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Bluetooth Based Smart Vacuum Design and Implementation

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Abstract: The number of smart devices that are developed to facilitate people's everyday tasks is increasing day by day. The devices presented to the end user can communicate with each other through the concept of Industry 4.0. This process, known as the internet of things (IoT), allows devices to be controlled over the Internet. A vacuum cleaner designed in the scope of this study can connect to the internete and fulfill the assigned tasks. Autonomous home sweeping can be performed in accordance with given tasks. The autonomous electric vacuum cleaner developed in this study; body, vacuum part, sensors, battery, motors that provide movement consists of battery and electronic circuit. It can sweep itself autonomously without touching the surrounding objects by means of the absorbers on the broom which is a small design. In addition, the Bluetooth wireless communication technology that you use can be commanded via smart phone / tablet. A home plan can be defined by means of developed software. At this point, the robot can be instructed which parts to clean. In this respect, self-autonomously assigned tasks can be successfully replaced. The system also allows remote control over the internet with the help of wi-fi. Routine home sweeping is performed autonomously with the developed smart vacuum cleaner. With the developed mobile software, it is possible to choose which environment and how much the robot can work. In addition, the robot measures its own charge and can go to the charging station and the need. It has been seen that the robot fulfills the assigned tasks in a three-room home plan. With the developed Android application, the robot can be controlled automatically and manually. With the concept of internet of objects, the developing trend made it possible to produce many smart devices. When combined with economical electronics, mechanical hardware and software, a lot of innovations come into play that will make human life easier. In this developed work, it was ensured that the routine work of the people was done by means of an intelligent broom (autonomous robot). With improved hardware and software, people will save time and work power. As a result, human life will greatly facilitate.

Keywords: IoT, Smart Vacuum Cleaner, Autonomous Robot.

1. Introduction

Mechatronic systems consist of mechanical parts, electronic circuitry and software (Carryer et al., 2011). The equipment that makes up these systems is easy to reach in recent years. With the used 3d printing machines, mechanical parts designed in the desired structure are produced (Kesner & Howe, 2011). The software developed for microcontrollers used in electronic circuit design can be controlled quickly and flexibly. All these components form the mechatronic system. Sensor technology is used for intelligent mechatronic systems. Autonomous operation can be achieved by processing the information from the environment with the used sensors.(Mahalik, 2003).

The number of intelligent devices produced by utilizing these opportunities is increasing day by day.

In recent years, the development of electronic circuits and communication protocols used in wireless communications have brought autonomous and intelligent work to another dimension. In this way, the machines can be remotely controlled and communicated with each other to be able to function. This period, called Industry 4.0, offers

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many conveniences (Lasi et al., 2014). During this period, studies such as speed safety came to the forefront in studies on machines communicating with one another.

This period when objects communicate with each other is called "IoT". A lot of studies have been done in this area in the last time. (Gubbi et al., 2013).

In this study, a remote controlled mobile robot was designed to allow autonomous motion. In the next sections, mechanical, electrical and software designs will be mentioned. The findings and usefulness of the robot's work will be explained.

2. Material and Method

This section is explained in three parts. Firstly, the visual design is described by mechanical design. Electrical equipment used later is mentioned. Lastly, the software is mentioned. The software is microcontroller control software and developed mobile application.

2.1. Mechanical Hardware

The autonomous mobile vacuum cleaner is mounted on a mechanical chassis. A 12V powered vacuum cleaner is mounted on the designed chassis. In addition, battery, electronic card, sensors, Bluetooth module, motor and wheels are mounted on the chassis.

The robot is able to move in the environment with information from sensors that perceive it. Differential driving model is used for the design which takes center of gravity of the robot. There is one free-moving passive wheel on the front. Figures 1 and 2 are shown robot images.

Figure 1. Smart Vacuum Robot

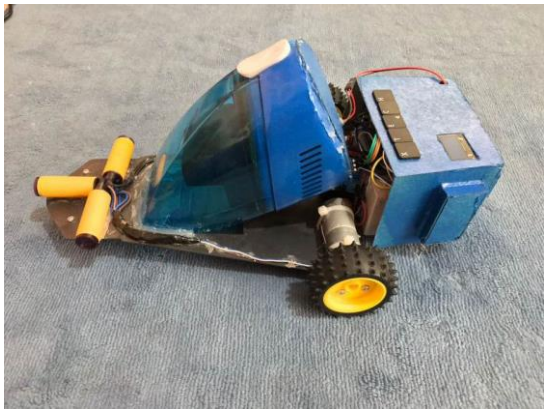

Figure 2. Smart Vacuum Robot

2.2. Electronic Hardware

Modules have been used in electronic circuit design. Arduino platform is used in control part of this prototype robot. The Atmega328p 8bit microcontroller is used. With the L298 h-bridge integration, two motors are independently controlled.

