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Automotive Safety System Using ARM Microcontroller

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***Abstract*—This paper presents a system which can improve the safety of a vehicle and reduce the risk of accident .Automobile industry and automobile market is in a high speed development state for several years. However, as the sharp rise of the automobile quantity, the chance of accidents is also increasing. Consistently the existences of roughly 1.3 million individuals are cut short because of a road traffic crash. Somewhere in the range of 20 and 50 million additional individuals experience non-fatal injuries, with many causing a disability because of their physical issue. Road traffic injuries make high economic losses for people. So, here we design a system that can alert the emergency services over SMS as soon as an accident is detected. This can be achieved by interfacing certain sensors and peripherals with the microcontroller/processor. In this project we are using a microcontroller which is having ARM Cortex M4 as its core.**

This project deals with two aspects one is the hardware and the other is software. Basically, the hardware aspect is about the type of sensors used, over-view of our target board. Where as the software aspect is all about the IDE (Integrated Development Environment) that is required to program our target board.

***Index Terms*—ARM, GSM, Sensors, SMS, Ultrasonic sensor, Alcohol sensor**

I. INTRODUCTION

The basic need is to provide safety to the car. This can be accomplished with the help of a IR sensor / Ultra-sonic sensor which plays an important role in obstacle detection. Further, we require an MQ-3 sensor for the purpose of alcohol detection. The main concept in this design is introducing the mobile communications into the embedded system. This will be accomplished with the help of Global System for Mobile Communication (GSM).

In this project we are going to use an ARM based microcontroller which improve the overall performance of the system. Usually, we require a GPS module for location tracking, but in our project we are going to use SIM800 series that support GSM location operation

II. HARDWARE ASPECT

A. NUCLEO F401RE

In this project we are going to use a microcontroller manufactured by STMicroelectronics NUCLEO F401RE

The STM32 NUCLEO-F401RE provide an affordable and flexible way for users to try out new concepts and build prototypes with the STM32 microcontrollers in LQFP64 package, choosing from the various combinations of performance, power consumption and features. The Arduino™ Uno V3 connectivity support and the ST morpho headers allow to expand easily the functionality of the Nucleo open development platform with a wide choice of specialized shields The STM32 Nucleo boards do not require any separate probe as they integrate the ST LINK/V2-1 debugger and programmer. The STM32 Nucleo boards come with the STM32 comprehensive software HAL library together with various packaged software examples, as well as direct access to the Arm® Mbed™

Features of NULEO F401RE

- ARM® 32-bit Cortex®-M4 CPU with FPU
- 84 MHz max CPU frequency
- 512 KB Flash
- 96 KB SRAM
- GPIO with external interrupt capability
- 12-bit ADC with 16 channels
- General Purpose Timers (7)
- Watchdog Timers (2)
- USART/UART (3) Communication protocols
- I2C (3)
- SPI (4)

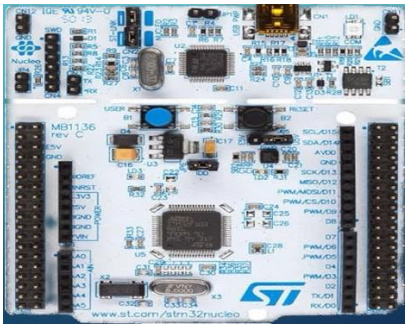

Fig. 1. NUCLEOF401RE

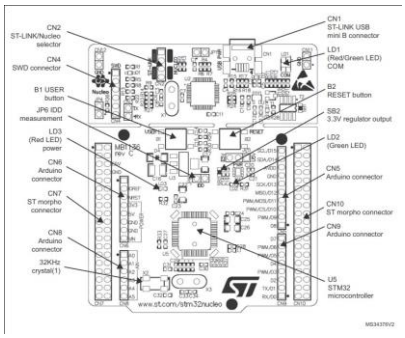

Fig. 2. TOP LAYOUT

Fig. 3. ULTRASONIC

B. ULTRASONIC SENSOR

This sensor provides better accuracy than IR sensor.VCC supplies power to the HC-SR04 ultrasonic sensor.Trigger pin is used to trigger ultrasonic sound pulses. By setting this pin to HIGH for 10µs, the sensor initiates an ultrasonic burst.Echo pin goes high when the ultrasonic burst is transmitted and remains high until the sensor receives an echo, after which it goes low. By measuring the time the Echo pin stays high, the distance can be calculated. GND is the ground pin.

Fig. 4. ALCOHOL SENSOR

C. Alcohol sensor(MQ-3

This sensor composed by microAL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-3 have 6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current. Electric parameter measurement circuit. In MQ-3 sensor the sensing is based on the change in resistance of the sensing material when exposed to alcohol GND is the ground pin. Vcc supplies power to the module. D0 indicates the presence of alcohol. D0 becomes LOW when the alcohol concentration exceeds the threshold value (as set by the potentiometer), and HIGH otherwise. A0 produces analog output voltage proportional to alcohol concentration

Fig. 5. VIBRATION SENSOR

D. Xluma piezoelectric vibration sensor

Vcc: 5 v Output signal LED indication, TTL level output Analog signal output, according to the vibration intensity of the output voltage is higher Vibration amplitude sensitivity can be adjusted by potentiometer. (low left sensitivity, high right sensitivity). GND: 0 v

Fig. 6. GSM MODULE

E. GSM Module(SIM900C

The SIM900 is an excellent choice for providing 2G cellular functionality. It's small size, low-cost, and ability to communicate via a simple UART interface using AT commands makes it an excellent choice for many applications. This module can be turned on by using a power adapter (12V,1A). The TX of the module is connected to RX of the controller and RX of module is connected to TX of the controller.

