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Implementing Unmanned Aerial Vehicle for Rescue and Assistance in Flood and Disaster Situations using Machine Learning, Computer Vision and Sensor Fusion

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Abstract: *Disasters and Natural calamities are unstoppable and exceptional events causing loss of life and injuries on serious scale to the masses. The Major challenge faced by the search and rescue teams during such situations is to reach out to the entire zone as fast as they can and rescue the victims as well as make sure the victims receive the help in time. However the rescue teams are unable to reach the all the disaster ridden areas at the same time due to lack of man power as well as absence of exact locations of the victims stuck in such disaster situations. The results in loss of lives of hundreds of people due to incapability of the search and rescue teams to track the exact location of the victims and rescue them in time. Medical emergencies in such situations is another major problem as all the means of transport are usually broken. This project proposes the concept of unmanned aerial vehicles for search and rescue operations in Disaster and Flood related situations using machine learning, Computer vision and sensor fusion. The proposed system consists of an autonomous unmanned aerial vehicle which can carry out aerial surveillance of disaster ridden zones autonomously using GPS guided system. The onboard Camera continuously captures the video feed of the surveillance and feeds it to the pre-trained Neural network model and detects the presence of humans and animals in such situations. If the presence is detected, the Exact location of the same will be communicated to the rescue teams using IOT, which can immediately arrive at the location and rescue the victims. The proposed concept also includes provision food and medicine storage which can be distributed to such zones without any delay. The proposed concept also uses Onboard medical Diagnosis system which provides a provision of remote medical diagnosis of the victims in disaster zones using IOT. Thus proposed project eliminates the need of search in "Search and Rescue Operations" to make sure help reaches on time and quickly in such situations using Machine learning, Sensor Fusion, IOT and Computer Vision.*

Key words:

1. Introduction

Now a days in recent years, robots and automation have been applied at different domains to organize collaborate behaviour in distributed system and providing a powerfull basis for application of complex natur. An important aspect of robot security system is surveillance of specified area. Security managers are increasingly helping to get the job done to robot. The kind of works focus on target perception and identification and robot available to handle disaster related situation. Hence implemented on such robot.

Flood becomes one of the major problems in most of the countries around the world. Flooding is the world's most costly type of natural disaster. Across the developing world floods can strike with deadly regularity, destroying housing, agriculture and communications. Flood causes considerable damage to human lives and property almost every year. It is not possible to from control station for its navigation. This system continuously sends live video stream to the base station or to provide protection against all flood. Flood Forecasting & warning has been recognized as the most important, reliable and cost effective non-structural measures for flood mitigation.

This project deals with concept of unmanned Arial vehicle for rescue and assistance in flood and in disaster situation using machine learning and computer vision. This system will be controlled the control station. The system consists of a camera which will continuously feed the information to the trained machine learning model, which will detect the presence of the people or animals, stuck in flood related situations. If such victims are found, Exact GPS coordinates of the same would be sent to the rescue teams so that they can immediately reach the location and rescue the people.

2. Literature review

Song et al. [1], they have proposed a system that Unmanned Aerial Vehicles rapid delivery routing of the emergency rescue in the complex mountain region. They have used a concept of graph theory and then they developed a dynamically programmed module. And after

that they have implemented optimal routine for UAV can be computed through solving a minimum cost flow problem. Finally they have calculated the effectiveness of the system.

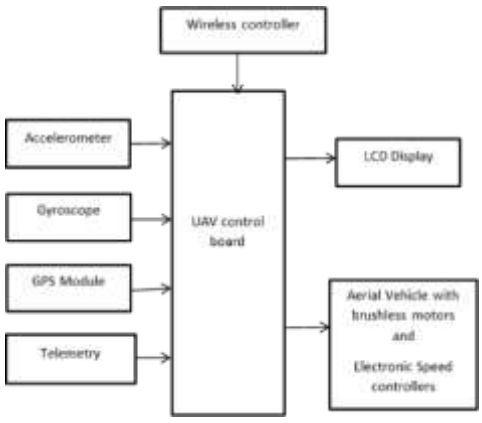
Gorczak et al. [2] they have introduced unmanned aerial system for maritime Search and Rescue via LTE data link. The approach is evaluated with a laboratory setup using software-denned radio modules. Measurements are taken on the application layer, using real-world telemetry data generated by an autopilot system in the presence of high bandwidth background traffic. Evaluations demonstrate that our system falls UAV requirements in terms of latency and reliability

Bayanbay et al. [3] they have proposed and approach to increase the efficiency of emergency medical assistance during emergency situation. This Arial vehicle can save the time frame and give the best results for medicine supply.

