SPECIAL FEATURE

Design of a Fast Charging Interleaved DC-DC Converter with EV Battery Monitoring System

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AQI Demystified…

Breathing clean air is everyone's birthright. However, with the incessant advances in technology and urbanization over the past century, the 'clean' in clean air has taken a pounding! For air quality, the relevant quantifier is Air Quality Index (AQI).

AQI is an indicator of atmospheric air pollution, and usually goes from a scale of 0 to 500; the higher the number, the worse is the air quality. The US EPA (Environmental Protection Agency) and the Indian CPCB (Central Pollution Control Board) have slightly different constituents that make up AQI - 6 pollutants form the basis for calculation of AQI in the US, whereas 8 pollutants are used in India. In the Indian context these are, Particulate Matter (PM), PM 2.5 and PM10 microns, Carbon monoxide (CO), Ozone (O3), Nitrogen dioxide (NO2), Sulfur dioxide (SO2), Ammonia (NH3), and Lead (Pb). The table below gives an overview of what the different AQI numbers signify.

0-50	:	This range defines air quality as good and it shows minimal impact on health.
51-100	:	This is a satisfactory air quality range but can have effects such as breathing difficulty in sensitive groups.
101-200	:	The range shows moderate air quality with impacts such as breathing discomfort for children and the elderly.
201-300	:	AQI falling in this range indicates that the air quality is poor and shows ill health effects on people.
301-400	:	This range shows very poor air quality and causes respiratory illnesses.
401-500	:	This is the most severe range of AQI causing major health impact to normal people.

Let us delve deeper into the origins and consequences of the pollutants. PM2.5 and PM10 are ubiquitous, and emanate primarily from construction work and manufacturing industries. These microscopic dust particles have an uncanny knack of lodging themselves deep in our respiratory tracts and depending on their settling velocities, can cause eye, nose and throat irritation. CO is a toxic and deadly poison, and is typically the result of combustion processes in automobiles, industrial operations and fires. Just as the upper atmospheric Ozone is good and protects us from the harmful UV rays of the sun, ground level Ozone is equally bad, and can cause shortness of breath and sore throat. Ozone is released as a secondary product of combustion of fossil fuels in cars and furnaces, and is a key ingredient in smog formation. Of the numerous oxides of Nitrogen that exist, NO2 is probably the worst offender. It's a reactive poisonous gas that can cause respiratory tract damage when inhaled, and results from combustion of bound nitrogen in the fuel, from power plants and automobile exhausts. Sulfur present in fossil fuels is released in the form of SO2 when combusted, either in electricity generation or in cars. Ammonia, which has a noticeable pungent odor, is only used in India for AQI calculations; its sources are mostly agricultural, from fertilizers and other farm products. Lead is tricky, as it is a heavy metal and gets into the food chain relatively easily. Its sources are from 'leaded' fuel, industrial mining and other factory processes.

Awareness is key, but mitigation and remediation are equally important. If we all make a conscious effort to minimize producing those noxious compounds by making environmentally friendly choices, the AQI in our city is bound to get better. We can then breathe easy!

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Design of a Fast Charging Interleaved DC-DC Converter with EV Battery Monitoring System

Abstract : *With the increase in popularity of electric vehicles the demand of DC fast charging station is increasing. The converters required in the fast-charging station need to operate at different power level as per the SOC level of the EV battery. Hence, the efficiency varies with respect to the SOC level. Hence, this project presents a multiphase bidirectional interleaved DC-DC converter. The simulation of DC-DC bidirectional interleaved converter is analyzed on MATLAB/SIMULINK. The amount of energy supplied to the vehicle is decreasing gradually that leads to the performance degradation. In this project, the idea of monitoring the performance of the vehicle using IoT techniques is proposed, so that the monitoring can be done directly. The proposed IoT-based battery monitoring system consists of two major parts i) monitoring device ii) user interface. Based on experimental results, the system is capable to detect degraded battery performance and sends notification to the user.*

I. INTRODUCTION

This Now a days, with the increase in demand of electrical vehicles (EV) in the market to minimize the carbon emission. EV's has mainly few challenges as high charging time, battery cost, battery replacement, charging infrastructure and large investment. In which battery cost is one of the main challenges in the utilization of potential of EV's. For customer, a good battery Lifecyle is one of the main factors. For better lifecycle of battery, Battery effective utilization is necessary. Now, EV's are contributing to the grid in two ways:(1) Consumer mode (2) Prosumer mode. Consumer mode battery is charging at consumer end. In Prosumer's end batteries are used to inject the power to the grid at given time to specific operator at different loading on the grid. That helps operator to maintain the energy rates at high loading time. Consumer mode is called G2V mode and Prosumer mode is called V2G operation. Bidirectional V2G operation has several advantages as (1) Active power support (2) Reactive power support (3) Power factor control. Active power support during peak hours helps to make stabilize the grid. Reactive power supply helps to minimize the voltage regulation of the grid . To implement the V2G operation efficient bidirectional dc-dc converter is needed. In this paper, Focus is given for a DC-DC converter that can be connected to DC-grid to EV Lithium- ion battery for charging. A Three-Level Three-port Bidirectional DC-DC Converter Due to Three-level structure, voltage level across the switches is minimum. This converter cannot work for different current charging of battery at different level of SOC of battery [1]. Dual active bridge (DAB) converter DAB converter has some characteristics as high-power density, small size, high efficiency, and bidirectional power flow that makes it suitable for EV's charging operation. It has disadvantage as we must choose one between zero voltage switching and reactive power. 3-phase bidirectional dc-dc multiphase half bridge interleaved converter This converter coupled inductor is used for reducing the output current ripple in the battery. This converter can be used for high power charging station. [7-11] The proposed converter is based on the principle of bidirectional buck-boost converter that will work as buck converter in charging mode operation of the battery and in boost mode operation during discharging of battery [2,3].

II. OPERATING PRINCIPLE OF CONVERTER

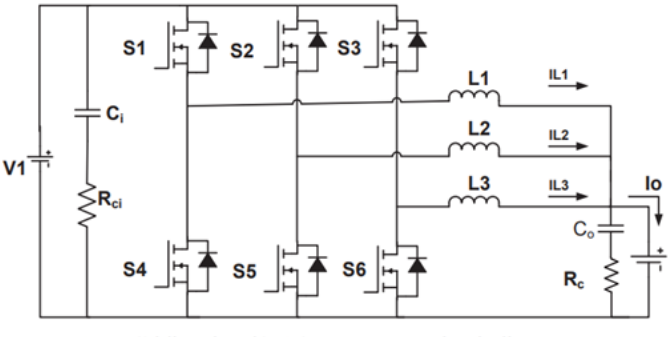


Fig. 1. Bidirectional DC-DC converter.

Fig. 1 shows the circuit diagram of converter. V2 is Li-ion battery voltage and V1 is DC grid voltage. L1, L2 and L3 are three same value inductors. Fig.2 shows the working of converter based on SOC. Three phase interleaved buck-boost converter is used [4,5]. For forward mode (during charging of battery), converter works as buck converter. Primary side voltage is higher than secondary side voltage. Duty cycle is taken as constant. Secondary voltage: V2= D ×V1, Where D = duty cycle, V1 = primary side voltage. Fig – 2 shows the modes of operation.

A. Operation

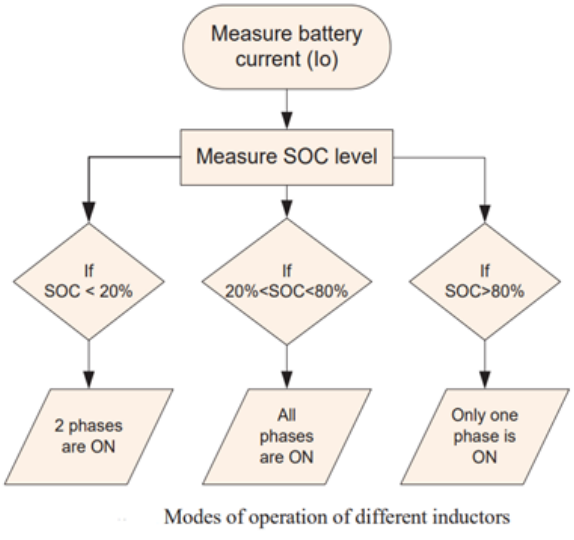
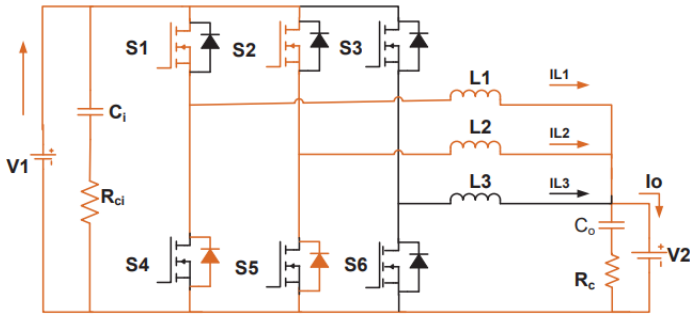


Fig. 2 Modes of operation

MODE I : For SOC (0-20%)

Fig.3 shows the working diagram of converter in this mode. Current flow through two inductor branches (L1 and L2). Therefore, only two phases are on in the converter. For this range of SOC level, Fast charging cannot be applied. Initially, if high current will flow that effects the life of the battery. Also, Slow charging is avoided that will take more time to charge the battery [6]. Constant current charging is used for this mode of operation.

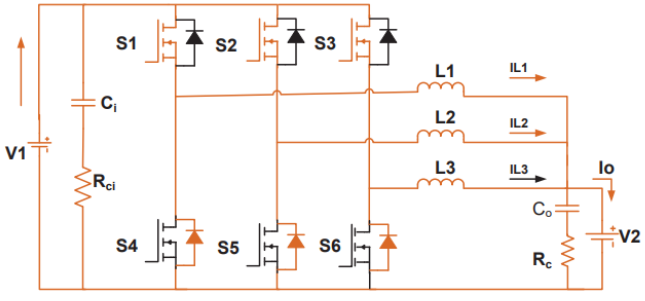


At SOC 0-20%, Switches S1, S2, S5, S6 will be ON and current will flow through only L1 and L2.

