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# The implementation of driving anti-sleep safety warning system

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**Abstract:** Sometimes a driver deviates from his natural or normal driving style due to inadequate attention or faces abnormal situation caused by a number of psychological and physical factors. Such abnormalities often lead a driver to a mistake that may cause an accident. This paper presents a novel approach called driver-adaptive assist system to avoid such abnormalities in driving scenario as a preventive measure against occurrence of vehicle collisions, assuming that natural driving style of individual drivers is the safest style. This paper presents a driving anti-sleep safety warning system. To prevent from traffic collision due to the driver fall asleep, the proposed system can supervise the driver by LED and buzzer. The system consists of three-axis accelerometer, LED, buzzer, and control circuit. When the system horizontal angle is bigger than setting ones, the system turns on the buzzer to alarm the driver. Finally, a driving anti-sleep safety warning system for vehicle is implemented and to verify the theoretical analysis.

**Keywords:** alarm systems, automation, driver warning systems, human factors, safety.

## 1 INTRODUCTION

Increasing trend in traffic collisions has become a serious social problem all over the world. A number of factors contribute to the risk of collision including; vehicle design, speed of operation, road design, road environment, driver skill and/or impairment and driver behavior. A 1985 study by K. Rumar, using British and American crash reports as data, found that 57% of crashes were due solely to driver factors, 27% to combined roadway and driver factors, 6% to combined vehicle and driver factors, 3% solely to roadway factors, 3% to combined roadway, driver, and vehicle factors, 2% solely to vehicle factors and 1% to combined roadway and vehicle factors [1]. Human factors in vehicle collisions include all factors related to drivers and other road users that may contribute to a collision. Examples include driver behavior, visual and auditory acuity, decision-making ability, and reaction speed. Worldwide motor vehicle collisions lead to death and disability as well as financial costs to both society and the individuals involved. Traffic collisions are often caused by mistakes of human drivers. A large number of mistakes are due to drivers with inadequate attention in driving led by fatigue, tiredness, drowsiness, having drunk, etc. It is obvious that a warning systems could be effective in most rear-end crushes and other accidents.

Researchers have been working to develop collision avoidance and steady following systems to avoid traffic collisions by providing automatic warning to the driver or braking the car in an emerged danger. Most of such systems use a similar algorithm to warn a driver when the inter-vehicle gap reduces to less than a critical distance. The critical distance for warning a driver is often determined heuristically based on the skill of an average driver in each of the systems [2-4]. Thus those warning systems provide the same type and the same level of assistance to all drivers, regardless of their driving behaviors, skills, ages and preferences. But it is believed that in reality the types and the levels of assistance desired by drivers vary widely according to their driving behaviors, because driving behavior of a beginner and an expert person, a young and an old person are completely different. So a typical assist system that assists all drivers in the same way may not be accepted widely due to mismatch with individual preference. This system may seem appropriate to only some drivers whereas it may seem noisy for providing unwanted advice to some other and may seem insufficient assistance to the others.

Since abnormality in driving leads a mistake that may cause an accident, a system of notifying abnormality in driving rather than only notifying at emerging collision probably produces a much more conducive outcome for reducing rear-end collisions. Some researchers have been working on the development of safety systems using different techniques based on physiological measures like brain waves, heart rate, pulse rate, respiration, etc. [5-7]. There are different methods that can be used to detect fatigue, drowsiness and other psychological facts in driving. But these techniques have the drawbacks since they require sensing equipment (electrocardiogram, electromyogram, respiration, skin conductance, wristband etc.) to be attached to the drivers causing annoyance to them [7], [8]. The other techniques monitor eyes and gaze movement using complicated image analysis.

A driver's state of attention can also be characterized by comparing current driving behavior with his natural driving behaviors like the lateral position, variation in headway range, braking and acceleration characteristics, speed and range fluctuations, steering wheel movements, and time-to line crossing. To cope with the actual inattentiveness in driving it is necessary to develop a non-intrusive system based on observation of indirect driving behavior of individual driver. Although, these methods seem a bit complicated due to variation in vehicle type, driver experience, road type, weather etc., it may be an efficient and widely accepted system, and contribute in reducing traffic accident due to mistakes greatly [9].

