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Design and Fabrication of Obstacle Avoiding Robotic Vehicle

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Abstract - *This paper presents an actual time for action or event motion preparation and obstacle preventing for an independent travelling robot. Obstacle discovery and preventing maybe considered as the main issue in plotting travelling robots. This science determines the machines with senses that it can use to contradict in inexperienced environments outside ruinous itself. In this paper an Obstacle Avoiding Robot is planned which can discover barriers in allure path and planned about them without making some accident. It is a machine vehicle that everything on Arduino Microcontroller and engages a quick distance sensor to detect barriers. The Arduino board was picked as the microcontroller platform and its software counterpart, Arduino Software, was used to execute the programming. The unification of the fast distance sensors supports higher veracity in detecting encircling impediments. Being a fully independent machine, it favorably maneuvered in mysterious surroundings without some accident. The fittings used in this place project is widely possible and cheap which form the machine surely replicable.*

Key Words: Microcontroller, Ultrasonic Sensors, Autonomous Robot, IOT, Arduino Software

1. INTRODUCTION

From its initiation in the 1950s, up-to-date androids have come at a great distance and implanted itself as an immutable aid in the progress of humanity. In the course of time, robots accepted many forms, established its request, and allure size different from a giant 51 extremities to microscopic level. In the course of mechanics incidents of robots, individual facet remained influential to their function, that is mobility. The term "obstacle avoidance" is now not new in new robotics to designate the proficiency of robot to handle over a mysterious environment outside bearing any accident accompanying surrounding objects. Obstacle avoidance in machines can bring more adaptability in scheming in varying atmospheres and hopeful much more efficient as constant human listening is not required. This project grown an impediment avoiding machine that can move without some accident by sensing impediments on its course with the help of the fast distance sensors. Robots led with this science maybe put into various uses, such as, surveying countryside's, driverless busses, autonomous cleansing, robotic lawn mower and projecting machine in industries.

The robot made in this project is expected to fulfil the following goals:

- The robot would have the ability to detect impediments in its way based on a calculated distance.
- After impediment detection, the robot would change its course to a somewhat open course by making autonomous decision.
- It would demand no extrinsic control all along its movement.
- It can measure the distance between itself and the encircling objects in real-period.
- It hopeful able to perform effectively in mysterious atmosphere.

2. LITERATURE REVIEW

Literature survey is the survey of existing work done by different groups or teams which can be taken as a base for the proposed model or system.

[1] Obstacle Avoidance and Navigation Robotic Vehicle is an intelligent robot that automatically senses, scans and directs itself to overcome obstacles on its path. The system uses the proximity sensor and ultrasonic sensor to detect and locate obstacles on its path and navigates to an obstacle-free path. This technique is designed to sense obstacles on its path, apply brakes automatically, scans its environment and take a safe route in order to avoid unpredicted danger. This robotic vehicle is a microcontroller-based system which is useful in automobiles as an intelligent vehicle assistant for safe driving. The system is designed using C programming language and Arduino Software (IDE) and uploaded on Arduino board. Ultrasonic sensor was used to detect an obstacle in front of the vehicle while the proximity detector/sensor to identify an obstacle behind the vehicle.

[2] The project proposes robotic vehicle that has an intelligence built in it such that it directs itself whenever an obstacle comes in its path. This robotic vehicle is built, using a micro-controller of AT mega 8 family. An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the micro-controller. Depending on the input signal

received, the micro-controller redirects the robot to move in an alternate direction by actuating the motors which are interfaced to it through a motor driver.

[3] The ability to detect and avoid obstacles in real time is an important design requirement for any practical application of autonomous vehicles. Therefore, a significant number of solutions have been proposed for this problem. This paper proposes a novel, reactive algorithm for real time obstacle avoidance, compatible with low cost ultrasonic sensor, fast enough to be implemented on embedded microcontrollers. We called this algorithm "the bubble rebound algorithm". According to this algorithm, only the obstacles detected within an area called "sensitivity bubble" around the robot are considered. Upon detection of an obstacle, the robot "rebounds" in a direction having the lowest density of obstacles, and continues its motion in this direction until the goal becomes visible, or a new obstacle is encountered.