Fig. 3 Mode 1, SOC (0-20%)

MODE II: For SOC (20-80%):

Fig. 4 shows the working in this mode of operation. Current flow through all 3 inductor branches. All three phases of the converter contribute to the total charging current. That helps battery to charge fast to make efficient charging operation. Constant current charging used for this SOC level condition.

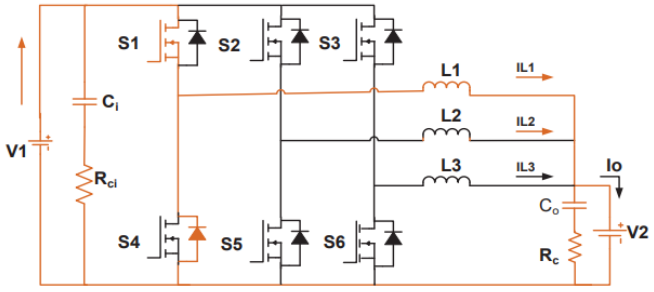


At SOC 20-80%, Switches S1, S2, S3 will be given pulses S4, S5 and S6 will be ON via body diode and current will flow through L1, L2 and L3.

Fig. 4 Mode II: For SOC (80-99%)

MODE III : For SOC (80-99%)

Fig.5 shows the working of converter in this mode. Current flows through only one inductor branch (only L1) [2]. For this range of SOC battery takes time to charge that is battery requirement. Therefore, only one phase is ON so low output current will flow. Fast Charging is avoided in this SOC range because it increases the battery temperature that will reduce the efficiency of battery and to make battery voltage within limit, constant voltage charging is applied.

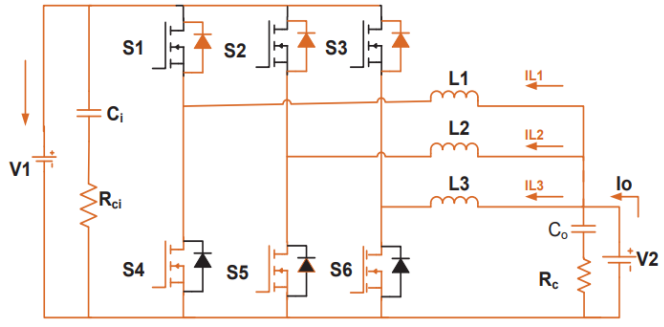


At SOC 80-99%, Switches S1 and S4 (body diode) will be ON and current will flow through only L1 V_2 is Li-ion battery.

Fig. 5 Mode II, SOC (20-80%)

DISCHARGING MODE:

Fig. 6 shows the boost mode operation of DC-DC bidirectional converter [7]. Boost mode operation of converter (battery discharging of converter) in backward direction here series switch of inductors works as diode and duty cycle in this operation is taken as (1-D) is 0.7. Here normal boost operation is performed by converter. Switching losses are neglected in simulation.



Boost mode operation Switches S1, S2 and S3 will work via body diodes, S4, S5 and S6 will be ON. V_2 is Li-on battery.

Fig. 6 Discharging Mode

III. SIMULATION RESULTS FOR DC-DC CONVERTER

In simulation, 96V Li-ion battery is charged via 350V voltage source in Buck mode operation by applying CC/CV mode operation and the other values are as shown in Table 1. Switching is done based on SOC level. Duty cycle of switches are controlled by closed loop proportional integral controller [8,9]. This table represents the simulation parameters.

Table 1. Design Specification

Parameter	Value
V1	350V
V2	96V
R1=R2=R3	1.1Ω
L1=L2=L3	0.743mH
Ci=Co	460uF
f	100kHz
Rc	0.507mΩ
Power Rating	12kW

The SOC level of battery during charging, different slope of SOC level shows the charging speed of Li-ion battery. The battery current at different level of SOC, during 0-20% two phases on for current, at 20-80% SOC level all three phases are on, during 80-100% SOC level only one phase is ON [10]. The simulation is shown in Fig. 7. Current from single phase is around 40A. Between 20-80% fast charging is applied. The inductor current in different phases Simulation of Discharging operation of Li-ion battery in Boost mode operation of converter is done on Resistive load of 100Ω [11] [12], [13] [14].

A. Constant current result (low):

SOC of Battery 0 - 20%

Battery Current = 75A

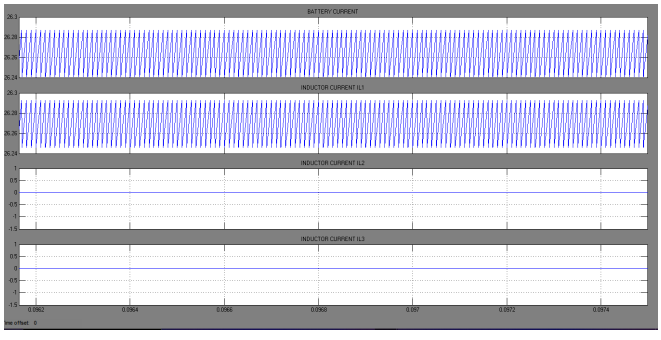


Fig. 7 Results with low constant current

IV. HARDWARE IMPLEMENTATION AND RESULTS

A hardware prototype for EV battery monitoring IS developed by using sensor network, Arduino UNO and sim 808 GPRS module

A. ARDUINO UNO:

The Arduino UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the Arduino UNO is the most robust board you can start playing with. The Arduino UNO is the most used and documented board of the whole Arduino family.

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

5.3 SIM 808 GPRS MODULE:

SIM808 Bluetooth Compatible GSM/GPRS/GPS Development Board with GPS Antenna (Arduino and Raspberry Pi Compatible) is a development board; with SIM808 module which makes you able to use GSM communication and GPS features with your Arduino or Raspberry Pi as shown in fig. 8. With this module, you can send and receive SMS; trace a location and you can even build your own cell phone. SIM 808 module on-card functions as GSM communicator and GPS receiver.

The module is 5 – 26V power supply when the power supply is less than 2A the need for 9V This. Direct. Road power supply port for Another 3.5 – 4.2V suitable lithium for battery power supply. Computer debugging USB – TTL can be.is suitable portable. Two sets of SMA antenna port presented the GPS and GSM antenna. two sets of IPX port, easy to embed in the aluminum box to lead out the antenna. 1 way of TTL serial port, the GPS and GSM functions can be arbitrarily switched. The pin diagram is shown in fig. 9 [14] [15].

Fig. 8 SIM 808 GPRS MODULE

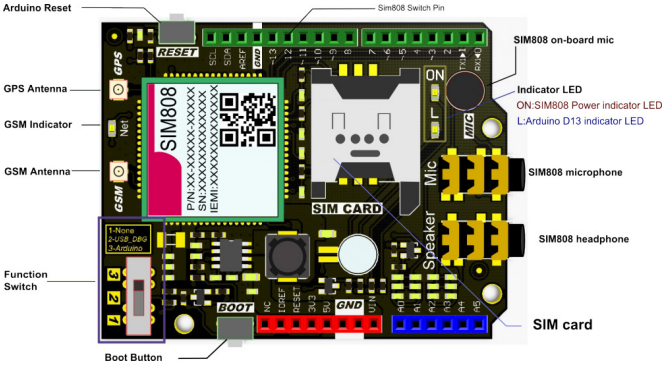


Fig. 9 Pin diagram of SIM 808

5.4 VOLTAGE SENSOR:

The voltage sensor module is a small size 0-25 DC voltage sensing device. The design of the module is based on a resistive voltage divider circuit. It is a voltage sensor module that reduces the input voltage signal by the factor of 5 and generates a corresponding analog output voltage with respect to step down voltage factor. This voltage measurement circuit is small and portable and can be used to detect under and over-current faults in electrical circuits. The Fig. 10 shows the hardware model. The results are shown in Fig. 11 and 13. Fig – 12 shows Hardware model of GPS tracking module.

