SPECIAL FEATURE

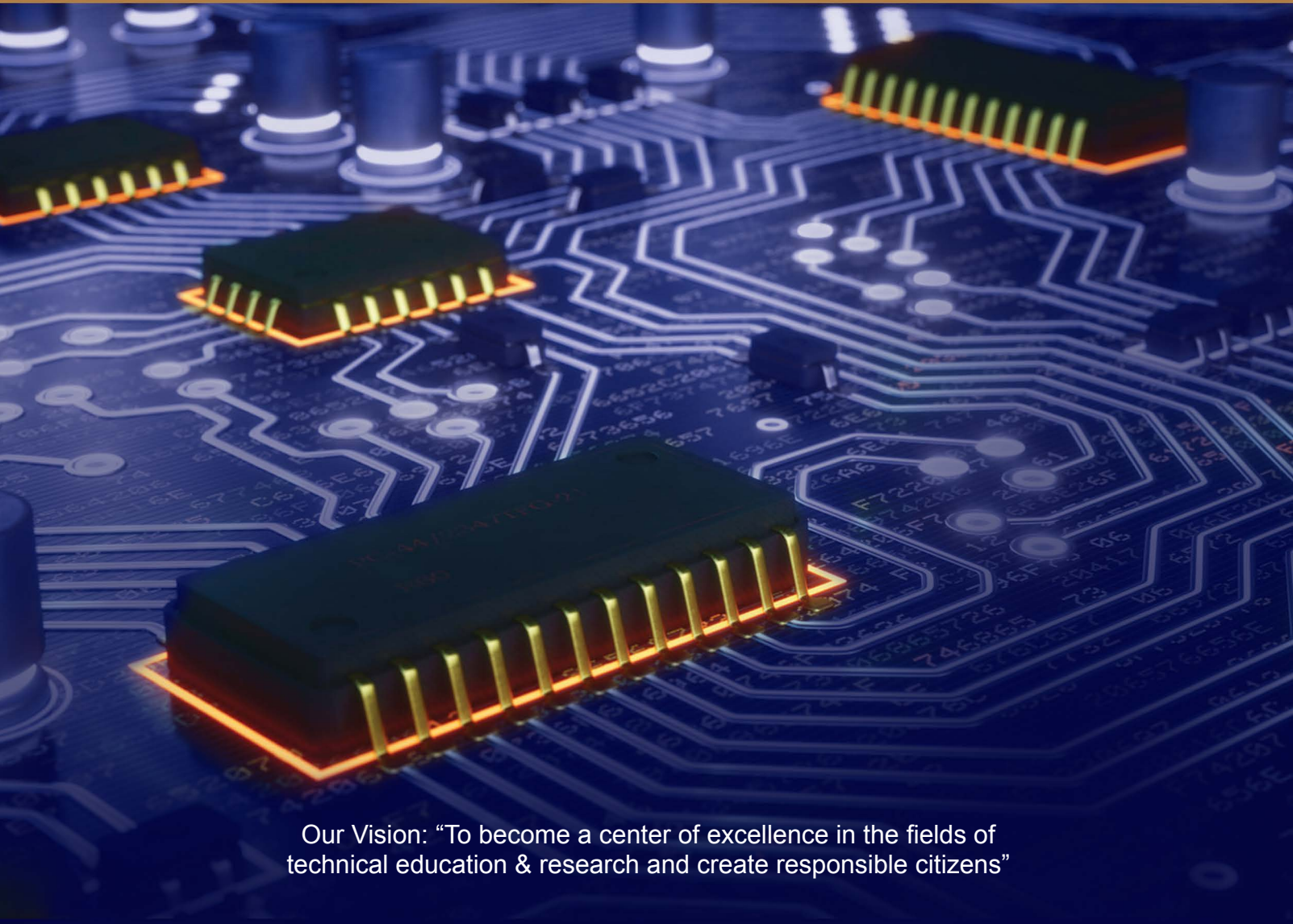
Password Protected
Circuit Breaker
System using Arduino

Silicon Tech

The Science & Technology Magazine

Digital Digest

Vol. 23 • March - August 2020



Our Vision: “To become a center of excellence in the fields of technical education & research and create responsible citizens”

Silicon Carbide

Silicon Carbide is a synthetically produced crystalline compound of silicon and carbon, which is extremely hard. It was originally produced by a high temperature electro-chemical reaction of sand and carbon. Silicon carbide is an excellent abrasive and has been produced and made into grinding wheels and other abrasive products for over one hundred years. Silicon Carbide (SiC) semiconductors are an innovative new option for power electronic designers looking to improve system efficiency, smaller form factor and higher operating temperature in products covering industrial, medical, mil-aerospace, aviation, and communication market segments. The need for higher switching frequencies, greater power densities, higher blocking voltages, lower losses, increased operating temperatures etc. has led to the introduction of Silicon Carbide (SiC) and other wide band gap materials in power devices. Silicon Carbide is a Wide Band Gap (WBG) material that is becoming more widely used in power semiconductors as Silicon based devices have nearly reached their maximum theoretical performance. The term "band gap" defines the difference in energy levels. The wider band gap leads to a higher critical electrical field (approx 10 x greater than Silicon) giving rise to breakdown voltages of 10's of kilovolts and therefore higher blocking voltages for power devices. Due to the high dielectric strength of SiC, it is possible to produce a thinner die that can be doped to a much higher level. This leads to much lower losses and therefore greater efficiency and also higher current density (2-3 times higher than Silicon), a feature that also increases cost effectiveness. SiC devices are able to switch much faster than Si with lower losses. The other main advantages of SiC are its high thermal conductivity (3 times that of Silicon) and high melting temperature. Temperature has little influence on switching performance and on resistance allowing SiC devices to operate at junction temperatures of 200^{o}C+ compared to 150^{o}C for Silicon. The increased reliability, higher operating temperature, increased efficiency, reduced size, higher voltage capabilities of SiC make it highly desirable in the electric vehicle and renewable energy industries. Traction inverters in electric vehicles are subjected to high thermal and load cycling and of course a high power to weight and physical size is very important. Renewable energy converters are also subjected to extreme environmental conditions (for example, solar inverters in desert locations, offshore wind farms etc.). In these instances the need for high reliability is paramount as maintenance and downtime can be extremely expensive for the operators. It goes without saying that maximizing power conversion efficiency is of utmost importance in the energy conversion process. This leads to cost savings as well as greater efficiencies and reliability. The adoption of energy solutions with SiC materials is accelerating in both the automotive and industrial markets. Making silicon carbide (SiC) wafers is a far more involved process than making silicon wafers. SiC power electronics support emerging industries such as renewable power including solar, thermal and wind power, EV/HEV power systems.

Dr. Lopamudra Mitra
Sr. Asst. Prof.
Dept. of EEE

Password Protected Circuit Breaker System using Arduino

Abstract : *A circuit breaker is an automatically operated electrical switch deigned to protect an electrical circuit designed to protect an electrical circuit. The basic function is to detect the fault function and interrupt the current flow. The cause of fault may vary from overloading to short circuiting. The main objective of this project is to enhance the traditional circuit breaker by including upcoming technology of password protection system for safety and efficiency purposes. When operated manually, fatal electrical accidents occur due to the lack of communication and co-ordination between the maintenance staff and line men at the substation. To reduce these casualties we aim to design the circuit breaker so that it can be accessible only by authorized personnel. The provision for password change is also available. The central part of the project refers to the Arduino board which is an open source electronic prototyping platform which creates an interactive environment. It controls all the processes like taking the password from the keypad module, comparing the password and sending the results to display.*

Keywords: circuit breaker (CB), password protection maintenance (PPM), Light Emitting Diode (LED), liquid crystal display (LCD)

I. INTRODUCTION

The article concentrates on improving the traditional circuit breaker by including a password system to improve security and safety conditions for linemen. Security is one prime concerns in our day to day life. To provide a safety measure to safeguard the operator is crucial looking into the present working style adopted at substations. This proposed system provides a solution that ensures safety primarily of the lineman who is given the control to turn the circuit on and off. Arrangement of the system is such that a password is required to operate the doors of the control panel and circuit breaker. A secured password is requested and received from the control room by the lineman for the point of repair or service. This request is registered and a password is sent to the lineman's mobile [1]. The password is entered through the matrix keypad which is interfaced to the Arduino Uno microcontroller. The entered password is compared with the password received by the control panel. If the entered password is correct then the circuit breaker on/off and door open/close feature is enabled for the lineman to take up repair. any intruder tries to operate the mechanism with the wrong password by three times it will display a message in the lcd display and a message is sent to the control room regarding unauthorized accessing of the system for the safety reasons [2].

The central part of the project refers to the "Arduino" which provides an open source electronic platform to combine hardware and software that is used for the implementation. Initially, focus was placed on developing the power supply circuit whose objective was to take a 230V ac supply and bring it down to a suitable level to be fed to the board. Connections were made based on the results derived from the software run. Following this the required equipment were experimented with using the Proteus software. A hit and trial method was adopted.

II. COMPONENTS USED

2.1 Power Supply:

The main objective of constructing a power supply is to provide a decrease voltage of 5v voltage to the circuit. It is combination of four processes namely, current decrease by transformer, rectification, smoothening, and regulation as shown in Fig. 1 [3]. The transformer decreases the current according to its turn's ratio. Following this the rectification process is carried out which converts the ac to dc. Smoothening is done to cancel out any distortions in the signal and noise. Regulation is the final step that is carried out that maintains the input that is given at a constant value

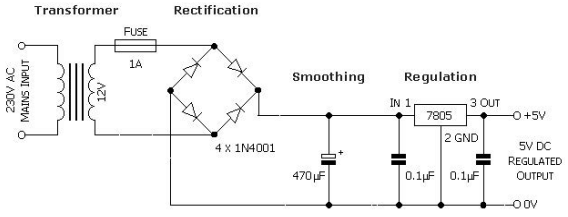


Fig1: *DC Power supply circuit*

2.1.1 Transformer (core type): A transformer is a passive electrical device that transfers electrical energy between two or more circuits. A varying current in one coil of the transformer produces a varying magnetic flux, which, in turn, induces a varying electromotive force across a second coil wound around the same core. Electrical energy can be transferred between the two coils, without a metallic connection between the two circuits. Transformers are used for increasing or decreasing the alternating voltages in electric power applications, and for coupling the stages of signal processing circuits. It works on the faraday law of induction.

2.1.2 Fuse: It is an electrical safety device that operates to provide overcurrent protection of an electrical circuit. Its essential component is a metal wire or strip that melts when too much current flows through it, thereby interrupting the current.

2.1.3 Bridge rectifier: A diode bridge is an arrangement of four (or more) diodes in a bridge circuit configuration that provides the same polarity of output for either polarity of input. When used in its most common application, for conversion of an alternating-current (ac) input into a direct-current (dc) output, it is known as a bridge rectifier.

2.1.4 Capacitor: In a power supply using and ac waveform input and diode rectifiers, this raw rectified output is normally smoothed using a reservoir capacitor aluminum electrolytic capacitors are ideal for the job as many electrolytes are able to have a sufficiently high capacitance and ripple current rating to supply the required current to smooth the waveform.

2.1.5 Voltage regulator: A voltage regulator is a system designed to automatically maintain a constant voltage level. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more ac or dc voltages.

2.2 Uno Arduino r3:

The Arduino Uno is an open-source microcontroller board based on the microchip atmega328p microcontroller and developed by arduino.cc .the board is equipped with sets of digital and analog input/output (i/o) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital pins, 6 analog pins, and programmable with the Arduino ide (integrated development environment) via a type b sub as shown in fig. 2 [4]. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. The word "Uno" means "one" in Italian and was chosen to mark the initial release of the Arduino software.

