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Bluetooth Based Obstacle Avoiding Robot

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Abstract: In today's world robotics has become one of the most used or relied techniques as it makes the world easy for humans. There are many types of robots such as Articulated, Delta, Autonomous robots and many more. There are many accidents occurring, using such robot in the car will help to safe many lives. In this project we use ultrasonic sensors, Arduino UNO board, servo motor, Bluetooth module. With the help of Bluetooth module, we can control the robot from the phone using android application. Sensors are used to detect the obstacles in its way and navigate the robot in the less obstacle way. Servo motor is used to rotate the wheels. The robot was tested placing in different distance and the robot gave the expected results.

Keywords: Arduino, Autonomous, Bluetooth, Servo motor, Ultrasonic sensors.

I. INTRODUCTION

In the developing world, Robotic plays a very important role. The robot is a machine which always works under the proper guidance. Controlling and monitoring the robot becomes easier through sensors. Electronic devices with sensors are used in robotics to achieve accurate results. In this project we are going to build a Bluetooth Controlled and Obstacles Avoiding Robot. When this robot is in an unknown environment, it is capable of detecting and avoiding the obstacles in front of it. An ultrasonic sensor is used to protect the robot by crashing and hence it totally controls the movement of the robot. Arduino UNO is acts as the Brain of the robot. User has to build a code on what are all the activities should be done by the robot. This code has to dumped in to the Arduino chip and the robot work accordingly. The robot can be controlled by both manual and automatic mode. If it is in automatic mode ultrasonic sensor helps the robot to sense the obstacles and for the further movement. And it is controlled manually by adding a Bluetooth module for the same. This requires an APK Application, which has to be installed in our Smart phone to control the robot through Bluetooth. There is a menu in the App which has buttons to instructs the robot. According to the instructions Robot confirms it's path. This Remote and manual control robot works essentially in the unknown environment.

II. LITERATURE SURVEY

Shantonu Kaisher et al. [1] proposed a robot is an electro-mechanical device with upgraded intelligence. In this project they have designed a robot to detect and avoid the obstacles. Arduino UNO is used as a main part of the robot system. With the help of ultrasonic distance sensor, it becomes easy to detect the obstacles. This sensor is mounted on the chassis produces electromagnetic waves and gets back the same waves after hitting to an object. The distance between the robot and obstacles or hurdles in the direction of the robot is done by using the below formula,

Distance = Time * speed of sound /2.

Two gear motors are used in both the ends of the robot. Which is able to change the directions of the robot. A Boost convertor is also used in this robot system. A boost convertor is converts power from DC to DC. Temperature sensor is also used in this robot which helps the robot to sense the surrounding temperature. Proteus simulation software is used for the simulation for the designing of the robot. For writing the code Arduino-1.0.5-R2 software is used. A Bluetooth module is used in this robot to control the robot in manual mode also. This wireless connection needs a remote to control this robot manually. This remote has to be installed in the smartphone. This app consists of buttons like Left, Right, Forward and Backward. Arranging the buttons in the app keypad is depends on the user. When the robot finds the object in its path the alarm will give the instructions to the user and this alarm will give the sound until the user changes the robot direction. And finally, the output of this project is useful in many small- and large-scale fields.

Miguel Molina et al. [2] proposed the construction of the obstacles avoiding robot. Robotics is one of the technologies which is growing fast in the field of artificial intelligence. The aim of the project is to protect the robot from the obstacles and move in the other direction. It avoids the obstacles by moving forward, backward, left and right. It uses ultrasonic sensors to detect the object, Bluetooth module to control the robot through phone. Bridge H L293D consists of four circuits in order to manage loads of medium power. Here the steering will be bidirectional with applying breaks rapidly and the speed can be controlled. And it helps the wheels to rotate. Arduino UNO is used as the brain of the robot. All the instruction will be given by the Arduino and the robot will act accordingly. It needs two batteries for powering. One for the Arduino and Bluetooth the other for the motor. The ultrasonic sensors are placed in front of the robot so that it will be easy for the robot to detect the obstacles and move in the obstacle less path. The work of Bluetooth is to transfer the

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messages signal so that the user can control the robot from their smart phone. These robots helped in development of technologies. Since it's easy to build and low cost. This type of the robot is used in the self-driving cars and we can save the lives of people.

