IT Express '20

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Dhulikhel, Kabhre

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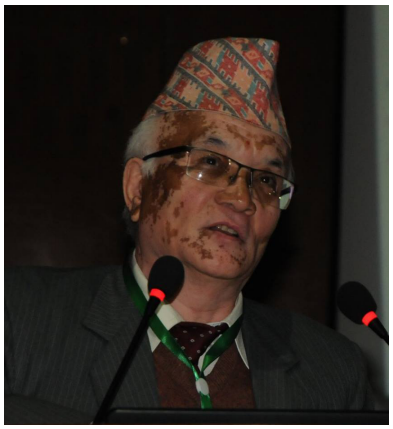
MESSAGES FROM THE DEANS



Dr. Damber Bd. Nepali
Dean,
School of
Engineering
011-661511
dean_engg@ku.edu.np

IT has become one of the essential aspects of our life in this modern era. In Kathmandu University, programs are designed to cover both theoretical as well as practical aspects of education. This is where events, such as IT MEET, provide an excellent platform for the students as well the faculty to emphasize the practical side of the curriculum. I, as the Dean, encourage all the students and faculties to work parallel in both the aspects and be competitive enough to fulfill the demands of the present generation.

As the annual event of the Kathmandu University Computer Club, IT MEET has made its recognition around the country over the past, and I expect it to continue its legacy in the future. I have experienced a lot of changes due to IT in my life and understand the need to upgrade education techniques with time. For this, we have already started collaborating with industries and professionals to provide on-site training, internship opportunities and abroad consultation by partnering with universities around the globe.

I am extremely glad to see the hard work put forward by the entire IT Express 2020 Team. I believe that the articles published will be impactful and share insightful information about the latest trends and technologies to a wide range of audiences. Personally, I enjoy the practical approach to learning. That's why I love articles that are application-based and informative. I expect to see such articles in this edition of IT Express and many more live projects during the IT MEET 2020.

Initiations such as Military Science and Tech Competition by Nepal Army is a great example of the adoption of IT in our country. I encourage all the tech-enthusiast from all the departments to take part in IT MEET and showcase their projects and share their ideas with people. I strongly believe that our students have the potential to lead the technology industry in Nepal, and IT MEET is a significant reflection of our success. Our alumni are working in the best industries and helping to promote IT in Nepal. I expect our students to continue the same while improving upon it. In the end, I want to encourage all the students to develop products and solutions that are useful for society and wish for the grand success of IT Express and IT MEET 2020.

Kanhaiya Jha, PhD
Dean,
School of
Science
Professor of
Mathematics
jhakn@ku.edu.np

It is my pleasure to write this letter of congratulations to the Department of Computer Science & Engineering and the Kathmandu University Computer Club (KUCC), a student club of Department of Computer Science & Engineering, who is publishing the new volume of IT Express 2020 including inspirational and motivational as well as student's university real life experiences related articles. I am confident that this magnize would be informative and guidance to prospective students.

At the Department of Computer Science & Engineering, our students are the important natural resources that we have. Their education is an investment in the future of the IT profession. Our outstanding faculty members work hard preparing students for the future which will bring further changes to the software development. Thus, we are proud of the friendly relationships that students build with the faculty and staff.

I hope, the department will continue achieving its mission with disciplined students, dedicated teachers and cooperative staff and finally to strengthen the status of our school.

I would like to congratulate the IT Express team for their hard work and dedication.

I wish all the best for the future endeavor.

MESSAGES FROM PROFESSOR

Dr. Manish Pokharel

Professor Department of Computer Science and Engineering
manish@ku.edu.np
Area of interest: Digital Governance,SMART City, Internet of Things (IoT),Artificial Intelligence (AI) , Cloud Computing ,Big Data,Software Technology
Kathmandu, University
Dhulikhel, Kavre

I would like to begin by appreciating the legacy of IT Express and how it has complimented each year's IT MEET. The magazine offers a good view of the latest trends in Information Technology and what not. I hope that from the beginning of the new decade the magazine also includes the achievements, progress and advancements of Information Technology and its benefits as well as challenges to the daily lifestyle of the common people because now it is not just about knowing technological terminologies but more on its impact and what future it holds.

Taking for instance, Artificial Intelligence is on the tech-trend for quite some time now. But to know that the term "Artificial Intelligence" was coined by John McCarthy in 1956 comes as a surprise for many in that field. Similarly, Machine Learning is of same age while Deep learning came into existence in the 80's. These terms came into the spotlight only in the past decade because of a rise in data and information that needed to be processed.

According to a report, by 2020 almost 40 zettabytes data will be available and by 2025 about 75 billion devices would be connected to the internet. This means a single person would have 10 devices on average. Every device will generate data on a regular basis and to manage such an explosion of data, AI has been reincarnated. By next year, there would be more than 4.5 billion people around the world connected to the internet. More than 2 billion people would be active in Facebook. In our country, more than 10 million people would join the facebook. The computer society has decided to implement 10G till 2030. This comes off as an impressive challenge for the country as well as its universities to maintain such pace. The university and its community of students, teachers and parents must maintain the expected pace to compete with the world in Information Technology. A research on future technologies like 4.0, AI, Robotics, Big Data, Internet of Things(IoT), 3D computing, Cloud computing and much more must be done for proper utilization to uplift of the economic, social, cultural and religious condition of our country. Every personnel related to IT must question constantly where IT will pave the path of progress in coming years.

For example, Watson, the question-answering computing system that won a match against human champions on the Jeopardy and similarly Deepmind's AlphaGo won the world champion playing "Go", both reflect the thriving condition of technology. Thus, Artificial Intelligence, Robotics, Big Data, Internet of Things(IoT) and so on must be studied not for the sake of credits or grades but for implementation in our practical lives to tackle the problems on a daily basis.

I would like to inform every student that they must develop the capacity for compatibility and adaptability in any situation because the dynamic nature of technological progress cannot be compared to the static nature of lectures and notes. For this, they must do research for the future regarding the information technologies. Hence, every student must develop a positive attitude to not only study the trend of future technology but to implement them on real life for personal, social as well as national benefit.

MESSAGE FROM THE HEAD OF DEPARTMENT

Bal Krishna Bal

The Head of Department

Head Department of Computer Science and Engineering
Associate Professor
Lead Researcher - Information and Language Processing Research Lab
Kathmandu, University
Dhulikhel, Kavre

It gives me a great pleasure to share a few thoughts on the IT Express magazine which gets released during IT Meet, a national landmark IT annual event. I would like to thank the entire IT Express Team for their hard work in order to publish the magazine. I am very confident that they would be coming up with some very interesting and useful articles as well as wider coverage in this year's edition . As a Department, we have now grown quite big (about 500 students) and the magazine could serve as a medium to update ourselves with any news on events that happens at the department every now and then. Furthermore, it is also a platform to showcase our ideas and projects and similarly share our knowledge with each other.

Let the IT Express flourish in the days to come and become instrumental in informing the developments in the dynamic and ever changing IT field. In today's era of vibrant Information Technology, every one of us needs to be abreast with the latest state-of-the-art developments in our respective domain and I believe that IT Express can serve the purpose.

My best wishes to the IT Express Team once again.

MESSAGE FROM THE KUCC PRESIDENT

"'If today were the last day of my life, would I want to do what I am about to do today?' And whenever the answer has been 'no' for too many days in a row, I know I need to change something."

In this age of emerging technologies, we stand at a crossroads where changes are bound to happen rapidly beyond anybody's imagination. Technology has advanced more in the last two decades, than in the entire extent of human civilization and is still advancing at an increasing pace. So, in this era of change and adaptation, student life sure is challenging, but I think this is significant in preparing us for our future and dreams. I think, for us, the students of Computer Science and Engineering, these exciting changes will help to bring forth our true potential and let us shine in the upcoming era. Keeping this in mind, the KUCC as a whole has been focused on bringing effective changes, initiatives for a research journal and an open-source product for the community, the two things which we think are necessary to increase the productivity of the students, have been started in this tenure, too. IT Express, our annual publication, in its current iteration, is also focused on bringing up valuable insights relevant to the current technological field. The efforts put forth by the editorial, design and marketing teams in the IT Express to make it all possible is really worth appreciating. Furthermore, I would like to thank the DoCSE faculty and the KUCC Board, as well as everyone who has made an effort for the magazine and wish for the tremendous success of the magazine in this iteration as well.

Yogesh Bhandari
President
Kathmandu University Computer Club
Department of Computer Science and Engineering
Kathmandu, University
Dhulikhel, Kavre
Email: kuyogeshswap@gmail.com

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THESE ARE THE AWESOME PEOPLE WHO MADE IT ALL POSSIBLE

Prabhat Neupane
Coordinator

Aashish Pokharel
Lead Editor

Sarayu Gautam
Editor

Siza Adhikari
Editor

Sagar Upreti
Editor

Rikesh Karmacharya
Lead Designer

Aseem Regmi
Designer

Oshan Shrestha
Designer

Manish Bhatta
Designer

Awan Shrestha
Marketing

Nabin Ghimire
Marketing

Jenny Tamang
Marketing

EDITORIAL

Dia Manandhar
Marketing

Anurag Timilsina
Marketing

"Coming together is a beginning. Keeping together is progress. Working together is success."

- Henry Ford

2020

A few months ago, during the early days of October, team was born. We were four individuals, who came together with the sole purpose of bringing IT Express 2020 to life. As we began work on the magazine, we came to realize that IT Express is not just a magazine, it is a legacy that is kept alive only by the love for technology we all share so dearly. Our seniors had handed to us a responsibility upon which we could easily build further and as a result, we simply could not imagine depleting or degrading what was already there. Hence, there was only one way we could go up and we took a vow to keep the magazine as error free and as accurate as we possibly could. We devised a workflow in order to make sure everything was as we had intended them to be. We have strived to maintain all the intriguing and enlightening sections. We hope all of our readers have something to get from this year's publication.

But what we just wrote is only part of the whole story. We are all aware of the philosophy of the web that "Content is King". Hence, we proudly claim that our annual publication would've never been possible without the priceless articles crafted with the same love for technology by our fellows, seniors and juniors. We thank all authors from the bottom of our hearts and humbled to receive a fraction of your knowledge.

As developers, we are also well aware that presentation is as important as the content itself. We are sure that nobody likes plain HTML without CSS and everyone is annoyed by Flashes of Unstyled Content. Hence, we also thank the designers of the Design Team from the bottom of our hearts. Without their innovative designs and presentation techniques, IT Express 2020 would neither be as appealing nor as elegant as it is today. Also we would like to thank the team, who were the ones that actually got the magazine from electrons in a screen to the physical magazine we all know and love so dearly. Also, heartfelt thanks to our coordinator for maintaining cooperation between distinct teams and consolidating the individual parts to form a complete whole. We also thank the management team for doing the things managers do best.

In the end, it is as Henry Ford has said. Our teams coming together marked the beginning of the IT Express journey of 2020, us working independently but for the common ultimate goal marked the progress we made and finally everyone dutifully performing the part of the grand responsibility assigned to ourselves marked the physical manifestation of IT Express 2020 which, to us, is nothing short of grand success.

Although we have tried our best to deliver as much quality we possibly could, We, hence, humbly request our readers to send suggestions they have over to itexpress020@gmail.com, however, we would like the suggestion to be critical and about a specific area of the magazine, rather than generic feedback, so that we can direct our efforts to improving that particular area.

An electronic copy of this magazine is also available at http://kucc.ku.edu.np.

MEET THE FACULTY

Professor

Dr. Manish Pokharel
manish@ku.edu.np
Area of Interest:Digital Governance,SMART City, Internet of Things (IoT),Artificial Intelligence (AI) ,Cloud Computing ,Big Data,Software Technology

Associate Professors

Dr. Bal Krishna Bal
Head of Department
bal@ku.edu.np
Area of Interests: Software Localization, Natural Language Processing, Language Specialization, Social Computing

Dr. Gajendra Sharma
gajendra.sharma@ku.edu.np
Area of Interests: E-Government, E-Commerce, Cloud Computing, Big Data, IT Security, IT Adoption and Design, Strategic Management of IT

Assistant Professors

Manoj Shakya
manoj@ku.edu.np
Area of Interests: Digital Learning, MOOC, Cloud Computing, Machine Learning

Pankaj Dawadi
pdawadi@ku.edu.np
Area of Interests: Image Processing and Computer Vision, Deep Learning, Media Technology

Dr. Rabindra Bista
rbista@ku.edu.np
Area of Interest: Wireless Sensors Networls, Software Engineering, Health Informatics

Santosh Khanal
skhanal@ku.edu.np
Area of Interests: Intelligent Systems, NLP, Machine Learning, Distributed System, NoSQL

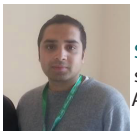
Sushil Shrestha
sushil@ku.edu.np
Area of Interest: Learning Analytics, Data Science,Human Computer Interaction

Dhiraj Shrestha
dhiraj@ku.edu.np
Area of Interests: Engaged Learning, ICT4D, Computer Graphics, Trust Negotiation in P2P

Sushil Nepal
sushilnepal@ku.edu.np

Sameer Tamrakar
sameer.tamrakar@ku.edu.np
Area of Interests: Cloud Computing, Load Balancing in High-Performance Computing

Lecturers



Satyendra Lohani
satyendra.lohani@ku.edu.np
Area of Interests: Smart Grid, ICT and Sustainable Energy

Nabin Ghimire
nabinghimire1@ku.edu.np
Area of Interests: Compiler Design, Internet of Things

Deni Shahi
denishahi@gmail.com
Area of Interests: Compiler Design, Theory of Computation

Praynita karki
praynita.karki@ku .edu.np
Area of Interests: E-Governance

Dr. Rajani Chulyadyo
rajani.chulyadyo@ku.edu.np
Area of Interests: Machine Learning,Data Mining

Manish Joshi
manish.joshi@ku.edu.np
Area of Interests: Online-Learning, Data Mining,Software Development

Dr. Prakash Poudyal
prakash@ku.edu.np

Teaching Assistants

Sarala Shakya
sarala.shakya@ku.edu.np

Bipashna Kshetri
bipashana.kshetree@ku.edu.np

Pratit Raj Giri
pratit.giri@ku.edu.np

Non-Teaching staff

Narayan Oli
narayan.oli@ku.edu.np

Chandrika Oli

Lab Technicians

Bibas Neupane

Rajendra Banjara

Communities Under KUCC with their co-ordinators

Anil Kumar Shrestha
KUOSC

Aseem Regmi
JavaScript Community

Utsav Prajapati
Design Community

Namit Adhikari
Python Community

Utsav Darlami
Python Community

Ashish Subedi
ML & AI Community

Bipin Acharya
Game Development Community

Mala Deep Upadhaya
Innovation And Entrepreneurship Community

Akriti Khadka

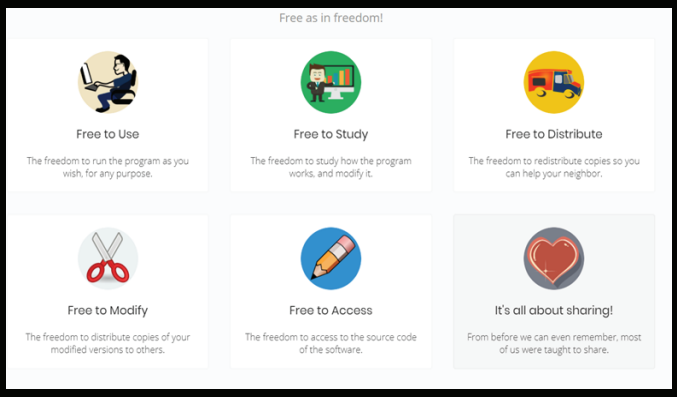
NEWS AND EVENTS

LINUX TALK

Date: 10 th and 11th Nov, 2019
Presented By: Aashutosh Aryal,Ashish Pokhrel, Ashish Pokhrel, Bibatshu Thapa, Bibhushan Baral, Sanskar Chand and Anil Kumar Shrestha.
Objectives:
• To familiarize the participants with Linux Operating System.
•To make the participants acquainted with basic Linux Commands.
Description:
The workshop was conducted on 10th and 19th Nov, 2019 in block 9, room no 301 and 304 respectively from 3PM to 5PM. The workshop was divided into three sessions. On the first session, covered about the basic introduction of Linux and some fundamental information of Linux kernel, Linux distributions and file system in Linux.
After that on the second session, basic commands of used in Linux was taught. This included creating of file and directory from terminal, editing files and appending files. In this session, the participants were also imparted the knowledge of root and super user. They were also taught to download applications from apt repository. After this specific queries and problems faced by students were addressed.
The last session of the workshop revolved around ssh. This included how to connect to a remote system using ssh and copying files between the computers.
In this way, the overall workshop went rather smoothly and familiarized with Linux operating system and enabled them to run some basic commands and operations in Linux.

Software Freedom Day

SFD is a worldwide celebration of Free and Open Source Software (FOSS). Our goal in this celebration is to educate the worldwide public about the benefits of using high quality FOSS in education, in government, at home, and in business -- in short, everywhere! The non-profit organization Software Freedom International coordinates SFD at a global level, providing support, giveaways and a point of collaboration, but volunteer teams around the world organize the local SFD events to impact their own communities. Our vision is to empower all people to freely connect, create and share in a digital world that is participatory, transparent, and sustainable.



Game Development Workshop

Game Development Workshop was a two-day workshop focusing on teaching beginners the basics of programming 2D games. Completing the workshop provided participants with a good jumping-off point for basic game development. They learned, at a rudimentary level, how a game operates 'under the hood', so to speak.
Languages: C++ or Python
Pre-requisites: some prior knowledge of programming
Date: 27th and 28th November

Python Workshop

Python Workshop was organized by Kathmandu University Open Source Community (KUOSC). The event coordinator was Utsav Magar and Namit Adhikari.

The main objectives of the python workshop were to impart the basic understanding to python programming language and to help the second year students with data structures by giving simple demonstration of use of data structures in any programming languages such as python

National Science Day 2019

Demonstration of Linux Terminal Server Project (LTSP) by the KUCC team in the event organized by Kathmandu University on the occasion of National Science Day 2019.

Annual General Meeting of KUCC board 2018-19

AGM was held for KUCC board 2018-19. Dr. Bal Krishna Bal, Head of Department and other faculty members also attended the formal program. The board of 2018-19 presented about the events duringtheir tenure. They were handed over with Tokenof Love as a farewell gesture. The tenure of KUCC board 2019-20 had formally started.

Face Detection and Recognition System Based on Artificial Neural Network

UMESH HENGAJU
GAJENDRA SHARMA
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
KATHMANDU UNIVERSITY
GAJENDRA.SHARMA@KU.EDU.NP

Abstract— Detection of face and its recognition in the field of pattern recognition and computer vision have gained increasing interest over recent decades. It is because of its many applications in a variety of fields such as security systems, video conferencing and identity verification. But, for machines like a computer, it is very difficult to make distinctions between the faces of different kinds and recognizing them. The main goal of this paper is to introduce a Neural Network based algorithm that simplifies the task of detecting and recognizing face. Under Neural Network, this paper has focused on the implementation of Haar Filter to detect face in the captured face image. Also, this paper explains the artificial neural network approach in combination with the PCA algorithm for the recognition of a human face. Mapping of Haar filter in face image extracts the facial information and with that facial information, Eigen Face Vector is produced. Then a matching technique is applied to find a match between the new face and all the known faces in the database. And the result of comparison distinguishes any face to be known or unknown.

Keywords—Neural Network, Haar Filter, Facial Features, PCA, Eigen Face

I. INTRODUCTION

Face is the most important attribute in human beings which is used for its identification and for conveying emotions in its social life. Human can easily recognize the face that had been seen if the face is remembered. Despite large variations in visual stimulus due to changing conditions and distractions such as beard, glasses or changes in hairstyles, human can easily recognize the face. This is due to the high degree of interconnectivity, adaptive nature, learning skills and generalization capabilities of the human nervous system which is composed of highly interconnected neurons [2].

In the case of computer, detection and recognition of face are some of the most challenging problems. It is because in computers there doesn't exit a nervoussystem like humans and is not capable of adaptive nature. Also, computer requires more complex algorithms for interconnectivity between its various components[4]. Moreover, computer needs system software for detection and recognition of human face. That is why detection and recognition of face for machines like computer is very much difficult.

Face detection involves separating image windows into two classes; one containing faces and another-containing the background [3]. It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin color, pose and facial expression. The problem is further complicated by differing lighting conditions, image quality, geometries as well as the possibility of partial occlusion and disguise. An ideal face detector would, therefore, be able to detect the presence of any face under any set of lighting conditions, upon any background [5]. For basic pattern recognition system, some of these effects can be avoided by assuming and ensuring a uniform background and fixed uniform lightening conditions. This assumption is acceptable for some applications such as the automated separation of nuts from screws on a production line, where lighting conditions can be controlled and the image background will be uniform. For many applications, however, this is unsuitable and the system must be designed to accurately classify images subjected to a variety of unpredictable conditions. And these systems take a complex algorithm for face detection.

