Web Based Intelligent Home Automation Using Raspberry Pi

Nesrin Aydın Atasoy*, Mehmet Tankül +, Ferhat Atasoy*

Computer Engineering Department, Karabük University
Baliklarkayasi Mevkii, Karabuk
{nesrinaydin, ferhatatasoy}@.edu

+ *Private Medikar Hospital,Karabuk*
mtankul@medikarhastanesi.com

***Abstract*— A smart home is one that serves automatic house management and remote control system to its homeowner. It is the integration of technologies applied to homes, offices and small buildings to provide security, comfort, communication and energy saving with less human interaction. Home technology is the adaptation of control systems used in many fields of industry to daily life, while home automation is the application of these technologies to individual needs and desires. One of the most important features of smart house is that it can be remotely controlled and monitored when necessary. Thanks to this system that can be controlled via Raspberry Pi-based web, users will be able to access the system from smartphone, laptop, tablet, desktop computer. In this low-cost system, it is aimed to use technology easily in daily life. Additionally, intelligent home technology can be carried out more easily and more effectively by means of building information modeling technology. Room temperature control system module, lighting system based on daylight module, a security camera system module controlled by PIR sensor, parking sensor module via ultrasonic HC-SR04 sensor are realized in this project.**

***Keywords*— Smart Home, Remote Control, Raspberry Pi, Web Based Control, Energy Saving in Building, Low Cost Intelligent Home Automation**

I. INTRODUCTION

Smart houses, houses that can learn, react to changes in the outside world, gathering information about lifestyles, decide what to do and when from the behaviour of the living and automatically do this work [1]. Independent and private houses for increasing the quality life of disabled and elderly people are realized only by intelligent houses [2, 3]. For this reason, in order for people to live a comfortable, safe and peaceful life together with their surroundings, the houses where the latest modern technology is used are preferred. Now, when people buy houses, they are also paying attention to whether the house is designed as a smart home [4, 5].

First examples of smart home applications have been developed in Japan and America. Smart houses have also taken its place in architectural development of Turkey. Home automation controls lighting, heating, air conditioning, security, telecommunication, audio-video systems, and comfort-providing functions using various microprocessors and sensors. These technologies change and improve the user's lifestyle, making the home more comfortable, safe and useful [1].

Remote control of smart home automation aims to more functional and reliable [6]. Besides, serious waste prevention and energy saving are provided. Users who have to be at the computer for hours in the work area where they do not leave their smartphones in their daily lives; without leaving the environment they are in, they can get rid of the questions inside their head such as "Did I turn off the light" by accessing to the system with one-click. Thus, by removing the suspicion of the minds of the users, the performance is improved in the works. Remote access to the system saves both energy and time.

It is also very important that the cost estimate and the actual cost are the same in smart house design. Because home automation systems are emerging as expensive technologies. This is one of the main objectives of the building information modelling (BIM) application. BIM technology have been asserted which is constituted according to interdisciplinary work conditions, which enables seeing the problems in advance and which can contribute to developing resolutions [7].

In this study, “Web Based Smart Home Automation with Raspberry Pi” is realized. The system allows remote control and monitoring of the designed smart home. The system is controlled using a web browser is registered to the data server. The aim of the work is to control the house automatically and to use technology more often in daily life, to increase security and energy saving. It is also intended to design a low-cost system.

II. INTELLIGENT HOME AUTOMATION SYSTEM

When smart home concepts are examined, it is seen that they have many systems and are controlled from the single point [8]. These smart home automation systems can be grouped under four main headings [9]:

- Lighting automation: As an example, controlling the whole lighting system with remote control, opening and closing the curtains by controlling the lightness with Light Dependent Resistance (LDR) sensor, the lights are automatically turn on in the

rooms when infrared receiver / receivers and light sensors detect someone entered into the room at night.

- Safety automation: Detectors sound or vibration sensitive that detect glass breaking, magnetic detectors sensitive to door or window opening, gas leak detectable, water level detectors.
- Temperature Automation: Heating, cooling and air conditioning systems can be put into operation by managing the environment temperature from the anywhere such as home and work place by telephone.
- Audio and Video System Automation: With audio and video systems, comfort and security can be improved at home and at work.

III. Intelligent Home Automation System

A model home is designed as seen in Fig. 1 to realize low cost web based smart home system. A raspberry Pi Model B is preferred to control peripheral devices and sensors such as web camera, servo motor, lamps, temperature and humidity sensor, ultrasonic distance sensor, PIR sensor, LDR sensor. The raspberry Pi was interpreted information obtained from sensors and controlled devices. The measurements and status of the devices are published via web server on the raspberry Pi.

