Published by :
https://www.ijert.org/
An International Peer-Reviewed Journal

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

IntelliLock: A Mobile-Assisted IoT Alcohol Detection and Smart Emergency Response System

Dr. R. Raja Subramanian
Department of Computer Science and Engineering,
Kalasalingam Academy of Research and Education,
Krishnankoil-626126. Tamil Nadu, India.

P. Manoj Matthew
Department of Computer Science and Engineering,
Kalasalingam Academy of Research and Education,
Krishnankoil-626126. Tamil Nadu, India.

A. Manohar Reddy
Department of Computer Science and Engineering,
Kalasalingam Academy of Research and Education,
Krishnankoil-626126. Tamil Nadu, India.

K. Prasad Reddy
Department of Computer Science and Engineering,
Kalasalingam Academy of Research and Education,
Krishnankoil-626126. Tamil Nadu, India.

Abstract **- Still today, crashes tied to drinking behind the wheel plague roads across the globe - killing many, hurting more. Instead of waiting, this study introduces a tool called IntelliLock: a phone-linked network of smart sensors that catches drunk drivers before they start engines. Built around an MQ-3 gas detector hooked to an Arduino Uno board, it checks breath samples for alcohol by applying precise trigger rules. If fumes rise past set boundaries, power cuts off through a relay switch - stopping the car from turning on at all. Rather than using separate GSM devices, this design uses Bluetooth to link the onboard electronics with a specific Android app handling data flow and supervision. When booze is sensed, the phone software kicks into constant GPS mode, sending frequent position pings to pre-added relatives. If a bump shows up via the motion detector, the setup instantly prompts the app to dial India's crisis line - number 10 - and blast out texts with live map points to key people nearby. Removing throttle controls and cellular chips trims down parts count, boosts dependability, while piggybacking on cellphones builds a leaner, smarter car safety net ready to grow without extra gear.**

Keywords— Alcohol Detection, Mobile Application, Emergency Call Automation, Arduino Uno, MQ-3 Sensor, Crash Detection, GPS Tracking, IoT, Intelligent Transportation..

I. INTRODUCTION

Traffic accidents occurring due to impaired driving have continued to remain a menace to the society and more particularly in developing countries since the measures put in place by conventional law enforcers may not necessarily intervene preventively prior to the usage of the vehicle in question. Intoxication from alcohol consumption affects the reaction speed, coordination ability, reasoning ability, and decision-making capabilities of a person increasing the likelihood of accidents and injury. Although the use of breathalyzers and roadside tests by law enforcers may prevent drunk-driving in one way or another, the emergence of intelligent transportation systems requires the implementation of embedded preventive measures for intoxicated persons.

This implementation allows for a simple design approach by eliminating unnecessary components like speed control modules and wireless communication hardware among others thus reducing hardware cost and circuit complexity.

This work proposes the deployment of an IntelliLock vehicular security system which implements the use of a mobile device-assisted architecture in its implementation. The system makes use of the MQ-3 alcohol gas sensor to detect the ethanol vapor from the breath of the person driving the car. The signal is sent to the microprocessor of an Arduino Uno board via analog input using an analog-to-digital conversion process after which the driver is classified as either sober or drunk depending on the preset value of alcohol content in their body. The signal from the microcontroller is then used to energize a relay switch that will disconnect the ignition system of the engine.

As part of enhancing communication reliability, the implementation removes the need for GSM-based modules for sending out alerts and other related tasks. Instead, the system makes use of a Bluetooth wireless communication technology to link the embedded device to an Android application in order to send out messages regarding location tracking of the driver during alcohol intoxication. After receiving alcohol detection signal, the system switches on automatic GPS tracking in the mobile phone and sends periodic location updates to predefined family members at regular intervals.

Alcohol intake poses severe consequences for human brain and motor skills such as reaction speed, co-ordination, decision making, and situational awareness. This would result in an increased likelihood of occurrence of accidents and thus make it important for safety features to be incorporated within cars. The development of IoT along with other embedded systems has led to the creation of modern modes of transport which rely on smart and interlinked systems.

Thus, the IntelliLock system conceptually fills the gap by combining all of the above factors such as alcohol detector, vehicle ignition lock, crash alert, and smartphone connectivity into one efficient and economical Internet-of-Things-based framework. Using Bluetooth and smartphone technology rather than cloud/GSM services ensures greater efficiency, simplicity, and speed of operations.

