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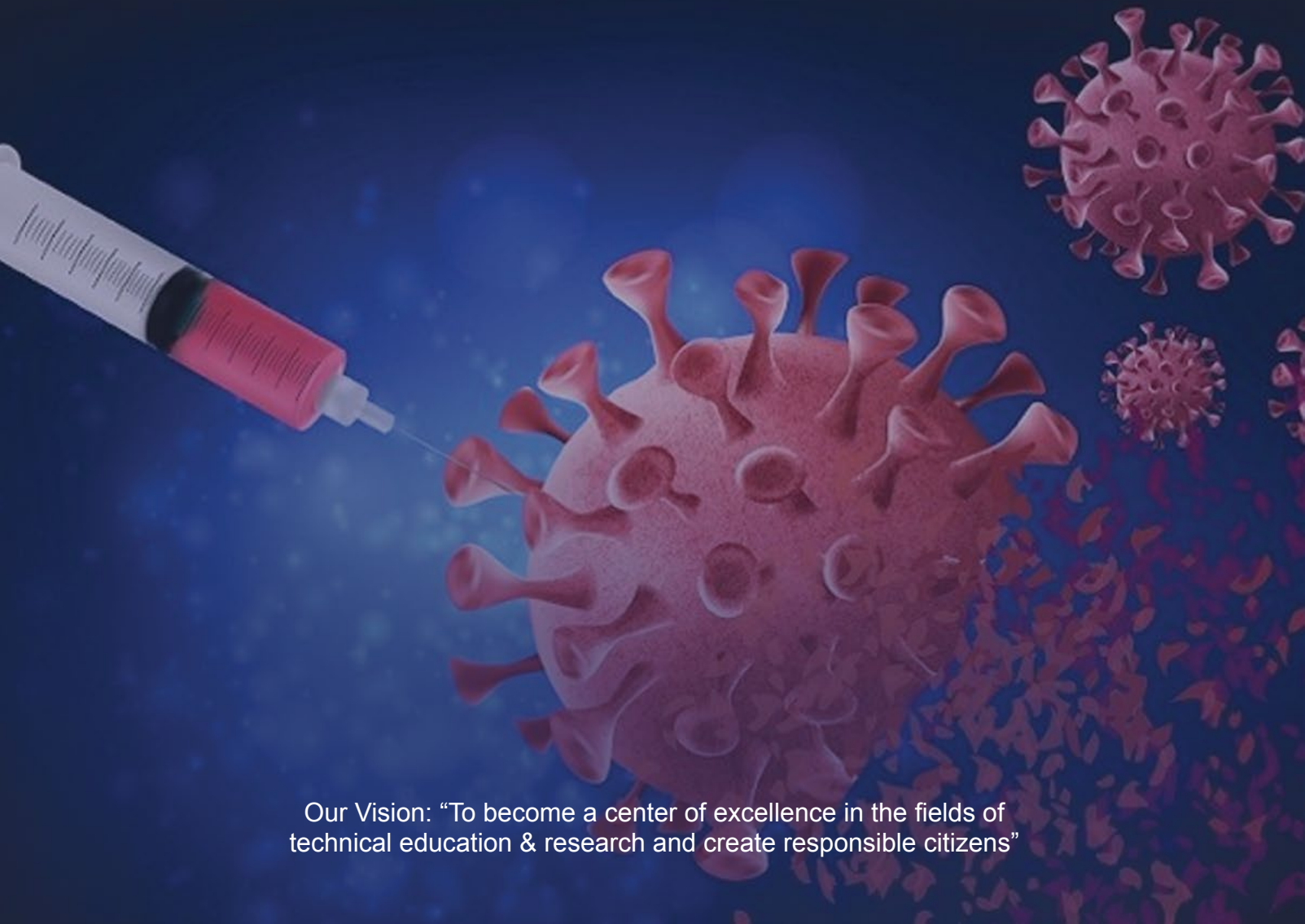
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The Workings of COVID Vaccines

The COVID-19 pandemic has shaken the human civilization over the past two years. In these unprecedented times doctors and researchers have worked tirelessly to come up with vaccines against the virus. How these vaccines work is very interesting, and worth delving into.

The environment around us contains millions of germs including the Corona Virus, SARS-CoV-2. The human body has its defense system to fight these pathogens (bacterium, virus, parasite or fungus). Each pathogen has a subpart called an antigen which is capable of stimulating a response and results in the formation of antibodies. Antibodies can identify specific antigens and trigger the immune system. However, the human body takes time to generate antibodies the first time it encounters the virus. The vaccines help by training a person's immune system to recognize the antigen and fight the virus.

The corona virus has spikes of protein (hence the name corona, or crown-like) which help it to attach itself to cells inside our body. There are several approaches in vaccine development - inactivated vaccine, live attenuated vaccine, viral vector vaccine and mRNA vaccine.

The inactivated vaccine is synthesized by creating the virus under safe conditions and then killing the virus by exposing it to radiation/heat/ chemicals. This deactivated or dead virus forms the key ingredient of the vaccine. This inactive virus does not infect the human being but at the same time it teaches the immune system as to how to fight against the virus. Covaxin is an inactivated viral vaccine developed by Indian Council of Medical Research (ICMR) in partnership with Bharat Biotech International Limited.

A live attenuated vaccine consists of an impotent/ weakened virus. This is similar to the inactivated viral vaccine and can be manufactured on a large scale. However, persons with weakened immunity may not be able to take this vaccine.

Viral vector vaccine uses viruses that are harmless to carry and deliver subparts (protein) of the covid virus. This will invoke and train the immune system without causing the disease. The Covishield vaccine is a viral vector vaccine developed by Oxford university and AstraZeneca. Sputnik Light is another viral vector vaccine developed by Gamaleya Research Institute of Epidemiology and Microbiology in Russia.

There is a genetic approach to the development of vaccines as well. Instead of using a dead or impotent virus this technique uses a genetic material for the virus. The genetic material is in form of messenger RNA (mRNA). It provides instructions in the form of a blueprint to our cells to generate specific proteins. The immune system recognizes the spike in specific protein and learns to respond to it. In this way the mRNA vaccine learns to train the immune system. The RNA from the vaccine does not interact with the DNA of our body. Moderna vaccine is a mRNA vaccine and is developed by Moderna, the United States National Institute of Allergy and Infectious Diseases (NIAID) and the Biomedical Advanced Research and Development Authority (BARDA). The Pfizer BioNTech COVID-19 vaccine is an mRNA-based COVID-19 vaccine developed by the German biotechnology company BioNTech.

With the availability of these vaccines there is a new ray of hope and enthusiasm amongst people to get back to the life and times that the human race was used to. Hopefully we will succeed in this fight against the virus and its mutants and the COVID scenario will be a distant memory.

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Visual Question Answering System

Abstract : *There has been immense progress in the fields of Artificial Intelligence, computer vision and object detection technologies in recent years. The adaptation of Natural language Processing (NLP) technology above to it makes machines understand human languages and allows the systems to provide answers to different user queries in natural languages. A Visual Question Answering System (VQAS) in this context is an extension of this technology to build a system that can answer queries about different images. Such a system may be helpful for the visually impaired person to know the environment or about the images verbally by asking specific questions. Also, searching for specific information from large collection of images is a time consuming and tedious task for a human. Through the VQA system, processing of large number of image data and fetching the required information from them can be done efficiently without manual human interference. In this work, a free-form and open-ended Visual Question Answering (VQA) system is presented which can provide answers to different user queries on varied image set.*

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

I. INTRODUCTION

Recent advancements in computer vision and deep learning research have enabled enormous progress in many computer vision tasks, such as image classification, object detection, and activity recognition. Given enough data, deep Convolutional Neural Networks (CNNs) rival the abilities of humans to do image classification [1]. With annotated datasets rapidly increasing in size similar outcomes can be anticipated for other focused computer vision problems through crowd-sourcing [2]. However, these problems are narrow in scope and do not require holistic understanding of images. As humans, we can identify the objects in an image, understand the spatial positions of these objects, infer their attributes and relationships to each other, and also reason about the purpose of each object given the surrounding context [3]. We can ask arbitrary questions about images and also communicate the information gleaned from them. But it becomes quite difficult and a tedious task when it comes to processing large bunches of image data simultaneously to fetch some needed information quickly. Also, for people with visual disabilities, knowing the contents of the images available over the web or shown in some platform may be beneficial to know about the environment. The VQA systems are mainly designed to provide answers to user queries on given images.

Developing a computer vision system that can answer arbitrary natural language questions about images has been thought to be an ambitious decades ago. However, there has been enormous progress these days in developing systems with these abilities to present VQA systems. VQA is a computer vision task, where a system is given a text-based question about an image or multiple images, and it must infer the answer [4]. Questions can be arbitrary and they encompass many sub-problems in computer vision, e.g. Object recognition - What is in the image; object detection - Are there any cats in the image; attribute classification - What color is the cat; scene classification - Is it sunny; counting - How many cats are in the image? Beyond these, there are many more complex questions that can be asked, such as questions about the spatial relationships among objects (What is between the cat and the sofa?) and common-sense reasoning questions (Why is the girl crying?).

A robust VQA system must be capable of solving a wide range of classical computer vision tasks. There are many potential applications for VQA systems. The most immediate is as an aid to blind and visually impaired individuals, enabling them to get information about images both on the web and in the real world. For

example, as a blind user scrolls through their social media feed, a captioning system can describe the image and then the user could use VQA to query the image to get more insight about the scene. More generally, VQA could be used to improve human-computer interaction as a natural way to query visual content. A VQA system can also be used for image retrieval, without using image meta-data or tags. For example, to find all images taken in a rainy setting, we can simply ask 'Is it raining?' to all images in the dataset.

VQA can be thought of as an extension to the concept of machine comprehension. It is a multi-disciplinary AI task which combines advanced techniques of computer vision and natural language processing to build a system that can answer a query about an image. The model attempts to understand the underlying meaning and semantics behind the image and answer questions based on its understanding. VQA require an in-depth knowledge of advanced techniques in the domains of computer vision, object detection and NLP. Until recently, most of the AI systems built failed to match humans in high-level vision tasks due to the lack of capacity for deeper reasoning. But with the ongoing research in this field it has become possible to now attempt and build a system that is supposed to succeed at tasks like VQA. Such a system typically needs more detailed understanding of the image and complex reasoning capabilities. A more advanced version of this system would also possess factual knowledge to be able to comprehend and answer questions whose answers are not directly depicted in the image.

Most of the extensive research going on in this field, makes use of different deep learning architectures and learning algorithms in the domains of computer vision, object recognition and natural language processing to accomplish the goal [3]. Building an AI system that can answer natural language queries about a given image is one of the most trending research areas in the recent years. Designing intelligent systems with those capabilities is an extremely challenging task as requires making the machine to be able to comprehend the meaning of the question, parse and understand the semantics of the image, identify the connection between the query and the image and then attempt to answer the question. Overall, the general problem of VQA system can be defined as building a system/algorithm that takes any image and a question asked in natural language about that image and provides answer to that question with reference to the image as the output. A high-level view of such a system is shown in Figure 1.
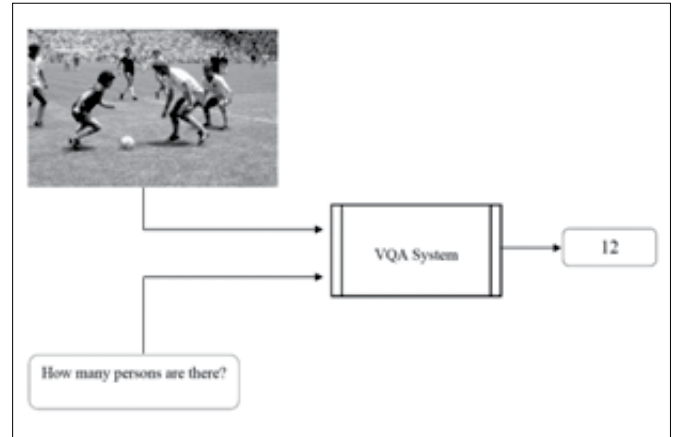
Figure.1: Example VQA system

In this work, we present a model that can process the query entered by the user and generate results accordingly to help the user perform complex tasks easily. For this purpose, the YOLO object detection model is used to detect the query object locations on image set. The presented VQA system is tested on different user queries and the results obtained were analyzed. The model is in its initial stage of development and can only provide answers to specific types of queries only. However, the results obtained in all the experiments performed shows the efficiency of the model in providing answers to user queries about different images.

II. LITERATURE REVIEW

Visual Question Answering (VQA) is one of the complex computer vision tasks which combine techniques from other computer vision tasks to improve interaction with the machines. For example, we can provide an image and ask text-based questions regarding that image and VQA system provides the answers in natural language. Such questions can contain other sub-problems like scene classification (What is the weather in the image?), object recognition (What animal is in the image?), object detection - Are there any cats in the image?), attribute classification (What color is the dog?), counting problems (How many dogs are in the image?), etc. Current VQA models can answer better than human for some type of questions like counting question or object detection but are far behind when some reasoning is required [1]. The human accuracy on DAQUAR dataset which consist mostly indoor images has human accuracy of about only 50% [2]. The models available for natural abstract images, does not work with graphical plots, as the questions asked are quite different and need different

approach to find the answers [3]. Various approaches are presented by researchers like multimodal fusion, compositional approaches, question-aware models, etc [4] to develop efficient models to work on graphical images that can provide satisfactory results. The VQA systems were not that great for answering graphical questions to images and plots which are formed using numeric data collected by sensors or from markets. Because question asked mostly are relational, so models require reasoning and relating capability. The questions can be one to one, one to many or many to many [4]. Therefore, models require a different approach to train for such images and more over require a balanced dataset for training such models.

III. PROPOSED MODEL

The presented model has two major components: query processing unit and object detection model. The overview of the VQA system is shown in Fig. 2. In the query processing phase, the user entered queries are preprocessed to extract the intent of the user. For this purpose, the basic NLP text processing steps such as: tokenization, lemmatization, and stop word removal are applied. The details of the NLP steps are presented in Section A. The processed query is then passed to the object detection model to match the query keyword against the image. For object detection, the YOLO (You Only Look Once) object detection model is used that is fast, accurate and can works in real-time environment. YOLO takes the entire image in a single instance and predicts the bounding box coordinates and class probabilities for these boxes. It uses CNN (Convolutional Neural Network) for object detection. The details of CNN model are presented in section B. The YOLO model detects the required area in the figure and answers the query accordingly. The YOLO model identifies object by plotting bounding boxes. The working of the YOLO model is presented in Section C.
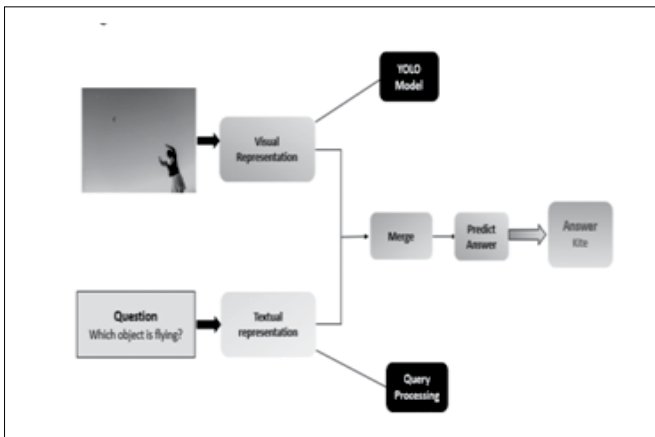

Figure.2: Overview of VQA system

A. Query processing Steps

Tokenization: It involves splitting of the whole text into the list of tokens. The lists can be words, sentences, characters, numbers, punctuation, etc. The user queries are tokenized into smaller units first for further processing.

