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# UAV Based Weather Estimation Using Mobile Phone

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**Abstract**

Unmanned Aerial Vehicle (UAV) is an aircraft with no pilot on board. UAVs can be remote controlled aircraft or can fly autonomously based on pre-programmed flight plans or more complex dynamic automation systems. The typical launch and recovery method of an unmanned aircraft is by the function of an automatic system or an external operator on the ground. In this project we sense the weather condition using a UAV which is controlled by the mobile application and the received data is displayed in the mobile phone. UAVs are commonly used in both the military and police forces in situations where the risk of sending a human piloted aircraft is unacceptable, or the situation makes using a manned aircraft impractical.

***Keywords:*** *Unmanned Aerial Vehicle (UAV), Signal transmission, weather, mobile applications*

## 1. Introduction

Unmanned aerial vehicle (UAV), colloquially known as a drone. There are a wide variety of UAV shapes, sizes, configurations, and characteristics. Historically, UAVs were simple remotely piloted aircraft, but autonomous control is increasingly being employed. They are deployed predominantly for military and special operation applications, but also used in a small but growing number of civil applications, such as policing and firefighting, and nonmilitary security work, such as surveillance of pipelines. UAVs are often preferred for missions that are too difficult for manned aircraft. Our objective in this UAV project is for weather estimation. In this project UAV is controlled by a mobile application, which is used to determine the weather conditions. As per of the signals given from mobile the motion of the UAV can be controlled and the sensors in the UAV measure the corresponding parameters and give back the signal to mobile.

It is difficult to determine the weather conditions at dangerous areas or forest areas etc. Usage of UAVs is helpful for the measurement at restricted areas. Motion of UAV is based on the information from mobile phone. Thus it is possible to control the UAV movement as per of the users wish. Various parameters such as temperature, pressure, etc. can be measured corresponding to the sensors used. These measured details can be displayed in the mobile phone.

## 2. Related works

The IEEE paper on Thermal and narrowband multispectral remote sensing for vegetation monitoring from an unmanned aerial vehicle [1], deals with the sensing of temperature in an agricultural field. In which they are measuring the temperature over the cultivating area. It checks whether the climate (temperature) is suitable for cultivation. Here the UAV is remote controlled.

Trajectory tracking for UAV with velocity and heading rate constraints [2] is a work by Wei Ren considers the problems of constrained nonlinear trajectory tracking control for unmanned air vehicles. The proposed approach is applied to a simulation scenario where the UAV is assigned to transition through several targets in the presence of multiple threads. In this paper, it tracks the position of the UAVs.

The IEEE paper on cooperative UAV formation with obstacle/collision avoidance [3] deals with the avoidance of obstacle on the path. It works in two modes such as safe mode and dangerous mode. Safe mode means that there will be no obstacle in its path and the dangerous path refers to the path with obstacle. For the monitoring of path it use the IR wave. A number of types of UAV systems with various onboard sensors have been developed for civilian applications such as homeland security, forestry fire monitoring. In this it checks weather the path is clear or not.

Wind estimation by UAV with delta wing is IEEE paper [4] describes sensing the direction of wind. It is mainly used for the wind direction estimation over the ocean regions. The UAV used is called as KITE PLANE, which is delta shape. It also considers the humidity over the ocean. So it is possible to know the weather change over the ocean.

## 3. Motivation

### 3.1 Real time motivation

The real time motivation of our project is that software is developed for the control of an UAV where the usual practice is to control UAV using a remote. Also various parameters are measured using different sensors in the UAV[1]. The program can be modified according to the users need and the applications can be improved.

### 3.2 Technical motivation

Day today mobile applications are developing. Now most of the mechanical systems are controlled by software technology. Everyone is looking for easy ways to do activities. Software and various new applications help us to decrease the working loads. It is possible to control various equipments using mobile applications. This made us to think about making the use of mobile technology for controlling UAV.

