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Unmanned Aerial Vehicle in Oil & Gas Industry

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ABSTRACT
Unmanned AerialVehicle (UAV's) or Drones are increasingly being used by the Oil &Gas industry for the irmonit oring and inspection operations. With the use of drones becoming increasing lypopular over traditional method slikedangling overropes and wire, it is time to finally a bandon these roles and insteadadoptdronestotakecareofboth on- shoreandoff-shoreinspections. Due to the smart technology which are being embedded in drones it help in reducing the time required for processing any particular function which it is designed to perform. It helps by reducing the manpower required to perform a particular task. We can make use of these devices in our day to day life. This study of drones will help us analyze the issues faced by the chemical industries and how can we overcome these issues. These use of autonomous robots will help us to reduce the man power and the computation time required to perform a particular task.

KEYWORDS:DRONE, PETROLIUM , OIL & GAS

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I. CHAPTER 1

1. Introduction

1.1 General

The petroleum industry is a vast industry which contains many other global processes, such as, detection, extraction, purifying, transporting (often by oil tankers and pipelines). In this Seminar we are going to study in detail about the issues faced by this industry while such material is being transported and how drones can be utilized in order to solve these issues.

As mentioned above the petroleum industry also known as oil and gas industry has many global processes. We are going to focus on transportation and storage process. Initially this process starts when the crude oil is being extracted from the oil fields and is being sent to the refineries. The refineries is a place where this crude oil is further processed and sent to the storage locations. These refined petroleum products which are present in the storage will be used for distribution.

The main mode of transportation of these material is done through heavy vehicles (tanker), rail road and pipelines.

During the process of transportation, spills and leaks are a common site in this industry and are devastating events for the oil and gas industry.

It's highly important to respond effectively and efficiently when such event occur.

Here we will be utilizing the smart features of drones to overcome the above issues.

Previously pipeline process involved aircraft or helicopters in order to inspect the pipeline. This was a relatively expensive process for which the solution can be a light weighted aircraft (drone) which would also be able to incept at a lower ground level (10 – 400 ft.) for the process of inspection which would give a better accurate result while inspecting.

II. CHAPTER 2

2. DRONE

2.1 Introduction To Drone

Drones is a part of unmanned aerial vehicles that are being generally used for military or industrial purposes, or personal day to day use. When referring to drones it's regularly pointing at any of a range of quadcopters.

The difference/change in a helicopters and quadcopters is that they have two sets of propellers, making them simpler to fly both in closed areas and in open wide areas. Present day quadcopters have started fusing a scope of new technology, including electronic sensors that balance them out, with a few models even controllable by means of a cell phone application rather than massive controllers. A few models can even be modified to fly set ways or examples.

The one overpowering achievement is the modernized flight-control frameworks and multi-rotor innovation. Conventional RC airplane expect expertise to fly and many turn out to be very costly. Many are controlled by minor gas motors, some even turbines, and fly at scaled paces focused with kept an eye on flying machine. Multi-rotor UAVs, as unmistakable for helicopters by prudence of the multifaceted nature of their control frameworks, require a PC to direct control input. The best way to adjust flight is by turning the rotors at various velocities, and there is recently no real way to do this physically. A reaction of this fly-by-wire execution is that they can fundamentally pilot themselves, particularly when outfitted with GPS, optical stream, and other direction frameworks. This implies pretty much anybody can fly.

Since they can take after extremely exact flight designs, and in addition drift in a settled position (accepting GPS or optical stream), it was inescapable that a standout amongst the most prevalent utilize cases for multi-rotors would be capturing images. HD and 4K cameras have become truly conservative and truly shoddy making tying one to a UAV basically an easy decision.

