

# MAV for Fire Extinguishing: A Review

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**Abstract** - Micro Air Vehicles have been used for many applications in recent times like helping in natural disasters for locating people, for surveillance, fire sensing, and many military applications. Many commercially available MAV's today focus on image based sensing and help locating people and property. Due to increased fire accidents there is an urgent need to relook at MAV application for not only for fire sensing but also from extinguishing. Towards a an extensive survey is conducted to choose a right structural configuration among four available models namely fixed wing type, rotor type, bird type insect type models. The design principles of these vary due to variation in structural configuration and operating principles. A survey of existing types is carried out which is simple yet have the capability to carry a payload for carrying fire extinguishing gas. Out of all rotor type micro air vehicles has the easy operation and manuararable features. The attachment mechanism to Macro Air Vehicle is the key aspect in dicing applications that required pay load carrying. Various attachment mechanism for grease, camera, and evaluated the mechanism for a better mechanism for carrying extinguishing gas is lacking. The sensor techniques are evaluated and cross compared a ultra-light high resolution sensor is needed for knouting onto micro air vehicle fire and smoke and flame sensors are evaluated. All the commercially available micro air vehicles are compared for a majority of them as such no micro air vehicle designed specifically for fire extinguishing. Review indemnifies a the need for a MAV for fire extinguishing A survey of aircraft, train, bus accidents that took place in recent times is undertaken for understand the end effects of accident rather than root causes. While the root cause will enable a better engineering design where end effect is necessary to safe guard the human life. In a recent study [1] it was brought out that majority of fatalities are due to crash accidents. In each of these crash accidents end effect of fire that endangered the lives of people. The occupant's inability to respond quickly to fire lead to fatality. Even though Trains, Buses, aircrafts etc., are equipped with fire sensors that could sense and give an alarm. As the progress in technology happened sensing technology has been improving upon. There is a need to put together available sensing techniques of smoke and fire so that a sophisticated technique can still be developed based o lacunae. Current research aims at a consolidate the available fire and smoke sensors as on date. A start of the art review of sensors which will guide the designers for choosing a fire or smoke detector. In general fire consists of a visible part flame and other smoke which is gas form. This will ultimately help in better system design for future. In this paper we reviewed about different MAVs which are in existing for the fire detection and many more applications. This paper is to tell that we should have micro air vehicle which can not only identifying the fire but also it should some extent to mitigate it up to some extent also notified some change should come over the existing MAVs at present

**Keywords** - Extinguisher, Fire Detection, Micro Air Vehicle (MAV), Mitigation of Fire, Quad Copter.

## I. INTRODUCTION

### *Micro Air Vehicles:*

Micro air vehicles are the vehicles which is the one branch of the unmanned air vehicles which are small in size and weighs about less than 2kgs. these micro air vehicles are used for different types of applications such as military operations, medical assistance, surveillance, fire sensing and fire estimations etc., In these micro air vehicles different types based on their type of structure of construction

1. Fixed wing (hover type)
2. Entomopters (Bird type)
3. Ornithopters(Insect type)
4. Rotor type

#### *1. Fixedwing Type:*

Fixed wing type of micro air vehicles are built as similar to the aeroplanes as shown in figure(1) above, these are used where there is a need of high flight speed this flight speed may consider both its advantages and limitations these fixed wing having the low endurance(stand still in air) and it cannot take vertical takeoff .

#### *2. Entomopters (Bird Type):*

Entomopters are the micro air vehicles are developed by taking the inspiration from the birds exist in the nature so these are similar to the bird in appearance as it is shown in the figure(1). These are having good endurance but these are having low flight time and takeoff problems

#### *3. Ornithopters (Insect Type):*

Ornithopters are the micro air vehicles are similar to the insects in appearance as it shown in the figure(1). These are having endurance and they are having very low pay load capacity.

#### *4. Rotor Type:*

Rotor type of micro air vehicles are similar to the helicopters as shown in the figure these are having many advantages. These rotor type are also known as vertical takeoff vehicles it is having more endurance, more payload capacity.

