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# Design and Development of smart UAV assistance for Firefighters

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**Abstract -** *There is an increasing need in the world today for supervision to ensure people's safety and security. The use of drones during structure fires, search and rescue operations in fire services shows great benefits. Artificial Intelligence (AI) is the technology to come in action here. AI is a futuristic technology that will be a powerful tool to save lives and help us with disruptive nature. It is a strong concept to save lives and help in disaster relief operations and humanitarian aid activities. This dissertation concentrates on the idea of building an Unmanned Aerial Vehicle (UAV) to help firemen estimate people stuck by fire using AI and image processing. This innovation can help the task force to plan relief efforts and to help the needy to be rescued. To achieve our desired aerial surveillance system, we shall incorporate these technologies.*

***Key Words***: supervision, people's safety, Artificial Intelligence, drones, rescue operations, Unmanned Aerial Vehicle, firemen, etc.

## 1. INTRODUCTION

An aircraft without a human pilot or crew or passengers on board is an unmanned or orbital spaceflight aircraft, commonly referred to as a drone. The UAVs constitute an unmanned aircraft system that also includes a ground control system and a communication system with the UAV. For tactical planning and observation UAV is used. This technology can now be used to support crew members in the emergency response field. UAVs are classified by altitude, durability and mass and are used for a wide variety of purposes, both military and commercial.

Fire Fighter Drones are dispatched as scouts to flaming places by employing thermal imagery cameras - Thermal cameras are advanced gadgets that process and show the acquired image on a screen. These photos are available for instant diagnosis or for additional examination, accuracy and reporting using specialist software which helps to understand where the people are trapped and then they can be rescued. Thermal cameras can be used to identify anomalies of different facilities in low light-dark environments. Due of their size and mobility it is easy to handle it even in critical places.

In recent decades, owing of its compact size and effective functioning of those gadgets, the Robotics community has become extremely interested in Unmanned Aerial Vehicles. One of the Aerial Vehicles is Quadcopter, and it is capable of vertical takeoff. The Quadcopter consists of four rotors, a battery and a control device. The RPM for controlling the lift and keeping the torque varied. There are number of similar designs like Quadcopter with different names with different additional features.

For tactical planning, UAVs are utilized for observation. This technology may now be used to support crew members in the emergency response area. UAVs are categorized by weight, endurance and altitude and are suitable for several purposes, including military and business uses.

The objective of this study is to construct a UAV device for monitoring, estimating and supporting firefighters in rescue operations by applying artificial intelligence. This idea can allow the relief workers to plan and aid save the needy.

## 2. SPECIFICATION AND DESIGN

The research on best practises to develop a UAV will begin this project work. We would develop the preliminary UAV after considering feasible specifications. Work on included code and engine synchronisation to fly the UAV within a controlled environment. Then flying UAV will be attached to the camera to receive data video that we are going to employ for AI processing.

The last stage is to create an effective AI system for the assessment of the number of survivors within Fire and to make fire fighters' efforts to remove the affected people efficiently and increase the survival rate as a whole by employing a UAV, a deployable device.

### 2.1 Flight Controller

The Flight Controller is the aircraft's brain and is a circuit board that has a range of sensors that monitor drone movements and human inputs. It then adjusts the speed of the engines with this data to propel the vessel according to instructions. It is a little, varied sophisticated circuit board and its purpose is to guide the input RPM of each motor. The flight controller is provided with a pilot signal to drive the multi-rotor forward, which dictates how engines are manipulated accordingly.

The KK-Mini is the next development of the KK flight control panels of the original generation. The KKMini builds on the design of KK2.1.5 and has the same inputs and outputs as its big brother and complete functionality. The new 36mm design has been developed to meet the demands of the new tiny market, but do not let it mislead you, as it is in every size multi-rotor at home. For the same fantastic experiment the KK small is still employing a built-in graphical user with a hi-res mini-LCD and 4 micro buttons.

