Report

Title: Smart Helmet with Collision Detection and Alert System

MICROCONTROLLER AND APPLICATIONS LABORATORY (ECE 322)

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BY

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Abstract

Road accidents involving two-wheelers often result in severe injuries or fatalities due to delayed medical response. To address this issue, we propose a Helmet with Collision Detection and Alert System, which automatically detects accidents and alerts emergency contacts. The system utilizes an 8051 microcontroller, a vibration sensor, a GSM module, an LCD display, and a buzzer to provide real-time accident detection and notification. Upon detecting a collision, the system triggers an alert mechanism that sends SMS notifications and makes phone calls to predefined emergency contacts, ensuring timely medical assistance.

The helmet-based system is designed to be cost-effective, easy to implement, and reliable, making it a practical solution for enhancing road safety. The Proteus simulation of the system demonstrates its functionality, with a switch or signal generator used to simulate vibration detection. The project can be further improved by integrating GPS for location tracking, IoT for cloud-based monitoring, AI for impact severity detection, and alcohol sensors to prevent drunk driving. This smart safety helmet has the potential to become a standard protective gear for riders, significantly reducing accident-related fatalities and improving emergency response time.

Introduction

Road accidents involving two-wheelers are a major safety concern, often resulting in severe injuries or fatalities due to delayed medical response. To address this issue, we propose a Helmet with Collision Detection and Alert System, which automatically detects accidents and alerts emergency contacts. This system integrates a vibration sensor, an 8051 microcontroller, an LCD display, a buzzer, and a GSM module to provide a real-time accident alert mechanism. By sending SMS and call notifications, the system ensures rapid response, potentially saving lives.

Problem Statement

Two-wheeler riders are at a high risk of accidents, and delayed medical assistance increases the chances of severe injuries. Traditional accident response relies on bystanders to report incidents, which may lead to delays or even cases where no one reports the accident. A smart helmet-based accident detection system can eliminate such delays by automatically detecting collisions and sending alerts.

Objectives

- To develop a smart helmet system capable of detecting collisions using a vibration sensor.
- To automate accident alerting via SMS and call notifications using a GSM module.
- To provide visual and audio feedback through an LCD display and buzzer.
- To ensure a cost-effective and easy-to-implement solution.

System Components

1. **8051 Microcontroller:** The processing unit responsible for handling sensor input and controlling the GSM module.
2. **Vibration Sensor:** Detects impact or collision, triggering the accident alert system.
3. **GSM Module:** Sends SMS and makes calls to predefined emergency contacts upon accident detection.
4. **LCD Display (16x2):** Provides real-time feedback on system status and accident alerts.
5. **Buzzer (LED in simulation):** Provides an audible alert upon detecting a collision.
6. **Power Supply:** The system operates on a 5V DC supply for microcontroller.

