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Fundamentals of Aerial Robotics & Applications

Utkarsh Sahu[1], Akshay Chakole[2], Rajat Vidhate[3], Pranoy Singh Bandwal[4], Akshay Dube[5], Umesh Bobde[6]

Electronics Department, RCOEM, Nagpur, India [1, 2,3,4,5]

EDT Department, RCOEM, Nagpur, India [6]

Abstract: Aerial robotics can be used in the application of research and research operation in which it will automatically and accurately detect the disaster places such as collapsed buildings, fire, forest fire etc. And provide the guidance to the ground reserve team and could save the time. Aerial Robot is the only solution to reach to inaccessible places to take images and collect the information in natural disaster and environment protection. AERIAL ROBOT is used in various fields and it can contribute a lot in development and enhancement.

Keywords: Aerial robotics, Drone, Agriculture, Medical, Motor, Sensor.

I. INTRODUCTION

One case of large scale use of robots in farming is the milk bot. it flourished among British dairy farms because of its efficiency and non-requirement to move. Also in the field of horticulture of RV100by harvest automation incept. It also used in pesticides spraying in the farms where manual work is done on large scale in now a day's etc.

II. AGRICULTURAL ROBOT

Agricultural robot or agribot is a robot deployed for agricultural purpose. The main area of application of robot in agriculture today is at harvesting stage. A possible emerging application is robots or drones for weed control.

Application areas:

- Fruit picking robots
- driverless tractors
- sheep shearing robots
- Horticulture tasks such as pruning, weeding, spraying and monitoring.

III. FACILITIES

Benefits for agricultural industry including a higher quality of fresh produce, lower production costs and a smaller need for manual labor. They can also be used to automate manual tasks like weeding or bracken spraying, where the use of tractors and other manual vehicles is too dangerous for operators.

IV. SURVEILLANCE

Equipped with appropriate sensors the FRSWAN XI collect and transmits in real time images used for reliable prevention tool efficient and discard if needed. Lot can detect any abnormality, danger or offence consisting a threat to safety of persons and property or the protection of population. With an anatomy close to 40 flights hours at an average, speed of 90 km per hour, the FR SWAN XI is able to cover many fields of application. It is extremely low cost equipment

Its uses may be considered as;

- Prevention of illegal activities such as smuggling, privacy, gold panning, illegal immigration, etc.
- The surveillance of borders, marine zones, sensitive areas or isolated highways rail or sea.
- Prevention of forest fire.
- The damage assessment, post disasters, like earthquakes, floods epidemic etc.
- Spouting and monitoring in marine zones, sensitive or isolated areas.
- Aerial surveillance of pipelines.

V. NAVY

The robot can be used for security and scanning purpose. Aerial Robot systems can be situated on the border lines so that they can be used to detect the unwanted persons or naval ships to enter the secured border.

VI. MEDICAL DOMAIN

In medical field this drones can be helpful in providing first aid to the accidental spots where the facilities like ambulance and doctors requires high time so the aerial robot can be used as a Robot Ambulance. This could be the best possible alternative and lifesaving task.it can also save time and life of a person caught in accident.

This can also be used in many medication and scientific technologies for rapid growth in country.

VII. MILITARY

Aerial robots can also be used in the military application with some addition specification in our bot. Optical sensor such as video camera is widely used in the purposes now a days as they include digital, television, omnidirectional, infrared and night vision cameras and they are such plotted on a bot to take a multiple views at the same time.

Other sensors which have been successfully used on such aerial bots are Sonar, metal detector, tactile, chemical, biological, radiation, explosive, laser, radiometer, pressure, depth, GPS, INS, radar, angle of attack, mapping, motion detection, and thermometers.

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The presence of opposition military can be detected by the virtue of there angle and distance they are coming from. With the help of these it becomes easier for the solider to detect there locations. Also an aerial robot is helpful to detect the bombs and can also attack the opposition military forces. Aerial robot can also be used to detect the injuries and can be helpful in providing the first aid.

VIII. OTHERS

Accidental or natural disasters like earthquake, floods, tsunami, creates havoc for the areas. There occurs a tremendous amount of both human and materialistic loss. Herein this areas, this drones can help in detecting bodies of peoples, provide them first aid, food and the necessary help.Moreover this can also be used in chemical industries and also help in pollution control board.