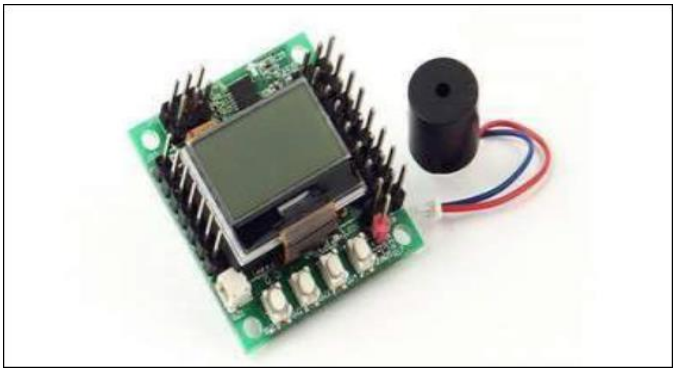

**Fig -1**: KK-Mini 2.1.5

It was designed from the ground so that everybody, not only specialists, may do multi-rotor flights. There are several different types of Multi-Rotor craft preloaded, you can just pick your craft type, verify the motor layout or direction of the propeller, and calibrate the ESC and the radio. Everything is done with straightforward instructions on the screen. The original KK Gyro system has now been modified to an exceptionally sensitive 6050 MPU system, which makes the KK board the most stable and allows an auto level feature to be included. The core of the KK-Mini is a microcontroller with an AVR Atmel Mega644PA 8-bit RISC 64k memory.

For the voltage detection, an extra polarity protected header has been introduced so that no on-board soldering is necessary. For auditory warning when the board is activated and deactivated, a convenient piezo buzzer is also provided. The KK-Mini provides the voltage sensing header and buzzer with polarity protection. For improved accuracy, the voltage sensing line is changed.

Specification:

i. Size: 36x36x11.5mm
ii. Weight: 8.6g
iii. IC: Atmega644 PA
iv. Gyro/Acc: 6050MPU InvenSense Inc.
v. Auto-level: Yes
vi. Input Voltage: 4.8-6.0V
vii. AVR interface: standard 6 pin.
viii. Signal from Receiver: 1520us (5 channels)
ix. Signal to ESC: 1520us
x. LCD size: 24*18mm
xi. Mini buttons size: Four 3.3*4.2mm

## 2.2 UAV body

This is the modular and highly light weight Fiber Glass Quad Copter Frame. The major reasons to use this particular frame are: It is reasonably cheap, highly sturdy, it has a plate in the center that serves as a power supply board to sort things out rather, the design is nicely conceived - the frame is tiny. Lots of space for receiver and control board is available for ESCs and batteries, there is also a space available for installing GoPro or other camera configuration and a broad range of other replacement components and accessories may be chosen from such as landing gears, jigs etc.

**Fig -2**: UAV body (frame)

Specification:

i. Material used: Glass fiber and Polyamide nylon.
ii. Width: 450 mm
iii. Height: 55 mm
iv. Weight: 270 g (without electronics)
v. Motor Mount Bolt Holes: 16/19 mm
vi. Integrated PCB connections.

## 2.3 Transmitter and Receiver (Flysky Ct-6b)

We need a computer system to alter variables of the channel, mix and reverse servo. You may control the quadcopter using the Radio transmitter and receiver. Many compatible models are available; however for a basic quadcopter with a KK2.1.5 control table you will need at least four channels. A radio transmitter is an electrical device for electronics and telecommunications, which creates radio waves via an antenna.

A radio frequent alternating current is generated by the transmitter itself and it is used on the antenna. The antenna radiates radio waves when stimulated by this alternating current. The term transmitter normally applies to equipment producing radio waves for communication; or radiolocation, such as radar and browser transmitters. It can be a distinct electronic unit or an electrical circuit in an electronic unit. Transceiver is considered a transmitter and a receiver united in one device.

Most transmitters have the objective of radio transmission across a distance. It is furnished with information such as a microphone audio signal, the TV signal of a TV camera or the computer digital signal of wireless network devices. The transmitter mixes the sent data signal with the radio frequency signal that creates the radio waves, sometimes termed the carrier. This is what modulation is called.