[4] This can be design to build an obstacle avoidance robotic vehicle using ultrasonic sensors for its movement. A micro-controller (AT mega 328P) is used to achieve the desired operation.

An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the microcontroller. Depending on the input signal received, the micro-controller redirects the robot to move in an alternate direction by actuating the motors which are interfaced to it through a motor driver.

[5] The robot is equipped with low-resolution optical sensors and electronic compass and is driven by stepper motor. Thus, there are three guidance modes: target tracking using optical sensors, directional guidance using compass, and dead reckoning. There is another optical sensor equipped on board to detect obstacles. The vehicle is controlled based on the information from these sensors. In the proposed technique, the control algorithm is switched to wall following mode when facing an obstacle. This technique is very simple but efficient. Several simulation and experiments demonstrate good performance even though using low-resolution sensors.

[6] Ultrasonic sensors are adopted to implement a real-time obstacle avoidance system for wheeled robots, so that the robot can continually detect surroundings, avoid obstacles, and move toward the target area. Secondly, six ultrasound sensors installed on the wheeled robot were utilized to detect large obstacles and to obtain distance information between the robot and the obstacle.

The PD controller was used in the wall-following method to achieve the optimized path design. Experimental results verified that ultrasonic sensors of the obstacle avoidance system on the wheeled robot, with ATMega162 embedded microcontroller as the core of the system, can indeed help avoid obstacles and reach the established target area.

3. METHODOLOGY AND DISCUSSION

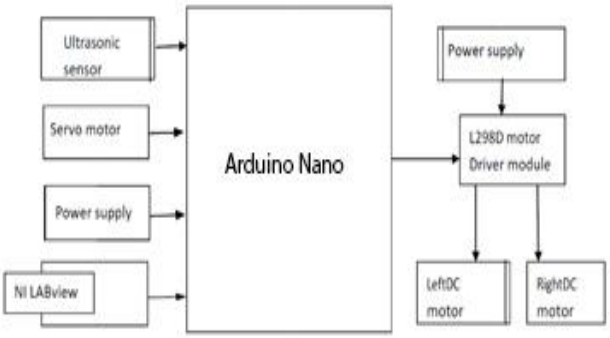

Fig. 1 Block diagram of the system

In our project HC-SR04 ultrasonic sensor is used to decide the distance of an object or impediment. HC-SC04 offers superior face like contactless range remark from 2 cm to 400 cm or 1feet to 13 extremities. The repetitiveness signal hopeful discharged by Ultrasonic maneuver. If vehicle notices some hurdle, then they get even with someone the echo signal that is acquire the I/P to the sensor direct echo pin. The user initializes the switch on and echo pin as 0 and by which tool goes in ahead note. When hurdle is raise the echo pin will signal I/P as 1 to data processing machine boss. Through the hurdle the time space is calculated by rhythm signals. Each period the task holds till the pin goes substantial and before starts organize, the managing will be interrupted when the pin enhances narrow. The beat distance in microseconds is happened likely just before the full pulse is not collected within the time it is designated.

The aim of timing is set, is it specifies in consideration of pulse and mistakes perform in short pulses. The Pulse period from 10ms to 3 minutes in point are consumed into concern. After the time is set, it converts into space. If the space of the object is limited before the pace of machine is cut down then it would take recreation towards the left, if hurdle is existent in left portion, therefore it is noticed that the right turn is suggested. If the space is also less between deviator and object then motion of tool is dropped off and therefore turns in reverse way and again can go in left or right supervision.

Operation of Obstacle avoider use software, that includes the program that assist infix up the HC- SR04 sensor and predetermine signals to motor pins to go in wanted surveillance. Initially, we regulate the trig and echo pin of HC-SR04 in the program plan. Hardware links trig pin is likely to pin nine of Arduino board and echo pin is set as I/P. If space is more before it means no hurdle is skilled and goes in forward project.

If the space is less, then it decides as there is hurdle in way, so that the robot vehicle stops and looks over whether there is hurdle on other side, if no it starts going forward.