There are many face detection techniques to locate a human face in a scene [7]. Some of them are template matching method which operates by performing direct correlation of segments, Eigen face approach that applies Karhonen-Loeve transform for feature extraction and feature-based method which employs knowledge about facial information to detect a face. Many algorithms implement the face detection task as a binary pattern-classification task i.e. the content of a given part of an image is transformed into features, after which a classifier trained on example faces decides whether that particular region of the image is a face or not.

In face recognition process, face of an individual is recognized by comparing an image against the images of all stored in the database. The related task of face detection has direct relevance to face recognition because the image must be analyzed and faces identified before they can be recognized. Like face detection methods, there are a number of methods that can be used for recognition of face. Some of them are Eigen face approach which recognizes the face by computing Eigen vector of the faces and then associating the facial information into the Eigen vector, template matching method which employs the concept of template for recognition of face, Neural Network which operates on constructing the artificial neuron that collects facial information through training and then use the training information to test the recognition process.This paper explains the detection of human face using Haar Filter. For detecting a face, Haar filter is mapped into the face image

and during mapping the filter checks for the presence of facial features like Eye, Nose, and Mouth. The filter returns 1 if it detects facial features otherwise it returns 0. The neural network is trained accordingly to detect the face in the face image. Then, to extract the face region, various pre-processing activities are applied. This paper also explains the recognition of face using the PCA algorithm. For recognition of human face, first, an Eigen Face vector is created using the facial information that is extracted during the detection phase. Then, PCA algorithm maps the facial information extracted from captured image into an Eigen Face vector created from the gallery of face image. The result of mapping discovers the new face image. Then the presence of this new image is checked into face database. If any equivalent image is present in the face database, then the captured face is treated as a known face, otherwise, the face is unknown.

II. DESCRIPTION OF THE SYSTEM

The system is based on using neural network for detection of face and extracting the facial information and performing mathematical operations on the values corresponding to them for recognition of face. And for this, a very simple methodology is employed. Haar filter is used as a Neural Network based filter to detect face in the captured face image. Haar filter is mapped into the face image. During mapping, the filter checks if there is a presence of facial features or not. The neural network is trained accordingly to detect the face in the face image. Then, the face region is extracted from the image by applying various pre-processing activities. Using these facial information, an Eigen Face vector is created. And for recognition of face in the captured face image, PCA algorithm is implemented. PCA algorithm maps the facial information extracted from captured image into an Eigen Face vector created form gallery of face image. The result of mapping discovers the new face image. Then the presence of this new image is checked into face database. If any equivalent image is present in the face database, then the captured face is treated as known face otherwise the face is unknown.

treated as known face otherwise the face is unknown.

•Face Image Acquisition:

In this, a digital image of an object is captured and is converted into a digital image. The output of image acquisition process is a face image that is set for preprocessing. The input to the face recognition system is an image that contains many other objects along with the facial images. So, this needs the assistance of certain face detection techniques.

•Preprocessing:

Before the image is presented to the system, it should be standardized so that it could be compatible with the system specifications. In preprocessing, all or some of the following tasks may occur.

a)Size Normalization:

Changing the size of the acquired image into default size so that the face recognition system can operate.

b)Histogram Equalization:

This preprocessing task improves the quality of the image by enhancing the quality of image but only in the case if the image is too dark or too bright.

c)Median Filtering:

Median filter can be used for cleaning noises in the images without losing information.

d)High Pass Filtering:

High pass filtering emphasizes the detail of an image such as contours which can dramatically improve the edge detection performance.

e)Background Removal:

Face backgrounds are removed for dealing primarily with facial information itself. This is especially important for the face recognition systems where entire information contained in the image is used.

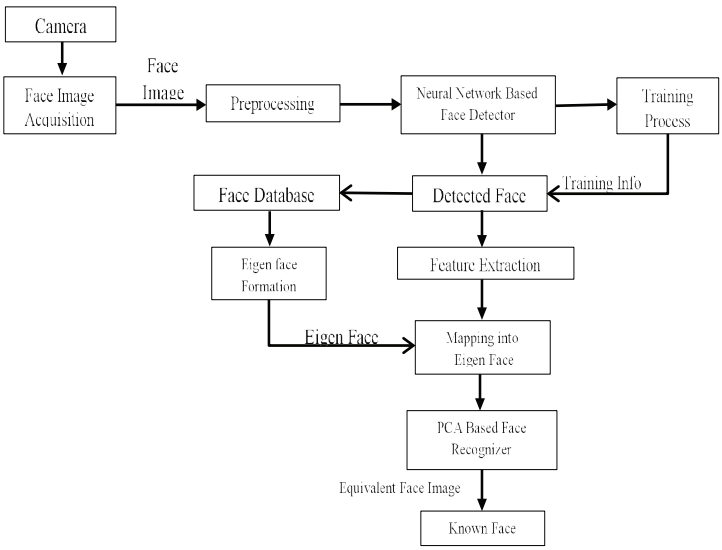


Figure: - Block Diagram of FDRS Based on ANN

f) Edge detection:

Face edge detection technique is applied to find various face features that are required before representing and segmenting an image.

Face Detection:

For the purpose of face detection, Haar filter is used. The Haar filter feature's value is calculated as a weighted sum of two components: the pixel sum over the black rectangle and the sum over the whole feature area (all black and white rectangles). The computed feature value is then used as input to a very simple decision tree classifier that usually has just two terminal nodes, that is:

$$f_i = \begin{cases} +1, & \text{if } x_i \geq t_i \\ -1, & \text{if } x_i < t_i \end{cases}$$

Where +1 means the face and -1 means non-face.

t denotes the threshold and the data is denoted by x.

Neural network is used to train the classifier so that it can easily detect the face. The network learns to detect the face by propagating the signals through the network. The inputs and outputs are computed by using a feed-forward network, then error values are calculated and the calculated error value is made propagated back through the network to adapt the weights during training.

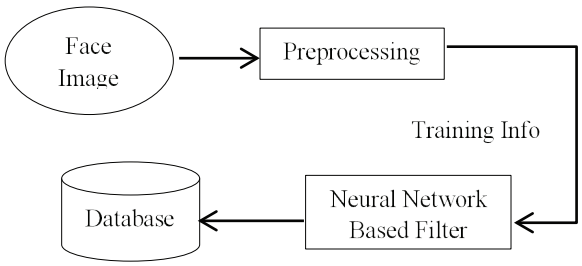


Figure: Block diagram of the training phase of system

•Face database:

Face database is a database of known faces. Actually, the Eigen face formation transforms the face image to the subspace for comparing the input image to the image stored in the face database. The face database can be updated, after the classification of faces, by adding a face classified as "unknown", to the database. This process adds learning capability to the system.

•Eigen Face Formation:

Eigen face of the input image is formed for projecting the image into the subspace spanned by the Eigen vectors. Eigen face vector is a face vector that is produced by acquiring the common features of the face image stored in the face database. This is done by following the steps of PCA as discussed below in the "calculating Eigen face" section.

•Feature Extraction:

The feature extraction is carried out by taking the facial features such as eyes, mouth, nose, ears, etc. Generally, there are two methods of representation about facial features: One is the local facial features such as eyes, nose, and mouth are located; the other is about the whole facial features as expressing with a rectangle area containing eyes, nose, and mouth. We had considering the two features: eyes and mouth in this system.

The feature extraction algorithm is explained below:

1. Divide the localized face column-wise into two equal parts.
2. For each row 'r' do steps 3 and 4.
3. The first black pixels encountered on either side are taken as (x1, y1) and (x2, y2) respectively.
4.Calculate the distance between those points using the formula:

Distance = Sqrt ((x2 – x1)^2) + ((y2 – y1)^2)

From step 4, two sets of non-zero distance values corresponding to eyes and mouth are obtained.

6. Find the maximum of the distances for each non-zero set. They represent the distance between the eyeballs and the distance between the mouth endpoints.
7. Using the pixels corresponding to that maximum distance, calculate the following:

i. Distance from the left eyeball to the right eyeball.
ii. Distance from the left mouth endpoint to the right mouth endpoint.
iii. Distance from the left eyeball to the left mouth endpoint.
iv.Distance from the right eyeball to the right mouth endpoint.
v. Distance from the left eyeball to the right mouth endpoint.
vi. Distance from the right eyeball to the left mouth endpoint.

8. The six values calculated above are given as inputs to the neural network recognizer

•PCA Based Face Recognizer:

The PCA based face recognizer recognizes the face. The PCA algorithm maps the facial information extracted from captured image into an Eigen Face vector created form gallery of face image. The result of mapping discovers the new face image. Then the presence of this new image is checked into face database. If any equivalent image is present in the face database, then the captured face is treated as known face otherwise the face is unknown.

•Principle Component Analysis (PCA):

PCA is a common statistical technique using a holistic approach to find patterns in high dimensional data. The holistic approach uses the whole face region as input data. Dimensionality reduction, also known as feature extraction, by retaining dataset characteristics is done by PCA. The main principle of PCA is derived from the information theory approach, which breaks down facial images into small sets of feature images called Eigen faces. Eigen faces, in turn, are known as principal component analysis of the original training set of face images. Face images are deconstructed by extracting relevant information.

The main idea of using PCA for face recognition is to express the large 1D vector of pixels constructed from the 2D facial image into the compact principal components of the feature space. This can be called Eigen space projection. Eigen space is calculated by identifying the eigenvectors of the covariance matrix derived from a set of facial images (vectors).

Mathematics of PCA:

A 2D facial image can be represented as a 1D vector by concatenating each row (or column) into a long thin vector. Let's suppose we have M vectors of size N (= rows of image × columns of image) representing a set of sampled images. pi's represent the pixel values.

Xi = [p1 . . . pn] T , i = 1, 2, . . ,M equation (1)

The images are mean centered by subtracting the mean image from each image vector. Let m represent the mean image.

equation (2)

$$m = \frac{1}{m}\sum_{i=1}^{M} x_i$$

And let wi be defined as a mean-centered image

Wi = xi − m equation (3)

Our goal is to find a set of ei's which have the largest possible projection onto each of the wi's. We wish to find a set of M orthonormal vectors ei for which the quantity

equation (4)

$$\Lambda i = \frac{1}{m}\sum_{i=1}^{M}(e_i^t w_n)$$

is maximized with the orthonormality constraint

e_i^tek = δik equation (5)

It has been shown that the ei's and Λi's are given by the eigenvectors and eigenvalues of the covariance matrix

C = WWT equation (6)

Where W is a matrix composed of the column vectors wi placed side by side.

The size of C is N × N which could be enormous. For example, images of size 64 × 64 create the covariance matrix of size 4096×4096. It is not practical to solve for the eigenvectors of C directly. A common theorem in linear algebra states that the vectors ei and scalars λi can be obtained by solving for the eigenvectors and eigenvalues of the M × M matrix WTW. Let di and μi be the eigenvectors and eigenvalues of WTW, respectively.

WTW di = μi di equation (7)

By multiplying left to both sides by W

WWT (W di) = μi(W di) equation (8)

This means that the first M − 1 eigenvectors ei and eigenvalues λi of WWT are given by Wdi and μi respectively. Wdi needs to be normalized in order to be equal to ei . Since we only sum up a finite number of image vectors, M, the rank of the covariance matrix cannot exceed M− 1 (The −1 come from the subtraction of the mean vector m).

The eigenvectors corresponding to nonzero eigenvalues of the covariance matrix produce an orthonormal basis for the subspace within which most image data can be represented with a small amount of error. The eigenvectors are sorted from high to low according to their corresponding eigenvalues. The eigenvector associated with the largest eigenvalue is one that reflects the greatest variance in the image. They decrease in an exponential fashion, meaning that roughly 90% of the total variance is contained in the first 5% to 10% of the dimensions.

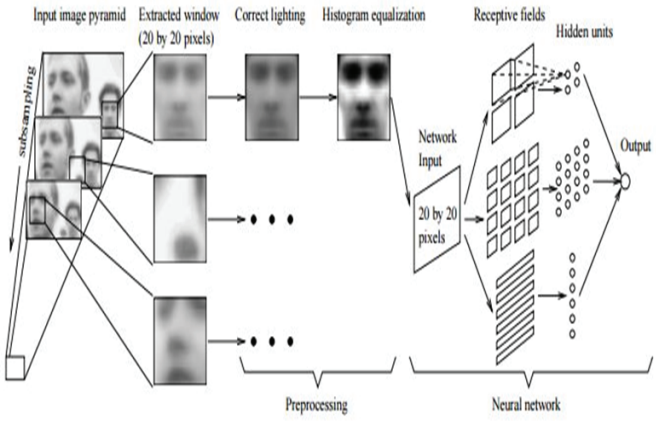


Figure (c): Illustration of the training process

Source: HenryA. Rowly Sanner, S. "Rowley-Baluja-Kanade Face Detector", 2014, Page No.2

III. EXPERIMENTAL RESULT

•Training Process:

The neural network-based classifier for detection of face using Haar filter is trained to produce an output of 1 for the face examples, and -1 for the non-face examples. To detect faces anywhere in the input, the filter is applied at every location in the image. To detect faces larger than the window size, the input image is repeatedly subsampled by a factor of 1.2, and the filter is applied at each scale. In the training process, first, a preprocessing step applied to a window of the image. The preprocessing first attempts to equalize the intensity values across the window.The preprocessed window is then passed through a neural network. The network receives as input a 20x20 pixel region of the image and generates an output ranging from 1 to -1, signifying the presence or absence of a face, respectively.

For training the neural network, the sample of 100

face images were divided into 10 parts say 10 folds. , in each fold, there are different numbers of images of different people with different expressions and illumination conditions. The features from each of the images from all folds were detected and separate as true features detected and falsely detected. The table given below shows the result of the training process.

Folds	No of training images	Correct	Wrong
Fold 1	10	8	2
Fold 2	10	9	1
Fold 3	10	8	2
Fold 4	10	10	0
Fold 5	10	10	0
Fold 6	10	8	2
Fold 7	10	9	1
Fold 8	10	9	1
Fold 9	10	10	0
Fold 10	10	8	2

Table: Training result

Mean Correct = (8+9+8+10+10+8+9+9+10+8) /10
= 8.9
= (8.9 / 10) * 100
= 89%
Mean Error = (2+1+2+0+0+2+1+1+0+2) / 10
= 1.1
= (1.1 / 10) * 100
= 11%

After the first epoch, the mean accuracy of the testing process is found to be 89% and the mean error is found to be 11%.

- Testing

For testing the system, a set of images that are completely distinct from the training set images were taken. And the system was tested with different test cases.

Test Case 1 (Different Position of Face)

For the test to detect the face, six images of a face with different positions as shown in the figure given below are chosen and inputted.

Figure:- Different Orientations of Fingerprint Sample

Test Result 1
Total number of face position = 6
Face detected = 5
Not detected = 1
Accuracy (%) = (5/6)*100 % =83.33%
Error (%) = (1/6)*100 % = 16.67 %

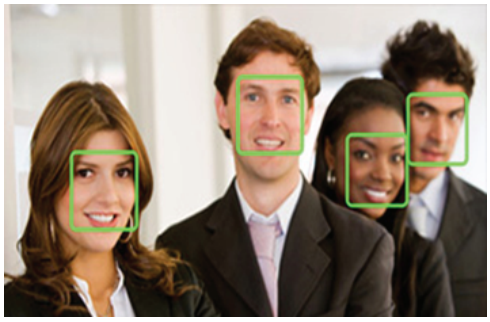


Figure: - Full Frontal Display of Different Face

Test Result 2
Total number of face position = 4
Face detected = 0
Accuracy (%) = (5/5)*100 %= 100%
Error (%) = (0/5)*100 % = 0 %

IV. DISCUSSION

The task of detecting face in an image and recognizing the face for machines like computer can be done by the implementation of algorithm based on neural-network-based Haar classifier and Eigen face vector. Implementation of these algorithms can provide nearly about 84% accuracy. Thus, this system can be used for different applications such as video surveillance, face image database management, etc.

V. CONCLUSION

In conclusion, this system detects the face by extracting facial information such as eye, nose, mouth, etc. and recognizes the individuals' face by comparing this facial information with those already stored in the database. For this, the system had used Back-propagation algorithm in Neural Network. This system first trains the classifier by using gallery images in order to recognize face.

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DIGITAL LEARNING RESEARCH LAB

SUSHIL SHRESTHA
ASSISTANT PROFESSOR | DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (DOCSE)
LEAD RESEARCHER | DIGITAL LEARNING RESEARCH LAB (DLR LAB)
PHD SCHOLAR |SCHOOL OF ENGINEERING
KATHMANDU UNIVERSITY

Mr. Sushil Shrestha is an Assistant Professor in Department of Computer Science and Engineering (DoCSE) at Kathmandu University, Nepal. He joined as faculty from 2008. His research areas include Online Learning, Knowledge Discovery and Data Mining, Human Computer Interaction and Learning Analytics . He is a Lead Researcher in Digital Learning Research Lab (DLR Lab). He is also a PhD scholar and has numerous experiences of participating and presenting in several national and international conferences.

Research, due to its extensiveness, requires a team Research, due to its extensiveness, requires a team effort so there has to be some space for discussions and knowledge sharing. The most important component that differentiates between a university and a college is "research". For instance, a student is highly interested in knowledge engineering, but this student along with the various other students who may or may not be interested in the same thing will be studying the same course offered by the department. This is where research plays an important role, it is what gives you the edge in your field of interest. As I attended Seoul National University, I came to realize that research lab are compulsory. Such labs are platforms where professors and students share their knowledge, research and discuss different projects along with applying grants under the mentorship of professor with graduates and undergraduates. During 2015, a project: Massive Open Online Course (MOOC) initiated the lab as requirement for some space for researcher and research-assistant which supported our dream for establishing lab at Kathmandu University along with Mr. Manoj Shakya (Assistant Professor at DoCSE) who is currently on study leave in Singapore for his PhD.

From this idea and fund from the project, equipment was added without giving any extra burden for department settling the basic infrastructure. After completion of project within a year, we started projects provided by University Grant Commission and NAST which open a pathway for student of Master level. Since project are of limited time, labs need to be sustained for longer time which opens the door for continuous research activities resulting applying for funding on different sources and continuing the research activities by involved students. Recently six Master students graduated from DLR and are the proud alumni of this lab. As I also assign some mini-projects on Human Computer Interaction (HCI) from where few are elected for writing research paper for given topics and presenting them on international conferences. For undergraduate, presenting the research paper on international conferences and publishing them on journals seems biggest achievement for the lab because being a faculty of any university doesn't mean teaching the assigned subject but indeed is motivating,encouraging the student and preparing the skilled manpower for further study. Since research skill are needed for these studies, selected students are taught about research,its methodologies and methods for applying grants. Research labs like the ones our department has were not in existence when I was a student in this university.

By this lab, in Department of Computer Science and Engineering, a research culture has been established by this lab. To begin with research, one must first identify one's domain. This is a scenario wherein one is highly curious about a particular subset of a larger domain. The DLR Lab was established in 2016 to promote research culture in the university with the following objectives: To promote online learning and e-learning pedagogy in higher education of Nepal; To develop online system to assist teachers and educators in professional teaching and learning; and empowering digital innovation in Education by using ICT. Our students have even collaborated with a group from University of Pennsylvania, USA on a research project, which was immensely difficult for both the parties to accomplish because of various obstacles and differences, but in the end they all came out with flying colors. I have been encouraging my students in my classes to work on research papers and I make sure to recommend the worthy ones for different international conferences. Side by side, I have added Data Mining as subject I added a large domain to involve the student for research activities.

Overall, DLR lab created a better environment developing the research culture among the student benefitting them in their studies. The alumni are also doing well on their profession. The impact of lab is good and pushing the University and Depart for advancement, such labs are needed to be established.

IOT for Vehicle Monitoring System Project

AI4SD 2019
Kathmandu University, Nepal

Background

Traffic Management is a major issue in development of Smart City. Public and private authorities need to keep track of the vehicles ranging from fire brigade, ambulance, police vehicles to daily operating public and private vehicles. Implementation of IOT based solutions can help the authorities to monitor their vehicles in real time. Use of GPS based solution is popular, although we barely find such implementation in Nepal. Even though GPS is widely used, it has few limitations such as receiver reliability, indoor use and inaccuracies caused by tree canopies and buildings. Implementation of RFID sensors embedded in the vehicles and stations, can give a real time information of vehicles. With the use of RFID sensors, the authorities can keep the attendance of vehicles entering and leaving a booth, time of arrival, departure, frequency of visit, average speed.

Objectives

The objectives of this project are:

- To develop a IOT solution for monitoring vehicles in realtime.
- To develop a vehicle traffic data aggregation system with the help of IOT devices.

