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Smart Accident Free Equipment ATmega328P

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Abstract: The S.A.F.E (Smart Accident Free Equipment) system is an innovative smart helmet designedtoenhanceriders afetyusingembeddedelectronicsandwirelesscommunication.This project integrates an Arduino-based system with multiple sensors to monitor critical safety conditions in real time.The system consists of two main sections: a transmitter unit placed inside the helmet and a receiver unit installed in the vehicle. The transmitter uses sensors such asanIRsensorforhelmetweardetection,anadditional IRsensorfordrowsinessdetection,and an MQ-3 sensor for alcohol detection. These sensors continuously collect data and transmit it wirelessly using a 433 MHz RF module.
Thereceiverprocessestheincomingdataandcontrolsthevehicle'signitionsystemthrougha relay module. The engine starts only when the rider is wearing the helmet and has not consumed alcohol. Additionally, the system detects drowsiness using a time-window-based logic and alerts the rider using a buzzer and display unit.
Thissmarthelmetsystemaimstoreduceroadaccidentsbyenforcingsafetyrulesandproviding real-time alerts. It is a cost-effective and practical solution that can be widely implemented to improve road safety and prevent accidents caused by negligence or unsafe riding conditions.

I. INTRODUCTION

Roadaccidentsareoneofthemajorcausesofinjuryanddeath,especiallyamongtwo-wheeler riders. Many of these accidents occur due to negligence such as not wearing a helmet, driving under the influence of alcohol, or falling asleep while riding. Although helmets are legally mandatory, many riders still ignore safety rules.To address these issues, the S.A.F.E (Smart Accident Free Equipment) system is developed as a smart helmet that uses embedded technology to improve road safety. This system integrates sensors, microcontrollers,andwirelesscommunicationtomonitortherider'sconditioninrealtime.Thesmarthelmetconsistsoftwomainparts:atransmitterunitplacedinsidethehelmetandareceiverunitinstalledinthevehicle.Itdetectswhethertherideriswearingthehelmet,checksforalcoholconsumption, and monitors drowsiness. Based on these conditions, the system either allows or prevents the vehicle fromstarting and provides alertsusing a buzzer and display.This project aims toreduce accidents by enforcing safety measures automatically and ensuring that riders follow essential precautions before and during riding.

II. LITERATURE SURVEY

In recent years, many researchers have focused on developing smart helmet systems to improvethesafetyoftwo-wheelerriders.VarioustechnologiessuchasIoT,Arduino,sensors, and wireless communication have been used to enhance traditional helmets.

A study on an IoT-based smart helmet system proposed the use of sensors like alcohol sensors and vibration sensors to detect accidents and prevent the vehicle from starting if safety conditions are not met. It also included an emergency alert system to send messages to predefined contacts during accidents .Another research work focused on drowsiness detection andtheftpreventionusingsensorssuchaspulsesensorsandmotionsensors.Thesystemalerts the rider when signs of fatigue are detected and also provides warnings if the helmet is stolen, improving both safety and security.

A review paper on smart helmets highlighted that integrating technologies like RF communication, alcohol detection (MQ-3), and helmet wear detection using IR sensors can significantly reduce accidents. It emphasized that such systems help enforce safety rules automaticallyandimproveriderawareness.Someadvancedsmarthelmetmodelsalsoinclude features like GPS tracking and GSM communication, which help in sending the rider's location to emergency services in caseof an accident. These systems aim to reduce response time and increase survival chances .Additionally, research shows that major causes of two-wheeler accidents include alcohol consumption, drowsiness, and not wearing helmets, which can be effectively addressed using sensor-based smart helmet systems.

III. PROBLEM STATMENT

Road accidents involving two-wheeler riders are increasing rapidly due to unsafe riding practices such asnot wearing helmets, driving under the influence of alcohol, and drowsy driving.

Despite strict traffic rules and awareness campaigns, many riders continue to ignore basic safety measures, leading to serious injuries and fatalities.Traditional helmets provide physical protection but lack any intelligent system to monitor the rider's condition or enforce safetyrules.Thereisnomechanismtopreventarider fromstarting thevehicleiftheyare notwearing ahelmetor are under the influence of alcohol.Additionally,drowsiness whileriding is difficult to detect and can result in dangerous situations.Therefore, there is a need for asmart, automated, and reliable system that can monitor the rider's safety conditions in real time and take preventive actions. The system should ensure helmet usage, detect alcohol consumption anddrowsiness,andrestrictvehicle operationunderunsafeconditionstoreduceaccidentsand improve road safety.

