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Invisible Drone- A New Design to Spy



Abstract: A recently created technologically based drone is called The Invisible Drone. The main goal of the invisible drone is to solve the issue of drone visibility while flying in the air at a specific height. There are specific parts to the undetectable drone. The functioning of these parts renders the drone undetectable by converting the drone into a camouflage drone which is used to produce an optical illusion. This optical illusion is obtained by the complex-shaped display screen which will change its color based on the surrounding color. The camera which is placed at the top will identify the color and then the same color is broadcasted on the display screen. This paper is limited to the design of an invisible drone with the projection of colors projection as per surrounding colors. The invisibility of the drone will be achieved by installing a display screen at the outer surface of the drone body which will include a camera in the middle of the front side of the display screen. The microcontroller is linked to both the camera and the display panel. The microcontroller is configured such that the camera records the surrounding scenery identifies the color and projects it on the display screen. This drone is converted into a camouflage drone and thus, it causes an optical illusion.

Keywords: Invisible drone, complex display screen, optical illusion, and camouflage drone.

I. INTRODUCTION

Drones have been around for a while now. The unmanned aerial automobiles had been created in the early 1900s by Nikola Tesla and William Crozier. In recent years, the drone era has truly come into its own, with newbie drones getting superior and popular than ever before. In many areas, drone technologies are extremely important. Drones are used in many real-time applications in industries like construction, military, aerial photography, marketing, delivery, agriculture, rescue, and entertainment. In many areas, drone technologies are extremely important. [18] Drones are used in many real-time uses in industries like construction, military, aerial photography, marketing, delivery, agriculture, rescue, and entertainment. The major utilization of drones is for military applications as mentioned below:

Since they were initially introduced to the military- industrial complex, drones have radically changed defense and combat operations. Unmanned ground or aerial vehicles are not a new concept, but there are unquestionably numerous advantages to using them. Drones have improved military capabilities globally in a variety of ways. Additionally, it will continue to alter armed conflict in the following ways:

- a) Improved Target Collection, Surveillance, and Reconnaissance (RSTA): The locations of objectives, the topography, and enemy movements are all made known to ground commanders in real-time via drones. Drones can take photos and movies at a closer range without sacrificing resolution when compared to high-altitude aircraft.
- b) Lower Cost: Drones cost less to purchase and maintain than traditional aircraft. There is less chance of a pilot getting hurt when flying a drone because they are unmanned.
- c) More Practical: Drones are more quickly and easily deployable than traditional planes. Compared to the bulk of aircraft, they are simpler to use and require less training. In addition, many drones do not require runways, and some may be carried in a backpack with ease.
- d) Improved Security: Drone pilots can offer real-time data without putting themselves in danger. The same data also instructs commanders on the best locations for their soldiers to be secure.

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- e) Improved Flexibility: Military personnel are expected to always be prepared for anything. Drones are the clearest illustration of the military-industrial complex's equipment that emphasizes this demand. Drones can also function completely on its own. More military initiatives are now using drone technology, which is being developed by several military warfare companies. Due to their numerous advantages and benefits, they are highly beneficial in a variety of occupations. As a result, more militaries are looking into deploying drones to improve their capacity for combat and surveillance. The following are the tasks that drones are most frequently used for:
 - i) By repeatedly circling a target location, drones can carry out surveillance operations.
 - ii) Drones can transmit vital information for command and control about the locations of significant targets.
 - iii) Unmanned vehicles are used extensively in combat and combat support activities. Operators can hit their targets with greater accuracy and precision thanks to the existing targeting software.
 - iv) Target practice and training drills using UAVs can improve operators' accuracy. Target detection and reaction are automated by targeting software that is embedded into drones.
 - v) Drones can be used to transfer essential supplies and equipment as well as act as military-industrial couriers. Additionally, they could support evacuation attempts.

With the recent surge in consumer drone sales, they may now also be evolving for commercial uses. The development of drones over time shows that, despite initial military focus, industrial drones are today used for a wide variety of purposes. [1] The popularity of drones and unmanned aerial vehicles in 2014 was unimaginably unanticipated. More than a million civilian drones were reportedly sold in 2015, according to numerous shops, as civilian drone sales topped military drone sales. However, a 2014 prediction was made in a documentary about the drone industry's likely future. Back then, drones were viewed as enigmatic, impenetrable weapons for the navy. One of the best-kept secrets in the American army was the use of the drone. Drones can operate independently using onboard computer systems, remotely controlled by a human operator, or without a pilot. These days, drones are employed for risky or dirty missions. [2] The records of drones and toy drones show that, like maximum present-day technology.