Applications

IOT can assist a wide range of physical systems, automate and monitor them with the help of ICT. This project uses RFID-RC522 sensor, Raspberry Pi 3 Model B to implement Vehicle Monitoring System. RFID sensors are widely used in keeping attendance of employees, in supermarkets, door locks etc.

Following are some applications of our project:

- Tracking of public and private vehicles
- Monitoring Ambulances and fire brigades in a real time during emergencies
- Attendance record of vehicles passing any police booth
- General Public as well as Vehicle Drivers can view traffic congestion status via their phone, tablets and consoles.

Methodology

Vehicle Monitoring System is a IOT based project which involves computer/mobile devices, sensors and vehicles. To develop the system, technically, the project involves following steps:

- **IOT Device Setup:** This involves installation of RFID tag reader in Raspberry Pi and sensors in vehicle.
- **Server Installation:** This involves installation of suitable Linux based Operating System in Raspberry Pi, Network Setup, enabling connectivity of server with mobile or personal computer via WiFi.
- **Development of Application:** This involves programming interfaces to read data from sensors, database management and aggregation using SQL and a web application in Django Framework to view the vehicle data in a real time via phones of web browsers.

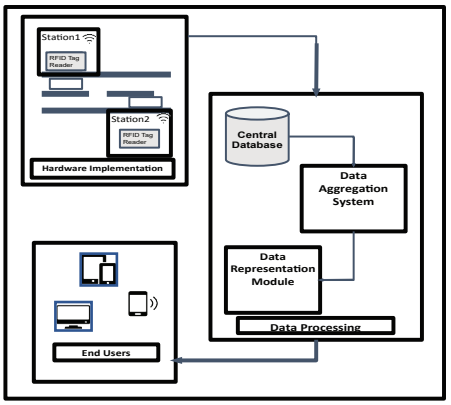


Figure 1: System Architecture

Table 2: Realtime Vehicle Data

Vehicle	Station	Next Station	ETA(Mins)
BA 2 KHA 2408	Sanga	Bhaisipati	5
BA 2 KHA 2408	Bhaisipati	Tindobato	5
BA 3 KA 1319	Palanse	Sanga	4.5
BA 3 KA 1319	Sanga	Bhaisipati	4.5
BA 2 KHA 2048	Tindobato	Chardobato	2
BA 3 KA 1319	Bhaisipati	Tindobato	4

Table 1: Aggregated Vehicle Data

Vehicle	Average Speed(KM/Hr)	Average Waiting Time(Mins)	Frequency(Per Month)	Station	Vehicle Company
BA 2 KHA 2408	55	2	80	Banepa	Kavre Minibus Sewa Samiti
NA 2 K 1253	60	1.9	50	Khawa	Araniko Yatatat Pvt. Ltd.
BA 2 KHA 1319	70	0.5	100	Dhulikhel	Kavre Minibus Sewa Samiti
BA 1 PA 9870	50	1.5	75	Panauti	Mayur Yatayat
SE 5 DA 007	55	1.3	80	Sanga	Annapurna Yatayat

Discussion

IOT devices provide substantial data in understanding the vehicle traffic. With the data gathered by Vehicle Monitoring System authorities can have an insight about traffic in a particular area in realtime. These information can help in traffic management, allocation of human resources, routing of Ambulance and Fire brigades, etc. This project can be implemented in large scale with minimum budget allocation. RFID sensor with a sizeable range should be used in order to achieve accurate data. Integration of Google/Open Maps, in the application gives a better visual representation of vehicles.

Conclusions

Vehicle Monitoring System with the use of IOT devices can play a key role in building a Smart City. Results reflected by the system helps authorities in monitoring and planning city traffic. Public can rely on this system to pick their daily ride, vehicles with higher importance can choose route with less traffic congestion, drivers can examine their waiting time. Implementation of RFID sensors with Raspberry Pi will be cost effective when implemented in a large scale. Project can be further extended with features such as attendance of staffs, measurement of speed, and implementation of GPS. Such feature enhancement can be useful to observe activities of bus staffs, and vehicles.

Team Members

Pankaj Dawadi, pdawadi@ku.edu.np
Birat Bade, badebirat@gmail.com
Sanjog Sigdel, sigdelsanjog@gmail.com
Department of Computer Science and Engineering,
Kathmandu University

IOT BASED AIR QUALITY MONITORING SYSTEM

INTRODUCTION

This project is an IoT based Air Quality Monitoring System that measures the air quality (parts per million) and communicates the information to the user. The gas sensor that is used in our system measures the level of NH3, benzene, alcohol, smoke and CO2 in the air and outputs the overall quality of the air. Once connected to the network, the users can access the air quality data in real time through the designated webpage along with the information about whether the current quality of air is suitable or harmful for their health. Along with the information of the air quality, data visualization functionality integrated into the system depicts how air quality changes throughout the span of the day. Data visualization performed on yearly/monthly and weekly data compares and contrasts how the quality of air is changing over a long period of time.

OBJECTIVES

- To monitor the overall quality of the air of a specific area
- To communicate the air quality data to the users
- To use data visualization techniques to see the trends in air quality variation over a period of time

OVERVIEW OF SYSTEM

This system uses MQ135 Gas Sensor to measure the quality of air of a specific place. The sensor is connected to to the local server(computer) with Arduino Uno microcontroller. Wi-Fi module ESP8266 allows multiple users to access to the system to view the air quality data by connecting to the local network.

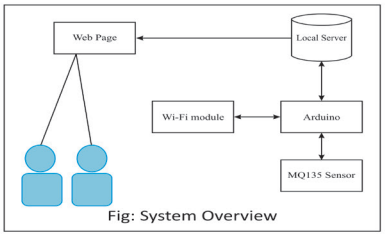


Fig: System Overview

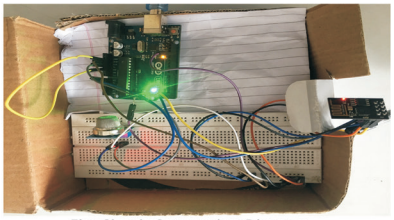


Fig: Circuit Connection Diagram

RESULT

The system will display air quality data in PPM along with the information if the current air quality is suitable or harmful for human health. Along with the data about air quality, the system will depict the visualization of the air quality data in the form of a line chart.

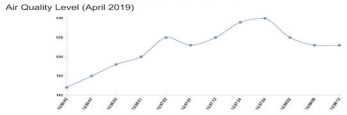


Fig: Line Graph of Air Quality Level

CONCLUSION

This IoT based air pollution monitoring system monitors the air quality of a specific place using sensors and transmits the data to a server where it is stored. The data can be accessed by users in real time making them aware about the condition of air in that place. Data visualization on air quality data over a long period of time can help to identify trends in air quality variation according to temperature, season and rainfall along with other factors like time of the day.

TEAM MEMBERS

Dr. MANISH POKHAREL
Supervisor
Professor, DoCSE
Kathmandu University

SUBARNA ADHIKARI
Masters in Computer Engineering
2018 Batch, DoCSE
Kathmandu University

ROJINA SHAKYA
Masters in Computer Engineering
2018 Batch, DoCSE
Kathmandu University

IJANA KUMPAKHA
MTech IT
2018 Batch, DoCSE
Kathmandu University

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
E-mail: manish.pokharel@ku.edu.np, shakyarojina2@gmail.com, dsurachi@gmail.com, adhikarisubarna95@gmail.com

IoT Based EMG Monitoring System
Kathmandu University, School of Engineering

Introduction

EMG is a technique for measuring electrical activity of muscles. The EMG provides electromagnetic signals of muscle movement known as electromyogram. The EMG signal is used to examine the cause of muscle weakness, several types of limb pain, cramping, muscle disorder and can be used to find the weakness and strength level muscle for diagnosis and cure. The EMG measures, filters, rectifies and amplifiers the electrical activity of a muscle followed by conversion into simple analog signal that can be read by microcontroller such as Arduino. The raw EMG signal are generated from person and according to their muscle movements, then signals are recorded, stored and analyzed on EMG circuit. The muscle activity in different phase can be evaluated to detect the muscle fatigue, its strength based on peak voltage of phase.

Overview of the System

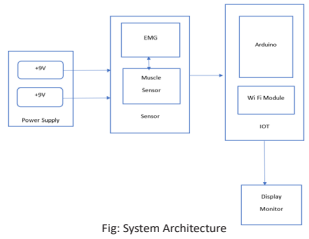
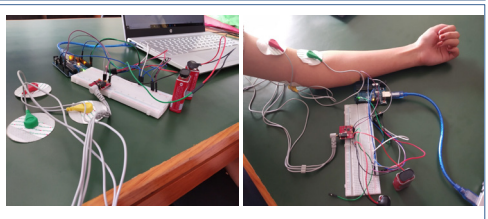
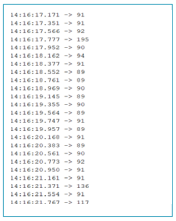


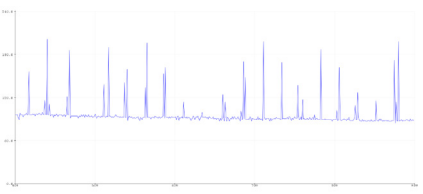
Fig: System Architecture


System Implementation

Result

Table 1. EMG data in mv




Graph: EMG Signal

Objective

- To measure the activity of muscle by monitoring the electrical potential generated by muscle cells.
- To develop a IoT based EMG monitoring system that analyze the EMG signal generated from muscle to check the performance of weakness.

Discussion

EMG sensors detected electromagnetic signals. The EMG signal was measured from muscular activities like contraction or relaxation. The raw signal varies from person to person, these signals were recorded and stored for further analysis. The analysis was carried out by peak voltage of the phase or the pre-defined standard scale of healthy muscular activities.
However, surface EMG can have limited applications due to inherent problems associated with surface EMG. Adipose tissue can affect EMG recordings because adipose tissue increases the active muscle directly below the surface. This EMG signal recordings are typically more accurate with individuals who have lower body fat, more compliant skin such as young people as compared to old.

Conclusion

Hence, EMG was used to measure the activity of muscle by monitoring the electrical potential generated by muscle cells. An IoT based EMG monitoring system analyzed the EMG signal generated from muscle to check the performance, weakness, strength or any disorder in the muscular activities.

Team Members

Aarati Pandey
Prakriti Dhakal
Toshika Ojha

Supervisor
Prof. Dr. Manish Pokharel

Contact Information

aarati.pandey745@gmail.com
prakritidhakal2008@gmail.com

What is the "Most Complex Software" in the World?

SUBARNA ADHIKARI
ME COMPUTER, 2018

If you google the term 'most complex software', instead of getting results for high risk critical systems like I was expecting, you will probably be introduced to Stuxnet (if you aren't already) and all the reasons why people believe that this computer worm is one of the most complicated piece of software in history.

If you are already skeptical about how good a malware can be, then it would be useful to know that Stuxnet is also often associated with titles like 'the virus that almost started WW3' or 'the virus that saved the world from Nuclear Iran', and is also the subject of a 2016 documentary called 'zero days' and many research papers . Although the term complexity is subjective, and it is difficult to vouch for the validity of many of these titles without concrete evidence, a lot of people do believe that Stuxnet is one of a kind in the ever-evolving ecosystem of malware, and that is certainly enough to make most of us curious. It is also a good example of what a malware is capable of.

Although credited as the first cyber weapon, the exact origin of the Stuxnet computer worm is highly debated. In the mainstream media, the development and deployment of Stuxnet are largely attributed to the US and the Israeli government to delay the growth of Iran's nuclear program. By the time it was identified in 2010, it had been deployed for quite a few years and had caused substantial damage to the uranium enrichment facility at Natanz, Iran.

As the story goes, due to the 'air gap' (isolation between the internal network and the internet for security), Stuxnet could not be directly inserted into Natanz's infrastructure via the network. Hence, Stuxnet was introduced into the plant through an infected USB drive. Stuxnet was engineered to only affect a specific type of target, and elsewhere it would just lie dormant and not cause any harm. It was designed to attack the Siemens industrial control systems, used in large scale power plants, and other industrial systems.
At Natanz, the worm used the then-unknown vulnerabilities of Windows (now patched) to infect the control system's PLC (Programmable Logic Controller). Stuxnet would provide the PLC with malicious information that would modify the centrifuges' rotor speed at the plant, and cause them to explode. In addition to the destruction of the centrifuges, the worm would also intercept the system output. It would then remind the monitoring system that everything operated as expected by replaying previously recorded data (when the activity of the process was normal) on the loop. That's also why it took so long to find out what was behind the destruction at the enrichment facility of about 1,000 centrifuges. Although Stuxnet was leaked later and found throughout the world in more than 10 other industrial systems, it lay dormant and did not cause any harm to these systems as it did at the Iranian enrichment plant.

As to why the worm has been called the most sophisticated software, a lot has to do with a popular article on Quora by Gigantic Software CEO John Byrd on the topic. According to the article, the worm specifications include - multiple ways of running itself on the target system, ability to sneak past most antivirus software (at the time of its detection) and automatically transmit itself across a network, copy itself into USB drives that were inserted into the infected PC using fake disk driver signed with signatures stolen from Realtek and JMicron . The worm was also intelligent enough not to get caught as its rootkit component concealed its malicious activities to avoid suspicions. Although at the time, Stuxnet only targeted enrichment facilities in Iran, its design and architecture were generic. The industrial plants using Siemens Supervisory Control and Data Acquisition (SCADA) systems all over the world like power plants, factories and oil plants were vulnerable to it.

So, is Stuxnet the most complex software in the world? Probably not. Is it one of the most sophisticated malware? Definitely. Since Stuxnet, the world has seen much destructive malware like Industroyer, WannaCry, and Triton. But in its defense, Stuxnet was groundbreaking in its time and still is as it sets an example of how a weapon made out of code could bring down physical infrastructure, and no one would even have a clue.

Double up on Security: Two Factor Security

ROJI KAYASTHA
MASTERS BATCH 2018

Verizon 2018 Data Breach Investigations Report states, "About 81% of confirmed data breaches in the Accommodations industry involved stolen credentials."

Securing an online or mobile account with just one password is almost impossible. Infringements of data, malware, device theft and myriad other methods can be used to compromise digital passwords, regardless of how secure they are. Anyone with sensitive information protected by a password needs to have a second method of securing their account, hence two-factor authentication. There are various ways to protect accounts via two-factor authentication: biometrics, one-time passwords, verification codes, QR codes, hardware tokens and other methods all add another layer of security.
Regardless of the method, one thing is for sure: Two-factor authentication is necessary no matter how inconvenient users think it is.

What is two factor authentication?
Two-factor authentication is a supplement to a digital password that, when used properly, makes it harder for a cybercriminal to access a compromised account. Also referred to as 2FA, two-step verification, login verification, and two-step authentication, two-factor authentication has lots of users and a high client demand. PayPal, Facebook, eBay, Yahoo, and many other websites support two-factor authentication nowadays.

Authentication Factors:
There are several different ways in which someone can be authenticated using more than one authentication method.
Authentication factors, listed in approximate order of adoption for computing, include:
1. A knowledge factor is something the user knows, like a password, a PIN, or some other kind of shared secret.
2. A possession factor is an identification token, a smartphone, or other mobile devices a user has like an ID card.
3. An inherence factor, more commonly called a biometric factor, is something inherent in the user's physical self. These may be personal characteristics mapped from physical features such as fingerprints authenticated by a fingerprint reader. Other commonly-used inherent factors include facial and voice recognition, behavioral biometrics such as keystroke dynamics, gait, or speech patterns.
4.A location factor, usually denoted by the location from which an authentication attempt is being made, can be enforced by limiting authentication attempts to specific devices in a particular location, or more commonly by tracking the geographic source of an authentication attempt based on the source IP address or some other geolocation information derived from the user's mobile phone or other device such as GPS data.
5. A time factor restricts user authentication to a specific time window in which logging on is permitted and restricting access to the system outside of that window.

How does two-factor authentication work?
Two-factor authentication requires, along with a password, the second form of identity verification. After successfully logging in to an account with a password, the user is prompted to either confirm their identity using a one-button push with a verification app or input a random security code from a text, email, push notification, authenticator application or physicall key.

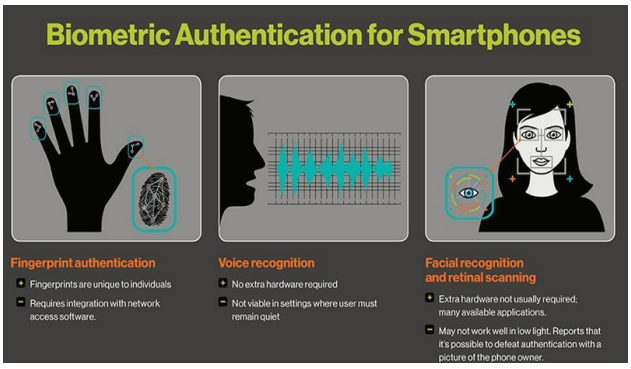


*Illustration SEQ Illustration * ARABIC 1: Mobile Phone 2FA*

The second factor is, ideally, harder to spoof than a password; it requires something the legitimate user has physical access to, like a smartphone with a particular authenticator app installed, a linked phone number for push notification or SMS.

An authentication code, or a hardware security key, leave a hacker stuck even if they have the correct password to the account. Two-factor authentication is available for Apple ID, Google, Facebook and Twitter accounts, bank websites and most other services--it's often as simple as enabling the option.
Biometrics (like Touch ID and Face ID), authenticator apps, SMS authentication, email authentication or a physical security key are common practices to authenticate an account with an authentication code.

Why does two-factor authentication matter?

Two-factor authentication matters to everyone--in particular, security professionals and anyone who uses digital passwords.
If it's in an account on the internet, it's safe to assume that it's fair game for hackers to try gaining access to it. A password is usually only a stumbling block to getting ahold of your business or personal information.
It seems like we hardly go a week without news of a massive data breach affecting millions of people. The information that's stolen, in many cases, includes usernames and passwords that could allow cybercriminals access to accounts. If those users have two-factor authentication active on their accounts, they won't need to worry nearly as much.
To the individual user, two-factor authentication matters. It protects personal information like email, financial records, social media and other sensitive information. Businesses also need two-factor authentication to protect company secrets from being spilled out as they should be sure that the users, internal and external, are using it.

Proof of Work – Ethereum

PALISTHA SHRESTHA
CS BATCH 2015

Ethereum is a blockchain-based open technology platform that enables individuals to develop and launch decentralized applications (also known as dapps). This is made possible due to the smart contract functionality that the Ethereum platform possesses. Today, miners play an important role in making sure ethereum works.

Ethereum Tokens:

Ethereum's tokens are created through the process of mining at a rate of 5 ether per mined block.

Mining is one innovation that makes decentralized record-keeping possible.

Although ethereum is looking into other methods of coming to consensus about the validity of transactions, mining currently holds the platform together.

Proof of Work:

•The Ethereum blockchain is maintained by a distributed network of nodes, and in order for a node to add a block to the blockchain, it must undergo Ethereum's proof of work mining process.

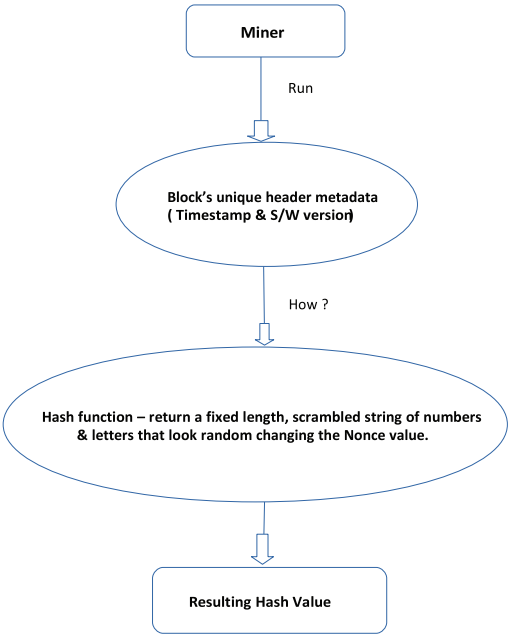
• Miners hash variations of the input data by including a nonce. The nonce is an arbitrary number that varies the input data such that the correct output that allows the miner to add a new block to the blockchain can be found.

•The ethereum algorithm , Etash, is the hashing algorithm that is used in this proof of work algorithm.