IV. PROPOSED METHODOLOGY

The proposed system consists of two units: a transmitter (helmet) and a receiver (vehicle). The transmitter uses sensors such as an IR sensor for helmet wear detection, another IR sensor for drowsiness detection, and an MQ-3 sensor for alcohol detection. These sensors continuously monitor the rider's condition.The collected data is processed by the Arduino and transmitted wirelessly using an RF module. The receiver unit receives this data and controls the vehicle ignition using a relay module.The engine starts only if the rider is wearing the helmet and no alcoholisdetected.Ifunsafeconditionslikealcohol consumption,drowsiness,ornohelmetare detected, the system either stops the engine or gives an alert using a buzzer and display.

V. COMPONENTS USED

1) ArduinoUNO-ArduinoUNOisamicrocontroller-baseddevelopmentboardusedtocontrol electronic components and sensors. It is based on the ATmega328P microcontroller.

It has 14 digital input/output pins and 6 analog input pins, which are used to connect sensors, LEDs, and other devices. It can be easily programmed using the Arduino IDE with simple code. Inthisproject,theArduino UNOactsasthemaincontroller, whichreadssensordata,processes it, and controls output devices like buzzer, relay, and RF module.

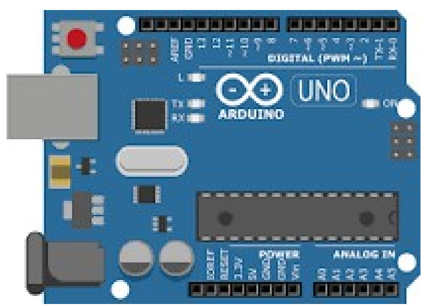

Fig:ArduinoUNO

2) IRSensor-AnIR(Infrared)sensorisanelectronicdeviceusedtodetectobjectsorobstacles using infrared light. It consists of an IR transmitter and an IR receiver.

Thetransmitteremitsinfraredrays,andwhentheseraysshitanobject,theyarereflectedback and detected by the receiver. Based on this, the sensor gives an output signal.

Fig:IR Sensor

3) MQ-3-TheMQ-3sensorisagassensorusedtodetectthepresenceofalcoholintheair.Itis highly sensitive to alcohol vapors like ethanol.It works by measuring the change in resistance when alcohol gas comes in contact with the sensor. Based on this, it gives an analog or digital output.In this project, the MQ-3 sensor is used to: Detect alcohol from the rider's breath.Preventthevehicle fromstartingifalcoholisdetected.

Fig:MQ-3

4) Helmet-Ahelmetisaprotectivegearwornbyriderstopreventheadinjuriesduring accidents. It is made of a hard outer shell and a soft inner padding for safety.

Inthisproject,thehelmetisusedasabaseunittomountallcomponentslikesensors,Arduino,andRFtransmitter.Itplaysanimportantroleindetectingwhether therider iswearing itornot


Fig:Helmet

5) LCD-AnLCD(LiquidCrystalDisplay)isanelectronicdisplaymoduleusedtoshowtextand data. In this project, a 16x2 LCD is used, which can display 16 characters in 2 rows.

ItisconnectedtotheArduinousinganI2Cmodule,whichreducesthenumberof wires.

Fig:LCD

6) F.LED-AnLED(LightEmittingDiode)isanelectroniccomponentthatemitslightwhenelectric current passes through it.It works on the principle of electroluminescence, where electrical energy is converted into light energy.In this project, the LED is used as an indicator to show different system conditions such as alerts or status of the system.

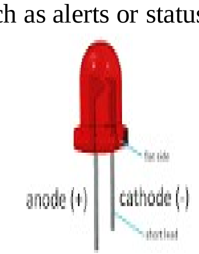

Fig:LED

7) Buzzer-Abuzzerisanelectronicaudiodeviceusedtoproducesoundasanalertorwarning signal.It works when an electrical signal is applied, converting it into a sound (beep). It is commonly used in alarm systems and safety devices.

