A Real Time Embedded Vision System for Ground Target Detection and Tracking the Unmanned Rotorcraft

Kavitha.k1, Muthamizhselvi.M2

Student, EEE Department Embedded Systems, Dhanalakshmi Srinivasan Engineering College, Perambalur.
Asst Prof, EEE Department Embedded Systems, Dhanalakshmi Srinivasan Engineering College, Perambalur.
1kkavithaceee89@gmail.com
2muthamizhece@gmail.com

Abstract—In this paper, the systematic design and implementation of a real time embedded vision system for ground target detection and tracking the unmanned rotorcraft. The hardware construction of the vision system is presented and onboard software system is developed on a multithread technique capable of coordinating multiple tasks. The vision system is automatically detected and tracked the ground target in video sequence and the rotorcraft speed is controlled through PIC microcontroller using Zigbee technology. The unmanned rotorcraft is guided using vision system. The overall vision system has been tested in actual flight mission and the results obtained show that the overall system is very robust and efficient.

Keywords—PIC microcontroller, Brushless DC motor, target detection following, unmanned aerial vehicles (UAVs), vision systems.

I INTRODUCTION

The Unmanned Aerial Vehicles (UAVs) have recently aroused much interest in the civil and industrial markets ranging from industrial surveillance, agriculture, and academic research to wildlife conservation. In particular, owing to its vertical takeoff-and-landing, hovering, and maneuvering capabilities, the unmanned rotorcraft has received much attention in the defense and security community.

More specifically, an unmanned rotorcraft equipped with a vision payload can perform a wide range of tasks, such as search and rescue, surveillance, target detection and tracking, etc., as vision provides a natural sensing modality in terms of human comprehension for feature detection and tracking. Instead of vision being merely a payload, many research efforts have also been devoted to vision-aided flight control, tracking terrain mapping and navigation. Moment invariant method has the significant advantages of simple calculation and invariance under translation, rotation and scaling of the object in images, caused by the movements of the UAV and a target. The design and implementation of a comprehensive real-time embedded vision system for an unmanned rotorcraft, which includes an onboard embedded hardware system, a real-time software system.

II RELATED WORKS

In general the literature survey provides that the complete design and implementation of the vision system for unmanned rotorcrafts, which includes architectural and vision system. In addition, the target tracking in video sequences there has been very little research related to the implementation of vision-based target following for UAVs.

Feng Lin 2012 [1] in this paper a robust real time embedded vision system for an unmanned rotorcraft for ground target following. The hardware construction of the vision system is presented, and an onboard software system is developed based on a multithread technique capable of coordinating multiple tasks. The vision feedback is integrated with the flight control system to guide the unmanned rotorcraft to follow a ground target in flight. The results obtained show that the Overall system is very robust and efficient.
J. Ferruz 2011[2] in this paper presents the architecture of an onboard controller developed for the HERO autonomous helicopter, which is a low-cost unmanned aerial vehicle research platform. An embedded digital-signal-processor-based low-level controller is devoted to flight control, while a PC-based high-level controller is used for onboard perception tasks and interaction with other agents in a distributed system. The functional design, software architecture, and implementation of the low-level controller are analyzed in detail, focusing mainly on its runtime environment (JULIET) and its capability for flexible reconfiguration. The connectivity functions of the low-level controller with external possibly distributed agents are also addressed. Finally, the results of real autonomous flight experiments are presented, including the tracking of a smooth 3-D path described by over two hundred waypoints.

LIN FENG 2009 [4] in this paper, the development of a vision based ground target detection and tracking system for a small UAV helicopter. The kalman filter is used to estimate and predict the position of the target. Once the target is identified, an automatic control scheme is utilized to control the pan/tilt visual mechanism mounted on the helicopter such that the identified target is to be tracked at the centre of captured images. The result based on images captured by small scale unmanned helicopter, actual flight tests demonstrate the effectiveness and robustness of the overall system.

G. W. Cai 2008 [5] in this paper the modeling and flight control system design for the yaw channel of an unmanned aerial vehicle (UAV) helicopter using a newly developed composite nonlinear feedback (CNF)-control technique. The CNF-control method has been proven to be capable of yielding a fast transient response with no or very minimal overshoot in tracking a specific target. The CNF-control method is then utilized to design an efficient control law, which gives excellent overall performance. The results are verified through actual flight tests.

E. N. Johnson 2007 [6] in this paper, two vision-based techniques for the navigation of an aircraft relative to an airborne target using only information from a single camera fixed to the aircraft. By applying an Extended Kalman Filter for relative state estimation, both the velocity and position of the aircraft relative to the target can be estimated.