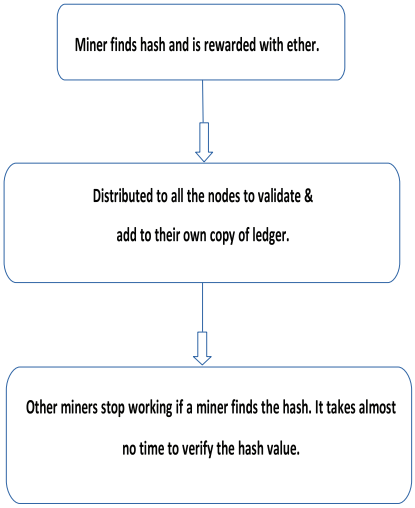
• Every 12 – 15 seconds, a miner finds a block . If the miner slows down or moves fast than this time limit, algorithm readjusts the difficulty of the problem so that the miners spring back to roughly the 12-second solution time.

How mining works in ethereum ?

•For each block of transactions, miners use computers to repeatedly and very quickly guess answers to a puzzle until one of them wins.



Mining uses the puzzle- solving method :



How do miners earn ?

• A block reward of 3 ether.

• All of the gas that was consumed when executing all of the transactions within the block.

• An additional reward for including uncles as part of the block. Miners that include uncles in a block receive 2.625 ether.

DAG in Ethereum Blockchain ?

• Dagger Hashimoto is the mining algorithm for ethereum.

• Dagger Hashimoto aims to simulatneously satisfy two goals:

1. **ASIC-resistance** : the benefit from creating specialized hardware for the algorithm should be as small as possible.

2. **Light Client verifiability** : a block should be relatively efficiently verifiable by a light client.

Dagger algorithm :

• Dagger algorithm works by creating a directed acyclic graph (the technical term for a tree where each node is allowed to have multiple parents) with ten levels including the root and a total of 225 - 1 values.

• In levels 1 through 8, the value of each node depends on three nodes in the level above it, and the number of nodes in each level is eight times larger than in the previous.

• In level 9, the value of each node depends on 16 of its parents, and the level is only twice as large as the previous; the purpose of this is to make the natural time-memory tradeoff attack be artificially costly to implement at the first level, so that it would not be a viable strategy to implement any time-memory tradeoff optimizations at all.

• Finally, the algorithm uses the underlying data, combined with a nonce, to pseudorandomly select eight bottom-level nodes in the graph, and computes the hash of all of these nodes put together.
• If the miner finds a nonce such that this resulting hash is below 2256 divided by the difficulty parameter, the result is a valid proof of work.

Pseudocode for Dagger algorithm :
• Let D be the underlying data , N be the nonce and || be the string concatenation operator (ie. 'foo' || 'bar' == 'foobar') .
• spread(L) = 16 if L == 9 else 3
node(D,xn,0,0) = D
node(D,xn,L,i) = with m = spread(L)
p[k] = sha256(D || xn || L || i || k) mod 8^(L-1) for k in [0...m-1] sha256(node(L-1,p[0]) || node(L-1,p[1]) ... || node(L-1,p[m-1]))
eval(D,N) =
with xn = floor(n / 2^26)
p[k] = sha256(D || xn || i || k) mod 8^8 * 2 for k in [0...3] sha256(node(D,xn,9,p[0]) || node(D,xn,9,p[1]) ... || node(D,xn,9,p[3]))
Objective: find k such that eval(D,k) ↓ 2^256 / diff

4

Hashimoto algorithm :
• Uses cryptographic hash function not as a proof of work itself, but rather as a generator of pointers to a shared data set allows for an I/O bound of work.
• Difficult to optimize via ASIC design and difficult to outsource nodes without full data set.
• Derived from three operations: hash, shift and moldulo.
Pseudocode for Hashimoto algorithm:
hash_output_A = sha256(prev_hash, merkle_root, nonce) for i = 0 to 63 do
shifted_A = hash_output_A **>>** I
transaction = shifted_A mod total_transactions txid[i] = get_txid(transaction) **<<** I end for
txid_mix = txid[0] txid[1] ... txid[63] final_output = txid_mix (nonce **<<** 192)

• We define the following functions :
1.Nonce : 64bits. A new nonce is created for each attempt.
2.get_txid(T): return the txid (a hash of a transaction) of transaction number T from block B.
3.block_height: the current height of the block chain, which increases at each new block.
•The target is then compared with final_output, and smaller values are accepted as proofs.
•The initial hash output is used to independently and uniformly select 64 transactions from the blockchain. At each of the 64 steps, the hash_outputA is shifted right by one bit, to obtain a new number,-shifted_A.
•A block is chosen by computing shifted_A modulo the total number of blocks, and a transaction chosen by computing shifted_A modulo the number of transactions within that block..
• These txids are also shifted by the same amount as the shifted_A which selected them. Once the 64 txids have been retrieved, they all XORed together and used as the input for the final hash function, along with the original nonce.
• The original nonce, shifted up into the most significant bits, is needed in the final XOR function because very small sets of transactions may not contain enough permutations of txids to satisfy the proof of work inequality.
• In fact, this algorithm only becomes I/O bound as the blockchain expands insize. In the extreme case of a blockchain with only 1 block and 1 transaction, the entire 64 iteration process can be omitted, and the nonce for final_output can be rapidly iterated as the txids will always be the same.

5

Ethash algorithm : Proof of work algorithm that ethereum implements :
• The Ethash algorithm relies on a pseudorandom dataset, initialized by the current blockchain length. This is called a DAG, and is regenerated every 30,000 blocks (or every 5 days) and the DAG will continue grow in size as the blockchain grows.
• The fixed output that is produced during the hashing process, in order for a node to add a block to the Ethereum blockchain, must be a value that is below a certain threshold.

Ethash ASIC-resistance :
• Proof of working mining on the Ethereum algorithm, Ethash, requires retrieving pieces of random data from the DAG, hashing randomly selected transactions from any block on the blockchain, and then returning the result from the hashing process.

• Thus, in order for an individual to mine on Ethereum, they will have to store the entire DAG for the purposes of being able to fetch data and compute selected transactions.

• The result of the Ethereum mining structure is that a miner spends more time reading the DAG, as opposed to executing computations that are fetched from it. This is an intentional design architecture that is aimed at making mining on Ethereum ASIC (application-specific integrated circuit) resistant.

• The requirement of having to hold a large amount of memory during the mining process means that entities such as mining farms gain little benefit from loading terabytes of memory into their mining devices.
• Large-scale miners receive little benefit from doing this because smaller miners can similarly also purchase terabytes of memory, as the energy cost of memory taken on by a large-scale miner and a smaller miner is comparable.

What is memory hard ?

Memory hardness essentially means that your performance is limited by how fast your computer can move data around in memory rather than by how fast it can perform calculating operations.

• Every mixing operation requires a 128 byte read from the DAG . Hashing a single nonce requires 64 mixes, resulting in (128 Bytes x 64) = 8 KB of memory read.

• Since fetching the DAG pages from memory is much slower than the mixing computation, we'll see almost no performance improvement from speeding up the mixing computation.

• The best way to speed up the ethash hashing algorithm is to speed up the 128 byte DAG page fetches from memory. Thus, we consider the ethash algorithm to be memory hard or memory bound.

The primary reason for constructing a new proof of work function instead of using an existing one *was to attack the problem of mining centralisation,* where a small group of hardware companies or mining operations acquire a disproportionately large amount of power to impact or manipulate the network .

• *The Preprocessed Header* - derived from the latest block and the *Current Nonce* - the current guess, are combined using a SHA3-like algorithm to create our initial 128 byte mix, called *Mix 0* .

• The *Mix* is used to compute which 128 byte page from the DAG to retrieve, represented by the *Get DAG Page* block.

• The *Mix* is combined with the retrieved DAG page. This is done using a ethereum-specific mixing function to generate the next mix, called *Mix 1* .

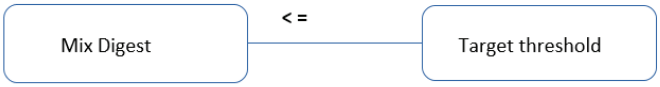
• Steps 2 & 3 are repeated 64 times, finally yielding *Mix 64.*

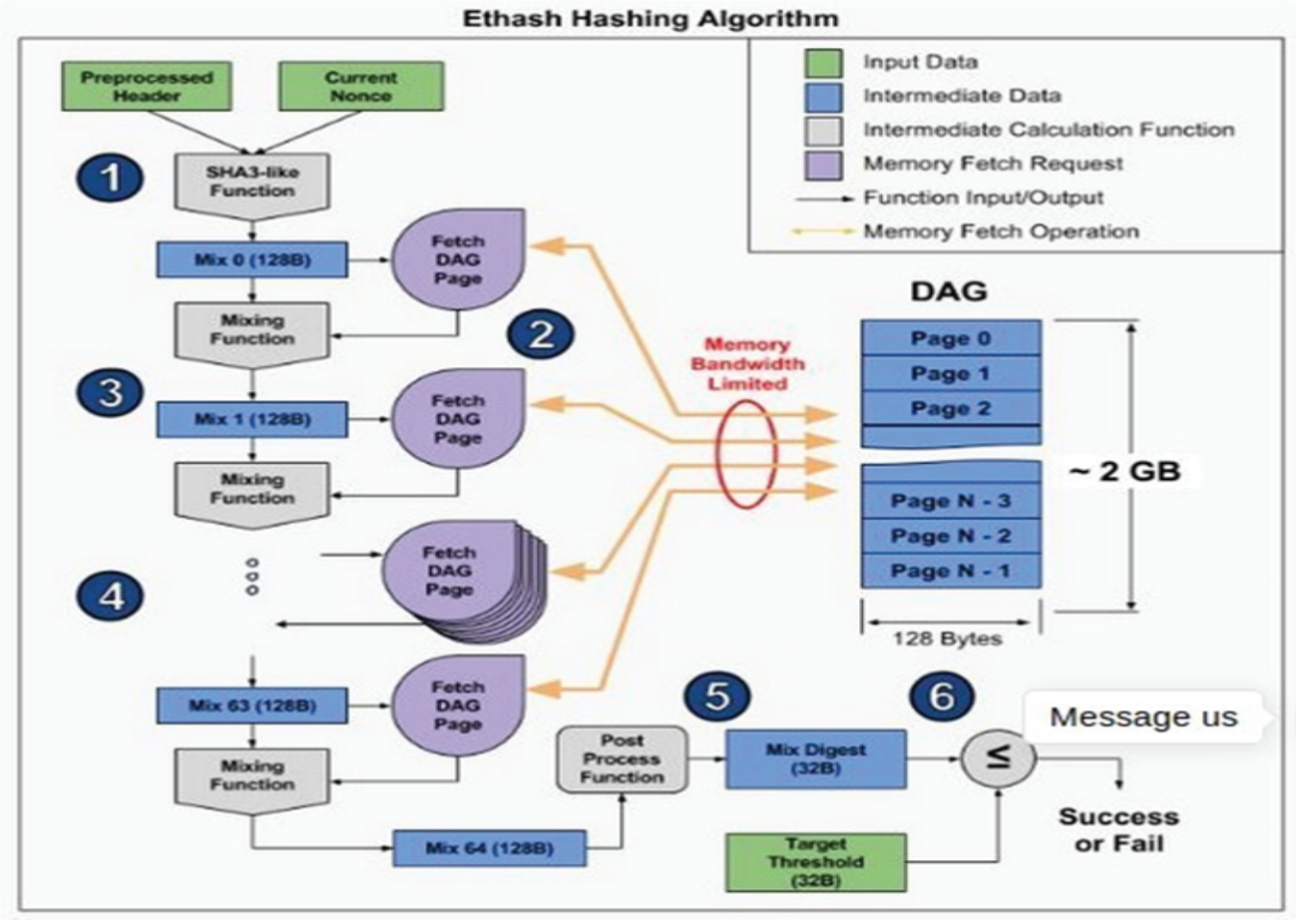
• *Mix 64* is post processed, yielding a shorter, 32 byte *Mix Digest.*

• *Mix Digest* is compared against the predefined 32 byte *Target Threshold.*

• If *Mix Digest* is less than or equal to *Target Threshold,* then the *Current Nonce* is considered successful, and will be broadcast to the ethereum network

• Otherwise, *Current Nonce* is considered invalid, and the algorithm is rerun with a different nonce (either by incrementing the current nonce, or picking a new one at random).





An Interview with Dr. Rajendra Adhikari Regarding the First Supercomputer of Nepal

Abstract— *Dr. Rajendra Adhikari is an Assistant Professor of Physics at Kathmandu University. He has been in charge of the only supercomputer in Nepal, set up at Information Technology (IT) Park, Kavre, from the day of its installation. The team got a wonderful opportunity to converse with Dr. Adhikari and harvest insightful information on the supercomputer, present status, ongoing research and its future plans*

What is a supercomputer in simple terms? And how is it different from a normal computer?

Supercomputer got its name from being relatively 'super' as we commonly say for extraordinary things. 'Super' in the sense that the computing power, storage, and reliability of this computer is higher than any normal computer. To say this collectively, a supercomputer is a machine having powerful computing hardware, stable software, robust networking ability, and eloquent user policies. It has a significantly higher performance than our normal PC's. It is admiringly reliable at the same time.

Do supercomputers have any type? If so, which type of supercomputer do we have in IT Park?

Taking about the types of supercomputers, new trends are gaining popularity than the conventional types. Before 2000, CPU based supercomputers used to rule the market. In recent years GPU based supercomputers are becoming a hot topic. There are also ARM processor-based supercomputers. The architecture of supercomputers is constantly evolving, but CPU based supercomputers have been dominating the market. The supercomputer in the IT park is CPU based. It consists of a total of 200 nodes among which 16 are storage nodes, 147 computing nodes, and recently we have added 1 GPU node and 10 Gbps networking cards. Overall, the computer has 7 terabytes of RAM, 1.5 petabytes storage and more than 2000 processing units.

PCs are becoming powerful and smarter every day. In spite of such feats in computer technology, why is there a need for a supercomputer? And what are its application fields?

Normal computers have their limitations. No matter how advanced it is, we can't stretch its storage, memory and processing power beyond a certain limit. Hardly 4 processors can be accommodated in any powerful workstation to date. Compared to that, supercomputers can handle 1000s of processing units. The performance is huge, more than hundreds of times higher than normal computers. Between normal computers and supercomputers, supercomputers win in most of the aspects. Taking about applicable fields, the supercomputer is mainly used for numerical computations. In the context of Nepal, it is specifically being used for number crunching and massive data storage. We have been working on computational fluid dynamics, and environmental modelings such as weather forecasting, detection of air and water quality, watershed simulations and more. Besides that, I, being a material physicist, am working on innovative materials, also referred to as novel materials, such as high-temperature superconductors, and for making smart materials. The most useful and experimentally verified application is Image Processing. For instance, if we need to conduct any survey of the land, we capture the images via drones and process those images in the supercomputer for the 3-dimensional reconstruction of land and topology, which can be subjected to further processing for other beneficiary results.

How many researches have been successful, and what is the present status of ongoing researches?

I would say we have been successful all along. We have published 2 to 3 papers to date compiling the researches made using the supercomputer, and few are on their way to publication. We consider it one of the biggest academic achievements. In the educational field, we have conducted 4 workshops for students by providing open access to prototype units as demo supercomputers. Students are allowed to use and play with those computers so that they can see and learn for themselves by experimenting. They can learn from a relatively lower level on how to make a supercomputer and can gain firsthand experience.

We have been actively working on Image Processing, designing novel materials and environmental modeling, and they are going well. Besides that, storing and processing the data of Dhulikhel hospital is included in our plan on the supercomputer. Also, we have been talking to the musical department. Music-related projects are extremely data-intensive. Audio and video oc-

cupy excessive storage in our devices. We have planned to store their data reliably, and process them as per the need. We have been thinking to work on digital archives, archives of musical heritages and similar other stuff.

How long have you been working on supercomputers? And what was your main motivation to engage in this field?

I have been working on this field since 2007. So, it may have been approximately 12 years. The motivation was my passion for physics, and my then ongoing Ph.D., as I worked on computational material science. During that time, due to highly intensive computations, the situation compelled me to work with supercomputers. I started doing some research on how supercomputers worked and did an in-depth study on supercomputers to have convenience in my research. Those experiences of working with supercomputers accumulated to help me work on one now. The first time I got access to a supercomputer was on the College of William and Mary, located in Virginia in 2007.

From the day the supercomputer was brought in KU till now, can you share your good and bad experiences throughout this journey?

No journey in itself is a bad journey. Every journey should be considered a good one because each one teaches us something. The establishment of the supercomputer is in itself an onset of a wonderful journey. Diligence is indeed the most important factor in the success of research or any project. We have been laboring continuously on our part. There was much hustle when we had to fetch it on customs allowance. We had to deal with the university grant commission and other governmental and legal bodies to establish it. And, even after bringing it to KU, we had to be continuously involved in its maintenance without hampering regular classes and academic fields. Since then, we have been working incessantly. There are 5 faculty members and university students in our volunteering team. It is a volunteering mission of us all to make this journey a success. The internet service is also provided voluntarily by SUBISU. This can be considered as one of the greatest achievements in the academic-industry partnership. That's why till now we have been able to run it on minimal finance which is a great triumph. Overall, I have considered this journey successful. Small bumps and obstacles should be ignored in the face of such achievement.

This supercomputer is Nepal's first supercomputer. How did it come to IT Park? Precisely, how did KU ended up getting such an opportunity to house it? Also, did we get funds for its establishment?

I had been working on supercomputers for a significant amount of time when I started wishing to have a supercomputer in my homeland so that I can work there. I joined KU in 2015, and the question regarding the whereabouts of its establishment was dark, mainly due to its high price. Supercomputers are worth millions of dollars, which is practically not affordable in demand of a faculty or university for a country like ours. Fortunately for us, KU had been working in collaboration with CERN, a laboratory in Switzerland for a long time. After I was part of the University, I worked on further enhancing that relationship. Many Nepalese fellows in that team supported and played a vital role in making the mission of bringing a supercomputer in Nepal a success. We received a complete set of hardware as a gift from CERN. Even after its installation, we have been continuously receiving support from the team. Recently, we got a chance to work together with the CERN team members on the supercomputer in their one-week visit out here. We also conducted a workshop for students on working with the supercomputer.

How can the supercomputer be beneficial to students? Also, how students at KU can be involved in learning and working with supercomputers?

Supercomputer is a huge conglomerate of hardware, software, user policies, and networking as I mentioned previously. So, students have plenty of choices to work on a particular part. Some may choose to work on hardware, some on software, some on defining user policies, some on managing nodes, some on load balancing, some on storage, some on job queuing and more based on his/her interest and ability. So, students can join in any field of supercomputers they would like to work on and can further tune the computer and its efficiency. We have openly invited students to come and learn with us. We have a prototype unit of the supercomputer where students can experiment and show their expertise, and they are doing it even now. Besides that, there is a concept of parallel programming that is used for increasing the efficiency of the supercomputer on which we are currently involved. Parallel programming is the low-level benefit that is obtained from the supercomputer. We have been conducting workshops on parallel programming every year. We are also working on CUDA programming and we recently conducted a workshop on it in collaboration with Robotics Club.

Could you tell us about the plans for supercomputers and on their researches. Are there any plans for extending its capacity? Do you have something to add in the end?

Actually, that is a very beautiful question, thank you. Our priority on the supercomputer is to make it constantly up and running, and we have been continuously working on that. The work on enhancing the capacity of the supercomputer can also be considered as started. We recently added a GPU network on the computer through our initiative. It is a Titan-V card, which is the latest one in the market worth about $3000. Besides that, we have been benefiting from Networking by increasing its capacity up to 10 times. As a policy, we have decided to form a National Committee to handle the responsibility of this supercomputer jointly. We are working on its smooth operation and expansion of facilities. The most noteworthy idea that we plan on executing is Green Computing. We want the computer to be able to run on low-level renewable energy so that the electricity cost can be reduced substantially. Also, we plan to have more engagement of people, researchers, students and faculty members on the supercomputer. We plan on doing a nationwide promotion to involve more people in our research.

Microsoft Azure Explained: What It Is and Why It Matters

SAMBAD BIDARI
CS BATCH 2015

Microsoft Azure is usually described as having "limitless potential" and "unlimited possibilities," but what does Azure do and what can it do for your business?
In this paper, I'll answer these questions and show you the value with four concrete ways **Azure can be used by your business and the real benefits you can gain today.**

What is Azure?

At its core, Azure is a public cloud computing platform—with solutions including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) that can be used for services such as analytics, virtual computing, storage, networking, and much more. It can be used to replace or supplement your on-premise servers.
Here are some quick facts about Azure.
Microsoft Azure – IaaS, PaaS and SaaS
Flexible – Move compute resources up and down as needed
Open – Supports almost any OS, language, tool, or framework
Reliable – 99.95% availability SLA and 24×7 tech support
Global – Data housed in geosynchronous data centers
Economical – Only pay for what you use
Azure is a fast, flexible, and affordable platform and its pricing and capabilities make it the best public cloud offering on the market. Now let's take a look at how to put it to work for you.

