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Acoustic Wave Based Forest Fire Extinguisher and Detection using Deep Learning

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Abstract: *Apart from causing tragic loss of lives and valuable natural and individual properties including thousands of hectares of forest and hundreds of houses, forest fires are a great menace to ecologically healthy grown forests and protection of the environment. Every year, thousands of forest fire across the globe cause disasters beyond measure and description. This issue has been the research interest for many years; there are a huge amount of very well studied solutions available out there for testing or even ready for use to resolve this problem. Forest and urban fires have been and still are serious problem for many countries in the world. Currently, there are many different solutions to detect the forest fires. People are using sensors to detect the fire. But this case is not possible for large acres of forest. In this paper, we discuss a new approach for fire detection, in which modern technologies are used. In particular, we propose a platform that Artificial Intelligence. The computer vision methods for recognition and detection of smoke and fire, based on the still images or the video input from the cameras. Deep learning method "convolution neural network "for finding the amount of smoke and fire. The accuracy is based on the algorithm which we are going to use and the datasets and splitting them into train set and test set.*

Keywords: Deep Learning.

I. INTRODUCTION

- Forests are the protectors of earth's ecological balance. Unfortunately, the forest fire is usually only observed when it has already spread over a large area, making its control and stoppage arduous and even impossible at times.
- The result is devastating loss and irreparable damage to the environment and atmosphere (30% of carbon dioxide (CO2) in the atmosphere comes from forest fires), in addition to irreparable damage to the ecology (huge amounts of smoke and carbon dioxide (CO2) in the atmosphere)
- To avoid uncontrollable wide spreading of forest fires it is necessary to detect fires in an early state and to prevent the propagation
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II. METHODOLOGY

The sensor system is used to verify an ambiguous situation detected by a video-based system as well as observing an extinguished fire. Therefore sensors have to be widely immune against disturbances like steam, fog, dust pollution and condensing water which usually cause video-based systems to give false alarms. If fire gases are carried to the detector by the airflow they are analyzed with different semiconductor gas sensors. A gas permeable protective cap made of sintered metal protects the sensor elements against soiling with dust and humidity. Thus the sensor array is not affected by nuisance aerosols like dust, dirt, mist or condensing water [4]. Early forest fire detection sensors (Fig. 6) have to fulfill a lot of specific requirements compared to conventional applications. High sensitivity is needed to detect even low smoke concentration; dilution and extreme turbulence caused by wind are essential factors. Due to high occurrence of hydrogen during an open fire a H2-Sensor. Forests are the protectors of earth's ecological balance. Unfortunately, the forest fire is usually only observed when it has already spread over a large area, making its control and stoppage arduous and even impossible at times. The result is devastating loss and irreparable damage to the environment and atmosphere (30% of carbon dioxide (CO2) in the atmosphere comes from forest fires), in addition to irreparable damage to the ecology (huge

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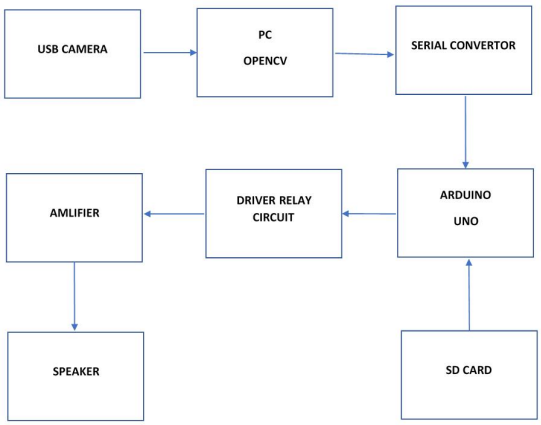
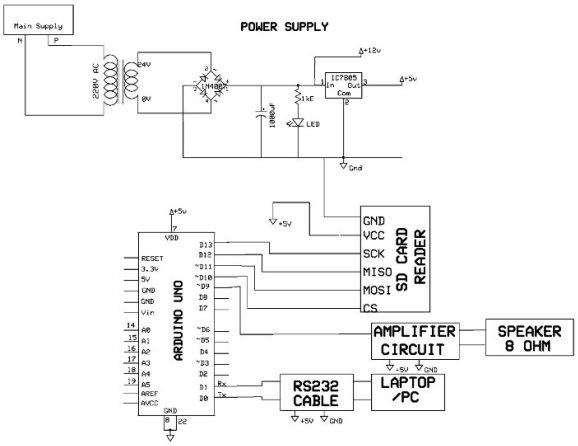
III. BLOCK DIAGRAM



IV. CIRCUIT DIAGRAM



V. ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans. Leading AI textbooks define the field as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. Colloquially, the term "artificial intelligence" is often used to describe machines (or computers) that mimic "cognitive" functions that humans associate with the human mind, such as "learning" and "problem solving".

Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans. Some of the activities computers with artificial intelligence are designed

VI. CONVOLUTION NEURAL NETWORK

A neural network is a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates. In this sense, neural networks refer to systems of neurons, either organic or artificial in nature. Neural networks can adapt to changing input; so the network generates the best possible result without needing to redesign the output criteria.The concept of neural networks, which has its roots in artificial

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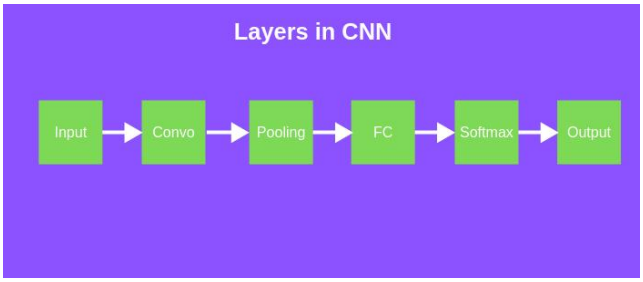
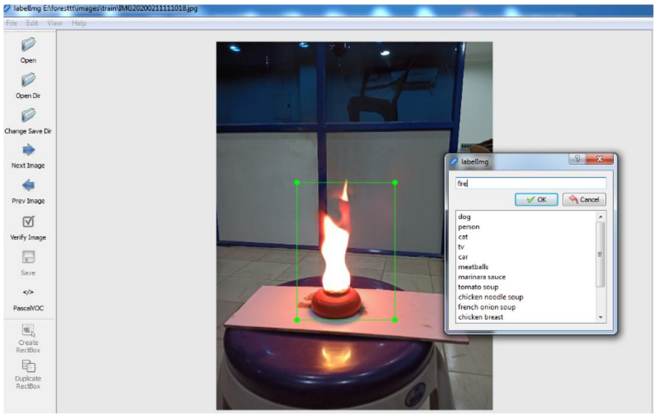
intelligence, is swiftly gaining popularity in the development of trading systems. Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics



VII. LABELING DATA

Now that we have our images we need to move about 80 percent of the images into the object detection/images/train directory and the other 20 percent in the object detection/images/test directory. In order to label our data, we need some kind of image labeling software. LabelImg is a great tool for labeling image. To create the bounding box the "Create RectBox" button can be used. After creating the bounding box and annotating the image you need to click save. This process needs to be repeated for all images in the training and testing directory.



VIII. CONCLUSION

The recent improved processing capabilities of smart devices have shown promising results in surveillance systems for identification of different abnormal events i.e., fire, accidents, and other emergencies. Fire is one of the dangerous events which can result in great losses if it is not controlled on time. This necessitates the importance of developing early fire detection systems. Therefore, in this research article, we propose a cost-effective fire detection CNN architecture for forest architecture. Translations and content mining are permitted for academic research only. Although, this work improved the flame detection accuracy, yet the number of false alarms is still high and further research is required in this direction. In addition, the current flame detection frameworks can be intelligently tuned for detection of fire. This will enable the video surveillance systems on forest to handle more complex situations in real-world.

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IX. FUTURE WORK

Supporting research to improve the understanding of forest fires and their ecology, ecological and social costs and benefits, causes and management options. Building awareness among st policy-makers, the public and the media of the underlying causes of catastrophic forest fires. Mandating and equipping managers to implement integrated fire management programs. Involving local communities and land managers in management planning and implementation,

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assisting them to participate effectively. Developing and enforcing compatible and mutually reinforcing land-use laws that provide a legal basis for the ecologically appropriate use of fire. Discouraging land management practices that predispose forests to harmful fires. Promoting management strategies to mimic natural fire regimes, including techniques such as prescribed burns and managed wildfires.

Avoiding manipulating natural or well-established fire regimes. Establishing reliable fire monitoring systems that provide early warning of high fire risk and fire occurrence, and include evaluation of ecological and human impacts of fire. Preventing further forest loss and degradation from recurrent catastrophic fires, and reduce fire risk in forested landscapes, through ecologically appropriate restoration.

X. RESULT AND DISCUSSIONS

Most of the systems analyzed in Section 2 are either too expensive for an average user or are designed at a conceptual level with no actual physical implementation. Designing a vial and practical smart system for forest monitoring proved to be challenging, as the system needed to be energy efficient, weather-proofed, capable of withstanding harsh environmental condition and able to communicate efficiently when placed in remote areas. The constraints were solved or partially solved, by using a low-power, IoT specific device (the Raspberry Pi 3), a certificated enclosure, an IoT and M2M orientated communication protocol (MQTT), specially designed algorithms, Python programs, and Android applications. This prototype can be improved in many ways by adding a solar panel, converter and battery; using a more rigid and higher IP certified enclosure; using more energy efficient electronic devices; implementing more efficient classification algorithms; developing an application for iOS.

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