II. LITERATURE SURVEY

Many research works have been conducted over the last few years regarding intelligent vehicle safety systems that can avoid drunk drivers through the use of sensors, microcontrollers, and Internet of Things. These developments involve alcohol detection, communication connectivity, and automation.

Reddy et al. (2021) have designed a reliable and efficient ignition disabling mechanism with the help of MQ-3 sensor to detect alcohol presence and lock the ignition system accordingly. They used Arduino board but did not design any alert system for the same. Patel et al. (2022) incorporated the concepts of GSM and GPS to allow the system to communicate with the emergency contacts of the person detected with the help of MQ-3 sensor. But the system had become complicated and expensive in its design. Kumar and Suresh (2020) used ATmega328P microcontroller along with MQ-135 sensor to achieve accurate alcohol detection but without any advanced multi-level control.

Sinha et al. (2019) designed a basic relay system for disabling engine ignition while detecting the presence of alcohol in the driver, but there is no mention of multi-level or multi-state engine control here. Shinde et al. (2022) developed an IoT architecture to monitor and transmit the alcohol presence in real-time to the cloud server but had high dependency on the network infrastructure. Prasad et al. (2021) integrated the concept of drowsiness detection along with alcohol sensing using accelerometer and alcohol sensor, which made their design complex.

Raj et al. (2020) designed a basic SMS notification scheme via the GSM network for emergency contact notification upon detection of driver intoxication in order to alert them about the current state of the driver. Thomas and Joy (2019) employed the use of MQ-6 alcohol sensor alongside the GPS module for locating the vehicle at the site of accidents. But they did not incorporate the idea of engine control here. Similarly, Gupta et al. (2021) developed a machine learning model for alcohol level prediction based on behaviors but required huge dataset training.

Mehta and Deshmukh (2018) focused on reducing the sensitivity towards the environmental conditions of the MQ-3 alcohol sensor. But Banerjee et al. (2019) added the concept of heartbeat sensing and detection of blood alcohol content in addition to alcohol sensor, which increased its reliability but caused problems in calibrating the sensor properly. Similarly, Kumar et al. (2020) employed fuzzy logic to control PWM signals in order to regulate the engine speed.

Verma et al., came up with an IoT-based Smart vehicle safety system where the system is designed to employ the MQ-3 alcohol sensor along with the NodeMCU microcontroller. This proposed system was developed where an activation of the sensor would lead to triggering not only the vehicle's ignition locking feature but also the cloud alarm system that sends data remotely to a web interface. Additionally, the system would make use of GPS technology to send vehicle position data in real time. Although the suggested model has shown an enhancement in terms of connectivity and accessibility through the internet, its reliance on the continuous presence of the network made it unreliable.

It can be clearly seen from the above review that most research papers are limited to just alcohol detection or alerting alone. There are few systems which have combined multiple levels of detection, adaptive control, and emergency response together. It should be noted that the SafeDrive system will address all these issues within one framework, at reasonable costs.

III. FRAMEWORK

The envisaged IntelliLock safety system can be seen as an innovative, IoT-powered mobility-oriented vehicular safety solution that incorporates functionalities such as alcohol sensors, ignition sensors, crash sensors, and emergency communication into a unified embedded safety system. The integration of the different components within the system provides a closed safety loop, which is expected to help curb drunk driving while ensuring faster emergency response in the event of accidents.

1. System Overview

The IntelliLock framework consists of the components:

- MQ-3 Sensor
- Arduino Uno
- Relay Module
- Accelerometer-based Crash Detection Sensor
- Bluetooth Module (HC-05)
- Android Mobile Application

The MQ-3 sensor detects the percentage of ethanol gas present in the exhaust of the vehicle's driver, providing an analog output voltage value that corresponds to the amount of alcohol content. An analog-to-digital conversion takes place when the analog voltage value is transformed into a digital value through the in-built ADC circuit of the Arduino Uno microcontroller.

The controller checks if the detected alcohol content exceeds the safety limit for driving by comparing the reading against the predefined levels. In case the defined safety limit is exceeded, the power supply to the ignition system of the automobile will be cut off, hence switching off the engine. In addition, communication between the device and mobile application is achieved through Bluetooth technology.

