Brief Study of Civil Application of Drones and Scheduling Algorithm Used in RTOS

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***Abstract*—In simple terms drones can be considered as flying robots. It does not require a pilot unlike the normal aircraft. It flies on the basis of set of instructions provided by the software controlled flight plans embedded in their embedded systems working in conjunction with onboard sensors and GPS. Hence, giving them the name as unmanned aerial vehicle (UAV). In this modern era where technology is our biggest companion drones have made a major contribution and is still increasing in terms of the efficiency of its contribution. Significant contributions are those used for rescue, surveillance, weather monitoring, agriculture, photography and so much more.**

I. Introduction

It was the launching of the quadcopter (a lesser version of the drone) in 1907 by Jacques and Louis Bregeut. Which led to the creation of drones later in 1917.

Drones can be used both for personal purposes and for community purposes as well. When it comes to personal purposes drones can be used for photography, videography, picking items and transporting from one place to another.

When it comes to community purposes drones have played a major role in terms of security and surveillance to maintain the peace of the city.

Drones have played a significant role in military purposes as well. Drones can be used to pick bombs and displace it in enemy's area hence incurring ten times more damage than what humans can do. If there is any occurrence of war between any countries, it won't be a fight between the people rather it would be a fight between the flying robots.

The main aim of this project is to understand the usage of a drone in various civil applications and to know the role operating system has in its working.

II. Literature Survey

A. MILITARY PURPOSES

[1] Hazim Shakhatreh(2019)- The main goal of these different types of military drones is to reduce the involvement of human factor and hence reducing the risk to lives. At the same time to also to bring maximum damage to the opposite side.

1) How drones are cutting out the surveillance ?: [2] Companies are developing hyper sonic weapons that is capable of flying five times faster than sound and can dodge air defense system. Thus combat drones moving at hyper sonic speed could bypass detection making them more lethal.

These drones have electro-optical sensors to loiter over high value military targets like surveillance bases and radar stations before attacking them.

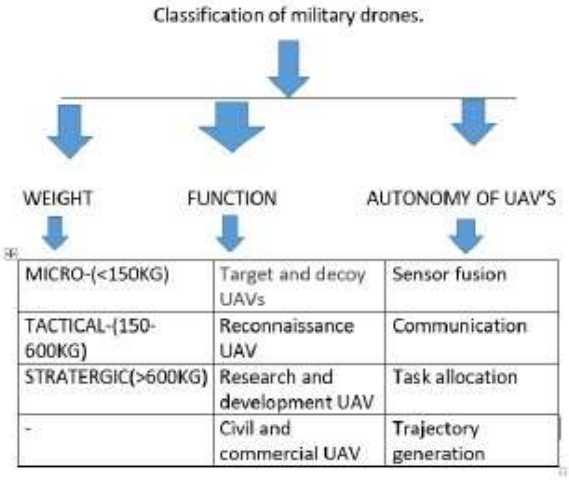

Fig. 1. Classification of military drones

B. AGRICULTURE

[3] Michal Mazur (2016) - The evolution of drones have created a revolutionary changes in the field of agriculture. Its precision has been the x-factor for bringing major changes. Predominantly through 3 different ways it has become an aid to the farmers.

(I) Soil and field analysis - Drones are essential at the start of the crop cycle as they produce a 3-d map of the soil and how much production can be expected from it. Also it gives an idea to add the adequate amount of fertilizers.

(II) Planting- Humans are not precise but drones are. When it comes to planting drones have an accuracy of more than 75% thereby reducing the planting cost by 80%. Drones shoot the pods and the nutrients together into the field thereby creating a means of sustenance for the plants.

(III) Irrigation- Drones with hyperspectral, multispectral or thermal sensors are used to identify which parts are void of water and nutrients. It also calculates the heat density, vegetation index of the crops.

[4] Nowadays the drones are equipped with Wi-Fi technology in the form of first person view. Due to which all the live streaming can be seen in our personal gadgets. In the field of plowing RGB-sensor is used to distinguish between different fields. RGB and depth data has been acquired using an ASUS Xtion pro sensor .

With drones, crop health imaging can be done using Infrared, NVDI and multispectral sensors making

The farmer's better track the health of crop, transpiration

rates and sunlight absorption rates etc.

Quad copter and wing aircraft drone are best suited drones for the agriculture industry. Drones are well equipped with an autopilot system using GPS and a point to shoot camera that is also controlled by GPS. Importance of Drone can be understood from the fact that it can provide farmers with three detailed features.

1) Keeping eye on crop from the air can help reveal patterns that show a problem related to irrigation, soil variation and fungal infestations .
2) Drone uses Satellite remote sensing method which is used to identify the crop growth by comparing multiple images taken by the satellite.
3) Airborne cameras can take multispectral images, capturing data using visual spectrum as well as infrared, which shows the difference between the distressed and healthy plants which can't be viewed with naked eyes .

Agricultural drone has successfully paved a new means of increasing productivity by the farmers. These drone are becoming popular tools similar to any other consumer device . The Drone will play a crucial role in agriculture in the next decade, which will help the farmer to transform the agriculture industry with little technical knowledge .

