Security Surveillance Drone

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***Abstract* - The current state of security in Kenya is marred by security breaches, expensive and inefficient. Criminal activities go undetected and unnoticed despite the use of sophisticated equipment and trained workforce like surveillance helicopters and manned soldiers hence leading to loss of lives and destruction of equipment and property. This research presents the background information, problem statement, research questions and objectives, justification of the problem, scope, and limitations of the developed prototype. It presents an IT software development and research approach that will be applied to study the various types and ways of automating UAV using relevant or any related literature. Further, the project presents how the design, development, and evaluation of autonomous aerial security surveillance UAV are accomplished. With the use of Unmanned Automated Aerial surveillance vehicles, we can be able to curb the criminals by surveying the security prone territories where it is not safe for a human to go and report in advance. A construction research method and a simple prototype developed and presented that will be used to obtain, analyze, interpret, and present the findings. The implication of the study is that it will provide a basis for further development, automation, and adoption of UAV in aerial security surveillance and reporting to authorities the information that will be used to raise alarms and enhance security.**

***Index Terms* - Kenya, protocol, surveillance, property, interpret.**

1.INTRODUCTION

Unmanned Aerial Vehicles (UAVs) are becoming popular to a within Kenya for recreation, that are the entertainment, and military use. Some other are areas of the world such as the United States and Sweden UAVs have been used in military and is government operations especially in security surveillance. The rapidly advancing technology has made these drones more effective and less costly, and this has made the interest of many organizations to adapt and explore the use of UAVs in various applications. Some of the areas where the use of UAVs can be applied or incorporated include Entertainment, Search and rescue missions and Surveying among others. [34] Research on UAVs found that Drones have been used in other places to monitor for environmental abuses by private corporations and deployed by forestry trusts, environmental researchers and private companies to survey and assess otherwise inaccessible areas. Suggestions have been made applications of UAVs include use in, mining companies, hydroelectric power Using UAVs for remote aerial security surveillance has the advantages regarding workforce needed and the overall response time. This would help in making quick, sound decisions. Some of the decisions include what type of vehicle to use, what level of warning is needed and the attack strategy to use to.

By staging the UAV at strategic insecure territories, such as within long borders and the areas where the terrain is rugged and most prone to be used by criminals, a live video feed of the area could be transmitted within minutes to monitor or track the object or the intrusion. The drone described in this paper uses brushless motors for the actuation, combined with two counterclockwise propellers and two clockwise propellers. The APM hardware firmware is Open Source. Ground controller Station software of various kinds have been.

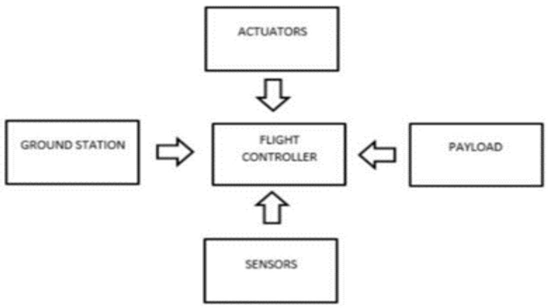
- APM Planner
- Andropilot
- Droid Planner

2.METHODOLOGY

2.1System overview

The creation of the vehicle required the interaction between different hardware and software components. The vehicle for this project is divided into the following components, Frame and Propellers, the Autopilot and APM controller, the flight management system, the video receiver and transmitter and the GPS transmitter, Mission Planner and lastly Integration System and Monitoring System. The basic drone avionics architecture consisted of the Payload, Flight controller, Ground station, Sensors and the Actuators. The diagram below showed the basic avionic architecture the Drone.

SYSTEM COMPONENTS



The flight control system is used to fly the UAV. The flight controller ensures the stabilization and control of the multirotor is attained to this part a two-way radio for remote controlling and an onboard computer with GPS navigation was attached to the aircraft control system [31]. The APM 2.5 is a completely open-source autopilot that allows the user to make any fixed, rotary wing or multirotor vehicle into an autonomous vehicle that is capable of performing programmed GPS missions with waypoints. In APM 2.5, assembly need not be done since the board is already assembled, configured ready for firmware installation. Its underlying software is the Arduino Mega; it has several pins for different components that can be integrated into the APM 2.5 controller which includes the Receivers, the external GPS module, the USB control port, the input and Output pins, Power input pins and other auxiliary inputs and outputs. Most of these controls and inputs are not necessary for basic drone set up and only a few mandatory ones are needed for setting up a drone. To set up a drone the power module is connected to the power supply LiPo battery, the Electronic speed controllers are connected to the Output pins, and the Input pins have been connected to the RC receivers. Finally, the Telemetry is attached to the telemetry pin, and the GPS receiver is properly connected to the GPS pin to receive accurate GPS fixes. When the Drone is in flight, turbulence and flight motion contributes to the shaking of the APM and thus to absorb the shock, shock absorbers that come with the APM are mounted. The APM is loaded with the Open-source firmware that supports different vehicles types including Multicopters, helicopters, and rovers [18]. In order to set up the APM controller, the open-source Mission Planner was downloaded, at the time of this writing it was v1.3.44 build 1.1.6240 11550.

