WWW.NEWELECTRONICS.CO.UK

VOLUME 56 / ISSUE 09
SEPTEMBER 2023

new electronics

DELIVERING MORE EFFICIENT FABS

HOW CAN TECHNOLOGY HELP SEMICONDUCTOR COMPANIES ADDRESS THE GROWING COMPLEXITIES OF CHIP PRODUCTION?

newelectronics

New Electronics keeps designers and managers abreast of the latest developments in the world's fastest moving industry

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ISSN 0047-9624 Online ISSN 2049-2316

Annual subscription (12 issues):
UK £108. Overseas; £163. Airmail; £199.
New Electronics, incorporating Electronic Equipment News and Electronics News, is published monthly by MA Business, Hawley Mill, Hawley Road, Dartford, DA2 7TJ. T: 01322 221144
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MA Business
Part of
Mark Allen
www.markallengroup.com

Printed by: Pensord Press Ltd, CF48 3TD.

SEPTEMBER ISSUE

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DID YOU KNOW?

$25bn The projected value of the UAV market in 2027

ADDRESSING UAV DESIGN COMPLEXITY

CHRIS BOWERS and HUGH WRATTEN consider the key design challenges associated with UAVs and how best to overcome them

In recent years, there has been, and continues to be, a huge increase in the demand for unmanned aerial vehicles (UAVs) and as the technology improves and expectations of what UAVs are capable of grow, so do the challenges and complexity for designers.

There are four key areas of focus that designers are battling with today: information gathering, command and control, networking and processing.

The market for UAVs has changed fundamentally in the last decade. In the military context, we have seen a shift from expensive, high-tech machines such as America's Reaper Drone, to lower cost drones that can be used en masse.

This is true from mid-level 'loitering munitions' that simply fly into their target with a payload attached, or even more crudely, homemade UAVs that take a domestic model and customise it to drop grenades or take videos. These devices have been used with great effectiveness on both sides of the Ukrainian conflict.

However, before the war, the development of these entry to mid-level drones was mainly driven by industries and hobbyists.

"The industrial use for drones is where the potential really comes alive, with a myriad of component choices to suit a huge array of missions," explains Chris Bowers, a Field Applications Engineer at Solid State Supplies. "For example, the agricultural use of drones could be anything from remote-controlled, low-range models that use a camera to store data on-board for future viewing, through to live streaming drones that automatically fly a pre-set route over huge landmasses, while recording HD video. Military uses only add to the countless design choices – with new priorities to consider such as encryption and armament.

"There is a vast number of options for drone applications. As with most devices, the mission and context will be the deciding factors regarding which components are best suited."

INFORMATION GATHERING

The first aspects to consider are how data will be collected and what then needs to happen to that data. According to Hugh Wratten, Franchise Manager, Solid State Supplies, "In a basic application, a simple camera may capture rudimentary footage which is stored in local memory on the drone itself. The data does not need to be transmitted by the drone but can be viewed once the drone has safely returned.

"At the other end of the complexity spectrum, a drone may need to provide live streaming – performing both the capture and the transmission of video data, and possibly also feeding back corresponding positional information. Applications such as inspection of asset damage for insurance purposes would require higher quality video, which would of course mean a much larger volume of data."

PROCESSOR POWER

The more complex the functionality of the drone, the more powerful a processor is needed. An MCU, or microcontroller unit, is the cheapest and most basic. In many cases, it won't be sending data back – and any footage or data will be stored on board. This is the type of processor found in most 'off the shelf' models.

A step up here would be an MPU, or microprocessor unit – more complex but able to support a wider range of functions and which can often still be bought as a standard component. The next progression would be to an FPGA, or field-programmable gate array.

"FPGAs are modular chips that provide a customised solution, such as by interfacing with customisable logic conditions, non-standard parts, or other specialist attachments or functions.

"Finally, full custom processors are the most advanced and expensive solutions for highly advanced, specialist devices," explains Bowers. "These are not neat separations - grey areas exist between the four approaches, and several can be used in unison –

for example, a quadcopter drone might use four simple MCUs, one to power each propeller, with an MPU or FPGA to process power management, camera operation, and communications."

COMMUNICATIONS

The simplest type of drone communication could be a basic radio link to a control unit sitting in the hands of the pilot, who guides it by line of sight. Alternatively, Wi-Fi connectivity can provide short range network connectivity. Naturally, this limits the range to what the pilot can see (or the range of the Wi-Fi signal, which is usually about 150 feet max).

Less frequently used is a drone-to-drone comms configuration – in which a drone will position itself according to one or more other drones, such as for aerial visual displays. Of course, one drone within the formation will have to fly a pre-ordained or manually flown path.

Finally, and paradoxically at its most complex, a drone may not need to communicate at all – if it can either set out on a pre-determined fixed path or fly by itself using artificial intelligence. The former has no connectivity or communication needs, whereas the latter would need a powerful computer to process the data required by AI algorithms.

Assuming some signal does need to be sent back to the operator, the range of the drone will be the most important factor to consider when choosing a type of network or connectivity. If a drone flies out of range of the pilot, then the signal will need to reach the operator from the maximum potential distance of the mission.

Several options become available here, according to Wratten. "Drones may connect via 4G or 5G, which is the easiest and cheapest way, providing near-infinite range and therefore allowing you to launch a fully remote drone from anywhere. However, this will necessitate a modem on board the drone, which adds weight, and the computing power needed to process the signal.

"It would also require a central modem, which is no problem in most applications, as either there will be pre-existing networks, or if not, one could take a modem to isolated and unconnected places. In a conflict situation, however, this becomes more challenging because if the central connectivity node is destroyed, the signal will then be lost.

"Alternatively, more sophisticated military deployments may employ mmWave, which uses a local network of self-healing nodes to provide a signal. If one is destroyed, the rest fill in the gaps. The potential for conflict will also decide how threat resistant the signal needs to be against potential jamming or interception attempts – which of course will require a much more powerful processor."

PROPULSION METHOD

The final area to consider is the method of propulsion. The majority of drones are battery powered, particularly for non-military uses. Here, the same rules apply as for batteries in any other vehicle – power adds weight, and more weight means more batteries are needed to increase range. This may not matter if you plan to fly the drone for short time periods before returning to charge, or better still, if there is a replaceable battery so you can interchange them between charges.

Bowers adds, "The only other option is a combustion engine, which rarely means large engines or jets as these are only found on the biggest and most advanced drones, and so usually refers to something like an engine used on remote control aircraft. Choosing this method over a battery will further the range, as conventional fuel rather than battery capacity can be added which minimises weight, and furthermore, the engine can charge the drone."

THE MISSION DECIDES THE FORMAT

Thanks to advancements in both conventional and military uses, the market for drones has grown larger and much more complex. Consequently, there are now many options to consider when specifying or designing a drone. The most important thing to always consider from the outset is the final mission or context in which the drone will be used. Only then can you begin to identify the core components and ensure you design and deliver a fit-for-purpose solution that meets requirements. NE