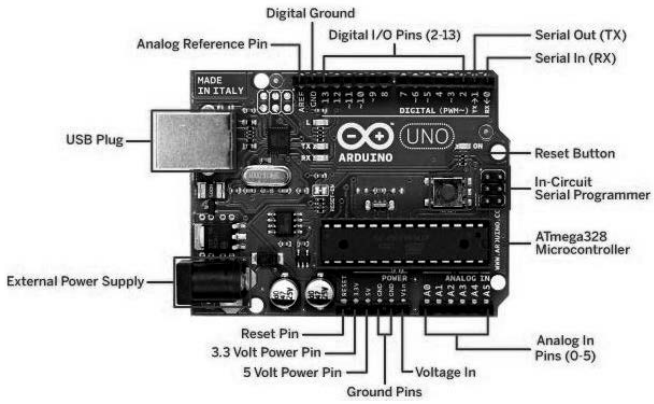


Fig 2: *Arduino Circuit Connections*

2.2.1 General pin functions:

LED: There is a built-in LED driven by digital pin 13. When the pin is high value, the fed is on, when the pin is low, it's off.

VIN: the input voltage to the arduino/genuino board when it's using an external power source (as opposed to 5 volts from the usb connection or other regulated power source). One can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin [5].

5v: this pin outputs a regulated 5v from the regulator on the board. The board can be supplied with power either from the dc power jack (7 - 20v), the usb connector (5v), or the VIN pin of the board (7-20v). Supplying voltage via the 5v or 3.3v pins bypasses the regulator, and can damage the board.

3v3: a 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 ma.

GND: ground pins.
ioref: this pin on the arduino/genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the ioref pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

Reset: typically used to add a reset button to shields which block the one on the board [6].

2.2.2 Special pin functions: Each of the 14 digital pins and 6 analog pins on the uno can be used as an input or output, using pinmode(), digitalwrite(), and digitalread() functions. They operate at 5 volts. Each pin can provide or receive 20 ma as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40 mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The uno has 6 analog inputs, labeled a0 through a5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the aref pin and the analog reference () function.[7]

In addition, some pins have specialized functions:

Serial / uart: pins 0 (rx) and 1 (tx). Used to receive (rx) and transmit (tx) ttl serial data. These pins are connected to the corresponding pins of the atmega8u2 usb-to-ttl serial chip.

External interrupts: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

PWM (Pulse-Width Modulation): 3, 5, 6, 9, 10, and 11 Can provide 8-bit PWM output with the analog write () function.

SPI (Serial Peripheral Interface): 10 (ss), 11 (mosi), 12 (miso), 13 (sck). These pins support spi communication using the spi library.

Communication using the wire library.

Are (analog reference): reference voltage for the analog inputs.

Rather than requiring a physical press of the reset button before an upload, the Arduino/genuino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (dtr) of the atmega8u2/16u2 is connected to the reset line of the atmega328 via a 100 Nano farad capacitor. When this line is asserted (low), the reset line drops long enough to reset the chip

2.3. Relay:

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. the traditional form of a relay uses an electromagnet to close or open the contacts, but other operating principles have been invented, such as in solid-state relays which use semiconductor properties for control without relying on moving parts. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called protective layers [8].

Latching relays require only a single pulse of control power to operate the switch persistently. Another pulse applied to a second set of control terminals, or a pulse with opposite polarity, resets the switch, while repeated pulses of the same kind have no effects. Magnetic latching relays are useful in applications when interrupted power should not affect the circuits that the relay is controlling.

2.4 Keypad:

A keypad is a set of buttons arranged in a block or “pad” which usually bear digits, symbols and usually a complete set of alphabetical letters. If it mostly contains numbers then it can also be called a numeric keypad. In order to detect which key is pressed from the matrix, the row lines are to be made low one by one and read the columns. Assume that if row1 is made low, then read the columns. If any of the keys in row1 is pressed then correspondingly the column 1will give low that is if the second key is pressed in row1, then column2 will give low.

2.5 Liquid Crystal Display (LCD):

Most common LCD connected to the microcontrollers are 16×2 and 20×2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively. The standard is referred to as hd44780u, which refers to the controller chip which receives data from an external source (and communicates directly with the LCD).

III. CIRCUIT BREAKER USING ARDUINO

As we know the circuit breaker needs a time to time maintenance and lots of mechanical power for its operation.

In this model SHOWN IN Fig. 3, we have designed a circuit breaker using an ARDUINO UNO R3 and various other components like keypad, potentiometer, BJT, relay, display, that can be operated remotely. Only after the entry of correct password the circuit breaker is turned OFF by the controller before opening the panel doors [9]. A relay is simulated as a circuit breaker for ease of demonstration. The status is indicated by LEDs and message on LCD display allowing to the service or repair activity by the lineman without any doubt with security. The turn ON of the circuit breaker is interlocked with the closure of the panel doors for the safety reasons. On the completion of the repair or service the lineman sends a request for the password to turn ON the circuit breaker from the control room. On verification of the true password and door condition circuit breaker turns ON. This method provides greater safety and assurance to the lineman on work.

Advantages

- Avoids electrical accidents to lineman and also electrical equipment's.
- Ease of operation, maintenance and repair.
- Concept works on a secured password which can be modified easily.
- Concept is simple, economical and easy to implement as it uses commonly available components.

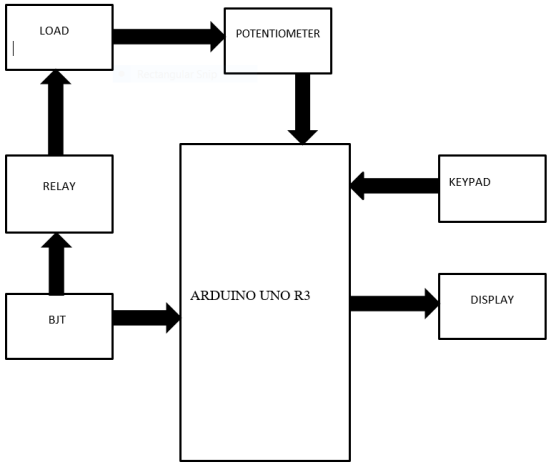


Fig 3: *Block Diagram of the layout*

IV. WORKING

For the operation of circuit breaker through a password, program is written in Arduino IDE and created into a .hex file. The .hex file is burnt into the Arduino using Proteus. Connections were made as per the circuit diagram given in fig. 4.

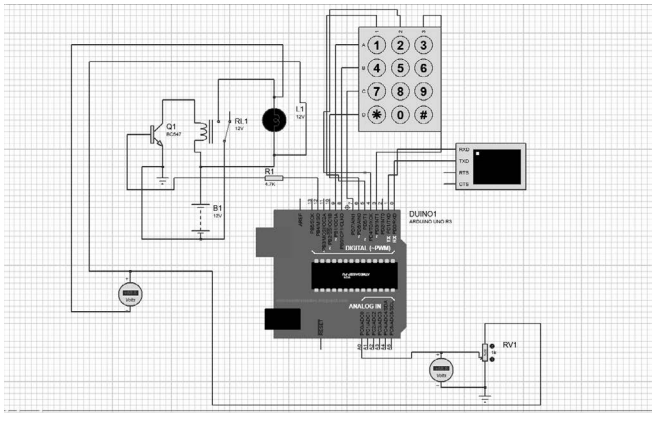


Fig 4: *Proteus Simulation*

While giving the connections, it should me made sure that there is no common connection between ac and dc supplies. 5V power supply circuit is to be used to provide regulated 5V DC to the controller. Now the DC supplies are switched on .The virtual terminal displays "enter password" as in fig. 5. A password is entered with the help of keypad. Now if the password is wrong then the lamp load doesn't glow and "incorrect password" is displayed on the virtual terminal as in fig. 6.

Here, we are aiming to detect the overvoltage condition. For that a predefined voltage is set; if the voltage across the load exceeds the set voltage then the overvoltage will be detected. If the password is correct, then the Arduino checks whether the voltage across the load is over the set (predefined) voltage or not. If the voltage across the load is less than the set voltage, the Arduino sends a high input to the BJT (Q1) which completes the relay circuit making the lamp glow and "normal condition" is displayed on the virtual terminal as shown in fig. 7. If the voltage is above the set voltage, the Arduino sends a low input to the BJT and the relay circuit remains open, hence the lamp doesn't glow and "over voltage is being displayed on the virtual terminal'' as shown in fig. 8.

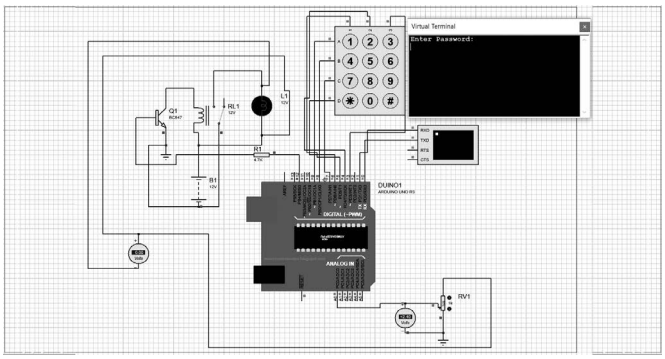


Fig 5: *Proteus Simulation with Virtual Terminal*

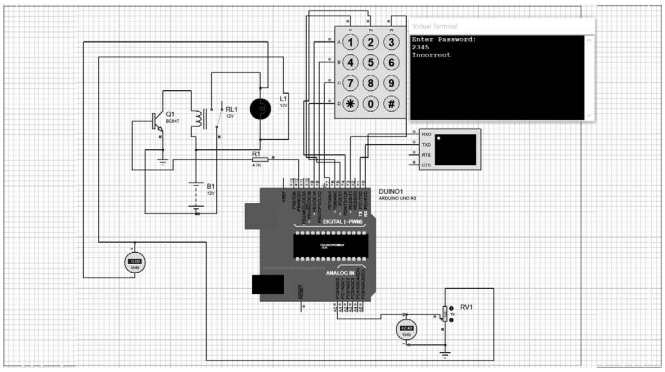


Fig 6: *Virtual Terminal displaying "incorrect Password"*

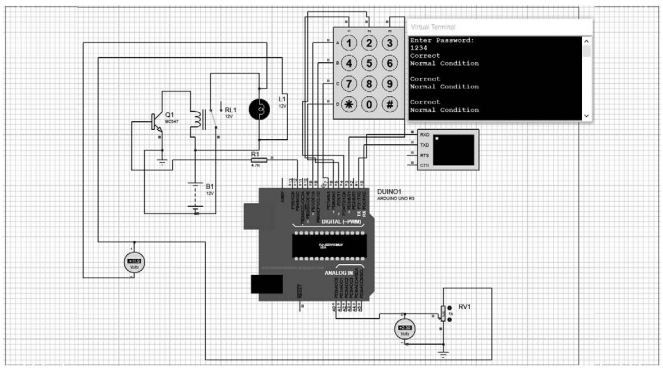


Fig 7: *Virtual Terminal displaying "correct Password and normal Voltage"*

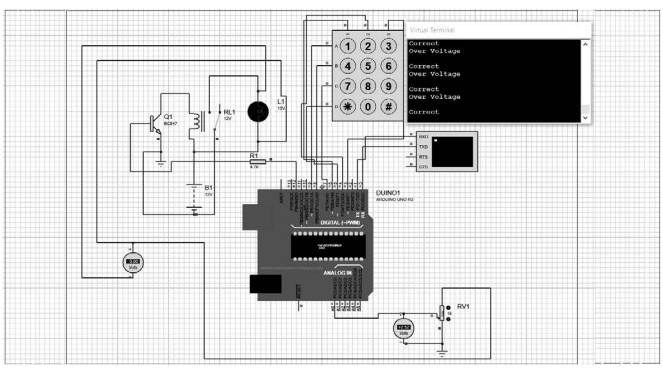


Fig 8: *Virtual Terminal displaying "correct password and over Voltage"*

V. CONCLUSIONS:

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by any fault or abnormal condition in a system. Its basic function is to detect a fault condition and interrupt. After a circuit breaker operates, it can be reset (either manually or automatically) to resume normal operation. When operated manually there may be fatal electrical accidents to the line man. Similarly, during a line repair, such accident may occur due to lack of communication and coordination between the maintenance staff and the electric substation staff. Such accidents can be prevented by using password protected circuit breaker. Line man can turn off the supply and comfortably repair it, and return to the substation, then turn on the line by entering the correct or same password.

