B.Tech IoT Programming

Project Report

On

SMART HELMET

by

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Abstract

Every year, thousands of lives are lost in road accidents in which two wheelers accounted for the maximum number of deaths. According to investigation, lack of proper protection, drunken driving, rash driving and sleepiness due to long drive are the major causes of accidents. To tackle this, our aim is to design an IoT based Smart Helmet that not only promotes safe riding but also provides immediate assistance in case of an accident. Here, we are using various sensors to build the smart helmet. For example, to detect the consumption of alcohol by the rider we use Alcohol sensors, in order to check a rider's helmet, an infrared sensor is used. We use Vibration detector in the helmet to indicate harsh hitting of the helmet during an accident. When the two-wheelers slide down, the GSM module is activated to quickly send an emergency message, along with the rider's details, to police stations, emergency contacts, and nearby hospitals. The bike will not get started without wearing a helmet and the engine will not provide power. The project is expected to improve safety and reduce accidents hence also reducing the number of deaths due to accidents. Our project is completely efficient as well.

Important keywords- Internet of Things, Smart Helmet, Microcontroller(Arduino), GSM module, MQ3 Sensor, Infrared Sensor, Vibration Sensor.

1. Introduction

In India, we have seen that motorcycles and bikes (two-wheelers) are the most popular and affordable modes of transportation. Also most of the youth have a craze of motorcycle riding and as we know that two wheelers have relatively less safety than other modes, so we can't take any chance of neglecting the security measures. The increasing number of bike accidents in India demands the urgent need for an innovative solution.

As a report from the Indian Journal of Public Health says that nearly 25% of motorcyclists involved in accident were teenagers in Indian. According to the Ministry of Road Transport and Highways, two wheelers account for over 37% of total road accidents in 2021 and approx. 30% of all road fatalities. We have seen that; many lives are lost in accident due to lack of timely medical assistance, especially in the less crowed areas or during late hours when fewer people are outside. Often, after an accident, the injured person remains unnoticed for around 30 mins or more, with no one to call for help or to inform the family. Because of these delays, the ambulance is not able to reach on time and the victim may lose their life.

So, the primary motivation behind this project is to reduce the number of deaths by providing immediate assistance to the victim. Timely assistance during the accident can reduce the risk of permanent deaths and injuries. The solution that we are proposing is to create a smart accident helmet which will help in alerting emergency services in case of accident. Here, we are

using Alcohol sensor to detect alcohol consumption, Infrared sensor to check a rider's helmet, Vibration sensor to indicate harsh hitting during accident and GSM module to quickly send an emergency message, along with the rider's details to police stations and emergency contacts.

Unique Functionality of the project:

Ignition Lock: Our helmet is keyed to the motorcycle, so the motorcycle won't start unless the helmet is on.

GSM Module: The helmet has a GSM module where an alert SMS to the family of the rider and the police station is given.

Enhanced Safety and Response: This dual notification system ensures very swift and efficient help during emergencies, thus almost minimizing the scope of potential severe consequences after an accident.

2. Related Works in Project

There are many pre-existing projects like this. A lot of work has been done on this project and a lot of smart motorcycle helmet are already made having many features in them. Some of the most important features and key points are:

(a) **In Design & Implementation of IoT Based Smart Helmet for Road Accident Detection** et al [1], an IoT-based smart helmet is designed for road accident detection using various sensors. The Sharp IR sensor to detect if the rider is wearing helmet or not, and an MQ-3 gas sensor to identify alcohol consumption. If the rider is drunk, the system prevents the motorcycle from starting. Additionally, a vibration sensor (SW420) detects accidents, and GPS and GSM technologies send the accident location to the rider's emergency contacts and nearby hospitals.

(b) **The Smart Helmet using IoT for Alcohol Detection and Location Detection System** et al [2] presents a system that includes an alcohol detection sensor (MQ-3) and an infrared (IR) sensor. These sensors ensure the rider is wearing the helmet and has not consumed alcohol 5 before the ignition starts. If alcohol is detected or the helmet is not worn, the ignition is blocked. The system uses GPS to access location of the rider and send it to the contacts.

