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DEVELOPMENT OF GO-ONTO-TARGET GUIDANCE AND CONTROL SYSTEM FOR SEMI-BALLISTIC VEHICLE FOR RAPID AND PRECISE SEARCH AND RESCUE OPERATIONS

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ABSTRACT: The Philippines is viewed as one of the most disaster-prone countries due to its location along the ring of fire and typhoon belt. Thus, it needs rapid and precise assessment technology. Its assessment should be conducted immediately to measure the extent and impact of the damage caused by the disaster as well as for the affected victims to receive immediate and proper supplies and their needs identified. An unmanned aerial system that can be conveniently and rapidly deployed to the affected areas to perform real-time assessment and surveillance is highly desirable. In this paper, a developed semi-ballistic vehicle with go-onto-target guidance and control system is discussed. Likewise, it has been comprehensively used and its structure has transformed into a huge field in giving a continuous correspondence framework in direction, salvage, following, and observing applications. The system is fit for gathering, putting away and examining data from several devices installed in the unmanned aerial vehicle (UAV). Preliminary testing results showed that the multi-sensor blend and coordination accepted a key employment and execution improvement of the created semi-ballistic airborne vehicle for fast and accurate pursuit and salvage activities. The consequences of the testing demonstrate that the goals to build up a UAV application have been effectively accomplished.

KEYWORDS:*MEMs Vibratory Gyroscope, Wireless Sensor Networks, Embedded System, UAV*

1.0 INTRODUCTION

An archipelago about again 7,100 islands, the Philippines, is the most in at risknationon that reality for climate-related common disasters. It needsto endure a

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boundless number of dangerous typhoons, volcano eruptions and different regular disasters. This cause of this disaster is because of the area of the Philippines which is along that ring of shoot / hurricane belt- an expansive pacific sea locale where a number from claiming Earth's volcanic eruptions Furthermore seismic tremor happen.
Despite of being a disaster-prone country, humanitarianorganizations in the Philippines have started to utilize an Unmanned Aerial Vehicles (UAV) to enhance data collection and information gathering for immediate assessment of critical areas.Given that UAVs do not require a pilot, it could be a remote-controlled aircraft and can fly autonomously.
Figure 1 below shows the worst disaster happen in the Philippines that depicts the difficulty in search and rescue operations. Those winged/ helicopter style UAVs these dayswaste more time and energy to take off which is actually its disadvantage. It may result unwanted circumstances that would delay rescue operations.
In line with this, it would then require the UAV to rapidlylandits destination. It can provide wireless coverage, guidance, search, and rescue.It could also help in delegating the immediate necessities.
Moreover, among the factors that limit the maximum altitude that water rockets can reach are drag and weather cocking. The nosecone and fins of a rocket are designed to

Figure 1: Worst Disaster in Philippines

minimize drag. Following the launching of the water rocket, wind travelling its path often causes the rocket to turn into wind. This maneuver is called weather cocking. Similarly as a rocket accelerates away from the propel pad, those speed increments and the air motion facilitating drives on the rocket build. Though there no wind present, the flight way is normal should take after those edge of slant relative with its air speed and over course inverse of the flight way. Because of the weather cocking, the maximum altitude that the water rocket can reach will now decrease since the payload of the rocket is dependent on this altitude of the system which actually prevents weather

