DESIGN AND IMPLEMENTATION OF MICROCONTROLLER BASED TECHNOLOGY FOR AUTOMATIC CONTROL OF BRAKING SYSTEM IN VEHICLES

H Prakash[1], Rashmi H K[2]

[1]*Assistant Professor, Department of Mechanical Engineering,*
JSSATE, Bangalore, VTU, Belgaum, (India)
[2]*Assistant Professor, Department of Electronics and Communication Engineering,*
PNSIT, Bangalore, VTU, Belgaum, (India)

ABSTRACT

Most of the accidents in four wheeled vehicles occur because of failure of breaking systems. Manual method of applying breaks is always dangerous as it leads to accidents. Unconsciousness of driver, failure in the linkages of breaking systems, road conditions, uncontrollable speed of the vehicle and manual operation of breaking systems are the reasons of accidents. It is necessary to control breaks automatically through electronics devices to minimize the accident problems. In this research paper we propose an effective methodology for automatic control of breaking system to avoid accidents. In this technology we used micro controller, relays, IR transmitter, IR receiver and embedded C for effective function of breaking control system. This complete system can be fitted on to dashboard of a vehicle and effectively used for automatic control of braking system. In this research we implemented this technology for prototype model and experimentation is carried out. Based on the experimentation we can make a conclusion of using this technology for real time implementation.

Keywords: Embedded C, Hydraulic brake system, IR receiver, IR transmitter, Microcontroller,

I. INTRODUCTION

With the current fast development in information technology, there has been a tremendous increase in the number of cars. Cars have become a major tool of transportation in the current society. Car safety system becomes important as traffic density is increasing every day. Because it is always difficult to apply brake in such traffic density it is required to design and implement an effective technology which automatically controls the braking system of car to provide safety to the vehicle. There are three kinds of systems for automatic control of braking system namely ultrasonic system, radar system and infra red system. Ultrasonic systems are widely used in many applications, whose strength lies in its wide range of detection and anti-interference. Moreover, the original material is cheap and production cost is low, making its price more widely acceptable. Its weakness lies in the valid radius of detection that is rather limited and in its accuracy in obstacle detection that is the lowest among the three. Ultrasonic systems are generally used in middle and low-end cars. The radar system is difficult to use in cars as it is not cost effective. Here we used infrared based technology to implement our research as the infrared system can have long-distance detection and accuracy outshining that of ultrasonic and cost effective

II. LITERATURE REVIEW

Honda company developed idea of using ABS (Anti lock braking system) to control the car speed. But ABS has its own braking distance and it avoids the collisions only when driver applies brake at right time. Volvo introduced XC60SUV technology for intelligent braking control. This technology has capability to sense and avoids collision only when the vehicle speed is below 50 KMPH. Volvo's laser assisted braking system could not work in rainfall and snowfall. William K. Lennon and Kevin M. Passino, discussed about fuzzy model reference learning controller, genetic model reference adaptive controller and general genetic adaptive controller in their research. Cirovic, Velimir, Aleksendric, and Dragan discussed about their model predictive control (MPC) based braking system. Here we presented an idea of designing and implementation of microcontroller based technology for automatic control of braking system to avoid accidents.

III. WORKING OF BRAKE SYSTEM

Fig 3.1 shows principle of working of a typical hydraulic braking system. In a hydraulic brake system, when the brake pedal is pressed, a pushrod exerts force on the piston(s) in the master cylinder, causing fluid from the brake fluid reservoir to flow into a pressure chamber through a compensating port. This results in an increase in the pressure of the entire hydraulic system, forcing fluid through the hydraulic lines toward one or more calipers where it acts upon one or two caliper pistons sealed by one or more seated O-rings (which prevent leakage of the fluid).The brake caliper pistons then apply force to the brake pads, pushing them against the spinning rotor, and the friction between the pads and the rotor causes a braking torque to be generated, slowing the vehicle. Heat generated by this friction is either dissipated through vents and channels in the rotor or is conducted through the pads, which are made of specialized heat-tolerant materials such as Kevlar or sintered glass.

Subsequent release of the brake pedal/lever allows the spring(s) in the master cylinder assembly to return the master piston(s) back into position. This action first relieves the hydraulic pressure on the caliper and then applies suction to the brake piston in the caliper assembly, moving it back into its housing and allowing the brake pads to release the rotor. Fig. 3.2 describes the different components of a car braking system.

