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AUTONOMOUS MONITORING SYSTEM

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ABSTRACT

The project of Autonomous monitoring system deals with an issue of driving a small airship that is capable of independent operation inside a closed hall. Supposed to be operating inside the building of the university, this airship is accommodated to carry different monitoring units providing students with the opportunity to process various experiments and measurements. Indeed, it can be modified for other purposes such as various monitoring.

The first of these experiments is monitoring of the closed area with an IP camera. The airship will move through a hall at random directions carrying a small IP camera. The WiFi connection will be used to transmit the picture from the camera to a server. This server will allow registered users to view the picture on their computers through standard web interface.

The three-dimensional orientation of the airship is ensured by means of ultrasonic detectors that monitor distances between the airship and objects in its neighborhood. Information gained through the detectors is then processed and serves to drive electric motors.

This project should help students of applied informatics to treat their projects on a real machine.

Keywords: ultrasonic detector, airship, monitoring, WiFi

1. INTRODUCTION

For a long time airships seemed to be outdone but now they are experiencing a considerable renascence. Nowadays, we distinguish between two main groups:

- big ones for outdoor operation,
- small ones optimized for indoor operation.

For instance, the big airships are used for monitoring numbers of animals in reservations or weather conditions in a particular height. The small ones can hold equipment such as camera or electromagnetic field gauge. Owing to this they can be used in educational institutions.

Let us focus on the small airships that can operate inside buildings. They can be used for several purposes. Knowing the physical advantages of the airships, especially their capability to float in the air with minimal power consumption, we decided to develop a small autonomous platform that is able to hold various monitoring systems.

The Faculty of Informatics at Tomas Bata University in Zlin deals with education of applied informatics and that is why not only programming but also the application of computing systems is

being taught there. This project gives students the opportunity to work with a real system, not only a computer model. It incorporates several fields of study: electrotechnics, measurement, algorithm development, automated control and Ethernet data transfer.

2. SCOPE OF DEVELOPMENT

Currently, the project of autonomous monitoring system is under development, which means it runs in several branches simultaneously. The target state is shown at figure 1.

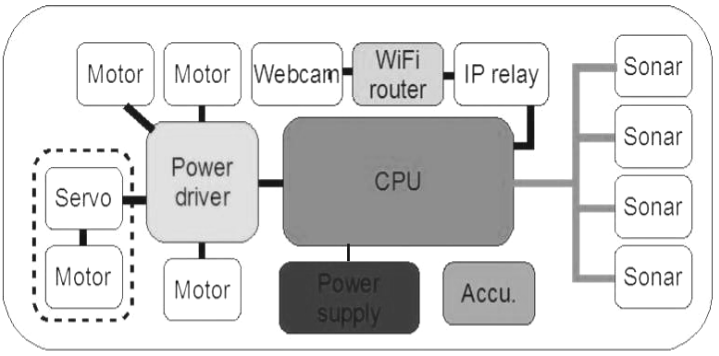

Figure 1. Block diagram showing the supposed final state of the project

In the block diagram at Figure 1 we can see one CPU unit that controls the whole system. Ultrasonic detectors connected via one I^2C monitor the surroundings and provide information about obstacles in the direction of the flight. According to this information the CPU drives motors that move the airship. Moreover, the airship is provided with the web camera that can transfer the picture by means of the WiFi router to the Intranet. There is also the IP relay connected to the WiFi router, by means of which the user, watching the transmitted picture on his computer, can control the airship manually. In the future, possibilities of this configuration may be expanded in order to enable the IP relay to transmit information gained by additional sensors attached to the airship (air pressure, humidity etc.).

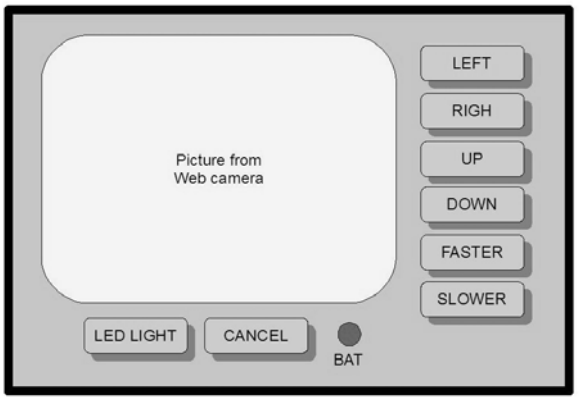

Figure 2. Web interface example

The target state of the web interface is shown at Figure 2. By means of this interface the user connected to the Internet can watch the picture and after being authorized, he can also drive the airship manually using predefined commands.