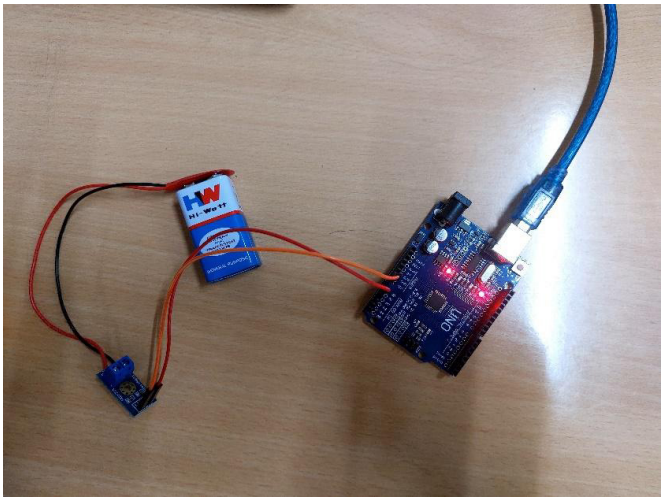


Fig. 10 Hardware model

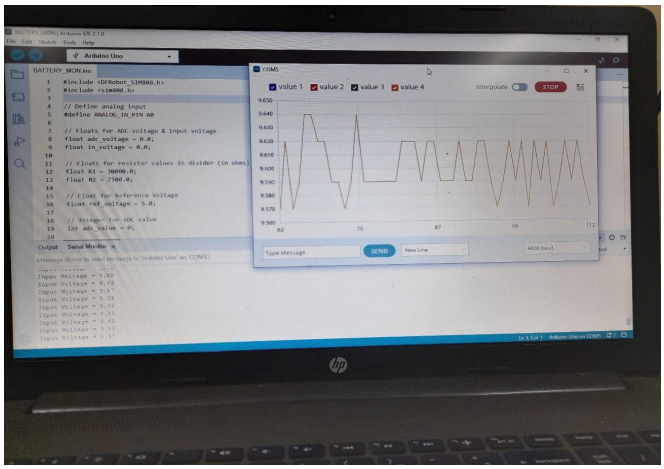


Fig. 11 Result of hardware model

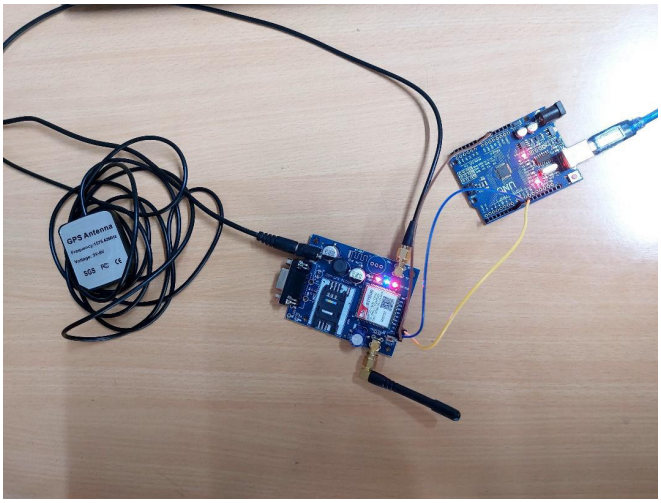


Fig. 12 Hardware model of GPS tracking module

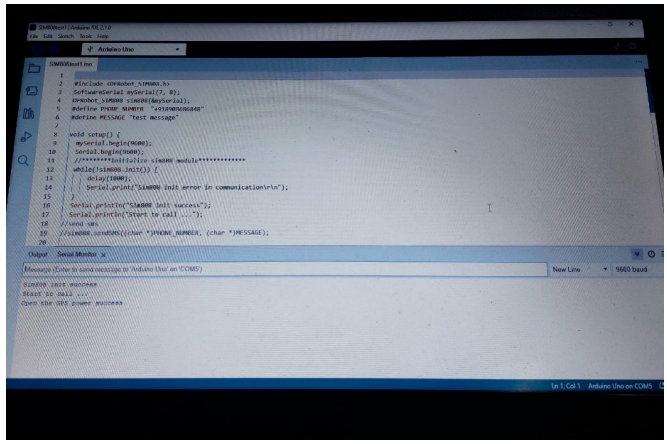


Fig. 13 Result of hardware model of GPS tracking system

V.CONCLUSION

A multiphase interleaved DC-DC converter for fast charging application of EVs was modelled. The output current of the converter is varying based on the SOC level of the battery. The constant current and constant voltage control is implemented to charge the battery in charging and discharging modes. A hardware prototype with Li ion battery of 9V using and Arduino Uno, SIM808 GSM module was developed and the state of charge of the battery is monitored for different charging and discharging modes and also the location of the vehicle can be tracked.

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Image Enhancement using First-order and Higher-order Statistical Parameters

Abstract : *Low light image enhancement is still a challenging task. The low light condition in everyday photos often occurs due to various environmental factors e.g., nighttime, uneven illumination, cloudy day, and structured shadow which leads to loss of details and surface changes of underlying structures in a given scene; which significantly deteriorate the image quality and degrade the viewing experience. It is well known that capturing images in low light conditions brings about much degradation such as low contrast, poor visibility, and intense noise. Besides degrading the visual aesthetics of images, this poor quality may also significantly degenerate the performance of many computer vision and multimedia algorithms that are primarily designed for high-quality inputs. Although these imperfections can be improved by professional equipment and using photographic skills, the inherent effects of these degradations are inevitable and are costly to be addressed at the hardware level. Therefore, low-light enhancement techniques are highly desired at the software level. Undoubtedly, high visibility images reflect clear details of target scenes, which are critical to many vision-based techniques such as object detection and tracking, object recognition, and stereo matching.*

Keywords: Image Enhancement, Histogram clipping, Histogram Equalization, threshold calculation, Histogram bins.

I. INTRODUCTION

Image enhancement techniques have gained the attention of researchers from the early years. Image enhancement improves the appearance of the image and enhances the finer details of an image having low luminance. These enhancement techniques can be broadly divided into two categories – transform domain and spatial domain [1]. The first category involves techniques operating on the frequency transform of an image. Spatial domain techniques such as contrast enhancement operate directly on the pixel level of the image. Histogram Equalization (HE) is the most extensively utilized contrast enhancement technique due to its simplicity and ease of implementation. Histogram equalization flattens the density distribution and stretches the dynamic range of gray levels to improve the overall contrast of the image. HE utilizes the cumulative density function (CDF) of the image for the transformation of the gray levels of the original image to the levels of the enhanced image. The main drawback of HE is that it tends to change the mean brightness of the image to the middle level of the dynamic range and results in annoying artifacts and intensity saturation effects [2]. This drawback makes the HE technique unsuitable for most consumer electronics applications such as TV and Cameras. Image enhancement is widely used to enhance the quality and visual appearance of an image. Low-Light Image Enhancement is a computer vision task that involves improving the quality of images captured under low-light conditions. The goal of low-light image enhancement is to make images brighter, clearer, and more visually appealing, without introducing too much noise or distortion. The enhancement technique differs from one field to another depending on its objective [3].

We briefly review several histogram-equalization-based enhancement techniques in this section. To overcome the mean brightness shifting problems of CHE, Kim proposed Brightness Preserving Bi-Histogram Equalization (BBHE) in 1997. BBHE, which works by dividing the input histogram into two sub-histograms using the mean brightness of the image and independently equalizing the sub-histograms, can preserve the mean brightness while reducing the saturation effect and avoiding unnatural enhancement as well as unwanted artifacts. Following BBHE, Dualistic Sub-image Histogram Equalization (DSIHE) was proposed. It uses the median value to separate the histogram of the input image instead of the mean value. The generalization scheme of BBHE and DSIHE, Recursive Mean-Separate Histogram Equalization (RMSHE), and Recursive Sub-image Histogram Equalization (RSIHE) were developed. RSIHE and RMSHE generate 2r sub-histograms through

recursive division of the input histogram more than once based on the mean and median values respectively. The recursive property of RMSHE and RSIHE techniques enables scalable brightness conservation [1]. The common disadvantage of RMSHE and RSIHE is the difficulty of defining the optimal value for r. The number of decomposed sub-histograms is restricted to some powers of two. When r becomes very large, the output image will be the same as the input image and there will be no enhancement [2, 3].

II. DESIGN FORMULATION

Several studies were conducted on histogram clipping with the concept of limiting the enhancement rate. One of them is Bi-Histogram Equalization with a Plateau Level (BHEPL), which is proposed in the year 2009. BHEPL clips the histogram at its average number of intensity occurrences. An extension of BHEPL, Bi-Histogram Equalization Median Plateau Limit (BHEPLD) was subsequently proposed. Instead of setting a mean number of intensity occurrences, BHEPLD uses the median of occupied intensity as the clipping limit. In 2010, Ooi observed and compared the performance of different combinations in assigning mean and median values as thresholds for histogram separation and clipping. Based on his findings, the best enhancement result is obtained when the input histogram is divided by the median value and when the sub-histograms are clipped with the median value of the occupied intensity. This technique is known as Brightness Preserving Plateau Limits Histogram Equalization (BPPLHE). Another example focusing on preserving the small parts in images was proposed by Abdullah-Al-Wadud. The proposed Modified Histogram Equalization (MHE) technique manipulates the accumulation in the input histogram components before equalizing the histogram [4].

Meanwhile, another approach uses a modified histogram-based image enhancement technique to maintain the details in the image have been performed. An example of a technique that focused on maximizing image entropy is the Adaptive Histogram Equalization Algorithm (AHEA). Information entropy is used as the objective function to select the optimum value for the adaptive parameter introduced in AHEA. Singh and Kapoor recently proposed Image Enhancement Using Exposure Based Sub Image Histogram Equalization (ESIHE). ESIHE clips the input histogram at the average number of intensity occurrences and divides the clipped histogram at its exposure threshold [5].

The minimum value among the histogram bins, mean, and median of histogram bins is set as the clipping limit. This criterion provides flexibility for the proposed AIEBHE to choose the best clipping limit. As proven in the literature done in this study, image enhancement techniques that employ fixed clipping limits either based on histogram bins, mean, or median value of the occupied histogram bins do not produce promising results for all types of images. Thus, by providing this flexibility, the proposed technique is believed to have the better capability in choosing the best clipping limit criterion and yielding a resultant image with more image details preserved [4,5].

The use of higher-order statistics (HOS)-based methods is proposed to address the problem of image restoration. First, images degraded by linear or zero phase blurring point spread functions (PSF) and additive Gaussian noise are considered. A second degradation model for astronomical images is examined where the blur is caused by the turbulent atmosphere and telescope aberrations. The restoration strategy in both cases is based on the fact that the phase information of the original image and its HOS, are not distorted by the blurring function. The difficulties associated with the combination of truly two-dimensional signals and their higher-order statistics are reduced through the radon Transform. The projection at each angle of a 2-D image is a 1-D signal which can be processed by a 1-D higher-order statistics-based method. Methods that apply the Bicepstrum Iterative Reconstruction Algorithm (BIRA) and the Weight-Slice Algorithm (WS) are developed.

