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Design of Border Surveillance Monitoring Application

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Abstract— In recent years, quad-copters got a lot of popularity. The highly agile dynamics of a quad-copter allow it to easily take off and fly in any indoor or outdoor scenario. For photography and for recording videos by mounting a camera on them people are using drones. The goal is to come up with a network of UAVs that will help our soldiers for patrolling the country border with efficiency, while remaining cost effective. The purpose was one of detection of intruders as opposed to detainment. To make UAV completely autonomous this requires localization. In an outdoor environment it is possible to use GPS based position feedback to fly over a particular trajectory. By using GPS calculate the path distance, speed, tracing path is possible and also avoiding the obstacles is possible. Software technologies and hardware required for multi tasks are modularized based on the requirements of the mission. The air and ground teams worked together to provide a system that has a comprehensive picture of the border while remaining cost effective and also maintain strict security on the border . The UAV or quad-copter will remain in constant communication with the ground base to effectively detect and track targets. This demonstrates a use of GPS to make autonomous vehicles. Drones are able to gather data when running miles of cables isn't an option. Drones will continue to become more and more relevant in industry and thus a curriculum that includes a course on drone creation would be invaluable.

Keywords—Surveillance, Drone, Quadcopter, UAV,GPS.

I. INTRODUCTION

Apart from finance, banking, technology and science, nation's security is the most important issue, on which every nation takes it very seriously. Every year every country reserves a large component of its budget for the defense system so that systems will be upgraded and it will provide latest weapons to soldiers. Defense system safeguards the country's sea, air and land borders. The focus of our work is to propose a smart Surveillance system for land borders only. Surveillance is the most common strategy used by the defense system to protect borders from illegal activities.

The border of a country defines areas of its jurisdictions and political boundaries. A border region carries importance for a country in terms its national security as these boundaries not only contain land areas but also water bodies and rough territories [3]. But, controlling of such areas is a major challenge for most of them. The border is not entirely secure and is open to threats of various kinds. With an unsecure border, our country opens itself to terrorist attacks and extensive drug running and other forms of smuggling. In addition to these problems, there is also the large influx of illegal aliens.

This paper aims towards border surveillance using quad-copter which will work without any manual control and will also provide real-time monitoring of data using a web application. In automatic detection, the real-time surveillance video from camera is processed for detecting human intruder and then checking its position using GPS . Intruder position in any type of cases, a responsive action can be made such as alarm or alert signal send to the nearest patrolling team when any illegal activities are going on border. The paper proposes a mechanism for automatic detection of human intruder with automatic navigation mechanism. Here intruder is considered to be a human being only, not any other living or non-living object. Therefore human detection everywhere shall be taken as intruder detection.

The paper is organized as follows. In Section 2 we present related work, relevant to our border monitoring problem. In Section 3 we present a discussion of different related techniques with their uses. In Section 4 we present a proposed solution and describe the control architecture that is

the starting point of our design. In Section 5 we highlight some of the subtle issues raised.

II.RELATED WORK (SURVEY OF EXISTING METHODS)

A) *Border Patrol and Surveillance Missions using Multiple Unmanned Air Vehicles.*

In this Section, they propose a hierarchical control architecture for a system that does border or perimeter patrol using Unmanned Air Vehicles (AUVs) .By control architecture they mean a SPECIFIC WAY OF ORGANIZING MOTION control and navigation functions performed by the UAVs. It is convenient to organize the functions into hierarchical layers. [1] This way, a complex design problem is partitioned into a number of more manageable sub-problems that are addressed in separate layers. This paper discusses vehicle control requirements and maps them onto layered control architecture. The formalization of the hierarchy is accomplished in terms of the specific functions accomplished by each layer and of the interfaces between layers .Proposed System:

To deal with mission handling and safety issues, a five-layer architecture (as in figure 1.) incorporates both discrete to continuous signals is used . Their approach aims at presenting a more integrated design for the architecture, where the controllers are designed and implemented with hybrid featURES FROM THE START. THIS HELPS alleviate problems that might occur if the discrete layers make requests that are incompatible with the state of the continuous layer. Each of the five layers have a specific role and level of Control, as summarized below:-

Layer 1: Autopilot: This layer represents the lowest level of control for the automated vehicles. This level deals with continuous signals, and interfaces directly with the vehicle hardware. It contains several control algorithms and sensor data processing and monitoring for fault detection

.Layers 2 and 3: Maneuver coordination: These layers contain the combination of trajectory generation and path tracking controllers, to provide control and observation subsystems responsible for safe execution of the basic maneuvers.