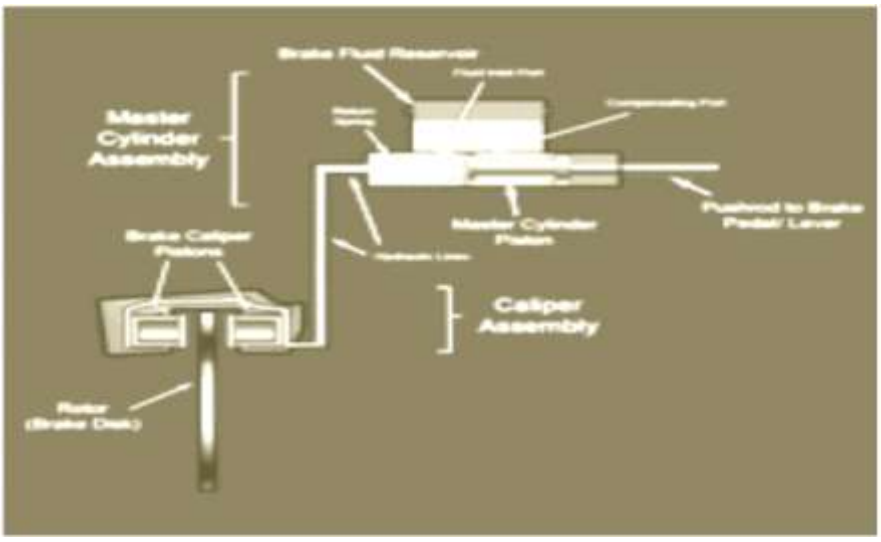

Fig. 3.1: Working Principle of Hydraulic Braking System

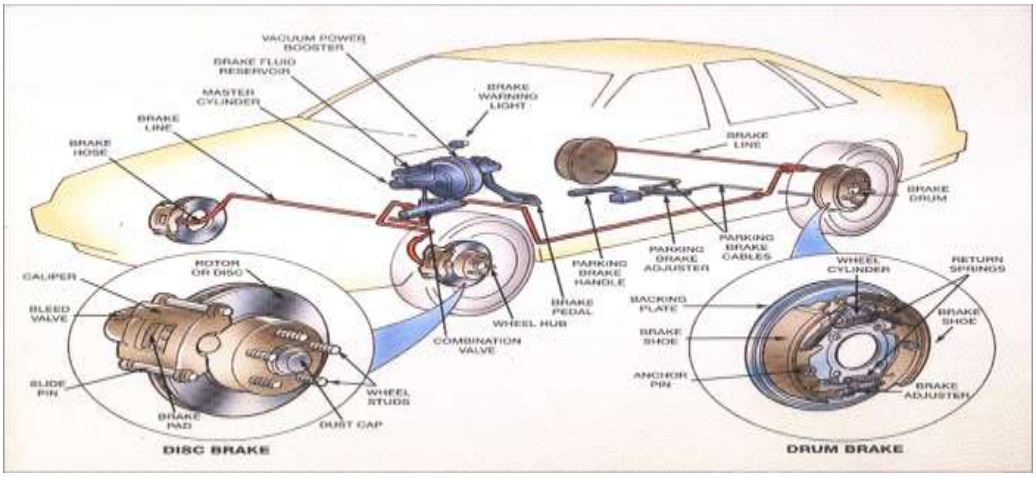

Fig. 3.2: Components of Braking System in a Car

IV.WORKING OF MICROCONTROLLER BASED AUTOMATIC BRAKING SYSTEM (MBABS)

Fig 4.1 shows the block diagram of working principle of proposed research. Microcontroller is the heart of the system. Here we used 8051 based P89V51RD2 microcontroller. The IR transmitter circuit transmits the Infra-Red rays continuously and if any obstacle like other vehicle, human being are detected then IR transmitter circuit produce the reflected rays. These reflected rays are received by IR receiver and these are compared with the comparator circuit and suitable signal will be given to microcontroller. Based on the input signal microcontroller will generate suitable control signal. This signal will be received by relay to control the motor. Motor is connected to brake pedal the car and actuates it to control the speed of the car. If there is no obstacle then motor will bring the vehicle speed to normal. In this research we implemented this technology for prototype model and experimentation is carried out. Based on the experimentation we can make a conclusion of using this technology for real time implementation.