Stop Word Removal: Stop words are the too common words in any language such as: a, of, the, this, etc which does not contribute much towards meaning to a sentence. As in object detection task those words have no role to play and are not providing any information about the user intent, they can safely be ignored without sacrificing the user intent.

Named Entity Recognition: It involves extracting the entities such as person, organization, location, place, time, monetary values etc in the text. It tags the words with their respective predefined categories.

Stemming/ Lemmatization: A user may provide the query with combination of varied words and those words may be the inflectional or derivational forms of some root words. Those words are required to be converted to the base form for processing. Stemming is the process of reducing inflected (or sometimes derived) words to their word stem or base or root form. It cuts off all the suffixes. Lemmatization usually refers to do things with the proper use of vocabulary and morphological analysis of words, normally aiming to remove inflectional endings only and to return the base or dictionary form of a word, which is known as the lemma.

B. Convolutional Neural Networks (CNNs)

Artificial neural network (ANN) is a network that is composed of many artificial neurons that are linked together according to specific network architecture. The objective of the neural network is to transform the inputs into meaningful outputs. ANN architecture consists of one input layer, one output layer and a number of hidden layers. Convolution is a mathematical operation which is performed on two functions taken as input. It typically gives an integral of the point-wise product of the two input functions. Intuitively, it can be thought of as a modified version of one of the original functions with respect to the other function. Convolutional Neural Networks (CNNs) are multiple layers of convolutions stacked on one another with non-linear activation functions like tanh or ReLU.

In a traditional fully-connected neural network, each node in the current layer is connected to every node in

the next layer. However, in CNNs convolutional filters are used to slide over the nodes in the input layer and then compute the output. In contrast to simple multi-layer perceptrons, the concept of sliding convolutions over nodes in the input layer results in regions of the input layer being connected to each node in the output layer. Each layer in the network uses different convolutional filters to compute the output. When the network sees the training data, it automatically learns which filters are to be used. Figure 3.shows a simple example of CNN with pooling.
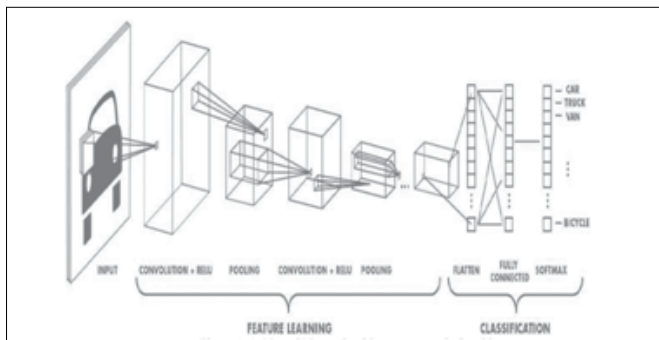

Figure.3: Neural network with many convolutional layers

A CNN image classification takes an input image, process it and classify it to fixed object categories such as: Dog, Cat, Tiger, Lion, etc. An input image is seen as array of pixels and it depends on the image resolution. Based on the image resolution, it will see h x w x d (h = Height, w = Width, d = Dimension). Technically, deep learning CNN models to train and test, each input image will pass it through a series of convolution layers with filters (Kernels), Pooling, fully connected layers (FC) and apply Softmax function to classify an object with probabilistic values between 0 and 1. In neural networks, the role of an activation function is to determine the output of a particular node given an input set of nodes from the previous layer. There are many different commonly used activation functions, both linear and non-linear. hyperbolic tangential function, Rectified Linear Unit or ReLU, Softmax.

C. Working of YOLO Model

The YOLO (You Only Look Once) framework takes the entire image in a single instance and predicts the bounding box coordinates and class probabilities for these boxes. The major advantage of using YOLO is its superb speed – it's incredibly fast and can process 45 frames per second. YOLO also understands generalized object representation. YOLO is a clever CNN for doing object detection in real-time. The algorithm applies a single neural network to the full image, and then divides the image into regions and predicts bounding boxes and probabilities for each region. These bounding boxes are weighted by the predicted probabilities. It achieves high accuracy while also being able to run in real-time. The algorithm "only looks once" at the image in the sense that it requires only one forward propagation pass through the neural network to make predictions. After non-max suppression (which makes sure the object detection algorithm only detects each object once), it then outputs recognized objects together with the bounding boxes. With YOLO, a single CNN simultaneously predicts multiple bounding boxes and class probabilities for those boxes. YOLO trains on full images and directly optimizes detection performance.

This model has a number of benefits over other object detection methods:

- YOLO is extremely fast

- YOLO sees the entire image during training and test time so it implicitly encodes contextual information about classes as well as their appearance.

- YOLO learns generalized representations of objects so that when trained on natural images and tested on artwork, the algorithm outperforms other top detection methods.

The input image is divided into an S x S grid of cells. For each object that is present on the image, one grid cell is said to be "responsible" for predicting it. That is the cell where the centre of the object falls into. Each grid cell predicts B bounding boxes as well as C class probabilities. The bounding box prediction has 5 components: (x, y, w, h, confidence). The (x, y) coordinates represent the centre of the box, relative to the grid cell location. These coordinates are normalized to fall between 0 and 1. The w and h are width and height of the bounding box. The (w, h) box dimensions are also normalized to [0, 1], relative to the image size. An example of box coordinate calculation is shown in Fig. 4.
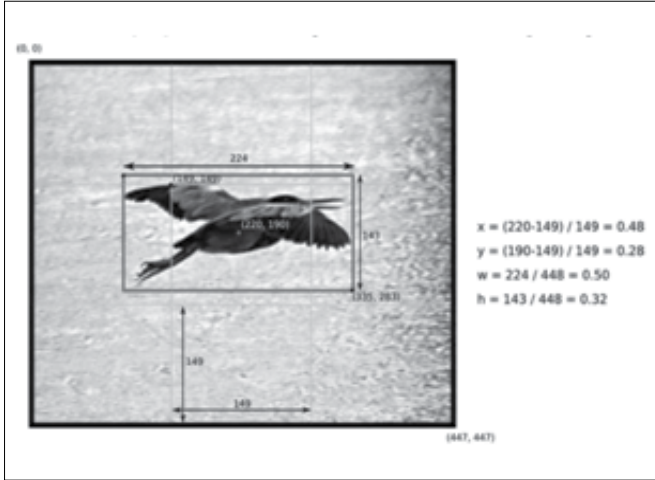
Figure.4: Example of box coordinate calculation in a 448 x 448 image with S=3

Most of the cells and bounding boxes predicted will not contain an object. Therefore, a value pc is predicted, which serves to remove boxes with low object probability and bounding boxes with the highest shared area in a process called non-max suppression.

IV. IMPLEMENTATION DETAILS AND RESULTS

The presented VQA system is implemented in python environment. Given an image and a free-form, open-ended, question, expressed in natural language, the goal of VQA system is to provide accurate answer to this question with respect to the image. The task is challenging because it requires simultaneous and intricate understanding of both visual and textual information. At an initial phase of implementation, the query processing model processes only queries of "YES/NO", "How many" and locating objects in the image when asked with queries like, "Where is the object in the image?". The model can process the queries of these type only. The YOLO objection detection model is trained on COCO-dataset to identify 80 different object classes.

For query pre processing the NLTK tool is used. After processing of the query, the query processing model outputs, a list of objects to be detected in the image. The list is represented as a single word the object and as a combination of two objects. The combination of two objects are used to detect some special objects like traffic lights, baseball bat, etc. which are one object but represented in two word. The tokenization process in query processing splits the query and hence splits such special word objects

and to detect them we have used combination of two words. The object list is then passed to the object detection model which identifies the object in the image and passes the output for final processing to produce the output. The output result of the object detection model on human object identification is shown in Fig. 5. The output results on some sample queries are presented in Fig.6 and Fig. 7. The overall accuracy obtained on various experiments performed on 3 types of queries is shown in Fig. 8.

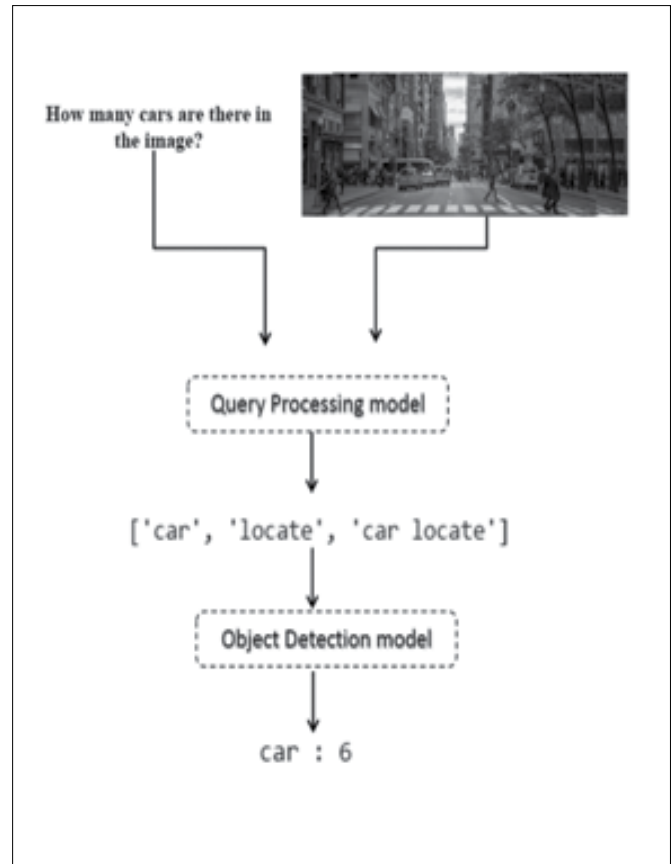*Figure.5: Output of object detection model on human object detection*

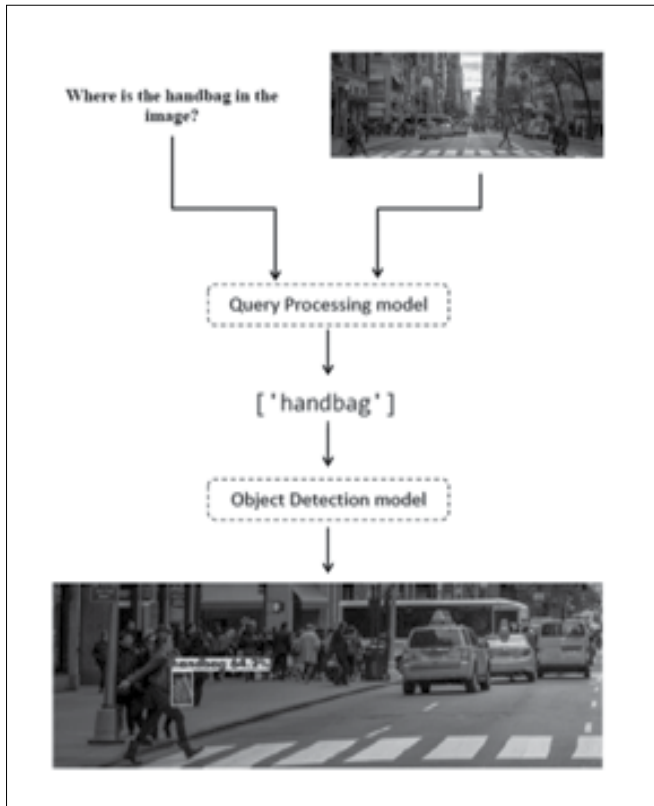*Figure.6: Output on query type "how many?" and object "car"*

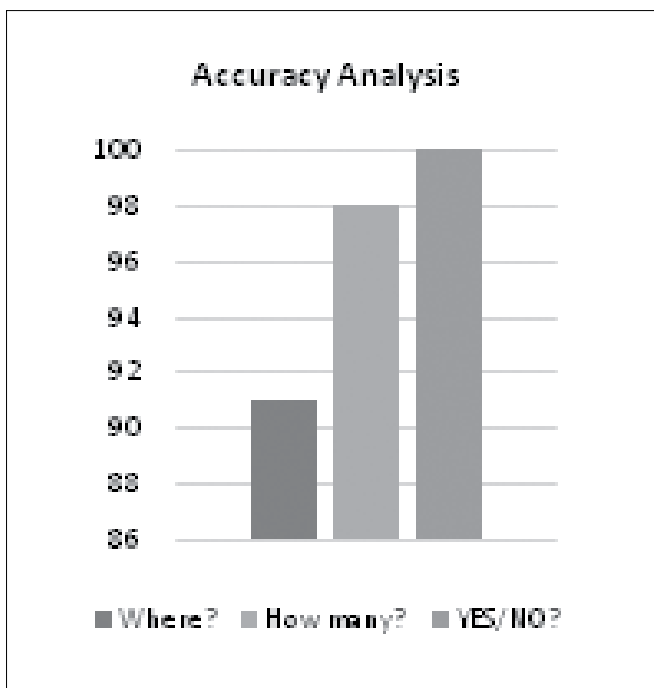*Figure.7: Output on query type "where?" and object "handbag"*

Figure.8: Accuracy percentage measures

V. CONCLUSIONS:

This work presents development of a VQA system, where the users can ask their questions in natural language text about a set of images and the model returns the answers to the queries. However, the model is in its initial phase of development and can process only selected types of queries and objects. The model uses the YOLO object detection model to work on real time environment and detect objects present in the images quickly as per the user queries. With limited type query set and objects, the model achieves 98% accuracy in an average in all the tests performed. However, the model may further be enhanced to address other types of queries and to work on varied object types.

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Compact Microstrip Patch Antenna Design using a Metamaterial Substrate

Abstract : In this paper, a miniaturized circular patch antenna with two split ring slots is designed using a metamaterial substrate. The proposed antenna is resonating at 2.4 GHz frequency. Initially, a simple circular patch antenna is designed using FR4 epoxy substrate resonating at 2.4 GHz. However, the dimension of the antenna is large. The antenna dimension is significantly reduced using a metamaterial substrate and two split ring slots. There is a 70.86 % reduction in the patch surface area and a 52.53 % reduction in the volume of the antenna as compared to the initial antenna. The proposed antenna is simulated using ANSYS HFSS software. The antenna has an S11 value of –20.32 dB and a substantial gain of 3.62 dB. It has an excellent radiation efficiency of 99.9%. The proposed antenna is suitable for Wi-fi, WLAN, Bluetooth, etc. applications.

