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Design and Implementation of Wireless Blended Astute Drone Drifter with VR Technology for Smart Cities

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ABSTRACT: As the technology is increasing day by day the requirements are also increasing in every field from home applications to industry and space applications. In this era the unmanned vehicles plays major role to full fill all requirements with good quality and efficiency. According to this robots plays major role. So here in advancements with robotic technology drones plays important role. Drone is an unmanned flying object which can be controlled from some where else. The applications are also increasing day by day with increasing drone capacity. In some cities drones can take humans from one place to another place by using simple application. Some drones can carry medical equipment from one location to another location. This concept of drone also used in defence for security purpose or it can destroy enemy with bomb blast. But some applications are not fulfilled with only flying. Some applications are limited to flying. For ground applications we can use robots as rovers with wheels or bipedal robots to climb. What is the case if a particular application requires both sky and ground. So here drone applications are limited to flying and robotic applications are limited to ground. So by combining both the scenarios it is possible to achieve excellent applications. Hence the main objective of this paper is to design a kind of drone which can fly and as well as crawl on ground to fulfil the concept of smart cities. So the blended astute drone drifter is a kind of drone-rover and it is the combination of drone technology and robotic technology. Blended astute drone drifter will be capable to fly over obstacles or run under the obstacles while touching the ground. It can also transform itself from a flying quad-copter into a running robot.

KEY WORDS: Blended, Drifter, Drone Technology, VR Technology, 3D printing

I. INTRODUCTION

In the present era the technology is increasing very rapidly from normal applications to very complex applications. The safety is an important attribute while doing scientific experiments. The scientists can invent new technologies with safety as the first concern. In the olden days the experiments will be carried out in the laboratory with less security and safety. The results are some times good but some times the situation is really worse such as loss of life or damage of property. But it is not acceptable as a humans for new technology innovations. These kind of problems are simply vanished by introducing robots. So many tasks can be performed by robots with safe and secure attributes. The applications including industries are using robots for assembling large mechanical parts in case of automobile manufacturing companies. The man power is less and it is more safe. Some applications regarding high temperature applications robots can measure all the readings instead of humans. To detect unknown places robots can be used as humans can not enter into some narrow areas for finding something which is harmful and danger. So many applications are there based on robots instead of humans. On the other hand robotic applications ar limited to ground only. If the application depend on flying then what is the solution. In this case drones plays major role. The drone is an unmanned flying object which can receive RF waves and can be controlled from far distance. More security features also there in the drone like camera to see live streaming. It can capture images and record videos. These drones can carry humans from one location to other with GPS technology. The size is the major factor in designing the drone. As the technology is increasing the drone technology is also increasing and hence these drone scan be used to attacks enemies with guns and bombs. The surveillance is the major application of drone. The restricted zones, defence armed areas for security purpose are already using drones for surveillance. Now due to lock-down some customers using drone services from shops to get required things in to their homes.

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II. LITERATURE REVIEW

[1] S. H. Alsamhi, O. Ma, M. S. Ansari and F. A. Almalki, "Survey on Collaborative Smart Drones and Internet of Things for Improving Smartness of Smart Cities," in IEEE Access, vol. 7, pp. 128125-128152, 2019. In this paper the author explained about Smart cities and they contain intelligent things which are increasing life quality, people's safety and security. To achieve all advantages this concept includes IoT, AI with improved connectivity and quality of service. These drones involved in communication, transportation, disaster management, public safety, environmental protection, surveillance and also health care. In agricultural field drones plays major role while plating seeds and to detect diseases of plants over acres which is manually a difficult task. Here IoT plays the connecting medium between user and the drone. Here the combination of these two increases the smartness of the city to next level.

[2] T. Menkhoff, E. K. B. Tan, K. S. Ning, T. G. Hup and G. Pan, "Tapping drone technology to acquire 21st century skills: A smart city approach," 2017, pp. 1-4. In this paper the author described about the drone technology and service in future to increase the smartness of the city with satisfying ethics and legal issues. The author also explained about smart cities and drone-robotics technologies in 21st century. He said that students also need to learn the technologies for their bright future especially the drone and robotic technologies as well.

