

# Dual Generators and Double Motors Measurement and Control System

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**Abstract**—In this paper, a SCADA (supervisor control and data acquisition) system HMI (human machine interface) software was been implemented based on a driver system which consisted by double generators and double motors. This software was been implemented by NI Labview based on the CAN bus. Meanwhile the dynamical monitoring and alarm are implemented. The data collected for the HMI include the collecting data of bus voltage and current; the speed; the temperature on IGBT, bearing and winding. The generator and the motor controller running status and the fault status are also been sent to the HMI. The command sent to the double generators and the double motors are including start/stop, speed, bus voltage, PID parameters to DSP (speed circle Kp and Ki, Kp and Ki in D axis for current circle), etc. The main works focus on the design of CAN communication protocol; multichannel CAN bus control implemented in Labview; bit data and different byte data combination and unpack. In practical engineering application, this system can absolutely realize automatic supervision and control process efficiently and reliably.

**Keywords**—Supervisor control and data acquisition (SCADA); human machine interface (HMI); testing system; Labview; Can2.0B

## I. INTRODUCTION

It is a hot issue that supervisor control a UAV and optimize the energy supply. After researched the different kinds of SCADA system[1-6], this paper show a SCADA system about a double generators and double motors. The system is a important part of our research in long endurance of multi-axis unmanned aerial vehicle. Our work focus on: First, we designed a multi-axis unmanned aerial vehicle platform based on the laser energy supply which is showing in fig.1. Second, this paper show a SCADA system about a double generators and double motors.

## II. SYSTEM OVERVIEW

Our multi-axis unmanned aerial vehicle platform design is showing in fig.1.

Power supply based on two generators which reserved each other. The laser generator connected with power supply use cable. The laser generator output to the beam expanding lens use the optical cable. Then the laser beam irradiation to the photovoltaic cell after beam expanding. In the last stage, the system completes photoelectric conversion, and supply the energy to the propeller.

The SCADA system was designed to supervisor control the electrical signals of two generator and the two propeller motor.

## III. SUPERVISOR CONTROL SYSTEM DESIGN

This system software was been implemented by NI Labview based on the CAN bus.

Therefore, our design includes that A. the design of CAN communication protocol; B. CAN bus control implemented in Labview, bit data and different byte data combination and unpack.

### A. Communication Protocol Design

We use the standard frame. The arbitration field and the control field defined as TABLE.I.

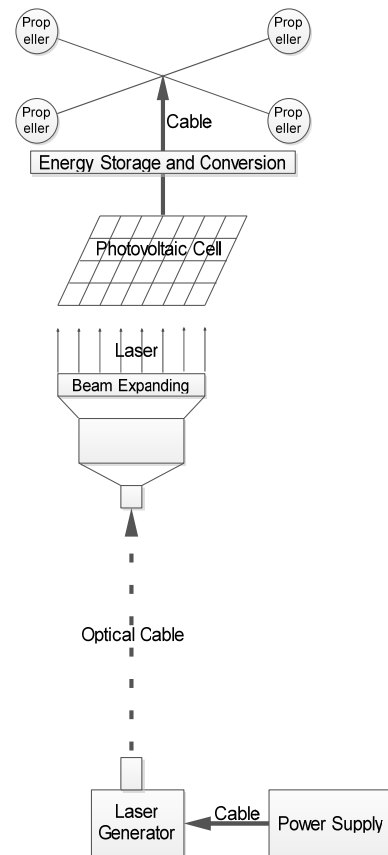


Fig. 1. multi-axis unmanned aerial vehicle platform design

TABLE I. FRAME INFORMATION

ID10	ID9	ID8	ID7	ID6	ID5	ID4	ID3
Communication mode		Slave node address				Data content mode	
ID2	ID1	ID0	RTR	IDE	R0	DLC:3-0	
Data content mode			0	0	0	Data length 0-8	

RTR: fixed as data frame, the value is 0.

ID10: The value is 0, means Master-slave communication; The value is 1, means broadcasting communication. Here, ID10 fixed as 0.

ID9: When the ID10 fixed as 0, ID9 equals to 0 means master to slave. Meanwhile, ID8-ID5 is the destination address. Conversely, ID9 equals to 1 means slave to master. ID8-ID5 is the source address.