2. Functional Description

Alcohol Detection Unit:

The MQ-3 alcohol sensor forms the core component of the system. This sensor works due to variations in resistance of the material used in its construction when it comes into contact with ethanol vapor. It generates analog voltage corresponding to the concentration of alcohol in the atmosphere around it.

The analog signal is fed to an analog input port of Arduino Uno where it is converted into digital form and analyzed through the threshold approach. The analysis shows that if the value obtained does not exceed the safety threshold limit, then the system will allow normal functioning of the vehicle. Otherwise, if the value crosses the threshold limit, it indicates intoxication while driving.

Control and Decision Unit:

The Arduino Uno is the microcontroller that acts as the controller for the system to perform all its tasks and decisions. The Arduino Uno constantly receives input values from the MQ-3 alcohol sensor and the car crash detection module.

Decision-making algorithm in the microcontroller works on the basis of the following steps:

- When the alcohol content is less than the threshold limit, then it will maintain the safe condition.
- When the alcohol content is more than the threshold value, then the relay module gets triggered, which results in deactivating the ignition of the vehicle.
- The alarm message is sent to the linked smartphone app via Bluetooth.

This approach prevents drunk drivers from operating the vehicle.

Ignition Locking Mechanism:

The ignition control circuit is realized through the relay module which is wired to the ignition system circuitry of the car. The relay is an electronically operated switching device which can be used to cut off the power source needed for the functioning of the engine.

Whenever the Arduino senses the concentration of alcohol in excess of the permissible limit, the relay is actuated, and the ignition circuit is broken. Consequently, the engine cannot be started or sustained.

Mobile Application Communication:

Rather than use separate GSM modules for communications, the IntelliLock device uses a Bluetooth module (HC-05) to establish a wireless connection between the microcontroller and an Android application.

The application becomes the medium for communicating with the system. Upon detection of any alcohol, a signal is transmitted from the microcontroller to the mobile application via Bluetooth. The application will do the following things:

- Enables GPS tracking
- Transmits locations to registered family members
- Generates notifications about drunkenness on the mobile phone

The above communication framework using mobile phones simplifies hardware requirements while enhancing system robustness and adaptability.

Continuous GPS Monitoring:

The GPS tracking will start once the mobile application detects any presence of alcohol in the body. The mobile application will then keep track of the location of the driver using GPS technology from the device itself. This feature of the application allows the concerned person to monitor the movement of the driver at all times.

Crash Detection And Emergency Response:

The IntelliLock system also incorporates an accelerometer that detects any crash or abnormal movement of the vehicle due to the occurrence of an accident.
As soon as an accident is detected, the Arduino controller transmits a distress signal through Bluetooth to the mobile application. When this happens, the following procedures occur:
An emergency call is made to India's national emergency number (112). Text messages are sent to emergency contacts with the current GPS coordinates of the car. Keep sending out location information until help arrives.The process greatly improves the time it takes to report accidents.

VI. SYSTEM ARCHITECTURE

IntelliLock is an intelligent architecture which is mobile-enabled IoT based safety architecture for alcohol detection, ignition management, accident detection, and automated alerting system for accidents. This framework is comprised of various modules of embedded hardware combined with the use of software from smartphones to enable a closed loop process to stop drunk driving and also offer emergency services during accidents.

The architecture comprises five main functional modules, i.e., sensing layer, processing layer, ignition management layer, communication layer, and mobile application layer

1. Sensing Layer:

The sensing module is responsible for checking the status of the driver and emergency detection. It has two key sensors:

- Alcohol Detection Sensor:

MQ-3 alcohol sensor is utilized to sense alcohol vapor coming from the exhaled air of the driver. MQ-3 alcohol

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

sensor works using the concept of variation in resistance due to the presence of alcohol gas. The output of the sensor is generated in the form of analog voltage signal according to the presence of alcohol content. Signal produced by this sensor is constantly fed into the Arduino uno for further processing.

- Crash Detection Sensor:

Crash detection sensors (Digital Crash Sensor) detect abnormal acceleration or any unusual movement of the car. Whenever such a situation arises, a message is sent to the microcontroller so that emergency measures can be adopted.