[3] C. Giannini, A. A. Shaaban, C. Buratti and R. Verdone, "Delay Tolerant Networking for smart city through drones," 2016, pp. 603-607. In this paper the author described about sensors plays major role in future smart cities. These sensors can prevent critical situations, wastage of resources, disasters. The existing networks also suffering from large telecommunication infrastructures with heavy traffic. So the author described that the delay will be occurred while transmitting some data from one location to another location. So by using drones it is possible to reduce delay between source and destination. The drones can be used like Delay Tolerant Network to transmit data to destinations. According to author some areas are isolated while collecting data so if drones were used then they can take data from isolated areas and that data can reach the destination without any delay as the author said.

[4] A. Giyenko and Y. I. Cho, "Intelligent Unmanned Aerial Vehicle Platform for Smart Cities," 2016 pp. 729-733. In this paper the author explained about smart cities with the help of drones. He said that the smart is the combination of technologies like IoT and AI. The author described about application areas of drones in smart cities by quoting 'device as a service'. Here the author described the drone as a multi agent system with intelligent service based on M2M technology.

[5] J. Won, S. Seo and E. Bertino, "Certificateless Cryptographic Protocols for Efficient Drone-Based Smart City Applications," in IEEE Access, vol. 5, pp. 3721-3749, 2017. In this paper the described about drones with security features. But securing various restricted zones without any proper encoding methods is not acceptable. According to author it is required to use cryptographic protocols to increase security. In this case the design of such strategy should include mobility, limited battery of drones, and constrained resources of smart objects[5]. Here the author explained three different cases according to implement drone based smart cities. These cases are one to one, one to many, many to one. In this concept the case 1 is one to one means drone communication to one destination with secured keys with encrypted feature style. So the device which can access that key can able to get service from drone. It is not possible to any device to access drone data without that key. In one to many case the devices should get keys and they can receive data from drone. The encrypted keys play major role here. The third one is many to one. Here drone can receive data from different devices only when the key is matched from all devices. All these three are developed in this paper to achieve more secure smart city concept.

[6] R. Tariq, M. Rahim, N. Aslam, N. Bawany and U. Faseeha, "DronAID : A Smart Human Detection Drone for Rescue," 2018, pp. 33-37. In this paper author described about rescue drones for people. Here the author described about drones with extra features alike Earthquake detection, disaster detection, wild fires detection, flood and terrorists attacks with the help of high resolution electronic camera. The major challenging task faced during rescue operations is finding survivors and victims as early as possible. In this work the objective is to rescue people under dangerous conditions due to natural disaster or terror attack. The drone named here is DronAID[6] which can be controlled and fast moving towards the surviving people. So it will detect exact location of the people who require help at very fast and accurate.

[7] S. Rokhsaritalemi, A. Sadeghi-Niaraki and S. Choi, "Drone Trajectory Planning Based on Geographic Information System for 3D Urban Modeling," 2018, pp. 1080-1083. In this paper the author explained about the drone application in smart cities to enhance urban infrastructures with live streaming or 3D modelling of the area. But here the drone

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efficient will be decreased based on its battery and flight time. So the author developed a frame work which works based on flight map of the drone and it can create 3D modelling images of the urban area. By collecting geographical information from the drone they can create 3D images for urban development under the concept of smart cities.

[8] E. Vattapparamban, İ. Güvenç, A. İ. Yurekli, K. Akkaya and S. Uluağaç, "Drones for smart cities: Issues in cyber security, privacy, and public safety," 2016, pp. 216-221. Here the described about security features of the drone under smart city concept. In this paper the author showed that drone with different features like surveillance, public safety, security, physical attacks and cyber attacks also. This is a survey paper based on technological features of drones in smart cities to detect problems occurred to people in travelling places, offices and any zone of the city.

