Obstacle detection using embedded platform – An experimental platform

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Abstract. The research work is about obstacle detection using embedded platform with ultrasonic sensor and servo motor. The working principle of the experimental setup is when embedded board powers then ultrasonic sensor starts detecting the objects which is attached with dc servo motor which is also rotating about 180 degrees. When there is a object or motion caused by any object identified in the path of the ultrasonic sensor vision, it detects the particular object and also calculated the distance in cms and direction view. The embedded board used is arduino controller which controls the ultrasonic sensor and servo motor and the software used to show the graphical representation is Processing IDE which calculates the angle, position of the object, length of the object. The application of this project comes where required different fields of navigation, mapping, positioning the object, and tracking with less cost, more efficient and reliable.

1. Introduction

The experimental setup is designed to detect object coming in the vision of ultrasonic sensor. An Arduino board is acting as embedded board which controls and monitors the desired operation. Ultrasonic sensor is having two eyes which is capable of sending pulse from one eye and if there is an object the generated pulse will get hit with the object and comes back as echo which is collected by the second eye.[1]Skolnik, M.I. Radar Handbook. McGraw-Hill, 1970. Radar is an system which detects objects by sending microwaves to calculate and know the distance, height, direction, or velocity of objects. The radar sends radio waves which come back after hitting off any object in their path with this method easily finding any object in the radar range.

[2]NadavLevanon, and Eli Mozeson. Radar signals. Wiley.com, 2004. In 1940 US Navy acronym Radar word from Radio Detection and Ranging. The updated radar experimental setup is more far or ahead in development or progress and the uses of radar are highly required to detect objects like traffic control and defence system in air, Astronomy, Antimissile system, Ocean monitoring system, outer space surveillance etc.

[3]HaoHe,Jian Li, and PetreStoica. Waveform design for active sensing systems: a computational approach. Cambridge University Press, 2012.An Arduino acting as embedded system radar project is more than a visual project because of its hardware execution. The different hardware used to maintain the Arduino Radar Sensor. Like as, Arduino UNO. HC-SR04 Ultrasonic Sensor including a Servo Motor. [4]Solomon W. Golomb, and Guang Gong. Signal design for good correlation: for wireless communication, cryptography and radar.

2. Literature survey

Object identify has been the main concern since few decades. The most acknowledged myth of the accident being unavoidable is a disadvantage for any society. Accidents can be unintentional and can be generally found to occur due to the unnoticed obstacles on the path. We created the design of the obstacle detector irrespective of their movements in this research.
It detects the stops and starts that is the irregular path in terrain and alerts users of the possible hazards like the manholes which are kept open, potholes, protrusions, etc. which is a very common scenario on Indian roads. Hence, this design safety can be improved by predicting a collision before it occurs and therefore providing additional time to install safety technologies. Warnings can be like alarms and any sounds of beep, if the vehicle is coming near to a pothole, or any mobile obstacle, the one in the driver seat can be warned in advance regarding what the road demand for. Self-drive vehicles have a key job in generating urban communities for making known about smart transport setup for individuals with low cost and environmental friendly. With the help of past experience, one can make conclusions to evaluate the perfect driving. The work which utilizes the human design of essential authority for accomplishing the effectiveness in self-governing driving. Such insightful setups are exceptionally proficient in this day and age.

[1] Debattisti S et al. has done a survey on the different sensors which are available for performing a project regarding the object identification. Then a research algorithm used for estimating or approximating the range in the object detection. Atlast they designed and implemented optical detection setup by adding vision sensor with obstacle detection sensor which was used to visually impaired are the great.

[2] Kohara et al he utilized a sensor named stereo vision sensor for creating inhabitance network map, which is the bit of leeway for showing the situation of the impediments. A virtual disparity image (VDI) is used in the field of displaying of objects and their location calculation. In general it is used for navigating the road surface. Similar to [3] JankuRamachandran et al have designed obstacle detection for visually impaired persons that is the blind. They have utilized a portion of IR and ultrasonic sensor for signal transmission and TSOP receiver for accepting the reflected signal from the obstacles.

3. System design & its requirements
In the research work the main components used are Arduino, ultra-sonic sensor and DC servo motor. The research setup is used for detecting motion or movement of object. The Hardware components used in the research work are:-

- Bread Board
- Ultra sonic sensor
- Arduino Uno
- DC servo motor
- Jumper wires

3.1 Software Required:
- Arduino IDE (Integrated Development Environment)
- Processing (Integrated Development Environment)
RADAR is an object recognition setup that utilizes radio waves to calculate the range, angle, or velocity of objects. It very well may be utilized to identify aircraft, ships, shuttle, guided rockets, engine vehicles, climate arrangements, and landscape.

The fundamental bit of leeway of RADAR is that it gives prevalent starting ability through climate condition, and can be utilized in the day or night time. Radar utilizes electromagnetic wave that does not require a medium like sonar (that uses water). So it tends to be utilized in space and air.

3.2 Arduino:

Arduino is an open source in gadgets stage and easy way to use for both equipment and programming purposes. Such boards are skilled to peruse the sources of info like light on a sensor and convert it into a yield like demonstrating red lines when impediment draws close to it.

