

Wireless DC Motor and Breaking Control System

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ABSTRACT: Wireless DC motor and brake control system is a system that's been designed to control the speed in high rate accident and to reduce the number of accidents. A braking system has been designed and connected to the system to be controlled automatically. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems. The programming in this project was done and installed into the microcontroller to give the orders to the system. Radio frequency is the main responsible to control the signal between the transmitter and the receiver units. The DC motor was used to present the engine of the car and it was connected and controlled by the system. This paper presents the structural prototype, hardware design implementation and the software development.

KEYWORDS: Wireless, DC motor, breaks control system, Mechatronics, microcontrollers, automobile engine control system.

I. INTRODUCTION

Many of us have become very dependent on technology as it plays a very important role in our daily lives. Technology has moved its way into our daily lives making its presence essential. Complicated tasks are made easy with the help of such intelligent instrument. As a matter of fact, we experience this effect in our daily lives for instance driving an everyday vehicle. Technology runs in the veins of society. It is the fuel that drives our lives. It is an integral part of daily life. It has definitely benefited society. It has brought luxury in the life of the common man [1].

Automation brought about by technology has saved human effort and time to a large extent. It has brought distant places closer and simplified information access. It has made the world a smaller place to live in. However, as the days of manned driving are decreases, accidents decrease as well. According to IEEE SPECTRUM magazine, Mr. Willie D. Jones done a research where he put into analysis and numbers that person dies in a car crash every second. Vehicles involved in these reported accidents are manned by human beings [2]. Dangerous road condition, unfavourable weather condition and reckless drivers are some of the causes to the increasing ratios of fatal car crashes. Therefore, automation of the driving control of two-wheelers has become one of the most vital needs of this hour. Technology runs in the veins of society. It is the fuel that drives our lives. It is an integral part of daily life. It has definitely benefited society. It has brought luxury in the life of the common man, controlled lane driving; in which I strongly believe will minimize such death rates [3].

The Vehicle Control System is intelligently designed to suit every regular driver. The system is created in a way that collision percentage is lower to its minimum. It offers the possibility of fundamentally changing transportation. Equipping cars and light vehicles with this technology will likely reduce crashes, energy consumption, pollution and reduce the costs of congestion. However, the joy of driving will not be strip off a driver [4]. This is because the system is designed in a way that the brake pedal and acceleration pedal controls are left to the motorist while the microcontroller simply handles the steering and the collision detection mechanism. In short, the driver need not do more than enjoy the driving as this intelligent system has now make driving an automated task. Therefore, it is safe to say that this system is extremely beneficial in the sense that majority of the functions related to driving are fully automated. With the existence of such systems, the number of deaths caused by fatal car accidents may be reduced as it

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takes over the majority driving. By controlling the steering and with the help of our collision detection mechanism, driving on the road is now safer [5].

II. HISTORICAL OVERVIEW OF INTELLIGENT SPEED ASSISTANCE SYSTEM

The intelligent speed assistance is a promising type of advance driver support system. The intelligent speed assistance is a high-tech of driver assistance system that improves the commitment of speed limits by drivers. Many researches show that, over speeding in the main reason for accident and causing the road deaths. So that, it will be safe if the speed of each vehicle is controlled individually and the road safety is expected to increase highly. The invention of this noteworthy system plays an important role in making the road a safer place for all drivers [6].

Over the years, speeding has been the major causative agent of tragic accidents globally as research findings agreed upon. Hence, control of the speed of vehicles by drivers contributes immensely to safety measures. On the other hand, due to the recklessness of many drivers, the Intelligent Speed Assistance System has been a promising solution over the past decade.

Early 2002, Australia has done studies and researches of the intelligent speed assistance spark fire. In the early days, it was done by the Monash University incident research Centre sharing with the Australian Ford Motor Company. Actually, nowadays Australian studies is the only transportation accident commission (TAC) safe car project that does details analysis regarding the design, development and evaluation of the intelligent speed assistance device technologies. The two companies have carried a common research regarding to the TAC. The research was done to imitate requirement by the owner of the cars and encourage the needs by the society for car Intelligent Speed Assistance technologies. These simulations have the ability to improve the safety on the Australian road. The study focused on three main majors which are the Seat Belt Reminder, Following Distance Warning and the Intelligent Speed Assistance systems [7].