(c) **In SMART HELMET** et al [3], the helmet system ensures that the rider wears the helmet before starting

the bike using an IR sensor. An alcohol detection sensor checks if the rider is under the influence of alcohol. The system also uses an RF transmitter and receiver for communication between the helmet and the bike. Additionally, a temperature sensor monitors the engine to prevent overheating, while accident detection modules send location alerts in case of a crash. Signboard detection through RF modules provides early warnings to riders.

(d**) The project** et al [5]: In the Smart Helmet project, the helmet is equipped with various sensors, including an accelerometer, gyroscope. The system uses MPU6050 sensor to detect rider's heads movement and abnormal movements. If an accident is detected, it immediately sends an alert to emergency contact and nearby hospital.

Author	Link of published work	Year	Features	Model/Sensors used	Drawback in their project
Mohammad Ehsanul Alim, Marzieh Naghdi Dorabati, Sarosh Ahmad, Ihab Hassoun	link	2020	• IR sensor detects the helmet usage and MQ-3 sensor checks for alcohol. • Accident is detected by vibration sensor and alert is also send.	IR sensor, MQ-3 gas sensor, vibration sensor (SW420), GPS and GSM module	False detection, sensor inaccuracy, network dependency, high cost, power consumption, bulky design, durability issues, safety concerns
Gurpreet Singh Chhabra, Monika Verma, Khushi Gupta, Abhinandan Kondekar, Dr. Siddhartha Choubey, Dr. Abha Choubey	link	2022	•The sensors used block the ignition of vehicle if condition is unsafe. •GPS module sends the location of accident.	alcohol detection sensor (MQ-3), IR sensor, GPS module	False positives in alcohol detection, GPS limitations, dependency on network, power consumption, user discomfort, cost overhead, durability issues
Nataraja N, Mamatha K S, Dr. Keshavamurthy ,Dr. Shivashankar	link	2018	•Uses RF transmitter/receiver for bike communication. • Accident alert system with temperature monitoring and signboard detection by RF modules	IR sensor, temperature sensor, RF modules	False alarm potential, sensor inaccuracy, dependency on GPS/ network, limited battery life, cost of components, delayed alert transmission
Jesu, M Kabi, Kimaya	link	2022	GPS ,alcohol detection, accident alert, and mobile app integration for enhanced motorcycle safety	MQ3alcoholsensor, GPS module, ESP8266Wi-Fi, relay, vibration, IR sensors	Relies heavily on sensor accuracy, which may lead to false positives or undetected accidents
Dr. M. Kiran Kumar1, Aniruddha Balbudhe, CH Sai Karthikeya	link	2023	•Use accelerometer and gyroscope to detect head and abnormal movements. • Send the accident alert to emergency contacts and hospitals.	MPU6050 sensor	Sensor inaccuracy, network dependency, GPS limitations, battery drain, maintenance issues, cost overhead
Sr K Nee, Rashmi Gad.	link	2024	Alcohol detection, crash alerts, GPS reporting, and helmet usage confirmation.	Alcohol sensors, accelerometers for impact detection, and GPS for location tracking	Potential sensor failures, false alarms, and challenges in user adoption.

Drawbacks in these existing projects:

- Lacking In-built Features: The safety models do not respond in case of accidents immediately.
- Ignition integration: In most of the helmets, the motorcycle's ignition system does not integrate; that makes the rider start the motorcycle without wearing a helmet, which leaves the safety untouched.
- Limited Emergency Notifications: Existing solutions typically notify only family members in emergencies, which may delay support from the authorities.
- Sensor Dependency: The system's effectiveness is highly reliant on sensor accuracy, and sensor failures or false readings can lead to malfunction.
- Increased Cost: Use of multiple sensors and modules like GPS, GSM, and wireless communication can significantly increase the overall cost.
- Power Consumption: Continuous operation of sensors and modules might result in higher power usage, reducing battery life.
- Helmet Design Complexity: Integrating numerous components may lead to a bulky and less comfortable helmet, which could discourage user adoption.
- Maintenance Requirement: Regular maintenance may be required to ensure the reliability and proper functioning of the sensors and electronic components.
- Connectivity Issues: The system's performance might be affected by connectivity problems, especially in remote areas with weak network signals.

Our Helmet Solution:

Ignition Lock: Our helmet is keyed to the motorcycle, so the motorcycle won't start unless the helmet is on.
GSM Module: The helmet has a GSM Module where an alert SMS to the family of the rider and the police station is given.
Enhanced Safety and Response: This dual notification system ensures very swift and efficient help during emergencies, thereby almost minimizing the scope of potential severe consequences following an accident.

