Design and Implementation of Bicycle Testing Platform with Automatic Image Processing

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In recent years, the sport consciousness and environmental consciousness are increased so that cycling has become very popular around the world. The demand of people increases of performance of the bike and one of these is the electronic shifting system. This paper designs and implements a test system that can achieve synchronizing control data measurement, flywheel gear recognition and ramp simulation of the bike test platform. That can test the emulate the different road environment, such as upward slope or downhill, etc. An automatic image process is developed to test the electrical shifter. The quality of motors, shifting position, pedal pressure and the shifting time can be measured automatically by using a high-speed camera.

I. Introduction

In the recent years, the demand of people increases of performance of the bike and one of these is the electronic shifting system. The product quality is very significant, especially for bicycle product. The traditional quality check process manually cannot meet the requirements of product quality control. How to check the quality of bicycle parts in a short time automatically is a challenge[1]-[3].

This paper designs and implements a bicycle testing platform with automatic image processing. That can test the emulate the different road environment, such as upward slope or downhill, etc. An automatic image process is developed to test the electrical derailleur. The quality of motors, shifting position, pedal pressure and the shifting time can be measured automatically by using a high-speed camera.

II. System Architecture

A. System Platform

This paper presents a test system illustrated in Fig. 1. The test system can achieve synchronizing control data measurement, flywheel gear recognition and ramp simulation of the bike test platform. The system architecture is divided into three sections: bicycle detecting server, automated equipment control and measuring instrument for electronic shifting system. Bicycle detecting server is used to perform the identification algorithm for flywheel and ramp simulation. Automated equipment control can synchronize control of the electronic shifting system and high speed camera. Measuring instrument for electronic shifting system can measure voltage, current and pedaling force. The automated equipment control is implemented by using C# programming language. The measuring instrument is implemented by using NI components and LabVIEW[4].

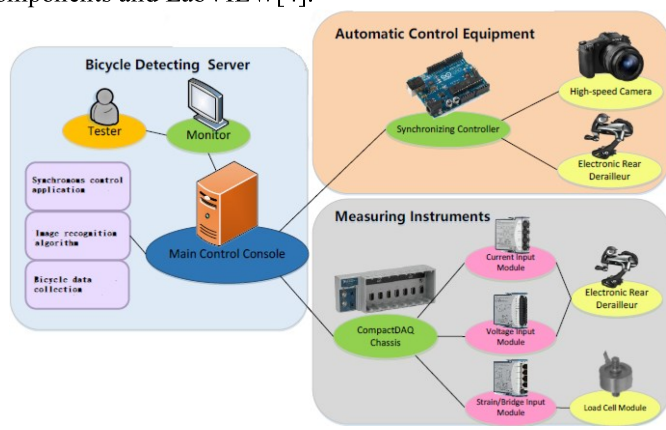

Fig. 1. System structure diagram

III. Image Processing

A. Image-Processing Algorithm

The gear recognition algorithm mainly deal with the position detection of gear, bicycle chain and electronic derailleur. After figuring out the three objects with color identification and noise elimination. The related distances of the tree objects can be calculated automatically. The image-processing algorithm is illustrated in Fig. 2.

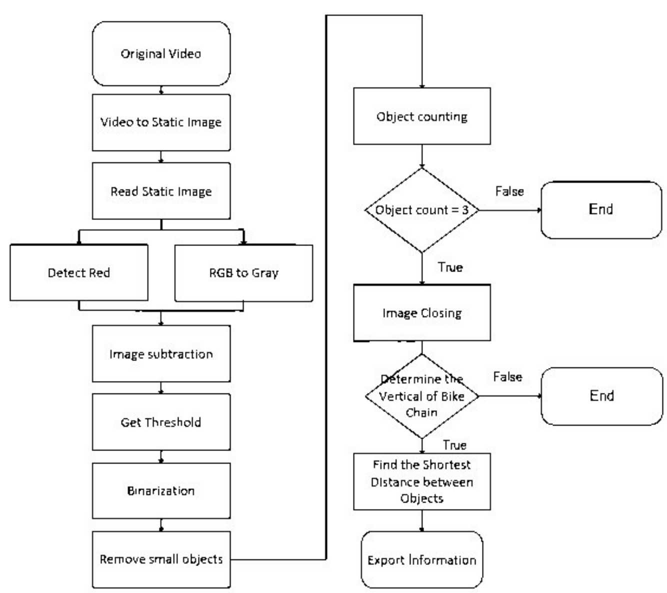

Fig. 2. The identification algorithm of bicycle objects.

IV. RESULTS

Our system captures the still images with high-speed video. The image-processing algorithm can identify the positions of gear, bicycle chain and electronic derailleur. Moreover, the related distances of the tree objects can be calculated. In our captured image, the unit distance is the pixel, and one pixel equals to 0.1496 mm. The time interval of each still image is 4.22ms. The test data is shown in Fig. 3.

	A	B	C	D	E	F
1	Filename	Object Counting	Distance_1	Distance_2	Time(4.22ms)	Steps
2	C0504 001.jpg	3	457.055805	411.056448	1	1
3	C0504 002.jpg	3	454.041	410.055933	2	1
4	C0504 003.jpg	3	456.055933	411.073557	3	1
5	C0504 004.jpg	3	455.055805	410.041188	4	1
6	C0504 005.jpg	3	456.055805	411.041094	5	1
7	C0504 006.jpg	3	455.041094	410.073053	6	1
8	C0504 007.jpg	3	455.028473	410.040907	7	1
9	C0504 008.jpg	3	455.07322	410.056189	8	1
10	C0504 009.jpg	3	454.07322	410.041377	9	1
11	C0504 010.jpg	3	455.041282	411.055933	10	1
12	C0504 011.jpg	3	456.05606	411.073388	11	1

Fig. 3. Gear identification report

Finally, the test report is generated automatically and shown in Fig. 4. The report inclues the results of the maximum, minimal, average and standard deviation values of object distances.

First gear			Sixth gear		
	Distance_1	Distance_2		Distance_1	Distance_2
MAX	457.0558	412.0285	MAX	327.0826	232.0518
MIN	453.0102	408.0408	MIN	320.0284	227.0561
Average	455.230201	409.790919	Average	323.50264	229.49736
Standred	0.80551499	0.83943622	Standred	1.32815638	0.65571435
Second gear			Seventh gear		
	Distance_1	Distance_2		Distance_1	Distance_2
MAX	432.041	383.0561	MAX	301.0182	196.0728
MIN	428.0285	378.0411	MIN	296.0412	192.0286
Average	430.344245	380.711721	Average	298.69905	193.926082
Standred	0.78958344	0.6696427	Standred	0.74085627	0.58777698
Third gear			Eighth gear		
	Distance_1	Distance_2		Distance_1	Distance_2
MAX	408.0559	412.0285	MAX	271.0413	196.0559
MIN	403.0182	408.0408	MIN	267.073	192.0285
Average	405.072862	409.790919	Average	268.847941	193.761582
Standred	0.73422274	0.83943622	Standred	0.6002073	0.59664767

V. CONCLUSION

In the paper, the test system prototype is approached to improve the efficiency of electronic shifting system of testing. In our system, the tester can easily test the quality of the electronic derailleur. In our test results, we can observe that our test data is exact and stable. Our system can meet the requirements of the quality test. In the future, the standard test process can be added in our test system, such as ISO.

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