Keywords: circular patch antenna, metamaterial, HFSS, miniaturized, microstrip, WLAN, Bluetooth

I. INTRODUCTION

In today's world of growth in wireless communication, devices are becoming smaller in size. The antenna which is an important component of a wireless communication system it is required to be miniaturized so as to fit into smaller size wireless devices. Multiple antennas are needed to be embedded in MIMO systems so there is a need for miniaturization of the antenna. Miniaturized microstrip patch antennas are light in weight, small in size, economical, and easy to fabricate. Thus they are used in a wide range of applications in spacecraft, aircraft, mobiles, satellites, missiles, etc. These miniaturized antennas can be designed using the novel material called the 'metamaterial'. Smaller physical size, high radiation efficiency, wider bandwidth are three important characteristics for antenna design and these can be improved using these metamaterials.

Metamaterials are manmade materials made up of assembling composite materials like metals and plastics. These materials are used to improve gain, radiation efficiency, bandwidth and reduce the volume of a microstrip patch antenna. It can be of SNG (Single Negative) type where either one of permittivity or permeability is negative or of DNG (Double Negative) type where both permittivity and permeability are negative.

A literature survey is done on the use of metamaterial in the design of patch antenna. It is found that several antennas are designed using metamaterial for various applications. Some of them are given below.

In [1], an antenna having a double circular slot ring resonator metamaterial unit cell is designed. Due to the use of metamaterial, there is an electrical size reduction and multi-band operation with high antenna gain. The size of the antenna is 19 mm × 19 mm with proximity coupled feed. It resonates in 3.2 GHz, 5.4 GHz, 5.8 GHz with a gain of 3.28 dBi, 2.76 dBi, 3.1 dBi respectively. A quad-band circular polarization antenna working in 2.39 - 2.55 GHz, 3.05 - 3.1 GHz, 4 - 5 GHz, and 6.3 - 6.64 GHz bands is proposed in [2]. It has a dimension of 38 mm × 32 mm × 1.6 mm with a radiation efficiency of 89%. In order to enhance the properties of the metamaterial, a waveguide mode of analysis is done for SRR and CSRR.

A compact microstrip patch antenna using metamaterial used for multiband applications is discussed in [3]. There is one base patch having the main radiator and four sub patches on the FR4 substrate. The metamaterial substrate is placed over it leaving a gap of 1 mm. The antenna covers the frequency range of L, S, and C bands. A 2D metamaterial structure is used for the reduction of mutual coupling of two radiating patches of the MIMO antenna [4]. The metamaterial is placed between the two radiating patches. The antenna operates in 2.35 -2.45 GHz frequency band.

A metamaterial-loaded microstrip patch antenna with a closed C-shaped slot is given in [5]. It is operating in 2.5 GHz, 4.7 GHz, 5.3 GHz, and 6.2 GHz frequency bands with a gain of 5.48 dB, 6.09 dB, 5.77 dB, and 8.4 dB respectively. The upper substrate is FR4 and the

lower substrate is a metamaterial. Being compact in size it is used in MIMO applications. In [6] rectangular microstrip patch antenna loaded with metamaterial has been proposed for a dual band of 3.6 GHz and 5.3 GHz with S11 parameter of −18.2888 dB and −15.2262 dB respectively. The dimension of the antenna is 25 mm × 50 mm. Another miniaturized patch antenna is designed using a metamaterial cell array [7]. It has a size of 29.2 mm × 41.6 mm and can be used for the WLAN application.

The literature survey shows that miniaturized and multiband patch antennas can be designed using metamaterial. Therefore, an attempt is made to design a miniaturized circular patch antenna with a metamaterial substrate.

II. ANTENNA DESIGN USING METAMATERIAL

Initially, a simple patch antenna (conventional) is designed which is resonating at 2.4 GHz frequency. A commercially available substrate material i.e. the FR4 epoxy substrate is chosen for this design. The height, relative permittivity, and loss tangent of the substrate are 1.6 mm, 4.4, and 0.02 respectively. Subsequently, the radius of the patch is found out using equations (1) and (2) [8].

$$R = \frac{F}{\left\{1 + \frac{2h}{\pi \varepsilon_r F}\left[\ln\left(\frac{\pi F}{2h}\right) + 1.7726\right]\right\}^{1/2}} \quad (1)$$

Where

$$F = \frac{8.791 \times 10^9}{f_r \sqrt{\varepsilon_r}} \quad (2)$$

R = Patch radius (cm).
h = Substrate height (cm).

The ground plane/substrate dimensions (length (L), width (W)) are found out using equations (3) and (4).

$$L = 2 \times R + 12 \times h \quad (3)$$

$$W = 2 \times R + 12 \times h \quad (4)$$

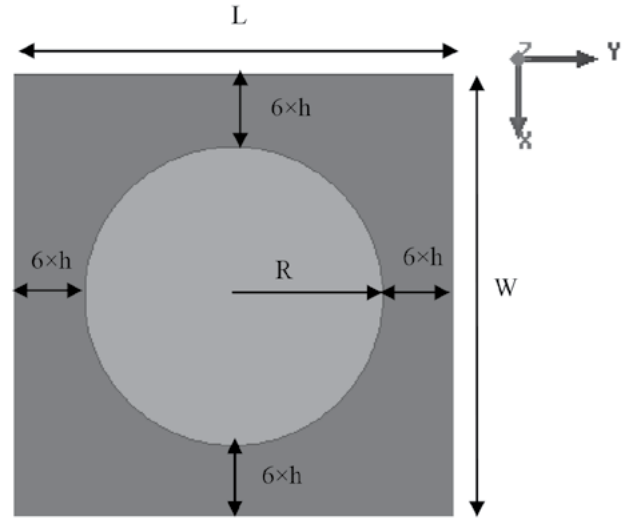The initial design of a simple circular patch is as shown below.

Fig. 1. Simple Circular patch along with FR4 epoxy substrate

Here, the coaxial feed is used for the excitation of the antenna. The coaxial feed has an outer radius and an inner radius of 1.6 mm and 0.7 mm respectively. It is the dimension of an SMA connector practically available. The detailed dimension of the patch antenna is shown in Table I. The S11 characteristic of the patch is as shown in Fig. 2.

TABLE I **DIMENSION OF THE SIMPLE CIRCULAR PATCH ANTENNA**

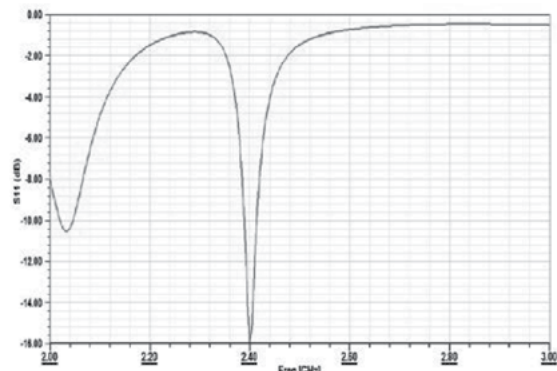| DIMENSION	VALUE (MM)
Ground Plane / Substrate Length (L)	59.22
Ground Plane / Substrate Width (W)	59.22
Patch Radius (R)	20.01
Substrate Height (h)	1.6

Fig. 2. S11 characteristics of the conventional circular patch

From Table I, it is noticed that the size of the conventional antenna is large for 2.4 GHz application. Therefore, a novel metamaterial is used to design a miniaturized antenna. The proposed design of the antenna is having a circular patch on a metamaterial substrate with two circular split ring slots. The design of the proposed antenna is depicted in Fig. 3. The dimesions are given in Table II.
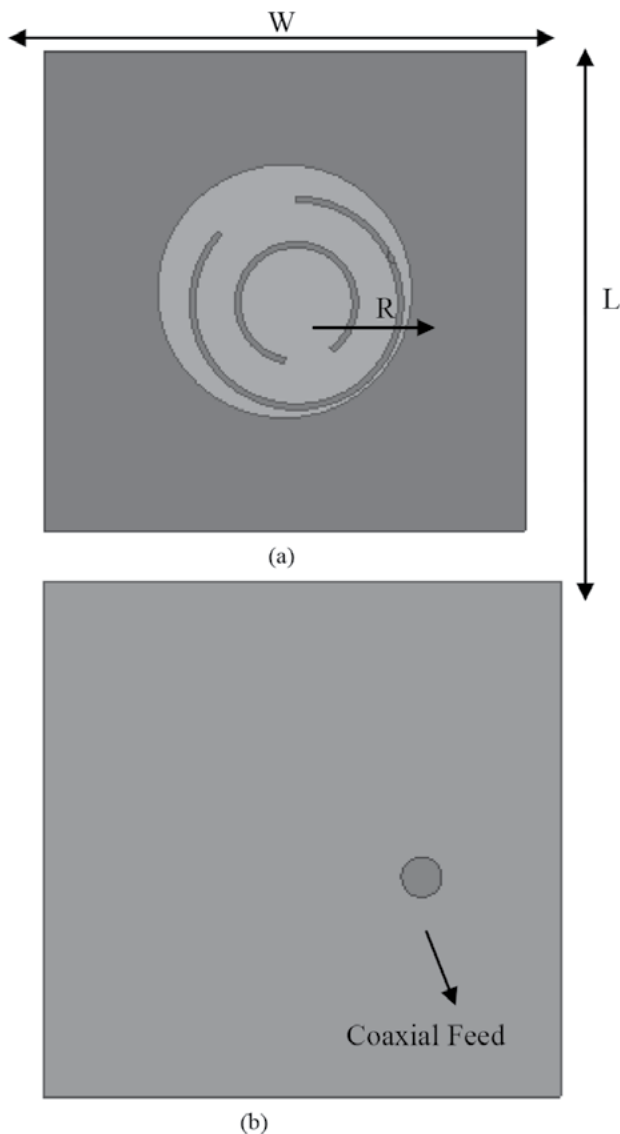
TABLE II **DIMENSION OF THE PROPOSED ANTENNA**

DIMENSION	VALUE (MM)
Ground Plane / Substrate Length (L)	40.8
Ground Plane / Substrate Width (W)	40.8
Patch Radius (R)	10.8
Substrate Height (h)	1.6

When compared with the conventional antenna of dimension 59.22 mm × 59.22 mm × 1.6 mm and the patch radius is 20.01 mm there is a reduction of 52.53 % in volume of the antenna and a 70.86 % reduction in the surface area of the antenna.

In order to increase gain, radiation efficiency, bandwidth, and decrease the size, the substrate used is of SNG (single negative) type which means only the value of either permeability or permittivity is negative. The permittivity and permeability values used for the metamaterial substrate are shown in Table III.

TABLE III **PARAMETER VALUE USED IN THE SUBSTRATE**

PARAMETER	VALUE
Permittivity of metamaterial substrate (εr)	10.2
Permeability of metamaterial substrate (μr)	-10

Fig. 3. Proposed Antenna with Metamatrial (a) Top view (b) Bottom view

The radius of the patch is found to be 10.8 mm having a dimension of the antenna 40.8 mm × 40.8 mm × 1.6 mm.

III. RESULTS AND DISCUSSIONS

The proposed antenna is designed and simulated using ANSYS HFSS software. It is a single band antenna resonating at 2.4 GHz which is the working frequency for Bluetooth, Wi-fi, WLAN, etc. application bands. The S11 parameter at 2.4GHz is –20.328 dB. The S11 characteristic of the proposed patch antenna is given in Fig. 4.
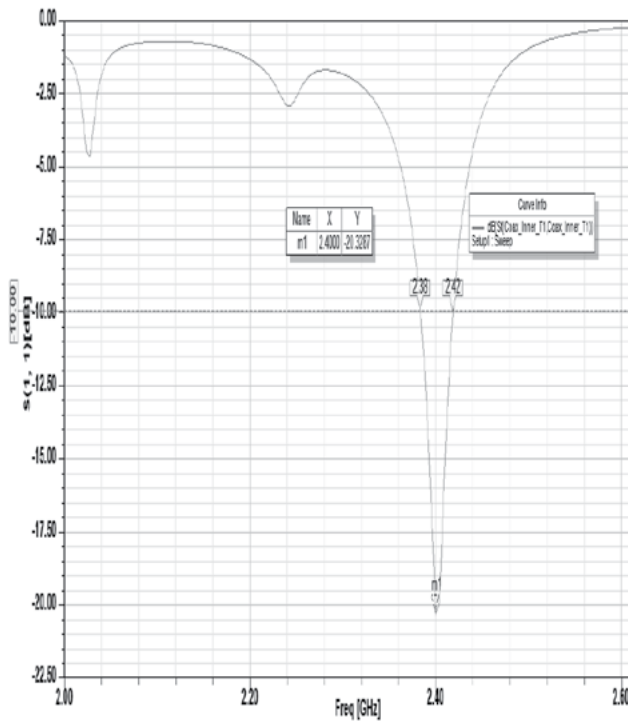
Fig. 4. S11 (dB) Versus Frequency (GHz) of the proposed antenna

The impedance of the coaxial feed is 50 Ohm and it should match with the antenna impedance for maximum power transfer. The proposed antenna has an impedance of 54.86 – j 8.58 Ω. The impedance versus frequency plot of the proposed antenna is given in Fig. 5.
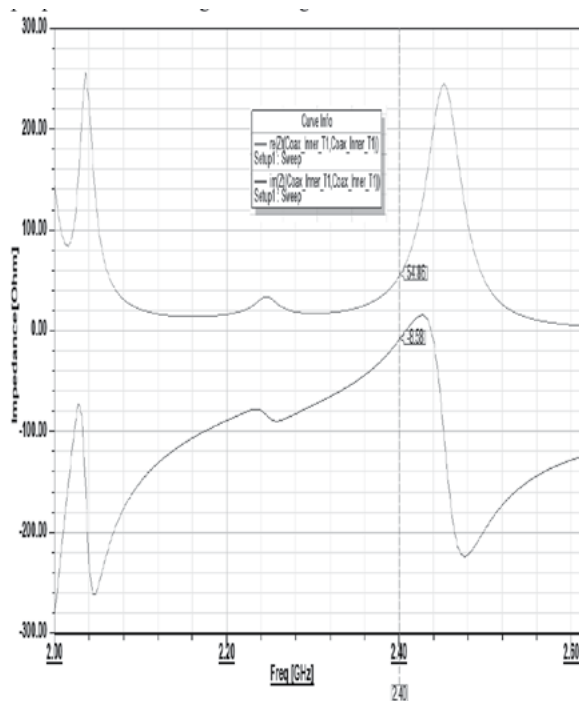

Fig. 5. Impedance (Ohm) versus Frequency (GHz) of the proposed patch antenna

The radiation pattern of the proposed patch antenna is given in Fig. 6. It has an E-plane and H-plane gain of 3.627 dB and 3.599 dB respectively. The antenna has a high radiation efficiency of 99.9%.
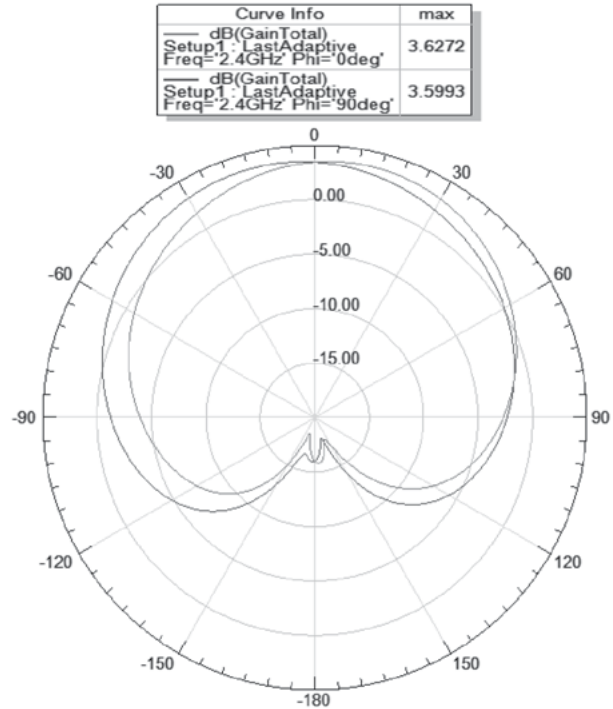

Fig. 6. E-plane and H-plane pattern of the proposed patch antenna

IV. CONCLUSIONS

A miniaturized circular patch antenna with two circular split ring slots on the patch is designed using ANSYS HFSS software. The antenna is designed using a novel metamaterial substrate having a permittivity of 10.2 and permeability of –10. It resonates at 2.4 GHz frequency which is suitable for Bluetooth, WLAN, Wi-fi, etc. application bands. It has an S11 parameter of -20.328 dB. The proposed antenna is having an excellent radiation efficiency of 99.90 % and its impedance is 54.86 – j 8.58 Ohm. The gain of the antenna is found to be 3.627 dB. Due to the use of metamaterial in the substrate, the patch surface is reduced by 70.86 % in comparison with conventional patch antenna operating at 2.4 GHz. The miniaturized size, high radiation efficiency, and good impedance matchings make it more efficient for the above mentioned applications.

