PEDESTRIAN DETECTION IN NIGHT TIME

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***Abstract*: Safe road traffic, clean environment, environmentally friendly vehicles and eco-buildings are components of the world's vision of immediate future supported by scientists and statesmen. Aspiration for healthy environment and sustainable development of technologies give life for idea of smart cities which consist of all these visions towards modern world. The aim of research was connection pedestrians and alarm system of the vehicle to prevent road incidents with the help of RFID technology. There were proposed vehicle RFID system and tags for pedestrians. System was designed on the basis of scientists' research in this area. The main factors influencing the construction of proposed system were working range of the system and coverage width of the reading devices. Further were compared existent subsidiary systems for drivers versus designed system. The study represents the expected effectiveness of the proposed RFID system as well as the ability to implement it even in old vehicle control systems.**

***Keywords*: RFID, smart city, vehicles, detecting systems, accidents, pedestrians, road traffic.**

I. INTRODUCTION

Road fatalities are a major concern in the developed world. Recent studies [1] show that a third of the number of fatal or serious accidents are associated with excessive or inappropriate speed, as well as changes in the roadway (like the presence of road-work or unexpected obstacles). Reduction of the number of accidents and mitigation of their consequences are a big concern for traffic authorities, the automotive industry and transport research groups. One important line of action consists in the use of advanced driver assistance systems (ADAS), which are acoustic, haptic or visual signals produced by the vehicle itself to communicate to the driver the possibility of a collision. These systems are somewhat available in commercial vehicles today, and future trends indicate that higher safety will be achieved by automatic driving controls and a growing number of sensors both on the road infrastructure and the vehicle itself [2]

A prime example of driver assistance systems is cruise control (CC), which has the capability of maintaining a constant user-preset speed [3], and its evolution, the adaptive cruise control (ACC), which adds to CC the capability of keeping a safe distance from the preceding vehicle [4]. A drawback of these systems is that they are not independently capable of distinguishing between straight and curved parts of the road, where the speed has to be lowered to avoid accidents. However, curve warning systems (CWS) have been recently developed that use a combination of global positioning systems (GPS) and digital maps obtained from a Geographical Information System (GIS), to assess threat levels for a driver approaching a curve too quickly [5]; likewise, intelligent speed assistance (ISA) systems warn the driver when the vehicle's velocity is inappropriate, using GPS in combination with a digital road map containing information about the speed limits [6]. However useful, these systems are inoperative in case of unexpected road circumstances (like roadwork, road diversions, accidents, etc.), which would need the use of dynamically-generated digital maps. The key idea offered by this paper is to use Radio Frequency Identification (RFID) technology to tag the warning signals placed in the dangerous portions of the road. While artificial vision-based recognition of traffic signals might fail if visibility is poor (insufficient light, difficult weather conditions or blocking of the line of sight by preceding vehicles), RF signals might still be transmitted reliably.

The work described in this paper is a collaboration between AUTOPIA (Autonomous Vehicles Group) and LOPSI (Localization and Exploration for Intelligent Systems), both belonging to the Center for Automation and Robotics (CAR, UPM-CISC). The aim of the research is to build a sensor system for infrastructure to vehicle (I2V) communication, which can transmit the information provided by active signals placed on the road to adapt the vehicle's speed and prevent collisions. By active signals we mean ordinary traffic signals that incorporate long-range active RFID tags with information stored into them. This information is collected in real time by RFID sensors placed onboard of the vehicle (an electric Citroën Berlingo), which we have modified to automatically change its speed to adapt to the circumstances of the road. In particular, we have implemented a fuzzy logic control algorithm acting on the longitudinal speed of the vehicle, with actuators which control the vehicle's throttle and brake to reach and maintain a given target speed.

The research shows that RFID system was proposed as solution for city management systems before. Should be highlighted the research of Soichi Kubota, Oisin Morgan, D.F. Llorca and their group of scientists [11], [12], [13]. Their scientific articles were issued in 2006, 2015 and 2017 year. Despite the fact that the studies were established at different times - they have common features and their goal was prevention complex accidents on intersections. For example, the research of Soichi Kubota includes RFID tags for every participant of the road traffic, urban tag reader (repeater) and long frequency (LF) generators.

This paper in organized as follows. A description of the sensors installed in vehicle and infrastructure is provided in Section 2. This includes the RFID traffic identification tags and the placement of the detector readers in the vehicle;

In this paper, by using RFID module as its main component, automatic speed control of our vehicle can be achieved. RFID tag is fixed on the different sign boards and RFID reader on the vehicle. When the reader comes in the speed limit area, speed is controlled automatically.

