



DEVELOPMENT AND IMPLEMENTATION OF ANDROID APPLICATION BASED CURTAIN CONTROL SYSTEM

Azat Kakajanovich Babayev*

Oguz Han Engineering and Technology University of Turkmenistan, Ashgabat, Turkmenistan.

*Corresponding author

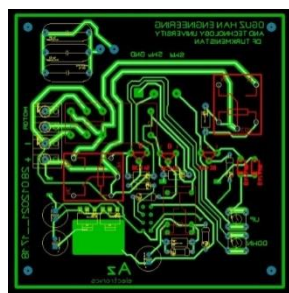
Recent days, digital and smart technologies, automated control devices are widely implemented in various fields of industry, manufacturing, agriculture and other important industries, as well as in residential buildings [1, 2]. The "Smart Home" system is aimed at improving the living conditions of residents by providing comfort and safety [3, 4]. Remote control of home electrical appliances with the help of mobile phones not only makes life convenient but also makes it easier for the elderly and disabled to control these appliances. Remote control of curtains in residential and office buildings is one of the main types of home automation [5, 6].

The first step in automating curtain management is to prepare the mechanism that will perform this task. Second, we need to develop an electronic circuit board to drive this mechanism (Figure – 1 a), 1 b)). Then we need to solve the problems of remote control of this electrical device and determine the sequence of its operation. Finally, we need to prepare controlling application to make this system work compatibility with the smart home system.

A curtain control system is a device that supply the forward or reverse rotation of an electric motor that is connected to the curtain's drive mechanism. Electric curtain usually consist of a transmission, wheels, belt, electric motor and connecting components. Figures 2 a) and 2 b) show a simplified diagram of a curtain.

The movement of the curtain can be controlled based on the signal from the hall sensor. Based on the information provided by the magnetic sensors embedded in the belt, it will possible to determine the state of the curtain opening level. Also, the direction of rotation of the electric motor and the direction of movement of the curtain can be determined by the sequence of signals. Finally, the curtain is controlled according to the user's preferences.

In order to achieve the communication of the system components and the reliability of the transmission of signals, the system's components are transferred to a special printed circuit board. The selected schematic shape is drawn using the EasyEda software (Figure 1 (a)) and then transferred to the surface of the epoxide board (Figure 1 (b)).



a)



b)

Figure 1. a) Electrical circuit of the smart curtain system, b) printed circuit board of a smart curtain system

Opening or closing of the curtain is carried out by gearbox. Movement is transmitted on the curtain by means of special wheels and belts. A special wheel is attached to the end of the rotor of the actuator. The belt consists of a string of beads and rope which is also passed over the same wheel. The other end of the belt is attached to the second wheel, that is, the wheel of the curtain's axle. The wheels have special hollows like size of the beads, and the belt is firmly stretched between the wheels, the wheels can also rotate due movement of the belt.

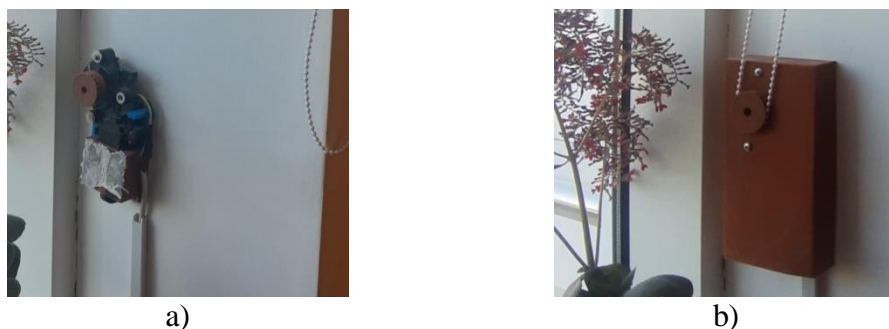


Figure 2. a) Interior and b) exterior view of transmission box

The main components of the curtain's movement transmission box: 12 V JGY370 electric motor; HI-LINK HLK-40M12 12 W, 3.3 A power supply; L298N electric motor control module [13,14]; ESP-01 Wi-Fi communication module.

Software of the system consists of two phases: a) The first step is to make the software for the ESP-01 microcontroller. it is carried out in Arduino IDE environment which is supplied connection between programmer and microcontroller. This environment runs in the C/C++ programming language. The ESP-01 microcontroller provides data transfer and processing between the system and the user's mobile application. b) The second stage is the prepare of a mobile application for system management. The ESP-01 allows us to make decisions based on the information coming from the microcontroller and issue the appropriate commands. This software is designed for Android and IOS operating systems (figures 3 a), b)). The main language of this application is turkmen language, and it is changeable the if necessary.

