Autonomous Controlled Robotic Car based on Node MCU with Real Time Obstacle and explosive Detection

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Abstract

Real-time obstacle identification and avoidance are major problems for automatic cars. This work presents the design and implementation of a robotic car with real-time obstacle recognition and avoidance capabilities, taking into account hardware, software, and communication contexts. The system has been implemented using Esp32, Android applications, and the Arduino platform. This study presents the design and use of robotic cars using sensor programming on a platform. This automated device was created in collaboration with an Android-based smartphone. The Esp32 has served as the brain of the robot. Numerous hardware parts make up the robot, including led, buzzers, ultrasonic sensors, servo motor, touch metal, Esp32 cam and Esp32. It also includes the mobile application-using software component.

Use cases of car:

You can operate robotic car from any where using your mobile application to detect the bomb.. instead of bomb detection we have used touch metal to detect the metal. And car also shares the views around itself captured by esp32 cam and sends it to your server(that you can use access it by ip address provided by esp32 cam) to see the live view. That will help to control your car or to move your car at preferred location.

Some details about android application.

The user of the robotic automobile can control the car's movement by selecting the preferred direction or mode via a mobile application.

In which the can set speed of car, directions of application and also from there user can set the angle of camera to see the view

And there is also a button to set the car to move automatically with avoid obstacle.

Future Use:

Remote controlled car, bomb detection without involving the human being

The robot can be programmed to move in tandem with the user's intelligent device, or it can be left in autonomous mode, allowing the vehicle to follow its own course. As a result, the robot is able to both recognize living things and escape the obstruction. This article's goal is to warn military and civilian persons of possible terrorist attacks, particularly in sections of the military equipped with live, detectable sensors.

Keywords Android-based Devices, Robotic Car based on Arduino, Obstacle Detection, Obstacle Avoidance

Introduction

With the advancement of technology over the past ten years, sensors integrated into electronic gadgets have found widespread use in improving people's quality of life. Sensors are apparatuses that transform various sources of energy into electrical energy. The sensors act as a link between different electronic equipment and the surrounding environment. Any physical setting, including airports, factories, hospitals, and shopping centers, can serve as the environment,

and technological objects like smartphones, tablets, robots, and smart clocks can be found there as well. These devices can be used in many different industrial processes for control, protection, imaging, and identification. The advancement of technology has led to the creation of hundreds of different kinds of sensors nowadays, including ones that sense pressure, heat, obstacles, and people. In the past, sensors were utilized for lighting; today, they are used to

simplify living. The two modes are automatic and user control. To choose the actions, a menu with

buttons has been seen on the screen. The robotic car can be moved with these buttons in the following directions: forward, backward, right, left, stop, and automatic. When the automatic mode is chosen, the user relinquishes control of the robot, allowing it to navigate its path without colliding with any obstacles. In this way, new inventions and applications can be created every day to improve lives and make things easier. These days, artificial intelligence algorithms are used in the development of robot systems. Among them is the field of robotics. The perception system is the most crucial component of the robot. A robot's ability to see its surroundings will be crucial to its design. For example, it is critical that robots recognize explosives in order to use sensors to identify terrorists in the military. A robot must sense and analyze environmental variables (such as temperature variations) before determining how to respond. This article describes a remote-controlled, autonomous robotic car that uses sensors to detect and avoid obstacles. Bluetooth has been used to establish the

connection between the Android device and the robot. Robot action can be carried out based on the user's input value after the Arduino Uno processes the incoming data. The Android application on a mobile phone can operate the robotic car in two primary modes. When it encounters a living thing, the robot recognizes it and warns. The robot navigates without hitting any obstacles, recognizing them and stopping when they are encountered. It simultaneously

uses a temperature sensor for live detection and a red led for warning.

We implement a novel vehicle design with real-time obstacle avoidance and detection in this

study. As far as we are aware, no prior research has looked into real-time obstacle avoidance and detection using the Arduino Uno and Android Platform. Here is the work that it is. In this sense, related works are covered in Section 2. The

principles of the robotic car's operation and the system architecture are explained in Section 3. The materials and specifications for the robotic car are displayed in Section 4. The robotic car's design and implementation are covered in Section 5. The paper's conclusion is given in Section 6

Literature review:

In this section, similar studies in the past have been explored and some of the methods and working principles used are summarized.

