Journal of Advanced Control, Automation and Robotics (JACAR), 3 (2): 113-119, December 29, 2017
e-ISSN 2432-5562, p-ISSN: 2186-9154
Applied Science and Computer Science Publications

Preliminary Assessment for Inshore Fishing UAV (ISFUAV)

Mbaitiga Zacharie and Honda Kyuhei

Abstract: The development and entry into service of unmanned air vehicle (UAV) systems has a long, history. Unfortunately, the vision of engineers and scientist ~~is~~ have seldom matched that of administrators, regulators or financiers. The availability of UAV systems has also often depended upon the maturation of the requisite technology. UAV systems are now being operated by several military forces and currently, to a more limited extent, by civilian organizations. Civilan organizations, however, may eventually expand to exceed, in number and diversity, those of the military [1]. UAV are now use in many domains to perform tasks that may cause risk to human life or in the surveillance of ~~the~~ suicide sites to prevent young people in depression ~~to~~ from committing suicide. UAV are also used to collect information to support decision making during crises, in monitoring disasters sites, for assisting rescue teams during ~~the~~ rescue operations and the list goes on. Given the capability of UAV to perform many civilian tasks to contribute to a sustainable society, this paper assesses what is needed to move the UAV to the fishing industry in order to develop the Inshore Fishing Unmanned Aerial vehicle (ISFUAV). The assessment consists of how to combine real fishing materials, ~~their~~ fishing material weight in relation to the ISFUAV, and the system capable of carrying those fishing materials to the fishing area into the sea and depth zone fishing.

Keywords: UAV; Fishing drone; Seashore; Fishing, Fishing zone

I. INTRODUCTION

With the ongoing progress in technology in general and computer science in particular, the Unmanned Aerial Vehicles (UAVs), are becoming a promising research area that could overtake robotics, avionics, and other research fields in the years to come. This is due to the current research topics on the UAVs around the planet. In the beginning, UAVs were accepted very slowly by the military in 1990's but as time went by, UAVs brought a real revolution in military operations. These military operations include:

A. Non-offensive operations such as:

- Day and night reconnaissance and surveillance
- A collection of information to support political decision making in crisis management
- Battle damage assessment description of operations
- Nuclear, biological and chemical detection
- Communication and non-communication jamming

B. Offensive operations such as:

- Target acquisition (the process of detecting, identifying, and locating a target insufficient detail to permit the effective employment of weapons)
- Target designation (the process of making or otherwise pointing to a target by any means).
- Close air support and defense against theatre ballistic missile and cruise missile.
- Mobile target strikes

Presently, UAVs are considered not only as a standard tool in military thinking [2] but have also reached a high level of reliability with a large variety of civil applications. These civil applications include:

- River and sea application monitoring.
- River and sea pollution monitoring

Corresponding Author: Mbaitiga Zacharie. Dept. of Media Information Engineering, National Institute of Technology, Okinawa College. 905 henoko, Okinawa, Japan. Tel: +81-98-055-4174, Fax: +81-980-55-4012, E-mail: zacharie@okinawa-ct.ac.jp

- Detection of pollutants in the atmosphere.
- Assistance in the case of criminal actions
- Video transmission of sports competition and so on

Due to the impact of the UAVs on every part of our living style, academic institutions, research laboratories and agencies have been recently shifting their research interests from robotics to UAVs for both educational and commercial purposes. Among those institutions is the University of Minnesota UAV laboratory with an aim to conduct flight research on navigation systems, guidance and control systems to develop future commercial aircrafts and small UAVs that are significantly safer and more fuel efficient [3]. This UAV laboratory also supports bringing the education of real world aircraft development and flight testing experiences into undergraduate and graduate courses.

