AUTONOMOUS SURVEILLANCE DRONE WITH FIRST PERSON VIEW AND FACIAL RECOGNITION

PS.Subramaniaraja, J.Gajapathi

UG Student, Dept. Of ECE, Panimalar Engineering College, Chennai, India

Assistant Professor, Dept. Of ECE, Panimalar Engineering College, Chennai, India

ABSTRACT: Autonomous surveillance drone with first person view and facial recognition will help the role of monitoring a controlled environment without any manual control.

To provide surveillance remotely to an organization or to disaster relief search by using an autonomous drone paired by Li-ion battery 2200mAh, which uses FPV at approximately 150 fps. Being built with open-source flight controller (APM 2.4.8), the UAV is designed to manoeuvre either manually or in autopilot mode using the compass and GPS module integrated with its embedded system. While on surveillance, drones can be equipped with face recognition feature to demand for the granted entries, which use CNN algorithm to recognize the registered using particular face extraction recognition principle, but optimising the performance applied on this algorithm is done using the exploitation of GPU of Raspberry Pi.

UAVs play a major role for the acquisition of data from the available resources by controlling them remotely. This brings a problem statement to provide ill-defined experience with the acquired data from the resources, which can be solved by using FPV to have a precise analysis of the medium.

The remote flight system with stable buffers can help the drones to function without any hinderance to the air tractions and obstacles on its time of flight, as it is highly preferable to conserve energy that are wasted to encounter the hinderances. The auto-pilot mode lets the operator to set waypoints in the maps via machine planner, letting the drones to hover with effective displacement.

Recently, drones have been involved in several critical tasks such as infrastructure inspection, crisis response, and search and rescue operations. Such drones mostly use sophisticated computer vision techniques to effectively avoid obstacles and, thereby, require high computational power. Therefore, this work tuned and tested a computationally inexpensive algorithm, previously developed by the authors, for adaptive obstacle avoidance control of a drone. The algorithm aims at protecting the drone from entering in complex situations such as deadlocks and corners. The algorithm has been validated through simulation and implemented on a newly developed drone platform for infrastructure inspection. The design of the drone platform and the experimental results are presented in this study.

KEYWORDS: Unmanned Aerial Vehicle (UAV); First-person view (FPV); Ardu-Pilot Mega (APM); Ground control systems (GCS); Universal asynchronous receiver-transmitter (UART),