Looking into the scenario of military requirements and the threat at the borders, the idea of an invisible drone came into the picture. This paper focuses on the design, working, and analysis of invisible drones. Section II explains the importance of drones in the military. Section III proposes and explains the Invisible drone. Section IV proposes the design. The analysis of the proposed idea is projected in Section V.

II. IMPORTANCE OF DRONES IN MILITARY

The Second Nagorno-Karabakh War started on September 27, 2020, following a brief confrontation between Armenia and Azerbaijan near Tovuz in July 2020. As a result of the fighting, Azerbaijan achieved significant gains in the occupied Nagorno-Karabakh territory, while the Armenian forces suffered devastating losses. The 44-day operation saw Turkey, which gave Azerbaijan diplomatic and military support, play a vital role in the retaking of Baku's occupied areas. Particularly following Armenia's assault on Tovuz, Turkey made it obvious that it was in Baku's favor, and the Nagorno-Karabakh conflict moved from words to deeds. Azerbaijan was given access to a variety of Unmanned Aerial Vehicle inventories from the Turkish military industry. (UAVs). The status quo that Russia had established in the area was altered as a result, and Armenia, which Moscow had long backed, was defeated by Azerbaijan on the field.

Turkish Bayraktar TB2 (Fig. 1) UAVs inflicted substantial deaths in the fight, especially to mechanized forces and air defense systems. Turkey had successfully utilized these UAVs in operations in Syria and Libya. Roketsan MAM-L laser-guided bombs were one of the main weapons used in the Nagorno-Karabakh War and were launched by these UAVs. The significant contribution of the UAVs provided by Turkey and Israel, as well as the advisory role played by Turkish top military personnel in Azerbaijan's operational plans and command, are two factors that observers consider to be "magic bullets" for Azerbaijan's military success. [19] It is important to note that, in contrast to the second conflict, which involved an army still operating in the 20th century and a modern army built to Western standards, the first conflict involved two armies based on the foundation of Soviet military tradition. According to several analysts and former diplomats, the scale of the fighting and the fact that Turkey supported Azerbaijan more directly made the second war different. [20]



Fig. 1 Participating in a military parade in Baku to commemorate the end of the military conflict in Nagorno-Karabakh is the Bayraktar TB2 produced by Baykar Makina in Turkey. [21]

The main problem for drones is being detected by radar cameras or IR detection. But it is not possible for an invisible drone because this drone has a special shield that will block infrared rays, and it will convert radio waves into DC power. Finally, it uses a display screen to produce a camouflage effect. The outer body of the drone is covered with a display screen which will generate optical illusion. Upon the display screen a two-layered transparent shield is covered for protecting the display screen and also blocking some number of infrared waves and the last layer which is attached to the screen has micro antenna that will convert radio waves into DC power. This drone is autonomous means just we need to give the starting and final point when the drone reaches the targeted place, we can use a drone to demolish the target by dropping a missile or by self-killing. And, we can use this on spy operations by using mini/spy drones/ insect drones. Since spy drones have very low range, we are using invisible drones to act as a bridge for spy drones and operators.

III. INVISIBLE DRONE

A drone that takes images in all directions, or 360 tiers, using a screening technology is known as an invisible drone. The videos may be revamped to any view after recording, making the drone invisible. In other words, invisible drones allow you to fly an "invisible" camera through the air and capture 360° aerial footage without the drone being visible everywhere. Of course, the Pavo360 is not the first invisible drone; there are currently a number of them on the market. [3] Unlike manned aircraft, which most radars are designed to detect, drones are flown remotely. They can move evasively or unpredictably at varying speeds, especially in bad circumstances like fog, which makes them considerably harder to identify. Drones can also move in large groups called swarms. No longer is it clear whether one wants to know how to make drones undetectable. Since most drones are too small to be picked up by radar, they are difficult to find and track. If you made the radar capable of detecting smaller objects, birds might produce a lot of unpleasant unwanted returns.