This project aims to explore suitable design of an electronic circuit breaker which works efficiently in the face of most common short circuit or open circuit faults on line or load.

The system will be fully controlled by the AURDINO UNO board. If the password entered is correct, then the line can be turned (ON/OFF).If the password entered is incorrect then we also have option to enter password again. The password can be changed any time. A keypad will be used to enter the password and a relay to open or close circuit breaker, which is indicated by a lamp load turning off or on.

A literature survey along with a detailed study has been done regarding different kinds of circuits, components and sensors. A circuit has been designed and tested on PROTEUS software which has yielded satisfactory results.

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Suraj Behera, Kunal Kumar,
KVD Pallavi, Bandan
Kumar Sahoo, Rajat Mohanty
Dept. of EEE

COMET NEOWISE

The C/2020 F3 comet aka NEOWISE has caught the attention of the stargazers in India as they will be able to get a glimpse of the celestial event from July 14 onwards. The comet will be visible to the naked eye for 20 minutes every day for 20 days. On July 14, the comet was visible an hour before the dawn sky. This will continue in mid-July. However, the comet will be visible in the evening later this month before it starts to fade away in August. It will be visible only through binoculars and telescopes before disappearing next month as it enters the outer orbit of our solar system. It will be closest to earth on July 22 as the distance from Earth will be 64 million miles or 103 million kilometres as it crosses the planet's orbit."From July 14, C/2020 F3, a comet discovered on March 27, will be clearly visible in the north-western sky. It will be visible after sunset for around 20 minutes for the next 20 days. People can observe it from naked eyes," Odisha planetarium's Deputy Director, Dr. Subhendu Pattnaik told ANI. "In the evenings to follow, the comet will rapidly climb higher in the sky and will be visible for a longer period," he added. The NEOWISE will be visible in the northwest sky which is 20 degrees from the horizon.

Handwritten Digit Recognition

Abstract : *Handwritten character recognition is one of the practically important issues in pattern recognition applications. The heart of the problem lies within the ability to develop an efficient algorithm that can recognize hand written digits and which is submitted by users by the way of a scanner, tablet, and other digital devices. This paper presents a comparative study of various machine learning models to tackle the handwritten digits recognition problem. Several machines learning algorithm namely, Decision Tree, K-Nearest Neighbor, Multilayer Perceptron and Support Vector Machine were analyzed for the recognition of digits. The Multilayer Perceptron model is selected as the model with highest accuracy and is used for custom digit recognition with custom training and testing data, which recognizes the scanned image of user handwritten digits. The presented model is experimented on the well-known MNIST data set.*

Keywords: digit recognition, MNIST dataset, Decision Tree, K-Nearest Neighbor, Multilayer Perceptron, Support Vector Machine

I. INTRODUCTION

Automatic recognition of handwritten digits is a challenging task [1] [2]. Different people have very different writing style, even digits of same person written in different time were not identical [3]. Digit recognition system is the working of a machine to train itself or recognizing the digits from different sources like emails, bank cheque, papers, images, etc. and in different real-world scenarios for online handwriting recognition on computer tablets or system, recognize number plates of vehicles, processing bank cheque amounts, numeric entries in forms filled up by hand (say — tax forms) and so on [4] [5]. In this paper several classifiers like Decision Tree, K-Nearest Neighbour, Multilayer Perceptron and Support Vector Machine were used for recognizing the handwritten digits (0-9) and a comparison is presented on the basis of classification metrics like Precision, Recall, F1-Score, Support and Accuracy. The Multilayer Perceptron model is implemented on the custom training and testing data to recognize the handwritten digits of scanned images.

A discussion on the various machine learning techniques is presented next followed by the digit recognition model and its implementation results.

II. METHODS AND MATERIALS

A. Decision Tree:

A decision tree is a flowchart-like structure in which each internal node represents a "test" on an attribute (e.g. whether a coin flip comes up heads or tails), each branch represents the outcome of the test, and each leaf node represents a class label (decision is taken after computing all attributes) [3]. The paths from root to leaf represent classification rules as shown in Fig. 1.

The basic idea behind any decision tree algorithm is that we first select the best attribute using Attribute Selection Measures (ASM) to split the records. Then make that attribute a decision node and breaks the dataset into smaller subsets and start tree building by repeating this process recursively for each child until all the tuples belong to the same attribute value or there are no more remaining attributes or there are no more instances. Attribute selection measure is a heuristic for selecting the splitting criterion that partition data into the best possible manner. It is also known as splitting rules because it helps us to determine breakpoints for tuples on a given node. ASM provides a rank to each feature (or attribute) by explaining the given dataset. Best score attribute will be selected as a splitting attribute. In the case of a continuous-valued attribute, split points for branches also need to define. Most popular selection measures are Information Gain, Gain Ratio, and Gini Index.

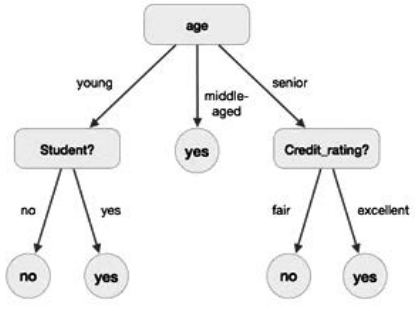

Fig. 1. *Division based on some features*

Another decision tree algorithm CART (Classification and Regression Tree) uses the Gini method to create split point.

$$\text{Gini(D)}=1-\sum_{i=1}^{m} P_i^2$$

Where, pi is the probability that a tuple in D belongs to class Ci.

The Gini Index considers a binary split for each attribute. A weighted sum of the impurity of each partition is computed. If a binary split on attribute A partitions data D into D1 and D2, the Gini index of D is:

$$Gini_A(D) = \frac{|D_1|}{|D|} Gini(D_1) + \frac{|D_2|}{|D|} Gini(D_2)$$

In case of a discrete-valued attribute, the subset that gives the minimum Gini index for that chosen is selected as a splitting attribute. In the case of continuous-valued attributes, the strategy is to select each pair of adjacent values as a possible split-point and point with smaller Gini index chosen as the splitting point.The attribute with minimum Gini index is chosen as the splitting attribute.

$$\Delta Gini(A) = Gini(D) - Gini_A(D)$$

B. K-Nearest Neighbour:

In pattern recognition, the k-nearest neighbour algorithm (k-NN) is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether k-NN is used for classification or regression. In k-NN classification, the output is a class membership. An object is classified by a plurality vote of its neighbours, with the object being assigned to the class most common among its k nearest neighbours (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of that single nearest neighbour. Ink-NN regression, the output is the property value for the object. This value is the average of the values of k nearest neighbours. k-NN is a type of instance-based learning, or lazy learning, where the function is only approximated locally and all computation is deferred until classification. The KNN classifier used for classification is shown in Fig. 2.

The direct solution would be when these are nonlinear decision boundaries between classes or when the amount of data is large enough. Input features can be both qualitative and quantitative in nature. Whereas output features can be categorical values which are typical classes seen in data.

KNN explains categorical value using majority votes of K nearest neighbors where the value for K can differ soon changing the value of K, the value of votes can also vary.

The KNN Step:

- Enter the unclassified data.
- Measure the distance of new data to all other classified data.
- There are various methods are available for calculating the distances between the new data and the dataset present.

Euclidean distance:

$$\sqrt{\sum_{i=1}^{k}(x_i - y_i)^2}$$

Manhattan Distance:

$$\sum_{i=1}^{k}|x_i - y_i|$$

Minkowski Distance:

$$\left(\sum_{i=1}^{k}(|x_i - y_i|)^q\right)^{1/q}$$

- Gets the k smaller distances.
- List the shortlisted class labels of data and their frequency.
- The class labels with the highest frequency will be the class label for new data.

Fig. 2. *KNN Classifier*

C. Multilayer Perceptron:

Multilayer perceptron consists of three different layers, input layer, hidden layer and output layer. Each of the layers can have certain number of nodes also called neurons and each node in a layer is connected to all other nodes to the next layer. For this reason, it is also known as feed forward network. The number of nodes in the input layer depends upon the number of attributes present in the dataset. The number of nodes in the output layer relies on the number of apparent classes exist in the dataset. The convenient number of hidden layers or the convenient number of nodes in a hidden layer for a specific problem is hard to determine. But in general, these numbers are selected experimentally. In multilayer perceptron, the connection between two nodes consists of a weight. During training process, it basically learns the accurate weight adjustment which is corresponds to each connection. For the learning purpose, it uses a supervised learning technique named as Back propagation algorithm. The MLP classifier used for classification is shown in Fig. 3.

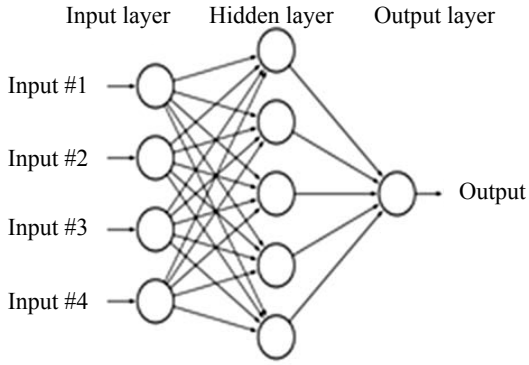

Fig. 3 *Multilayer Perceptron*

D. Support Vector Machine:

A support vector machine (SVM) is a discriminative classifier formally defined by a separating hyperplane. In other words, given labeled training data (supervised learning), the algorithm outputs an optimal hyperplane which categorizes new examples. In two-dimensional space this hyperplane is a line dividing a plane in two parts where in each class lay in either side. The main objective is to segregate the given dataset in the best possible way. The distance between the either nearest points is known as the margin. The objective is to select a hyperplane with the maximum possible margin between support vectors in the given dataset.

Some problems can't be solved using linear hyperplane, as shown in the figure below (left-hand side). In such situation, SVM uses a kernel trick to transform the input space to a higher dimensional space as shown on the right. The data points are plotted on the x-axis and z-axis (Z is the squared sum of both x and y: z=x^2+y^2). Now you can easily segregate these points using linear separation. The SVM classification process is shown in Fig. 4 and Fig. 5.

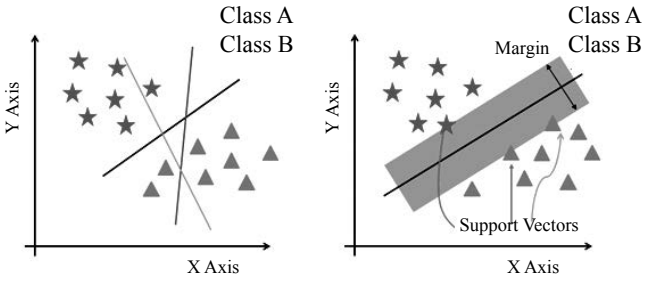

Fig. 4. *SVM Linear Classification*

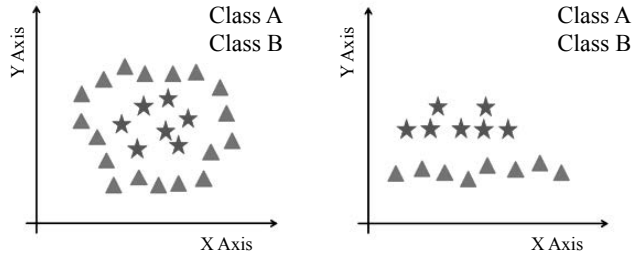

Fig. 5. *SVM Classification*

Tuning Hyperparameters:

Kernel: The main function of the kernel is to transform the given dataset input data into the required form. There are various types of functions such as linear, polynomial, and radial basis function (RBF). Polynomial and RBF are useful for non-linear hyperplane. Polynomial and RBF kernels compute the separation line in the higher dimension. In some of the applications, it is suggested to use a more complex kernel to separate the classes that are curved or nonlinear. This transformation can lead to more accurate classifiers.