## 4. Problem domain

It is possible to check or measure the weather condition at any place especially at the restricted or dangerous areas, by the use of UAV. The usual practice is controlling the UAV using a remote. In our project we are developing software to control the motion of the UAV. This project is mainly used in the communication and robotic fields. There will be communication between the UAV and mobile phone.

That is, the UAV can be controlled by the user through mobile phone and also the UAV provides the required information in return. It is the UAV that acts as the robot and the Bluetooth, RF signals and ZIGBEE are used for communicating UAV with the mobile phone. Using these three signals the control signals can be exchanged between the UAV and mobile phones.

The mobile technology is developing day by day .Nowadays most of activities can be controlled by mobile apps. The usual practice is to control the UAV by remote. So we think about controlling the UAV by mobile application. Here our problem is to develop software to control the UAV.

## 5. Problem definition and statement

UAV is used to check the weather conditions by measuring various parameters by using corresponding sensors and the UAV is controlled by a mobile application, so that the user can control the UAV by giving instructions through the application and also possible to display the measured parameters in the mobile screen.

## 6. Problem issues

Inputs for the UAV aregiven through mobile phone.Signals are transmitted using Bluetooth, RF and zigbee.UAV motion is controlled using RF.Sensors in UAV measure the various parameters.Measured parameters are displayed in mobile phone.

## 7. Problem capture

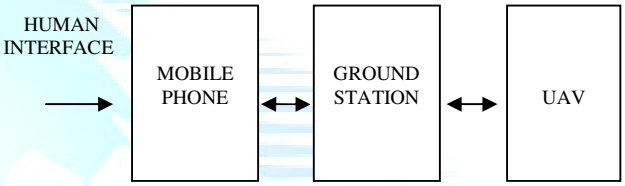


Fig. 1 Overall block diagram

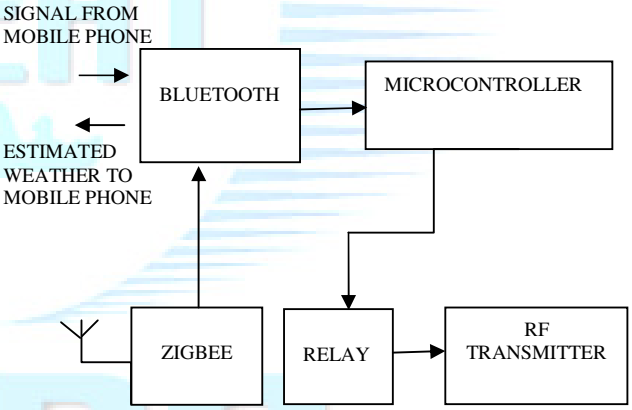


Fig. 2 Ground station

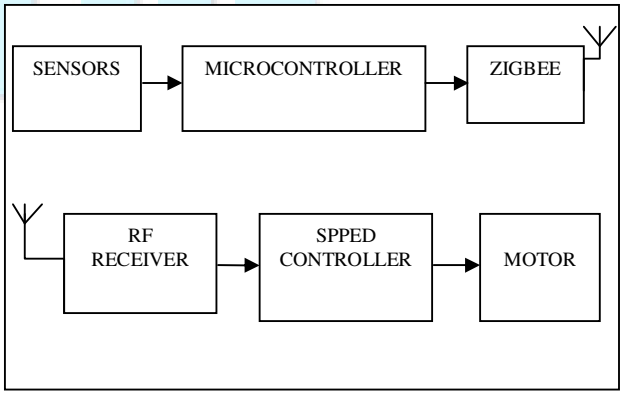


Fig. 3 UAV

There are three parts for block diagram

1) Mobile
2) Ground station
3) UAV

Mobile sends control signals through Bluetooth. Control signals are transmitted using a mobile phone according to the instructions given by the user or instructor. A Bluetooth device in ground station receives this signals and given to microcontroller.USART is used for communication.Five relays are connected to five pins of microcontroller.Two of them are for left and right motion and other three for three different speeds.

