memory. Neural Computation, 9(8), 1997.

[3] Oriol Vinyals, Alexander Toshev, Samy Bengio, and Dumitru Erhan. 2015. "Show and tell: A neural image caption generator ". In 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR). Institute of Electrical and Electronics Engineers (IEEE), Jun.

[4] Karen Simonyan and Andrew Zisserman. 2014. "Very Deep Convolutional Networks for Large-Scale Image Recognition". CoRR, abs/1409.1556.

[5] M. Hodosh, P. Young, and J. Hockenmaier. "Framing image description as a ranking task: Data, models and evaluation metrics". JAIR, 47, 2013.

[6] K. Simonyan and A. Zisserman. "Very deep convolutional networks for large-scale image recognition". arXiv preprint arXiv:1409.1556, 2014.

[7] A. Farhadi, M. Hejrati, M. A. Sadeghi, P. Young, C. Rashtchian, J. Hockenmaier, and D. Forsyth. Every picture tells a story: "Generating sentences from images". In ECCV, 2010.

[8] Junhua Mao, Wei Xu, Yi Yang, Jiang Wang, and Alan L. Yuille. 2014. Explain images with multimodal recurrent neural networks. In Proc. NIPS Deep Learning Workshop.

[9] Kishore Papineni, Salim Roukos, Todd Ward, and WeiJing Zhu. 2002. BLEU: a method for automatic evaluation of machine translation. In Proc. ACL'02 pages 311–318. Association for Computational Linguistics.

[10] Reiter and R. Dale. 2000. "Building Natural Language Generation Systems". Cambridge University Press, Cambridge, UK.

[11] Marc Tanti, Albert Gatt, and Kenneth P. Camilleri. 2017. "Where to put the image in an image caption generator". CoRR, abs/1703.09137.

[12] Chollet, F., 2017. "Xception: Deep Learning with Depth Wise Separable Convolutions." arXiv preprint, pp.1610-02357

[13] Junhua Mao, Wei Xu, Yi Yang, Jiang Wang, and Alan L. Yuille. 2014. Explain images with multimodal recurrent neural networks. In Proc. NIPS Deep Learning Workshop.

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Smart Aeroponics System

Abstract : *Agriculture has been the backbone of the Indian economy contributing a major part of the GDP. With the technological advancement and the new agricultural techniques coming up, this sector is expected to boom rapidly if proper techniques are adopted. With the decrease in fertile lands due to climatic and human exploitation, we need to look forward to some new techniques to meet the growing demand, profitability, and quality of our major farming techniques. One such technology used in India is greenhouse technology. Although it is centuries old, it is new to India. In India with the growing dependence on climatic conditions and lots of harvest being wasted due to extreme conditions we need some alternative like Aeroponics which mainly eliminates the dependence on climatic variations and also minimizes the waste of harvested crops. This project approaches with an effusively indoor cultivation system based on the modern farming concept called Aeroponics, in a controlled environment using ESP8266 Wi-Fi module and different parameter measuring sensors. Aeroponics is the modern agricultural conception in which the plants are grown without soil using a nutrient solution sprayed in the roots and is more efficient than traditional farming.*

Keywords: Farming, Aeroponics, ESP8266 Wi-Fi Module, Soil-less Culture

I. INTRODUCTION

Agriculture is considered as the vital piece of life for the human species as it is the fundamental wellspring of sustenance grains what's more, other crude materials required for person. It plays important part in the development of nation's economy and improvement. It additionally gives huge business openings to the general population. Development in agrarian segment is fundamental for the improvement of financial state of the nation. Vertical farming is the practice of growing crops in vertically stacked layers. It often incorporates controlled-environment agriculture, which aims to optimize plant growth, and soilless farming techniques such as hydroponics, aquaponics, and aeroponics [1]. The main advantage of utilizing vertical farming technologies is the increased crop yield that comes with a smaller unit area of land requirement. The increased ability to cultivate a larger variety of crops at once because crops do not share the same plots of land while growing is another sought-after advantage.

II. AEROPONICS

Aeroponics is the process of growing plants in an air or mist environment without the use of soil or an aggregate medium as shown in Fig. 1. The word "aeroponic" is derived from the Greek meanings of aer (ἀήρ, "air") and ponos (πόνος, "labour"). Aeroponic culture differs from both conventional hydroponics aquaponics, and in-vitro (plant tissue culture) growing [2]. Unlike hydroponics, which uses a liquid nutrient solution

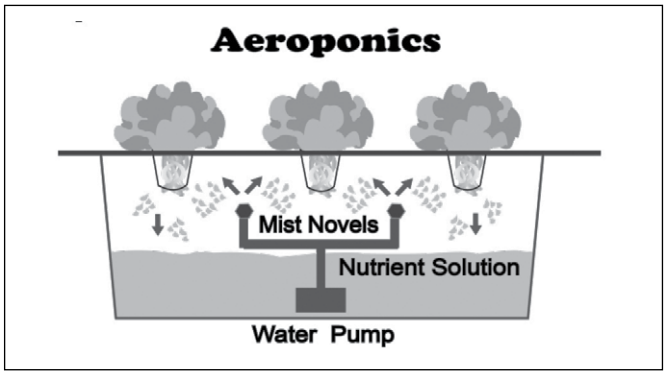

Fig 1.Working of Aeroponics System

as a growing medium and essential minerals to sustain plant growth, or aquaponics, which uses water and fish waste, aeroponics is conducted without a growing medium. It is sometimes considered a type of hydroponics, since water is used in aeroponics to transmit nutrients. The invention of aeroponics was motivated by the initiative of NASA (the National Aeronautical and Space Administration) to find an efficient way to grow plants in space in the 1990s. Unlike conventional hydroponics and aquaponics, aeroponics does not require any liquid or solid medium to grow plants in. Instead, a liquid solution with nutrients is misted in air chambers where the plants are suspended. By far, aeroponics is the most sustainable soil-less growing technique, as it uses up to 90% less water than the most efficient conventional hydroponic systems and requires no replacement of growing medium. The

basic principle of aeroponic growing is to grow plants suspended in a closed or semi-closed environment by spraying the plant's dangling roots and lower stem with an atomized or sprayed, nutrient-rich water solution [3]. The leaves and crown, often called the canopy, extend above. The roots of the plant are separated by the plant support structure. Often, closed-cell foam is compressed around the lower stem and inserted into an opening in the aeroponic chamber, which decreases labor and expense; for larger plants, trellising is used to suspend the weight of vegetation and fruit.

Ideally, the environment is kept free from pests and disease so that the plants may grow healthier and more quickly than plants grown in a medium. However, since most aeroponic environments are not perfectly closed off to the outside, pests and disease may still cause a threat. Controlled environments advance plant development, health, growth, flowering and fruiting for any given plant species and cultivars.

High-pressure aeroponics is defined as delivering nutrients to the roots via 20–50 micrometre mist heads using a high-pressure (80 pounds per square inch (550 kPa)) diaphragm pump.

The basic requirements of an Aeroponics system is:

i. An answer upkeep of corrosiveness or alkalinity (pH) and electrical conductivity (EC) in reasonable reaches for plant root framework.

ii. Water

iii. The supplement arrangement or the manure blend utilized must contain all smaller scale and large scale components important for plant.

iv. The temperature and air circulation of the supplement arrangement is appropriate for plant root framework as listed in Table1.

Table 1. Plant requirement

pH requirement	5.8-6.5
Temperature Requirement	20-30^{o} C
Light Requirement	14-16 hrs per day
ES Requirement	1.5-2.5 dS/m
computer	computers, pc, crt, chip

Some Examples of Nearest Neighbors of words

III. ESP8266 WI-FI MODULE

Fig.2 shows a ESP8266 which is a low-cost Wi-Fi microchip and has a full TCP/IP stack and microcontroller capability, produced by Espressif Systems in Shanghai, China [4].

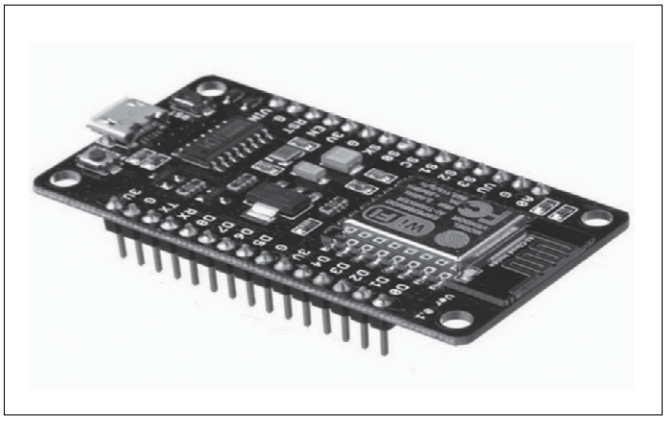

Fig 2. ESP8266 Wi-Fi Module

The chip first came to the attention of Western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, the chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing the building of single-chip devices capable of connecting to Wi-Fi. These microcontroller chips have been succeeded by the ESP32 family of devices, including the pin-compatible ESP32-C3.

IV. METHODOLOGY

The proposed model in this project uses shrewd and accurate sensing devices for controlling and monitoring the cultivation system as shown in Fig. 3.

1.ESP8266 Wi-Fi Module: ESP8266 module collects data from all the sensors and perform automated algorithm in order to provide suitable condition for the plant to develop overtime. For the base control unit

microcontroller, ESP8266 WiFi module has been used as it works very efficiently for interfacing with the sensing devices as well as Wi-Fi module for data collection and transmission to the created website.

Fig 3. Block diagram of the elements of proposed automated Aeroponic system

2.DHT11 Sensor: DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc to measure humidity and temperature instantaneously. DHT11 humidity and temperature sensor is available as a sensor and as a module. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

3.LDR A photo resistor (also known as a light-dependent resistor, LDR) is a passive component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface shown I Fig. 4. The resistance of a photo resistor decreases with increase in incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits and light-activated and dark-activated switching circuits acting as a resistance semiconductor.

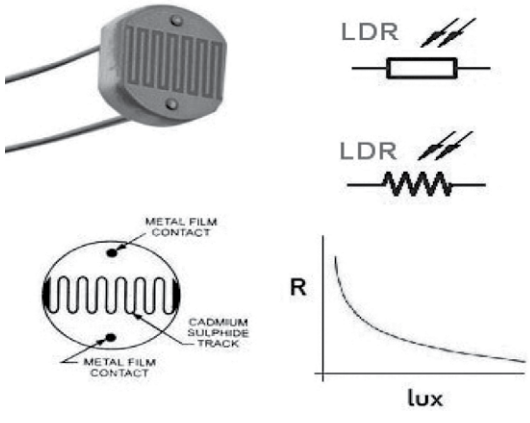

Fig 4. LDR

4. Relay Module: A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.The relay module is used to switch ON the fan in our system.

5.Fan for Cooling: Fans are used to draw cooler air into the case from the outside, expel warm air from inside and move air across a heat sink to cool a particular component.

6.Buzzer:A buzzer or beeper isan audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

7.Water Pump: Water Pump is so a common type of pumps that they can be found at home, in fields, on farms and other places. They are exclusively used for displacing water. Water pumps run on different sources of power. There are solar water pump, electric water pump, and engine water pump.

A submersible pump, also called an electric submersible pump, is a pump that can be fully submerged in water. The motor is hermetically sealed and close-coupled to the body of the pump converting rotary energy into kinetic energy into pressure energy.

8.HTML Web Designing: The HyperText Markup Language, or HTML(HyperText Markup Language) is the standard markup language for documents designed to be displayed in a web browser. It can be assisted by technologies such as Cascading Style Sheets (CSS) and scripting languages such as JavaScript.

Web browsers receive HTML documents from a web server or from local storage and render the documents into multimedia web pages. HTML describes the structure of a web page semantically and originally included cues for the appearance of the document.HTML elements are the building blocks of HTML pages. With HTML constructs, images and other objects such as interactive forms may be embedded into the rendered page.

V. FUTURE SCOPE OF HYDROPONICS SYSTEM

The indoor farming market is projected to account for USD 24.8 billion by 2026, growing at a CAGR of 9.4% during the forecast period.

One of the major drivers is the increasing technological advancements in indoor farming.

Acquisitions, products, launches, expansions and partnership can benefit the sector with potential opportunities in the next five years.

Market growth in Asia Pacific can be attributed to the growing acceptance of controlled environment agriculture.

Market growth in Asia Pacific can also be attributed to the increasing population and the need to ensure food security through alternative high yield farming techniques.

VI. RESULTS AND MEASUREMENT

Fig. 5 shows the Final system and Fig. 6 shows the website displaying the real data.

