SPECIAL FEATURE

Brain Tumor Detection using Machine Learning

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Building Resilience Against the Ransomware Menace

In today's digital age, technologyis a part of every facet of our lives.The rise of ransomware attacks has cast a shadow over individuals, businesses, and governments. These malicious attacks encrypt valuable data, holding it hostage until a ransom is paid. The scale and sophistication of ransomware incidents have escalated in recent years, prompting a shift in cybersecurity strategies. In this era of constant threat, the key to survival lies in building robust ransomware resilience. Ransomware, once a rare concern, has now evolved into a formidable threat that can cripple entire organizations.

One of the techniques of ransomware resilience is the cultivation of a robust backup and recovery system. Regularly backing up critical data and ensuring the redundancy of these backups is now necessary in creating digital safety. In the unfortunate event of a ransomware attack, having uncorrupted, up-to-date backups allows organizations to restore their systems swiftly, reducing the impact of the breach. This approach shifts the power dynamic away from the attackers, making their attempts to hold the owner of the data hostage less potent.

The human element, often the weakest link in cybersecurity, must also be strengthened. Employee training programs that emphasize the importance of cybersecurity hygiene, the recognition of phishing attempts, and the cautious handling of external links and attachments are extremely significant. Awareness can serve as an invaluable shield against ransomware, as human error remains a prevalent entry point for these attacks. By maintaining a culture of cyber vigilance, organizations can drastically reduce the likelihood of successful ransomware infiltrations.

Zero Trust Architecture, a relatively newer concept, is another integral component of ransomware resilience. Traditionally, organizations relied on perimeter-based security, assuming that once inside the organisation, users and systems could be trusted. However, the evolving threat landscape necessitates a shift in mindset. Zero Trust Architecture advocates for the verification of every user and device, regardless of their location within the network. This approach enables organizations to prevent ransomware attempts that exploit assumed trust within the network.

Artificial Intelligence (AI) and machine learning technologies have emerged as powerful allies in the battle against ransomware. These technologies enable the automation of threat detection and response, providing a real-time defence mechanism against evolving cyber threats. AI can identify patterns indicative of ransomware activity, allowing organizations to respond swiftly and decisively. The continuous learning capabilities of these technologies also enhance their effectiveness over time, adapting to new patterns of ransomware.

As organizations transition to cloud-based infrastructures, securing these virtual environments becomes paramount. Cloud security, a subset of ransomware resilience, involves implementing robust access controls, encryption protocols, and regular security audits. Ensuring the integrity and confidentiality of data within the cloud is instrumental in preventing ransomware attacks from exploiting vulnerabilities in these decentralized architectures.

Ransomware resilience is not a singular solution but a multifaceted approach that encompasses technological, human, and collaborative elements. As the frequency and sophistication of ransomware attacks continue to escalate, organizations must adapt and strengthen their defences. By investing in robust backup systems, cultivating a culture of cybersecurity awareness, embracing Zero Trust Architecture, leveraging AI technologies and securing cloud environments, we can build a resilient defence against the ransomware menace.

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Brain Tumor Detection using Machine Learning

Abstract : *The detection of brain tumors is a critical task for medical diagnosis and treatment planning. This report presents a comparative analysis of three different approaches for automated brain tumor detection: Support Vector Machines (SVM), Convolutional Neural Networks (CNN), and the VGG 16 architecture. The proposed methodology involves pre-processing the input Magnetic Resonance Imaging (MRI) scans and dividing them into training, validation, and testing sets. The performance of the three models is compared using metrics such as accuracy, sensitivity, specificity. The results show that the VGG 16 model outperforms the SVM and CNN models in terms ofaccuracy, sensitivity, and specificity. The VGG 16 model achieves the highest accuracy indicating its superior performance indistinguishing between tumor and non-tumor images.*

Keywords: Magnetic Resonance Imaging (MRI), Support Vector Machine (SVM), Convolutional Neural Network (CNN), VGG16, Datapre-processing, Deeplearning

I. INTRODUCTION

Brain tumors are abnormal growths of cells in the brain that can lead to serious health problems. Accurate detection and diagnosis of brain tumors are crucial for effective treatment and improved patient outcomes. Magnetic Resonance Imaging (MRI) is a common imaging technique used for brain tumor diagnosis, but manual interpretation of MRI scans can be time-consuming and subject to human error.

Deep learning is a subset of machine learning that has shown great potential in various image analysis tasks, including medical image analysis. Deep learning is a subset of machine learning that uses artificial neural networks to automatically learn complex patterns and features from large data sets. By leveraging the power of deep learning, it is possible to train models that can accurately detect brain tumors from medical images with high accuracy, speed, and reliability.

In this project, we aim to develop a deep learning-based system for brain tumor detection and classification from MRI scans. Our approach will involve pre-processing the MRI images, training deep learning models using various architectures, and evaluating the performance of our model on a benchmark data set. The ultimate goal of our project is to provide a reliable and automated tool for radiologists to assist in the accurate detection of braintumors, leading to better patient outcomes.

II. RELATED WORK

Over the years, many papers have been published regarding the accuracy of prediction algorithms. We studied a brief summary of the different methods that have been proposed for classification.

In the paper proposed by Shah et al [1], an algorithm using Matlab GUI has been developed for the segmentation and detection of brain tumor from MRI brain scanned images based on various operations like pre-processing, Fuzzy C-means and K-means segmentation, feature extraction. The two algorithms K-means and FCM algorithm were successfully implemented. Comparison of these algorithms is done on the basis of time, tumor area and reproducibility, PSNR, RI, GCE, and VOI. The proposed method gives 98% accuracy indetection and 96% and 89% accuracy in segmentation using FCM and K-means respectively. The results obtained conclude that the efficiency of FCM is comparatively better than K-means algorithm for overlapped datasets.

The paper prepared by Hossain et al. [2] followed steps of preprocessing, segmentation, feature extraction and segmentation using KNN and SVM. It was able to reach and design a computer application that allows the user to enter the image and identify the location of the tumor in it if it exists with many additional features.

A new CNN architecture for brain tumor classification was presented by Badza et al. [3] in this study. The classification was performed using a T1-weighted contrast-enhanced MRI image database which contains

three tumor types. The classification was performed usinga T1-weighted contrast-enhanced MRI image database which contains three tumor types. The best result for 10-fold cross-validation was achieved for the record-wise method and, for the augmented dataset, and the accuracy was 96.56%.

The system prepared by Khan et al [4], is three fold, the tumor regions from the dataset are segmented through a CNN model, the segmented data is further augmented using several parameters to increase the number of data samples, and apre-trained VGG-19 CNN model is fine-tuned for multi-grade brain tumor classification.

III. PROPOSED METHODOLOGY

The proposed method utilizes deep learning methods such as Support Vector Machines (SVM), Convolutional Neural Networks (CNN), and VGG16 to improve the accuracy of brain tumor detection. Fig 1. Shows the flow of the process included in the proposed method called proposed model.

We will pre-process the MRI brain scan images to remove the noise or artifacts that may affect the model's performance. We will then apply various augmentation techniques such as flipping, rotating, scaling, and shifting to the dataset [5] to increase its size and diversity.

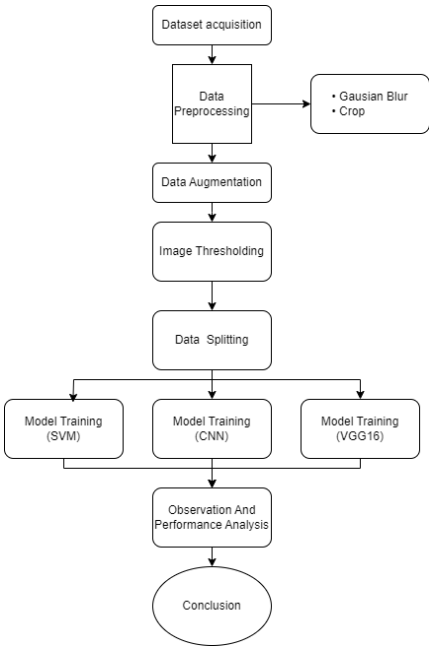

Fig. 1.Proposed Model

Next, we will train and evaluate multiple SVM, CNN, and VGG16 models using the augmented dataset [6]. We will fine-tune the models 'hyper-parameters and architecture to optimize their performance in detecting brain tumors accurately.

We will also explore various fusion techniques to combine the strengths of different models and enhance the overall performance of the system. This may involve feature-level fusion or decision-level fusion, depending on the nature of themodels being used.

Finally, we will evaluate the proposed method's performance against existing state of-the-art methods and compare the results to show the effectiveness of our approach We believe that our proposed method will lead to significant improvements in brain tumor detection accuracy and contribute to the development of more accurate diagnostic tools for this critical medical condition.

A. Data Preprocessing

We used data preprocessing techniques such as augmentation, cropping, Gaussian blur, and thresholding on MRI images of brain to prepare data for tumor detection. Augmentation creates new data by applying various transformations, cropping removes unwanted noise and reduces computational complexity, Gaussian blur smooths images, and thresholding segments an image into different regions. These techniques improve model performance, reduce overfitting, and simplify image analysis.

B. Support Vector Machine

Support Vector Machines (SVMs) have been used in brain tumor detection with promising results. We used SVM as a binary classifier that can distinguish between healthy tissue and tumor tissue.The SVM algorithm is trained using a set of features extracted from magnetic resonance images (MRI) of the brain, such as intensity, texture, shape, and location.These features are used to construct a hyper-plane that separates the tumor tissue from the healthy tissue in

the feature space. The hyper-plane is chosen to maximize the margin between the two classes, which increases the generalization ability of the classifier.

