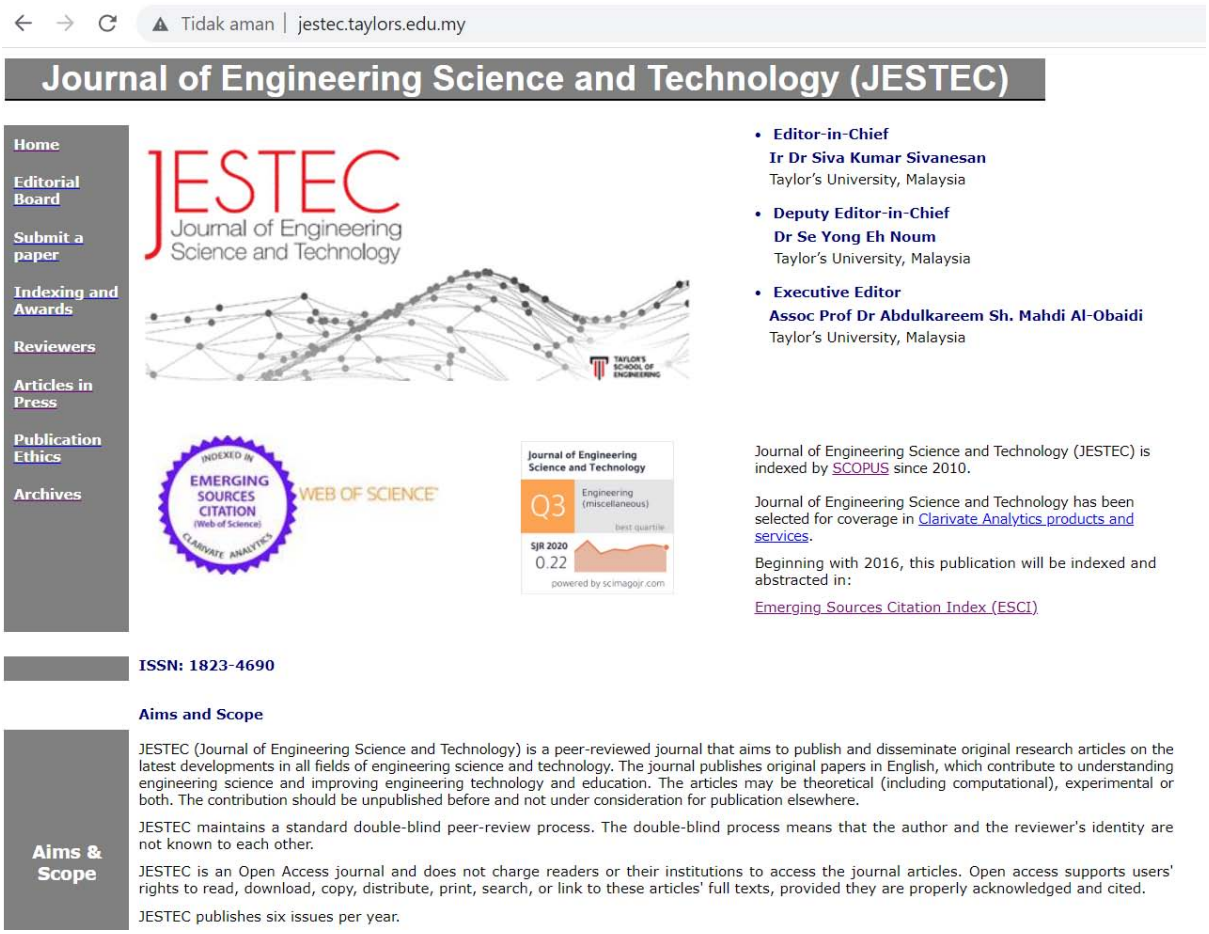
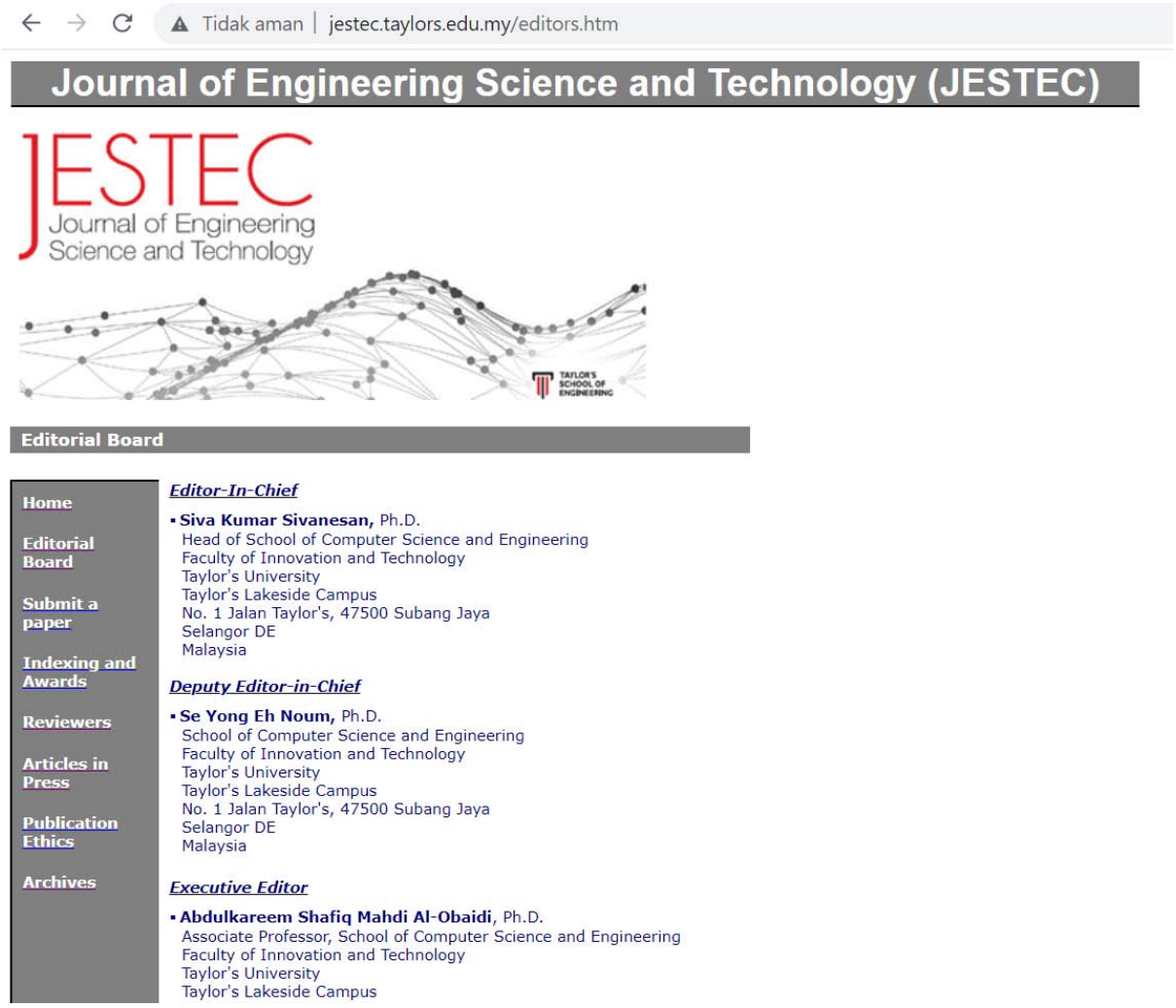
Halaman awal JESTEC