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cocking.
The overall architectural vision includes the support for the pliability in its operational environment of surveillance UAVs. That structurecomprises of a Raspberry Pi (RPi) board that fills done similarly as the on-board UAVs, working for assistance from workstation that fills for similarly as an on-board UAV PC, working with assistance from a workstation that fills in as the on-ground figuring establishingsubject to video information got from the UAV. It evaluates the hole between the on-board UAV camera outline rate (input) and the on-ground administrator watched outline rate (yield) for a particularclass of PC vision applications pertinent to the UAV-based elevated observation space[3]. The calculation used in this work distinguishes Points of Interest (POIs) by perceiving foreordained examples, as indicated by the mission particular. Through this calculation, the pictures caught by the camera will be dissected and, if POI is discovered, the GPS directions of that point will be recorded. To accomplish the target of all the while running more than one application, a change was made in the POI recognition calculation, producing two examples of a similar calculation [4]. Wireless sensor systems (WSNs) made out of sensor hubs that have the capacity of constant seeing and self-association. In perspective on the idea of execution, control usage and cost, this paper gives the hardware structure of embedded remote sensor frameworks center, which is concentrating on the common ARM focus microchip chip AT91SAM7S256, and the system gear and programming plan of introduced remote sensor frameworks vehicle security structure [5].The plan of the direction law with sway edge consistent is required or air-to-ground guided weapons to build their warhead impact. A direction framework is a gadget or a gathering of gadgets used to explore a ship, air ship, rocket, rocket, satellite, or different makes. It produces direction laws which take contribution from the route framework and use focusing on data to send sign to the flight control framework that will enable the vehicle to arrive at its goal [6]. Arduino has boundless applications as it has been used comprehensively for making adventures by an authority, tenderfoots and master in various fields of building. Considering the examination that using this essential microcontroller sheets, that uses an open source figuring stage that is used for building and programming electronic devices, it has the prepared for tolerating and sending information over the web with the help of various Arduino shields, uses a gear known as the Arduino improvement barricade and programming for building the code known as the Arduino IDE (Integrated Development Environment) [7][8]. An open source stage [9] that is utilized for building and programming of gadgets. It can get and send data to most gadgets, and even through the web to order the particular electronic gadgets. It utilizes an equipment called Arduino Uno [10] circuit board and programming program in rearranged C++ [11] to program the board. In the ongoing improvement in the comprehension and forecast of fluttering the wing streamlined features have a few fluttering wing designs are considered. In the single fluttering wings is treated with uncommon accentuation on the trust, lift and the propulsive

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productivity on the fluttering mode, the abundancy, recurrence, and the wing shape. The floating flight is another thought for a solitary fluttering wings and the streamlined wonders and advantages delivered by the fluttering wing communications on pair wings or biplane arrangements [12].

2.0 METHODOLOGY

When it comes to search and rescue operations, every second really counts. This paper has developed the UAV in which it can be used as an emergence technology that is capable in deploying search and rescue operations. This created framework could improve the activity of look and salvage, decreasing the expense brought about and affix an opportunity to react if there is any catastrophe that would occur. It is in reality because of its capacity as far as little scale size of gear when contrasted with the ordinary hunt and salvage offices, for example, pontoons, helicopter, landtransportation and so on. Therefore, this paper presents the developed UAV for rapid search and rescue operations in any unexpected natural catastrophic disasters.The aircraft used for the UAV is the water rocket which is reinforced with carbon fibre mat composite materials. Figure 2 below shows a platform can be divided into two: the air section and the ground section.

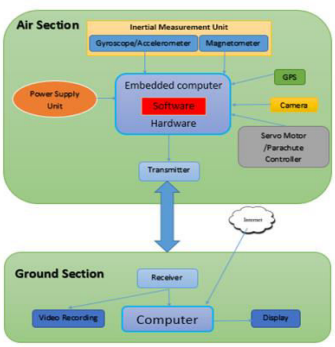

Figure 2 Unmanned Aerial Vehicle System Architecture

i. Air Section

The payload or the flight/correspondences contains the cerebrum of the rocket: the microcontroller the fundamental load up utilized for assortment and transmission of information to the collector area that is the ground segment. The Inertial Measurement unit (IMU) is an electronic gadget that is utilized to measures explicit power, the precise rate, speed, use as an electronic solidness control, use for route and situating that relates to the GPS of the UAVs. The create framework utilizes the IMU coupled to GPS, giving the route data for the heading, pitch, roll and the separation. The Global Positioning System (GPS) is a utility that supports the route execution, where the