S. S. Pujari et al. [1] designed a Robot for the working families that could monitor children remotely and communicate with the camera. Raspberry Pi 3, camera module, Wi-fi and Bluetooth technology used by the robot. For Raspberry Pi, the heart was defined as the Robot and used the Phyton language to code it.

M. R. Mishi et al. [2] designed a robotic car. Arduino Uno and Raspberry Pi were used together to control robot in this project. GPS was also used to trace the car and the distances between the obstacle and the path are measured. The data in the cloud was used without having to be online. Thus, the multi-motion system was controlled.

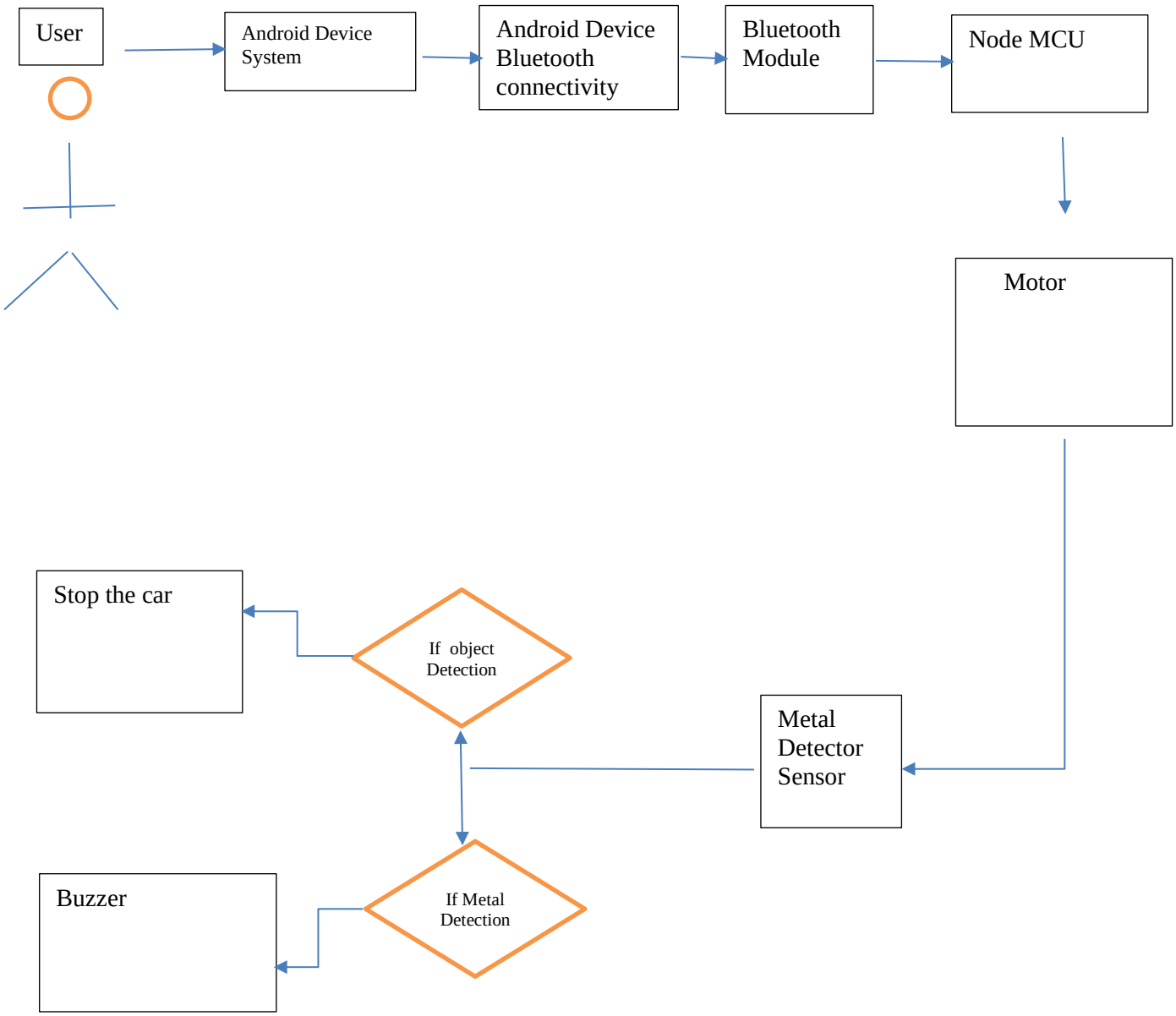
D. Chakraborty et al. [3] designed and developed a robotic car using sensors and Bluetooth technology. They had established communication between smart device and the robot. Thanks to the phone camera, they had observed the living beings. The obstacles in the opposite direction were prevented from colliding with the ultrasonic ranging sensor. Images recorded with the camera were recorded in the database and analyzed.
S. J. Lee et al. [4] designed an autonomous robotic car used Arduino Uno R3 for robot's brain. Also, Bluetooth module and the ultrasonic sensor had been used in this paper. The robot scanning the placed QR codes could move along the road in autonomous form thanks to the QR codes. It also provided voice communication with the Android device in the Text-to-speech feature. It also moved with the help of an ultrasonic sensor without hitting the objects around it. In this view, range information was collected. In order for the motion of the robot to be smooth, the deviation was minimized by the PID algorithm.
E. Amareswar et al. [5] designed a robot used for the military area. Thanks to the metal detector, the robot played an important role in the detection of explosives, and the surroundings could be viewed thanks to the camera of the used Android device. This robot system consisted of Android device, Bluetooth module, a microcontroller (Arduino Uno), DC motors, motor driver, wireless camera and metal detector.
Premkumar et al. [6] designed robotic arm controlled using Raspberry Pi. The main purpose of this robot was to add the human arm feature to the robot arm. Raspberry Pi was the code written in the Python language that provided arm movement. With the Android application, the user moved the robot arm in the desired direction. Robotic arm control was provided in this way. The Android app was written in Java. Thus, the communication between the Android application and Raspberry Pi was provided by the Wi-Fi connection. This communication moved the robot arm to the right and left.
In this study, real time obstacle detection and avoidance with remote and autonomous controlled robotic car based on Arduino has been carried out by using Android application.