http://jestec.taylors.edu.my/



Editor JESTEC

http://jestec.taylors.edu.my/editors.htm



Tidak aman | jestec.taylors.edu.my/editors.htm

Journal of Engineering Science and Technology (JESTEC)

JESTEC
Journal of Engineering
Science and Technology

TAYLOR'S SCHOOL OF ENGINEERING

Editorial Board

Home
Editorial Board
Submit a paper
Indexing and Awards
Reviewers
Articles in Press
Publication Ethics
Archives

Editor-In-Chief

- **Siva Kumar Sivanesan,** Ph.D.
  Head of School of Computer Science and Engineering
  Faculty of Innovation and Technology
  Taylor's University
  Taylor's Lakeside Campus
  No. 1 Jalan Taylor's, 47500 Subang Jaya
  Selangor DE
  Malaysia

Deputy Editor-in-Chief

- **Se Yong Eh Noum,** Ph.D.
  School of Computer Science and Engineering
  Faculty of Innovation and Technology
  Taylor's University
  Taylor's Lakeside Campus
  No. 1 Jalan Taylor's, 47500 Subang Jaya
  Selangor DE
  Malaysia

Executive Editor

- **Abdulkareem Shafiq Mahdi Al-Obaidi**, Ph.D.
  Associate Professor, School of Computer Science and Engineering
  Faculty of Innovation and Technology
  Taylor's University
  Taylor's Lakeside Campus

Tidak aman | jestec.taylors.edu.my/editors.htm

Executive Editor

- **Abdulkareem Shafiq Mahdi Al-Obaidi**, Ph.D.
  Associate Professor, School of Computer Science and Engineering
  Faculty of Innovation and Technology
  Taylor's University
  Taylor's Lakeside Campus
  No. 1 Jalan Taylor's, 47500 Subang Jaya
  Selangor DE
  Malaysia

Editors

- **G. Davies**, Ph.D.
  Professor, Dean, Faculty School of Engineering
  The University of New South Wales
  UNSW Sydney
  NSW 2052
  Australia
  Tel: +61 2 9385 4970

- **Rodney Chaplin**, Ph.D.
  Associate, Professor, Associate Dean (International)
  Faculty of Engineering
  The University of New South Wale
  UNSW Sydney
  NSW 2052
  Australia
  Tel: +61 2 9385 6361

- **Andrew Ooi**, Ph.D.
  Associate, Professor, Assistant Dean (International)
  School of Engineering
  The University of Melbourne
  Victoria 3010
  Australia
  Tel: +61 3 8344 6732
  Fax: +61 3 9347 8784

- **David WL Hukins,** Ph.D.
  B.Sc., Ph.D. (London), D.Sc. (Manchester), C.Phys., F.Inst.P., F.I.P.E.M., F.R.S.E.
  Professor of Bio-medical Engineering
  Head of Mechanical and Manufacturing Engineering
  School of Engineering
  Mechanical Engineering
  The University of Birmingham
  Edgbaston
  Birmingham
  B15 2TT
  United Kingdom
  Tel: +44 (0)121 414 3543
  Fax: +44 (0)121 414 3958

estec.taylors.edu.my/Archives.htm

Tidak aman | jestec.taylors.edu.my/editors.htm

- **Takayuki Saito**, Ph.D.
  Professor, Shizuoka University
  Graduate School of Science and Engineering
  3-5-1 Johoku
  Hamamatsu
  Shizuoka 432-8561
  Japan
  Tel: +81 53 478 1601
  Fax: +81 53 478 1601

- **S. B. Chin**, Ph.D.
  Professor, The University of Sheffield
  Mechanical Engineering Department
  Mappin Street, Sheffield
  S1 3JD,
  United Kingdom
  Tel: +44 (0) 114 222 7735
  Fax: +44 (0) 114 222 7890

- **Xiaoyu Luo,** Ph.D.
  Professor, Department of Mathematics
  University of Glasgow
  Glasgow G12 8QW
  Tel: +44 (0)141 3304746
  Fax:+44 (0)141 3304111

- **Stephen B M Beck**, Ph.D.
  Professor in Mechanical Engineering
  Faculty Director of Learning and Teaching – Engineering
  Department of Mechanical Engineering
  The University of Sheffield
  Mappin Street
  Sheffield
  S1 3JD
  United Kingdom
  Tel: +44(0)114 2227730
  Fax: +44(0)114 2227890

- **Xiao (Yun) Xu,** Ph.D.
  Professor of Biofluid Mechanics
  Department of Chemical Engineering
  Imperial College
  London
  United Kingdom
  Tel: +44 (0)20 7594 5588
  Fax: +44 (0)20 7594 5700

- **Seeram Ramakrishna**, Ph.D.
  Professor, Dean, Faculty of Engineering
  Dean's Office, Block EA, #07-26
  9 Engineering Drive 1,

Tidak aman | jestec.taylors.edu.my/editors.htm

Fax: +44(0)114 2227890

- **Xiao (Yun) Xu,** Ph.D.
  Professor of Biofluid Mechanics
  Department of Chemical Engineering
  Imperial College
  London
  United Kingdom
  Tel: +44 (0)20 7594 5588
  Fax: +44 (0)20 7594 5700