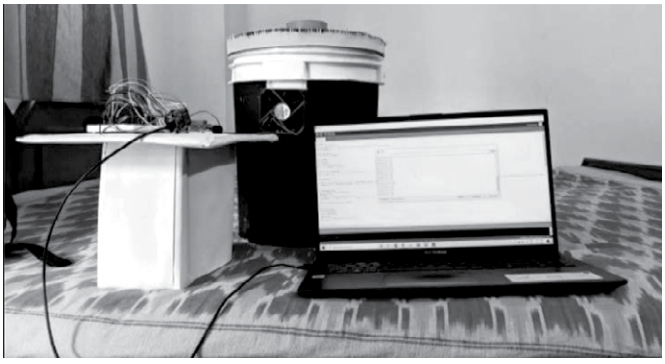

Fig 5. Final System Model

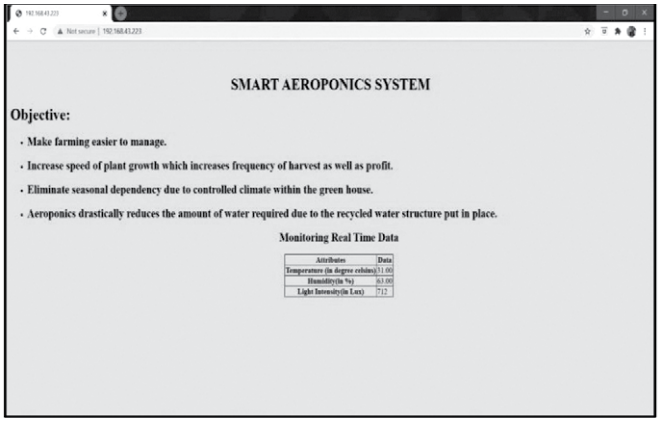

Fig 6. Website Displaying Real Time Data

VII. CONCLUSIONS

We created a website through HTML coding with different attributes and tags and linked the same through our microcontroller to interact and at the same time send real time output to the system. Here we are using HTML coding to make our system work like a display which gives the same real time data, which shows how widely the project can be expanded to make humans life much simpler.This data keeps on refreshing after every six seconds of delay provided, thereby preventing any harsh conditions from affecting the life of plant which is been grown. The website is created and opened through the same IP Address as in Arduino IDE Monitor in any of the browser.

REFERENCES

1. P Mithunesh, Kiran Gupta, Sujata Ghule, Prof. ShaileshHule, "Aeroponic Based Controlled Environment Based Farming System (e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 17, Issue 6, Ver. II (Nov – Dec. 2015), PP 55-58)"

2. Nutrient Management by University of Hawaii - College of Tropical Agriculture and Human Resources.

3. Martin PALA, Ladislav MIZENKO, Marian MACH, Tyler REED, "Aeroponic Greenhouse as an Autonomous System using Intelligent Space for Agriculture Robotics", Department of Cybernetics and Artificial Intelligence, Technical University of Kosice http://www.gardeningsite.com

4. R. Nalwade and T. Mote, "Hydroponics farming," 2017 International Conference on Trends in Electronics and Informatics (ICEI), Tirunelveli, India, 2017, pp. 645-650.

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A Comparison of Classification Algorithms

Abstract : *This paper presents a comparison of the performance of different classification algorithms on different data set. For this purpose, five popular machine learning algorithms, which include Support Vector Machine (SVM), Decision Tree, Perceptron, Naïve Bayes Classification, and an ensemble method; i.e. Gradient Boosting, are implemented for classifying data from multiple domains. The focus of the comparison is to identify the classifier, which works best for a given dataset. This may lead to conclude, which algorithm suits best for classifying the data from a particular domain. The major domains considered here are health care and image processing. The performances of the classifiers are improved by fine-tuning on hyperparameters of the classifier using an iterative method. To measure the performances, the metrics like confusion matrix, accuracy, precision, recall, F1 score, ROC curve (receiver operating characteristic curve), and AUC (Area under the ROC Curve) are considered.*

Keywords: : SVM, Decision Tree, Perceptron, Naïve Bayes Classification, Ensemble methods, Boosting methods, Gradient Boosting

I. INTRODUCTION

Classification is a form of data analytics that extracts models describing important data classes. Such models are called classifiers. Classifiers predicts categorical class labels for an unknown sample [1]. Data Classification is a two step process which is learning step and classification step. A classification algorithm builds the classifier by analyzing or learning from a training set made up of tuples i.e patterns and their associated class labels. The classification model that is learned in learning step is used for classification and can be viewed as:

$$y = f(x) \qquad (1)$$

where y is the predicted class label of a given tuple x by classifier f.

These classification algorithms perform differently for different datasets. The nature of dataset plays huge role in performance of any algorithm. By the nature of dataset, we basically mean whether the dataset is linear or non-linear, binary or multiclass and balanced or unbalanced. Some algorithms may perform exceptionally well on one dataset can fail badly on other. So, the present need is to gain initial information regarding which algorithm is best suited for a give dataset. The suggested algorithm can be further taken for hyperparameter tunning in order to achieve the best optimal results. This ultimately help in building up highly precise models for applications specially in medical fields.

In this paper we have taken into consideration classification algorithms like SVM, Perceptron, Naïve Baye and Decision Tree. The comparison was further extended to an ensemble method. The main idea of ensemble methodology is to combine a set of models, each of which solves the same original task, in order to obtain a better composite global model, with more accurate and reliable estimates or decisions than can be obtained from using a single model. Finally, a user interface developed using Streamlit is used for showcasing the performance result of each algorithm in terms of performance metrics like accuracy, precision, recall and f1 score.

II. SUPPORT VECTOR MACHINES

Classification is a form of data analytics that extracts models describing important data classes. Such models are called classifiers. Classifiers predicts categorical class labels for an unknown sample [1]. Data Classification is a two step process which is learning step and classification step. A classification algorithm builds the classifier by analyzing or learning from a training set made up of tuples i.e patterns and their associated class labels. The classification model that is learned in learning step is used for classification and can be viewed as:

$$g(x) = w^T + b \qquad (2)$$

where X is an input vector, W is an adjustable weight vector, b is a bias. Figure.1 shows the binary classification using SVM.

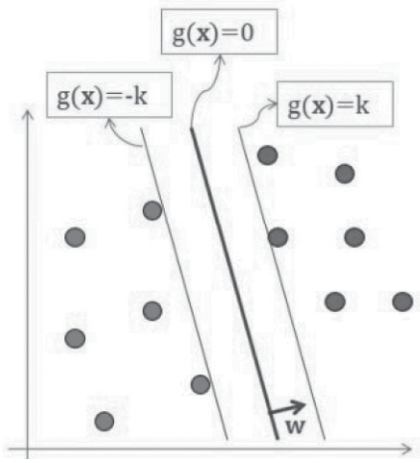

Figure. 1: Binary Classification using SVM

We maximize the value of k such that:

$$-w^T X_i + b \geq k \ for\ y_i = +1 \quad (3)$$

$$-w^T X_i + b \leq k \ for\ y_i = -1 \quad (4)$$

Width of separation: $\frac{2}{\|w\|}$

Objective is to maximize the width of separation. Therefore, the optimal hyperplane, $\frac{1}{\|w\|}$ where

$$\|w\| = \sqrt{w_1^2 + w_2^2 + w_3^2 + \cdots + w_p^2} \quad (5)$$

Minimise: $\frac{1}{2}\|w\|^2$ such that $1 - (w^T X_i + b) \leq 0$ (6)

Constraint optimization problem can be solved using the method of Lagrange Multipliers. The solution to the constraint optimization problem is determined by the min/ max point of L, which is to be minimized w.r.t w and b and maximized with respect to α as follows:

$$L(w, b, \alpha) = \frac{1}{2}\|W\|^2 + \sum_{i=1}^{N} \alpha_i \,(1 - (W^T X_i + b) y_i) \quad (7)$$

Subject to: $\alpha_i \geq 0 \ \forall\ i$

Optimal: $\frac{\partial L}{\partial w} = 0 \ and \ \frac{\partial L}{\partial b} = 0$

$\Rightarrow w_0 = \sum_{i=1}^{N} \alpha_i y_i X_i \ and \ \sum_{i=1}^{N} \alpha_i y_i = 0$

Dual Form of L with the above optimal value is written as:

$$L(w, b, \alpha) = \sum_{i=1}^{N} \alpha_i - \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N} \alpha_i \alpha_j y_i y_j X_i^T X_j \quad (8)$$

Subject to: $\sum_{i=1}^{N} \alpha_i y_i = 0 \ and \ \alpha_i \geq 0 \ \forall\ i$

SVM training is done by solving Nth dimensional QP problem which involves large matrix operations, as well as time consuming numerical computations which are very slow. One of the method to solve SVM QP is Sequential Minimized Optimization (SMO) which is very simple. Let the optimal value of α is α_(0,i). Using this, we find w_0= ∑_(i=1)^N α_(0,i) y_i X_i and b_0= y_i- w_0^T X where X is a support vector. Now the SVM classifier is:

$$f(x) = w_0^T X + b_0 \quad (9)$$

III. DECISION TREES

A decision tree is a flow chart like tree structure where each internal node denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node holds a class label. Internal nodes are denoted by rectangles and leaf nodes are represented by ovals. Decision tree can handle multidimensional data. Decision tree induction is a process of learning of decision tree from class label training tuples. Given a tuple X for which the associated class label is unknown, the attributed values of the tuple are tested against the decision tree. A path is traced from the root to a leaf node and the leaf node predicts the class for the tuple.

The attribute selection measure in decision tree provides a ranking for each attribute describing the given training tuples. The attribute having the best score for the measure is chosen as the splitting attribute for the given tuples. In some case, if a splitting attribute is continuous or if we are restricted to binary trees, then either a splitting point or a splitting subset must be defined as a part of splitting criteria. The tree node created for partition D is labelled with splitting criteria, branches are grown for each outcome of the criteria and the tuples are partitioned accordingly. The popular attribute selection measures are: Information Gain, Gain Ratio & Gini Index.

But the most annoying issue in decision tree is overfitting. A model is said to be overfit the training data if there exist some alternative model with significantly larger error the training examples but having smaller error over the entire distribution of instances. The overfitting mechanism is shown in fig. 2.

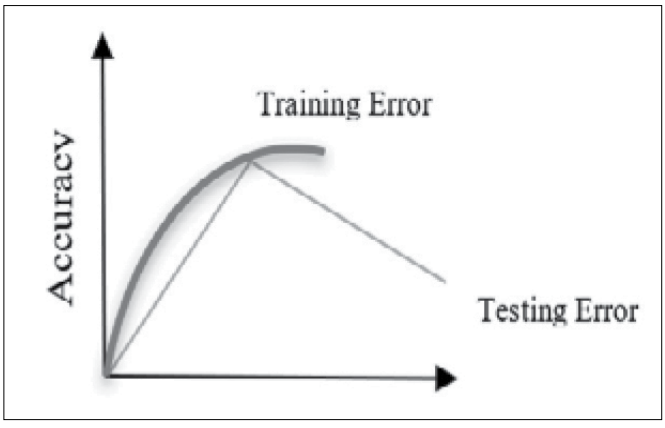

Figure. 2: Overfitting in Decision Tree

Accuracy on training data increases as decision tree grows whereas accuracy on test data increases with the grow of decision tree. But after certain point, its accuracy decreases and the training starts over-fitting. One of the solution for this is pruning. In pruning, grow the tree as far as possible and then prun the tree until it performs well in test dataset. When we prun a decision tree, the training error goes up but the true error goes down which can be cross checked by cross validation.

IV. PERCEPTRON

In 1958, Frank Rosenblatt proposes the perceptron first model for learning the parameters of the neural networks from supervised data. Perceptron is the simplest form of a neural network used for the classification of patterns said to be linearly separable. It consists of a simple neuron with adjustable weights and bias. The algorithm used to adjust the free parameters of the neuron.

Let t he t raining dataset be $\{ X_i, y_i \}_{i=1}^{N}$ where X_i represent one i nput p attern. Training patterns a re presented to the p erceptron. T he o utput y_i is c omputed after which the c onnecting weights w_i are modified a n amount i .e proportional to t he p roduct o f the difference between the actual output a nd t he d esired o ne and the input pattern.

Algorithm: Perceptron Learning

1. Input : Input pattern $< x_1, x_2, x_3, \ldots\ldots\ldots x_N >$, the desired output $v = \sum_{i=1}^{N} w_i x_i + b$, the maximum number of iterations T and learning rate η .

2. Initialize : The weights and thresholds to small random numbers. And $t \rightarrow 0$

3. Do While ($T \geq t$)

(1) Present a pattern x_i which is equal to $x_1, x_2, x_3, \ldots\ldots\ldots x_N$ to the neuron input and calculate the output.