Radio transmitters are electronic circuits transforming electric power in a radio-frequency alternating current from batteries or electricity, turning millions to billions of times per second in the direction. The energy in such a fast turning

current can irradiate a conductor like electromagnetic waves.

**Fig -3**: Flysky Ct-6b

An electronic receiver is an antenna-based circuit that uses electronic filters to separate the radio signal from any other signal collected by this antenna and amplifies it to a level suitable for further processing and converts it into a consumer-friendly form through demodulation and decoding.

Specifications:

i. Mode-2 Left hand Side Throttle Controller
ii. Full range 2.4GHz 6-Channel radio
iii. 4-Model Memory
iv. 4 Type (Airplane, Heli90, Heli120, Heli140)
v. 4 Models Select
vi. Integrated timer
vii. Contrast Adjustment
viii. Throttle Cut
ix. Computer Programmable
x. USB Socket
xi. Programmed by PC with included software

## 2.4 Drone Movements

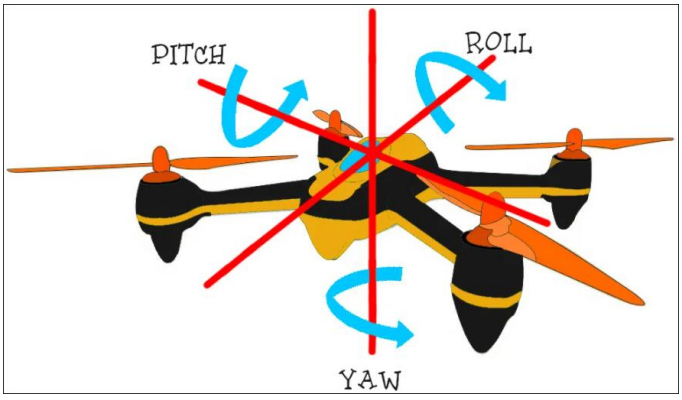


**Fig -4**: Drone Movements

The three dimensions of the movement are pitch, yaw and roll when an item travels through a media. The movement of the yaw is a side-by-side nose movement of the drone. The pitch axis is perpendicular to the yaw axis and is parallel to the plane of the wings with its origin at the center of gravity and directed towards the right wing tip. A pitch movement is the nose of the drone upward or downwards. Rotation is called roll around the forward-to-back axis.

## 2.5 ATmega644PA

The ATmega644PA is an 8-bit low-capacity CMOS microcontroller with 64k storage based on an upgraded RISC architecture. ATmega644PA delivers about 1MIPS per MHz throughputs. This enables the system designers to optimize the gadget to use power compared to process speed. Therefore we need an ATmega assembly code data sheet.

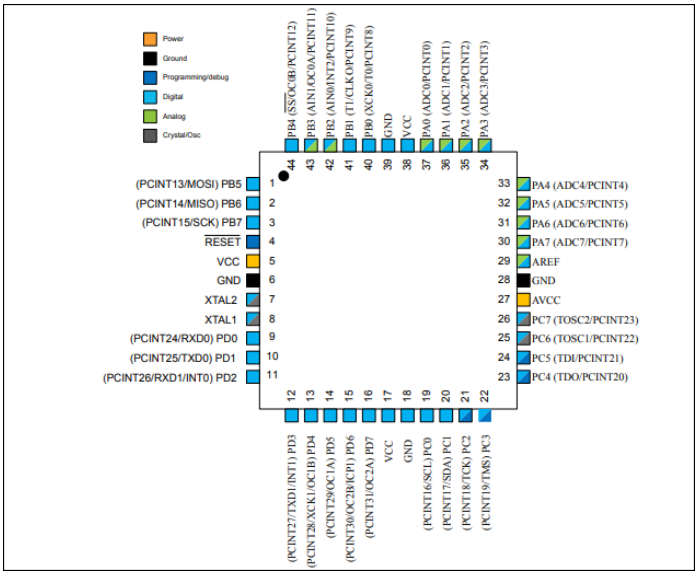


**Fig -5**: ATmega644PA

## 3. SOFTWARE WORK

### 3.1 T6config

T6Config is an application used to set up different mini-helicopter settings only if devices are correctly attached to the computer and loaded with configured drivers. This program has been used to sync and measure the transmitter quadcopter. The major purpose here is to assign the sender keys.