This study develops the design and fabrication for a 3-axis accelerometer and Programmable System-on-Chip Controller (PSoC) devices-based driving anti-sleep safety warning system.

## 2 ELEMENT CONFIGURATION AND OPERA TING PRINCIPLE

### 2.1 Three-axis accelerometer

A micromachined capacitive accelerometer is used for the motion tracker. There are various types of accelerometers with piezoresistive, capacitive, tunneling, resonant, and thermal properties. Among them, the capacitive type has high sensitivity, good DC response and noise performance, low drift, low temperature sensitivity, lower power dissipation, and simple structure. Shown in Fig. 1 and 2, the ADXL330 [10] is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs, all on a single monolithic IC.

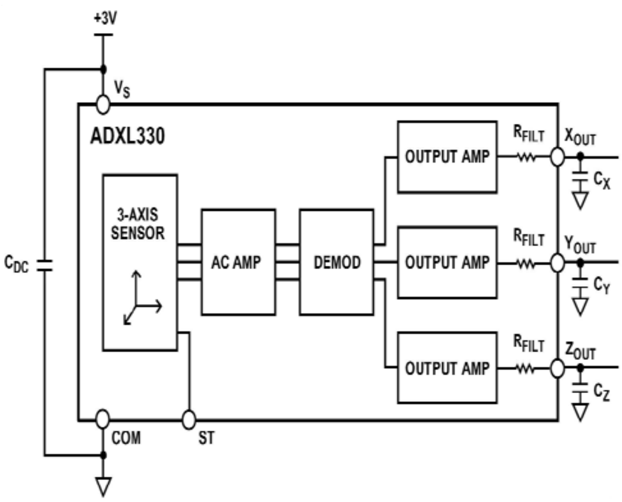


**Fig. 1.** ADXL330 functional block diagram

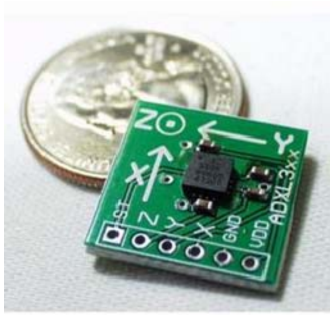

**Fig. 2.** ADXL330

The product measures acceleration with a minimum full-scale range of ±3 g (g=9.8m/m$^2$). It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the $C_X$, $C_Y$ and $C_Z$ capacitors at the $X_{OUT}$, $Y_{OUT}$, and $Z_{OUT}$ pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

### 2.2 Programmable system-on-Chip (PSoC)

The PSoC family consists of many Programmable System-on-Chip Controller devices. These devices are designed to replace multiple traditional MCU-based system components with one, low cost single-chip programmable device. PSoC devices include configurable blocks of analog and digital logic, as well as programmable interconnects. This architecture allows the user to create customized peripheral configurations that match the requirements of each individual application. Additionally, a fast CPU, Flash program memory, SRAM data memory, and configurable I/O are included in a range of convenient pinouts and packages.

Shown in Fig. 3 and 4, the PSoC architecture, as illustrated on the left, is comprised of four main areas: PSoC Core, Digital System, Analog System, and System Resources. Configurable global busing allows all the device resources to be combined into a complete custom system. The PSoC CY8C29x66 family can have up to five I/O ports that connect to the global digital and analog interconnects, providing access to 8 digital blocks and 12 analog blocks [11].

