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Autonomous Navigated Global Positioning System Based Surveillance Unmanned Aerial Vehicle

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ABSTRACT

In the last few years UAV (Unmanned Aerial Vehicle) systems have become relevant for applications in precision farming, military purposes, road and dam surveillance etc. The name UAV covers all vehicles, which are flying in the air whether it is a plane or a helicopter etc, with no person on board to control the aircraft. This project gives an overview about UAV systems. UAVs are costly systems and flexible. Our aim is to develop a UAV system which is low in cost and its performance must be up to the mark. Being a developing nation we cannot effort these costly systems and we cannot effort the loss of lives of our pilot as well, so we will have to make a low cost UAV system because it is the need of today. We have reduced its cost by shifting the whole controls of vehicle from the vehicle side to the base station side. Due to the advancement in satellite receiver tracking systems, an integrated system employing latest tracking techniques using satellite Receiver in the form of GPS integrated with an aerospace vehicle can be used to get the pictures from the attached camera. The data of GPS is transferred to the base station with the help of mobile phone, another mobile on the base station side receive that data and then it is stored in the Database. Radio frequency Transmitter controls the aerospace by integrating the above Technique & it uses Global Positioning System (GPS) as a tracking tool.

Keywords: *Unmanned Aerial Vehicle, Global Positioning System, Radio Frequency, UAVF, Remotely Operated Aircraft*

1. INTRODUCTION

An unmanned aerial vehicle (UAV) is an aircraft with no onboard pilot. UAVs can be remote controlled aircraft (e.g. flown by a pilot at a ground control station) or can fly autonomously based on pre-programmed flight plans or more complex dynamic automation systems. UAVs are currently used for a number of missions, including reconnaissance and attack roles. For the purposes of this article, a UAV is defined as being capable of controlled, sustained level flight and powered by a jet or reciprocating engine. The acronym UAV has been expanded in some cases to UAVS (Unmanned Aircraft Vehicle System). The Federal Aviation Administration has adopted the acronym UAS (Unmanned Aircraft System) to reflect the fact that these complex systems include ground stations and other elements besides the actual air vehicles. The name UAV covers all vehicles, which are flying in the air with no person on board. They are mainly used for surveillance, reconnaissance and penetration of hostile territory without the deployment of human beings in areas of high risk. .The term UAV is used commonly in the Engineering and artificial intelligence community, but terms like Remotely Piloted Vehicle (RPV), Remotely Operated Aircraft (ROA), Remote Controlled UAV (RC-UAV), Unmanned Vehicle Systems (UVS) and model UAV are often used, too. The RC and model UAVs are clearly defined by the Unmanned Vehicle Systems International Association as mini, close short and medium range UAVs depending on their size, endurance, range and flying altitude. UAVs are mostly used in military applications for recognition, environmental observation, maritime surveillance and mine removal activities. In any theatre of war the key to success is information. The information on enemy defense lines, its capabilities to launch an attack can help the field commander to chalk out his strategy to counter the enemy's line of defense, for this purpose UAVs are used. They can penetrate in enemy area without the involvement of human being on board (without pilot) and it will be completely controlled by a person sitting on the base station .We can get all the necessary information without putting our pilot's life in danger. In the past Unmanned Aerial Vehicles (UAVs) used in the Photogrammetric community was not defined precisely. Therefore, the historical background for the development of UAVs and their different definitions in the literature will be explained. Non-military applications are environmental surveillance, rice paddy remote sensing and spraying as well as Infrastructure maintenance. The photogrammetric applications of UAVs will be discussed in more detail. Here are some examples of UAVs.

2. LITERATURE SURVEY

Due to the immense importance of unmanned aerial vehicles considerable research has been done on developing UAV systems. We analyzed a number of research papers and websites to find out the various methods implemented for UAVs and we would like to mention some of those. We find a lot of information about the UAV system, who they are categorized and their different models in the research paper of Henri Eisenbeiss, its title is "A MINI UNMANNED AERIAL VEHICLE (UAV): SYSTEM OVERVIEWAND IMAGE ACQUISITION ".He was a researcher in Institute for Geodesy and Photogrammetric, ETH-Hoenggerberg, CH-8093, Zurich, Switzerland, that paper was published and presented in the "International Workshop on

