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Development of Water Level and Water Quality Monitoring System in Multiple Water Areas of Hongze Lake Based on 5G Technology

Li Jing, Li Ruofan, Wang Kundong, Li Hui*

School of Automation, Huaiyin Institute of Technology, Huai An, China

Email address:
13645234923@163.com (Li Hui)
*Corresponding author

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Abstract: In order to further improve the intelligence level of current multi-water level water quality monitoring in Hongze Lake and reduce the incidence of catastrophic accidents, a multi-water water level water quality monitoring system based on 5G communication technologies in Hongze Lake was proposed in this paper. The embedded system chip RK3399 was used to construct the bottom-level monitoring core module. For the convenience of emergency and system debugging, the bottom-level module was also designed with a matrix keyboard and corresponding LCD liquid crystal display. Zigbee communication was used to obtain the water level and water quality sensor array information in multiple waters, and data fusion processing was performed through 5G communication. 5G module was used for communication between bottom-level module and server. At present, the cost of server leasing is relatively high. In order to reduce the cost of server leasing, the high-level language Delphi was combined with Socket communication to independently build the underlying server module in this paper. The underlying server module was convenient and flexible, with large storage capacity and low cost; the mobile APP client was designed to communicate wirelessly with the server. After on-the-spot monitoring of the Hongze Lake area, the monitoring system was in good operation, with fast parameter acquisition and screen capture, which could meet the expected results and provide a good solution for water level water quality monitoring in multiple water areas.

Keywords: Multiple Water Areas, Water Level, Water Quality, Monitoring, 5G Communication

1. Introduction

With the rapid development of computer technology + network technology, the application of 5G technology was becoming more and more extensive [1-9]. 5G technology had the advantages of fast data exchange speed and short delay, and had always been favored by all walks of life [10-16]. 5G technology was applied to high-precision synchronous vector measurement by Xu Quan and others from China Southern Power Grid Research Institute, and used 5G technology to accurately synchronize the second pulse of the clock, with high precision, small delay, and high reliability, and achieved good results [1]. Sun Jiping of China University of Mining and Technology used 5G hard slicing technology to realize the intelligentization of coal mines, ensuring coal mine safety monitoring and mine safety [2]; Li Shulan and others of Jingdezhen University used 5G technology millimeter wave transmission to communicate with ships [3]. The network was systematically reconstructed, and the transmission was stable and the effect was good; Guo Ling and others from the Army Service College applied 5G technology to military logistics and warehousing, realizing the deep integration of high-precision positioning network and 5G [6]; The 5G technology had been successfully applied to the remote control of farm mobile robots by Cheng Zhiliang from Xinxiang Vocational and Technical College, realizing the functions of remote control operation control and path planning [12]; A remote monitoring system for water level and water quality in multiple water areas of Hongze Lake was built by 5G technology on the basis of predecessors in this paper.

2. The Overall Structure of the System

The system was mainly divided into server, client and bottom monitoring module. At present, most of the servers used the rental cloud server method, which had high rental costs and limited capacity. This system adopted the self-built server mode, and adopted the high-level language DELPHI combined with SOCKET network communication technology to cooperate with the database to realize the system. The system was flexible, large in capacity and high in cost performance. The client was mainly implemented by ANDROID programming, and the underlying module was mainly implemented by RK3399 combined with 5G communication module and peripheral circuits. The specific structure was shown in Figure 1.