Methodology:

When army vehicles move with the convoy it is important to detect any anonymous objects in the path. In the project we are using ultrasonic sensor which work on the principle of sending out a sound wave at a frequency which is above the range of human hearing. The transducer of the ultrasonic sensor works as a microphone to receive and send the ultrasonic sound. And metal detector sensor detects the metallic object in the path. If ultrasonic sensor detects any anonymous object it will stop the car. If the metal detector sensor it will gives the signal to Node MCU and it will process the information and blink LED light.

And user can stop the car and go to the ground and verify that risk. Soldiers can send the message to their senior authorities and move forward safely one place to another place. This system is very simple and user friendly anyone can operate this easily. There is no technical knowledge required to operate this automated system. The ESP-32 module is used to control all these modules as well as other components of the system which is shown in the given figure.

System architecture:

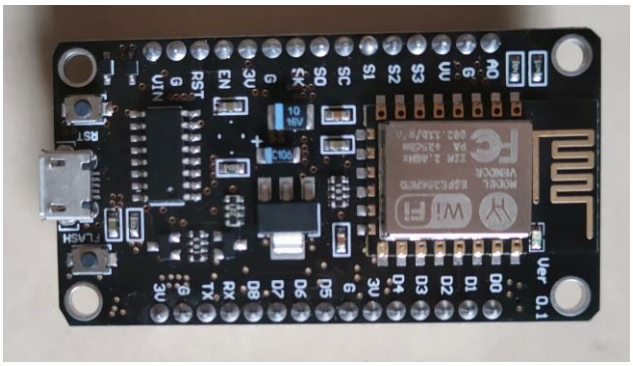


Technical Specification of the automated car:

4.1. Node MCU

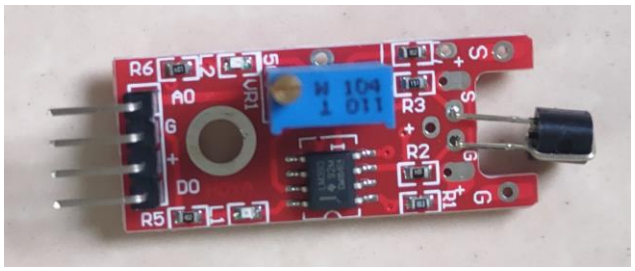
Node MCU uses ESP8266 single core processor. It is widely
employed development board for the IOT applications. It provides effective connectivity to the internet.