Also we use different types of kernels to evaluate our model that is linear kernel, polynomial kernel and RBF kernel. RBF kernel gives more accuracy but takes more computational time. SVM tries to find the best hyper-plane that separates the data into normal and abnormal classes. The hyper-plane is selected based on the data points that lie closest to it, called support vectors. Our goal is to find the hyper-plane that maximizes the margin between the support vectors of normal and abnormal brain.

Our goal is to find the hyper-plane that maximally separates the positive (tumor) and negative (normal) samples in the feature space. The SVM algorithm uses a kernel function to transfer the data into a higher-dimensional space where it is easier to find the hyper-plane.

C. Convolutional Neural Network (CNN)

In brain tumor detection, Convolutional Neural Networks (CNNs) are a popular type of deep learning algorithm that has been proven to be effective in identifying the presence of tumors in medical images.

ACNN consists of multiple layers, including convolutional layers, pooling layers, and fully connected layers. In the first convolutional layer, the input image is convolved with a set of learnable filters to produce a set of feature maps that highlight the presence of different features in the image, such as edges and corners. The feature maps are then passed through a nonlinear activation function to introduce nonlinearity into the model.

In subsequent layers, the feature maps are down sampled using pooling operations, such as max pooling, to reduce the dimensionality of the data while preserving the most important features. Also we use zero padding to avoid information loss.Then we passed resulting feature maps through additional convolutional and pooling layers to further extract higher-level features from the in put image.

Finally, the output of the convolutional layers is passed through one or more fully connected layers, which perform a classification task by separating normal and abnormal MRI images.

In summary, CNNs work by extracting hierarchical features from the input image using multiple layers of convolutions and pooling, and then using these features to classify the image into normal and abnormal classes.

D. VGG16

The Visual Geometry Group (VGG) is a family of deep convolutional neural networks that were developed by researchers at the University of Oxford for image classification tasks, including the detection of brain tumors in medical images.

The VGG architecture consists of a series of convolutional layers followed by pooling layers, which extract increasingly abstract features from the input image. The key innovation of VGG is the use of very small convolutional filters, such as 3x3 or 1x1, which allow for a deeper network architecture while still keeping the number of parameters relatively low.

In the VGG network, we passed MRI images of the brain through multiple convolutional layers, with each layer increasing the depth of the feature representation. The feature maps are then passed through a pooling layer, which reduces the size of the feature maps while preserving the most important features.

After several rounds of convolution and pooling, the feature maps are passed through a series of fully connected layers, which perform the final classification between normal and abnormal images of the brain.

One advantage of the VGG architecture is that it can be pre-trained on large data sets, such as Image Net, to learn a set of general features that can be fine-tuned for specific tasks such as brain tumor detection. This pre-training helps to avoid the of over fitting on small data sets and can improve the accuracy of the model.

In summary, the VGG architecture is a deep convolutional neural network that uses smal lfilters

to extract hierarchical features from the input image, and then uses these features to classify the image into different categories of braintumors.

IV. RESULTS AND DISCUSSIONS

The experiment is performed using python Scikit-learn library. In Fig 2 and Fig 3 the 'loss vs epoch' and 'accuracy vs epoch' graphs are shown for CNN model. Then in Fig 4 and Fig 5 the similar comparison graphs are represented for VGG16 model.

Fig. 2. Loss Vs Epoch in CNN Model

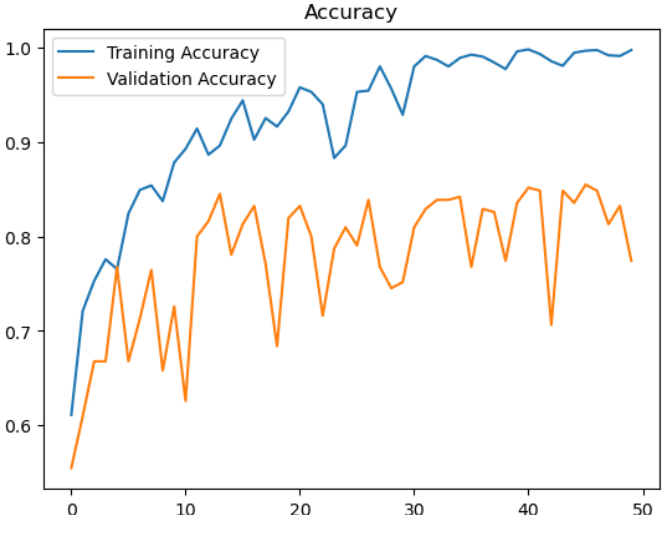

Fig. 3. Accuracy Vs Epoch in CNN Model

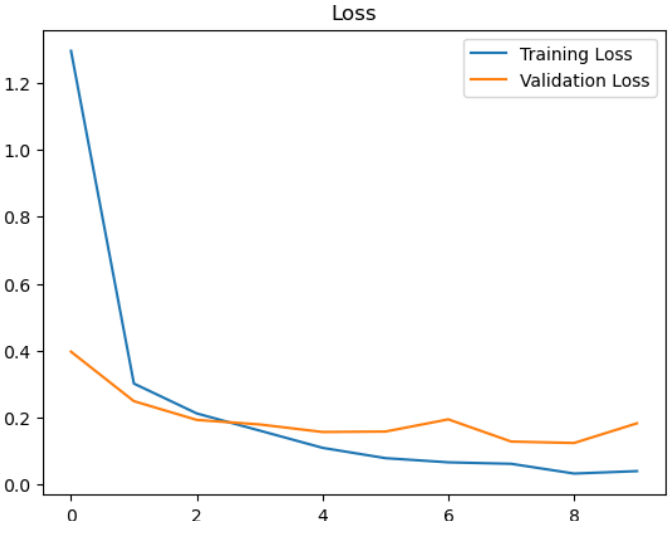

Fig. 4. Loss Vs Epoch in VGG16 Model

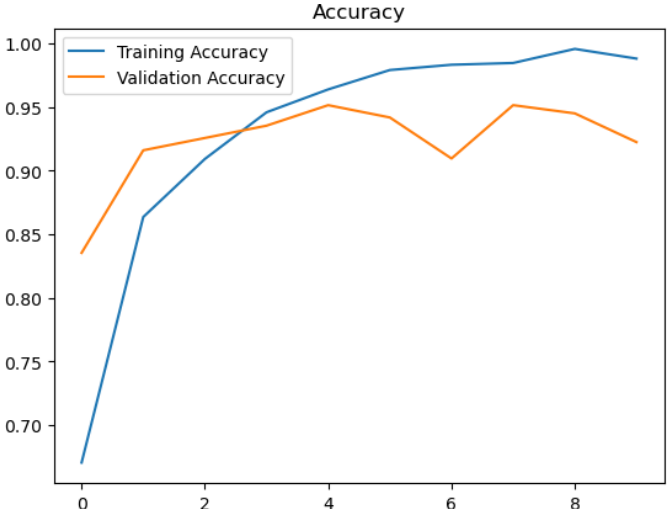

Fig. 5. Accuracy Vs Epoch in VGG16 Model

From these figures it is evident that the VGG16 model was able to obtain better accuracy with less loss as compared to CNN model.

Table1. Comparison of results

Metric	SVM	CNN	VGG16
TestAccuracy	0.73	0.76	0.92
Precision	0.68	0.70	0.90
Recall	0.75	0.90	0.97
F1score	0.71	0.78	0.93

The results of the three models are compared in Table 1. It is found that VGG16 has better performance in accuracy, precision, recall and F1 Score than others.

V. CONCLUSION

The brain tumor detection using deep learning methods has yielded promising results. It is demonstrated that proper augmentation with optimized parameters can significantly improve the accuracy of brain tumor detection. The use of pre-trained models like VGG16 can significantly reduce the training time and improve the model's accuracy, especially when working with larger datasets. With the advancements in technology and the availability of large datasets, these algorithms can be further optimized and improved to provide more accurate and faster diagnosis of brain tumors.The integration of artificial intelligence in medical imaging can significantly improve the efficiency of the health cares ystem, allowing for earlier detection and timely treatment of brain tumors, leading to better patien toutcomes and potentially saving lives.

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Creating Human Scanning Electron Microscopes from Naive Pluripotent Stem Cells: A Technical Breakdown

This analys is provides an exploration of the technical intricacies involved in creating human embryo-like structures, Spatially Organized Morphogenesis (SEMs) from naive pluripotent stem cells. This groundbreaking research offers a deeper understanding of early human development, alongside the unique challenges researchers faced during the process.

Starting with Naive Pluripotent Stem Cells:

The research kicks off with the utilization of human naive pluripotent stem (PS) cells. Naive PS cells possess the potential to mimic various stages of natural human in utero development. These cells serve as the foundational building blocks for the creation of SEMs.

Calibration of Aggregation Conditions:

Achieving successful SEMs necessitates the precise calibration of aggregation conditions. This includes determining the optimal cell numbers, ratios within cell mixtures, and media compositions tailored for different stages of development. Researchers conducted thorough experimentation to fine-tune these conditions.

Optimal Aggregation Conditions:

After rigorous experimentation, the researchers identified the most effective aggregation conditions. The protocol utilized a specific cell ratio (1:1:3 naive PS cell: PrE/ExEM-like: TE-like) in basal N2B27 conditions supplemented with BSA (bovine serum albumin). The addition of BSA was crucial in mitigating the stickiness of human aggregates, ensuring their proper development.

Ex Utero Culture:

A pivotal phase of this research is the ex utero culture, where the aggregates are allowed to grow and develop outside the human body. To prevent TE-like cell attachment to the culture plate, a key factor that can disrupt morphology after day 3, researchers employed orbital shaking conditions.

Human SEMs Development:

Over the course of 8 days in ex utero culture, the aggregates undergo extensive growth, forming 3D spherical structures with discernible tissue compartments and self-organization. This structure formation closely resembles the early stages of human embryonic development, providing valuable insights into human in utero development.