(2) Update the weights using the formula :

$$w_j(t+1) = w_j(t) + \eta\,(y_i - \hat{y}_i)\,x_j$$

$t \leftarrow t + 1$

4. Output : Parameters of the linear model

Rosenblatt proved that if the pattern used to train the perceptron are drawn from two linearly separable classes, then the perceptron algorithm converges and position the decision surface in the form of a hyperplane between two classes. The proof of convergence of the algorithm is known as perceptron convergence theorem.

V. NAÏVE BAYES CLASSIFIERS

Naive Bayes is a group of supervised machine learning classifiers used for classification which are highly scalable, requiring a number of parameters linear in the number of variables (features/predictors) in a learning problem. The classifiers are based on the baye's theorem which says:

As, $$P(A\,|B) = \frac{P(A \cap B)}{P(B)} \quad (10)$$

&

$$P(B|A) = \frac{P(B \cap A)}{P(A)} \quad (11)$$

So, $$P(A\,|B) = \frac{P(B|A)\,.P(A)}{P(B)} \quad (12)$$

All the naive Bayes classifiers assume that the value of a particular feature is independent of the value of any other feature, given the class variable. Parameter estimation for naive Bayes models uses the method of maximum likelihood instead of Bayesian Probability.

The likelihood of the observed data D ={ x_1, x_2, x_3,..... x_N} which are dependent on modern parameter θ, if the conditional probability:

$$L(\theta) = P(D|\theta) = \pi . P(x_i|\theta) \quad (13)$$

The maximum likelihood estimate is the value of θ for which L(θ) is maximum.

A. Gaussian Naïve Bayes Classifier :

Extending the naïve baye's to real valued attributes can be done by the assumption of gaussian distribution. It is the normal distribution which when plotted gives a bell shaped curve which is symmetric about the mean of the feature values as shown in Fig. 3.

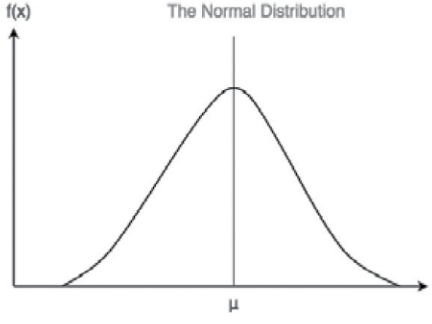

Figure. 3: Gaussian Naïve Bayes

The likelihood of the features is assumed to be Gaussian, hence, conditional probability is given by:

$$P(x_i|y) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp(-\frac{x_i-\mu_y}{2\sigma_y^2}) \quad (14)$$

VI. ENSEMBLE LEARNING

In the past few years, experimental studies conducted by the machine learning community show that combining the outputs of multiple classifiers reduces the generalization error [2] [3]. Ensemble methods are very effective, mainly due to the phenomenon that various types of classifiers have different "inductive biases". Indeed, ensemble methods can effectively make use of such diversity to reduce the variance-error without increasing the bias error. In certain situations, an ensemble can also reduce bias-error, as shown by the theory of large margin classifiers. Given the potential usefulness of ensemble methods, it is not surprising that a vast number of methods is now available to researchers and practitioners. Bagging and boosting are two most frequently used methods for ensemble models were the prior follows sequential approach and the latter follows continuous approach.

In sequential approaches for learning ensembles, there is an interaction between the learning runs. Thus, it is possible to take advantage of knowledge generated in previous iterations to guide the learning in the next iterations. In the concurrent ensemble methodology, the original dataset is partitioned into several subsets from which multiple classifiers are induced concurrently, as shown in Fig. 9.

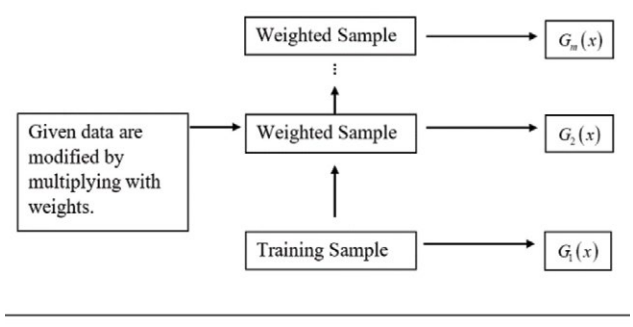

Figure. 4: Sequential approach of Ensemble method.

Schapire introduced the first boosting algorithm in 1990. In 1995 Freund and Schapire [4] introduced the AdaBoost algorithm. The main idea of this algorithm is to assign a weight in each example in the training set. In the beginning, all weights are equal, but in every round, the weights of all misclassified instances are increased while the weights of correctly classified instances are decreased. As a consequence, the weak learner is forced to focus on the difficult instances of the training set. This procedure provides a series of classifiers that complement one another.

To establish a connection with the statistical framework, a gradient-descent based formulation of boosting methods was derived. This paper implements gradient-decent boosting as its ensemble method. The gradient boosting algorithm, as originally proposed by Friedman [5]. The exact form of the derived algorithm with all the corresponding formulas will heavily depend on the design choices of loss function and base-learner model. Here loss functions basically represent the price paid for inaccuracy of predictions in classification problems. Loss-functions can be classified according to the type of response variable y.

Algorithm: **Friedman's Gradient Boost Algorithm**

1.Input : Input data $\{x_i, y_i\}_{i=1}^{N}$, number of iterations M, choice of loss function $\Psi(y, f)$, choice of the base learner model $h(x, \theta)$.

2. Initialize : $\widehat{f_0}$ with a constant

3. for t=1 to M do

(1) Compute the negative gradient $g_t(x)$

(2) Fit a new base-learner function h(x,θ_t)

(3) Find the best gradient descent step-size ρ_t:

$$\rho_t = arg\ min_\rho \sum_{i=0}^{N} \Psi\ [y_i, \widehat{f_{t-1}(x_i)} + \rho h(x_i, y_i)$$

(4) Update the function estimate :

$$\widehat{f_t} \leftarrow \widehat{f_{t-1}} + \rho_t h(x_t, y_t)$$

end for

4. Output : Final Model $\widehat{f_t}$

VII. EXPERIMENTAL RESULTS

The analysis of the classification methods is carried out based on accuracy, precision, recall and F1-scores.

A. Accuracy in classification problems is the number of correct predictions made by the model over all kinds of predictions made. The results obtained are listed in Table.1 and the accuracy measures are shown in Fig. 5.

Table 1. Accuracy

	Diabetes	Breast-Cancer	Waveform	Image	Glass	Segment	Heart
Perceptron	0.58	0.85	0.83	0.64	0.02	0.77	0.67
SVM	0.79	0.9	0.89	0.76	0.23	0.86	0.56
Naïve Bayes	0.77	0.95	0.83	0.74	0.23	0.79	0.77
Decision Tree	0.71	0.95	0.77	0.93	0.65	0.97	0.7
Gradient Boosting	0.8	0.96	0.87	0.93	0.77	0.98	0.69

We observed that on Glass dataset, the accuracy of Perceptron, SVM and Naïve Bayes was extremely poor. This is because Glass dataset is highly unbalanced. That's why these algorithms failed badly. But at the same time Decision Tree manages to get some what decent accuracy and Gradient Boosting just outperformed others. On the basis of accuracy, Gradient Boosting performed well on five datasets (diabetes, breast-cancer, image, glass, segment) out of seven datasets.

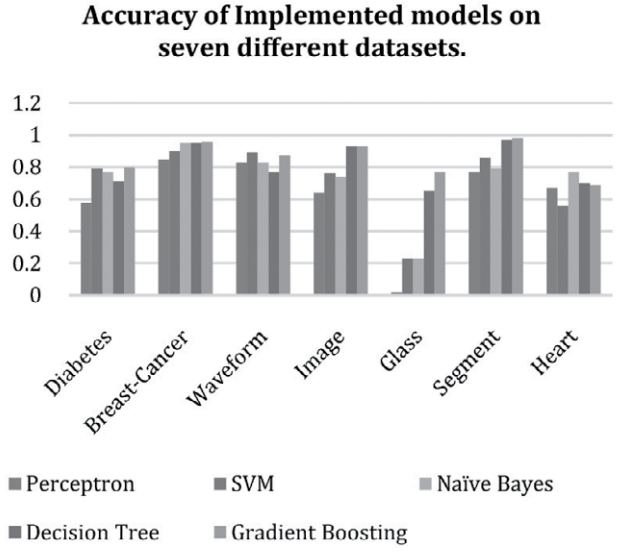

Figure. 5: Accuracy of the models

B. Precision reflects the ability of the classifier not to label as positive a sample that is negative. The results obtained are listed in Table.2 and the precision measures are shown in Fig. 6.

Table 2: Precision

	Diabetes	Breast-Cancer	Waveform	Image	Glass	Segment	Heart
Perceptron	0.67	0.87	0.85	0.72	0	0.81	0.68
SVM	0.79	0.92	0.88	0.9	0.05	0.87	0.57
Naïve Bayes	0.77	0.95	0.85	0.74	0.37	0.82	0.77
Decision Tree	0.7	0.95	0.77	0.96	0.7	0.97	0.71
Gradient Boosting	0.8	0.97	0.87	0.97	0.78	0.98	0.69

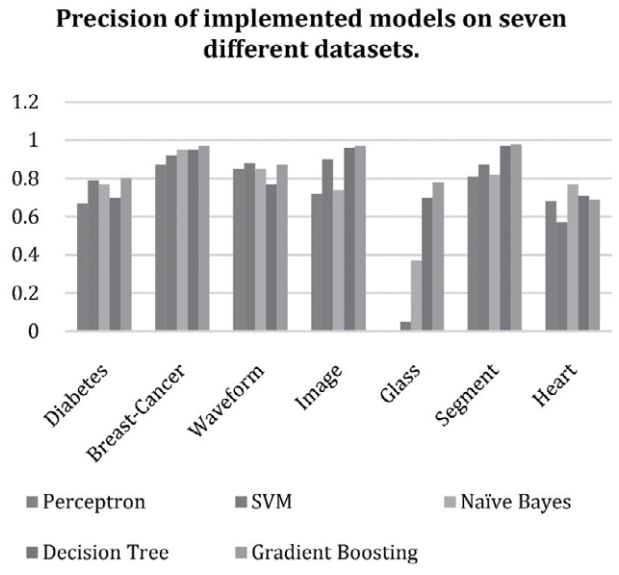

Figure. 6: Precision of implemented models on seven different datasets.

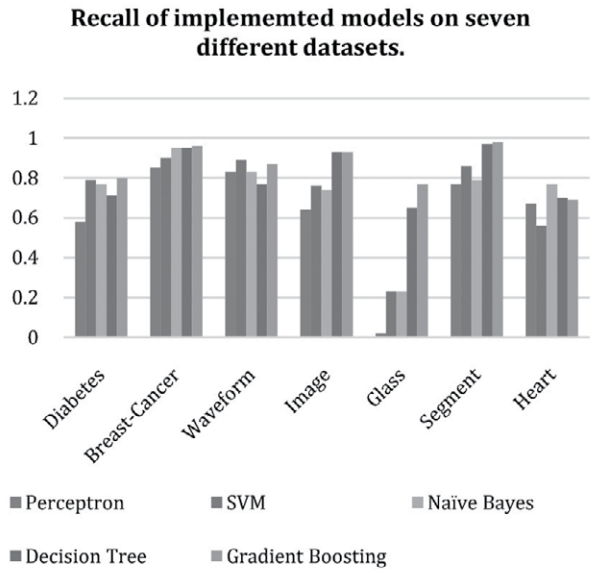

Figure. 7: Recall of implemented models on seven different datasets.

On the basis of precision, Gradient Boosting performed well on five datasets (diabetes, breast-cancer, image, glass, segment) out of seven datasets.

C. Recall reflects the ability of the classifier to find all positive samples. The results obtained are listed in Table.3 and the accuracy measures are shown in Fig. 7.

Table 3: Recall

	Diabetes	Breast-Cancer	Waveform	Image	Glass	Segment	Heart
Perceptron	0.58	0.85	0.83	0.64	0.02	0.77	0.67
SVM	0.79	0.9	0.89	0.76	0.23	0.86	0.56
Naïve Bayes	0.77	0.95	0.83	0.74	0.23	0.79	0.77
Decision Tree	0.71	0.95	0.77	0.93	0.65	0.97	0.7
Gradient Boosting	0.8	0.96	0.87	0.93	0.77	0.98	0.69

On the basis of recall, Gradient Boosting performed well on five datasets (diabetes, breast-cancer, image, glass, segment) out of seven datasets.