However, drones emit electromagnetic radiation that may be detected by directional antennas feeding correctly tuned receivers, allowing for the use of a number of these dispersed structures to track them. One transmitter is typically used for video downlink while the other is used for telemetry by drones. The receiver that drones use emits electromagnetic radiation (EM radiation or "radio noise"), even though they lack both of these qualities, which may conceivably be used to song or advise the drone. I would claim that drones may be tracked and traced as a result. The distinctive feature of the invisible drone is its capacity to turn invisible while in flight, which also facilitates communication with other diminutive spy drones like the black hornet, axis vidius, and insect drones. An invisible drone floats over the electric board while carrying small drones. Since the invisible drone is surrounded by display panels, it creates illusion by showing scenes from the opposing sides of its surroundings. The primary objective of the invisible drone is to address the issue of visibility while flying at a specific altitude. The drone will use display screens to produce an optical illusion that will make it look like it has disappeared. To disappear, the drone will create an optical illusion. The ability to vanish while in flight makes the invisible drone unique, and it aids in communication with other small spy drones like the black hornet, axis vidius, and insect drones. Small drones are carried inside an invisible drone that hovers over the electric board.

As the invisible drone has display screens all around the drones it generates the illusion by displaying the

scenes of the opposite sides of its surroundings.

a) Benefits of Invisible Drone

The benefits of the invisible drone are: -

- The drone will be invisible in the air.
- It is used for security purposes and surveillance.
- It is used in the military; navy & air forces.
- It can be used as an advertising purpose.
- It can be used as a carrier for small drones & act as a bridge for operators.

b) Design of Invisible Drone

In any designing software like SolidWorks, Correlator3D, SIMNET, etc, the Design of the invisible drone is as shown in Fig. 2.

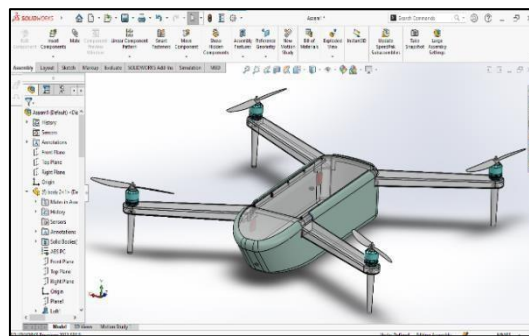


Fig.2 Invisible Drone

The invisible drone has certain components. The working of these components makes the drone invisible. The invisible drone has complex-shaped display screens at the body of the drone (front, back, right, left & bottom) with the camera placed at the center of the front side and also at the top side shown in Fig 2. This display screen is supported by the frames of the drone. The display screen is placed on the outer surface of the drone body. The invisible drone contains transmitters & receivers. when the drone is flying in the air at a specific height, the camera will identify the color of the surroundings transfer that data to the flight controller, and project it into the display screen

c) The Inventive step

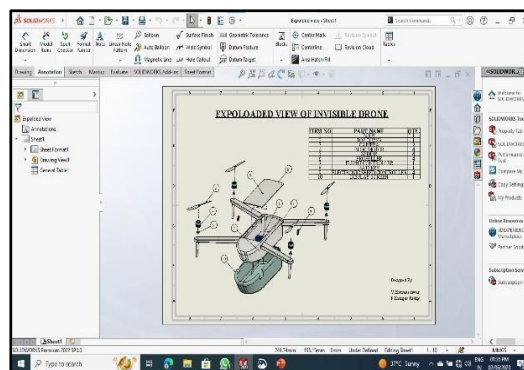


Fig.3 Part view of Invisible Drone

- i) **Aero Screen:** - The drone will get an aerodynamic design through the Aero Screen. A drone's aerodynamic shape is made to reduce drag caused by air currents, wind, and other environmental factors. Airfoils and bodies are designed using aerodynamic shapes. The fluid that surrounds an object and applies force to it is what creates the

lift. The portion of this force that is parallel to the incoming flow is known as the lift. [5] In contrast to drag force, which is the component of the force that is parallel to the flow direction, it is the opposite. The lift can also act at an angle to any flow. However, it typically acts upward to oppose the force of gravity.[4]

- ii) **Propeller:** - The propeller is the device that converts rotational motion into linear propulsion. By creating airflow and a difference in pressure between the top and bottom surfaces of the propeller, drone propellers raise the drone off the ground. When a mass of air is accelerated in one direction, lift is produced, which opposes the gravitational pull of the earth. For balance on multirotor drones, the hexacopter, octocopter, and quadcopter propellers are coupled and rotated either clockwise or anticlockwise. The drone can modify its yaw, pitch, and roll as well as hover, rise, and fall by varying the speed of these propellers. [5]
- iii) **Electronic Speed Controller:** - Drone electronic speed controls are typically rated to have a maximum current. As seen in Fig. 4, ESCs with a higher current draw are frequently larger and heavier, which may be a major problem for smaller UAVs. The number of times the motor speed may be changed each second is indicated by the ESC's refresh rate, which is measured in Hertz. Electronic speed controllers for quadcopters and other multirotor drones may have greater refresh rates because the stability and maneuverability of these devices depend on the balance of rotor speeds.