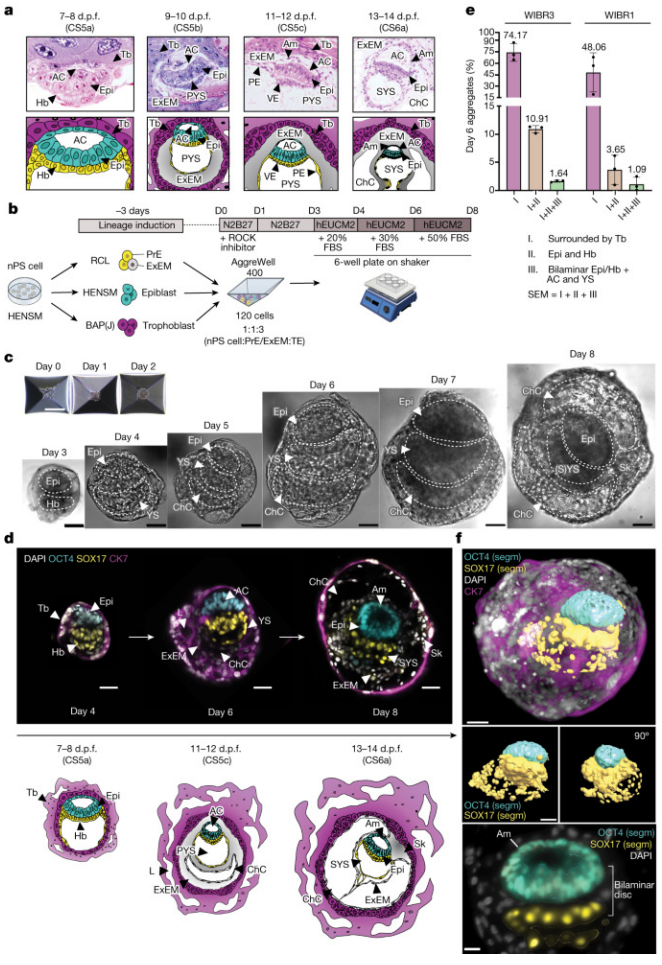

Fig 1: Self-assembly of human post-implantation SEM exclusively from non-transgenic naive ES cells.

Formation of Trophoblast-Like Compartment:

A noteworthy aspect of this research is the development of a trophoblast-like compartment within the SEMs. This compartment is marked by specific proteins and structures, closely mirroring early human in utero development. Syncytiotrophoblasts begin to envelop the SEMs, a crucial step in providing nutrition support during in utero development.

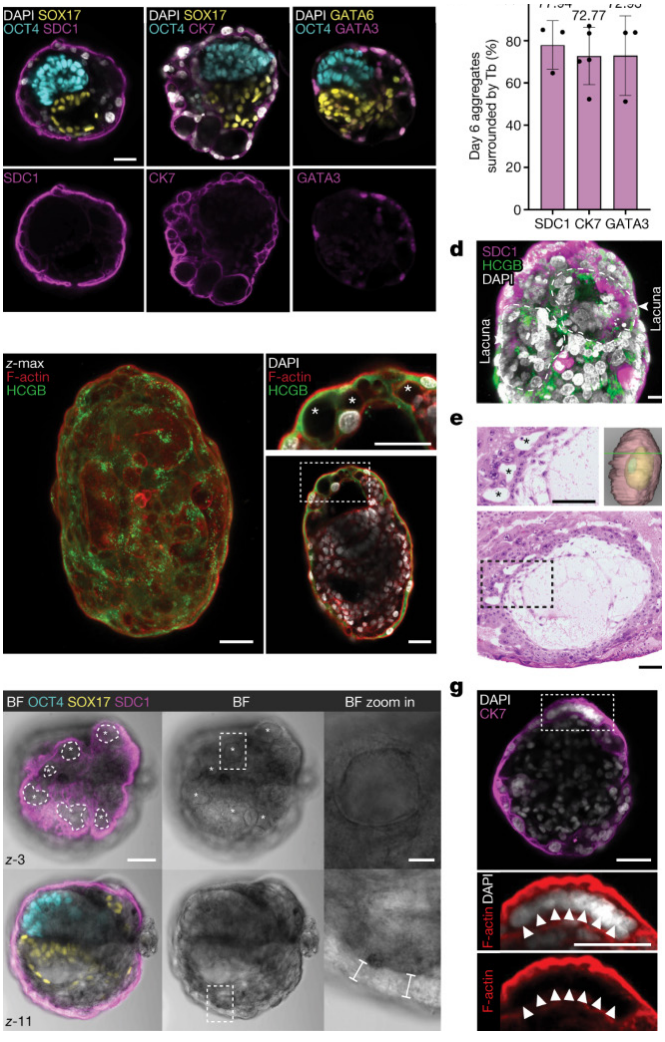

Fig 2: Trophoblast-like compartment integration and maturation in human SEMs.

Segregation of Lineages:

Within the SEMs, epiblast-like and primitive endoderm (PrE)-like cells segregate into distinct compartments, each expressing characteristic markers. This segregation closely reflects the natural process in early human development, where the inner cell mass differentiates into the epiblast and hypoblast.

Technical Advancements and Challenges:

It's essential to acknowledge the technical innovations that enabled this research. High-quality genetic manipulation, careful control of culture conditions, and the adaptability of human naive pluripotent cells played crucial roles in this achievement. Researchers also encountered significant challenges, such as the need for consistent TE-like cell integration into the aggregates and maintaining proper SEM morphology throughout the ex utero culture period.

The creation of SEMs from human naive PS cells represents a significant technical achievement in the field of developmental biology. It allows researchers to delve deep into the intricacies of early human development, offering an unprecedented view of in utero growth. This research not only expands our scientific knowledge but also holds the potential to influence fields such as fertility and developmental defects. The technical nuances outlined here underscore the remarkable complexity and significance of this groundbreaking work.

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Accident Avoiding System Using IoT

Abstract : *The accident-avoiding system using IoT with eye blink and alcohol sensor is a system designed to prevent road accidents caused by driver drowsiness and alcohol consumption. The system uses IoT technology to monitor the driver's behavior, specifically their eye blinking pattern and alcohol levels, to determine if they are fit to drive.The eye blink sensor monitors the driver's eye blinking pattern, and if it detects prolonged periods of closed eyes, it triggers an alarm to alert the driver to take a break. The alcohol sensor measures the driver's blood alcohol content, and if it detects levels above the legal limit, the system automatically prevents the vehicle from starting.The system is designed to improve road safety and prevent accidents caused by drowsy or drunk driving, ultimately saving lives and reducing the economic costs associated with accidents. With the increasing number of accidents caused by these factors, this system could prove to be an essential tool in ensuring road safety.*

Keywords: ADAS, IoT, ESP 8266, eyeblink sensor, alcohol sensor modules

I. INTRODUCTION

In recent years, road accidents have become a major cause of concern, claiming countless lives and causing significant economic and social losses. One of the primary causes of road accidents is driver error, which can be attributed to a range of factors, including drowsiness and alcohol consumption. In fact, according to the World Health Organization, approximately 1.35 million people die each year as a result of road traffic accidents, with drowsy and drunk driving being major contributing factors[1]. To address this critical issue, researchers and technologists are exploring new and innovative ways to enhance road safety, and one such solution is the accident avoiding system using IoT with eye blink and alcohol sensors. This system is designed to monitor driver behavior and provide real-time feedback to prevent accidents caused by drowsiness or alcohol consumption. The accident avoiding system using IoT with eye blink and alcohol sensors relies on IoT technology to collect and process data related to the driver's behavior. The system is equipped with an eye blink sensor that monitors the driver's eye blinking pattern and detects when the driver's eyes remain closed for a prolonged period[1][2]. This is a crucial feature as drowsiness is a significant cause of road accidents, and drivers who are feeling fatigued tend to have difficulty keeping their eyes open, resulting in a higher likelihood of accidents.In addition to monitoring the driver's eye blinking pattern, the system also includes an alcohol sensor that measures the driver's blood alcohol content. This feature is essential as alcohol consumption impairs a driver's judgment, slows their reflexes, and reduces their ability to concentrate, increasing the risk of accidents. The system is designed to prevent the vehicle from starting if the driver's blood alcohol content is above the legal limit, thereby minimizing the risk of accidents caused by drunk driving.Overall, the accident avoiding system using IoT with eye blink and alcohol sensors is a promising solution that has the potential to enhance road safety significantly. By providing real-time feedback to drivers and preventing them from driving while under the influence of alcohol, this system can prevent accidents, save lives, and reduce the economic and social costs associated with road accidents. [1] [2]

II. LITERATURE REVIEW

A literature survey of accident avoiding systems using IoT is a comprehensive review of existing research and literature on the topic. It involves an analysis of published research papers, technical reports, and other relevant literature that discuss the development, implementation, and evaluation of accident avoiding systems using IoT. There are various methods that can be used for accident avoiding systems, including::-

Sensors: Sensors can be used to detect potential accidents by monitoring the speed, distance, and direction of vehicles on the road. This data can then be analyzed to predict and prevent accidents.

Cameras: Cameras can be used to monitor traffic and road conditions and detect potential hazards, such as debris on the road or poor weather conditions.

GPS Technology: GPS can be used to track the location of vehicles and provide real-time information on traffic and road conditions.

Machine learning algorithms: Machine learning algorithms can be used to analyze data from sensors, cameras, and other sources to identify patterns and anomalies associated with accidents.

V2V communication: Vehicle-to-vehicle communication can be used to enable vehicles to share information about traffic conditions and potential hazards, allowing drivers to adjust their speed and avoid accidents. [2] [3].

