Inter-vehicle Collision Avoidance Using Zigbee Sensor Networks

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Abstract— This research paper presents a system for vehicles collision avoidance using zigbee sensors. The system developed provides timely safety information for drivers who do not have any idea of happening collision. This system calculates the distance covered by vehicle from the moment brakes are applied till it stops and the time taken by it, at variable speeds. With zigbee sensors it gives the warning to the driver in case of getting in to the proximity of other vehicle and removes any possible chance of the collision. This will help the drivers in maintaining a safe distance from other vehicles moving in front of them and will save them from the collision

Index Terms— intervehicle, collision avoidance, zigbee sensors, vehicle driving, traffic control, wireless networks, accidents, safety driving support.

1 INTRODUCTION

TRAFFIC accidents have been taking hundreds of lives each year, which is quite a big number for human deaths from vehicular accidents than deadly diseases or natural disasters.

About *60%* roadway collisions could be avoided if the operator of the vehicle was provided warning one-half second before the collision.[1]

Human drivers suffer because of there limitations in there abilities like observing, noticing or watching an event on roadway emergency, resulting in large time delay in spreading the emergency warnings, as it is described in the following simplified example

Now as its shown in Figure 1, three vehicles, let say we have three vehicles vehicle 1, vehicle 2 and vehicle 3 traveling in a same lane. When vehicle 1 suddenly notices an emergency event it applies its brakes abruptly, both vehicles vehicle 2 and vehicle 3 are in danger because of there less distance from the vehicle 1, and being even further away from vehicle one does not make vehicle 3 any safer than vehicle 2 due to the following two reasons:

Line of sight limitation of brake light:

Typically a person driving a car only sees the brake light from the vehicle directly

in front to that vehicle. Thus, very likely vehicle 3 will not know the emergency at vehicle 1 until vehicle 2 brakes.

Now here in this picture driver can not see what is in front of that bus.?

Similarly on foggy days

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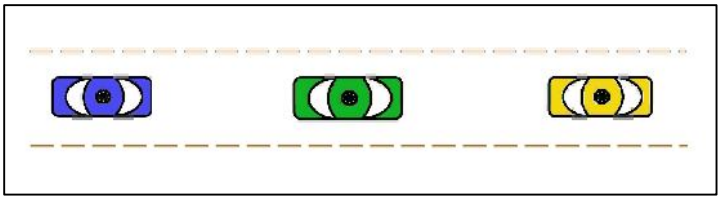


Fig 1 : Three vehicles moving on the road

And on rainy days

Whats behind the bend

Large processing/forwarding delay for emergency events:
Driver reaction time, i.e., from noticing the brake light of vehicle 1 to stepping on the brake for the driver of vehicle 2 . it generally ranges from 0.7 seconds to 1.5 seconds [2], which results in a much large delay in spreading the emergency event warning .


Car A


Car B


Car C

Communications between vehicles increase the safety and efficiency level of future transportation systems. Experiments and observations by different authors shows that v2v communication helps alot in the safety and ease in the traffic flow [3]

Now the system we designed here does the following jobs

- The system measures the distance covered between the instant, the brakes are applied till the vehicle stops, moving at variable speeds.
- The time elapsed after applying the brakes till it stops.
- The zigbee sensor measures the distance between the vehicle in front of the car and will warn the vehicle in case there are any chances of collision.

And it will help in

- Easy traffic movement on the busy roads.
- Emergency Braking of vehicle moving in front.
- Reduces the number of accidents in case of emergency warnings delay.
- Supporting large number of vehicles on the road.
- Improve the work in the field of vehicle to vehicle communication.

2 Related Work

Well there is excess of studies which considers the exchange of information related to safety of the vehicles between the vehicles [4, 5]. Haas et all developed a simulation environment capable of being easily expanded or easily upgraded that showed the stimulations of the crashes happening actually and addressed the requirements of communication to be safe from the crashes [6].According to us the first paper that studied the communication requirements for the safety of the vehicles [7]. Use of DSRC is very helpful in collision avoidance of vehicles it provides usually a range of 1 km and allows the exchange of information between vehicles moving upto the speed of 160 km / hour [8].