A. Median-Mean Based Sub-Image-Clipped Histogram Equalization

The median of the image is denoted as an intensity value Xe where the cumulative density function is 0.5. Two mean intensity values (Xml and Xmu) are calculated for two individual sub-histograms divided based on the median value. The values of Xe, Xml, and Xmu are calculated before the histogram clipping process. Equation (1) computes the total number of samples N for a given image.

$$N = \sum_{k=0}^{L=1} h(k) \quad (1)$$

Where h(k) is the histogram of the image and L is the total number of gray levels. For calculating Xe consider a variable z(k) as computed in equation (2) as

$$z(k) = z(k-1) + h(k)$$

for k = 0, 1, . . ., L − 1 and z (0) = h (0) (2)

The median variable can be calculated as per equation (3) using (1) and (2) as

$$X_e = k \; where \; z(k) \geq {}^{N}/_{2} \quad (3)$$

Equations (4) and (5) express the calculation of mean variables Xml and Xmu

$$X_{ml} = \sum_{k=0}^{e-1} Pl(k) \times k \quad (4)$$

$$X_{mu} = \sum_{k=0}^{L-1} Pu(k) \times k \quad (5)$$

The idea behind the histogram clipping is to control the enhancement rate consequently resulting in a natural appearance of the image. For limiting the enhancement rate, we need to limit the first derivative of the histogram or the histogram itself [9]. The histogram bins having a value greater than the clipping threshold are limited to the threshold. The clipping threshold is calculated as the median of occupied intensity. The formula for clipping threshold Tc is presented in (6), and (7) calculates the clipped histogram. Fig-1 shows the process of histogram clipping.

$$T_c = \text{median[h(k)]} \quad (6)$$

$$h_c(k) = T_c \; for \; h(k) \geq T_c \quad (7)$$

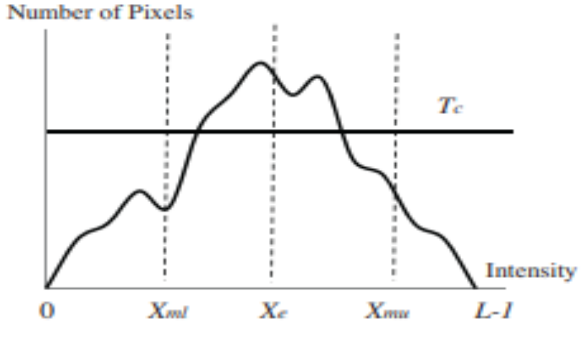

Fig. 1. Process of histogram clipping

B. Histogram Sub-Division and Equalization

The original histogram is first bisected based on exposure threshold value Xe as calculated in (3). These individual sub-histograms are further divided into two small sub-histograms where the individual mean Xml and Xmu as calculated in (4) and (5) acts as separating point of sub-histograms. The Histogram Sub Division process results in two sub-images WLl, WLu, WUl, and WUu ranging from gray level 0 to Xml, Xml + 1 to Xe, Xe + 1 to Xmu and Xmu + 1 to L − 1. PLI(k) and PLU(k) are the corresponding PDF of these sub-images as defined in

PLl(k) = hc (k)/NLl for 0 ≤ k ≤ Xml (8)

PLu(k) = hc (k) /NLu for Xml + 1 ≤ k ≤ Xe (9)

PUl(k) = hc (k)/ NUl for Xe + 1 ≤ k ≤ X (10)

PUu(k) = hc(k)/ NUu for Xmu + 1 ≤ k ≤ L – 1 (11)

NLl, NLu, NUl, and NUu are the total number of pixels in sub-images WLl, WLu, WUl, and WUu respectively. CLl(k), CLu(k), CUl(k), and CUu(k) are corresponding CDFs of individual sub-images, and CDFs can be defined as Eqs. (12)

$$\text{CLl(k)} = \sum_{k=0}^{Xml} \text{PLl(k)} \quad (12)$$

C. Algorithm of Low light image Enhancement

Step 1: Compute the histogram h(k) of the image.
Step 2: Compute the value of exposure and threshold parameter Xa.
Step 3: Compute the clipping threshold Tc and clip the histogram hc(k).
Step 4: Divide the clipped histogram into two sub histograms using the threshold parameter Xa.
Step 5: Apply the histogram equalization on individual sub histograms.
Step 6: Combine the sub-images into one image for analysis.

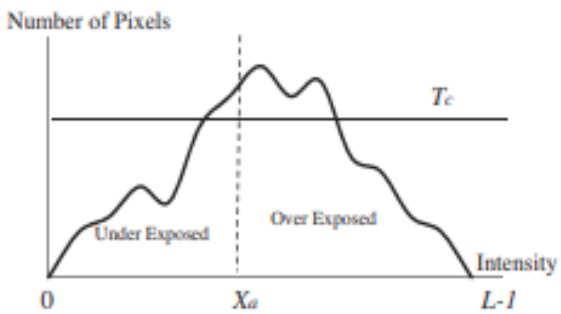

Fig. 2. Process of Histogram sub-division and clipping

III. RESULTS AND DISCUSSIONS

To see the effect of the combination of local and global enhancement methods of an image, the abovementioned algorithm is applied. Fig-2 shows process of histogram sub-division & clipping.

A. Benchmark testing of the proposed algorithm

Exhaustive MATLAB simulation was done to enhance the Leena image. In most practical applications, we deal with the problem of estimating the cumulant or moment spectrum of a process when a finite set of observation measurements is available.

The deciding factor for the division of the image depends on exposure value and it possesses values greater than L/2 gray level for under-exposed images (exposure value less than 0.5) and compensates for low exposure by introducing higher gray levels in sub-image so that after individual histogram equalization process the overall exposure value increases. The inverse is true for the over-exposed images where the sub-division of images is done on the gray level lesser than L/2 the gray level. Over-enhancement can be controlled by the histogram clipping approach by restricting the enhancement rate.

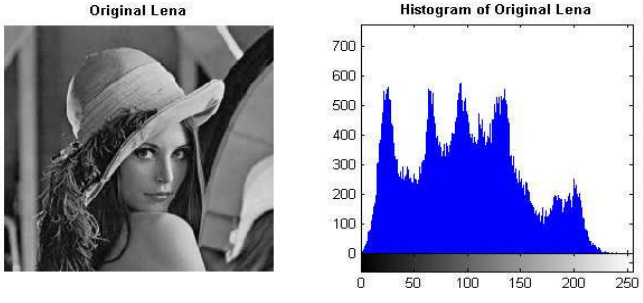

Fig3: Histogram of Leena Image

A qualitative assessment of contrast enhancement is necessary along with a quantitative assessment. The enhancement results can only be appreciated if the resultant image gives a pleasing effect in appearance.

The deciding factor for the division of the image depends on exposure value and it possesses values greater than L/2 gray level for under-exposed images (exposure value less than 0.5) and compensates for low exposure by introducing higher gray levels in sub-image so that after individual histogram equalization process the overall exposure value increases. The inverse is true for the over-exposed images where the sub-division of images is done on the gray level lesser than the L/2 gray level. Over-enhancement can be controlled by the histogram clipping approach by restricting the enhancement rate. The combination of all the above-mentioned processes termed ESIHE meets the objective of the paper and produces images that are not only quantitatively better but also better in terms of quality in comparison to other conventional HE methods. Fig-3 shows histogram of leena image.

B. Performance assessment based on image quality measures

The problem of image restoration refers to finding an estimate of the ideal image from its blurred and possibly noisy rendition. Often, noise can be characterized by a colored Gaussian process of unknown covariance.

We consider HOS-based methods to restore images affected by one of the two blur models presented before. In the first model, deterministic blurring and additive noise, third-order statistics will reduce the presence of zero-mean symmetrically distributed noise while preserving the phase information.

From the assessment of all the visual inspections, it can be concluded that:

(i) The image Enhancement method is well suited for brightness preservation in comparison to other methods.

(ii) This technique is best among other methods in terms of bringing out the information content, i.e. providing the highest entropy.

(iii) This produces images with contrast enhancement and with natural appearances. The objective of this paper is to maximize entropy, preserve original brightness, and control the enhancement.

Gamma encoding of images is used to optimize the usage of bits when encoding an image, or bandwidth used to transport an image, by taking advantage of the non-linear manner in which humans perceive light and color. The human perception of brightness, under common illumination conditions (neither pitch black

nor blindingly bright), follows an approximate power function, with greater sensitivity to relative differences between darker tones than between lighter tones. Fig4, 5,& 6 shows after mean-median calculations, equalized Leena image and Gamma correction based on brightness of the image respectively.

Fig. 4. After Mean Median Calculations

Fig. 5. Equalized Leena Image

Fig. 6. Gamma Correction based on brightness

IV. CONCLUSIONS

The motivation behind the use of these methods is the following. First, using HOS allows us to reduce the effects of the noise and at the same time obtain an estimate of the Fourier phase or the Bispectrum phase of the signal that leads to the original signal. Second, employing the projections of the image reduces the high complexity associated with the HOS of images. Algorithms for the proposed work are developed. Simulation and coding are curated using MATLAB.

Here we have also proposed a Gamma correction method to compare both of the images. It can have wide applications in our daily life and different scientific research fields, like night surveillance, automated driving, fluorescence microscope, high-speed imaging, and so on. When the images are degraded most existing methods do not work properly and more robust techniques are necessary. On the other hand, noise can be realistically described as a colored Gaussian process. In such circumstances, Higher-Order Statistics may offer some advantages since cumulants of Gaussian processes are asymptotically zero.

The method is successfully carried out in MATLAB. This method works fine in most dark images. It has more significance to those images where we need local minute gradient information such as the image of planetary and heavenly bodies, satellite images, and medical images.

V. REFERENCES

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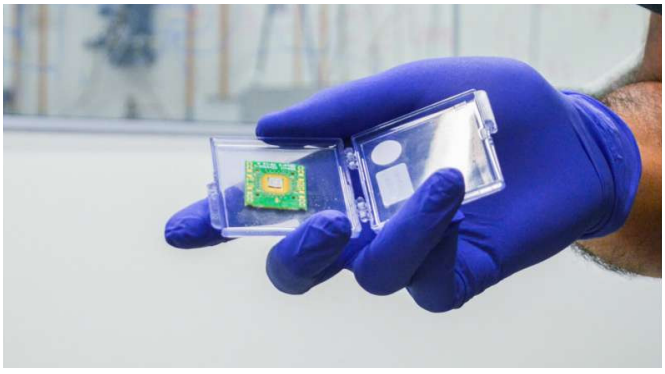
AI to help spot wildfires
(Source: The Indian Express)

Artificial intelligence is being used by California firefighters to aid in the detection of wildfires. They stream video from over 1,000 strategically positioned cameras around the state into a computer that warns first responders when it is time to deploy. A camera with a range of 50 miles (80 kilometers) may detect a fire that has started at any moment in the distant.When people are sleeping and the smoke is hidden by night, it can be contained before it spreads like wildfire. This AI program informs a fire captain, who has firemen, bulldozers, water tankers, and hand teams to successfully put out the fire.

