HAND TALK

Grade12

Semester 1

Group

16313

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I. Present & Justify the Problem and Solution Requirements

Grand challenges:

Egypt has been suffering from serve water scarcity in recent years. Uneven water distribution, misuse of water resources and inefficient irrigation techniques are some of the major factors playing havoc with water security in the country. Being more or less an arid country, Egypt is heavily dependent on rain in other countries to support its rapidly growing population and development. The river Nile is the lifeline of the country as it services the country's industrial and agricultural demand and is the primary source of drinking water for the population. Egypt faces many grand challenges that block its way to progress. These problems can totally be summarized into ten grand challenges. Those grand challenges are:

1. **Urban congestion**
2. **Arid areas**
3. **Recycling**
4. **Alternative Energies**
5. **Pollution**
6. **Population growth**
7. **Water resources**
8. **Immigration and unemployment**
9. **Public health issues**
10. **Increasing the industrial base**

1- Working to eradicate public health issues and diseases:

In light of the current conditions of the Coronavirus, emerging (Covid-19), the prevalence of several underlying health conditions associated with severe COVID-19 outcomes, according to Centers for Disease Control and Prevention study released last week. Between 2017 and 2019, whether part of the overall population or among racial and ethnic minority groups, reported higher rates of asthma, chronic obstructive pulmonary disease, stroke, kidney disease, cancer, and heart disease. Based on these findings, in COVID-19 data collections could improve knowledge about disparities in these communities. The Egyptian health care

system faces multiple challenges in improving and ensuring the health and wellbeing of the Egyptian people. The system faces not only the burden of combating illnesses associated with poverty and lack of education, but it must also respond to emerging diseases and illnesses associated with modern, urban lifestyle. Emerging access to global communications and commerce is raising the expectations of the population for more and better care and for advanced health care technology. A high birth rate combined with a longer life expectancy is increasing the population pressure on the Egyptian health system. By the year 2020 it is estimated that the population of Egypt will have grown to about 92 million people.

Egypt-based startups Chefaa, Vezeeta and D-Kimia are among the leading health tech startups revolutionizing the industry on various levels. Rapid advancements in digitisation are changing every aspect of our lives, with technology innovations such as blockchain, Internet of things and artificial intelligence being applied in almost all sectors to improve efficiency—and healthcare is no exception.

The global digital healthcare market was valued at around $147 billion in 2019. A Global Digital Health Outlook 2020 report published by Frost & Sullivan noted that the sector will be valued at around $234.5 billion in 2023.

Established in 2017, Chefaa, an Egypt-based healthtech startup manages chronic patient’s monthly prescriptions and all pharmacy needs with the use of AI and GPS technology. Its cutting-edge technologies are managed by a domain expert team.the quality of public healthcare is heavily dependent on the complex, geography-specific, system-driven processes, and the motivation and urge of the public health caregivers, the expectations from tech are high. As technology has successfully transformed various walks of human life, it is anticipated that it is a change-maker in the field of healthcare as well.

According to a report by Healthcare IT News, 63% of the research subjects suggest that Artificial Intelligence and Machine learning (AI/ML) are already providing excellent value in specialty care departments like radiology, generic pharmacy, and pathology. Along with private healthcare, AI is now rapidly replacing conventional public health care systems to make improved healthcare accessible to all.

Along with improved diagnostics and screening, how AI can significantly bring about a change is by helping risk prediction. The same AI-driven pattern for screening is used to identify potential risks and susceptibility to diseases and illnesses. Many patients across the globe do not have access to multiple screenings. The public healthcare systems, on the other hand, do not have bandwidth and resources for repeated screenings. This is where AI can help since it eliminates the need for actual experts for screenings with futuristic tools that also have a proven accuracy rate better than humans. Identifying risks for large groups of people, especially during epidemics, can further help to successfully intervene in the situation and break the chain of disease contraction.

2- Communication:

Fifty-two children who had deaf parents and were thought to have normal hearing were evaluated for speech, hearing, and language problems. Standardized tests, audio logical evaluations, and informal conversation and play techniques were used. Of the 52 children of deaf parents, less than half were considered to be developing speech and language normally and 12% had previously undiagnosed hearing loss. The prevalence of speech and language problems and hearing losses is higher in this population than in the population at large. The children appeared to be using two systems to communicate, one with hearing people and one with the deaf. Of the children having some speech and language difficulty, approximately half had problems that were not associated with other known physiological or environmental factors that might affect speech and language. Although there were no children of intelligible mothers who had speech and language problems, there were children developing normally who had parents whose speech intelligibility was poor.

Contrary to indications in the literature, speech and language problems did not disappear after the children entered school. A large number of school-age children, as well as preschoolers, appeared to be having speech and language problems. The amount of time spent with hearing adults during the preschool years or the presence of older normal-hearing and -speaking siblings did not seem related to speech and language difficulty. However, when an elder sibling

had speech and language difficulty, the younger siblings tended to have similar problems.

The relationship between sign and oral language development is ambiguous, but there is no indication that the use of sign language deters oral language development. In view of the high incidence of communication problems in this population, annual audio logical evaluations and counseling of deaf parents concerning aspects of hearing loss and normal language development are recommended.

The problems encountered in providing therapy are discussed. Successful communication requires the efforts of all people involved in a conversation. Even when the person with hearing loss utilizes hearing aids and active listening strategies, it is crucial that others involved in the communication process consistently use good communication strategies

3- Technology:

In today's society, everyone has gotten used to computers, and cell phones being our go-to for everything. Yes, technology is great -- unbelievable, in fact. It can take us to an unknown location, or give you the answer to a question you've been dying to know. But, in the midst of all of the great things it does, it has ruined our society and it's only getting worse.

Have you ever been to a restaurant and looked around as you sat down and realized that not one person in the restaurant isn't on their phone? Not just friends and couples, but entire families too! Even four-year-olds are glued to an iPad at dinner while the parents and older siblings are all on their own iPads or iPhones. When was the last time you could look around and see a conversation?. People actually talking, with their voices and facial expressions. It sounds crazy, but next time you're out, looks around and see for yourself. Our society has attached itself to technology and it's not healthy.

Social Media is an entirely different issue, especially with the upcoming generations. Without Facebook, Snapchat, Twitter, Instagram, and more, where would tweens and teenagers find themselves today? They physically cannot function without staying updated with the newest social media craze. News flash: people don't actually care about your lives that much. What happened to the times of just having Facebook and people would post-life goals, college acceptances, and pictures of their vacations? Now, social media is flooded with what people do all day every day and it needs to stop.

There should NOT be an app for people to buy followers and likes on social platforms such as Instagram. Why does that even matter? People should not be judged by how many likes they get on pictures. They should be judged by who they are as an actual person. Are those likes' ever real friends? No. It's pathetic that some people feel the need to actually buy likes. No one should care if you get 15 likes, 50, or even 500. You should be judged by who you are as a person, not who you are on social media, and if people don't understand, they aren't worth your time. Let them live in their fake virtual world while you explore and grow as a person in the real world. Trust me, it's a much better place to spend your time.

Now, no, I'm not saying throw your phones and laptops away and live like a caveman in your back yard. All I'm saying is that maybe we, as a society, need to learn to live less behind screens and more in the real world. Sure, post a picture here and there, or tell your friends and family about the next big thing in your life, but stop the addiction before it gets worse. You never know when it's going to be your last day, so enjoy life and the people around you, stop being glued to technology all of the time and maybe you'll just enjoy life a little bit more.