The University of Florida does not miss the party. It disposes an Unmanned Aircraft System Research Program (UFUSRP) that focuses on the development of small unmanned aircraft systems that are both affordable and address scientific questions in natural resources through remote sensing [4]. Eisenbeiss et al. proposed the UAV systems and their applications for the photogrammetric recording and documentation of cultural heritage [5]. Wich et al. proposed a preliminary assessment of a conservation drone for Sumatran orangutan distribution and density. The assessment focuses on whether or not drones could detect the nests of the critically endangered Sumatran orangutans ~~on~~ in imagery acquired from a camera mounted drone to determine distribution and density [6]. Jones GPN et al. proposed an assessment of small UAVs for wildlife research to capture high-quality progressive scan video of a number of landscapes and wildlife species [7]. Unfortunately, the UAV system was unable to collect geo-reference imagery and at the same time it was difficult to deploy in unimproved areas. But the performance of the autonomous control systems and the quality of the progressive-scan imagery indicated strong promise for the future UAVs as useful field tools. Goerzen and Mettler did a survey of motion planning algorithm from the perspective of autonomous UAV guidance [8] with aim to provide an overview of existing motion planning algorithm while adding perspective and practical examples from UAV guidance approaches. Geins, Weigank and Shning contributed to the UAV applications by assessing biodiversity in forests using high resolution images and UAVs [9]. All these surveys and assessments have shown how UAVs are showing signs of future success in many different areas that will change our life style despite research on the UAVs being in their early stages. They will without doubt contribute to sustain our society, as well. The purpose of this work is to make an assessment on how to develop a robust and affordable inshore fishing UAV (IFUAV) in order to help fisherman or fishing enthusiasts in all levels that do not have a boat and cannot go far out to sea from the seashore to enjoy fishing during their spare time.

II. OVERVIEW OF CIVILIAN UAV APPLICATION

UAVs have been a hot button issue as of late. Some UAVs will soon show their ability to perform many tasks human are unable to do. Others UAVs will offer the opportunities for entertainment such as spending time with friends and family. In fact, the first civilian science-related mission involved counting sand hill cranes, a task that usually involves a biologist flying in a plane or helicopter. However, with the use of UAVs, which have the ability to fly very close without scaring off animals, scientists were able to utilize a thermal imagery camera on the UAVs called Raven to count the cranes settled in the wetland during the evening. The following are some civilian UAV applications.

A. UAV guiding students around the campus

The Massachusetts Institute of Technology (MIT) has developed an unmanned autonomous vehicle system which uses GPS and cameras to guide students and visitors around the campus. The system called Skycall allows its users to call it via phone call and then flies to their location to guide them on to their destination. The prototyped Skycall system consists of a quad-copter drone equipped with on board autopilot, cameras, Wi-Fi, GPS navigation and sensors that allow it to fly autonomously to specific locations. Not only does Skycall copter have an onboard camera that provides information to the base location upon a user but it also has a manually controlled camera which is accessible to users via the Skycall applications. The Skycall application enables users to make requests and the UAV to both locate and wirelessly communicate with them. Skycall also detects if a user is falling behind and as then to close the distance.

B. Amazon UAV delivery service

Operationally or technically the Amazon UAV Delivery Service has not happened yet but it is still something that will draw our attention on how the UAVs applications continue to develop in the coming years. The Amazon UAV Delivery Service prototype tested and shown on the TV is to deliver a package under five pounds (23kg) to a costumer within a 10-mile (16 km) radius of an Amazon fulfillment center. The UAV will drop off the package right at the costumer doorsteps. This is a matter of time but for this to be successful, a certain number of issues are needed to be addressed first.