Esra Yilmaz et al. [3] constructed a remote control and autonomous car based on Arduino. Building Obstacles avoiding robot is the main aim of the project. The robot is capable of detecting obstacles in any physical environment. Detecting obstacles is done by the sensors. This includes hardware and the software system. Arduino UNO is used as brain of the robot. All the connections of the robot will end in Arduino UNO chip. Programming is easier in Arduino UNO. The code has to build in order to guide the robot directions and This code has to dump into the chip. This code includes what all the actions to be taken by the robot when it finds the obstacles. A Bluetooth module is used to control the robot in manual mode also. An app which controls the robot has to be installed in the android phone which has so many buttons on its keypad namely Forward, Backward, Left, Right and Stop. These are the buttons which helps the user to control the robot manually. It is also possible to add more options of directions in the keypad. There will be password for the remote to switch from one mode to another. A buzzer is mounted on the robot to give information about the obstacles in the form of sound waves. If robot gets sound from the buzzer, then it will automatically stop to change its direction. An ultrasonic sensor and PIR sensor are used here to guide the robot. Ultrasonic sensor is the sensor which is capable of detecting the obstacles. Which produces electromagnetic waves in its direction, when those rays hit the object, they will come back and Ultrasonic sensor calculate the time of returning using the formula. According to the condition in the code robot changes its directions. And hence Ultrasonic sensor is successful in finding objects and guiding the robot sensor i.e., used to sense the human present in the way of the robot sensor is capable of detecting Human temperature and it will secure the robot in this way. As mentioned earlier Arduino will do the controlling job with the use of code. Arduino IDE software is used to handle the coding in order to control the robot directions. The robot can be switched from manual to automatic mode by pressing a button in the Arduino app, which instructs the robot to work in automatic mode. When it's in automatic mode the ultrasonic sensor will look for the obstacles, if there are no obstacles at the range of 25cm from the robot, then the robot will continue its movement in the same path. If it finds the obstacles then the robot will automatically go 2cm back. Here PIR sensor will on and it will detect that the object is a human or not. If it is a living thing then the alarm gives its instruction in the form of alarm sound to the robot to escape from the object. If the robot finds any object in its way, then it will automatically change its path. The same controlling will be done using Bluetooth through the android mobile application. With the help of combined hardware and software environment the robot is successfully able to detecting and avoiding the obstacles. In the place of Bluetooth module, we can also use WI-FI, because it is more convenient than Bluetooth.

Prerna Sharma et al. [4] proposed an intelligent object detection and avoidance system. Robotics, nowadays is growing so much, everyone is into robotics and trying to create something new which makes the human life easy. Automation is the something that require minimal or no human help to carry out the procedure. Obstacle avoidance is the prime feature that must be in any robots. In this project the presenters have made an attempt to build an autonomous robot which can travel in unknown location and send us the signals when it detects the obstacles. It has to deal with three rules, those are i) Obstacle detection ii) decision making iii) Obstacles avoiding. Arduino UNO is used as the brain of this robot. Ultrasonic sensor is used to detect the obstacles in front of it and emit the signal. With the help of the signal robot can redirect its motion. The main disadvantage of ultrasonic sensor is its slower than IR sensor, acoustically loud sounds in the typical range of ultrasonic units can affect the sensor reliability and give undesired results. Motor driver module will help to move the wheels of the robot in the favourable direction. Usage of multiple ultrasonic sensors will make it difficult for the robot to detect the obstacles, as there will be more signals emitted and the robot will get confused which signal to analyses and may not give required results. This condition can be solved by making some changes in the code. This is the small step towards the bigger goal and this kind of robots can be used in battlefields to detect mines and they can also be used in self-driving cars and pick and drop service of light weight object can be done. This system gives the desired output as expected. 98% of the ultrasonic waves were emitted and the robot was able to sense the object and avoid it.