4- Energy:

Every day our energy needs increasing more and more. We all know that energy is one of the major challenges faces Egypt. Energy is used in many different fields in our life (electricity, mechanical, industry and chemical), so we have to find alternative energy sources. We have two sources of energies:

1. Non-Renewable.

2. Renewable energy (Shown in fig.1)

Fig.1

Non-Renewable Resources:

Are energy resources that will eventually run out – once used they cannot be used again. Examples are fossil fuels (coal, oil, natural gas) and nuclear fuels (uranium, plutonium). Fossil fuels are mainly made up of Carbon. It is believed that fossil fuels were formed over 300 million years ago when the earth was much different in its landscape. It had swampy forests and very shallow seas. This time is referred to as 'Carboniferous Period' Advantages of fossil fuels

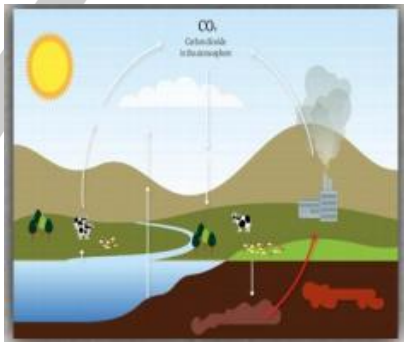

Fig.2

Unlike many renewable sources of energy, fossil fuels are relatively less expensive to produce. This is probably why it is in higher demand as it tends to cost less. Fig(2) disadvantages of fossil fuels Fossil fuels are made up mainly of carbon. When they are burned, they produce a lot of carbon compounds (carbon dioxide and other greenhouse gases)that hurt the environment in many ways Air , water and land pollution are all consequences of using fossil fuel There is also uranium which is not a fossil fuel It is energy that is generated from natural processes that are continuously Replenished. The bad effects of the nonrenewable energies guide the world to search for alternative energies which depend on the renewable resources (sunlight, geothermal heat, wind, tides, water, and various forms of biomass).

Renewable Resources energy: This energy cannot be exhausted and is constantly renewed.

Advantages of renewable energy:

They are non-traditional, have low environmental impact and most renewable energy sources produce little to no global warming emissions, Jobs and other economic benefits. Alternative energy encompasses all those things that do not consume fossil fuel. They are widely available and environment friendly. They cause little or almost no pollution. They cause little or almost no pollution. There have been several alternative energy projects running in various countries to reduce our dependence on traditional.

There are many impressive options that you can take into consideration.

• There are a lot of examples that alternative energy includes as:

• Wind energy.

• Solar power.

• Hydropower energy.

• Biomass.

1- **solar power :** Most renewable energy comes either directly or indirectly from the sun. Sunlight, or solar energy, can be used directly for heating and lighting homes, for generating electricity, hot water heating, solar cooling, and a variety of commercial and industrial uses. (in fig.3)

Fig.3

2- **wind energy :** The wind is a clean, free, and readily available renewable energy source. Each day, around the world it also is the processes of converting wind to other energy by using turbines which are devices convert the wind's kinetic energy into electrical energy. A single wind turbine Can produce enough electricity to power 357 home. it is source of power generation plays an increasingly

Fig.4

important role in the way which we power our world. (in fig.4)

Problem to be solved:-

Deaf people suffering can't deal with us and we can't understand them. This makes an effect on them in a lot of sides:

1- Effect on health side:

Language barriers are a significant healthcare problem—and this is not just a problem for second-language speakers. Deaf people who communicate using sign language, most commonly American Sign Language (ASL), frequently do not have access to clear and efficient communication in the healthcare system, which deprives them of critical health information and qualified health care. Studies show that deaf patients, compared to hearing patients, make less frequent visits to their primary care provider and make more trips to the emergency room, which is likely due to the lack of communication access. The lack of health information and communication access in ASL often results in deaf people, including those who are educated, scoring lower in measurements of health literacy and health knowledge. Due to inequity and autism, deaf people are at a higher risk for adverse health outcomes compared to hearing (non-deaf) Americans, such as cardiovascular health, testicular cancer, and pregnancy and birth.

2- Effect on education:

Some countries don't have a standard sign language — there is no universal version — so deaf children in those places lack a structured communication system from the outset. Many countries don't have an equivalent law to the Americans With Disabilities Act (ADA), which mandates that specific support services are provided to deaf or hard of hearing children in the U.S. And technology may also be a threat to the spread of sign language. Cochlear implants, surgically implanted neuron prosthetic devices that allow deaf or hard of hearing people to hear sound, were fitted on 40 percent of U.S. deaf children as of 2014, according to the National Institute of Deafness. That's a 25 percent increase from 2009. But research suggests that interpreting sign language activates the brain and supports development. Some even recommend teaching sign language to all children, hearing or not, before age two because babies exposed to sign language typically

acquire signs at an earlier age than they acquire spoken words, according to a 2007 paper in the Journal of Applied Behavior Analysis

-Positive results if we deal with this problem are:

1- Take advantage of the creativity and thinking of deaf people, such as what happened with Secup.
2- Benefit from work outcomes (manpower)
3- Facilitating communication between deaf and hearing people - to meet their needs -
Many things will benefit us if we do this project psychologically and practically.

-Negative results if we not deal with this problem:

1- Not benefiting from the ability and creativity of the deaf
2- Loss of manpower to the country by 33%
3- The inability of the deaf to communicate with the hearing aid
This will negatively affect the country's economy and the health and psychological state of the deaf.

Research:-

Related topics to our problem:

- Communication in Egypt.
- The category of people that needs technological projects with artificial intelligence.
- Technology.
- Statistics of deaf people.
- Projects for deaf people.
- Hospital States in the Corona Virus (Covid-19) Period.
- Dealing hospitals with deaf people.

Related topics to our solution:

- Artificial Intelligence (AI).
- Machine Learning.
- Deep Learning (Neural Network).
- Tensor Flow Platform.
- Keras Library (Python language) .
- Types of functions in AI.
- Types of Applications.
- Courses in (Python – Tensor flow – Deep Learning).

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Other Solutions Already Tried:-

Current solution to solve this problem:

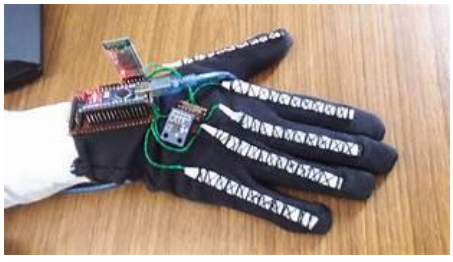


Fig.5

The proposed system consists of two units. (1) A subsystem that can be clipped on the collar of the shirt (as a lavaliere microphone). This consists of input – condenser microphone and output – speaker sections and a camera to capture and record human face for future reference with their voice modulation (2) the main system is a portable device where the user sends and receives messages as text (as In fig.5). Also, the device acts as a mobile phone and the communication is performed as text chatting.

The communications between these two units are via Bluetooth. When a normal person tries to interact with a disabled person using this device, the device starts vibrating informing that someone is around you for interaction. It takes inputs from the lavaliere microphone. Then the device does speech to text (STT) conversion and displays it on the device screen, based on what the normal person conveys. The user can give a reply as a text message and the device does text to speech (TTS) conversion. The output is obtained from a small and powerful speaker. An advanced prediction texting concept will be provided so that the delay in communication can be reduced. Finally, the contacts of every person can be stored/recorded as voice modulation and face photographs based on image processing techniques deployed with the device camera.