Layer 4: Vehicle Supervision: This layer supervises the operation of a single vehicle, and upon the occurrence of certain events (including the ones triggered by the operator), starts patterns of interaction with the supervisor of other vehicles.

Layer 5: Team Supervision: The highest layer provides task generation and allocation mechanisms that acts between the operator and vehicle supervisor to take a complex mission, separate it into a set of tasks and allocate tasks to vehicle supervisors.

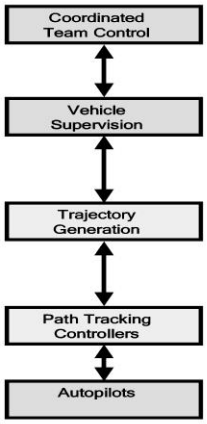

Fig 1. Hierarchical Control Architecture

B) *Evaluation of continuous consensus algorithm in border surveillance missions*

Large scale wireless sensor networks require intelligent and reliable distributed information processing mechanisms which can effectively delegate decision at the field level. Consensus algorithms have been extensively studied and deployed in many generic multiagent systems framework and are able to provide localized agreement among sensing entities. The paper discusses the evaluation of a local consensus algorithm for a border surveillance system, focused on detection of military terrain vehicles, starting from a system architecture for large scale monitoring systems previously proposed. Simulation scenario of a ground local WSN was developed using real data as reference for initial states of the sensor nodes. Performance indicators such as speed of convergence and accuracy of consensus were discussed.[2]

In this section, they evaluate a local consensus algorithm for border surveillance system, focused on detection of military terrain vehicles. The multi-level structure is illustrated in figure.2.

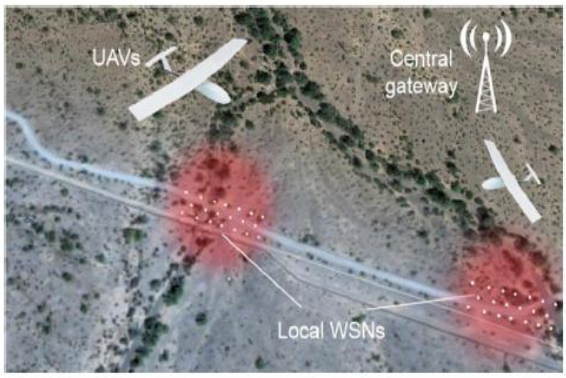

Fig 2. Border Surveillance Scenario

Ground level comprising levels 2 and 3 in the multi-level structure proposed is dedicated for data collection and in-network processing. WSNs are geographical distributed in local sensor node clusters that collect data from specific areas of interest. In the aerial level (level 1), UAVs collect information from the ground sensor node clusters and relay it to the upper level (Center Gateway – level 0).This overall system architecture perfectly suits the particular application of bored surveillance. Multiple sensors can be deployed to simultaneously monitor given points within the border, guaranteeing that the failure of one node would not necessarily compromise the network's integrity.

C) Unmanned Aircraft Vehicle Assisted WSN-based Border Surveillance

In this section a novel border surveillance solution, composed of a Wireless Sensor Network (WSN) deployed terrestrially to detect and track trespassers, and a set of lightweight unmanned a quadcopters that interact with the deployed WSN to improve the border surveillance, the detection and investigation of network failures, the maintenance of the network, and the response to hostage situations.
In this section they use A THICK BORDER STRIP SURVEILLANCE WSN to detect moving object, and to collect alert massage from DRNs A thick linear and hierarchical WSN which integrates three types of sensors. Basic Sensing Nodes (BSNs) are used for the detection of moving objects, the alerting, and the cooperative relaying of messages. Data Relay Nodes (DRNs) are responsible of collecting alerts from the different BSN nodes in their vicinity, and cooperating with neighbour DRNs to forward these alerts to Data Dissemination Nodes (DDNs). The latter are a set of sink nodes in charge of collecting data from their neighbour DRNs, and aggregating and forwarding them to the Network Control Centre (NCC).[3] The designed WSN follows a multiple thick line topology where the DRNs and DDNs are deployed linearly over multiple lines, while the BSNs are distributed around all the DRNs as shown in figure 3.