Fig 2.1: Image of Drone

2.2 Components Of Drone

Like any other embedded device, drone also consists of hardware and software.we will be going through each one of these components hardware/software involved in building of drone as per the following:

- Main Controller (MC)
- Gyros/Sensors
- Electronic Speed Controllers (ESCs)
- Receiver
- Motors
- Propellers
- Transmitter
- GPS
- Optical Flow
- Obstacle avoidance

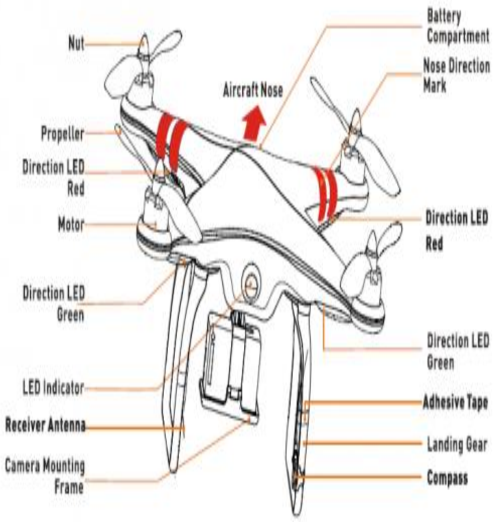

Figure 2.2 Components Of Drone

2.2.1 Main Controller (MC):

The core of the flight-control framework, this can be thought of as the "mind" of the UAV. It is an inserted PC (many run Linux -OS) that has custom programming for controlling the flying machine, in some cases client reprogrammable through a product advancement pack or software development kit (SDK). In a few plans, the MC is a different module with association ports. On others, particularly customer items, there might be a solitary circuit load up (PCB) that incorporates the MC, gyros/sensors, electronic speed controllers (ESCs), and other center flight hardware.

With particular plans, some type of network—undifferentiated from SATA ports inside a PC—is given, permitting peripherals and client moves up to be introduced. CAN-Bus is broadly utilized.

Secluded frameworks have the preferred standpoint that they can normally be redesigned.

2.2.2 Gyros/Sensors

For drones to be self-sufficient to work, the MC needs to track how the flying machine is flying. To fulfill this, some type of sensor cluster is given. For the most part, it will incorporate accelerometers, inertial estimation units (IMUs), and gyros, and may likewise work in conjunction with positional information from an optical stream framework or GPS/compass. Essentially, these sensors tell the UAV how quick its increasing speed is changing, in what course, and whether it is correct side up. Those acquainted with mechanized gimbal camera stabilizers may perceive a similar sensor innovation being utilized here as in gimbals.

2.2.3 Electronic Speed Controllers (ESCs)

Each engine has an ESC (however a few outlines put all on one board). In its most essential frame, an ESC controls control setting off to the engine with which it is combined. More modern frameworks can likewise hand-off information back to the MC, for example, vitals about how the engines are performing. With at least six rotors, dynamic criticism makes it conceivable to continue (sufficiently flying to arrive wellbeing) on the off chance that one engine comes up short.

2.2.4 Receiver

The reciever/collector is for the radio control framework. It sets ("ties") with the controller the pilot or administrator holds, which sensibly is known as the "transmitter." Modern collectors normally work in the 2.4GHz territory and have at least four channels, additional channels empowering custom usefulness to be transferred by means of the control motion, not withstanding fundamental steering inputs. In airborne imaging applications, the additional channels can now and then be devoted to gimbal or camera control.

2.2.5 Motors

Generally, brushless electric engines are used. The engines are normally matched/paired, each combine a set containing one clockwise (CW) engine banded together with one counterclockwise (CCW) pivoting engine, however they might be sold separately. It is imperative when supplanting them or building your own framework to utilize the right rotational bearing in the right position. the propellers are regularly assigned CW or CCW in view of which way they screw on.

2.2.6 Propellers

Light UAVs utilize plastic propellers, which oppose breaking on affect since they are adaptable, and they are more secure. Heavier models utilize carbon fiber or other more unbending materials (planes as often as possible utilize wood or nylon/glass). Carbon fiber propellers are risky, even savage, and ought to be utilized just by experienced pilots and well far from individuals.however,the advantages of carbon fiber over plastic are minor on multi-rotors.