Other Solutions already tried:

1- Next word predictor:

Next Word Prediction or what is also called Language Modeling is the task of predicting what word comes next. It is one of the fundamental tasks of NLP and has many applications. You might be using it daily when you write texts or emails without realizing it.

2- Handwritten Digits Recognition

Handwritten digit recognition is the ability of computers to recognize human handwritten digits. It is a hard task for the machine because handwritten digits are not perfect and can be made with many different flavors. Handwritten digit recognition is the solution to this problem which uses the image of a digit and recognizes the digit present in the image. (as in fig.6). We have successfully built a Python deep learning project on handwritten digit recognition app. We have built and trained the Convolutional neural network which is very effective for image classification purposes. Later on, we build the GUI where we draw a digit on the canvas then we classify the digit and show the results.

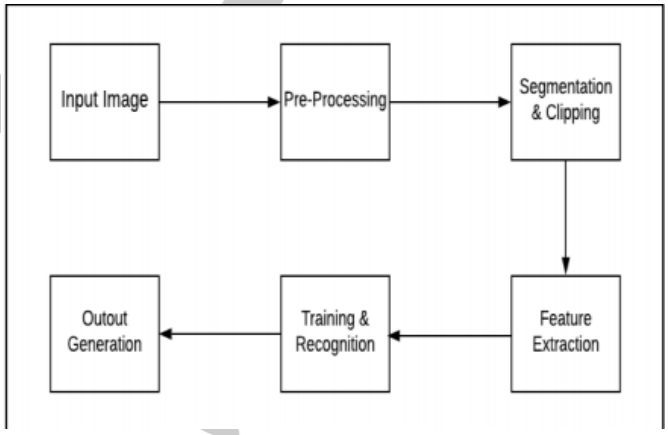


Fig.6

Digit Recognition is a noteworthy and important issue. As the manually written digits are not of a similar size, thickness, position, and direction, in this manner, various difficulties must be considered to determine the issue of handwritten digit recognition. The uniqueness and assortment in the composition styles of various individuals additionally influence the example and presence of the digits. It is the strategy for perceiving and arranging transcribed digits. It has a wide range of applications, for example, programmed bank checks, postal locations and tax documents, and so on. The aim of this project is to implement a classification algorithm to recognize handwritten digits. The after-effects of probably the most broadly utilized Machine Learning Algorithms like SVM, KNN, and RFC and with Deep Learning calculation like multilayer CNN utilizing Keras with Theano and Tensorflow. Utilizing these, the accuracy of 98.70% utilizing CNN (Keras + Theano) when contrasted with 97.91% utilizing SVM, 96.67% utilizing KNN, 96.89% utilizing RFC was obtained.

3- Lane Line Detection

A lane detection system used behind the lane departure warning system uses the principle of Hough transform and Canny edge detector to detect lane lines from real-time camera images fed from the front-end camera of the automobile. A basic flowchart of how a lane detection algorithm works to help lane departure warning is shown in the figures. (as in fig.7)

Fig.7

Lane-keeping and lane departure systems use forward-facing cameras to monitor the lane lines around your vehicle and will provide visual, audible, and/or tactile warnings—such as through steering wheel or seat vibrations—to alert the driver when the car approaches or crosses lane markings. These systems do not activate when you use your turn signal. If your vehicle has lane-keeping assist (LKA), automatic steering or braking will try to correct the vehicle if it starts to exit the lane.

There are several common variations of lane systems:

- Lane Departure Warning (LDW): Drivers get audible and/or visual warnings that their vehicle is approaching or crossing lane markings when the turn signal is not activated.
- Lane Keeping Assist (LKA): Provides automatic steering and/or braking to keep a vehicle in its travel lane.
- Road Departure Assist: Provides automatic steering and/or braking to try to keep the vehicle from departing the roadway.
- Lane Centering Assist (LCA): Provides automatic steering and/or braking to continually center the vehicle in its lane.

In a recent survey, we asked CR members to rate their experiences with the advanced safety and driver-assist systems on their model-year 2015-2019 cars. Respondents answered questions about their satisfaction with the systems and told us which ones helped them avoid a crash. The survey covered about 72,000 vehicles. See the highlights below.

4- Spoiler Blocker Extension:

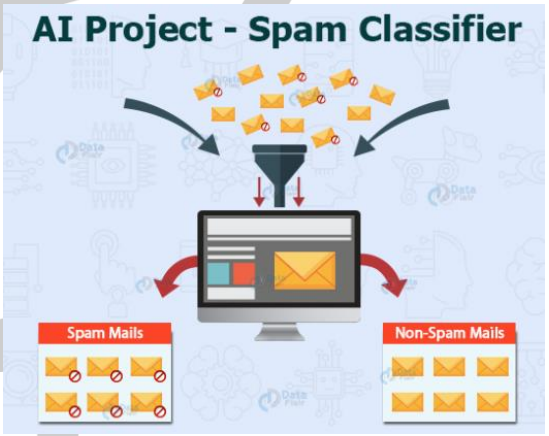


Fig.8

A spam filter is a program that is used to detect unsolicited and unwanted email and prevent those messages from getting to a user's inbox. Like other types of filtering programs, a spam filter looks for certain criteria on which it bases judgments. For example, the simplest and earliest versions (such as the one available with Microsoft's Hotmail) can be set to watch for particular words in the subject line of messages and to exclude these from the user's inbox. This method is not especially effective, too often omitting perfectly legitimate messages (these are called false positives) and letting actual spam through. More sophisticated programs, such as Bayesian filters or other heuristic filters, attempt to identify spam through suspicious word patterns or word frequency.(as in fig.8)

Detecting Email Spam: Modern spam filtering software continuously struggles to categorize the emails correctly. (As in fig.9) Unwanted spam & promotional communication is the toughest of them all. Spam communication algorithms must be iterated continuously since there is an ongoing battle between spam filtering software and anonymous spam & promotional mail senders. The naive Bayes Algorithm in data analytics forms the base for text filtering in Gmail, Yahoo Mail, Hotmail & all other platforms. Like Naive Bayes, other classifier algorithms like Support Vector Machine or Neural Network also get the job done!

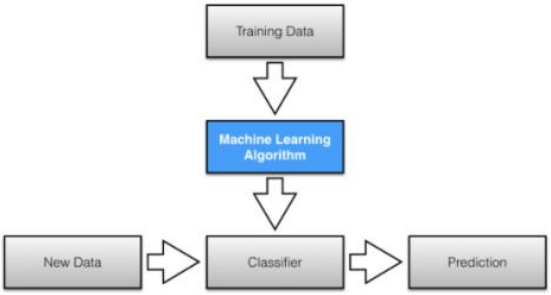


Fig.9

5- Artificial intelligence and machine learning can help improve data-sharing practices for better public health outcomes so AI was used in solving problems of public health:

Incidence and mortality rates of endometrial cancer are increasing, leading to increased interest in endometrial cancer risk prediction and stratification to help in screening and prevention. Previous risk models have had moderate success with the area under the curve (AUC) ranging from 0.68 to 0.77. Here we demonstrate a population-based machine learning model for endometrial cancer screening that achieves a testing AUC of 0.96. by training seven machine learning algorithms based solely on personal health data, without any genomic, imaging, biomarkers, or invasive procedures. The data come from the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial (PLCO). Then further compare our machine learning model with 15 gynecologic oncologists and primary care physicians in the stratification of endometrial cancer risk for 100 women. It had found a random forest model that achieves a testing AUC of 0.96 and a neural network model that achieves a testing AUC of 0.91. We test both models in risk stratification against 15 practicing physicians.