3. Project

We have made a smart helmet which is different from the normal helmet .It has some special features like helmet wearing ,alcohol detection and accident detection.This smart helmet reduces the number of accidents.

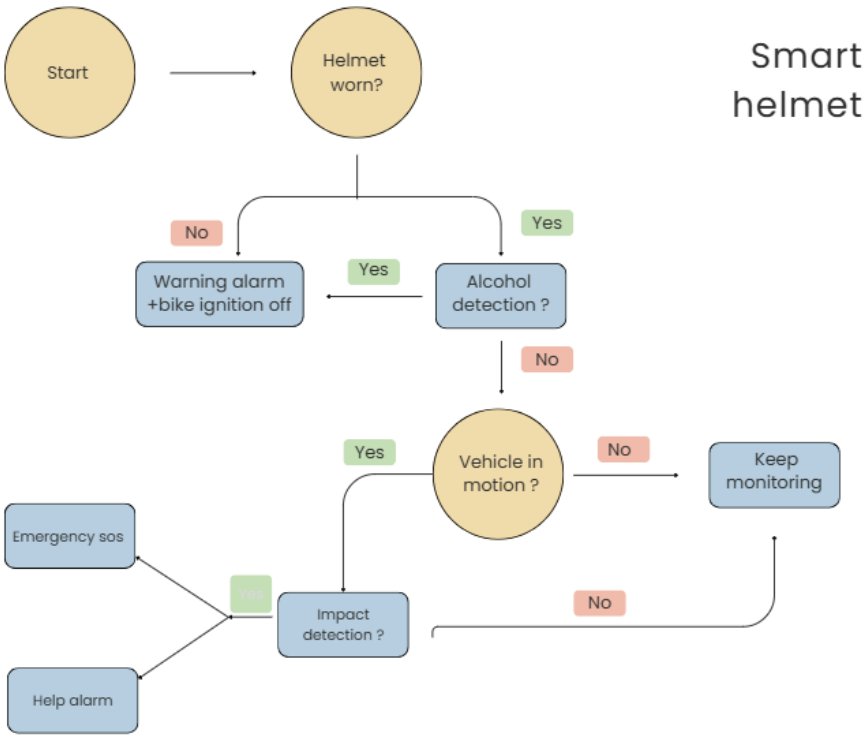
First we detect whether the rider is wearing the helmet ,so we use an INFRARED SENSOR to detect the presence of the helmet on the head. If the rider is not wearing the helmet , the bike will not start as power supply from the engine will be cut off. If the helmet is worn then we checked for the alcohol with the help of ALCOHOL SENSOR .We placed this sensor near the mouth of the rider to detect alcohol in their breath. If the sensor detects no alcohol in the rider's breath the signal will be given as positive , the bike will start, otherwise the arduino will detect and it will not start and will trigger an

alarm and also send message. We added to the helmet a VIBRATION SENSOR that monitors the safety of the rider. Assuming there could be an accident when it senses a very high vibration frequency, it will send out an emergency message to the saved contact numbers. An alert will also be sent to the police station. If no such high vibrations are detected, the helmet will just continue monitoring during the ride or until it is removed. With this, it makes the rider safe.