- **Seeram Ramakrishna**, Ph.D.
  Professor, Dean, Faculty of Engineering
  Dean's Office, Block EA, #07-26
  9 Engineering Drive 1,
  National University of Singapore,
  Singapore 117576
  Tel: +65 6516 2142
  Fax: +65 6775 0120

- **Ramesh Singh Kuldip Singh**, Ph.D.
  Senior Professor of Mechanical and Materials Engineering
  Faculty of Engineering
  University of Malaya, 50603 Kuala Lumpur, Malaysia
  Universiti Teknologi Brunei, BE1410 Gadong, Brunei Darussalam
  Tel: +603 79677671, 673 2461020

- **Gary Hawley,** Ph.D.
  Professor of Automotive Engineering
  Dean and Medlock Chair of Engineering,
  Faculty of Engineering and Design
  University of Bath,
  Claverton Down, Bath BA2 7AY
  United Kingdom
  Tel: 44(0)1225 386855

- **Yousif Abdall Abakr**, Ph.D.
  School of Mechanical Engineering
  The University of Nottingham, Malaysia Campus
  Jalan Broga, 43500 Semenyih, Selangor
  Malaysia
  Tel: 00 603 8924 8143

- **R. Rajesh @ Nithyanandam,** Ph.D, PGCHeTL, MIChemE
  Professor, Department of Chemical Engineering
  Mohamed Sathak Engineering College
  Kilakarai, Tamil Nadu
  (Affiliated to Anna University)
  India
  Contact No.: 0091-8925326185

Reviewer JESTEC

http://jestec.taylors.edu.my/reviewers.html

Tidak aman | jestec.taylors.edu.my/reviewers.html

Journal of Engineering Science and Technology (JESTEC)

Reviewers

JESTEC Journal of Engineering Science and Technology

INDEXED IN EMERGING SOURCES CITATION (Web of Science) CLARIVATE ANALYTICS WEB OF SCIENCE

Besides our contributors, we owe our success and sustainability to our reviewers.
If you are interested in joining the list of our reviewers, please

- download JESTEC Reviewers Form for reviewers,
- fill it in completely,
- attach you latest CV and
- send both to the Executive Editor.

- **Abdulkareem Sh. Mahdi Al-Obaidi,** Ph.D., CEng MIMechE (Mechanical Engineering)
  Associate Professor, School of Computer Science and Engineering
  Executive Editor, Journal of Engineering Science & Technology
  Taylor's University
  Taylor's Lakeside Campus
  No. 1 Jalan Taylor's, 47500 Subang Jaya
  Selangor DE
  Malaysia
  E-mail: abdulkareem.mahdi@taylors.edu.my

- **David WL Hukins,** Ph.D. B.Sc., Ph.D. (London), D.Sc. (Manchester), C.Phys., F.Inst.P., F.I.P.E.M., F.R.S.E.
  Professor of Bio-medical Engineering
  Head of Mechanical and Manufacturing Engineering
  School of Engineering
  Mechanical Engineering
  The University of Birmingham

Tidak aman | jestec.taylors.edu.my/reviewers.html

- **Takayuki Saito,** Ph.D. (Physics and Astronomy)
  Professor
  Shizuoka University
  Graduate School of Science and Engineering
  3-5-1 Johoku
  Hamamatsu
  Shizuoka 432-8561
  Japan
  E-mail: ttsaito@ipc.shizuoka.ac.jp

- **Stephen B M Beck**, Ph.D. (Mechanical Engineering)
  Professor in Mechanical Engineering
  Faculty Director of Learning and Teaching - Engineering
  Department of Mechanical Engineering
  The University of Sheffield
  Mappin Street
  Sheffield
  S1 3JD
  United Kingdom
  E-mail: s.beck@sheffield.ac.uk

- **Sulaiman Al-Zuhair**, Ph.D. (Chemical Engineering)
  Associate Professor
  Chemical and Petroleum Engineering Department
  Faculty of Engineering
  UAE University
  P.O. Box 17555
  AlAin, U.A.E.
  E-mail: alzuhair72@yahoo.com

- **Manoj Kulshreshtha**, Ph.D. (Food Engineering)
  Professor and Dean, Faculty of Science Engineering & Technology
  Director, Amity Institute of Food Technology
  Amity University Uttar Pradesh, Noida (UP)
  India
  E-mail: manojkul@gmail.com

- **Yousif Abdall Abakr**, Ph.D. (Mechanical Engineering)
  School of Mechanical Engineering
  The University of Nottingham, Malaysia Campus
  Jalan Broga, 43500 Semenyih, Selangor
  Malaysia
  E-mail: yousif.abakr@nottingham.edu.my

- **Marwan Alrubaye,** Ph.D. CEng MIChemEl (Chemical Engineering)
  Research and Development Director
  Executive Mat Service Ltd.
  #6, 115 28 Street S.E.
  Calgary, AB, T2A 5K4
  Canada
  E-mail: marwanmalik@yahoo.com

Tidak aman | jestec.taylors.edu.my/reviewers.html

- **Lester Ingber**, Ph.D. (Theoretical Physics)
  Professor
  Lester Ingber Research
  USA
  E-mail: lester@ingber.com

- **Kartini Kamaruddin**, B.Eng [Hons], MSc [Construction], PhD [Concrete Technology]
  Professor Ir Dr
  Lecturer
  PEPC, MIEM, FCSM, AAE
  Faculty of Civil Engineering
  Universiti Teknologi MARA
  40450 Shah Alam, Selangor
  MALAYSIA
  E-mail: kartini@uitm.edu.my

- **Rita Moura Fortes**, Ph.D. (Civil Engineering)
  Professor
  Mackenzie Presbyterian University
  Engineering School
  Civil Engineering,
  Brazil
  E-mail: rita.fortes@mackenzie.br

- **Ronny Widjaja**, Ph.D. (Mechanical Engineering)
  Defence Science and Technology Organisation
  Australia
  E-mail: Ronny.Widjaja@dsto.defence.gov.au

- **Mohamed Kheireddine Aroua**, Ph.D. (Chemical Engineering)
  University Malaya
  E-mail: mk_aroua@um.edu.my

- **Hussain H. Al-Kayiem**, Ph.D. (Mechanical Engineering)
  Professor
  Mechanical Engineering Department, block 17
  Universiti Teknologi PETRONAS
  31750 Tronoh
  Perak
  Malaysia
  E-mail: hussain_kayiem@utp.edu.my

