A remote controlled system implementation for object video monitoring

Ivo Dochev, Liljana Docheva, Maria Pavlova

In the current article a solution of the problem with information taking from difficult to reach and dangerous earth places is described. The robots will be very useful in this case. In the article hardware part researching and designing of such a system is done. The main modules are: a quad-copter and a control system. A modern technology allowed to survey the remotely objects is presented. The system can record information and after that transmit the data to the remotely work station. The problems, which appears in the research work and the solution for their solving is discussed. The possibilities for information transmission are considered. The proposed solution can be used in disasters, ecology projects, sports events, energy sectors and etc.

Keywords – control system, remote control, image recognition.

Възможност за реализация на дистанционно управлявана система за видеонаблюдение (Иво Н. Дочев, Лиляна Е. Дочева, Мария Ц. Павлова) *В настоящата статия е разгледана възможност за получаване на информация за обекти, разположени на трудно достъпни или опасни за хората части от земната повърхност. В този случай е полезно използването на роботи. В статията е разгледано проектирането и реализацията на дистанционно управлявана система за видеонаблюдение. Тя се състои от квадракоптер и система за управление. Информацията за наблюдаваните обекти може да се запише и да се предаде към отдалечена работна станция, където данните могат да се обобщят и обработят. Изложени са проблемите, които биха затруднили реализацията и експлоатацията на дистанционно управляваната система за видеонаблюдение. Обсъдени са възможностите за предаване на информацията към оператора. Тази система може да намери приложение в екологични проекти за опазване на околната среда, спортни мероприятия, енергетика и др.*

Introduction

The automated systems are widely used in our homes, industry, farming, environmental protection or water exploitation. It is difficult to control and manage automated systems in these cases and these operations usually are carried out remotely [1]. This in turn leads to the impossibility to be noticed changes in the working conditions end the working environment. Equipping such systems with video control and the appropriate sensors increases their capabilities by making them flexible and easy to manage.

The installation of a video observation system and sensors on various mobile objects with the possibility of remote control, allows reaching and monitoring of difficult to access and dangerous objects. This in turn creates the conditions for acquiring new scientific knowledge and for solving important issues in education, farming and ecology.

The remote-controlled system equipped with video observation system and appropriate sensors is able to solve problems like the insects control, disaster reaction, and hard meteorological conditions acquiring. It could help for prevention and improving the reaction if some of these events are happens again.

Many different factors and climatic conditions have influence of the environment. Using a video monitoring remote-controlled system equipped with appropriate sensors makes it possible to reach and observe the unapproachable places, including protect natural objects, where the human access is denied. This gives the possibility to acquire information about the changes that occurs in the environment and allows evaluating their impact in real time. This would provide useful information for their protection.

The collected data will create a data base which contains important information for making of new scientific knowledge in the field of education. The

students could use the data and that will give them the opportunity to face things they would never be able to without the remote observing system. Moreover they could take a part in the remote controlling and monitoring some of the processes. The data base could be used from the students and that will give them the opportunity to solve a problems and make decisions in situations that they couldn't reach without the remote observing system.

System architecture

The remote controlled video observation system could be used for electricity network breakdowns tracking, for water supply networks sources monitoring, for forest fires monitoring and a number of other areas where the object reaching of it is quite expensive. Fig. 1 presents one of the possibilities for practical application of a system for remote controlling of difficult accessible objects.

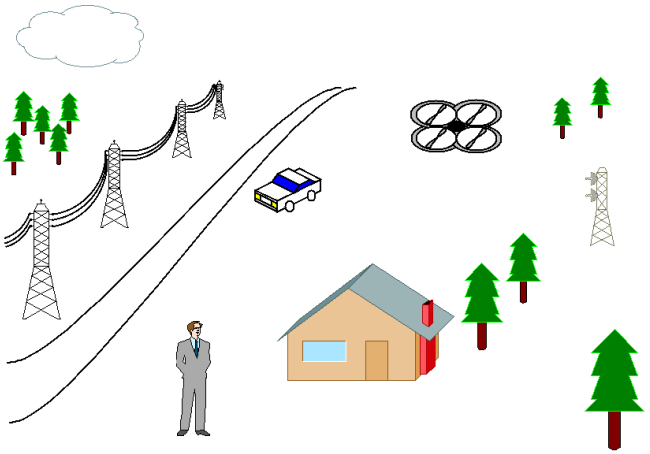

Fig.1. A remote controlled system application.

According to the investment and selected equipment the opportunities in such a system can significantly increase which in turn leads to expansion of its application. The quad-copter should be chosen according the possibilities to fly under sufficient big area for monitoring. With the quad-copter capacity increasing its ability to be in the air longer and to collect video information that can subsequently be processed and available for use increases too. The use of additional sensors may make it possible to collect as much information as possible with one flight of the quad-copter. The coordinate transmission of the monitoring place is an additional advantage of the control system. A real-time data and video information transfer increases the system capabilities. The video information storage, in turn, prevents the loss of information because of interruption in transmitting channel.