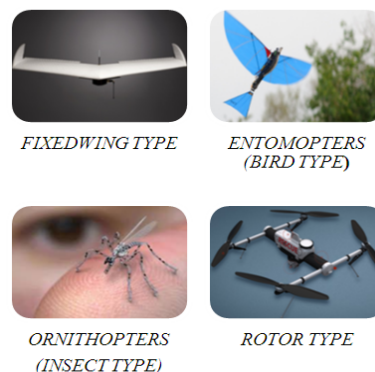


Fig.1. Types of Micro Air Vehicle

## II. MOTIVATION

On reviewing different fire accidents held in different buses, trains and buildings we decided to do something new and we thought that why don't we introduce some micro air vehicle to control or extinguishing the fire. Is there an issue to develop a micro air vehicle in today's world means yes by seeing different accidents held in India in this year itself saying that a technology is required to stop these fire accidents by it is causing great damage. These are some of the fire accidents held in recent years. In April 2014 fire Andhra Pradesh Secretariat no deaths but there is massive destruction of files. The accident occurred near Davanagere in Karnataka six people fired alive on April 2014. The 2013 Mahabubnagar bus accident occurred on 30 October when a private Volvo bus on the way from Bangalore to Hyderabad results to 45 members death. In Nov 2013 seven people died due to by catching fire to diesel tank. These are the some examples which can be predictable and save the lives of the people but we cannot save them due to lack of technology to resist fire at the specified locations.

## III. REVIEW OF MAVs BASED ON APPLICATION

The un manned vehicle are came into existence in 21st century after UAVs and these MAVs com under these UAVs. whereas these UAVs are used in different places like wars, fire mitigation, searching etc., Now a day's these MAVs are also used for the medical assistance, disaster response, commercial deliveries, farm management, public safety etc., here are the some of the literature regarding the micro air vehicles. Arthur F. Huber II[5] explained why these MAV should be developed and he discussed major differences between the UAVs and MAVs what are the developments should be done and what are the major limitations should be kept while building a MAV and application of MAVs. Cesar Beltran[2] presented a MAV which can mitigate the fire the mechanism is discussed in mechanisms. Alex Hansen[6] took the challenge of a air vehicle which take the more pay load by Utah students and this air vehicle can survey the fires. AeroVironment a Qube quad copter used for rescuing and for the observation of forest fires. Mohd. Shariff Ammoo, Md. Nizam Dahalan[3] both have been reviewed these micro air vehicles and they had conclude that by keeping the different mode of propulsion systems these can be used for the different applications like rescue, forest fires, mitigation of fire. Lin Chi Mak[4] proposed a MAV which can search, tracking and reconnaissance and which can have a flight time of 12 min of 450 grams with a movable ground station. Honey well company introduced a MAV named as T-HAWK[7] which plays a great role in rescue in nuclear plant disaster in Japan occurred at Fukushima Daiichi. Jennifer Pandolf, Zanchary Rosen[8] says that Quad copter is a good tool for search and rescue.

## IV. SAMPLE CASE STUDY

Unmanned aircraft systems (UAS) it may be a micro air vehicle can provide fire fighters with an eye in the sky to help them see where the fire is headed, hotspots behind the fire front and structures nearby that might be in danger. UAS can also provide communications relay between the field command center and fire fighters battling the fire in the field, providing actionable data for resourcing and support while greatly reducing the risk to life and property.

Fire fighting activities are often impaired due to thick smoke or darkness. Vision enhancement, such as infrared (IR) thermal imaging, increases responders situational awareness, enhancing safety and the ability to make informed decisions.

AeroVironment's UAS offer the fire industry valuable capabilities that can reduce operational cost and risk, while improving efficiency.

Applications include:

- Fire-monitoring support and coordination
- Damage assessment
- Hot-spot detection
- Wildfire mapping
- Explosive detection
- Disaster & emergency response
- Hazardous material investigation

### 4.1. Smoke Sensors

There are different type of smoke sensors are in existence as such said by Lakshmi and Ravi[1]. There is a requirement of sensors to sense the fire in any area there are different kinds of smoke sensors available at present.

- Optical smoke sensors
- Ionization smoke sensors
- Air sampling sensors
- Semi conductor smoke sensors

### 4.2. Resources of Fire:





There are different type of fire accident that means by what means the get emerged and spread throughout by different fire resources. According to fire department there are five types fire which can be caused by five resources they are

- Solids(paper, wood)
- Flammable liquids(petrol, diesel, kerosene)
- Flammable gases(LPG, Methane)
- Electric equipment( short circuits)
- Cooking oils & fats(oils used in cooking)

### 4.2. Type of Extinguishers:

There are four types of fire extinguishers

- Water
- Foam
- Dry powder
- Carbondioxide (CO<sub>2</sub>)