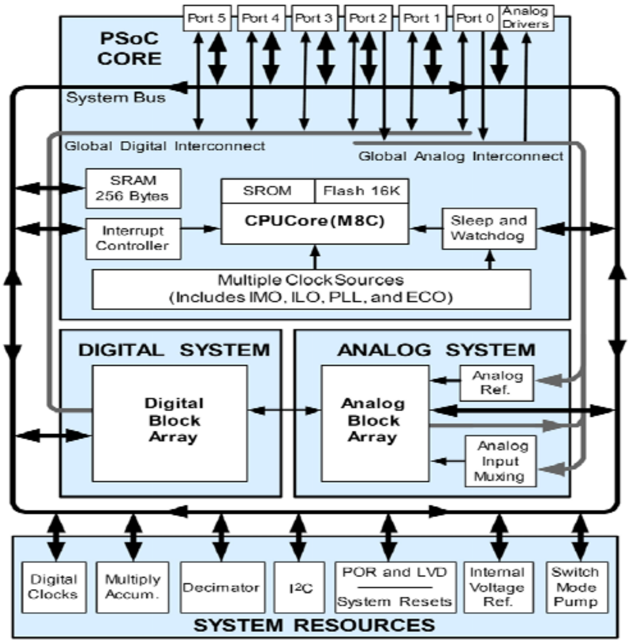


**Fig. 3.** CY8C29466 functional logic block diagram

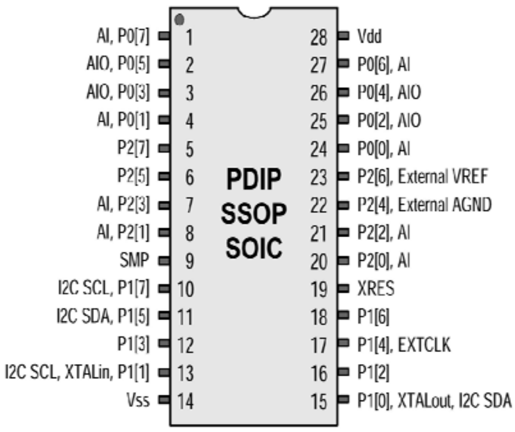


**Fig. 4.** CY8C29466 connection diagram

## 3 THE DESIGN STEPS

Fig. 5 is the flow chart diagram of design. From the beginning, we found the related literature reviews and confirmed basic model and material as we need. Secondly, we use PSoC to edit the program to control output element by ADXL330. And then, wiring these elements at solderless breadboard to pre-test. After several trial and errors, we can find the angle sensitivity as we need. Third, we check each function of the combination of pre-test solderless breadboard. Finally, we finish and validity a 3-axis accelerometer and PSoC-based driving anti-sleep safety warning system by the assembly of ADXL330, useful output elements, and power.

