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Design of Electric Bike Information System

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Abstract: As the electric bike rental market develops very fast in China, this paper designs a new electric bike data collection, processing and display system. This system combines with wireless communication technology, Internet technology and computer software technology. The SSH framework is used in the design of the server. The client of the system gets the data in the database through the connection with server, analyzes and processes the data to achieve a comprehensive collect and analyze of the status of the bike.
Keywords: electric bikes, server, database, SSH framework, data processing

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1. INTRODUCTION

Most of the current vehicle information systems are designed for logistics vehicles and buses, not for electric bikes. Electric bike information system not only allows the bike rental company to grasp the current status of each bike, but also can collect motor and battery data. The data can be processed and analyzed for the future to improve the performance of the bike.

For a particular brand of electric bike, this paper designs an information system. In this system, the information such as speed, power and position of the bike is uploaded to the server through the mobile terminal, and the client downloads the data uploaded by the mobile terminal in the database through the server, and the data is finally displayed on the client.

2. DESIGN THE STRUCTURE OF THE SYSTEM

The system consists of mobile terminal, communication network, server and client. The overall structure of the system is shown in Figure 1.

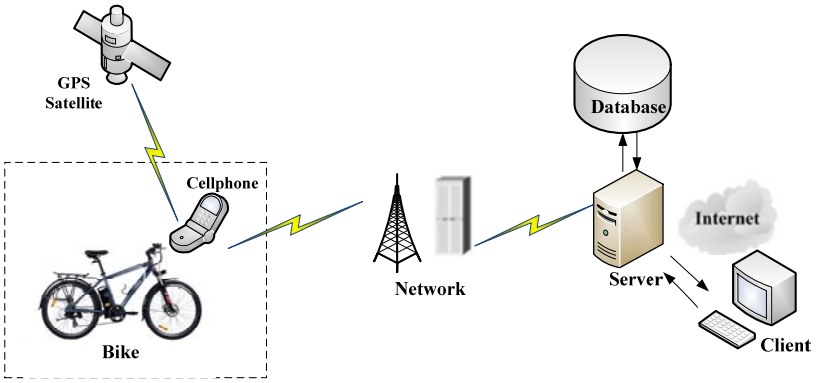


Fig. 1 The overall structure of the system

Using the supporting application in the cellphone to unlock the bike, then the cellphone is able to communicate with the bike's motor controller via Bluetooth[1]. On one hand, the bike's data will be processed and displayed on the phone, on the other hand, the data will be uploaded to the server through 3G network[2]. Finally, the data will be stored in the database. The client accesses to the server through the Internet and reads the data in database[3]. In this way, rental companies can not only know the location of each bike, but also analyze and process the abnormal data timely in order to avoid more serious consequences.

3. DESIGN OF COMMUNICATION PROTOCOL

3.1 Communication between mobile terminal and bike

Table 1 The format of the data frame

data byte	function	describe
BYTE0	initial flag	Fixed to 0x64.
BYTE1	voltage state	bit7: 0 indicates the battery is OK, 1 indicates the battery is under voltage. bit6-0: Reserve.
BYTE2	current state	Operating current of the controller.
BYTE3	high-byte of the speed	Wheel rotation cycle, the unit is millisecond.
BYTE4	low-byte of the speed	
BYTE5	remaining capacity	0-100%.
BYTE6	gear	4 gear: 0x00, 0x04, 0x08, 0x09.
BYTE7	power switch status, headlight switch status	bit0: 0 indicates the headlight is off, 1 indicates the headlight is on. bit4: 0 indicates the power is off, 1 indicates the power is on.
BYTE8	fault code	
BYTE9	checksum	
BYTE10	end flag	Fixed to 0x0E.

In order to ensure that the mobile phone can get the bike running data, this paper designs a communication protocol. Bluetooth is used for data transmission between the motor controller and the mobile phone. The Bluetooth module of the motor controller sends a data frame length of 11 bytes, the data frame is sent every 500ms[4]. The format of the data frame is shown in Table 1.

3.2 Communication network and protocol

Communication network is responsible for the communication between mobile terminal and server. This system chooses 3G network as the communication network. As the communication protocol, this system chooses HTTP protocol which is based on the application layer of TCP[5]. The process of communication is shown in Figure 2. After encapsulated, the HTTP packet is sent to the server. The server receives the packet, releases the packet and gets the data.

