

Automatically Activating Parachute with In-build Tracker

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Abstract— This mechanism relates generally to altitude above sea-level based parachute release system and more particularly to a control circuit which automatically activates the release mechanism of the parachute when the altimeter detects the pre-set altitude. The altimeter thus converts the altitude into a signal and supplies the same to the micro-controller. The micro-controller will provide signal to the DC Motor in the form of input source which will trigger the DC Motor. This will activate the release mechanism. The parachute will also be provided with a tracker used for detection purpose. It is a satellite based tracker.

Key words: Parachute, Tracker

I. INTRODUCTION

A parachute is a device used to slow the motion of an object through an atmosphere by creating drag (or in the case of ram-air parachutes, aerodynamic lift). Parachutes are usually made out of light, strong cloth, originally silk, now most commonly nylon. Parachutes often take the shape of a dome, but shapes may vary including some taking the shape of an inverted dome. Depending on the situation, parachutes are used with a variety of loads, such as people, food, equipment, space capsules, etc.

A. Parachute

1) Components:

- 1) Parachute
- 2) Microcontroller
- 3) Altimeter
- 4) DC motor
- 5) Tracker

2) How it works:

There are 2 forces at work when a parachute descends. The force of gravity pulls an object to the earth. It causes elevated objects to fall from their place. If however, the object is attached to a parachute, an upward drag force is exerted on the object as well. This is because there is a certain level of air resistance against a parachute's canopy, and this slows down the objects fall. If a jumper descends too quickly, he may reach the ground too soon and hurt himself. When a jumper uses a parachute that has a large canopy, his drop velocity reduces, and he will descend safely. Generally, it is safe to land at a speed of up to 5km/h.

B. Ripstop Nylon

1) Advantages of Ripstop Nylon:

- 1) Light weight nylon fabric with interwoven ripstop reinforcement threads in crosshatch pattern.
- 2) Available in different colours and sizes, including thickness.
- 3) Woven with coarse, strong warp and filling yarns at intervals so that tears will not spread.
- 4) Ripstop Nylon are waterproof, water resistant, fire resistant, tear resistant with zero porosity (will not allow water or air through).

- 5) Textures range from a soft and silk-like material to a crisp or stiff fabric.
- 6) Favourable strength-to-weight ratio.

C. Altimeter

An altimeter is the most important piece of skydiving equipment, after the parachute itself. Altitude awareness is crucial at all times during the jump, and determines the appropriate response to maintain safety. An altimeter or an altitude meter is an instrument used to measure the altitude of an object above a fixed level. The measurement of altitude is called altimetry, which is related to the term bathymetry, the measurement of depth under water.

1) Types:

- Pulse type radio altimeter.
- Conventional FMCW altimeter.
- Constant difference frequency FMCW altimeter.

2) Basic Principle:

Aircraft altitude is measured using the basic principle of radio ranging i.e. measuring the elapsed time between transmission of the electromagnetic wave and its reception after reflection from the ground. The altitude is given by half the product of the elapsed time and the speed of light.

$$2H=C*T$$

Where,

H = Altitude of the aircraft

T = time taken for round trip travel

C = speed of light

D. Micro-controller: Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.

E. DC Motor

1) Working:

A motor is an electrical machine which converts electrical energy into mechanical energy. The principle of working of a DC motor is that "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left hand rule and it's magnitude is given by $F = BIL$.

Where,

B = magnetic flux density

I = current

L = length of the conductor within the magnetic field

2) Fleming's left hand rule:

If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other and direction of magnetic field is represented by the first finger, direction of the current is represented by second finger then the thumb represents the direction of the force experienced by the current carrying conductor. When armature windings are connected to a DC supply, current sets up in the winding. Magnetic field may be provided by field winding (electromagnetism) or by using permanent magnets. In this case, current carrying armature conductors experience force due to the magnetic field, according to the principle stated above. Commutator is made segmented to achieve unidirectional torque. Otherwise, the direction of force would have reversed every time when the direction of movement of conductor is reversed the magnetic field.

F. Tracker

A tracking unit is a device, normally carried by a moving vehicle or person, that uses the Global Positioning System to determine and track its precise location, and hence that of its carrier, at intervals. The recorded location data can be stored within the tracking unit, or it may be transmitted to a central location database, or Internet-connected computer, using a cellular (GPRS or SMS), radio, or satellite modem embedded in the unit. This allows the asset's location to be displayed against a map backdrop either in real time or when analysing the track later, using GPS tracking software. Data tracking software is available for smartphones with GPS capability.