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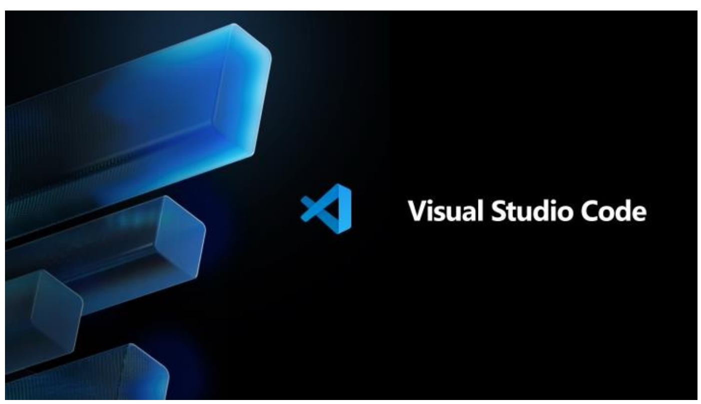
Fig:Buzzer

8) Register-AregisterisasmaIl,high-speedstoragelocationinsideamicrocontrollerorCPU used to temporarily hold data during processing.It is used to store instructions, data, or addresses that are currently being used by the system.Registers are very fast compared to memory and help in quick execution of operations

Fig:Register

9) SoftwareTools:VisualStudioCode(VSCode): VisualStudioCodeisacodeeditordeveloped by Microsoft. It allows developers to write, edit, and manage code in different programming languages. For IoT projects, VS Code is useful because it supports extensions, debugging tools, and project management features that make coding easier and more efficient.

Arduino IDE : Arduino IDE is software used to write and upload programs to Arduino boards liketheArduinoUno.Itprovidesasimpleinterfacetowritecode,compileit,andsendittothe microcontroller, allowing projects to run smoothly on the Arduino board