Advanced driver assistance systems (ADAS): ADAS can provide drivers with warnings and recommendations to prevent accidents, such as lane departure warnings and collision avoidance systems. Real-time communication systems: Real-time communication systems can be used to alert emergency services and other drivers in the vicinity of an accident, reducing response times and providing immediate assistance.

The use of these methods can greatly improve road safety and reduce the number of accidents on the road. However, it is important to ensure that these systems are designed and implemented in a safe, secure, and ethical manner to avoid any unintended consequences. [3].

III. BLOCK DIAGRAM

In this project report, we discuss the various concepts involved in designing and implementing the Accident Avoiding System using IoT sensors like eye blink and alcohol sensors, microcontroller ESP8266, and relay module as shown in Fig 1. We will explore the functionality of each component and the overall system design, as well as the challenges and limitations encountered during the development process. [3].

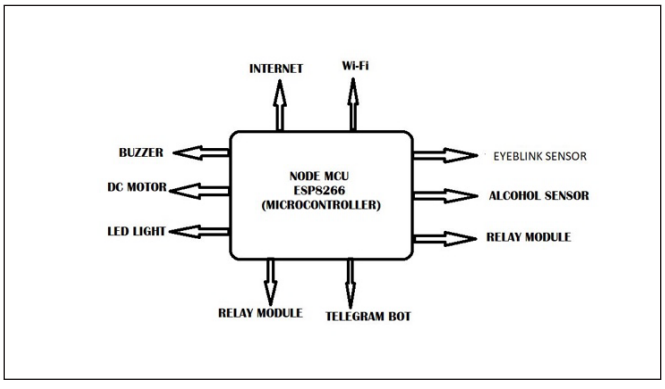

Fig1: Block Diagram

IV. FLOWCHART

The flowchart as shown in Fig. 2 represents the basic logic of the system, which continuously monitors sensor data and triggers safety measures if necessary, records data, and sends alerts to a remote server or cloud platform. [1] [3].

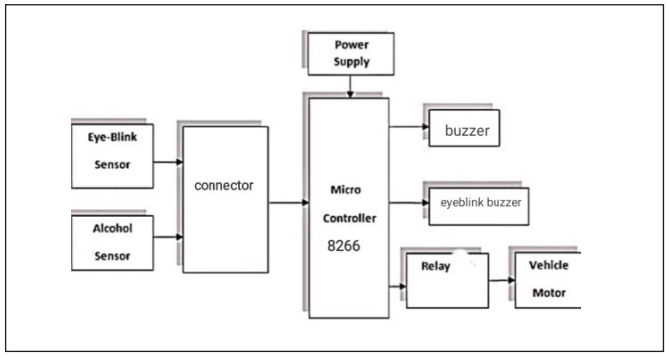

Fig 2: Flowchart

V. WORKING PRINCIPLE

An accident avoidance system using IoT (Internet of Things) is designed to detect and respond to potential hazards on the road by using a network of connected devices and sensors. The working principle of such a system typically involves the following steps:

Sensor data collection: The IoT system collects data from various sensors, such as cameras, radar, lidar, and ultrasonic sensors, installed on the vehicle. The data collected includes information about the vehicle's surroundings, such as the distance to other vehicles, the road condition, and the weather. [4].

Data processing and analysis: The collected data is processed and analysed using machine learning algorithms to detect potential hazards on the road. The algorithms can recognize patterns in the data and predict potential collisions or other safety risks.

Alert generation: Once a potential hazard is detected, the system generates an alert to warn the driver. The alert can be in the form of visual or audible warnings, such as flashing lights or beeping sounds. [4][5]. The circuit diagram as shown on bread broard is shown in Fig. 3.

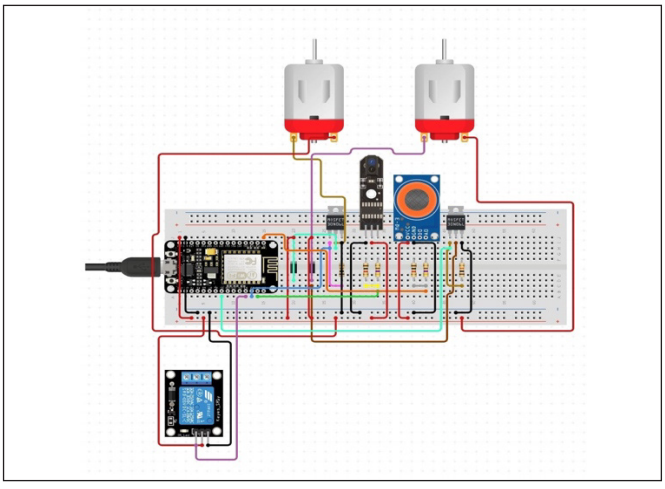

Fig3: Circuit Diagram on Bread Board

VI. COMPONENTS REQUIRED

Further in this paper, we are going to discuss the components used in this project.

ESP8266:

The ESP8266 as shown in Fig. 4 is a low-cost, Wi-Fi-enabled microcontroller developed by Expressif Systems. It is a popular choice for IoT applications due to its small size, low power consumption, and built-in Wi-Fi capabilities. The ESP8266 is based on the Xtensa LX106 processor and has a clock speed of 80 MHz.

The ESP8266 is programmable using the Arduino IDE or other development environments such as the Espressif IoT Development Framework (ESP-IDF) and MicroPython. It has a number of GPIO pins that can be used for input/output (I/O) operations, including digital and analog inputs and outputs, pulse-width modulation (PWM), and interrupts.[1][3]

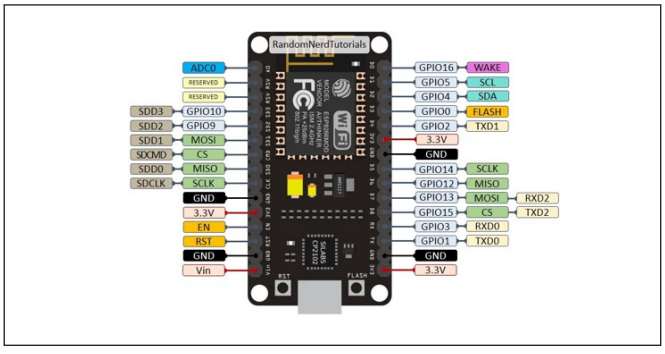

Fig4: ESP8266 NodeMCU kit pinout

Eye blink sensor:

An eye blink sensor as shown in Fig. 5 is a type of sensor that detects the blinking of an eye. It is often used in various applications such as monitoring the health of a person or in controlling devices using eye movements.

There are different types of eye blink sensors, but one of the most common types is the electrooculography (EOG) sensor. The EOG sensor measures the electrical potential difference between the cornea and retina of the eye, which changes when the eye moves or blinks. This signal is then amplified and filtered to extract the blink signal.[4].

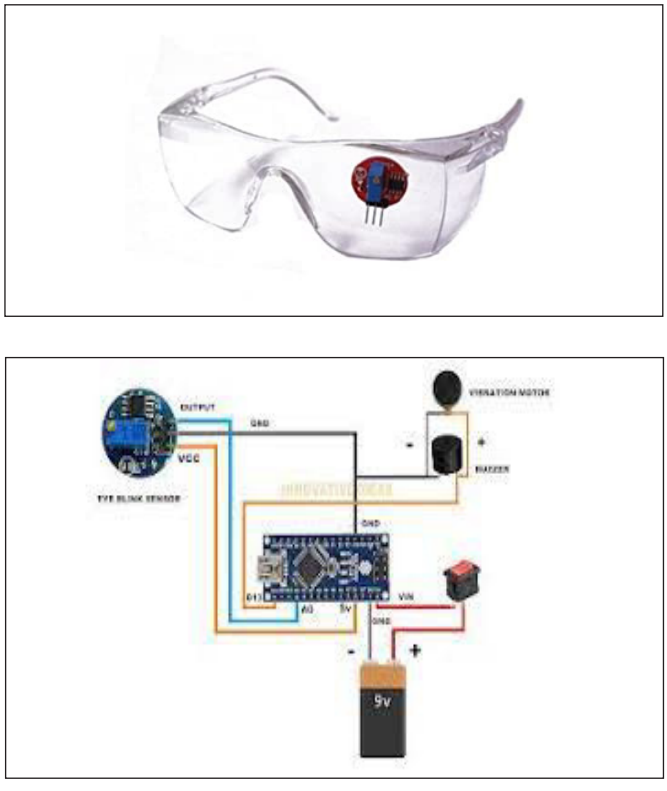

Fig 5: Eye Blink sensor

Alcohol Sensor module:

An alcohol sensor module as shown in Fig 6 is an electronic device designed to detect the presence of alcohol in the air. These modules typically use a sensor that reacts to the presence of alcohol vapor and generates an electrical signal that can be read by a microcontroller or other electronics.

There are different types of alcohol sensor modules, including those that use semiconductor sensors, infrared sensors, and electrochemical sensors. Semiconductor sensors are the most common type and work by measuring changes in electrical resistance caused by the presence of alcohol vapor.[1][4].

Alcohol sensor modules are commonly used in breathalysers, which are devices used to measure the blood alcohol content (BAC) of a person by analysing their breath. They are also used in industrial settings to detect alcohol vapors in the air, such as in chemical processing plants.[4].