Our random forest model is 2.5 times better at identifying above-average risk women with a 2-fold reduction in the false positive rate. Our neural network model is 2 times better at identifying above-average risk women with a 3-fold reduction in the false positive rate. so machine learning models provide a non-invasive and cost-effective way to identify high-risk sub-populations who may benefit from early screening of endometrial cancer, prior to disease onset. Through statistical biopsy of personal health data, we have identified a new and effective approach for early cancer detection and prevention for individual patients.

II. Generating and Defending a Solution:-

Design Requirements:

In the sake of achieving our goal, the prototype had specific design requirements which were:

1) Image Classification:

The total number of images that were included in our dataset were divided into train and test. A ratio of split was performed with the train folder having more images and the test folder. This could help to check the ability of the project in classify the images which it has unrecognizable for it before, thus confirm that it learns from inputs and outputs.

2) Loss test:

As the dataset was very large, they are grouped into batches. The epochs should be multiples according to the batch size. Thus, leads to reach the least loss percentage in the predicted text. The requirement was maintained using loss function, so this method specifically shows how well the algorithm will model the data.

3) Accuracy test:

The target in this requirement is making the project's accuracy percentage higher than the expert human being in sign language. In addition, the project's aim is to replace the human expert for more facility and higher accuracy. This was done by multiple epochs to reach the closest accuracy.

4) UI design test:

UI design stands for user interface design which show the performance of the application and its effects on the phone which can be tested after downloading the App on the phone and calculating how it consume energy and space and in order to reach least data cellular usage.

Selection of solution:

Communication is vital in the everyday lives of people because it helps them express their feelings, ideas, and emotions towards others. The process of giving and receiving information helps people understand each other. Our eyes fell on one of the most serious problems, and it is the communication between us and the deaf. This leads to many other problems for the deaf people, such as lack of understanding, unemployment, depression, and public health issues. They also face barriers to health care before they even reach the consultation room as they could not communicate easily with hospital staff. for example, it is difficult in many parts of Egypt deaf patients to access Psychological Therapies program or counselling services via primary care. However, lip-reading is not reliable, writing notes is inadequate, and Sign Language interpreters are scarce, in order to there is not a fixed sign language. After the previous ideas we searched for, in addition to establishing the design requirements for the project, we were able to find the most appropriate solution for this problem.

As technology became in all aspects of our life, and mobile applications became widespread, the solution was to create an application based on artificial intelligence to serve both deaf and people who do not understand sign language to work as a bridge of communication between each other. The application serves like a translator of the American Sign Language (ASL) (as in fig.10). ASL is expressed by movements of the hands and face. It is the primary language of many North Americans who are deaf and hard of hearing, and is used by many hearing people as well.

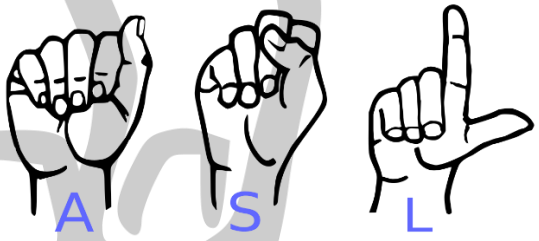


Fig.10

We wanted to replace the sign language interpreters with this application, which is more facilitated to serve deaf, the application is based on the artificial intelligence. As AI is the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions, thus it could serve the desired goal. The solution will face the obstacles face the deaf by providing the app with certain features that must be provided to the deaf person, as follows:

1) **Detecting various shapes and sizes of fingers:**

As we will deal with different ages of deaf people, we will take photos of one person's hand of each age while expressing the same text, and then compare between the resulted texts of each one to check if the project was able to detect them accurately.

2) **Correct choice of sign movement among the movements that have been taken during the hand movement:**

Data entry into the program will be via multiple images in a specific duration, so there will be taken pictures that do not express the correct character. Our project will classify this data and choose the correct expressions to prevent any errors in the predicted text and expressing the hand movement.

3) **Expanding the dictionary of sign language of deaf people:**

The project aims to facilitate the communication between us and deaf people by allowing them to express any statement in English language. Each letter of the 26 alphabets will have a specific expression, so that they will express any speech as any natural human being.

Selection of prototype:

For achieving the main goal of our prototype, which is translating expressions included in images, we will deal with deep learning specifically as images needed a high recognition level, and this is accurately done by convolutional neural network (CNN).

We chose to make the model with python language. This choice was for many reasons: Python offers concise and readable code. While complex algorithms and versatile workflows stand behind machine learning and AI, Python's simplicity allows developers to write reliable systems. Additionally, Python code is understandable by humans, and it's easy to learn which makes it easier to build models for machine learning.

The dataset is images of ASL (American sign language). It will be split into train and test, so the model can learn and memorize the information for future prediction. Ai model will be VGG16 and it will be suitable for our goal because it is a very Deep Convolutional Network for Large-Scale Image Recognition. Also, The VGG16 is competing for the classification task winner (GoogLeNet with 6.7% error). The model also achieves 92.7% top-5 test accuracy in ImageNet, which is a dataset of over 14 million images belonging to 1000 classes, in addition, Vgg16 was trained for weeks.

The accuracy of the model will be recorded in the code after many epochs for training. The training will be done for the model until reaching the highest possible accuracy and the least error, so we can meet our design requirements.

Also, the learinng rate should be short according to the concept of Gradient descent. It is used to minimize some function by iteratively moving in the direction of steepest descent to optimize the parameters of our model.

After training the model, the images in the test folder will be tested to check the ability of the project to classify the unrecognizable images for it. The predicted text will appear in the code and it will tell us how the training of the model could help us achieve the design requirement of "image classification", consequently, the demonstration of the project that is Ai based.

Finally, the user interface will be created for testing our project on a deaf. To complete our goal of providing facilitated usage of the application, we will test the user interface to make sure that it will not affect the performance of the phone.

III. Constructing and Testing a Prototype

Materials and Methods:

			
laptop	**Smart phone**	**python**	**Dataset**

```
In [1]: import os
        import cv2
        import numpy as np
        from time import time
        from tensorflow.keras import utils
        from tensorflow.keras.optimizers import Adam
        from tensorflow.keras.models import Sequential
        from tensorflow.keras.layers import Dense, Flatten
        from tensorflow.keras.applications import VGG16
        from sklearn.model_selection import train_test_split
        import matplotlib.pyplot as plt
        %matplotlib inline
```

Fig.11

Methods:-

First: - the TF model

The model depends on many blocks:

The first block (1): the keras library from the tensor flow platform was used and Numpy library as it has functions for working in matrices and keras contain two models and it was import from the functional model the main function for classification and detection which is vgg16 then import train-test split and the flatten layer was chosen as the dense layer as it convert 3d image to neuron then import matplotlib to plot the graphs. (as shown in fig.11)

The second block (2): it includes the output classes of the test and the place of the dataset and in the testing the result is ŷ then by comparing the y and ŷ it determines the accuracy. (as shown in fig.12)

Fig.12

```
In [2]:
train_dir = 'E:\\sign\\asl_alphabet_train'
test_dir = 'E:\\sign\\asl_alphabet_test'
classes = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K',
           'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U', 'V',
           'W', 'X', 'Y', 'Z', 'nothing', 'space', 'del']
plt.figure(figsize=(11, 11))
for i in range (0,29):
    plt.subplot(7,7,i+1)
    plt.xticks([])
    plt.yticks([])
    path = train_dir + "/{0}/{0}1.jpg".format(classes[i])
    img = plt.imread(path)
    plt.imshow(img)
    plt.xlabel(classes[i])
```