- **Suhana binti Koting**, Ph.D. (Civil Engineering)
  Senior Lecturer, Department of Civil Engineering
  Faculty of Engineering University of Malaya
  50603 Lembah Pantai,
  Kuala Lumpur,
  Malaysia
  E-mail: suhana_koting@um.edu.my

- **Sucharita Srirangam,** PhD in Architecture (Edinburgh, UK)
  Senior Lecturer

JESTEC Volume 16, Issue 4, August 2021

Page 2795 – 3599

http://jestec.taylors.edu.my/V16Issue4.htm

Tidak aman | jestec.taylors.edu.my/V16Issue4.htm

Music classification using association rule and k nearest neighbor

K. C. Waghmare, B. A. Sonkamble

2876 - 2887

Permeation of potassium chloride from its solution into deionized water through poly-(vinyl alcohol)/glutaraldehyde/ *Premna Oblongifolia Merr* membrane

H. Hendrawan, F. Khoerunnisa, F. Z. Maulidah, N. T. Gultom

2888 - 2900

Comparative analysis of performance of deep CNN based framework for brain MRI classification using transfer learning

S. M. Kulkarni, G. Sundari

2901 - 2917

Driving cycle tracking device (DC-TRAD)

S. K. Arun, I. N. Anida, W. M. W. Mariam, J. S. Norbakyah, A. R. Salisa

2918 - 2926

An enhanced naïve bayes classification algorithm to predict type ii diabetes

P. B. K. Chowdary, R. U. Kumar

2927 - 2937

Cooling vest (CV-F) to improve recovery effectiveness of Pencak Silat martial arts student-athletes

J. Lubis, A. Sukur, A. Haqiyah, A. A. Irawan, D. Suliyanthini, S. Sukriadi, E. Susianti

2938 - 2949

Fiber laser welding of similar and dissimilar aluminum alloys

Y. M. Baqer, S. Ramesh, F. Yusof, R. Mahmoodian, S. Sivakumar, T. Wu, C. Tan

2950 - 2959

Effectiveness of ventilation strategies in reducing the temperature in the main prayer halls of mosques in Malaysia

N. B. I. Rasli, N. A. Ramli, M. R. Ismail, N. S. Zainordin, M. R. Razman

2960 - 2979

Sustainable architectural design in the Egyptian natural protected areas - Al-Gharqana fishermen village, NABQ protected area, Sharm El Sheikh, Egypt

W. M. Yousef, A. A. Elmansoury

2980 - 3004

Green approach in designing Rumah Susun Sewa Sederhana (Flat Rent) in Rancacili Bandung Indonesia

W. S. Abioso, G. B. Kusnadi

3005 - 3014

Tidak aman | jestec.taylors.edu.my/V16Issue4.htm

Magnetic flux leakage (MFL) Defect characterization using I-KAZ statistical analysis for non-destructive test (NDT) application
N. A. Sharif, R. Ramli, M. Z. Nuawi, A. Z. Mohamed, M. S. Amiri, K. Ahmad
3015 - 3024

Modified fiber bragg grating based heavy metal ions sensor in C-band
H. A. Mohammed, B. A. Esttaifan, M. H. Yaacob
3025 - 3032

SDN based device to device communication architecture for 5G mobile networks
M. K. Murtadha
3033 - 3047

Analytical hierarchy process (AHP) to determine zoning region vocational education
I. M. Purwaamijaya, R. M. Masri
3048 - 3056

Tile damage detection in temple facade via convolutional neural networks
K. Chaiyasarn, A. Buatik
3057 - 3071

Investigating the particle size distribution of synthesized copper powder via electrodeposition
S. Wahyudi, S. Soepriyanto, M. Z. Mubarok, Sutarno, M. Iqbal, A. T. Qodratillah
3072 - 3083

Synthesis and study of the mechanical properties of biodegradable polyvinyl alcohol/eggshell composites
A. T. Abbas, A. J. Al-Obaidi, S. J. Ahmed
3084 - 3093

Development of augmented reality technology in vocational school: A socio-technical curriculum framework
I. Widiaty, A. Ana, Suciati, D. Kuswardhana, Y. Achdiani, S. R. Mubaroq
3094 - 3103

Modeling the pedestrians walking behaviour at a commercial center in Baghdad city
H. A. Khudhair, S. M. Alsadik
3104 - 3118

Parallel object tracking in image sequences based on k-means and an improved gradient vector flow
H. Meddeber, B. Yagoubi
3119 - 3135

Tidak aman | jestec.taylors.edu.my/V16Issue4.htm

Development of models for forecasting of seasonal ground level ozone (O_3)

N. L. M. Napi, S. Abdullah, A. A. Mansor, A. N. Ahmed, M. Ismail

3136 - 3154

Study of hybrid flood forecasting approach combining multiplicate seasonal ARIMA and hybrid-neuro fuzzy based on long-term time series

S. Supatmi, R. Hou, I. D. Sumitra

3155 - 3164

Landmarks exploration algorithm for mobile robot indoor localization using vision sensor

M. N. Noaman, M. Qasim, O. Y. Ismael

3165 - 3184

Bubble coalescence model effect on oxygen mass transfer using non-Newtonian fluids

L. Niño, M. Peñuela, G. Gelves

3185 - 3198

Green synthesis of iron nanoparticle using tea leave extract for removal ciprofloxacin (CIP) from aqueous medium

M. A. Atiya, A. K. Hassan, F. Q. Kadhim

3199 - 3221

River water monitoring system using internet of things to determine the location of river pollution

A. H. S. Budi, E. A. Juanda, I. Kustiawan, N. N. N. Kurniadi, H. Henny

3222 - 3233

Inorganic perovskite solar cells based on $CsPbBr_3$ films grown by different thermal evaporation routes

G. Gordillo, J. C. Peña, C. A. Otálora, O. G. Torres

3234 - 3249

Classification of benign and malignant pulmonary nodules in LDCT images using radiomic features

S. R. Ziyad, V. Radha, T. Vayyapuri

3250 - 3266

Flexural behavior of hollow reinforced concrete haunched (RCH) beams

S. Suparp, P. Joyklad

3267 - 3282

Investigating and developing the ability to model physics phenomena

Sujito, Liliasari, A. Suhandi, E. Soewono

3283 - 3294

Tidak aman | jestec.taylors.edu.my/V16Issue4.htm

Numerical parametric study on the flexural capacity of reinforced concrete beams strengthened with non-metallic materials