Vijayalakshmi S et al. [5] constructed a robotic car using Arduino with Bluetooth controller. Robots are changing the world in all aspects. In every field of modern technology robotics is one of the fast-moving fields. In this project they have designed a robot which is used as an obstacle avoiding robot in the physical environment. A system software called Software Development kit (SDK) is used in this project. The DC motors are used for the movement of the robot. For the Forward and Backward motion, the robot will go in the same and opposite directions respectively. Bluetooth connection is used in order to control the robot in manual mode. An Android software is used to control the robot through smart phone. It is an operating system which enables the control of robot through Bluetooth. This android application includes buttons in order to control the robot. A RC module is there in the robot, this module consists of Arduino UNO chip, Bluetooth module and Motor driver in the circuit. Here L298N motor drivers are used to control the DC motors. Bluetooth module HC-06 is used in this project. A 6v battery is connected to the RC module. A temperature sensor is connected to

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the circuit so the temperature of the environment can be noted. The constructed robot is capable of detecting and avoiding obstacles by this movement it can easily move around in the desired environment and able to measure the temperature.

Daggubati Vinay et al. [6] Sai proposed a novel approach ultrasonic sensor. In this research paper they have designed a robot which is able to protect itself from the obstacles. Arduino UNO is used to process and the ultrasonic sensor. This Arduino chip is connected to sensor and holds all information about action of the robot. This is done by using code or programming. A Bluetooth module HC-05 is used to control this robot in manual mode so that the controlling will be in both the mode manual and autonomous. The Bluetooth module is a cheaper and highly reliable. There are two modes one is Slave and another one is Master. There is very simple switching process between Slave and Master, the default is designed in Slave mode. Using AT commands, the modes can be changed. The robot is able to detect the obstacles by Echo sensors. The very reliable sensor used here is Ultrasonic sensor HC-SR04. There are four pins in the Ultrasonic sensor namely Vcc, Trigger, Echo and Ground. DC motors are used to have the movement in the robot. There is an inductor in the DC motor. This inductor produces Magnetic field which is responsible for the movement. The DC motor converts electrical energy to mechanical energy. A breadboard is used for the better connection of the component. All the electric devices can be fixed on the breadboard. Arduino UNO and Ultrasonic sensor are used as inputs. These two together gives the information about the obstacles. The PC (Preparing Unit) manages the works like receiving information from the input units and processing it. An RC module is used to control the whole body of the robot. This RC module consists of all the controlling devices used. This module was successfully able to protect itself from the obstacles in both the modes. This can be used in Traffic control. This module can be further developed using LASER or LIDAR to get precise output.

Mingyu Gao1 et al. [7] constructed an obstacles detection and avoidance robot. Research on robotics were stared earlier in 90s and due to advancement of the technology researchers were able to develop autonomous robot. This robot completely depends upon the sensors and the that signals to redirect it movements. The presenters used laser radar, laser radar is responsible for collecting the information from the environment and helps to move in other direction where there are no obstacles. Laser radar locates the obstacles from laser and send the information to the control circuit. The received signal is converted into PWM by Control Board. Then this is used by the Motor shield for the robot movement. To simplify the co-ordination data and settings they have use two co-ordinate system, local and polar co-ordinate system. We can't ignore the distance between the robot and the object, if it is ignored there will be complexity in the results. So, we set up a scaling window. There are three layers in Scrolling window (1) Urgent layer, (2) Fuzzy layer and (3) Precise layer. In the end the robot was successful in detecting the obstacles in front of it and avoid it. This system was tested by keep the obstacle and robot in varying distance, the robot gave the out as expected.