We can get the most 15 slave node and one master node according to the above design. We suppose that the master address is 0, the address of the motor A, B, and the generator A, B respectively is 1, 2, 3, 4.

The communication message can be master to motor A, or motor A to master, etc. So the data content mode code is shown in the TABLE.II.

TABLE II. DATA CONTENT MODE CODE

	master to motor A,B	motor A,B to master	master to generator A,B	generator A,B to master
Data content mode code	0	1	0	1
		2		2
		etc		etc

A typically message is show in TABLE III.

TABLE III. EXAMPLE OF A COMMUNICATION MESSAGE

Message Name	Master To Motor A
Data content Mode	0
Data length	8 byte
Communication cycle	100ms
1Byte	Motor speed low byte
2Byte	Motor speed high byte
3Byte	Motor Control Mode
4Byte	Bus voltage
5Byte~8Byte	reserved

B. CAN Bus Control Implemented In Labview

Slave to Master:

Here, used the *Unbundle control* and *Unbundle by name control*. The message would be sent to the *unbundle control* if the arbitration ID is matched. Then, the data part would be unbundled by the *unbundle by name control*.

- Single byte data can be used directly

Single byte data can be used directly When we sent the message to the master. Like shown in fig.2 below.

- Bit data unpack and double byte data combination

Some two byte data need two single byte data to make itself. And some bool value need to split the single byte data to get itself. Shown in fig.3.

Here, the double byte data like “Motor Speed” should be grouped by two single bytes output. So we used the *Join Numbers control*.

Some output like “boolean” shown in fig.3 is a series of bool values. We use *Number to boolean array control* and *Index array control* to get them.

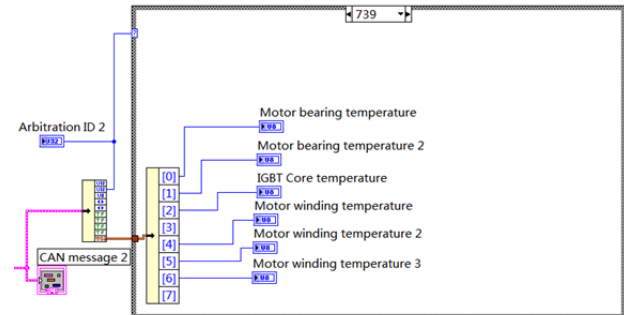


Fig. 2. Single byte data

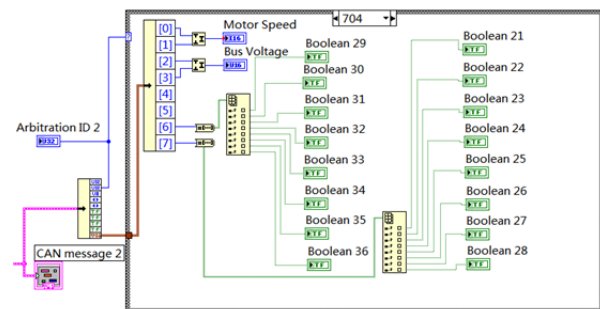


Fig. 3. Bit data unpack and double byte data combination

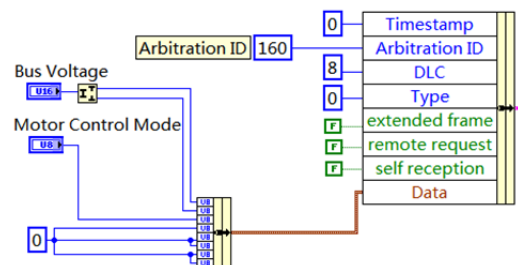


Fig. 4. Communication message encapsulation

Master to Slave:

- Split Number, bundle and bundle by name control

When we sent the data to the slave, we should bundle the 8 byte data use the *bundle control*. Double byte data like “Bus Voltage” should be split into two single byte data and then bundle with other single byte data together. Then, we assembled the communication message use the *bundle by name control*. It is shown in fig.4.

IV. RESULTS

We design the UAV platform, and accomplished the SCADA system aimed at the platform above. The SCADA system achieved multichannel signal acquisition and control, the HMI is shown in fig.5. The system successfully completed

the test task of the dual generators and the double motors. The system achieved good applied results, and has a very important significance for our research in long endurance of multi-axis unmanned aerial vehicle.

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Fig. 5. HMI