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High-speed internet via airborne beams of light

This novel way of delivering high-speed internet via beams of light through the air has successfully transmitted data across the Congo River. It means that citizens in Brazzaville and Kinshasa could get faster and cheaper broadband. The cities lie only three miles apart but connecting them is tricky because traditional cable has to be routed around the river, making broadband prices five times more expensive.

The system uses very narrow, invisible beams of light to deliver high speeds, similar to the way traditional fibre in the ground uses light to carry data but without the cable casing. The technology, known as Free Space Optical Communications, grew out of experiments the team had previously used to beam lasers between balloons.

*Source: **High-speed internet via airborne beams of light - BBC News***

OneMED App: A Gift to Healthcare

Selected Article from ASCI-2021, organized by SWITCH: **https://github.com/nirmal700/OneMED1**

Abstract: *The healthcare industry is one of the largest industries in the world having direct effect on the life of people. Establishing a connection between hospitals, doctors, pharmacies and patients and minimizing the pen-paper work is a challenging task. The medical history of a patient is very important in emergency situations for doctors to attend the patients. The physical copy of the reports may not be available always when needed in emergency situations. In this context, digitization of all medical documents related to the patients and their availability through an app may help keeping the doctors informed about the patient's medical history in every situation. This work focuses on designing an Android application (OneMED) to establish a connection between doctors, pharmacy and patients and minimize the pen-paper work. It is designed focusing on multi-specialty hospitals, to cover a wide range of hospital administration and management process of patient-centric system. The application is an integrated end to end hospital database management system that provides relevant information across the hospital to support effective decision making, patient medical record management and pharmacy billing in seamless flow.*

Keywords: Android Studio, Firebase, Hospital Database Management

I. INTRODUCTION

The importance of digitization has been pretty well understood for quite a while now, but some businesses and industries are still hesitant to go through it. The healthcare industry is one such example, but given the security threats technology poses, it's quite understandable with advancements in software and server security, healthcare can now fully take advantage of digitization. It should be realized that healthcare is a trillion dollar industry spread over hospital care, clinical services, nursing homes, home healthcare, medications, research and development. If they take advantage on such advancements mixed with proper marketing of the healthcare services, it can double or even triple the amount they're getting. That's not to say that there isn't any digitization in healthcare– patient management is already being enhanced by available technologies. There are a number of hospital management systems designed for maintain patient details. However, there is still a lot of scope for digitization in healthcare towards establishing a connection between hospitals, doctors, pharmacies and patients and towards minimizing the manual pen-paper work.

A few vocal healthcare professionals resist the new wave of technology and healthcare, but those who are quick to inculcate technology into their practice possess a definite advantage over the competition. Digitization

makes it easier for patients to maintain a history. Gone are the days when you had to maintain a physical file on every doctor's appointment. Medical history is critical in emergency situations when a physical copy may not be available. In this case, digitization may help by keeping the doctors informed about the patient's medical history in every situation. An app in this context may provide an interface to patients where they can create and maintain a digital file on their medical history. They can upload the reports to a cloud service and share it with the people or doctors they want. Of course, this does require a bit of effort to maintain but it certainly pays off in emergency situations.

The pandemic has shown that our healthcare system is lacking on multiple fronts and calls for a rework by all stakeholders. In recent days due to the unprecedented pandemic, it is getting more difficult to find a doctor and fix appointment with the patients who were unable to go to hospital to visit doctor. In this work we present an Android app-OneMED created to establish a connection between doctors, pharmacies and patients. With the help of this app, patient can easily post their issues with details along with their requested appointment time. Doctor can view those issues and fix their appointment time from the app. The whole data of the patient would be stored

on cloud storage and there will be no need of having a physical paper prescribed medicines or information where in the app will show the patient details, medicines prescribed and for how many days and the pharmacy may also has access to it.

II. PROBLEMS WITH EXISTING SYSTEMS

Existing systems provide the basic functionalities needed to be handled in a hospital management environment. In the existing system all the patient details, doctor availability details and regarding the tests done to the patients prescribed by the doctor is maintained manually by the receptionists. There are also many loopholes when we look at the security of the system. Patients request for appointment for any doctor. The details of the existing patients are retrieved by the system. New patients update their details in the system before they request for appointment with the help of assistant. The assistant confirms the appointment based on the availability of free slots for the respective doctors. Sometimes it is crucial to retrieve the exact patient's history or related information quickly when needed. It is quite difficult to go through various registers or printed copies of the reports and fetch the data immediately in urgent situations.

In the existing hospital management systems, changes to information like patient details are quite difficult to incorporate as manual paper work is involved. Preparation of accurate and prompt reports becomes a difficult task as information is difficult to collect from various registers or sources. In addition, there can be manual error and calculation error at the time of billing at the pharmacy. All those manual efforts may be minimized by an efficient applications that may include patient's healthcare related all information at one place. Considering those limitations of the available systems, in this work we present OneMED-an android app for various healthcare services.

III. PROPOSED SOLUTION

OneMED is an android application created to establish a connection between doctors, pharmacy and patients and minimize the pen-paper work. Recent days due to the unprecedented pandemic, it is becoming difficult to find a doctor and fix for an appointment for the patients who were unable to go to hospital to visit doctor. This app may provide a platform to patients where they can easily post their issues with details along with their requested appointment time. The app will provide an interface to the doctors, where they can view all issues posted by their patients and fix their appointment slots. Once any appointments is confirmed, the app will automatically set up an alarm to both patient and doctor. By this app both the patient and doctor doesn't have to be physically present at the same place, both of them can conveniently attend call at their different places and the patient health records will be stored in the cloud so there is no need to come with reports. The app has different layouts for login/registration, hospital, patients and pharmacy. The users have to register first with their details and they may upload their medical documents to the system. The flowchart of the system is shown in Fig.1 and the details of the app development are discussed in the next section.
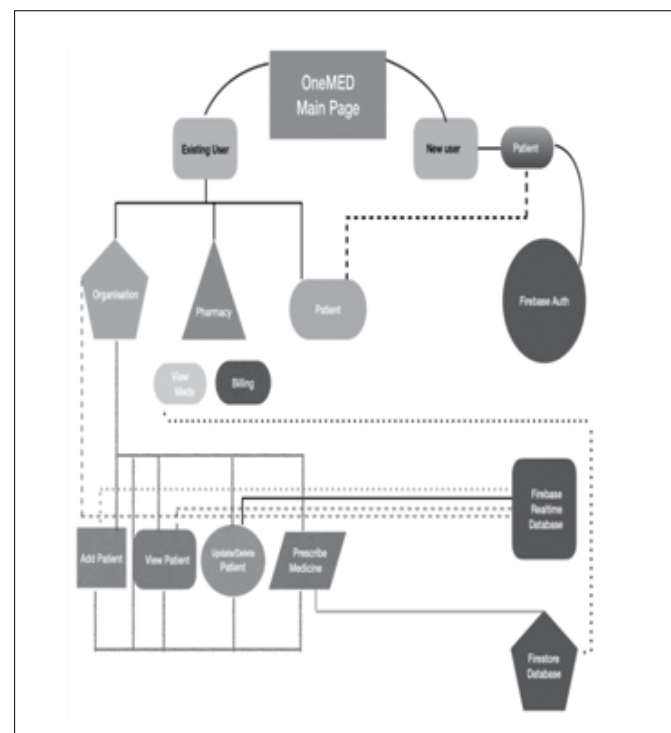

Figure.1: Flowchart of OneMED

IV. DETAILS OF APP DEVELOPMENT

This app is created using android studio and implemented in java platform. Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android application development [1]. It is available for download on Windows, macOS and Linux based operating systems or as a subscription-based service in 2020 [2]. It is a replacement for the Eclipse Android Development Tools (E-ADT) as the primary IDE for native Android application development.

The Firebase Real-time Database is used to store the data of the patient, doctor and appointment from which the app communicates. The material design dependence is included to enhance the appearance of the app. To establish a secured authentication, the firebase authentication is used. Firebase authentication is a service provided by Google to enable secure authentication to the application [3]. To enable firebase authentication, we need to include google-services.json file to the root of our directory. This file can be downloaded from the firebase console and the dependencies are needed to be included to the build. gradle file to access all the provided services. There are many types of authentications like email, phone, Google and Github [4]. In this work, we have used email and password type of authentication.

The Prescribed medicine data is stored in the firestore which gives an advantage over real-time database and the further development will include the display of the prescribed medicine in the recycler view. Firestore is a NoSQL document database built for automatic scaling, high performance, and ease of application development. While the Firestore interface has many of the same features as traditional databases, as a NoSQL database it differs from them in the way it describes relationships between data objects [5]. It can store multiple types of values like String, int, boolean, array, geo-location, date etc. The Prescribed medicines can be shared to the pharmacy where in the patient can easily buy the medicines from the pharmacy without carrying any physical prescription.

Through the app the patient can book appointment without visiting the hospital and with no third person involving in between. The user can call the hospital on an emergency in which an explicit intent will be added to place a call, The patient can be able to view his details and the prescribed medicines and also can schedule an appointment with the doctor, where in the doctor has the authority to accept or decline the appointment. After the doctors confirm the appointment, the patient would be able to see the prescribed medicines and for how many days, and the patient can even see his/her health records which will be stored in the Firebase cloud. The layouts of the FireBase real-time database, firebase authentication and Cloud Firestore are shown in Fig.2, Fig3, and Fig.4 respectively.

A few vocal healthcare professionals resist the new wave of technology and healthcare, but those who are quick to inculcate technology into their practice possess a definite advantage over the competition. Digitization

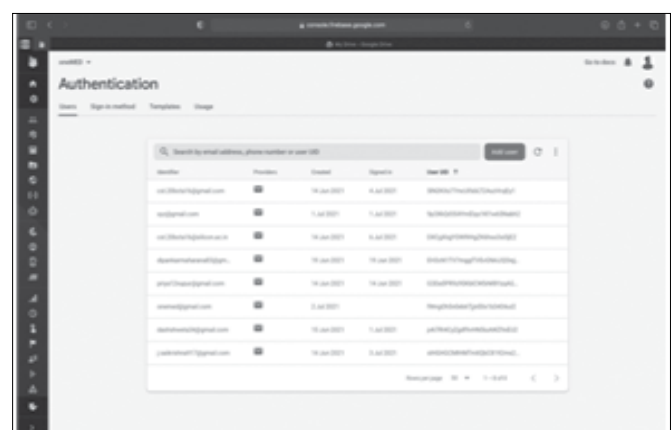*Figure.2: FireBase Realtime Database*

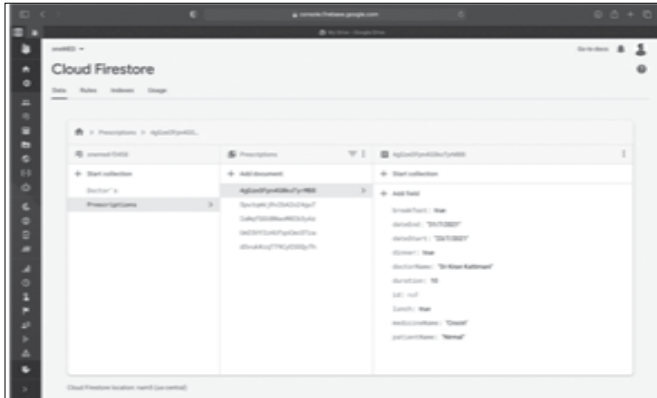
Figure. 3: Firebase authentication

Figure. 4: Cloud Firestore

V. LAYOUTS OF THE APP

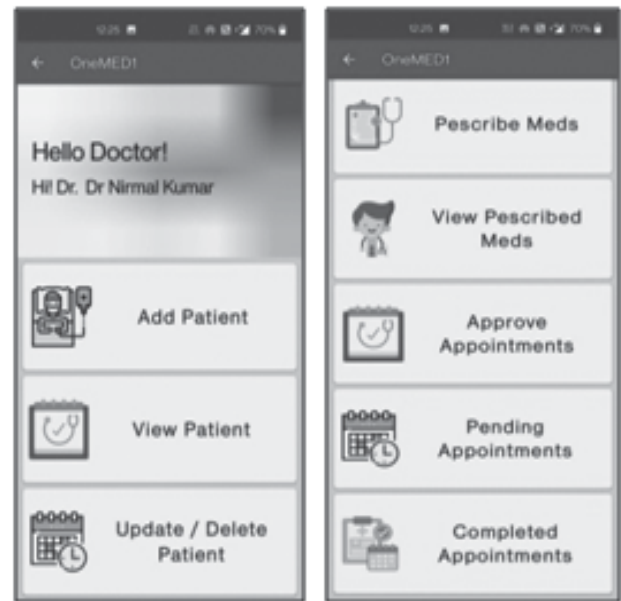The different component layouts of the designed app are shown in Fig. 5, Fig. 6 and Fig. 7.
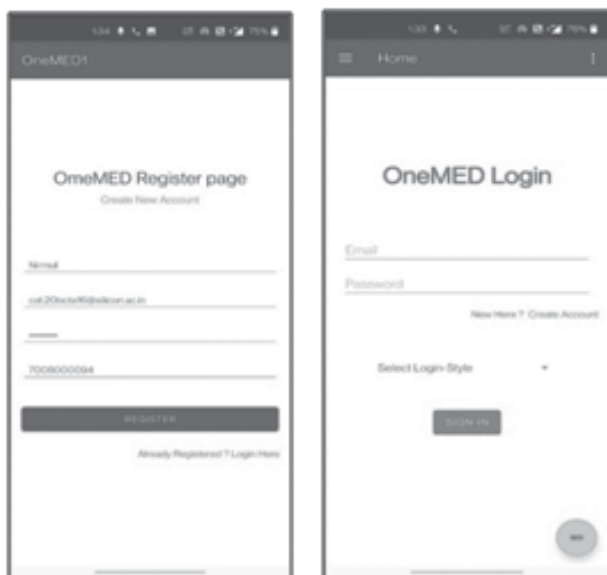