2.2.7 Transmitter

A transmitter can also be refferedas radio controller. For an expanding number of tech toy and section level UAVs, the "transmitter" is essentially the mix of a versatile application and a Wi-Fi-empowered tablet or cell phone (eg: Parrot utilizes Wi-Fi control for the greater part of its quadcopters). UAVs furnished with beneficiaries.

While considering a transmitter, for the most part, compatibility can be dictated by referingto the specs for the collector.the receiver and the transmitter must follow the same protocols,The transmitter should also be able to give as many channels as the receiver wants. for instance, a DSMX 4-channel beneficiary will work with a DSMX 6-channel transmitter.

2.2.8 GPS

GPS frequently nonexclusively refers to GNSS to incorporate GLONASS and different frameworks—is truly standard on multi-rotors. By giving (moderately) exact positional information, GPS empowers flight modes including settled drifting, auto return home, introduction control, and security "bubbles" that breaking point how shut the UAV can get to the pilot. GPS additionally gives an additional level of granularity to additionally upgrade flight steadiness. UAVs that are outfitted with GPS can for the most part fly without it, however will lose some of their self-governance. In this way, they are more reliant on the abilities of the pilot to remain airborne. For GPS to work, a compass is likewise required to give bearing, and compass alignment may include an ornate yet basic pre-flight schedule.

2.2.9 Optical Flow

Optical Flow—known as Vision Positioning on DJI-based frameworks—is intended to do inside near the ground what GPS does outside at higher elevations. In great execution, there is a camera taking high-recurrence still pictures to monitor its relative position, utilizing a strategy called "movement estimation." Since current optical stream can just give relative positional information inside restricted limits, it won't give you full self-governing capacities, for example, return home, yet enables settled drifting.

2.2.10 Obstacle avoidance

While GPS and sensors empower UAVs to essentially fly themselves, they chip away at the suspicion of unhindered air space. Beginning in 2015, we started to see the main purchaser impact shirking frameworks. Yuneec's adjustment of Intel® RealSense™, for instance. Hindrance shirking gives attention to the encompassing condition, not just encouraging the UAV to not find anything, but rather additionally retaining a 3D delineate can be rung later when refreshing an autopilot flight line. This innovation puts UAVs one terrifying bit nearer to the sci-fi/frightfulness bad dream of full vehicular self-rule.

It ought to be noticed that having impediment shirking is no motivation to toss wellbeing out the window or unshakably work in the region of items into which one may crash. Equipment and programming are error prone, and even with the best frameworks, the UAV can just respond so rapidly. With air ship surpassing velocities of 50 mph and no "brakes," as it were, a great deal can turn out badly—and quick.[1]

III. CHAPTER 3

3.Detection

3.1 Thermal imageing

A unique focal point centers the infrared light produced by the majority of the objects in sight. The concentrated light is filtered by a staged exhibit of infrared-detector components. These components make an exceptionally nitty gritty temperature design called a thermogram. It just takes around one-thirtieth of a moment for the locator exhibit to acquire the temperature data to make the thermogram. This data is acquired from a few thousand focuses in the field of perspective of the detector array. [2]

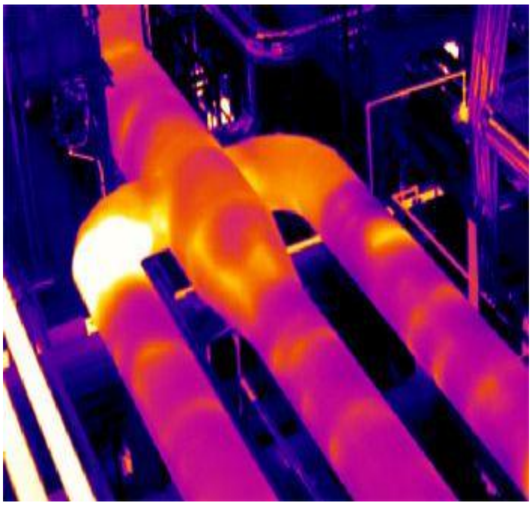

Figure 3.1 Thermal Imaging(optical imaging)

The thermogram made by the indicator components is converted into electric impulses.