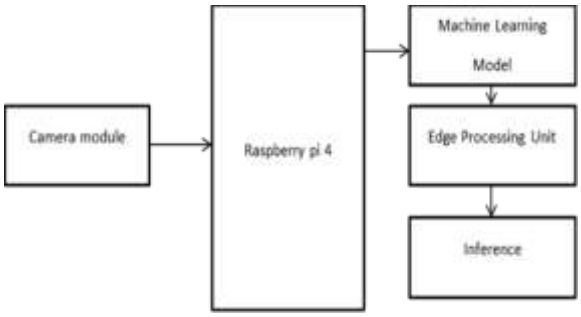
Bejiga et al. [4], they have developed a system that is Convolutional Neural Networks for Near Real-Time Object Detection from UAV Imagery in Avalanche Search and Rescue Operations. They used convolutional neural network to train the model for object detection and to extract the discriminant features. They have used SVM clssifire to get the accurate results of object detection.

3. System architecture

The unmanned aerial vehicle part:



The Victim Detection and Identification system:



4. Methodology

•The UAV Fabrication and Assembly:-In this phase the basic structure of the unmanned aerial vehicle is developed. This involves mechanical fabrication of UAV and its assembly

•The telemetry System:-Telemetry is the data transfer from UAV to the ground station. In this phase the telemetry system is developed. This is responsible for sending all the UAV data to the developed ground station, which will be used for debugging during all the phases of development.

•The Autonomous Navigation System:-In this phase the GPS is interfaced and the autonomous navigation system is developed. This permits the UAV to navigate on predefined coordinates without the aid of manual control.

•The Human and Animal detection system:-In this phase the machine learning model trained to detect and correctly identify humans and animals stuck in such situations is deployed on raspberry pi.

•The Edge Acceleration system: This phase involves interfacing of the hardware acceleration systems for AI inferencing on the edge.

•Dataset collection-The project involves determining the location and detects the object using machine learning.

•Model training configuration-Using the same the model will be trained. This involves deciding the weights and the steps for training the model.

1. Train and Test Data

2. The data is split into train and test

3. Training the machine learning model after the configuration the model to detect the objects that are stuck in disaster area or in flood affected area.

4. Testing the trained model and fine tuning it to increase the prediction accuracy:

The model once trained is tested on sample dataset to determine the detecting accuracy. If the accuracy is low the model is retrained by changing the weights, batch size and epochs.

5. Result

As is common in modern architectures, the convolution layers are followed by batch normalization. The activation function used by MobileNet is ReLU6. This is like the well-known ReLU but it prevents activations from becoming too big:

$y = \min(\max(0, x), 6)$

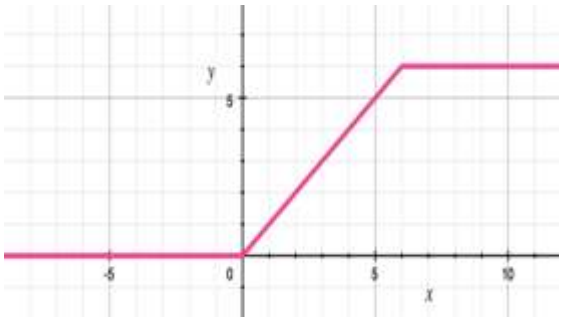
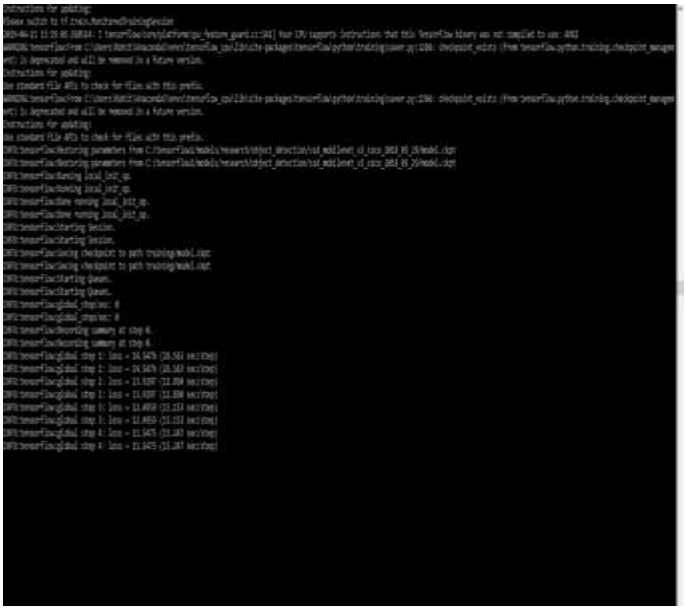


