The highest accuracy we got is nearly 0.95 for the Inceptionnet-V3 model with SGD optimizer and the ROC CURVE is as follows:

AUTOMATIC EARLY FIRE DETECTION USING DEEP LEARNING AND SENDING ALARM ALERT AND SMS

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INTRODUCTION

In recent years, technological advancements have revolutionized the way we approach fire safety in our homes and workplaces. Wireless fire detection systems have become increasingly popular due to their ability to detect fires quickly and efficiently without the need for complex wiring or infrastructure. The Raspberry Pi Pico is a powerful microcontroller board that is compatible with Python programming language, making it an ideal platform for developing a wireless fire detection system. Its compact size and low power consumption make it ideal for use in small spaces, making it an ideal choice for both residential and commercial applications. Deep learning algorithms allow the system to analyses data from sensors in real-time, making it possible to detect fires quickly and accurately. The system can also learn from past data, allowing it to improve its accuracy over time. The GSM call and SMS alert feature is a critical component of the system, ensuring that authorities are alerted to fires quickly, allowing them to respond promptly and minimize damage. In summary, the wireless fire detection system using deep learning and Python with Raspberry Pi Pico is an innovative and intelligent solution for fire safety. Its ability to detect fires quickly and accurately, and its GSM call and SMS alert features make it an essential tool for protecting homes and businesses from the devastating effects of fires.

The motivation for the above project is to make our machine which is capable of early fire detection , cost effective , scalable and safe and also to integrate other technologies in this to make it more innovative.

OBJECTIVES

- The core objective of our project is to build a wireless fire detection system using deep learning and python with Raspberry Pi Pico as an intelligent solution for fire safety.
- The outcome of our project must have GSM call and SMS alert features along with the ability to detect fire quickly and accurately which can help in protecting homes and businesses from the devastating effects of fire.
- We have to overcome the challenges of the data scarcity, class imbalance, real –time processing , environmental factors , safety issues and the complexity of generalizing the environments.
- The dataset used or created has nearly 3000 images with the train data having 2700 images and the test data with 300 images. The dataset is totally divided into 3 classes that is fire, smoke and neutral as it is also important for us to take the consideration of the distinction between the smoke and the fire and consideration of non-fire scenarios.

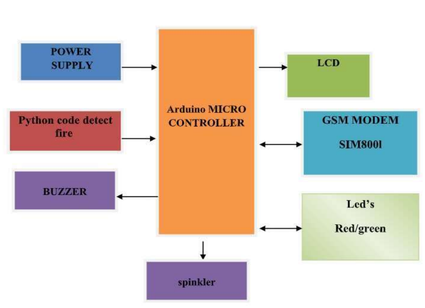
SCOPE OF THE PROJECT

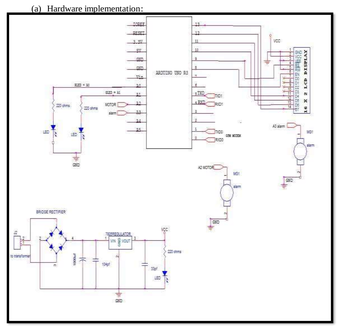
Firstly, when we thought about the places which are , effected by the fire constantly but people cannot recognize them then we thought about the Forest Fires, Power Stations and public places such as the metro stations or the metro rail tracks etc. If we take the case of the Forest Fire, then we are unable to identify that where the fire is starting or when it is starting but due to delay in detection the forest land is mostly effected in summer. At power stations or places where transformers are placed in the public places , early fire or the spark detection is important for less loss rather than it effecting the people or the property. Apart from these scenarios, even at the metro tracks , public places early fire detection is very important. So it is very important for us to have a technology to detect early fire. So our machine probably detects the fire in a very less time and sends notifications to the concerned people and turn on the alarm and fire extinguisher using the live video footage using the deep learning algorithms.