Y. Haryanto, H. -T. Hu, A. L. Han, F.-P. Hsiao, N. G. Wariyatno, B. A. Hidayat

3295 - 3311

Customized AlexNet models for automatic classification of skin diseases

A. K. C. Huong, K. G. Tay, X. T. I. Ngu

3312 - 3324

A mathematical model to enable the virtual commissioning simulation of wick soilless cultivations

G. Barbieri, G. Quintero, O. Cerrato, J. Otero, D. Zanger, A. Mejia

3325 - 3342

Driving safety application using wearable device and mobile technology

E. B. Setiawan, T. F. Fatoni

3343 - 3357

JaCoCo-coverage based statistical approach for ranking and selecting key classes in object-oriented software

B. I. Al-Ahmad, I. Al-Taharwa , R. S. Alkhawaldeh, I. M. Alazzam, N. Ghatasheh

3358 - 3386

Propose a conceptual framework for the cloud ERP adoption among Malaysian SMES

A. Razzaq, S. A. Asmai, Z.. Z. Abidin, M. S. Talib, M. F. Ali, A. A. Mohammed

3387 - 3406

Convection heat transfer performance for the SCF-CO_2 media in mini-tube with fins experimentally

A. A. Jaddoa

3407 - 3420

Comparisonal analysis mechanical properties of material mixer blade AISI 1522 carbon steel and white cast iron due to hardening process

I. Kuntadi, U. Sumirat, M. Komaro, H. F. Al-Gifari

3421 - 3434

Using agricultural waste as biosorbent for hazardous brilliant green dye removal from aqueous solutions

S. M. Badr, I. S. Samaka

3435 - 3454

Establishing a computerized model for designing different types of concrete in terms of strength, quantity and cost

A. A. Gamal, M. S. Bakir, A. Mahmoud, M. Abdel-Hamid

3455 - 3480

Tidak aman | jestec.taylors.edu.my/V16Issue4.htm

Establishing a computerized model for designing different types of concrete in terms of strength, quantity and cost

A. A. Gamal, M. S. Bakir, A. Mahmoud, M. Abdel-Hamid

3455 - 3480

Reduction of PAPR pattern with low complexity using hybrid-pts scheme for the 4G and 5G multicarrier systems

F. M. Mustafa, H. M. Bierk, M. N. Hussain

3481 - 3504

Comparative analysis of AHP and fuzzy AHP for solar power plant site selection

A. G. Abdullah, N. A. Dwitasari, A. H. Setiorini, D. L. Hakim

3505 - 3520

The effects of multi-layers surfaces on the elastic deformation of journal bearing

M. Z. Khalifa

3521 - 3533

NIPSA intrusion classification

M. N. B. Ali, M. M. Saudi, T. Bhuiyan, A. B. Ahmad, M. N. Islam

3534 - 3547

The impact of problem-based learning toward enhancing mathematical thinking: A meta-analysis study

D. Juandi, M. Tamur

3548 - 3561

Suction effect on shear strength of an over consolidated unsaturated soil

H. M. Mekkiyah, M. Y. Fattah, I. A. Abd

3562 - 3575

Designing a cMOOC for academic communities to support awareness of scaffolding procedure on sharing knowledge

R. Kusumawati, P. Setyosari, I. N. S. Degeng, S. Ulfa

3576 - 3587

Comparison of MD & ZCC one dimension code for optical-CDMA over multi-mode fiber based on Laguerre-Gaussian modes

A. Ghazi, S. A. Aljunid, S. Z. S. Idrus, A. Fareed, L. Hamood, R. Endut, N. Ali, C. B. M. Rashidi, A. M. Fakhrudeen, A. Al-Dawoodi, R. Matem, S. S. Abdullah

3588 - 3599

SCHOOL OF ENGINEERING
TAYLOR'S UNIVERSITY

Copyright ©2006-2021 by: School of Engineering. Taylor's University

Journal of Engineering Science ar | Scopus preview - Setiawan, E. B. | scopus.com/authid/detail.uri?authorId=56829262300

View list in search results format

View references

Set document alert

Article

Driving safety application using wearable device and mobile technology

0 Citations

Setiawan, E.B., Fatoni, T.F.

Journal of Engineering Science and Technology, 2021, 16(4), pp. 3343–3357

Show abstract | Related documents

Conference Paper • *Open access*

Private Cloud Development in West Java Cooperative and Entrepreneurship Education and Training Center

1 Citations

Setiyadi, A., Setiawan, E.B.

IOP Conference Series: Materials Science and Engineering, 2020, 879(1), 012036

Show abstract | Related documents

Conference Paper • *Open access*

Blind scanner Server and Batch Programming Implementation in the Process of Automatically Scan Documents

1 Citations

Setiyadi, A., Setiawan, E.B.

IOP Conference Series: Materials Science and Engineering, 2019, 662(2), 022068

Show abstract | Related documents

Conference Paper • *Open access*

Quality Analysis of Mobile Web Server

1 Citations

Setiawan, E.B., Setiyadi, A., Wahdiniwaty, R.

IOP Conference Series: Materials Science and Engineering, 2019, 662(2), 022043

Show abstract | Related documents

Journal of Engineering Science ar
scimagojr.com/journalsearch.php?q=18200156709&tip=sid&exact=no
also developed by scimago: SCIMAGO INSTITUTIONS RANKINGS
SJR Scimago Journal & Country Rank
Enter Journal Title, ISSN or Publisher Name
Home Journal Rankings Country Rankings Viz Tools Help About Us

Journal of Engineering Science and Technology

COUNTRY

Malaysia

Universities and research institutions in Malaysia

SUBJECT AREA AND CATEGORY

Engineering
Engineering (miscellaneous)