Nowadays, Sweden is the first researchers in the world about the safety benefits of the intelligent speed assistance technologies. University of Lund in Eslöv has run an early experiment of speed controller system. This early experiment technology is to test the ability of acceptance of the speed controller and drivers and it affects the driving performance during extensive use. In this experiment, 25 drivers were involved in analyzing of the result. An automatic speed adapter was installed into each participant car [8].

This is meant to be used on the fuel pedal set not more than 50km/h. this is simply means when driver reach to more than 50km/h zone, there will be an increasing of the resistance in the accelerator pedal and the vehicle speed wont goes more than 50km/h. When the driver is trying to increase the speed beyond the speed set on the automatic speed adapter, he will feel such a resistance in the fuel accelerator pedal. This resistance was occurred because the adapter prevents the driver to go beyond the speed limit set. Before the experiment was started several transmitters were placed along the road. Automatically activate and deactivate of the speed limit device by the radio. It was more surprise that the result was generally encouraging [9].

Another alerting experiment on the intelligent speed assistance system was done in Netherland by de Waard and Brookhuis and it was generally meant to test the feedback and the effect of the intelligent speed assistance system under several issues. Among them are the cognitive workload, speeding performance and acceptance of the system. The reading of the local speed limits was received by the transmission of tags which are installed on the traffic sign along the cost way. Different ways of warning were used such as visual and auditory to notify the driver if exceed the speed limit. In this test, 24 participants were involved. Various types of roads were used during the test and the vehicles were drove on the normal traffic hours. The test was to see the performance the device when it used under different conditions [10].

Mäkinen, Várhelyi and Comte have done some test of the speed controller as a part of managing speed of traffic on European roads project. The test was done by the two men to analyze the effect of speed controlling on the travelling period, acceptance, speed performance, driver workload and traffic violations. During the test, appraisal was carried out between the two speed controller system, consultative technique and baseline overseeing. The data of the speed limit and dangerous circumstances ahead were offered by the consultative system [10]. The speed of the car was automatically reduced by the system into the maximum set speed while the "dynamic" system functioned to reduce the vehicle speed even more during dangerous situations. 60 participants drove through 25km fake road network who took

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part in this 1998 trial either with one out of the three speed control systems or no system in use which acts as the control group. Speeds reading were taken and data were recorded during the test. After analysis and comparing, result proved that the limiting speed system has benefit for drivers as well as offering safe environment. In addition of reducing the speed, the system also offer better speed adaptation during the dangerous situations [11].

In Australia alone, attempts to capitalize on this technology have shown potential benefits and improvement on cautious driving with reduced casualties. This was indicated by the Center for Automotive Safety Research of Australia in April 2010. Because of this, many governments are now encouraging a wider adoption of this technology to get full control over such drastically increasing traffic casualties. This is the reason why the developed nations such as Australia are now trying to fully leverage on this technology to provide full National Road Safety Strategy from 2011-2020 [12].

Recently, Aalborg University in Denmark conducted a further test on the intelligent speed assistance system. This experiment was to promote an on-board unit for a Global Positioning System based intelligent speed assistance system. The user reaction towards the system can be obtained if and only if this system tested by the drivers. After much fine tuning and better implementations, a consultative Intelligent Speed Assistance system and Global Positioning System/digital map technology was utilized and implemented in this project. The result was tremendous after innovations and better implementations. During the trial, there was a maximum speed limit so once the vehicle exceeded that limit the system will respond with auditory and visual warnings. Results shown that auditory and visual warnings gave a better and clearer warning to the drivers when they drive in a reckless manner or when they are attempting to go beyond the speed limit [13].

Finland has also actively taken part in the advancement of this new technology. A recent field trial conducted aimed to estimate three different devices of intelligent speed assistance that is informative, compulsory and recording. In this experiment, a car was prepared with a Global Positioning System receiver, a direction navigation system and the three intelligent speed assistance systems. The first system (informative) installed on the vehicle will provide data regarding the maximum speed limit by displaying it on a visible display and later issue an aural warning if the vehicle attempts to exceed that limit. The second system (compulsory) found in the Intelligent Speed Assistance system limits the maximum speed of the vehicle to the posted limit. No vehicle is allowed to accelerate beyond the maximum speed set [13].