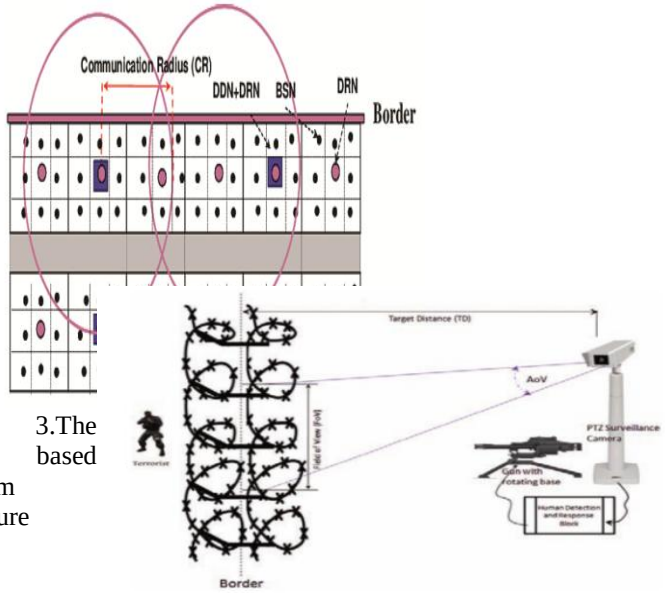

Fig 3.The WSN based subsystem architecture

D) *Optimizing Border Patrol Operations Using Unmanned Aerial Vehicles*

In this section they proposed for optimizing the use of UGSs and UAVs for border patrolling could be extended to Perimeter Patrol Operations as well. The application of such operations could be a military installation or securing a nuclear facility and monitoring an oil field. A perimeter patrol problem consisting of multiple UAVs equipped with cameras and controlled remotely by an operator is addressed. The decision problem solved is the determination of optimal loitering or dwelling time of a UAV at an alert site. That is the optimal amount of time spent at a site so that maximum amount of information can be gathered but at the same time the servicing delay to other sites is kept as minimal as possible. The problem is formulated as a Markov decision process and a solution is obtained using dynamic programming. Simulations are run for cases like using one or two UAVs and UAVs with or without turnaround capabilities. A system to coordinate the working of multiple UAVs to be utilized in border and perimeter patrolling jobs is presented in.[4] The motion control and navigation among the UAVs is divided into a hierarchical architecture. The lower hierarchy consists of controllers that perform positioning and tracking jobs. The higher hierarchy systems are used for maneuvering operations. A team of UAVs is assigned to patrol a particular region of a border. A border region is defined to be a geographical region which is, in general, like a line: thin and long.

E) Automatic Intruder Combat System : A way to Smart Border Surveillance

The task of automatic surveillance involves automatic detection of human intruders continuously in the real-time surveillance scene. In automatic detection, the real-time

surveillance video from camera is processed for detecting human intruder and then checking its position relative to the fences is shown in (figure 4). This auto firing is a form of auto combat, which makes border surveillance smarter. This paper has also proposed a mechanism for automatic detection of human intruder with the auto combat provisions. Here intruder is considered to be a human being only, not any other living or non-living object. [5] Therefore human detection everywhere is taken as intruder detection. In (figure 5,6,7) cases of intruder position is described which follows- In case 1(figure 5), when intruder is behind the fence, the responsive action is simply keeping track of intruder. In 2nd case(figure 6), when intruder tries to climb the fence or come across the fence, raising an alarm is the responsive action. 3rd case(figure 7) needs auto combat as part of responsive action when intruder has actually crossed the fence and is in front of the fence.

fig 4. Surveillance scene with proposed design parameters.