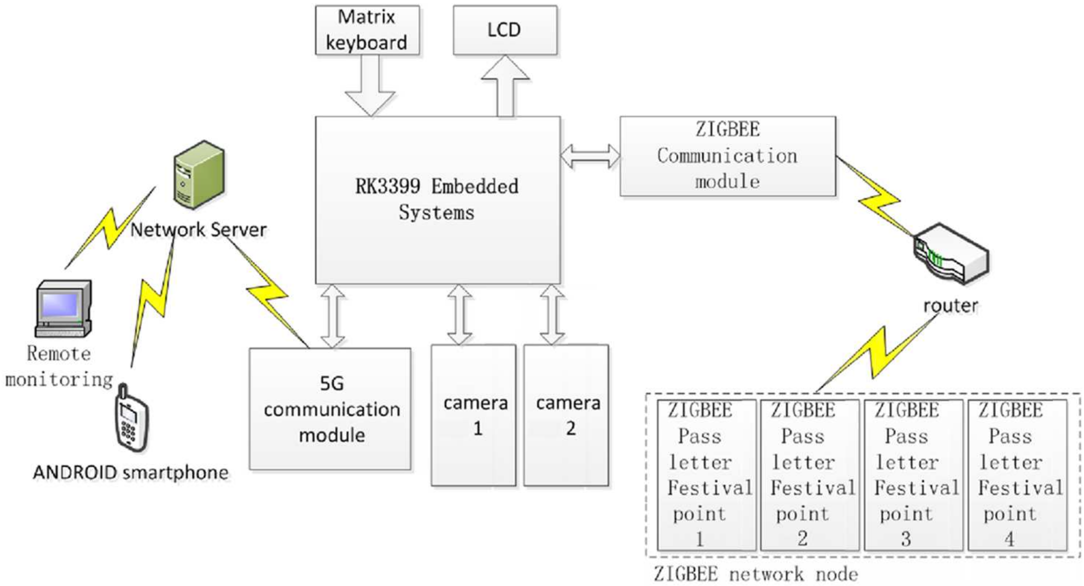

Figure 1. *Overall architecture of the system.*

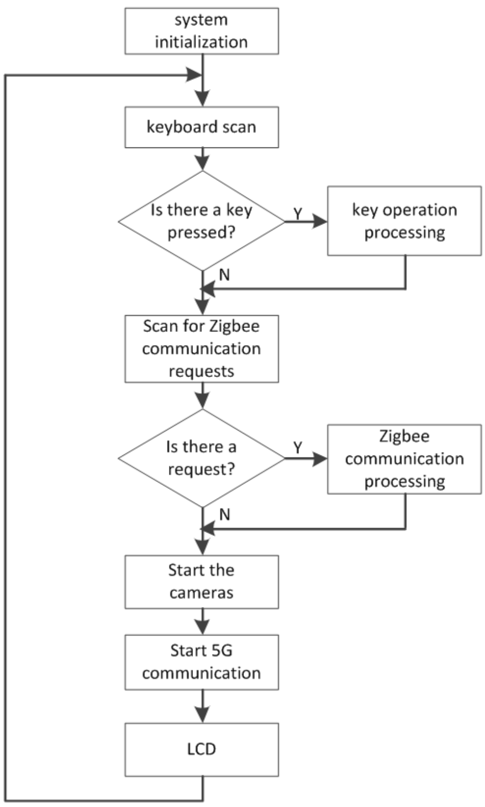

Figure 2. *Execution flowchart of the underlying module.*

3. The Bottom Module Design

RK3399 was a industrial-grade wide temperature chip with multi-channel USB cameras, supported multiple operating systems, and had stable and reliable performance. And quad-core image processor was integrated in RK3399. The bottom monitoring module was based on the RK3399 embedded microprocessor, and the multi-water sensors were composed of 4 sensor arrays. Each sensor array was composed of an independent ZIGBEE network node. Each ZIGBEE network node was composed of a CC2530 microprocessor. It was composed of various sensors, such as water level sensor, pH value sensor, salinity sensor, ammonia nitrogen sensor, dissolved oxygen sensor, etc. The ZIGBEE network nodes in their respective waters sent sensor data information to the router in real time, and the router sent it to the ZIGBEE communication module of RK339 to conduct real-time wireless communication with RK3399. RK3399 collected the multi-water area sensor array information and sent it to the designated network server through the 5G communication module. At the same time, it started 2 cameras to transmit the water surface situation to the network server in real time through the 5G network.

After the RK3399 system was powered on, first, the system parameters and peripheral interface parameters were initialized one by one, and then the keyboard was scanned, the communication request was waited, the camera was started, 5G communication was opened, and finally the LCD liquid crystal display was called. The specific execution flow chart was shown in Figure 2.

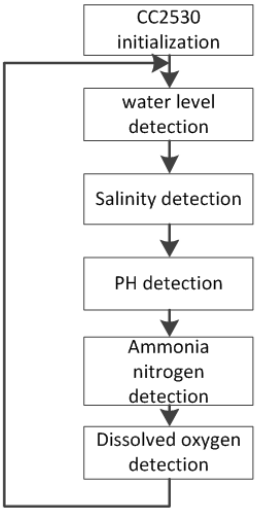

Figure 3. *CC2530 execution flow chart.*

Correspondingly, the RK3399 received the water level water quality data in multiple water areas from the sensor array. The sensor array was mainly composed of CC2530 microcontroller combined with several sensors, which were distributed in several water areas. The CC2530 sensor array execution flow chart was shown in Figure 3.