II. RFID TECHNOLOGY

In the recent years, RFID technology is being incorporated to commercial transportation, highway toll collection system is an example of RFID based system. Reason for its gaining popularity is low cost tag which can be installed on the sign boards easily. Tag generates an ID code which is sensed by the reader. This ensures security of data. An RFID system contains one emitter or tag which is attached to traffic lights or sign boards. They contain specific codes for different information. Other element of the system is RFID reader which is installed inside the vehicle. Reader senses and detects the tag ID [3][4][5]. This is shown in fig. 1.

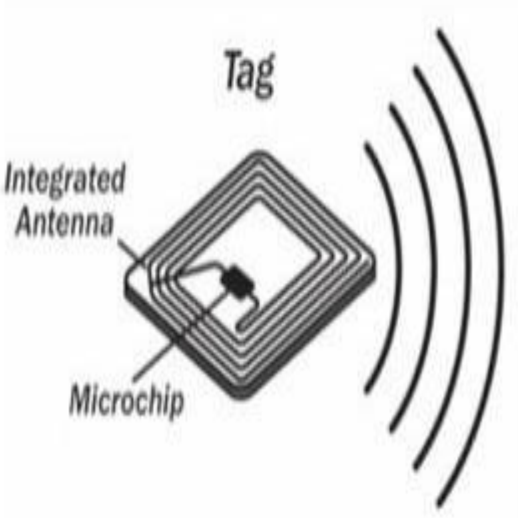

Fig 1: RFID tag

RFID tags are of two types, viz., passive tags and active tags. Passive tags do not contain any power source. These are activated when it comes within the range of the reader. Active tag turns on only if there is power supply. These tags emit identification signals regularly within span of few seconds.

There are two different possibilities of using these tags: First possibility is when tag is attached to traffic light. Only active tags, as shown in fig. 3, will be used here because active tags turns ON when it is given a supply voltage. We connect active tag in series with the Red light. Whenever there is a Red light traffic signal situation, that is, if the traffic signal turns red it also supplies power to the active tag at the same time. The tag remains inactive as long as Red light is OFF that is if there is a Green or Yellow traffic signal. When Red light turns ON the reference speed in this case is considered to be 0 Km/hr. This information of Red light is sent to the reader through specified code.

Second possibility is when tag is connected to speed limit boards on the side of the road. Here we can use active or passive tags depending on the intensity of traffic. These tags contain a particular unique code corresponding to the speed on the speed-limit sign boards. This particular code ID referring to the speed to which the vehicle's speed has to be reduced is transmitted by the tag to the RFID reader. This is shown in fig. 2

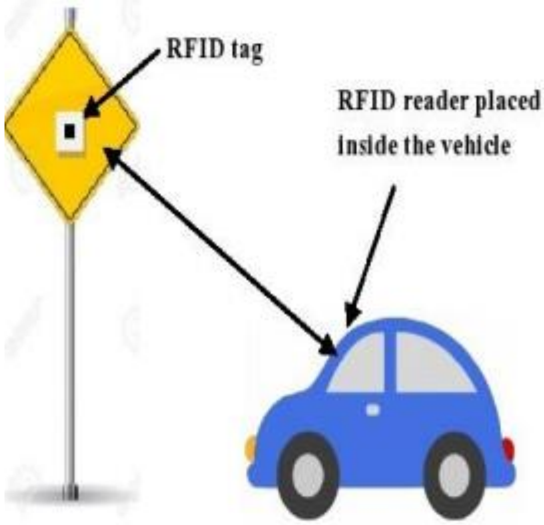

Fig 4: Speed limit sign board posts equipped with RFID tag (left side) Automobile equipped with the RFID reader (right side)

III. ECU (ENGINE CONTROL UNIT)

An engine control unit (ECU) is a type of electronic control unit incorporated in the vehicle that controls a series of actuators on an internal combustion engine to ensure optimal engine performance [4] . This is shown in fig. 5. ECU does this by reading values from different sensors within the engine bay, interpreting the data and adjusting the engine actuators accordingly. For the vehicles when facility of ECU has not been incorporated, the speed control of vehicle is made by controlling air-fuel mixture and ignition timing. Vehicle speed is mechanically set and dynamically controlled by mechanical and pneumatic means