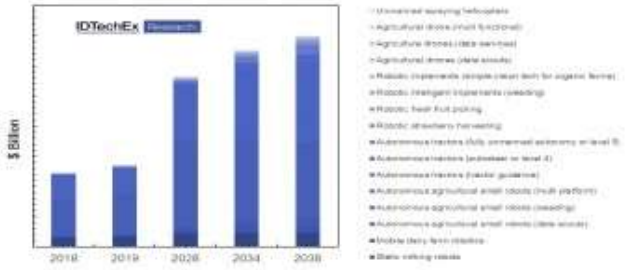

Fig. 2. [5] Usage of drones for agriculture (I)

C. Photography

Drones also play a vital role in photography as it gives a wider framework of an object or a place. The best camera drones is used by amateur and professional photographers in order to reach areas and shoot from angles which normal cameras can ' t reach. For the photography purposes the drones consist of four or more propellers to provide with a vertical lift from each corner, and an onboard processor to control the lift from each processor and keep the drone at balanced level. Drones being lightweight increases the ease of usage and handling capability of users as well.

D. Security and Surveillance

Using drones helps security forces to get closer to the intruders without alerting them. It can also be used to search blind spots thereby responding to the situation with less injury. Using thermal imaging drones will be able to track intruders through dense undergrowth and obstructions thereby providing the team with required information to catch the enemy.

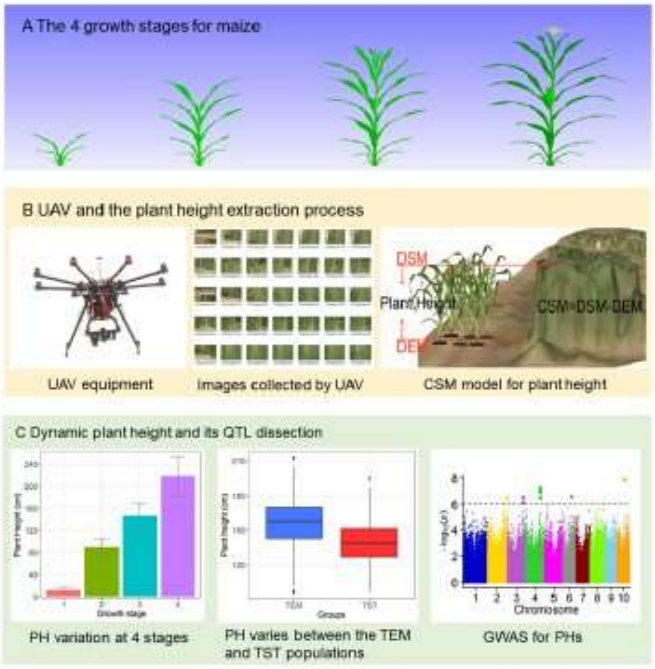

Fig. 3. [6] Usage of drones for agriculture (II)

III. Existing Methodology

The operating system used for handling drones is AIRWARE. It is a based on Linux, but avionics require a set of analog interface that don't really exist anywhere and also certain function still needs to be black boxed thereby making the usage of airware necessary. Airware is a combination of Linux+ black boxes +interfaces.

FlytOS is another operating system used for drones. It is a combination of robot operating system and Linux.

A. Parrot AR drones

[7] Parrot AR drone has got 1 GHz, 32 bit ARM Cortex, A8 processor with 1 Gbit RAM and supports WiFi standards IEEE 802.11 . It comes along with a Linux machine called BusyBox8, which has Unix tools in an executable file and can run over various operating system interfaces like Linux and Android. This drone can be controlled using various interfaces, like using an Android or iOS app to take images and videos to be stored in the phones and also using tools like LabVIEW which has a dedicated tool kit to control it called AR Drone Toolkit9. AR Drones were used in unknown areas for surveillance, for spying and to detect suspicious devices and objects using an extended Kalman filter. Drones can be controlled using various other programming languages such as Python, javascript, and node.js10. Due to their ease of programming, parrot Drones have been very popular.

Parrot AR drone is equipped with two cameras, accelerometers, gyros, sonar, and sufficient onboard processing to autonomously cancel drift if there is (visual) texture on the ground surface. The availability of these sensors, the relatively low price, and an open source Standard Development Kit (SDK) have resulted in the robotics community making

extensive use of the Parrot AR drone for their experiments. However, these experiments have been limited to flights without GPS-based navigation.

[2] In order to facilitate MAV research with GPS-enabled flight, we have recently adapted the particularly versatile and powerful Paparazzi autopilot for use with the Parrot AR drone. The autopilot works completely with the Parrot hardware, i.e., the drone itself and the GPS-module. Hence, no hardware modification is necessary.

There are two ways to make the AR drone fly with GPS: (1) enhancing the Parrot firmware with Paparazzi firmware (the Paparazzi AR drone SDK version), (2) only using Paparazzi firmware (the Paparazzi AR drone raw version).

Another major operating system used for drones is RTOS (Real Time Operating Systems).