3.1 SENSOR FOR OBSTACLE AVOIDANCE

Varieties of sensors are accessible that maybe used for the discovery of barriers few of the very successful sensors are: Infrared sensors (IR), Ultrasonic sensors, Cameras, that maybe used as any of Computer Vision, Sonar. It can measure the distance in its visual field of about pertaining to 1000 to great number point in the design of machine, we are utilizing ultrasonic sensors for impediment discovery and avoidance. The ultrasonic sensors steadily diffuse the repetitiveness signals, when barrier is discovered this signal are mirrored back that before considered as input to the sensor.

The ultrasonic sensor exists of a multi vibrator, that established at its base. The multi vibrator is association of a resonator and vibrator the fast waves produce for one vibration are given to the resonator. Ultrasonic sensor indeed, resides of two parts: the emitter that produces a40 kHz sound wave and detector that detects 40 kHz soundwave and sends energetic signal back to the microcontroller. HC-SR04 ultrasonic sensors are used that include 4 pins VCC, Trigger, Echo and GND.

Features of Ultrasonic Sensor:

- Compact and light weight
- High sensitivity and high pressure
- High reliability
- Power consumption of 20mA
- Pulse in/out communication
- Narrow acceptance angle
- Provides exact, non-contact separation
- estimations within 2cm to 3m
- The explosion points LED shows estimations in
- advancement
- 3-pin header makes it simple to connect utilizing
- a servo development link

3.2 OPERATION FOR ULTRASONIC SENSOR

When an electric pulse of more voltage is given to the ultrasonic transducer so it vibrates and form sound waves. When the hurdles are found by ultrasonic sensor the sound waves are given back as a signal and create an electric pulse. The ultrasonic receiver will observe signal from ultrasonic transmitter and sent waves falls on the hurdle. Combination of these 2 form the vehicle to uncover the hurdle hindering it is going.

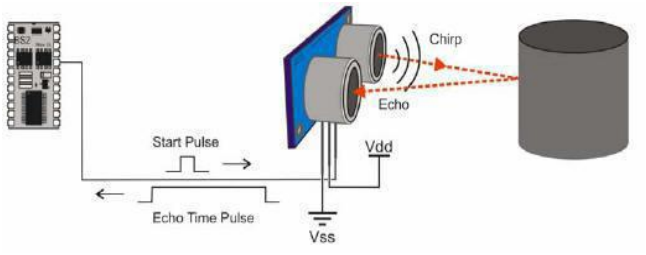

Fig. 2 Ultrasonic Sensor Working

3.3 ARDUINO NANO

The Arduino Nano is a small, complete, and breadboard-familiar board based on the ATmega328P announced in 2008. It offers the alike connectedness and specs of the Arduino Uno board in a tinier form aspect. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, that maybe programmed utilizing the Arduino Software integrated development environment (IDE), that is coarse to all Arduino boards and running two together connected to the internet and offline. The board maybe stimulate through a type-B tiny-USB cable or from a 9 V battery.

Fig. 3 Arduino Nano

To power the Arduino, either you use a battery, AC – to – DC adapter or utilizing a USB wire to combine it on a computer. The rating should be 9V DC 100-500mA capacity adapter, accompanying a 2.1mm barrel plug and definite tip. Beside the USB jack is a jumper cables accompanying 3 pins. If the jumper cables act 2 pins forthcoming the USB jack, it means you're powering through a USB cable; if it's on 2 pins forthcoming the DC jack, you are powering by way of a battery or wall adapter. The ideas between the Arduino and the computer is approved utilizing the USB cord to transfer data evenly. One benefit of Arduino Uno is its smooth programmability. The Arduino programming is performed in the Integrated Development Environment (IDE). The programming language picked is Embedded C language. Using signals from sensors, it helps to design machines and systems that influence the surroundings.

3.4 DC MOTOR

The DC motor is an electric system that works accompanying the fundamental of "A current giving conductor is exposed to humid when it enters a magnetic field of currents". There are

6 parts of DC motor and they are coils, magnets, rotors, brush, stator and direct current source. The DC motor is used in this work to turn the wheels. The armature is arranged in the magnetic field of currents create for one coil and alternated using direct current so that mechanical force is produce.