I. INTRODUCTION

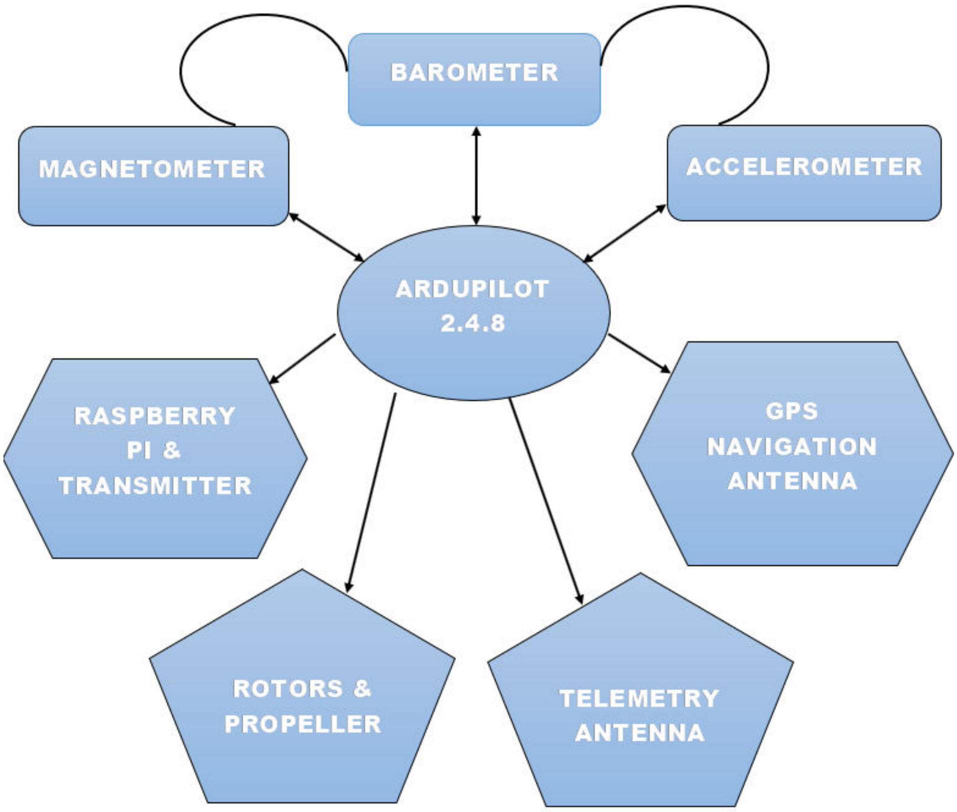
In the recent trends, UAVs play a major role in the fields of agriculture, patrolling, geographical survey, photography and payload delivery. UAVs with camera providing FPV feature, helps the operator to get more defined experience over the purpose of the drone, while remotely controlling it or by switching to autopilot mode. The usage of Ardu-Pilot helps to calibrate UAVs precisely by its user interface and kernel commands. UAVs play a major role for the acquisition of data from the available resources by controlling them remotely. This brings a problem statement to provide ill-defined experience with the acquired data from the resources, which can be solved by using FPV to have a precise analysis of the medium. The visual perception of every details analysed in the area of inspection is highly required to be optimized and ill structured so that any visual feed is on good quality [1]. This can bring us to concepts of having a First-person camera making the visual details more reliable to categorizes the objects detected in the video. It lets the user to get every stat on the FPV goggles. One of the biggest challenges of unmanned aerial vehicles (UAV) (drones, UAV) is their teleoperation from the ground. Both researchers and regulators are pointing at mixed scenarios in which control of autonomous flying robots creates handover situations where humans must regain control under specific circumstances. UAV fly at high speeds and can be dangerous. Therefore, ground control handover needs to be fast and optimal. The quality of the teleoperation has implications not only for stable drone navigation but also for developing autonomous systems themselves because captured flight footage can be used to train new control policies. Hence, there is a need to better understand the implications of the ground control and find a solution that provides the best combination of human teleoperation and autonomous control in one visual setup. Existing commercial drones can be controlled either from a third person view (TPV) or from a first-person view (FPV). The TPV type of operation creates control and safety problems, since operators have difficulty guessing the drone orientation and may not be able to keep eye contact with them even at short distances (>100 m). Furthermore, given that effective human stereo vision is limited to 19 m, it is hard for humans to estimate drone's position relative to nearby objects to avoid obstacles and control attitude/altitude. In such cases, the ground control gets more challenging the further the drone gets from the operator. UAVs play a major role for the acquisition of data from the available resources by controlling them remotely. This brings a problem statement to provide ill-defined experience with the acquired data from the resources, which can be solved by using FPV to have a precise analysis of the medium. The remote flight system with stable buffers can help the drones to function without any hinderance to the air tractions and obstacles on its time of flight, as it is highly preferable to conserve energy that are wasted to encounter the hinderances. The auto-pilot mode lets the operator to set waypoints in the maps via machine planner, letting the drones to hover with effective displacement. Image recognition and detection is a complex process that demands a lot of calculations. It requires using complex decision systems. Their speed depends on the processing algorithms applied and the implementation method of these algorithms. The implementation should efficiently use the hardware platform on which the system runs. Usage of AI methods and machine learning in processing, allows to gain greater system effectiveness than using algorithms and rules that ire established by programmer at the time of system implementation. By fusing such system with movable sensors, which can provide stream of digital images, allows us to observe (in real time) a selected area under search for requested objects. Additionally, if my system has base data of object types of the requested object, I can classify my object more accurately. The system proposed in this article is used for identification of people who are located in an area of special security. The system contains a learning sub-system and a processing subsystem. The next chapters describe each component of system and most significant algorithms which have particular influence on the system's performance. The UAV provides FPV with autopilot manoeuvre using commercial flight controller hardware which has magnetometer, accelerometer and barometer. The machine planner provides complete stats for the flight hovering which enables stable flight time. The computer vision algorithm used in the project helps to grant access with face recognition or identifies object with trained MLP models based upon accuracy equivalence.