What is more important, precision or recall? This really depends on our specific classification problem. Imagine, for example, that our classifier needs to detect diabetes in human patients. "Positive" means the patient has diabetes. "Negative" means that the patient is healthy. In this case, we probably want to make sure that our classifier has high recall, so that as many diabetics as possible are correctly detected. Let us take another example — say we are building a video recommendation system, and our classifier predicts Positive for a relevant video and Negative for non-relevant video. We want to make sure that almost all of the recommended videos are relevant to the user, so we want high precision. There's usually a trade-off between good precision and good recall.

D. F1-Score is the harmonic mean of recall and precision. The results obtained are listed in Table.4 and the accuracy measures are shown in Fig. 8.

Table 4: F1-Score

	Diabetes	Breast-Cancer	Waveform	Image	Glass	Segment	Heart
Perceptron	0.59	0.84	0.83	0.61	0	0.75	0.67
SVM	0.77	0.9	0.88	0.77	0.09	0.86	0.53
Naïve Bayes	0.77	0.95	0.82	0.73	0.21	0.77	0.77
Decision Tree	0.7	0.95	0.77	0.93	0.67	0.97	0.7
Gradient Boosting	0.79	0.96	0.87	0.94	0.77	0.98	0.69

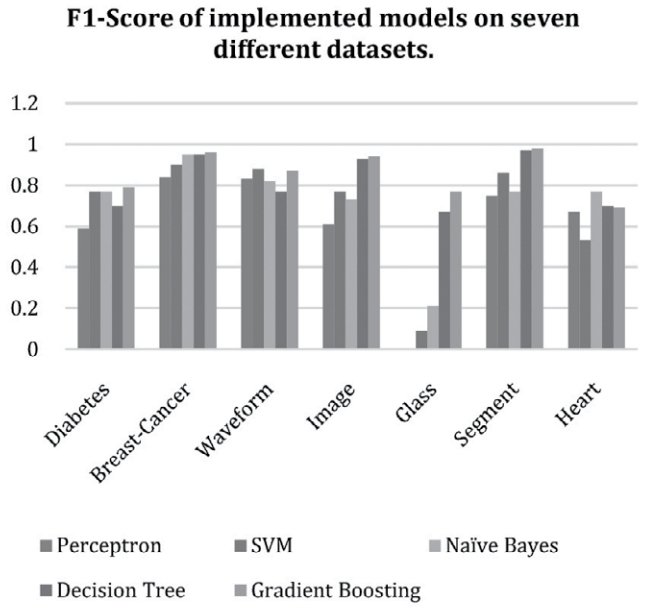

Figure. 8: F1-Score of implemented models on seven different datasets.

Now imagine that we have two classifiers- classifier A and classifier B- each with its own precision and recall. One has a better recall score, the other has better precision. We would like to say something about their relative performance. In other words, we would like to summarize the models' performance into a single metric. That's where F1-score are used.

On the basis of recall, Gradient Boosting performed well on five datasets (diabetes, breast-cancer, image, glass, segment) out of seven datasets.

VIII. CONCLUSIONS AND DISCUSSIONS

This work reflects importance of comparison between classification algorithms, as their performance highly depends upon the datasets. One classifier can perform great on one dataset can fail for the other. From the simulation result certain important conclusions can be drawn. Firstly, a Perceptron performance was overall average with a maximum accuracy of 0.85 for Breast-Cancer dataset but when it was computed on glass dataset the results were highly surprising. Its accuracy falls to 0.02, which means it was totally a failure. The reason behind this can be the unbalanced nature of Glass dataset. Therefore, these stats help us to conclude perceptron cannot be seen as an option when dealing with unbalanced dataset.

The same stats were observed in the case of SVM as well as Gaussian Naïve Bayes. With a maximum accuracy of 0.9 and 0.95 respectively for breast-cancer dataset, they can only mange a 0.23 accuracy for glass dataset. SVM holds the highest accuracy of 0.88 as compared to other classifiers for Waveform dataset. For Heart dataset the important parameter was recall and Gaussian Naïve Bayes topped the list with 0.77 recall.

The performance of Decision tree was pretty decent for all the datasets. Even for the Glass dataset it pulls out to be an average classifier with an accuracy of 0.65. Out of seven different datasets, decision tree backed the accuracy of 0.95 or plus for three datasets and for remain four it manages an accuracy of 0.65 or plus. The consistent performance of decision tree over all datasets makes it as one of the reliable classifiers for the given domain of datasets.

The biggest take away of this paper was Gradient Boosting. Gradient Boosting managed the highest accuracy, precision, recall and F1-score for four datasets straight away. It exceptionally outperformed other classifiers on the Glass dataset with an accuracy of 0.77. Which is far better than second highest accuracy of 0.65 of decision tree. It backed a highest 0.98 for segment dataset.

Therefore, with this simulation result we conclude that Gradient Boosting, i.e., an ensemble method comes out to be a more robust model for the domain of datasets we worked on. Specially observing the way, it handled the unbalanced dataset Glass.

ACKNOWLEDGMENT

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REFERENCES

[1] Harsh Patel and Purvi Prajapati. "Study and Analysis of Decision Tree Based Classification Algorithms". INTERNATIONAL JOURNAL OF COMPUTER SCIENCES AND ENGINEERING, October 2018.

[2] Domingos. "Using Partitioning to Speed Up Specific-to-General Rule Induction." In Proceedings of the AAAI-96 Workshop on Integrating Multiple Learned Models, pp. 29-34, AAAI Press, 1996.

[3] Opitz, D. and Maclin. "Popular Ensemble Methods: An Empirical Study." Journal of Artificial Research, 11: 169-198, 1999.

[4] Freund Y. and Schapire. "Experiments with a new boosting algorithm." In Machine Learning: Proceedings of the Thirteenth International Conference, pages 325-332, 1996.

[5] Friedman. "Greedy boosting approximation: a gradient boosting machine." Ann. Stat. 29, 1189–1232. doi: 10.1214/aos/1013203451, 2001.

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Biosensors

Biosensors are self-contained integrated analytical devices that convert a biological response into quantitative and processable signals. A biosensor is thus a self-contained integrated device that mixes a biological recognition part with a physical electrical device. A biosensor contains analyte, bioreceptor, transducer, physical science, and show for knowledge work. Biosensors needed for measure ought to have fast detection, be correct, be straightforward to work, have a coffee latent period, and be inexpensive, sensitive, and reliable. Biosensors are often more classified into chemistry, optical, electricity, and thermal sensors supported the kind of electrical device. There are various applications in numerous fields like water quality observation, food sample analysis, drug and medication analysis, blood-sugar detection, contamination in water and soil, and DNA-based sensors.

Biosensors can be classified into 3 generations in line with the degree of integration of the separate elements i.e., the strategy of attachment of the biorecognition or bioreceptor molecule to the bottom electrical device part. within the initial generation, the bioreceptor is physically entrapped within the neighbourhood of the bottom device behind a discriminating membrane like a qualitative analysis membrane. In succeeding generations, immobilization is achieved via valence bonds at a befittingly changed electrical device interface or by incorporation into a chemical compound matrix at the transduction surface. within the second generation, the individual elements stay primarily distinct (e.g., management electronics- electrode- biomolecule), whereas within the third generation the bioreceptor molecule becomes associate integral a part of the bottom device. whereas these definitions were in all probability supposed for accelerator conductor systems, similar classifications applicable to biosensors normally are often created. it's within the second and third generations of those families that the main development effort will currently be seen.

Biosensors are enjoying an enormous impact in our everyday routine and their role to create our life straightforward can't be unheeded. during this technology era, even the health care system depends on biosensors. With personalization of medicines, currently the personalization of biosensors has become associate approaching field. 3D printing technology integrated with custom-built biosensors is that they would like of associate hour. It's influencing the medical specialty field by making them at accelerator, DNA, medicine, in addition as genes levels. The revolutionary technology builds up the technique to be used alongside imaging techniques like resonance imaging (MRI) and computerized tomography (CT) scanning, that more permits one to visualize a patient's dataset with utmost clarity. health care professionals' area unit victimization biosensors in testing, medicine, education domain, surgical procedure, and even in interference. during this chapter, biosensors supported 3D-printing technology area unit mentioned alongside the fundamentals of 3D-printing technology.

Any biosensor is functionally composed of 3 elements. The biological part, that is liable for police work the analyte and generating a response signal, forms the first part of the biosensor. The signal generated by the biological part is then remodelled into a detectable response by the second part known as electrical device, that is that the most important part in any biosensing device. The third a part of the biosensor is that the detector that amplifies associated processes the signals before showing it victimization an electronic display system. Imperative utilization of biosensors has noninheritable preponderating importance within the field of drug discovery, biomedicine, food safety standards, defence, security, and environmental observation. This has semiconductor diode to the invention of precise and powerful analytical tools victimization biological device as biosensor. Glucometers utilizing the strategy of chemistry detection of gas or peroxide victimization

immobilized aldohexose enzyme conductor seeded the invention of biosensors. Recent advances in biological techniques and instrumentation involving visible light tag to nanomaterials have inflated the sensitive limit of biosensors. Use of aptamers or nucleotides, affibodies, amide arrays, and molecule imprinted polymers give tools to develop innovative biosensors over classical strategies. Integrated approaches provided a much better perspective for developing specific and sensitive biosensors with high regenerative potentials. numerous biosensors starting from nanomaterials, polymers to microbes have wider potential applications. it's quite necessary to integrate many-sided approaches to style biosensors that have the potential for numerous usages. In light-weight of this, this review provides a summary of various kinds of biosensors being employed starting from chemistry, visible light labelled, nanomaterials, oxide or quartz, and microbes for numerous medical specialty and environmental applications with future outlook of biosensor technology.

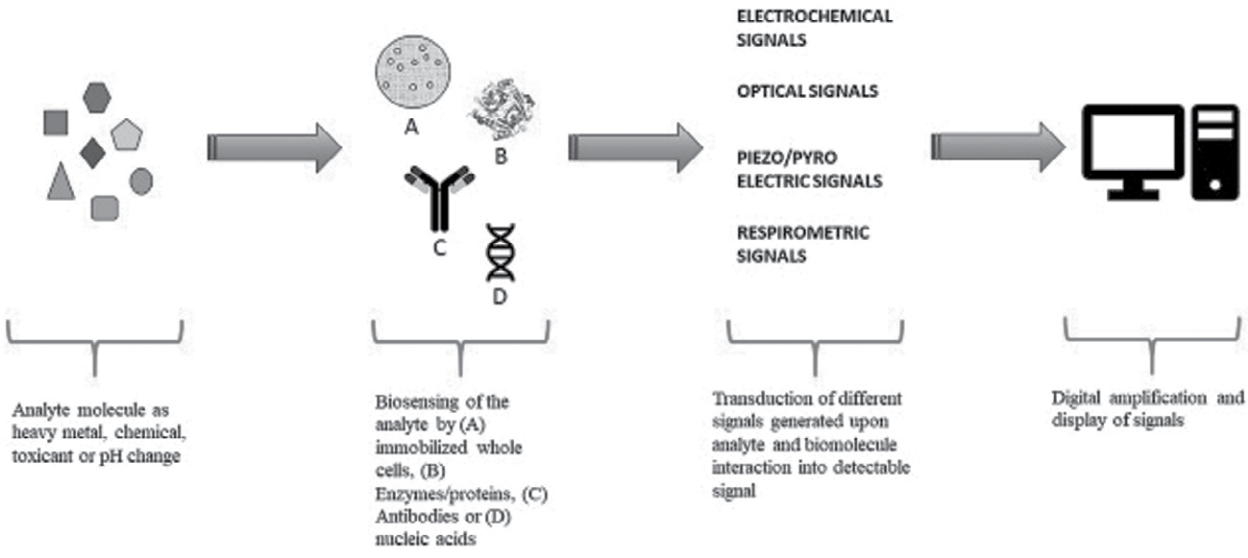

Figure1: Pictorial description of the different steps involved in the signal processing of any biosensor.

Image Credit: https://www.sciencedirect.com/topics/engineering/biosensors

Integrated methods victimization multiple technologies starting from chemistry, mechanical device, and fluorescence-¬cum-optical-based biosensors and genetically built microbes' area unit fashionable strategies for biosensor discoveries. a number of these biosensors have tremendous application prospects in unwellness diagnosing and medication. because the demand and wish for victimization biosensor for fast analysis with cost-effectiveness need bio-fabrication which will pave thanks to establish cellular to whole animal activity with a detection limit of high accuracy for single molecules. Next, the biosensors ought to be targeted to figure beneath multiplex conditions. in this scenario, each 2nd and 3D detection area unit needed with subtle transducers for targeting and quantifying tiny analytes of interest. In this, many milestone discoveries were created with contact or non-contact-based patterning at completely different levels. Next level of development ought to aim for locating additional sturdy regenerative biosensors for semipermanent use. If this happens, new diagnostic biosensors are often developed for medical specialty, which is able to facilitate each clinician and patients during a long-term for additional integrative understanding of diseases and medical care.