[9] G. Baldoni, M. Melita, S. Micalizzi, C. Rametta, G. Schembra and A. Vassallo, "A dynamic, plug-and-play and efficient video surveillance platform for smart cities," 2017 pp. 611-612. In this paper the author explained about drones applications as surveillance with cameras. The drones can collect information from zones which are under surveillance. Here the author described two platforms for the smart cities. They are smart and network based access nodes. These nodes are nothing but a sensor, camera. The smart access nodes can place in different areas of the city to provide connectivity between users. The dataflow transmitters may be IP cameras, transducers or drones with electronic cameras.

[10] J. J. Roldán, P. Garcia-Aunon, E. Peña-Tapia and A. Barrientos, "SwarmCity Project: Can an Aerial Swarm Monitor Traffic in a Smart City?," 2019, pp. 862-867. In this paper the author described about smart cities facing problems due to heavy traffic pollution, wastage and pollution due to large crowd. The smart cities equipped with fixed sensors and pollution controls which can create blind zones. The is not possible to detect these zones because of fixed functionality of sensors in a particular area. So by using zones it is possible to monitor traffic and possible to identify pollution by collection atmospheric conditions in that area, capturing images in large crowd area and also used to detect wastage in the cities and resources without man power. So based on drone results it is possible to control and monitor the traffic and pollution in Smart Cities.

III. HARDWARE IMPLEMENTATION

Block Diagram:

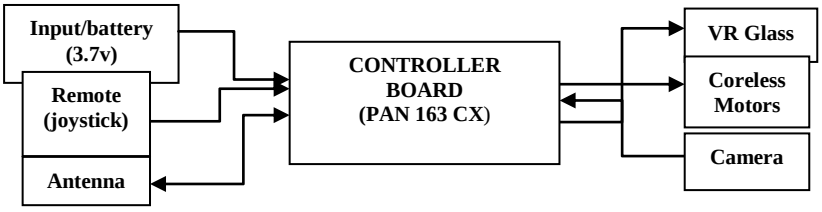

Figure.1: Block Diagram

Working Principle: The above figure shows the block diagram of the system and it contains battery power supply, antenna, camera module, coreless motors, remote controller and VR glass. The delivered to the system is based on battery it is a rechargeable battery of 3.7V. The rover it self designed with wired RF antenna so that it is possible to receive signals from the remote controller. The communication is based on RF wave communication. Camera module can be used for live streaming and also used to capture images and which is placed at the front end of the drone to cover maximum geographical area. Coreless motors can be used to drive the drone propellers and wheels as well. The additional feature here in this system is VR view. This can be achieved with the help of VR glass which is connected to the drone through antenna. When the power button is on then drone is ready to fly or crawl. This mechanism is implemented with the remote controller. The remote controller used here is a joystick based remote and its throttle is the main part to change the drone in to flight mode or crawl mode. If this throttle value is more than 0.2 then the drone will change into flight mode or if throttle value is less than 0.2 then drone will crawl like rover. This mechanism was implemented in the control algorithm dumped into the board. Here the board is PAN controller board specially used for drone applications. Here the single board can be used for both applications. It is configured with embedded code for both applications such as flight and rover. It is possible to view with VR technology in both flight mode and rover mode. The important modules in the system are discussed in the following sections.

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Coreless motors: In this paper the drone and rover applications are based on coreless motors. These are DC motors and mainly used where rapid acceleration is required. It contains rotor with copper about 0.1 mm wire and it doesn't contain any iron or magnet. In this project 6 coreless motors are used in which 4 are for drone propellers and 2 are for rover movement on the ground. In the 6 motors, 4 motors can produce 20,000 rpm and these are for drone application and 2 motors can produce 10,000 rpm used for rover application.

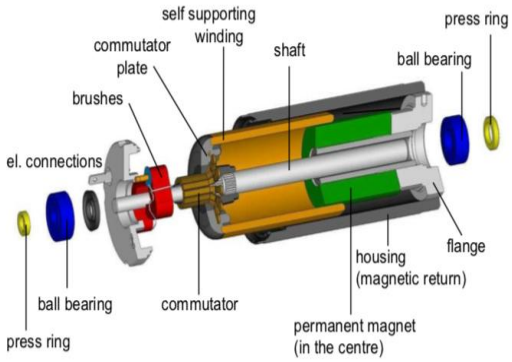

Figure 2: The structure of coreless motor inner view.