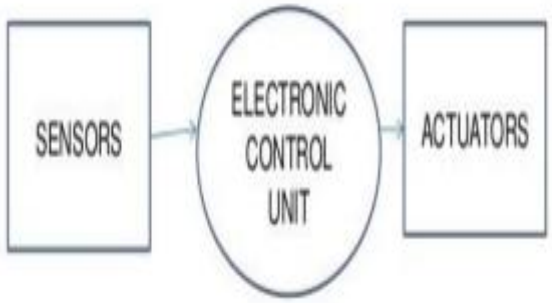

Fig 3: Block diagram for Electronic Control Unit

ECU is an electronic circuit based on embedded on printed circuit board. Microcontroller is the most important component of ECU and it is programmed to execute entire control action. ECU is small and occupies less space than mechanical control system. ECU makes controlling of different block of vehicle easy and effortless. ECU takes input from multiple sensors, interpret the signal and command the respective actuators to take required action. For example, Pedal position sensor senses the movement of pedal and sends this signal to ECU which in turn controls the amount of air-fuel mixture [6].

IV. WORKING

Passive RFID tags are kept at the beginning and end of speed limit zones. When a vehicle enters the speed limit zone the RFID reader installed in the vehicle detects the tag which is placed on the speed limit indicator at the beginning of the speed limit zone. Now the reader has the 12 digit code which is transferred by the tag. This 12 digit code indicates the speed limit which is to be maintained in that region. Once the reader gets this code, it is then transferred to the control unit, here Arduino microcontroller, for processing.

When the microcontroller gets this 12 digit code, it compares this with the 12 digit codes which are already saved in the database of the micro controller. If the code matches with any of the codes in the database, then the micro controller knows that it is a valid code. Also it knows the speed limit which is to be maintained in the zone indicated by the tag. Then the speed of the vehicle is varied accordingly. In this paper, the drive of the vehicle is provided by a 12 V dc motor. The speed of the motor is controlled using Pulse Width Modulation (PWM) technique. During normal operation the speed of the motor is controlled by an accelerating unit. The accelerating unit used here is a variable resistance. As the resistance of the accelerator unit varies the DC reference voltage given to the pulse width modulator also varies thereby changing the width of the output pulses.

Pulse width modulation is the technique in which the width of the output pulse is varied by varying a dc voltage reference which is given as one of the inputs to a comparator [5]. The other input is a saw-tooth voltage waveform. The width of the output pulses decreases or increases as the dc reference voltage level increases or decreases respectively. This pulse produced by the PWM is given to the motor driver unit for controlling the speed of the motor. When the pulse width is large, the speed of the motor increases and when the pulse width is small, the speed of the motor decreases. The motor driver unit is a MOSFET switch which turns on and off depending on the gate voltage. When the gate voltage is high the MOSFET turns on connecting the motor to the power source and ground and when the gate voltage is low the MOSFET turns off. The high and low voltage at the gate is obtained by the pulse from the PWM. Hence for larger pulse.

widths the motor is connected to the power source for longer duration, making the effective dc voltage input to the motor high. Hence, the speed of the motor increases. When the pulse width is small, the MOSFET switch is turned on for only a short period, and hence the motor is connected to power source for only a short duration. Now the effective voltage input to the motor is low and the speed of the motor decreases.

The motor used in this paper is a 12 V dc motor. Also the MOFET switch which acts as the motor driver is a high power device. Hence it requires high power to drive the motor unit. But the pulses used for driving the motor are produced by the PWM in the microcontroller. The microcontroller is a low power device which can produce a maximum of 5 V output. If this low voltage output is connected directly as input to the high power circuit, it will not work properly. Also if the low power circuit is connected to the high power circuit directly, it can damage the low power circuit. Hence for isolating the low power and high power circuits an isolator is used. Here we are using an opto-coupler (TLP250) as the isolator. It uses low power signals as input and produces corresponding high power signals as output. Since it is coupled using light waves, there is no electrical contact between the two circuits hence providing the necessary protection [5].

Hence during normal operation the accelerator unit controls the speed of the motor. When a tag is detected and identified, the microcontroller has to limit the speed of the vehicle to the speed indicated by the RFID tag. In this paper, we have employed two different methods for the speed control of the DC motor- a closed loop method and an open loop method.