3 Hardware and architecture

Hardware used in this project consists of the following parts:

- Step down transformer (I/P 230v AC O/P 12 AC)
- Fullwave bridge rectifier (4 IN4007 diodes)
- B10K potentiometer
- Voltage regulators using C1815, D313, L789CV,L785CV Transistors
- Permanent magnet DC motor
- CD 4026BE decade counter
- NE 555P Timer
- Magnetic Pulse Sensor
- Relay
- PIC Microcontroller
- Zigbee sensor

4 Software and operations

Softwares which have been used in this project are

- Keil version 2 for creating HEX files
- Proteus is used for microcontroller simulation.
- Live wire is also used for simulation.
- PCB is used for connecting electronic components and to view the current and voltage flow among different components

5 Overall simplified flow chart

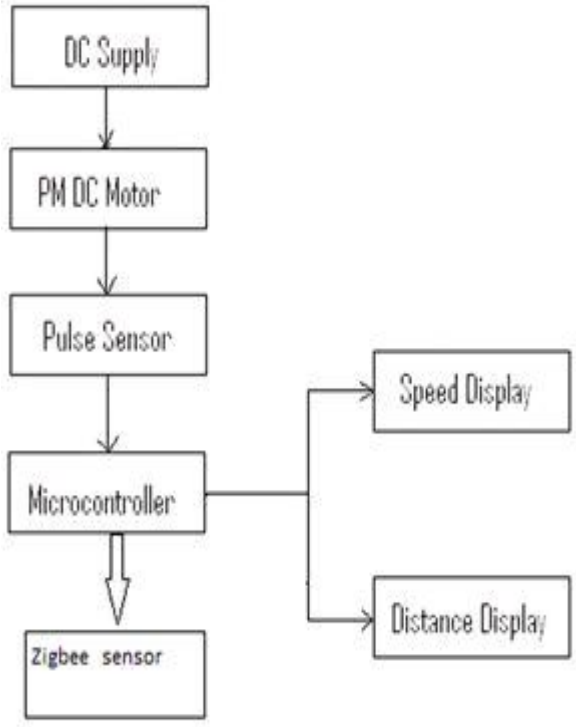
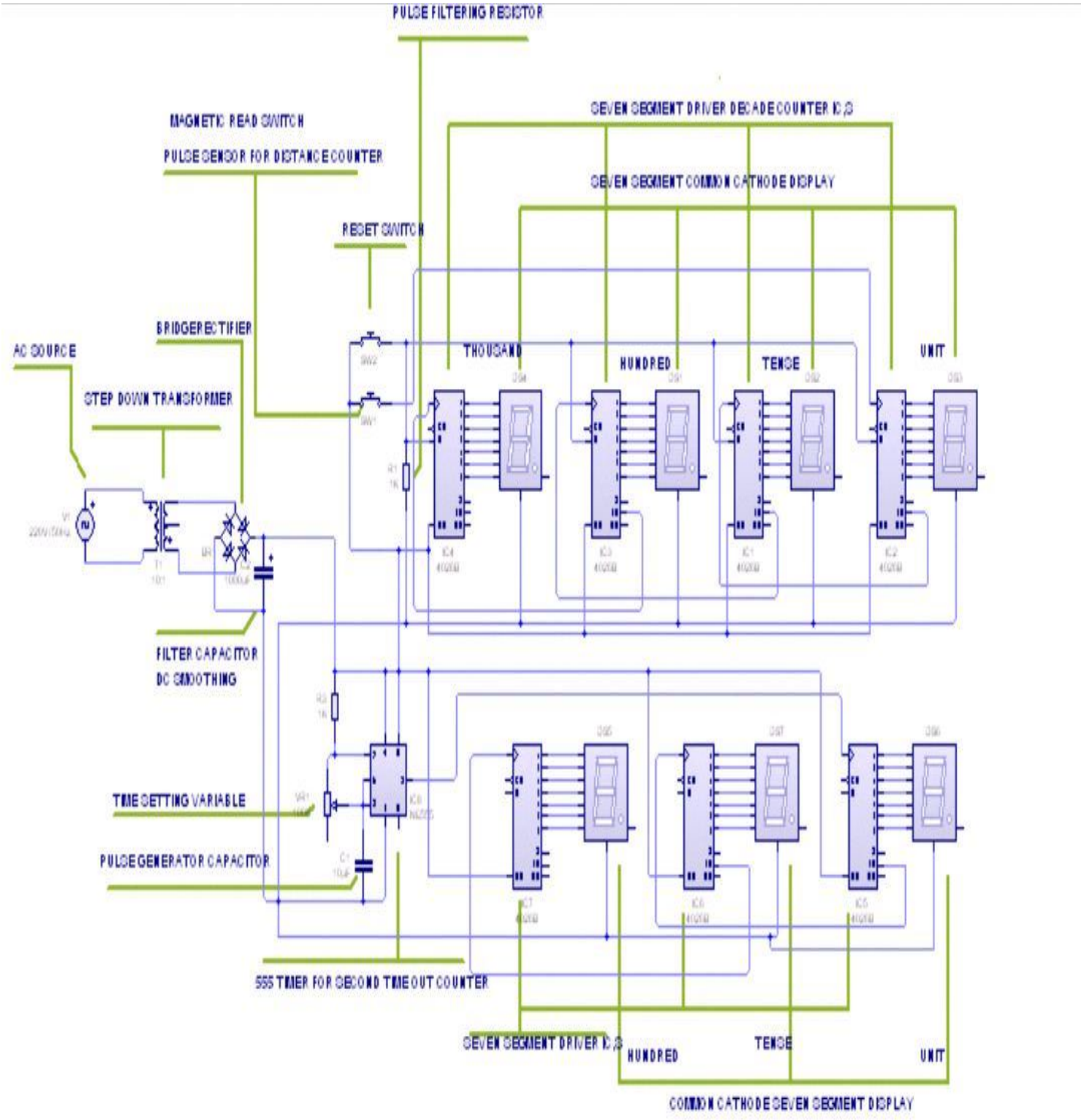