By the year of 1996, Paine conducted a research on the subject of speed limiting devices for the Traffic Authority and New South Wales Roads. Besides, this is the era where the advance of Intelligent Speed Assistance has spearheaded the prevalent commercial use of the GPS. Therefore, in order to assess the significance of the Intelligent Speed Assistance, Paine has conducted a driving test on the vehicles by himself in August 2006 on the roads of Sydney by the use of a Speed Alert Passive Intelligent Speed Assistance system. With this, every vehicle was mounted with each type of speed limiter. This was to carry out an overall test on the Intelligent Speed Assistance systems and to further get concrete evidence that they function remarkably on general public roads. Later on in the year of 2007, Paine published an article about this matter for the procedures of the 20th International Conference which was focusing on the Enhanced Safety of Vehicles [14].

III. METHODOLOGY

The main concept in this project is to have a speed limiter system that obtains speed information from the wireless transmitter fitted along the road side. This project consists of the following components

1. The DC motor (Fig.1) used in this project is a normal brushless TAMIYA toy motor. It will be used as an engine of the car. When the speed is increase more than the limit, the transmitter will send the sign to the receiver so that the fuel will be cut automatically from the engine and the car will start to slow down into the limited speed. Even if the driver tries to accelerate there will be no speed beyond the sit speed in the zone.

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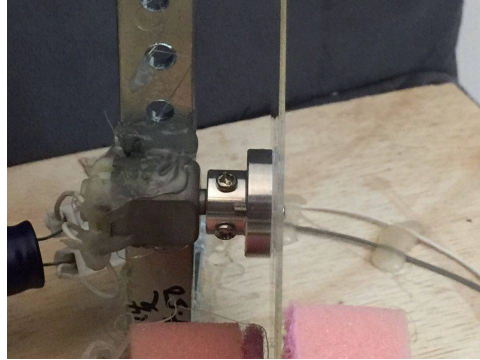


Fig.1: DC motor that used in the project

2. A robotic arm (Fig.2) is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. In this project, two robotic arms will be made of wood and it will help to clamp the CD. It will be cut into the shape and at the end of each arm there will be a sponge attached to present the brake pad.



Fig.2: Robotic arms made of wood

3. The CD in (Fig.3) used in this project to present the disk of the car because the experiment can't be done on the real disk as well as if a normal mini wheel was used it will be more easy to break the robotic arms due to the heavy weight. The reason being of choosing the CD to present the disk is due its surface because it's more similar the surface of the real disk. Also, connecting the motor into the CD was easier and gives a clear result to achieve the aim of the project.



Fig.3: Braking disk & pad (CD & sponge)

4. Two syringes (Fig.4) used during this project to present the braking system of the design. One of them with diameter of 3 cm and it will as brake pad (to touch the disk of the wheel). The other one will connecting to the motor and when

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the motor stop the small syringe will automatically push the big syringe into the disk. This system won't fully stop the car but it will just give friction that reduce the speed of the wheel and insure the car to slow down.

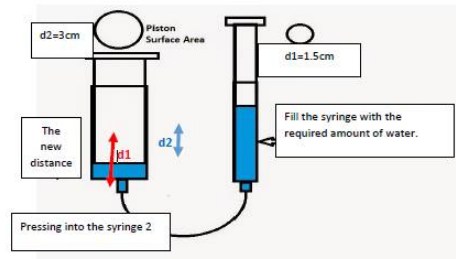


Fig.4: Explanation of syringe function

5. The RF module is chosen depending on the type of application it is used for. For instance, RF Transmitter-Receiver Module of frequency is used for short range wireless control application. It appears to be the most suitable type. These RF modules are shows amazing performance with encoder and decoder as acting as a remote control.

6. Linear solenoid's (Fig.5) basically consist of an electrical coil wound around a cylindrical tube with Ferro-magnetic actuator or "plunger" that is free to move or slide "IN" and "OUT" of the coils body. It can be used to electrically open doors and latches, open or close valves, move and operate robotic limbs and mechanisms, and even actuate electrical switches just by energising its coil [15].



Fig.5: Solenoids

IV. RESULTS

1. The focus of this project was upon speed controlling system; it was also important to obtain information on the static interface relationships between the system and the controlling brake. These data were needed in order to set a limit upon the force that the system should have to exert on the brake pad to obtain high deceleration from the vehicle. The measurement of the forces required is the amount of the force the produced from the two solenoids; that used in the system to present the force source which helps start to activate the brake pad.