Phung QuangAnh et al. [8] constructed and designed an obstacles avoidance mobile controlled robot. Nowadays autonomous robots are receiving attention from all over the world as it will be able to avoid the obstacles and move in the alternate direction. Some robots require human help while other robots do not require any human help. Developing mobile controlled and semi-automated robots become important because that can avoid the obstacles and help the user to get the desired output. The robot should be less power consuming, should allow the user to control it through phone via Bluetooth through the mobile application, the user can control the actions like moving forward, backward, rotating in 90^0 to left or right. Arduino R3 is used in this project which enables the control of the whole robot by manipulating the Bluetooth module. Motor driver module has two back wheels which helps to the mobile robot. Where the whole power is useful for the motor based on Pulse Width Modulation (PWM). Type AAA battery is used to charge the entire circuit. Bluetooth module HC-06 is used to make the connection between the robot and the mobile application. Ultrasonic sensors detect the obstacles in front of it and send the wave to the Arduino, it helps to redirect the movements of the robot. At the back of the robot there are two wheels. And in front it has one castor roller. With the help of this Castor roller the robot can move in obstacles free path and also in uneven surface. Ultrasonic sensor and Servo motor present in front of it and which allows the robot to judge the environment and act accordingly. The robot was successful in avoiding the obstacles and it can effectively move forward, backward, left, right in different angle to defend the obstacles. The robot is able to avoid the obstacles without any user help. Overall, this robot is able to protect itself from the obstacles.

Arulanath T S et al. [9] proposed IR sensor-based obstacles detection and avoiding robot. An obstacle avoiding robot is very useful in the industrial and military works. In this project IR sensor is used to detect the obstacles. IR sensor basically obeys three laws namely (1) Stephen –Boltzmann law, (2) Wien's Displacement law, and (3) Plank's Radiation law. By emitting or from receiving the IR radiation IR sensor will detect the obstacles. The emitted radiation is return to the receiver when they hit the obstacles. By comparing the radiated and reflected ray intensity, the IC will get to know at what distance the obstacle is placed. So that the robot can change its direction. IR sensor consists of Photo-Coupler, this photo coupler includes IR Photodiode and IR LED. The position of IR transmitter and IR receiver will be dependent on the user. If they are placed then the receiver will receive almost radiation from the transmitter. In this project these are

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placed indirect that is in adjacent so that the amount of radiation what is reflected can be measured. A Relay module is used in this project. It is used as a switch. It works on the materials magnetic property. BO geared motors are the motors with the combination of DC motors and Gears. From this the torque is increased. This increased torque will increase the motor load. Because of this nature it can be used in any robotic device with different material. Jumper wires are used for the simple circuitry. From these wires any electric components can be connected in the circuit to form a better connection between each other. This autonomous robot is capable of detecting the hurdles by itself through the IR sensor. This project can be even developed by using Bluetooth or Wi-Fi for the manual control of the robot. Then the robot will be able to do its work in both manual and autonomous mode, then it will be more usable for the end users.

Maryna Derkach et al [10] proposed an obstacle avoidance algorithm for small autonomous mobile robot equipped with ultrasonic sensors. The obstacle avoiding robot are used to scan the surrounding of the robot. This method of securing the environment is called Localization. To avoid the obstacles in its direction it should know the distance between robot and the hurdles. The ultrasonic sensor is used to detect the obstacles. The value of the position of the robot is between 0.07m to 0.2m. Kalman filtering is used in this project. The STM32 microcontroller is used in this robot. This provides the connection between Ultrasonic transmitter the receiver which helps in calculating the distance between the obstacles and in the further escaping process. The L9110S chip is used in this robot. This device is used to control or rotate the motors. This allows the connection between microcontroller, power supply and controlled devices. In this project they have used Keil version environment for the programming. This mobile robot is able to move in forward and backward directions. And this is able to adjust its velocity based on the obstacles. Assembling this robot is easier and also dissembling.