Fig 2: showing the over all procedure and working for the system.

6 Simulation for calculation of time and distance after applying brakes



7 Simulation for PIC microcontroller interfaced with key-pad and LCD:

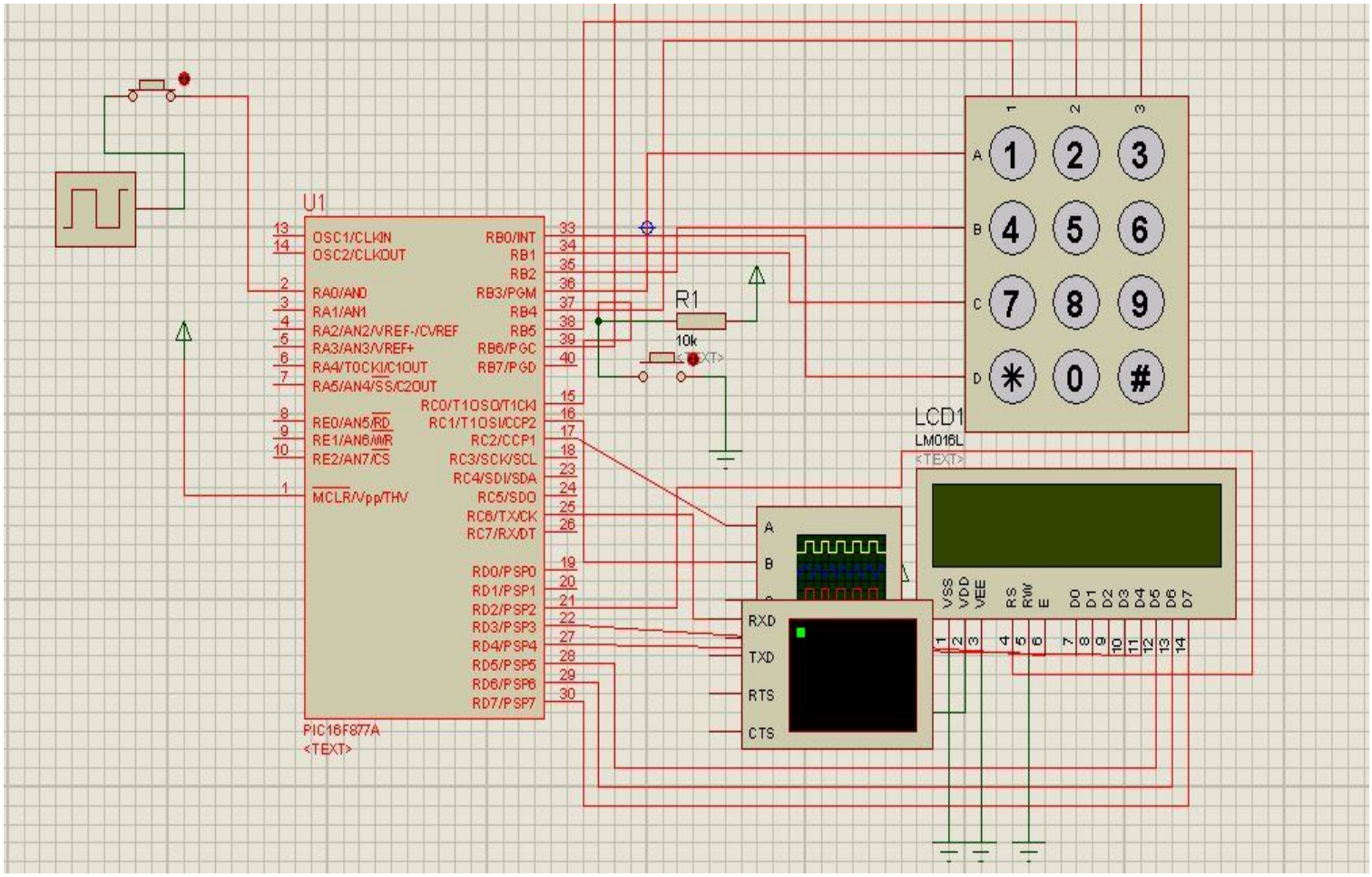
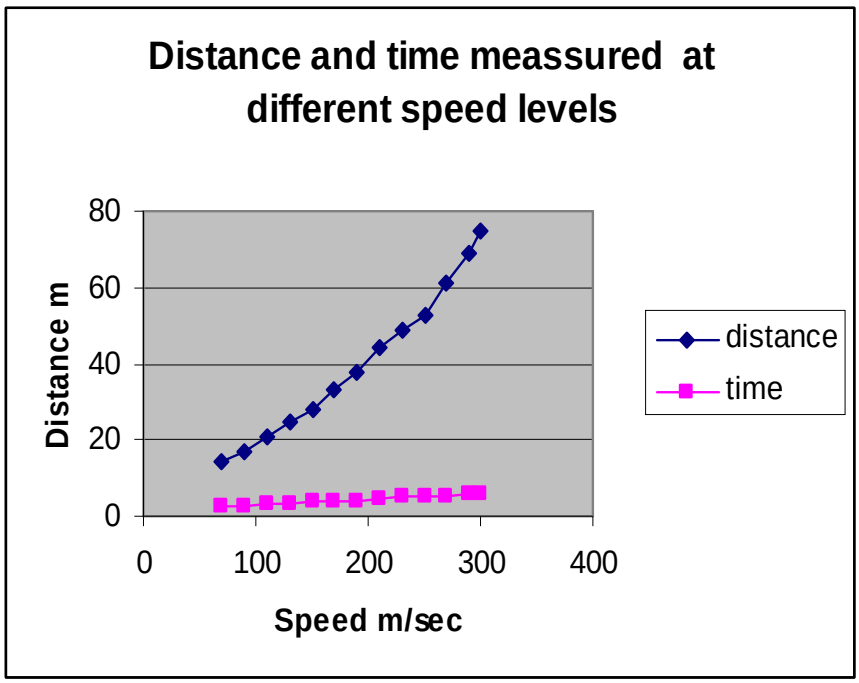


Fig 4: simulation for pic microcontroller working

8 Performance evaluation

The performance of the system is checked at 14 different scenarios
Results are as following

Speed (Km/hr)	Distance(meter)	Time(seconds)
50	11	2.6
70	14	2.8
90	17	3.1
110	21	3.4
130	25	3.6
150	28	4
170	33	4.2
190	38	4.6
210	44	4.9
230	49	5.1
250	53	5.5
270	61	5.8
290	69	6
300	75	6.9



9 Conclusion

Hence usage of this system can highly increase safety and efficiency of transportation system. While improvements in this system can bring out the more reliability and safety in the vehicular communication filed.

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