IX. MV BLUEFOX USB CAMERA

This camera is been using in aerial drone because it enables the communication of higher image resolution with high frame rate as well as the synchronous operation of several cameras without the image loss over USB 2.0 . It is a CMOS Camera with USB 2.0. Its USB interface sipportsupto 480 Mbits/sec and ADC resolution rate of upto 12 bits. This has been choosen among the wide range of cameras because it can partial scan for faster chart acqution. 8 mega pixel memory is been provided with this cam. Additional special features are it can efficiently transfer the images via USB bulk transfer without any loss. It is provided with horizontal and vertical mirroring. Sharpening and Bayer color conversion.
Its horizontal to vertical pixels are 2592×1954 with image format of mono8, mono 10. Lens mounts are S-Optical mount. The driver aremvIMPACT Acquire Sdk. It provide CCD sensor for full frame sutter. Addition feature are automatic gain control and Automatic exposur control. All the other parameters are adjustable via bus interface. Hardware real time controller is used for cirticalI/O and acquisition by defining a sequence of operating steps. Bus powered is less than 2.5 W. its permissible ambient temperature are 0 t0It is a compact industrial camera with USB 2.0. It has high quality sensors from VGA up to 5 megapixels. It has 8Megapixels of memory. From application point of view it is mostly used in Machine vision, Robotics, Surveillance, Medical imaging, and Automation. It consists of up to 12 bits ADC. CMOS sensor 200w with 110 dB high dynamic range. It has a superior image quality. Permissable ambient temperature: 0 to 45 degree C. Operation : 30 to 80 %RH

Camera model

Dimension Drawing

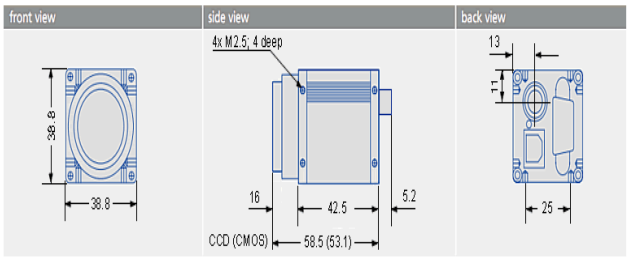

Fig 1.1(3D view of USBFOX camera)

X. HOKUYO UTM-30LX SCANNING LASER RANGEFINDER

This is basically used to find range of the object. It is a small, accurate, high speed device for robotic applications. Its detectable range is from 100mm to 30,000mm. 25msec/scan . Its Operating voltage corresponds to 12V. It has a 270 degree area scanning range with 0.25 degree angular resolution, USB 2.0 interface. The LX is suitable for real time distance data collection. This scanner is able to be used on battery operated platforms due to its low power consumption .Current rating 700mA at 12V. It is light weight (370g).

XI. MOTORS

There are various types of motors:
DC motor:(micromo.com)
Current:12v or less require 100mA to several amp,Voltage:1.5V to 100V, Speed:1 -2000 rpm, Torque:Less than 1 ounce inch to sevral dozen ounce inches, Power=(Torque*rpm)/9.57
Dynamo motor:(ludens.cl)
Volatge:12-48V, Torque:upto 50 oz, Speed:6000 rpm
Servo motor:(rapiro.com)
Current:100mA-2A, Voltage:4-6V, Operating speed:0.05-0.2 S/60*, Torque:0.5-10 kg/cm, weight:15-200gm
Stepper motor:(pololu.com)
Current:400mA-2A, Voltage:3V-12V, Torque:600gcm-9.7kgcm
BLDC:(portescap.com)
Max continous stall torque: Upto 39 oz-in, Torque:332.7 oz-in, Speed:100000 rpm, Standard diameter:0.5-2.3 in(12.7 to 58 mm)

XII. BLDC(BLU09)

BLU09 BLDC motors has very high power density and are come in a compact package. It is great for compact application and also provides cost effective solution to velocity control application. These are also capable for high speed applications. To achieve minimal balance its rotor is balanced. For long operation times, ball bearings are to be choosen with care and provide spinning of near 40000 rpm. By customizing the windings we can perfectly match our voltage, current and maximum operating speed. We can also customize it by providing special shaft modifications, cables and connectors as per our request.

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XIII. SPECIFICATIONS

22mm Round frame
Power:22-102 Watts
Voltage:24-32 V
Torque:2-4 oz-in

XIV. PIXHAWK

It is an advanced autopilot system. It features advanced processor and sensor technology. It has Nuttx real time operating system which delivers incredible performance, flexibility and reliability for controlling any autonomous vehicle. It includes integrated multi reading Unix / Linux like programming environment. All new autopilot functions such as sophisticated scripting of missions and flight behaviour accompanied with a custom PX4 driver layer ensuring tight timing across all processes. It allows existing APM and PX4 operators to seamlessly transition to this system. The pixhawk module includes new peripheral options, digital airspeed sensor , supports an external multi color led indicator and an external magnetometer. These peripherals are automatically detected and configured. It is a PPM input autopilot. It includes pixhawk autopilot, buzzer, safety switch button, 3DR power module with XT60 connectors and 6-position connector cable, extra 6-position cable a 3DR GPS + compass module, a micro USB cable, SD card and adapter, mounting foam, 3-wire servo cable, I2C splitter module with cable.