Fig. 4 Electronic Speed Controller {ESC}

Active or regenerative braking, which is the process of converting a motor's mechanical energy into electrical energy that might be used to recharge the drone's battery, can also be controlled by electronic speed controls. The motor can act as a generator when speeding up, and the ESC controls any extra current that might be sent back into the battery. [6]

- iv) **Batteries:** - When it comes to battery performance, the higher the number, the better. So, pick a battery with a high mAh rating if you want a strong battery. The amount of energy that a battery can store is measured in mill ampere-hours, or mAh. The battery will last longer if it has a higher mAh rating. For instance, a battery with a 5000 mAh capacity may run a device for five hours. Maintenance, Analysis, and Handling of Batteries is referred to as Mah battery, as shown in Fig 5. In essence, it's a method of maintaining your batteries and ensuring their functionality.[7]



Fig.5 Battery

Battery Indicator: - Devices that show the condition of a battery are called battery indicators. Furthermore, visual cues on battery indicators frequently accurately reflect the battery's state of charge. A battery indicator as shown in Fig 6 is also always included in any gadget that depends on a strong battery to operate. Two examples of this technology are smartphones and personal computers. [8]



Fig. 6 Battery Indicator

- v) **Receiver:** - The "receiver" in the communication process is the individual (or group of people) to whom a message is addressed. Other names for the receiver include "audience" and "decoder." When work starts in the invisible drone, the individual who sends the first message during the communication process is referred to as the "sender." When a message is recognized as the sender intended, it has been successfully sent. The intended message might not reach the intended recipient because of issues on either end. We can already tell how the receiver looks from the diagram we discussed in ECG. [9]
- vi) **Motor:** - Electrically linked DC motors without brushes are brushless DC motors, also referred to as BLDC motors (Fig. 7) or BL motors. The controller regulates the synchronous motor's speed and torque by delivering brief current bursts to the motor windings. These motors have a remarkable ability to generate a lot of torque over a wide speed range. Brushless motors do not require an electrical connection to the armature because they have a fixed armature with permanent magnets. Electronic-based transportation offers a lot of flexibility and alternatives. They are renowned for their quiet operation and capacity to hold torque while at rest. [10]

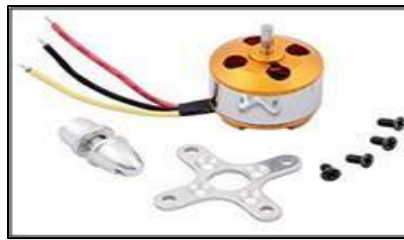


Fig.7 BLDC Motor

- vii) **Flight Controller (Fig 8):** - A circuit board with electronic chips on it makes up the fundamental building block of a flight controller. They may be compared to the motherboard and processor in a laptop. The brain of a drone is the flight controller. The drone's operations are managed and controlled by a small box equipped with sophisticated electronics and software. Flight controllers come in a variety of sizes and intellect levels, just like the brains of other species.[11]

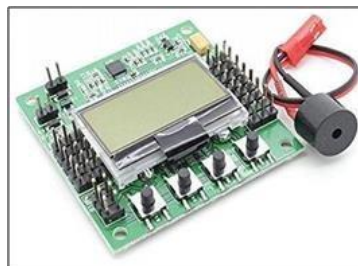


Fig. 8 Flight Controller

- viii) **Remote Control:** - A drone controller communicates with the drone by radio transmission using a remote control to give it instructions. The radio transmitter of the drone controller transmits radio signals that are picked up by the drone's receiver. The drone controller is frequently referred to as a drone radio transmitter or a drone radio controller as a result. [12]
- ix) **Display Screen:** - A display is a tool for displaying information visually. Any display's main objective is to facilitate information exchange. Today, a wide variety of displays are accessible, each with a unique set of uses. The three types of displays that are available are video displays, non-video displays, and 3D displays. Understanding the displays that are currently available is crucial because there is an increasing requirement for high-quality screens. The entire screen of a video display, which is effectively a rectangle, is a two-dimensional display. [13]
- x) **Camera:** The optical equipment used to capture visual images is a camera. Cameras are made up of sealed boxes (the camera body) with a minute whole (the aperture) that lets light pass through