II. RELATED WORK

In [2] the author had designed in a wat that the user can set mission with multiple waypoints and the PID controller to control MAV autonomously moving along the waypoint to the desired position without remotely controlled by radio control and guidance of pilot. The results show PID controller is capable to control MAV to move to the desired position with high accuracy. As the conclusion, the result of real flight experiment shows that the %OS of designed PID controller for x is 13% while y is 11.89% and z is 2.34%. Meanwhile, SteadyState error for all axis is 0%. This shows that the performance of PID controller is satisfied. Hence, the quadrotor MAV could move to the desired location via waypoint navigation without guidance of pilot. Quad-rotor MAV is getting more useful for people as they are often used to capture pictures, send parcels and even do constructions. But problems arise when the task is beyond the pilot's sights as pilots are unable to control the MAV in order to complete the mission. Paper [3] presents a brief idea about drones, their technology, the process to make that technology energy efficient and can be used for different purposes. Major aim of the prototype is for surveillance of terrifying notions and hidden activities which can be captured in the camera which gives us an aerial view of objects. Paper presents a brief idea about advancements in drones using Raspberry PI. A camera is attached with drone which helps PI to capture images and then PI can process it further to recognize person. The drone can be controlled from server room. The video can be seen live in the server room and simultaneously stored in the server. [3] The main aim of the project as per the author is to recognize the face of person using drone camera and load all information about that person sitting in the server room. It is useful for biometric attendance, for military operations at remote areas and for surveillance purpose. Prototype is designed with high-tech specifications where it is made more stable and noise reduction feature is added. Depending upon the criteria more feature can be added. Detection of object with the help of artificial neural network has come out to be another useful way, where GPU are used to process algorithms. To reduce the time consumption highly configured graphic cards which can process large amount of data in a small interval of time. Searching in Image space and Efficient Histogram equalization are the algorithms used in execution. Multiple images from drone are captured to create a database of sub system processing. Implementation of AI for object detection with the use of Neural network. It helps the system to get a knowledge about the requested object. Digital neurons never get tired as compared to the biological neurons which helps the system to maintain the quality of processing constant.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 07 | July - 2021 ISSN: 2582-3930

III. PROPOSED BLOCK DIAGRAM



IV. METHODOLOGY

GYROSCOPE TECHNOLOGY WITHIN THE IMU: The main function of gyroscope technology is to improve the drones flight capabilities. The drone's hardware, software and algorithms work together to improve all aspects of the flight including hovering perfectly still or taking steep angled turns. A drone with six axis gimbal feeds information to the IMU and flight controller to vastly improve the flight capabilities.

The gyroscope needs to work almost instantly to the forces moving against the drone (gravity, wind etc.) to keep it stabilized. The gyroscope provides essential navigational information to the central flight control systems.

AUTO-PILOT NAVIGATION USING APM: An Unmanned Aerial Vehicle (UAV) is a pilotless aerial vehicle which can be controlled either autonomously by onboard computers or remotely controlled by a pilot at the Ground Control Station (GCS). Nowadays, commercial drones are used to support critical services such as forest fire and illegal hunting detection, search and rescue operations or for delivering something to customers. For this purpose, they are often equipped with a navigation system (GPS), a camera and an audio interface. Furthermore, they have a radio that enables wireless communication with a GCS or a remote control. In particular, the wireless communication channel opens up the door for several types of remote attacks. In this case, data-link should be safe and it has to provide low network latency. A communication link between APM and the GCS is established using a MAVLink communication protocol. MAVLINK PROTOCOL The Micro Air Vehicle Link Communication Protocol allows entities to communicate over a wireless channel. When used in drones, it is used for the bidirectional communications between the drone and the GCS. The GCS sends commands and controls to the drone whereas the drone sends telemetry and status information. The APM 2.8 autopilot module in this research is configured to analyse network latency and data loss between GCS and autopilot. Mission Planner supports configuring telemetry radios using a simple GUI interface.

Wireshark software is used to capture and analyse packets transmitted over the data-link. The measurements of average network latency and packet loss of the MAVLink communication protocol during each attempt leading to auto-pilot navigation.