Ikuomola a. J. Et al. [11] constructed an obstacle detection and avoidance robot vehicle. A robot, in this modern era is a machine which is capable of making its own decision and having the ability to provide artificial intelligence or may be programmed and controlled by the end user. The obstacle detection and avoidance are one of the most used and important aspects in the robotic vehicle. The robot is having the capacity to avoid the obstacles and maneuverer around them without colliding with the obstacles in its path. The robot's movements will be redirected when it senses the obstacles in front of it and move in the obstacle free path without having the risk of damage. The ultrasonic sensor will sense the obstacles in front of it and sends the signal to the microcontroller, based on the signal emitted by the ultrasonic sensors the robot will be able to redirect its movement. Depending on the signal received, the robot will move in the alternate direction by operating the motors that are connected to the driver motor. Arduino board was chosen as micro controller platform and Arduino software was used to carry out the program. Usage of multiple sensors placed in the different angle to cover the large distance. The robot was able to adapt for the surrounding environment. It was less complex and small amount of power was given to robot. The system has 8 components, Arduino board, bread board, jumper wires, L293D motor driver, rotors, buzzers, ultrasonic sensors, 9V battery. Ultrasonic sensors sense the object, its places with the buzzer on the bread board, it makes sound with it encounters the obstacles. L293D microcontroller will control the rotor of the wheel. Simulation was also done using Virtual Robot Experimentation Platform (V-REP), output was also achieved. The robot was successful in detecting the obstacles and avoid it with an accuracy of 83.6%. We can conclude that the robotic vehicle was being able to move forward, backward, applies break, avoid the obstacles based on the information it gets from the sensors and accordingly the buzzer will buzz. This robot was fully autonomous initially when the code is loaded, it does not require any human intervenes. Hence, robots like this can be used in the environments where human reach is not possible.

A. O. Agbeyangi et al. [12] proposed an autonomous obstacle avoidance robot using ultrasonic sensor. Robotics is one of the most interesting fields. Autonomous robots are used in the place where human cannot reach. It is the branch of artificial intelligence and engineering. To achieve any of the task, they intelligently decide their actions and move in the required direction. Navigation is the primary need for a robot and it consists two important components localization and path planning. The hardware is built around Arduino board, it is the brain of robot. All the instructions will be sent to the board and the robot act accordingly. The Arduino board is also responsible to transfer the commands via Bluetooth. It is also responsible for the ultrasonic sensors to detect the signal. But the ultrasonic sensors will be able to measure the object distance of 400cm. The ultrasonic senor sends 40khz pulse and the reflected wave from the object will reach the Arduino, Arduino will send the commands and the robot will redirect its movements. The formula for measuring distance d=v/2t. (d refers to the distance between the robot and obstacle, v refers to the velocity of the air 330 m/s, t refers to time). A Bluetooth module was also incorporated in the robot, that sends the signal and helps the end user to control the robot. Commands like 'a' which means the robot is autonomous. 'e' means user-controlled mode. 'F' means forward. 'B' means backward. 'R' means right. 'L' means left. 'S' to stop the robot. Testing has been conducted in stages like pre-implementation and post-implementation testing. After this testing performance evaluation was done and the robot gave the expected results. The robot was able to produce the basic movements without any issues, it was moving in left or

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right direction autonomously or when controller by the end user. This type of robot can be used in military service, self-driving car.

Ekeh Godwin e et al. [13] proposed obstacle avoidance and navigation robotic vehicle using proximity and ultrasonic sensor, Arduino controller Obstacle Avoidance and Navigation Robotic Vehicle is an intelligent device that locates the obstacles and navigates in the obstacle free path. These robots detect the obstacles in its path with the help of ultrasonic sensors and proximity sensors. This technique is designed in such a way that when robot senses the obstacles it automatically applies the brakes and scans the environment and navigates the robot in obstacles less path. This robotic vehicle is microcontroller which is used in automobiles as an intelligent vehicle for the safe driving. This system is designed using C programming and Arduino software and the code is dumped in the Arduino board. 4 VCNL4010 Proximity Sensor is the sensor used in this robot, this is designed for the short distanced about 10 – 150 mm. It can be used in 12C microcontroller capability and voltage of 3V or 5V with no risk of damage for the robot. This senor gives the end used an interrupt when they find the obstacle. The main working principle of this robot is to avoid the obstacle and navigate in the obstacle free path. When it finds the obstacles, it must apply breaks, move backwards and scan the surroundings and move in obstacle free path. The proximity and ultrasonic sensors emit the electromagnetic waves to scan the object in return signal, when it receives the signal, it instructs the robot to stop and scan for obstacles. This robot was tested by keeping the obstacles in various distance across the path. The two sensors were evaluated individually. This robot was also tested in high speed and the robot does it work, it quickly applies the break, takes the path which is obstacles free. The conclusion of this project is that it should detect the obstacle, apply breaks, scan the environment and move in the less obstacle path which must be done with the help of ultrasonic and proximity. The end result of this project is that the robot was efficiently and accurately avoid the obstacles, this application can be used in the automobiles to avoid accidents and loss of life.