System Design and Working

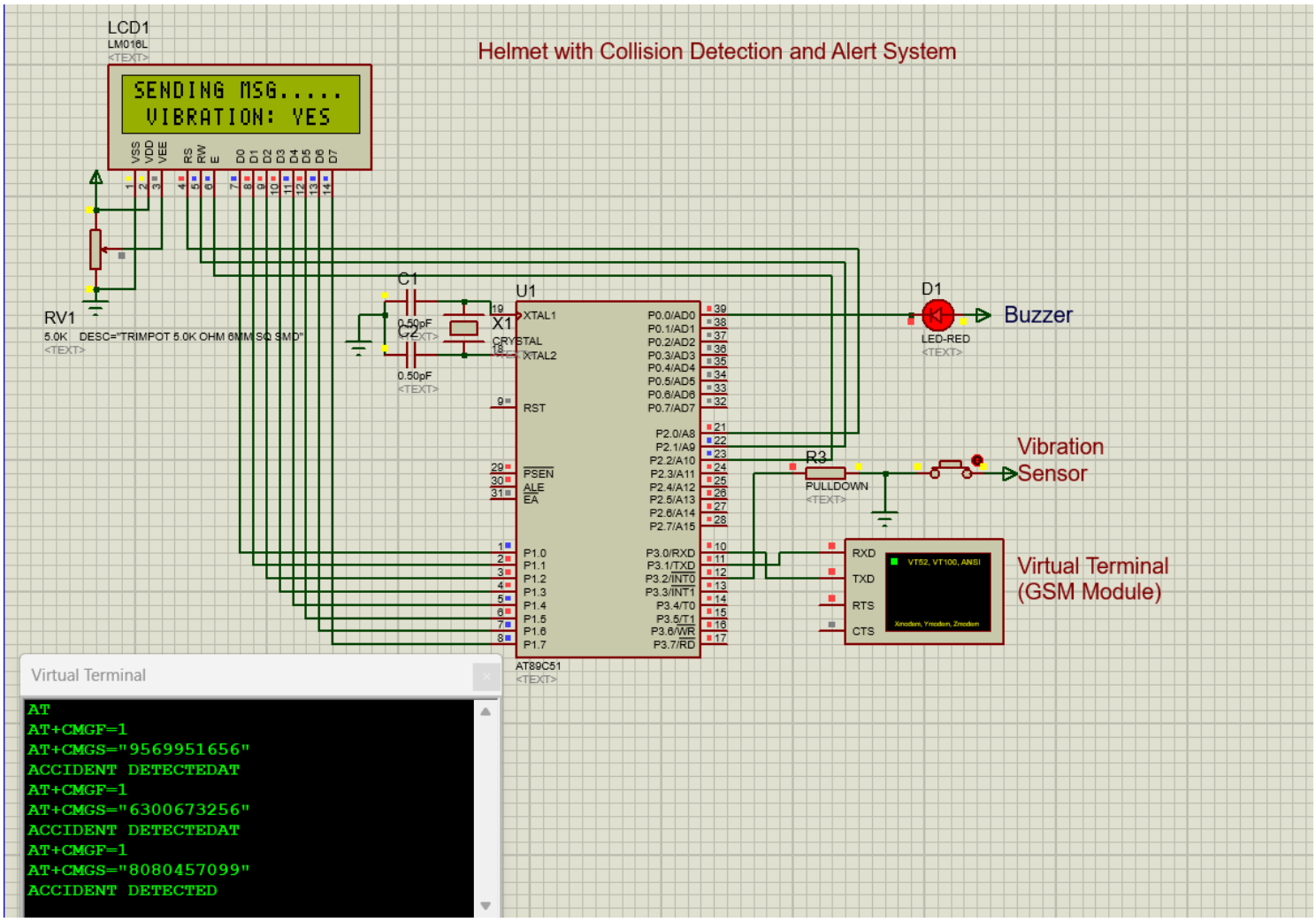
The system works by continuously monitoring the vibration sensor. Under normal conditions, the LCD displays **“Vibration: NO”** and the buzzer remains off. When the helmet experiences an impact, the vibration sensor detects the force and sends a signal to the 8051 microcontroller. The system then:

1. Activates the buzzer (LED in Proteus simulation) to indicate an accident.
2. Updates the LCD display to “Vibration: YES”.
3. Sends an SMS alert to three predefined emergency contacts using the GSM module.
4. Initiates automatic phone calls to the emergency contacts for immediate attention.

Circuit Diagram and Proteus Simulation

The Proteus simulation represents the real-world implementation, allowing testing and debugging before hardware deployment. Due to the unavailability of a vibration sensor in Proteus, a switch or signal generator is used as an alternative to simulate collision detection. The microcontroller processes the input, triggering alerts as expected. The circuit design includes:

- **P3.2 (INT0)** connected to the vibration sensor (switch in simulation).
- **P0.0** used to drive the buzzer (LED in simulation).
- **LCD module** connected to P1 for displaying messages.
- **GSM module** connected via serial communication (TXD, RXD).