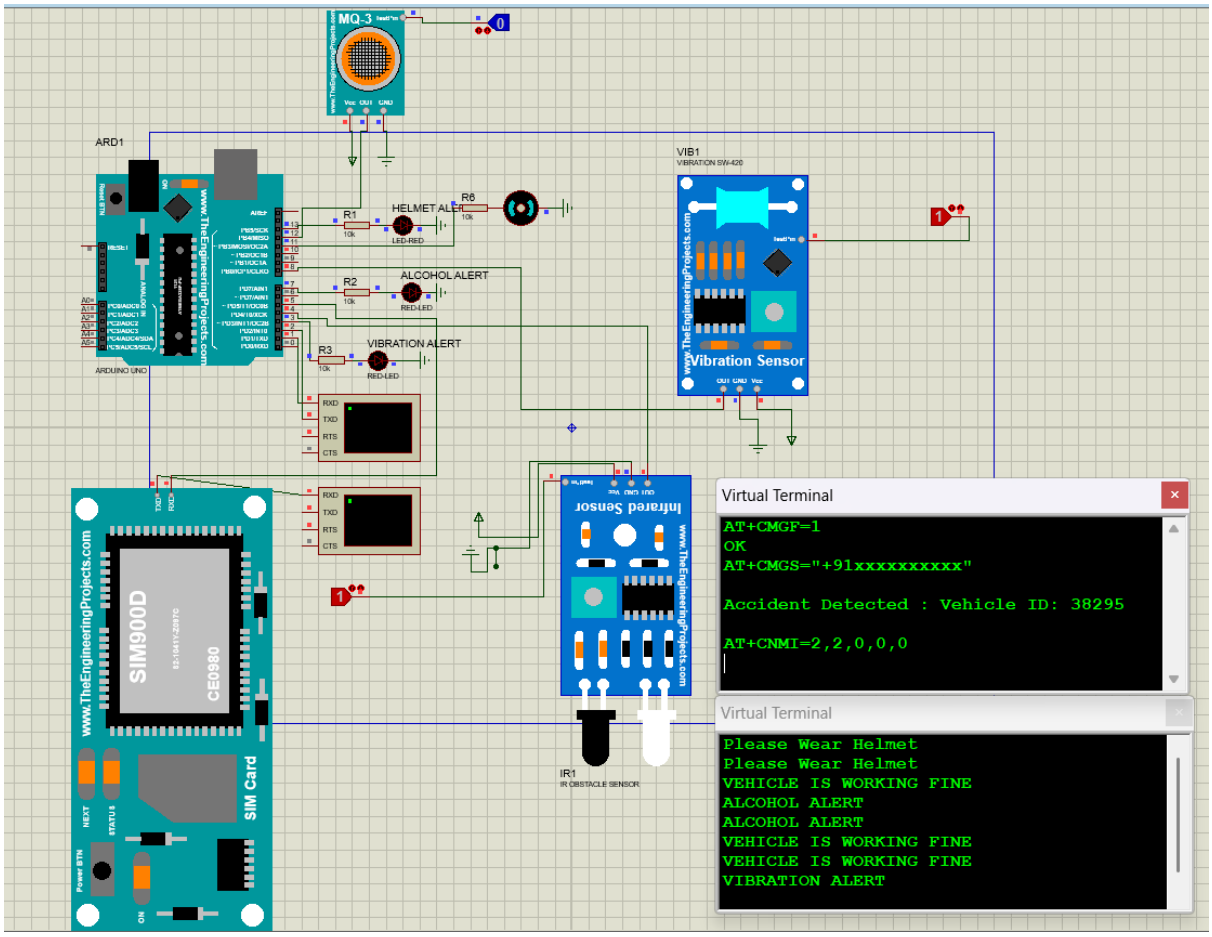
Technical Details

- Sensors Used:
  - o Vibration Sensor: It will detect the vibration and according to a threshold value it can tell that an accident occurred or not.
  - o MQ-3 Gas Sensor: It will detect whether the person has consumed alcohol or not before wearing the helmet.
  - o IR Sensor: It will make sure that the helmet is worn by the rider.
- Communication:
  - o GSM Module: It will send emergency alerts to pre-registered contacts via SMS and email.
- Microcontroller: A microcontroller (Arduino) is used which will act as the central unit, processing sensor data and managing communication protocols.

3.1. Conceptual Design Diagram



3.2. Working Example



4. Experimental Setup

4.1. Implementation details: Implementing a Smart Accident Avoiding Helmet involves integrating several technologies like sensors, communication modules, and microcontrollers so that rider's safety can be enhanced. The system aims to prevent accidents by detecting potential hazards, monitoring the rider's condition, and ensuring the helmet is worn properly. Below are the details of every sensor, model, library used in the project and their functional descriptions.