2.2.2 Sensors

Some sensors are used to provide functionality such as maintaining flight without the intervention of human input. Sensing payload extends beyond intelligence collection and reconnaissance surveillance and target acquisition, the sensors are interfaced with microprocessors to allow UAV to fly complete missions autonomously [31].

2.2.3 Video Capture and transmission Component

For video capturing, RunCam camera module was used which is a configurable camera with high viewport and vision capabilities and configurations. More details about this camera can found on the manufacturer's manuals.

2.2.4 Integration API

The integration API consists of a REST webservice that was installed on tomcat 8 servlet container. And used MYSQL community database as the data store.

SYSTEM INTEGRATION API

The System Integration API is used in linking the drone and the Rover and or with any other third-party systems or hardware. The integration API was developed in Java REST framework; the data exchange format was simple JSON instead of XML. The API architecture is as shown below in Fig 3. It was preferred to use REST over soap because REST was light compared to SOAP and the message exchange was the lightweight JavaScript Object Notation Object and hence optimize the performance. The communication from the drone to the API was via HTTP. The API was implemented using Java language and MySQL database community version and which is open source was used for data storage. The database was designed, and the API was bundled as a war file using Gradle build tool which is also open source. The war file was then deployed to Tomcat application server. The project structure for the API that was adopted was maven project structure which was used to develop our API and it conformed to the standard J2EE structure: The API was developed using the MVC structure of model view and controller paradigm. The requests come via Resteasy main

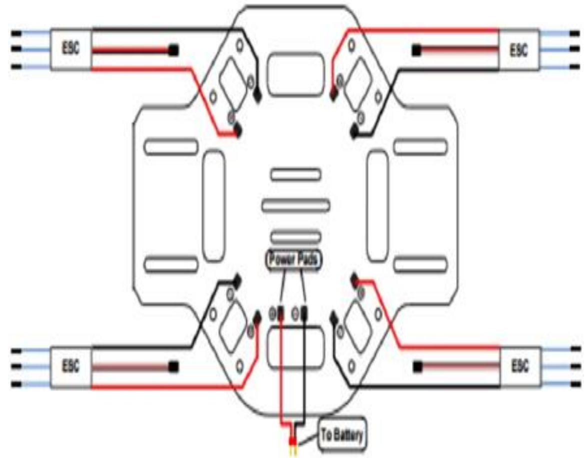
Dispatcher which was configured on the web.xml. If a resource was found the request was routed to the appropriate handler on the API for execution before the result is returned. Hibernate was used as the ORM framework that abstracted the database operations for, below is a snippet of the above operation for inserting the data into the database.public Location insertPhone (Location location)

```
{
try {
em.getTransaction().begin();
em.persist(location);
em.getTransaction().commit();
}catch(Exception e){
log.error(e);
em.getTransaction().rollback();
}  return location;
}
```

SYSTEM ASSEMBLY AND WIRING

Several tools were used in the assembly and installation of the different components into the final product. Assembly of the drone entailed frame assembly, propeller mounting, ESC mounting, and calibration. APM 2.5 installation, SIK Radio mounting, GPS installation, Camera mounting and Video Transmission System installation and Power mounting. Server configuration and installation of server components and installing the app server were also done. Finally, API application installation was done. F450 frame from DJI Innovations was used, more information can be found in the user manual. The frame and associated components were components together; these included the Bottom Board, Frame Arms. The motors were also attached to the frame and the propellers attached. The below figure shows the Connection of the ESC to the power distribution board according to the DJI user manual; Fig. 3 below shows our ESC connected onto the board. Fig. 3: ESC Wiring on the power distribution board in total there are 4 ESC one for each motor. After the components are wired together including the mounting of the motors and the wiring of the ESCs, the next thing was to calibrate the ESCs. The DJI manual gives a step-by-step guide on the assembly of the whole system with diagrams to aid in the connections. Wiring the controller is documented in Ardupilot.

BLOCK DIAGRAM



3.RESULT

For manual mode, the RC receiver was set to loiter flight mode and the propellers armed. The throttle was then raised higher, and the drone was gradually taking off as the thrust was getting higher. The drone attained an altitude of 25 meters, we lowered the throttle gradually, and the drone descended gradually until it safely touched the ground. Approximate wind speed was 10cm/s. The ascend to the safe altitude was seamless with no shaking, and no noise was detected. The GPS was able to lock quickly due to the clear sky. The Pitch was tested and initially, the vehicle was moving at 500cm/s. It was settled for 200cm/s which was better so that we could complete a flight without depleting the battery faster. During this initial test, the drone's weight was about 1.3 Kg.Manual flying was tested with additional payload, in this case, the camera was mounted, the telemetry, the RC receiver, the GPS modules and the Camera video qtransmission modules. When the copter was armed during this second scenario with the weather partially cloudy, the GPS was able to attain a fix, the flight was good both take off, inflight and landing. 3.2 Manual Launch with Autonomous

Flying

To trigger the autonomous mode, the copter was armed using the RC receiver and then switched to auto mode. The plane was able to take off successful and was able to follow the mission below that was planned for test and loaded onto the controller. The copter was armed without the payload the take-off was smooth without much payload. The cloudy weather was not a good scenario for the drone because the GPS fix could not be stable. The copter was loaded with the other components, and then the mission loaded onto the APM 2.5, and then armed and autonomous mission triggered. The copter was able to take off successfully and hit the second way point successfully, it took the course to the third way and successfully hit the waypoint. At this instance, the plane started jerking off, and it started climbing higher and higher it resumed its mission to completion and we attributed this unexpected behavior to the addition of more weight and the high-power demand by the additional electronic components that were added onto the vehicle and a partial loss of the GPS signal.