**Figure 2.** Arduino Uno board

Arduino is called the mini computer. The Arduino Uno is an open-source microcontroller board dependent on the microchip ATmega328P microcontroller and designed by Arduino.cc. The board is fabricated with sets of advanced and simple digital, analog input/output pins that is used to interfaced to different extension boards and other circuits.

Language for Arduino:

The Arduino language is merely a set of c/c++ functions that can be called from code.

3.3. *HC-SRO4 ultrasonic sensor*:

Ultrasonic transducers or ultrasonic sensors are kind of acoustic sensor partitioned into three general classes: transmitters, beneficiaries and handsets. Transmitters convert electrical signals into ultrasound, collectors convert ultrasound into electrical signals, and handset can both transmit and receive ultrasound. The setup integrated with sensor produces sound waves in the ultrasonic range, over 18 kHz by transducer which convert electrical energy into sound, at that point after getting the reverberation changing the sound waves into electrical vitality which can be estimated and shown. This experimental setup additionally can recognize motion objects and track their positions.

**Figure 3.** Ultrasonic sensor

It contains with two ultrasonic eyes where one eye goes about as a transmitter which changes over electrical signal into 40 KHz ultrasonic sound heart beats. The second eye receiver listens for the
transmitted pulses. The sensor is little and offers astounding non-contact go recognition between 2cm to 400cm with a precision of 3mm.

3.4 DC servo motor:
The other name for this Servo Motor is Control motors. They are used as output actuators and does not use for continuous energy conversion. The guideline of the Servomotor is like that of the other electro and magnetic engine, yet the development and the activity are extraordinary. Their capacity rating shifts from a small amount of a watt to a couple hundred watts.

![DC servo motor](image)

Figure 4. Dc servo motor

The rotator of motor latency of the engine is low and has a high fast of response. The rotator of the Motor has the huge length and littler distance across. They work at very minimal speed and once in a while even at the neutral speed. This engine is broadly utilized in radar, PC’s, mechatronics, machine apparatus, following and direction frameworks, preparing important decisions about the way that it is run, and so on.

4. Implementation
Implementation of this research work is done in two ways. The first method is by using tinker cad website where design and simulating is done virtually. The best thing with this method is without physical hardware one can able to design, implement virtually and can also monitor the output. The second method is using real time hardware and to visually graphically processing application is required where the distance can be observed.

With tinker cad implementation, one can select the arduino board, required sensors and components. By connecting the ultrasonic sensor, dc servo motor to the arduino as per system model, the output generates.

![Tinker cad implementation](image)

Figure 5. Tinker cad implementation

The second methods of implementation is using real time hardware, connecting ultrasonic sensor and dc servo motor to the arduino board and verify the object detection and their range parameters in processing application which is to be installed in the pc.

Initially place arduino board and connect the Arduino ground to the bread board ground. Now place and connect the dc servo motor ground to the bread board ground. Now connect the servo
motor signal pin to the arduino pin 4. Connect the Vin pin of servo motor to the 5v in arduino board. Connect the ultrasonic sensor echo pin to the arduino board pin 2, sensor ground pin to the arduino board ground pin, trigger pin from sensor to the board pin 3, Vcc pin of sensor to the 5v pin in the board and the final hardware setup in Figure 6.

After hardware connection, compile the code in the arduino IDE software where one can write the code, compile and upload the code to the board. After compiling the code successfully without any kind of errors, check the port and connect the board to the pc with the port number matching. Starts upload the code to the board with the com matching. Once after uploading the code, the experimental setup starts detecting the object which can be seen in the serial monitor.

Now install the processing application in the pc, while running the code if any object comes under the vision, then it detects with the range.

![Figure 6. Real time hardware setup](image)

The below Figure 7 shows the coding part in tinker cad website and ready to simulate the design and in the serial monitor section one can notice the distance of the object. The same code is valid for real time hardware setup.

![Figure 7. Coding in the tinker cad](image)
5. Result

The red color tells presence of an object in the particular range which is in the vision of ultrasonic sensor. It also gives the angle and distance of the object as shown in below Figure

![Figure 8. Displaying angle, distance of the object when the object is in the vision of ultrasonic sensor in real time environment](image1)

In the Figure 9, as the object is not in the range and not in the sight of ultrasonic sensor so no red color indication.

![Figure 9. Displaying angle, distance of the object when the object is not in the vision of ultrasonic sensor in real time environment.](image2)

The below Figure 10 and Figure 11 explains about the range and rotation of dc servo motor.
Figure 10. Displaying distance in tinker cad virtual design in one particular range

Figure 11. Displaying distance in tinker cad virtual design in different range

The above results in both ways real time design and virtual design with tinkercad shows obstacle detection, calculate distance between the object and angle with the help of Arduino as embedded board attached with ultrasonic sensor and dc servo motor.

6. Conclusions
The experimental setup is designed in two methods and results are carried out in two methods. This design is very cost effective, easy to calculate the parameters of the object. This research work introduced a basic, practical setup for object detection with embedded platform and level of accuracy with good reliability. The experimental setup works well in all-weather condition provided with shield to the setup. In advance level more features can be developed like sending the data of obstacle detection over cloud.
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