ARDUINO

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VI. RESULT

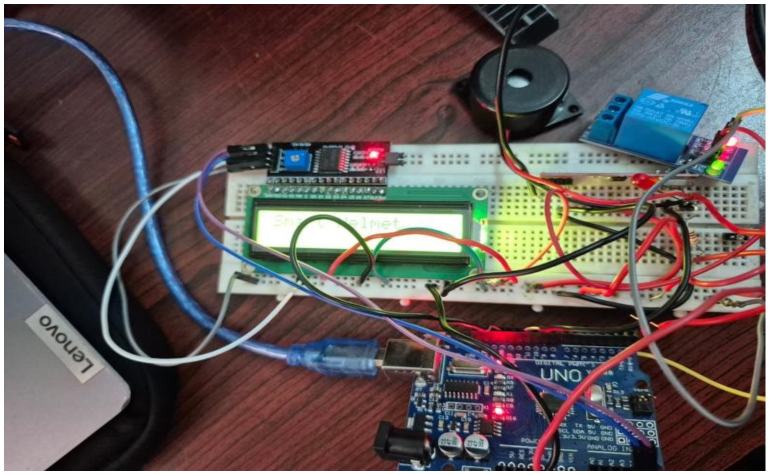

Fig :Circuit Connection

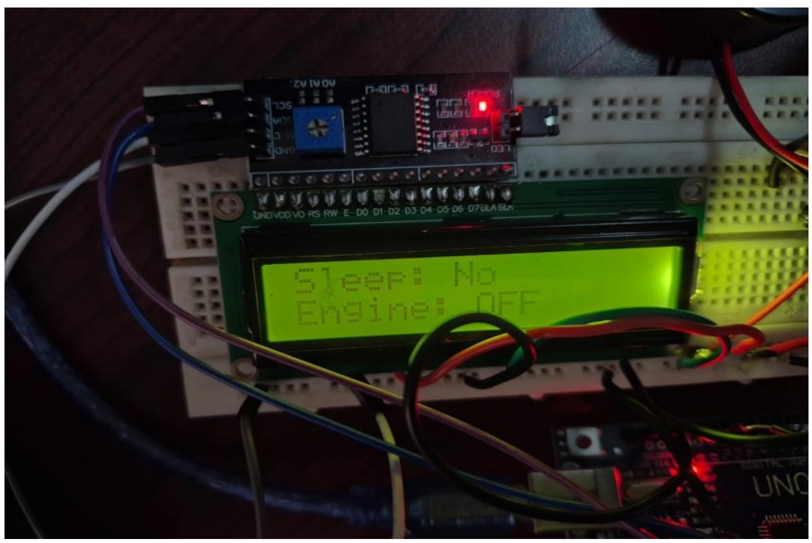

Fig:Systemison

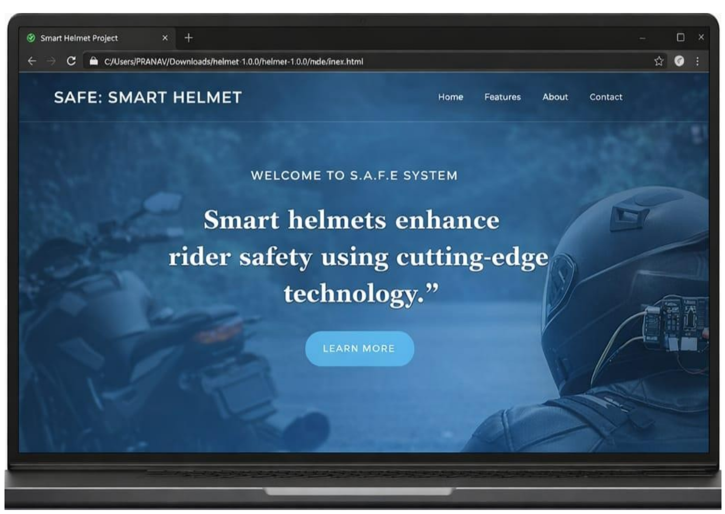

Fig:System Website

TheSmartHelmetMonitoringandControlSystem(S.A.F.E)isdesignedtoimprovethesafetyof two-wheeler riders by automatically monitoring important conditions such as helmet usage, alcohol consumption, and drowsiness. The system uses different sensors, an Arduino UNO microcontroller, RF modules, and relay modules to create a smart safety system.

The systemcontinuously checks whether the rider is wearing a helmet using anIRsensor.If the helmetis notworn,the systemdoes notallowthe vehicletostart.Another IRsensor is usedfor detecting drowsiness by monitoring eye closure. If the rider feelssleepy, the system activates a buzzertoalerttheriderandpreventaccidents.AnMQ-3alcoholsensorisusedtodetectalcohol in the rider’s breath. If alcohol is detected, the Arduino sends a signal to the relay module to turn off the engine, ensuring that the vehicle cannot be operated under unsafe conditions.

Thetransmittersection,placedinsidethehelmet, collectsdatafromallsensorsandsendsit wirelessly using a 433 MHz RF transmitter. The receiver section, installed in the vehicle, receives this data through an RF receiver and processes it using another Arduino UNO.

The Arduino compares the received values with preset conditions. If all safety conditions are satisfied(helmet wornandnoalcohol detected), the systemallows the engine tostart using a relaymodule.Otherwise,theengineremainsoff. A16x2LCDdisplayisusedtoshowreal-time information such as helmet status, alcohol detection, and engine condition. A buzzer and LED are used to provide alerts during unsafe situations like drowsiness or system errors.

TheArduinoUNOactsasthemaincontrolleroftheentiresystem.Itcollectsdatafromsensors, processes it, and controls devices like the buzzer, relay, and display. This system helps reduce accidents by ensuring that riders follow basic safety rules and by providing real-time alerts.

VII. FUTURE SCOPE

The Smart Helmet system can be further improved by adding advanced features to enhance safetyandusability.Inthefuture,GPSandGSMmodulescanbeintegratedtosendtherider’s live location and emergency alerts to family members or hospitals in case of an accident.

ThesystemcanalsobeupgradedusingIoTtechnology,allowingreal-timemonitoringanddata storage on cloud platforms. This will help in tracking rider behavior and improving safety measures.Additional sensors such as accident detection (vibration sensor) and heart rate monitoring can be included to detect emergencies more accurately. A mobile application can also be developed to display all data and alerts in a user-friendly way.

Moreover,thesystemcanbemademorecompact, wireless,andpower-efficientforbetter practical implementation in real-world conditions.

VIII. CONCLUSION

TheS.A.F.E(SmartAccidentFreeEquipment)systemsuccessfullydemonstrateshowtechnology canbeusedtoimproveroadsafetyfortwo-wheelerriders.Byintegratingsensors,Arduino,and wireless communication, the system ensures that important safety conditions such as helmet usage, alcohol detection, and drowsiness monitoring are continuously checked.