A. Closed loop control

In the closed loop speed control method, the speed of the motor is constantly monitored using proximity sensors. The proximity sensor is an IR Transceiver unit which measures the number of rotations of the wheel connected to the motor. The wheel has reflectors attached to its surface. When the reflector comes in line of sight with the IR transceiver, a pulse is produced. By measuring the number of pulses produced by the sensor we can calculate the speed of the motor. By increasing the number of reflectors kept on the wheel we can measure the speed of the motor much faster. The speed thus measured by the sensor is then converted to the required unit and is compared with the speed obtained from the RFID tag. If the speed of the motor is greater than the speed limit of the zone, then the speed of the motor is decreased to the speed indicated by the tag [4]. If the speed of the motor is less than the speed limit of the zone, then the speed of the motor is increased or decreased depending on the accelerator position.

B. Open loop Control

In the open loop control, the speed of the motor is not measured. Instead the accelerator position is identified and the expected speed of the motor is obtained. This is then compared with the speed limit obtained from the tag. If the speed from accelerator is greater than the speed limit, then the speed of the motor is brought to the speed indicated by the tag. For that, the input to the PWM is compared with the speed limit. If the limiter speed is greater than PWM input, then the PWM input is increased in steps. If the PWM input is greater than the limiter speed, then the PWM input is decreased in steps. Now if the speed from the accelerator is less than the speed limit of the zone, then the speed of the motor is varied with respect to the accelerator position.

Here the PWM input is varied in small steps so that the speed variation is smooth. For each step the microcontroller has to check for each of the conditions mentioned above. In our prototype for the closed loop control, we have placed only eight reflectors. Hence there is a delay while measuring the speed using sensor which in turn causes a delay in the speed control as the speed has to be monitored in every step. This delay can be eliminated to a very large extend by using encoders. Encoders are small wheels having a large number of holes (reflectors) (about 1000 holes) on them. Hence pulses are produced at much higher frequencies in the sensor, which enables the speed measurement of the motor at a faster rate, thus eliminating the delay [5]. The closed loop control is more efficient than the open loop control as it is more reliable and based on actual data than calculated or assumed data. The closed loop control gives more accurate and smooth speed control as compared to open loop control.

C. Circuit Diagram

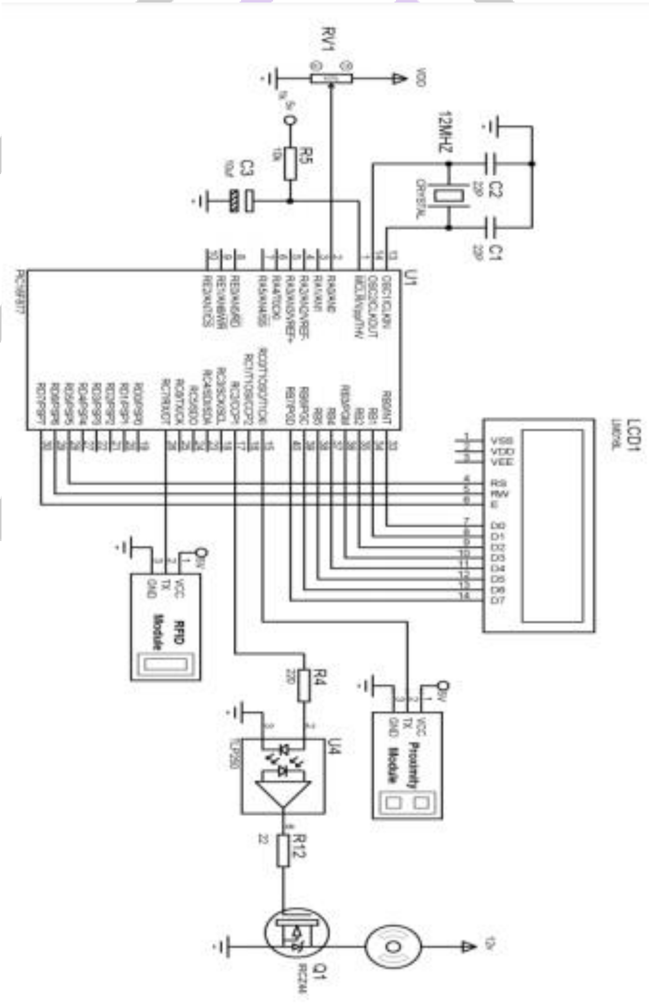

Fig.4.Circuit diagram

V. RESULT AND DISCUSSION

To have a theoretical study on our design, we consider an atmel‟s microcontroller with an operating frequency range of 16MHZ and wireless module. It is a 2.45GHZ radio transceiver. It can operate in the temperature range of -40 degree centigrade to 85 degree centigrade. At86rf230 in the transmitter section will be either in the transmission state or sleep state and the at86rf230 in receiver section will be in the receiving state.