4. Server Module Design

The server module of this system was designed and constructed by the high-level language Delphi, and used the Socket network communication technology to complete the network communication with the underlying module. The server mainly received the information data from the underlying sensor array according to the IP address and port number, and stored it in the database in real time. At the same time, the camera data information and the data communication request from the Android mobile phone client were received, and the data was sent to the corresponding requesting client. You could browse the corresponding data trend curve in real time, and the specific interface design was shown in Figure 4.

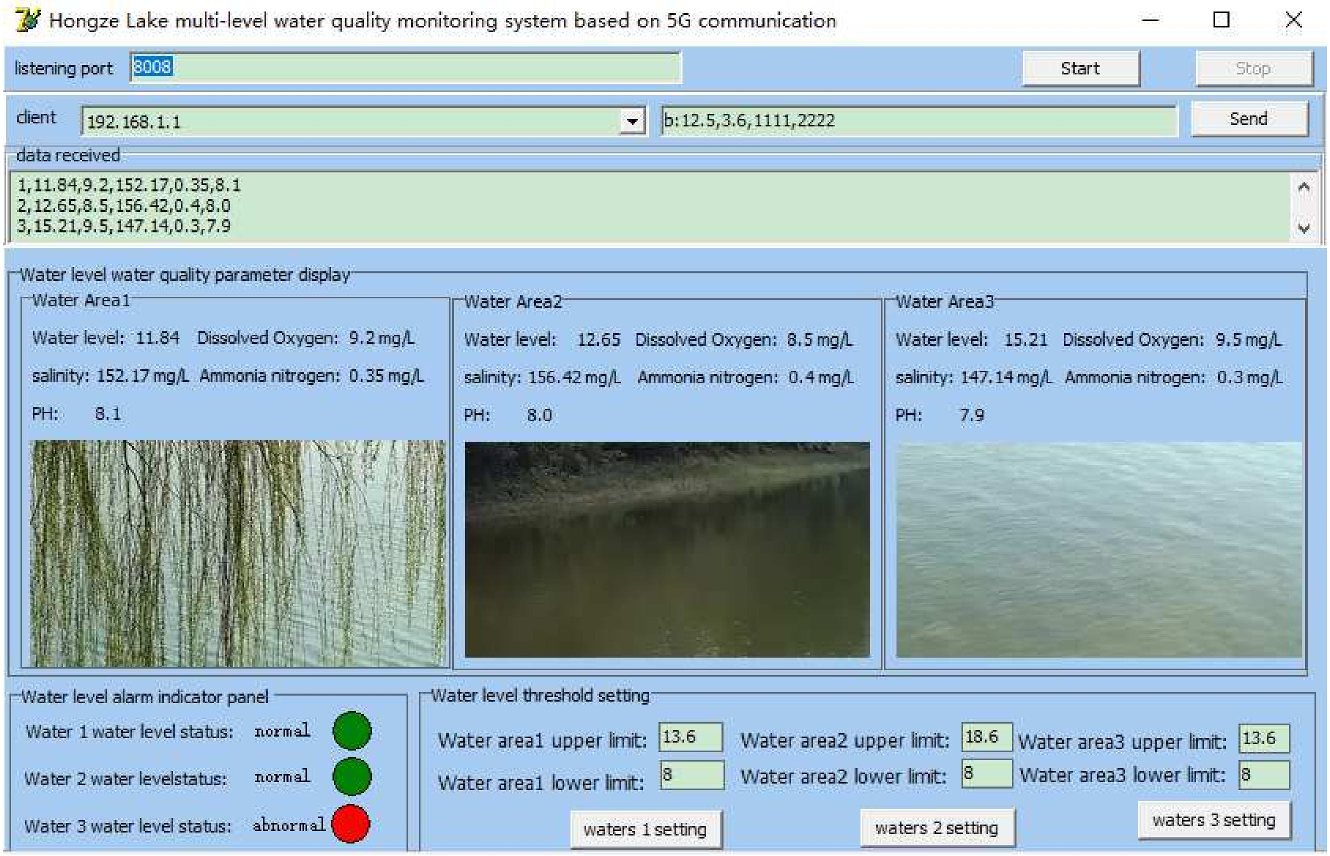

Figure 4. *Interface design of PC server.*

5. Mobile Client Module Design

The mobile phone client was implemented by the Andriod system programming. After the system was initialized, for the first-time user, the user entered the public network IP address and port number of the server. After the user input was completed, the system automatically saved it to the mobile phone database. Read the IP address and port number information from the mobile phone database, and directly communicated with the server through Socket. If the underlying server IP address and port number changed and need to be updated, you could modify the user's IP address and port number information on the mobile phone page, and then updated the corresponding IP address and port number information in the mobile phone database. And then a data request would be sent to the corresponding server. After receiving the data request, the server sent the data to the corresponding requesting client. After receiving the data, the Android phone processed it, displayed it in real time, and stored it in the corresponding in the database.