3.2 Basic Functionalities of RTOS

3.2.1 Tasking - [8] every task has its state which is ready to run: in which the task has the amount of recourse to run. Running: in which the task is running in the CPU and finished: in which the task has finished it functionality or terminated rather by itself or by force. RTOS is responsible for managing Next task, coordination messages between the tasks and handling them .

3.2.2 Messaging

RTOS manages Semaphores, event flags, mail boxes, message queues which is necessary for multi -tasking operating system to deliver the information around multiple operations.

3.2.3 RTOS Kernel

RTOS real time Kernel is responsible managing task related operations which includes creating the tasks, deleting eh task, holding the take prioritizing the task and changing the state of the tasks.

3.2.4 Scheduling

Task scheduler is a main component of RTOS, that gives the ability to schedule the launch of the tasks at pre-define time span or after the specified time intervals.

3.2.4.1 Round Robin Scheduling

Round robin scheduling handles the task by separating the time quanta equally between all the task in the cycle and executing without the prioritization. If the task is not able to complete in the particular time quanta given it is terminated and has to wait for the next turn.

3.2.4.2 Rate Monotonic Scheduling

[9] Wamika Basu (2016) and [10] Nandana(2015)- Rate monotonic scheduling algorithm is an optimal static scheduling algorithm with preemption. It schedules periodic task with deadline equal to the period. The task with the shorter period has the highest priority.

3.2.4.3 Deadline Monotonic Scheduling

Deadline monotonic scheduling is algorithm is very similar to rate monotonic algorithm but the only difference is that it schedules the periodic task with deadline less than or equal to period. This implies that task with shorter deadline has relatively higher priority.

3.2.4.4 Earliest Deadline First Scheduling

Earliest Deadline First scheduling is an optimal dynamic scheduling algorithm with preemption. Here it schedules periodic task with deadline less than the period. Which implies that task with shorter absolute deadline has higher priority.

$$Utilization(U) - \sum_1^n C_i/P_i \leq 1$$
$$where,$$
$$C_i = worst\ case\ computation\ time$$
$$P_i = period$$

3.2.4.5 Ant Colony Scheduling

[11] Harshal Garodi (2015) and [12] G.Harkut(2014) - This scheduling algorithm is based on the nature of real ant, where each ant constructs a path and one or more ants simultaneously active at the same time. ACO scheduling algorithm mainly working with the time slice manner. In ACO algorithm, each ant is called as a "node" and each of them will start their journey from different node.

IV. Proposed Methodology

As we can observe from above tables that each of these algorithms have drawbacks of itself. So in order to increase the efficiency of CPU utilization we have to combine two or more scheduling algorithms together. In this study we would like to create an hybrid algorithm to increase the efficiency of CPU utilization and enhance the computational performance of the drones.

V. Conclusion

In this study we found out about the major civil applications of drones such as military purpose, agriculture,photography along with security and surveillance. we also found about the major operating systems used in drones such as Airware, Flytos and RTOS. we studied about the different scheduling algorithm used in these operating systems. lastly we also searched about the current famous drones called the parrot drones.

VI. Future Scope

In this technological era drones have played a substantial role in all major civil applications. In our study about drones we have found some important points which when taken into considerations can bring a major change in the effectiveness of drones in a much faster and smarter way.

Hardware:

1) light weight drones have much greater speed, so depending upon the weight of the object we have to find the optimum weight for greater air speed.

2) Structure of the drone and right choice of propellers can bring a change in speed up.

Software:

Usage of Hybrid algorithms such as ant colony and earliest deadline first algorithm may bring a change in the efficiency of operating systems.

If the points can be made practical then it will improve the performance of the drones for any of its use.

TABLE I

Algorithm	Advantages	Disadvantages
Round Robin(RR)	Eliminates convoy effect	Not suitable for time critical and safety critical applications.
Rate Monotonic(RM)	Simple to implement and commonly used algorithm	Not optimal when deadline ≠ period When DM fails, RM will always fail
Deadline Monotonic(DM)	When RM fails, DM will produce a feasible solution Can schedule both periodic and sporadic tasks	Does not guarantee full processor utilization
Earliest Deadline First(EDF)	Less context switches Full processor utilization	During overload condition cannot predict which tasks will miss their deadlines
Ant Colony(ACO)	Simple to implement, also eliminates convoy effect as well as handles overloaded condition	The limitation of ACO algorithm is, that it takes more time for execution than the EDF algorithm.

TABLE II

ALGORITHM	PRIORITY ASSIGNMENT	Scheduling Criterion	Constraint	CPU Utilization	Optimality	Type of scheduled task
Round Robin	Fixed	Time quantum	Allocation of process only for that time quantum.	Less	When burst time= time quantum	Periodic
Rate Monotonic	Fixed	Task period	Deadline equal to the period.	Less	When deadline=task period	Periodic
Deadline Monotonic	Fixed	Relative deadline	Deadline less than equal to the period.	More than rate monotonic	Deadline<=period	Periodic
Earliest Deadline First	Dynamic	Absolute deadline	Deadline equal to the period.	High	Deadline=period	Periodic
Ant Colony	Dynamic	Absolute deadline	Heuristic value	Less than EDF	When heuristic value is more.	Periodic

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