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dependability and respectability checks of the GPS information is basic which makes the framework solid. The Camera is an electronic device that catches and records the pictures. The servo engine controller is a circuit that is utilized to control the servo engine that is utilized to move the wing of the UAVs. It comprises of Arduino Uno for controlling upper wing controller, slave controller which is fell in the upper wing controller, servo engine and the power supply. Parachute controller was principally intended for parachute sending of UAV. It comprises of a solitary servo engine that can open a lock on a parachute entryway. The custom firmware goes about as a clock which at that point screens a trigger change to open the parachute entryway. The Arduino Uno is a microcontroller board that is utilized to control and synchronize the development of the wings of the UAVs and the sending of the parachute. The handset is a gadget that consolidates the transmitter/beneficiary in a solitary bundle that is utilized for remote specialized gadget for air area and ground segment.

ii. Ground Section

FPV Transmitter and Receiver Aomway DVR with double 5.8GB is a gadget that is utilized for video recording from FPV camera models legitimately on a miniaturized scale SD card. The checking area is a product part that utilizations Matlab to screen assets and execution of remote sensor organize.

3.0 RESULTS AND DISCUSSION

By using the UAV, technology is the forefront of the progress that is being made to provide safer and more effective way conduct search and rescue operation. Innovations of this technology in response and recovery are less hazardous and more cost-effective option for assessment. TheUAV has several advantages over the traditional manned searched and rescue methods. Since its design is portable due toits small size, therefore it would allow putting it into a flight 90d to land at the disaster site itself. This design has made advantages over planes and helicopters which need specialized areas nearby for take-off and landing. This also provides a significant, time-saving advantage that can be critical in emergency response condition. Innovations are being made that increases the efficiency ofUAV in this case of emergency response situations.

i. Design Specification

This section presents the actual hardware design, the graphical user interface of the software, the functionality test of the overall system integration. It shows also the output of the study from the hardware, firmware, software, development, implementation, integration, testing and deployment.

The idea is develop Two - stage system. The first stage uses a water rocket as the semi-ballistic vehicle system which uses a water-propelled locket. The second stage is a glider UAV that acts as a payload to the first stage which then be released as

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it reaches a certain altitude.

The developed system is equipped with a guidance system that steers the rockets in the near vertical path as it reach high altitude. The control system uses 2 sets of four movable fins placed near the payload and the rear end of the rocket. This fins will be attached to a controlled micro servo.

The basic principle that causes propulsion of the water rocket is to eject 0.5 Liter of water from the rocket nozzle throughcompressing air using hand pump as the energy would supply the rocket. As the water discharges from the nozzle, force is produced which causes the rocket initially at rest as supported by Newton's first law of motion. Moreover, the rocket is acceleratedby the magnitude that is proportional to the unbalanced force as described by the second law which states that force is equal to mass times the acceleration. Finally, the rocket released, the force is expected to movethe rocket in opposite direction as described by the law of reaction-the third law of motion. The result of this study is to test the developed system for localization, target identification, guidance and control using fins and release mechanism for steering at a specified angle of inclination as well as to determine the efficacy of the system through actual field test.

The researcher analyzed, designed and developed the flow of the wholesystemfor the construction of the re-enforced material, as well as the design of the hardware, firmware and software. To make the design possible, the researcher had gone to many design revisions until the design had been finalized. All components had a big part in maintaining the functionality and effectiveness of the whole system that can be used for guidance, navigation and controls of a water rocket. The developed UAV for a navigation system that delivers altitude command to a flight control system, it allows the rocket to be directed to a particular path or specific target.

As shown in Figure 3, the flight of the water rocket can be portrayed by stages delineated as Launch, Coasting Ascent, Maximum Apogee, Coasting Descent and the Recovery.

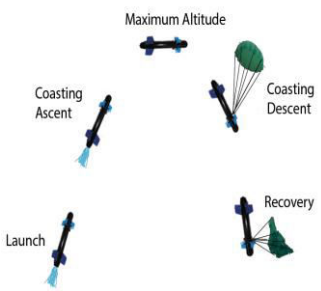

Figure 3 Phases Model of a Water Rocket Flight

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ii. Water Rocket Design

Figure 4 below demonstrates the three-dimensional plan of the UAVthat is made of cvmposite material that incorporate the body of thereinforccd structure, wings, nosecone. weight vessel, the aeronauticalstructure and the booster.