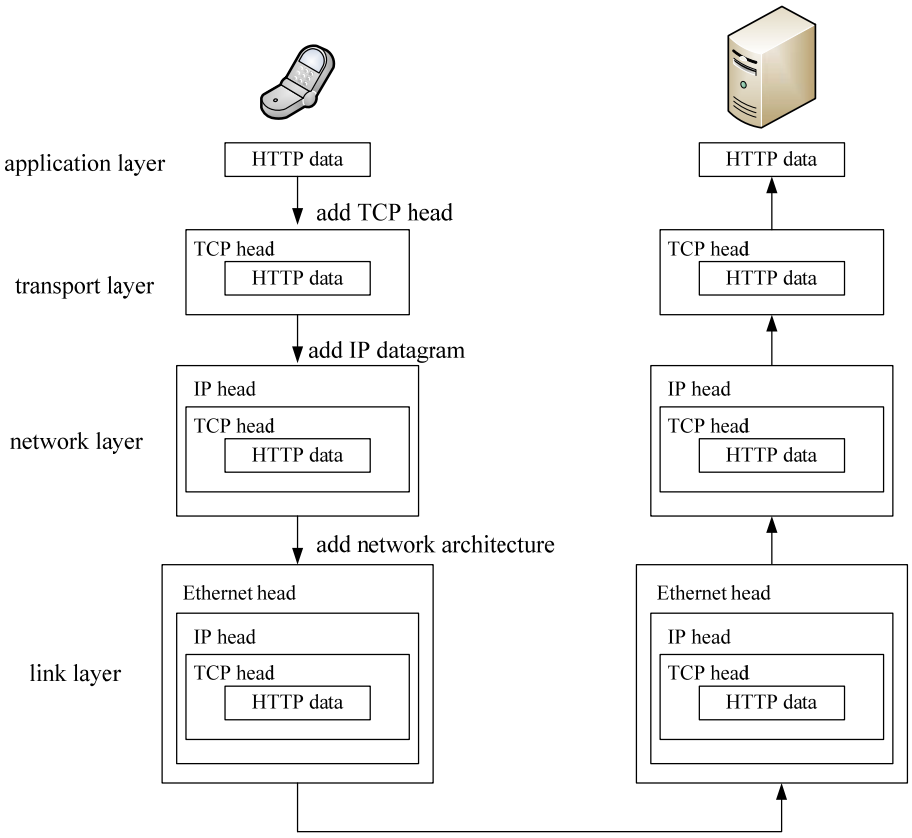


Fig. 2 The process of communication

4. DESIGN OF DATABASE

For the information system designed in this paper, in order to ensure the data reduction and integrity, the data can be divided into three categories, including bike number, bike status information and bike location (GPS)[6]. The physical model of database is shown in Figure 3.