2. The source of the force came from the solenoid because when the speed set from the transmitting unit; it will send a signal to the receiving unit which is going to on the solenoid. The reason being for using four solenoids in linear arrangement was created pull and push forces. When the first two push the syringe, the syringe will move for 10 mm (because the force of each solenoid is 200g/10mm) until the sponges moved and clamp the CD then the other two will

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push the syringe back to the original position. This force will move through small syringe to the big one then it will be divided into each sponge.

3. After finishing assembly the hardware, set of running was done to ensure the functionality of the prototype. The speed in the hardware was measured and found to be 70, 50 and 30 km/h. The most important thing in this project was to reduce the speed into the desire speed by controlling the motor and the brake. This was successfully done and there was some different in time to reduce the speed from 70 to 50 and 70 to 30. The force applied was the same in both cases because the force supplier is the same solenoid but the time taken to slow down from 70 to 50 is 4.6 s and from 70 to 30 is 6.9s.

Table1: Summary of force on the disk and required time

Speed [km/h]	Speed [m/s]	Required time [S]	Required force [N]
70	19.44	Max speed	3.9
50	13.26	4.7	3.9
30	8.33	6.9	3.9

From the above calculations (Table 1) it can be noticed that; the main source of the force are the two solenoids (force exerted to push the system) and these two forces will cause the movement of the small syringes into the big syringes and end at sponges (hydraulic system). The sponge will release the force and the hall process by clamping the CD then the other two solenoids will return the system to the original position and wait for another signal to start the processes again.

When the car enter the controlled zone, the transmitter will send a sign to the receiver then the motor (engine) will be cut it means no more fuel go to the engine. For more safety the brake was designed and connected to the system because cars will come with different speed and this will ensure more safety and more good result for the system. The brake will give only a touch to the disk to slow down not fully clamp to avoid the accident and shock for driver and passenger. If the cars reach to the desire speed and low, then the driver will be able to accelerate but not more than the sett speed. After the study of these methods which has been applied in the system. The Linear solenoid is used for this application. The Air hydraulic is too expensive and that is another pump generator to be prepared while the DC motor and the linear solenoid could be easily used and performed. Finally, the combination between DC motor and solenoid was done. The body of the whole DC motor was mostly the in size and voltage comparing to the solenoid. The DC motor also was noisy. Thus, the solenoid is used for this project application and it is very direct to be used. It is just supply the voltage and it can behave pull and push.

Figure 6 below shows that the complete assembly of the break control system. It can be seen that haw the system was designed to work. The solenoids were the main source of the force two of them was used to push the syringes and the other two were used to pull them back. The remote control was made to present the transmitter unit which sends the sing to the car to slow down the desire speed.

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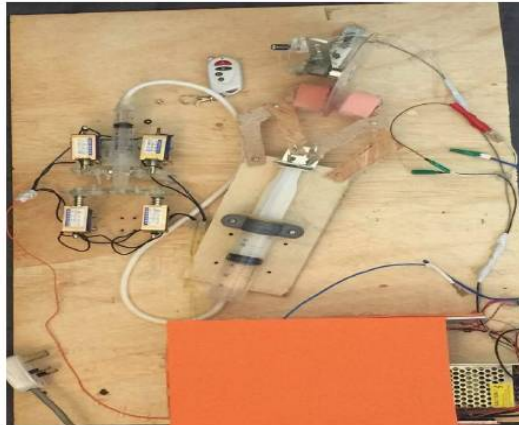


Fig.6: Prototype Assembly

V. CONCLUSION

At the end of this project, it is safe to conclude that the project has been successfully completed. The aim of this project was to implement and design a DC motor speed and brake control system by using microcontroller and RF. The controller will restrict and reduce the speed to desired speed which is the maximum speed limit. The motor speed and brake could be controlled and reduced back to that maximum speed.

The design details and research was done to ensure that the performance of the system. Combining the features of the hardware elements and components used and implementing various new technologies are among the steps taken to further improve this project. Every module was selected specifically to perform its function was sited strictly hence contributing to the most excellent functioning of the unit. Thus within the transmitted signal that encoded the information has been sent so that a perfect designed receiver can divide the information from the signal onto reception of that signal. Then the decoded information can be used to carry out specified functions.

Using very advanced this kind of advance technology and design help to complete the project and run it successfully. This is a very useful technique to control the motor speed and the brake automatically. Finally, after running the prototype several times, do the testing and the troubleshooting; the result has been seen clearly and the objective has been achieved.

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