1. Enhance and Implement Backup and Disaster Recovery

Azure is a backup and disaster recovery dream tool. Why? Because of its flexibility, advanced site recovery, and built-in integration.As a cloud-based solution, Azure is innately flexible – it can back up your data in almost any language, on any OS, and from any location. Plus, you define the frequency and extent of your backup schedule (daily, weekly, monthly, etc.).
Tape backup has a time and place, but it has limited abilities as a stand-alone backup and disaster recovery solution. Azure site recovery can enhance your tape backup with offsite replication, minimal onsite maintenance, up to ninety-nine years of data retention, minimal or no capital investment, and minimal operational costs. Azure backup stores three copies of your data in three different locations in the data center, and then another three copies in a remote Azure data center, so you never have to worry about losing data.
If you're in a Windows virtual environment, Azure's built-in integration for the additional backup will be a quick and painless solution. Azure site recovery integrates with System Center and HyperV architectures, creating a robust and seamless cohesion between Azure, System Center, and HyperV
.

2. Host and Develop Web and Mobile Apps

Whether you're looking for a platform for hosting, developing, or managing web or mobile app, Azure makes those apps autonomous and adaptive with patch management, AutoScale, and integration for on-premises apps.
With Automatic patch management for your virtual machines, you can spend less time managing your infrastructure and focus on improving your apps. Azure also comes with continuous deployment support, which allows you to streamline ongoing code updates.
AutoScale is a feature built into Azure Web Apps that adjusts your resources automatically based on customer web traffic so you have the resources you need when traffic is high, and save money when you're not in peak times. Through Azure, you can seamlessly link your web app to an on-premise app. Connecting apps in both locations let both employees and partners securely access resources inside your firewall—resources that would otherwise be difficult to access externally.

3. Distribute and Supplement Active Directory

Azure can integrate with your Active Directory to supplement your identity and access capabilities—this gives your DNS a global reach, centralized management, and robust security. With Azure, you can globally distribute an Active Directory environment that is direct connect enabled. No other cloud provider has the ability to extend the reach of your domain controller and consolidate AD management like Azure. If you have multiple locations or use on-premises apps or cloud apps like Office 365, Active Directory integration with Azure will be the central tool for managing and maintaining access to all of these tools. Azure also enables you to utilize multi-factor authentication, adding a new layer of security to your data and applications with zero hassle for your users. You can also easily implement single sign-on for Windows, Mac, Android, and iOS cloud apps.

4. Innovate with IoT Industry Solutions

The scalability, flexibility, and security of Microsoft Azure makes it the perfect resource for companies moving toward IoT solutions. You can connect your devices to the cloud using solutions that integrate with your existing infrastructure and start collecting new data about your company.
Within the Azure IoT Hub, you can monitor and manage billions of devices and gain insights to help you make better business decisions, improve customer experiences, reduce complexity, lower costs, and speed up development.
The enhanced security of Azure is a huge asset for IoT solutions, which traditionally have security gaps that hackers can take advantage of. Other benefits include remote monitoring and predictive maintenance and analytics. Getting started is easy with Azure IoT solution accelerators, preconfigured templates that are customizable to your needs.

How will you use Azure?

These four services are just a glimpse of what Azure can do for your environment. Besides Microsoft's defined services, it is full of cloud-computing potential that you can utilize in almost any way imaginable.

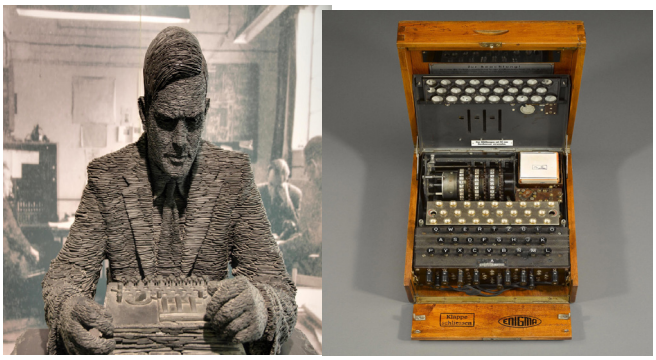
DNA Cryptography

BIPIN BOHARA
CE 4TH YEAR

Cryptography is the study of secure communication technique that prevents unauthorized access of data and allows only the sender and the intended recipient to view the actual contents. The term 'kryptós' means secret, and 'gráphein' means written. Art of scrambling ordinary text into ciphertext is known as encryption, and the unscrambling of ciphertext into plaintext is known as decryption. In cryptography, information is protected using mathematical concepts and algorithms by converting the information into a non-decodable form.

A short story about Alan Turing:

The Turing Award is recognized as the highest distinction in Computer Science, and the Nobel Prize of Computing is named after a British Mathematician Alan Turing. Alan Turing made contributions in World War II in deciphering the code of The Enigma, an encoding machine used by the German forces to keep the radio communication between military units secret. The Enigma was an extremely complex apparatus consisting of five rotors and thousands of different settings and its code was considered unbreakable. Turing largely contributed to the cracking of The Enigma, which was kept secret until the 1970s. The breaking of Enigma is featured in the movie **The Imitation Game.**



Jumping into DNA Cryptography

DNA Cryptography is one of the rapidly evolving technologies which works on the concepts of DNA Computing. A new technique for securing data was introduced using the biological structure of DNA called DNA computing. It was invented by Leonard Max Adleman (Pioneer of DNA Computing) in 1994, for solving the complex problems such as Seven Point Hamiltonian Path problem & NP-complete problem, similar to the Travelling Salesman Problem. The technique was later extended by various researchers for encrypting and reducing the storage size of data, which made data transmission over network faster and secured.

The concept of using DNA computing in the fields of cryptography and steganography has been identified as a possible technology that may bring forward new hope for unbreakable algorithms.

Strands of DNA are long polymers of millions of linked nucleotides. The nucleotides that make up these polymers are named after the nitrogen base that consists of Adenine (A), Cytosine (C), Guanine (G), and Thymine (T).

Traditional cryptography and its security are focused on complex mathematics issues that are advanced in both theory and reality. There are fundamental flaws in both the secret-key and the public-key methods of cryptology. The keys used in modern cryptography are so large that a billion computers running a billion calculations per second would still take a trillion years to crack the code. While this may not be a concern as of now, due to the growth of computing power and technology, it will soon be.

Advantages of DNA Storage of Data:

- The massive parallelism of DNA molecules.
- A gram of DNA contains 1021 DNA bases = 108 Terabytes of data.
- A few grams of DNA can hold all data stored in the world.

The large parallelism of DNA molecules is one of the benefits of DNA computation. About 101 processors functions in parallel in an in vitro assay. Because of this immense parallelism, the trapdoor function can be solved in polynomial time, which is the basic security key of most conventional cryptosystems. So it's high time to consider the conventional cryptosystem's replacement. Since the computational component of cryptography is being replaced by DNA chemistry in the DNA cryptography field, conventional methods, as well as quantum computing, make this technique practically unhackable. Many research activities are being carried out worldwide to suggest an innovative and imaginative approach in the area of DNA cryptography. In the coming years, once DNA computers become commercially available, it will take over traditional silicon-based technology

BitTorrent!

MANISH BHATTA
CS 2ND YEAR

Ever wondered why bitTorrent is so fast? and what does peers and seeders mean? In this article, you'll be learning the following things.

What is BitTorrent?

How does it work?

Is Torrenting illegal?

Some useful applications of BitTorrent.

What is BitTorrent?

BitTorrent is a peer to peer (P2P) file-sharing communication protocol. A peer to peer (P2P), in the simplest definition, means a network that is created between two or more computers to share resources, without involving a separate host server. There are a couple of ways to download resources.

Normal Download : It involves downloading particular resources that are hosted on a server or any other cloud storage platform (like Dropbox, Google Drive).

Torrent Download: When you're using torrent to download resources, you are not only downloading from one source who uploaded it initially, but also from other computers, and that's why the process is efficient, smooth and fast. We'll talk about the download process in detail later on.

If you've been using torrents, then you might be familiar with the following terms.

Peers: A peer is someone who downloads the file.

Seeder: When you are downloading and uploading the file at the same time, you become a seeder.

Leecher: When you are only downloading, you become a leecher.

Swarm: A collection of peers that are downloading/uploading the same file forms a swarm.

Torrent Client: Programs such as µTorrent or BitTorrent which helps you download, manage and transfer your files are torrent clients.

How does it work?

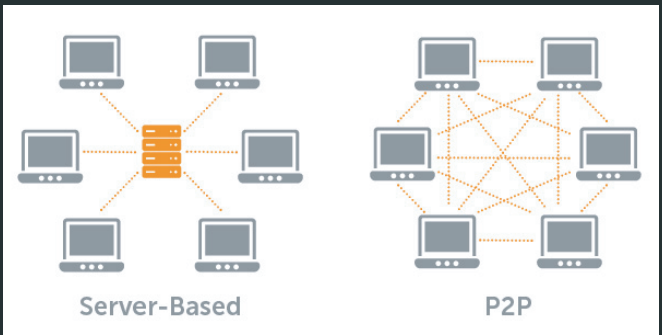
Let's say you visit torrent sites such as 133x.to or eztv.io to download a movie. A file gets downloaded on your computer with an extension of '.torrent'. So, what is that file? Is that really what you need? No, definitely not! That particular file is actually a torrent file.

Torrent File: A torrent file does not contain the actual content to be distributed, but the information about the file, such as name, size, folder structure and the list of the network location of trackers.

Tracker: A tracker is a server that keeps track of seeds and peers, just like you and me sharing the same resources.

So, when you add a torrent file to your torrent client (uTorrent), you'll announce the tracker and ask for the seeder's IP address, who is sharing the same file. The tracker will then send you the IP address of the seeders, and your torrent client will connect to peers and start the downloading process. The file that you're downloading is divided into small parts, and you download different parts from different seeders. Once, all parts are downloaded, it'll merge into a single file and then you're ready to share. This is the phase where you become a seeder, and you will let others download it. This is basically how file sharing is done with torrents. Remember, when you're opening your torrent client, you are constantly uploading the file

using your bandwidth. So, here's a little tip to help you save some bandwidth. Either stop the seeding in your torrent client, or delete the torrent file, or you may simply set your maximum upload speed to 0 in the settings.



Is torrent-ing illegal?

As said earlier, "torrent is just a file-sharing protocol". There's nothing illegal in that. It's just an efficient means of sharing files just like "SHAREit", but with multiple hosts. What is illegal is pirating software and entertainment media. For reference, it's illegal if you photocopy a book you got at the library, but the government won't come after you if you photocopy the library book at home. So, when you download a copyrighted movie or a book, you're doing the same thing. Imagine if you set up a system, where anyone in the world could receive a photocopy of any book, available at the library, just by asking you for it. Then you become the source providing free copies of copyrighted material to everyone. That's when the authorities get interested, and you might get caught. Many copyright holders (authors, producers, artists, etc.) are losing millions of dollars because of such activities in popular torrenting sites. Hence, the legitimacy of torrenting solely depends on how you use it.

Some useful applications of BitTorrent.

There are quite a lot of interesting applications of BitTorrent.

Perhaps you and your friends have made a music video, and want to release it for free, then BitTorrent is one of the best ways to do it. If you host your files on a server, you'd have to pay a lot for the bandwidth. If you make the files available via BitTorrent, you'd save a lot of bandwidth and money, by letting your fans contribute their bandwidth as they download your content.Blizzard Entertainment uses its own BitTorrent client to download games like World of Warcraft, StarCraft II, and Diablo III. When you purchase one of these games and download it, you're just downloading a BitTorrent client that will do the rest of the work. When an update is available, the BitTorrent client built into the game's launcher automatically downloads it for you. Since users have to authenticate online before they can play the games, Blizzard is happy to provide its game files to anyone.

Linux distributions use torrents legitimately for distributing installation media ISO files. Whether you're downloading the latest release of Ubuntu, Fedora, Debian or any of the other best Linux distros, there's a good chance you're getting it via BitTorrent. BitTorrent can help them save on bandwidth costs and speed up downloads.

Plagiarism: An Unethical Practice

JASMINE KARKI
CE 4TH YEAR

The age of the internet introduced us all with access to unlimited information. Unlike the old days of going through a handful of books and getting stuck on a problem for several days, the advancement of technology narrowed the distance between a problem and its numerous solutions to just a Google search. The digital era has been a blessing as it brought ample opportunities for the academic community to digital learning and teaching environment. Technological development has made this process easy, productive, inventive and enjoyable. But it ended up being a curse to some because an old disease, going by the name of plagiarism, introduced itself to the digital world and brought with itself threats to academic integrity.

Plagiarism is the act of copying another person's words and ideas, with or without the owner's consent and incorporating it in our work without giving proper citation or acknowledgment. It can be seen as passing on the work of others like data, thoughts, concepts, and findings (in whole or part), and taking their credit. According to Scribbr, the different types of plagiarism are listed below. (1)

Paraphrasing: It is an act of rephrasing a text in own words without citing the sources. It occurs when key points from the source are extracted and rewritten as if they were one's own ideas.

Mosaic Plagiarism: It is copying and pasting together pieces of different texts to create a new text. This kind of plagiarism occours when synonyms are used to reword pieces of text while keeping the original structure of the text unchanged.

Verbatim Plagiarism: It is the word for word copying of other's words. Quotation marks are not used to quote the original words and words copied without a proper source citation. The reader basically has no idea where independent work begins and where others' ideas and language have been drawn on.

Citing incorrect or non-existent sources: The use of incorrect sources or non-existent sources in a citation is also plagiarism. Guidelines aren't followed for proper citation style.

Self-Plagiarism: It is an unintentional type of plagiarism which involves using ideas and phrases from previous papers or assignments. Once a paper is turned in, it is no longer new and original work.

Plagiarism is taken seriously around the world and can result in personal, professional, ethical, and legal consequences. Plagiarism can cause a deduction of marks, suspension or even expulsion of students from the institution depending upon the seriousness of the offense. It can sometimes destroy the academic or professional career. Many cases of plagiarized research findings from Nepal have led professionals to be internationally blacklisted[CITATION 5KU \l 1033]. It can seriously damage a person's reputation taking their jobs and ending up with legal and monetary repercussions.

In the context of computer science and programming fields, code plagiarism has been an irrepressible problem. Source code plagiarism is the offense of copying or reproducing other's source code without citing the owner. It is one of the burning issues as it prevents the student from learning to solve the problems properly and encourages them to continue cheating. Many universities have implemented MOSS and Turnitin for plagiarism detection in the computer science department. Lexical and structural modifications in source code are detected by these systems. Lexical modifications involve formatting source code, changing the comment, renaming identifier, splitting or merging declaration variable while structural modifications involve changing the order of

variables in statements, changing the order of the statements in blocks, realigning function blocks, adding statements or redundant variables. [CITATION DMa19 \l 1033]

The best way to avoid being caught for source code plagiarism while submitting assignments and performing projects is by changing the entire variables' name, modifying functions, changing if-else to switch statements and code style in every program copied. But instead of performing such a level of effort for making others' work our own, we can invest this hard work in actually learning and doing it ourselves. We should always remember that we also copy its bugs and errors by copying and pasting the code. You're cheating yourself, after all, and not just the institution or the teachers. Every creation, research, journal and finding is believed to have maintained intellectual honesty. The international community considers knowledge and ideas to have developed from years of research, innovation and debates that a copy-and-paste issue is an unethical act. We are a member of this community and it is our responsibility to maintain this honesty. A simple step that can be practiced is, acknowledging or crediting the authors of the work by proper citation.

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3. The analysis of source code plagiarism in basic programming course. D Maryono, R A Yuana and P Hatta. 2019, IOP Conf. Series: Journal of Physics

Parsing an INI File Using JavaScript

AASHISH POKHAREL
CE 3RD YEAR

You may have seen a .ini file at least once in your life if you spend most of your time inside of a window's box. That's because an INI file, (that's what everyone lovingly calls this file format), is the informal configuration standard for the Microsoft Windows operating system. If you are not so fascinated by system administration, which I can understand why you may have encountered an INI file while playing those fancy AAA games. Indeed, many video games use this file format for exposing configuration options meant to be changed by the users, such as the keys used to move around or cast a spell in an RPG. But, you may be wondering, why are we supposed to know all this? Well, my dear reader, that's because we are about to implement a simple parser for all your game configuration INIs today, in JavaScript. You are welcome to follow along with your text editor if you please.

What is a Parser anyway?

A parser, according to Wikipedia is, "A software component that takes input data (frequently text) and builds a data structure – often some kind of parse tree, abstract syntax tree or other hierarchical structure, giving a structural representation of the input while checking for correct syntax." Wow! What a revealing definition, I know! Let me simplify that a bit for you.

A parser is a piece of program which is used to convert a giant string of textual data into a manageable data structure, such as the aforementioned parse tree. A parser is mostly used by a compiler to "understand" the code you write in any programming language. A parser is also, as the definition above mentions, used to check the syntactic correctness of your program. Ever wondered, how your C compiler smelt out that pesky missing semicolon that you simply couldn't find for the life of it? Yeah, thank the parser for that.

Okay, kind of understand what a Parser is, but how do I get around on implementing it?

Good question. It seems as if you too are as excited as me to bring our INI parser to life. But before we get started with the parser, I must tell you something about regular expressions.

Now, what are regular expressions again?

A regular expression, or regex for short, date back to the 1950s when a mathematician named Stephen Cole Kleene helped develop the regular language

Regular expressions have an interesting history that you can readily find in Wikipedia. Let's talk about the important stuff first. Why do we need regex to build our parser? That's because regular expressions are widely used in both human and computer languages for searching a given pattern through a string of text using string searching algorithms, such as in search engines or, as I mentioned earlier, in programming language compilers. We will only be covering some basic regex notations in this article. For more details, you can consult the grep man page or various online blog posts explaining the topic.

There are many popular formats for representing regex, though the three popular ones are POSIX style regex or Basic Regular Expressions (BRE), Extended Regular Expressions (ERE) and Perl Compatible Regular Expressions (PCRE). The format used in JavaScript, and as a result, the format we will use here, is PCRE. In PCRE, the following symbols have the following meanings:

* is Used to represent zero or more occurrences (a* matches " ", "b", "a", "aa", "aaa", "aba", ...)

+ is Used to represent one or more occurrences (a+ matches "a", "aa", "aaa", "ab" but not "bbb")
? is Used to represent zero or one occurrence (a? matches "b", "a", "abb" but not "aab")

[] is Used to represent a single character choice ([ab] matches either "a" or "b")

^ is Used to represent the start of a string

$ is Used to represent the end of a string

Okay, that's about all we will learn about regex in this article. These many should suffice for implementing our INI parser.

The Parser

Before we start with the actual implementation, I want to share with you the general design of the parser.

The Concept and Design

The parser will be a simple JS function, which will take a single string as an argument. That string will be the following INI string that we have happened to come across in an action RPG.

```
game=BossO'Rama
[Wombat]
```

```
nickname = Wom
health=25
speed=44
damage=11

[SquiDemon]
nickname=Squid
health=50
speed=22
damage=25

[Boss]
nickname=Bossman
health=100
speed=30
damage=40
specialDamage=44
```

The parser function will simply parse the INI string and spit out a JavaScript object. Here is a brief description of the actual parsing algorithm:
1.We first initialize an object parsedINI which will hold the parsed data.
2.We read in the INI string in one line at a time.
3.For lines with square brackets, such as [Wombat] which are called sections, we create a new object for Wombat within our original parsedINI object.
4.For lines without square brackets and with equals signs that are below a section, such as nickname=Wom, beneath [Wombat], which are called properties, we simply add them into the Wombat object created within the parsedINI object.
5.For lines above any square bracket lines, such as game=Boss0'Rama which are called global properties, we put them directly into the parsedINI object.
6.We ignore any lines beginning with semicolons (;) or whitespaces
So following the above rules, the parsedINI object for the first 8 lines of the INI file will look like the following:

```
parsedINI = {
        game: "Boss0'Rama",
        Wombat: {
                nickname: 'Wom',
                health: 25,
                speed: 44,
                damage: 11
        }
}
```

The Code
Finally, Thank God, we are ready to start implementing our little parser. The following lines of code implement a simplified version of the above parser.
.

```
"use strict"

/* A simple ini file parser */

;(function parseINI(iniString) {
  // This is the object we will use to store the parsed INI
 const parsedINI = Object.create(null)
 // This particular regular expression matches all lines with one or more
 // characters ending in a Windows or Unix style line ending.
 let lineRegex = /(.+?)\r?\n/g
 // Matching the regex against an the INI string, this will basically
 // return the contents of a single line
 let match = lineRegex.exec(iniString)
 for (; match; match = lineRegex.exec(iniString)) {
  if (!match[1]) continue

  let line = match[1]
  // if line contains a comment or an empty line
  if (/^[;\s].*?$/.test(line)) {
        console.log(`${line}: A Comment or An Empty Line`)
  // if line contains a square bracket section
  } else if (/^\[(.*)\]$/.test(line)) {
        console.log(`${line}: A Section`)
  // if line contains a new property
    // or a line does not begin with [, ; or a whitespace
  } else if (/^[^[;\s]*?$/.test(line)) {
        console.log(`${line}: A Property`)
  // if non of the above, indicate an error albeit,
  // in a peculiar way
  } else {
        console.log("Wait what!")
  }
 }
})("; A sample ini string\n[Wobmat]\nhealth=25\n")
// This is the actual INI string being passed in
} else {
    console.log("Wait what!")
  }
 }
})("; A sample ini string\n[Wobmat]\nhealth=25\n")
// This is the actual INI string being passed in.
```

This program is rather simple. All it does is takes in an INI string as input and logs a message into the console. The program, in essence, is an interpreter, simply reading the string line by line until reaching the end of the stream. So, while processing the current line, if it has a section, (such as [Wombat]), the program will display "[Wombat]: A Section". Similar behavior also applies to comment or property lines as well.