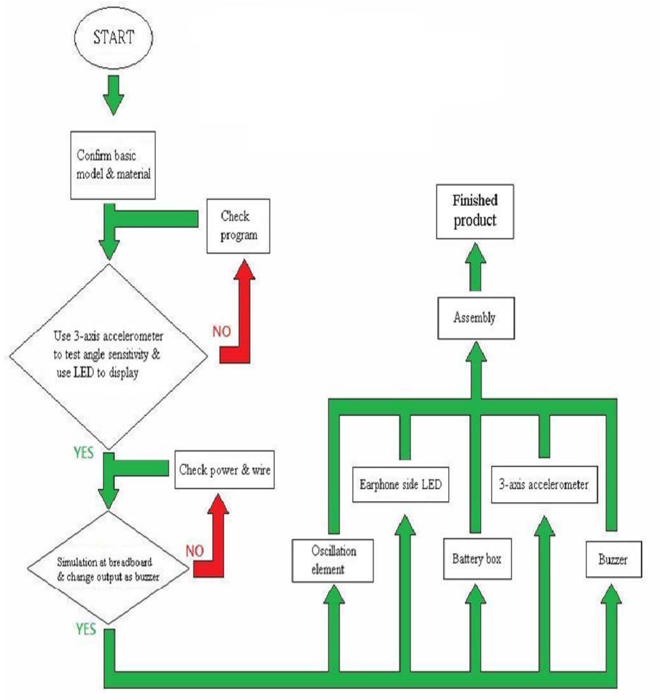


**Fig. 5.** The flow chart diagram of design

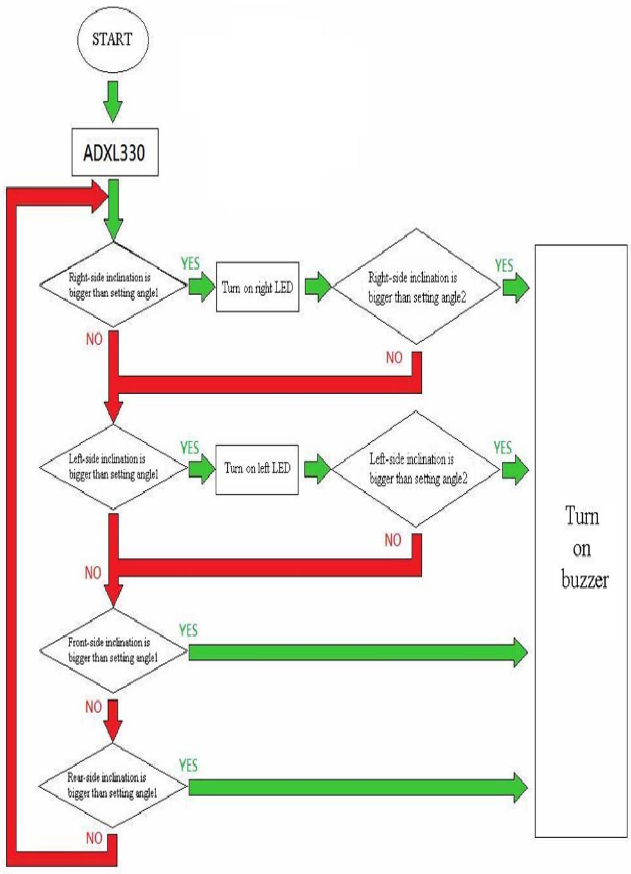


**Fig. 6** The flow chart diagram of PSoC system programing

## 4 PSoC SYSTEM PROGRAMING

In PSoC System program, we declare a variable of ADXL330 inclination angle of human head as a virtual switch in Fig. 6. When the angle is bigger than setting angle 1, it will trigger and turn on the LED. When the angle is bigger than setting angle 2, it will trigger and turn on the buzzer to alarm the driver. Whatever the direction of left, right, front, and rear, they all have the same function. Angle 2 is bigger than angle 1, consequently.

## 5 HARDWARE F ABRICATION AND CONCLUSION

Shown in Fig.7, we place the ADXL330 at control module region due to sense balancing angle. The power circuit includes 5V circuit and 3.3 V circuit. Using 9V battery box, then converts 5Vpart by IC7805, and 3.3V part by IC LM1804 [12]. Because the voltage supply of ADXL330 and CY8C29466 is different, so it needs two voltage sources. And then, we write the program into CY8C29466 by PSoC Designer 5.0 Service. It cooperates with ADXL330 to control LED and buzzer. We wear the finished product to test four-side inclination angles. Various function testing has been completed to verify the accuracy of the hardware design.

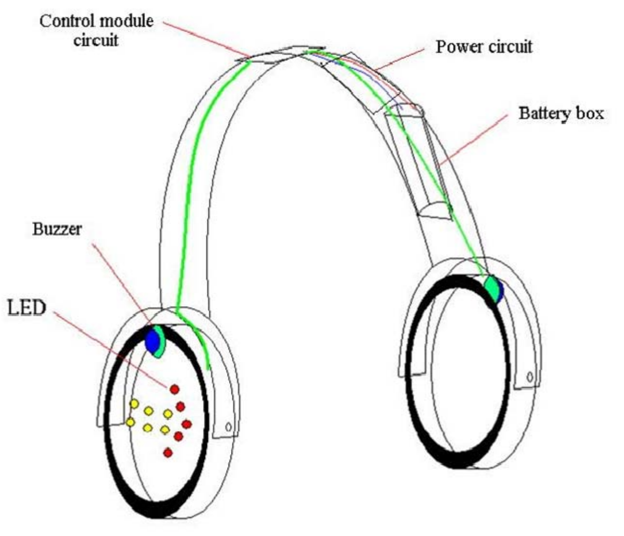


**Fig. 7** The hardwere schematincs

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