Figure.6: Hospital Layout

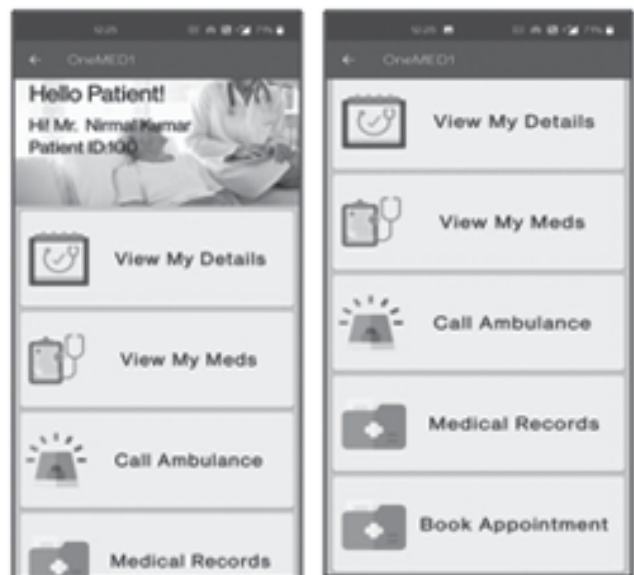*Figure.5: Login/Registration Layout*

Figure.7: Patient Layout

VI. CONCLUSIONS

This work focuses on designing an Android application-OneMED to establish a connection between doctors, pharmacy and patients and minimize the pen-paper work. However, the app development is in its initial phase and many additional components may further be included to enhance the functionalities. The future scope of this work may include automating the process of all hospital management activities and minimizing the pen paper work at the hospitals. Also, adding the pharmacy layout with options to buy prescribed medicines may be a useful feature for the users.

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Mouth Bacteria may be the reason why some people hate broccoli

When confronted with the tiniest forkful of cauliflower or broccoli, some people can't help but scrunch up their faces in disgust. But don't blame them - a new study hints that specific enzymes in spit might make cruciferous vegetables taste particularly vile to some people.

These enzymes, called cysteine lyases, are produced by different kinds of bacteria that live in the mouth. The same enzymes are also locked away in the cells of Brassica vegetables, such as cabbage, Brussels sprouts, broccoli and cauliflower. So when we chomp into a broccoli floret, these enzymes spill out of their storage containers in the veggie's component cells while those in our spit kick into gear.

*Source: **LiveScience.***

Smart Blind Stick

Abstract: *Technologies are scaling new heights on an exponential rate; it helps people to get a better and easier life. The smart stick is a technique to help sightless people to recognize their way. Sightless people suffer from the lack of ability to do their daily activities, from walking in the street to visiting friends or relative or any daily things. Therefore, the solution for this major problem is proposed by designing a stick that can aid the person to walk safely without having fear of hitting someone on the way or any solid objects. The stick has been designed using Solid Work software. The electric circuit was simulated using Proteus software for designing and simulating electrical circuits. In this paper, we have used three ultrasonic sensors. One sensor has been placed in front of the stick and the other two have been placed on sides, left and right. To detect the motion from almost every side, it has been used vibrating motor and buzzer alarms to alert the person if some obstacle is detected near him.*

Keywords: Raspberry Pi, Smart stick, Ultrasonic sensor, Controller, Wet sensor

I. INTRODUCTION

"Humans are not disabled. A person can never be broken. Our built environment, our technologies, is broken and disabled. We the people need not accept our limitations, but can transfer disability through technological Innovation" says Hugh Herr who lost his limbs at the age of 17 in rock climbing and today he is building limbs not just for himself but for entire world at MIT Media Lab. He says "I'm titanium, carbon, silicon, a bunch of nuts and bolts", he is enabling the disability through blend of technology and that's what we are trying to do through our approach of blind stick [1,2].

Blindness is a term that used to describe people that cannot use the ability to see. Human beings receive around 80% of the information from the environment via sight. Therefore, for blind people, it became difficult for them to fit in natural life. That's why they used either the ordinary white cane, a dog, or the help of other human beings [3]. Recently, many studies have dealt with smart stick design used Arduino NANO with one Ultrasonic sensor and buzzer to detect obstacles. But in that they were just alerting the person through the output of Buzzer or vibrator. Nobody was defining the kind of obstacle the person was going to face. Every situation, every obstacle demands a different level of response or alertness so just by saying obstacle ahead doesn't actually helps the challenged person actually.

In our proposed system we have used Raspberry Pi and some specific sensors for specific obstacles and after recognizing the kind of obstacle we alert the person for the particular kind of obstacle [4]. Technically these sensors are eyes to the challenged person and it helps in proper navigation of the person. Be it staircase, water, fire, small or large obstacle everything is precisely recognized in our system and person gets proper alert message. Earphones come handy with it as it is directly connected to the controller board through a jack and it can be plugged and unplugged as and when required.

II. PROPOSED METHOD

A. Sensing for Obstacle Recognition

The first and foremost task of entire process is recognition of kind of obstacle. This the job which eyes do in normal case. In this case when the person moves with powered on smart stick all the sensor work parallelly and takes the reading simultaneously and sends it to the control unit. At a particular instant of times if the sent data is true or qualifies the set of conditions defined in the code block or defined algorithm of smart stick then the action is taken. For instance, if the person is walking just after it has rained then the water sensor will detect the moisture of surface and will send the readings to control unit. In normal case too when there is no obstacle these sensors will keep sending the readings, their job is on every single second just in that case no action will happen because there is no obstacle. The sensing unit keeps the stick ready for any sudden dangerous situation too as blind stick never sleeps these sensors are always on duty sensing doing their job [5].

B. Decision Making by Control Unit

This happens after the sensing part is done. In control unit the reading gets merged with the defined algorithm

of smart stick working and if the reading qualifies or falls between the set of algorithms of smart stick then an alert audio message is generated and sent to the person. Control unit is the brain of entire process flow, it has set of conditions, it has set sensor merged to it, it converts analog to digital values overall it is pool for individual devices to work as a team. All the hazardous conditions which are possible in real life are defined as set of conditions in code block of control unit and if those conditions turn true then actions are taken [6,7]. Control unit is flexible can be manipulated according to need as we can increase or decrease the number of sensors, we can change the set of code and even output devices too as and when required.

III. METHODOLOGY USED

A. Sensing Domain

In this domain the blend of sensor together works to recognize the kind of obstacle the person is going to face, these sensors basically do the work of eye for the person. There are set of conditions defined for every sensor and if the sensing values falls in that range the controller takes the action [8]. Each sensor is building block of sensing domain like for saving the person from fire smoke sensor works, for alerting the person from water it measures the moisture content and alerts the person, for solid obstacle ultrasonic sensor works and for staircase & pit-hole IR sensor does the job.

B. Building Blocks of Sensing Domain

1. Ultrasonic Sensor

   Ultrasonic sensors are here including precise detection of objects and contactless monitoring of fill levels. Ultrasonic sensors work in much the same way as radar and sonar. Ultrasonic transceivers (consisting of a set of an ultrasonic transmitter and receiver) convert energy into ultrasound. They generate high frequency sound waves and evaluate the echo which is received back by the sensor. The time interval between sending the signal and receiving the echo (time-of-flight, TOF) is calculated in order to determine the distance to an object.

2. IR Sensor

   IR (infrared) sensors detect infrared light. The IR light is transformed into an electric current, and this is detected by a voltage or amperage detector. The IR Sensor consists of two IR LEDs, the first IR LED is wired to emit LED and the second LED is wired to transmit a signal when it receives an IR input.

3. Water Sensor

   It can be used to detect the presence, the level, the volume and/or the absence of water. While this could be used to remind you to water your plants, there is a better Grove sensor for that. The sensor has an array of exposed traces, which read LOW when water is detected [9].

IV. EQUIPMENTS USED

Spectrum of equipment are used in fabricating the entire blind stick. It includes set of sensors, powering device, output device and the control device. Various distinct symbols are used are listed in Table 1 for representing them in actual prototype of smart stick [10].

V. WORKING

The presented system is designed and configured for practical use. The system is able to handle seven states that may face the blind people. The system will respond to each state according to a specific program which is coded and installed in the Arduino microcontroller.

When obstacle is detected by the ultrasonic sensor in the left, right and front side of the stick, then Arduino send the message to the blind through buzzer and vibrator and also send the voice message through earphone. The light sensor is used to detect presence or absence of light, if there is no light then the buzzer will be on, warning through vibration and voice message through earphone. Water sensor is used to detect the presence of water and send the message to the blind through buzzer, vibrator, and also send the voice message through earphone.

A simple, cheap, configurable, easy to handle electronic guidance system is proposed to provide constructive assistant and support for blind and visually impaired persons. The system is designed, implemented, tested, and verified. The real-time results of the system are encouraging; it revealed an accuracy of 93% in detecting distances. The results indicate that the system is efficient and unique in its capability in specifying the source and

distance of the objects that may encounter the blind. It is able to scan areas left, right, and in front of the blind person regardless of its height or depth. Therefore, it was favored by those who participated in the test. The ultrasonic sensor has been fully utilized in order to advance the mobility of the blind and visual impaired people in safe and independent way. The water and light sensors are used for the detection of presence of water and light. This system does not require a huge device to be hold for a long distance, and it also does not require any special training. This system also resolves limitations that are related to the most of the movement problems that may influence the blind people in their environment.

VI. ALGORITHM

The working algorithm of entire smart stick functioning is based on certain set of conditions. These set of conditions are based on individual sensors. If the reading of sensors falls in the range of condition then alert audio output is provided to the user else if condition is normal there is no such obstacle then no action is taken. The working algorithm constitutes the high low obstacle detection, obstacle distance detection, different states of obstacle so that user can react with desired level of alertness in every situation. The working algorithm starts with powering the device then initializing different set of ports and then checking the defined conditions. Entire working algorithm condition check happens in control domain. And after passing each block of condition the message is sent from control domain to the output domain.

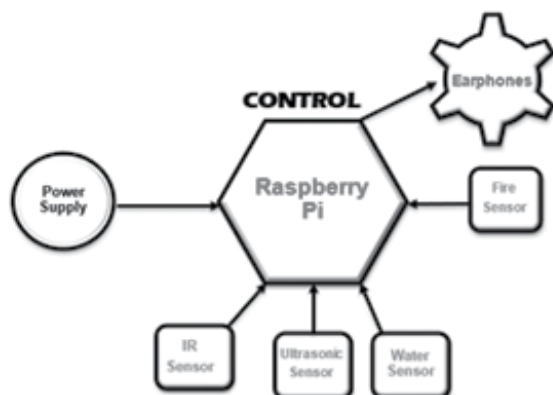The working algorithm is shown in figure 1.

Fig.1 Working algorithm

VII. CONDITIONS OF WORKING ALGORITHM

ALGORITHM

We have used certain set of conditions for proper recognition of kind of obstacle. The actual set of conditions are represented below is given in fig. 1.

1. For General Obstacle

2. For High/Low Obstacle

3. For Water

4. For Fire

5. For Upstairs/Downstairs

1. Someone ahead

if (distance_up<=50 and a==True): pygame.mixer. music.load("/home/pi/Downloads/someone. mp3")

pygame.mixer.music.play()

while pygame.mixer.music.get_busy() == True:

continue

2. For Upstairs

if (sens==False): pygame.mixer.music.load("/ home/pi/Documents/trident/upstairs.mp3")

pygame.mixer.music.play()

while pygame.mixer.music.get_busy() == True:

continue

3. For Wet Surface

```
if (output<=80.00):

pygame.mixer.music.load ("/home/pi/
Documents/trident/wet.mp3")

pygame.mixer.music.play()

while pygame.mixer.music.get_busy() ==
True:

continue
```

4. For Downstairs

```
### downstairs ultrasound

elif(distance>=10):    pygame.mixer.music.
load("/home/pi/Documents/trident/downstairs.
mp3")

pygame.mixer.music.play()

while pygame.mixer.music.get_busy() ==
True:
```

VIII. CONCLUSIONS

The Smart Stick acts as a basic platform for the coming generation of more aiding devices to help the visually impaired to be more safe. It is effective and afford. It leads to good results in detecting the obstacles lying ahead of the user in a range of four meters, detecting stairs and water pits. This system offers a low-cost, reliable, portable, low-power consumption and robust solution for navigation with obvious short response time. Though the system is hard-wired with sensors and other components, it's light in weight. Further aspects of this system can be imped via wireless connectivity between the system components, thus, increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles. While developing such an empowering solution, visually impaired and blind people.

VIII.FUTURE SCOPE

There is always scope of improvement and there is lot more that can be done to make this more convenient and feasible for the blind person. Some of the future scope we are looking forward are:

- We are in unprecedented pandemic so our foremost scope we see is make this stick as a Covid shield synchronizing it with Arogya Setu App or installing oximeter with it

- Merging of GPS Module in stick for real time location tracking of person.

- An application merged with the stick so that the family members can keep note of everything happening with blind person

- GSM Module can be included to send emergency messages when person meets any accident or is in danger.

- It can be further enhanced by using VLSI technology to design the PCB unit. This makes the system further more compact.

- In order to run this integrated set of hardware we can use solar panels as an alternative to the battery, it will get easily recharged.

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Fossils and DNA paint a vibrant picture of human origin.

These are the locations of some of human evolution's biggest fossil discoveries. The search in Africa

began in the 1920s. Yet there is still much of the continent left to explore, as paleoanthropologists have

mostly focused on eastern and southern Africa.

A. The oldest known Homo sapiens fossils, dating to about 300,000 years ago, come from Jebel Irhoud in Morocco.

B. At the Toros-Menalla site in Chad, scientists found what may be the earliest known hominin, Sahelanthropus tchadensis.

C. Ethiopia's Afar region hosts numerous sites, some stretching back more than 5 million years. Major finds include the early hominin Ardipithecus and Lucy.