PUBLISHER

Taylor's University

Taylors University in Scimago Institutions Rankings

H-INDEX

27

PUBLICATION TYPE

Journals

ISSN

18234690

COVERAGE

2009-2020

INFORMATION

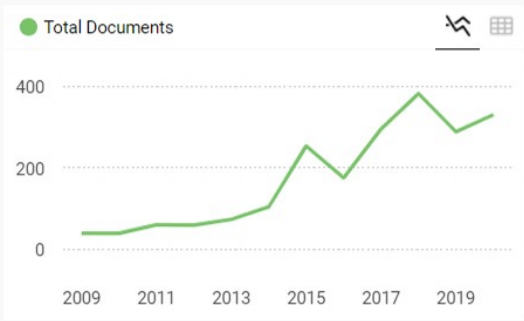
Homepage

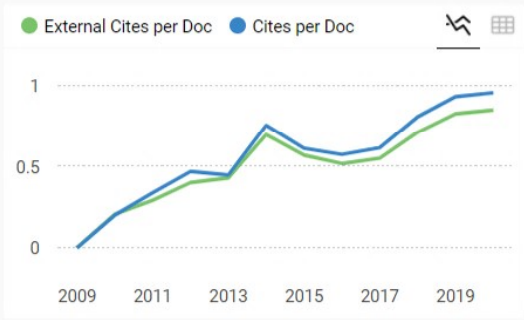
How to publish in this journal

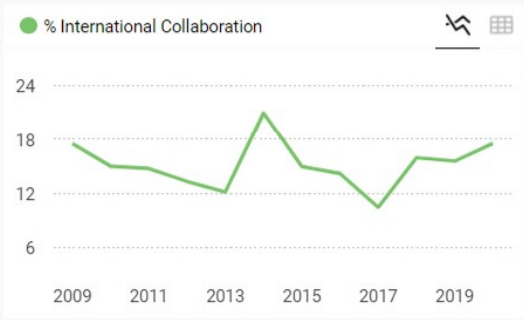
g.davies@unsw.edu.au

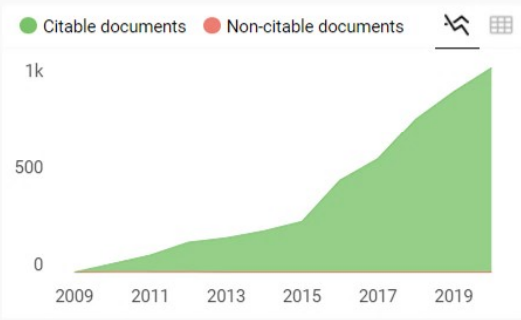
Journal of Engineering Science ar

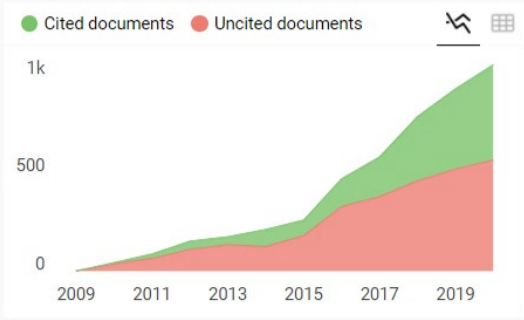
scimagojr.com/journalsearch.php?q=18200156709&tip=sid&exact=no











← Show this widget in your own website

Just copy the code below and paste within your html code:

<a href="https://www.scima

Metrics based on Scopus® data as of April 2021

Journal of Engineering Science and Technology
Vol. 16, No. 4 (2021) 3343 – 3357
© School of Engineering, Taylor's University

DRIVING SAFETY APPLICATION USING WEARABLE DEVICE AND MOBILE TECHNOLOGY

EKO BUDI SETIAWAN*, TUBAGUS F. FATONI

Informatics Engineering, Universitas Komputer Indonesia,
Jl. Dipatiukur 102-116 Bandung, West Java, Indonesia, 40132
*Corresponding Author: eko@email.unikom.ac.id

Abstract

This research is conducted to help motorbike riders in avoiding accidents caused by drowsiness. The wearable device technology used was smartband and accelerometer from Android smartphone. It was used to obtain heart rate data and detect drowsiness experienced by motorbike riders. An accelerometer was used to detect if an accident occurs and send the information to the driver's family. The method in this research was quantitative research and development. The results obtained showed that detecting drowsiness is equal to 80% and the accident detection test gets an accuracy of 100%. The accuracy of drowsiness detection during the day is 75% and testing that carried out at night has an accuracy rate of 90%. Functional suitability test results obtained a value of 100%, compatibility aspects have 100%, usability aspects of 84.7%, and performance aspects in terms of response time are in the range of satisfaction equal to 3.88 seconds. The tests conducted using Likert scale showed that the application is feasible to use, and the driving safety application has reached its desired purpose. This research impacts on driving safety that must prioritize safety both for self and for others.

Keywords: Accelerometer, Drowsiness, Motorbike driver, Safety ride, Smartband,.

1. Introduction

Based on data released by the NTSC Indonesia from 2010 to 2016, 41 accident investigations caused as many as 443 fatalities. One of the causes of accidents comes from driver error. There were 69.7% of motor vehicle accidents caused by sleepy motorists [1]. Drowsiness is a condition where someone feels like sleeping. Drowsiness can happen at the inappropriate time, for example working, studying, or driving. Sleepiness is usually characterized by fatigue, loss of consciousness, falling asleep, interference with activity [2], and forgetting [3]. Besides of hurting oneself, it can also harm other motorbike riders.

Drowsiness can trigger various problems, such as disturbing driving performance [4], productivity, affecting one's emotions, disturbing social interactions, and the most fatal is accidents both on the road and in the work environment [5]. Accidents can occur not only because of human factors but also road or vehicle factors. Accident can be handled well if the driver is still conscious and asks for help or a family member knows if there is an accident just occurred. There are cases of late accident handling because the family do not know [6]. An accelerometer sensor can detect the tilt or change the position of an object so that family can know information about accidents [7].

Several studies have been conducted related to this research such as wearable device technology use for drowsiness detection [8], text messaging use to control smartphones remotely [9], accelerometer data use to identify idling times of a vehicle [10] and assess road quality [11]. In this research, to detect drowsiness is the Mi Band 3 smartband because it can track the user's activities such as heart rate [12], sleep quality [13], and activity trackers [14].

In contrast to Aloul's research which uses smartphones to detect car accidents, this research uses smartphones and wearable devices to detect motorbike rider accidents [15]. A smartband retrieved the motorbike driver's heart rate data and sent it to Android smartphone to calculate the average heart rate. If it is categorized as sleepy, the smartband will vibrate and the smartphone will sound an alarm. When an accident driving is occurred, the accelerometer sensor on Android smartphone will detect the location and time data then send it to the family. This research aims to build a driving safety application and uses a software development life cycle method for the system development process.

2. Method

This research consisted of several stages. The initial stage is to carry out case analysis to obtain accident-related data, analyse sleepiness, and accidents up to the implementation stage, and system testing. Figure 1 shows the stages flow carried out in this research.