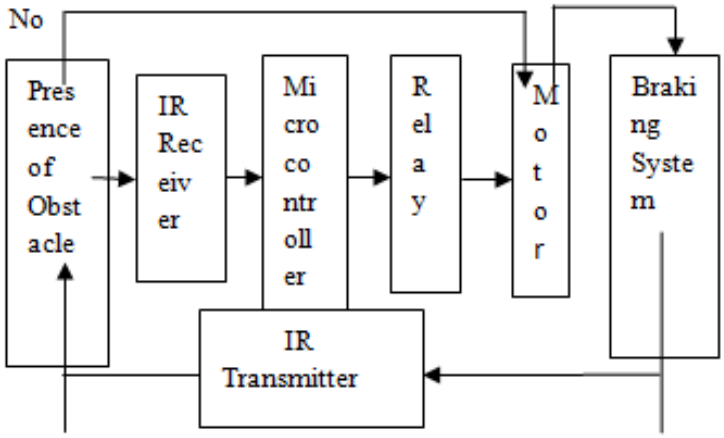

Fig 4.1: Working principle of Microcontroller based Automatic braking system

V. DESIGN AND DEVELOPMENT

5.1 Microcontroller

The main centre part of the project is the microcontroller. Here we used the 8051 based Philips P89V51RD2 microcontroller. The P89V51RD2 are 80C51 microcontrollers with 64kB flash and 1024 B of data RAM. A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (six clocks per machine cycle) to achieve twice the throughput at the same clock frequency.

5.1.1 Features of Microcontroller

80C51 CPU with 5V operating voltage from 0 to 40 MHz, 64 KB of on-chip flash user code memory with ISP and IA, SPI and enhanced UART, Four 8-bit I/O ports with three high-current port 1 pin, Three 16-bit timers/counters, Programmable watchdog timer, Eight interrupt sources with four priority levels, Second DPTR register, Low EMI mode (ALE inhibit), TTL- and CMOS-compatible logic levels, Brownout detection, Low power modes, Power-down mode with external interrupt wake-up, Idle mode