Fig. 4 DC Motor

3.5 L298D MOTOR DRIVER

The L298D Motor Driver IC authorizes Direct Current (DC) engine to drive on either course. The Motor Drive is a 16-pin IC that controls a set of two DC motors together in some route. That is, the single L298D IC can control two DC engine.

Fig. 5 MOTOR DRIVE

3.6 HC-05 BLUETOOTH MODULE

The HC-05 Bluetooth Module arrange permissive Bluetooth Communication between Arduino and Android Phone. HC-05 Bluetooth Module is a simple Wireless Communication device based on the Bluetooth Protocol. This module is based on BC417 Single Chip Bluetooth IC that is compliant accompanying Bluetooth v2.0 standard and accompanying support for both UART and USB interfaces. Generally, the HC-05 Bluetooth Module, or the HC-05 Sub Module, to be precise, comes with the BC417 IC in addition to a flash memory. Such Modules reach as surface mount board and various third-party manufacturers use these board to build a more total system accompanying essential pins and components.

- **EN:** It is the enable pin. When this pin is floating or connected to 3.3V, the module is enabled. If this pin is connected to GND, the module is disabled.
- **+5V:** This is the supply pin for connecting +5V. As the Module has on-board 3.3V regulator, you can provide +5V supply.
- **GND:** It is the ground pin.
- **TX:** It is the Transmitter pin of the UART Communication.
- **RX:** It is the Receive Pin of UART.
- **STATE:** This is a status indicator pin. This pin goes LOW when the module is not connected to any device. When the module is paired with any device, this pin goes HIGH.

Fig. 6 HC-05 Bluetooth Module

3.7 ARDUINO SOFTWARE (IDE)

The Arduino IDE is a software development platform that allows you to use the Arduino kits to write codes, compile the codes, and load the compiled codes directly into the Arduino Uno controller board. The controller board is used to communicate with the computer using serial communicator (USB connection). The data is transferred between them bit by bit. An adaptor is used to supply power to the controller board and a USB programmer is used to burn the hardware program (written in Arduino IDE) into the Arduino board. The programming for the system is done in C Language and uses various pre-defined header file.

4. EXPERIMENTAL RESULTS

The grown system was tried-and-tested by placing obstacle at different distance across its pathway. The reaction of sensors was evaluated separately, because they were positioned on various part of autonomous motor. Table-1 rundowns the results obtained.

S. no.	Calculated t_{IN} (Duration)(ms)	Experimentalt_{IN} (Duration) (ms) by ultrasonic sensor	Actual distance of object (cm)
1	680	580	10
2	1360	1160	20
3	2040	1754	30
4	2720	2322	40
5	3400	2956	50
6	4080	3510	60
7	4760	4031	70
8	5440	4656	80
9	6120	5262	90
10	6800	5859	100
11	19040	16514	280
12	20400	20000	300

Table-1. Analysis of Ultrasonic sensor for different actual object distances.

The characteristic profile produce by the ultrasonic sensor is uninterrupted and constant that maybe noticed in Figure-8. This is as result of the smooth and good refraction surface of impediment used in the experiment. Also, there is variation in the relative descriptions for both determined and experimental time durations achieved in Figure-8. It is established that as the distance of the impediment evenly increases, time taken for the ultrasonic sensor to discover the object further increases evenly.