Regularization: Regularization parameter in python's Scikit-learn C parameter used to maintain regularization. Here C is the penalty parameter, which represents misclassification or error term. The misclassification or error term tells the SVM optimization how much error is bearable. This is how you can control the trade-off between decision boundary and misclassification term. A smaller value of C creates a small-margin hyperplane and a larger value of C creates a larger-margin hyperplane.

Gamma: A lower value of Gamma will loosely fit the training dataset, whereas a higher value of gamma will exactly fit the training dataset, which causes over-fitting. In other words, you can say a low value of gamma considers only nearby points in calculating the separation line, while the a value of gamma considers all the data points in the calculation of the separation line.

III. DIGIT RECOGNITION

In this work, the custom training and testing data is used in order to train the model. Scanned images of handwritten digits were used as input to the Multilayer Perceptron model to recognize the digits. In order to extract the digits from the scanned image, image pre-processing is done.

A. Pre-processing:

- **Grayscaling-** also known as halftone, the only possible shades are pure black and pure white. R,G,B, image holds different intensity labels. RGB image is represented by 3 channels. each of the channel generally consists of 8-bits. Therefore, for a color image you will have intensities for each scale. Hence, lots of data to store and or manipulate.
- **Thresholding-** Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. Image thresholding is most effective in images with high levels of contrast.
- **Categorizing Thresholding-** To make thresholding completely automated, it is necessary for the computer to automatically select the threshold T.
- **Erosion-** Erosion (usually represented by ⊖) is one of two fundamental operations in morphological image processing from which all other morphological operations are based. It was originally defined for binary images, later being extended to grayscale images, and subsequently to complete lattices.
- **Dilation-** The dilation operation usually uses a structuring element for probing and expanding the shapes contained in the input image.
- **Contour-** A contour is a closed curve of points or line segments, representing the boundaries of an object in an image. In other words, contours represent the shapes of objects found in an image.
- **Contour Hierarchy-** in some cases, some shapes are inside other shapes just like nested figures. we call outer one as parent and inner one as child. This way, contours in an image has some relationship to each other. And we can specify how one contour is connected to each other, like, is it child of some other contour, or is it a parent etc. Representation of this relationship is called the Hierarchy.
- **Contour Retrieval Mode-** This extracts the contours using methods like RETR_LIST, RETR_EXTERNAL, RETR_CCOMP, RETR_TREE
- **Bounding Boxes-** Bounding boxes are imaginary boxes that are around objects that are being checked for collision, like pedestrians on or close to the road, other vehicles and signs. There is a 2D coordinate system and a 3D coordinate system that are both being used.

B. Feature Descriptor:

It is a simplified representation of an image that contains only the most important information about the image. There are a number of feature descriptors out there. Here are a few of the most popular ones:

- HOG: Histogram of Oriented Gradients
- SIFT: Scale Invariant Feature Transform
- SURF: Speeded-Up Robust Feature

The HOG descriptor focuses on the structure or the shape of an object. Now you might ask, how is this different from the edge features we extract for images? In the case of edge features, we only identify if the pixel is an edge or not. HOG is able to provide the edge direction as well. This is done by extracting the gradient and orientation (or you can say magnitude and direction) of the edges.

Additionally, these orientations are calculated in 'localized' portions. This means that the complete image is broken down into smaller regions and for each region, the gradients and orientations are calculated. Finally the HOG would generate a Histogram for each of these regions separately. The histograms are created using the gradients and orientations of the pixel values, hence the name 'Histogram of Oriented Gradients'

IV. DATASET DESCRIPTION

Samples provided from MNIST (Modified National Institute of Standards and Technology) dataset includes handwritten digits total of 70,000 images consisting of 60,000 examples in training set and 10,000 examples in testing set, both with labeled images from 10 digits (0 to 9) are used. This is a small segment form the wide set

from NIST where size was normalized to fit a 20*20-pixel box and not altering the aspect ratio. Handwritten digits are images in the form of 28*28 gray scale intensities of images representing an image along with the first column to be a label (0 to 9) for every image. The same has opted for the case of the testing set as 10,000 images with a label of 0 to 9.

A. Discussion:

The data is stored in a very simple file format designed for storing vectors and multidimensional matrices. The MNIST data set is a popular data set, on which various classification algorithms has been tested. The state of art on this data set is large Convolutional Neural Network with unsupervised pre-training. It achieved an error rate of 0.39% on test set. However, to make a fair comparison, it's more beneficial to compare performances of different algorithms without any preprocessing on the data set. Table 1 lists the error rates of several algorithm, applied on the original data set.

TABLE I. Error Rates (IN %)	
Linear Classifier	12
Nearest Neighbor Classifier	3.09
Neural Network	4.7

V. RESULTS AND DISCUSSION

All the models were compared using various metrics such as: Precision, Recall, F1-Score and Support.

- Precision = Percentage of relevant results obtained.
- Recall = Percentage of relevant results accurately predicted by our algorithm.
- F1-score = Harmonic mean of precision and recall.
- Support = Frequency of class labels present in the database.

A. Classification Report For Decision Tree Classifier:

The evaluation report of decision tree on various parameters is shown in Table. II. These parameters show that how efficient is decision tree in digit classification.

TABLE. II Classification Report				
Class Labels	**Precision**	**Recall**	**F1-Score**	**Support**
0	0.94	0.90	0.92	1011
1	0.93	0.94	0.94	1139
2	0.83	0.81	0.82	963
3	0.81	0.79	0.80	1049
4	0.84	0.85	0.84	932
5	0.79	0.79	0.79	892
6	0.87	0.90	0.88	991
7	0.89	0.91	0.90	1058
8	0.78	0.79	0.78	969
9	0.83	0.82	0.82	996
Accuracy			0.85	10000
Macro Average	0.85	0.85	0.85	10000
Weighted Average	0.85	0.85	0.85	10000

B. Classification Report For KNN Classifier:

The evaluation report of KNN on various parameters is shown in Table.III.

TABLE. III. Classification Report				
Class Labels	**Precision**	**Recall**	**F1-Score**	**Support**
0	0.99	0.99	0.99	91
1	0.79	0.99	0.88	93
2	0.99	0.83	0.91	109
3	0.82	0.92	0.87	114
4	0.95	0.83	0.88	92
5	0.92	0.86	0.89	92
6	0.95	0.99	0.97	101
7	0.92	0.92	0.92	111
8	0.96	0.78	0.86	101
9	0.83	0.94	0.88	96
Accuracy			0.90	1000
Macro Average	0.91	0.90	0.90	1000
Weighted Average	0.91	0.90	0.90	1000

C. Classification Report For Neural Network Classifier:

The evaluation report of neural network is shown in Table IV.

TABLE. IV Classification Report

Class Labels	Precision	Recall	F1-Score	Support
0	0.98	0.97	0.97	1011
1	0.97	0.99	0.98	1139
2	0.96	0.97	0.97	963
3	0.96	0.95	0.96	1049
4	0.98	0.96	0.97	932
5	0.96	0.95	0.96	892
6	0.96	0.99	0.97	991
7	0.96	0.98	0.97	1058
8	0.97	0.94	0.96	969
9	0.96	0.94	0.95	996
Accuracy			0.97	10000
Macro Average	0.97	0.96	0.96	10000
Weighted Average	0.97	0.97	0.97	10000

D. Classification Report For Support Vector Machine:

The evaluation report of support vector machine is shown in Table V.

TABLE. V Classification Report

Class Labels	Precision	Recall	F1-Score	Support
0	0.92	0.88	0.90	1011
1	0.90	0.89	0.90	1139
2	0.87	0.61	0.72	963
3	0.72	0.73	0.72	1049
4	0.62	0.89	0.73	932
5	0.75	0.63	0.69	892
6	0.83	0.88	0.85	991
7	0.77	0.89	0.97	1058
8	0.66	0.78	0.83	969
9	0.69	0.46	0.55	996
Accuracy			0.77	10000
Macro Average	0.77	0.76	0.76	10000
Weighted Average	0.78	0.77	0.76	10000

E. Accuracy Graph:

In Fig. 6, the accuracy of four techniques is shown. The decision tree is shows less accuracy than MLP and SVM.

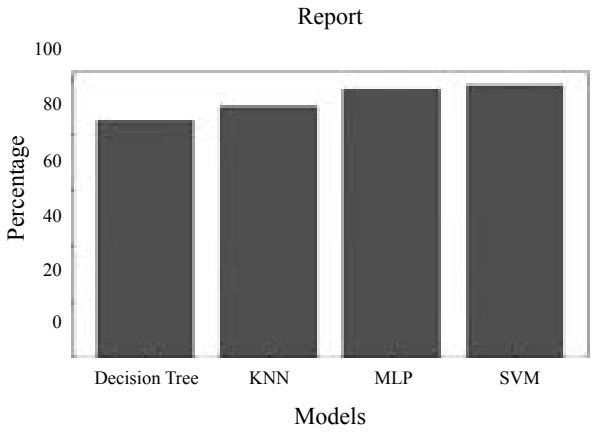

Fig. 6 *Accuracy graph of four ML models.*

VI. CONCLUSIONS

In this work, we have analyzed different machine learning models like KNN, SVM, MLP, Decision tree on the basis of parameters like precision, recall, macro accuracy, micro accuracy. The MLP model is used for training the custom dataset which has been pre-processed using some image processing methods like gray-scaling, thresholding, erosion, dilation etc. Our trained model on custom dataset gives about 80% accuracy on user input image for digit prediction, which is a satisfactory outcome.

However, the classifier can further be advanced with convolution neural network and deep learning concepts to achieve better results.

ACKNOWLEDGMENT

We would like to show our gratitude to our project guides Dr. Jasaswi Prasad Mohanty and Dr. Ajay Kumar Tripathy for their guidance in carrying out this project.

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Ritu Rani Keshri,
Sandhya Kumari,
H. Rukshar,
Ina Priya,

Dept. of CSE

THE UNIVERSE MIGHT HAVE A FUNDAMENTAL CLOCK THAT TICKS VERY, VERY FAST.

Time could be the result of particles interacting with a ticking cosmic timepiece Like a metronome that sets the tempo for a musician, a fundamental cosmic clock may be keeping time throughout the universe. But if such a clock exists, it ticks extremely fast. In physics, time is typically thought of as a fourth dimension. But some physicists have speculated that time may be the result of a physical process, like the ticking of a built-in clock.If the universe does have a fundamental clock, it must tick faster than a billion trillion trillion times per second, according to a theoretical study published June 19 in Physical Review Letters. In particle physics, tiny fundamental particles can attain properties by interactions with other particles or fields. Particles acquire mass, for example, by interacting with the Higgs field, a sort of molasses that pervades all of space (SN: 7/4/12). Perhaps particles could experience time by interacting with a similar type of field, says physicist Martin Bojowald of Penn State. That field could oscillate, with each cycle serving as a regular tick. “It’s really just like what we do with our clocks,” says Bojowald, a coauthor of the study.The researchers considered the effect that a fundamental clock would have on the behavior of atomic clocks, the most precise clocks ever made (SN: 10/5/17). If the fundamental clock ticked too slowly, these atomic clocks would be unreliable because they would get out of sync with the fundamental clock. As a result, the atomic clocks would tick at irregular intervals, like a metronome that can’t keep a steady beat. But so far, atomic clocks have been highly reliable, allowing Bojowald and colleagues to constrain how fast that fundamental clock must tick, if it exists.