While relative states such as bearing can be estimated fairly easily, estimating the range to the target is more difficult because it requires achieving valid depth perception with a single camera. The two techniques presented here offer distinct solutions to this problem. Simulation results indicate that both methods yield range estimates of comparable accuracy while placing different demands on the aircraft and its system.

III. SYSTEM ARCHITECTURE DESIGN

The overall system architectural design is shown in fig 1.

![System architecture design](image-url)
The PC (personal computer) sends the value of speed through UART (Universal Asynchronous Receiver Transmitter) cable. UART sends the value of speed to PIC microcontroller. The PIC microcontroller controls the speed of BLDC motor through wireless Zigbee in the rotorcraft. The Zigbee acts as transmitter and receiver wireless. Motor driver circuit which is connected to BLDC motor. The motor drive circuit drives the motor as given instruction. Wireless Camera with transmitter is fixed in the rotorcraft. Wireless AV receiver is connected to the TV tuner and the tuner is connected to the PC. Instructions to rotorcraft are sent from PC and at the same time Audio Video visuals from camera are seen wirelessly through PC.

A. PIC microcontroller
The PIC 16F877 is a 40-pin 8-Bit CMOS FLASH Microcontroller from Microchip. The core architecture is high-performance RISC CPU with only 35 single word instructions. 16F877A comes with 3 operating speeds with 4, 8, or 20 MHz clock input. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital(A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

1. Features
- Flash Memory: 14.3 Kbytes (8192 words).
- Data SRAM: 368 bytes.
- Data EEPROM: 256 bytes.
- Watchdog Timer with on-chip RC oscillator.
- Programmable code protection.
- Power-saving Sleep mode.

B. Zigbee
The Zigbee is the technology which is used to carry less data rates but it will transfer the data to very long distances fig. 2. The Zigbee will receive the data from the microcontroller and will send to the control section. In the control section the Zigbee technology is used to send the commands from the user to the microcontroller. Zigbee is a mesh-networking standard based on IEEE 802.15.4 radio technology. ZigBee is a specification for a suite of high level communication protocols used to create personal area networks built from small, low-power digital radios. In API (Application Programming Interface) mode the data is wrapped in a packet structure that allows for addressing, parameter setting and packet delivery including remote sensing and control of digital I/O and analog input pins.

C. BLDC Motor
Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. As shown in fig. 3.
D. Motor Driver IC (L293)

The most common method to drive DC motors in two directions under control of a computer is with an H-bridge motor driver. H-bridges can be built from scratch with bi-polar junction transistors (BJT) or with field effect transistors (FET), or can be purchased as an integrated unit in a single integrated circuit package such as the L293. The L293 is simplest and inexpensive for low current motors, for high current motors, it is less expensive to build your own H-bridge from scratch.

E. AV CAMERA

Aperture priority, A or Av (for Aperture value) on a camera mode dial, is a setting on cameras that allows the user to choose a specific aperture value while the camera selects a shutter speed to match. The camera will ensure proper exposure.

F. TV Tuner

A TV tuner card is a kind of television tuner that allows television signals to be received by a computer. Most TV tuners also function as video capture cards, allowing them to record television programs onto a hard disk much like the digital video recorder.

IV. SOFTWARE DESIGN

The software used in this project are Microsoft visual studio, X-CTU (Zigbee configure), virtual terminal. Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop console and graphical user interface applications along with Windows Forms or WPF applications, web sites, web applications, and web services in both native code together with managed code for all platforms supported by Microsoft Windows, Windows Mobile,.NET Framework,.NET Compact Framework and Microsoft Silverlight. Visual Studio includes a code editor supporting IntelliSense as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. XCTU allows you to directly edit the setting within any XBee in a mesh/network. Virtual Terminal is a terminal emulator capable of connecting to systems through Dial-Up Modems, and COM ports.

V. CONCLUSION

In this paper, the design and implementation of the real time embedded vision system for ground target detection and tracking the unmanned rotorcraft, including hardware construction, software development and ground target. The experimental results show that the vision system is automatically detected and tracked the ground target in video sequence and the rotorcraft speed is controlled through PIC microcontroller using Zigbee technology. The rotorcraft is automatically take on and take off through the pc (personal computer) using Zigbee technology. The robustness and efficiency of the developed vision system for UAVs (unmanned aerial vehicles) could be achieved by the current system.

VI. REFERENCE