### 3.2 KK mini firmware

KK2 firmware is far harder than its KK parent firmware. This is primarily due to KK2 having additional sensors (LCD) KK2 has two flying modes, first in ACRO mode, which is where just gyros are used to balance, to read and to scale gyro data and subsequently to operate motors with a basic PID control. Stabilization mode is the other mode. This mode employs gyros and accelerometers to calculate the pitch-roll angle of the quadcopter and then utilize PID to determine engine operations.

Gyro: These are the sensors detecting a quadcopter rotation, the output of which is deg/sec. It detects quadcopter rotation in three dimensions. Gyros are supposed to be fantastic, precise, and quick to fit in with the reading, but that isn't the

actual case. The gyros do have a problem called drift it won't be zero if you leave a board that isn't moving or spinning, and try to incorporate gyro measurements. However, it can be regarded zero for a brief duration smaller than a second gyro drift.

Acc: It is a sensor that forces detection. As "g" is the acceleration of the earth, the Acc sensor may be used immediately by simple equations to detect a pitch and roll. However, as quadcopters are not stationary, it does not make the acceleration sensors for quick readings accurately due to other factors, such as linear acceleration forces and centrifugal forces.

### 3.3 Atmel Studio 7

Atmel Studio has been intended to support hardware developers in the development and debugging of microcontroller applications. It comes with Microsoft's Visual Studio shell as an integrated development environment. This software manages apps in C/C++ and in assembly language effectively.

As students of electronics, we know that microcontrollers at Atmel were employed heavily in this discipline. Many tools are available to program these devices, although many of them do not support all Atmel series microcontrollers. Atmel Studios offers several tools to assist students and professionals design and debug microcontroller applications. It is also valuable for students and professionals.

This program may be very personalized. You gain access to a variety of settings for the graphical user interface or numerous software modules with access to Options or Customization. Atmel Studio also has several project templates for different applications. It saves our valuable time by supplying repeat parts of code in several project files automatically.


**Fig -6**: Result Image

The outcome is identification and tracking with a unique identification number provided to each detected person in real time. The total number of persons inside is shown.

