ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

INDUSTRIAL APPLICATIONS OF DRONES: AN INSIGHT

Ravi Katukam
Cyient Limited, Hyderabad, Ravi.Katukam@cyient.com

ABSTRACT

Drones are Micro, Mini, and Miniature Unmanned Air Vehicles which are capable of taking a payload along with sensor which can be used for sensing, image capturing. Drones have been extensively used for hobbyists to for photo shoots, sports shoots. In recent times FAA also certified the use of drones for film making and it is in the process of making regulations for drones for wide spread use in open spaces and private spaces. Apart from generic uses drones have potential use for industrial needs leading to increased productivity, humans' safety, access to hazardous environments. Current papers aim at high lighting the potential use of drones in aerospace, Oil & Gas, Solar, Mining, Manufacturing, after market industry. The paper highlights approach for identifying a engineering problem and integrate the solution with drone technology so that end to end engineering solution can be offered. Advancement in sensors technology, wireless communication, miniature power source is paving the way for numerous industrial applications for drones. The paper brings out the key factors for generating an application using drones in engineering domain.

Keywords: Drones, Engineering, Sensor, Integrated Solution

I. INTRODUCTION

Drones are Micro, Mini, and Miniature Unmanned Air Vehicles which are capable of taking a payload along with sensor which can be used for sensing, image capturing. Drones have been extensively used for hobbyists to for photo shoots, sports shoots. he future of the Small UAV market will be dominated by commercial &civil applications. However, the SUAVs will be used significantly in military as well as homeland security applications.Defense companies are focusing on this nascent market and investing heavily to develop more innovative applications for SUAVs that are more feasible, portable, and cost effective. Nano, Micro, Mini drones. Successful Industrial application of drones for industrial and enterprise needs is explored.

Unmanned Air vehicles have been existing since long, the mini, micro size drones coupled with variety of payload capability is leading to numerous industrial applications which a customer might use. Advancement in Technology Largely Drone research is focused on lab scale demonstration which has a controlled environment, but the practical application of drone needs to be done in an uncontrolled environment along humans, other living beings, human made and natural objects. So to be able to apply to a given practical application the drone needs to be intelligent and self-defensive.

- Progress on Auto Pilot Capability
- Progress in Applications
- Progress in Miniaturization-
- Progress Various Propulsion Systems

II. EMERGING MARKET

An estimated $ 6.4 billion is currently being spent each year on developing drone technology around the world [1], this would include cost of Research& Development, Testing, Manufacturing, and Operations. That number is expected to nearly double in future years, bringing the total amount spent on drones for both military and commercial applications to $ 11.5 billion annually by 2024. Drones as seen as emerging industry by 2025 the drone industry will employ 100,000 people and be worth $82 billion globally, according to the Association for Unmanned Vehicle Systems International. Drones when viewed as technology can transform the how industries across the globe operate by generating intelligent applications that addressed to solve specific industry problems. The expertise to design, build and operate, customize drones will make the engineering service enterprises a leadership position in future and also most sought after co-creator Global OEM's.

The report also classifies payloads which include sensor payload, camera, telemetry, NBC detection, and autopilot. Further, the sensor payloads are segmented into electro-optic, laser designator, meteorological sensor, and LiDAR. The market for sensor payload is estimated to grow at a CAGR of 13.41% during the forecast period. The market for Small UAV has maximum number of applications in commercial and civil sector which include agriculture, mining & natural resource exploration, wildlife research & survey, 3D mapping, film industry& photography, oil & gas, product delivery, and internet connectivity. Amongst all these applications of SUAV, agricultural sector are estimated to contribute highest market share; whereas, the product delivery market is estimated to grow at highest CAGR of 21.92% during the forecast period.The regional analysis offers the market share and size for the major regions of North America, Europe, APAC, the Middle East, Latin America, and Africa. Wherein, the Small UAV market is majorly acquired by North America and APAC region. During the forecast period, the market share for the regions of Africa and the Middle East are estimated to grow at a high CAGR. The report offers the leading competitors in the SUAV market, the general overview of the companies, and also provides their financial position, key products, and market share. The future of the Small UAV market will be dominated by commercial &civil applications. However, the SUAVs will be used significantly in military as well as homeland security applications.Defense companies are focusing on this nascent market and investing heavily to develop more innovative applications for SUAVs that are more feasible, portable, and cost effective. An estimated $ 6.4 billion is currently being spent each year on developing drone technology around the world [1], this would include cost of Research& Development, Testing, Manufacturing, and Operations. That number is expected to nearly double in future years, bringing the total amount spent on drones for both military and commercial applications to $ 11.5 billion annually by 2024. Drones as seen as emerging industry by 2025 the drone industry will employ 100,000 people and be worth $82 billion globally, according to the Association for Unmanned Vehicle Systems International. Drones when viewed as technology can transform the how industries across the globe operate by generating intelligent applications that addressed to solve specific industry problems. The expertise to design, build and operate, customize drones will make the engineering service enterprises a leadership position in future and also most sought after co-creator Global OEM's.