Relay contacts are connected to RF transmitter. According to the signals the relays can be ON/OFF. The signals send are received by RF receiver at UAV and thus controlling of UAV takes place.Sensors are connected to microcontroller using ADC'S.Collected weather information's are transmitted through ZIGBEE.ZIGBEE at ground station receive this signals and is given to mobile.Using the received parameters i.e. temperature and humidity, weather details can be displayed in the mobile phone.

## 8. Algorithm

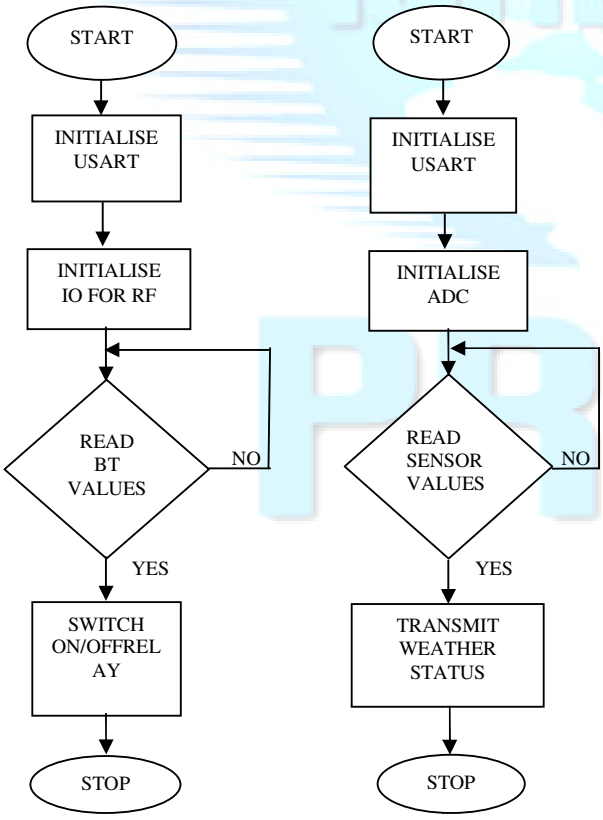


Fig. 4 Algorithm for microcontrollers at Ground station and UAV

## 9. Circuit diagram

Circuit consists of two microcontrollers, one at ground station and another at UAV. Microcontroller at ground station can be used to switch ON/OFF the relays according to the signals send from mobile phone. The weather can be estimated by using the microcontroller at UAV. Five relays are used for the UAV motion control at the ground station. These relays can be used to control three levels of speed namely high, medium, low and also the left and right motions. According to the signals given from the mobile phone the UAV motion can be controlled by switching ON/OFF corresponding relays. Temperature sensor, LM35 and humidity sensor, SHT71 is used to sense the temperature and humidity.

Two zigbee modules and Bluetooth modules are used for the signal transmission. Bluetooth module is used for the signal transmission between mobile phone and ground station. Zigbee module is used for the signal transmission between ground station and UAV. The sensed parameters are displayed in the mobile phone in return. Display the received temperature and humidity value on the mobile phone and also display wether the day is rainy or sunny or cloudy. So it is possible to know the weather.