3. ACTUAL STATE

For the purpose of this research we obtained a small helium airship. The dimensions of this airship are designed with respect to the fact that it should be operated inside a building. We also prepared several testing kits. As the lifting capacity of helium is limited, the dimensions of the airship are resulting from a compromise among load capacity, length relative to the area of operation and aerodynamic shape. Characteristics of the airship are as follows:

- Filling gas: He
- Load capacity: 0,65kg
- Power source: Li-Pol 7,2V, 2,4Ah
- Length: 2,6m
- Max. width: 1,45m
- Volume: 2,7m3

The load capacity considers the Li-Pol accumulator, three motors with servo and a plastic gondola attached to the bladder.

3.1. Orientation testing kit

The three-dimensional orientation of the airship is ensured by ultrasonic detectors that monitor distances between the airship and objects in its surroundings. Information gained through the detectors is then processed and serves to drive electric motors. The ultrasonic detectors are dislocated around the surface of the airship bladder. At present we are preparing tests of ultrasonic detectors reliability. In the Figure 3, ultrasonic detectors testing kit block diagram is shown.

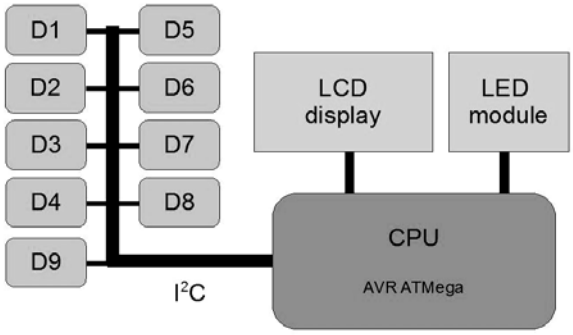

Figure 3. Ultrasonic detectors testing kit

We prepared two versions of testing kits, one uses 3 detectors and the other 9 detectors. Both of these kits can be attached to the airship. The detected obstacles are indicated on the displays of the kits.

3.2. Monitoring testing kit

Monitoring of the surroundings will be ensured by a web camera and thus we developed a kit, containing a web camera, WiFi router and IP relay, that connects to the Intranet. As the second task, the web interface was developed in order to ensure communication with this kit and to make it possible to watch picture recorded by the camera on a computer connected to the intranet. Furthermore, it is possible to send commands through the web interface back to the monitoring kit. These commands are indicated by relevant LEDs. Block diagram of this kit is shown at Figure. 4.

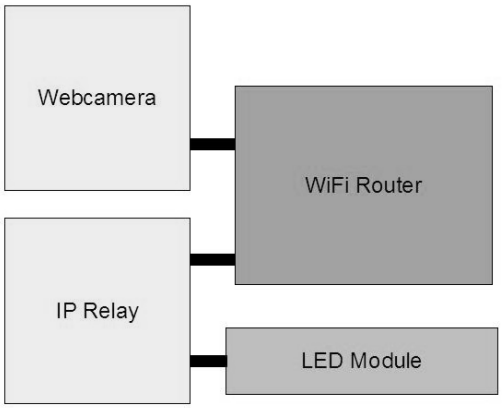

Figure 4. Monitoring testing kit block diagram

3.3. Other research

Although the main priority is to develop systems for monitoring and orientation, there are several problems related to this project. Especially the problem of power supply because different units need different supply and, also, the Li-Pol battery should be protected by some intelligent system that ensures its balanced and safe discharging. There are also topics on the EMC because some units such as the WiFi router are susceptible to electromagnetic disturbances.

4. CONCLUSION

The project deals with issues of automated operating of a small airship inside a building. This airship can be used for monitoring its surroundings, using a web camera and, respectively, some other sensors. At the university, it serves as a real system the students can develop their projects on.

5. ACKNOWLEDGEMENT

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