Understanding the Drone Revolution

The origins of modern drones go back six decades to the early 1960s, when radio-controlled hobby aircraft became widely available in the western world. The introduction of these aircraft was made possible by advances in radio technology at the time. While these aircraft were available to the general public, their audience was limited to enthusiasts, who were willing to put in the time and money needed to understand and operate these sophisticated machines.

One of the main challenges in these machines was learning how to operate and maintain the complex glow engines that were specifically designed for these applications. Though powerful, these engines were noisy and polluting, which meant that such planes needed to be operated far away from populated areas. Then there were the bulky and power-hungry radios that had limited range. Many model aircraft crashed after they lost contact with the transmitter.

Finally, there was the complexity of flying itself. without any electronic aids, the model aircraft had to be trimmed correctly and flown accurately without the benefit of a first-person view.

Despite these challenges there were a significant number of enthusiasts that took to radio controlled aircraft. Consequently, there existed an ecosystem that served the needs of this niche market. Kolkata, was one of the early Indian hubs for this hobby and it eventually spread to other metro cities by the 1990s.

Despite being overshadowed by drones that have now come to take center stage, the hobbyist radio control aircraft ecosystem continues to thrive. Models have gotten more complex and several are now powered by jet engines. These high-end models can cost several thousand dollars and can achieve speeds as high as 500 mph. Needless to say, most require a special FAA license to fly them.

Technology Shifts

While the introduction of drones into our everyday life can be best described as explosive and sudden, the technologies that underpinned this revolution grew at a more linear pace.

Electric propulsion systems

Electric motors are lightweight, have few moving parts and are extremely durable. However, for a large part of the 20th century they simply lacked the power to weight ratio to be used for such applications. A significant step forward in motor design came with the invention of the brushless DC motor in the 1960s. However, it would take over four decades of advancements in control electronics and metallurgy before these motors became a viable choice for drone manufacturers .

The Glow Engine

A glow plug engine, or glow engine, is a type of small internal combustion engine typically used in model aircraft, model cars and similar applications. The ignition is accomplished by a combination of heating from compression, heating from a glow plug and the catalytic effect of the platinum within the glow plug on the methanol within the fuel.

The glow plugs used in model engines are significantly different from those used in full-size diesel engines. In full-size engines, the glow plug is used only for starting. In model engines, the glow plug is an integral part of the ignition system because of the catalytic effect of the platinum wire. The glow plug is a durable, mostly platinum, helical wire filament recessed into the plug's tip. When an electric current runs through the plug, or when exposed to the heat of the combustion chamber, the filament glows, enabling it to help ignite the Glow fuel used by these engines.

Glow fuel generally consists of methanol with varying degrees of nitromethane content as an oxidizer for greater power, generally between 5% and 30% of the total blend. These volatiles are suspended in a base oil of castor oil, synthetic oil or a blend of both for lubrication and heat control

Today a number of motor/propeller combinations have an efficiency exceeding 70%. This is nearly twice the energy efficiency of a modern petrol engine.

The introduction of high efficiency BLDC motors was just half the puzzle, the other half was finding a suitable way to power them.

Energy Storage

Think of batteries and the first thought that comes to your mind are alkaline AA or AAA batteries. Indeed, these were the energy storage devices of choice for many years. The phenomenal growth in portable electronic devices has spurred the development and commercialization of a number of battery chemistries. Some of the initial battery chemistries included Nickel Cadmium and Nickel Metal Hydride.

Today, the industry standard is the Lithium Polymer or LiPo battery. As these batteries are used in a variety of applications they are produced at a massive scale. Consequently, they are incredibly cheap and have specific energies as high as 158 Watt Hours per kilogram. This represents a three-fold improvement over alkaline batteries.

With these energy dense batteries available at rock bottom prices, the efficient BLDC motor had found the perfect match.

Flight Control Electronics

Remember how one of the biggest challenges for hobbyists was actually flying the aircraft. This problem was solved not by leveraging the rigid laws for physics but rather by leveraging Moore's law of computing. As predicted, microchips became more powerful and energy efficient while simultaneously becoming cheaper to manufacture. About 15 years ago these chips finally became powerful enough to perform the complex calculations required by modern drones.

By writing a complex algorithm which is referred to as a flight controller, engineers were able

Understanding Quadcopters

A quadcopter or quadrotor is a type of helicopter with four rotors. Each rotor produces both lift and torque about its center of rotation, as well as drag opposite to the vehicle's direction of flight.

If all four rotors are spinning at the same speed, with two rotating clockwise and two counterclockwise, the net torque about the yaw axis is zero, which means there is no need for a tail rotor as on conventional helicopters. Yaw is induced by mismatching the balance in aerodynamic torques. This is achieved by offsetting the cumulative thrust commands between the counter-rotating blade pairs.

Quadcopters generally have two rotors spinning clockwise (CW) and two counterclockwise (CCW). Flight control is provided by independent variation of the speed and hence lift and torque of each rotor. Pitch and roll are controlled by varying the net centre of thrust, with yaw controlled by varying the net torque.

For small drones, quadcopters are cheaper and more durable than conventional helicopters due to their mechanical simplicity. Their smaller blades are also advantageous because they possess less kinetic energy, reducing their ability to cause damage. For small-scale quadcopters, this makes the vehicles safer for close interaction. It is also possible to fit quadcopters with guards that enclose the rotors, further reducing the potential for damage. However, as size increases, fixed propeller quadcopters develop disadvantages relative to conventional helicopters.

Increasing blade size increases their momentum. This means that changes in blade speed take longer, which negatively impacts control. Helicopters do not experience this problem as increasing the size of the rotor disk does not significantly impact the ability to control blade pitch.

Gimbals: The secret behind smooth drone videos

The gimbal was first described by the Greek inventor Philo of Byzantium (280–220 BC). It is A gimbal is a pivoted support that permits rotation of an object about an axis. A set of three gimbals, one mounted on the other with orthogonal pivot axes, may be used to allow an object mounted on the innermost gimbal to remain independent of the rotation of its support.

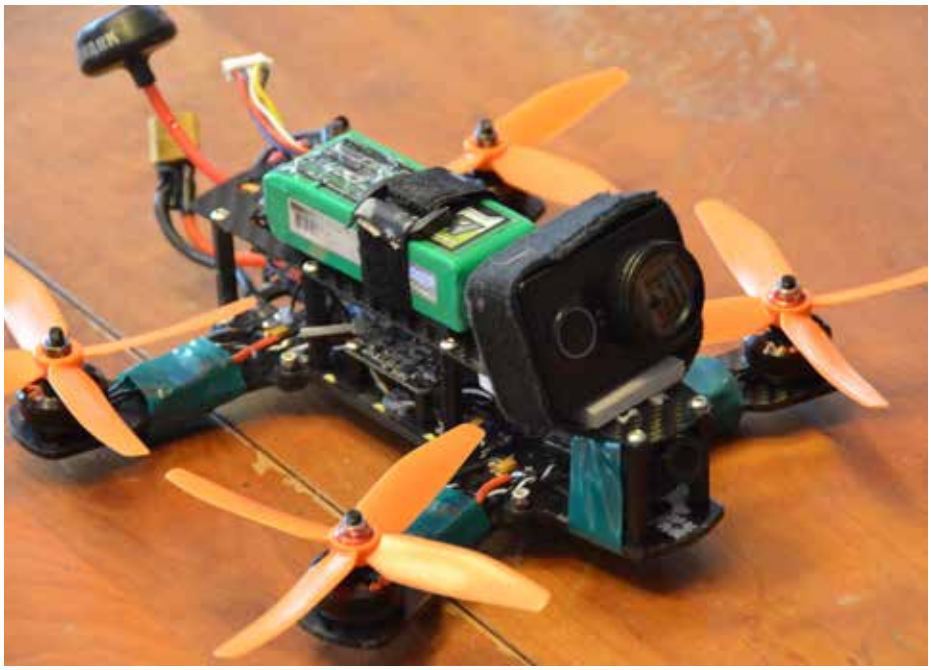
Mounting cameras on drones use the same concept but with one notable difference. Sophisticated electronics now allow the drone operator to control the onboard camera independent of the motion of the drone. To do this a sophisticated IMU detects changes to the drone's orientation in real time, any changes in the drone's position are quickly relayed to control unit that then adjust the position of each ring in the gyro with the help of small motors.

to get microchips to do much of the hard work of flying. This also opened the avenues to design complex aircraft configurations that were previously beyond the capabilities of human control.

Today an inexpensive "computer" can not only control the drone, but also perform several secondary functions such as processing video feeds, controlling external sensors and ensuring that the drone does not hit any obstacle.

Supporting Developments

One of the key developments in the evolution of drones was the miniaturization of Inertial Measurement Units (IMU). The IMU is the critical sensory system for the flight controller without which the flight control algorithm simply cannot obtain the inputs needed for flying the aircraft. Along with the development of the IMU, the miniaturization of GPS receivers greatly enhanced the ability to produce drones that are easy to fly.