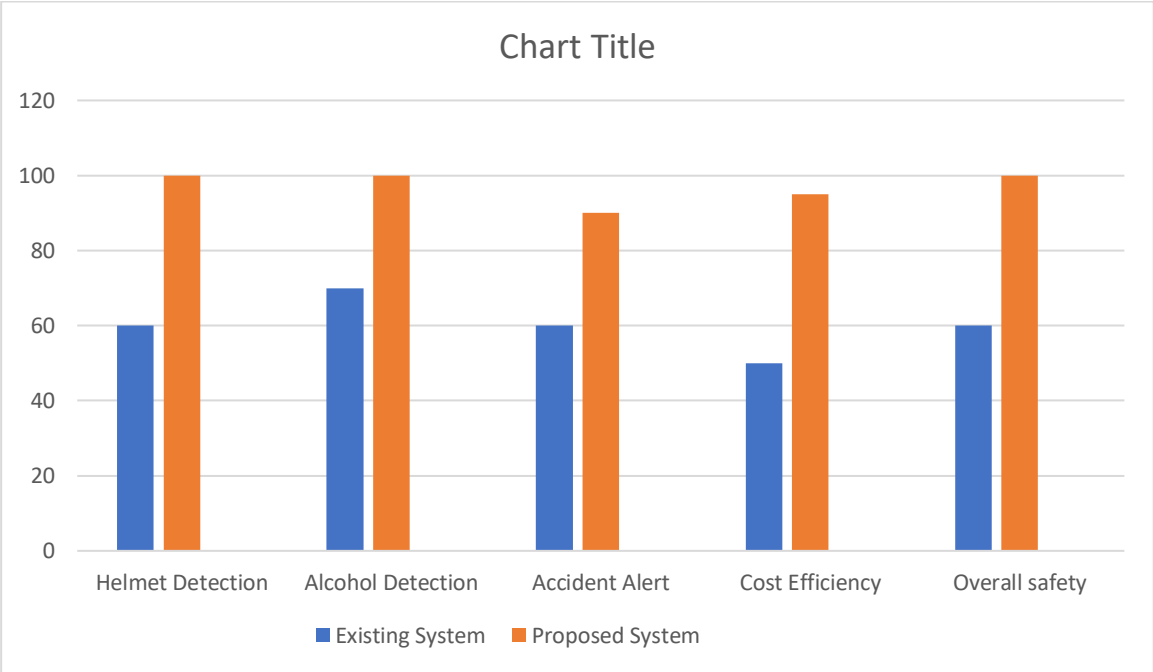
Sr. No.	Sensors	Model	Library	Description
1.	Vibration Sensor	SW-420	VibrationSensorTEP	Designed to detect vibrations or shocks in a system and generate a response when movement exceeds a set threshold value.
2.	Alcohol Sensor	Gas Sensor (MQ3)	GasSensorsTEP	Used for detecting alcohol and ethanol vapor concentrations in the air. The MQ-3 specifically detects alcohol, making it suitable for breathalyzers, gas leak detection, and similar applications.
3.	GSM Module	SIM 900D	GSMLibraryTEP	**GSM module (Global System for Mobile Communication)** used to enable cellular communication for various applications like IoT (Internet of Things), remote monitoring, and mobile data transfer or connect to the internet through **GPRS** (General Packet Radio Service).
4.	IR Sensor	IR Obstacle Sensor	InfraredSensorsTEP	An Infrared (IR) Sensor is an electronic device that detects infrared (IR) radiation emitted by objects. It can sense the presence, proximity, or motion of objects by analyzing the heat emitted in the form of IR radiation, which is invisible to the human eye but detectable by the sensor.

```
#include <SoftwareSerial.h>
SoftwareSerial mySerial(10,5);;
void setup() {
  mySerial.begin(9600);
  Serial.begin(9600);
  pinMode(13, OUTPUT);//HELMET ALERT
  pinMode(11, OUTPUT); //VEHICLE
  pinMode(7, OUTPUT);//ALCOHOL ALERT
  pinMode(3, OUTPUT);//VIBRATION ALERT
  pinMode(12, INPUT); //ALCOHOL SENSOR
  pinMode(8, INPUT); //VIBRATION SENSOR
  pinMode(4, INPUT); //HELMET SENSOR(IR)
}
void loop() {
  int gasDetected = digitalRead(12);
  int vibrationDetected = digitalRead(8);
  int helmetDetected = digitalRead(4);
  if (helmetDetected == 1) {
    digitalWrite(13, LOW);
  } else {
    digitalWrite(11, LOW);//VEHICLE STOP
    digitalWrite(13, HIGH);//HELMET ALERT
    Serial.println("Please Wear Helmet"); }
  if (gasDetected == 1) {
    Serial.println("ALCOHOL ALERT");
    // digitalWrite(7, HIGH);//ALCOHOL ALERT
    digitalWrite(11, LOW);//VEHICLE STOP
    for (int i = 0; i < 3; i++) {
      digitalWrite(7, HIGH);//ALCOHOL ALERT
      delay(50);
      digitalWrite(7, LOW);
      delay(50); }
  }  else {
    digitalWrite(7, LOW);
    if (helmetDetected == 1 && gasDetected == 0) {
  digitalWrite(11, HIGH); // VEHICLE ON
  Serial.println("VEHICLE IS WORKING FINE");
  digitalWrite(13, LOW);  // HELMET ALERT OFF
} }
  if (vibrationDetected == 1) {
    Serial.println("VIBRATION ALERT");
    digitalWrite(11, LOW);//VEHICLE STOP
    for (int i = 0; i < 3; i++) {
      digitalWrite(3, HIGH);//IMPACT ALERT
      delay(50);
      digitalWrite(3, LOW);
      delay(50);
    }
    SendMessage();
    RecieveMessage();
  }
  delay(500);
}
void RecieveMessage() {
  mySerial.println("AT+CNMI=2,2,0,0,0");
  delay(1000);
}
void SendMessage() {
  mySerial.println("AT+CMGF=1");
  delay(1000);
  mySerial.println("AT+CMGS=\"+91xxxxxxxxx\"\r");
  delay(1000);
  mySerial.println("Accident Detected : Vehicle ID: 38295");
  delay(100);
  mySerial.println((char)26);
  delay(1000);
}
```