D. Southern Ethiopia and northern Kenya hold a long hominin history, including Australopithecus fossils, some of the oldest known stone tools, early Homo fossils and early H. sapiens fossils.

E. Louis and Mary Leakey put Tanzania's Olduvai Gorge on the map with discoveries of Paranthropus boisei and Homo habilis. The nearby Laetoli site preserves hominin footprints dating to 3.6 million years ago.

F. The Kabwe skull, the first hominin fossil found in Africa, came from a mine in Zambia in 1921.

G. South Africa's limestone caves have yielded Australopithecus, Paranthropus and Homo fossils.

H. Quarry workers near Taung, South Africa, recovered the first Australopithecus fossil ever found.

I. At caves along coastal South Africa, scientists have recovered a rich record of H. sapiens activity, including what may be the earliest known drawing and other signs of symbolic behavior.

*Source: **National Research Council/Understanding Climate's Influence on Human Evolution 2010; Adapted by E. Otwell***

Stress-Engineered AlGaN/GaN
High Electron Mobility Transistors Design

Abstract: *The performance of AlGaN/GaN High Electron Mobility Transistors (HEMTs) can be improved using the strain engineering technique. We have investigated the role of nitride passivation layer induced stress/strain on the spontaneous and piezoelectric polarization in nitride/AlGaN/GaN heterostructures with particular emphasis on the drain current. The variation of stress profile due to change in nitride layer thickness has been presented. The study encompasses topography simulation, which realistically reproduces an experimental HEMT and the stress distribution in the device.*

Keywords: Stress/strain engineering, GaN/AlGaN, HEMT, piezoelectric, spontaneous polarization,

I. INTRODUCTION

The excellent physical properties of Gallium Nitride (GaN) and alloy Aluminum Gallium Nitride (AlGaN) make the devices based on an AlGaN/GaN heterojunction the most exciting contender for future high-power and high frequency applications. The unique feature of AlGaN/GaN HEMTs is the strong confinement of the two-dimensional electron gas (2DEG) channel formation. However, the high concentration of sheet carrier and the confinement of the 2DEG located at the heterointerface is due to the band bending. A strain in the AlGaN layer is induced due to the large lattice mismatch and the 2DEG relies both on piezoelectric and spontaneous polarization induced effects. These piezoelectric effects make a significant impact on the free carriers in strained group-III nitride heterostructures. The piezoelectric polarization of the strained AlGaN barrier layer is more than five times that of AlGaAs/GaAs structures, which results in increase in current density. The high concentrations of electrons with high mobility and high saturation velocity is the basics of AlGaN/GaN HEMTs.

Stress is a significant factor influencing the operation and performance in AlGaN/GaN HEMTs based devices. The 2DEG charge density and mobility can be altered by different Al mole fraction and thickness of the AlGaN layer. AlGaN/GaN HEMT devices mainly found in high power microwave applications due to its high-power densities. Since both the polarization effects are dependent on the stress at the heterointerface, the impact of stress on the device performance can be evaluated which further enhances the device design. To diminish the rupture of the AlGaN surface and improvement in the 2DEG properties, strain engineering is essential. Strain engineered GaN-based HEMTs have been reported using AlN interlayers in the GaN bulk layer [1]. The stress generated between GaN and AlGaN due to lattice-mismatch drives electrons near heterojunction [2]. The electrical characteristics can be enhanced by applying strain which induces pronounced piezoelectric charges in the submicron region [3-4].

In this work, we investigate the stress distribution which arises due to nitride passivation layer and the presence of stress polarization are studied using the Victory Process tool [5] from Silvaco. The distribution of stress is resulted from nitride intrinsic stress which can be either compressive or tensile and for calculation of this "stress evolution" model was used. The device structure generated from process simulation is used in the Victory Device tool [6] for device simulation of the output (ID-VG) characteristics. The impact of compressive or tensile stress on the electrical characteristics are studied and compared for different tensor scale factors as well as different nitride layer thicknesses. The effect of spontaneous and piezoelectric polarization in nitride heterostructures for characterization and analysis of GaN/AlGaN HEMTs is investigated.

There are four sections in this manuscript. The design related issues have been discussed in Section I. The simulation conditions such as material properties, physics

based models, have been discussed. The simulation results such as, stress a analysis, output characteristics of GaN/AlGaN HEMTs, including the effects of geometry (thickness of nitride) and intrinsic stress are discussed in Section III. The conclusion is presented in Section IV.

II. GaN / AlGaN HEMT DESIGN

The mechanism of the formation of two-dimensional electron gas is shown in Figure 1. Consider a layer of AlGaN over a GaN layer without stress. They are both of gallium polarity. The lattice parameters of the AlGaN layer are lower than those of the GaN layer. The AlGaN layer is therefore stressed in tension. The polarization vectors in these two layers and the surface charges are shown [7]. This positive charge is compensated by the presence of electrons at the interface. They form two-dimensional electron gas which is confined to this interface. The AlGaN layer is called "barrier", the layer GaN where the electrons are at the interface is called "channel". Note that there is no intentional doping of the AlGaN barrier. Electrons confined to the interface can come from several sources: intrinsic faults, impurities in the GaN buffer layer, the AlGaN barrier, or surface conditions. Epitaxially grown III–V semiconductor materials with a Wurtzite structure, such as GaN and AlN, exhibit a strong polarization effect. This polarization effect is critical in modeling nitride heterostructure or layered-structure devices, as it significantly alters the device performance [8].
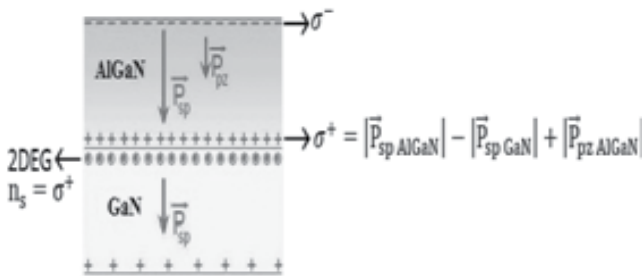

Figure 1. Demonstration of the formation of 2DEG at the AlGaN/GaN interface

Let us consider the case of the gallium polarity. Spontaneous polarization vectors do not change with stress. There are only the piezoelectric polarization vectors that are influenced by stress. We have three possibilities for the GaN layer strain on the substrate: without stress, stress in tension and stress in compression. Each case imposes a stress state for the AlGaN layer and thus a density of positive charge at the interface. The total polarization is the sum of spontaneous polarization and piezoelectric polarization. The presence of this polarization can have significant effects on device structures and has inspired us to study the effects of strain/stress applications for III-nitride devices.

In the first case as shown in figure 1, this is the optimum case because the stress in the AlGaN is not too large and the polarization vectors (spontaneous and piezoelectric) are in the same direction in the AlGaN. In the second case, the GaN layer is stressed in tension. The piezoelectric polarization appears in GaN and increases the stress of AlGaN in tension. Theoretically, this case can generate a positive charge density, more raised to the interface than the previous case. However, the stress levels applied to the AlGaN would also be important causing the formation of dislocations or even cracks and consequently the material relaxation.

III. TCAD SIMULATIONS

For GaN HEMT fabrication, the basic process steps are deposition, lithography, and etching. The basic process steps used are: initialization of sapphire (substrate), deposit AlN, deposit GaN, deposit AlGaN, deposit aluminum, etch aluminum and deposit nitride. The basic structure after the virtual fabrication is shown in figure 2. To study the effects of nitride intrinsic stress on device performance, strain/stress distributions were simulated with the Victory Stress tool [9]. To model the intrinsic stress due to the nitride passivation layer during the deposition for the xx-component and the zz-component of the stress tensor, linear elasticity theory was used. The GaN crystal has orthotropic symmetry, meaning that its mechanical properties are isotropic in all directions within the basal plane of the Wurtzite structure. The mechanical elastic constants for the c-axis (or growth direction), which is perpendicular to the basal plane are however different from those in the basal plane. A general stress-strain relationship is used.
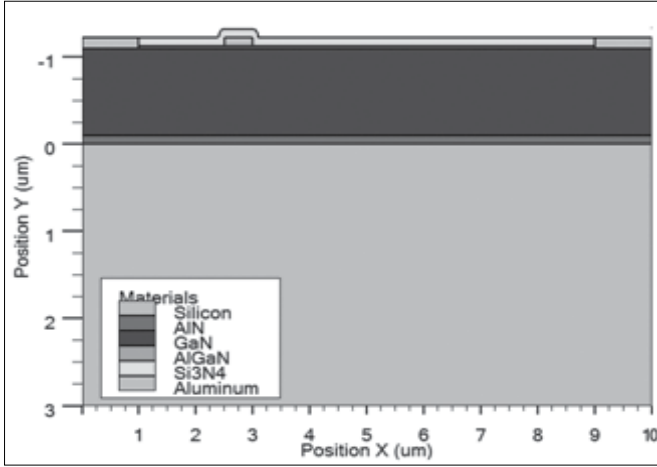
Figure 2. Basic GaN HEMT structure after the virtual fabrication used in this study.

In epitaxial layers, the strain tensor can be represented by ε_{xx}, ε_{yy}, ε_{zz}, ε_{xy}, ε_{yz}, ε_{zx}. The relationship between the various components of the strain tensor are given as follows

$$\varepsilon_{xx} = \varepsilon_{yy} = \frac{a_S - a_0}{a_0} \; ; \; \varepsilon_{zz} = -2\frac{C_{13}}{C_{33}}\varepsilon_{xx} \; ; \; \varepsilon_{xy} = \varepsilon_{yz} = \varepsilon_{zx} = 0$$

where C_{13} and C_{33} are elastic constants. Figure 3 shows the stress distribution due to nitride passivation layer.

To study the effects of intrinsic stress on the electrical performance, the Id-Vg characteristics at a drain bias (VD) of 1V for different gate voltages (V_{GS}) varied from -6 to 1.0V are shown in Figure 4. Finite element modeling techniques were applied to quantify the mechanical stress distribution in planar AlGaN/GaN structures. Piezoelectric charges due to induced stress was scaled independently. For different Al concentrations, the 2DEG carrier concentrations are in good agreement with those expected to arise from the combined polarization effects (spontaneous and piezoelectric) [10]. The variations in mechanical stress resulting from change in the charge density which affects the maximum current in AlGaN/GaN transistors.
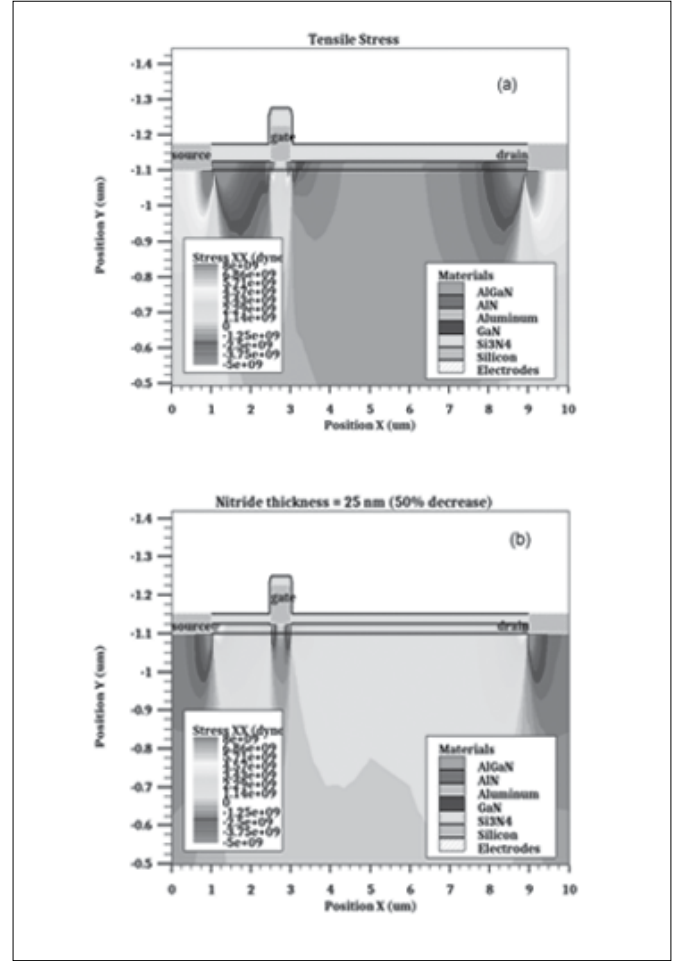

Figure 3. (a) An intrinsic (tensile) stress has been introduced by the nitride passivation layer during deposition. The xx-component of the stress is shown and (b) Nitride layer thickness dependence (for 25 nm thick) is shown. (dyne/cm2: unit of stress)

Figure 3. (a) An intrinsic (tensile) stress has been introduced by the nitride passivation layer during deposition. The xx-component of the stress is shown and (b) Nitride layer thickness dependence (for 25 nm thick) is shown. (dyne/cm2: unit of stress)
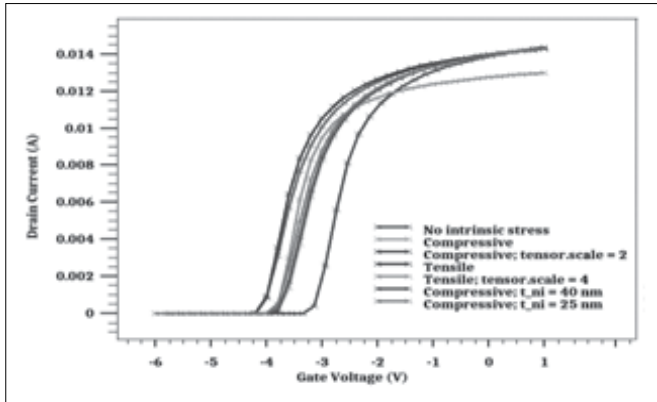
Figure 4. Transfer characteristics at VD= 1V when ramped from -6 V to 1.0 V for different stress conditions. Piezoelectric charges due to stress have been scaled.