The third block (3): loading data from image, label, size, and index then the splitting between training image and testing image. (As shown in fig.13)

Fig.13

```
In [3]:
def load_data(train_dir):
    images = []
    labels = []
    size = 32,32
    index = -1
    for folder in os.listdir(train_dir):
        index +=1
        for image in os.listdir(train_dir + "/" + folder):
            temp_img = cv2.imread(train_dir + '/' + folder + '/' + image)
            temp_img = cv2.resize(temp_img, size)
            images.append(temp_img)
            labels.append(index)

    images = np.array(images)
    images = images.astype('float32')/255.0
    labels = utils.to_categorical(labels)
    x_train, x_test, y_train, y_test = train_test_split(images, labels, test_size = 0.1)

    print('Loaded', len(x_train),'images for training,','Train data shape =', x_train.shape)
    print('Loaded', len(x_test),'images for testing','Test data shape =', x_test.shape)

    return x_train, x_test, y_train, y_test

start = time()
x_train, x_test, y_train, y_test = load_data(train_dir)
print('Loading:', time() - start)
```

```
Loaded 78300 images for training, Train data shape = (78300, 32, 32, 3)
Loaded 8700 images for testing Test data shape = (8700, 32, 32, 3)
Loading: 57.585143089294434
```

The fourth block (4): determining the batch number which was 128 and the epoch which is =5 and setting the graph data and calculation of the loss by the loss function loss (ŷ , y) = - (y log(ŷ)) + (1-y) log (1-ŷ). (As shown in fig.14)

Fig.14

```
In [4]:
classes = 29
batch = 128
epochs = 5
learning_rate = 0.0001

def results(model):
  adam = Adam(lr=learning_rate)

  model.compile(optimizer=adam, loss='categorical_crossentropy', metrics=['accuracy'])

  start = time()
  history = model.fit(x_train, y_train, batch_size=batch, epochs=epochs, validation_split=0.1, shuffle = True, verbose=1)
  train_time = time() - start

  model.summary()

  plt.figure(figsize=(12, 12))
  plt.subplot(3, 2, 1)
  plt.plot(history.history['accuracy'], label = 'train_accuracy')
  plt.plot(history.history['val_accuracy'], label = 'val_accuracy')
  plt.xlabel('epoch')
  plt.ylabel('accuracy')
  plt.legend()
  plt.subplot(3, 2, 2)
  plt.plot(history.history['loss'], label = 'train_loss')
  plt.plot(history.history['val_loss'], label = 'val_loss')
  plt.xlabel('epoch')
  plt.ylabel('accuracy')
  plt.legend()
  plt.show()
```

The fifth block (5): setting the model then output the testing accuracy, time, and loss. (As shown in fig.15)

Fig.15

```
model = Sequential()

model.add(VGG16(weights='imagenet', include_top=False, input_shape=(32,32,3)))

model.add(Flatten())

model.add(Dense(512, activation='sigmoid'))

model.add(Dense(29, activation='softmax'))

results(model)
```

```
Epoch 1/5
551/551 [==============================] - 2444s 4s/step - loss: 0.4645 - accuracy: 0.8698 - val_loss: 0.0742 - val_accurac
y: 0.9770
Epoch 2/5
551/551 [==============================] - 2412s 4s/step - loss: 0.0533 - accuracy: 0.9837 - val_loss: 0.0641 - val_accurac
y: 0.9791
Epoch 3/5
551/551 [==============================] - 2570s 5s/step - loss: 0.0327 - accuracy: 0.9906 - val_loss: 0.0229 - val_accurac
y: 0.9936
Epoch 4/5
551/551 [==============================] - 2464s 4s/step - loss: 0.0254 - accuracy: 0.9929 - val_loss: 0.0223 - val_accurac
y: 0.9923
Epoch 5/5
551/551 [==============================] - 2466s 4s/step - loss: 0.0157 - accuracy: 0.9956 - val_loss: 0.0106 - val_accurac
y: 0.9973
Model: "sequential"
```

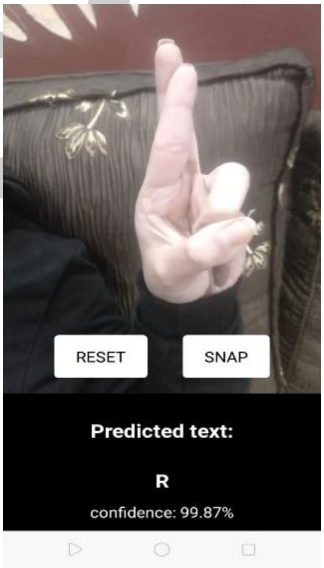
The sixth block (6): the project will be saved at E disk. (As shown in fig.16)

```
In [6]: model.save("E:\\sign_lang.h5")
```

Fig.16

Second: -the TF model was covert to Tflite by the official Tflite converter then the Tflite model was put in the react native as it has camera view that take photo and get it in the model. (As shown in fig.17)

Fig.17



Test plan:

To make sure that the project success some design requirements were tested in the prototype

The first trial: was done by dataset that has the same background and quality, so the project was train to have only one background that effect on the output result.

The second trial: was done by expanding the dataset by training the project to has different background and quality.

1) **Image Classification:** it was tested by checking the ability of the project in classify the images which it has unrecognizable for it before
2) **Loss:** it will be test by how well the algorithm will model the data by using loss function it will figure out the least loss percentage in the predicted text.
3) **Accuracy:** the accuracy of output will be compared to the accuracy of (other AI project)

4) **UI design test:** it can be tested after downloading the App on the phone and calculating how it consume energy and space and to reach least data cellular usage.

Data Collection:-

For the sake for providing an affordable project, we conducted many tests for the design requirements. Then, a negative trail was a result of the first data set having a background which affected the training test, as well as the resulted text. After expanding the data set, the results of the positive trail were recorded:

Fig.18

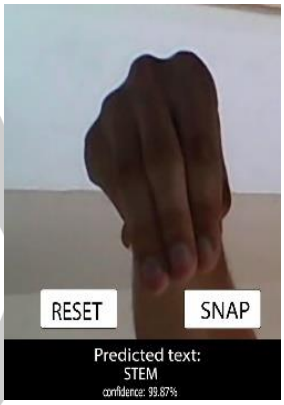


Image Classification Test:

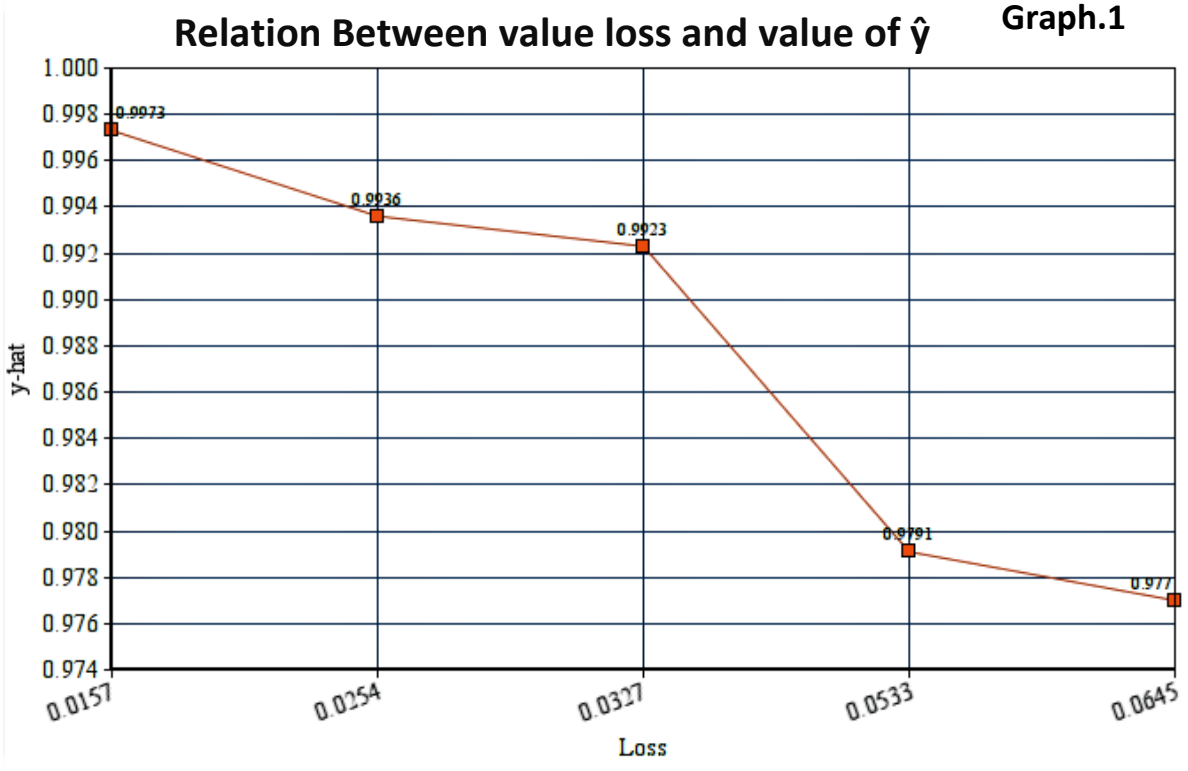
A total of 87000 images were included in our dataset were divided into train and test. The ratio of split was performed as the train folder had 78300 images and the test folder had 8700 images. The photo of the hand of the deaf showed the predicted text with after 5 epochs as shown in fig (18), with a confidence of 99.87%.
This confirmed that the project could classify the images which they were unrecognizable for it before, thus it demonstrates AI basics and the learning from inputs and outputs.

Minimum Loss test:

Five epochs were done to train the VGG16 model on the 78300 images. Thus, leaded to reach the least value of loss and the highest value of $\hat{y}$ in the predicted text as shown in the table (1). And graph (1).

	$\hat{y}$	Value Loss
Epoch 1	0.9770	0.0645
Epoch 2	0.9791	0.0533
Epoch 3	0.9923	0.0327
Epoch 4	0.9936	0.0254
Epoch 5	0.9973	0.0157

Table.1



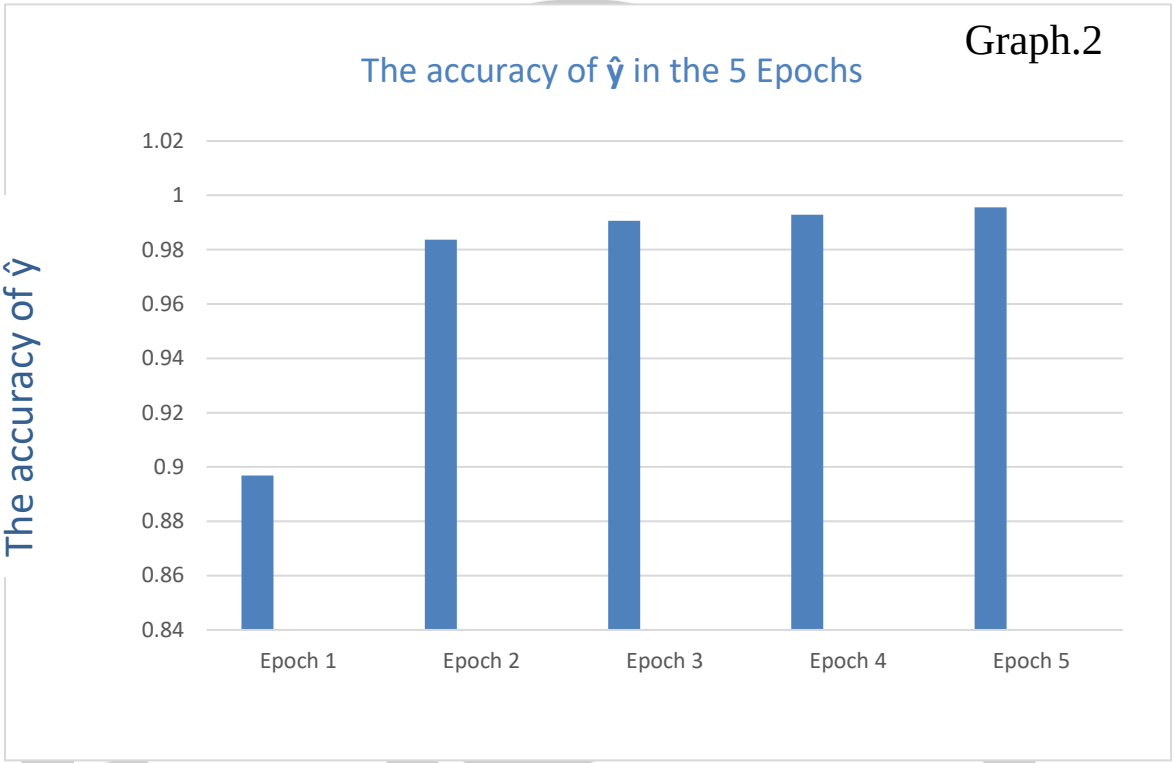
Accuracy test:

In the five mentioned epochs, the accuracy percentage was recorded until we reached the highest accuracy percentage by 99.56% as shown in table (2), and graph (2). Thus, it was higher than the expert human's accuracy percentage which is 88.8%. Accordingly, the application can replace the human expert for more facility and accuracy.

	Accuracy
Epoch 1	0.8698
Epoch 2	0.9837
Epoch 3	0.9906
Epoch 4	0.9929
Epoch 5	0.9956

Table.2

Graph.2



UI design Test

The UI design proved its prosperity, as it does not consume a very large space which is 121 MB, as shown in fig (19), and its energy consumption was less than 0.1% .In addition, the application does not need an internet connection, thus, no data cellular usage, as shown in fig (20). It means that Blue Lines has a high performance.

Fig.19

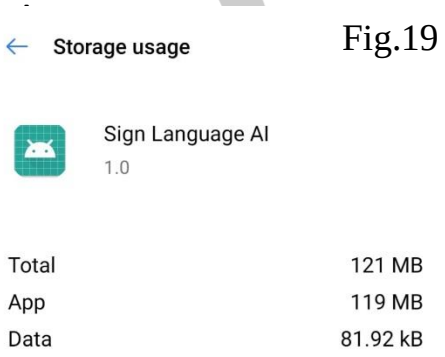
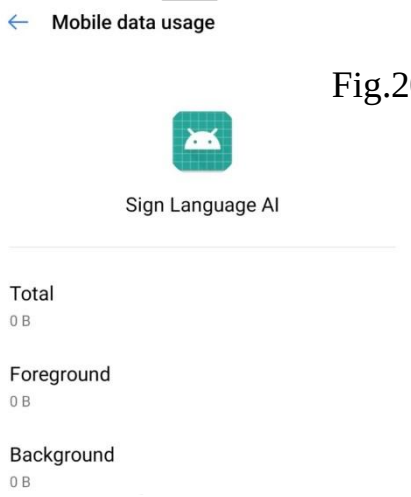


Fig.20



IV. Evaluation, Reflection, Recommendations

Analysis and Discussion:

The project aims to break down communication barriers between deaf people and people who are unable to communicate in sign language because this issue significantly affects many fields such as public health. The main goal is to make deaf people communicate easily at any place, specially at hospitals. This is done by translating the sign language into text so people can understand well.