4.2. Experimental Results

Sr. No.	Test Scenario	Input	Output
1.	Helmet Activation	Rider will wear the helmet	IR Obstacle Sensor detects the rider has worn the helmet and starts the system.
2.	Alcohol Detection	Rider wears helmet	If rider has consumed alcohol, the MQ-3 sensor detects it and alerts the system.
3.	Accident Detection	Rider met with an accident	Vibration Sensor (SW-420) detects vibrations/shocks and informs the system about the accident.
4.	Sending Messages	Alerts and accident info	GSM module (SIM900D) sends alert messages to hospital and emergency contacts about the rider's accident.

6. Comparison with existing work



As we have made on Software, our smart Hemet is showing 100% efficiency.

7. Conclusion and Future Work

Our helmet design provides safety and reduces the accident and also notifies about the accident so that the person can be provided with timely treatments, reducing the chance of death of the person. The alcohol detection will prevent drink and drive cases and the effects of drink and driving to the public and the rider himself. It will make two-wheeler riding a little bit safe. It will also increase reliability on two wheelers and thus will reduce the number of deaths due to the road accidents. This helmet not only enhances the 2-wheeler safety but also serves as a milestone for future advancements.

Future work can be like:

(a) We can use a solar panel which can store energy in the helmet. It can also include working on solar energy when it is available and switch to battery when needed.

(b) Helmet can also include a charging port where the person can use helmet's battery to charge his/her device.

(c) Helmet can include something that can clear out some fog or slightly increase some of the visibility in winters as a lot of accidents are happening due to poor visibility during foggy days causing a lot of deaths.

(d) We can also add sensors to check whether the user's drowsiness and if he is feeling sleepy it will raise an alarm or buzzer and awake him. It will call his emergency contacts and also to the user so that he/she can rest somewhere after the advice of close ones and the people from the company.

References

(1) Smart Helmet using IoT for Alcohol Detection and location detection system

https://ieeexplore.ieee.org/document/9985543

(2) IMPLEMENTATION AND ANALYSIS OF SMART HELMET
https://ieeexplore.ieee.org/abstract/document/8269660

(3) Konnect: An Internet of Things (IoT) based smart helmet for accident detection and notification
https://ieeexplore.ieee.org/abstract/document/7839052

(4) Sreenivasulu Kyathari Neelakanteshwara; Rashmi Gadenahalli Puttaswamy; Sunil Thimmaiah; Rohith Shivashankar; Yashas Ponnasamudra Thippeswamy

(5) Design & Implementation of IoT Based Smart Helmet for Road Accident Detection
https://ieeexplore.ieee.org/document/9284820

(6)] IoT Based Smart Helmet and Accident Identification System
https://ieeexplore.ieee.org/abstract/document/9230823