Figure 2 presents the remote controlled system architecture. The system contains following modules: a camera for objects capturing, a development platform; an external memory for information storing, a GPS module and sensors for coordinates transmission location to the development platform, a power supply, a transceiver that provides the connection to a remote terminal, a power supply for the control module; flight control module, a transceiver for the remote control.

The camera has the option to work in two main software modes: image capturing and video recording. The generated data in the second mode are too large and it takes a lot of memory to store this information. This problem can be solved by compressing video information.

The second part of fig. 2 includes a power supply-2, a receiver-transmiter-2- and a remote control module. The quad-copter is managed through remote control and receiver-transmiter-2, which gives information to flying control module.

The data from the microcontroller are transmitted by a wireless network to a workstation and vice versa. The development model for the application works with LINUX operation system.

This architecture gives the opportunity for different development applications.

On figure 3 a quad-copter is shown as an option to mount the hardware platform. From the propeller size and the quad-copter battery capacity depends :

- The perimeter that can be monitored by the remote control system;
- The weight that can be lift, which in turn determines the quantity and type of sensors and equipment that could be mounted on it.
- The quad-copter flight stability which affects the quality of video capture.

A lot of the commercially available quad-copters have built-in cameras and factory software does not support additional image processing. This requires the use of a dedicated development system that allows image recognition. The camera that is used of the development system is 8 MP "NoIR Camera V2" (fig. 4). One has the ability to capture images in the infrared spectrum [5]. The image resolution can be selected between 1080p 30fps, 720p 60fps and 640x480p 90fps. The camera weight is about 3 gr. The camera's size and weight are very important for mobile applications [2].

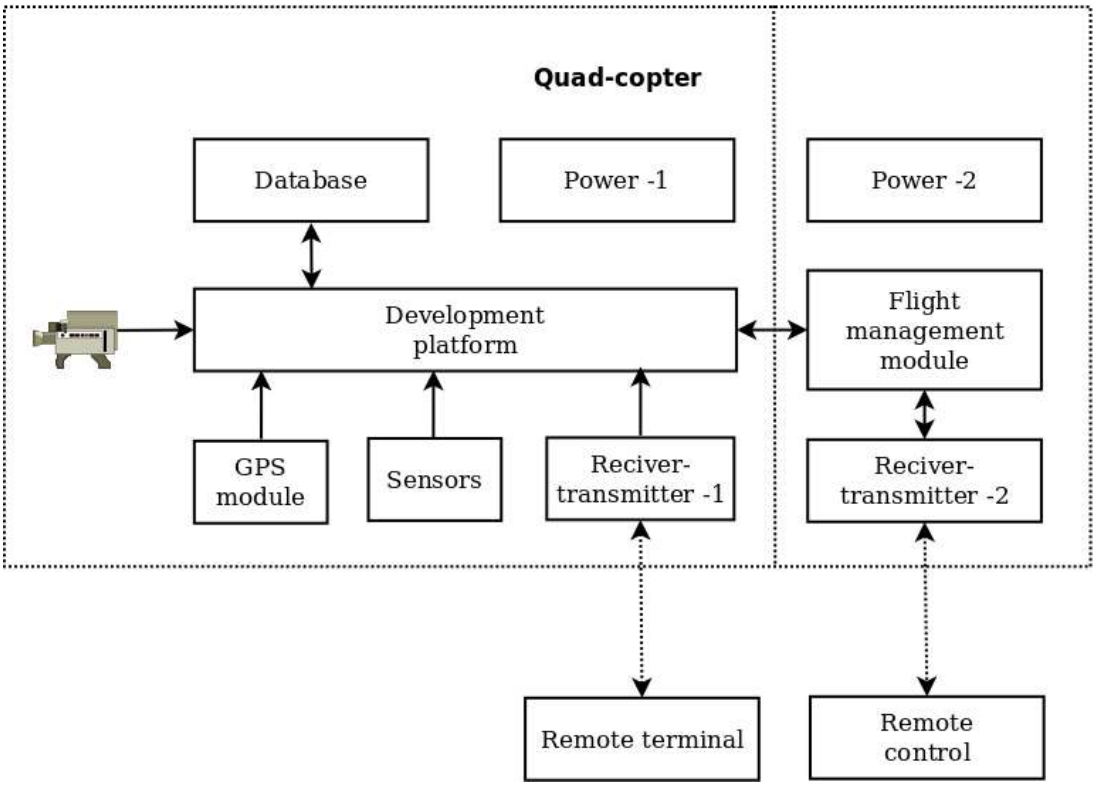

Fig.2. Architecture of the remote controlled system.