II. LITERATURE REVIEW

A. Parachute

A parachute is a device used for safe-landing using air resistance as a key factor, used for safety purposes. Due to this many lives has been saved from unexpected disasters. Today we are facing major problems of safety. The number of accidents are increasing day by day and at the same time safety measures are less to prevent it, therefore a lot of research is being carried out on different safety measures or equipment development.

According to the research by Clancy,L.J. "Aerodynamics". London: Pitman Publishing Limited, 1975 [1] . It is a device used to decelerate the motion/ speed of an atmosphere by creating drag, or in the case of ram- air parachutes, aerodynamic lift. Drag (also referred to as air resistance and fluid resistance) is the forces that act on an object (solid) in the direction of the relative fluid flow velocity. Drag forces always lower fluid velocity relative to the object in the fluid's path. A fluid flowing past the surface of a body exerts a force on it. Lift is the component of this force that is perpendicular to the oncoming flow direction. If this fluid is air then the force is called an aerodynamic force. Parachuting is a dangerous activity. In case if any unexpected disaster occurs in the aeroplane the primary safety measure that can be taken is to jump off the plane using a properly working parachute. In the operation of a parachute the main factor is its deploying at an appropriate altitude. If the parachute does not open at the

safe altitude which is 1200ft-1000ft, the jumper may be subjected to accident. According to survey a considerable amount of people face such accidents due to malfunctioning of the primary parachute. This arises the need of employing an automatically activating parachute that is triggered at a pre-set altitude (above ground level) or air pressure. The automatically activating parachute with an in-built tracker will serve has a device which is activated without any manual input at a pre-set altitude. It is also provided with a tracker which helps in detection of the jumper in case if he/she crash lands at an unexpected place. The automatically activating parachute with an in-built tracker uses a radio altimeter as the sensor. The microcontroller Arduino Uno R3 plays the role of the heart of the entire system. It receives the signal, processes it and provides an output used as power supply by the DC motor. The material of the parachute also plays the important according to the research by Clancy,L.J. "Aerodynamics". London: Pitman Publishing Limited, 1975[1] . When it comes to the speed of descent of a parachute, several aspects of the material can affect it. One aspect deals with the strength of the material. If the material cannot withstand the impact or shock of the parachute opening, the parachute will not function properly or at all. Some other characteristics of material that could affect how a fast a parachute descends are elasticity, porosity, and weight or density. Elastic material will stretch, changing the shape of the parachute canopy. Non- elastic material will create and keep a constant canopy shape.

B. Altimeter

National Advisory Committee for Aeronautics, S.R Winters, "Altimeters For Blind Flying", Flying Magazine, 1936.[3], discloses a thorough study of altitude measurement in blind flying and the instruments necessary for safe and proper navigation under such conditions. Much of the success attained may be attributed to altimeters that are divided into two main groups: absolute and aneroid. Most of the development work on absolute altimeters has been confined to sonic, radio and capacity types; the aneroid group includes sensitive and barometric altimeters. Leo V. Maloratsky "An Aircraft Single-antenna FM Radio Altimeter", microwave journal, May 2003[2]. Aviation radio altimeters are usually designed as short-range FM radars operating in the 4.2-4.4GHz frequency band. Their main application are instrumented approaches and landings of large commercial aircraft. The accuracy and resolution of aviation altimeters is usually limited to a few feet due to the limited available bandwidth of 200MHz in the 4.3GHz frequency band. This accuracy is considered sufficient even for the flare during an auto land manoeuvre of a large commercial jet aircraft.

C. Micro-controller

Micro-controller is the technology which helps in storing pre-set value, processing and input/output transmission. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also

used for loading programs from personal computers. Arduino was explained in research by Alicia M. Gibb in "NEW MEDIA ART, DESIGN, AND, THE ARDUINO MICROCONTROLLER: MALLEABLE TOOL" [4]

