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Research Paper



Security system of an electric motorcycle based on Gsm & Zigbee communication

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Abstract

The time has come that people need to think about saving fuel seriously because burning too much of fuel can cause a large number of environmental pollutions. The concept of making the battery operated electric vehicle comes as a rescue. In one hand it helps to save fuels and on the other it helps in lowering the level of air pollution; which helps in improving the health condition of the populace. Even though several automobile manufacturers have introduced Hybrid Vehicles (hybrid vehicles generally utilize a traditional combustion engine and a fuel tank, as well as one or more electric motors and a battery pack).This paper is going to propose an electric motorcycle security system based on ARM microcontroller, 8051 microcontroller, ZigBee and GSM communication which can be utilized both in Hybrid motorcycles and Electric motorcycles. When the proposed security features will be merged with those vehicles it will be an evolutionary concept in the world of next generation two-wheeler industry because besides lowering the level of air pollution and helping in controlling the use of fuel it mainly helps people to drive motorcycles safely.

Keywords: *ARM7 LPC2148 Microcontroller, 8051microcontroller, ZigBee module, GSM module, Ultrasonic and Proximity sensor, IR Eyeblink sensor, Alcohol sensor, Limit switch, Vibration sensor, Battery pack, DC motor etc.*

1. Introduction

India is witnessing a drastically growth in the field of automobile industry from the last few decennaries. Various researches made the automobile industries capable to invent hybrid vehicles successfully and many different companies are still working to increase its reliability, making it more user friendly and secured. The over growing amount of vehicles is causing a lot of problems like deficit of fuel, air pollution, fatal crashes etc. As a way out several companies are inventing such motorcycles which will use lower amount of fuel like hybrid vehicles and electric vehicles. The usage of fuel and the level of pollution can be decreased by using these type of vehicle but there is not sufficient alternative ways to decrease possibilities of accidents. Some security features are already introduced in the market with modern vehicles such as combined braking system (CBS), Electronic stability control, Anti-lock braking system (ABS), Intelligent speed assist (ISA), Blind Spot warning system and GPS. Identifying the vehicle's position is becoming easy by posing a bigger concern in the development of satellite communication technology. This project is going to make a compact programmed hardware module as a security feature in an electric motorcycle which will include ARM7 LPC2148 microcontroller, 8051 microcontroller, ZigBee, GSM and some sensors. If the rider loses control this will help the vehicle to take some immediate decision automatically in order to avoid an accident. Besides this, if any object comes in front of the vehicle (within 100 centimeters), the motorcycle automatically will decelerate the speed of the vehicle using Ultrasonic sensor and moves towards it to avoid collision. And also the theft detection facility helps the owner of the motorcycle to lock the engine GSM module, if the vehicle gets stolen. Now a days riding in drunk condition during riding have become the most important and usual cause of accidents. We are employing Alcohol sensor will lock the engine if anyone starts the motorcycle after consuming alcohol by detecting the vapor of alcohol. Even though any accident happens then an auto generated SMS which includes the location of the motorcycle will be sent to the family of the rider and to the accidental rescue team with the help of GSM module. Though some technologies are already introduced in market but all the features are not yet assembled together to make a smart electric motorcycle in a cost effective aspect.

In this paper section (II) is describing the methodology of the proposed system, section (III) is describing the block diagram of the proposed microcontrollers' connectivity layout, and section (IV) is describing the used softwares to assemble the hardware components, section (V) is describing detailed specifications of implemented hardwares, section (VI) contains conclusions and future works and section (VII) references.

2. Methodology

Two microcontrollers (ARM7 development board LPC2148 & 8051 microcontroller) are going to be used in this proposed system; one of which will be attached with the helmet and another will be with the motorcycle. The microcontroller (8051), attached with the helmet, will have ZigBee module, Infrared Eye-blink sensor and Alcohol sensor with it. And the microcontroller (LPC2148), attached with the motorcycle, will have ZigBee

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module, GSM module, Ultrasonic sensor, Proximity sensor, Vibration sensor, Temperature sensor, LDR sensor, 12Volt DC motor (150 rpm), DC motor driver, etc. with it. Both the microcontrollers (One attached with the helmet and another with the motorcycle) will be connected through ZigBee with each other. The user/rider can ignite or stop the engine (Motor) ignition by using an SMS consist of a password. This procedure can be categorized as an anti-theft facility which will make the motorcycle more secured so that no one can steal it.