III. EMERGING TRENDS

While FAA is in the process of formalizing the regulatory requirements for drones in coming two years, Its time for Indian ESO Enterprises to leverage the rich domain expertise to create drone based solutions for OEM's to cut down cost, decrease manual dependency and help them to significantly reduce the product design cycle time and manufacturing time. A reliable Engineering service provider can significantly take away the burden of OEM's from the day to day routine process of data collection, assets maintenance, inspection to enable the OEM's to focus on new product definitions to meet growing customer needs in this globally competitive environment. Engineering Service Organizations need to proactively develop solutions using drone technology for their customer needs which would otherwise spent Time, Money, Effort, and Expertise. Drones are used for hobbies journalism, hunting, sports photography real estate sales, wildlife research, high way monitoring, and disaster relief. FAA also issued approval for drones use in Movie, Arial shooting Industrial drones are have less regulatory hassles they can operate under control private spaces. A regulatory hassle for industrial drones is minimal as they operate under major under private spaces.

Confluence of Advanced Technology

Advancement in Technology in the domain Materials like ultrahigh strength lightweight materials, Sensors, Propulsion, Wearable devices, Internet of things, Wearable devices computers makes it possible to imagine and innovate wide range drones ranging from a few meters size to a wristband size, Nixie is tiny drone [1], which can be worn while wrapped around the user's wrist. The drone will then be able to launch into the air to capture images from hard-to-reach locations. Similar to a boomerang, the Nixie quadcopter will then return to its owner after it has done its duty. The drone then automatically syncs the images that it took to the user's smartphone. The data from smart phone could be potentially coupled to big data

- Human Safety
- Programmable software
- New Sensors-New Applications

ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

Advancement in Technology in the domain Materials like ultrahigh strength light weight materials, Sensors, Propulsion, Wearable devices, Internet of things, Wearable devices computers makes it possible to imagine and innovate wide range drones ranging from a few meters size to a wristband size, Nixie is tiny drone [1], which can be worn while wrapped around the user's wrist. The drone will then be able to launch into the air to capture images from hard-to-reach locations. Similar to a boomerang, the Nixie quadcopter will then return to its owner after it has done its duty. The drone then automatically syncs the images that it took to the user's smartphone. The data from smart phone could be potentially coupled to big data generate instantaneous Engineering Analytics to make instantaneous decision in case of critical human safety scenarios, weather data monitoring.

IV. POTENTIAL INDUSTRIES FOR APPLICATION

Fleet Maintenance-lorry, 7buses, train, taxis	Disaster Management	River Pollution Monitoring
Rail track maintence	Power, Maintence	Energy Pipeline Maintenance
Flying Ambulance	Traffic congestion Management	Tourist Safety
Mountain,Himalayan surveillance	Flood, emergency scenario management	Water Body Health Monitoring
Civil Engineering Applications	Rural landscaping	Fire safety
Agriculture	Insurance	Agriculture
Fleet Maintenance	Disaster Management	River Pollution Monitoring
Rail track maintenance	Power, Maintence	
Flying Ambulance	Traffic congestion Management	Tourist Safety
Mountain,Himalayan surveillance	Flood,emergency scenario management	Water Body Health Monitoring
Civil Engineering Applications	Rural landscaping	Fire safety