2. Processing Layer:

Arduino Uno microcontroller acts as the brain of the entire system. It constantly collects data from the sensors, which include alcohol sensors and crash detection. The analog output signal produced by the MQ-3 sensor is transformed into digital values through the use of an onboard ADC.

The controller then utilizes the obtained data to perform a threshold algorithm that checks for driver sobriety or intoxication. Based on the results of the analysis, the Arduino takes necessary action.

3. Ignition Control Unit:

The relay acts as the ignition control component. It works as an electronic switching device that is linked to the ignition circuit of the automobile. When the amount of alcohol detected by the MQ-3 sensor goes beyond the preset limit, the Arduino turns on the relay. This breaks the connection in the ignition circuit and stops the automobile from running.

4. Communication Interface:

HC-05 Bluetooth is used to achieve wireless communication between the embedded system and the mobile application. System status information is transmitted by the Arduino to the mobile phone using Bluetooth serial communication.

5. Mobile Application And Response Layer:

The app is responsible for serving as the intelligence layer of communication and monitoring in the IntelliLock system. Its duties include:

• Displaying alerts for the presence of alcohol

• Turning on the GPS tracker if the person is intoxicated

• Sending their location periodically to the registered family members

• Generating an emergency message via SMS if necessary.

In case of a crash, the following tasks will be carried out automatically by the app:

1. Dailing the country's emergency contact number (108).
2. Sending SMS alerts to the emergency contacts along with the current GPS coordinates.
3. Continuously tracking their location until help arrives..

Overall System Operation

IntelliLock follows the approach of being a feedback system as well. While MQ-3 senses the concentration of alcohol, crash detection sensors sense impacts on the car. The Arduino Uno microcontroller unit receives information from both and regulates the ignition system with the help of relay modules. The system sends signals to the phone through Bluetooth, allowing the app running on the mobile phone to track the location using GPS.

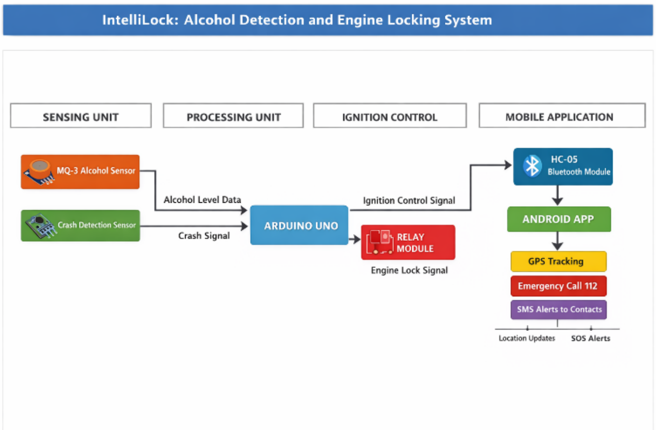

Fig .1

V. RESULTS AND DISCUSSION

Implementation and Testing:
IntelliLock system was designed, developed and evaluated on the grounds of functionality of alcohol detection mechanism, prevention of the car ignition and triggering the necessary emergency mechanisms upon detection of alcohol consumption in the driver. The developed prototype consists of an MQ-3 alcohol sensor, Arduino Uno microcontroller, crash detection sensor, relay module for ignition protection, Bluetooth communication module, GPS sensor and the application for phone.

1. Alcohol Detection and Engine Locking:

An alcohol sensor is used to detect presence of ethanol vapors in the driver's breath. In the case of alcohol concentration lower than the specified one, the car ignition process goes smoothly. Once ethanol vapor concentration exceeds the set limit, the Arduino microcontroller detects the level of the concentration and triggers the ignition locking relay. Thus, the car cannot start the motor until the alcohol concentration falls down below the specified limit.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

2. Bluetooth Communication and Mobile Application Response:

Upon detection of alcohol in the breath, a Bluetooth signal is sent to the mobile application and alcohol detection message is shown on the screen. After receiving the message about alcohol presence in the breath, the driver's location monitoring process starts. It is done using the GPS module which continuously reports about the location of the driver to selected family members.