### 3.4 Survivor Counter Code

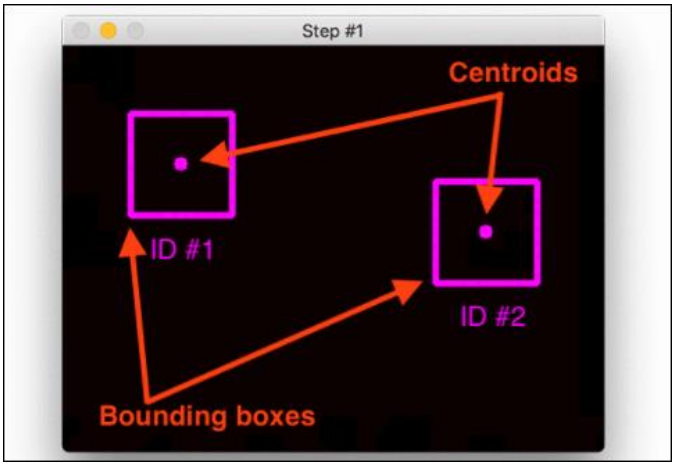


**Fig -7**: Accept a set of bounding boxes and compute their Corresponding centroids

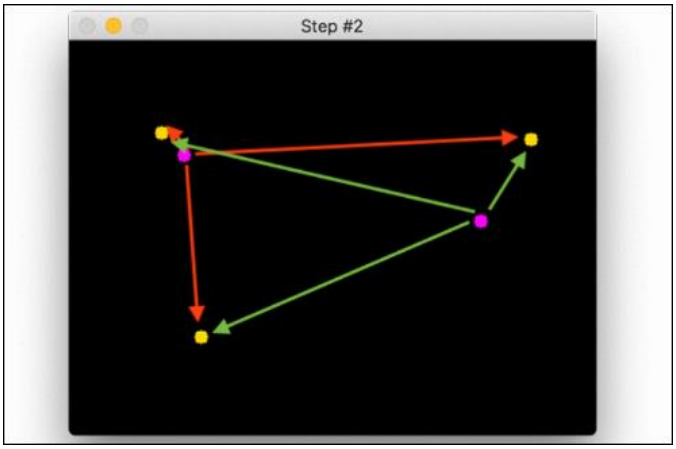


**Fig -8**: Compute the Euclidean distance between any new centroids (yellow) and existing centroids

It includes the detection of objects as well as the tracking. The two processes involved here are detection and follow-up. For this aim SSD caffe pretrained files of profound learning models were utilised and the needed pretrained classes were provided. The supplied video source is supplied at the end of the input. The pictures are sent via DNN through the image conversion blob (i.e.Binarization). The trust value is then compared to expected 0.4. If the object is 'person,' then build a bounding box. For its implementation, the dlib library will be utilised. Centroid algorithm is used to identify and record people.

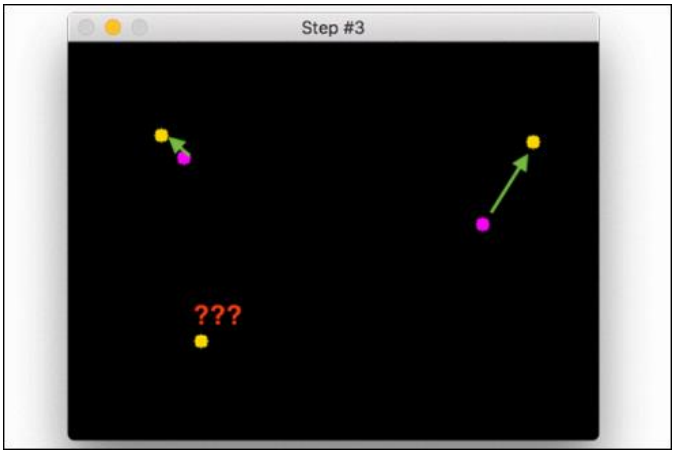


**Fig -9**: Updating the tracked object centroids to their new centroid locations based on the new centroid with the smallest Euclidean distance

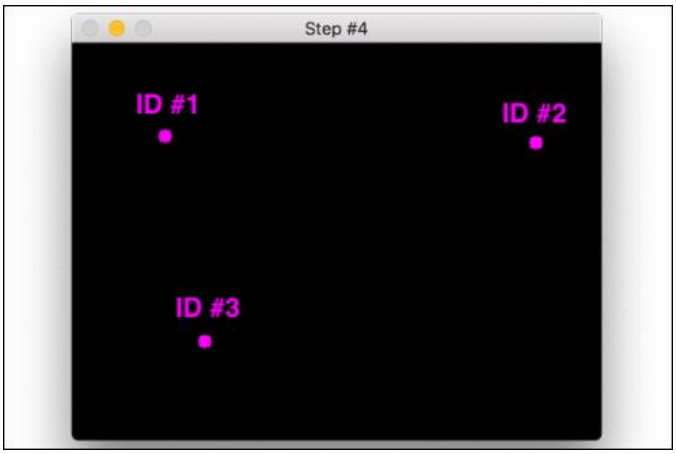


**Fig -10**: Assigning it a new object ID

## 4. CONCLUSIONS

From the above study, conclusions drawn are;

i. Over the last several decades, a surge in the number of fire events has taken many lives and ruined a huge number of structures. An intelligent method has been applied to resolve the problem and decrease loss of lives, thereby not only reducing time to extinguish a fire, but also saving lives. Unmanned air vehicles (UAVs) come and claim that events of this nature would be prevented.

ii. In the next several years extinguish of wild fires, supply of emergency infrastructure, the evaluation of structural damage, mapping and hazardous chemical waste are the areas of enormous potential for expansion of drone technology in the world.

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