5.1.2 Block Diagram of Microcontroller

Block diagram of microcontroller used in our research is shown in fig 3.1.1

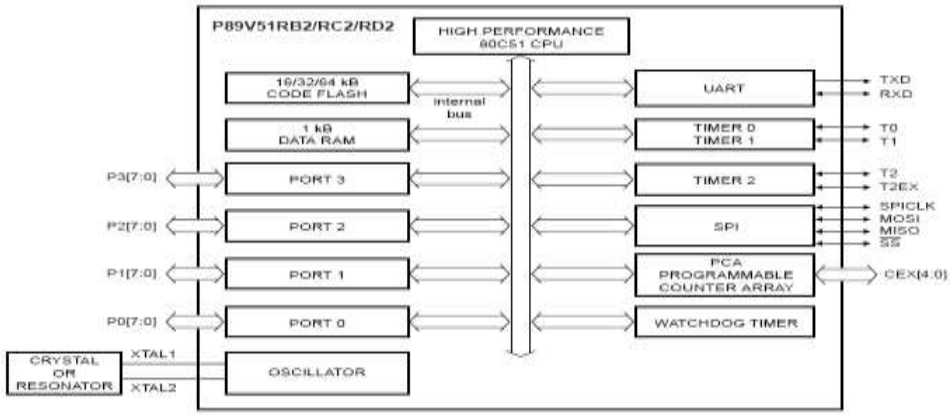

Fig 5.1.1: Block Diagram of Microcontroller

5.1.3 PIN diagram of P89V51RD2 microcontroller

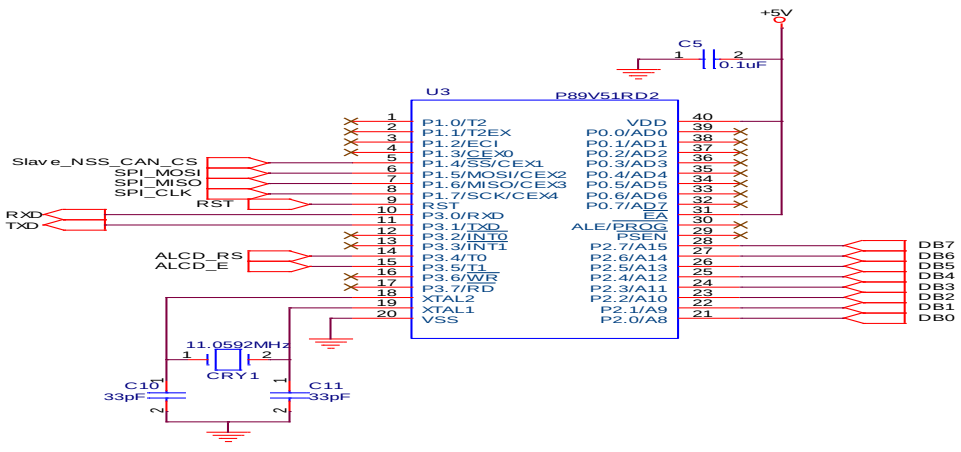

Fig 5.1.2: PIN diagram of P89V51RD2

PIN diagram of P89V51RD2 Microcontroller is shown in the fig 3.1.2

5.2 Piezoelectric Sensor

A piezoelectric sensor is a device that uses the piezoelectric cause to measures the load, hastening, strain or force. And it converts them to an electrical signal.

5.3 Relay

A relay is an electrical switch that uses an electromagnet to move the switch from the off to on position instead of a person moving the switch. It takes a relatively small amount of power to turn on a relay but the relay can control something that draws much more power. Ex: A relay is used to control the air conditioner in your home. The AC unit probably runs off of 220VAC at around 30A. That's 6600 Watts! The coil that controls the relay may only need a few watts to pull the contacts together.

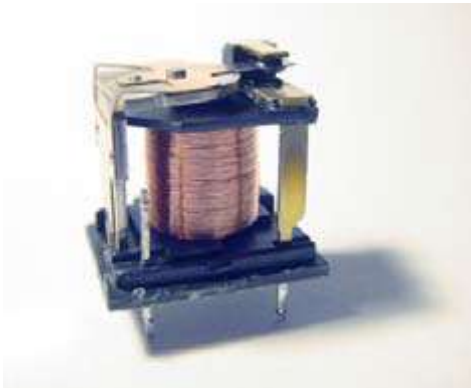

Fig 5.3: Relay

Fig 5.3 shows the schematic representation of a relay. The contacts at the top are normally open (i.e. not connected). When current is passed through the coil it creates a magnetic field that pulls the switch closed (i.e. connects the top contacts). Usually a spring will pull the switch open again once the power is removed from the coil

5.4 IR Transmitter and Receiver

To monitor the density of the traffic, we used a few sets of IR transmitter and receiver sensors on the sides of the roads. One side IR transmitter will b placed and right opposite to the IR transmitter, an IR receiver will be kept. This set of IR transmitter and receiver will be kept on roads at different intervals. The IR transmitters are connected to supply, so that they will transmit high signal all the time. The IR receivers are connected to the comparator circuit, to get digital signals. A low power operational amplifier LM324 IC has been used to develop a comparator circuit. Two set of LM324 IC has been used in this project. The circuit diagram of the comparator is shown in fig 3.4.

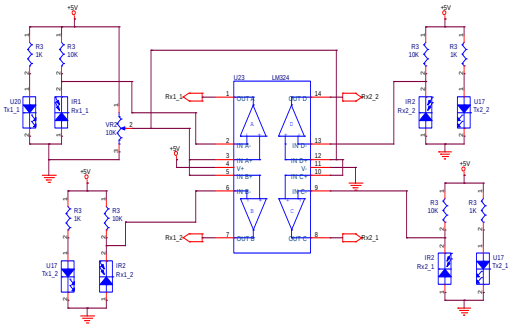

Fig 5.4 Comparator Circuit

5.5 IR Sensors

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. We used IR sensor in this project to sense the presence of obstacle.

Infrared technology is found in many of our everyday products. For example, TV has an IR detector for interpreting the signal from the remote control. Key benefits of infrared sensors include low power requirements, simple circuitry, and their portable feature.