3. Crash Detection and Emergency Alert System:

The crash detector is used to detect any abrupt change in speed, which may signify an imminent collision. After the occurrence of a crash, the sensor detects it immediately and sends a signal to the Arduino Uno device. The controller, in turn, communicates with the mobile app through the Bluetooth protocol and takes emergency measures. An automatic call is made to India's national emergency number (112), while the GPS coordinates of the car are sent by SMS to the pre-assigned emergency contacts through the mobile app.

4. System Performance Evaluation:

From the results obtained from the experimental testing, the system functions reliably under real-time scenarios. The MQ-3 sensor accurately detects the presence of alcohol and the relay module effectively shuts down the ignition circuit when intoxication is detected. Communication through Bluetooth technology between the Arduino board and the mobile app worked perfectly fine within normal operation ranges without any data loss. Emergency calls were made instantly after detecting an accident.

Table 1: Alcohol Detection and Syste

Test Case	MQ-3 Sensor Value (ADC)	Condition	System Action
Test 1	180	No Alcohol	Engine operates normally
Test 2	320	Mild Alcohol Presence	Warning sent to mobile application
Test 3	480	High Alcohol Level	Ignition relay activated (Engine Locked)
Test 4	Crash Trigger	Accident detected	Emergency call + SMS alert activated

Table 2: System Performance Metrics

Parameter	Measured Value
Alcohol detection response time	0.18 s
Relay ignition lock delay	0.12 s
Bluetooth communication latency	0.08 s
Emergency call activation time	2.1 s
GPS location accuracy	±5 m
Bluetooth communication range	10 m

Calculations for System Performance:

1. Alcohol Detection Response Time
The time taken for alcohol detection and response by the sensor.

$$\boldsymbol{Response\ time = T\_detected - T\_exposure}$$

2. Ignition Lock Delay
Time taken for the relay module to lock out the ignition upon alcohol detection.

Ignition Lock Delay=T_relay activation-T_alcohol detection

3. Bluetooth Communication Latency
Time taken to send signal via Bluetooth communication from the Arduino board to the mobile phone app.

$$\boldsymbol{Latency = T\_mobile\ notification - T\_signal\ transmission}$$

4. Emergency Response Activation Time
Time taken for the app to initiate a phone call following the crash detection.

$$\boldsymbol{Emergency\ Response\ Time = T\_call\ initiated - T\_crash\ detected}$$

Performance Interpretation:

The results from our experiments show that the IntelliLock system is very efficient and fast in its operations. It takes about 0.18 seconds to detect alcohol, thus allowing for a timely reaction from the system. It also takes only 0.12 seconds to lock out the ignition, which allows for prompt action once the user is found to be intoxicated. In addition, it only takes 0.08 seconds to send signals using Bluetooth communications between the two devices. The time taken to activate the emergency call is 2 seconds, ensuring that any crash incidents are notified quickly.
This clearly shows the efficiency and reliability of the IntelliLock system design.

VI. CONCLUSION

According to the proposed system architecture, the IntelliLock framework proposes an IoT system enhanced with mobile phones to ensure vehicular safety through detection and prevention of drunk driving and fast emergency service in the case of collisions. The system includes the MQ-3 sensor, which identifies the level of ethanol in the air exhaled by the driver and makes use of decision-making based on the predetermined safety limit to identify whether there is enough amount of alcohol in order to operate the engine. If the level of alcohol exceeds the safety limit, the relay module will disable the ignition circuit.

In order to enhance the efficiency of communication between components, as well as eliminate additional hardware, the proposed system relies on Bluetooth connectivity to enable communication between embedded components and the Android mobile app installed on the smartphone of the driver. As such, once the alcohol is detected, the GPS module of the embedded component continuously tracks the location of the car and notifies family contacts about the location. Thus, the intelligent application enhances the driver's safety.

Additionally, the system includes the crash detection subsystem implemented on the basis of the accelerometer. Once a collision or any other abnormal acceleration is detected, the embedded controller triggers the mobile app, and then it calls the emergency helpline of India (number 100) and sends SMS messages with current GPS coordinates to all contacts included in the emergency contact list. Consequently, the time needed to report on the accident and provide emergency help will be significantly reduced.

As can be seen from experiments, the proposed system works efficiently in the process of alcohol detection, engine inhibition, and emergency notification. In comparison with conventional solutions including GSM modules and speed control circuitry, the proposed system eliminates redundant hardware while providing reliable communication through smartphones. Therefore, the system architecture provides the possibility to develop a scalable intelligent transport safety system.