Density Based Smart Traffic Signal Control Using Microcontroller and GSM Module

Abstract: Handwritten character recognition is one of the practically important issues in pattern recognition applications. The heart of the problem lies within the ability to develop an efficient algorithm that can recognize hand written digits and which is submitted by users by the way of a scanner, tablet, and other digital devices. This paper presents a comparative study of various machine learning models to tackle the handwritten digits recognition problem. Several machines learning algorithm namely, Decision Tree, K-Nearest Neighbor, Multilayer Perceptron and Support Vector Machine were analyzed for the recognition of digits. The Multilayer Perceptron model is selected as the model with highest accuracy and is used for custom digit recognition with custom training and testing data, which recognizes the scanned image of user handwritten digits. The presented model is experimented on the well-known MNIST data set.

Keywords: GSM, ATmega16, IR LED, AVR

I. INTRODUCTION

A steady increase in metro-city population, the number of automobiles and cars increases rapidly and metro traffic is growing crowded which leads to the traffic jam problem [1, 2]. Nowadays, controlling the traffic becomes major issue because of rapid increase in automobiles and also because of large time delays between traffic lights. So, in order to rectify this problem, we will go for density based traffic lights system. This article explains you how to control the traffic based on density. In this system, we will use IR sensors to measure the traffic density. One IR sensor is arranged for each road; these sensors always sense the traffic on that particular road. All these sensors are interfaced to the microcontroller. Based on these sensors, controller detects the traffic and controls the traffic system. The main heart of this traffic system is microcontroller. IR sensors are connected to the PORT C (PC0, PC2, PC4, and PC6) of the microcontroller and traffic lights are connected to PORT A and PORT B. If there is traffic on road then that particular sensor output becomes logic 0 otherwise logic 1. By receiving these IR sensor outputs, we have to write the program to control the traffic system. If you receive logic 0 from any of these sensors, we have to give the green signal to that particular path and give red signal to all other paths. Here continuously we have to monitor the IR sensors to check for the traffic. We have to place these IR pair in such a way that when we place an obstacle in front of this IR pair, IR receiver should be able to receive the IR rays. When we give the power, the transmitted IR rays hit the object and reflect back to the IR receiver. Instead of traffic lights, you can use LEDs (RED, GREEN, YELLOW). In normal traffic system, you have to glow the LEDs on time basis. If the traffic density is high on any particular path, then glows green LED of that particular path and glows the red LEDs for remaining paths [3,4]

II. OBJECTIVE

During the literature survey we come across many journal papers in which traffic is control with the help of microcontroller. It is density based traffic signal system. Utilizing the concept of IR sensor and control the density of traffic. In this article with the help of command we control the microcontroller. [5]

III. PROJECT OVERVIEW:

The overview of this article is to implement Density based traffic control system using IR technology and ATmega16 microcontroller. The article density based traffic light control is an automated way of controlling signals in accordance to the density of traffic in the roads. IR sensors are placed in the entire intersecting road at

fixed distances from the signal placed in the junction. The time delay in the traffic signal is set based on the density of vehicles on the roads [6].

The IR sensors are used to sense the number of vehicles on the road. According to the IR count, microcontroller takes appropriate decisions as to which road is to be given the highest priority and the longest time delay for the corresponding traffic light [7].

The GSM module used in the project helps in escape of emergency vehicles like ambulance, police cars and VIP cars [8].

IV. PROJECT DESCRIPTION:

Traffic Congestion detection and Alert System use different hardware components and software to govern the system are as follows:

- Microcontroller (ATmega 16) Board
- GSM (SIM900) Module

A. Microcontroller(ATmega 16):

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed [1, 9].

ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively. ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD. ATmega16 has various in-built peripherals like USART, ADC, AnalogComparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals. [8].

B. GSM (Sim 900) modem:

This is a GSM/GPRS-compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz and which can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs [7].

Externally, it looks like a big package (0.94 inches x 0.94 inches x 0.12 inches) with L-shaped contacts on four sides so that they can be soldered both on the side and at the bottom. Internally, the module is managed by an AMR926EJ-S processor, which controls phone communication, data communication (through an integrated TCP/IP stack), and (through an UART and a TTL serial interface) the communication with the circuit interfaced with the cell phone itself. The processor is also in charge of a SIM card (3 or 1.8 V) which needs to be attached to the outer wall of the module [5, 6]. The GSM module is shown in Fig-1.

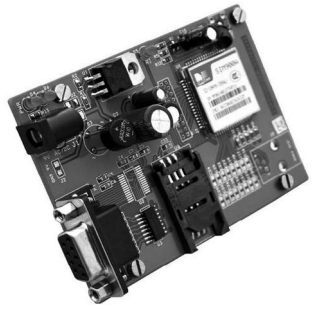

Fig. 1: *GSM module*

The circuit diagram of the system is shown in Fig.-2

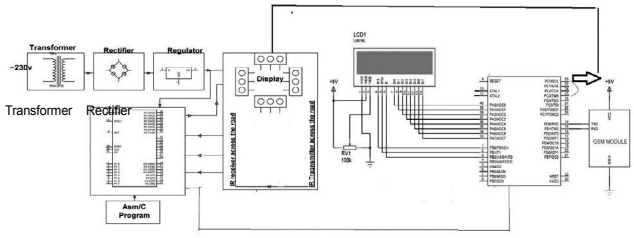

Fig. 2: *Circuit diagram of designed system*

V. CONCLUSION:

In this work, we have implemented density based traffic signal system using microcontroller. The hardware equipment is tested and result is obtained. This project is cost effective. Implementation of this project in present day will effectively solve the traffic congestion which is a severe problem in many modern cities all over the world. Consider a scenario of highly congested area where many vehicles such as personal transport, public transport and emergency vehicles (Ambulance, Fire brigade, VIP cars and other rescue vehicles) have to wait for long for the change of traffic signals at intersection points. This leads to the wastage of precious time

especially in case of rescue vehicles for emergency conditions. It is possible to propose dynamic time-based coordination schemes where the green signal time of the traffic lights is assigned based on the present conditions of traffic. This is achieved by using IR sensors across the road to monitor the length of vehicles blocking the road traffic. The signals from the IR receivers are fed to the microcontroller to follow the program with the time as desired. With a slight modification this project can be implemented in a nearby area.

VI. FUTURE SCOPE:

Integration of multiple traffic junctions using GSM technology linked with satellite to control the traffic lights dynamically along with sharing the real time data to the traffic users. Also in order to reduce the delay of the transmission of the emergency vehicles by tracking their real time movement using GPS so that to reduce the time delay in the sending of message at multiple traffic junctions. Also we can use digital image processing. The proposed system can be prolonged further by make use of same system for vehicle number plate detection which will help the cops and traffic management system for identifying vehicles. In future this system can be used to inform people sitting on a single place about traffic conditions of different places by developing a mobile phones application. LCD can be increased in N numbers to display traffic conditions and control the traffic of whole city.

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Jyoti Ranjan Sahoo,
Kumar Ayush,
Kumar Mangal Singh,
Mahip Kakan,
Mamta Solanki,
Pratik Mangaraj,
Ritu Amrita Palo

Dept. of ECE

Medical Data Sharing using Blockchain

Abstract: ***The dissemination of patients' medical records results in diverse risks to patients' privacy as malicious activities on these records cause severe damage to the reputation, finances, and so on of all parties related directly or indirectly to the data. Current methods to effectively manage and protect medical records have been proved to be insufficient. In this work, we propose a system that addresses the issue of medical data sharing among medical stakeholders in a trust-less environment. The system is blockchain based and provides data origin authentication, auditing, and control for shared medical data among the related entities. It monitors entities that access data for malicious use. In our system data transitions and sharing from one entity to the other, are recorded in a tamper-proof manner. The design employs smart contracts and an access control mechanism to effectively track the behavior of the data and revoke access to offending entities. By implementing this proposed system, medical stakeholders will be able to achieve data origin authentication and auditing while sharing medical data with entities such as research and medical institutions with minimal risk to data privacy.***

Keywords: Blockchain, public key, private key, digital signature, authenticator, consensus node, data sensitivity.

I. INTRODUCTION

In modern societies, cultures and organized groups, the dissemination of medical data has been perceived to be a breakthrough for the discovery of new techniques and therapies for curing diseases [1]. The key drive for the above mentioned statement is due to the digitization, electronic storage and remote accessibility of medical data by professionals [2]. These records are generated by hospitals after patient visits thereby making patients' sole owners of electronic medical. The importance of data and the value inherent in its dissemination has given birth to business entities that collect, process, analyze, store, and given the appropriate incentive sharing of data with other interested parties [3], [4]. For data owners and custodians, there is an existing risk of collected data being vulnerable in the hands of malicious data users. For such risks, policy makers lessen intent of exposing data content by instilling policies that exploit the fear of data users. Although policies work in the favour of data owners and custodians, the fear of breaching regulations and the ensuing penalties to be paid in both financial and reputation terms foster an atmosphere of distrust which ensures data sharing does not occur [5].

For establishing right inducements geared towards data sharing while highlighting attractive features of such acts, there remains the issue of loss of control over the data [6]. Traditionally, once the data leaves the custodians system where the data was first collected or generated, there is no control over what the next user can do with it [7]. This permits malicious users to abuse data, causing data owners and custodians several legal and reputation-attacking problems with industry regulators.

Several cryptographic methods have been proposed to address these problems arising from sharing of medical data but have still been insufficient [8] [9]. Nonetheless, the blockchain is seen as a strongest to provide a suitable solution to addressing this problem through its attractive features such as immutability and decentralization [10] [11].

In this paper, we proposed a blockchain based solution for sharing medical data among cloud service providers while providing data access control, provenance and auditing. Actions of data beneficiaries are constantly monitored through mechanisms mentioned later in the paper and breaches are addressed accordingly by revoking access to the data.

II. RELATED WORKS

In this section, different research trends pertaining to data sharing and access control with emphasis on the improving blockchain technology are outlined. Xia et al. [12] proposed a blockchain-based data sharing framework that sufficiently addresses the access control challenges associated with sensitive data stored in the cloud using immutability and built-in autonomy properties of the blockchain. They employed the use of secure cryptographic techniques to ensure efficient access control to sensitive shared data pool(s) using a permission blockchain and design a blockchain-based data-sharing scheme that permits data users/owners to access electronic medical records from a shared repository after their identities and cryptographic keys have been verified. The requests after verification and onward servicing form part of a closed, permissioned blockchain.

In this work, we provide a secured blockchain-based data sharing of electronic medical records among untrusted parties. The main contribution of our work is to provide data provenance, auditing and secured data trailing on medical data. The various literatures reviewed in this section provide insufficient mechanisms in achieving data provenance, auditing and data trailing on medical data. It should be mentioned that our system relies on smart contracts to effectively monitor the behavior of data out of the custodians care.

III. PRELIMINARIES

In this section, we formally define the preliminaries used in our blockchain based data sharing system among un trusted parties. We highlight the blockchain network with side blocks as part of individual components in addition to triggers put in place to achieve the system. A brief outline on the supposed behaviour of cryptographic behaviour required for the System is further described.

A. Blockchain Network:

The blockchain is a distributed database that contains an ordered list of records linked together through chains, on blocks. Blocks can be defined as individual components that contain information relating to a particular transaction. An example of such information can be a log on a single event (requestor needing data from the system). A blockchain network maintains a continuous growing list of records which are immutable. Due to this reason, many systems built on the blockchain technology achieve secured distribution of assets among untrusted clients.

B. Cryptographic keys:

Cryptographic keys indicate the sets of keys highlighted to execute specified tasks relating to the security of a framework. For the blockchain-based data sharing scheme, we highlight keys needed to achieve confidentiality for transactions between systems via untrusted channels. These keys help to guarantee for a level of security of the scheme. These keys includes:

- Requestor's private key and public key
- Data-owner's private key and public key
- Authenticator's private and pulic key

IV. DESIGN FORMULATION

A. System model:

In the presented system, there are three main layer. i.e. user layer ,existing database layer and Data Structuring and provenance layer. Each layer consists of different classes which interact with each other. The Layers of the presented model is shown in Fig. 1.