Figure 3: The structure that shows reduction of mass and inertia

The coreless DC motor uses graphite metal for the propose of brush mechanism in it. The brushes used in coreless DC motors can be made of precious metal or graphite. The metals like silver, gold, platinum, palladium are usually paired with coomutators to achieve desired functionality. This design contains low contact resistance so that can be used in low current applications. The metal graphite brush with copper commutator is the best combination under this construction. This combination is more suitable for applications requires high power and current thresholds.

Controller Board:

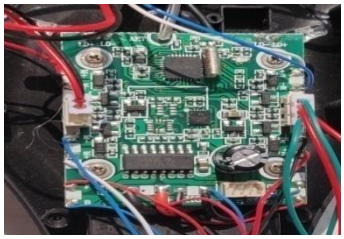

Figure .4: Controller Board

Main Features:

- High-performance
- CPU32-bit MCU, which can run up to 48MHz
- 29KB Flash memory is used to store program code (APROM), 2KB Flash is used for Loader (LDROM), 4KB SRAM is used for internal high-speed data cache (SRAM)
- Can process data packets automatically
- Communication data rate programmable 250Kbps / 1Mbps
- Two-channel analog comparator with 16-level internal reference voltage
- 12-bit ADC

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Table .1: Functions of Pins

S.no	Module name	Port pins
1	Motors Drone Rover	P0.4, P5.6, P5.7, P2.2. (1,2,3,4 pins) P2.3, P2.6.(5,8 pins)
2	software	Burn data pin - P4.6 (15 pin) Burn clock pin – P4.7 (16 Pin)
3	Camera	P1.3, P1.2 (19,20 pins)
4	Transceiver	P1.4 (Pin 21)
5	Timer pins	P3.4, P3.5 (31,32 pins)
6	VDD, GND	Pins 9,33.
7	Browner Protection Circuit	Pin 23

Transmitter and Receiver: The NRF module is a single chip radio transceiver worked under 5.8 GHz band. The transceiver contains inbuilt frequency synthesizer, power amplifier, crystal oscillator, demodulator and modulator. It can be operated at 250 kbps to 2 Mbps speed. Its range can reach up to 200 meters.

Figure.5: NRF Module

Battery: A lithium-ion polymer battery abbreviated as LiPo, LIP, Li-poly, lithium-poly is used in this application for power supply to controller board and it is a rechargeable battery of lithium-ion technology with the help of polymer electrolyte instead of a liquid electrolyte. High conductivity semisolid (gel) polymers are used to form this electrolyte. The capacity of this battery is about 3.8V per cell which is sufficient for the required operation.

Figure 6: LiPo Battery

Algorithm:

STEP 1: Start the process.
STEP 2: Switch on the blended astute drone drifter.
STEP 3: Check whether the Joystick is on, if not, switch on the Joystick.
STEP 4: Check the throttle value in the joystick.
STEP 5: If the throttle value is greater than 0.2, then it acts as drone.
STEP 6: If the throttle value is less than 0.2, then it acts as drifter.
STEP 7: Connect the VR Glass and watch the live video signal sent by the Drone Drifter.
STEP 8: Control the System.

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STEP 9: Stop.

RESULT:

Figure .7: Blended Astute Drone Drifter

Figure .8: Blended Astute Drone Drifter with spare propellers (diagonal)

IV. CONCLUSION

The concept "Design and Implementation of Wireless Blended Astute Drone Drifter with VR Technology for Smart Cities**"** has been successfully implemented, developed and tested. It can fly and crawl according to the throttle output value efficiently**.** Integrated features of all hardware modules used in this project are working efficiently. The working of each module in this system was described and discussed carefully. By using dedicated MCU with all remaining components the project objective is achieved with expected results for smart cities.

Future Scope: As per the above discussions the drone cum rover can be implemented with extra features which can provide services for consumers in online shopping. Amazon and FlipKart like shopping also very easy and simple and less burden for workers. It can give better life style under smart city concept. The door delivery through drone is really good achievement in the main concept. With the help of both flight and rover modes it is possible to fulfil requirements in all areas in the city efficiently. It can cover all applications from home needs to medical applications. It can be further extended with under water mechanism. So it is possible to fulfil the requirements under water for defence applications.