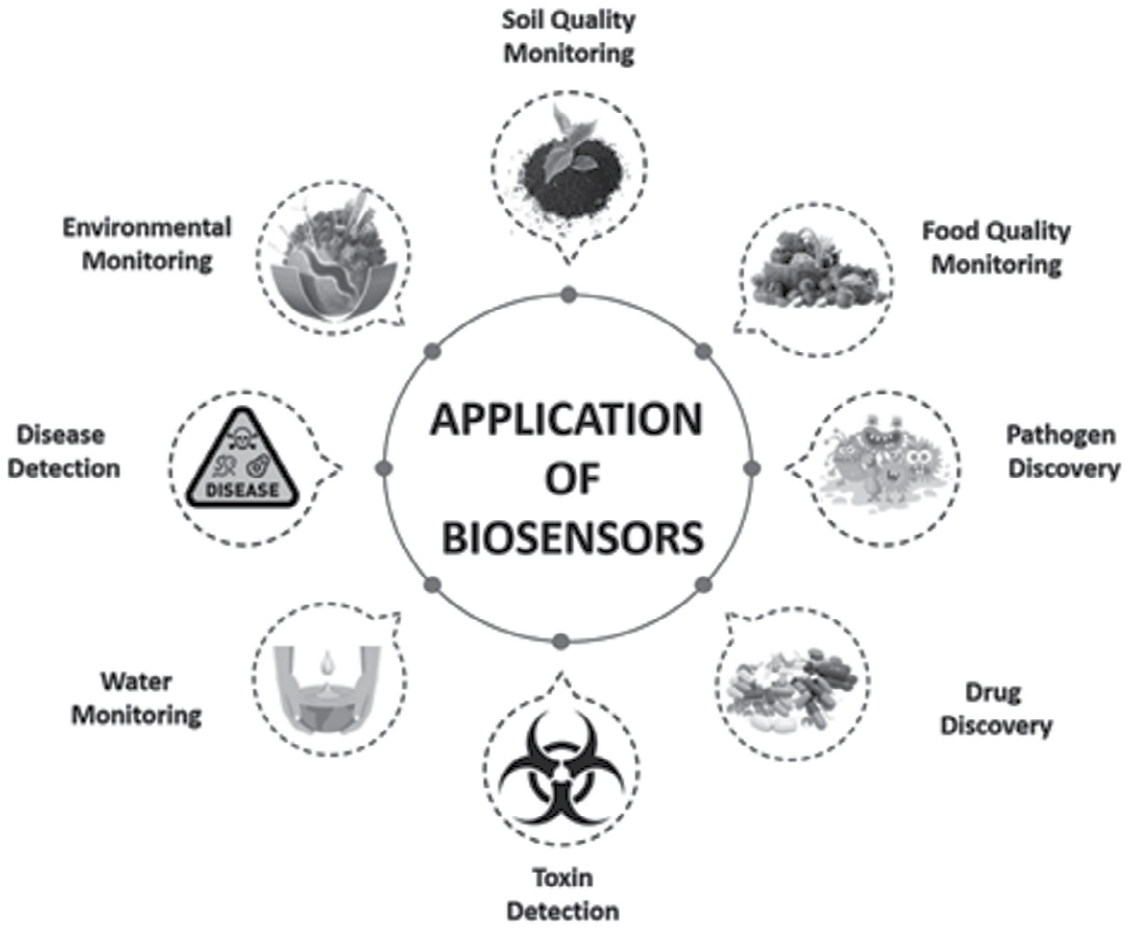

Figure 2: Different applications of biosensors

Image Credit: https://link.springer.com/chapter/10.1007/978-981-15-2817-0_14

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Parallel Prefix Adders- A Comparative Study for Fastest Response

Abstract : *- VLSI, in modern day technology has seen extensive use of PPA with a better delay performance. These pre-compute the carries and thus have upper hand over the commonly used Ripple Carry Adder (RCA). Addition has been an indispensible operation in most of the widely used applications. We present the 16 and 32 bit of different adders- Carry Look Ahead (CLA), Carry Save Adder (CSA), Kogge Stone Adder (KSA), Sparse Kogge Stone Adder (SKSA), Brent Kung Adder (BKA), Sklansky Adder, Lander Fischer Adder (LFA) and Han Carlson Adder (HCA). They have been categorized and ranked as per delay, device utilization and cell usage. These adders are implemented in VHSIC Hardware Description Language (VHDL) using Xilinx Integrated Software Environment (ISE) 9.2i Design Suite.*

Keywords: Adders, KSA, SKSA, BKA, simulation, synthesis

I. INTRODUCTION

Binary addition is a fundamental operation that continues to have pivotal role in most modern day digital, control systems, DSP circuits.The adders are required to have faster computation for great accuracy and small area consumption. Binary adders are one of the most essential logic elements within a digital system. These determine the performance of design. Also, binary adders are helpful in units other than (ALU), such as multipliers, dividers and memory addressing units and so on. The major drawback for binary addition is the carry chain. With the increase in width of the input operands, the length of the carry chain also increases. In order to improve the performance of the carry-propagate adders, it is possible to accelerate the carry chain, but not eliminate it. As a result, most digital designers come up building faster adders by optimizing computer architecture. In this paper we mainly focus on finding a better adder in terms of delay constraints, device utilization and cell usage.

II. WORKING ARCHITECTURE

Parallel Prefix Adders employ three basic stages to for the adder operation, namely[1]:

1) Pre-computation of Pi and Gi .

2) Carry generation network

3) Post-computation

1)Pre-computation stage

This step involves computation of generate and propagate signals corresponding to each pair of bits in A and B.

$$P_i = A_i \oplus B_i$$
$$G_i = A_i \cdot B_i$$

2) Carry generation network: $G_{i:k} = G_{i:j} + P_{i:j} \cdot G_{j-1:k}$

$$P_{i:k} = P_{i:j} \cdot P_{j-1:k}$$

III. DIFFERENT TYPES OF PPAs

A. 16 Bit Kogge Stone Adder

Kogge-Stone adder is a common design for high performance adders. It is a parallel form of carry look ahead adder[2]. It has low logic depth, high node count and minimum fan-out[3]. Low logic depth and minimum fan-out gives faster performance, but high node count results in larger area. It is generally considered as the fastest adder[4] as shown in Fig.1.

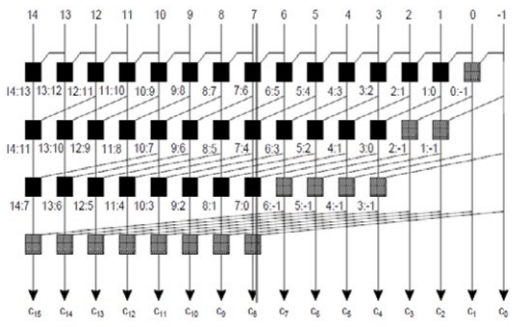

Fig 1. 16 Bit Kogge-Stone Adder

B. 16 Bit Sparse Kogge Stone Adder

The sparse Kogge-Stone adder consists of several smaller ripple carry adders (RCAs) on its lower half, a carry tree on its upper half[5].Only in the Sparse Kogge-Stone adder, the design terminates with a 4- bit RCA, as shown in Fig. 2.

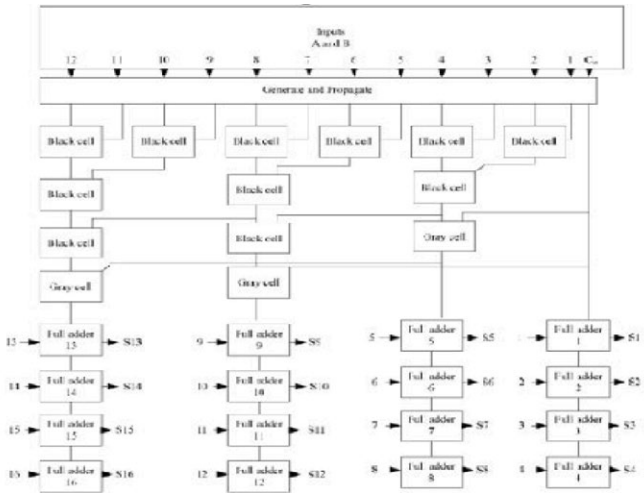

Fig 2. 16 Bit Brent-Kung Adder

C. 16 Bit Brent Kung Adder

It has a minimum number of fan-out.The number of processing components is less as compared to KSA or SKSA. Hence, it reduces delay without compromising the power performance of the adder[7], as shown in Fig. 3.

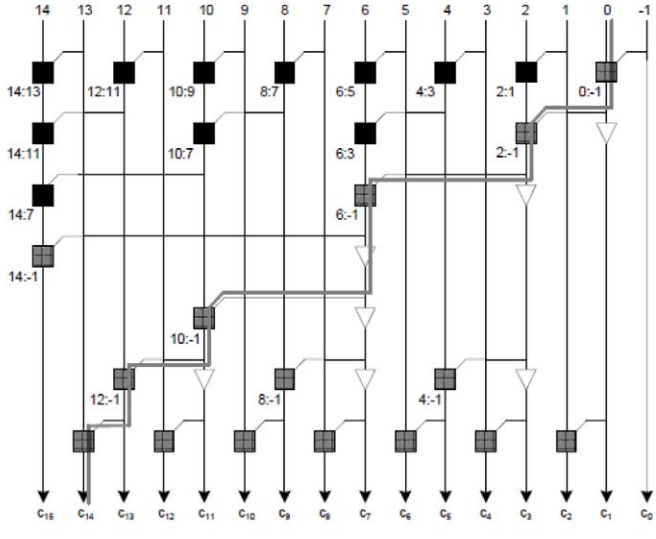

Fig 3. 16 Bit Brent-Kung Adder

D. 16 Bit Sklansky Adder

The structure can be viewed as a compacted version of Brent-kung's, where logic levels is reduced and fan-out increased. In this adder, binary tree of propagate and generate cells will first simultaneously generate all the carries, Cin. It builds recursively 2-bit adders then 4-bit adders, 8-bit adders, 16-bit

adder and so on by abutting each time two smaller adders.[7], as shown in Fig. 4.

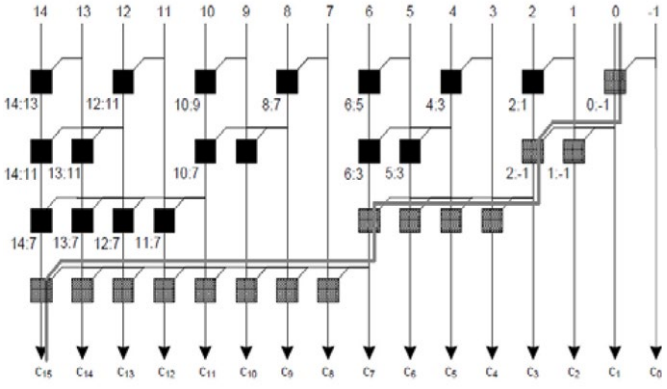

Fig 4. 16 Bit Sklansky Adder

E. 16 Bit Ladner Fischer Adder

This adder structure has minimum logic depth, but has large fan-out requirement up to n/2 [8]. In 1980, Fischer and Richard Ladner presented a parallel algorithm for computing prefix sums efficiently. They show how to construct a circuit that computes the prefix sums in the circuit, each node performs an addition of two numbers. With their construction, one can choose a trade-off between the circuit depth and the number of nodes[9], as shown in Fig. 5.

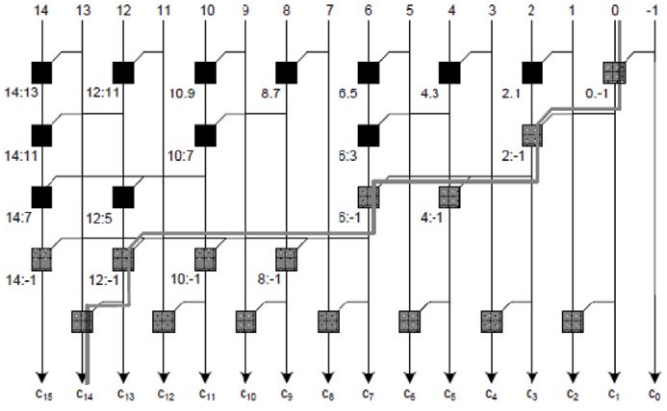

Fig 5. 16 Bit Ladner-Fischer Adder

F. 16 Bit Han-Carlson Adder

It is a hybrid design of Kogge-Stone and Brent Kung. It has less number of cells and wire tracks as compared to Kogge-Stone at the cost of one extra logic level. Generate and propagate signals of odd bits are transmitted down the prefix tree. They recombine with even bits carry signals at the end to produce the true carry bits. Thus, the reduced complexity is at the cost of adding an additional stage to its carry-merge path[7], as shown in Fig. 6.