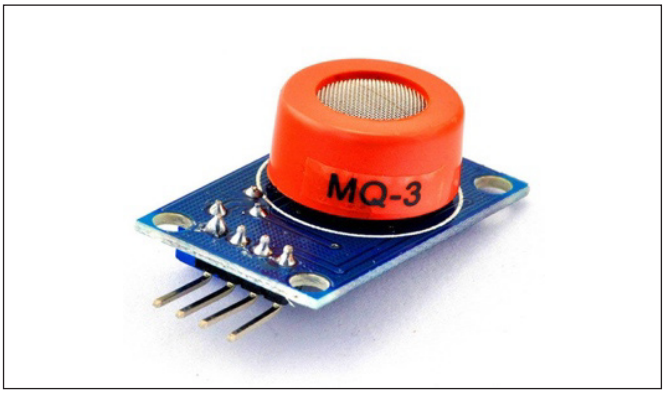

Fig6: Alcohol Sensor module

Relay Module:

A relay module is an electronic device that allows a low-voltage signal to control a high-voltage or high-current circuit. It consists of a relay, which is an electromagnetic switch, and a control circuit that operates the relay.

The relay module as shown in Fig. 7 typically includes one or more relays, each with its own set of input and output pins. The input pins are connected to the control circuit and are used to trigger the relay, while the output pins are connected to the circuit being controlled.[3][5].

Relay modules can be used in a variety aof applications, such as home automation, industrial automation, and automotive systems. They are commonly used to switch high-voltage devices on and off, such as motors, lights, and heaters.[5].

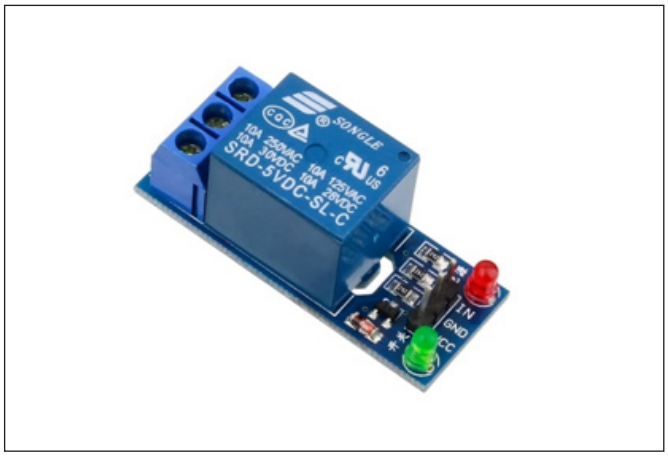

Fig7: Relay Module

CONCLUSION

In conclusion, the use of IoT technology in accident avoiding systems can significantly improve road safety. By integrating eyeblink and alcohol sensors, the system can detect potential safety hazards such as driver drowsiness or drunk driving. The system can then trigger safety measures such as an alarm, seatbelt tightening, or automatic braking, helping to prevent accidents and save lives.[5].

The combination of eyeblink and alcohol sensors provides a comprehensive approach to detecting potential safety hazards, as both sensors can detect different types of driver impairment. Eyeblink sensors can detect drowsiness and fatigue, which can impair a driver's ability to react quickly in an emergency situation, while alcohol sensors can detect whether a driver is under the influence of alcohol, which can impair a driver's judgment and reaction time.

Overall, the accident avoiding system using IoT and eyeblink and alcohol sensors has the potential to significantly improve road safety and save lives. With continuous monitoring and result verification, the system can be further refined and optimized to meet the evolving needs of road safety.[1][2][4][5].

ACKNOWLEDGMENT

We would like to express our sincere gratitude to our project supervisor, Dr. Sangamitra Das, for her constant guidance and encouragement throughout the course of our study. We are greatly indebted to her for allowing us to carry out our project work under his guidance.

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Demand Side Management Using Peak Load Saving

Abstract : *The electrical energy cannot be stored in large scale because we have no resource to store. It has to be produced, transmitted, distributed and used instantly. The power generating plants are designed for maximum demand. The peak load increases suddenly in peak hours so we need to install large power generating plants to meet peak demand. It is not possible for developing countries to install large power generating plants due to limited financial resources.The proposed solution of this problem is Demand Side Management (DSM) technique. DSM is an important part of Smart Grid (SG) which is used to shift load to off peak timings as well as reshape load curve. As a result, importance of SG increases and there is a decrease in per unit energy cost.*

Keywords: Demand Side Management, Real Time Pricing, Smart Grid, Time of Use Rates, Energy Consumption Scheduler.

I. INTRODUCTION

Electricity demand is a key driver of energy consumption and greenhouse gas emissions, particularly during peak periods when demand is highest. As a result, managing peak demand has become a critical priority for utilities, governments, and businesses around the world. Demand Side Management (DSM) is an important approach for optimizing energy consumption and reducing peak demand. This project aims to explore the potential benefits of DSM through peak load saving, a key component of DSM. The project will investigate the effectiveness of different strategies for peak load management and develop a plan for implementing the most effective strategy. Through this study, we aim to contribute to a more sustainable energy future by reducing energy consumption and minimizing peak demand.

Demand Side Management (DSM) is an approach used by utilities to optimize energy consumption and reduce peak demand. Peak load saving, a key component of DSM, is a strategy used to shift energy consumption away from peak periods when demand is highest. Various approaches have beenproposed for peak load saving, including pricing incentives, demand response programs, and load shifting technologies [1,2].

Pricing incentives are a popular approach for peak load management. Time-of-use pricing, for example, provides customers with lower electricity rates during off-peak hours, encouraging them to shift their energy consumption to non- peak hours. Critical peak pricing is another approach that provides customers with higher electricity rates during peak periods, incentivizing them to reduce energy consumption. These pricing strategies have been shown to be effective in reducing peak demand and shifting energy consumption to non-peak hours.

Demand response programs are another approach for peak load management. These programs provide customers with incentives to reduce energy consumption during peak periods. For example, utilities may offer customers rebates for reducing energy consumption during peak periods or offer them smart thermostats that automatically adjust energy usage during peak hours. These programs have been shown to be effective in reducing peak demand and improving grid stability.

II. DEMAND SIDE MANAGEMENT

DSM was introduced by USA in 1973 due to energy issues as shown in Fig. 1. Types of DSM is 'Energy Side Management' and 2nd is 'Energy Demand Management'. The DSM basic goal is to overcome energy issue during peak hours. Demand Side Management is a basic solution to managing load. The Demand Side Management covers economic activities through reduce electricity demand during peak hour. The current situations offer to adopt DSM to overcome above said problems and solve the current electricity shortage issue. The DSM is a viable option to meet the future electricity demand through implementing DSM strategies.

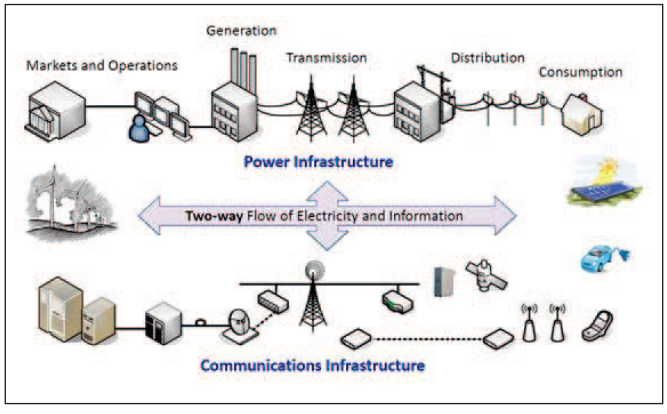

Fig. 1 DSM Solutions

A. DSM Technique

Through using DSM method, it is possible to change the load profile and reshape the load curve as shown in Fig. 2. The possible way used in DSM. But the mostly common DSM applications are as follows.

a) Peak clipping: In this basically want to decrease the peak demand' for peak timing and shift flexible load to minimize load curve. This is a way to reshape the load profile [3].

b) Valley filling: In this we want to fill the off-peak hour period and shift the flexible load to off peak that why increase the consumption during off peak hours period.

c) Load Shifting: In this type of DSM want to reschedule the peak load usage to fit the lower portion.

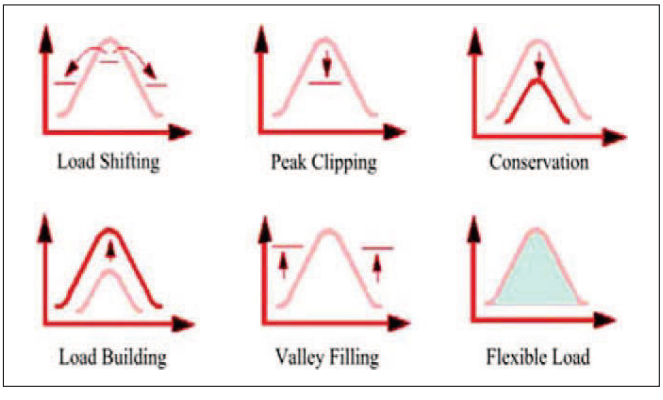

Fig.2 DSM Techniques

B. Real Time Pricing

Real-time pricing (RTP) refers to the pricing of goods or services based on current market conditions and changes in supply and demand. It is a pricing model that enables companies to adjust their prices in real-time based on factors such as inventory levels, market demand, and competition as shown in Fig. 3.In the context of energy markets, real-time pricing is a pricing mechanism that allows electricity prices to change frequently based on the supply and demand of electricity in the market. This means that the price of electricity may vary from hour to hour or even minute to minute.Real-time pricing is often used in industries such as transportation, hospitality, and retail, where pricing is adjusted based on factors such as time of day, location, and demand. It is becoming increasingly popular as companies seek to improve their revenue management strategies and respond more quickly to market fluctuations [4].

The Real Time pricing system provide consumers the ability to access hourly bases electricity rate and consumer can manage the load according to price and take the advantage the low price during off peak hours. In this consumers should control load and only Shift the flexible load during high price period to low price period.