The Arduino microcontroller is used in art and design as an open source programmable tool to create interactive works. It can drive motors, LED, sensors and other components. Microcontrollers are small computing systems used for low power and low memory purposes. A microcontroller consists of a microchip on a circuit board with read-write capabilities, memory, inputs and outputs. While microcontrollers have had a presence in the arts for decades, the Arduino microcontroller is among the first microcontrollers specifically designed for artists and designers. The Arduino microcontroller allows artists and designers to execute electronic incorporated works without knowing the internals of the hardware or software. Artists and designers have been influential in the evolution of the Arduino. The triggering of parachute is done by ripcord system. Ripcord system pulls a closing pin (sometimes multiple pins), which releases a spring-loaded pilot chute, and opens the container; the pilot chute is then propelled into the air stream by its spring, then uses the force generated by passing air to extract a deployment bag containing the parachute canopy, to which it is attached via a bridle. A hand-deployed pilot chute, once thrown into the air stream, pulls a closing pin on the pilot chute bridle to open the container, then the same force extracts the deployment bag. There are variations on hand-deployed pilot chutes, but the system described is the more common throw-out systems.

D. Brushless DC Motor

The content of brushless DC motor I been referred by "http://electronics.stackexchange.com/questions/43105/control-differences-between-ac-induction-motor-and-brushless-dc-motor" [5]. Brushless motors full fill many functions originally performed by brushed DC motors, but cost and control complexity prevents brushless motors from replacing brushed motors completely in the lowest-cost areas. Nevertheless, brushless motors have come to dominate many applications, particularly devices such as computer hard drives and CD/DVD players. Small cooling fans in electronic equipment are powered exclusively by brushless motors. They can be found in cordless power tools where the increased efficiency of the motor leads to longer periods of use before the battery needs to be charged. Low speed, low power brushless motors are used in direct-drive turntables for gramophone records.

E. Tracker

Real-time tracking management system using GPS, GPRS and Google earth. Available from: https://www.researchgate.net/publication/4362301_Realtime_tracking_management_system_using_GPS_GPRS_and_Google_earth [6] accessed Oct 11 2017]. GPS tracking system is a common approach to get vehicle location information in real-time for fleet planning. We proposed a GPS tracking system called GooTracking that is composed of commodity hardware, open source software and an easy to manage user interface via a Web

server with Google Map or via Google Earth software. The system includes a GPS/GPRS module to location acquisition and message transmission, MMC to temporary store location information, and an 8-bit AVR microcontroller.

III. PROBLEM DEFINITION

- 1) Beginners: Most of the users don't have enough knowledge about operating a parachute.
- 2) Critical Situations: Some users may lose consciousness as they are exiting the plane or falling. Jumping off a plane or from very high altitude can cause the jumper to become scared. Even a trained person under critical situations can lose control.
- 3) One time use: In normal parachute the AAD (automatic activation device) cutter can be used only once.
- 4) Time of Triggering: There is a possibility that the user may lose track of the altitude because they get distracted.
- 5) Unexpected Circumstances: Something completely unexpected happens such as second skydiver flies too close to the user and either damages their equipment or makes them unstable.
- 6) Disaster Management: Disasterous situations such as fire hazards, human attacks, etc., can lead to unfavourable conclusions.

IV. OBJECTIVES

- 1) AAD cutter can be used only once whereas our mechanism of DC motor can be reused.
- 2) If initially the altimeter-arduino mechanism doesn't work using the first DC motor, there will be a second DC motor which will be triggered using a timer. At set time the second DC motor will be activated. This will make the mechanism safer.
- 3) Automatically Activating Parachute with In-build Tracker could be cheaper compared to the currently used devices.
- 4) It is possible for the user to change the pre-set value of the microcontroller

V. CONCLUSION

This mechanism will make parachute landing safer. This will provide an advanced technology of automatically operating device with low cost compared to the already existing devices. The tracker provided will make detection of the user easier.

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REFERENCE

- [1] Clancy,L.J., “Aerodynamics”. London: Pitman Publishing Limited, 1975.
- [2] Leo V. Maloratsky “An Aircraft Single-antenna FM Radio Altimeter”, microwave journal, May 2003.
- [3] S.R Winters, “Altimeters For Blind Flying”, Flying Magazine,1936.
- [4] Alicia M. Gibb, “NEW MEDIA ART, DESIGN, AND, THE ARDUINO MICROCONTROLLER: MALLEABLE TOOL”.
- [5] [http://electronics.stackexchange.com/questions/43105/control-differences-between-ac-inducti on-motor-and-brushless-dc-motor](http://electronics.stackexchange.com/questions/43105/control-differences-between-ac-inducti-on-motor-and-brushless-dc-motor).
- [6] <https://www.researchgate.net/publication/4362301> Real time tracking management system using GPS GPRS and Google earth.