Fig. 1 Designed model home

Realized controls are given as follows:

- Temperature of the home is measured periodically, then according to measurements results fan or heater is activated. Also, the measurement result and the activated devices is shown on web page. However, fans are activated, if the temperature is higher than set value, registered users are informed against the possibility of fire.
- Lights of the home garden and exterior lighting are controlled depend on daylight.
- Real-time video broadcast on web page and motion-sensitive snapshot which is sent to the registered users are done by camera module.
- HC-SR04 ultrasonic distance sensor is used to inform drivers when they park the car in the garage to prevent crash.

Temperature Sensing Module Design

Home temperature; a system was designed to measure the temperature of the air with the aim of keeping it at the desired temperature range, and when the temperature exceeds the reference temperature, the cooling mechanism starts to work and when it is not enough, the warning mechanism becomes active.

With the DHT22 temperature and humidity sensor, the temperature of the environment is transferred to the computer at every minute. DHT22 is an advanced sensor that provides temperature and humidity sensor as digital signal output. The connection of the sensor to the Raspberry Pi is shown in Fig. 2.

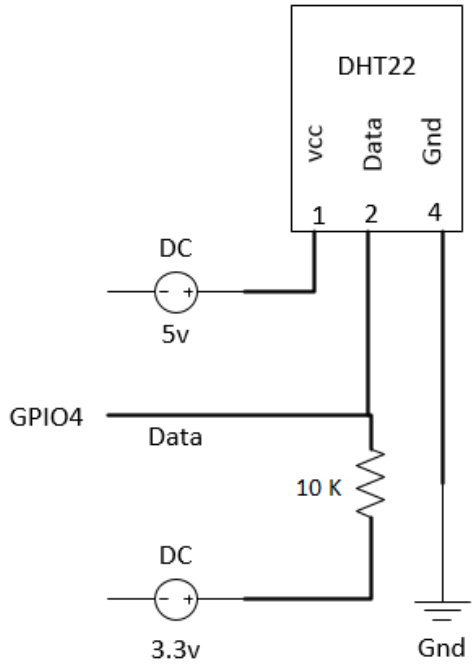

Fig. 2 DHT22 - Raspberry Pi circuit

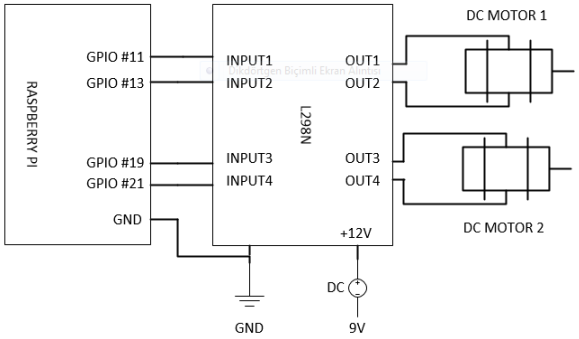

Fig. 3 L298N - DC motor circuit via Raspberry Pi

When the temperature rises above the desired range, cooling becomes active and the fans automatically start to operate. Fig. 3 shows the fan circuit using a DC motor. If cooling is sufficient, the system will continue to operate. In case of danger, present temperature, humidity values and the image of the environment taken from the camera are transmitted to the relevant person by e-mail.

Lighting Module Design

The LDR light sensor is used to enable the indoor-outdoor lighting lamps to automatically on-off according to the state of daylight. It is a sensor that perceives the change of light as analogue and changes its resistance according to the severity of the light falling on it. LDR - Led - Raspberry Pi connection are shown in Fig. 4.

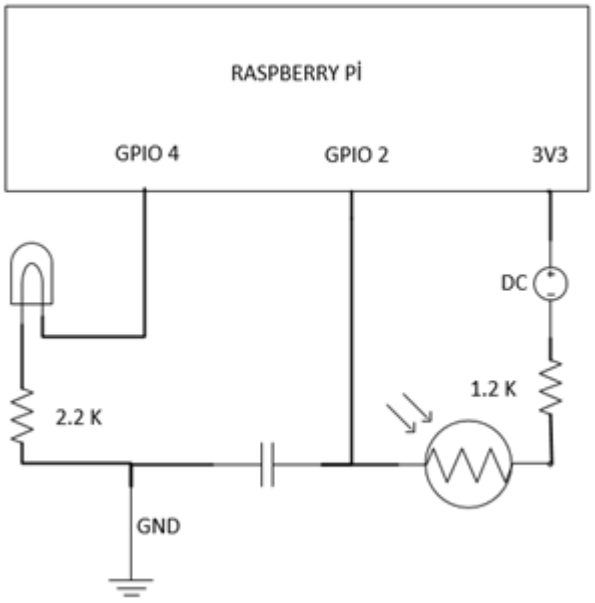

Fig. 4 LDR - Led - Raspberry Pi circuit

A. *Web based camera system*

The cameras that are activated through the port opened for cameras can be viewed at any time via the web. When the lock mode is turned on, at the first warning detected by PIR (Passive Infrared Sensor) system automatically captures the image. This photo is mailed to the relevant person. Fig. 5 shows the connection of the sensor on the circuit.