Diode in Quantum Computers
and AI (Source: phys.org)

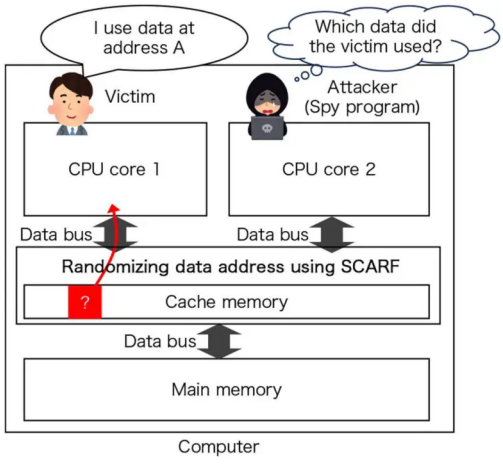


The University of Minnesota Twin Cities developed a novel superconducting diode that might aid in scaling up quantum computers for industrial application and improving the performance of artificial intelligence systems. This innovative diode uses less energy, can process numerous electrical signals at the same time, and has a set of gates that control the flow of energy. This feature has never been included in a superconducting diode previously.

Paralysed Man Walks
(Source: The Indian Express)

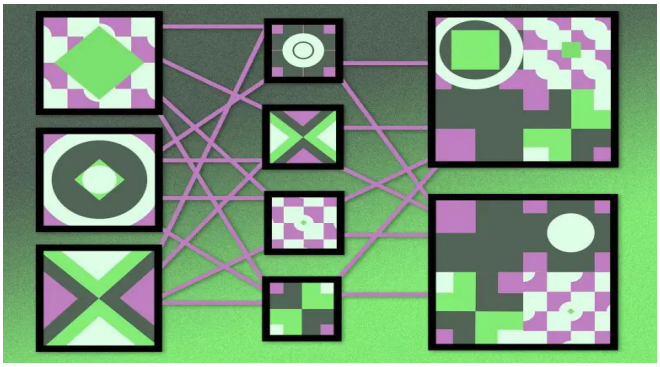
Thoughts can be transformed into action by an artificial intelligence-based gadget. Gert-Jan Oskam, who has been paralysed from the waist down since 2011, can now walk due to artificial intelligence technology. The 40-year-old was able to regain control of his limbs just by thinking about it, thanks to two implants that reestablished the communication between his brain and spinal cord. This technology allowed him to walk again by bypassing all of the afflicted regions. The innovation will definitely provide new hope to many people and the healthcare industry worldwide.

SCARF: New Cipher System
(Source: SciTechDaily)



SCARF provides strong security by a cache side-channel attacks. SCARF performs admirably and finish the randomization process with half the time of conventional cryptography approaches. The potential influence of SCARF extends beyond individual computers, since it has the potential to contribute to the development of a more secure information society.

CausalSim Simulates Complex Systems
(Source: SciTechDaily)

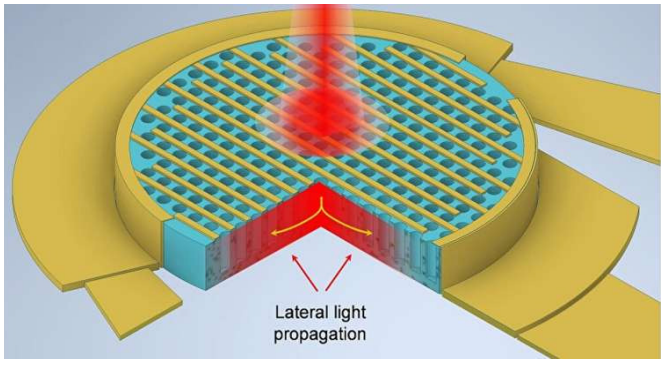


A novel approach devised by MIT researchers eliminates this source of bias in trace-driven simulation. The new method, which enables impartial trace-driven simulations, might help researchers create better algorithms for a range of applications, such as boosting video quality on the internet and raising the throughput of data processing systems.

Lighter and Stronger Than Steel
(Source: SciTechDaily)

Materials that are both strong and light in weight have the potential to improve anything. The two characteristics, however, are usually mutually exclusive. The University of Connecticut researcher created a highly durable material with an exceptionally low density by building a structure using DNA and then covering it in glass. An ultra-thin coating of perfect glass reinforces the DNA skeleton. This gives it a lot of strength. The spaces make it light. The glass nano lattice frameworks are four times stronger than steel but five times less dense. This idea has a lot of potential as energy-saving materials for autos and other devices that require strength and lightness.

Enhanced Light Absorption in Silicon Photodetectors
(Source: SciTechDaily)



Silicon (Si) has traditionally been the most common semiconductor in the electronics industry. Unfortunately, as compared to gallium arsenide (GaAs), Si has a very modest light absorption coefficient in the near-infrared region. A team of researchers from UC Davis in California developed a novel method for significantly increasing the light absorption of thin Si sheets. The researchers discovered that Si-based photodetectors with light-trapping micro- and nano-surface structures produce extraordinary performance gains comparable to GaAs and other group III-V semiconductors.

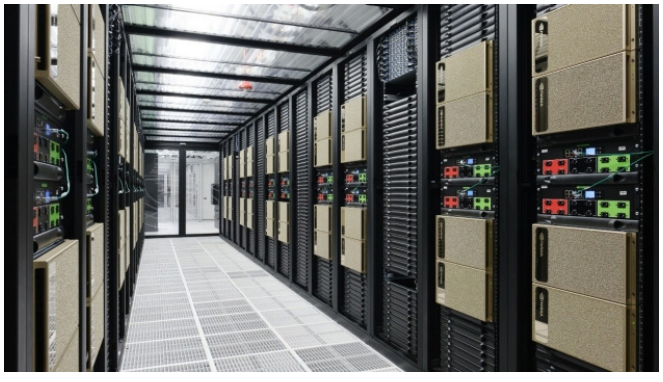
Maya OS (Source: The Indian Express)

An Ubuntu based operating system Maya is developed by DRDO, C-DAC and NIC agencies of INDIA. Maya means “illusion” that prevents several cyberattacks of from foreign actors from critical infrastructure and defence systems. The OS is in evaluation stage. It will be upgraded in all computer systems by the end of the year along with the Chakravyuh protection system.

Quantum Echoes (Source: The Indian Express)

A novel approach for effectively transforming electrical quantum states into sound and vice versa is created. This is essential for future quantum computers, which are built of electrical circuits, to store quantum information.

Nvidia DGX GH200 supercomputer
(Source: Silicon Republic)



Nvidia DGX GH200 is a new supercomputer that will help companies to develop generative AI models. It connects 256 Grace Hopper superchips into a single massive 144TB graphics processing unit (GPU) that can deliver up to 1 exaflop of computing power for giant generative AI models. This system has nearly 500 times more memory than the previous Nvidia DGX supercomputer introduced in 2020. As competition in the field heats up, Google Cloud, Meta, and Microsoft are among the first businesses likely to receive access to the new supercomputer. In order to meet the demand for generative AI applications, the company is also creating Israel's most powerful AI supercomputer, Israel-1.

Running Protects Memory Loss (Source: Labroots)

Memory loss and neurodegenerative disorders are prevalent ageing signs. While evidence indicates that exercise might improve a brain function. A group of experts studied the effects of long-term running on mice brains and found that long-term running kept adult-born neurons connected into a network crucial for episodic memory storage even as they aged.

Rock dust absorbs vast CO2
(Source: E & T news)

The UK Centre for Ecology & Hydrology (UKCEH) studied that adding crushed rock dust to farm fields has the potential to remove and lock up massive amounts of carbon dioxide from the atmosphere while enhancing agricultural output. They put 56 tonnes of quarried finely powdered basalt stones to three hectares of agriculture. The basalt rock dust particles, which are smaller than 2mm in size, collect and store carbon at a quicker pace than the naturally existing rocks. The process decreases the timescale from decades to months as compared to natural process. The team will also track the quantity of carbon stored in soil and transmitted to the river, as well as other effects on biodiversity, grass production, and water quality overall.

Everyday Objects as Spy Cameras
(Source: SciTechDaily)

Reflections from the glossy paint or side mirrors of parked vehicles can assist a motorist see items that would otherwise be concealed from view, such as a child playing on the sidewalk behind the parked automobiles, when a car goes down a small city street. Based on this concept, researchers from MIT and Rice University developed a computer vision approach that uses reflections to capture the world. This technology transform glossy things into "cameras," via the "lenses" of common objects such as a ceramic coffee cup or a metallic paperweight. This technology might be very beneficial in self-driving cars. For example, a self-driving car to see around a parked truck by using reflections from things it passes, such as lampposts or buildings.

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Student Placement Prediction Using Machine Learning

Abstract : *The high rates of unemployment in India can be battled by increasing the employability of people. The 20-24 age group is one of the largest groups of unemployed people, of which college graduates constitute a big portion. One of the biggest challenges that higher learning institutions face today is to improve the placement performance of students. The placement prediction is more complex when the complexity of educational entities increases. Educational institutes look for more efficient technology that assist better management and support decision making procedures or assist them to set new strategies. One of the effective ways to address the challenges for improving the quality is to provide new knowledge related to the educational processes and entities to the managerial system. With the machine learning techniques, the knowledge can be extracted from operational and historical data that resides within the educational organization's databases. Colleges can drastically reduce the number of unemployed graduates by introducing courses and changing the curriculum to help develop the skills that employers look for in graduates. We built a system that helps analyze the difference in the skill sets of placed and not placed students. It predicts whether a student with a given skill set would be able to secure a job or not.*

Keywords: Data Analysis, Machine Learning, Decision Tree Classifier, Gaussian Naïve Bayes, Accuracy Score.

I. INTRODUCTION

Placements are considered to be very important for each and every college. The basic success of the college is measured by the campus placement of the students. Every student takes admission to the colleges by seeing the percentage of placements in the college. Placements are considered to be very important for each and every college. The basic success of the college is measured by the campus placement of the students. Every student takes admission to the colleges by seeing the percentage of placements in the college. Placements have progressively come to be a vital part of an institute's offerings, which turned into now no longer the situation earlier. In the modern-day age, campus placement clutches prodigious importance for college students and academic organizations. Campus placements offer the scholars a foot-in-the-door opportunity, permitting them to start their profession proper when they have finished their direction curriculum. Nowadays, college students pay unique interest to placement information whilst choosing a university or college for admission. Machine learning is a growing technology that enables computers to learn automatically from past data.

A. BACKGROUND

The primary aim of students who join professional courses in higher learning institutions is to secure a well-paid job in a reputed organization. The prediction of placement status that students are most likely to achieve will help students to put in more hard work to make appropriate progress in stepping into a career in various technical fields. It will also help the teachers as well as placement cell in an institution to provide proper care towards the improvement of students in the duration of course. A high placement rate is a key entity in building the reputation of an educational institution. Hence such a system has a significant place in the educational system of any higher learning institution.

B. PROBLEM STATEMENT

In this project the main objective was to develop a machine learning model to predict whether or not a student will be placed. so that they can give them additional care and aid in their employment.

C. OBJECTIVE AND MOTIVATION

This project aims to develop a machine learning-based model that can predict the likelihood of a student getting placed in a job role based on their academic performance, skills, and other relevant factors. The model can be used by educational institutions and recruiters to identify the most suitable candidates for specific job roles, thereby improving the placement rate and reducing the time and resources required for the process.

D. ABBREVIATIONS

EDA-Exploratory Data Analysis, ASM-Attribute Selection Measure, SSC-Senior secondary Certificate, HSC- Higher Secondary School Certificate, GNB Gaussian Naïve Bayes

II. LITERATURE SURVEY

Bharadwaj and Pal et al. [1] used decision Tree algorithm to classify students to predict students' division on dataset obtained from VBS Purvanchal University, Jaunpur (Uttar Pradesh). Not only previous semester result has been chosen as the attributes but the lab work and the seminar performance also have contributed to the findings. Their research also able to identify those students which needed special attention in order to reduce fail ratio.

A student data set with 309 records and 14 features was collected by a survey from various graduation level students majoring in Computer Science under University of Calcutta [2]. It shows how to select the best features to predict the results. The best results are obtained by Feature Selection algorithm with 8 features.

To predict the performance of student in secondary school at Tuzla was conducted by Karthika & Sairam [3]. The study is performed on data set with 19 features using Gain Ratio (GR) feature selection algorithm. The results with Random Forest classification (RF) algorithm reveal best results in terms of prediction accuracy.

Strecht et al. [4] have done a research paper on method to categorize the educational qualification using the Naïve Bayes Classification algorithm. It is found that Naïve Bayes Classification algorithm performs well when the attributes are nonnumerical.

The goal of Kaur et al. [5] research it to predicting students' final grade. They evaluated various popular regression algorithms, i.e., Ordinary Least Squares, SVM, CART, kNN, RF and AdaBoost R2. The experiments were carried out using administrate data from the university's Student Information System (SIS) of Porto, concerning approximately 700 courses. The algorithms with best results overall were SVM, RF and AdaBoost R2.

The prediction of whether a student should be considered as qualified or not. Mayilvaganan et al. [6] experimented with five classification algorithms and four attribute evaluation methods, using a sample dataset of 152 regular high school students. The Multilayer Perceptron (MLP) was the best performing classifier among all other methods.

Sinha et al. [7] used C4.5 algorithm and Naive Bayes' Classifier for Predicting the Cognitive skill of students. The cognitive skill of a student is tested during the online test which is associated with the intelligent test score (IQ) and health, more specifically morbidity (physical and mental). The cognitive skills of the students are classified using naive Bayesian classifier and C4.5 algorithm.

The core idea, goal, and summary of most of the papers covered for this research are listed above. A short explanation about the research papers taken as guiding tool for this project. Many papers covered from different researchers from across globe and different field. They have explored different aspects of student performance evaluation and predictive model development. Their research involved different algorithms, data sets and features. Work performed by them is truly remarkable and it works as a support for our project.

III. METHODOLOGY

The primary objective is to describe the methodology used to build and evaluate the performance of two classifiers, Gaussian Naive Bayes, and Decision Tree for predicting student placement. Fig-1 represents the placement prediction system of architecture.

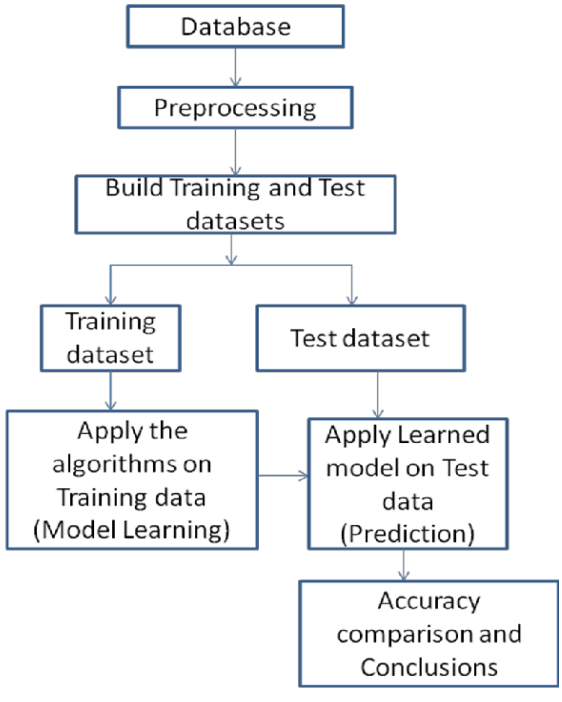


Fig. 1 Methodology used

A. DATASET

This data set consists of Placement data of students in a campus. It includes secondary and higher secondary school percentage and specialization. It also includes degree specialization, type and Work experience and salary offers to the placed students. Fig-2 shows placement dataset.

	sl_no	gender	ssc_p	ssc_b	hsc_p	hsc_b	hsc_s	degree_p	degree_t	workex	etest_p	specialisation	mba_p	status	salary
0	1	M	67.00	Others	91.00	Others	Commerce	58.00	Sci&Tech	No	55.0	Mkt&HR	58.80	Placed	270000.0
1	2	M	79.33	Central	78.33	Others	Science	77.48	Sci&Tech	Yes	86.5	Mkt&Fin	66.28	Placed	200000.0
2	3	M	65.00	Central	68.00	Central	Arts	64.00	Comm&Mgmt	No	75.0	Mkt&Fin	57.80	Placed	250000.0
3	4	M	56.00	Central	52.00	Central	Science	52.00	Sci&Tech	No	66.0	Mkt&HR	59.43	Not Placed	NaN
4	5	M	85.80	Central	73.60	Central	Commerce	73.30	Comm&Mgmt	No	96.8	Mkt&Fin	55.50	Placed	425000.0

Fig. 2 Placement dataset

B. DATA CLEANING AND EXPLORATORY DATA ANALYSIS

Data cleaning is the process of identifying and correcting or removing errors, inconsistencies, and inaccuracies in a dataset. It involves removing irrelevant data, handling missing or duplicate values, correcting formatting issues, and resolving inconsistencies in the data. The goal of data cleaning is to ensure that the dataset is accurate, consistent, and complete, making it suitable for analysis and modeling.

EDA helps in determining the suitability of data for statistical analysis, identifying potential data quality issues, and selecting appropriate models and techniques for further analysis. The primary objective of EDA is to understand the data, identify patterns, and generate insights that can be useful in making decisions. It involves identifying missing values, outliers, and anomalies, as well as exploring relationships and trends among variables. Fig – 3 shows processed data.

```
print('='*50)
print("\nDescribe data\n")
print('='*50)
print(data.describe())
```

```
==================================================

Describe data

==================================================
            sl_no       ssc_p       hsc_p    degree_p     etest_p       mba_p  \
count  215.000000  215.000000  215.000000  215.000000  215.000000  215.000000
mean   108.000000   67.303395   66.333163   66.370186   72.100558   62.278186
std     62.209324   10.827205   10.897509    7.358743   13.275956    5.833385
min      1.000000   40.890000   37.000000   50.000000   50.000000   51.210000
25%     54.500000   60.600000   60.900000   61.000000   60.000000   57.945000
50%    108.000000   67.000000   65.000000   66.000000   71.000000   62.000000
75%    161.500000   75.700000   73.000000   72.000000   83.500000   66.255000
max    215.000000   89.400000   97.700000   91.000000   98.000000   77.890000

              salary
count     148.000000
mean   288655.405405
std     93457.452420
min    200000.000000
25%    240000.000000
50%    265000.000000
75%    300000.000000
max    940000.000000
```

Fig. 3 Processed data

C. PREPROCESSING

In the project of student placement prediction, the original dataset was split into a training set and a test set using a 70:30 ratio. The pre-processing technique used in the given code preprocessing. scale () is Standardization or Z-score normalization. It scales the features such that they have zero mean and unit variance.

Now our data is ready to prepare model to predict solution. There is plenty of predictive algorithm out there to try. In this project, we are going to use classification algorithms.

```
# Seperating Features and Target
X = data.copy().drop('status', axis=1)
y = data['status']
```

```
[117] # scale each features
X_scaled = preprocessing.scale(X)
```

```
[118] #Train Test Split
X_train, X_test, Y_train, Y_test = train_test_split(X_scaled, y, test_size=0.3)
X_train.shape, Y_train.shape, X_test.shape
```

```
((150, 13), (150,), (65, 13))
```

In the given code, X is the feature matrix, and X_scaled is the scaled feature matrix. The purpose of scaling is to avoid the impact of different units of measurement or different scales of the features on the model's performance.

D. FEATURE MAPPING AND GENERATION

Feature mapping and generation is the process of transforming raw data into a form that can be effectively used. . It involves selecting and extracting relevant features from the data and generating new features that may be useful in predicting the target variable.

Therefore, it is important to carefully evaluate and select relevant features and generate new features that may be useful in predicting the target variable.

Let us drop all unwanted columns as mentioned in above section.