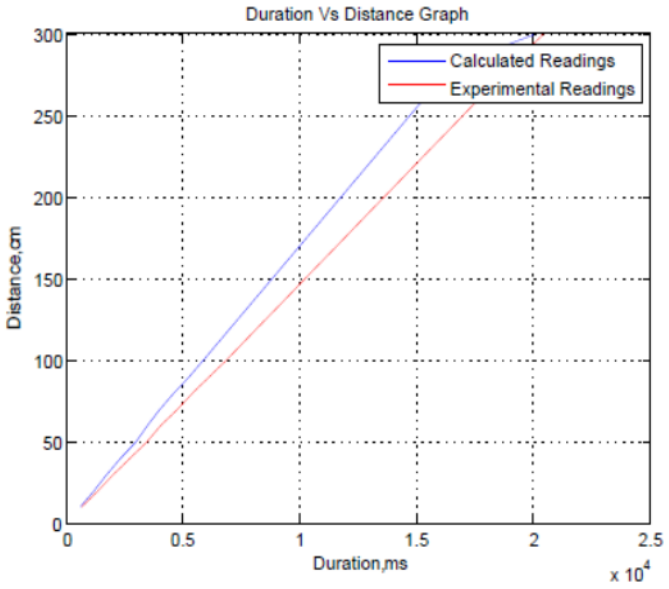

Fig. 7 Response of the Ultrasonic Sensor with Respect to the Obstacle Detection at Various Distances

Movement	Pin10	Pin11|	Pin 12	Pin 13
Forward	1	0	0	1
Backward	0	1	1	0
Left	1	0	1	0
Right	0	1	0	1

Fig. 8 Input Pins for Movement

Arduino board is connected with DC Motor through Motor driver board (pin10, pin11, pin12, pin13) that supplies power to the actuators. Actuators are used to move machine in Forward, Backward, Left and Right directions. The brief writing of inputs pins for activity of machine is likely given above in table. The activity of machine will be stop at whatever time there is an impediment is present on its course that maybe discovered by ultrasonic sensors. Ultrasonic sensors give time in distance to the microcontroller as an input for further conduct.

Fig. 9 MODEL OF PROJECT

5. CONCLUISION AND FUTURE SCOPE

This project developed an obstacle preventing machine to detect and prevent barriers in its way. The machine is built on the Arduino platform for electronic data processing and its program counterpart helped to correspond accompanying the robot to transmit limits for guiding movement. For impediment detection, ultrasonic distance sensor was used that provided a more off-course field of detection. The robot is adequately independent and after the initial loading of the code, it demands no consumer intervention all the while its operation. When established in mysterious environment accompanying impediments, it moved while preventing all impediments with considerable preciseness.

The work done in this project can be a part of a base for further enhancements to increase accuracy and adaptability of obstacle discovery in different atmospheres. In future, the authors concerning this project determine to test the feasibility of merging various types of sensors to complement each other's difficulties. For instance, image sensor maybe advantageous when ultrasonic sensor may not perfectly recognize impediments in atmosphere subjected to noisy environment and variable hotness or air pressure. The preciseness of deciding the distance to the barriers maybe raised by the addition of a photoelectric instrument that measures atmospheric pressure for mechanical adaptation of the sonic speed in air. Also, the addition of a Bluetooth scheme can offer the flexibility of remotely dynamic control limits in the code.

The objective concerning this task be able make an autonomous robot that sensibly identifies the obstacle in its direction and survey as determined by the activities that we set for it. So, what this foundation gives is an alternative in contrast to the current foundation by supplanting smart automated apparatus, that in this manner can handle more cases in less time accompanying better precision and a lower each capita cost.

Further progress possibly achieved by including sensors on the left and right side of the robot. Besides that, computer vision accompanying camera features maybe achieved for

monitoring uses. For further bettering, to implement an impediment avoidance in aerospace, suitable sensors concede possibility be used to draw the accurate facts about the surroundings and barriers. The laser located (LIDAR) sensor plan is strong especially in off-road rustic atmospheres. LIDAR sensor is considered as an active answer to the question of obstacle detection and identification. However, the impediment avoidance poses challenges to the image processing utilizing LIDAR sensor. However, most of these ideas will cost more fund and period also.

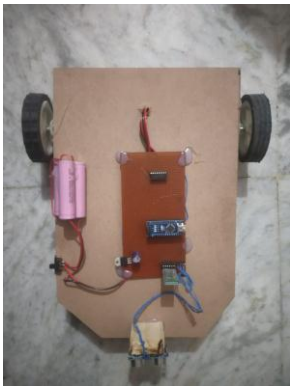

Fig. 10 Model of Project

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