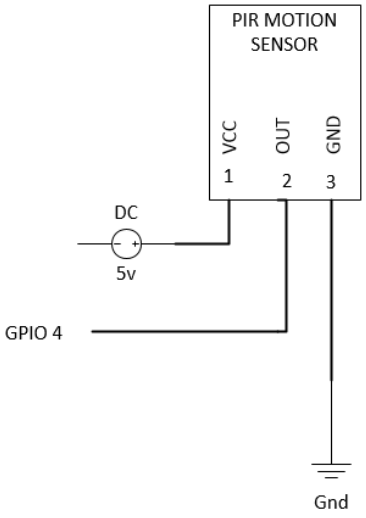

Fig. 5 PIR - Raspberry Pi circuit

Accident Prevention Parking System Module Design

The Ultrasonic HC-SR04 Distance Sensor is used for vehicles that do not have a parking sensor or are faulty in operation. Sensor, can measure from 2cm to 400cm with accuracy of 3mm. Vehicle distance is reported to the user with the help of LEDs. Thus, the vehicle can be parked without any problems. Fig. 6 shows the connection of HC-SR04 - Raspberry Pi.

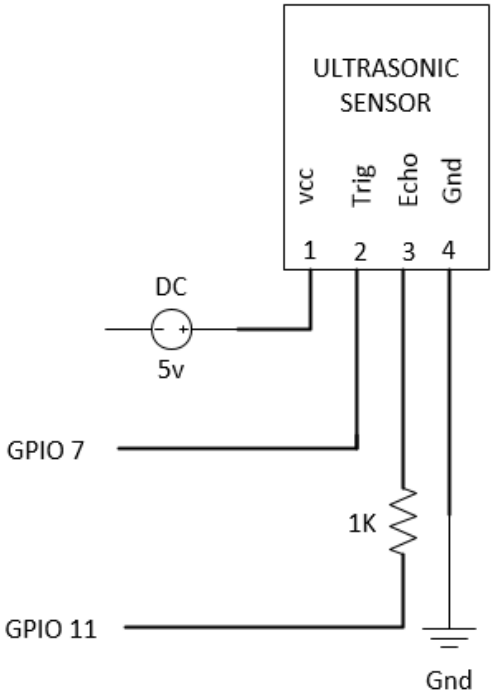

Fig. 6 HC-SR04 - Raspberry Pi circuit

Web Interface Design

For the web interface; Home, Lighting, Temperature Values, Camera Display are designed respectively as in Fig. 7, Fig. 8, Fig. 9 and Fig. 10.

Fig. 7 Home page design

Fig. 8 Lighting page design

Fig. 9 Temperature information page design

Fig. 10 Web based camera monitoring page design

IV. CONCLUSIONS

Smart homes have been designed to make people's lives easier, which will accommodate the changing climate, social, economic and business life.

It has been shown that you can do your homework very easily with mobile phone and internet access. The most important reason for using home automation system is to provide energy and work power and also to increase productivity.

These systems, which significantly reduce the fuel costs in the residence and meet some of the electricity consumed, provide the user with a low-cost life.

In this study, a low-cost system development has been targeted. So we designed a system that we can easily use the technology with the materials that can be supplied easily.

There are some deficiencies have been arisen in systems which controlled by mobile applications. One of them; since the system is controlled by bluetooth, the user has to be near the house. The mobile application must be integrated separately for the operating systems like IOS, Android, Windows Phone. In addition, everybody who is at home, needs a smartphone to use the system. With this web-based system, it is easy to access from every device and from every platform.

In this study, a basic product has been developed for smart home automation systems. More control mechanisms which controlled by Raspberry Pi can be added to the system and system can be controlled over the internet. It is important to determine the control structures in intelligent home systems which will be developed using BIM technology. Because the 3D computer model includes building architecture information, mechanical and electrical information. Therefore, disciplinary conflicts that are noticed during construction can be determined by 3D model. The necessary resolutions can be made.

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