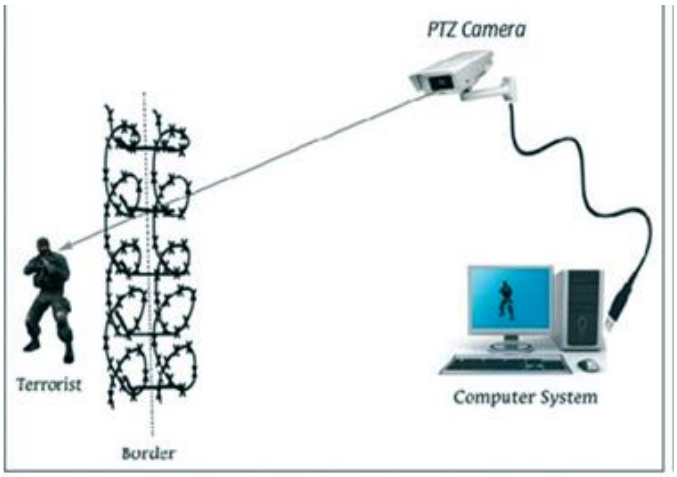

Fig 5. Case 1

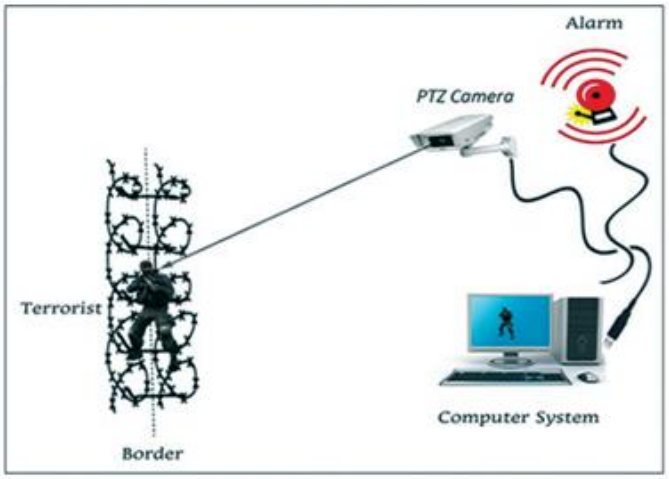

Fig 6. Case 2

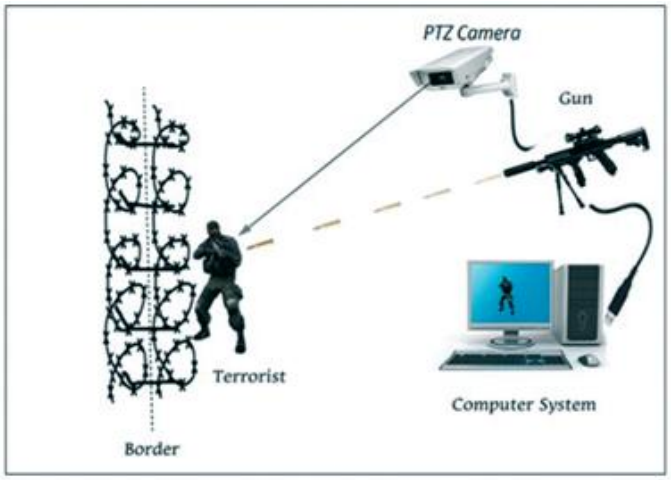

Fig 7. Case 3

F) *Aerial Surveillance System using UAV*

The Aerial Surveillance System is being used to keep an eye on the specific area to provide safety and security .The mission is built on laptop using previously available ground stations like Mission Planner and APM Planner[6]. After building the mission it is uploaded on the drone. To do this a 915MHz transmitter is used for establishing connection between the flying machine and our laptop. The laptop is acting as a ground control station to monitor the mission. A USB camera interfaced with Raspberry Pi is also attached to the flying machine. A wireless adapter is also attached to it. The Raspberry Pi is connected to a Wi-Fi Hotspot which is on the

same network as our laptop. They are connecting to the Raspberry Pi by establishing an SSH connection so that commands can be given to it and also access its GUI from laptop. The camera on the flying machine which is also attached to the Raspberry Pi is live streaming the video data to laptop through this path. This video data is further processed. It can also provide warning messages stored in it as shown in figure 8 .