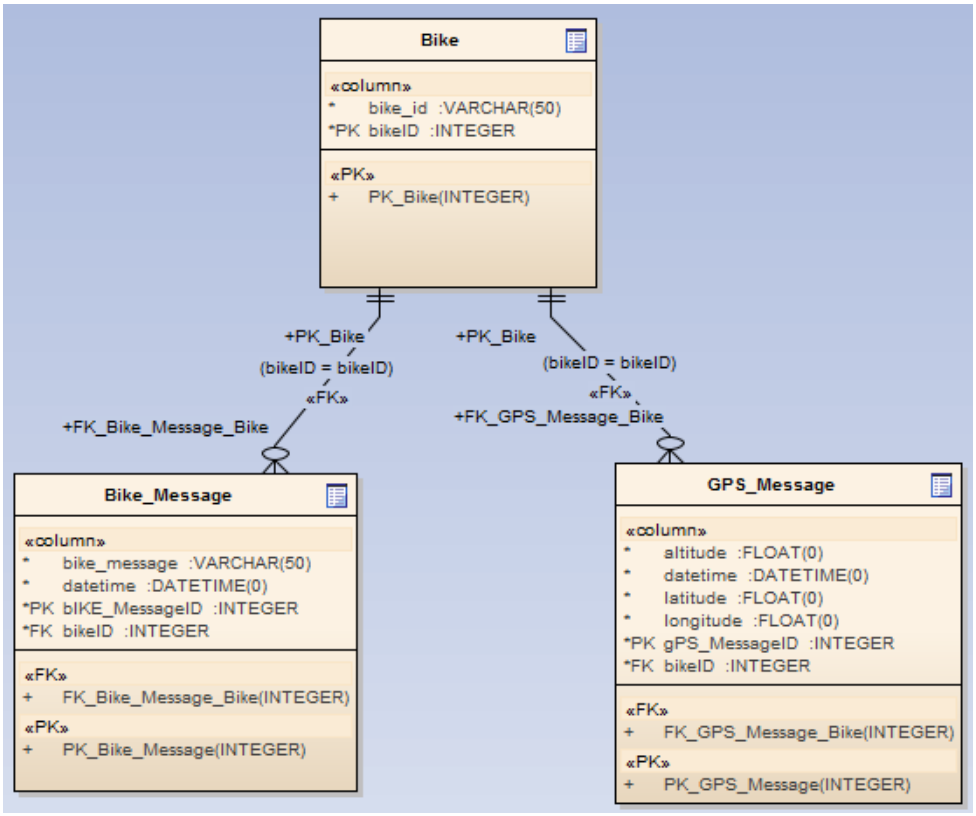


Fig. 3 The physical model of database

In the system, MySQL is used as the database. GPS data and riding data is shown in Table 2.

Table 2 The format of the data

Data	Field	Type	Primary key	Null
GPS	gPS_MessageID	int	yes	no
	time	datetime	no	no
	longitude	float	no	no
	latitude	float	no	no
	…			
Riding	bIKE_MessageID	int	yes	no
	bikeID	int	no	no
	time	datetime	no	no
	speed	float	no	no
	…			

5. DESIGN OF SERVER

In the system, SSH framework is used to build server, it is the integration of struts, spring and hibernate.

In the presentation layer, the JSP page is responsible for receiving the request and transmitting response. Then according to the configuration file struts-config.xml, Struts will send the Request received by ActionServlet to the corresponding Action. In the business layer, the service component managed by Spring IoC container is responsible for providing the Model component and the DAO component to the Action[7]. In the persistence layer, Hibernate is responsible for object mapping and database interaction, it processes the data requested by the DAO component and returns the results. The design flow of the server framework is shown in figure 4.

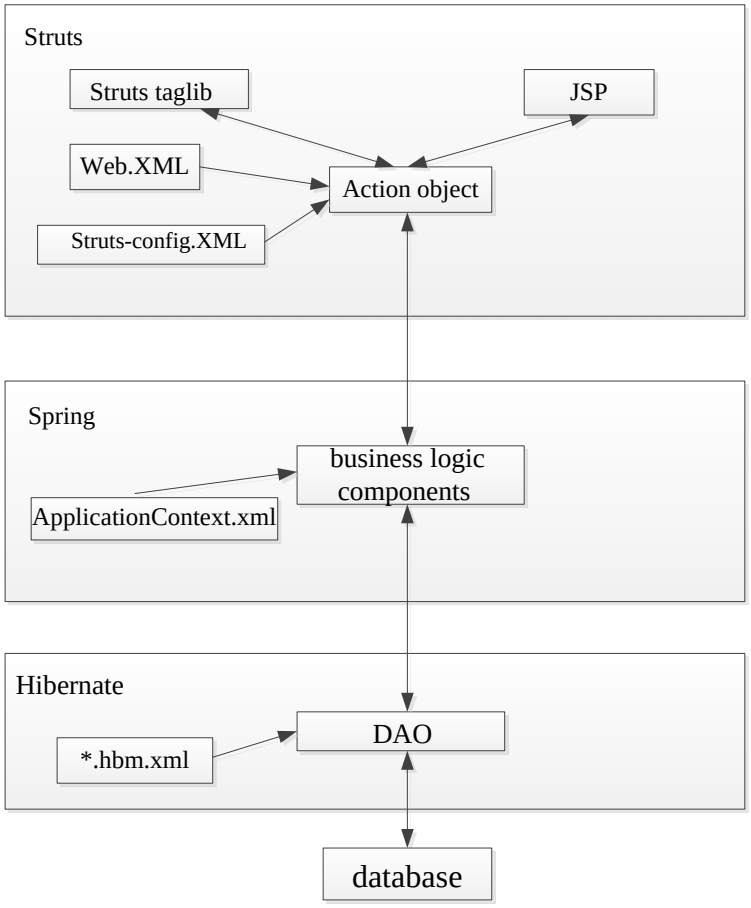
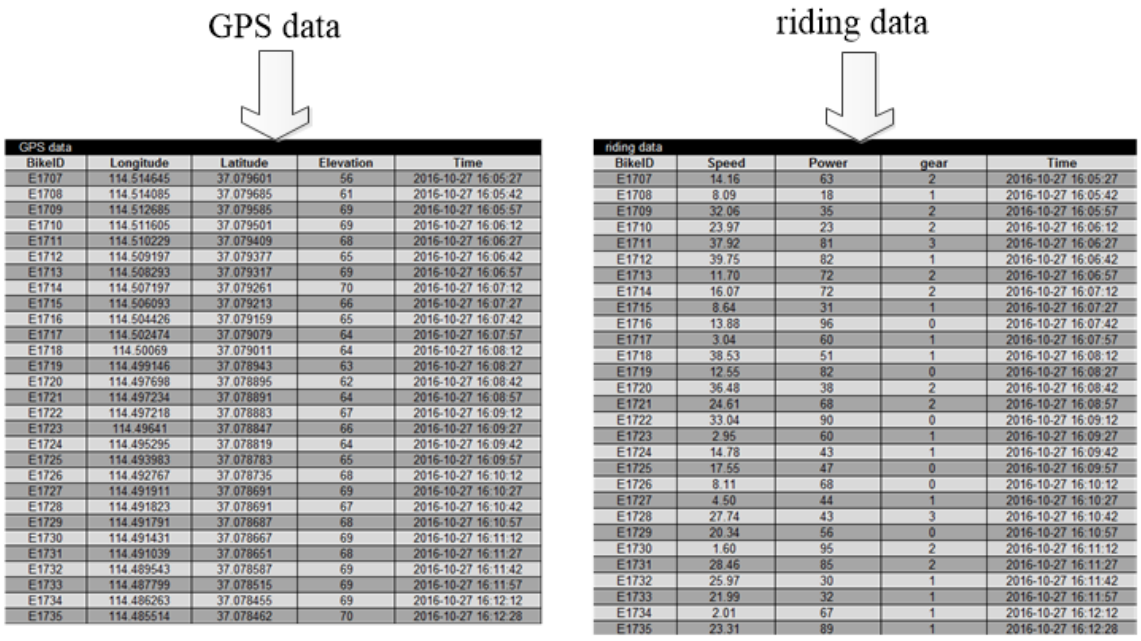