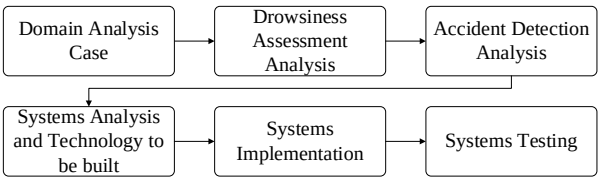


Fig. 1. Stage of research method.

2.1. Domain Analysis Case

At this stage, an analysis of cases is carried out in the form of an analysis of common problems when driving accidents. There is up to 69.7% of motor vehicle accidents caused by rider drowsiness. Every day many riders are passing by on the highway. Based on data from BPS Indonesia (Central Bureau of Statistics) recorded that until 2017, there were 138,556,699 motor vehicles units in Indonesia. This number is increasing every time and it can also cause higher accident rates.

Drowsiness while riding can occur due to several factors such as fatigue or the urge to sleep at night [16], long travel, or less fit body condition. Drowsy while also riding can-do harm to other riders. Drowsiness is a condition in which a person feels like to sleep. It can happen at the most opportune times, such as at work while studying or while riding. Thus, the results of the domain analysis case stage in this study are that several reasons can cause driving accidents, one of which is sleepy.

2.2. Drowsiness assessment analysis

At this stage, an analysis of the heartbeat data obtained from the smartband was calculated based on previous studies to determine the driver's condition. It is because drowsiness usually occurs because of lack of sleep. Everyone has different sleep needs, depending on age and daily activities. Ideally, adults need 7-9 hours of sleep per day, while children and teenagers need 9 hours, toddlers need 10-12 hours, and the new-born takes 16-18 hours. The following workflow of drowsiness assessment in this research is shown in Fig. 2.

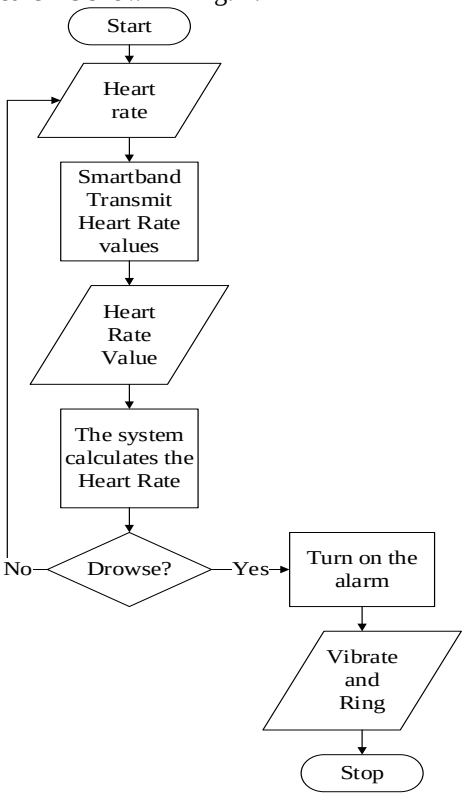


Fig. 2. Drowsiness assessment workflow.

Drowsiness detection application was made using smartband. It can be used on the left or right wrist to detect the heart rate. Mi Band 3 uses green LED light paired with a light-sensitive photodiode to detect the heart rate flowing through the wrist. When the heart beats, the smartband will reflect light and its reflections is readable by a photodiode. If it does not reflect light, this means that the heart rate is high. Through the observation, the sensor analyses the data and calculates the heart rate. Through blinking LED lights hundreds of times per second, Mi Band 3 can calculate the heartbeat frequency.

The heart rate is the number of heartbeats per unit of time, usually expressed in beats per minute (bpm) [17]. The normal heart rate of adults is 60-100 bpm with the heart rate maximum is 220 - age [18]. Table 1 below shows a normal heartbeat.

Table 1. Normal heart rate.

Age	Normal Heart Rate
1-2 years	80-130
2-6 years	70-120
6-10 years	70-110
Ten years and over	60-100

The time body relaxes either at rest, drowsiness, sleep, and heart rate is relatively slower than doing the activity. In general, the decline ranges from 10-20% of the current state of operation. This value has been validated by an expert Doctor.

2.3. Accident detection analysis

At this stage, an analysis of the smartphone slope data was calculated based on the data from previous studies. It is done to determine the position of the motor falls is to the left or right. A smartphone today generally already has an accelerometer sensor for various needs, such as changing the display from portrait to landscape by tilting the body of the phone. It happens because of a change to the coordinates x, y, and z smartphone. The x-axis is the form of a horizontal line, a vertical line forming the y-axis, and a z-axis pointing to the front and rear of the display device. Accelerometer values is shown in Table 2.

Table 2. Accelerometer axis value.

Position	X	Y	Z
Vertical	0	1	0
Vertical reversed	0	-1	0
Left landscape	1	0	0
Right landscape	-1	0	0
Flat	0	0	1
Flat reversed	0	0	-1

The calculation of the value of the accelerometer is focused on the x-axis. This is because the amount of x to determine the slope of smartphone, which is placed on the speedometers to find out the overall effect accelerometer and to detect an accident. The following workflow drowsiness ratings is shown in Fig. 3.

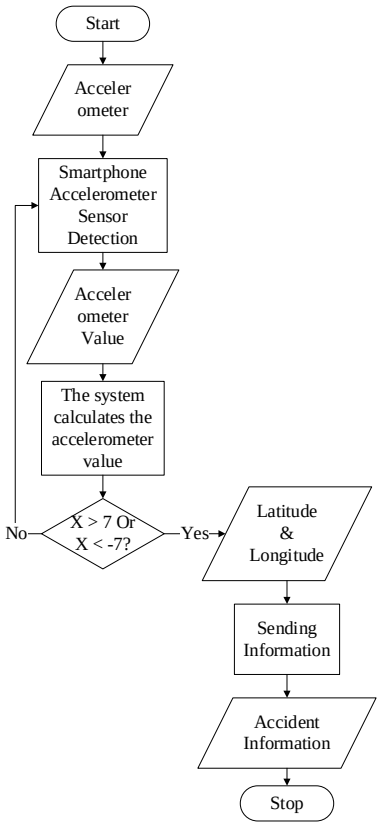


Fig. 3. Accident detection workflow.