Figure 5 demonstrates the real design of the UAV. It comprises of payload or the flight/interchanges contains the mind of the rocket: the microcontroller the primary

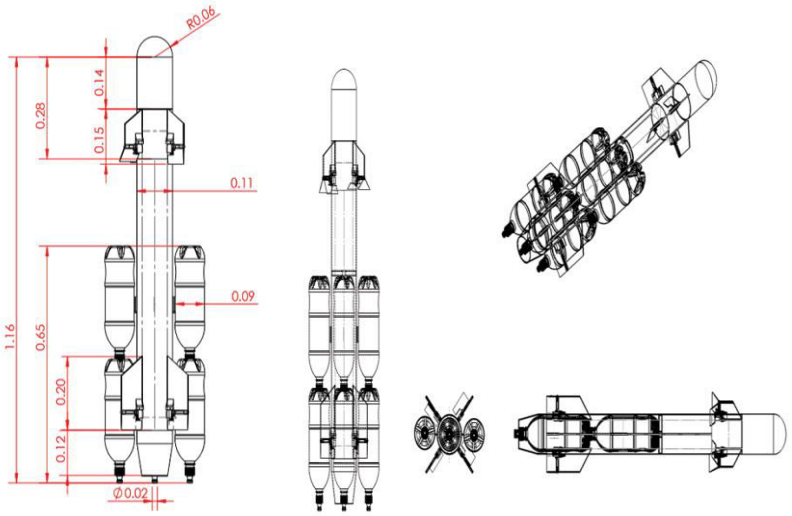

Figure 4 Orthographic View of UAV with Booster Design

load up utilized for gathering and transmission of information to the beneficiary area that is the ground segment, the Camera for video recording, Battery, GPS, Accelerometer and Compass, and the servo controller. The equipment or the water tank comprises of a flawless container and the balanced-out wings that shield the rocket from turning and satisfactory drag that the rocket can manage itself, while the payload or the flying/interchanges contains the mind or the gag of the rocket.

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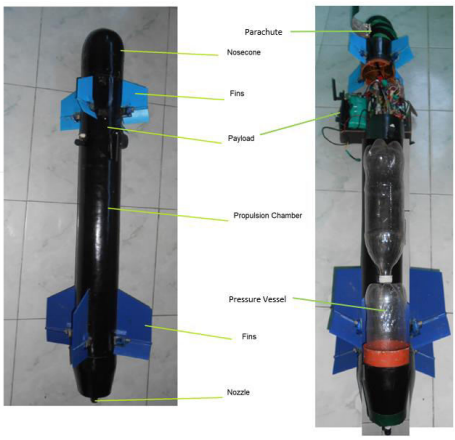

Figure 5 Implementation of UAV Air Section

The movable fins use a shaft that connects a fin on one end and a servo rotor on the other end. Four fins of the same size for the rear and smaller size for the above fins, shape and weight will be attached at equal angles. The fins are made of a 3D printed of ordinary filament because of its durability, lightweight, waterproof and easy to install. The shaft of the micro servo motors is attached to the joining edge of the fins.

iii. Circuitry Implementation of the Ground Section

The circuit design as appeared on Figure 6, hardware of ground segment is the format which incorporates the accompanying segments, for example, collector, widespread offbeat beneficiary transmitter (UART) to USB converter, Laptop and the Aomway for video

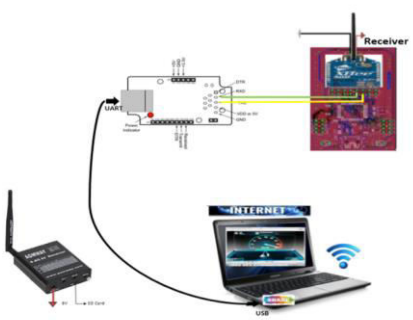

Figure 6 Circuitry of the ground section

recording.

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iv. Air Section:Circuitry Implementation

The circuit as showed up on Figure 7 equipment of the air portion is the structure that consolidates the coordination of the general arrangement.