C. Drug bust using UAV by USA Coast Guard

In July 2003, the USA coast guard used a UAV that they developed to aid in the interdiction of 600 kilograms of cocaine. This is the first time the coast guard used a UAV in an interdiction operation. The UAV called Scan-Eagle can monitor a suspected go-fast vessel for more than 90 hours. When the UAV located the suspected vessel, it maintained constant on-scene surveillance until the short-range recovery helicopter and over the horizon cutter boats arrived to interdict and apprehend the vessels crew. The UAV has an integrated EO900 imager electro-optical model combining an electro-optical telescope with Insitu's electro-optical camera which provides 170x zoom. It is gyro-stabilized with coordinate hold mode and includes a video progressive board, picture-in-picture display, and articulated nose enclosure. The coast guard has identified a cutter-based UAV as a key component to enhance the operation effectiveness of its major cutter fleet through on demand, persistent surveillance capabilities. So, with the progression of the UAVs civil applications, what type of impact can we expect when it comes to using the UAVs in the scientific research community in the years to come? Perhaps in an immediate application, as most developed drones are currently under experimentations for safety concerned by federal movement, research agencies or academic institutions. Based on the reported UAVs and civil aircraft incidents in the air, the Federal Aviation Administration of some countries are working on new guidelines, which would allow for the full integration of private commercial UAVs into airspace. Some company leaders in the scientific community are already waiting eagerly for the new rules to be adopted as they expect the approval to result in safer, lower-cost data capture and so forth. This approval will pave the way for the use of the current shore fishing UAV being developed.

III. FISHING UAV SPECIFICATIONS

This project when completed, the IFUAV will operate at sea level for a duration of more than 20 minutes. The distance range will be between 500 meters to one kilometer for about 30 meters high above the sea. The UAV will carry bait attached to the fishing hooks. Such a UAV should have specification that fit the project aim. To this end, a survey ~~is~~ was conducted within the UAVs community resulting in the selection of the Phantom 3. The Phantom 3 is a quadrotor with a built-in flight control system, integrated gimbal and camera as shown in Fig.1.

Fig.1 Phantom 3 (prospective Inshore Fishing UAV)

The Phantom 3 (Fig.1) features a flight control assistance (FCA) part, camera port and specialized battery compartment for its flight battery. The flight control system can communicate with PC assistance through a micro-USB cable between the Phantom assistant (FCA) port and the PC. These features make it possible for the user to use assistance to configure the aircraft and upgrade the Phantom firmware. One of the strongest points of the selected drone is the antenna orientation that can be kept and pointing skyward to the ground for maximum control range during the flight. The phantom 3 is also equipped with a camera having a resolution of 4000 x 3000, sensor with a size of 1/2.3". The camera supports burst shots, continuous capture and time capture, and exports to both Adobe DNG Raw and JPEG. For aerial video, it can shoot in ultra HD and can even shoot for internet ready movies. The LED light indicators are also attached to ISFUAV. The LEDs light are installed at the front and the rear of the ISFUAV. The front LEDs are used for indicating where the nose of the ISFUAV is during its operations. The LEDs can light up solid red after the motors have started spinning. While the rear indicators light up to show the aircraft current flight status once the light battery is also powered on. The 3-axial stabilizer Gimbal is also attached to the aircraft with the following two working modes: The non-FPV mode and FPV mode. The FPV is defined as "First Person View".

IV. METHODOLOGY

We are living in a world surrounded by seas, extending from the Pacific Ocean to the Mediterranean. This refers to phenomena wherein physical movement

Table I is the aircraft specifications and Fig.2 Inshore Fishing UAV operating zone.

Table I Aircraft Specifications

Battery	DJI 4480mAh
Weight	1216g
Max Ascent Speed	Ascent: 5m/s,
Max Descent Speed	Descent: 3 m/s
Max Flight Speed	16 m/s
Motor Diagonal Length	350 mm