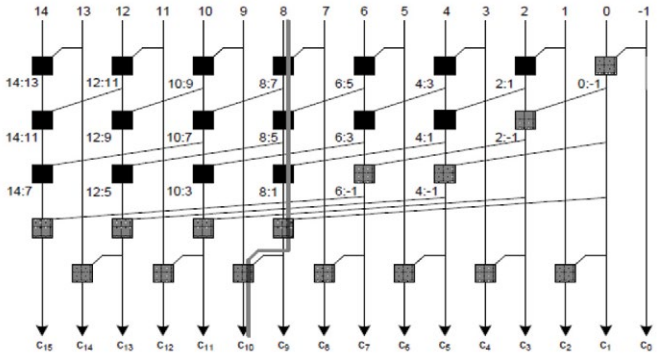

Fig 6. 16 Bit Ladner-Fischer Adder

IV. SIMULATION AND RESULTS

Simulation results are shown in Fig.7 to Fig. 11.

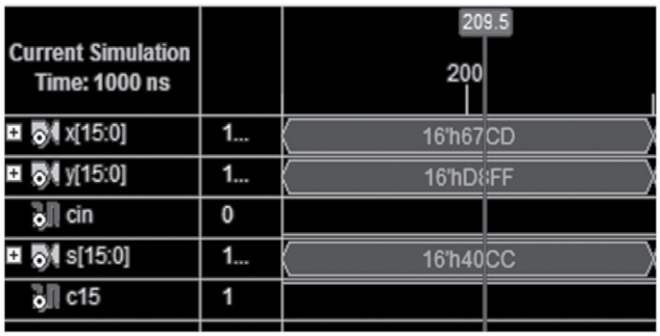

Fig 7. 16 Bit KSA

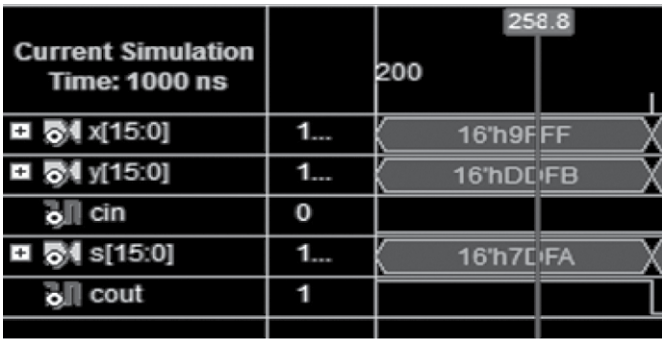

Fig 8. 16 Bit SKSA

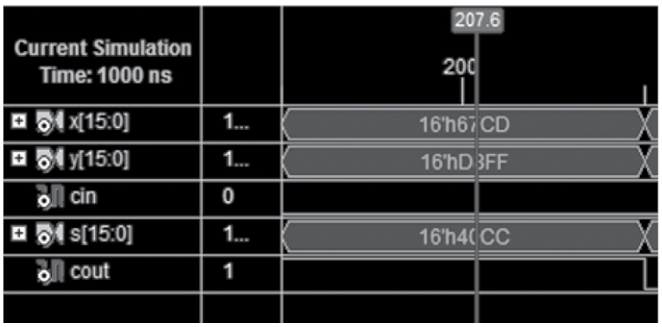

Fig 9. 16 Bit BKA

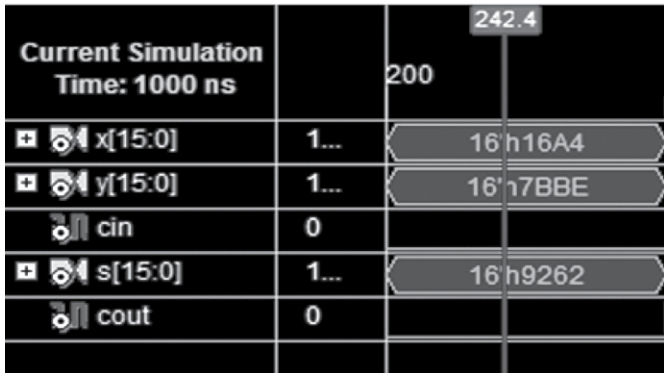

Fig 10. 16 Bit Ladner Fischer Adder

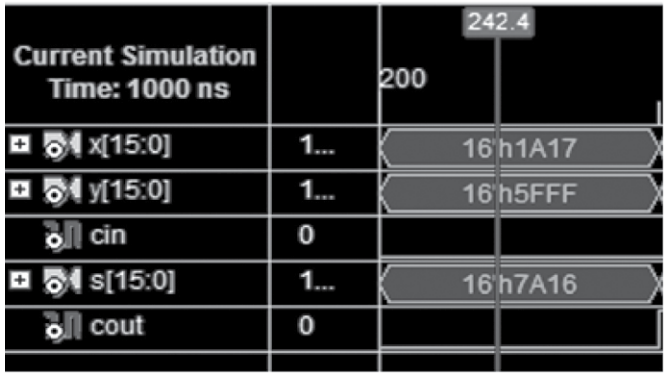

Fig 11. 16 Bit Sklansky Adder

V. COMPARISION TABLES

Table I. 16 Bit Adders

Sl. No.	Name Of Adder	Logic Delay (Ns)	Route Delay (Ns)	Total Delay (Ns)
1.	CLAG	15.050 (65.7%)	7.847 (34.3%)	22.897
2.	KSA	13.518 (66.7%)	6.742 (33.3%)	20.260
3.	SKSA	11.530 (67.4%)	5.572 (32.6%)	17.102
4.	BKA	12.938 (64.0%)	7.292 (36.0%)	20.230
5.	Sklansky	13.580 (65.4%)	7.172 (34.6%)	20.752
6.	LFA	13.259 (64.5%)	7.302 (35.5%)	20.561
7.	HCA	12.938 (64.8%)	7.026 (35.2%)	19.964

Table II. 32 Bit Adders

Sl. No.	Name Of Adder	Logic Delay (Ns)	Route Delay (Ns)	Total Delay (Ns)
1.	KSA	13.642 (64.0%)	7.684 (36.0%)	21.326
2.	SKSA	19.854 (63.8%)	11.274 (36.2%)	31.128
3.	BKA	13.963 (63.0%)	8.194 (37.0%)	22.157
4.	LFA	20.237 (62.0%)	12.403 (38.0%)	32.640
5.	HCA	15.754 (62.7%)	9.356 (37.3%)	25.110
6.	Sklansky	19.533 (62.6%)	11.694 (37.4%)	31.227
7.	HCA	12.938 (64.8%)	7.026 (35.2%)	19.964

B. Device Utilization and Cell Usage

Table III. 16 Bit Adders

Sl. No.	Name Of Adder	DEVICE UTILIZATION SUMMARY				CELL USAGE			
		NO. of SLICES	4INPUT LUT'S	IO's	BONDED IOB'S	BELS	IOB's	IBUF	OBUF
1.	CLAG	18	32	50	50	33	50	32	18
2.	KSA	36	64	50	50	73	50	32	18
3.	SKSA	23	42	50	50	48	50	32	18
4.	BKA	24	43	50	50	50	50	32	18
5.	Sklansky	20	37	50	50	44	50	32	18
6.	LFA	22	40	50	50	47	50	32	18
7.	HCA	30	52	50	50	55	50	32	18

Table IV. 16 Bit Adders

Sl. No.	Name Of Adder	DEVICE UTILIZATION SUMMARY				CELL USAGE			
		NO. of SLICES	4INPUT LUT'S	IO's	BONDED IOB'S	BELS	IOB's	IBUF	OBUF
1.	KSA	89	157	98	98	164	98	64	34
2.	SKSA	57	104	98	98	123	98	64	34
3.	BKA	49	88	98	98	103	98	64	34
4.	LFA	46	84	98	98	100	98	64	34
5.	HCA	59	107	98	98	122	98	64	34
6.	Sklansky	50	90	98	98	106	98	64	34

VI. CONCLUSIONS

Parallel-prefix structures have been found to be attractive for adders due to its logarithmic delay. This project analysis has paved the way for the development of Adders Design with reduced delay. Our sole aim was finding out the fastest adder among the various kinds of binary and PPA's discussed above. The findings showed us that there is hardly any difference in delays when the lower bits are taken into account, but as we increase the number of bits there is a remarkable difference in delays. Again, higher the LUT's used higher will be the area consumed. Results suggest that no single type of architecture is the best for all bit values, rather offer enough insights of which type of adders is the best for a specified bit value. Looking forward to the future aspects we can elaborate on other important design parameters viz. area, power, energy and can be compared. It would be worthwhile for future FPGA designs to include an optimized carry path.

VII. REFERENCES

[1] Mr. Deepak Raj, Mrs. Sahana K Adyanthaya , Prof. Praveen J, Prof. Raghavengra Rao R, "Design and Implementation of different types of efficient parallel prefix adders", International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering(IJIREEICE), Vol. 3,Special Issue 1, April 2015.

[2] T.Kiran Kumar, P.Srikanth," Design of High Speed 128 bit Parallel Prefix Adders", Journal of Engineering Research and Applications (IJERA), ISSN : 2248-9622, Vol. 4, Issue 11(Version 3), Nov 2014.

[3] Raghumanohar Adusumilli and Vinod Kumar K, "Design and Implementation of a High Speed 64 Bit Kogge-Stone Adder Using Verilog Hdl", International Journal of Electrical and Electronic Engineering and Telecommunication (IJEETC), ISSN-2319-2518, vol-4 No. 1, Jan 2015.

[4] Pakkiraiah Chakali, Madhu Kumar Patnala, "Design of High Speed Kogge Stone Based Carry Select Adder", International Journal of Emerging Science and Engineering (IJESE), ISSN: 2319-6378, vol 1, Issue 4, Feb 2014.

[5] E. Sreenivasa Goud, P.C. Praveen Kumar, "Design and Characterization of Sparse Kogge Stone Parallel Prefix Adder Using FPGA", International Journal of Scientific Engineering and Technology Research, ISSN 2319-8885, vol 03, Issue.06, July-2013.

[6] A. Madhu Babu, K. Harikrishna, "Evaluation of High Speed and Low Memory Parallel Prefix Adders", IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), e-ISSN:2278-1676, p-ISSN:2320-3331, vol 8, Issue 4, Nov-Dec 2013.

[7] Megha Talsania, Eugene John, "A Comparative Analysis of Parallel Prefix Adders", University of Texas at San Antonio.

[8] P. Chaitanya Kumari, R. Nagendra, "Design of 32 bit Parallel Prefix Adders", IOSR journal of Electronics and communication Engineering (IOSR-JECE), e-ISSN:2278-2834, p-ISSN:2278-8735, vol. 6, Issue 1 May-June 2013.

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Modelling of Cascaded Boost Converter

Abstract: *Renewable energy technologies (RETs), such as photovoltaic (PV) or fuel cell (FC) system becoming more and more popular because these systems are polluted free method to fulfill electricity requirement. .But the photovoltaic system has low voltage at the output; in this scenario dc-dc boost converter become very necessary part to get high voltage gain. In literature many types of boost converter presented and implemented successfully. Even if the boost converter with extended cell is presented, the disadvantage of this converter has many switch which cause switching losses, which impact on overall efficiency and voltage gain not much high. In boost converter with voltage lift cell and switched-capacitor technics has been tried as a substitute, the main disadvantage of these types of converter semiconductor switches surface has high transit current which cause increase the conduction losses. For instance, boost converter with coupled inductors, the disadvantage of these kind boost converters is complex because to adjust turn ratio of coupled inductor and voltage stress across the switches is equal to output voltage. Hence boost converter with transformer is presented these types of converter can get high voltage gain at the output, however the main disadvantage of transformer increase the cost, size and losses.*

I. INTRODUCTION

For many years, fossil fuel cells have been the primary source of energy. The wide use of these sources has leaded to the emission of greenhouse gases. Climate change, caused by these greenhouse gases, has seriously damaged the environment. Due to the limited supply of these sources on the earth and their environmental effects, the world trend nowadays is to find a non-depletable and clean source of energy [1].

The DC-DC converters have become an essential component of industrial and military applications over past decades. New technological developments require power supplies with significant step-up voltages; for example, in portable applications and fuel cell arrays. This project deals with a wider voltage ratio obtained by cascaded converter, which consists in two or more basic DC-DC converters connected in cascade with the corresponding increase in power loss. Hence, this converter is more useful and effective than the standard boost converter and has replaced it.