FIRST PERSON VIEW: My proposed FPV setup is to be understood as a piece to be combined with autonomous obstacle avoidance algorithms that run on the drone's onboard computer using the same cameras. Overall, I believe that such a system will enhance the control and security of the drone with trajectory correction, crash prevention, and safety landing systems. Furthermore, the combination of a human FPV drone control with automatic low-level obstacle avoidance is superior to fully autonomous systems at the time of writing. In fact, current regulations are required to contemplate handover situations. While the human operator is responsible for higher level navigation guidance with current regulations, the low-level automatic obstacle avoidance could decrease operator's cognitive load and increase the security of the system. My FPV system can be used for both operator's FPV drone control and automatic obstacle avoidance. In addition, my system can be used to collect training data for machine learning algorithms for fully autonomous drones. Modern machine learning approaches with deep neural networks need big data sets to train the systems; such data sets need to be collected with optimal navigation examples that can be obtained using ground FPV navigation systems. With my setup, the same stereo cameras can be used to evaluate the navigation during semiautonomous or autonomous flying and also to provide an optimal fully immersive FPV drone control from the ground when needed.

OBJECT DETECTION IN DRONE: The basic principle used for drone is to make it produce an optimum amount of thrust which will help the drone to raise and due to its light weight, we are able to frequently move it from one place to another. There are some modes attached to my drone such as Horizon which is used for a stable flight and 3 Acro which is used to move drones at high speed. There are few fail safe mechanism attached to my system which helps us to prevent it from accidents. Coming to second part of my drone where Raspberry Pi is attached with camera is kept at the centre of Drone. VNC server client connection is used to remotely access the Raspberry Pi. Considering security as the most important issue we are have enabled a password protection to my raspberry Pi. With the help of open CV and lbph algorithm we have trained the machine where the training data is used and the test data is captured from the real time environment. We have used support vector machine for labelling of the data. We the help of remote access we are able to record the video that is being transmitted which can be further used for analysis purpose. The data will be stored in Memory card attached to the Raspberry Pi.

V. RESULTS

The autonomous drone is designed using a bunch of thrust to weight ratio by calibration of each parameter via several aerial sorties. This project can the help the future evolution of drone industry to rely on an autonomous architecture which does the function of many different constituents individually. The technology developed helps to recognize objects or face, to either grant access or to deny by the means of floating databases available in infrastructure. The drives by the efficiency of obstacle avoidance and stable auto pilot mode which extend the accessibility of the manoeuvring beyond the traditional transmitter- receiver manual control.

Figure 1: Drone Model

Components	*No. of quantity*	*Mass per quantity (g)*	*Total mass (g)*
X Airframe	1	460	460
Battery 3S (11.1V)	1	420	420
Motor	4	52	208
Raspberry Pi	1	45	45
Navio2	1	23	23
ESC	4	14	56
Telemetry Air Module	1	12	12
BB Alarm	1	11	11
Propeller protector	4	11	44
Propeller	4	8	32
Power Module and cables	1	25	25
		Grand total	1336

Table 1: Thrust-to-weight ratio calculation

VI. Conclusion and Future Work

From the experiments on different GPU systems, it was evident that Jetson AGX Xavier was powerful enough to work as a replacement of a GPU system like NVidia GTX 1080. All sorts of contemporary target detection algorithm performed very well in Jetson Xavier. Jetson TX1 is feasible if the user uses a small weight or model like YOLOv2 tiny. Because YOLOv2 and v3 tiny showed reasonable FPS results for object detection, they were not good enough to detect a target from a far distance. Moreover, the confidence output for using the weight of YOLO tiny was very low. Jetson Tx2 is a moderate GPU system. The performance was not like that of the Xavier, but it showed outstanding results in the case to YOLOv2 and SSD-Caffe. If there was a limitation in drone weight and power consumption, a neural computing stick attached to the system was quite helpful. Among the three on-board GPU-constrained systems, Odroid XU4 with NCS showed better performances. We also presented the algorithm procedure for tracking with the respective embedded system. We also presented the runtime, GPU consumption, and size of the platform used for the experiment. Another major part of this project is power consumption. When we compare these with the military drone they can stay above the ground for hours or days at a time. Their advanced cameras can scan huge areas, or alternatively, can give us a clarity on a newspaper text from 20,000 meters. Our prototype can be used for lesser time, but the advantages are quite similar to these military drones which costs very high. We are also trying to extend our project in the field of landmine detection which will lead to a sustainable platform were the major difficulties come when we are trying to distinguish between metal, bomb and making the circuit small.