The driving forces are sent to a flag handling unit, a circuit board with a devoted chip that deciphers the data from the components into information.

The flag handling unit sends the data to be viewed, where it shows up as different hues relying upon the power of the infrared discharge. The mix of the considerable number of impulses from the greater part of the components makes the picture.

3.1.1 Uncooled

This is regularly the premier normal assortment of thermal imaging gadget. The infrared-identifier components are contained in a unit that works at room temperature. This sort framework is thoroughly calm, initiates forthwith and has the build in battery.

3.1.2Cooled

Expensive and vulnerable due to rough usage, these frameworks have the components fixed inside an instrumentation that cools them to beneath 32 F (zero C). The upside of such a framework is the inconceivable determination and affect ability that come about because of cooling the components. Cooled frameworks can "see" a refinement as little as 0.2 F (0.1 C) from more than 1,000 ft (300 m) away, that is sufficient to advise on the off chance that somebody is holding a weapon at that distance.

3.2 LASER

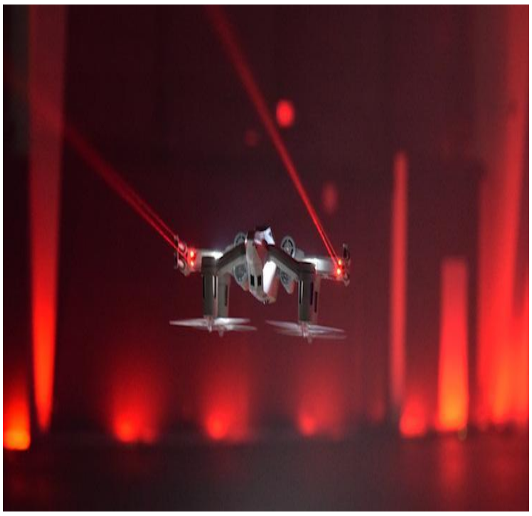

Figure 3.2 Laser

Laser scanners distinguish two-dimensional profiles on various target surfaces utilizing the laser triangulation guideline. Uncommon focal points are utilized to grow a laser pillar to shape a static laser line and venture it onto the objective surface. The diffusely reflected light of this laser line is anticipated by the optical framework onto an exceptionally touchy sensor lattice. From this network picture, the separation data (z-axis) and the position nearby the laser line (x-axis) are computed by the controller. These deliberate esteems are then yield in a two-dimensional facilitate framework that is settled concerning the sensor.

IV. CHAPTER 4

4 Data collection

4.1 Base station

A base station can be land station or a mobile station. This is the point from which the drone and the operator communicate through. In this base station the operator who is managing or monitoring drone activities can also send commands on how to proceed or what action the drone must take next. At the base station there is a processing unit and data base where the drone must give data for processing and analyzing and store collected data respectively.[3][4]

4.1.1 Ground station

A ground station is an across the board answer for control, FPV, telemetry information, and even full self-sufficient flying. It might be bound together into one air-end and one ground-end part or may require a mind boggling collection of equipment. Ground stations base on desktop programming or an application. Much of the time, the product alone is all that is required for operation; however a transmitter can frequently be attached to it for coordinate manual control.

Figure 4.1.1 Ground base station

Regardless of the limitation on BVR, which discounts numerous business applications, for airborne video and photograph it is as yet conceivable to exploit "waypoint" traveling to set exceptionally controlled flight designs for predicable, repeatable shots, even while keeping the airplane inside visual range.

The ground base station is a fixed base station. As mentioned above it has data base to store collected data and processing and analysis is also done in this fixed base station. In order to collect and analyze the data which the drone has received it will have to continuously monitor if any leakage has occued and report back to the base station. Here the collected data will be processed and analysed once the drone comes back to this base station from its trip. It has to keep going back and forth , to and from the location of leakage and Base station.

4.1.2 Mobile base station

The mobile base station does the same operation as that of the fixed base station but the only differenece here is that it is mobile. It will be positioned in such a way that the drone will be in line of sight of the base station. Eg: a helicopter traditionally was used to do the monitoring analysis and leaksge detection which would take a couple of weeks to do this process. But by using drones here, the drone will be in line of sight of the helicopter where the helicopter will act as base station and this process will be done in matter of couple of hours.