Shashank Venkatesh et al. [14] proposed obstacle avoidance robotic vehicle using hc-sr04 ultrasonic sensor. In this project, they have designed a robot which is used to detect and avoid the obstacles. Arduino UNO, Ultrasonic sensor HC-SR04 are used as main part in controlling and protecting the robots from the obstacles. Ultrasonic sensor is the one which detects the obstacles by emitting frequency signal. If there any sort of obstacle then the signal hits to that obstacle and comes back to the echo pin. So that it helps the robot to escape from the obstacles in its direction. This is in the range of 2cm to 400 cm (1ft to 13ft). Arduino UNO is used for the whole connection of the robot. And code has to be dumped in this chip, according to this code the robot will act. Motor Driver module L298D is a H-bridge module with the voltage 5v-35v DC.A battery (6v UM 3R-6) is connected to the whole system for the better power supply management. Servo motor (Tower Pro SG90) is also used in this project for the movement of ultrasonic sensor in all directions. Two Geared motors helped in robot movement. This robot is successfully able to detect and avoid the obstacles. Whenever it finds hurdles in its direction it automatically stops for a while and then changes its direction. So that it is easily able to protect itself from the upcoming obstacles.

Dr. Meena chavan et al [15] proposed obstacle avoiding robot. Obstacles avoiding robots are widely used because of the accurate results in avoiding obstacles. An obstacle detecting and avoiding robot can be constructed using more than one Ultrasonic Sensor. In this project they have used two ultrsonic sensors. Both the sensors are used for the obstacle detection only. Earlier in the left and right part of the robot there were blind spots which leads to the collision. That's why here two ultrasonic sensors are used. For every 300ms both the sensors will emit ultrasonic beams. When these beams hit the opposite object or obstacle then it sends an echo. Ultrasonic sensor receives this echo sound and Arduino uses this to calculate the distance between the emitted beam and the echo beam. If the distance is lesser than the estimated distance, which means there will be a code which represents the action of robot when it finds the obstacle. According to the robot will stop and it moves 12m backward, and look for another direction. Which ultrasonic sensor finds obstacle in far distance; in that direction the robot starts moving. Arduino platform i.e., Arduino IDE is used here, where we can upload the code of action. L293 Motor Driver is used to control the movement of the sensors.9v battery is used for the power supply. This robot has two ultrasonic sensors for the better performance. This enabled the robot to manage its movement in physical environments like military applications in huge scale.

III. CONCLUSION

From this project, the designed robot achieved all the stated objectives. The robot is capable of navigate itself based on the algorithm, thus the movement of the robot confirms the accessibility of the algorithm used. The basic movement of the robot is produced by DC motors. Robot navigates in forward, backward, right and left directions. This movement depends on the obstacles in the path. Ultrasonic sensor provided the information regarding to the obstacles. Thus, it helped the robot to protect itself from any crashing. The servo motor turns the sensor, so that the sensor can rotate in 1800. The motors are being controlled by the motor shield. Motor shield was placed above the Arduino Board and the

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Arduino acts as the brain of the robot. Adding Bluetooth module for this robot helped the end to control the robot through phone. The robot succeeded in both the aspects. The robot was tested by changing the distance, it was succeeded that also. In future this project can be further implemented using many electrical devices. Here we've used Bluetooth module for the manual control. In the place of Bluetooth module Wi-Fi module can be used. And for the better enhancement of the path, a camera can be used.

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