It is open-source firmware which is used for prototyping board designing. It provides user to write program in low-level machine instructions that can be interpreted by the chip hardware. Node MCU is very cost effective for the IOT devices. Node MCU also provides SDK for the customized cloud server development. For running the program in Node MCU user have to install Arduino IDE that is ESP32 and ESP8266.



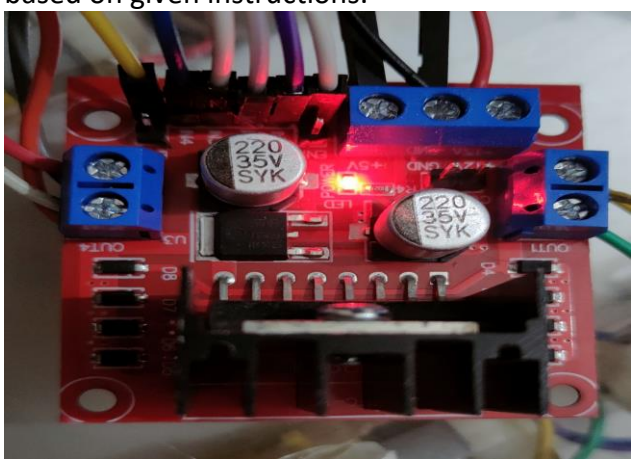
Metal Detector sensor

A metal detector sensor is a device that used electromagnetic waves to detect the metal objects. When any metal objects come in the range of the sensor then it generates the output signals that shows the presence of the meta. These signals can be analog or digital both. This sensor is widely used for security purpose checking in various fields. But here it is used for detecting explosive for the safety of the military vehicle movement.



Motor Driver

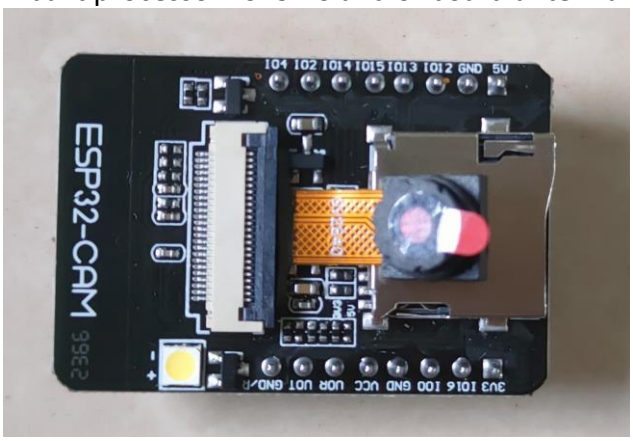
A motor driver is an integrated circuit chip which helps to control motors. It also helps to build automated systems. This is widely used to creates simple robots and automated cars. It also helps in the designing of IOT based embedded systems. Motor drivers one most important work is to converting electrical energy to mechanical energy that enables to move the automated cars. It is very important to choose right motor because it is very essential for proper working of engine. Motor driver helps to control the direction of the car based on given instructions.



ESP32CAM

ESP32-CAM is a very cost-effective device with an onboard camera. This is best solution for developing the IOT based wireless

monitoring DIY projects. It is capable of video streaming and QR based IOT solutions. It is widely used for personal or smart home surveillance. It takes very less electricity to work. It can be easily connected with wi-fi and Bluetooth and managed very easily. It is having inbuilt processor ESP32-S and onboard antenna.



Buzzer:

A buzzer is an electronic device that helps in converting audio signals into sound. It is mainly used to build alarm. It can produce various sounds like music sound, flute sound, alarm sound and many more.