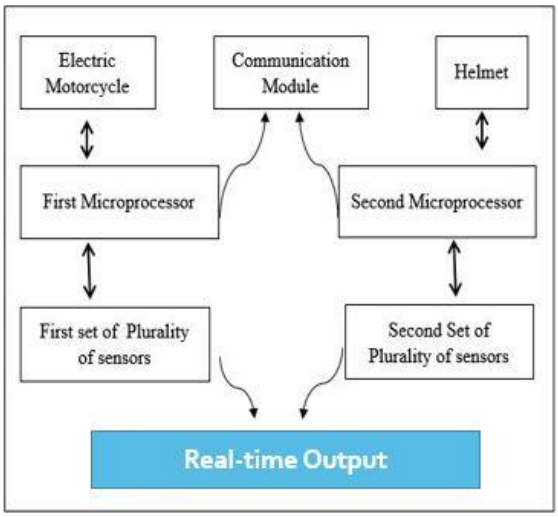


Fig. 1: Helmet and Motorcycle connectivity procedure

This proposed system will have also a limit switch which is placed in the top position inside the helmet. This limit switch is used for limiting the ignition of the engine which makes the user to wear the helmet. When the rider will wear the helmet the circuit will be closed and power will be transmitted to the microcontroller and when the rider will not wear the helmet the circuit will be opened and the power will not be transmitted to the microcontroller. If the circuit stays opened then the microcontroller placed in the helmet will not be able to connect via ZigBee with the microcontroller placed in the motorcycle to accept the ignition start password. If the rider puts off his helmet after igniting the bike will automatically get stopped. This procedure will motivate the rider to put on the helmet always during riding. Then the IR eyeball sensor will start its work that is monitoring the eyeballs of the rider continuously. If the rider falls asleep while riding the motorcycle or if the eyes of the rider suddenly get closed in any reason even then the sensor will decelerate the speed of the motorcycle and stop it. Ultrasonic sensor & Proximity sensor will continuously measure the distance and if the motorcycle goes out of control due to sudden arise of any object in front of the motorcycle and if the user stops his activity the sensor will decelerate and stop the engine to prevent the motorcycle to collide with the object in front of it. In any case if user collide with the object vibration sensor will sense the collision and send an auto generated SMS to the rescue center and family of the rider. Temperature sensor will measure the engine motor generated heat. If the motor gets hot and crosses limit, then it will inform the rider to put the engine off for cooling it. Sometimes at night the eyes of the riders get dazzled if the users of the vehicles' coming from the opposite side forget to adjust the light (upper/deeper) properly even the rider of a motorcycle can make the same mistake too and that can cause a fatal crash. LDR sensor controls its headlight focus system to make the upper/deeper automatically during riding at night. GSM module helps the system to operate the SMS facility properly. DC motor driver helps to control the DC motor. Alcohol sensor positioned in the helmet locks the engine if rider rides the vehicle after consuming alcohol by detecting the vapor of alcohol.

3. Proposed Microcontroller Connectivity Block Diagram

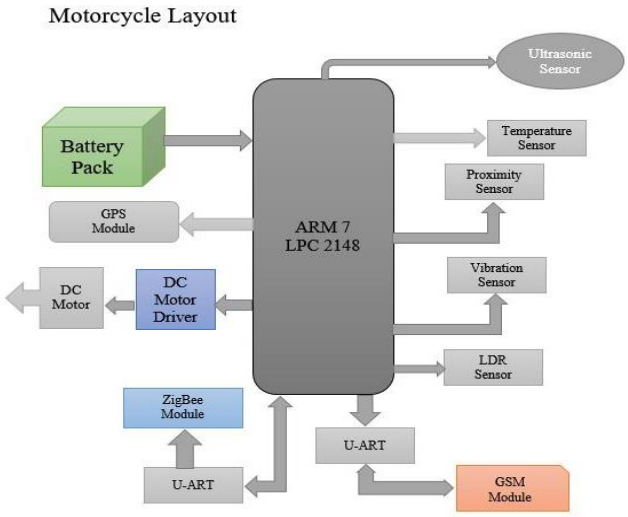


Fig. 2: Microcontroller positioned in the motorcycle

'Figure 2' contains an ARM 7 LPC2148 microcontroller board which is connected with some sensors(Temperature, Ultrasonic, Proximity, LDR, Vibration), DC motor driver, 12V DC motor, 12V 1.2Ah battery pack as an input power to the engine as well as to the microcontroller. There are also two U-ARTs one is for GSM module, and another is for ZigBee module.