One particular thing to take note of is the expression within the parentheses. The line let lineRegex = /(.+?)\r?\n/g allows us to extract just the characters without the line endings. Later in the code, when we perform let line = match[1], we will be able to extract, for example, just "[Wombat]" from the line "[Wombat]\n" or "[Wombat]\r\n". Such parentheses expressions, in general, allow us to extract values matching just the sub-expression and not the surrounding expression. This will be useful to us later, as we extract values from the section or property lines.
Now, our intention is to not simply display whether each line is a section or a property. We aim higher. We aim to convert an ini string into a JS object. For that, a bit more work is required. First, we will need to extract the text inside the [] for section headers or around the = for properties. Then we will need to create new objects for section headers and assign all new properties in those sections to those newly created objects and create even more objects when new headers are encountered, all the while ignoring lines beginning with whitespace characters or semicolons.
The following code is supposed to do just that.

```
"use strict"

/* A slightly more complex ini file parser taking input from an ini file*/
const {readFile} = require("fs").promises

function parseINI(iniString) {
  // An empty object for storing the parsed ini data
  const parsedINI = Object.create(null)
  let iniHeader
// Regular Expression to recognize a line of an ini file
  let lineRegex = /(.+?)\r?\n/g

  let match = lineRegex.exec(iniString)
  for (; match; match = lineRegex.exec(iniString)) {
    // Ignore empty lines
    if (!match[1]) continue

    let line = match[1]
    // Check if the line is an ini header
    if ((match = /^\[(.*)\]$/.exec(line))) {
      iniHeader = match[1]
      parsedINI[iniHeader] = Object.create(null)
    // Check if the line is a property
   } else if ((match = /^([\w\d.]*?)\s*=\s*([^=]*)$/.exec(line))) {
      let prop = match[1], data

     if (!match[2]) throw new Error(`Value not specified for property ${prop}!`)
      data = match[2]
      // if Number(data) is not NaN, aka if data is a number, convert data to a number
      if (Number(data) === Number(data))
        data = Number(data)
      // Check if the property is global or local to a header
      if (!iniHeader)
        parsedINI[prop] = data
      else
        parsedINI[iniHeader][prop] = data
    // Check if the line is a comment
    } else if (/^;.*$/.test(line)) {
      console.log(`${line}: A Comment`)
    } else {
      throw new Error("Invalid INI format!")
    }
  }
  return parsedINI
}

// Read an ini file from disk
// This is not a part of the actual parser
// And is only included for demonstration purposes
readFile("./test.ini", "utf8")
  .catch(err =↑ {
    if (err.code === "ENOENT") console.log("File not found")
    else throw err
  })
  .then(iniString =↑ {
    let parsedINI
    try {
      parsedINI = parseINI(iniString)
    } catch (err) {
      return console.log(`Error: ${err.message}`)
    }
    console.log("The ini file parsed as a JavaScript Object is:")
    console.log(parsedINI)
  })
try {
      parsedINI = parseINI(iniString)
    } catch (err) {
      return console.log(`Error: ${err.message}`)
    }
    console.log("The ini file parsed as a JavaScript Object is:")
    console.log(parsedINI)
  })
```

Let me walk you through the code above. The first line of the function parseINI simply initializes the object parsedINI used to store the parsed data. The next line initializes the iniHeader which holds the current section header. This is important to track, as we need to know later which section a property belongs to. Then we use

the exec method of regex objects to get the array of matches, at index 1 of whose we will find the current line using the sub-expression data I mentioned earlier. Then we check to see if the current line is a section header. If it is we set the value of iniHeader and then create a new object with the section header name within the parsedINI object. If instead, the line holds a property, we use the second condition to extract the key and the value and convert the value to type Number, if it is a number. After performing the conversion, we assign the key and the value to either the section object or the parsedINI object itself depending on whether it is within a section or not. All comments are just logged onto the console for the time being and empty lines are ignored. I've also demonstrated reading an ini file from disk using the readFile function provided by Node.js but that is optional and not a part of the parser.

And That's a Wrap!

Well well well, it seems we have a pretty decent INI parser at our disposal now. If you have been following along, then congratulations, you have just implemented an INI file parser. I chose an INI parser for this article as they are simple and easy (enough, with persistence, of course) to implementand our implementation is not exactly the most robust one. If you want something more robust that also happens to be better tested, please check the "ini" npm package.
By the way, you are free to use the code as you like.play around with it. Try to make the parser even

Notes:

1.The parseINI function hiccups when you do not provide a trailing newline to the iniString argument. Could you find a way to get around that?
2.The parseINI function also doesn't completely ignore comments. It logs them to the console, which is a waste of a loop cycle. It may not affect performance for small ini files, but for large ones, it can show an impact. Can you improve the parser to completely ignore comments as early as possible?

Internet of Things: What is IoT and why should you care?

SARAYU GAUTAM
CE 3RD YEAR

You surely must have heard about the home automation system or smart city. Most of you must have used or seen wearable gadgets like a fitness tracker or GPS shoes. Visualize things around you beginning to talk and provide information in a smart way. Imagine! being able to control all applications in your house remotely and get security updates through your smartphone. Think of having your health condition continuously monitored by a device and updated to your doctor, if there is anything unusual. All of this will be and has been made possible by IoT. Gone are the days when people had to manually set the temperature of their air conditioners. Now, thanks to IoT, they can leave this task to their IoT thermostat. How would you feel if your alarm clock knows your office location and path, knows traffic conditions, has learned enough to create an estimate of your arrival time and wakes you up accordingly? Automation would feel like a boon for lazybones like us, and automation is just the tip of the iceberg among the multitude of amazing feats IOT can achieve.

What is Internet of Things?

IoT, in short, is enabling things around you to send information over the Internet. Any physical device, for example, smartphones, washing machines, televisions, wearable devices, lamps, headphones, vehicles, buildings, and other possible appliances can be thought of as the "thing" in IoT. These things are embedded with software, sensors and other electronic components that help them send and receive data. The inter-connectivity of these devices among each other and the internet makes IoT a giant network of connected "things". Practically, IoT can be thought of as installing micro-sensors and controllers on things to make them "smart", thus, allowing everyday devices to communicate and share data over some sort of network. If we adopt IoT, it will help the digitization of our society and economy by connecting objects and people via digital medium.

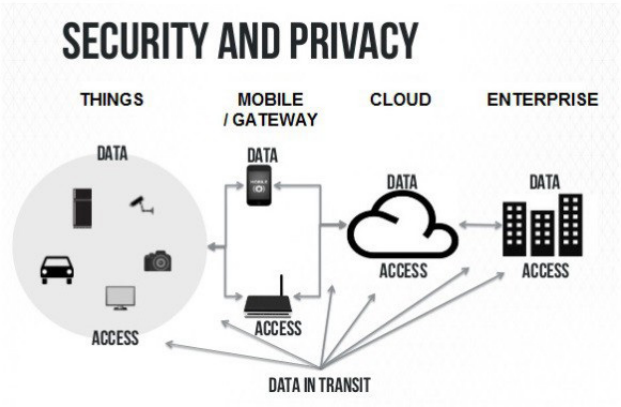
The trends in IoT app development can be seen in wearable gadgets, cars, smart homes & smart city to name a few. The market is booming with other emerging trends such as smart retail, connected health, and smart supply chain. Even Artificial intelligence (AI) can enhance IoT with the help of the cloud. Green IoT is a new practice, which deals with the use of smart devices and sensors integrated within a network in a way that harms nature as little as possible. Smart farming is one of the fastest-growing fields in IoT, and farmers are using meaningful insights from the data to yield a better return on investment. Sensing for soil moisture and nutrients, controlling water usage for plant growth and determining custom fertilizer are a few applications of IoT in smart farming. The concept of Smart Grid is becoming very popular all over

the world. The basic idea behind smart grids is to collect data in an automated fashion and analyze the behavior for electricity consumers and suppliers with the intent of improving efficiency as well as the economics of electricity use. The Industrial Internet is the new buzz in the industrial sector, also termed as Industrial Internet of Things (IoT). It is empowering industrial engineering with sensors, software, and big data analytics to create brilliant machines. IoT is everywhere. Soon, it will be true that "Anything that can be connected will be connected".

YEAR	NUMBER OF CONNECTED DEVICES
1990	0.3 million
1999	90.0 million
2010	5.0 billion
2013	9.0 billion
2025	1.0 trillion

The future of IoT is more fascinating than this, where billions of things will be talking to each other and human intervention will become a minimum. It will bring a macro shift in the way we live and work. If you're not already excited about it, just look around and connect the dots. It's time that we are literate, if not proficient, about IoT and IoT devices, which have the potential to revolutionize our lives. A few years from now, we will be living in a world with more ideas and less workload, more efficiency, and less incompetence. You should care so that, you can control your IoT devices for your benefit and not the other way around.

As said by Hippocrates, "Everything in excess is opposed to nature" and there is a lot of truth in his saying. Although IoT is rapidly growing, it faces many security and privacy issues, and that is where you should care the most. IoT devices connect to your desktop or laptop, and lack of security increases the risk of your personal information being leaked during data transmission in the IoT device. Living in the 21st century, we have become used to sharing more of our lives with our gadgets than we do with people. In the way of automating everything, we share our personal information and routines with our trusted devices. But the Internet was never, and it's hard to imagine if it ever will be a trusted medium. IoT devices are connected to a consumer network which in turn is connected to other systems. So, if the IoT device contains any security vulnerabilities, it can be harmful to the consumers' network. This vulnerability can lead to attacks and damage other systems. Also, the IoT devices are transmitting the user's personal information such as name, address, date of birth, health-data, credit card detail and much more without encryption. Sometimes, unauthorized people might exploit security vulnerabilities to create risks for physical safety.



It is in our own conscience to act wisely and know that at the end of the day, no matter how a device may uplift our lives, it is a device that has the potential to make or break our lives, by being connected to the world wide web.

Emerging Technologies Shaping e-Learning

SAILESH DAHAL
CE 3RD YEAR

The e-Learning industry is experiencing a revolution owing to the modern advancements made in technology. The introduction of new gadgets, innovative tools for trainers, and cutting-edge equipment has allowed us to create new e-learning experiences that we could only dream of a decade ago. According to Education Sector Factbook 2012, e-learning was expected to grow at a rapid average of 23% in the years 2013-2017. The present day's hottest technological trends play a major role in influencing e-learning and offering brand new ways to share knowledge and deliver content. Let's take a look at the presently emerging technologies and how they are taking e-learning to the next level.

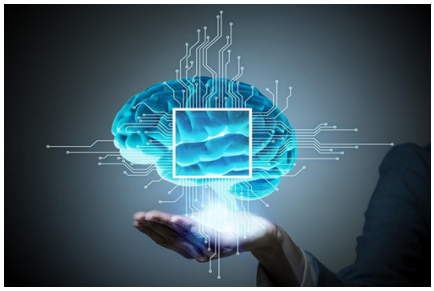
1.Virtual Reality (VR)

The spread of smartphones gave virtual reality a big push. Virtual Reality (VR) is a computer technology that utilizes multi-projected environments or virtual reality headsets, sometimes in conjunction with props or physical environments. They aim to create realistic sounds, images and other feelings that promote a user's physical presence in an imaginary or virtual environment. The functional applicability of virtual reality has made it an incredibly popular topic in e-learning. For now, potential applications in the fields of medicine and physics show the most promise. That said, what benefits can this newfangled technology bring? Firstly, VR can transmit students to the farthest corner of the universe in just a blink of an eye. It can submerge them into a deep and exciting educational environment. The great motivational possibility is another key benefit. Students will no longer be stuck in pages i.e. pages of boring text. They will have a chance to go through the experience and get the most out of it. Virtual reality holds great potential, and is expected to go beyond gaming, and cover non-gaming uses, such as training and education, as well as VR films, sports, and music.

Augmented Reality (AR)

Augmented reality is an animated direct or indirect outlook of a corporeal, real-world atmosphere whose components are "augmented" by computer-produced or derived real-world sensory input like video, graphics, or sound. When it comes to e-learning, augmented reality can make the learning process interesting and easier to grasp. For instance, if you were an online instructor and your target subject was astronomy, you could offer your students a virtual tour of Mars without asking anyone to leave their home. The concept would also be excellent for research. The more people you have looking at a particular issue in terms of a subject, the more likely solutions will become available. Experts speculate the AR market could be worth £122 billion by 2024, showing real potential for the future.

2.Artificial Intelligence (AI)



In comparison to the natural intelligence shown by humans and animals, the intelligence shown by computers is Artificial Intelligence. It is revolutionizing the whole e-learning experience due to the many advantages it has to offer. AI can help highlight areas that require improvement and assist students in focusing on areas where they are lagging. Advanced versions can generate new problems from the source material and test users in a more comprehensive way as compared to the typical classroom curriculum. Furthermore, the technology can also create immersive experiences, instead of mere

lessons after identifying each user's needs and coming up with method-focused models.

3.Big Data

Big Data, in terms of the e-learning industry, is the data that is generated by learners while they are taking a training module or an e-learning course. For example, if an employee interacts with a training module based on company policies, their progress, social sharing, evaluation results, and other relevant results are generated throughout the e-learning course. Big Data allows e-learning experts to comprehend how the users are digesting the information and which learning aspects appeal the most to them. This helps them understand training needs that need to be fine-tuned within the e-learning curriculum or course. Based on the learning patterns, e-learning experts can predict where learners may excel or struggle. This way, they can advance their e-learning courses so that learners get a fair opportunity to accomplish the best possible outcome.

4.Machine Learning

Machine learning is a field of computer science that provides computers the capacity to learn without being openly programmed. There is a range of benefits that Machine Learning can offer to online learners, as well as organizations that invest in LMS (Learning Management System) platforms. First of all, machine learning delivers more personalized e-learning solutions based on the past successes and learning goals of the learner. Secondly, it enables efficient resource allocation since online learners receive the exact e-learning resources they require to fill in the gaps and accomplish their learning goals.

5.Wearable Devices

Wearable devices are smart electronic devices that can be worn as an accessory or implants on the body and are often known simply as wearables. They include fashion electronics and computer togs. As they can create an immersive environment and interactive training experiences, these wearable devices can act as valuable corporate training tools. Wearable devices have the potential to take scenarios and simulations to the next level, which is why they can be used to make learning solutions much more interesting and comprehensive. In turn, workers will be able to benefit from in-depth product awareness learning – for example, they may analyze the product's three-dimensional examples, swipe it around and view it from each perspective, and click different product elements to see its advantages and features. All of the above technologies are game-changers for e-learning platforms and can greatly enhance online users' entire learning experience. Besides cutting down training costs by a significant fraction, these technologies can also assist businesses in allocating their resources better, thus transforming the entire e-learning landscape. E-learning companies in the EdTech sector should check out these technologies to lift up their game and remain competitive, yet efficient.

Quantum Computing Explained!

SAGAR UPRETY
CS 2ND YEAR

Today we live in an era of advanced technology, where every part of our life is impacted by it. For all the successes, there are some problems that even the most efficient supercomputers in the world cannot overcome, such as simulating a large number of chemical bonds and prime factorization. To understand why classical computers cannot solve these problems, we first need to understand their working principle. Any information from simple text to audio & video is represented in a classical computer by a combination of 0's and 1's called bits. Even the best supercomputers do not have enough variations of these bits and run out of space for problems such as modeling a human brain. Quantum computing comes into play here.

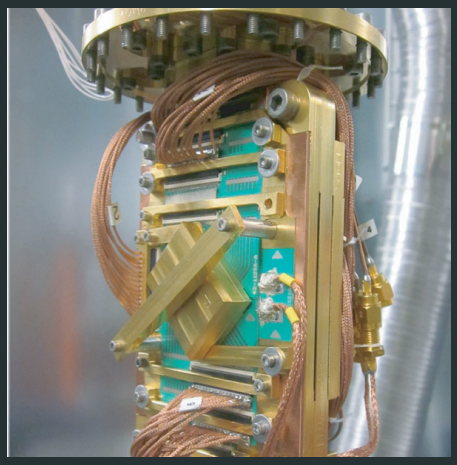


Fig: Quantum Processor

Physics Behind Quantum Computers | Working

To understand how a quantum computer works, first we need to know about three fundamental quantum phenomenon superposition, entanglement, and interference.
In the quantum level, an electron can exist at two different positions (states) at the same time, a phenomenon termed as superposition.That's why it can be 0, 1 or both 0 and 1 at the same time. Think of it as a spinning coin that is simultaneously Heads(H) and Tails(T).

Entanglement refers to a quantum property in which particles behave together as a system. In quantum computing, when two are entangled, they share their information and act as one. This means, if the first qubit is 0, then the second one is also 0, and vice versa. Since the information of entangled particles does not need a medium to travel, one qubit can be used to extract the info of another qubit, which saves a lot of time in quantum processing.

The other important concept is interference. Unlike classical computers where logic gates are used to generate a single output from the input(s), in quantum computers, there may be multiple outputs for a problem, say, the reaction of molecules in your body when you take a medicine. That's why, once the qubits reach their quantum states, interferences are created through microwave pulses, and constructive interference is used to amplify signals for the correct solution(s) while destructive interference to cancel incorrect solution(s).

Classical Vs Quantum Computers, Under the Hood

Now, let's take a closer look at the basic difference between classical and quantum computers. For example, a one-bit classical system can be in two different states, 0 or 1. Similarly, a two-bit system has four possible states- 00, 01, 10 or 11. But to represent one of these four states, say 10, we need only the value of the 1st bit (1) and the 2nd bit(0), i.e. two-bit data. Similarly, an 'n' bit classical computer has 2^n different states. However, for one particular combination, we only need the information of n bits.

But in a quantum computer, a qubit is represented as, a|0↑ + b|1↑ (a2+b2=1)
where a and b are amplitudes (probabilities) of qubits being measured to 0 and 1, |0↑ "ket 0" and |1↑ "ket 1" are the states of qubits. For instance, a qubit in superposition can have the probability 1/3 of being 0, and 2/3 of being 1. So, to represent a qubit, we need the values of both a and b.

Similarly, a two-qubit system is represented as, a|00↑ + b|01↑ + c|10↑ + d|11↑. So, we need four probabilities/amplitude (a, b, c, d). Likewise, for n qubits, we will need 2^n numbers to represent the overall state of that quantum system. This shows that the more qubit we add, the possible combination of states

grows exponentially, and this is why quantum computers are much more efficient than classical computers.

Applications and Developments

Quantum computers are being studied from cybersecurity and economic stratification to medical science and chemistry. Because nature itself is quantum, the phenomena such as atomic bonding and electron orbital overlap can be imitated by a quantum computer. In 2017 AD, scientists were able to simulate the largest molecule to date, Beryllium Hydride (BeH2), on a quantum IBM processor that had 50 qubits. Researchers are also trying to use quantum computing powers to accelerate machine learning and neural networks training. Scientists are experimenting in the medical field to accurately model the chemical reaction at the molecular level, which could advance medical research and save millions of people's lives. Likewise, properties such as entanglement can open the future of **Quantum Communication Channel** and used for cryptography and super secure communication.

Limitations and Current Stage

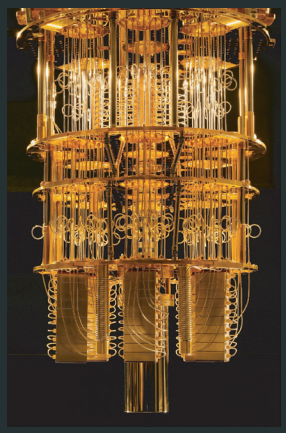


Fig: Dilution Refrigerator

You must have felt by now that Quantum Computing is amazing, and yes it is, but the present generation of quantum computers has certain limitations. The most important are the environmental factors and the tolerance of faults. Present quantum computers use supercond ucting which requires a temperature of nearly 0 Kelvin in a radiation-free zone, as even slight interference can disrupt the qubits from its quantum states. That's why the quantum processor is housed in a dilution refrigerator which is expensive to set up and draws a lot of power.