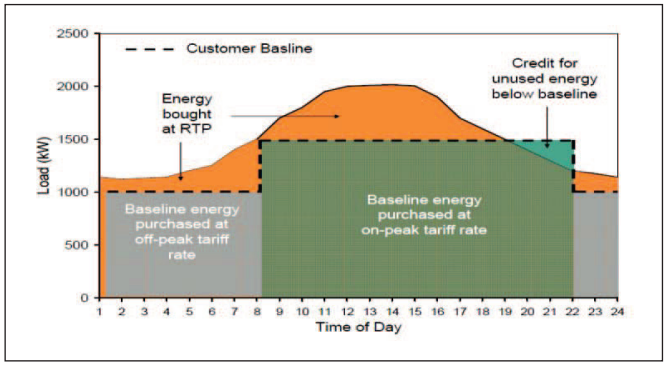

Fig. 3 Real Time Pricing (DSM)

C. Load Curve

The graph which shown in Fig. 4 shows the variation of load on the power station with respect to time is called the load curve of the power station.The load on a power station does not remain constant; it changes from time to time. These changes in the load on a power station during whole day (i.e. for 24 hours) are recorded half-hourly or hourly and are plotted with respect to time on the graph. The obtained graph is called the daily load curve of the power plant.The daily load curve shows the variation of load with respect to time during the day [5]. A typical daily load curve of a power station is shown in the figure. From the figure, the load on the power station is varying and being maximum at 6 pm.The monthly load curve of the power station can be obtained from the daily load curves of that month. To plot the monthly load curve, average values of power over a month at different times of the day are calculated and then plotted on the graph. The monthly load curve of power station is mainly used to fix the rates of energy.The yearly load

curve can be obtained from the monthly load curves of that year. To plot the monthly load curves, average values of power over the year are calculated and then plotted on the graph. The yearly load curve is generally used to determine the annual load factor of the power station.

Importance of Load Curves: Load curves are very important in generation of electrical power because they provide the following information −

- The daily load curve shows the variation in the load on the power plant during the different hours of the day.
- The peak point on the daily load curve represents the maximum demand on the power station on that day.
- The load curves help in selecting the size and the number of generating units of the power station.
- The load curves help in preparing the operation schedule of the power station. That means, to determine the sequence and time for which the various generating units in the power station will be put in operation.

The area under the daily load curve represents the number of units generated on that day, i.e.,

$$\text{Average load per day} = \frac{\text{Area under daily load curve(inkWh)}}{\text{24 hours}}$$

The ratio of area under the daily load curve and the total number of hours gives the average load on the power station on that day, i.e.

$$\text{Load Factor} = \frac{\text{Average load}}{\text{Maximum demand}} = \frac{\text{Average load} \times \text{24 hours}}{\text{Maximum demand} \times \text{24 hours}}$$

$$\therefore \text{Load Factor} = \frac{\text{Area under daily load curve (inkWh)}}{\text{Total area of rectangle in which the load curve is contained}}$$

Load curve or chronological curve is the graphical representation of load (in kW or MW) in proper time sequence and the time in hours. It shows the variation of load on the power station. When the load curve is plotted for 24 hours a day, then it is called daily load curve. If the one year is considered then, it is called annual load curve.

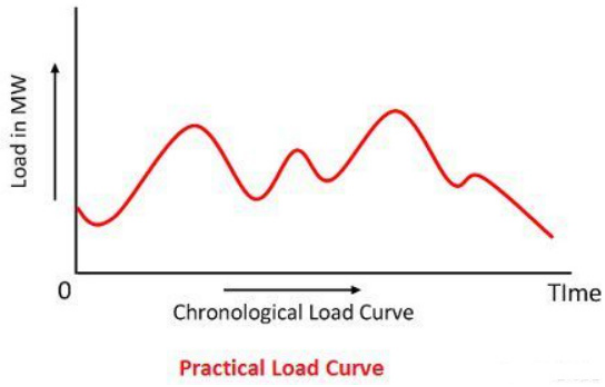

Fig. 4 Practical Load Curve

Utility of Load Curve
The following are the utility of the load curve.

- Load curve decides the installed capacity of a power station.
- It is helpful in choosing the most economical sizes of the various generating units.
- The load curve estimates the generating cost.
- It decides the operating schedules of the power station, i.e., the sequence in which the different generating units should run.

III. METHODOLOGY

Fig. 5 shows system overview which containESP32, Relay Module, Switch, Bulb (Load), Transistor, Resistors.

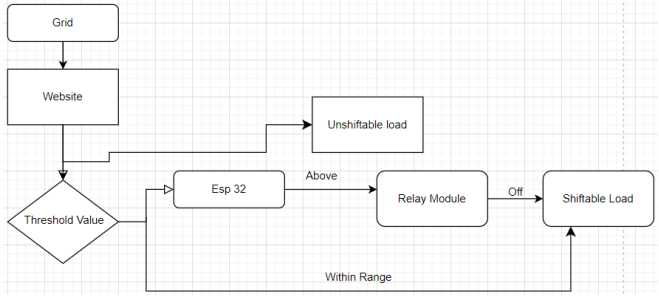

Fig.5 System Overview

A. ESP32

Fig. 6 shows the ESP32. It can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality

through its SPI / SDIO or I2C / UART interfaces. ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth.

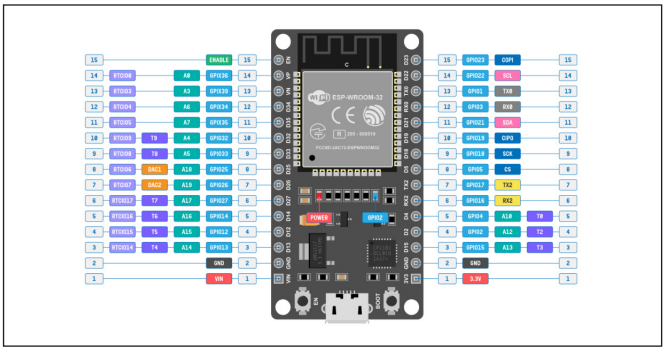

Fig. 6 ESP32

B. Data Collection and Processing

In Grid SCADA collects load data with respect to time and these load data are shared to the website. Then Esp32 collects data from the website. Then Esp32 compares the collected load data with the pre-programmed load value. If the collected load value is greater than the pre-programmed load value, then Esp32 send a signal to relay module. Then the relay module active and cut off the load supply [6,7]. Fig. 7 shows the flowchart of Data Collection and Processing.

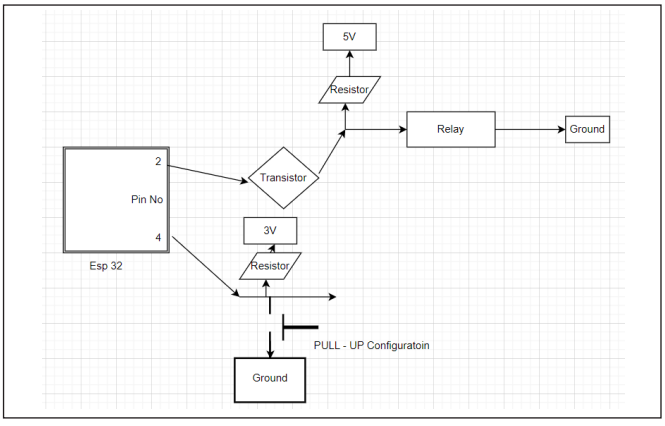

Fig. 7 Data collection and Processing

C. Power Relay Module

A power relay module is an electrical switch that is operated by an electromagnet as shown in Fig. 8. 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.A simple relay consists of wire coil wrapped around a soft iron core, or solenoid, an iron yoke that delivers a low reluctance path for magnetic flux, a movable iron armature and one or more sets of contacts. The movable armature is hinged to the yoke and linked to one or more set of the moving contacts. Held in place by a spring, the armature leaves a gap in the magnetic circuit when the relay is de-energized. While in this position, one of the two sets of contacts is closed while the other set remains open. When electrical current is passed through a coil, it generates a magnetic field that in turn activates the armature. This movement of the movable contacts makes or breaks a connection with the fixed contact [8]. When the relay is de-energized, the sets of contacts that were closed, open and breaks the connection and vice versa if the contacts were open. When switching off the current to the coil, the armature is returned, by force, to its relaxed position. This force is usually provided by a spring, but gravity can also be used in certain applications. Most power relays are manufactured to operate in a quick manner.

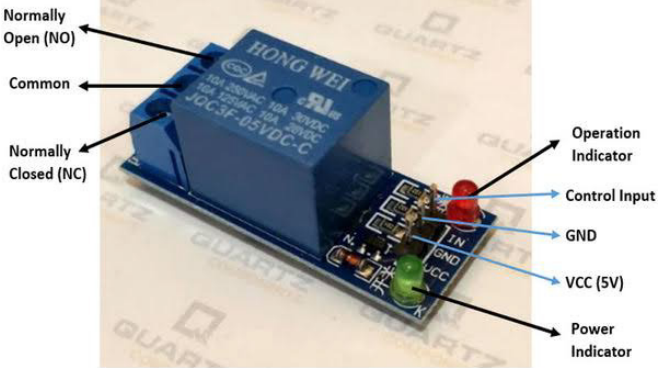

Fig. 8 Power Relay Module

IV. Results and Discussions

The bulb switches off when the threshold price exceeds the average per unit price.The price high sends signal to esp-32 which actuates the relay and trips the bulb.The simulation result show that the peak load during peak hours shifted to off peak hours by using DSM technique and also reduced price during peak hours. Shiftable loads like dishwashers, washers, dryers, PHEVs, etc. This type of load is off when the price of electricity is high and can be used at times of low pricing.

Real-time pricing is a dynamic pricing model in which the cost of electricity changes in real time based on the supply & demand of electricity. Real-time pricing works by using smart meters to track the electricity usage of individual consumers & provide them with real-time pricing information.We used Arduino instead of raspberry pi because Arduino had inbuilt communication device and WiFi but raspberry pi does not has any communication device and inbuilt WiFi device.