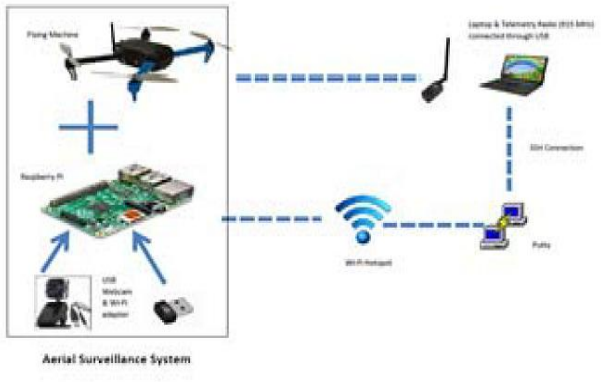

Fig 8:- System Overview

Paper No.	Technology used	Device Used	Uses
A	Berkeley UAVs,RS232 Telemetry . Hardware-In- the-Loop (HIL) simulations.	Camera, aircraft,UAV	Border patrol missions using UAVs.
B	MTIDS (Matlab Toolbox for Interconnected Dynamical Systems)simulation tool, 3-axis anisotropicAMR magnetometers.	Wireless sensor networks, magnetometers,UAV,central gateway	environmental conditions observation, modern agriculture solutions, critical infrastructure monitoring, healthcare and even military surveillance missions..
C	Basic Sensing Nodes(BSNs), Data Relay Nodes (DRNs),RFID technology,	EEPROM, VTail quadcopter, mobile sensors, GPS , 2D LIDAR, camera	Detection of moving objects, collecting alerts from the Different nodes
D	Maximizing Utility(MEU),UAV, ,MONITORING ALGORITHM	Unattended Ground Sensors, drones,	securing a nuclear facility or a military installation and monitoring a wildlife reserve or an oil field
E	Human detection, Fence detection, Decision rules for responsive action,	Camera, INSAS gun.	Human detection, Fence detection**.**
F	Ground Station, Lipo Battery, Radio Controller, Pixhawk, Quadcopter	quadcopter; UAV,GPS, camera, LCD TV, Raspberry Pi	safety and security of the citizens and soldiers.

III. DISCUSSION

IV. PROPOSED SYSTEM

The Purpose of this developing system or software is to automatically detect intruders and trespassers on the border and will send the alert message to the server and ground patrolling team. And the aims towards border surveillance using quad-copter which will work without any manual control and will also provide real-time monitoring of data using a web application. The user needs to “train” machine to recognize or detect a human body so that it can generate alert signal. The border is not entirely secure and is open to threats of various kinds. With an unsecure border, our country opens itself to terrorist attacks and extensive drug running and other forms of

smuggling. In addition to these problems, there is also the large influx of illegal aliens. For a computer, there is a digital database where all the details about intruders are maintained. And it needs a speed to compare this data with signals.

FACTORS ARE CONSIDERED :-

1) Accuracy:- After real time monitoring, proper output with great accuracy.
2) Travelling time:- Travelling time is the time required to travel the distance between two or more points.
3) Parameters:- Algorithm with large number of parameters Require trial and error method to find accuracy or the Good combination.

***Proposed Framework*:-**

Our System consists of two parts Quad-Copter And Desktop Application Quad copter will be used for patrolling and for aerial surveillance in that particular region. The quad copter will be provided with the flight data from the desktop application .Using that flight data it will do the surveillance of that particular region. The Desktop Application will be used to control the quad copter, preparing flight data and also for image processing and flight report generation. The quad copter can be controlled manually by the desktop application but as we are use autopilot mode hence user only has to create a flight data and send it to the quad copter. The real-time video footage from quad copter is received to desktop application and then processed and result will be generated as shown in figure 9 and figure 10.