5.6 Motor Driver circuit

Motor driver circuit is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and to drive motors. In this research we used two L293Ds to drive the motors. When both the inputs are low motor will not drive actuators keeping the vehicle speed constant. When first input is high and second input is low the motor actuates brake pedal to slow down the vehicle. When first input is low and second input is high motors actuates the brake pedal to release the brake. Fig 5.6 shows the Pin configuration of Motor driver circuit

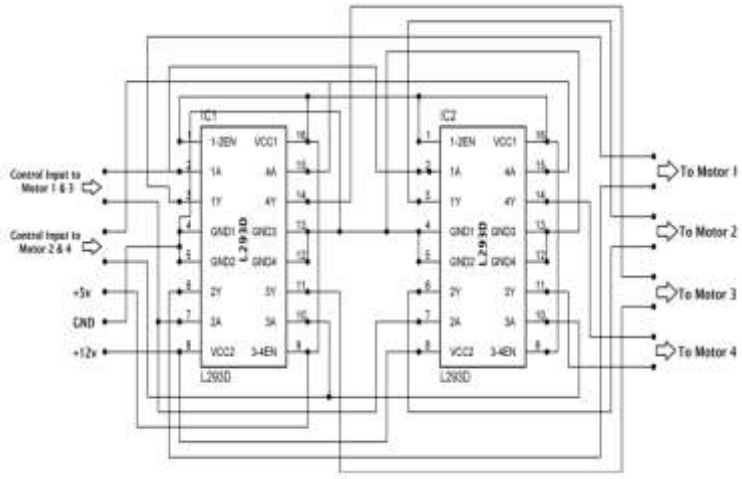

Fig 5.6 Pin configuration of Motor driver circuit

5.7 Introduction to Embedded C

The C programming language is a general-purpose, programming language that provides code efficiency, elements of structured programming, and a rich set of operators. C is not a big language and is not designed for any one particular area of application. Its generality combined with its absence of restrictions, makes C a convenient and effective programming solution for a wide variety of software tasks. Many applications can be

solved more easily and efficiently with C than with other more specialized languages. The Cx51 Optimizing C Compiler is a complete implementation of the American National Standards Institute (ANSI) standard for the C language. Cx51 is not a universal C compiler adapted for the 8051 target. It is a ground-up implementation dedicated to generating extremely fast and compact code for the 8051 microprocessor. Cx51 provides you the flexibility of programming in C and the code efficiency and speed of assembly language.

The C language on its own is not capable of performing operations (such as input and output) that would normally require intervention from the operating system. Instead, these capabilities are provided as part of the standard library. Because these functions are separate from the language itself, C is especially suited for producing code that is portable across a wide number of platforms. Since Cx51 is a cross compiler, some aspects of the C programming language and standard libraries are altered or enhanced to address the peculiarities of an embedded target processor.

VI. IMPLEMENTATION OF RESEARCH

6.1. Circuit Diagram

We prepared prototype model of vehicle braking system along with controller to implement our technology. Fig 6.1 shows the overall circuit diagram of the microcontroller based automatic braking system. Based on the circuit diagram we assembled the components to experiment our technology. Fig 6.2 shows complete hardware set up of the research.