II. LITERATURE SURVEY

In the year 2006, Jorge Alberto Morales-Saldaña, Roberto Galarza-Quirino, Jesús Leyva-Ramos, Member, IEEE, Enrique Eduardo Carbajal-Gutierrez and Ma. Guadalupe Ortiz-Lopez wrote a paper. In this paper, a controller design methodology is given for a cascaded boost converter with a single switch using current-mode control. Nonlinear and linear models are presented, the later exhibits fourth-order characteristic dynamics with right-half side zeros. The proposed control scheme is based on sensing the current of the switch and using it for feedback purposes. When the current loop is introduced, the fourth-order dynamics of the converter is changed to a dominant first-order, which simplifies substantially the controller design of the outer loop. For this loop, a conventional controller is designed.

In the year 2012, Ndtoungou, Ab. Hamadi, A. Missanda and K. Al-Haddad, HOORZPHPEH wrote a paper based on design, modeling and implementation of a cascaded boost converter for its application as interface to battery electric vehicle system. The cascade boost converter is compared with the classical boost converter; the performance of the designed converter is validated through simulation in two different modes, with resistive load and with battery charging electric vehicle system. A nonlinear control strategy is used to control the power devices of a cascade boost converter and a boost converter. Simulations carried out in Matlab/SIMULINK environment and tests on a prototype setup have verified the capability of this topology in performing desired duties.

In 2004, Nesrine Boujelben, Ferdaous Masmoudi, Mohamed Djemel, and Nabil Derbel, together discovered and prepared a research. According to them, Photovoltaic (PV) energy is a very important renewable energy source. The output voltage in renewable energy sources is improved using DC-DC converters, which are the key part in a photovoltaic chain. Among the classic DC-DC topologies, the boost converter is the most used because of its simplicity and high efficiency. The aim with this converter that the switching frequency is limited so the output voltage is reduced. A possible solution to this

problem is to use other topologies; the quadratic boost converter results from the generalized cascaded boost topologies with a single switch and the double cascade boost results from the association of two identic elementary boost converters connected in tandem. In this

chapter a comparison of the efficiency of the classic boost converter with the two cascaded boost converters is discussed.

In the year 2011, Muhammad Zeeshan Malik, Amjad Ali, Dileep Kumar collectively wrote an article. According to the article, a new topology of cascaded boost converter with voltage multiplier cell (VMC) is presented. The proposed cascaded boost converter consist two boost converters connected in series with voltage multiplier cell. The advantage of proposed topology can attain high voltage gain without working extremely duty ratio. To validate the performance of proposed converter experimental results, attain in laboratory, where input voltage 10VDC are given and the 100V output voltage attain at the duty ration 60%. As compare to traditional boost converter the output voltage at same parameters is 25V which is lower than the proposed converter. Voltage stress across the switches of proposed converter is less than output voltage but the voltage stress of traditional boost converter is equal to output voltage. Furthermore the voltage conversion ratio graph of proposed and conventional converters at different duty cycle and efficiency graph of proposed converter shown in experimental results respectively.

In 2015, Jinsung Choi, Jin-san Kim, and Giyung Lee Dept. of Control and Instrumentation Engineering wrote paper that a cascaded boost dc-to-dc converter employing a tapped-inductor to obtain a high voltage boosting ratio. It consists of two voltage boosting stages. Stage-I configures like boost converter, and Stage-II is designed by using a tapped-inductor. Both stages have a cascaded connection to maximize a voltage boosting ratio between input and output voltage. After theoretical analysis, computer-aided simulation and experiment carries out to verify the validity of the proposed converter, and compares a voltage boosting ratio with conventional counterparts. This paper intended

- To obtain a high voltage ratio DC-DC boost converter which will be desirable in most of the applications.
- To obtain a converter with low voltage ripples

III. STANDARD BOOST CONVERTER

The standard DC/DC boost converters used is shown in the figure 1

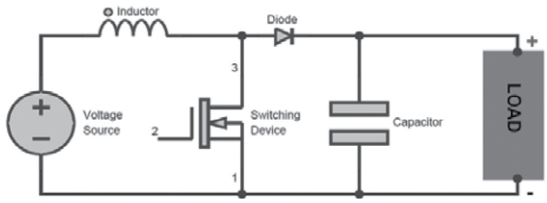

Fig 1 Boost converter

Fig 1 Boost converter

It is one of the simplest types of switch mode converter which takes an input voltage and boosts or increases it [2]. It consists of a DC voltage source, an inductor, an uncontrolled diode, a capacitor, and a switching device. It boosts the voltage with high efficiency, but has some disadvantages.

The key principle that drives the boost converter is the tendency of an inductor to resist change in current by either increasing or decreasing the energy stored in the inductor magnetic field. Disadvantages of boost converter are:

- High peak current flows through the switch.
- Output voltage is highly sensitive to changes in duty cycle.
- Large inductor and capacitor is required to provide ripple free output.
- There is no isolation from input to output which is very critical in many operations.

This paper proposed the solution methodologies as follows:

- Here we are proposing the design of cascaded boost converter with high voltage ratio and low current ripples.
- With this topology there will increase in the effective switching frequency on the input side of the converter which will reduce the input current ripple.
- The proposed topology is suitable to be used for PV and fuel cell power generation system.

IV. CASCADED BOOST CONVERTER

A cascaded boost converter results by assembling the components of two boost converters by using single switch.

This converter is a fourth-order structure having two inductors and two capacitors. The circuit diagram of a quadratic boost converter is shown in Fig. 2.

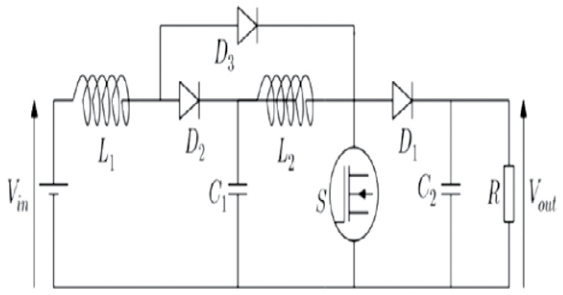

Fig 2 Cascaded Boost converter

This converter comprises of an input voltage Vin, an active switch S, three passive switches D1, D2 and D3, two capacitors C1 and C2 and two inductors L1 and L2 [3]. Thus, diodes D1 and D2 are replaced by voltage sources, and diode D3 and the transistor switch by the corresponding current source.

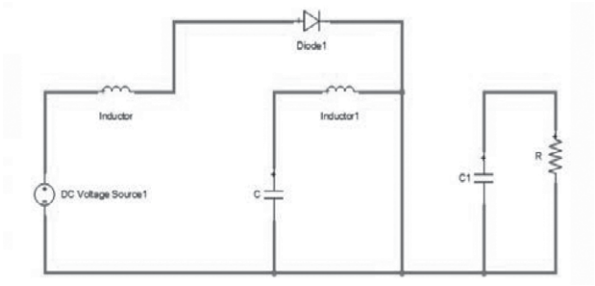

Fig 3 On state of boost converter

As it is shown in Fig 3, the quadratic boost converter has two possible structures in continuous mode [4]. In on-state, switch S and diode D3 are turned on, and diodes D2 and D1 are turned off.

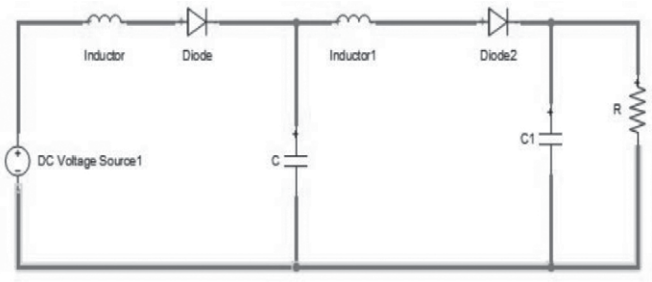

Fig 4 Off state of boost converter

In off-state, switch S and diode D3 are turned off, and diodes D2 and D1 are turned on as shown in Fig.4.

V. STATE SPACE ANALYSIS OF CASCADED BOOST CONVERTER

- **When switch is ON (dT)**

$$L_1 \frac{di}{dt} = V_{in} \text{ (Eq. 1)}$$

$$L_2 \frac{di}{dt} = V_{C_1} \text{ (Eq. 2)}$$

$$C_1 \frac{dv}{dt} = I_{L_2} \text{ (Eq. 3)}$$

$$C_2 \frac{dv}{dt} = \frac{V_{C_2}}{R} \text{ (Eq. 4)}$$

The required state matrix for this condition is:

$$\begin{bmatrix} i_{L_1} \\ i_{L_2} \\ v_{C_1} \\ v_{C_2} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 1/L_2 & 0 \\ 0 & 1/C_1 & 0 & 0 \\ 0 & 0 & 0 & 1/RC_2 \end{bmatrix} \begin{bmatrix} i_{L_1} \\ i_{L_2} \\ v_{C_1} \\ v_{C_2} \end{bmatrix} + \begin{bmatrix} 1/L_1 \\ 0 \\ 0 \\ 0 \end{bmatrix} [V_{in}] \quad \text{(Eq. 5)}$$

- **When switch is OFF (1-dT**

$$L_1 \frac{di}{dt} = V_{in} + V_{C_1} \text{ (Eq. 6)}$$

$$L_2 \frac{di}{dt} = V_{C_1} + V_{C_2} \text{ (Eq. 7)}$$

$$C_1 \frac{dv}{dt} = I_{L_1} + I_{L_2} \text{ (Eq. 8)}$$

$$C_2 \frac{dv}{dt} = I_{L_2} + \frac{V_{C_2}}{R} \text{ (Eq. 9)}$$

The required state matrix for this condition is:

$$\begin{bmatrix} i_{L_1} \\ i_{L_2} \\ v_{C_1} \\ v_{C_2} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1/L_1 & 0 \\ 0 & 0 & 1/L_2 & 1/L_2 \\ 1/C_1 & 1/C_1 & 0 & 0 \\ 0 & 1/C_2 & 0 & 1/RC_2 \end{bmatrix} \begin{bmatrix} i_{L_1} \\ i_{L_2} \\ v_{C_1} \\ v_{C_2} \end{bmatrix} + \begin{bmatrix} 1/L_1 \\ 0 \\ 0 \\ 0 \end{bmatrix} [V_{in}]$$

(Eq. 10)

The obtained state matrix is:

$$A = A_1 D + A_2(1 - D)$$

$$B = B_1 d + B_2(1 - d)$$

$$\dot{X} = \begin{bmatrix} 0 & 0 & 1-d/L_1 & 0 \\ 0 & 0 & 1/L_2 & 1-d/L_2 \\ 1-d/C_1 & 1/C_1 & 0 & 0 \\ 0 & 1-d/C_2 & 0 & 1/RC_2 \end{bmatrix} \begin{bmatrix} i_{L_1} \\ i_{L_2} \\ v_{C_1} \\ v_{C_2} \end{bmatrix} + \begin{bmatrix} 1/L_1 \\ 0 \\ 0 \\ 0 \end{bmatrix} [V_{in}] \quad \text{(Eq. 11)}$$

VI. SIMULATION AND GRAPH OF CASCADED BOOST CONVERTER

The complete simulation diagram is shown in Fig. 5 and the obtained voltage is shown in Fig.6

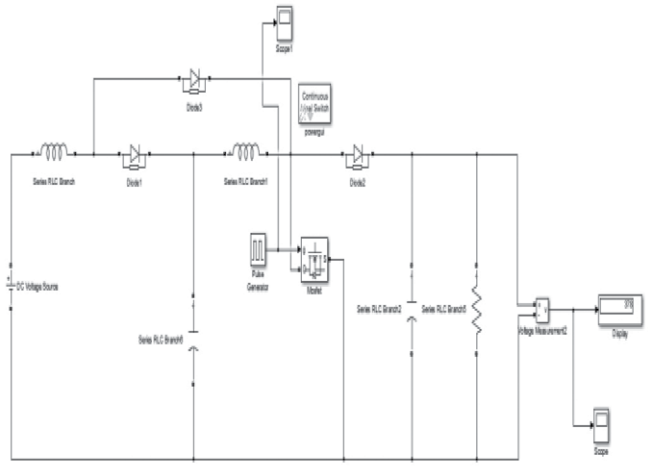

Fig 5 Simulation diagram

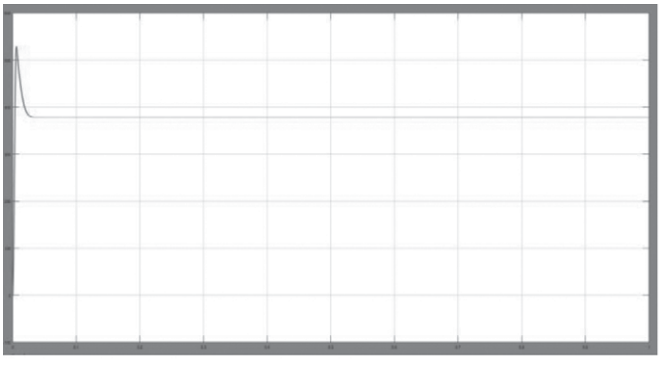

Fig 6 Output voltage

VII. CONCLUSIONS

In some applications high boost rates are needed. Different techniques and converter topologies can be obtained to handle this problem. In this project, the two cascaded boost converter has been studied for this potential use in this kind of application. It has been analyzed theoretically and by numerical simulations using MATLAB software.