Design and implementation of the automated car:

This automated car is made up of a Node MCU, Motor driver, ultrasonic sensor, 9V battery, ESP32-CAM, metal detector sensor as given below in the figure.

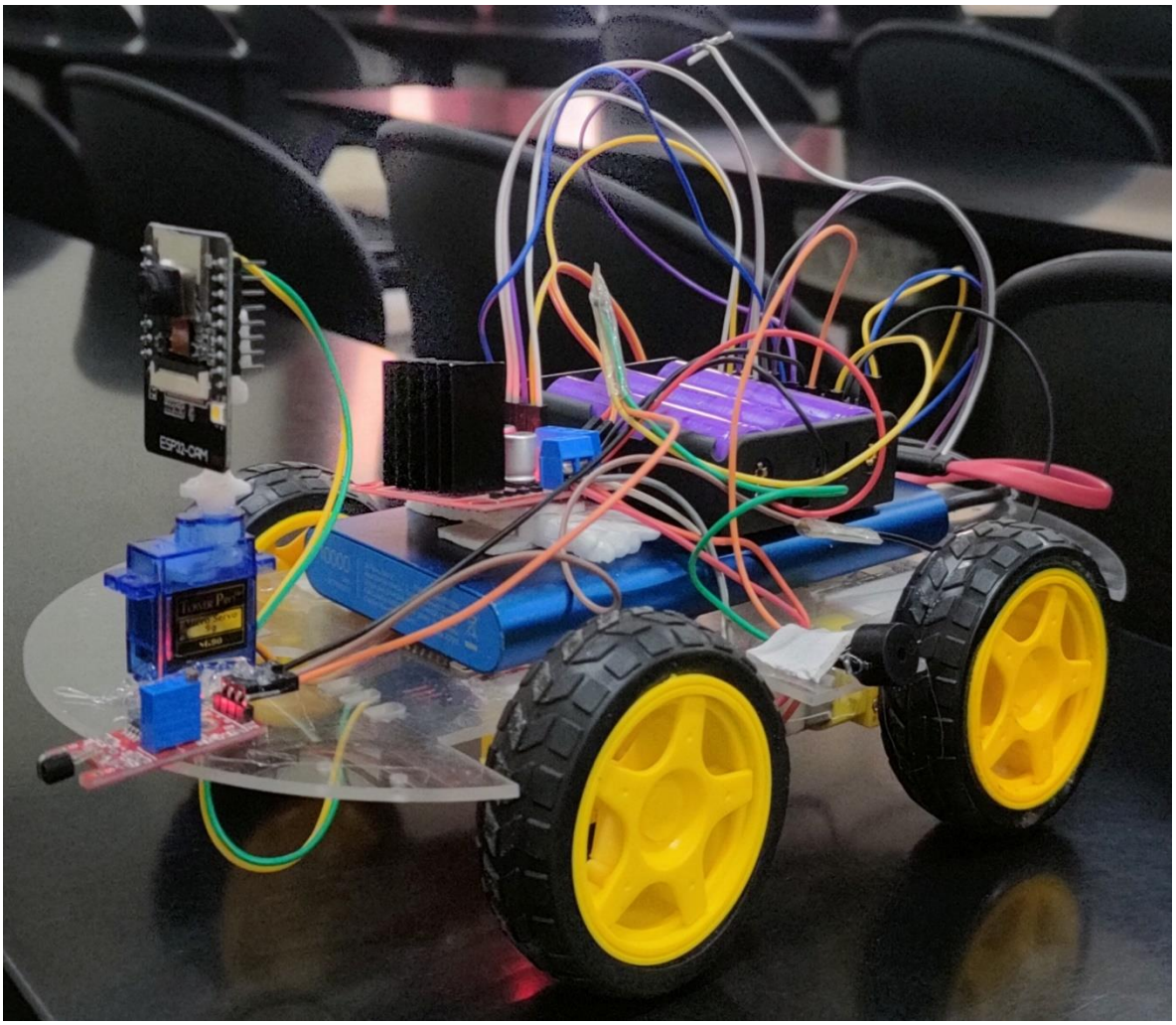
In the implementation part first user should download the Arduino app from the google play store. After installing the app user should user should write code in embedded C to give instructions to the automated car. Node MCU should connected with the wi-fi. So that it can process the signals and provides the desired instructions to the motor driver. After getting the proper signal car can moves in the right direction according to the given instructions.