Extinguisher		Type of Fire				
Colour	Type	Solids (wood, paper, cloth, etc)	Flammable Liquids	Flammable Gasses	Electrical Equipment	Cooking Oils & Fats
	Water	✓ Yes	✗ No	✗ No	✗ No	✗ No
	Foam	✓ Yes	✓ Yes	✗ No	✗ No	✓ Yes
	Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes	✗ No
	Carbon Dioxide (CO <sub>2</sub> )	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes

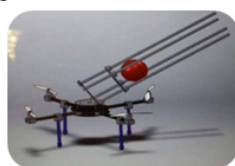
## V. REVIEW OF EXISTING MECHANISMS

There are potential gaps in acquiring remotely sensed data for use by Reclamation, particularly in the isolated, scarcely populated and occasionally hazardous environments. Micro air vehicles (MAVs) may provide the opportunity to fill some of those gaps, reduce the risk to personnel and, in some cases, offer a more cost effective alternative to obtaining certain information. o improve and innovate in ways to control and prevent fires on high rise buildings. Quadcopters are systems that have become popular in recent years, because they have the capacity of transporting objects while maintaining high stability levels. For that reason, this team decided to innovate mounting on the top of the frame of quad copter a release mechanism to throw the fire extinguish ball inside of a building[2].

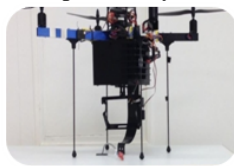
This is he another new fire fighting quadcopter made by Utah students [6] in this by changing the controls the flight time is changed

This combination of Micro Aerial Vehicles [4], Unmanned Ground Vehicles and a Base Station creates a system with the ability to perform the hostage rescue mission in less than 40 minutes.

The below show MAV is known as T-HAWK [7] which is used in battle fields by USA. it is used to map the enemies and it is having a day and night view camera and having a diameter of 14in and it is operated by a remote



QUAD COPTER  
WITH SMOKE  
GRANAD



QUADCOPTER  
WITH HIGH  
ENDURENCE



MAV WITH  
MOVABLE  
GROUND  
STATION



T-HAWK

Fig.2. Different types of MAVs in Existence

Table 1: Different Applications of existing MAVs

Applications	Availability
Fire monitoring	AeroVironment(QUBE)
Hot spot detection	AeroVironment (QUBE)
Wild fire mapping	AeroVironment (QUBE)
Explosive detection	T-HAWK
Disaster Emergency	T-HAWK
Hazardous material investigation	T-HAWK
Damage assessment	T HAWK
Pay load	STEADI DRONE
Fire mitigation	As such there is no MAV to meet this application

By reviewing all mechanism we came to an conclusion that we are having the different MAVs for finding the hot spots of fire and also for disaster assessment but there is no such MAV that which can mitigate the fire when it is found.

## CONCLUSION

By reviewing different papers about fire mitigation we came to an conclusion that there is no such micro air vehicle that can mitigate the fir as we mentioned in the above literature there is a vehicle which can mitigate but it had a complex mechanism so there is need of a micro air vehicle which can mitigate the fire and also that micro air vehicle should satisfy the applications stated below

- Application for exhsistinguinsh the fire need to develop
- Mechanism to pick and transportation need to develop
- There is a need of Structures like quad copter to be used for mitigation of fire due there stability, easily construction and operation
- Mitigation process in the micro air vehicle should be as simple and user interface for operation
- A tiny sensing technology state of the art for fire and smoke sensor should be needed.
- Disaster

## REFERENCES

- [1] Laksmi Kiran Pragada, Ravi Katukam, Manzoor Hussain "Innovation for Safe Travel" International Journal of Innovations in Engineering and Technology (IJET), Vol. 3 Issue 4 April 2014
- [2] Cesar Beltran Miriam Carolina Freitas Alex Moribe "Unmanned aerial vehicle with fire extinguishing grenade release and inspection system " Florida international university, November 2013
- [3] Mohd. Shariff Ammoo, Md. Nizam Dahalan "Micro Air Vehicle: Technology Review and Design Study" 2006
- [4] Lin Chi Mak, Makoto Kumon, Mark Whitty "Design and development of the Micro Aerial Vehicles for Search, Tracking And Reconnaissance (MAVSTAR)" 2008 MAV08
- [5] Arthur F. Huber II" Micro-air vehicles in the service of air force missions" 2002
- [6] <http://www.steadidrone.eu/new-firefighting-quadrocopter-made-by-utah-students/>
- [7] potential reclamation applications of the T-Hawk a gasoline micro air vehicle a guide for potential reclamation UAS users
- [8] Jennifer Pandolf, Zanchary Rosen "Quadcopter: Design, Build and Test" 2013