3.3 Live video streaming

The link between the on-Board camera was tested and the transmitter was able to send the video signals to the ground monitoring and display device. The video clarity was excellent, and we used Channel 8 from the receiver to get clear video stream. The delay was negligible, and the objects on display were identifiable, the stream had little noise, and angle of coverage was 145 degrees. The camera was stationary, a gymble was not used for mounting the camera, so the position was fixed on the drone and not movable. In some advanced configurations, the camera is normally fixed to a gymble and wired onto the APM auxiliary channel hence allow the motion of the camera from the ground station.

3.4 Integration API

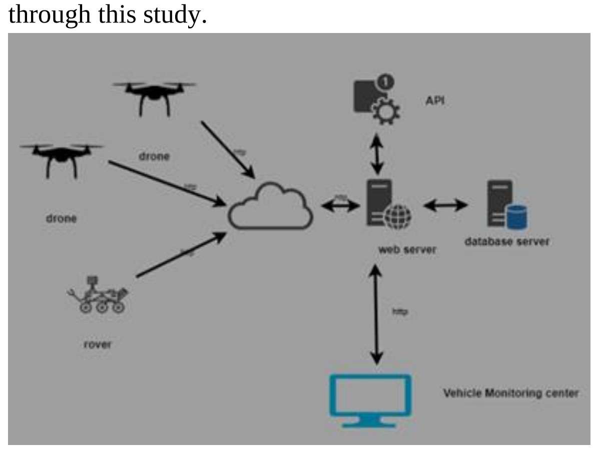
The motion of the drone changes the position in real-time, and this has to be recorded in addition to other parameters that were gathered during flight. These flight parameters and the location of the drone were submitted to a central system for integration to other systems. monitoring system assisted in tracking the drone in real-time and locating any other vehicle that has been configured on to communicate to the API.

4.DISCUSSIONS

4.1 Flight Analysis

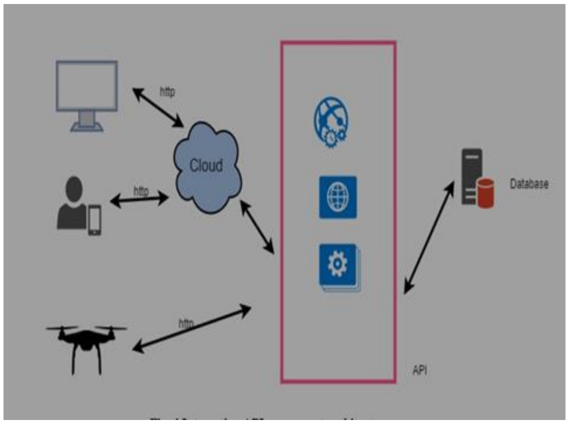
The tests focused mainly on the planes ability to fly and to maintain stability while in flight. The results showed that the drone needed much throttle to take off, and the take-off was done manually using the RC Turnigy radio transmitter. It was also noted that some propellers were not rotating unless the throttle was increased. The first test that was done showed that the plane was able to rise gradually at a slow speed of approximately 15 cm/s. In the first test the camera modules, RC transmitters, and the receivers were not mounted. This led to recalibration of the ESCs' before doing the next test. The "All at once" method was used to calibrate the ESCs' and resumed the tests. In all the tests that were done the weather was calm, hence the reason the plane was stable on its flight to the altitude. At 30 meters the plane was stable, and we tested the yaw and noted that the plane had very little forward thrust, the roll was good. The factors that affect the flight performance include the weather conditions, the controller, and the overall weight of the system. The drone can fail to fly as a result of a combination of any of these factors or all of these factors.

We can say that for 1m3 M20 grade of concrete consumption of fine aggregate is 775.96 kg. Here in specimen M-3 we replace fine aggregate by 24.62 kg of crumb rubber for $1m^3$M20 grades of concrete. So, we can say that up to 15% foundry sand utilized for economical and sustainable development of concrete. Uses of crumb rubber in concrete can reduce the harmfulness to the environment and produce a greener concrete for construction. An innovative supplementary Construction Material is formed through this study.



5.FUTURE WORK

Improvement on battery power in terms of weight and capacity is an area that can be researched to come up with powerful long-lasting batteries and yet light ones. A look into incorporating charging modules like solar panels so that the vehicles can have long duration and range while on air. Of importance is the research on



the payload capacity with regard to speed and uplift. These are areas that are of importance for further research on the areas of unmanned.

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