Figure 2.3.1.2 Mobile base station

4.2 Cloud

Unlike the above two base stations, which are mentioned(mobile & ground base station),cloud service is a totally unique platform.This platform provides a huge memory space of about 1 billion gigabytes or even more.Due to this the data collection process for the drones becomes much easier and faster as it doesnot require to go back to the base stations for the collected data .In this the data is collected remotely so that the authentic users can access the data from anywhere at any point of time[5].

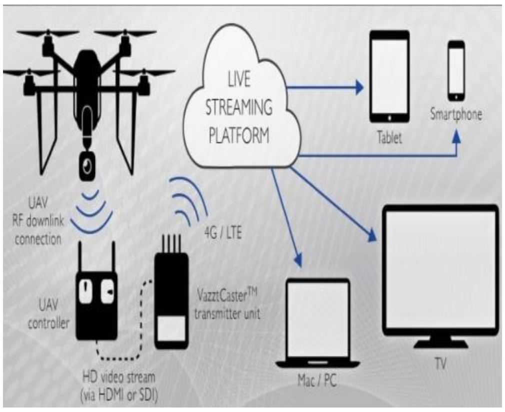

Figure 4.2 Cloud

V. CHAPTER 5

5. Data Analysis

As discussed above,the task of the drone was to go and collect data and store in specified loactions, the storing of this data is not the only thing required in this process. Data is collecting in order to study and make beneficial amendments to the environment or get accurate information on how things can be made better in studies(eg: Agriculture and water shoratges or to detect Petroleum leakages etc). Here, Pix4Dmapper is specifically custom fitted to handling drone images and it additionally offers a free mobile application called Pix4Dcapture (used to control the automaton) which worked with the software.Allphotogrammetry programming utilizes a similar essential principles,where Pix4Dmapper works is likewise alluded to as Pix4D.[6]

5.1 Basic principles of photogrammetry software

Our brains perceive depth by comparing the images that our eyes see. If you look at an object and alternatively close each eye, the object will seem to shift left and right. An object that is closer, will seem to shift more than an object that is farther away. This is stereoscopic vision, and the core concept behind creating the illusion of 3D objects and space from 2D images. Your brain can use this information to subconsciously calculate and tell you how far away an object is. In a similar way, photogrammetry is a photography technique using software to determine the position and shape of an object by comparing two or more photographs. The science of photogrammetry has been around for over 100 years, but it is only more recently with the advent of powerful PCs and high resolution digital cameras that it has become possible to easily generate 3D models from still images.

5.2 Working of Pix4D mapper

Pix4D uses the principles of photogrammetry to convert images into a 3D point-cloud, a 3D digital surface model and an orthomosaic. An orthomosaic is an image that is composed of multiple overhead images and is corrected for perspective and scale, which means that it has the same lack of distortion as a map. The software starts by identifying keypoints in a series of overlapping images. A keypoint is a point of interest, like the corner of a vehicle, that Pix4D can identify in multiple images. Knowing the camera position, orientation and camera properties like focal length, it then projects a line from the camera through a keypoint. It then repeats this for the next image, resulting in a triangulated position of that keypoint in 3D space, which is used to create a point in the 3D point cloud. Ideally you want to take sufficient overlapping images so that a single keypoint can be identified in 4 or 5 different images. In a typical 14 megapixel image Pix4D can identify about 60,000 keypoints. And it will typically find 6,000 matched pairs of keypoints per pair of images. By analysing so many keypoints the accuracy of the project is improved. It also enables the software to back triangulate the camera position and camera properties. It will correct the GPS position of the camera and will also correct the focal length if necessary.[6] The software can even process images that aren't geo-tagged. Without geo-tags it can still generate a 3D point cloud and orthomosaic, but it will not have the correct scale; however, scale can be added by entering known distances between points in the 3D cloud.[6] Traditional photogrammetry has always relied upon a very precisely known camera position, orientation and optical properties. The technique employed by Pix4D, to analyze multiple key points and correct for errors in camera position, orientation and optical properties, is known as modern photogrammetry. It is this technique that enables drones to be used as the camera platform and for low-cost cameras to be used on the drone.