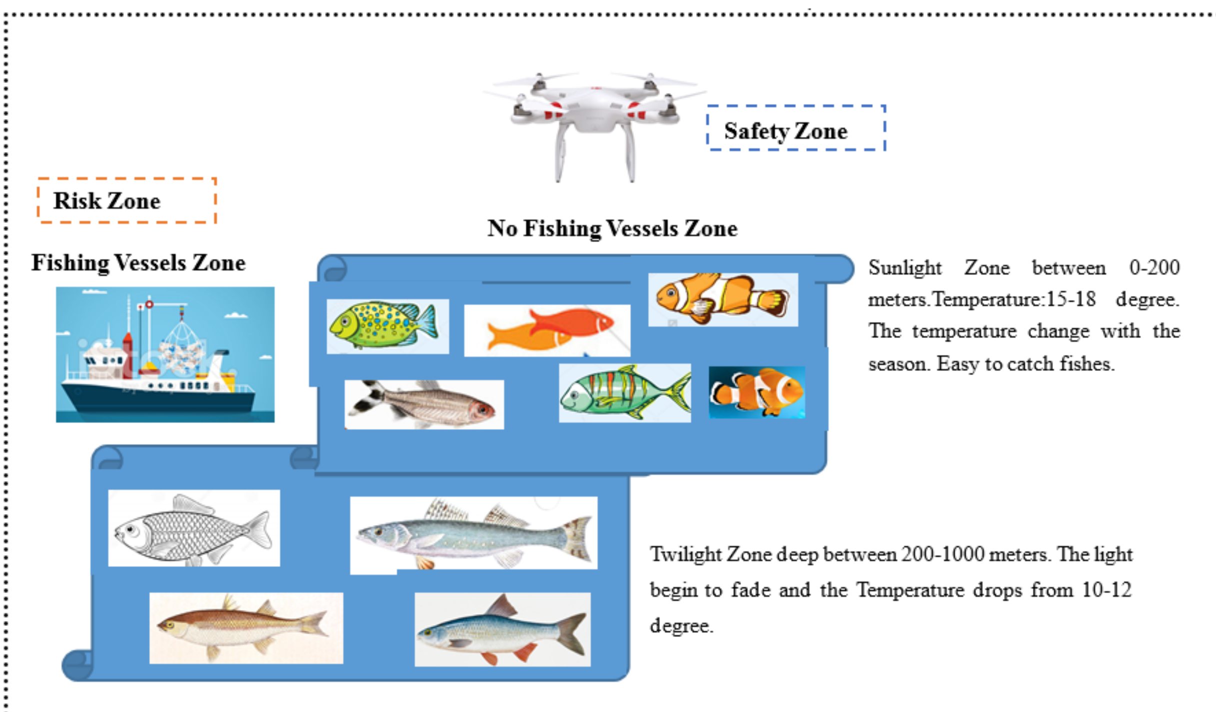

Fig. 2 Inshore Fishing UAV operating zone

to the red sea in Egypt which mark the history of how God has shown his love to his people by delivering in the hand of pharaoh the king of Egypt with its all kind of wealth. When we compare the sea to the land with its millions kind of animals and all living creatures, the sea also has an uncounted number of fishes and living species that we enjoy every day. But when we take a few times to think about where these fishes and species we are buying every day at the marketplace come from? The answer is: these fishes and species mostly come from the sea and usually those people who possess either a small or big boat have the privilege to go far away deep into the sea for about a mile or more where they can catch a variety of fishes such as tuna, mackerel, salmon and so on. While those who do not have a boat can just struggle around the shore with their small hooks and can stay for an hour sometimes three to four hours without catching even small fishes. Even if the opportunity has been given to them to catch fish, what they can catch are only tiny fishes. So in order to take the advantage of the technology and to give an opportunity to whoever wants to enjoy fishing, we came up with the idea to develop the Inshore Fishing Unmanned Aerial Vehicle (ISFUAV). The ISFUAV operation will be limited on to inshore fishing and not offshore. The biggest different between inshore and offshore fishing is the depth of the water. Inshore fishing is any fishing that take place in the water up to 30 meters deep. Since the waters are calm, vessels are less intense and a boat can even not be see, and there more fishes are playing around. Within a water depth of 30 meters deep is the border between the two shores (inshore and offshore). When one fishes inshore, they are usually within a few miles of shore. When water depth exceeds more than 30 meters, this area is considered and boats becomes more robust, fishing becomes more athletic and less of relaxing and more often than not within the casting distance of the working popular spots. The ISFUAV can extend the fishing depth from 30 meters to 80 meters and fly over the sea for a distance of 500 meters to one kilometer and 30 meters high above the sea level as shown in Fig.2. The flight duration will be at least 20 minutes.