Likewise, coherence time, the time for which a qubit is in a quantum state is very less and creates difficulty in running quantum algorithms to generate correct solutions. Also, the present quantum processors are not 100% fault-tolerant i.e. there might be errors during processing. Quantum computer won't replace your home PC, and you're not going to play "Battlefield: Quantum Edition", this soon.

Quantum Supremacy

Current classical computers are still advanced than quantum computers in most of the aspects. In simple terms, quantum supremacy is the phase when a programmable quantum device can solve a problem that classical computers practically cannot. Scientists at Google claim that they have achieved quantum supremacy according to the announcement published in Nature on 23rd October 2019. A team led by John Martinis, an experimental physicist at Google says that their quantum computer carried out a specific calculation that would take even the best classical supercomputer 10,000 years to complete. However, IBM reported in a preprint on 21st October that the problem could be solved in just 2.5 days using a different classical technique. No matter the truth, we can sense the impacts of quantum computing and its buzz in the tech community.

What the future holds?

Despite all the limitations and challenges, the quantum computing community is moving in the right direction. More people are now beginning to realize its potential, and scientists are giving their best to make a better version of a quantum computer. The initiative such as IBM Q allows public access to a 16-qubit quantum computer for research and development purposes. The tech-giants like Google, NASA, IBM, D-Wave are all in a quantum race for finding their applications.No matter who wins, this will be a great achievement for humanity, and I cannot think of a better time to be alive in this world and see mysteries being unfolded. I truly believe that quantum computing will become very stable and effective in the next 2-3 decades, and it will surely change the way we think about not just computing, but the entire nature of our existence.

Magecart: Web Skimming

MILAN DHAMALA
CS 2ND YEAR

Credit card skimming is a type of credit card theft where crooks use a small device to steal credit card information in an otherwise legitimate credit or debit card transaction. These little devices you could stick on a real card readers at self-service sale terminals and anyone who comes and swipes a card will get their numbers saved to this little device. It's a popular attack. They are small, battery powered and can store up to a gigabyte of data on them. You stick them on the sale terminals and come back a few days later, hook up a USB cable and download all the card data off of there. This data is called 'track data'. The 'track data' is then transferred into blank cards using a card writer. This would allow you to buy stuff with the stolen cards. These stolen cards are used to purchase gift cards; the gift cards don't have a name attached to them so it's much easier to use them anonymously or sell them. In fact, it's a way to launder the money.

Skimming like this is growing in popularity. Due to its popularity, it's not just card readers anymore, this problem of card skimming has infected the online world too. It's not just at the physical sale terminals but it's happening online in ways you might not be aware of. Let's go deep into how it's affecting the online world. You probably spend most of your time on a PC browsing, whether that is Facebook, news or just blogs or pages that appeal to your particular interest. You might think you don't need to worry about malicious websites because you only browse on safe and reputable pages such as Wikipedia or Amazon. As per Heimdal Security, 76% of these websites contain a vulnerability. Further to make matters even worse, 9% of sites contain a vulnerability that is serious in nature, which could allow an attacker to infect a visitor's PC, download malware or even execute code on it.

Websites can exploit your browser if you have an outdated browser or plug-ins, then take control of your browser and infect you through JavaScript, Flash, Silverlight or some back end language.

Back in 2015, a team at the company named RiskIQ working as a Cyber Threat Intelligence, noticed some interesting stuff happening to websites running Magento. Magento is an e-commerce site builder just like how you can download WordPress and host your blogs, Magento is the same deal, but for online stores. You download the Magento PHP bundle and it has templates and themes for how your store looks. So, you customize the store to make it look how you want and then you list the items you want for sale and you publish it. Now, people can go to your Magento store, select items and checkout. In the process of checkout, they enter their credit card details to buy something from you. Magento itself is safe and secure, owned by Adobe at this point and is open source, so there are a lot of developers working on it. But, there are people who quickly set up their online store and don't think much about the security. If you don't update Magento, you're vulnerable to well-known attacks, if you don't secure your servers you're hosting it on; it can leave you open.

The aforementioned RiskIQ team, noticed a group of hackers in 2015, who had found their way into websites running Magento and sniffed out where the checkout section was. They then put in a JavaScript snippet to make a copy of any credit cards that were entered on their page, effectively giving the hackers a digital copy of the credit card. They were, in essense, doing credit card skimming on the website. The team at the RiskIQ called this group 'Magecart'.

The skimming code is a small piece of JavaScript, it can be as small as fifteen lines and can reach up to fifteen hundred lines. It all depends on what the hackers are doing with the skimmers. For the most part, it's for getting payment data. These small pieces of JavaS-

cript are loaded onto the websites and from the browser's perspective it's just another script, browsers don't usually differentiate once you load up a web page since there's a whole lot of stuff happening. These scripts have the same level of access to any data in the webpage. The same script that gives you a pop-up to submit your payment data can very well steal it. Once these scripts are running under the web pipe, they basically go through everything that you see on the website. When you're entering the payment information on your payment form, the script looks for identifiable names like payment form pay out or fields that have names like sixteen number or credit card number. Once the script identifies potential form that could hold payment data, then it waits for you to submit the data back to the website. The script then grabs the entered data and then relays back to their own server. In order for this to work, hackers need to get those piece of malicious JavaScript to run on these websites. That isn't always easy. But, there are some ways to do it. Some of them breach the websites directly, a lot of these platforms have the option to add google analytics code, for example. You can add your little snippet of google analytics to the footer but they instead add their JavaScript to the snippet for google analytics. Or you can get compromised through the supply chain, on which you have no control over.

Most websites today don't just run HTML, but they have CSS which stylises the page and JavaScript which brings in more features and functionality but typically you don't code all the CSS and JavaScript yourself, you find a library someone else made and bring it over to your webpage. At this point, you're running code on your website that you didn't write. That JavaScript you took from some other library now executes in the users' browser. You're good as long as you use open-source library that has all its bug squashed and people are actively updating it.

But here's a thing, a lot of people who run websites don't host these JavaScript libraries themselves, instead they just link to it. So, when a user visits their site it says "Oh, you need this jQuery library from the other site before you can see this page" and your browser automatically goes to that site, gets jQuery and runs it. Basically, it's like going to a store to buy bottled water. The store didn't bottle the water, they ordered it from a bottling plant and then stocked it for you to buy. The store trusts that bottle of water is good and won't make people sick but what if someone got into the bottling company and poisoned the water; the water then gets bottled and shipped to stores all over. This poisons the supply chain. The same thing can happen online, imagine the central JavaScript library got hacked and started hosting JavaScript libraries with credit card skimming code in it. And, that's what happened with 'Magecart'. The hackers were getting this malicious JavaScript into the sites through the supply chain. In fact, the website owners would never know if their supply chain got hacked unless they go through and look at every line of JavaScript code and confirm that it's good and do that every day to make sure it hasn't changed.

The hacker groups are actively developing versions of the malware, adding various enhancements and trickery. Each group has its own distinctive code signature and methods so that researchers can classify them. Thankfully, many banks and credit card issuers are becoming better at detecting fraudulent transactions and may not process suspicious charges until you verify that you initiated the transaction. So, this is all about the 'Magecart' hacking group. Stay safe online.

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Try Linux

ASHUTOSH B. RAJAN
CE 1ST YEAR

Let's not begin the article by defining "Linux", as most of us have heard about it, or have used it at some point in life. Some of us may also have heard the false rumor about it being complex, having no Graphical User Interface (GUI), and containing only Command Line Interface (CLI). But let me assure you that it's not as tough as you may be assuming. Most of the popular Linux distributions(distros) have GUI, or can be installed on it in some way or another. To motivate you all, let me introduce some basic advantages of LINUX:

- It's free and open source, unlike windows or mac.
- It's also secure.
- It's light on system resources.
- It gives you full control over your privacy.
- It can be customized to your liking and many more.

Windows being our first choice, we can't even imagine trying or exploring new OSes. But I want you all to just trust me, and at least try it for once. Trust me, you will be falling in love with it. I know a lot of thoughts maybe wandering inside your head, like - where to get it from? Is it for free? Will it meet my requirements? If you need any support, then you can google it, and if you can't find the solution to your problem, then you can always post it in the help forums of various Linux distros. If you are worried about the availability of software, then you can find good alternatives, and to your wonder, Yes! most of them are free. If you don't want to leave windows at any cost, then you can try Linux in a *Virtual Machine (VM)*, or dual boot your computer. Also, if you are worried thinking that it is not as popular as windows, then please take a look at the data of OS used by supercomputers, IoT devices, and many other big companies. The most popular mobile OS 'android' also uses Linux in a customized way. Even for personal computers, Linux is rising at a fast pace.

As we all know every coin has its two sides, so does the LINUX. No OS is perfect, and Linux too has its shortcomings. I just want you to try out Linux, and see if it works for you. if not, then you can certainly switch back to your preferred OS.

Me, being LINUX's supporter, let me help you with LINUX's errand by highlighting some of the points. Rest depends upon you and your curious mind. If you are going to try Linux for the first time ***(Please backup your data before installing Linux as it will get erased, unless trying it on virtual environment or trying dual boot),*** and if you want it to work without any hassle, then do try distribution with built-in desktop environments and drivers like Ubuntu, Linux Mint, MX Linux, Manjaro, etc. (For popular Linux distros you may visit www.distrowatch.com). All of them provide you with steps to install the OS. But, if in any case, you encounter any problem, try searching for the error displayed in Google or community forums, and you will most likely find your solution. If still, you get stuck somewhere, then feel free to create an account on the official page of the distribution, and create a new topic describing the problem you encountered in the forums; you will be replied within a short duration. After installing, you can read the documentation regarding how to update and customize as per your liking.

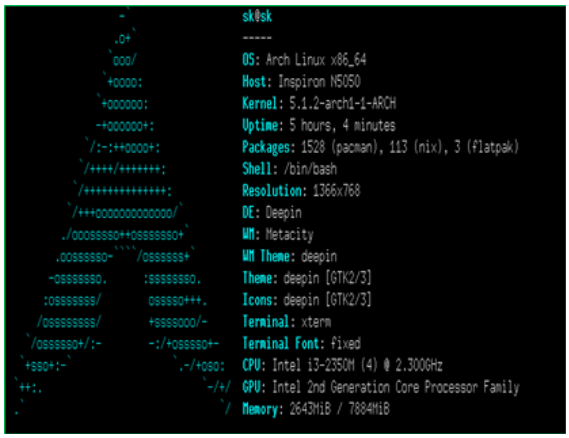
And if you want to dig deeper and understand

under-the-hood stuffs, then try ***Arch*** or Gentoo, it will give you bare-bone OS and you can customize it as per your need. These distributions will certainly take time, and you might mess up with the system in your first try. As you go through the documentation on their official websites and tutorials on YouTube, you will be all set to go. It is definitely not as scary as it seems.
And please be aware before posting in forums of such distribution, as you might get replied as RTFM suggesting that the problem you encountered has already been mentioned in the arch wiki, and you did not go through it before posting.

Some terminology to look up to:

- Desktop Environment (DE)
- Package manager
- Shell
- File system
- Partitioning

Here, is a short glimpse of the terms and the process that it looks like. It will be helping you all, to some extent.



There are many popular desktop environments like Gnome, KDE, XFCE, etc. Gnome and KDE Plasma in their stock configuration look like OS X and Windows respectively, but can be highly customized. XFCE is light on system resources, and mostly used for low-end PC. Regarding package manager, ***Debian based*** Linux uses ***Advanced Package Tool (APT)*** whereas arch-based uses Pacman. If you didn't already know then Ubuntu, Linux Mint, MX Linux, etc. use APT package manager i.e. they are Debian based, and Manjaro, Antergos(discontinued), Archman uses Pacman i.e. they are arch-based. Fedora uses RPM as a package manager.

For the shell, most of the distribution by default uses bash as a shell, but I recommend you try out ZSH, which will make your navigation in terminal much more fluid, and it also has various plugins and themes. Also, the file system used by Linux is different than Windows or Mac as it uses ext4 as default in most of the cases (Ubuntu 19.10 brings support for the ZFS file system as well), whereas Windows uses NTFS and Mac uses APFS due to which you may face compatibility issues.

Regarding partitioning which you will also be asked during installation, it means dividing your secondary storage (hard disk or SSD) into multiple independent volumes, as you have Local Disk C, Local Disk D etc. on Windows. You can use the entire disk for Linux, or divide it into multiple volumes as per your convenience. Also, you can allocate some space for swap, if your PC does not have sufficient RAM, else it is fine not keep a swap partition. For further information, follow the documentation or google it.

I know these words might be acting as an unsolved puzzle for you, and I am pretty sure you will encounter many problems on the way. As mentioned above, you can always seek help. I am not a genius at all, and might have missed some points or left them for you to explore on your own.

SEO: The Never-Ending Marathon

AADARSHA DHAKAL
CE 1ST YEAR

Search Engine Optimization (SEO) is a work of pushing all of your web content, blogs, and landing pages on top of the Internet search results. It is the most important thing to succeed in an online business. SEO sounds so simple, but in reality, it's not as simple as it sounds.

As we all know, Google is the most popular search engine by now. Almost 90% of the searches made on desktops and mobiles are done via Google. So, we'll take it as a reference in this whole article.

If someone is saying that he or she is doing SEO, then we need to understand that he or she is trying to crack Google's algorithm of indexing search results.

Why is SEO Important?

SEO has become the best way of marketing in today's world. Every second, Google receives 63000 searches. And this number translates into at least 3.8 million searches per minute, 228 million searches per hour, 5.6 billion searches per day, and 2 trillion searches per year.

SEO can bring numerous free-targeted web traffic to your websites, blogs, etc. This will help you reach new audiences from different parts of the world. In this way, you can grow your business online for little or no investment, if you have SEO skills.

SEO is not only about locating your website on the front page of search results, but it also demands improvement of the user experience and usability of a website. It is a full package of website optimization. It includes speed optimization, content update and optimization, gaining user trust, and much more. This will help you develop secondary skills, and will help you stand at the top of the search results.

A good SEO practice will bring more customers to your e-commerce sites than to competitors. It will help you grow subscribers to your blogs and if you are good at SEO, you will also have a high chance of being hired by web companies as an SEO expert.

How to SEO?

It has been reported that Google changes its search algorithm around 500 to 600 times each year. So, SEO techniques will also change frequently, but not in the way you are thinking. Here are a few things you should care about while doing SEO.

Content is the King

If you want to rank on top, produce great content. Content seems to be a complicated factor nowadays. Every second, millions of articles are being posted, so you need to write better content than theirs, ensuring it would be more reliable and updated as well.

Do some research, and try to provide facts rather than myths. Also, your content should be fresh. You should figure out what your users want and provide it in your article. Similarly, take in mind that "Quality is above Quantity". Try to write new content or upgrade your content. Updated contents are more likely to do well in the search results. Engage your visitors as much as you can.

And most importantly, always prioritize user's interests. If your users are bouncing back after a few seconds, then you will not rank high because Google knows that people are not liking your content.

Keyword Research

Keyword research is all about finding a perfect keyword to rank for. It's a practice of finding keywords that have high search volume but has really low competition. There are a lot of keyword-research tools that you can use. Most of them are paid tools, but there are some tools that you can use for free. What you need to look for is a keyword that matches your content. Find a long-tail keyword for that.

Here are some tools you can use:

1. Google Keyword Planner
2. Google Search Console
3. Ubersuggest
4. Keywordtool.io
5. Google Trends
6. Semrush

Use of Title Tags

Appropriate use of title tags is the most important factor when it comes to SEO. Google's goal is to deliver results that are relevant to the searches

people make. For that, it should know what different pages on the web are about. Since the title reflects what the content is all about, the use of appropriate title tags will certainly help you rank #1 on Google.
While creating a title, you should take care of few things. Your title should be short. A good title contains less than 60 characters. You should include your major keyword in the title. This helps Google find out easily what your content is going to be about, and appropriately locate your content in search results.

Make Improvements
As I have already mentioned, SEO is not only about in-page or link building. You should also be concerned about other factors that affect your site's SEO. Making improvements in these things is considered as a good SEO practice.
1. Time on site (More time on site is better).
2. Bounce rate (Less bounce rate is better).
3. Page views per visitor (More page views per visitor is better).
4. Site speed or load time (High site speed or low load time is better).

Generate Backlinks
A **backlink** is an incoming hyperlink from one webpage to another webpage of another website. When a web page links to any other pages, it's called a backlink. In the past, backlinks were the major metric for the ranking of a webpage, but that's not the case nowadays. However, this doesn't mean that back-links are obsolete.
A page with a lot of backlinks still tends to rank higher on search engines. There had been a time when even low-quality links helped in ranking a site. However, since Google has changed its algorithm a few years back, you will climb the search result only if you have quality backlinks (backlinks from reputed websites). Backlinks are a signal of trust depending on where the links are coming from.

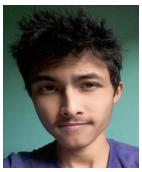
To generate quality backlinks, you can do:
- Guest blogging.
- Create a cornerstone article (A cornerstone article is an article that reflects the theme of your website).
- Use of infographics
- Create multiple small blogs to support your main blog.
- Fix broken links (Broken links are links that don't work when for example, a website is no longer available).

Social Shares
Social shares are another factor that affects SEO. More social shares mean that you have better chances of ranking higher. You need good content for getting more social shares. Social shares drive traffic to your sites and create a buzz around your brand.
More social shares also improve your domain score and probably generate backlinks as well. And you already know how important backlinks are.
But sharing links only may not work. You should be using catchy images and a well-crafted description to attract the readers.

Other Good Practices
There are a few other things you should care about SEO:
- Use key-phrase in the slug (A slug is a text which comes after your domain name as a part of your permalink that is leading to your content).
- Use alt attributes for images (Add alt-tags containing your key-phrase).
- Internal Linking (Link related articles within your blog).
- Use a dense key-phrase (Density of keywords in your content should not be too low or too high. Keyword density should be between 1-3%)

SEO is a Marathon!
I have done the SEO of a website. Only after 6 months of my regular follow-ups, I became successful in ranking it at the top of Google searches. Many people do SEO. They optimize their site well and manage to rank their pages at the top of Google searches after countless hours of dedication and patience. But then, Google rolls out another twist in their ranking algorithm and they find themselves struggling to catch up to the pack.
You cannot rely on what other people are telling. You can't even believe Google itself. What works for others may not work for you, so what you need to do is a series of experiments to find the right choice for you. Prepare for a long-haul marathon. Save your stamina and keep moving in a uniform speed i.e. without a break.
SEO is not a thing that you do today and reap rewards tomorrow. It takes a lot of time to see the results of your work. It requires a lot of passion and patience. In the race of SEO,*" slow and steady always wins the race".*

Are Your Passwords "Weak"?



AWAN SHRESTHA
CE 3RD YEAR

When was the last time you changed your email's password? When I asked this to my friends, most of them answered, years ago. And even then, most of them had forgotten it and had to request a reset. Yes, passwords are a pain, and we obviously cannot survive without different forms of social media networks. Passwords are hard to remember, and different social networks have their own rules to create and change passwords. But is your password safe? Is your password strong enough?

First, what is a "weak" password? A weak password is a password that is easy to guess both by humans and by computers. People often use simple passwords about someone or something they love, or they owe in order not to forget the passwords. However, the simpler the password, the easier it is to detect. How many of you have used your name plus your birth year as your passwords? Or your phone number, or the name of your beloved ones, your favorite singer, player? In 2019, the United Kingdom's National Cyber Security Centre analyzed public databases of breached accounts to see which words, phrases, and strings people used to protect their digital treasures. Topping the list was "123456", appearing in more than 23 million passwords. The second-most popular string, "123456789", exponentially more difficult to guess, I know, while others in the top five included "qwerty", "password" and "1111111", all very lovely phrases, for the infiltrator, of course. Many sites won't even allow you to use a weak password, but there are still some that do. A study in 2017 found that the password "password$1" is deemed 'Very Weak' by Dropbox, 'Weak' by Apple, 'Fair' by Google, and 'Very Strong' by Yahoo. What kinds of information are you sharing on social networks like Facebook, Twitter, LinkedIn, Pinterest and YouTube? Maybe, your name, location, email, travel, schools, everything else? Trust me, you don't want this information in the hands of someone who has bad intentions. And the irony is that many people publicly share their date of birth on Facebook, all the while having the same date as a part of their Facebook password. Ouch!

Why do you think when signing up for some sites, they have specific password requirements? A six-letter password using all upper-case letters, or all lower-case letters have 308 million possible letter combinations. This is easily broken within a couple of minutes by an automated password cracking program that hackers can download from the internet. With some combination of both upper and lower case letters, a six-letter password has 19 billion possible combinations. If you increase the password to eight letters and use both upper and lower case letters, there are 53 trillion possible combinations. Substitute a number for one of the letters, and there are 218 trillion possible combinations. Substitute a special character for another one of those letters, and this has 6,095 trillion possible combinations -- still crack-able, but requiring a more sophisticated program, a far more powerful computer, and a lot more time.