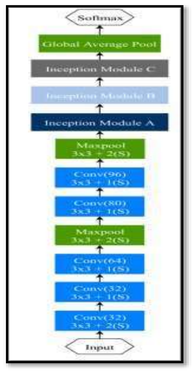
METHODOLOGY

- **Step 1: Connect the Arduino board.**
- **Step 2: Connect the GSM module.**
- **Step 3: Connect the LCD module.**
- **Step 4: Connect the LEDs.**
- **Step 5: Connect the fire alarm.**
- **Step 6: Turn on the Arduino board.**
- **Step 7: Install and configure the required software.**
- **Step 8: Implement the fire detection system.**
  1. **Dataset Collection.**
  2. **Data Augmentation.**
  3. **Data Pre-processing.**
  4. **Feature Extraction.**
  5. **Applying the deep learning algorithms such as the Resnet, InceptionV3, YOLO, MobilenetV2 and also, we use the hyper parameter tuning such as the SGD Adam, Adagrad & the RMSProp etc.**
  6. **Selecting best deep learning model and deploying using OpenCv.**
- **Step 9: Test and troubleshoot.**

ARCHITECTURE





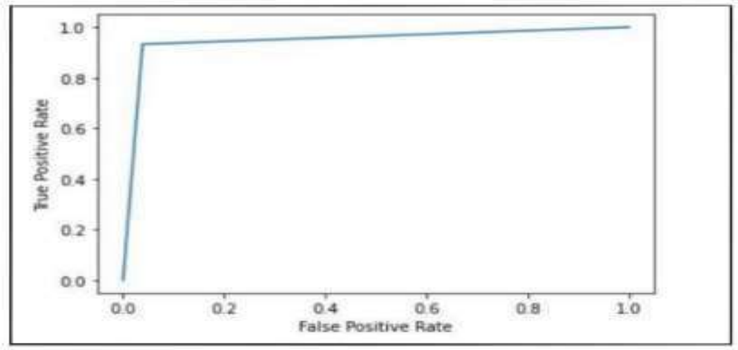


A key component of fire safety is early fire detection. Fires can be disastrous, resulting in the loss of life, destruction of property, and harm to the environment. Early fire detection can help avoid these disastrous effects by enabling timely action to put out the fire and reduce damage. Deep learning models like Inception Net v3 have demonstrated particularly promising outcomes in early fire detection using artificial intelligence (AI). InceptionV3 is a deep convolutional neural network architecture that has been used for image classification and object detection tasks. It consists of multiple layers of convolutional and pooling operations, followed by fully connected layers. InceptionV3 has shown high accuracy in detecting flames and smoke in fire scenarios.

RESULTS AND DISCUSSION

The highest accuracy we got is nearly 0.95 for the Inceptionnet-V3 model with SGD optimizer and the ROC CURVE is as follows:

	precision	recall	f1-score	support
0	0.92	0.96	0.94	518
1	0.97	0.93	0.95	656
micro avg	0.95	0.95	0.95	1174
macro avg	0.94	0.95	0.94	1174
weighted avg	0.95	0.95	0.95	1174
samples avg	0.95	0.95	0.95	1174

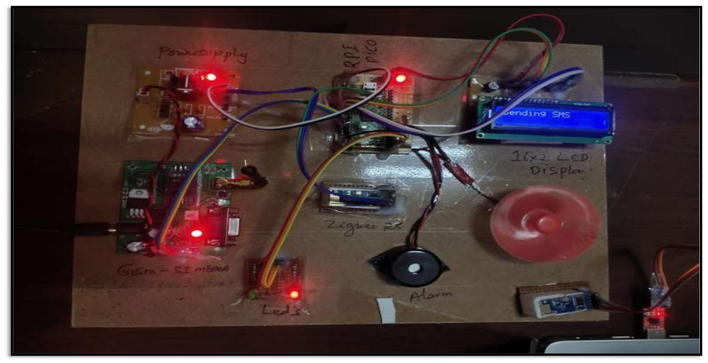


PERFORMANCE METRICS & ROC CURVE OF THE DEPLOYED INCEPTIONNET-V3 MODEL

The reaction time is very fast compared to other algorithms and the reaction time is nearly 1.7 seconds. The use of Inception-netV3 is very less based on our survey and the accuracy and the reaction time is pretty good and also the OpenCV is helping us to capture the frames properly.

CONCLUSION

In summary, deep learning has shown great potential for fire detection due to its ability to automatically learn complex patterns from large amounts of data. Using deep learning models and Open-Cv demonstrated high accuracy in detecting fires in various environments, including indoor and outdoor environments, and through different imaging and video modalities.



REFERENCES

I. https://www.researchgate.net/publication/347869434_Early_Detection_of_Forest_Fire_using_Deep_Learning
II. https://iopscience.iop.org/article/10.1088/1757-899X/732/1/012056
III. https://ieeexplore.ieee.org/document/9451553