REFERENCES

1. Nesrine Boujelben, Ferdaous Masmoudi, Mohamed Djemel, and Nabil Derbe, "Modeling and Comparison of Boost Converter With Cascaded Boost Converters", Modeling, Identification and Control Methods in Renewable Energy Systems, Green Energy and Technology

2. Jorge Alberto Morales-Saldana, Roberto Galarza-Quirino, Jesus Leyva-Ramos, "Modelling and Control of a Cascaded Boost Converter with a Single Switch", IECON 2006 - 32nd Annual Conference on IEEE Industrial Electronics.

3. JFJ van Rensburg, MJ Case and DV Nicolae "Double-Boost DC to DC Converter",34th Annual Conference of IEEE Industrial Electronics, 2008

4. H. Komurcugil, "A PI-Type Self Tuning Fuzzy Controller for Dc-Dc Boost Converters", 30th Annual Conference of the IEEE, Industrial Electronics Society, November 2-6, 2004.

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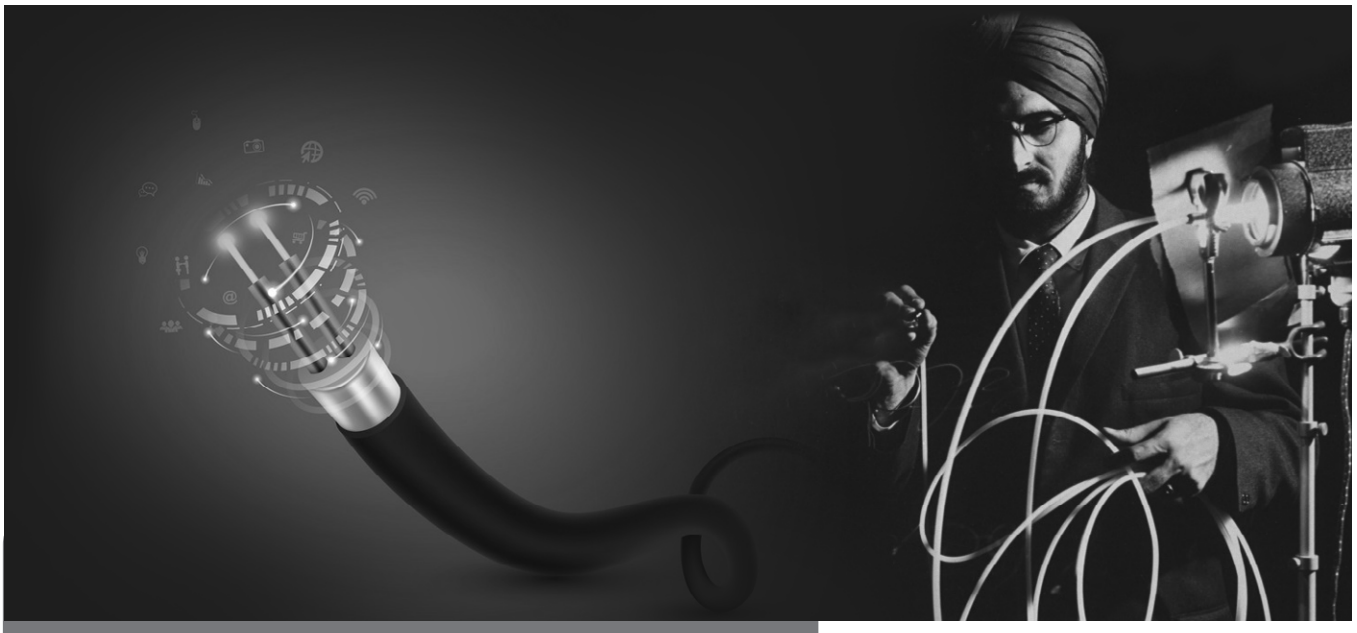

NARINDER SINGH KAPANY

By: **Avantika Mishra**

A pioneering scientist, teacher, entrepreneur, businessman, patron of arts and philanthropist, Moga-born Narinder Singh Kapany was truly multi-faceted. He coined the term "fibre optics" for the technology transmitting light through fine glass strands in devices from endoscopy to high-capacity telephone lines that has changed the medical, communications and business worlds. The "father of fibre optics" turned his research into a thriving business, and in the process revolutionised communication and helped provide the underpinnings of the Internet infrastructure of today. He was also a major patron of Sikh arts and sponsored many activities through the Sikh Foundation that he founded.

His research and inventions have encompassed fibre-optics communications, lasers, biomedical instrumentation, solar energy, and pollution monitoring. He has over one hundred patents and was a member of the National Inventors Council. He is a fellow of numerous scientific societies including the British Royal Academy of Engineering, the Optical Society of America, and the American Association for the Advancement of Science. He has also served on the boards of various companies. He was a member of the Young Presidents Organization and later was a member of the World Presidents Organization.

As an academic, Dr. Kapany taught and supervised the research activity of postgraduate students. He was a Regents Professor at the University of California, Berkeley and at the University of California, Santa Cruz (UCSC). He was also director of the Centre for Innovation and Entrepreneurial Development at UCSC for seven years. At Stanford University, he had been a visiting scholar in the Physics Department and consulting professor in the Department of Electrical Engineering. As an author and lecturer, Dr. Kapany had published over one hundred scientific papers and four books on opto-electronics and entrepreneurship. He had lectured to various national and international scientific societies. He along with Harold Hopkins at Imperial College in London achieved low-loss light transmission through a 75 cm long bundle which combined several thousand fibers. Their article titled "A flexible fibrescope, using static scanning" was published in the journal Nature in 1954. Kapany's article on fibre optics in Scientific American in 1960 established the term "fibre optics".

Kapany was posthumously included in the list of Padma Vibhushan awardees for 2021. The award is India's second highest civilian honor. He received the UC Santa Cruz Foundation Fiat Lux Award in 2008. He was also the recipient of the Pravasi Bharatiya Samman in 2004, "The Excellence 2000 Award" from the USA Pan-Asian American Chamber of Commerce in 1998. In November 1999, he was identified by Fortune as one of the seven "unsung heroes who greatly influenced life in the twentieth century" in the "Businessmen of the Century" issue. Dr. Kapany was also on Time Magazine's list of top ten scientists of the 20th century in Time's last issue of 1999.

Design of Patch Antennas Using Different Optimization Techniques for Microwave Applications

A significant development in the wireless communication system necessitates low cost, small size, and lightweight antenna structures. Microstrip patch antennas (MPAs) are the appropriate candidates for satisfying all these above requirements. Therefore, various MPAs are optimally designed for several microwave frequency applications. Specifically, fifteen different MPAs are designed which operate at different microwave frequencies within the range of 2 GHz to 12 GHz.My research work of fifteen different MPA designs is organized into nine dissertation chapters. The Introduction is the first chapter and Concluding Remarks is the last chapter. The literatures referred for my research are presented in Chapter-2. In Chapter-3 various optimization algorithms that are used for my MPA designs are briefly discussed. In the rest five chapters, fifteen MPAs designed for microwave frequency applications are explained. First of all, three simple patch designs are considered for the optimal design for some specific applications. The first design is a simple rectangular patch antenna (RPA) resonating at 5 GHz frequency. The dimensions of this RPA are optimized using the Bat Search Optimization Algorithm. In the case of the second design, optimization of a simple circular patch antenna (CPA) is conducted using the Firefly Optimization Algorithm. The optimized CPA resonates at 5 GHz. In the case of the third design, the dimensions of another RPA are optimized using Gravitational Search Optimization Algorithm to resonate it at 5 GHz. These three designs are described in Chapter-4. In these three designs, MATLAB code is used for the optimization of the patch antennas, and Computer Simulation Technology Microwave Studio (CSTMWS) software is used for their simulations. But the limitation in this approach is that MATLAB codes are available for simple RPA and CPA. Therefore, a researcher doesn't have the flexibility to design any arbitrary shape antenna or multi-band antenna or slot antenna which may give better results. So I have switched from MATLAB code-based antenna design to structure-based antenna design using CSTMWS and HFSS (High Frequency Structure Simulator) software where there is better scope for optimum designs. In the case of any MPA design, it is very important to know the proper feeding technique for which its performance is optimum. Therefore, I have explored the feeding techniques by designing six different CPAs in CSTMWS software. These six designs are described in Chapter-5. Subsequently, in the tenth design, a novel, dual-band RPA with two narrow vertical slots for WiMAX and WLAN application is proposed. This design is described in Chapter-6. Two CPA designs are described in Chapter-7. First of all, a CPA with a Swastika-shaped slot with multi-band resonant frequencies is proposed. Later, another CPA with a circular open ring slot and a pentagonal open ring slot on the patch is proposed for multi-band applications. In the thirteenth and the fourteenth designs, multi-band RPAs using defected ground structure (DGS) are proposed. In the last design i.e. the fifteenth design, a miniaturized proximity-coupled fed CPA is successfully designed for the WLAN application. These MPA designs using DGS are described.

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Pharmaceutical Waste contaminates India's main rivers

A wastewater outlet on the Ganges River. Studies show that India's major rivers are full of toxic waste. Copyright: Neil Palmer (IWMI), CC BY-NC-ND 2.0

India's major rivers are thick with heavy metals, dyes, toxic chemicals and pharmaceutical products. According to a study, published in December in the journal Science of the Total Environment, were found high concentrations of pharmaceutical waste as well as toxic metals such as arsenic, zinc, chromium, lead and nickel in the Cauvery, a major river in southern India.

Ligy Philip, an author of the study and member of the research team from the Indian Institute of Technology (IIT) Madras, Chennai, says that their observations are alarming. The team's environmental risk assessment has shown that pharmaceutical contaminants pose medium to high risk to selected aquatic lifeforms of the riverine system. Pharmaceutical products found in the river included anti-inflammatories like ibuprofen and diclofenac, anti-hypertensives such as atenolol and isoprenaline, enzyme inhibitors like perindopril, stimulants like caffeine, antidepressants such as carbamazepine, and antibiotics such as ciprofloxacin.

India is among the world's biggest producers of pharmaceutical drugs. Although there are regulations governing effluents from manufacturing units, there is very little real monitoring by regulators such as the state pollution control boards. For instance, the Karnataka State Pollution Control Board takes samples only once in every three months and only during the day whereas illegal dumping of effluents is often done at night.

Source: *https://www.globalcitizen.org/en/content/indias-polluted-rivers-now-legally-humans/*

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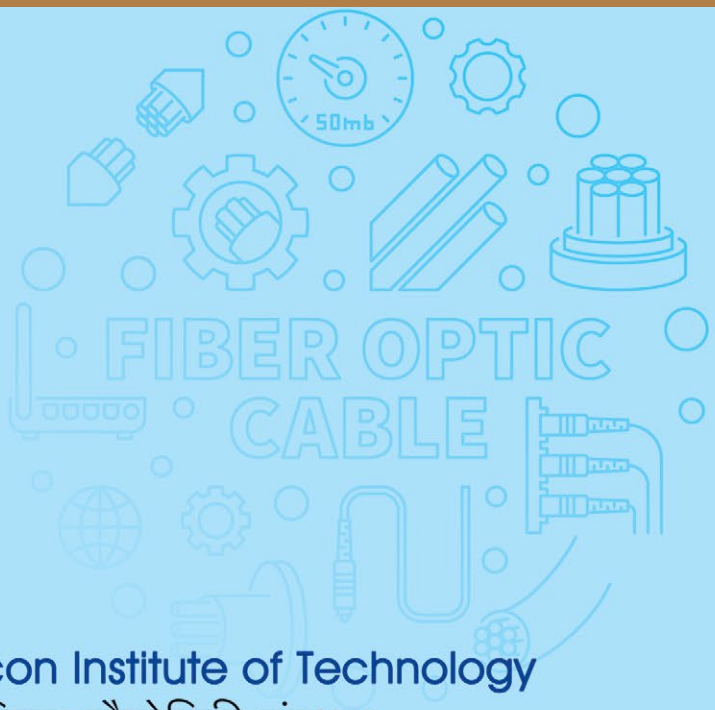

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