There are tons of social media networks we use and for some, we even create multiple accounts and remembering the passwords for all these accounts might be a headache. The result? Some people write their passwords down in a notebook. But what good is your strong password if it is open to see for anyone who has access to that notebook of yours. That notebook is not just a notebook anymore, it has the passwords which might be keys to your digital vault. Some people just save it in some document files on their computers, and it's hardly possible that you never let anyone touch your computer. Also never let anyone, I repeat, anyone, know your password. No matter how strong it is, once someone else knows it, it's no longer strong.

Yes, we have a ton of passwords and when your browser asks for something like "Do you want Google Chrome to save your password for this site?", most of the time we click yes. You won't disagree that Google knows everything about you. But now the stakes are higher than ever before. We are trusting Google with the passwords that protect the rest of our life – our bank, our shopping, our travel,& our private life. It makes life a lot easier as once we are logged into our Google account using Chrome, we can see all our saved passwords. But here is the thing. If someone learns or guesses your Google account password, you are completely compromised, and if by default "Sync everything" had been enabled, the intruder might not only see your other saved passwords but also your bookmarks, history and basically your entire virtual life. So, it's always a good idea to have two-factor authentication for login.

And finally, one last piece of life-saving advice, never go with admin, admin.

Bitcoin Mining, Explained

NIRBHAY ADHIKARI
CE 1ST YEAR

Chances are you hear the phrase *bitcoin mining* and your mind begins to wander to the Western fantasy of pickaxes, dirt and striking it rich. As it turns out, that analogy isn't too far off. Far less glamorous but equally uncertain, bitcoin mining is performed by high-powered computers that solve complex computational math problems. The luck and work required by a computer to solve one of these problems is the equivalent of a miner striking gold in the ground while digging in a sandbox! At the time of writing, the chance of a computer solving one of these problems is about 1 in 13 trillion, but more on that later. The result of bitcoin mining is twofold. First, when computers solve these complex math problems on the Bitcoin network, they produce a new bitcoin (when referring to the individual coins themselves, "bitcoin" typically appears without capitalization), not unlike when a mining operation extracts gold from the ground. And second, by solving computational math problems, bitcoin miners make the Bitcoin payment network trustworthy and secure by verifying its transaction information.

There's a good chance all of that only made so much sense. In order to explain it in detail, how bitcoin mining works, let's begin with a process that's a little bit closer to home: *The regulation of printed currency.*

Bitcoin Basics: How Bitcoin Differs From Traditional Currencies

Consumers tend to trust printed currencies in most countries of the world. That's because these currencies are backed by central banks such as the Federal Reserve or the Nepal Rastra Bank. In addition to a host of other responsibilities, these banks regulate the production of new money, and the government prosecutes the use of counterfeit currency.

Even digital payments using printed currencies are backed by a central authority. When you make an online purchase using your debit or credit card, the transaction is processed by a payment processing company such as MasterCard or Visa. In addition to recording your transaction history, those companies verify that transactions are not fraudulent, which is one reason your debit or credit card may be suspended while traveling.

Bitcoin, on the other hand, is not regulated by a central authority. Instead, Bitcoin is backed by millions of computers across the world called nodes. This network of computers performs the same function as the Federal Reserve, Visa, and MasterCard, but with a few key differences. Nodes store information about prior transactions and help to verify their authenticity. Unlike those central authorities, however, Bitcoin nodes are spread out across the world, and record transaction data in a public list that can be accessed by anyone, even you.

Bitcoin Basics: What Is Cryptocurrency Mining?

When someone makes a purchase or sale using bitcoin, we call that particular term a transaction. Transactions made in-store and online are documented by banks, point-of-sale systems, and physical receipts. Bitcoin miners achieve the same effect without these institutions by clumping transactions together in blocks and adding them to a public record called the blockchain. Nodes then maintain records of those blockchains so that they can be verified in the future.

When bitcoin miners add a new block of transactions to the blockchain, part of their job is to make sure that those transactions are accurate. (More on the magic of how this happens in a second.) In particular, bitcoin miners make sure that bitcoin is not being duplicated, a unique quirk of digital currencies called double-spending is made. With printed currencies, duplicating money isn't an issue. Once you spend Rs. 20 at the store, that bill is in the clerks' hands. With digital currency, however, it's a different story.

Digital information can be reproduced relatively easily, so with Bitcoin and other digital currencies, there is a risk that a spender can make a copy of their bitcoin and send it to another party while still holding onto the original. Let's return to the printed currency for a moment and say someone tried to duplicate their Rs 20 bill in order to spend both the original and the counterfeit at a grocery store. If a clerk knew that customers were duplicating

money, all they would have to do is look at the bills serial numbers. If the numbers were identical, the clerk would know the money had been duplicated. This analogy is similar to what a bitcoin miner does when they verify new transactions.

Rewarding Miners

With as many as 500,000 purchases and sales occurring in a single day, verifying each of those transactions can be a lot of work for miners, which gets at one other key difference between bitcoin miners and central banks, MasterCard or Visa. As compensation for their efforts, miners are awarded bitcoin whenever they add a new block of transactions to the blockchain. The amount of new bitcoin released with each mined block is called the 'block reward'. The block reward is halved every 210,000 blocks or roughly every 4 years. In 2009, it was 50. In 2013, it was 25, in 2018 it was 12.5, and sometime in the middle of 2020, it will halve to 6.25.

At this rate of halving, the total number of bitcoin in circulation will approach a limit of 21 million, making the currency more scarce and valuable over time, but also more costly for miners to produce.

How Does Bitcoin Mining Work?

Here's the catch! In order for bitcoin miners to actually earn bitcoin from verifying transactions, two things have to occur. ***First,*** they must verify 1 megabyte (MB) worth of transactions, which can theoretically be as small as 1 transaction but are more often several thousand, depending on how much data each transaction stores. ***Second,*** in order to add a block of transactions to the blockchain, miners must solve a complex computational math problem, also called a '***proof of work***'. What they're actually trying to do is to come up with a 64-digit hexadecimal number, called a '***hash***' that is less than or equal to the target hash. Basically, a miner's computer spits out hashes at a rate of ***Megahashes*** per second (MH/s), ***Gigahashes*** per second (GH/s), or even ***Terahashes*** per second (TH/s) depending on the unit, guessing all possible 64-digit numbers until they arrive at a solution. In other words, it's a gamble.

The difficulty level of the most recent block at the time of writing is more than 13 trillion. That is, the chance of a computer producing a hash below the target is 1 in 13 trillion. To put that in perspective, you are about 44,500 times more likely to win the Powerball jackpot with a single lottery ticket than you are to pick the correct hash on a single try. Fortunately, mining computer systems spit out much more hash possibilities than that. Nonetheless, mining for bitcoin requires massive amounts of energy and sophisticated computing rigs, but more about that later as well.

The difficulty level is adjusted every 2016 blocks or roughly every 2 weeks, with the goal of keeping the mining rate constant. That is, the more miners there are competing for a solution, the more difficult the problem will become. The opposite is also true. If computational power is taken off of the network, the difficulty adjusts downward to make mining easier.

Explain it Like I'm Five (ELI5)

Here's a helpful analogy to consider:

Let's say, I tell three friends that I'm thinking of a number between 1 and 100, and I write that number on a piece of paper and seal it in an envelope. My friends don't have to guess the exact number, they just have to be the first person to guess any number that is less than or equal to the number I am thinking of. And there is no limit to how many guesses they get.

Let's say I'm thinking of the number 19. If Friend A guesses 21, they lose because 21↑19. If Friend B guesses 16 and Friend C guesses 12, then they've both theoretically arrived at viable answers, because 16↓19 and 12↓19. There is no 'extra credit' for Friend B, even though B's answer was closer to the target answer of 19.

Now imagine, I pose the same question, but I'm not asking just three friends, and also I'm not thinking of a number between 1 and 100. Rather, I'm asking millions of would-be miners and I'm thinking of a 64-digit hexadecimal number, too. Now you see, it's extremely hard to guess the right answer.

How Can You Compete with Millions of Miners?

If 1 in 13 trillion doesn't sound difficult enough as is, here's the catch to the catch. Not only do bitcoin miners have to come up with the right hash, but they also have to be the first to do it.

Because bitcoin mining is essentially guesswork, arriving at the right answer before another miner, has everything to do with how fast your computer can produce hashes. Just a decade ago, bitcoin mining could be performed competitively on normal desktop computers. Over time, miners realized that graphics cards commonly used for video games were more effective at mining than desktops, and Graphics Processing Units (GPU) came to dominate the game. In 2013, bitcoin

miners began to use computers designed specifically for mining cryptocurrency as efficiently as possible, called Application-Specific Integrated Circuits (ASIC). These can cost from several hundred US dollars to tens of thousands. On the other hand, given that the current price of a bitcoin as of this writing is roughly USD 9,330, and that the reward for completing a block is 12.5 coins, or close to USD 117,000, an upfront investment in an expensive ASIC may ultimately be worthwhile.
Today, bitcoin mining is so competitive that it can only be done profitably with the most up-to-date ASICs. When using desktop computers, GPUs, or older models of ASICs, the cost of energy consumption actually exceeds the revenue generated. Even with the newest unit at your disposal, one computer is rarely enough to compete with what miners call the 'mining pools'.
A mining pool is a group of miners who combine their computing power and split the mined bitcoin between participants. A disproportionately large number of blocks are mined by pools rather than by individual miners. At some points in bitcoin's history, mining pools and companies have represented roughly 80% to 90% of bitcoin computing power.

Is Bitcoin Mining Sustainable?
Between 1 in 13 trillion odds scaling difficulty levels, and the massive network of users verifying transactions, one block of transactions is verified roughly every 10 minutes. But it's important to remember that 10 minutes is a goal, not a rule.

The bitcoin network can process about seven transactions per second, with transactions being logged in the blockchain every 10 minutes. For comparison, Visa can process somewhere around 24,000 transactions per second. As the network of bitcoin users continues to grow, the number of transactions made in 10 minutes will eventually exceed the number of transactions that can be processed at the same time. At that point, waiting time for transactions will begin and continue to get longer, unless a change is made to the bitcoin protocol.

This issue at the heart of the bitcoin protocol is known as scaling. While bitcoin miners generally agree that something must be done to address scaling, there is less consensus about how to do it. There have been two major solutions proposed to address the scaling problem. Developers have suggested either decreasing the amount of data needed to verify each block or increasing the number of transactions that each block can store. With fewer data to verify per block, the first solution would make transactions faster and cheaper for miners, and the second solution would deal with scaling by allowing more information to be processed every 10 minutes, by increasing the block size.

In July 2017, bitcoin miners and mining voted to incorporate a program that would decrease the amount of data needed to verify each block. That is, they went with the First solution.
The program that miners voted to add to the bitcoin protocol is called a segregated witness, or SegWit.Segregated Witness means to separate transaction signatures from a block and attach them as an extended block. While adding a single program to the bitcoin protocol may not seem like much in the way of a solution, signature data has been estimated to account for up to 65% of the data processed in each block of transactions.

Less than a month later, in August 2017, a group of miners and developers initiated a hard fork, leaving the bitcoin network to create a new currency using the same codebase as bitcoin. Although this group agreed with the need for a solution to scaling, they worried that adopting segregated witness technology would not fully address the scaling problem.

Instead, they went with the second solution. The resulting currency, called bitcoin cash, increased the block size to 8 MB, in order to accelerate the verification process and allow a performance of around 2 million transactions per day. On November 6, 2019, Bitcoin Cash was valued at about $302 to Bitcoin roughly $9,330.

LABS UNDER DoCSE

ILPRL

Information and Language Processing Research Lab (ILPRL), Department of Computer Science and Engineering, Kathmandu University

Background

The Information and Language Processing Research Lab (ILPRL) at the Department of Computer Science and Engineering, Kathmandu University was founded in the year 2004. The lab was found on the wake of the PAN Localization Project, http://panl10n.net, a multi-national localization Project that was conducted in 11 countries and 22 partners of South and South East Asia. Kathmandu University was a collaborating partner along with Madan Puraskar Pustakalaya (MPP) representing the Nepal Country component. The PAN localization project was a forerunner in the domain of Software Localization and Natural Language Processing in Nepal and the participating countries.

Projects of ILPRL lab:

1. NepaLinux Project [2004 -2009]
2. Dobhase Project [2005 – 2006]
3. E-Gov and Trust Issues [2010 – 2012]
4. Nepali OCR Project – Phase I [2016-2017]
5. Nepali Text-to-Speech (TTS) Project [2017-2018]
6. Popularity Tracking and Trend Analysis of Named Entities and Political Figures in News Media – [2017 – 2019]

DLR

The DLR Lab was established in 2016 to promote research culture in the university with following objectives:

- To promote online learning and e-learning pedagogy in higher education of Nepal.
- To develop online system to assist teachers and educators in professional teaching and learning.
- Empowering digital innovation in Education by using ICT.

Research Projects

1. Integrating Knowledge Management Techniques and HCI Principles for Effective Online Learning, funded by University Grants Commission (UGC).
2. Student Retention in Higher Education using Machine Learning Technology.
3. Implementing Data Mining methods in Online Learning System.
4. Study of Pedagogy in Online Learning System.
5. Identification of Online Learning Users in Online Learning System.
6. Developing MOOC on Scientific Research Writing, funded by Nepal Academy of Science and Technology (NAST).
7. MOOC for Higher Education in Nepal, funded by IDRC, Canada and administered by FIT-ED, Philippenes under the theme "Digital Learning for Development (DL4D)".
8. Enhancing Online Learning by implementing Knowledge Management Tools and Techniques.
9. Usability Evaluation of MOODLE in Kathmandu University.

OPEN LAB

Graduate Students(MTech. and ME) of DoCSE, batch 2018 developed a web application to address the Student Information Management for Kathmandu University. This project is a part of Software Engineering Course.

Project Details

Timeline: Jan-April, 2019

Project Status: Completed

Project Supervisor: Asst. Prof. Rabindra Bista, Ph.D.

Project Members: Aakash Bashyal(Project Lead), Subarna Adhikari, Ijana Kumpakha, Pramiti Munakarmi, Aarati Pandey, Prakriti Dhakal, Toshika Ojha, Roji Kayastha, Rojina Shakya, Birat Bade, Sanjog Sigdel, Arun Timalsina, Sahit Baral, Sabin Pahari, Ram Nath Pandit, Umesh Hengaju

Language: PHP7

Framework: Laravel5.5*, Vue, JQuery

Source Code: https://github.com/openlab-ku/KUSIMS/tree/V1

Features Implemented:
Following features are implemented in KUSIMS:
1. Login with Gmail Account
2. Creation of User
3. User Management
   (Roles and Permission provision)
4. Creation of School, Department, Course, Batch, Job Type, Employee & Program
5. Profile(Student, Admin & Employee)
6. Course Assignment
7. Addition of Subject Scores
8. Notice Publication
9. Adding Students
10. Hostel
11. Bus

Limitation and Future Works
1. Rigorous Testing to be Done
2. Project Deployment in Production
3. Each feature can be extended by discussing with the KU Administration. Team has currently prepared a base system where one can plugin other necessary features of an Information Management System such as Library, Finance & Examination, End sem scores addition, GPA calculation.

The project source code is available on Github. Interested students can continue this project as their semester project and work on a small module. Or you can work on a new module and integrate it with the system as well. Feel free to consult Project Supervisor or email us at openlab@ku.edu.np

DoCSE Alumni Association Web Application

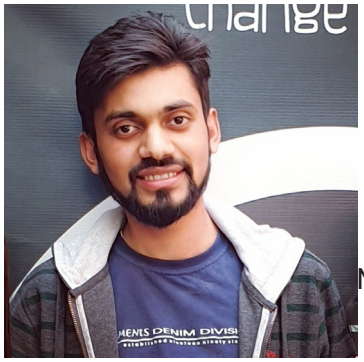
April 7, 2019

Contributors at OpenLab are currently developing a Web Application for DoCSE Alumni Association. This project aims to provide a platform for faculties, students and alumni. Students can find information about Alumni, Alumni find information about fellow alumni and share different career opportunities which benefit each other.

Project Details
Tilemine: March-July, 2019
Project Status: Ongoing
Project Supervisor: Assoc. Prof. Bal Krishna Bal, HoD, DoCSE
Project Mentor: Sanjog Sigdel
Language: PHP
Framework: Laravel5.5*
Source Code URL:
https://github.com/openlab-ku/DoCSE-Alumni

Application Features
Following are the features which were groomed during the project discussion meetings:
1. Student/Faculty/Alumni Login
2. Alumni's Profile(Batch, work experiences, skill set)
3. Event announcement by Faculty and Alumni
4. Email Notification
Timeline
Call for participants was published in the last week of March. Four undergraduate students(2 from DoCSE & 2 from DoEE) applied for the project. Project discussion, grooming, and development began in April.

MESSAGES FROM ALUMNI

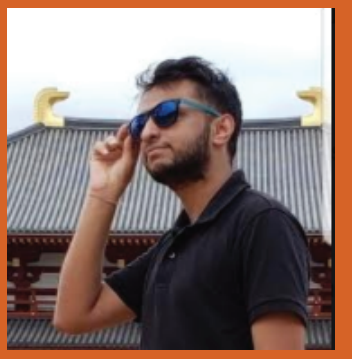


Ayush Kumar Shah,
Machine Learning Engineer
Fusemachines Nepal

My decision to pursue my bachelor's degree at Kathmandu University is one of the finest decisions I have made. My journey of becoming a computer engineer at KU was quite a memorable one with lots of challenges, breakdowns, accomplishments, and failures down the road. Now, when I look back at my times at KU, I want to relive every moment again.

I fell quite fortunate to be considered as an alumnus of KU and being provided an opportunity to give a message to my juniors. I encourage them to live to the fullest and imbibe as much as possible during your time at the university. The university provides a lot of opportunities to explore one's skills and expand your knowledge horizon. Grasp such opportunities and follow your dream so that one day you will be the one to galvanize others. Do not limit yourself by any restrictions but think beyond the box. Explore yourself and your talents and always make yourself up to date by being in coherence with the developments taking place daily since innovation is the key to success.
Finally, best wishes for the upcoming ITMEET, which gives an exciting opportunity to showcase one's skills and a great learning experience for everyone.

Thank you



Shakar Bhattarai
Application Engineer
Rakuten Inc.

Many congratulations on the upcoming IT MEET, and especially on publishing the IT Express magazine. As an involved member of KUCC, I'd like to recognize the time, effort, resilience, and skills it goes into organizing an event of this scale. There's no doubt ITMEET is now being recognized as one of the notable tech events across the tech community. Thanks to the pioneers who conceptualized this mass event, and also to all the batches who executed it to perfection.

At the same time, I think it's inevitable to mention that as engineers and scientists, we belong to the prestigious community that drives innovation all over the globe. However, innovation now is not merely the cherry on top of the cake, but the whole cake on its own. I, hence, believe that it's now high time we made changes to the format of this mass event and the magazine. To quote Mark Zuckerberg, "Young people are just smarter".

I refuse to believe as a 24-year old, that the young blood from one of the most creative universities in the country should feel the slightest pressure of the legacy before them and follow what is already being done. I refuse to believe that these creative minds should by anyway, pressurized to keep the same set of events, stick to the same sequence, or just do what's always being done. Yes, ITMEET has been, and probably will be, just as successful as an event the way it is. But our potential as KU students is way beyond.

I hope the brilliant minds of tomorrow reading this will critically go through every page, every detail and every event of any upcoming ITMEET and question themselves if the way things are being done is the best way to do it. If the answer is "No, but that's how it's always being done", that'd be the point to decide whether we're into Innovation or love getting comfortable with the operation.

I'd also like to mention my experience of working in the tech community in Nepal and abroad. We, KU graduates, don't differ much with students from other universities in Nepal or other parts of the world based on our tech skills, our attitude, approach, and determination. And when I trace this back, as much as this goes back to the environment the university has provided us with, it has more to do with events like these that bring out the best among every individual.

Best wishes once again for the event and special thanks for letting me put my thoughts onto the platform.

PHOTO GALLERY

DoCSE Faculty and Staff

DoCSE Faculty with CE Batch of 2016

Masters' Batch of 2019

Masters' Batch of 2018

Computer Science | Batch of 2016

Computer Engineering | Batch of 2016

Computer Science | Batch of 2017

Computer Engineering | Batch of 2017

Computer Science | Batch of 2018

Computer Engineering | Batch of 2018

Computer Science | Batch of 2019

Computer Engineering | Batch of 2019

IT MEET 2020

Create. Compete. Contribute.