V. INDUSTRIAL DRONES- FEW USE CASES

Within days of the Deep-water Horizon accident, British Petroleum began working with state and federal trustees through the natural resource damage assessment (NRDA) process to collect data to evaluate the potential for injury to wildlife and habitat, and the recreational use of these resources [2]. Deep-water Horizon accident continues to play an important role in understanding its causes, preventing future accidents and improving the safety of deep-water drilling. Transocean, The world's largest drilling contractor has faced staffing problems long before its Deep-water Horizon rig exploded. To find people to work in highly unsafe environment is a challenge to Rig operators. Periodic monitoring of Rig is also a challenge [3] Telecom Fixed assets management [4] remains an important competitive differentiator as it presents significant operational and internal control challenges for telecom operators like Bharathee. For those with fixed assets worth more than US$41 billion, teams of more than 200 are working for management. Operators are also becoming increasingly diligent in reviewing asset services lives annually, as well as in a more sophisticated manner with the use of integrated ERP systems. They dedicate teams cost, effort, energy on fixed assists Can WE think of solution to speedy, reliable, fixed assets management for global telecom operators?

RioTinto is using advanced airborne gravity gradiometer technology for mineral exploration as exploration is time-consuming and expensive, making an unsuccessful attempt extremely costly. For global Oil & Gas Industry [6] Advanced leak detection will have profoundly impact the way that utilities approach pipeline safety. According to the U.S. Pipeline and Hazardous Safety Administration, natural gas pipeline

failures cause an average of 17 fatalities, 68 injuries and $133 million in property damage every year. Leaks also annually contribute to $3 billion of lost and unaccounted for natural gas—impacting the bottom line for companies both upstream and downstream. Unmanned radiation measurement Drone can be used for nuclear industry for radiation level monitoring which is a regulatory norm for continued operation and inspection. A similar system is employed at Japan's Fukushima Daiichi Nuclear power plant.

PG&E routinely uses a specialized helicopter to wash a targeted set of power lines that tend to accumulate significant amounts of contamination throughout the year such as dirt, salt and bird excrement. This contamination can build up inside electric insulating equipment and cause power outages. PG&E can clean about 150 electric towers and cover approximately 20 miles a day with a helicopter as opposed to about 50 towers a day with a line washing truck. In total, PG&E cleans 11,000 to 12,000 targeted electric towers each year As recent information shows companies like Xcel energy which recently completed a $110 million 34-mile, 24-inch diameter natural gas pipeline to serve a gas-fired generation plant might need an intelligent leak monitoring system and autonomous aerial inspection system. Oil field service provider Schlumberger has been pursuing autonomous modes of improving its operations.

Belgacom a major Belgium telecom company can largely benefit if the solutions to telecom asset management can be custom made and can be monitored in a virtual environment. Drones not only used in load pay load activities, they can also perform heavy lifiting/heavy Engineering activities,Drone Robotics Introduces New Robot To Do The Heavy Lifting For The Business World. Photovoltaic Thermography has been used to know health of large solar power plants by major energy players

For Aerospace & Defense the challenge of Mid Air Refueling has been challenge to which was recently performed by drones. A recent test of Defense Advanced Research Projects Agency (DARPA) has completed autonomous refueling trials with two Northrop Grumman RQ-4 Global Hawks, demonstrating that unmanned air vehicles could refuel in mid-air. This would open up the possibility of "flying gas stations

Easy jet is using mini drones for MRO Operations. Uk based Airline operator Easy Jet is experimenting the use of drone for MRO operations. Aircraft Manufacturing and MRO can benefit largely from Drones. The drones are fitted with high definition video cameras but can also use lasers to scan the outside of the aircraft "We could zoom [the laser scanner] up and down the aircraft and map the surface," he said. "If we've mapped the aeroplane we can have a complete history of its full life

In Rail transportation industry drones are used for predictive maintenance and security on the railway network. The winter storms of 2014 saw extensive damage to the infrastructure on the South Coast. Network Rail used a drone to monitor the rebuilding of around 100 meters of sea wall in Dawlish,[7] Devon which was destroyed by the storms. Union Pacific is exploring at drones to improve the efficiency of maintenance on the network, Deutsche Bahn (DB), Europe's largest railway and rail infrastructure operator began last year using drones in an effort to combat graffiti-spraying gangs. Removing graffiti costs DB €7.6million a year and its hoped these drones will help lower this annual cost. Light rail network in Jerusalem, drones are being deployed to act as extra surveillance following recent riots which saw stations and tracks of the line destroyed. Australia's largest rail freight operator Aurizon has begun testing the use of unmanned aerial vehicles for inspections of assets along its central Queensland coal network. Can WE explore similar opportunities with Our Esteemed Customers in Rail?