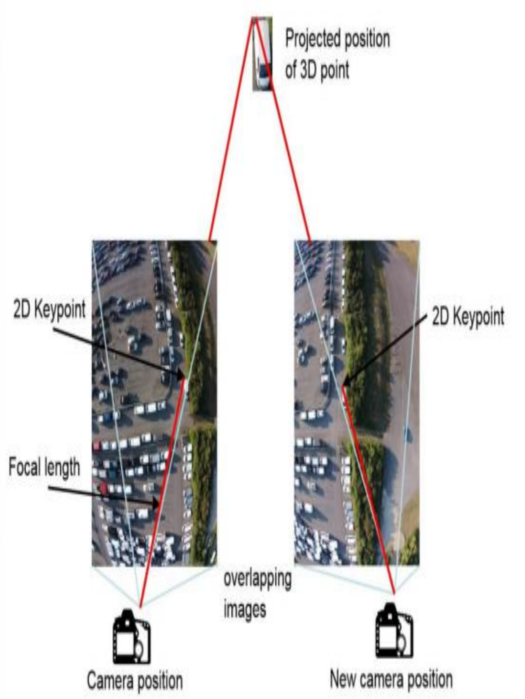

Figure 5.2 Working of Pix4DMapper

5.3 Acquiring images from drone to use in Pix4D

To empower Pix4D to produce a high caliber and exact orthomosaic, we have to procure a progression of covering pictures with the automaton camera orientated 90° down, ie pointing directly at the ground; these are called nadir images. The camera needs gyroscopic adjustment to keep up the 90° downwards tilt. Pix4D prescribes at least 75% cover between pictures. To make it simple to do this Pix4D have made an application called Pix4D catch (which keeps running on the two iOS and Android) that controls the automaton. It works with the Phantom arrangement of automatons from the 2V+ onwards, the Inspire and some different automatons. When you open the application in your area it will download an elevated picture (expecting you have a web association) and you can draw a crate on the picture to feature the territory you need mapped. You at that point select the level of picture cover you need and the application will ascertain the matrix design it needs to fly and how as often as possible it requirements to take a still.

Figure 5.3.1 Acquiring images from drone to use in Pix4D

The application likewise contains choices to set the speed of the automaton. A quicker speed will enable you to cover a territory all the more rapidly which is helpful for substantial territories that should be filtered; notwithstanding, a slower speed will bring about higher quality pictures and a more precise task. There is likewise the alternative called 'SAFE' which makes the automaton stop before taking each picture. This outcomes in the best quality pictures yet takes longer and may surpass the battery life for the coveted lattice. The most critical setting in the application is the flight stature. On the off chance that you pick a high tallness the automaton doesn't have to fly the same number of legs to accomplish a similar rate cover as flying at a low tallness, so the zone is checked snappier. This is on account of at a high tallness each picture contains a higher evel of the coveted territory than pictures from a low stature. Be that as it may, pictures taken from a higher stature will as a rule result in a less precise task than pictures from a low tallness. What we have discovered functions admirably by and by is checking the whole mischance site from a stature of 50 m or 75 m, and afterward doing a moment output of the primary destruction zone from a tallness of 15 to 30 m. On the off chance that you're simply searching for a general outline picture, fly high. In case you're hoping to produce a precise 3D point cloud and profoundly definite pictures, fly low.There are numerous factors that influence exactness yet one of them is Ground Sampling

Distance (GSD). GSD is the separation between two continuous pixel fixates measured on the ground. For instance, in a picture with a 1 cm/pixel GSD, nearby pixels picture areas are 1 cm separated on the ground. The higher the GSD, the lower the spatial determination of the picture with less obvious points of interest. The GSD you can expect can be figured in view of camera stature, central length, sensor size and picture determination. The conditions can be discovered on the web and I've utilized an online calculator4 to decide tallness versus GSD esteems for the FC200 camera on the P2V+ ramble (Table 1). This camera has a central length of 5 mm, a sensor width of 6.17 mm, and a determination of 4384 x 3288 pixels.demonstrates the ground separate width of each picture and the separation you would need to permit between pictures to guarantee a 75% cover. At a low flight tallness of 10 m you would need to take an picture each 3.1 m.