(usually, a digital sensor or photographic film) to capture an image on a light-sensitive surface. To regulate the amount of light that reaches the light-sensitive surface, cameras employ a variety of techniques. The light that enters the camera is focused on by lenses. The aperture can be adjusted in size. A shutter mechanism controls how long the photosensitive surface is exposed to light. [14]

- xi) **Microcontroller:** Microcontrollers are integrated circuit (IC) devices that commonly use memory, peripherals, and a microprocessor unit (MPU) to control other electronic system components. These gadgets are designed for embedded software that needs fast, accurate communication with analog, digital, or electromechanical components in addition to computing power. [15] A system component that manages a single function is a microcontroller. It achieves this by using its main CPU to analyse the data that it receives from its I/O peripherals. The processor uses instructions from its programmed memory to interpret and apply incoming input using temporary data stored in the microcontroller's data memory, which the processor accesses. Microcontrollers are used in numerous devices and systems. Devices commonly employ many microcontrollers to fulfil a variety of tasks. [16]

IV. Working of Invisible Drone

Although most people may believe that operating a drone is simple, it has a lot of difficult technology. Before delving into the inner workings of how drones and helicopters operate, it's critical to understand the differences between the two. The former, however, can fly on its own without a pilot. A drone has a specially created multi-propeller system that increases autonomy while reducing failure rates. This gadget includes many propellers, so even if one of the motors malfunctions, it will still be able to fly thanks to the propellers working together to support it. Huge-motor drones can change their elevation while in flight, allowing them to carry more cargo.

Most of these gadgets have detachable batteries, which allow them to hover for extended periods. A dedicated source powers these propellers. Using powerful batteries will extend a device's flight time. The drones' flying system would be incomplete without these. This gadget includes many propellers, so even if one of the motors malfunctions, it will still be able to fly thanks to the propellers working together to support it. Huge-motor drones can change their elevation while in flight, allowing them to carry more cargo. The majority of these gadgets have detachable batteries, which allow them to hover for extended periods.

A dedicated source powers these propellers. Using powerful batteries will extend a device's flight time. The drones' flying system would be incomplete without these. A controller's primary responsibility is to create a trustworthy communication path between the remote device and the radio waves. Most drones operate in the 2.4 GHz frequency range, and many of their controllers actively pick where to fly thanks to Wi-Fi networks. There are many similarities between smartphones and drones, including the use of GPS, Wi-Fi, and other standard sensor units. These built-in sensors help the drone stay in the air for a long time and make wise decisions about its height, direction, and other crucial actions. The 3-dimensional view and rotational direction of the propeller of the invisible drone are shown in fig 9 & 10

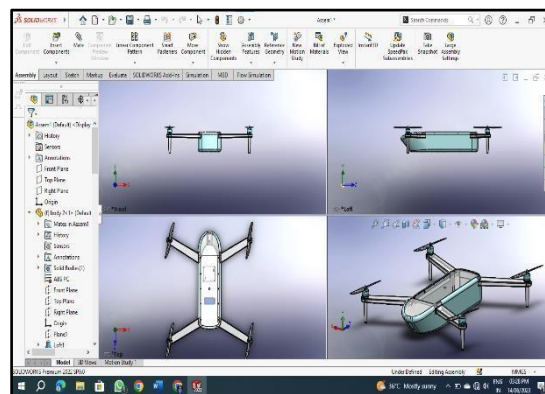


Fig.9 All Sides View of Invisible Drone

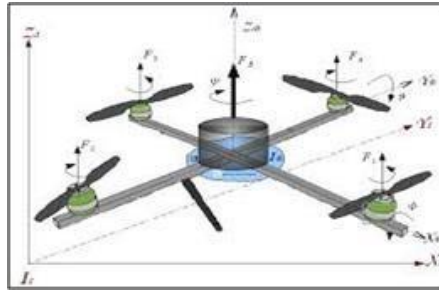


Fig.10 Rotating Direction of Propeller

An internal propeller system controls the landing process as well, and sensors make decisions about its speed, altitude, and motor rotation, among other things. A drone is an intelligent aircraft that has powerful batteries that allow it to travel great distances while providing you with secret information like a spy. The invisibility of the drone will be achieved by installing a display screen at the outer surface of the drone body which will include a camera in the middle of the front side of the display screen. The microcontroller is linked to both the camera and the display panel. The microcontroller is configured such that the camera records the surrounding scenery identifies the color and projects it on the display screen. This drone is converted into a camouflage drone and thus, it causes an optical illusion. Since this drone is invisible to