After applying the project in a clinic, the trail could not succeed. This was a result of the unification of the background and image quality of the data set. This unification affected the training of the project, similarly, the predicted text. It meant that the project could not translate the sign language which explains the symptoms, thus, leaded to a wrong Diagnose by the doctor.

As a result, the dataset was expanded, images with different background were added, and another training for the project took a place. Consequently, a positive trail successfully was done: The symptoms were expressed with no fear of misunderstanding, similarly, the doctor could give the right diagnose.

As the main goal is translating expressions included in images, we dealt with deep learning specifically as images needed a high recognition level, and this is accurately done by convolutional neural network (CNN)

In **CS 3.2.6,** it was benefited from how neural networks work to mimic human brain. Neural networks are a class of machine learning algorithms used to model complex patterns in datasets using multiple hidden layers and non-linear activation functions. A neural network takes an input passes it through multiple layers of hidden neurons, and outputs a prediction representing the combined input of all the neurons. After each cycle of training, an error metric is calculated based on the difference between prediction and target.

The Python library “tesnsorflow.keras” was imported to provide optimized pre-trained model to be deployed in sign language application, as shown in fig (21).

The imported data set was 87000 images, each one expresses a character in English sign language “ASL” as shown in fig (22)

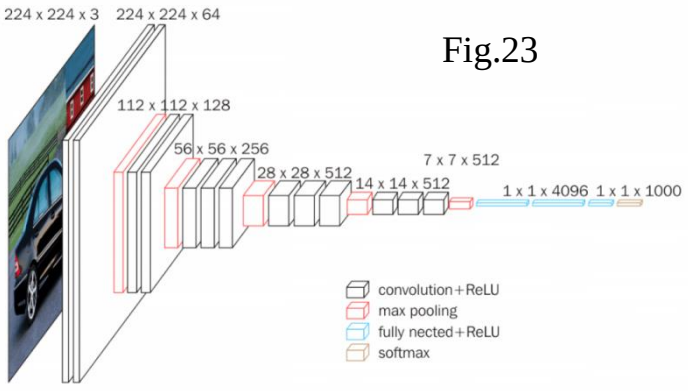
Fig.21

```
import os
import cv2
import numpy as np
import tensorflow as tf
from time import time
from tensorflow.keras import utils
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.applications import VGG16
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
%matplotlib inline
model = tf.keras.models.load_model("E:\\sign_lang.h5")
```

Fig.22

A 9:1 split ratio of data set in two folders- train and test- was done with 78300 images for training and 8700 images for testing. By this, the model can learn and memorize the information for future prediction. Because Ai models deal with small numbers, the images were resized and a scale of RGB was changed from 0:255 to 0:1.

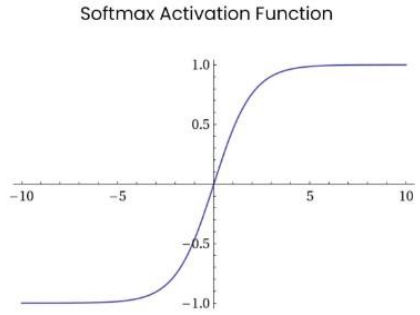
Fig.23



The Ai model was VGG16, as shown in fig (23), it was used because it’s a very Deep Convolutional Network for Large-Scale Image Recognition. The VGG16 result is competing for the classification task winner (GoogLeNet with 6.7% error). The model also achieves 92.7% top-5 test accuracy in ImageNet, which is a dataset of over 14 million images belonging to 1000 classes, in addition, it was trained for weeks, so it was a best fit for reaching our purpose.

After inputting the images to VGG16, the neurons were activated with SoftMax activation function. The Softmax activation function compresses values to positive values between 0.0 and 1.0., as shown in graph (3). Typically placed in output layers of the network, the Softmax neurons allow the prediction of the text to certain classes as a mimicking for human brain.

Graph.3



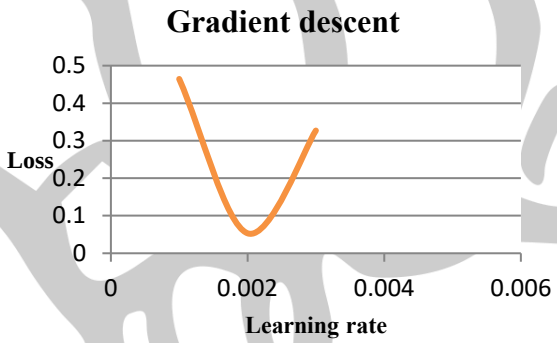
In Statistics 2.2.5, as we studied about probabilities, we related this concept with the function of SoftMax. It calculates the probabilities of distribution of the event over 'n' different events. In general way of saying, this function will calculate the probabilities of each target class over all possible target classes and the calculated probabilities will be helpful for determining the target class for the given inputs.

Then, the loss function which is called "Categorical Cross-Entropy" used to calculate the rate of change of the error between **y**(text) and **ŷ** (predicted text) as shown in the equation:

Loss (ŷ, y) = - (y log(ŷ)) + (1-y) log (1-ŷ)

In this point, **MATH 3.1.2** was helpful in knowing how the local minima of the loss occur. As it was studied, the local minima can be calculated when the derivative of a function is zero. Thus, when the loss function is used, the derivative is equal to zero only when the text (y) and the predicted text (ŷ) are the same, which means the global minima is reached!

Accordingly, the learning rate was short- only 0.0001- this was for minimizing the gradient decent steps that was took by "Adam" optimizer. Adam is an adaptive learning rate optimization algorithm that's been designed specifically for training deep neural networks. It was imported as shown in fig (11). Gradient descent is used to minimize some function by iteratively moving in the direction of steepest descent to optimize the parameters of our model, after training, the loss of y could reach the minimum value. It was only 0.0157 as shown in graph (4), thus, achieving the loss test.



Graph.4

The epochs for training VGG16 were five epochs, and the accuracy of the model was recorded, as shown in graph (2). Thus, it reached the highest accuracy of 99.56%, which is even higher than the accuracy of expert human interpreter which is 88.8%.