IV. CONCLUSIONS

In this manuscript, we have studied the stress/strain distribution in AlGaN/GaN structures. The effect of stress has been analyzed. The geometry dependent electrical characteristics have been investigated. The critical design issues involving spontaneous polarization, which does not change with stress, and the stress-dependent piezoelectric polarization are discussed.Stress is a significant factor influencing the operation and performance in AlGaN/GaN HEMTs based devices. The 2DEG charge density and mobility can be altered by different Al mole fraction and thickness of the AlGaN layer. AlGaN/GaN HEMT devices mainly found in high power microwave applications due to its high-power densities. Since both the polarization effects are dependent on the stress at the heterointerface, the impact of stress on the device performance can be evaluated which further

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Contactless Tachometer using NodeMCU

Abstract: *This paper mainly focuses on the design of a contactless digital tachometer. It is built using microcontroller, an infrared system and LCD module. The infrared system senses the interruption in the beam of rays caused by rotating object and generates pulses which will be sent to the microcontroller and these pulses will be counted; this count will be displayed on the LCD in revolution per minute i.e. RPM. The system is economical and has wide applications in automobile industry and medical field. A tachometer is a device that measures the rotational speed of a shaft or disk in motor or other machines. This paper presents the design of a simple, easy to implement contactless tachometer using low cost linear digital integrated circuits (ICs). This tachometer can be easily used for both industrial and laboratory purposes where it should be able to measure rpm and display reading in revolutions per minute (RPM) on the liquid crystal display (LCD module). This device is an embedded system; it is built using an alpha-numeric liquid crystal display (LCD) module and an infrared system to detect the rotation of the machine whose speed is being measure. Most of the controllers employed in the industry to control industrial process use a tachometer which gives the provision of feedback in a control circuit. It can measure the speed of rotating objects in the most accurate form possible. In automotive, it is used as a gauge showing the speed of the engine shaft that is driving the transmission, usually in thousands of rotations per minute.*

Keywords: Tachometer, Integrated Circuit, Mirco-controller, Node MCU

I. INTRODUCTION

In this modern era of industrialization most of the industries contain rotating objects such as motor, rotor etc for its proper monitoring its speed has to be measured and controlled. For such measurements, there are many methods and one of such method is use of tachometer. Tachometer is an instrument which measures the speed of any rotating objects in revolution per minute (RPM). There exist mechanical tachometers, where direct contact between motor and the tachometer is needed for measurement of RPM. This kind of tachometers requires regular maintenance and is complicated to use. These instruments suffer from wear and tear. Hence there is a requirement for a contactless digital tachometer which can be easily used with monitoring system. This work is about contact-less digital tachometer designed using infrared methodology [1]. It works on the principle that the number of times the IR receiver transmitter circuit is cut and re-established in a second gives the number of rotations per second. The value is displayed the LCD display. The screen is refreshed after each second. The sensor unit used for measurement is IR sensor and the processing unit used is Node MCU. The measured value is displayed using a 16X2 LCD module. This kind of tachometer can employed in the region where speed is unit of measurement and size and precision is a factor.

This model can be employed in vehicles and robotic arms [2,3]. This is also used in aircraft, rails and traffic engineering to estimate traffic speed and volume. Digital tachometers are preferable due to its better accuracy, no A/D conversion, less maintenance (as they are brushless) and noise immunity. A digital tachometer works on the principle of frequency measurement which has two distinct approaches which are –

    (1) Measurement of elapsed time between successive pulses.

    (2) Counting the number of pulses in a fixed period of time.

In olden days tachometers were completely mechanical, but tachometers have changed due to development of modern technology. The first mechanical tachometer was similar in operation to a centrifugal governor. The inventor of the first mechanical tachometer is assumed to be a German engineer Dietrich Uhlhorn; he used it for measuring the speed of machines in 1817 [4]. Since after then, it has been used to measure the speed of locomotives in automobiles, trucks, tractors and aircrafts. Early tachometer designs were based on the principle of mono stable multivibrator, which has one stable state and

one quasi stable state. The circuit remained in a stable state, producing no output. However when it receives triggering current pulse from the ignition system, the circuit transitions to the quasi stable state for a given time before returning again to the stable state. This way, each ignition pulse produced a clean pulse of fixed duration that was fed to the gauge mechanism. The more of such fixed duration pulses the gauge received per second, the higher it read. The mono stable multi vibrator is still used in tachometers today, although the tendency is to use voltage pulses rather than current pulses, the latter requiring that the ignition coil current passes through the tachometer on its way to the coils. Later designs of tachometer were in no way to do any improvement on the early type; indeed the change seemed to have been made to be more economical. Integrated Circuit (IC) where in their infancy in the late 1960's and was both expensive and not proven to be robust in automobile applications.

II. WORKING PRINCIPLE

Tachometer is an RPM counter which counts the no. of rotation per minute. There are two types of tachometer one mechanical and other one is digital. Fig. 1 shows the working [5]. Here we have designed an Node MCU based digital tachometer using IR sensor module to detect object for count rotation of any rotating body. As IR transmits IR rays which reflect back to IR receiver and then IR Module generates an output or pulse which is detected by the Node MCU controller when we press start button [6]. It counts continuously for 5 seconds. After 5 seconds Node MCU calculate RPM for a minute using given formula.

RPM= Count x 12 for single object rotating body.

But here we demonstrate this project using CPU fan. So we have done some changes that is given below:

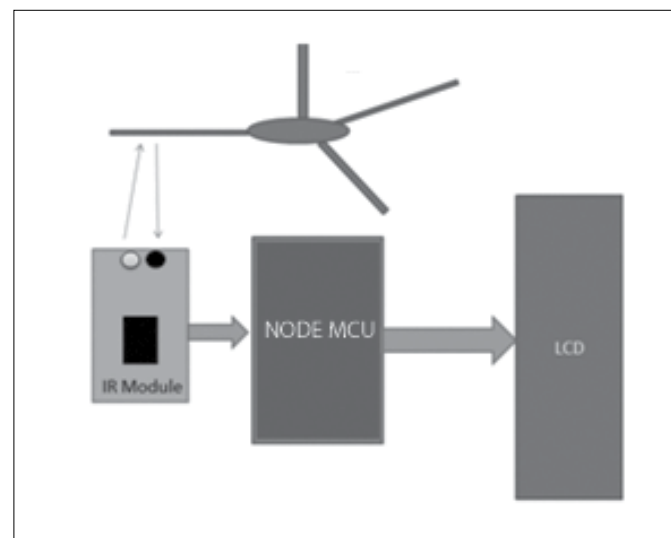RPM=count x 12 / objects

where object = number of blades in fan.

The hardware components required for the above system are given below:

1. Node MCU ESP8266
2. IR sensor Module
3. 16x2 LCD Display
4. Push button
5. Zero PCB board
6. 9 volt battery
7. Connecting wires
8. Motor Driver L298N

Figure 1 represents the block diagram of the working principle.

Fig. 1 working principle of tachometer

III. SYSTEM ARCHITECTURE

The system works mainly on infrared transmission principle as shown in Fig. 2. It has mainly controlling unit, sensing unit display unit and motor. The object of interest i.e. motor is placed in front of sensors. The sensor has IR LED and photodiode and the IR LED emits continuous beam of light rays. When motor starts rotating this light ray will be interrupted. The light ray will be rebound back and will be absorbed by the photodiode [7].
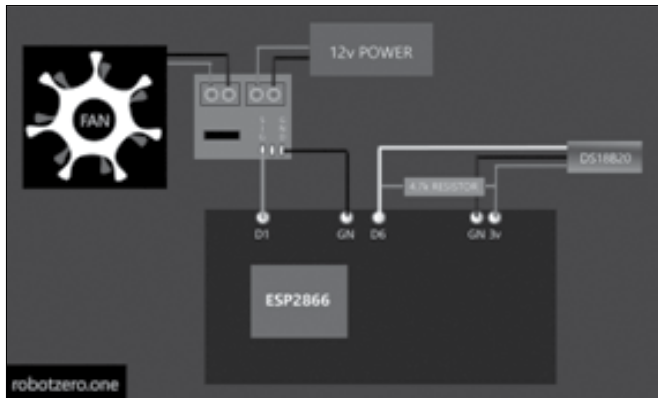
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Fig. 2 Circuit Diagram of contactless tachometer

This interruption of light ray is continuous in each and every rotation. This results in pulse of light ray that is fed to the microcontroller. The microcontroller counts the number of pulses and that in turn is the number of rotations. This obtained value will be displayed on the LCD screen.

IV. RESULTS

Mobile App

For the user to see the speed of the motor from anywhere in the mobile app we have shown speed of the motor in the form of an analog speedometer. To control the speed of the motor we are giving a slider which the user can slide on his mobile app to control the speed of the motor i.e. he can set the slider to 50% or 75% or 90% according to his need and the motor will run at 50% or 75% or 90% of it's full speed. We have also given a button to the user if he wishes to turn off or on the motor. A screen shot is given in fig. 3.
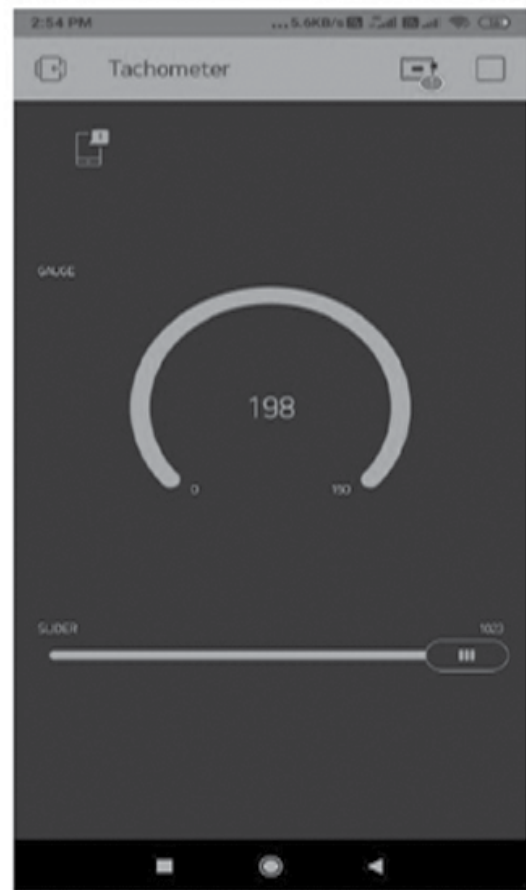

Fig. 3 Screenshot of Application

Fig. 5 Screenshot of Excel sheet

In the excel sheet shown in fig. 5 the first column is time, the second column is entry id and the third column is speed of the motor in rpm.

Website

We are dynamically sending data from Esp8266 to the website where the data is plotted on a graph of speed vs date/time where the speed of the motor at any instant can be seen just by moving cursor at the different times of the day and the data can be seen as any type of graph such as bar graph, line graph, etc. but for simplicity and easy understanding we are showing data in the form of a line graph as shown in fig. 4.

Fig. 4 Screenshot of website

V. CONCLUSIONS

The data sent from the Esp8266 to the website is also being stored and can be seen in the form of excel datasheets if the user wants to see or inspect if the motor has been running in an abnormal or concerning way as the speed of the motor is recorded and stored after every few seconds as shown below, thus making the process of surveillance and maintenance very easy. The time shown in the excel sheets is in the utc i.e. universal coordinated time which can very easily be converted to regional time as per time conversions present on the internet.

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The Perseverance Rover

On 30th July, 2020, NASA launched one of its most complex Rover ever sent to Mars. It was called the Perseverance Rover and it was the third among the three Mars Missions that were launched in the span of 3 days. This rover will be the first mission ever to collect rock samples to be brought back to Earth. It will also search for existence of ancient life. Along with that, it will launch helicopter on the planet in order to use microphones to collect sound samples from the planet.

This rover costs about US$ 2.7 Billion, weighs 1025 Kg. It was projected that this rover would land on the Mar's Jezero Crater by 18th February, 2021. After landing, this rover is in now on its One Mars year mission (Nearly 2 years on Earth) where it is exploring a landscape where an ancient river flowed into a lake that might have hosted Martian Life. From the Jezero Crater, it has been doing as much geology as possible. It has been taking pictures and sending the analysis of the rocks nearby. So far, the analysis has led the scientists to believe that the rocks there are very similar to the volcanic rocks on earth, and that wind and water has led to their erosion.

In the virtual meeting of Lunar and Planetary Science Conference on the 16th of March, 2021, Keneth Farley, Perseverance's Mission Scientist described the Perseverance's progress. "Everything is going great so far", said Keneth. As planned, the primary missions of the rover had to wait for a few months. During which time, the scientists conduct checks on all the instruments attacked to the rover and prepare for the first helicopter flight into the Red Planet. In the near future, the rover is set to deploy geological tools like drills, chemical sensors and cameras what will help determine the signs of Past Life in Mars.

Along with the above preflight checks system analysis, the scientists are also trying to determine the safest and most efficient path of travel for this rover. The target destination for this rover's mission is the 40-meter-high cliffs of the ancient river delta. This delta, was formed by an ancient river which used to flow billions of years ago. This would have had been the best landscape for ancient Martian Life, had there been any. However, a very high dune, which the rover is incapable of crossing,

lies in the path between the rover's landing point and the delta. Thus, the rover now has to go around the dune. The scientists now have to choose between taking it either counter-clockwise, which will shorten the time taken or clockwise which will take the rover through a greater variety of soils and rocks.

Ingenuity is the helicopter that has been attached to the Perseverance rover. Its primary mission is to capture sound waves from Mars. Along with that, it will also be the rover's eyes in the sky i.e., it will help the rover in navigation across the landscape. Upon reaching a plain area, not to far from the rover's current location, the helicopter would be deployed from the rover's belly. Then, after reaching an acceptable distance, the helicopter would be deployed for the first flight test. Once the test is complete, Ingenuity would be able to fly around the planet so as to capture the different sounds in the planet. It would also be able to follow wind patterns in order to determine the wind flow and wind currents in the planet.

Immediately surrounding the rover are lighter-coloured rocks coming out of dark soil. Perseverance has used a laser-based instrument to determine that several of these rocks, are chemically similar to basaltic rocks on earth. The instrument shoots rocks with a laser to vaporize small portions and study their chemical make-up. Through this analysis, the scientists have seen that Yeehgo shows signs of having water locked up in its minerals, said Roger Wiens, a geochemist at Los Alamos National Laboratory in New Mexico who is head of the laser-instrument team. These discoveries fit with what scientists had expected from Jezero — that it might have volcanic rocks on the crater floor, which could have interacted with water over time.

After the flight checks, and before Perseverance moves for the delta, the rover will probably drill its first rock sample into the dark, fractured rock that makes up much of the Jezero Crater floor. Molten rock traps radioactive elements that decay at a predictable rate and can be used as a clock to date when the material was originally molten. During its mission, Perseverance will collect approximately 30 tubes full of Martian rock and soil, laying them down on the Martian surface for a future mission to retrieve and fly back to Earth for scientists to analyse. When this happens, no earlier than 2031, it will be the first time that a sample has ever been returned from Mars.
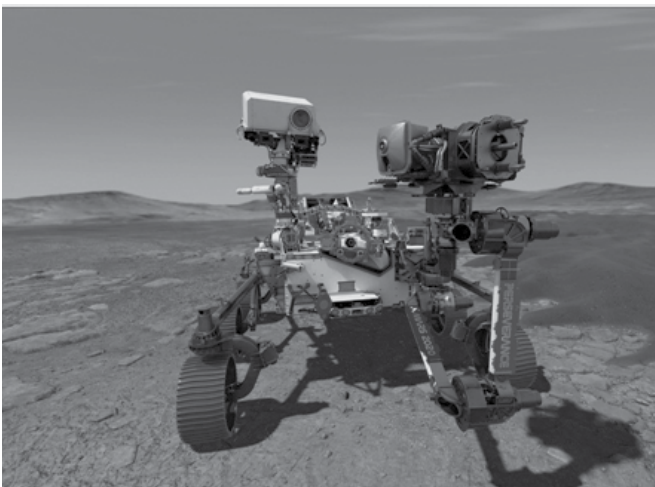
The Perseverance Rover

The Perseverance Rover drilling into Dark Rocks for collection of Martian Samples.