The user can control the basic movement of the automated car. And when sensors will detect any object in the path. It will give signal to the user. User can see the output in the form of audio signals in the buzzer and it will give output accordingly. And user according to the signal can move forward safely.

Results and discussion:

As the objective of the project is to give emergency signals to the army vehicles immediately and the result we got is very impressive. In this topic many research papers are available but they are mainly for the automated cars. Here we have focused for the safely movement of the army convoy. The main objective was the safety of our soldiers from the enemies. Because now a days terrorists are using IDE blast on the road. Because of that every year we are losing life of our soldiers. It is important for the soldiers to provide any automated solution to this problem. And our system is giving desired solution. It provides better safety to the soldiers because if our soldiers are safe then our country is safe.

Implementation:



Conclusion:

By using these IOT devices. The proposed system will detect the unwanted object in the path and through the output we will be getting emergency alert. And it will help to the soldiers to the take right decision and they can do better search operations in the difficult situation. And they can move with their convoy safely from one place to another place. It will also help the soldiers to avoid dangerous situation. There are many economic benefits also. Because sometimes they lost heavy machineries that are very important equipment for the army. And lastly the safety of our soldiers is most important and by using this system they can move safely.

REFERENCES:

[1] S. S. Pujari, M. S. Patil, and S. S. Ingleshwar, "Remotely controlled autonomous robot using Android application", 2017 IEEE International Conference on I-SMAC (IoT in Social, Mobile, Analytics, and Cloud) (I-SMAC), 2017.

[2] M. R. Mishi, R. Bibi, and T. Ahsan, "Multiple motion control systems of the robotic car based on IoT to produce cloud service," 2017 IEEE International Conference on Electrical, Computer and Communication Engineering (ECCE), 2017.

[3] D. Chakraborty, K. Sharma, R. K. Roy, H. Singh, and T. Bezboruah, "Android application based monitoring and controlling of movement of a remotely controlled robotic car mounted with various sensors via Bluetooth," 2016 IEEE International Conference on Advances in Electrical, Electronic and Systems Engineering (ICAEES), 2016.

[4] S. J. Lee, J. Lim, G. Tewolde, and J. Kwon, "Autonomous tour guide robot by using ultrasonic range sensors and QR code recognition in an indoor environment," IEEE International Conference on Electro/Information Technology, 2014.

[5] E. Amareswar, G. S. S. K. Goud, K. R. Maheshwari, E.
Akhil, S. Aashraya, and T. Naveen, "Multipurpose military service robot," 2017 IEEE International Conference of Electronics, Communication, and Aerospace Technology (ICECA), 2017.

[6] Premkumar, Keerthi, and K Gerard Joe Nigel. "Smart Phone-Based Robotic Arm Control Using Raspberry Pi, Android, and Wi-Fi." 2015 IEEE International Conference on Innovations in Information, Embedded, and Communication Systems (ICIIECS), doi:10.1109/iciiecs. 2015.7192973, 2015.

[7] Varshney S., Gaur, B., Farooq O., Khan Y. U. "Brain Machine Interface for wrist movement using Robotic Arm", IEEE 16th International Conference on Advanced Communication Technology, DOI: 10.1109/ICACT. 2014.6779014, 2014.

[8] Internet: Geleceği yazanlar, Bluetooth ile İletişim, https://gelecegiyazanlar.turkcell.com.tr/konu/arduino/egitim/arduino-201/bluetooth-ile-iletisim, 20.06. 2018.

[9] Verma, S, Android App Controlled Bluetooth Robot, Internal Journal of Computer Applications, vol 152, no 9, p.35 – 40, 2014.

[10] Internet: Robotpark, DC Motor Nedir?http://www.robotpark.com.tr/Dc-Motor-Nedir, 21.06.2018.

[11] Internet: Güvenlik Online, PIR Sensör,https://www.guvenlikonline.com/makale/219/pir-sensor.html, 21.06.2018