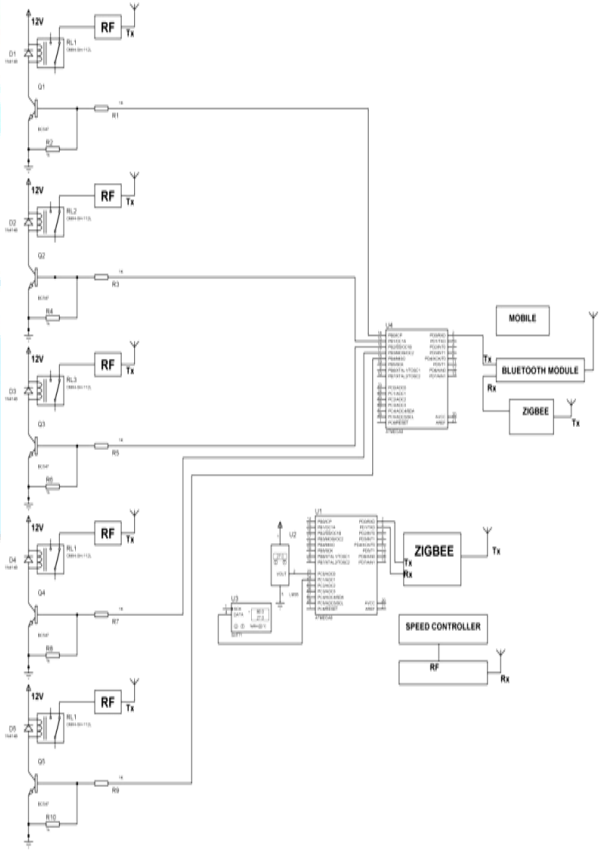


Fig. 5.Circuit diagram of UAV based weather estimation using mobile phone

### 9.1 Microcontroller

Microcontroller ATmega8 is used, which shows high performance.ATmega8 is an 8 bit microcontroller.

### 9.2 Relay

It is an electromechanical switch. It can be used to control the motion of UAV. Here five relays are used. Three relays are used for the speed control and others for left and right control.

### 9.3 Humidity sensor

Here uses SHT71 which is smaller in size and have low power consumption.

### 9.4 Temperature sensor

LM35 is used. Electrical output is proportional to the temperature measured i.e. output is linear to temperature. It posses low self heating capacity and gives accurate value.

### 9.5 Bluetooth and zigbee module

Bluetooth have signals between 2402 to 2480MHz. It can be used for the signal transmission between mobile phone and ground station. Zigbee uses 2.4GHz. It has long range compared toBluetoothmodule so it can be used for the signal transmission between mobile phone and UAV.

## 10. Input-output model

### 10.1 ATmega8

Input: The control signals from mobile phone.
Process: Relay can be selected according to the motion required.
Output: The speed of the UAV can be controlled.

### 10.2 LM35

Input: The temperature in the atmosphere.
Process: Sensing the temperature.
Output: Produce electric signal proportional to the temperature.

### 10.3 SHT71

Input: Humidity in the atmosphere.
Process: Sensing the humidity.
Output: Produce electric signal proportional to the humidity.

### 10.4 ATmega8

Input: Measured parameters from sensors.
Output: The measured parameters can be transmitted through zigbee.

## 11. Result

Weather is estimated using UAV. UAV motion can be controlled according to the signal given through the mobile phone. Thus the objective is achieved. The sensors and microcontrollers are fitted in the UAV (here we use helicopter). For example, the UAV sense the temperature and humidity as 32ºC and 95% respectively then it display as sunny in the mobile phone. In future, it can be used in the area where human beings cannot reach. The areas where distraction likes bomb blast, forest fire, etc. UAV can easily reach and measure whether the climate is critical or not. So it is possible to estimate the weather conditions at crucial areas.

Fig. 6 UAV

## 12. Comparison of results

In the case of vegetation monitoring [1], they use remote control to control the UAV. So it is needed to have another device to control the UAV. In estimation of wind direction [4], it uses remote to control the UAV and it also estimates the humidity. And also there is a chance of occurring mechanical damage to the remote control. Remote control is used in the previous works. So the software idea to control the UAV is a compact one, easy to implement, and also it easy to handle.

## 13. Conclusion

This paper demonstrated the ability to estimate the weather using UAV, which can be controlled by mobile phone. It provides the signals at higher rate. The possibilities of distraction of signal are very less. This platform is suitable for a number of applications, including precision farming irrigation scheduling. Also it is possible to estimate the weather conditions at dangerous areas or forest areas etc. In this paper it's only dealing with the temperature and humidity of the environment. So in order to know the detailed climatic conditions advanced system is required, which is expensive.

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