6. Conclusion

According to the requirements of the project, this paper designed the bottom monitoring module, local server module and remote Android mobile client module, and successfully applied 5G technology to the water level and water quality monitoring of Hongze Lake. After the field system test of the Hongze Lake area, the system ran well and could realize the real-time monitoring of multi parameters in multi water area by bottom control model, with fast data communication speed, low error rate. Local server interface was designed friendly and could realize real-time large-capacity data storage. The remote mobile phone APP was based on Android architecture, which was simple, convenient, smooth and highly humanized.

Acknowledgements

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References

[1] XU Quan, YUAN Zhiyong, LEI Jinyong, et al. High Precision Synchronous Phasor Measurement and Test Method Based on 5th Generation Mobile Networks [J]. SOUTHERN POWER SYSTEM TECHNOLOGY, 2021, 15 (7): 76-80.

[2] SUN Jiping. Coal mine intelligence, mine 5G and network hard slicing technology [J]. Industry and Mine Automation, 2021, 47 (8): 1-6.

[3] LI Shu-lan. Construction of the ship communication network system based on 5G technology [J]. SHIP SCIENCE AND TECHNOLOGY, 2021, 43 (9A): 142-144.

[4] ZHANG Zuofang, LI Yang, LI Ying, et al. Integration of Satellite Communication-Navigation-Remote Sensing in 5G for Forest Resource Management [J]. Journal of Nanjing University of Aeronautics & Astronautics, 2021, 53 (Supplement): 102-106.

[5] LI LanLan, Feng Jianghua. Application of 5G Network Technology in Agricultural Intelligent Management [J]. Agricultural Mechanization Research, 2021, 9: 260-263.

[6] GUO Ling, DU Weiwei, LIU Ling, et al. Application of 5G and high-precision positioning in military logistics warehousing application [J]. Surveying and Mapping Bulletin, 2021, 9: 64-67.

[7] ZHAO Ting, LIU Xiaoqiu. Application of 5G in Stomatology [J]. Journal Oral Science Research, 2021, 37 (11): 970-972.

[8] Huang Yanqin, Yu Hao, Yin Junyi, et al. Data Transmission Schemes of Power Internet of Things: Present and Outlook Based on 5G Technology [J]. TRANSACTIONS OF CHINA ELECTROTECHNIAL SOCIETY, 2021, 36 (17): 3581-3593.

[9] JIANG Bo, TIAN Changhai, LIN Wei. Application of 5G-based Mmtc IOT System to Railway Logistics [J]. Railway informatization, 2021, 43 (12): 60-65.

[10] WANG Jian-qun, LI Wei, MA Zhang-chao, et al. 5G industrial Internet empowers smart steel [J]. Iron and Steel, 2021, 56 (9): 56-61, 73.

[11] WANG Yan, TONG Bo, LI Jiadong, et al. Application Status and Prospect of 5G technology in intelligent Operation and Maintenance of Offshore Wind Farm [J]. SHIP ENGINEERING, 2021, 43 (Supplement 1): 130-133.

[12] Cheng Zhiliang. Remote Operation System of Farm Mobile Robot Based on 5G Network [J]. Agricultural Mechanization Research, 2021, 8: 224-228.

[13] Chen Jun, Huang Feiyu, Li Zuoming. Research on DQN-based 5G edge slicing resource management of power internet of things [J]. Electrical Measurement & Instrumentation, 2022, 59 (1): 155-161.

[14] ZHANG Liya. Research on safety application technology of coal mine 5G communication system [J]. Industry and Mine Automation, 2021, 47 (12): 8-12, 45.

[15] GU Yidong, MENG Wei. Coal mine 5G wireless communication system construction concept [J]. Industry and Mine Automation, 2021, 47 (10): 1-6, 13.

[16] LI Xuexia, ZHANG Zhibin, CHU Jianli. Research on the application of 5G technology in intelligent garment factory [J]. Wool Textile Journal, 2021, 49 (12): 104-109.