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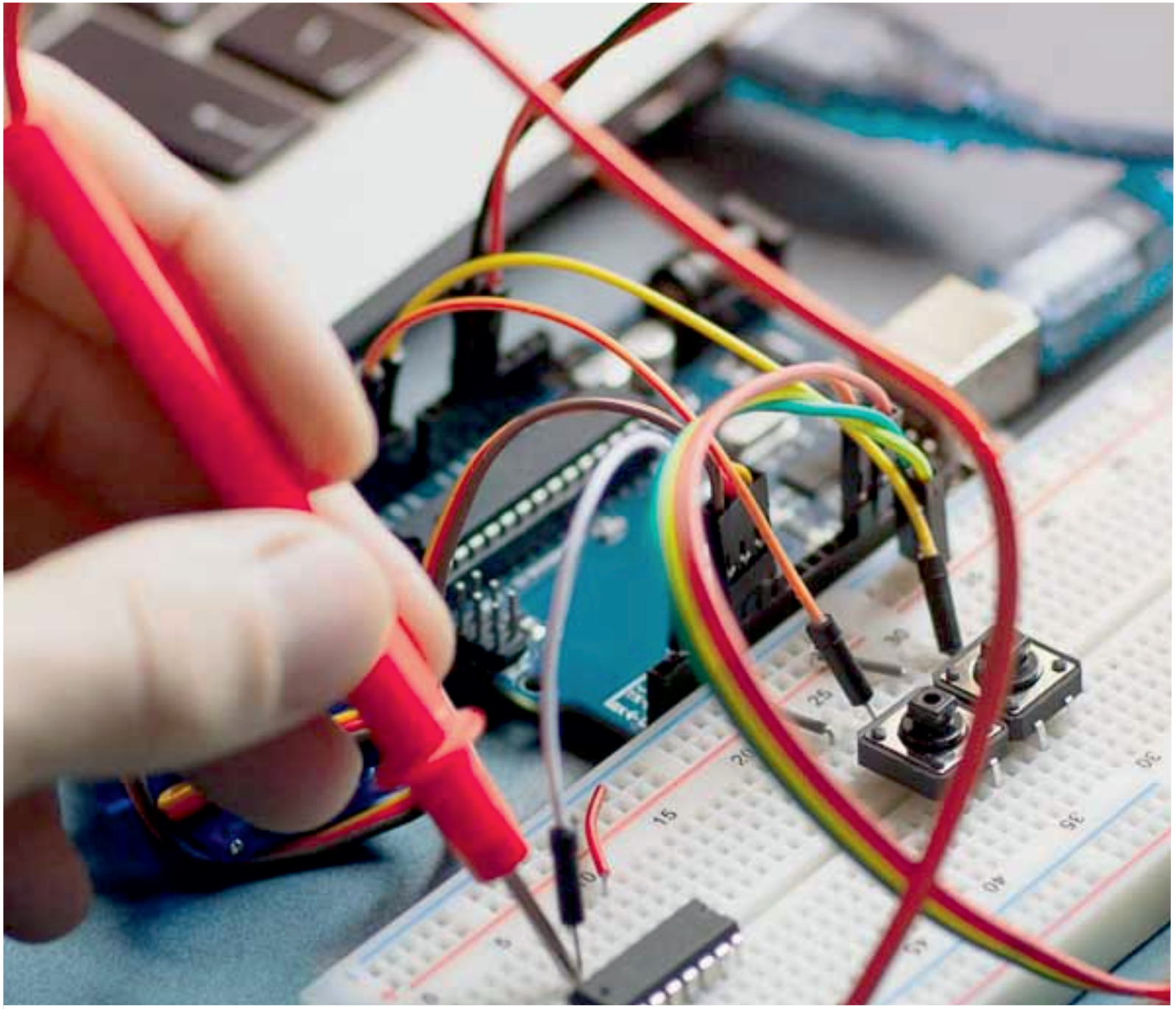

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