C:\Keil_v5\C51\Examples\HELLO\wtp 8051.uvproj - µVision

File Edit View Project Flash Debug Peripherals Tools SVCS Window Help

Target 1

Project

Project: wtp 8051

Target 1

Source Group 1

wtp8051.c

```
#include<reg51.h>
#include"GSM.h"
#include"LCD.h"

#define NUMBER1 "9569951656"
#define NUMBER2 "6300673256"
#define NUMBER3 "8080457099"

sbit vib = P3^2;
sbit buzzer = P0^0;

void main()
{
  unsigned int r;
  init_serial();
  LCD_initialise();
  comwrt(0x80);
  display("INITIALISING....");
  for(r=0;r<60000;r++);
  comwrt(0x80);
  display("GSM ACCIDENT DET");
  comwrt(0xC0);
  display(" VIBRATION: NO  ");
  buzzer=1;
  while(1) {
    if(vib==1) {
      buzzer=0;
      comwrt(0x80);
      display("VIBRATION DETECT");
      comwrt(0xC0);
      display(" VIBRATION: YES ");
      for(r=0;r<30000;r++);
      for(r=0;r<30000;r++);
```

Build Output

```
linking...
Program Size: data=24.0 xdata=0 code=1439
".\Objects\wtp 8051" - 0 Error(s), 0 Warning(s).
Build Time Elapsed:  00:00:00
```

Simulation L:5 C:32 CAP NUM SCRL OVR R/W

Coding Steps and Explanation

The Helmet with Collision Detection and Alert System is implemented using an 8051 microcontroller, a vibration sensor (simulated using a switch in Proteus), an LCD display, a buzzer, and a GSM module for sending alerts. The main coding steps are as follows:

1. **Initialization:**
    - The serial communication is initialized to interface with the GSM module.
    - The LCD display is initialized to show system messages.
    - The buzzer is set to OFF initially.
2. **Vibration Sensor Input Handling:**
    - The vibration sensor is connected to **P3.2 (INT0)** of the microcontroller.
    - In the simulation, a switch or signal generator is used instead of a vibration sensor.
3. **Accident Detection Mechanism:**
    - The system continuously monitors the vibration sensor’s status.
    - When a vibration (collision) is detected, it triggers an accident response.
4. **Alert System Activation:**
    - The buzzer (LED in Proteus) is turned ON to indicate an accident.
    - The LCD updates to display "VIBRATION DETECTED."
    - The GSM module sends SMS alerts to three predefined emergency contacts.
    - The system makes automatic calls to emergency numbers.
5. **System Reset and Standby Mode:**
    - After completing the alert sequence, the system resets and waits for another vibration event.

This structured approach ensures real-time accident detection and automatic emergency response, making it an effective and life-saving safety system.

Unique Features of the System

This project stands out due to its:

- **Real-time accident detection** without requiring human intervention.
- **Dual alert mechanism** (SMS + Call) ensuring emergency contacts are informed.
- **Helmet-based safety integration**, reducing response time in accidents.
- **Cost-effective implementation** using an 8051 microcontroller instead of high-end processors.

Future Enhancements

The system can be improved with additional features such as:

- **GPS Integration:** To send accident location coordinates for faster medical assistance.
- **IoT Connectivity:** Real-time accident data storage on cloud servers for monitoring.
- **AI-Based Impact Severity Detection:** Differentiating between minor and severe collisions to prevent false alerts.
- **Alcohol Detection Sensor:** Preventing drunk driving by detecting alcohol levels before allowing ignition.
- **Fall Detection Mechanism:** Identifying falls even in non-collision scenarios to enhance safety.

Conclusion

The Helmet with Collision Detection and Alert System is a practical and effective solution for reducing accident fatalities. It ensures that emergency responders receive timely alerts, increasing the chances of saving lives. With further advancements, this smart safety helmet could become a standard protective gear for riders, significantly improving road safety.