"PROCESSING AND VISUALIZATION USING HIGH-RESOLUTION IMAGERY" 18-20 November 2004, Pitsanulok, Thailand." This paper also helped us to get a lot of information about the different organizations which are associated with the UAVs. From the above paper we also came to know about a website "www.helicam.ch" from here we get information about the working of camera attached on a plane or a helicopter means what kind of camera we use, what is the resolution required for this purpose and how can we transfer that image or video to the base station? We also visited the website of "UVS International, 2004. www.uvs-international.org". In this website description about the different models of UAVs is given as it is the official website of an international organization called UVS (Unmanned Vehicle Systems). Then we visited websites of "We Control. 2004. www.wecontrol.ch"and"WITAS,2004.www.ida.liu.se/extwitas" on these web sites a lot of information about the functionality of the UAV systems was given that who they work. The study of the research papers led us to develop our UAV system which is controlled using RF link and it sends live video using RF, based on GPS technology using the SMS service due to its great usefulness in telling accurate location of anything on the earth. Our system has the capability of determining position, speed and time, of vehicle. Some of the Vehicle systems were built using a GIS mapping toolkit that can be purchased on the internet. We did not go for that as they were costly and their use would totally eliminate the essence of learning through our project. Therefore we obtained the GPS coordinates by the receiver and devised the mapping algorithm ourselves. We retained the client server model by defining a Vehicle Side Unit and a control Station. Also we were able to compare and analyze the cost of these UAV systems and helped us to define the cost factors of our paper such that it could be in the affordable range. These too are listed at the end of the paper.

3. PROPOSED METHOD

We have divided our research into two parts:

- Vehicle Side
- Base Station Side

3.1 VEHICLE SIDE

Vehicle side is also called the receiver side when we are controlling the vehicle but in case of camera and GPS it is the sending Side. In our Project we are using a plane as vehicle. On the vehicle side we have attached three different modules which have different functionality and these modules are

- Tracking Module
- Camera Module
- Module for Controlling the Vehicle

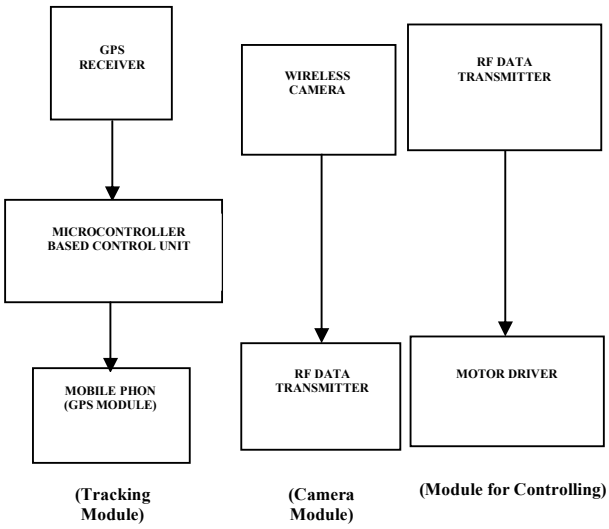

Fig.1. Block Diagram of the Vehicle Side

3.1.1 CONTROLLING MODULE

The first question in front of us was the selection of vehicle. We decided to use an aero plane as a vehicle which was an RC aero plane. It is controlled by an RF Transmitter and receiver circuit operating on a frequency of 35 MHz by using FM (Frequency Modulation) and it has a range of 3 km. The range and frequency can differ when you use some other RC planes. Frequency of this transmitter and receiver depends upon the crystal oscillator used in the circuit. Be sure that you are using same oscillators for both transmitter and receiver circuits otherwise they will not work correctly. These frequency bands used for communication can differ from country to country. e,g Frequency Band from 20 MHz to 50 MHz is called class A band while band from 70 to 80 MHz is called class B band. These bands are normally used for these RC toys like cars, planes, helicopters etc. Some countries like Pakistan, USA and Australia allow both of these bands for RC toys but in some European countries either Class A band or Class B band is used. So every vehicle will be having different frequency.

Fig.2.Real picture of RC aeroplane.