V. Conclusions

Peak load saving through demand side management can help to reduce electricity bills, improve energy efficiency, and maintain a stable power grid. Countries like Chile and Canada have implemented this technology successfully and we would like to implement such technology in our country. With the help of Shiftable loads during off peak hours peak load saving can be achieved. There are several ways to achieve peak load saving, including implementing demand response programs, using energy-efficient appliances, and deploying renewable energy sources such as solar power. By reducing peak demand, we can avoid the need for expensive and polluting fossil fuel power plants and better utilize renewable energy sources. Peak load saving is an important strategy for ensuring the reliability, sustainability, and affordability of our electrical grid. With the right policies and incentives in place, we can achieve significant reductions in peak demand and move towards a more sustainable and resilient energy system.

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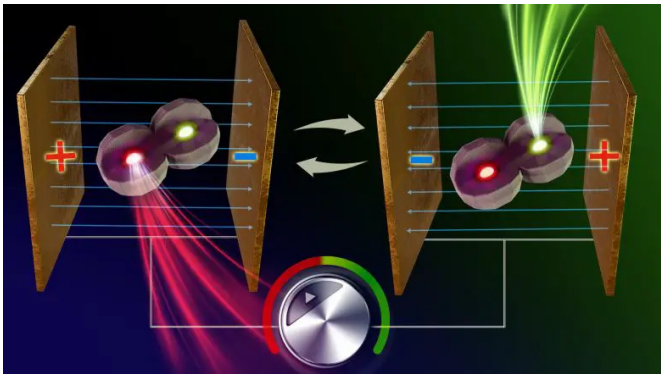
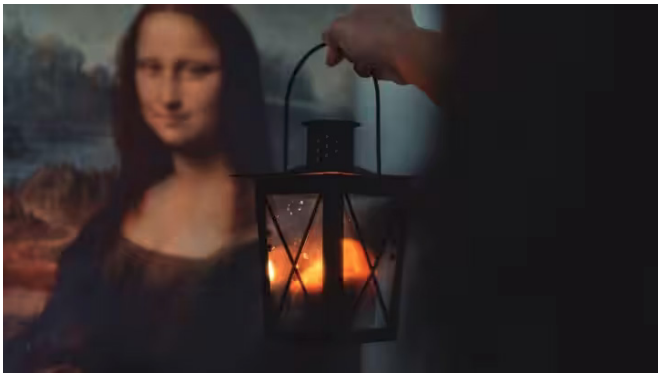
Department of EEE

Color-Tunable Nano-Devices (Source: SciTech Daily)



A nanoparticle is made of two coupled quantum dots, each emitting light with distinct colors. When an external voltage is applied, an electric field is induced, which can toggle the light emission from one side to the other. It switches the emission color while keeping the overall light intensity. Fast and rapid color change was performed in the form of an "artificial molecule" comprised of two connected semiconductor nanocrystals that produce light in two distinct colors. When color-emitting semiconductors are reduced to the nanoscale, a phenomenon known as quantum confinement occurs, which alters the size of the nanocrystal and changes the color of the light that is emitted. As a result, strong light sources encompassing the full visible spectrum may be generated.

Toxic secret behind da Vinci's Mona Lisa (Source: The Indian Express)



Da Vinci is well-known for his experiments. He was not only a painter but also an engineer, a physicist, a sculptor, an architect, and many other things. Recent research reveals that Leonardo made some quite interesting and yet undiscovered experiments with his paintings, both the Mona Lisa and The Last Supper. The study found that the Italian polymath experimented with lead oxide, a hazardous material, beneath its painting. This is a compound material called plumbonacrite. According to the Journal of the American Chemical Society, Da Vinci used substantial amounts of lead white and an orange colour generated by infusing oil with lead oxide.

Spynet spyware (Source: The Indian Express)

A cybersecurity firm, F-Secure, has released a study on the malicious Android software Spynet. The program spreads using the smishing technique (SMS phishing) and subsequently steals users' personal data, including, but not limited to, SMS access and call recording. The app isn't available on Google Play; instead, it spreads by smishing. When someone clicks on a malicious link, the software gets installed on the mobile device and takes control of it.

3D-printed rocket Agnibaan (Source: The Indian Express)

Agnibaan, a Chennai-based space technology company, is creating a locally produced launch spacecraft that will transport small satellites to low-Earth orbit. It can handle payloads weighing up to 100 kilograms. Agnilet is a "semi-cryogenic" rocket engine powered by liquid kerosene and supercooled liquid oxygen at room temperature. The integration process has commenced at the company's facility in Sriharikota's Satish Dhawan Space Centre (SDSC) SHAR.

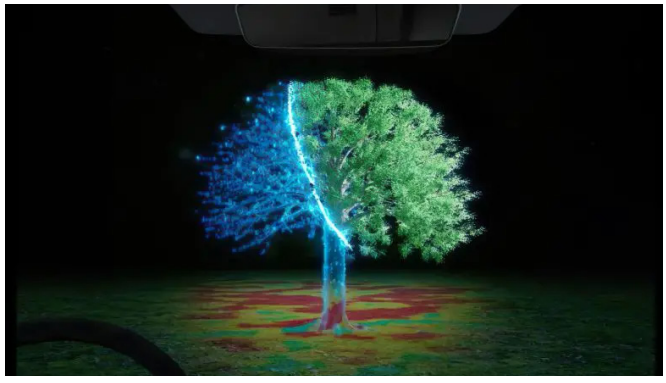
Efficient lithium batteries for EVs (Source: SciTech Daily)

EVs employ lithium-ion batteries are popular due to their high energy storage but contain a flammable liquid electrolyte component that burns when overheated. According to the National Transportation Safety Board, first responders are at danger of being electrocuted or exposed to harmful fumes released by broken or burnt batteries. All-solid-state batteries are safer than current electric or internal combustion models. When these batteries are used at the high capacities and charging-discharging rates required by electric vehicles, lithium dendrites form on the cathode side, causing short circuits and capacity loss. The stabilization of the battery's interfaces between the solid electrolyte and the anode and the electrolyte and the cathode distinguishes their solution. The novel battery structure includes a fluorine-rich interlayer that stabilizes the cathode side, as well as a magnesium and bismuth modification of the anode's interlayer, which suppresses the lithium dendrite.

ChatGPT gets ‘Browse with Bing’ and DALLE-3 integration(Source: The Indian Express)

ChatGPT users may now explore the internet with the newly featured 'explore with Bing' option and produce correct photos from scratch with DALLE-3 without leaving the app. To utilize the function, go to the ChatGPT app settings, select 'New Features,' and then select the 'Browse with Bing' option. When finished, pick GPT-4 from the model selector and click 'Browse with Bing'. OpenAI also included the most recent version of the DALLE-3 text-to-image generator. Users can now take photos in ChatGPT without leaving the app, thanks to the new model.

HADAR (Heat-Assisted Detection and Ranging) (Source: SciTech Daily)



The HADAR (Heat-Assisted Detection and Ranging) approach has revolutionized machine vision and perception in robotics. This technology overcomes the constraints of previous methods by combining thermal physics, infrared photography, and machine learning to sense the texture, depth, and physical properties of scenes and objects even in low-light settings. The procedure establishes the information-theoretic basis of thermal perception by demonstrating that pitch blackness contains the same amount of information as broad daylight. Humans have evolved to prefer the daylight hours. The next generation of machine learning will overcome the centuries-old divide between daylight and darkness. HADAR vividly recovers texture from packed heat signals and precisely separates temperature, emissivity, and texture, or TeX, of every component in a picture. It recognizes physical qualities beyond RGB, or red, green, and blue, visual imaging, or traditional heat sensing. It's amazing that anyone can see through complete darkness like it's daytime.

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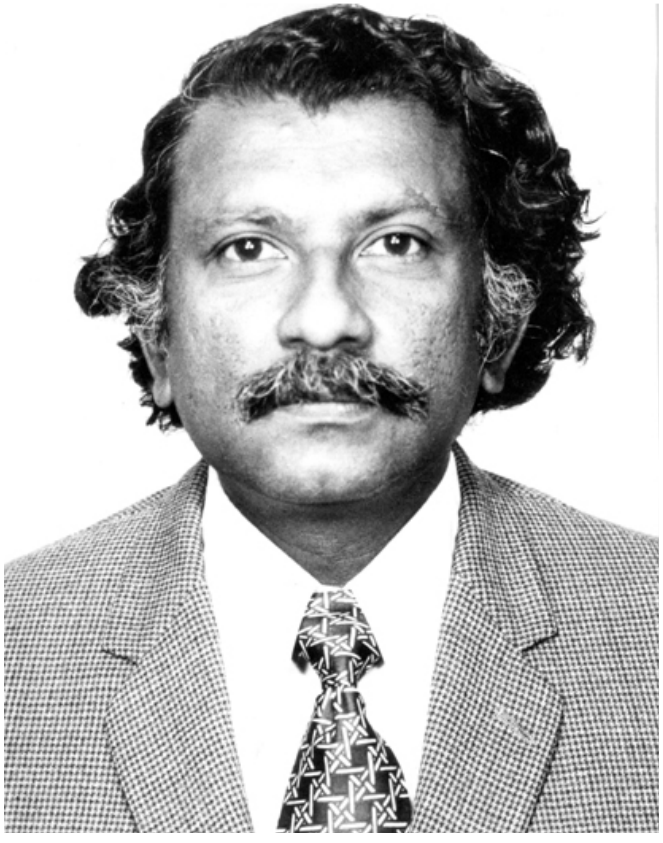
Dept. Of CSE

