Smart Parking Model using Ultrasonic sensor and Arduino for a Bluetooth Controlled Car

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***Abstract* -** Self-Driving car automation has now been realized as a true potential, thanks to the efforts of many companies, and they will continue to evolve. But with these fast-paced advancements in our society, one cannot compromise on the safety of humans, as well as the risks of accidents. Many automobile industries in the world use a very basic visual system for parking, which is not able to deliver the safety of the car. That's where our concept, simple yet inevitable, comes into the picture. To demonstrate our concept, we have implemented a small-scale prototype, built on the foundation of object proximity detection using HC-SR04 Ultrasonic sensor, that could alert the operator of the prototype about certain crucial thresholds it is about to cross, and could also result in complete shut down if alerts are neglected. Just like our prototype, the automobiles when the mechanism enabled, would function the same way, hence attempting to reduce the accidents to a greater extent

Key Words: automation, automobile, proximity detection, Ultrasonic Sensor, threshold, Complete shut down, Prototype

1.INTRODUCTION

In this evolving 21st century, we have witnessed some of the milestones that budding entrepreneurs have achieved, be it in the field of science, technology, or mankind. But these often get interrupted by some of the unknowing and unwelcomed challenges, one just simply cannot ignore. One such challenge is the highlight of this paper and our attempt to overcome it, which is accidents. It's a very strange subject, so common, yet so disastrous which has the potential to bring years of hard work to ruins

Now the question is, what could be the major reasons for it. Well, it's a known fact that most of us, while performing any task, tend to make mistakes, the major reason being lack of attention. Parking is one of the easiest yet crucial tasks to perform and the slightest miss of the driver's attention could lead to catastrophe. Have you ever come across a situation where you simply cannot have your dependency on parking cameras and have you wished to get a hard and fast solution to this problem?

2. LITERATURE SURVEY

2.1 Parking Space Detection Using Ultrasonic Sensor in Parking Assistance System [1] this paper gives a brief overview of how ultrasonic sensors can be used for measuring the space available in a parking lot.

2.2 Smart Parking System (SPS) Architecture Using Ultrasonic Detector [2]. The concept of using ultrasonic sensors to determine if the car has been parked correctly was introduced by this paper way back in 2012, but modification of that concept for collision avoidance and automatic power cutoff if dangerous threshold is crossed is what our prototype advocates.

3. MATERIALS

Before starting with any implementation, a prototype serves as a first step analysis for any innovation and clears the haze between the path to completion. We have also implemented this principle, basically, visualize the idea and get concurrent results in real life. The components that our prototype includes are:

3.1 Arduino UNO

It is the most recommended board for every electronics enthusiast as it enables us to create basic circuits as well as large-scale, real-world applications-based projects. Arduino is an open-source platform used for constructing and programming[3]. It is a microcontroller-based device that can be used to regulate the working of various other components. These controlling and regulation operations take place through the various codes that we upload into it. Now a common confusion about Arduino boards is that we need assembly language to program them but all we need is some basic knowledge about C programming. For writing and uploading these various codes we require an IDE (integrated development environment). Arduino even has this covered for us, a special and open-source software called the Arduino IDE is available over the internet and any person having a personal computer can download it.

Coming back to the working of the Arduino board, this board has ATmega328P 14 pin microcontroller IC as its primary controlling unit. Many other supporting circuitries is present along with the IC but our main focus is the Microcontroller.

Integrating sensors with the Microcontroller is made easy because of the various digital and power pin ports on the board. Ordinary jumper cables can connect them and the codes supplied will help in getting expected outputs. A total of 13 digital input-output pins are available on the board along with 5 analogue input pins.

3.2 HC-SR04 Ultrasonic Sensor

The ultrasonic sensor is an electronic interfacing device used to detect the distance between the object in its front and itself**.** The ultrasonic ranging module HC - SR04, provides contactless measurement with 3mm ranging accuracy between 20 – 4000mm.[4] The module includes ultrasonic transmitters, a receiver, and a control circuit.