Let the automobile equipped with our architecture is moving at maximum speed at ZONE 1 is about 176rpm and the minimum speed is about 35 rpm and the IR sensor are kept at 35cm away. Let the receiver can detect the frame at 35cm away from the transmitter. From the above considerations, the automobile will be in the range of transmitter for minimum time period of 500 milliseconds. This can be deduced from the formula

Distance = speed * time
Figure 6 shows speed v/s distance for which the automobile will be in the range of transmitter at different speeds. So that in ZONE 1 the maximum limit of speed is 90 rpm if the robot is moving maximum of 90 rpm then the sensor will interface and then the speed will be reduced. We have taken a reading of speed rate of robot for every 5cm so that when it enters to ZONE 1 that is the range of about 90 cm and we placed sensor at 35 cm away and started testing as we can clearly observe that it will reduces the speed of robot and then after finishing the ZONE 1 we can accelerate the robot speed and in between the zone if we accelerate then also the speed is not increased but we can slow down the robot.

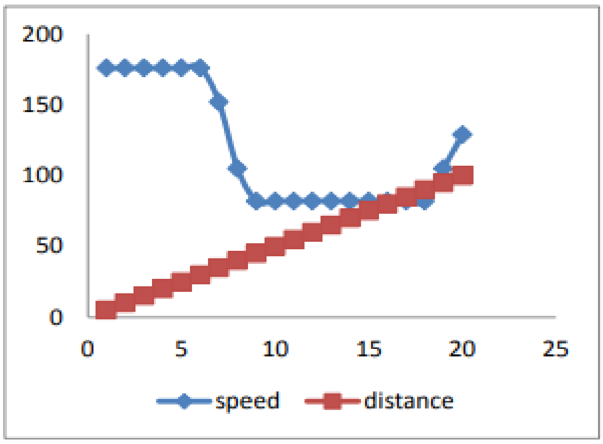

Figure 6: speed v/s distance graph in ZONE 1

Figure 7 shows speed v/s distance for which the automobile will be in the range of transmitter at different speeds. So that in ZONE 2 the maximum limit of speed is 90 rpm if the robot is moving maximum of 90 rpm then the sensor will interface and then the speed will be reduced. We have taken a reading of speed rate of robot for every 10cm so that when it enters to ZONE 1 that is the range of about 195 cm and we placed sensor at 65 cm away and started testing as we can clearly observe that it will reduces the speed of robot and then after finishing the ZONE 2 we can accelerate the robot speed and in between the zone if we accelerate then also the speed is not increased but we can slow down the robot. Here it has maximum signal strength so that it can cover large area to control the speed.

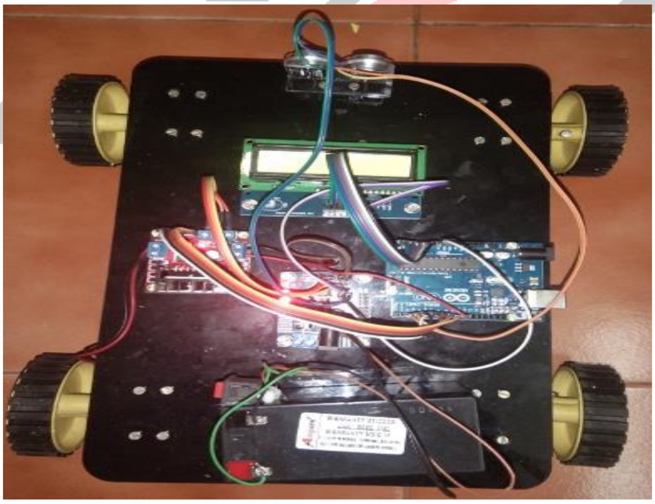

Figure 7: Vehicle Prototype

VI. CONCLUSION

It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Thus the data to be sent is encoded within the transmitted signal so that a well designed receiver can separate the data from the signal upon reception of this signal. The decoded data can then be used to perform specified tasks. Secondly, using highly advanced IC"s and with the help of growing technology the project has been successfully implemented. A low-cost and simple system to ensure the safety of passengers and pedestrians. It certainly provides a hope for bringing down the alarming rate of road accidents. The proposed system is capable of simply displaying the traffic signals in an LCD screen inside the vehicle. In future, provisions may be included to cut out the fuel supply to the engine to provide a smooth deceleration if the speed of the vehicle exceeds a threshold value.

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