10 June, 2022
Sydney, Australia

CURRENT ISSUES OF SCIENCE, PROSPECTS AND CHALLENGES
II International Scientific and Theoretical Conference

VOLUME 2

Sydney, 2022

ISBN 979-8-88526-801-1
DOI 10.36074/scientia-10.06.2022

Papers of participants of the II International Multidisciplinary Scientific and Theoretical Conference «Current issues of science, prospects and challenges», held on June 10, 2022 in Sydney are presented in the collection of scientific papers.

The conference is included in the Academic Research Index ReserchBib International catalog of scientific conferences.

Conference proceedings are publicly available under terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0).
SOFTWARE IMPLEMENTATION CONCEPT DEVELOPMENT FOR THE MOBILE ROBOT CONTROL SYSTEM ON ESP-32CAM

Small mobile robots can be used to solve complex specific problems in hazardous areas of man-made catastrophes, rescue operations, as well as in the field of critical technologies [1-3]. With the minimum dimensions, the mobile robot should provide the following functions: environment visualization based on computer vision with recognition and identification systems implementation, flexible adaptive control system with the possibility of using artificial intelligence in decision making [4-6]. Based on this, we can say that research in the development of control systems for small-sized mobile robots is a complex topical scientific and technical task.

Analyzing publications, it was found that for the development of small-sized mobile robots, a module based on ESP32-CAM can be used as a hardware base for controlling motion modules and sensors [7, 8]. Based on the technical parameters of the ESP32-CAM module [9] and its specifics, the following control structure for a small-sized mobile robot is proposed, which is shown in Figure 1.

Fig. 1. Control System Software Implementation Structure Concept
The developed concept is based on the "client-server" architecture [10], which allows us to divide the control system into two main blocks. “Terminal” is any mobile device that supports the wireless type of data transfer (Wi-Fi) at the hardware level and the possibility of implementing a Wi-Fi access point in software. The second block "System Control Unit" is the hardware module ESP32-CAM.

Let us consider in more detail the mobile robot control system software implementation structure in the "System Control Unit" block. Based on the specifics of software development (firmware) for dual-core 32-bit Xtensa processors, it is proposed to use the high-level programming language C / C ++, specialized libraries AVR Libc and ESP32 versions 1.06 for the Arduino IDE development environment. This solution will allow to implement the following features at implementation initial level void setup():

- obtaining static IP or dynamic IP, depending on the tasks that are set for the mobile robot, which allows to implement 2 methods of connecting to the mobile robot;
- implementation an error processor when setting up and connecting mobile robot control systems with the ability to display the type of error and its description in the port monitor, as well as test the signal level and video information transfer rate.

Based on the Arduino IDE development environment and using specialized libraries esp_http_server.h, we will organize a Web server with HTTP protocol support based on HTTP Server node JS. For the implementation of control of hardware modules (sensors, servomotors, etc.) through the General-Purpose Input / Output (GPIO) interface on the ESP32-CAM in the Control Commands subblock the Java Script language is used. The HMI of the control system is based on the HTML 5.0 language using CSS.

The block "Terminal User" in this concept acts as a "client" of the block "System Control Unit" - as a thin client [11]. This provides the ability to minimize the requirements for the “Terminal User”, that is, the control system will not depend on the OS (OS Windows10/11, iOS, Android, Linux, etc.), the main software requirement is the presence of any Web Browser (Google Chrome, Mozilla Firefox, Safari) which is installed on the OS. It allows to implement a flexible cross-platform control system.

Based on this, data transfer between "Terminal User" and "System Control Unit" will be organized based on HTTP POS/GET methods. The transfer of commands from the “Terminal User” to the “System Control Unit” system can be implemented directly (Fig. 1., Sign 1.), where the ESP32-CAM (static IP address) acts as the “Master” device, if it is not expedient to connect directly the operator can connect via Router/Mobile Phone/Laptop (Fig. 1., Sign 2.), then the “Master” the device will be a mobile device that can create a dynamic access point (Dynamic IP address).

Conclusions. Proposed analysis shows the relevance and complexity of control systems development for small-sized mobile robots that can support computer vision systems and the possibility of using intelligent decision-making systems. In this paper, the authors developed the mobile robot control system software implementation concept the based on ESP32-CAM. The proposed solution feature is the possibility to implement a connection to a mobile robot in 2 ways, and implementing a control system based on a “thin” client, which makes it possible to use any mobile device with a Web Browser installed on it as a control terminal with the ability to transfer streaming video from the built-in camera in ESP32-CAM.

References:


