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AUTONOMOUS CONTROLLED ROBOTIC CAR BASED ON ARDUINO WITH REAL TIME OBSTACLE DETECTION AND ACCIDENT AVOIDANCE

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Abstract : This article presents a robotic car that can be controlled remotely and has sensors to identify and avoid obstacles. Bluetooth is used to create a connection between the robot and an Android device. An Arduino Uno board handles data processing, enabling the user to regulate the robot's movements in response to input values. With on-screen navigation buttons, the Android application has two primary modes: user control and automatic mode. When in automatic mode, the robot moves around on its own, dodging objects and using warning lights to identify any living things. Additionally, temperature sensor functionality is included, which can issue further alerts as needed.

This robotic device has been developed with the interaction of Android-based device. Arduino Uno has been used as the robot's brain. The robot has many hardware components such as Bluetooth module, PIR sensor, ultrasonic sensor, and buzzers. It also consists of the software component that uses a mobile application. The desired direction or mode by mobile application can be selected by the user of the robotic car to control the movement of the car. The user can control the robot movements from his/her own intelligent device or take the robot in automatic mode and let the car drive its own way. Thus, the robot can flee from the obstacle and detect live objects. The purpose of this article is to alert the civilian and military personnel to potential terrorist attacks especially in military areas with live detectable sensors.

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

I. INTRODUCTION

With real-time obstacle identification and avoidance, we take a novel approach to vehicle design in this research. As far as we know, no previous research has been done on using the Arduino Uno and Android Platform for real-time obstacle detection and Avoidance. "Many areas to facilitate life. Sensors are devices that convert energy forms into electrical energy. The sensors serve as a bridge connecting the environment and various electronic devices. The environment can be any physical environment such as military areas, airports, factories, hospitals, shopping malls, and electronic devices can be smartphones, robots, tablets, smart clocks. These devices have a wide range of applications to control, protect, image and identification in the industrial process. Today, there are hundreds of types of sensors produced by the development of technology such as heat, pressure, obstacle recognizer, human detection. Sensors were used for lighting purposes in the past, but now they are used to make life easier. Thanks to technology in the field of electronics, incredibly fast developments are experienced. In this respect, it is possible to develop an invention or a new application every day and make life easier. Today, robot systems are developed with the use of artificial intelligence algorithms. The robotics field is one of them. The most important part of the robot is perception. Perception of the environment will be important for a robot design. For instance, it is very important to identify explosives by a robot to detect a terrorist in the military field by using sensors[1]. A robot must perceive some variables (like heat changes) around it, interpret it, and then decide to act accordingly. In this article, remote and autonomous controlled robotic car has been presented in terms of obstacle detection and avoidance by using sensors. The connection between the robot and the Android device has been established via Bluetooth technology. The incoming data will be processed by Arduino Uno and according to the input value of the user, robot action can be performed. There are two main modes that control the robotic car by Android application (mobile phone). These are user control mode and automatic mode. A menu with buttons has been seen on the screen to select the actions. These buttons will be used to move the robotic car forward, backward, right and left, stopping the car and switching to automatic mode. By selecting automatic mode, the user leaves the robot control, and the robot finds its way without hitting the obstacles.

II. EXISTING SYSTEM

The current state of robotic car technology faces significant challenges, particularly in real-time obstacle detection and avoidance. The existing systems often rely on complex hardware and software configurations to achieve reliable performance in

navigating environments with obstacles. These systems typically incorporate microcontrollers or processing units, sensors for environmental perception (such as LiDAR, radar, cameras, or ultrasonic sensors), and algorithms for decision-making and control.

Hardware components play a crucial role in the existing systems, with microcontrollers providing the computational power to process sensor data and execute control commands. Sensors like LiDAR and radar enable the robotic car to detect obstacles at varying distances and angles, while cameras provide visual information about the surroundings. Ultrasonic sensors are often used for close-range detection, aiding in things such as parking or avoiding nearby objects. The software aspect of existing systems is equally important, encompassing algorithms for sensor fusion, obstacle recognition, path planning, and control strategies. Sensor fusion algorithms integrate data from multiple sensors to create a comprehensive understanding of the environment. Obstacle recognition algorithms in sensor data identify obstacles and determine their positions, sizes, and trajectories. Path planning algorithms then generate safe and efficient routes for the robotic car to navigate, considering factors like obstacle avoidance, traffic rules, and vehicle dynamics. [2]Control strategies translate planned paths into precise control commands for the car's actuators, ensuring smooth and responsive movement.

Despite advancements in existing systems, challenges remain in achieving robust and adaptive obstacle detection and avoidance capabilities. Factors such as sensor accuracy, environmental variability, computational limitations, and real-time processing requirements contribute to the complexity of these systems. Additionally, the integration of safety features, fault tolerance mechanisms, and human-machine interfaces adds further complexity to ensure reliable and user-friendly operation.

In summary, the existing systems in robotic car technology leverage a combination of hardware components and software algorithms to address challenges in real-time obstacle detection and avoidance. Continuous research and development efforts focus on enhancing system performance, reliability, and scalability to enable safer and more efficient autonomous navigation in diverse environments.

III. Proposed System

The proposed system aims to address the challenges of real-time obstacle detection and avoidance in robotic car technology through innovative hardware and software solutions. The system design incorporates state-of-the-art components and algorithms to achieve efficient and reliable navigation in dynamic environments.

Hardware components play a crucial role in the proposed system, with a focus on integrating advanced sensors, microcontrollers, actuators, and communication modules. Sensors such as LiDAR, radar, cameras, and ultrasonic sensors are strategically placed on the robotic car to provide comprehensive environmental perception. These sensors capture data about obstacles, road conditions, and surrounding objects, enabling the system to make informed navigation decisions.

The proposed system also emphasizes the use of powerful microcontrollers or processing units to handle sensor data processing, decision-making algorithms, and control commands. [2]These microcontrollers are equipped with robust software interfaces and algorithms that enable real-time processing, sensor fusion, obstacle recognition, and path planning. Software algorithms in the proposed system are designed to be adaptive, responsive, and scalable. Sensor fusion algorithms integrate data from multiple sensors to create a unified and accurate representation of the environment. Obstacle recognition on the data to identify obstacles, predict their trajectories, and assess potential collision risks. Path planning algorithms generate optimal navigation paths considering obstacle avoidance, traffic regulations, vehicle dynamics, and user preferences[3]. Control algorithms translate planned paths into precise control commands for the robotic car's actuators, ensuring smooth and safe navigation.

The proposed system also includes a user interface, which may be in the form of a mobile application or a dedicated control panel. This interface allows users to interact with the robotic car, set navigation goals, monitor system status, and override autonomous functions if needed. Overall, the proposed system in robotic car technology represents a comprehensive and integrated approach to real-time obstacle detection and avoidance. By leveraging advanced hardware components and intelligent software algorithms, the system aims to achieve enhanced safety, efficiency, and autonomy in navigating complex environments. Ongoing research and development efforts focus on optimizing system performance, reliability, and scalability to enable widespread adoption of autonomous robotic car technology.

IV. Literature Review

Over the past decade, technological advancements have led to the widespread integration of sensors with electronic devices, revolutionizing various aspects of daily life. Sensors, which convert different energy forms into electrical energy, act as crucial links between the environment and an array of electronic devices. From military zones to hospitals, from smartphones to smart clocks, these devices find application in controlling, protecting, imaging, and identifying processes within industries. The continuous evolution of technology has resulted in the production of numerous sensor types, including heat, pressure, obstacle recognition, and human detection sensors. While initially used primarily for lighting purposes, sensors now play a pivotal role in enhancing convenience and efficiency in everyday life. The rapid pace of technological innovation in the realm of electronics continually paves. [4]Designed for 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.

designed a robotic car. Arduino Uno and Raspberry Pi were used together to control robots 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. Designed and developed a robotic car using sensors and Bluetooth technology. They had established communication between smart devices and robots. Thanks to the phone camera, they had ultrasonic sensor used in this paper. [5]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, a range of information was collected. For the motion of the robot to be smooth, the deviation was minimized by algorithm.

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 an Android device, Bluetooth module, a microcontroller (Arduino Uno), DC motors, motor driver, wireless camera, and metal detector.

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. [6]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. 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.

V. SYSTEM ARCHITECTURE

The system structure of the developed robotic car using various sensors for in this paper, the robotic car consists of two modes: The user control and Automatic mode. The robot and Android device communicate with each other using Bluetooth technology. Over the past decade, technological advancements have led to the widespread integration of sensors with electronic devices, revolutionizing various aspects of daily life. Sensors, which convert different energy forms into electrical energy, act as crucial links between the environment and an array of electronic devices. From military zones to hospitals, from smartphones to smart clocks, these devices find application in controlling, protecting, imaging, and identifying processes within industries. The continuous evolution of technology has resulted in the production of numerous sensor types, including heat, pressure, obstacle recognition, and human detection sensors. While initially used primarily for lighting purposes, sensors now play a pivotal role in enhancing convenience and efficiency in everyday life. The rapid pace of technological innovation in the realm of electronics continually paves.

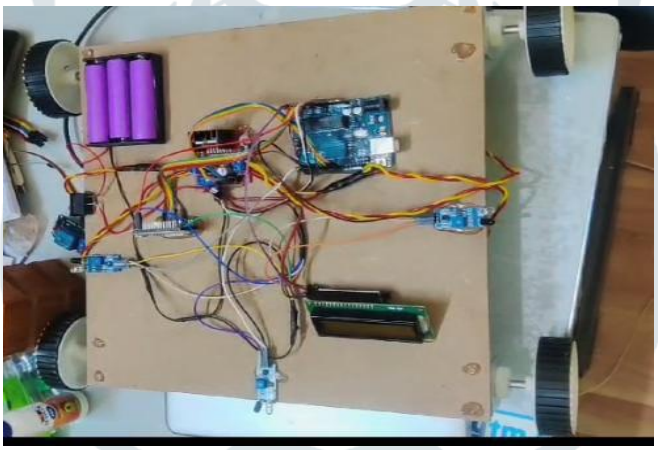

Fig.1 : Design and Implementation of Robotic car

The robotic car is made up of a Bluetooth module, Arduino motor shield, DC motor, Algorithms for artificial intelligence are essential to the robotics industry. Perception is a fundamental technology used in the creation of modern robotic systems. Robotics design heavily relies on perception of surroundings. For example, in military applications, sensor-equipped robots must recognize explosives precisely to identify possible threats. [7]Robots must be able to sense and comprehend environmental factors, such as variations in temperature, to make deft decisions and sensible conclusions Ultrasonic sensor.

In the implementation part, firstly the user should download the "Arduino Bluetooth Controller" from Google Play. After downloading the application, make sure that the Bluetooth connection is open. After entering the application, it must relate to the Bluetooth module password. After connecting to the application, the user should assign values to the desired keys. Once the assignment is done, the robots can now send input values.

The data sent from the Android application to the Arduino Uno with the Bluetooth module. Arduino Uno controls incoming signals and informs which signals should be transmitted to the motor driver. Thus, the robot moves in a certain order according to the inputs entered.

The user can control the basic movements of the robot, back and forth, right-left rotation, robot stop motion from their own intelligent device. The user can also take the robot in auto mode and allow the car to drive its own way. The robotic car can determine whether the obstacles across the vehicle are human. If there is an obstacle in existence, the red led on the robot lights up, the buzzer sounds an alarm, and the shortest distance that can be avoided is calculated and proceeded. If the obstacle facing the robot is an inanimate entity, it computes the shortest distance that it can avoid and proceeds this.

[8]To install the app, firstly, the user must have Google Play installed on his/her Android Device. If the user has Google Play installed, the user needs to download the application called Arduino Bluetooth Controller. To be able to connect to the application, Bluetooth must be turned on. After downloading the application, the user should connect the Bluetooth Module using password. Then, select the user will see some selection.

The user can change buttons on the Android application. [10] As shown in the figure, when the user clicks on the symbol in the upper right corner, the user can assign the desired value to the buttons. When the user presses the Start button, the program starts running. The user can select the desired option by the select button. The options and values assigned in this study are as follows:

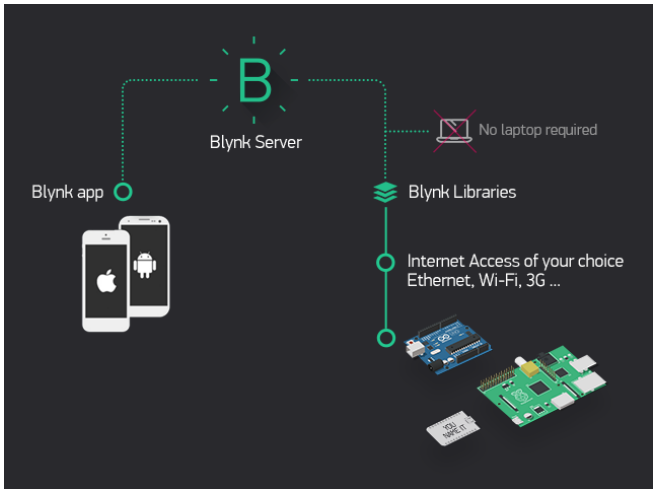

Fig.2 : Blynk Environment

These five options provide the basic movements of the robotic vehicle. When the user selects the last option which is automatic mode button in the application, the robot will be controlled by itself. [9]Thus, the robot will escape from the obstacles encountered and warn when it sees a living being, the user will be able to control the basic movement of the robot through the application. User-entered inputs will be forwarded to the robot via Bluetooth technology. The robot will receive inputs from the device, process them in the processor, and allow them to move according to the input order. The basic movements of the robot are forward, backward, right, and left. In addition, the user can stop the robot at any time.

VI. Conclusion

There are many papers designed to address robotic vehicles with Arduino Uno, Raspberry pi and Android platform. However, real time obstacle detection and avoidance by using Arduino Uno and Android Platform of the remote and autonomous controlled robotic car has not been studied. The purpose of this article is to alert the user to potential terrorist attacks on the military field using the application on an Android device. By taking input from the Android application, the basic movements of the robot are provided. Communication between the robot and the application is made by the Bluetooth module. The ultrasonic sensor is used to prevent the robot from crashing. Thanks to this sensor, to escape the obstacles. In addition, when the robot comes near the cliff, it perceives it and saves itself from falling. With the help of the PIR sensor, the obstacle detected by the ultrasonic sensor is a person emitting heat is revealed. The audible alarm will start ringing with human detection. Novelty of this research is the use of an ultrasonic sensor to detect the distance of the robot's obstacle, avoid obstacles in front of inanimate objects, and determine human simultaneous detection. Thus, the commissioning of such a robot can improve its effective operation and control its tasks remotely and wirelessly, possibly resulting in an attack. This study can be further improved by using more talented materials. The Wi-Fi module can be used instead of the Bluetooth module. In this way, the Wi-Fi cannot be broken as fast as Bluetooth and can be used in areas than Bluetooth.

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