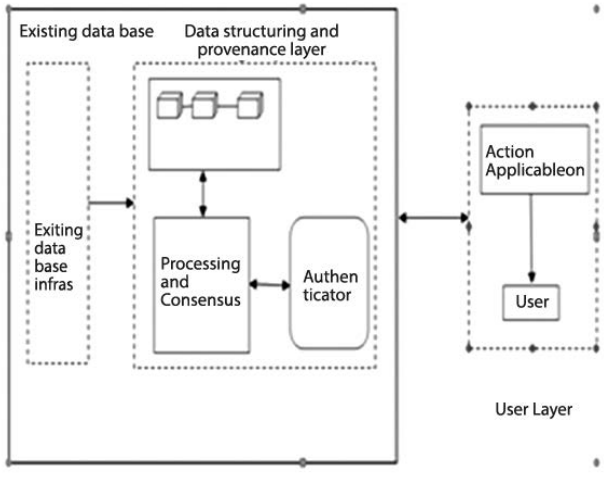

Fig. 1: *Layers of the presented model*

1. **User Layer:** The user layer consists of all the different classifications of users whose intentions are to access data from the system for research or other useful purposes. The intent of most users is to help analyse data for research purposes. Examples of users can be healthcare organizations such as hospitals, research institutions as well as universities, individual research personnel's and governmental bodies.

2. **Data Structuring and Provenance Layer:** Data structuring and provenance layer consist of individual components that help process request for access to data from the existing database infrastructure layer. The layer additionally performs computations on requested data and tag data with functionalities that monitor every action performed on the data. Results of every action completed are broadcast into an immutable network to guarantee trust-less and fair auditing. Finally, the layer has a responsibility of authenticating every request and actions pertaining to data access from the entire system.

   The different entities in the data structuring and provenance layer;

   Authenticator: The authenticator is responsible for verifying the legitimacy of requests sent by requestors to the data owners system. The authenticator generates authenticator contract keys that are used to encrypt actions from the data in the User's environment to the data owner's system. The authenticator tags the encryption keys to the entity responsible for reporting such actions. Additionally the authenticator encrypts a package which contains the data requested by the user and is finally delivered to the appropriate requestor.

   Processing and consensus nodes: The processing and consensus nodes process forms created for requests which are later developed into blocks and broadcast into the blockchain network.

   Blockchain Network: The blockchain network is composed of individual block broadcast into a network and chained together in a chronological method. The main role of the blockchain net- work is to maintain a chronologically distributed immutable database of actions on the delivery and request of data from the system.

3. **Existing Database Infrastructure layer:** The existing database infrastructure layer consists of already established database systems implemented by individual parties to accomplish specific tasks. Such database systems are only accessible by authorized personnel of such companies since they house sensitive information which requires secure mechanisms to adequately protect such sensitive data. For access to data from such databases, requested datasets are passed through sets of computations to decentralize the data before they shared.

4. **Block structure:** A block is made up of a format which uniquely identifies the block. This is followed by the block size which contains the entire size of the block. The next structure is the block headers. The block header is hashed with sha256(sha256()) as done in the bitcoin headers. The block header contains the data version which indicates the validation rules to follow for a particular data type. The data version gives account on the properties and the type of data being accessed. The header is also made up of the previous blocks hash which is a sha256(sha256()) hash whose function is to ensure that no previous block header can be changed without changing this blocks header. The merkle root hash forms part of the header by ensuring that none of the blocks in the blockchain network can be modified without modifying the header. This is achieved by taking the hashes of all the events in the blockchain network and appending the output to the current block.

   The final output is a sha256(sha256()). The header includes a timestamp of when the block was created. The header contains target difficulty which is a value of how processing is achieved by the processing and consensus nodes. This is unique to the system to make processing difficult for malicious nodes but efficient and solvable by verified consensus nodes in the system. Finally, the header consists of a nonce which is an arbitrary number the consensus nodes generate to modify the header hash in order to produce a hash below the target difficulty. The block header is therefore made up of six components.

   The block has an action counter whose function is to record the total number of violation actions applicable on the accessed data in the entire block. Preceding the action counter is the transaction which

is categorized into two parts that is, the timestamps and the data. The data part is made up of the data owner identity (OID), requestor identity (RID), sensitivity of data (Dsens), purpose of data request (DRP), processing node identity (NID) and signature of processing node (Nsig). Finally, the structure that defines the entire block is the block locktime. This is a timestamp that records the last entry of transaction as well as the closure of a block. When conditions for this field are met, the block is ready to be broadcast into the blockchain network. The block details is shown in Fig. 2.

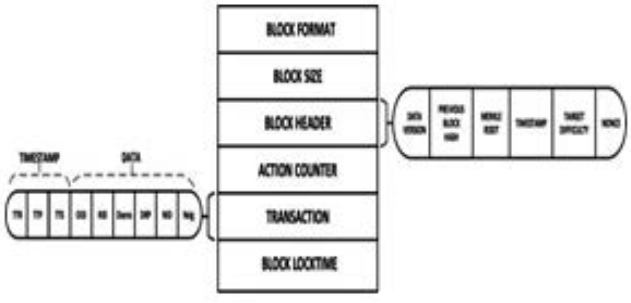

Fig. 2: *The block*

V. SYSTEM SIMULATION

In this section, we present a construction of entities and functions of components necessary for the secured sharing of data among un-trusted parties. We outline designed structures that realize data sharing by presenting our data access system which aims to provide a suitable sharing scheme whilst preserving the required security properties of the blockchain.

A user sends a request for data access to a system. The data request is signed by the user using a ‘‘pre-generated’’ requestor private key. The request is received by the query system an entry point for recording and processing requests. The query system forwards the request to the data structuring and provenance layer by the triggers since triggers translate the query (request) into a structure that can be understood by the data structuring and provenance layer. The authenticator receives the request and verifies the legitimacy by verifying the signature using the requestors' public key which was generated and shared before the request was sent. If the signature is valid, the process is accepted else dropped for invalid requests.

For a valid request, the authenticator forwards the request to the processing and consensus nodes where processing of requests into forms are completed. The form generated contains a hash of the timestamp of when the request was received and a hash of the ID of the requestor. The purpose for the data request is tagged to the form and then forwarded to the existing database infrastructure. The existing database infrastructure receives the form, retrieves the data and sends the retrieved data to the data structuring and provenance layer. This is received by the processing and consensus node and a hash of this timestamp is concatenated to the existing record of a hashed timestamp for the request. The processing and consensus nodes send a request to the smart contract center for appending sets of rules to the requested data. A smart contract is generated and tagged to the form which contains the data indexed to form some sort of adjacency with the related block.

Results of the processed data are then sent to the authenticator to generate an authenticator contract key and tag the encryption key of this generated set of data. The processing and consensus node process a block based on the information relating to the request and broadcasts the block into a blockchain network. The block forms a part of already existing blocks in relations to the requestor and is tagged with an identity to uniquely identify the different blocks in the network. This is achieved through chronology and perfect ordering. The data is encrypted, forming a package encrypted, and tagged with the ID of the requestor. The result is finally distributed to respective requestors. The structure of the final package is shown in Fig. 3.

DataID: <<ID of payload, excluding signature >> NodeID: <<ID of processing node, including Signature >>
Data Hash: <<Hash of payload >> Sensitivity: <<Sensitivity of payload >> Payload
Verifier Node NodeID: <<Node responsible for verifying processed
Encryption Authenticator Key <<Tag key to smart contract and Encrypt payload >> Timestamp: <<Timestamp of completed processing >>

Fig. 3: *structure of the final package*

VI. CONCLUSIONS

In this work, we have designed a data sharing model between medical stakeholders using the blockchain. The design gives authority to the data owner of the medical file to share with the requestors. As the whole design is implemented using blockchain, it provides better security in comparison with the centralized systems. The system provides data origin authentication and control for shared medical data among the related entities. However, the current system doesn't comprise data auditing feature and revoke access feature which may be added for enhancing the system.

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Aishwarya Singh, Jyotirmaya Sahu, Satya Narayan Pradhan, Baby Attraction

Dept. of ECE

Three Phase Load Balancing Using Arduino

Abstract: Now a days in India three phase unbalancing is a major problem. These unbalanced currents in three phase loads is a disturbance that can cause damage to the power transformer. Load unbalance on the power transformer causes losses, excess heat on one phase, reduced lifetime and efficiency on the power transformer and may result in a decrease in the power quality of the power system. The unbalanced distribution system can lead some areas overloaded and some areas with less loaded. So to avoid these condition, controlling of the load is required in this areas. It leads to the load balancing technique and the load balancing is the process to prevent the system from the overloading condition. This project explains the details of load balancing and steps for the how to design and implement automatic load balancing in the power distribution using Arduino. The proposed model highlights the automation of loads. Each house assumes to have a smart energy meter connected with some switches. These switches are used for phase swapping based on an algorithm for loads balancing in an unbalanced electrical distribution network. The proposed model is built on Arduino which provides a cost efficient alternative to existingsolutions.

Keywords: Arduino, static-VAR-compensators (SVC), integrated circuits (IC), In Circuit Serial Programming (ICSP), phasing unbalance index(PUI), Integrated Development Environment (IDE)

I. INTRODUCTION

The future of systems in the world is the transformation intelligent systems, including the electrical power system and distribution networks. Modern technology can be invested in order to eliminate many problems in the system, including an imbalance in voltage and current, as well as the unbalanced distribution of loads on the three phases of the network leading to one of its limbs exceeding the permissible load [1]. The risks of imbalanceare many, including voltage drop or malfunction of transformers and increase the probability of the breakdown. As well as the energy losses are increaseddue to imbalances. The unbalanced electric distribution network adversely affects the process of powerproduction in terms of increasing loss of network. As well as increase the operation and maintenance costs of network equipment of transformers, circuit breakers and others, which called for the search for, balance mechanisms to reduce the effects of the imbalance problem. Many ways can be used to solve this problem, but some areexpensive, such as redistribution and transfer of electrical transformers, using Scott transformer and Steinmetz, connect circuit breakers and capacitors, using static VAR compensators (SVC), feeder reconfiguration, and phase swapping [2]. This project explains the details of load balancing and steps for the how to design and implement a load balancing in the power distribution.

II. COMPONENTS

A. TRANSFORMER:

A transformer is a passive electrical device that transfers electrical energy between two or more circuits [3]. A varying current in one coil of the transformer produces a varying magnetic flux, which, inturn, induces a varying electromotive force across a second coil wound around the same core [4]. Electrical energy can be transferred between the two coils, without a metallic connection between the two circuits.Transformers are used for increasing or decreasing the alternating voltages in electric power applications.

B. 4-CHANNEL-5 VOLT RELAY MODULE:

Fig. 1 shows a 4 Channel 5V Optical Isolated Relay Module. This is a LOW Level 5V 4-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller [5]. This module is optically isolated from high voltage side for safety requirement and also prevent ground loop when interface to microcontroller.

