IOT-BASED MONITORING OF MOTORCYCLE MOTION: A STATE-OF-THE-ART REVIEW

INTRODUÇÃO À INVESTIGAÇÃO EM ENGENHARIA

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SOURCE: PERSONAL ARCHIVE

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MOTIVATION

- Personal connection
- Safety concerns
- Technological interest
- Research relevance
- Societal impact

INTRODUCTION

SENSOR TECHNOLOGIES

- Accelerometers
- Gyroscopes
- GPS

IOT FRAMEWORKS

- Edge, cloud, and hybrid computing models
- AI and ML

USER INTERACTION AND REAL-TIME FEEDBACK MECHANISMS

- Mobile applications
- Instant messaging platforms
- Heads-Up displays

CASE STUDY

- The BMW Motorrad ConnectedRide system
- Harley-Davidson's LiveWire Connect app
- Kawasaki Ninja H2 (sensors)

MOTION SENSORS

CURRENT STATE:

- IoT crash detection systems
- Notification of emergency services [1]
- Feedback on optimal speed and navigation [2]

FUTURE RESEARCH:

- Environmental sensors (e.g., road and weather conditions)

ACCELEROMETERS

Detect sudden changes in speed or jerks

GYROSCOPES

Measure tilt and orientation

PICS SOURCE: GOOGLE

GPS

Tracks location and speed

DATA PROCESSING AND COMMUNICATION MODULES

EDGE COMPUTING MODEL

+ Low latency [3] [4] [5]
+ Bandwidth efficiency [4]
+ Offline functionality [3]
+ Improved privacy [6] [5]
+ Energy efficiency [4]

- Limited computational resources [6] [5]
- High initial costs [4] [5]
- Maintenance complexity [6]
- Software and hardware dependencies [4]

CLOUD COMPUTING MODEL

+ Scalability and flexibility [7] [5] [8]
+ Real-time analytics and predictive modeling [9]
+ Cost efficiency [8] [10] [5]

- Latency issues [5]
- Dependence on stable internet connectivity [10] [5]
- Privacy and security risks
- High bandwidth and operational costs [11]

HYBRID COMPUTING MODEL

Combines edge and cloud computing for flexibility

Optimizes performance by balancing local and centralized processing

FUTURE RESEARCH DIRECTIONS

EDGE COMPUTING MODEL

Improve AI models for complex tasks

CLOUD COMPUTING MODEL

Reduce latency and enhance security

HYBRID COMPUTING MODEL

Develop dynamic task allocation for seamless integration [12]

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

ROLE

ANALYZE REAL-TIME DATA FROM SENSORS

DETECT IMPROPER MANEUVERS AND UNSAFE BEHAVIOR

APPLICATIONS

REAL-TIME FEEDBACK [4]

ACCIDENT PREDICTION [7]

FUTURE RESEARCH

USE ADVANCED MODELS

ANALYZE REAL-TIME DATA FROM SENSORS

IMPROVE COMPUTATIONAL EFFICIENCY AND SPEED

OUTCOME

RESPONSIVE AND EFFECTIVE SAFETY SYSTEMS

USER INTERACTION AND REAL-TIME FEEDBACK MECHANISMS

MOBILE APPS

Example: Android app with AI and IoT integration

Features: vehicle tracking, theft prevention, regulatory compliance [13]

WEB APPS

INSTANT MESSAGING PLATFORMS

Example: Real-time notifications via platforms like Telegram

Features: Accident detection and alerts using IoT and Telegram and high accuracy with GPS deviation of 1 meter [14]

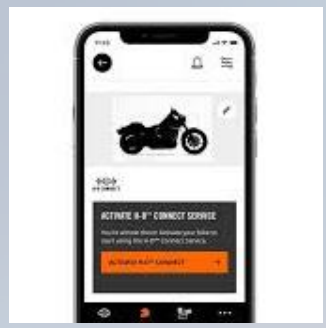
HEADS-UP DISPLAY

Example: Smart Helmets

Features: crash detection, sends real-time alerts with GPS location via IoT systems [15]

IOT INTEGRATION BY MANUFACTURERS

BMW MOTORRAD CONNECTEDRIDE SYSTEM



HARLEY-DAVIDSON LIVEWIRE CONNECT APP

KAWASAKI NINJA H2

DUCATI AND IOT USED FOR MOTOGP

PICS SOURCE: GOOGLE

CONCLUSION

CURRENT STATE

- IoT enhances rider safety and performance
- Motion sensors, AI, and data processing enable real-time tracking and predictions
- Edge, cloud, and hybrid computing improve efficiency and scalability

FUTURE RESEARCH DIRECTIONS

- System integration
- Adaptability to road conditions
- AI Model enhancement
- Cost reduction and standardization

SOURCE: PERSONAL ARCHIVE

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