- SSC Board
- HSC Board
- HSC Specialization
- Degree Type
- Salary

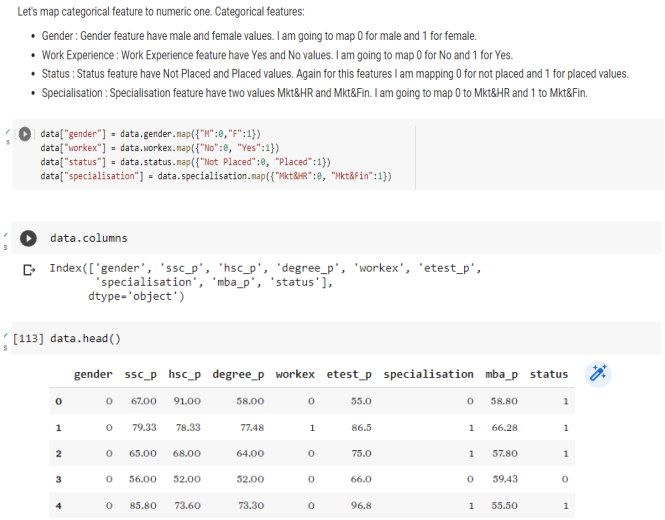
Let us map categorical feature to numeric one. Categorical features:

-Gender: Gender feature have male and female values. We are going to map 0 for male and 1 for female.

-Work Experience: Work Experience feature have Yes and No values. We are going to map 0 for No and 1 for Yes.

-Status: Status feature have Not Placed and Placed values. Again, for this feature we are mapping 0 for not placed and 1 for placed values.

-Specialisation: Specialisation feature have two values Mkt&HR and Mkt&Fin. We are going to map 0 to Mkt&HR and 1 to Mkt&Fin. Fig-4 shows the mapping of categorical attributes to numeric attributes.


Let's map categorical feature to numeric one. Categorical features:

- Gender : Gender feature have male and female values. I am going to map 0 for male and 1 for female.
- Work Experience : Work Experience feature have Yes and No values. I am going to map 0 for No and 1 for Yes.
- Status : Status feature have Not Placed and Placed values. Again for this features I am mapping 0 for not placed and 1 for placed values.
- Specialisation : Specialisation feature have two values Mkt&HR and Mkt&Fin. I am going to map 0 to Mkt&HR and 1 to Mkt&Fin.

```
data["gender"] = data.gender.map({"M":0,"F":1})
data["workex"] = data.workex.map({"No":0, "Yes":1})
data["status"] = data.status.map({"Not Placed":0, "Placed":1})
data["specialisation"] = data.specialisation.map({"Mkt&HR":0, "Mkt&Fin":1})
```

```
data.columns
```

```
Index(['gender', 'ssc_p', 'hsc_p', 'degree_p', 'workex', 'etest_p',
       'specialisation', 'mba_p', 'status'],
      dtype='object')
```

```
[113] data.head()
```

	gender	ssc_p	hsc_p	degree_p	workex	etest_p	specialisation	mba_p	status
0	0	67.00	91.00	58.00	0	55.0	0	58.80	1
1	0	79.33	78.33	77.48	1	86.5	1	66.28	1
2	0	65.00	68.00	64.00	0	75.0	1	57.80	1
3	0	56.00	52.00	52.00	0	66.0	0	59.43	0
4	0	85.80	73.60	73.30	0	96.8	1	55.50	1

Fig. 4 Mapping catigorical feature into numeric value

IV. MAKING THE MODEL

A. GAUSSIAN NAÏVE BAYES

Naïve Bayes is a probabilistic algorithm that is based on the concept of conditional probability. Naïve Bayes is a probabilistic algorithm that is based on the concept of conditional probability. We preferred Naive Bayes implementation because:

- Simple and trained on whole (weighted) training data
- Over-fitting (small subsets of training data) protection
- Claim that boosting "never over-fits" could not be maintained.
- Complex resulting classifier can be determined reliably from limited amount of data

1) FORMULA

$P(y|x) = P(x|y) * P(y) / P(x)$

where:

P(y|x) is the posterior probability of class y given input features x

P(x|y) is the conditional probability of input features x given class y

P(y) is the prior probability of class y

P(x) is the probability of input features x

In Gaussian Naive Bayes, the conditional probability P(x|y) is modeled as a Gaussian distribution with mean μ and variance σ^2:

$P(x|y) = 1 / (\sqrt{2\pi}\sigma) * e^{(-(x-\mu)^2 / 2\sigma^2)}$

where:

π is the mathematical constant pi
e is the mathematical constant e
σ is the standard deviation of the input feature x for class y
μ is the mean of the input feature x for class y

2) MODEL CREATED

Fig-5 below demonstrates the performance matrix of gaussian model.

```
print(classification_report(Y_test, gaussian_Y_pred))
```

	precision	recall	f1-score	support
0	0.83	0.88	0.86	17
1	0.96	0.94	0.95	48
accuracy			0.92	65
macro avg	0.90	0.91	0.90	65
weighted avg	0.92	0.92	0.92	65

Fig-5 accuracy results of gaussian model

B. DECISION TREE ClASSIFIER

The Decision Tree Classifier is a supervised learning algorithm that can be used for classification and regression problems. It works by recursively splitting the training set into smaller subsets, using the features that best separate the classes of the target variable.

1. Select the best attribute using Attribute Selection Measure (ASM) to split the records. The attribute with the highest ASM is chosen as the root node.
2. Split the dataset into subsets that contain the possible values for the selected attribute.
3. Repeat step 1 and 2 on each of the subsets recursively until all instances in the subset belong to the same class.

Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

1) FORMULA

The algorithm works by taking the dataset and dividing it into subsets based on the value of a selected feature. The decision tree is constructed by recursively selecting the best feature that splits the data into the most homogenous subsets. The homogeneity is measured by a statistical metric such as the Gini index or entropy.

Gini Index = 1 - (p0)^2 - (p1)^2

where,

p0 = the proportion of samples belonging to class 0
p1 = the proportion of samples belonging to class 1

2) MODEL CREATED

Fig-6 below demonstrates the performance matrix of Decision Tree.

```
# getting precision, recall and f1-score via classification report

print(classification_report(Y_test, decision_tree_Y_pred))
```

	precision	recall	f1-score	support
0	0.62	0.47	0.53	17
1	0.83	0.90	0.86	48
accuracy			0.78	65
macro avg	0.72	0.68	0.70	65
weighted avg	0.77	0.78	0.77	65

Fig-6 accuracy results of Decision Tree

C. COMPARSION OF THE MODELS

Fig-7 below demonstrates the accuracy results of Decision Tree.

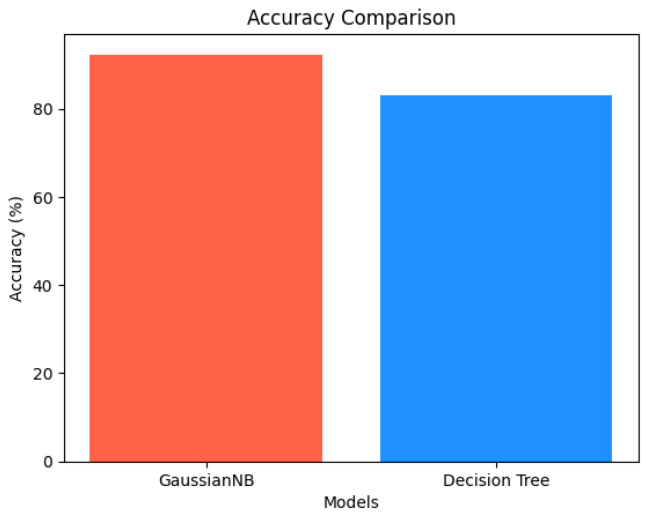


Fig. 7 Accuracy comparison

V. CONCLUSIONS

Based on the results of our project, we can conclude that the Gaussian Naive Bayes classifier outperformed the Decision Tree Classifier in predicting whether a student will be placed or not.

The accuracy of the Gaussian Naive Bayes classifier was 92%, while the accuracy of the Decision Tree Classifier was 78%. This means that the Gaussian Naive Bayes classifier correctly predicted the placement status of a student 92% of the time, while the Decision Tree Classifier was only able to do so 78% of the time.

ACKNOWLEDGMENT

We take upon this opportunity to acknowledge the many people whose contribution has been invaluable in the making of this project. We are deeply indebted to my supervisor and mentor Dr. Ajit Kumar Behera, whose guidance and support has helped us in giving shape to our ideas.

We further thank our teammates who have worked day and night to complete this project. Finally, I would like to wind up by paying our heartiest thanks to our parents for being sources of inspiration and strength for us.

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Meghnad Saha

Let's get some insights about an Indian Astrophysicist Meghnad Saha, who brought about profound changes in the academic scenario of the country. Son of a grocer, born in 1893 into a poor Bengali family in Shaoratoli village Dhaka, Bengal presidency of British India. Coming from a hapless family didn't shackle him from getting a decent education. He was strained to leave his school due to his participation in the Swadeshi movement and encounter challenges due to caste.

His further years define his keen interest in the field of physics leading him to study the thermal ionization of elements. The basic tool for the interpretation of the spectra of stars is known as the Saha ionization equation. 1917 marks the beginning of his professional career as a lecturer at the university college of Science in Calcutta. Teaching quantum physics and translating German papers on relativity further pushed him into this field. In 1919 his research paper – "On Selective Radiation Pressure and its Application" got published in the American astrophysical journal. It stated the presence of spectra of stars. The formula proved to be a breakthrough in astrophysics. Leading him to go to London and being regarded as a fellow of "London's Royal Society". After prominent inventions, he helped establish several scientific institutions such as the Physics Department at Allahabad University and the Institute of Nuclear Physics in Kolkata. He was the leading figure in organizing several scientific societies, such as the National Academy of Science (1930), the Indian Physical Society (1934), and the Indian Institute of Science (1935). He was the director of the Indian Association for the Cultivation of Science from 1953 to 1956. The Saha Institute of Nuclear Physics, founded in 1943 in Kolkata, is named after him. He was president of the 21st session of the Indian Science Congress in 1934. Saha stood as a candidate for North-West Calcutta in the 1951 Lok Sabha election. He ran as a member of the Union of Socialists and Progressives but maintained his independence from the party. His goal was to improve the planning of education, industrialization, healthcare, and river valley development. Saha was the chief architect of river planning in India and prepared the original plan for the Damodar Valley Project. Saha died on the way to the hospital on 16 February 1956 after getting cardiac arrest. It was reported he had been dealing with hypertension for ten months before his death. His remains were cremated at the Keoratola crematorium, Kolkata the following day.