This plane is also called as Hobby's Trainer Bird. It has a Petrol engine in which 50 ml of fuel is filled at once and it can fly for around 20 minutes. The fuel it uses it is a combination of methane, ethane and high octane petrol. We can use gas engines and electric engines as well. Due to the unavailability of those two we decided to use this petrol engine. This figure is of the engine we are using in our Project. The most important thing is the number of channels you are using to control the aerospace vehicle because as larger is the number of channels larger will be the complexity. The number of channels a plane requires is determined by the number of mechanical servos that have been installed. On smaller models, usually one servo per control surface is sufficient. So we are using four servos in our system.

- Ailerons - controls roll.
- Elevator - controls pitch (up and down).
- Throttle - control speed.
- Rudder - controls yaw (left and right).

For more complex models and larger scale planes, multiple servos may be used on control surfaces. In such cases, more channels may be required to perform various functions such as opening cargo doors, dropping bombs, operating remote cameras, lights, etc.

Fig.3.Petrol Equine

The right and left ailerons move in opposite directions. However, aileron control will often use two channels to enable mixing of other functions on the transmitter. For example when they both move downward they can be used as flaps (flaperons), or when they both move upward, as spoilers (spoilerons). Some aircraft, such as the Concorde do not have an elevator. When that function is mixed with ailerons the surfaces are known as elevons. Each of these mixes is common on radio control planes. With a three channel RC plane, either the ailerons or rudder control surface is eliminated. If the rudder is eliminated, turning is accomplished by rolling the plane left or right and applying the correct amount of up-elevator. If the ailerons are eliminated, the wing needs to have a significant amount of dihedral (V-bend in the wing). The rudder will turn the plane so that one wing will turn into the wind, causing it to lift and roll the aircraft. Many trainers and electric park fliers use this technique.

Fig.4.Model servos

This is an RF receiver used on the vehicle it receives the control signals transmitted from the transmitter. These controls signals are generated either by the joystick or by the PC based software. With the help of these received signals the Receiver controls the flying operation of vehicle. It is a four Channel receiver and it controls four servos, it should operate on the same frequency as transmitter has. It works on 6 volts battery and after receiving the signal it moves the servos according to the required action.

Fig.5.Model Receiver

3.2 BASE STATION SIDE

Base station side is also called the transmitting side when we are controlling the vehicle but in case of camera and GPS it is the receiving Side.

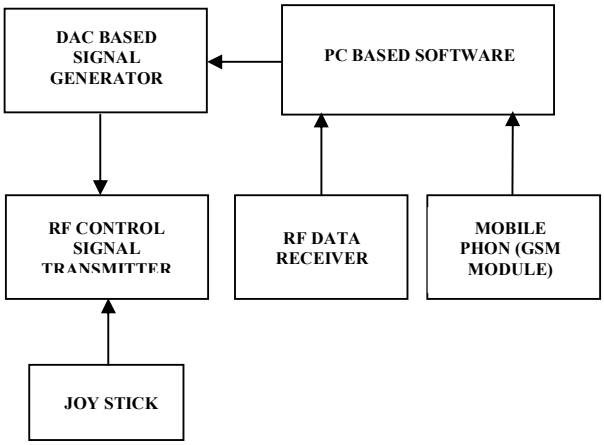

Fig.6.Block diagram of base station

We have made software in VB (Visual Basics 6) which is responsible for the following functions:

- Control the vehicle
- Display Live Video
- Store that Video
- Display the GPS data
- Store that data in the Database
- Display the level of fuel

4. SIMULATION AND RESULTS

As the camera transmits the video from the vehicle by using RF (Radio Frequency) at 1.2 GHz, we have an RF receiver at the base station side and with the help of it we receive that video and display it on the monitor with the help of software. For this purpose we have made a video player in VB and integrated it with our controlling software now you can control the vehicle and see the video on the same software as shown in the figure below.