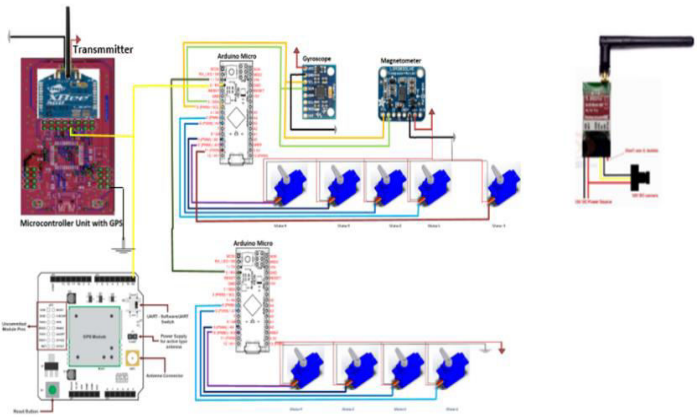

Figure7 Circuitry of the Air Section

v. Projectile Tracker Display Output

Since this examination utilizes a Matlab 2016 application for shot following and observing. Figure 8 below shows recreated shot following showcase. To have the option to associate the shot tracker show and be enacted, web button stays in green, it implies it isn't yet associated.

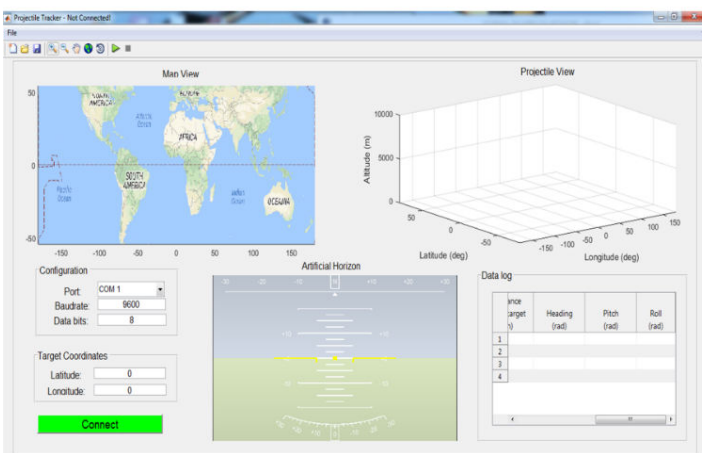

Figure 8 Off State : Projectile Tracker Display

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Figure 9 below shows the final result of the actual launching of the rocket. It shows the map view, projectile view, artificial horizon that corresponds to the data logger.

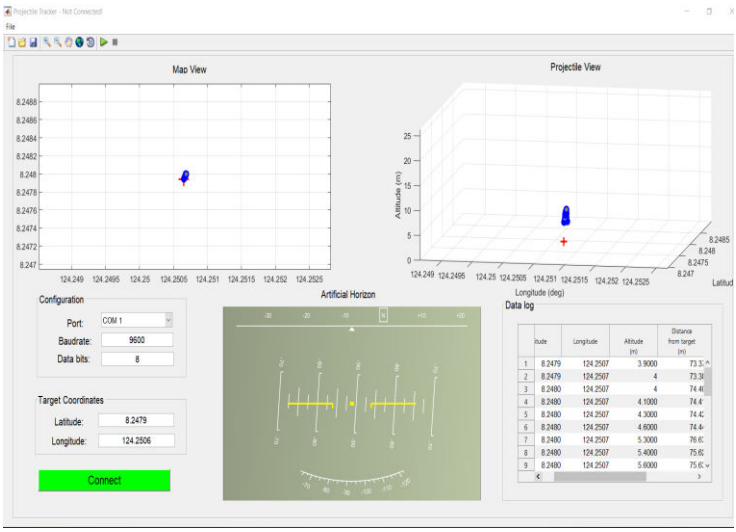

Figure 9 ON State: Projectile Tracker Display

CONCLUSION

The conceptualization and usage of the improvement of go-onto-target direction and control framework for semi-ballistic vehicle for fast and exact hunt and salvage activities were figured it out. The multi-sensor combination and mix for correspondence between the two segments were effectively cultivated in the general structure and execution upgrade of the semi-ballistic unmanned elevated vehicle being created. The after effects of the testing demonstrate that the destinations to build up a UAV application have been effectively accomplished.

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