3.3 Motor drivers

The L293 and L293D are quadruple half-H drivers with high current performance.[5] These devices can drive a variety of inductive loads, including relays, solenoids, DC and bipolar stepping motors, and other high-current and high-voltage loads. All of the inputs are TTL compliant and have a voltage tolerance of up to 7 V. Each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications with the proper data inputs.

Several other supporting hardware additives were included in the prototype simply to make it move as expected. Some of them are L- shaped BO motors, rubber-coated plastic wheels, 9V battery, etc.

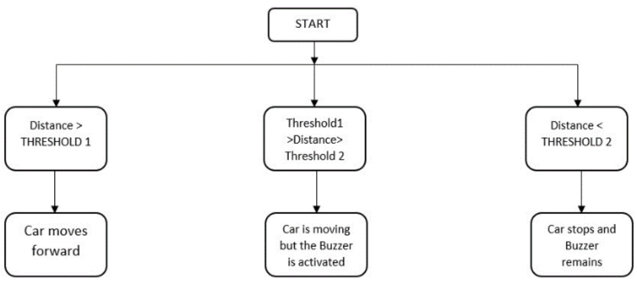

Fig -1: Methodology of prototyped system

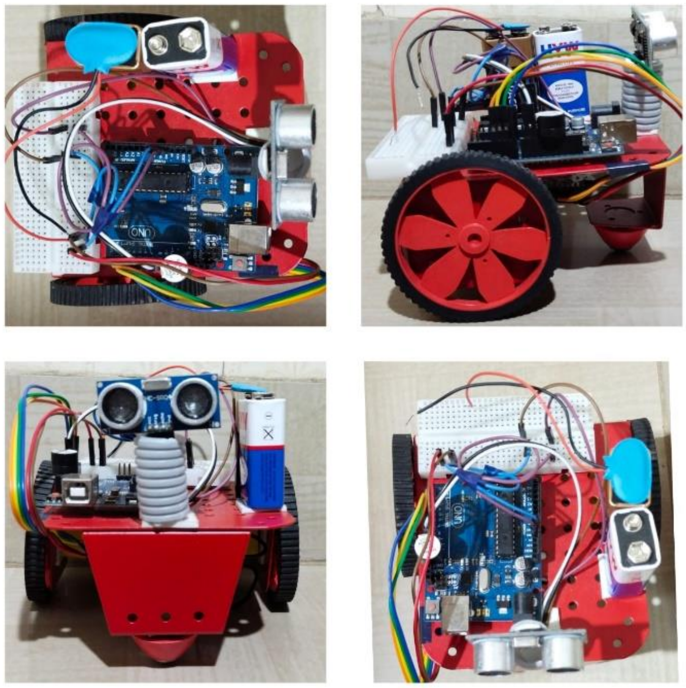

Fig -2: Prototype of Bluetooth Controlled Car

4. METHOD

1. We used a rationale of the conditions on which our prototype is based. Its high sensitivity ultrasonic sensor could give accurate result up to 98.88 percent (Detailed result below)

2. The Ultrasonic sensor detects any action, corresponding to the predefined values and sends a signal to the Arduino board.

3. Then the board processes this data and checks the specified functions on it. It's basically an if-else situation in programming

4. The board, after processing the signal, jumps to the set of outputs to yield which is then observed by us on our prototype.

5. For our case, we have used two sets of condition with two different sets of results
(I) The distance between the prototype and the obstacle when lesser than the first threshold but greater than the second threshold value, would result in alerting the observer, by signalling a buzzer through our board while the wheels keep spinning forward.
(II) The distance between the prototype and the obstacle, when lesser than the second threshold, would result in power shut down in our motor drivers, resulting in a complete halt and hence safeguards the prototype.