Fig. 4 The design flow of the server framework

6. DESIGN OF CLIENT

In this system, the client accesses to the server database, reads the data and downloads the data to do local processing. When the client requests the GPS data from the server, then the server returns GPS data in JSON format[8]. After receiving the GPS data, the client parses the data into

multiple arrays and assigns them to the location service system to realize the positioning function[9]. When the client requests the relevant data of the bike, then the server also returns the data in JSON format, the client receives the data, imports DBC file, puts the data into multiple arrays, the data are assigned to the drawing control and text display control, so the speed, power, gear and other state information can be displayed[10]. Figure 5 shows the data displayed in the client.



GPS data

BikeID	Longitude	Latitude	Elevation	Time
E1707	114.514645	37.079601	56	2016-10-27 16:05:27
E1708	114.514085	37.079685	61	2016-10-27 16:05:42
E1709	114.512685	37.079585	69	2016-10-27 16:05:57
E1710	114.511605	37.079501	69	2016-10-27 16:06:12
E1711	114.510229	37.079409	68	2016-10-27 16:06:27
E1712	114.509197	37.079377	65	2016-10-27 16:06:42
E1713	114.508293	37.079317	69	2016-10-27 16:06:57
E1714	114.507197	37.079261	70	2016-10-27 16:07:12
E1715	114.506093	37.079213	66	2016-10-27 16:07:27
E1716	114.504426	37.079159	65	2016-10-27 16:07:42
E1717	114.502474	37.079079	64	2016-10-27 16:07:57
E1718	114.50069	37.079011	64	2016-10-27 16:08:12
E1719	114.499146	37.078943	63	2016-10-27 16:08:27
E1720	114.497698	37.078895	62	2016-10-27 16:08:42
E1721	114.497234	37.078891	64	2016-10-27 16:08:57
E1722	114.497218	37.078883	67	2016-10-27 16:09:12
E1723	114.49641	37.078847	66	2016-10-27 16:09:27
E1724	114.495295	37.078819	64	2016-10-27 16:09:42
E1725	114.493983	37.078783	65	2016-10-27 16:09:57
E1726	114.492767	37.078735	68	2016-10-27 16:10:12
E1727	114.491911	37.078691	69	2016-10-27 16:10:27
E1728	114.491823	37.078691	67	2016-10-27 16:10:42
E1729	114.491791	37.078687	68	2016-10-27 16:10:57
E1730	114.491431	37.078667	69	2016-10-27 16:11:12
E1731	114.491039	37.078651	68	2016-10-27 16:11:27
E1732	114.489543	37.078587	69	2016-10-27 16:11:42
E1733	114.487799	37.078515	69	2016-10-27 16:11:57
E1734	114.486263	37.078455	69	2016-10-27 16:12:12
E1735	114.485514	37.078462	70	2016-10-27 16:12:28