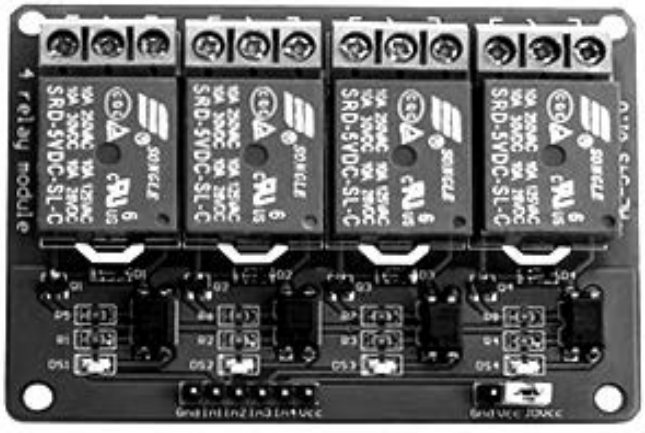

Fig 1: *4-Channel 5-Volt Relay Module*

C. ARDUINO UNO:

Arduino is an open source, computer hardware and software company, project, and user community that designsandmanufacturesmicrocontrollerkitsforbuilding digital devices and interactive objects that can sense and control objects in the physicalworld.It has 6 analog input pins and 14 digital input or output pins which can be used as PWM (Pulse Width Modulation) outputs. It has its own programming language [6]. The crystal oscillator frequency of this microcontroller is 16MHz. It has USB cable which can simply connect with computer, power barrel jack, reset button and ICSP (In Circuit Serial Programming). Eachpin of the Arduino Uno is operated at 5V.The programming language of this microcontroller is not complex [7].

D. ACS712 CURRENT SENSOR MODULE:

The ACS712 Module is shown in fig.2 uses the famous ACS712 IC to measure current using the HallEffect principle. The module gets its name from the IC (ACS712) used in the module, so for you final products use the IC directly instead of the module. These ACS712 module can measure current AC or DC current ranging from +5A to - 5A, +20A to -20A and +30A to-30A.

Fig 2: *ACS712 Current Sensor*

E. ARDUINO IDE SOFTWARE:

Software used to control this system is Arduino IDE (Integrated Development Environment). This software is used to write the program and compile it to the Arduino Uno board [8]. Therefore, the Arduino software commands control the Arduino board, sensing devices and another circuitry.

III. METHODOLOGY

- Arduino is a microcontroller which provides open source platform to perform software and hardwareoperations.
- The supply of 230 volt is being fed to the transformer rating 0f 230/12 Volt and the output of it is connected to the currentsensor.
- The output of current sensor is being connected to analog pins of Arduino to convert output voltage of sensor into current.
- The digital pins of Arduino is connected to the 5 volt 4 module relay input and a 5 volt supply and ground is connected torelay.
- There are two types of loads are used:
  1. Fixed loads, 2. Variableloads
- Some amount of load is always connected to the phases and they are known as fixedloads.
- Some loads are connected which is being switched between phases and they are known as variableloads.
- In Arduino the code is being uploaded which contains swapping algorithm as in fig. 3.

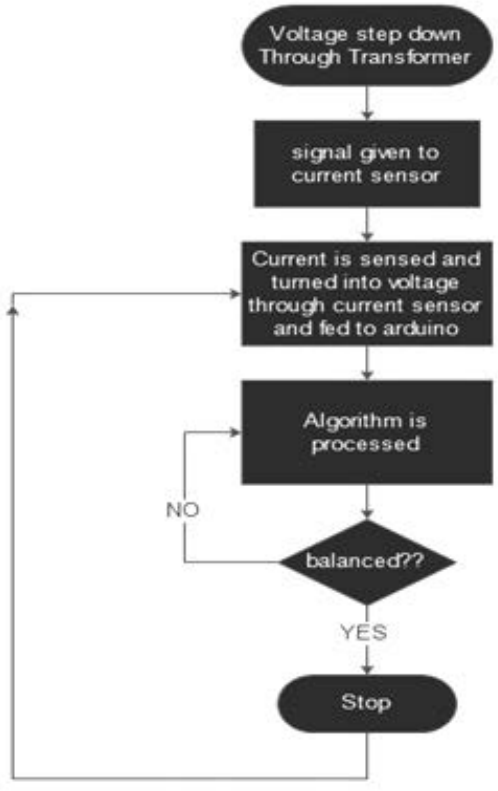

Fig 3: *Process Flow*

First the load in each and every phase is being calculated and then swapping is done by using certain algorithm between variable loads to make the current close to each and everyphase.It is possible to calculate the unbalance ratio "voltage or current unbalance index" for distribution networks and at each house by calculating the ratio between the negative sequence and the positive sequence component of the voltage or current. This can be approximated as the ratio between the values of the maximum deviation of one phase from the mean of three phases using the following equation:

$$\text{Current unbalance ratio (\%)} = \frac{\text{Maximum deviation from the means of the three phase current}}{\text{mean of the three phase current}} \times 100\%$$

$$= \frac{\text{Max}\left(|I_R - I_{avg}|, |I_Y - I_{avg}|, |I_B - I_{avg}|\right)}{I_{avg}} \times 100\%$$

And according to the European Standard EN 50160 (1994), the unbalance ratio within 2% is acceptable [22]. The unbalance ratio "phasing unbalance index(PUI)" of current can be calculated in the same way as voltage unbalance ratio using the following equation:

$$PUI = \frac{\text{Max}\left(|I_{avg} - I_R|, |I_{avg} - I_Y|, |I_{avg} - I_B|\right)}{I_{avg}} \times 100\%$$

Where IR, IY, IB: currents of phases R, Y, and B and Iavg is the average current of the three phase currents. The maximum acceptable rate of imbalance current is 10%. Where exceeding this ratio leads to an increased temperature of the transformer windings and that will affect the life span of the transformer. Also exceeds the maximum value of PUI, leads to increase the losses ofwindings and active power, and thus reducing the efficiency.

IV. RESULTS AND DISCUSSION

The circuit diagram and its hardware implementation is shown in Fig. 4 and 5.

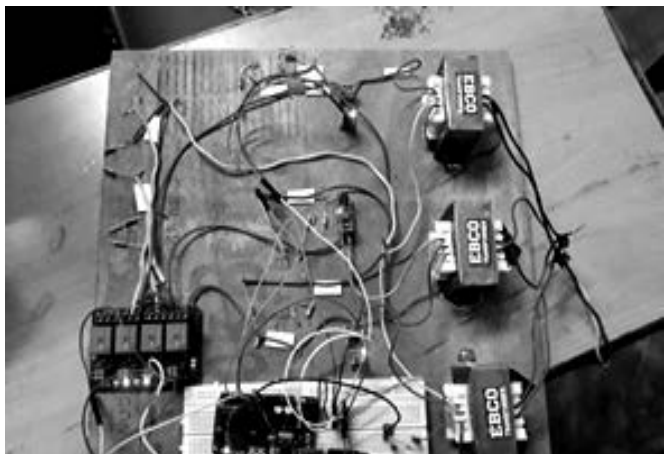

Fig 4: *Hardware Implementation*

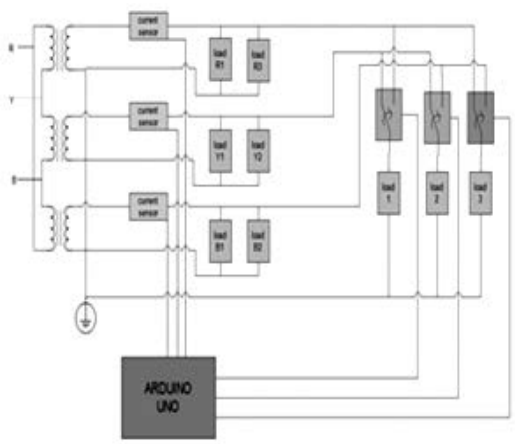

Fig 5: *Circuit Diagrams*

V. CONCLUSIONS

In this article, a smart distribution and load balancing model is presented. The proposed system is able to provide the status of different feeders with respect to changes in different loads namely domestic. For decision making and operation as per desired preferences, the proposed model has used Arduino. It is observed through experimental work that based on the Arduino control preferences, the model is able to provide automatic operation of the distribution as well as load balancing of the power system.

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Subhakanta Lenka, Sudipta Samal, Srinivas Sahoo, Raj Kumar Adhikary, Pradipta Kumar Parida

Dept. of EEE

SOME SCIENTISTS SAID SO...

"It is no good getting furious if you get stuck. What I do is keep thinking about the problem but work on something else. Sometimes it is years before I see the way forward. In the case of information loss and black holes, it was 29 years."

- Stephen Hawking

"If I have seen further it is by standing on the shoulders of Giants."

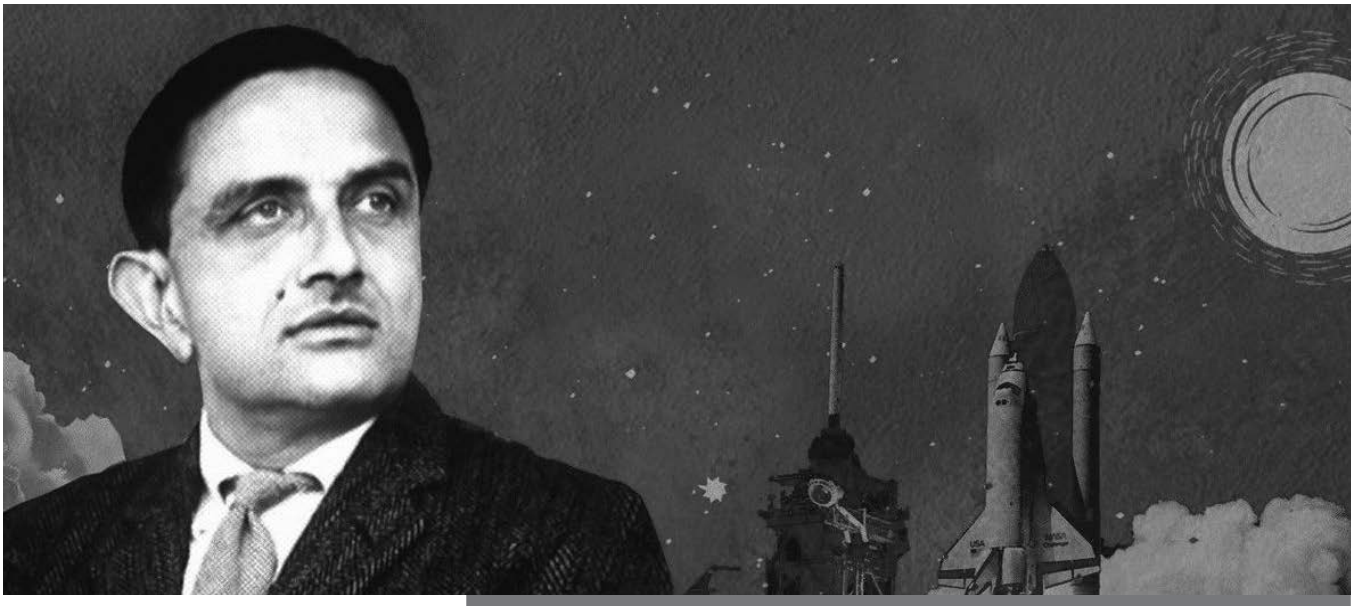
- Issac Newton

"Every brilliant experiment, like every great work of art, starts with an act of imagination."

- Jonah Lehrer

"Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less."

- Marie Curie



Dr. Vikram Ambalal Sarabhai

Vikram Ambalal Sarabhai was an Indian physicist, acclaimed as the father of India's space programme. He was also known as the "Renaissance Man", because he always had interest in revival of something new and different. This quality made him to establish a large number of institutions in diverse fields. He was honored with Padma Bhushan in 1966 and the Padma Vibhushan in 1972.

He was born in Sarabhai family of India who were major industrialists committed to the Indian Independence Movement and son of Ambalal Sarabhai. Vikram Sarabhai married the classical dancer Mrinalini in 1942. The couple had two children. His daughter Mallika gained prominence as an actress and activist, and his son Kartikeya too became an active person in science. He attended Gujarat College, Ahmadabad, but later shifted to the University of Cambridge, England.

He knew the importance of education in developing a nation. In order to achieve the goal of education, the establishment of Indian Institute of Management, Ahmedabad (IIMA) was one such innovative initiative. The importance of education can be known by his quotes: "The development of the nation is intimately linked with understanding and application of science and technology by its people"

The establishment of Indian Space Research Organization (ISRO) was one of his greatest achievements. He successfully convinced the government of the importance of a space program for a developing country like India. Dr. Sarabhai emphasized the importance of a space program in his quotes: "There are some who question the relevance of space activities in a developing nation. To us, there is no ambiguity of purpose. We do not have the fantasy of competing with the economically advanced nations in the exploration of the Moon or the planets or manned space-flight. But we are convinced that if we are to play a meaningful role nationally, and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society, which we find in our country."