Lastly improvements in wireless communications allowed for improved command and control at greater distances. These improvements subsequently enabled a real time video feed to the drone operator, making it possible to fly greater distances in a safe manner.

Though not directly related to building a drone, video sharing services allowed content taken from drones to travel around the globe and create demand that was based on utility rather than hobby.

DJI Phantom: The iPod Moment for Drones

Da-Jiang Innovations, popularly known as DJI, was founded in 2006 by Frank Wang, a student at the Hong Kong University of Science and Technology. From 2006 to 2013 the company launched several models that met with limited success in a nascent drone market.

All that changed in 2013 when the company launched the Phantom 1 drone in the United States market.

It's quadcopter design was easy to "fly" because the flight control algorithm actually controlled the vehicle. With the heavy lifting done by computers, all the operator had to do was command the drone to go up or down, left or right and rotate.

Its lithium-Ion battery pack gave it a usable flight time of 10 minutes. As the battery pack was easily swappable, most users simply carried multiple battery packs for extended flight times.

The initial control system was similar to those used for RC flying but much simpler. It was able to eliminate the need for trimming wheels and for the need to hold the throttle at a certain level. With the on-board GPS system, the Phantom could hold its position in three-dimension space without any external control. If the drone ever went out of the operator's sight or lost control with the control system, it would simply fly back to the start position and land itself.

In addition, the Phantom could carry a GoPro action camera. This found it a niche market among adventure sports enthusiasts who were already using the camera to capture and share their adventures. Needless to say as the videos went viral so did the demand for Phantom drones and the rest is history.

The phantom line of drones has been joined by others from the DJI stable and the company offers one of the most comprehensive lineup of consumer drones. Today DJI is synonymous with the word drone. It commands over 70% of the consumer drone market, its nearest rivals hold a mere 5% of the market.

Beyond Consumer Drones

The technologies that spurred the introduction of consumer drones continue to progress unabated. Consequently, drones too are becoming more capable with the passage of time. With their low cost of operation, ease of maintenance and high degree of autonomy, drones are excellent candidates for performing predictable tasks in dangerous environments. By deploying drones, companies across industries are looking to improve operating efficiencies and reduce costs.

Intel partnered with Airbus to conduct exterior aircraft inspections with UAVs. Intel supplied drones outfitted with cameras that allow them to collect images and data that can be used to create detailed, 3D-models of the Airbus fleet. Airbus has also launched its own drone subsidiary called Airbus Aerial, which looks to provide inspection services across a variety of industries.

Building Ecosystems

As we adapt drones to industrial use cases, there is bound to be an increase in drone complexity. In addition, the level of safety required of drone operations will be comparable to that of mainstream aviation operations. Thus, it is likely that businesses will outsource the actual operation of drones to a competent entity. The growth and development of such full service providers, will ensure that industries are able to leverage this new class of aircraft. In certain industries such as logistics the adoption of drones will hold the key to boosting efficiencies and remaining globally competitive.

The government has taken note of building such an ecosystem, and consequently the Centre-run flight training institute Indira Gandhi Rashtriya Uran Akademi (IGRUA) has announced its expansion plan to begin drone pilot training courses, a first of its kind initiative by a government body. The premier aircraft pilot training institute in Uttar Pradesh had recently entered into an agreement with Delhi-based private firm Drone Destination for the collaborative effort.

This is a huge step forward for the ecosystem. FTP

Indira Gandhi Rashtriya Uran Akademi Inks Training Pact With Drone Destination

Government-run premier flying training institute, Indira Gandhi Rashtriya Uran Akademi (IGRUA) has inked an initial pact with Drone Destination to launch drone pilot training courses for aspirant professionals at the former's Amethi campus in Uttar Pradesh.

Drone Destination is a sister-concern of the Delhi-based remotely piloted aircraft (RPA) manufacturing firm Hubblefly Technologies.

Under the memorandum of understanding (MoU), the institute will provide its state-of-the-art infrastructure and Drone Destination its domain expertise in training drone pilots at the campus.

"This MoU enables both the organisations to provide the best drone training to aspiring drone professionals using IGRUA's state of the art infrastructure and Drone Destination's expertise in providing high quality, professional drone training," said Krishnendu Gupta, Director, IGRUA.

Drone Destination aims to develop an integrated eco-system for RPAs right from manufacturing to training, services insurance, leasing and finance, as per the release.

The robust training programs will create responsible industry-ready drone pilots who maintain the highest levels of safety and security of the sky, said Chirag Sharma, Founder and Chief Executive Officer, Drone Destination.