riding data

BikeID	Speed	Power	gear	Time
E1707	14.16	63	2	2016-10-27 16:05:27
E1708	8.09	18	1	2016-10-27 16:05:42
E1709	32.06	35	2	2016-10-27 16:05:57
E1710	23.97	23	2	2016-10-27 16:06:12
E1711	37.92	81	3	2016-10-27 16:06:27
E1712	39.75	82	1	2016-10-27 16:06:42
E1713	11.70	72	2	2016-10-27 16:06:57
E1714	16.07	72	2	2016-10-27 16:07:12
E1715	8.64	31	1	2016-10-27 16:07:27
E1716	13.88	96	0	2016-10-27 16:07:42
E1717	3.04	60	1	2016-10-27 16:07:57
E1718	38.53	51	1	2016-10-27 16:08:12
E1719	12.55	82	0	2016-10-27 16:08:27
E1720	36.48	38	2	2016-10-27 16:08:42
E1721	24.61	68	2	2016-10-27 16:08:57
E1722	33.04	90	0	2016-10-27 16:09:12
E1723	2.95	60	1	2016-10-27 16:09:27
E1724	14.78	43	1	2016-10-27 16:09:42
E1725	17.55	47	0	2016-10-27 16:09:57
E1726	8.11	68	0	2016-10-27 16:10:12
E1727	4.50	44	1	2016-10-27 16:10:27
E1728	27.74	43	3	2016-10-27 16:10:42
E1729	20.34	56	0	2016-10-27 16:10:57
E1730	1.60	95	2	2016-10-27 16:11:12
E1731	28.46	85	2	2016-10-27 16:11:27
E1732	25.97	30	1	2016-10-27 16:11:42
E1733	21.99	32	1	2016-10-27 16:11:57
E1734	2.01	67	1	2016-10-27 16:12:12
E1735	23.31	89	1	2016-10-27 16:12:28

Fig. 5 The data displayed in client

7. CONCLUSION

In this system, the mobile terminal communicates with the remote server through 3G network and uploads the collected data. The client communicates with server, downloads and processes the data. The advantage of this system is that the collected data are all uploaded to the server, so the server can be treated as an information sharing center. The system can provide data support for the later research on bike condition, battery performance, market distribution and so on.

REFERENCES

[1] Liu Hongwei, Design of remote monitoring and fault diagnosis system for electric vehicle, Mechanical Engineering and Information Technology, 2011.8.

[2] Lu Xutao, Cui DongSen, Design of transport vehicles remote monitoring system, ICETC, 2010.

[3] Y. Zhang, G. Gantt Jr., M. Rychlinski, et al, Connected vehicle diagnostics and prognostics, concept, and initial practice, IEEE Transaction on Reliability, vol.58, no.2, June 2009.

[4] Jyong Lin, Shih-Chang Chen, Yu-Tsen Shih, Shi-Huang Chen, A Study on Remote On-Line Diagnostic System for Vehicles by Integrating the Technology of OBD, GPS, and 3G, Word Academy of Science, Engineering and Technology 56, 2009, pp.435-441.

[5] Rod Johnson, Jnergen holler et al, Professional Java with the Spring Framework, Wiley Publishing, 2009.

[6] M.B.Phalake, D.M.Bhalerao, Vehicle Telematics System Using GPRS, Int.J. Comp.Tech.Appl, vol.2, 132-135, 2008.

[7] Wilson A J, The use of public wireless network technologies for electricity network telecontrol, Computing and Control Engineering, 2005, 16(2): 32-39.

[8] McNeff J G, The global positioning system, IEEE Transactions on Microwave Theory and Techniques, 2002, 50(3): 645-652.

[9] Yilu Zhang, Mutasim Salman, et al. Remote vehicle state of health monitoring and its application to vehicle no-start prediction, Proceedings of IEEE International Conference on Prognostics and Health Management, 2009.

[10] Sefer Kurnaz, RustamB.Rustamov. Earth observation remote sensing and GIS services for monitoring of integration systems, International Journal of Engineering and Technology, 2007.