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Crime Segregation and Analysis through Crowdsourcing

Selected Article from ASCI-2021, organized by SWITCH: **https://github.com/debanwita27/Absidy**

Abstract: People migrating to new places lack the knowledge about places to avoid. Also, asking strangers online or offline is not feasible for them. Furthermore, the executive body of the country runs on obsolete and incomplete data. This work involves crowd sourcing data about prevalent crimes in different areas of a town or city and displaying them in descending order of importance for a city. Google Places Application Programming Interface allows fetching and display of nearest hospitals and police stations. With an additional page containing cherry-picked laws for travelers' convenience, we designed a web platform that aims to be a traveler friendly, hassle-free substitute to asking around strangers for information or scrounging through the internet.

Keywords: Crime Segregation, Crime Analysis, Hotspot identification, Crowdsource

I. INTRODUCTION

Safety remains the primary concern of people while migrating to/ laying over at new places. While the National Crime Records Bureau (NCRB) has criminal records available for broader areas viz. the country, states and districts, the data available is mostly outdated [1] and cannot be segregated into usable form at local levels. People largely rely on acquaintances online or offline to collect information about places to avoid. This is a severely hectic, time consuming, biased and unreliable process. Crowdsourcing may solve the issue of the massive area to cover and the delay in distribution of advanced technologies like Geographic Information System (GIS) to remote areas.

The police agencies of major cities of India such as Bangalore, Hyderabad, Goa, Mumbai, Delhi, Kolkata, and Chennai uses customized GIS and most of these GIS implementations are done by private organizations that work in cities few and far between. It's usually the people of towns who migrate to bigger cities and they have no access to those records. In this context, publicly available crowdsourced data may provide a platform for crime segregation and analysis with wide areas of utilization as discussed below:

A. Crime analysis:

Crime Analysis involves providing timely and pertinent information relative to crime patterns and trend correlations to assist the operational and administrative personnel. This may help in planning the deployment of resources for the prevention and suppression of criminal activities, aiding the investigative process, and increasing apprehensions and the clearance of cases. It may supports a number of department functions including patrol deployment, special operations, and tactical units, investigations, planning and research, crime prevention, and administrative services. The presented method in this work can aid crime analysis in two categories:

> **Tactical:** An analytical process that provides information used to assist operations personnel (patrol and investigative officers) in identifying specific and immediate crime trends, patterns, series, sprees and hotspots, providing investigative leads and clearing cases.

> **Strategic:** Concerned with long-range problems and projections of long-term increases or decreases in crime trends. Strategic analysis also includes the preparation of crime statistical summaries, resource acquisition, and allocation studies.

B. Identification and comparison of hotspots:

The approach of display in decreasing order of entries identifies areas that contain dense clusters of events or hotspots. These high concentration areas usually demand special police attention. Crimes that concern tourists and migrants, such as theft, pick-pocketing, scams, muggings, rapes and murders can be identified for the police station in charge of the area to probe further into. Crime hotspots that have been identified over several years can be displayed

at the same time. This may allow for the identification of areas with chronic problems and indicates the direction in which a particular crime may be shifting. Hotspots of different offence types can be displayed to identify where they overlap. For instance, theft hotspots can be displayed along with muggings to discover where they overlap.

C. Crime Control:

Local advice contains information that recorded data does not. Comparing existing information of hotspots to those identified trough crowdsourcing may help identify smaller crime clusters that have gone unrecorded for any reason. This may be helpful in charting the framework for police patrol planning and preventive measures.

II. METHODOLOGY AND RESULTS

For crime segregation and analysis the data may be collected through Crowdsourcing. Crowdsourcing has been preferred over traditional mapping through available data because, publicly available data such as NCRB data are very often incomplete. The data collected from croudesourcing is not dependent on any organization and the data they provide. It is a source of infinite data with local insight that might not be found in official recorded data. For this purpose, a web interface is created where, entry are done through a query that adds the submission into the database using a contribution form. While setting up the test data, we realized that we had to take some precautions to ensure the data is as valid and clean as possible. The first step entailed replacing the state field with a list of options so that there is no invalid state in the input. The fields for city and area have been left for the user to fill so as to include remote areas and not stick to popular cities. The type of crime is in a list since the website revolves around travel safety. We have included options that would be of interest to a traveler. For instance, a traveler/migrator does not need to know the statistics for domestic violence in an area but knowing if an area is infamous for pick pocketing will be of interest to them.

The database section is built using WAMP stack- Windows OS, Apache server, MySql database management system and PHP. The website works primarily on crowd-sourcing. It allows the collection of information and opinions from a group of people. The data is collected mainly in four fields: state, city, area, and type of crime prevalent in that area. After the required fields are filled by the user it is stored in the database by means of SQL queries which will insert the data into the respective fields in relational database tables created. After completion of this task an HTML table is made that is linked with PHP code. PHP is used to connect with the localhost and to fetch the data from the database table present in the localhost server by evaluating the SQL queries. Based on the crowdsourced data, the count of crime events for the considered categories are obtained. The selected fields are displayed in the webpage in decreasing order of its counts. This allows the user to identify the hotspots of a particular crime.

For output, the input state and city is matched with entries in the database and corresponding results are displayed in a table, grouped according to the number of similar entries and displayed in descending order of number of similar entries to give a priority list. The counting of number of similar entries also helps keep track of crime hotspots. Keeping track of entries of major hotspots will allow study of shift in crime patterns/regions/densities. This will aid in police personnel/enforcement concentration restructuring.

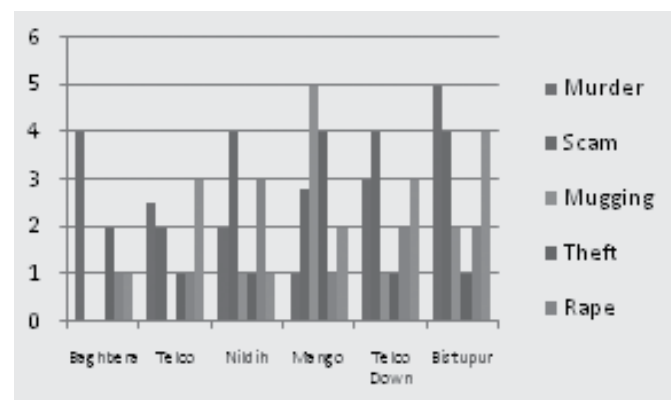The density chart for sample data is shown in fig.1.

Figure.1: density chart for sample data

The presented work also provides an interface to the users for searching for nearest hospitals or police stations in emergency situations. In order to check the nearest hospitals and police stations, tabs were included in the interface. It uses the Google Places API and the Geolocation API [2] to input user's current location and

set markers on the nearest hospitals (in a 5km radius) and police stations (in a 2km radius, keeping in mind that police jurisdiction is limited to small sections). It returns a list of hospitals/police stations with a map and clicking on any option centers that option on the map, for convenience. Initially, the markers are scattered with user position in the centre. For map integration the Maps Javascript API and Google Places API are used. For the map to display on a web page, first a spot is needed to be reserved. This is performed by creating a named div element and obtaining a reference to this element in the browser's document object model (DOM). The space is reserved in the HTML page which makes a callback to initMap() in the JavaScript file. A Nearby Search may allow the users to search for places within a specified area by keyword or type. An example search result is shown in fig. 2.

Figure.2: Linking to the map

III. CONCLUSIONS

This work was initially intended to be a safety and travel guide for tourists and migrators. However, at an initial phase of work, we focused on crowdsourcing data about prevalent crimes in different areas of a town or city and displaying them in descending order of importance for a city. This may help in crime segregation and analysis. The method of crowdsourcing information combines the knowledge of the locals with the resources of the executive system to build new analysis systems that go beyond existing recorded data into the epicenters of small scale crimes that can help identify, and later predict the shifts in criminal activity. Dead hotspots can be laid off the system and dormant hotspots can have fewer personnel with focus on the new major hotspots. Off the grid drug peddling points and empty streets used for evidence disposal can be identified. While it still remains a safety guide in essence, with the maps for nearby hospitals and police station searches and laws for travelers, a crowdsourced data system has its merits in the strength of numbers and the wisdom of the people living in these areas.

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[2] Google developers console documentation on APIs and map elements: https://developers.google.com/maps/documentation/javascript/reference/places-service

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DR. AKHILESH GUPTA

By: **Avantika Mishra**

Dr Akhilesh Gupta, the first Senior Adviser in the Department of Science and Technology (DST), Ministry of Science and Technology, Government of India, is one of the leading experts in tropical cyclone prediction, weather forecasting, location-specific weather forecasts, including those for the mountainous regions and climate change. He is the key contributor of India's new Science, Technology and Innovation Policy 2021, which will be released shortly and is also known for his contributions in the higher education sector. Having led the forecasting team at the National Centre for Medium-Range Weather Forecasting (NCMRWF), Dr Gupta is best known for exceptionally high accuracy in weather forecasts for the Mount Everest region, for which he received appreciation of Hon'ble President of India in the year 2003. An MSc of Lucknow University and Doctorate in Atmospheric Sciences from IIT, Delhi, he worked in the India Meteorological Department and the NCMRWF, both then under the DST and was also the Secretary to University Grants Commission (UGC). He became Adviser / Scientist-G to the Union Minister for Science and Technology and Earth Sciences in 2006. Dr. Gupta heads the Policy Coordination and Program Management Division and has been the head of Climate Change Program at DST, coordinating two National Missions on Climate Change. He has worked as Adviser to the Union Minister for Science and Technology and Earth Sciences and has been a member of National Coordination Team, which drafted India's National Action Plan on Climate Change. A fellow of Indian National Academy of Engineering (INAE), Indian Meteorological Society (FIMS) and an Honorary Professor of Amity University Rajasthan, he received D.Lit (Honoris Causa) from Jagatguru Rambhadracharya handicapped University, Chitrakut. He has been making significant contributions to the S&T evolution of the country through years of administering it under various capacities. Suffice it to say that the commendable work on climate research in India is also a tribute to his commitment and leadership qualities. The DST team is always inspired by the 'never-say-die' attitude of the lead scientist, Dr. Gupta, who had to fight an aggressive 'stage four' oral cancer mid-way. Undaunted by cancer, a series of surgeries and the aggressive treatment, Dr. Gupta returned to work with rare zeal, organizing research in climate change and Himalayan ecosystems. He works on with every DST team and committee member to raise their level of commitment to managing the research programs. The DST provided inputs on important research questions, possible collaborators and scope of networking in relation to each research area. These research initiatives under the National Action Plan on Climate Change cover programs in all the three areas of science, adaptation and mitigation. Dr. Gupta developed knowledge not only on climate change but has also focused the specific talents of scientists to best address national goals.

Some Access Control Mechanism for Data Sharing in Cloud Computing Environment

Recently cloud computing technology has come out as one of the popular commercial systems to deliver computing services to the end users. The service provisioning system is purely on-demand and pay-as-you-use basis. The Internet as a medium is used to dispatch the computing services among the end users. A cloud computing environment creates an illusion of the presence of infinite computing resources to the users. The users use these computing resources with no investment in both the infrastructure and maintenance. Data sharing service is considered as one of the popular cloud services which render benefits to the user.

Provisioning of cloud computing environment is a challenging task for the cloud service providers (CSP) due to several objectives of multiple user agreements. The CSP and users are two actors of the cloud computing environment with pareto optimal satisfaction. The objective of a CSP is to maximize the profit but follows the protocol mentioned in the Service Level Agreement (SLA) while for the users the provisioned computing services performance must meet the criteria specified in the SLA but with a minimum cost. The security breach during storage, computation and communication the trust level of a user is reduced towards selecting a CSP. Moreover, classical cryptography is not appropriate in cloud computing environment as cloud servers and users lie in two different security domains. In addition, traditional symmetric key cryptography model relies on public key infrastructure (PKI) which is not suitable for cloud environment. Moreover, any traditional security system relies on computational expensive operations to prove its security which makes classical security model inappropriate for the resource constraint devices. Over the time, data sharing in cloud server evolved with new challenges due to the advancement in computing technology.

We investigate the technical details of the problem, systematically study the literature and find the gaps in existing data sharing services and develop data sharing models for the remote servers. At the outset, towards development of a data sharing model for practical purpose, we proposed a secure as well as efficient data sharing model suitable for the shared hosting environments. Apart from performance and security, we also emphasize on development of a practical and real-life data sharing system accessible through resource constraint hand-held devices. We introduce a revocable multi authority data sharing model to distribute the load among several attribute authorities. This model overcomes single point failure and provides better reliability to the user. In this model a proxy re-encryption technique is used to develop an attribute revocation process which outsourced computationally intensive task of the process to the cloud server.

Further we present a decentralized data sharing system model RACC with light weight decryption process suitable for resource constraint devices. Even part of the computationally intensive decryption steps is delegated to be executed in the sophisticated cloud infrastructure, yet the security is not compromised for the process. Moreover, an attribute revocation process is introduced for the system. We consider various performance metrics to measure the performance of RACC. The system is found to be quite effective and can be integrated in resource constraint devices.

We have also presented a centralized multi authority CPABE data sharing system CEF-MACS with light weight decryption process. We obtain various performance parameters such mean of encryption time, mean of decryption time, and mean of attribute revocation time to establish the CEF-MACS.

As a refinement we propose a novel framework LIKC for fully outsourced data sharing in which both encryption and decryption schemes are outsourced using un-trusted cloud environment without compromising confidentiality. As a result, the service delivery time to the user is achieved within constant asymptotic time bound. All the proposed models have been compared with contemporary models and our model shows encouraging results in comparison with the investigated models.

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Heat Waves Rise in India as Climate Change Intensifies

Dry land in Ladakh in India. A new study says that heat waves linked to global warming are increasing in frequency in India.
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A new study reveals that, in the last three decades severe heat waves have been responsible for thousands of deaths across India and these heat waves are now increasing in frequency due to climate change. Heat waves are defined as temperatures above the normal average and lasting for two days or more. There were 660 heat waves during the time period 1978 to 2014 and it had caused the deaths of 12,273 people, says a new study published in Current Science.

According to the UN's IPCC (Intergovernmental Panel on Climate Change), since the beginning of the Industrial Revolution the earth has already warmed by one degree Celsius and if it is not checked and continues to follow the current trajectory, then the temperature rise may reach 1.5 degrees Celsius by 2040. Prof Omvir Singh, Professor of geography at the Kurukshetra University in India explain this to be due to India's unique geographical and climatic setup. Heat waves accompanied by humidity pose a major threat to human life in India. Another significant concern is that the Indian government does not recognize heat waves as potential threat to human lives, and the National Disaster Management Act and the National Policy on Disaster Management do not include heat wave fatalities in their list of natural calamities.

Source: https://www.scidev.net/asia-pacific/news/heat-waves-rise-in-india-as-climate-change-intensifies/

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