Flight height (m)	GSD (cm/pixel)	Image width on ground (m)	Distance between images for 75% overlap (m)
10	0.28	12.3	3.1
20	0.56	24.7	6.2
30	0.84	37.0	9.3
40	1.13	49.4	12.3
50	1.41	61.7	15.4
60	1.69	74.0	18.5
70	1.97	86.4	21.6
80	2.25	98.7	24.7

Table 1

For instance, the red specks in Figure demonstrate the position of each of the pictures that were taken from a stature of 50 m to guarantee no less than a 75% cover.

Figure 5.3.2 Aquiring image from drone to use in Pix4D

The aggregate flight time, from departure to arriving, to catch the 59 pictures as above was 9 minutes. The Pix4D handling time for these 59 pictures was around 1.5 hours utilizing a fundamental portable PC and the coming about orthomosaic.

5.4 Cloud processing

Similarly as with any PC based innovation, ramble information handling has now started venturing into the cloud. This development brings out a considerable measure of energy about vastly adaptable computational power, web investigation calculations, and expanded 'end-to-end' work process mechanization. [4]

As of now, cloud-based stages have extended the accessibility of handling execution without the need to put resources into server foundation or top of the line PCs. This is great incentive for some endeavors. Notwithstanding, the straightforwardness and handling alternatives, accessible in neighborhood programs, has been taken cover behind a cloak of mechanization or expelled for 'one catch study' effortlessness.

VI. CHAPTER 6

6. Scope of work

6.1 Networking Towers

Figure 6.1 Networking Tower

The communication industry is as of now profiting by the utilization of UAV. Tower climbing is viewed as the most unsafe occupations and telecommunication operators can avoid chances by using drones for broadcast communications tower inspection. Commercial drones are changing the way administrators are reviewing and investigating remote foundation by empowering a more secure gathering of high-resolution imagery and video of tower structures and gear.[7]

Using drone, telecom administrators can cut expenses as they can lessen the utilization of helicopters and other little flying machine to examine inspect telecommunications assets. UAV likewise lessen the requirement for specialists to climb media communications towers to perform routine reviews and investigations. Drone utilized for tower review additionally enable administrators to rapidly recognize and confirm tower gear determinations and harm.

Various organizations are as of now offering administrators drone solutions for tower assessment. One of these organizations is Air ware, which is providing UAV solution with cloud-based assessment arranging, commercial operator software, vehicles with complex independence and on board available sensors, cloud information preparing, examination and detailing all inside a work process intended to empower organizations to incorporate elevated information into their current business procedures and frameworks.

6.2 Agricultural usage

Figure 6.2 Agricultural usage

Drone technology will give the agriculture industry a high-technology makeover, with planning and strategy based on real-time data gathering and processing. Following are four ways aerial and ground-based drones will be used throughout the crop cycle [8]:

1. Soil and field examination: Drones can be instrumental toward the beginning of the product cycle. They create exact 3-D maps for early soil examination, helpful in arranging seed planting designs.
2. Planting: Startups have made drone planting frameworks that accomplish a uptake rate of 75 percent and decrease planting costs by 85 percent. These frameworks shoot pods with seeds and plant supplements into the soil, giving plant all the supplements important to support life.
3.Crop spraying: Distance-measuring hardware—ultrasonic echoing and lasers, for example, those utilized as a part of the light-recognition and going, or LiDAR, strategy—empowers an automaton to alter elevation as the geology and topography fluctuate, and in this manner dodge impacts.
4. Crop monitoring: Vast fields and low efficiency in edit checking together make farming's largest obstacle. Monitoring challenges are exacerbated by increasingly unusual climate conditions, which drive hazard and field support costs. Beforehand, satellite imagery offered the most progressive type of observing.