6. There are various physical factors that need to be taken into consideration, one of the main ones is inertial constraints, which would act in phase 2 of our threshold. We have created our model in such a way that once the threshold is crossed, the board sends instructions to the motor gear, which is the emergency braking along with complete power shut to the motor drivers.

7. With this, we ensure maximum safety to the car, with the attempt to tackle the inertial constraint.

8. Since our test subject is a prototype weighing just 1-1.5 kgs, this constraint will not matter too much, but implementing the idea in the real world, we just simply cannot take any chances.

5. RESULT

Table 1: Buzzer Threshold Readings

Buzzer Threshold (Theoretical)	Buzzer Threshold (Practical)
15	14.7
25	25
35	34
20	20
30	29.5
40	39.5
50	49.75

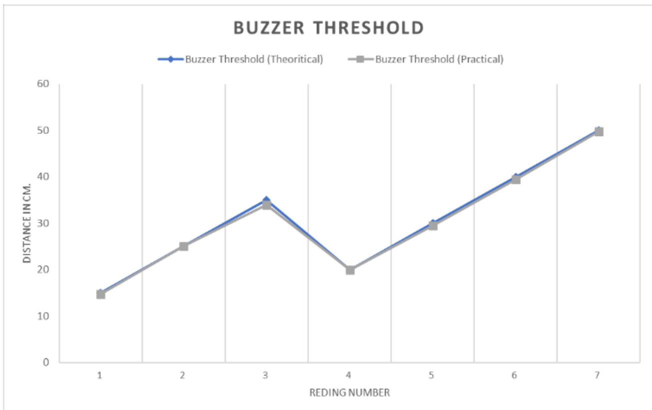

Fig -3: Buzzer Threshold Chart

Table 2: Braking Threshold Readings

Braking Threshold (Theoretical)	Braking Threshold (Practical)
10	10
20	19.5
30	30
15	14.6
25	24.7
35	35
45	44.56

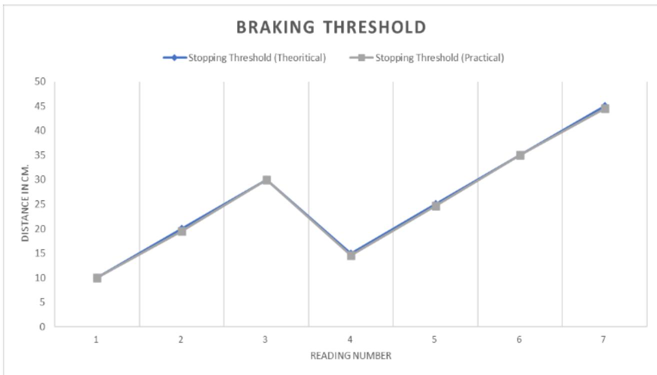

Fig -4: Stopping Threshold Chart

The results recorded show that the Ultrasonic sensor does a creditable job at measuring distance up to 3 meters. This value is enough for any real life application (inertia considered). There is a very small error percentage visible in these readings and hence the results are showing up as expected.

6. DISSCUSION

We tried to present the result and accuracy of our prototype in tabular format as shown in the figures, which contributed to the ease of analysis. We made various test cases available to our prototype and, depending on the theoretical and practical values, the safety margin was determined. This is one aspect that helps us to infer that the ultrasonic sensor measures the distance between itself and the obstacle correctly.

Since the tests carried out were on a small scale it was easier for us to draw conclusions but the actual implementation of this concept requires a deep understanding of automobile dynamics. This might lead to some variations from the observed values. Nevertheless, the core concept of replacing camera-based parking systems with ultrasonic sensors still remains the same.

7. CONCLUSIONS

The content of the above paper clearly emphasizes the safety parking concept, its benefits and the attempt to reduce the risk of accidents due to various reasons. This paper also gives insights to object proximity detection which was used to generate alerts and signals for any collision prevention. Implementation of this concept in large scale automobiles can reduce accidents and automate the industry for a better future.

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