As can be seen in Fig.2, small and medium fishes such as trout and bass often live near the surface of the water looking for food and attempting to escape the jaws of larger fish. This environment fits well the ISFUAV operation area and the fishes can be easy caught. The ISFUAV will be equipped with a fish detection sensor, if possible. This sensor will be used to locate the fish under the sea from 30 meters to 50 meters deep depending on the sensor performance. This sensor is under investigation and will be decided very shortly when the project development starts. In case the fish detection sensor cannot be integrated into the ISFUAV due to some constraints such as the load of the sensor, another appropriate sensor that fits the project will be investigated. Under the UAV a small gripper will be integrated that will serve as the fish food and the fish hooks carrier. The ISFUAV will have two control system modes. The first control system will focus on remote control based flight navigation in order to check the performance of all systems including the duration of the aircraft, battery life span and to make sure that all different navigation function work well. The second control system will make the aircraft ~~to~~ fly automatically based on the flight distance from the seashore up to 500 meters over the sea level with a speed of 10-12 m/s. The aircraft will also be integrated with a vision system for video recording during the flight operation (Table II).

Table II Camera Specifications

Operating Environment	0℃-40℃
Sensor Size	1/2.3”
Effective Pixel	12Mega Pixels
Resolution	4000×3000
HD Recording	1520p30, 720p60
Recording FOV	94 deg.

From this camera we will record videos, burst shots, continuous capture and timed capture. In order to avoid a sudden crash due to battery failure, the ISFUAV is equipped with a 3-axis stabilization Gimbal as described in Table III. This vision system is connected to a PC using a Micro-USB cable to copy image files from the vision system to the PC.

Table III 3-axis Stabilization Gimbal Specifications

Stabilization	3-axis(pitch, roll, yaw)
Controllable Range	Pitch:-90deg. to +30deg.

This gimbal has two working modes. Non-FPV (First person view) mode and FPV mode. In Non-FPV mode, the gimbal will stabilize across 3-axes for smooth aerial creativity. While in FPV mode, the gimbal will lock the movements of the aircraft for FPV experience. The system has a function to self-check when the flight battery is on and alert the base station in case of low power so that the aircraft operator can take preventive action such as calling back the aircraft to the base station before it can crash.

V. EXPERIMENTAL FLIGHT & DISCUSSION

The ISFUAV will operate in a zone where there will ~~be~~ not be any obstacles within a perimeter of 500 meters by 500 meters. From the base station at the seashore, the equipped camera will be activated to stream ~~to~~ data obtained to the base station in ~~a~~ real time to check the aircraft location and the surroundings before the activation of the gripper carrying the bait attached to the fish hooks. After the hook is released, the aircraft should return to the base. The distance from the first released hook and the second is to be set from 50 m to 100m apart. To examine the ISFUAV loading capacity to carry fishing materials such as fishing hooks, sinker, float, rigger and gripper holder, we conducted a preliminary experiment using a Phantom 3 Standard UAV with a manual remote control. We used two plastic bottles filled with water. Each of those bottles weighed about 300 grams and ~~is~~ were attached to a fishing line. The UAV could lift both bottles in the air for a duration of about 10 minutes without tangling the fishing lines as shown in Fig.3. However, a lack of climbing power was observed during its flight. The lack of climbing power observe during this preliminary test gives ~~us~~ an indication that the need to convey a command of motion in skyward direction is necessary. This preliminary test is the needed ~~for~~ to better design the ISFUAV project before. More details will be provided in a coming article on all aspects of this project including the relation between the ISFUAV and the operator.

Fig.3 Experimental flight assessment with two bottles and fishing lines.

Once the hooks are released, the ISFUAV fisherman assistant standing by will pull out the caught fish from the water. At least 5 to 10 hooks are expected to be released within a 30-minute time frame. Once the system is tested and successful, a commercial ISFUAV will be developed for anyone who wishes to enjoy fishing where the assistant fisherman will not be necessary anymore. The ISFUAV itself will do everything automatically. Although the intent is to operate the ISFUAV in a free obstacle zone, the number of small drones nearby will be unknown. Therefore, the ISFUAV path planning and collision avoidance will be necessary to deal with the sudden popping-up of drones, birds or other obstacles as the environment is not always static. In the air, there are not only a number of static anticipated threats, but also caused by sudden threats that maneuver into the ISFUAV's proximity [10]. Furthermore, even those static threat locations have been detected ahead of time, the threat grade or threat scope may change frequently, increasing uncertainty. Considering these uncertain factors, the preplanned trajectories often are not adapted to the practice of changing environments in air operations.