VII. References

[1] Z. Zaheer, A. Usmani, E. Khan and M. A. Qadeer, "Aerial surveillance system using UAV," 2016 Thirteenth International Conference on Wireless and Optical Communications Networks (WOCN), Hyderabad, 2016, Pp.1-7. doi: 10.1109/WOCN.2016.7759885

[2] E. Wang, S. Zhang and Z. Zhang, "Research on Composite Material UAV Low-Cost Avionics System Prototype," 2012 8th International Conference on Wireless Communications, Networking and Mobile Computing, Shanghai, 2012, pp. 1-4. doi: 10.1109/WiCOM.2012.6478650

[3] C. G. Sărăcin, I. Dragoş and A. I. Chirilă, "Powering aerial surveillance drones," 2017 10th International Symposium on Advanced Topics in Electrical Engineering (ATEE), Bucharest, 2017, pp.237-240. doi: 10.1109/ATEE.2017.7905185

[4] Yoon, Y.; Gruber, S.; Krakow, L.; Pack, D. Autonomous target detection and localization using cooperative unmanned aerial vehicles. In Optimization and Cooperative Control Strategies; Springer: Berlin/Heidelberg, Germany, 2009; pp. 195–205.

[5] Gietelink, O.; Ploeg, J.; De Schutter, B.; Verhaegen, M. Development of advanced driver assistance systems with vehicle hardware-in-the-loop simulations. Veh. Syst. Dyn. 2006, 44, 569–590.
[6] Geronimo, D.; Lopez, A.M.; Sappa, A.D.; Graf, T. Survey of pedestrian detection for advanced driver assistance systems. IEEE Trans. Pattern Anal. Mach. Intell. 2010, 32, 1239–1258.
[7] M. Nieuwenhuisen, D. Droeschel, M. Beul, and S.Behnke, "Autonomous Navigation for Micro Aerial Vehicles in Complex GNSS-denied Environments," J. Intell. Robot. Syst. Theory Appl., vol. 84, no. 1–4, pp. 199–216, 2016.
[8] N. A. Ismail, N. L. Othman, Z. M. Zain, D. Pebrianti1, and L. Bayuaji, "ATTITUDE
CONTROL OF QUADROTOR," ARPN J. Eng. Appl. Sci., vol. VOL. 10, p. 6, 2015.
[9] S. Bouabdallah and R. Siegwart, "Full control of a quadrotor," in 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems, 2007, pp. 153–158.
[10] K. Mohta, M. Watterson, Y. Mulgaonkar, S. Liu, C. Qu, A. Makineni, K. Saulnier, K. Sun, A. Zhu, J. Delmerico et al., Fast, autonomous _ight in gps-denied and cluttered environments, Journal of Field Robotics, vol. 35, no. 1, pp. 101.120, 2018.
[11] C. Richter and N. Roy, Safe visual navigation via deep learning and novelty detection, 2017.
[12] A. J. Barry, P. R. Florence, and R. Tedrake, High-speed autonomous obstacle avoidance with pushbroom stereo, Journal of Field Robotics, vol. 35, no. 1, pp. 52.68, 2018.
[13] S. Jung, S. Hwang, H. Shin, and D. H. Shim, Perception, guidance, and navigation for indoor autonomous drone racing using deep learning, . IEEE Robot. Autom. Lett., vol. 3, no. 3, pp. 2539.2544, Jul. 2018.
[14] A. Rosinol Vidal, H. Rebecq, T. Horstschaefer, and D. Scaramuzza,. Ultimate SLAM? combining events, images, and IMU for robust visual SLAM in HDR and high-speed scenarios, IEEE Robot. Autom. Lett., vol. 3, no. 2, pp. 994.1001, Apr. 2018
[15] J. Delmerico and D. Scaramuzza,. A benchmark comparison of monocular visual-inertial odometry algorithms for _ying robots, In IEEE International Conference on Robotics and Automation (ICRA), 2018