Theprojectpreventsthevehiclefromstartingunderunsafeconditionsandprovidesreal-time alerts to the rider. This helps in reducing accidents caused by negligence and unsafe driving behavior.Overall, the smart helmet system is a cost-effective, reliable, and practical solution that can be implemented in real life toenhance rider safety and promote responsible driving.

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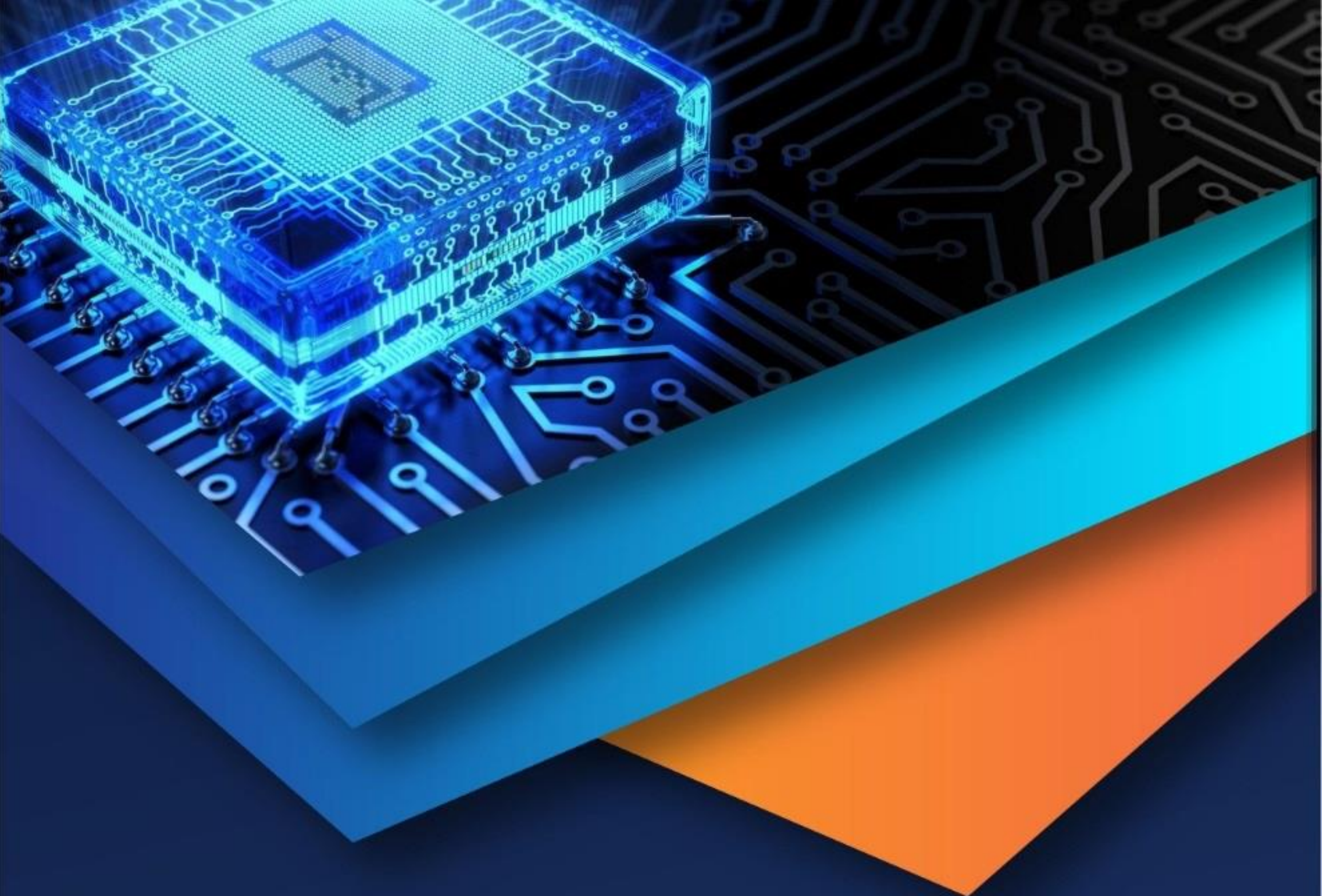

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