-To minimize the ISFUAV possibility of sudden crashes, avoid a sudden collision and to increase the chance of the ISFUAV survival, path planning is essential [1, 10]. Suppose maximizing the probability of the ISFUAV mission dynamic and uncertain environment will succeed, it is desirable to assign the ISFUAV to conduct where some of minimum criteria are implemented into the navigation system of the aircraft [11]. Thus, the problem of the ISFUAV coordinate path planning in dynamic and uncertain environments is required.

***Path Planting*:**

The path planning will concern both the Go-For Mission (GFM) and Return to the Base Station (RBS) after completing its fishing mission. The GFM and RBS will require determining an estimated time of arrival (ETA) at the specific destination spot. The ISFUAV should select its path and adjust its flight velocity corresponding to the ETA. The aircraft trajectory and velocity will change in the event sudden threats occur. The change of the ISFUAV trajectory and velocity will be influenced by the help of data coming in a real time from the sensors equipped to the aircraft.

Collision Avoidance:

The collision avoidance will require that the trajectory of the ISFUAV and sudden unknown aircraft flight paths should not intercept. All sensors on the flying aircraft will be programmed in the way that the distance between the sudden unknown flight aircraft and the ISFUAV maintain a distance of at least 50 to 100 meters based on the information from the sensors.

VI. CONCLUSION

This paper described a preliminary assessment of information needed to develop an inshore fishing unmanned aerial vehicle. The aim of this project is to help all fisherman at all levels enjoy fishing from the sea shore in their spare time. The project is intended to be completed as soon as possible and become commercially available

REFERENCES

[1] Reg Austin. Unmanned Aircraft Systems. UAVS design, development and deployment, xvii. 2010.

[2] H. Duan, and P. Li, “Bio-inspired Computation in Unmanned Aerial Vehicles,”, Springer ISBN: 978-3-642-41195-3

[3] http://www.uav.aem.umn.edu/

[4] http://uav.ifas.ufl.edu/people.shtml

[5] Eisenbeiss, H., “A mini unmanned aerial vehicle (UAV): System overview and image acquisition,” International workshop on processing and visualization using high resolution imagery, Vol. XXXVI-5/W1, 2004

[6] Serge Wich et al., “A Preliminary Assessment of Using Conservation Drones for Sumatran Orang-utan (Pongo abelii) Distribution and Density,”Journal of Unmanned Vehicle Systems, 2016, 4(1): 45-52

[7] George Pierce Jones, IV, Leonard G. Pearlstine and H. Franklin Percival, ” An Assessment of Small Unmanned Aerial Vehicles for Wildlife Research,” *Wildlife Society Bulletin, vol. 34, No.3,p., 2016*

[8] C. Goerzen, Z.Kong, B.Mettler, “ A Survey of Motion Planning Algorithms from the Perspective of Autonomous UAV Guidance,”Journal of Intelligent and Robotic Systems 57(1-4):65-100, January 2010

[9] Stephan Getzin, Kerstin Wiegand and Ingo Schoning, “Assessing biodiversity in forests using very highresolution images and unmanned aerial vehicles, ” Journal of Methods in Ecology and Evolution 2012, 3, 397–404

[10] M. Zucker, J. Kuffner, M. Branicky, “Multipartite RTTs for rapid replanning in dynamic environments, ” Proc. of IEEE International Conference on Robotics and Automation, 2007

[11] R. Beard, T. McLain, “Multiple UAV cooperative search under collision avoidance and limited range communication constraints, ”Proc. of IEEE Int. Conf. on Decision and Control, 25-30, 2003