On April 19, 1975, India made history when Aryabhata, India's first-ever satellite, launched into space successfully. Vikram Sarabhai's work in cosmic rays and properties of upper atmosphere continues to be an important landmark in science, and as the result of which, the first Indian satellite, Aryabhata, was put in orbit. If you are watching cable television right now, then you partly have Dr. Vikram Sarabhai to thank for it. Due to him, the channels of communication he had opened with NASA led to the setting up of the Satellite Instructional Television Experiment (SITE) in 1975. It started the advent of cable TV in India. The Physical Research Laboratory (PRL) was founded in 1947 by Vikram Sarabhai. PRL had a modest beginning at his residence, known as foundation of space sciences in India.

Born in the family of freedom fighters, Vikram Sarabhai's contribution to the history of Science and Technology in India is a milestone. Not only in the field of space technology, he had taken several step to educate people and to make our life easier in so many ways. He was honored by ISRO by giving the name "Vikram" to the lander on India's Moon Mission Chandrayaan-2 which was to land near South Pole of the moon on Sep. 20, 2019.

Tanmaya Bal
Dept. of ECE

The Large Hadron Collider

The Large Hadron Collider (L.H.C.) is the largest and most powerful particle accelerator in the world. It was built by the European Organization for Nuclear Research (CERN) between 1998 and 2008 in collaboration with over 10,000 scientists and hundreds of universities and laboratories, as well as more than 100 countries.[3] It lies in a tunnel 27 kilometers (17 mi) in circumference and as deep as 175 meters (574 ft) beneath the France–Switzerland border near Geneva. It first started up on 10 September 2008, and remains the latest addition to CERN's accelerator complex. The LHC consists of a 27-kilometre ring of superconducting magnets with a number of accelerating structures to boost the energy of the particles along the way.

Inside the accelerator, two high-energy particle beams travel at close to the speed of light before they are made to collide. The beams travel in opposite directions in separate beam pipes – two tubes kept at ultrahigh vacuum. They are guided around the accelerator ring by a strong magnetic field maintained by superconducting electromagnets. The electromagnets are built from coils of special electric cable that operates in a superconducting state, efficiently conducting electricity without resistance or loss of energy. This requires chilling the magnets to 271.3°C – a temperature colder than outer space. For this reason, much of the accelerator is connected to a distribution system of liquid helium, which cools the magnets, as well as to other supply services.

The L.H.C. was designed to bring into collision of opposing beams of either protons with energies of about 7 tera-electron volts (7 TeV/1.12 micro joules) per particle or lead nuclei with energies of 574 TeV (92μJ) per nucleus. Thousands of magnets of different varieties and sizes are used to direct the beams around the accelerator. These include 1232 dipole magnets 15 meters in length which bend the beams, and 392 quadrupole magnets, each 5–7 meters long, which focus the beams. Just prior to collision, another type of magnet is used to "squeeze" the particles closer together to increase the chances of collisions. The particles are so tiny that the task of making them collide is akin to firing two needles 10 kilometers apart with such precision that they meet halfway.

The construction of the collider included a circular tunnel of circumference 27 kilometers. It previously contained a large electron-positron collider. The collider tunnel contains two adherent parallel beam lines (beam pipes) that intersect at 4 points each containing a proton beam,1232 magnets used to keep the beam and circular path and 392 additional quadrepole to keep the beams focused, 1600 superconducting magnets (271 ton each) present to maximize the chances of collision. A temperature of 1.9K (-271.25ºC) required to maintained the superconductivity of magnets. Total 96 tonnes of liquid helium costing 7.64 U.S. dollars are employed.

An initial focus of research was to investigate the possible existence of the Higgs boson, a key part of the Standard Model of physics which is predicted by theory but had not yet been observed before due to its high mass and elusive nature. CERN scientists estimated that, if the Standard Model were correct, the LHC would produce several Higgs bosons every minute, allowing physicists to finally confirm or disprove the Higgs boson's existence. In addition, the LHC allowed the search for super-symmetric particles and other hypothetical particles as possible unknown areas of physics. Some extensions of the Standard Model predict additional particles, such as the heavy W' and Z' gauge bosons, which are also estimated to be within reach of the LHC to discover.

On 23rd November, 2009, the first ever electron collisions happened in all 4 detectors at 450 GeV. Following that, on 30th November, 2009, L.H.C. became the world's largest and the highest energy particle collider achieving 1.18 TeV per beam, crossing the previous record of 0.98 TeV per beam. Between July and August 2011, results of searches for the Higgs boson and for exotic particles, based on the data collected during the first half of the 2011 run, were presented in conferences in Grenoble and Mumbai. In the latter conference it was reported that, despite hints of a Higgs signal in earlier data, ATLAS and CMS exclude with 95% confidence level (using the CLs method) the existence of a Higgs boson with the properties predicted by the Standard Model over most of the mass region between 145 and 466 GeV. The searches for new particles did not yield signals either, allowing further constraining of the parameter space of various extensions of the Standard Model, including its super-symmetric extensions.

Soumyakanta Panda
4th Sem. Dept. of EEE

Priority Based Multi-Phase Phasor Measurement Unit Placement Using Soft-Computing Techniques for Smart Grid Implementation

An integrated virtual Technology CAD (TCAD) workbench has been used for SiGe-CMOS process and device simulations including mechanical stress analysis for device design and reliability characterization. The work begins with an overview of the band gap engineering involving Si/SiGe material systems for SiGe-CMOS technology scaling. The TCAD framework has been used for the virtual fabrication of strain and band gap engineered heterostructure MOSFETs. Mechanical stress generation (stress mapping) during fabrication of SiGe-CMOS devices has been studied for the first time. Using process simulation (etching), conversion of biaxial strain in SiGe layers into uniaxial strain is demonstrated. Uniaxially strained-SiGe channel FinFETs have been virtually fabricated for possible use in 7N technology node. A comprehensive analysis based on the state-of-the-art bias temperature instability (BTI) model of aging effects on hetero-FETs in SiGe-CMOS process technology has been performed. This dissertation has mainly addressed the hot carrier (HC) and NBTI/PBTI impacts on heterostructure CMOS devices electrical performances.

Variability in transistor parameters have been observed since the beginning of the MOS technology, but they are still not fully understood. Bias temperature instability degradation is one of the critical challenges for the semiconductor industry. Especially the thinning of oxide layers in advanced devices has further increased the effects of BTI on the functionality and lifetime of modern devices. BTI affects the overall reliability of nano scaled devices and circuits leading to system failure. Being able to predict BTI degradation is crucial for the development and long term success of novel transistor structures. In this work, we shall present a comprehensive study of BTI aging effects at predictive level for heterostructure MOSFETs in SiGe-CMOS technology. It is shown that "time-dependent" variability issues are a major source of device variability due to the formation of gate oxide defects at elevated temperature resulting in deviation of device characteristics (e.g., threshold voltage and drain current) and their impacts on reliability.BTI phenomenon is first explained by the reaction-diffusion (R-D) model. But due to inconsistencies with experimental data in predicting the recovery phase of BTI, the atomic trap based model is developed.BTI effects are then described with the help of the nonradiative multiphonon (NMP) four state model, which is capable to explain many effects related to BTI. The model is based on the exchange of charge carriers with oxide defects.The model is accurate and provides a detailed description of degradation mechanisms. In addition to two stable states, it considers two metastable states as well, which are essential to capture the complex processes involved in BTI.

It is expected that the findings of this thesis will contribute to the understanding of the BTI and HC reliability mechanisms in strain and band gap engineered heterostructure MOSFETs. Since the Capture-Emission Time (CET) model offers effective abstraction potentials, it is used as reference model. Thus, additional modeling approaches are developed to facilitate CET. Hydrogen mapping, a novel methodology is proposed that facilitates an accurate, efficient and reliable technique for device degradation studies.Main advantage of the proposed methodology is its industrial relevance. TCAD methodology for virtual fabrication of devices in SiGe-CMOS technology and predictive reliability simulation adopted in this work will open a new avenue for the prediction of the reliability of advanced devices and may be explored in other semiconductor technologies. Substantial novel insights have been demonstrated, enabling new approaches toward understanding reliability in present and especially in the upcoming CMOS technologies.

Dr. Sanghamitra Das
Dept. of ECE

COVID-19 effects on environment

These are the pictures of pre-lockdown and post-lockdown taken from a location in Noida.

The COVID-19 lockdown is healing the planet in a way never seen before in living history.Human beings often forget that we are largely dependent on Mother Nature and become ignorant towards taking care of it. We have been so reluctant to the preservation of natural resources and sustainable development that we had forgotten the inherent beauty of the Earth completely.

The COVID-19 lockdown imposed throughout the world has struck a chord in every one of us and it has made us thinking how nature is so important for our day to day living. The tangible improvements in nature have made us believe that the Earth can be saved. It has made us see that our actions can very well impact the Earth's sustainability. For breathing pure air to greener trees, there are some important environmental changes that we have seen for corona virus lockdown in India. Globally, due to a drastic reduction in the use of transportation fuels, primarily gasoline, diesel and aviation kerosene, the world air pollution levels have dropped markedly; these include major greenhouse gases like CO2 and Nitrogen and Sulfur oxides that have dropped by over 25%. The water quality in freshwater sources like rivers and lakes has also improved substantially during the lockdown, due to less industrial activity. For example, the famous canals in Venice have cleared and fish and other aquatic life is visible, for the first time in decades, owing to less waterway traffic.

The situation in India follows suit, mirroring global trends in reduction of pollution:

Ganga water fit for drinking in Haridwar

According to the Uttarakhand Pollution Control Board, water from Har-ki-Pauri in Haridwar was tested and the results from the tests reveal that the water here has been classified as 'fit for drinking after chlorination', for the first time in decades.

It is assumed that due to the lockdown, the drainage of industrial wastes into the river water has stopped and brought a significant change in the water quality.

Improvement in air quality in New Delhi

New Delhi was ranked as the most polluted city in the world by WHO in May 2014. The usual air quality of India's national capital according to the Air Quality Index (AQI) used to be 200. When the pollution level hit its peak, the index soared to 900 and sometimes was off the measurable scale.

While 200 itself is 25 percent above the unsafe level as deemed by the World Health Organization, as Delhi's 11 million registered cars were taken off the roads and factories and construction were ground to a halt, AQI levels have regularly fallen below 20. The skies are suddenly a rare, piercing blue. Even the birds singing seem louder.

In the capital of New Delhi, government data shows the average concentration of PM2.5 plunged by 71 percent in the space of a week - falling from 91 micrograms/m3 on March 20, to 26 micrograms/m3 on March 27, after the lockdown began.

With courage and hope in our hearts to move past the hard times, we envision a future of refined lifestyle choices to preserve Mother Nature and hope to be working collectively towards sustainability. Such efforts will undoubtedly play a major role in resurrecting our planet earth from the destruction caused by the ravages of pollution over the years.

https://www.indiatoday.in/education-today/gk-current-affairs/story/covid-19-4-vital-environmental-changes-evidenced-in-india-since-lockdown-1673726-2020-05-02

https://en.wikipedia.org/wiki/Impact_of_the_COVID-19_pandemic_on_the_environment

Image Credit: Megha Chaturvedi

Publication Cell

Tel: 99372 89499 / 7381499499
Email: publication@silicon.ac.in

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Bhubaneswar Campus
An Autonomous Institute
Silicon Hills, Patia
Bhubaneswar - 751024

Sambalpur Campus
An Affiliated Institute
Silicon West, Sason
Sambalpur - 768200

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