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Unraveling the Enigma of Galactic Microquasars: Unprecedented Discovery of Peculiar Quasi-Periodic Oscillation

INTRODUCTION

In a momentous stride towards unraveling the profound mysteries of the cosmos, an esteemed international consortium of astrophysicists, featuring the distinguished presence of Bing Zhang, the esteemed astrophysicist from UNLV, has accomplished a profound investigation into the enigmatic realm of microquasars. These celestial objects, bearing semblance to phenomena depicted in the realm of science fiction, have now divulged an unprecedented and intriguing feature, hitherto unseen in scientific observations.

Microquasars: Marvels of the Universe

Microquasars, a specific subclass of accreting stellar-mass black holes, have captivated the scientific community with their capability to emanate potent jets of magnetized plasma. Emanating from charged matter and a magnetic field, these jets achieve velocities approximating the speed of light. Stellar-mass black holes, denoting entities with masses approximately 10 times that of our Sun, attain detectability when they engage in the consumption of materials from companion stars. Of particular interest are supermassive black holes, whose masses correspond to millions or billions of solar masses and accumulate at the central cores of galaxies, creating luminous regions recognized as quasars.

Probing the Unseen: A Dedicated Observational Campaign

A concerted effort by the research team concentrated on a specific microquasar system, christened GRS 1915+105. Leveraging the prodigious Five-hundred-meter Aperture Spherical radio Telescope (FAST) situated in China, the astronomers attained an unprecedented revelation - the detection of a quasi-periodic oscillation (QPO) signal in the radio band, an exceedingly rare occurrence within microquasar systems. QPOs constitute a vital astrophysical phenomenon, diligently studied by astronomers as a pivotal tool to decipher the intricacies of stellar systems, especially pertaining to black holes. Previous observations had confined QPOs primarily to the domain of X-rays from microquasars, rendering their presence in the radio emission of these systems a singular and groundbreaking observation.

Unveiling a Peculiar Signal: The QPO Phenomenon

Professor Wei Wang, a distinguished luminary from China's esteemed Wuhan University and the leader of the research team, expounded on this remarkable revelation, disclosing that "The peculiar QPO signal, characterized by an approximate period of 0.2 seconds, or a frequency of about 5 Hertz, manifests selectively under distinctive physical conditions. Our team was granted the exceptional fortune of capturing this signal twice - in January 2021 and June 2022, respectively."

A Glimpse of the Jet: First Evidence of Activity from a Galactic Stellar-Mass Black Hole

Significantly, this unprecedented discovery has unveiled an extraordinary QPO signal that may potentially constitute the first empirical evidence of activity arising from a "jet" propelled by a Galactic stellar-mass black hole. These jets, propelled by charged matter and a magnetic field, attain astonishing velocities that approach the speed of light. Traditionally, X-ray emissions have served as instrumental tools to scrutinize the accretion disk encircling a black hole, while radio emissions have facilitated the examination of the jets emanating from the disk and the black hole itself.

Understanding the Mechanism: Exploring Jet Precession

Bing Zhang, the esteemed astrophysicist from UNLV and one of the prominent corresponding authors of this study, elucidated on the potential mechanisms

underlying the temporal modulation in a relativistic jet. He posited a plausible explanation in the form of jet precession, signifying the regular realignment of the jet's direction towards varying azimuthal angles and subsequently returning to its original orientation in 0.2-second intervals.

Future Prospects: Illuminating the Cryptic Nature of QPO Signals

This precession phenomenon could arise due to a misalignment between the spin axis of the black hole and its accretion disk, the latter characterized by intensely hot, luminous, and spinning gaseous matter encircling the black hole. Such misalignment is a natural consequence of spacetime dragging in close proximity to a rapidly spinning black hole. Astutely, Zhang contended that although the aforementioned mechanism represents a plausible explanation, alternative possibilities merit exploration. Continuation of observations directed towards GRS 1915+105 and analogous Galactic microquasar sources augurs promising insights into comprehending the cryptic nature of QPO signals.

CONCLUSION

The significance of this momentous discovery lies in its impetus to unravel the dynamic and enigmatic comportment of microquasars, illuminating the intricate interplay between stellar-mass black holes, their accretion disks, and the captivating jets they engender. As our technology and observational prowess progress, the unfathomable cosmos is poised to bestow further awe-inspiring revelations. Undoubtedly, the universe perpetually beckons humanity to unveil its cosmic wonders, and the recent triumph marks an extraordinary step forward in this incessant pursuit.

Image: Artistic representation of a Quasar with Accretion Disk

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Hybrid Intelligent System for Software Reliability Prediction

ABSTRACT: The modern world is propelled by the evolution of software systems. The application of software systems is currently widespread in areas such as process control, business, transportation, medical, house and building automation, and government applications. For gaining a competitive advantage in the market, high-quality software with acceptable performance is required. Software reliability is a critical factor in assessing and forecasting software quality throughout the testing process. Because of the importance of reliable software development, the goal of this research is to create more accurate and robust techniques for software reliability prediction. To measure software reliability, several methods have been used. However, no one model in the literature may be used in a variety of situations and has a high level of predictability. Various approaches, such as soft computing and evolutionary strategies, have been considered to circumvent this constraint. This study postulates a state-of-the-art hybrid intelligent system to predict the time between successive failures in the testing phase observed in a certain testing time. For the above objectives, the effect of the non-linear scaling function improves the prediction accuracy for all the problems. The technique proposed in this study predicts the accuracy of software reliability by designing an efficient computational intelligent model. Furthermore, extensive simulation experiments were conducted on the predictor models using the different software failure data. Finally, it has been observed that the hybrid intelligent system always shows better performance in terms of software reliability prediction.

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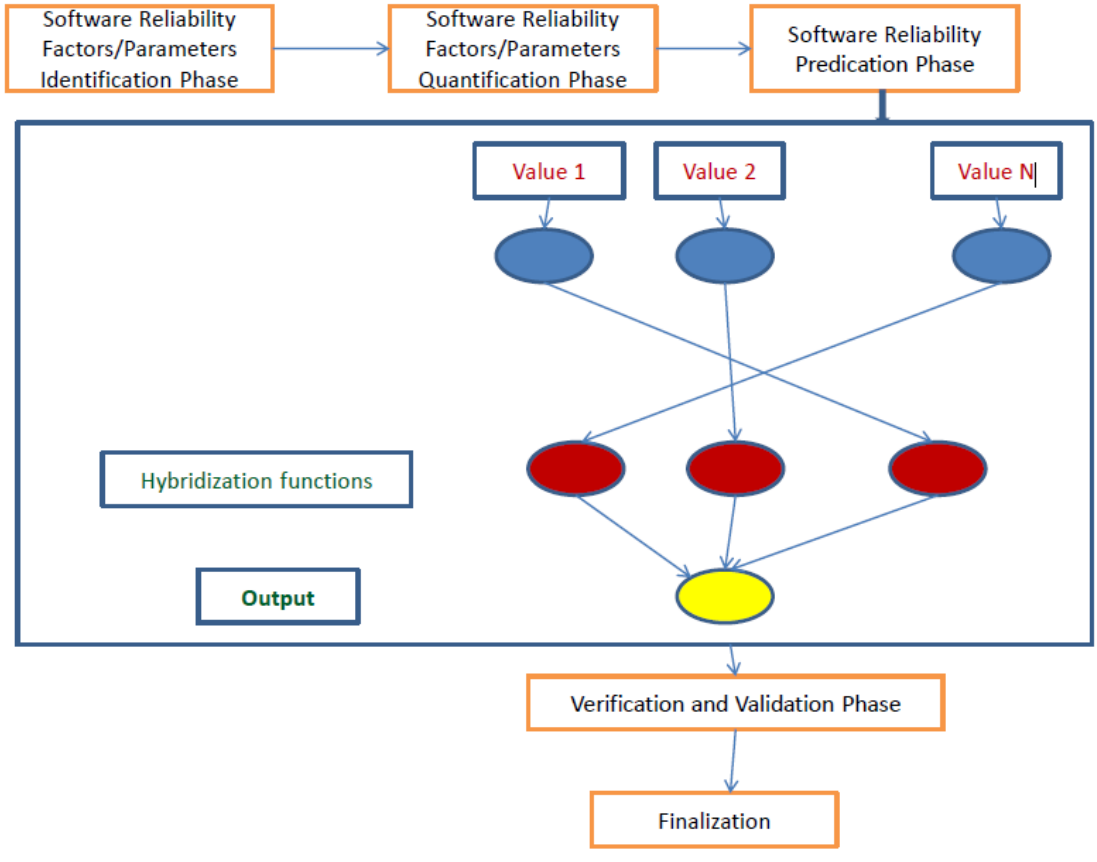

Effects of Poor Solid Waste Management (SWM)

Solid waste management deals with the complete process of collecting, treating and disposing of solid wastes. Due to improper disposal of solid wastes, the collected wastes get piled up and become a problem for both the environment and the public. By unnecessary dumping of huge garbage can lead to decay of biodegradable materials and decomposition under abnormal, uncontrolled and unhygienic conditions. After a few days of decomposition, it can be a breeding ground for different types of disease-causing insects as well as infectious organisms. A foul smell generating from those areas can spoil the aesthetic value of that area. The solid wastes collected from different industries may include toxic metals, chemicals, and hazardous wastes. When these wastes are released into the environment, they can produce biological and physicochemical problems to the environment and the chemicals may drain into the soil polluting the groundwater and altering the productivity of the soils in that particular area. In some cases, the hazardous wastes may get mixed up with the ordinary garbage and other combustible wastes causing the disposal process even harder and risky. By burning the paper and other scraps along with the hazardous wastes can produce dioxins and poisonous gasses and upon released into the air can result in causing various diseases including chronic disease, skin infections and cancer. So, all the solid wastes should be segregated from the beginning of generation and proper management is required for the better and safe environment.

Source: https://byjus.com/biology/solid-waste-management/

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