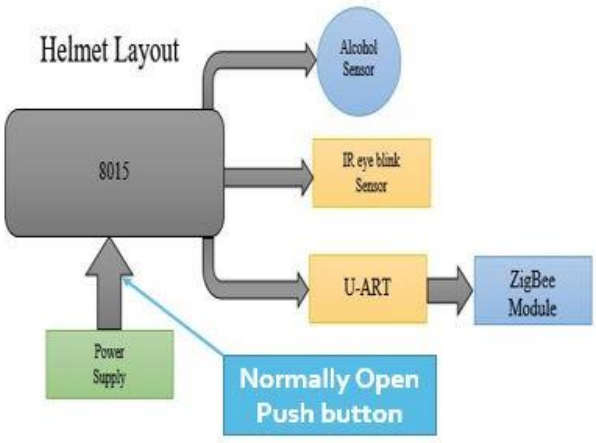


Fig. 3: Microcontroller positioned into the helmet

'Figure 3' contains 8051 microcontroller which is connected with Alcohol sensor, IR Eye blink sensor, and a limit switch and 9V DC battery as a power supply to the microcontroller. U-ART is using to connect with ZigBee module

4. Software Used

KEIL Programmer, Philips Flashing Utility, H-JTAG Debugging tool. ISIS Proteus 7 Professional

5. Hardware Implementation

In this system is going to include two microcontrollers-8051 (Connected to the helmet) and ARM7 LPC2148 (Connected with the motorcycle). This ARM7 microcontroller will include Ultrasonic Sensor (HC SR04) (Utilizes sonar to figure out the amplitude of an object), Proximity Sensor (LJ12A3-4-Z/BY) (includes an electromagnetic existence of an object whether it is a metal or not), Vibration Sensor (SW-18015P) (Hosts a piezo

element and is used for flex, touch, vibration and shock measurement), Temperature Sensor (DHT11), LDR Sensor (LM393) (It is a photoconductive cell and nothing but an optical phenomenon whose activity depends on the intensity of the light falls on it), 4*4 Matrix Keypad (REES52-621033926893) (For interfacing the 4x4 matrix key pad needs eight input/output ports. The Rows of the keypad are attached with the peripheral input/output (PIO) pins which are configured as output. The column of the same Matrix key pad are attached with PIO pins configured as input with interrupts. In order to increase the level of the corresponding input pins four pull up resistors must be added in this configuration.), GSM Module (SIM800A), ZigBee module (HC05-RS2320), 12Volt DC Geared Motor (150rpm), DC Motor Driver (L293D), Battery Pack (12Volt 1Ah) and the 8051 microcontroller will include ZigBee module (HC05-RS2320), Battery Pack (5Volt), Normally Open Push Button (PBS26C), IR Eye Blink Sensor (Works by highlighting the eye and eyelid zone with the help of infrared-ray), Alcohol Sensor (MQ-303A) (The presence of alcohol gasses at the concentrations from 0.05mg/L to 10mg/L can be detected by