Fig.3. A Quad-copter.

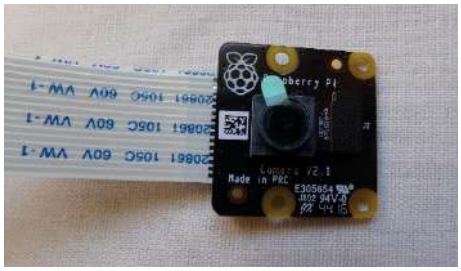

Fig.4. Video camera.

The received information from the camera is processed by development platform (fig. 5). One is attached to the quad-copter. A remote terminal controls the development platform by means of transmitter-receiver. The location of the system is transmitted to the development platform via the GPS module. It has the following features: 66 channel, small size, lightweight and compact, making it applicable to unmanned aerial vehicles.

Fig.5. Attached development platform to quad-copter.

The information from the camera is recorded in a memory. This creates a data base that can be used for data processing. Furthermore saving video information in development platform can prevent

information loss in the case of losing the connection through the channel.

A basic requirement for all elements attached to a quad-copter is a small weight, because the weight increasing affects the perimeter that can be monitored by the remote controlled system. This, in turn, guarantees a maximum mobility.

The microcontroller of the development platform is appropriate, because it is light and compact (fig. 6) [3]. The microcontroller has 4 core processor; 1 GB RAM; Wi-Fi module, low-energy consumption Bluetooth; 40 pin extended GPIO; 4xUSB 2 ports; HDMI; CSI camera port; DSI port for display; CD port that is used for loading of operation system and saving of information; USB power supply.

Fig. 6. The development platform "Raspberry Pi 3".

Conclusion

In this article the following results are obtain:

- Architecture of the remote controlled system has been proposed. It can be utilized for different development applications.
- Specific elements are suggested for the system building. The selected components parameters are in accordance with the system requirements.

Acknowledgement

This work was supported in part under grants of scientific research project by NIS №172ПД0008-07 (session 2017-2018) and Faculty of Telecommunications, Technical University of Sofia.

REFERENCES

[1] Iszaidy, I., A. Alias, R. Ngadiran, R.B. Ahmad, M.I. Jais, D. Shuhaizar Video size comparison for embedded vehicle speed detection & travel time estimation system by using Raspberry Pi. Proceedings of International Conference on Robotics, Automation and Sciences, ICORAS 2016, art. No. 7872631. 2016, pp 196-203.

[2] Raspberry Pi NoIR Camera v2. http://www.farnell.com/datasheets/2056180.pdf

[3] Raspberry Pi 3 Model B. https://cdn.sparkfun.com/datasheets/Dev/RaspberryPi/2020826.pdf.

[4] SDIO101A, SD/SDIO/MMC/CE-ATA host controller. http://www.nxp.com/documents/data_sheet/SDIO101A.pdf

[5] Sahani, M., M.N. Mohanty, Realization of Different Algorithms Using Raspberry Pi for Real-Time Image Processing Application. Advances in Intelligent Systems and Computing, 309 AISC, Vol. 2, 2015, pp. 473-479.

Assoc. Prof. Dr. Ivo N. Dochev *– works in Technical University of Sofia. He received the M. Sc. (Dipl. Ing.) degree in electrical engineering from Technical University of Sofia, Bulgaria, in 1996. In 1996 he joined the Faculty of Telecommunications and Technology, Technical University of Sofia, where he is currently working on topics in measure in telecommunications. He received the Ph. D. degree, in 2009. From 2010 he is Associate Professor in Faculty of Telecommunications, Technical University of Sofia. He has scientific interests in the area of measurement in telecommunications, electromagnetic compatible and analog circuit design.*

e-mail: idochev@tu-sofia.bg

Assoc. Prof. Dr. Liljana E. Docheva *– works in Technical University of Sofia. She received the M. Sc. (Dipl. Ing.) degree in electrical engineering from Technical University of Sofia, Bulgaria, in 1996. In 2006 she joined the Faculty of Telecommunications and Technology, Technical University of Sofia, where she is currently working on topics in television systems. She received the Ph. D. degree, in 2009. From 2015 she is Associate Professor in Faculty of Telecommunications, Technical University of Sofia. She has scientific interests in the area of television systems, image processing and neural networks.*

e-mail: docheva@tu-sofia.bg

Eng. Maria Tz. Pavlova *works in Technical University of Sofia as a senior assistant since 2017 where she is currently working on topics in measure in telecommunications.*

e-mail: mariapavlova@tu-sofia.bg

Received on: 28.05.2018