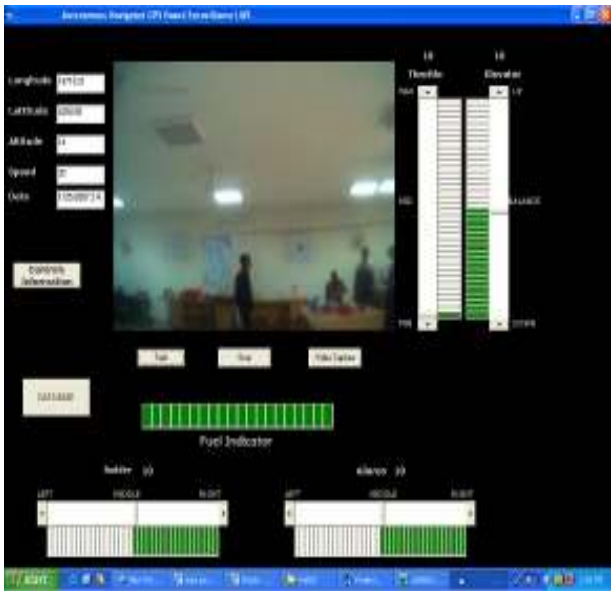

Fig.7.VB based Software displaying live video

The RF receiver receives the live video stream and then it decodes it and gives that video stream to the TV tuner card and by using it we display it on the software player. You can save that video in the 'avi' format according to will. You will just have to press the 'video capture' button on the software and give it the path on the hard drive where you want to save that video. When u want to stop just press the 'stop' button and video will be automatically saved on the path on the hard drive which you have set. We are using sms messages from mobile phone to transfer the data of GPS to the base station. So a same mobile phone T290i is attached to the *PC on the serial port. The reason for using* this mobile is that it supports sms in the text format and it is low in cost, you can use any other mobile which supports the sms text format because many mobiles cannot support it, they support the binary format. This format can be checked by the AT.

Fig.8.Displaying the data of GPS

The mobile phone receives the message from the vehicle side mobile which is send after filtration. Then this message is read from the mobile phone by using the AT commands and it is spitted into longitude, latitude, altitude and speed, then it is displayed on the VB based software as shown in the fig.8. We have also made a database to store GPS data. As the data is continuously coming from the vehicle side so the data is updated in the software and previous data is stored in the database. We used MS Access to make the database; this database can be made in SQL Server or in oracle as well.

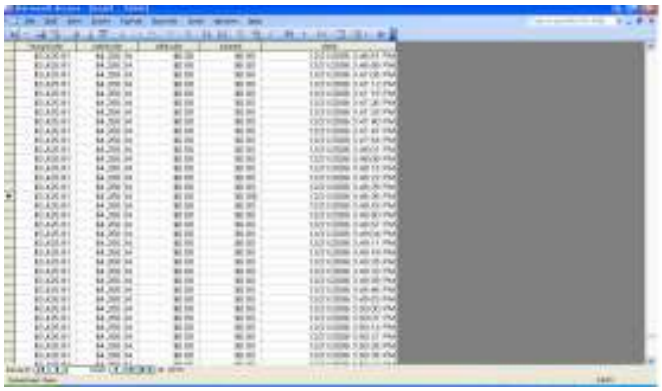

Fig.9.Database in MS Access

5. CONCULUSION AND FUTURE WORK

The UAV system is highly efficient as we can get all kind of information of a risky area without the deployment of human being. You can fully control the vehicle by sitting in an area far from the vehicle. With the help of attached camera we can surveillance the whole area and you can get the live video. The tracking system is highly efficient as it provides the location of the vehicle, maintaining the history of tracking, this vehicle tracking system can be effectively used in the industry and is also useful for personal use. It has been designed such that the future enhancements can be accommodated easily. The cost of the UAV has been reduced. The whole system is available in just 50,000/- rupees and there is no threat of technology theft as all the work has been deployed on the base station side, there is a camera on the vehicle which has transmitted its video to the base station and there is a mobile phone which has transferred its data to the base station as well so there is nothing on the vehicle. If someone somehow got this vehicle he will not get any kind of information. All the intended goals have been achieved successfully. The completion of this project has brought into the light many problems concerning hardware and the software and we also discovered ways to counter such problems. This paper is indeed a valuable contribution to the research on UAV systems. It will be extremely helpful to the engineering students as well.

One of the major upgrade or improvement required by this prototype system is to change its wireless camera module, with a camera which have a longer range about 1 km to 2 km having a high frame rate about 1000 frames per seconds to get the quality image. This will make the system more practical and feasible. Also we are working on the automation of the vehicle we have achieved the timing base Automation and currently working on the GPS based automation so that we'll just have to give the coordinates in terms of longitude and latitude and the vehicle will automatically reach there.

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