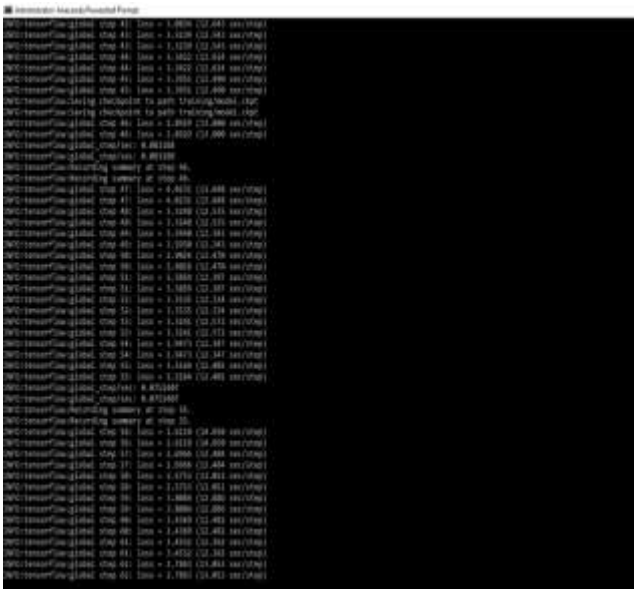
fig: It also makes the shape of the function look more like a sigmoid:

Figure below shows the training loss at different stages.

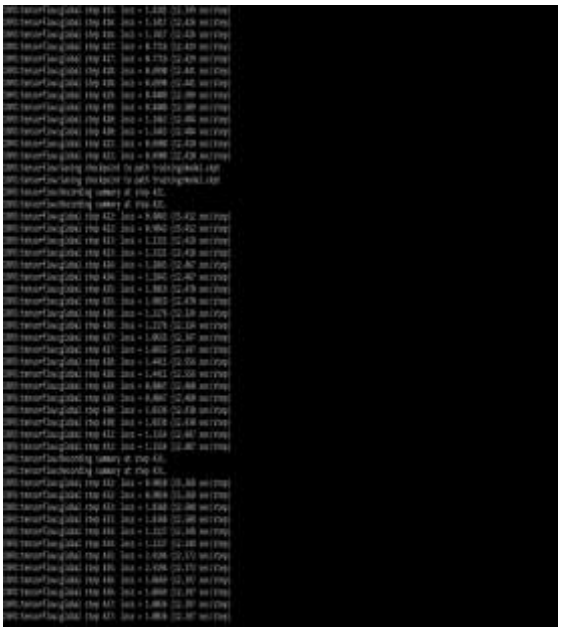
Initial loss: Initial loss with 11 point



Loss at 62 steps: Loss At step 62 with 3 point.



Loss at 437 steps: Loss at step 437 with 1.2222 point



The loss is less than 2 in this so we will be stopping the training. The loss can be further reduced but requires more training data.

6. Conclusion:

The proposed project deals with the implementation of machine learning and computer vision to detect the live objects which are stuck in flood affected area or in disaster situation. The system is implemented with GPS location module which helps to rescue the person or object from exact location. This system is unmanned Arial vehicle which is controlled from a control station for its navigation and for search and rescue purpose. This system should send the live video stream of an search operation to control station. This will eliminate the precious time which is wasted in searching and rescue teams can immediately reach the exact location as the geographical coordinates are already known. The IOT system makes it easy to visualize all the data from a single admin panel.

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