6.3 Geographical information system

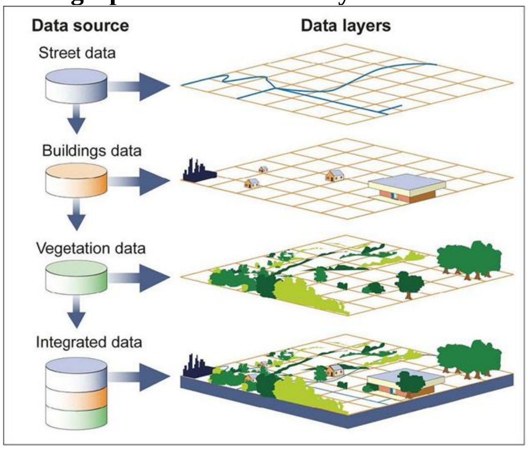

Figure 6.3 Geographical information system

A GIS is a PC program that can capture, store, arrange and display information identified with particular parts of the Earth's surface. GIS programs can demonstrate numerous kinds of information without a moment's delay on a similar guide. This allows scientists, historians and others to see patterns that might have otherwise gone unnoticed. GIS mapping enables us to perceive and dissect topographical connections, and we can utilize such data to detail intends to enhance life on Earth, and additionally the life of the Earth.

VII. CHAPTER 7

7. Conclusion/Contribution

Drones are widely used in many areas for different purposes. A few of these have been mentioned throughout the paper in the above. We have also seen the detection and analysis process of such drones.

In this paper the aim is to focus more on the petroleum industry and the difficulty it faces once there is a leakage or spill and how we can overcome this drawback using drones.

Traditionally, in the occurrence of a leakage, man power is required to go out into the field and do a few particular set of tasks which includes this set of men finding out the leakage, fixing it, reporting, monitoring etc., mainly to collect the leaked/spilt petrol. This process would not only take days but can even go up to months.

With the increase in technology these days, we are using drones to perform all of the above task.

By using this we can save time, man power also making this process cost efficient as man power cost is reduced.

The drones can be designed depending on the various types of fields and requirement of the user. In the case of petroleum leakages the drone must detect, analyze and report to the operator. In addition to the points earlier one of the contributions in this paper is that the drone must also collect the leaked/spilt petroleum, hence also saving lives. This can be done by the usage of a drone which has payload capabilities. The payload capability of the drone can range from 3Kg to 20Kg depending on the users requirement and the aspect which the user wants it to perform. The payload and the size of the drone are directly proportional, in other words, more the payload the bigger the drone must be.

Figure 7. Contribution

The leaked petrol is contained through brilliant direction age enlarged with picture preparing calculations (refer to detection and analysis section above).

Specific number of drones must be assigned to keep monitoring and checking for any leakages or spills. This in turn generally must be analyzed and reported at the base station where it will be evaluated by the operator. On basis of which operator will take a decision on the next action.

In this paper another contribution I would like to provide is that the drone must be self-sufficient which means that the drone should be intelligent enough that it does not need to wait on the next steps given by the operator. Generally, after the detection and analysis the data which is collected is processed at the base station and the operator decides on how to fix/solve this issue and then gives commands to the drone to perform the same. The contribution being given here is that this waiting time where the drones has to wait for the next command on how to proceed will be absent. Hence saving more time and making the process more efficient. This process can be done by implementing algorithms within the drone done by a programmer. After the analysis the drone must generated a report and on that report the drone must study it and act on the basis of this. These next steps can be set in the drone initially by the programmer. Hence the drone will be self-sufficient and after the task is done it should just provide the operator with the end result (solved issue).

For example: The drone is deployed in such a way that it is continuously monitoring the site. While monitoring if and when it detects any leakage it starts analyzing. Once the analysis is done due to the specific algorithm designed by the programmer, the next steps are to take place i.e.; the drone must start to collect the leaked petrol and at the same time must call upon another drone which only focuses on fixing the leakage in pipeline.

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