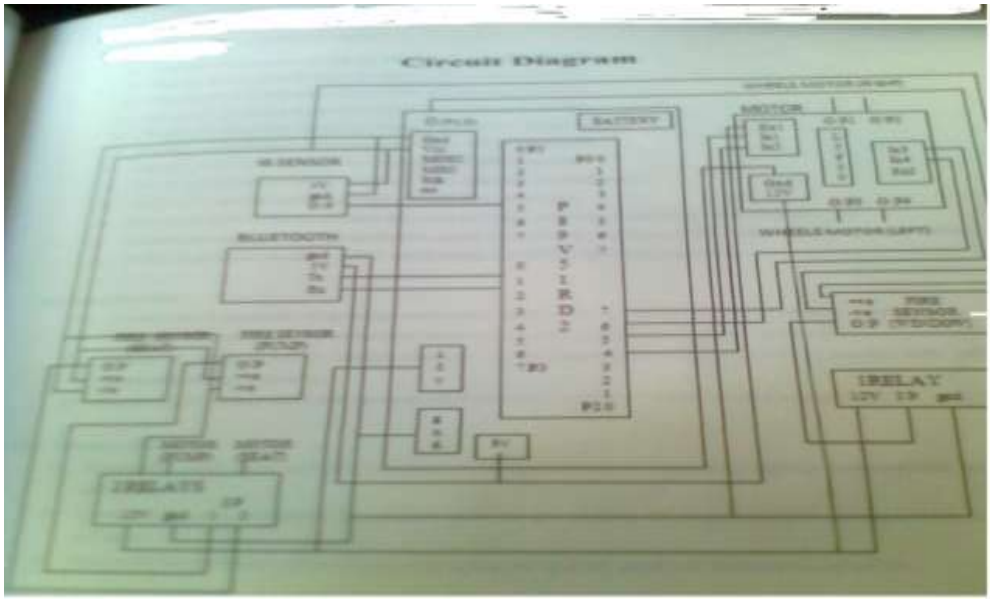

Fig: 6.1 Overall Circuit Diagram Of The Microcontroller Based Automatic Braking System.

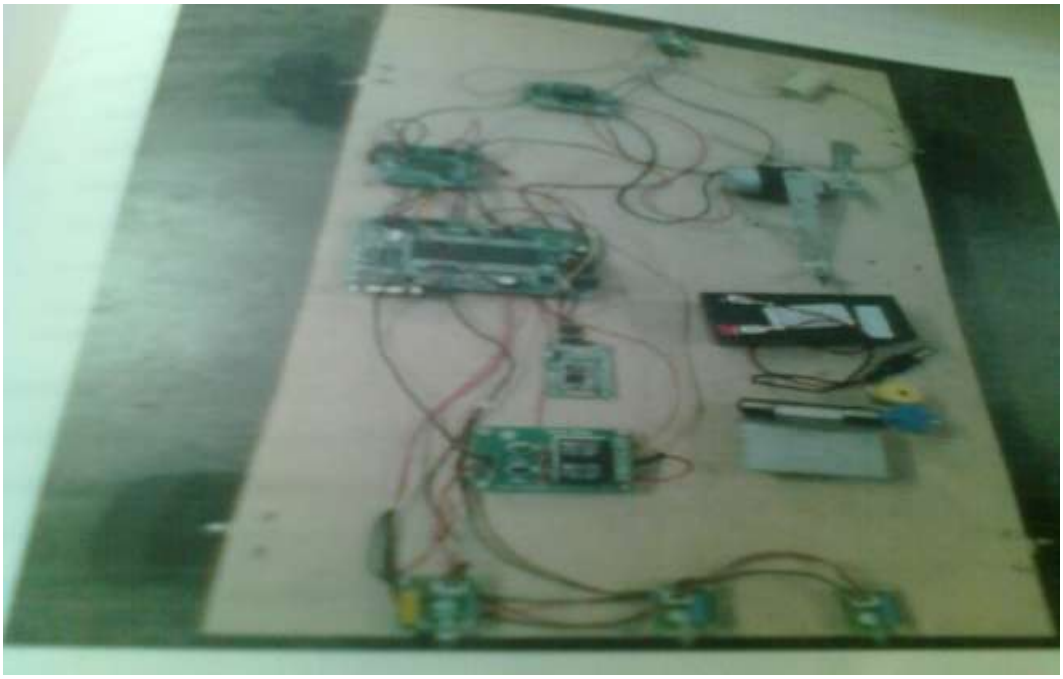

Fig 6.2 Hardware Set Up Of the Research

VII. EXPERIMENTATION AND RESULT

We conducted many experiments to test our technology. We used android based mobile phone to control the vehicle movements. By swiping the screen of mobile phone we tried to control all the movements of the car model and whenever vehicle senses an obstacle automatic application of brake is achieved. The result obtained is satisfactory. Same technology can be incorporated for real time system.

VIII. CONCLUSION AND FUTURE SCOPE

Based on the series of experimentation and the results obtained which are satisfactory we can conclude that the microcontroller based technology can be used for automatic application of brakes in car. It avoids accidents by intelligently identifying the obstacles. Proximity of this technology for sensing obstacle and application of brake is 15 inches. This may be difficult in case of real implementation. This can be set up with advanced sensors to sense the obstacles in for distance so that smooth application of brake can be achieved.

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