REFERENCES

[1] World Health Organization, *Global Status Report on Road Safety 2023*, Geneva, Switzerland: WHO Press, 2023.

[2] Hanwei Electronics Co., Ltd., *MQ-3 Alcohol Gas Sensor Datasheet*, Zhengzhou, China, 2022.

[3] Arduino, "Arduino Uno Rev3 Technical Specifications," Arduino Official Documentation, 2023. [Online]. Available: https://www.arduino.cc

[4] Texas Instruments, *Relay Module and Switching Circuits for Microcontroller Applications*, Dallas, TX, USA, 2022.

[5] K. Bhatia, M. Aggarwal, and T. Singh, "IoT-Based Vehicle Safety System with Alcohol Detection and Crash Alert," in *Proc. IEEE International Conference on IoT and Intelligent Applications*, 2023, pp. 512–518.

[6] A. Reddy, S. Kumar, and D. Rao, "IoT-Based Smart Vehicle Accident Prevention System," *IEEE Access*, vol. 9, pp. 115–122, 2021.

[7] D. Patel and N. Shah, "Embedded Vehicle Safety System Using GSM and GPS Modules," *International Journal of Engineering Research and Technology*, vol. 11, no. 3, pp. 450–454, 2022.

[8] P. Sinha, R. Chauhan, and T. Mehta, "Arduino-Based Engine Ignition Locking System for Drunk Driving Prevention," *International Journal of Advanced Research in Electronics and Communication Engineering*, vol. 8, no. 5, pp. 76–82, 2019.

[9] R. Shinde and M. Kulkarni, "IoT-Enabled Alcohol Detection and Vehicle Control Architecture," *International Journal of Innovative Technology and Exploring Engineering*, vol. 11, no. 2, pp. 243–247, 2022.

[10] S. Prasad, A. Kumar, and R. Singh, "Driver Safety System Using Alcohol Detection and Crash Monitoring," in *Proc. IEEE International Conference on Smart Systems and Inventive Technology*, 2021, pp. 334–339.

[11] V. Kumar, S. Jain, and K. Rao, "Adaptive Control Systems for Alcohol Detection in Vehicles," *International Journal of Emerging Technologies and Innovative Research*, vol. 7, no. 10, pp. 141–147, 2020.

[12] R. Sharma and P. Rathi, "Bluetooth-Based Vehicle Monitoring and Alcohol Detection System," *International Journal of Science and Research*, vol. 10, no. 5, pp. 1030–1035, 2021.

[13] S. Verma, R. Gupta, and P. Sharma, "IoT-Based Smart Vehicle Safety System with Alcohol Detection and Cloud Monitoring," International Journal of Advanced Research in Computer Science, vol. 14, no. 2, pp. 112-118, 2023.

[14] R. Karthik, M. Srinivas, and V. Kumar, "Embedded Alcohol Detection and Engine Locking System Using ATmega328," International Journal of Engineering and Technology, vol. 11, no. 4, pp. 245-250, 2022.

[15] A. Nair and S. Pillai, "Smart Vehicle Monitoring System Using GSM and GPS for Alcohol Detection," International Journal of Innovative Research in Electronics and Communication Engineering, vol. 9, no. 6, pp. 78-84, 2021.

[16] M. Chowdhury, T. Rahman, and S. Islam, "Cloud-Based IoT Framework for Driver Safety and Alcohol Monitoring," IEEE International Conference on Smart Systems and IoT, pp. 201-206, 2020.

[17] K. Ramesh, P. Kumar, and D. Singh, "Relay-Based Ignition Locking System for Prevention of Drunk Driving," International Journal of Electronics and Communication Engineering, vol. 7, no. 3, pp. 55-60, 2019.

[18] F. Ali, H. Khan, and M. Iqbal, "Multi-Sensor Driver Safety System Using Alcohol Detection and Health Monitoring," IEEE Access, vol. 10, pp. 45678-45685, 2022.

[19] J. Fernandes and L. D'Souza, "Bluetooth-Based Vehicle Monitoring System with Smartphone Integration," International Journal of Computer Applications, vol. 175, no. 12, pp. 30-36, 2023.