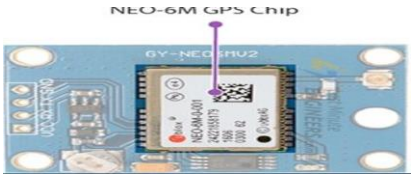

Fig. 7. GPS MODULE

F. GPS Module (NEO- 6M)

The heart of the module is a GPS chip from U-blox – NEO-6M. It contains the pins needed for communication with the microcontroller over the UART. The module supports baud rates from 4800bps to 230400bps with a default baud of 9600

Microcontroller	On Board	Label
PA8	D7 (input)	echo
PA13	RST (output)	trigger
PA5	D13 (output)	engine
PC13	User Button (input)	key
PB5	D4 (input)	alcohol
PA12	CN10-PIN12(output)	buzzer
PA10	D2	USART1-RX
PA9	D8	USART1-TX
PC6	CN10-PIN2(UART)	UART6-TX
PC7	D9(UART)	UART6-RX

Fig. 8. ASSIGNED PINS

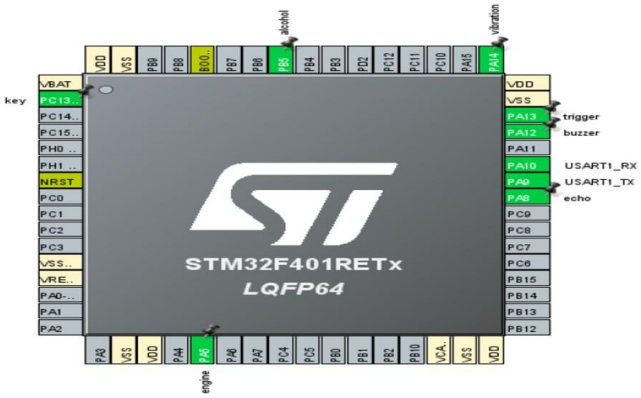

Fig. 9. PINOUT

III. SOFTWARE ASPECT

The ST Microelectronics allows us to program their microcontrollers by various IDE's. However, the official one is CUBE MX and CUBE IDE.In CUBE MX we can configure the MCU. We can select the required pins for desired output. We can also select the type of communication protocol needed for the purpose and we can configure the clock of the controller.CUBE IDE is the place where we can add our code and debug it. For this CUBE IDE uses HAL Library

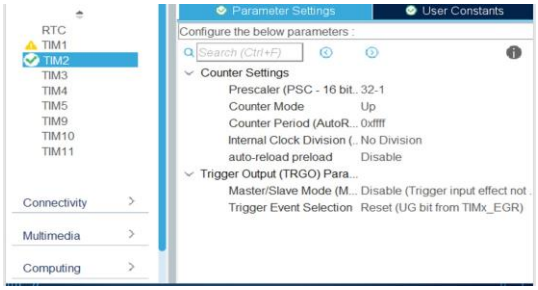

Fig. 10. TIMER CONFIGURATION

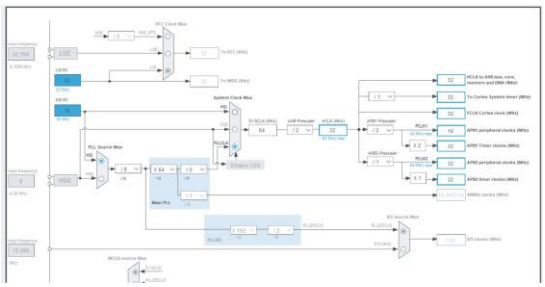

Fig. 11. CLOCK CONFIGURATION

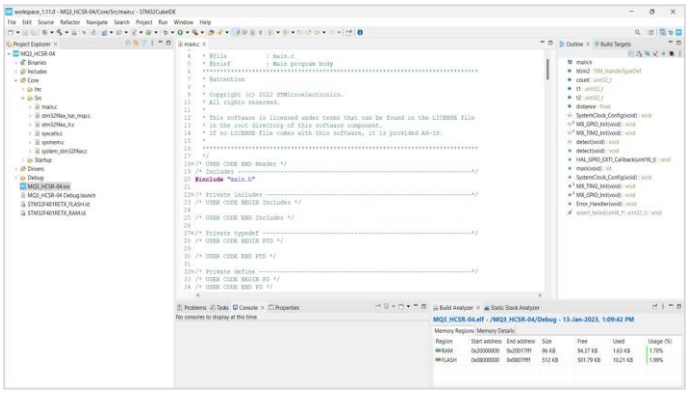

Fig. 12. IDE PLATFORM

IV. CONCLUSION

In this paper we proposed a system which can reduce the risk of accidents by interfacing several sensors like ultra-sonic,alcohol and vibration sensor.here we also implemented GSM GPS modules to detect acurate location of the user in emergency situations.hence we conclude that this system can reduces the risk of accidents.

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