Qimarox[8], a material-handling company based in the Netherlands, is studying the use of drones for picking goods off shelves and assembling them into pallet loads – inside a warehouse. The company envisions manufacturers of consumer products using drones to design a compact, flexible and scalable palletizing process to help in manufacturing plants. To automating picking processes within their warehouses – a task that can be effectively planned and optimized for As we have been helping our customers in DNO to improve their productivity, meet resources shortage, cost cut down, quick turnaround time for projects. With values FIRST we helped customers highest quality, on time delivery on each project, it's now time that we understand customer problems proactively, help them speak out engineering problems, define them so that together WE can solve them by using rich domain expertise armed with emerging technology trends. As Innovation has become an inevitable for every organization, those who can identify right problems can become successful innovator. Technology has been the driving force for industrial and engineering innovation and progress, mastering the

technology and applying technology tools to solve customer problem makes engineering enterprises a long term market leader. Advent of new technology like unmanned aerial technology or drones will enable us to think beyond the traditional frame of problem solving. As Drones are available in small, micro, mini sized with varying payload capability ranging from few grams to tons. It's up to the imagination of our engineers to develop applications to solve problems of our customers.

VI. KEY FACTORS FOR DRONE APPLICATION

- **Define a Customer problem**

  Essential element in applying drones application is defining the problem right to understand what kind of information/data is needed to be assessed by drone and what kind of decision are made based on the data. So that best in class hardware can be deployed Unstructured Environments Hovering capability

- **Understand Safety, Security, Regulation as applicable**

FAA is in the process of deciding drone use regulation; ensure that the intended use does violate safety security of individuals organizations involved

Determine appropriate Sensing mechanism & Payload requirements Practicable application requires longer endurance, better control, and more robust return-to-home features. It should not be difficult to evolve existing products to offers these enhancements. Longer endurance is simply is available simply from increasing battery capacity. As a general matter, basic airframe weight, exclusive of battery, motors, and control systems scale linearly. As power requirements increase, motor weight increases linearly. Likewise, as battery capacity increases, battery weight increases linearly.

- **Challenges for widespread use of Drones**

  Control strategies for a given application area with limited discussion hardware necessities and propulsion methodsHighlights the Engineering and Technology gaps with focus on commercial application (not lab scale application)Highlights the need for apps that can be used to operate drones for varied applications Add-ins'/ Embedment's/ intelligent sensors Regulations & Law Enforcement Lack of Complete Autonomous Capability Limitations on sensors Limited battery Life with heavy weight Expert Dependency Drone operation for a domestic application

- **Integrated Solution as End-to-End offering**

Coupling the drone technology with big data can significantly improve the decisions making process in engineering industry. Drones need to be coupled to virtual platforms for monitoring and two way communications; hence effort needs to take to develop an intelligent virtual platform for each of defined customer needs. Further on, updation of as-built networks onto a digital diagram will require integration with commercial digitization's tools.

VII. CONCLUSION

Drones as an industry would open up opportunities of design, development, and aftermarket services and also drone as technology would open up opportunities of to solve engineering problems in aerospace, defense, medical, oil and gas, solar, etc. As drone technologies is emerging, there is need to understand develop solutions around these technologies for future. Embedded sensors, integration with big data would enable the engineers provide solutions that will lead to productivity and less human dependency. Based on the working environment as relevant for chosen customer problem determine state of the sensing mechanism, Live streaming of data may be useful in case industries like oil leak detection, geo exploration, hazard & disaster management. Also possible usage of ultra-high strength materials, best in class propulsion system for improved payload capability and long flight range and duration should be considered.

REFERENCES

I. http://www.oscars.org/press/pressreleases/2014/20140108.html
II. http://en.wikipedia.org/wiki/Deepwater_Horizon_oil_spill
III. online.wsj.com/.../SB10001424052748704268004575417383606531658
IV. http://www.atkearney.com/documents/10192/5099581/Telecom+Assets-+Unlocking+the+Trillion-Dollar+Treasure+Chest.pdf/d9fe9622-9f59-48fd-9101-49db354c5b26
V. http://nicholas.duke.edu/news/5900-natural-gas-leaks-discovered-under-washington-dc
VI. http://www.smartrailworld.com/how_drones_are_already-being-used-by-railways-around-the-

ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

world

VII. http://mhlnews.com/technology-amp-automation/drone-palletizing-qimarox