XV. FEATURES

1. Advanced 32 bit Arm processor running NuttX RTOS.
2. 14 PWM / servo outputs.
3. Large connectivity options for additional peripherals.
4. It has integrated backup system for in-flight recovery and manual override with dedicated processor and stand alone power supply.
5. Backup system integrates mixing providing consistent autopilot and manual override mixing modes.
6. External safety button for easy motor activation.
7. Multicolour led indicator.
8. High power, multitonepiezo audio indicator.
9. Micro SD card for long time high rate logging.

XVI. MICROPROCESSOR

- 32 bit STM32F427 cortex M4 core with FPU.
- 168MHz/256 KB RAM/ 2MB flash.
- 32 bit STM32FF103 failsafe co-processor

XVII. SENSORS

- ST Micro L3GD20 3-axis 16-bit gyroscope
- ST Micro LSM303D 3-axis 14 bit accelerometer/ magnetometer
- Invensense MPU 6000 3-axis accelerometer/ gyroscope
- MEAS MS5611 barometer

XVIII. INTERFACES

5 UART, 1 high power capable, 2 HW flow control, 2 CAN, spectrum DSM/DSM2/DSM-X satellite compatible input upto DX8 (DX9 and above not supported), Futaba S.Bus compatible input and output, PPM sum signal, RSSI (PWM or voltage) input, I2C, SPI, 3.3 and 6.6V ADC inputs, External Micro USB port.
Weight and Dimensions:
Weight: 38g
Width: 50mm
Thickness: 15.5mm
LLength: 81.5mm

XIX. INTEL NUC I7 PROCESSOR

Overview:-
It is equipped with a 5th generation Intel core i7- 5557U processor. NUC5i7 RYH is the highest performing Intel NUC ever. Iris graphics 6100 delivers amazing multimedia experiences and makes NUC5i7RYH perfect for high end gaming. It has plenty of options for add-ons to extend system capabilities. It has Intel turbo boost technology 2.0 which delivers high performance. It can be extended in terms of storage. It has Wi-Fi 802.11 ac wireless, Bluetooth and 7.1 surround sound. It also has 4k display capabilities.

FEATURES:
- 5th generation Intel Core i7-5557U processor
- Two DDR3L SO-DIMM sockets (up to 16 GB, 1333/1600 MHz)
- M.2 slot with flexible support for a 42, 60, or 80 mm SATA or PCIe3 SSD
- 1x SATA port for connection to 2.5" HDD or SSD
- Intel Dual Band Wireless-AC and Bluetooth* 4.0
- Kensington lock support
- Backpanel DC power connector (12V - 19V)
- One Mini DisplayPort* version 1.2 supporting 8 channel digital audio (7.1 surround sound)
- Intel Gigabit LAN
- 2x USB 3.0 ports on the back panel
- Mini HDMI* port supporting HDMI 1.4a and 7.1 surround sound
- 2x USB 3.0 ports on the front panel (including one charging port)
- Intel HD Audio1 via Headphone/Microphone jack
- Consumer infrared sensor

Technical specifications:
PROCESSOR
- 5th generation Intel Core i7-5557U processor (3.1 GHz up to 3.4 GHz Turbo Dual Core, 4MB Cache, 28W TDP)
- Supports 64 bit architecture

GRAPHICS
- Intel Iris graphics 6100
- One Mini Display Port* version 1.2 supporting ultra-high definition 4K displays and multiple monitor functionality

- One Mini HDMI* 1.4a port

SYSTEM MEMORY
- Two DDR3L SO-DIMM sockets (up to 16 GB, 1333/1600 MHz) in dual channel configuration, 1.35V

STORAGE CAPABILITIES
- One M.2 Type M slot supporting 22x42, 22x60, and 22x80 SATA or PCIe3 SSDs
- One SATA 6 Gbps port for connection to 2.5" HDD or SSD

PERIPHERAL CONNECTIVITY
- Integrated Intel Gigabit LAN
- Four Super Hi-Speed USB 3.0 ports
- Two additional Hi-Speed USB 2.0 ports via internal header
- Intel Dual Band Wireless-AC 7265, 802.11ac, 2x2, up to 867 Mbps
- Dual Mode Bluetooth* 4.0

SYSTEM BIOS
- 64 Mb Flash EEPROM with Intel Platform Innovation Framework for EFI Plug and Play
- Advanced configuration and power interface V3.0b, SMBIOS2.5
- Intel Visual BIOS
- Intel Express BIOS update support

HARDWARE MANAGEMENT FEATURES
- Processor fan speed control
- Voltage and temperature sensing
- Fan sensor inputs used to monitor fan activity
- ACPI-compliant power management control

EXPANSION CAPABILITIES
- One NFC header
- 2x Internal USB 2.0 ports via 1x8 header
- One AUX_PWR header

MECHANICAL CHASSIS SIZE
- 115mm x 111mm x 48.7mm

BASEBOARD POWER REQUIREMENTS
- 19V, 65W wall-mount AC-DC power adapter
- Multi-country AC adapter (IEC plug types A, C, G, and I) environment operating, temperature: 0° c to +50° c&storage temperature: -20° c to +70° c

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