Venkatraman Radhakrishnan



This article is devoted to a renowned astrophysicist and scientist-sailor, Sir Venkatraman Radhakrishnan. Born in the suburbs of madras and descendent of the highly proficient physicist sir C.V. Raman. He subsequently served as a research scholar at the Indian Institute of Science, Bengaluru, before a brief stint with British Acoustic Films, a UK company involved in scientific research into audio and video with the objective of developing better film equipment.In 1955, aged 26, Radhakrishnan took up a research assistant's position at Chalmers Institute of Technology in Sweden, where he focussed on the observation and measurement of neutral hydrogen in interstellar space. In 1958, he moved further West to the California Institute of Technology (Caltech), where he served as a senior research fellow. In 1965, Radhakrishnan moved to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) division of Radio Physics in Sydney, Australia. At the Parkes Observatory, he was involved in a nascent but big project that studied hydrogen in the universe to understand the interstellar medium.Radhakrishnan and his collaborators also studied a pulsar called Vela. Pulsars are magnetic rotating neutron stars that emit electromagnetic radiation in pulses.After Raman died in 1970, the Raman Research Institute (RRI), Bengaluru, (which he founded to continue his research after his retirement),invited Radhakrishnan to help shape it.He collaborated with other institutes and brought RRI to the forefront in radio astronomy.Radhakrishnan served onvarious national and international science committees as well, including a stint (1988-1994) as vice-president of the International Astronomical Union (IAU), a group of professional astronomers from around the world, and was also a foreign fellow of the US National Academy of Sciences and the Royal Swedish Academy. He also contributed in designing and fabricating hang-gliders, micro-light aircraft and sailboats. His original contributions in these fields were acknowledged by the Government of India by way of support from the Aeronautics Research Development Board, Ministry of Defence (for designing hang-gliders) and ISRO (for sailboats). In October 2010, he announced plans to circumnavigate the world solo on a catamaran he had designed, named 'El da mer'. He passed away due to cardiac complications, two months before his 83rd birthday, on 3 March 2011.

excerpted from: https://theprint.in

By- ABHISHIKTA SAHOO
Year-3rd
Branch-ECE

Robust Performance Analysis of Linear & Non-Linear Controllers for a Double- Stage Stand-Alone PV system

Integration of the Renewable Energy with existing electrical industry is undergoing an exponential growth and will further rule in future. According to MNRE, the capacity of power from renewable sources is to be around 500 GW by the next decade. In order to meet the demands, Off Grid and On-Grid renewable systems are to play a vital role. The widespread of PV system faces great difficulty with the integration of PV with the existing conventional grid. The photovoltaic output can directly feed small loads such as lighting systems and DC motors but grid integration of PV requires certain variable structure devices like converters and inverters. The structure in which both DC-DC and DC-AC converters are used are known as double stage (DS) system whereas connecting the output of PV directly to the inverter and then to grid is known as single stage (SS) systems. As output of PV panel is fluctuating and unstable with the load conditions as well as the environmental conditions like solar radiation and ambient temperature, a DC/DC converter is necessary to regulate the voltage and minimize the variations with the help of controllers. There are numerous studies present that had performed the analysis of a SS and DS system using different linear and non-linear controllers to control the parameters like reactive power flow, grid voltage disturbances, voltage control etc.

The work is focussed on an overall study of a stand-alone double stage system. The components of the system are PV as a source dc-dc power converter as power conditioning unit, feedforward controller, an H-bridge inverter. The PV is designed with an electrical Maximum Power point Tracking (MPPT) method and the output of the MPPT is a reference voltage. This reference voltage is compared with the actual output of the dc-dc converter system and the error signal generated acts as input to the controller. The controllers are thus used to regulate the output voltage of the intermediate power conditioning stage. The regulated output is then fed to the inverter circuit. The primary objective in this work is to design the controllers and validate its performance for two different converter configurations, the Boost and the 3-state switching cell (3ssc) converters.

The attempted controllers are Proportional Integral (PI), Q, H∞ and Sliding Mode (SM). PI is the most simple and conventional controller but in context of variable and non-linear systems, it cannot be referred to as a robust controller Youla parameterization process is based on plant model inversion and takes into consideration the internal stability of the system through a stable transfer function, Q(s).The entire system is simulated using the SIMULINK platform and few of the simulated results are validated through the Software in Loop(SIL) platform using Opal-RT.As the SIL takes into consideration all the parameters associated with a true or actual system, and indicates that the controllers designed can be applied to an actual system as well.

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In the News….

Graphene-based semiconductor could revolutionize future computing

Scientists have created the world's first working graphene-based semiconductor, which could pave the way for chips that power much faster PCs and quantum computers in the future.

Graphene is made from a single layer of carbon atoms tightly bound in a hexagonal lattice, and is a better conductor than Silicon.

The new semiconducting material, made from epitaxial graphene (a particular crystal structure of carbon chemically bonded to silicon carbide), allows for more mobility than silicon, meaning electrons move with less resistance. Transistors made in this way can operate at terahertz frequencies — 10 times faster than the silicon-based transistors used in chips used today — the researchers wrote in a study published Jan. 3 in the journal Nature.

(Excerpted from livescience.com)

Stunning images, courtesy the James Webb Telescope

This year, the James Webb Space Telescope (JWST) celebrated its first full year of operation, during which it returned a treasure trove of images.

Since it first began sending pictures back home in July 2022 from its location 1.5 million kilometers beyond Earth's orbit, JWST has peered deeper in space and farther back in time than any previous telescope could accomplish. Hundreds of scientific papers have already been published based on JWST images, barely a year and a half into its planned 10-year lifetime.

(Excerpted from sciencenews.org)

The Marvel of Nature: Plastic-Eating Worms Tackling Pollution

In the ongoing battle against plastic pollution, scientists have discovered an unexpected ally in the form of a humble creature—a plastic-eating worm. These remarkable organisms, scientifically known as Galleria mellonella larvae, are shedding light on a potential solution to one of the most pressing environmental challenges of our time.

Plastic pollution has reached alarming levels, with vast amounts of plastic waste accumulating in landfills and oceans, posing a severe threat to ecosystems and wildlife. Traditional methods of plastic disposal, such as incineration and recycling, have limitations, prompting researchers to explore innovative, nature-inspired solutions.

The plastic-eating ability of Galleria mellonella larvae was first observed by chance. Researchers noticed that these waxworms, commonly used as fishing bait, were capable of consuming polyethylene—a common plastic used in packaging and single-use items. This discovery opened up new possibilities for addressing plastic waste in a natural and sustainable way.

The key to the plastic-eating prowess of these worms lies in their digestive system. The larvae produce enzymes that break down the molecular structure of polyethylene, allowing them to consume and metabolize the plastic into ethylene glycol—a substance that is non-toxic. This transformation suggests a potential avenue for harnessing nature's mechanisms to manage plastic waste without harmful environmental consequences.

While the plastic-eating abilities of these worms are impressive, it's important to note that the scale of their impact is still being studied. Scaling up this process for large-scale plastic disposal would require careful consideration of various factors, including the efficiency of the worms, the economic feasibility, and potential ecological implications.

The discovery of plastic-eating worms serves as a reminder of the incredible adaptability and resilience of nature. It also highlights the importance of exploring sustainable solutions inspired by the natural world. As researchers delve deeper into understanding the mechanisms behind the plastic-digesting abilities of these larvae, there is hope that this knowledge can be applied to develop practical and eco-friendly strategies for managing plastic waste.

(excerpted from theguardian.com)

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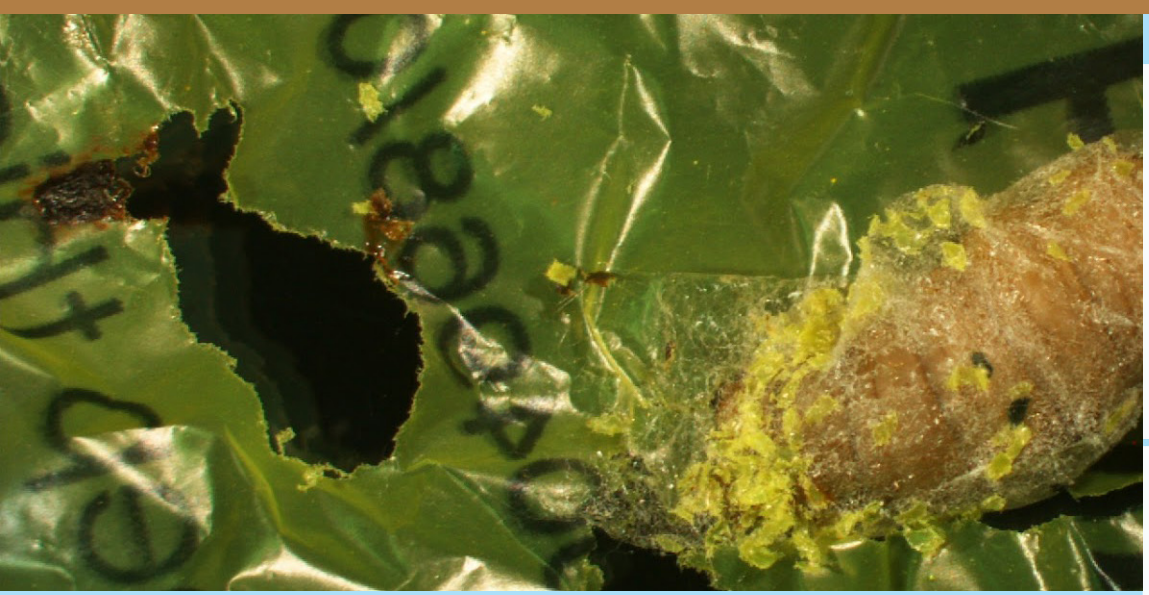

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