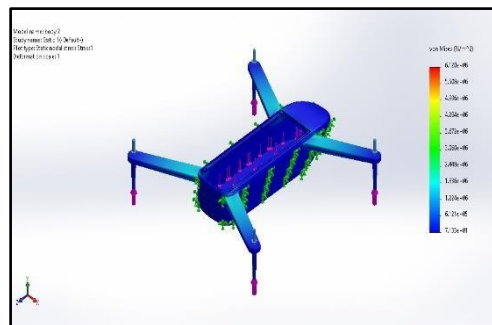


Fig.11 Static Force Analysis of Arm / Frame Member

V. Computational Analysis results

Solid Works is used for computational analysis, a contemporary technique for reproducing an experimental approach. Understanding how the system behaves under controlled settings is made easier with the aid of computational analysis. Two distinct analysis models have been conducted to comprehend the behaviour of the invisible drone.

a) Structural Analysis

The invisible drone frame undergoes various forces on its structural model, in which the majority of the force is due to the thrust generated by the propeller and the weight of the multi-rotor system.

Table 1 Material Properties

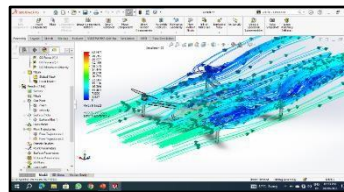
Name:	ABS PC
Model type:	Linear Elastic Isotropic
Tensile strength:	4e+07 N/m ²
Elastic modulus:	2.41e+09 N/m ²
Poisson's ratio:	0.3897
Mass density:	1,070 kg/m ³
Shear modulus:	8.622e+08 N/m ²

Table 2 Static Force Analysis Study Result

Stress Analysis	
Min	Max
7.133e+01 N/m ² Node: 158479	6.120e+06N/m ² Node: 8638
Displacement Analysis	
Min	Max
0.000e+00mm Node: 17	2.127e+00mm Node: 73647
Stain Analysis	
Min	Max
3.026e-08 Element: 191056	1.772e-03 Element: 14126

b) Aerodynamic Flow Simulation

The invisible drone was the subject of an aerodynamic investigation to see how air pressure might impact it when it was in the air. Fig 12 below analyses the aerodynamics of the invisible drone. According to the study, the drone is protected by air pressure. The pressure on the drone will be represented by the light green line (moderate pressure lines), while the sky-blue lines will stand in for atmospheric pressure at normal levels.

**Fig 12 Flow Simulation on Invisible Drone****VI. CHALLENGES**

There are 3 main challenges to developing invisible drones in the real world:

1. R&D & Manufacturing of Transparent Shield

- The shield consists of millions of small rectennas that will harvest energy from radio waves.
- The outer layer of the shield is layered with thin transparent material which will block thermal rays.

2. R&D & Manufacturing of Display Screen

- LCD screen is used to generate optical illusion.
- Since this display screen is so flexible it will cover all sides of the drone except the top side.

3. Integration of Display Screen & Camera

- The integration of the display screen & camera is used to project matching colors onto the display screen through a microcontroller.
- The main challenge is to connect and maintain continuous transmission of the projection of colors on the display screens.

VII. CONCLUSION

In the following years, there will be new requirements for the board application of future invisible drones. Drones can visit locations that are unreachable to humans, technological advancements increase speed and efficiency, and the major goal is to eliminate human error. Furthermore, a manufacturer-independent method of achieving a seamless migration of such reconfigurable manufacturing systems into the digital

world is required. To accomplish use cases in any way, it will also be crucial to expand drone structure and new models. The upshot of this process is that the human eye creates an optical illusion. The unique ability of the invisible drone to disappear while in flight is one of its specialties.

The invisible drone has its specialty of becoming invisible while flying in the air. As the invisible drone has display screens all around the drones it generates the illusion by displaying the scenes of the opposite sides of its surroundings. The invisibility of the drone will be achieved by installing a display screen at the outer surface of the drone body which will include a camera in the middle of the front side of the display screen. The microcontroller is linked to both the camera and the display panel. The microcontroller is configured such that the camera records the surrounding scenery, identifies the color and projects it on the display screen. This drone is converted into a camouflage drone and thus, it causes an optical illusion.

Nevertheless, there will be still demand in upcoming years for many more activities. We say it's the beginning of technology and to take the step forward with more unique methodologies and techniques that would be represented in the market.

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