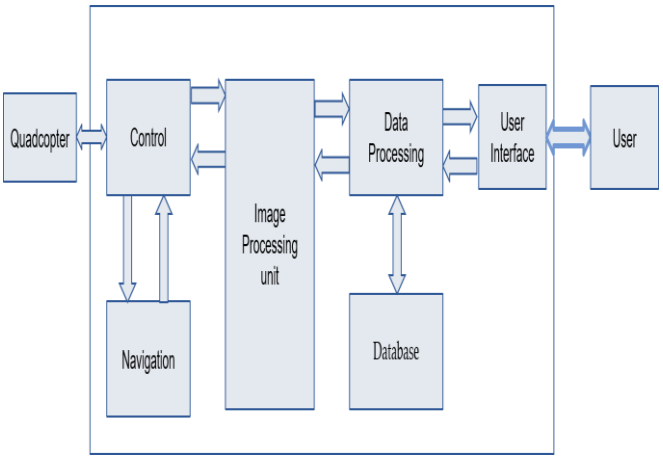

fig 9:- system Architecture

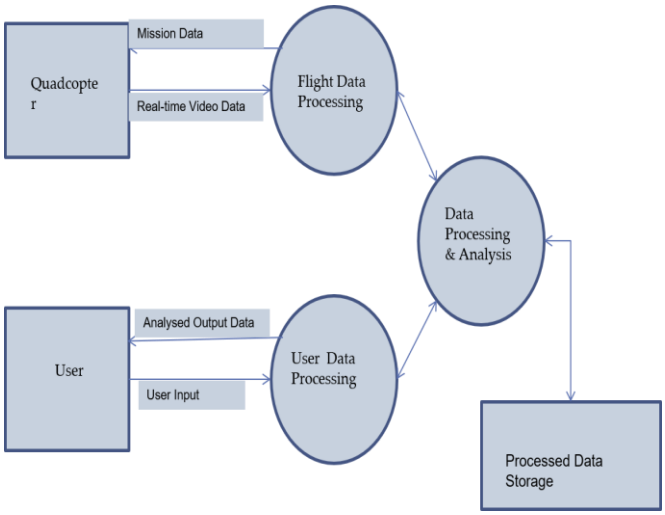

fig 10:- Data flow diagram

V. CHALLENGES AND FUTURE WORK

Durability – Drones durable enough to cover stated distance over their lifetime will be an absolute necessity.

Conditional Awareness – Drones will invariable fly into unusual situations, and whenever any kind of problem arise like swarms of bees, bird attacks, lightning strikes, or signal jammers, they will need to alert operators of problems as soon as they arise.

Better Battery Tech – Battery technology has not progressed nearly fast enough for the drone industry. We need batteries to fly through "quiet zones" such as hospitals, nursing homes, and environmentally sensitive areas.

Drones Operating System – An operating system is the most important software that runs on a computer because it defines how it functions. Users typically will choose between Android, iOS, Linux, or Windows for their operating system. Since drones have a different role according to their purpose, they will require an different kind of operating system.

Navigation System – Suppose, In the future there may be as many as 10,000 drones flying over a area in a given day. They need to avoid flying into buildings, trees, and commercial aircraft as well as they will need to avoid other drones as well.

Collision Avoidance Systems – With the potential of flying into everything from power lines, to trees, windmills,

Christmas decorations, and other UAVs, a comprehensive collision avoidance system will be necessary.

VI. CONCLUSION

In this paper, the basics of a quadcopter UAV are reviewed and the various elements that related to the quadcopter UAV including different sensors, applications and their advantages are surveyed. We proposed in this paper a border surveillance application using quadcopters as a tool for the proactive and reactive response to failures and intrusions, to improve the quality of detection, tracking of trespassers crossing a border and navigation system. The improvement in other technologies has given further leads in improving the design and computing power that can be associated with a quadcopter. Further work on quadcopters coupled with fields like power systems, path planning and SLAM can result in a great number of applications in everyday life.

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