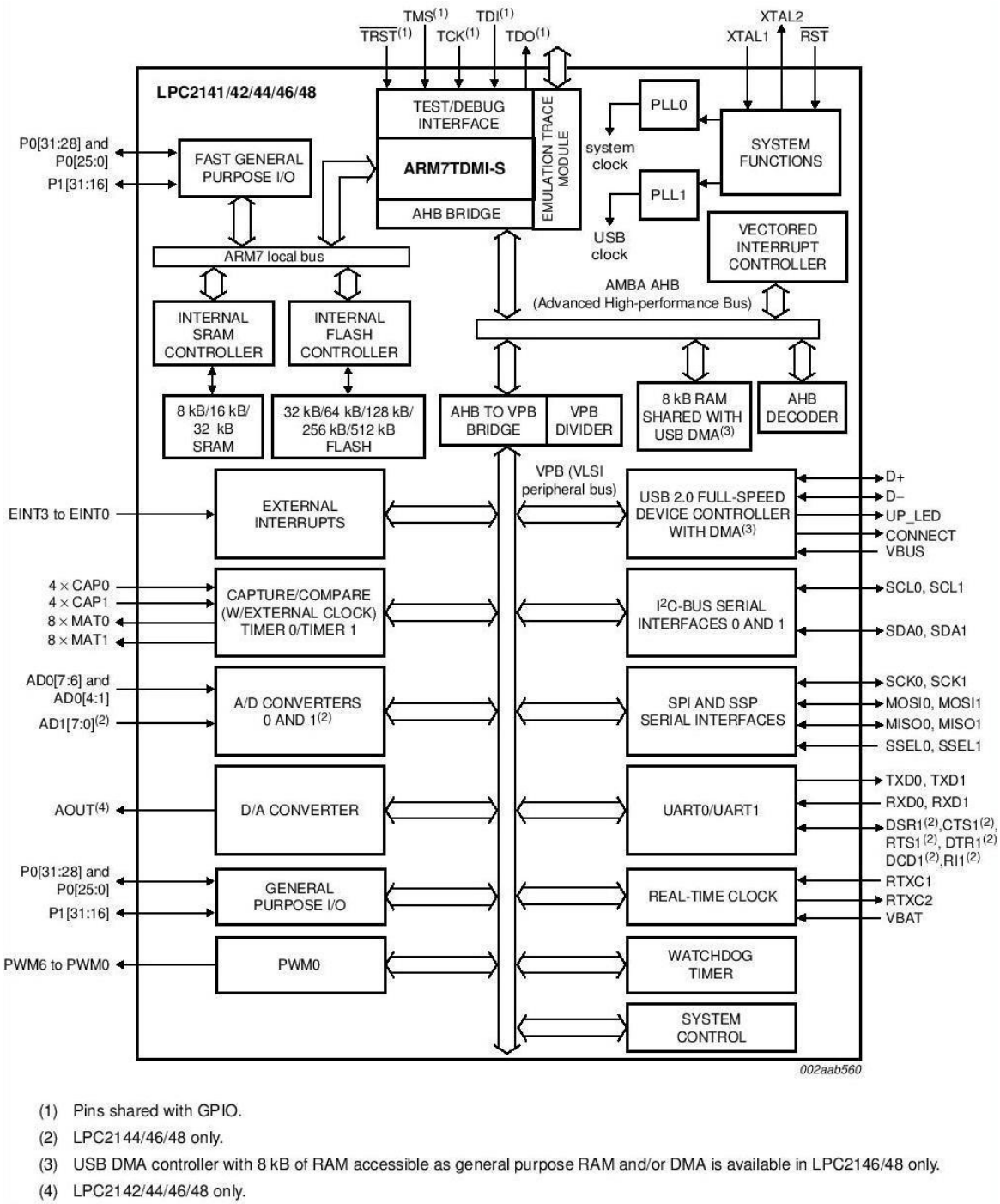


Fig. 4: LPC2148 Internal connection layout

Alcohol sensor. SnO2 is used for this as a sensitive material. In normal air the conductivity becomes very low. The level of conductivity increases with the rise of the concentration of alcohol gas. It is highly sensitive to alcohol vapor and can detect the vapor very quickly. It has a very high resistive power that can easily differentiate the vapor of alcohol from smoke and the vapor of gasoline). Many other components are used here like Regulator (7805 & 7812), LED Lights (Green & Red), 1K Resistor, Power Adapter (12V 1Amp), Ribbon Cable, Motorcycle Chassis and Wheels, Helmet, etc.

6. Conclusion

As a vehicle motorcycle taken the first place to be the most user friendly, widely chosen and easily affordable vehicle in the world. The electric motorcycles have improved the qualitativecharacteristics of the transport system by providing an extra ordinary creative mode and solving may problems (for example the increasing level of air pollution and the decreasing level of natural fuel) very efficiently. Besides this the security system of the electric motorcycle in this project will help the rider to ride the motorcycle more confidently and fearlessly because it is offering a lot of security features which will boost up the rider's self-confidence. Even though the rider faces any accident his present location will be automatically delivered to his family and to the accidental rescue team. In this security system all the hardware elements will be placed together and will also collect the result onwards. After that different results are analyzed to improve the overall credibility of the stated security system the security features makes the motorcycle to be able to avoid any kind of collision. The SMS facility helps the rider to ignite and off the ignition of the motorcycle. So it is prominently evident that the provided security features makes the invention of the electric motorcycle an exception evolution

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