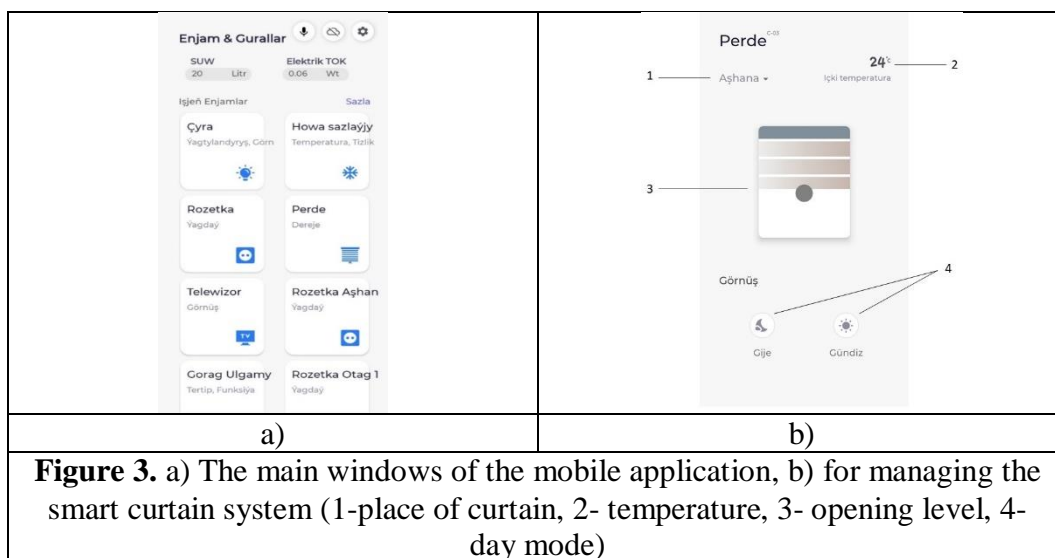


Figure 3. a) The main windows of the mobile application, b) for managing the smart curtain system (1-place of curtain, 2- temperature, 3- opening level, 4- day mode)

In the center of the page is a curtain-shaped button, which is used to open and close the curtain. It works in real time and shows the current state of the screen. This button structure is also convenient for adjusting the curtain level (to fully or partially open and close). We can

use the "Night" and "Day" buttons at the bottom of the page to set the curtain opening and closing time. In this case, the curtain opens and closes automatically according to the schedule at the specified time.

The "smart" curtain system was developed and implemented in the Science and Production Center of the Oguz Han Innovation Complex of the Oguz han Engineering and Technologies university of Turkmenistan. The work consisted of several stages, and in each test, several important indicators were recorded, such as the consumption of electric energy, costs for the execution of the work, compliance with technical and safety regulations (table 1). As a result, the most suitable form was selected for the introduction of production.

Table 1. Some important parameters obtained from the test with the JGY370 electric motor

No	Monitored physical size	Result of Measurement
1	Curtain height	71 cm
2	Upward motion time	7 s
3	Downward motion time	7 s
4	Current	0.27 A
5	Work done by upward motion	47.2 kw*hour
6	Work done by downward motion	47 kw*hour

In this experiment, we have to place a "smart" curtain 2 m away from a central wireless controller located in a fixed position and analyze the quality level of the Wi-Fi connection there. The experiments were repeated several times by moving the microcontroller to a distance of 2 m in each experiment. The received signal quality level is used to indicate the ability of the system's transmitted signals to pass through obstacles such as walls and doors.

1. The "Smart" curtain system was installed in the classrooms and reading rooms of the Oguz han Engineering and Technology University of Turkmenistan.

2. The "Smart" curtain system was installed in residential buildings in the 16th stage of the development of Ashgabat city. Its components: The reliability of electrical equipment and their connecting parts is determined. Remote control and monitoring of the system via mobile phones has been established. Along with this, the security and insurance of the system was also checked.

3. At present, works are being carried out to install a "smart" curtain system in a number of residential houses and administrative buildings in the Arkadag administrative center of Ahal province, which is under construction.

Results.

1. In the prepare of the "Smart Curtain" system were used several types of the most reliable, economically viable components, which require less electrical energy.

2. A simplified system of the electrical circuit of the system has been developed.

3. Secure and convenient methods of remote system management and monitoring have been developed.

4. Insurance rules have been prepare for cases where remote control of the system is not possible. In case of need, the possibility of manual control of the system was also consider.

Conclusion. During the work, several experiments were conducted and results were obtained. Automated methods of controlling residential curtains have been developed. The discrepancies between theoretical and experimental results were also noted. Remote control of devices and remote data transfer (wireless) are performed with high precision. Along with this, the security and insurance of the system was also checked. For the first time, software for managing intelligent technologies and automated systems was prepared in the Turkmen

language. Considering the convenience and features of the smart curtain system, it can be used in residential and other office buildings.

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