After training the model, the images in the test folder were tested to check the ability of the project to classify the unrecognizable images for it. The letters of word "STEM" was tested, and it showed the accurate predicted text as shown in fig (24)

Fig.24

```
test2_dir = 'E:\\sign\\asl_alphabet_test2\\'
classes = ['A', 'B', 'C', 'D', 'del' , 'E', 'F', 'G', 'H', 'I', 'J', 'K',
           'L', 'M', 'N' , '' , 'O', 'P', 'Q', 'R', 'S','space', 'T', 'U', 'V',
           'W', 'X', 'Y', 'Z']
images = []
labels = []
s= ''
size = 32,32
for image in os.listdir(test2_dir):
    temp_img = cv2.imread(test2_dir + image)
    temp_img = cv2.resize(temp_img, size)
    images.append(temp_img)
images = np.array(images)
images = images.astype('float32')/255.0
preds = model.predict(images)
for pred in preds:
    labels.append(classes[np.argmax(pred)])
#print(temp_img.shape)
#plt.imshow(temp_img)
#plt.show
for label in labels:
    s+=label
print(s)
```

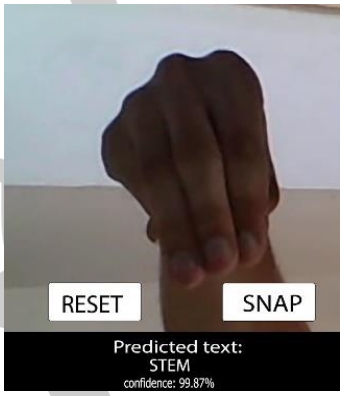
```
STEM
```

It means that the training succeeded to make the model learns from the images of train folder, consequently, the project demonstrates that is Ai based.

The user interface was created by converting the AI model into tflite model using official tflite converter. The tflite model was put into a react native app which has a camera view. This camera inputs the taken images of hands into the tflite model. Accordingly, the predictions of the characters appear in the prediction text component.

In order to complete our goal of providing facilitated usage of the application, we tested the user interface to make sure that it has no effects on the performance of the phone. As a test result, the application had less than 0.1% energy consumption, only 121 MB of space and no data cellular usage.

Fig.25



In the end, the application was also tested to recognize sign language of a deaf's hand. The word "STEM" was successfully predicted with a confidence level of 99.87%, as shown in fig (25).

All the previous illustrations represent the crucial importance of our project and its operative role in enhancing Egypt's communication and health for deaf people. Based on these achievements, it was concluded that:

1- The model is working effectively with training on a data set of images that had a different background to prevent the negative effectiveness on the hand's expression. Thus, it will reach 99.87% of confidence level of the predicted text.

2- The accuracy of the application in translating sign language which is 99.56% is higher than the expert human interpreter which has an accuracy of 88.85. consequently, the project can effectively replace him.

3- The application has no effect on the mobile phone as it does not need an internet connection, thus, no data cellular usage and it does not consume a very large space which is 121 MGB and its energy consumption was less than 0.1%

4- Sign language ai application will lead to increasing the opportunities for deaf community to interact more socially, thus, increasing the job opportunities.

Recommendations:

The project solved the main problem, Nevertheless the future researchers of the project may work on several aspects:

1- The project can be developed to convert text to sign language by making inverse system and allow the any one to communicate with sign language as text to ASL Generator Tool. It is the primary sign language used by the deaf and people with hearing impairment. This WeCapable Tool easily converts English text into sign language symbols.

2-The sign language can change to speech like Google sign language AI which turns hand gestures into speech or allow change voice into sign language by using voice recognition.

3-Using tensor flow lite instead of tensor flow as the applications developed on TensorFlow Lite will have better performance and less binary file size than TensorFlow mobile, lightweight version which is specially designed for the mobile platform and embedded devices, much faster and smaller in size.

4- In addition to ASL sign language, "sign language ai" application can translate more than language. So, the data set will have all distinguished sign languages, as well, the UI design will have a button to press for the required language.

Learning Outcomes:

1- Math G12 L.O 2

Gradient descent is an optimization algorithm used to minimize some function by iteratively moving in the direction of steepest descent as defined by the negative of the gradient, using gradient descent to update the parameters of our model.

2- CHEM G12 sem1

Constructing the experimental design

A- The title of the experiment is (The effects of the English language in deaf opportunities).

B- The independent, dependent and constant variables

- The independent variable is that the sign movement that the deaf will do it (input).
- The dependent variables are the text which will translate (output)

-the data set (pictures of alphabet) will be constant.

C- The qualitative and quantitative data

- The qualitative data is the type of devices such as mobile phones and small devises like (tablet).

-The quantitative data is the number of images that the project will predict it in 1 sec.

D- The experiment will be tested by taking the feedback from 100 deaf.

E- The conclusion will be taken by comparing the results from deaf people differ in the age.

3- Biology G12 Lo1

The neuron has three different structures: bipolar, multipolar and unipolar. Each transmits different information according to the type of information. At the same way the type of AI subset used in the project depend on the type of information in input as we use in our project (image processing) as the type of information that inter (input)in the project is sign language image to classify it into words as output.

4- Biology G11 sem 2

As AI is the science of getting machines to mimic the behavior of human for the events in brain development occur in the first two years of life for embryo one of the main event is learning language so the second year most dramatic changes involve the brain's language areas, which are developing more synapses and becoming more interconnected. These changes correspond to the sudden spike in children's language abilities where the neuron changes so the according to babies experience from millions of data gathering events in the same way that AI gets a lot of data and label the data such as images that AI learning from and improve itself continuously.

5- Geology G12 L.o1,2

There are three types of movement at plate boundaries 1-Convergent plate boundary 2-Divergent plate boundary 3-Transform boundary so the lithospheric plate motion change according to the type of movement and can be detect using GPS as Steel spikes pounded into the ground make up the targets then Receivers use the targets in order to monitor the movement of lithospheric plates as GPS navigation systems use stored map information and compared it to new information then predict the type of motion as well as AI use the stored information in the dataset to predict the output .

6- Technology G11 Sem2

Keras is a powerful and easy-to-use free open-source Python library for developing and evaluating deep learning models. It wraps the efficient numerical computation libraries like TensorFlow and allows you to define and train neural network models in just a few lines of code.

7- Technology G12 Sem2 L.O6

Neural networks are a class of machine learning algorithms used to model complex patterns in datasets using multiple hidden layers and non-linear activation functions. A neural network takes an input, passes it through multiple layers of hidden neurons, and outputs a prediction representing the combined input of all the neurons. Neural networks are trained iteratively using optimization techniques like gradient descent. After each cycle of training, an error metric is calculated based on the difference between prediction and target.

8- Statistics G12 Sem1 L.O1

Loss function: A loss function is our models predict function that tells us “how good” the model is at making predictions for a given set of parameters. The loss function has its own curve and derivatives. The slope of this curve tells us how to change our parameters to make the model more accurate! Can using the model to make predictions. We use the cost function to update our parameters. Popular loss functions include MSE (L2) and Cross-entropy Loss. Cross-entropy loss measures the performance of a classification model whose output is a probability value between 0 and 1. Cross-entropy loss increases as the predicted probability diverge from the actual label. So predicting a probability of 0.013 when the actual observation label is 1 would be bad and result in a high loss value. A perfect model would have a log loss of 0.

9- Math G11 Sem2 L.O5

From Statistics, our benefit from (probabilities) is the importance of Softmax function; it calculates the probabilities distribution of the event over 'n' different events. In general way of saying, this function will calculate the probabilities of each target class over all possible target classes and the calculated probabilities will be helpful for determining the target class for the given inputs.

10- Statistics G12 L.O 1

The difference between a statistic and a parameter is that statistics describe a sample. A parameter describes an entire population. Our project makes the deaf and speechless students are the target for applying it. To achieve the concept of the scientific steps (scientific methodology) and collecting the data to be sure that our solution is effective on the real ground. Statistics answered us when we want to know the sample of distribution that we will take from Testing in hospitals. To get the average of the results X par = summation x \ n X par: is the mean of the sample (average) X: the summation of the results test N: number of samples taken, after we get the mean, we will present this data in the distribution graph, and if the center limit theorem is achieved so we also achieve our goal.

APA Format:

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