Motor speed control is done by PWM signals. The control of the vacuum cleaner motor is controlled PID. PID coefficients were selected experimentally (Doğruer et al., 2017). The wheels are equipped with a hall effect sensor for position information. The estimated position is determined by the distance on this sensor. In addition, at certain distances, position verification and reference were made with RF-ID tags. An RF-ID sensor was used for this (RC522). In this way, the robot can correctly detect the location information. Since RFID tags can be attached to cash, clothing, and possessions, or implanted in animals and people, the possibility of reading personally-linked information without consent has raised serious privacy concerns(Angell and Kietzmann, 2006). These concerns resulted in standard specifications development addressing privacy and security issues. ISO/IEC 18000 and ISO/IEC 29167 use on-chip cryptography methods for intractability, tag and reader authentication, and over-the-air privacy. ISO/IEC 20248 specifies a digital signature data structure for RFID and barcodes providing data, source and read method authenticity. This work is done within ISO/IEC JTC 1/SC 31 Automatic identification and data capture techniques. Optical sensors are used to detect the environment. Three sensors surround the peripherals.

Bluetooth module for functions such as manual control. A protocol has been written for module communication with the robot. It is controlled via an application developed for mobile devices. This allows remote control.

2.3. Software and Mobile App

The software is made in two stages. First; microcontroller software. This is the main control software. This software, which communicates all of the electronic hardware, is encoded in the micro controller. The software running in conjunction with the mobile application controls the robot's hardware according to the received commands. The second one is mobile application software. The software developed on http://appinventor.mit.edu platform is used by being installed on the android device. The device that communicates via the Bluetooth platform can connect to the Internet via a server. Local control was carried out within the scope of this study. Designed mobile application screens are shown in Figures 3 and 4.

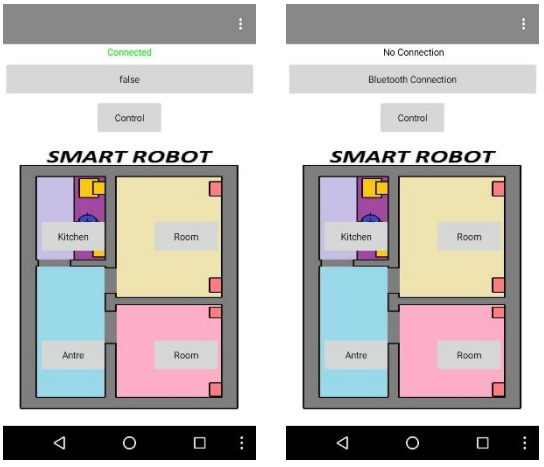

Figure 3. Mobile Application (Home Sketch

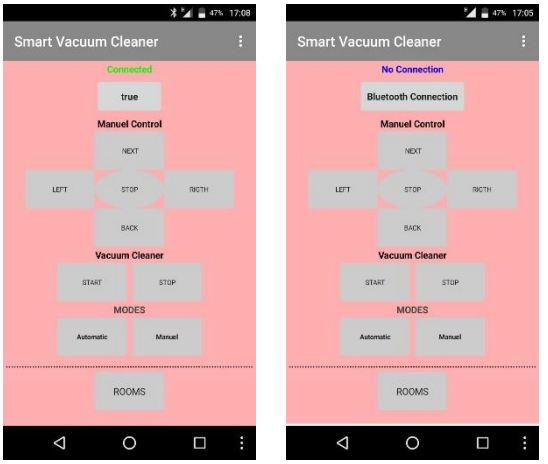

Figure 4. Mobile Application (Control Screen)

3. Results

In this study, an autonomous vacuum cleaner was designed. The design will be able to self-clean by sensing the objects around it. In addition, the robot communicates with Bluetooth and can execute commands that are given wirelessly. The mobile app has been developed for this process. This will make it easier for people to do daily tasks.

It also provides remote control via a network connection that can be set up. Location information is perceived on the robot side on the sketch side of the wheel and the previously defined sketch. The developed work can work more functionally with commercial facilities with limited opportunities

4. Conclusions

The common reasoning of different people by accessing information through internet technology has led to a rapid solution in practice. Another advantage is the availability of many sensor hardware with internet shopping. Open source microcontrollers also provide flexible control. In this study, an assistant mobile robot was designed by taking advantage of these advantages and it was operated more functional with the concept of objects' internet. A range of functions have been added to facilitate the human life, such as sensing the environment, working at the locale where self-charging is desired, and the area scanning function developed for equipment control. Tests made have given successful results for limited location.

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