2.4. Tools and technology

The technologies used in this research are as follows:

a. Smartband
Smartband was used to get the heart rate that detects drowsiness. Smartband is a device or application for monitoring and keeping track of fitness-related metrics such as walking or running distance, calorie consumption, heart rate, and sleep quality.

b. Accelerometer
This technology was used to get slope data of the smartphone and identify an accident. In this research, the accelerometer was used as a detector of the wave of the vehicle due to holes or damaged roads. It can change the display from portrait to landscape by tilting the smartphone to read three axes from different directions [19].

c. Google Maps API
It is used to get the latitude and longitude values in detecting the location of current accident [20].

d. SMS Gateway
This technology is used to provide and send information to a registered destination phone number when accident occurs [21].

2.5. System implementation

At the application development, along with the implementation of technology, it has been analysed previously. At this stage, the start of implementation drowsiness assessment, implementation of crash detection, smart band linking implementation, and the implementation of the SMS Gateway was done.

2.6. System testing

The results of this stage are testing process analysis technique based on functional suitability, compatibility, usability, and efficiency. The functional suitability test was assessed by the Guttman scale. After getting the test results in the form of points, it was then analysed using criteria in the document quality for Android applications as shown in Table 3.

Table 3. Functional Quality Standards Suitability.

Rankings	Warning	Critical
No error	0 points	0 points
An easy mistake	1 point	-
Difficult errors	2 points	-
Fatal error	4 points	-
The test fails	-	5 points

Compatibility analysis was conducted by operationally test series with the commencement of the installation of applications on different versions of operating systems and various specifications of smartphones based on the Android platform [22]. The next stage of calculating the percentage score test results is to determine the quality level of compatibility aspects, namely:

$$\text{Percentage of Eligibility} = \frac{\text{Score obtained}}{\text{Maximum Score}} \text{ x } 100\ \% \quad (1)$$

The usability aspect test was used Likert scale. The instrument's use questionnaire consisted of 30 questions for users to show the attitude towards ease of use of the application [23]. After finding the results of the calculations score, then a comparison with the criteria in Table 4 was made [24].

Table 4. Criteria interpretation score.

Percentage (%)	Interpretation
0% - 20%	Very unfit
21% - 40%	Less worthy
41% - 60%	fairly decent
61% - 80%	worthy
81% - 100%	very decent

Quality analysis of the efficiency performance was done by calculating the average response time of each activity. It was executed using program function trace view [25]. Tests on the performance aspect performed at least five times the amount calculated average response time when an application retrieves data from the server and then shown into the system [26]. The results are then compared in Table 5 user satisfaction with the response time [27].

Table 5. User satisfaction predicate.

Response Time (seconds)	Predicate
<3	Very satisfied
3-9	Satisfied
9-12	Quite happy
> 12	Not satisfied

3. Results and Discussion

These stages include results from testing assessment and discuss the results obtained for the implementation of further research.

3.1. Drowsiness assessment

Calculation of heart rate obtained are sent to the smartphone using Bluetooth 4.0 connection from Mi Band 3. The heartbeat data received by smart band are reprocessed to get the average heart rate. Here is the value of heart rate in normal conditions of 5 samples at the age of 21-23. The calculation of the average calculation of each sample are obtained while relaxing, during activity, sport, or at rest which is shown in Table 6.

Table 6. Calculation of heart rate average (BPM).

Sample	Age	Relaxing	Activity	Sport	Rest
1st sample	23	65	85	105	56
2nd sample	21	72	91	112	64
3rd sample	22	64	82	102	60
4th sample	22	62	80	98	54
5th sample	22	68	88	101	58

A summary from Table 6 is the average heart rate when relaxing = 66 BPM, during activity = 85 BPM, sport = 104 BPM, and rest = 58 BPM. Based on Table 6, it can be concluded that if the average heart rate of each person is different. Moreover, the theory from an expert doctor claim that if a person experiences drowsiness, the heart rate will decrease by approximately 10 to 20%. Calculation of the average heart rate was done in 15 seconds. The example of drowsiness assessment was a rider aged 22 years with a fit condition and has a regular heart rate of 80 BPM. From the theory when a person experiences drowsiness heart rate decreases by 10-20% from the current normal circumstances, the following formula determines the heart rate when a person is drowsy.

$$H_{beat} = N_{beat} - \frac{20}{100} \text{ x } N_{beat} \quad (2)$$

If N_{beat} = 80, then :
H_{beat} = 80 - 16
H_{beat} = 64 BPM
If the rider's heart rate is less than 64 BPM or 64 BPM, it is considered drowsy.

3.2. Detection of accident assessment

In this study, the smartphone was attached to the top speedometer. Table 7 shows the standard minimum values and maximum values accelerometer in a normal condition.

Table 7. Testing standard value accelerometer.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-0.13	0.16
Y	3.12	3.23
Z	8.70	9.65

Table 8 shows the minimum and maximum value from the accelerometer when receiving shocks while riding. The shocks that occurred were small to moderate shocks.

Table 8. Testing shock value accelerometer while riding.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-2.91	3.48
Y	2.61	5.44
Z	4.69	12.68

The occurrence of sudden braking also causes shocks. Table 9 shows the minimum and maximum values from the accelerometer when receiving shocks and a sudden brake is applied.

Table 9. Testing value accelerometer when brakes sudden shocks.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-3.52	3.86
Y	0.38	8.02
Z	0.28	20.20

Table 10 shows the minimum and maximum values from the accelerometer when receiving a shock during an accident occurs with the motorbike position falls to the right. While riding, it will declare in a motorbike accident in which position fell to the right.

Table 10. Accelerometer shock value current testing accident occurs.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-23.06	9.87
Y	-4.38	10.67
Z	-17.20	24.74

For the example assessment of the accident, a 22-year-old motorbike driver suffered an accident that caused the motor to fall to the right and give the accelerometer value on the x-axis of -7.56 m/s. After several experiments conducted in this research, it can ensure that the motorbike is said to have fallen when the value of the axis x>7 m / s or x<-7 m/s. To determine an accident occurred used a logical formula, which show as follows:

$A_{BL} = X_{axis} > 7 \vee X_{axis} < -7$

If X_{axis} = -7.56, then:
A_{BL} = -7,56>7 ∨ -7,56 <-7
A_{BL} = false ∨ true
A_{BL} = true
When A_{BL} is true, then it will be detected as an accident.

3.3. System architecture

The system architecture in this research is shown in Fig. 4. The smartband is used to detect the motorbike driver heartbeat. When the system detects drowsiness, it will sound an alarm and vibrate to riders. If an accident occurs, the system will detect it, take the scene, and send the location information via SMS to the family of the victim or the destination number that has been registered in the application.

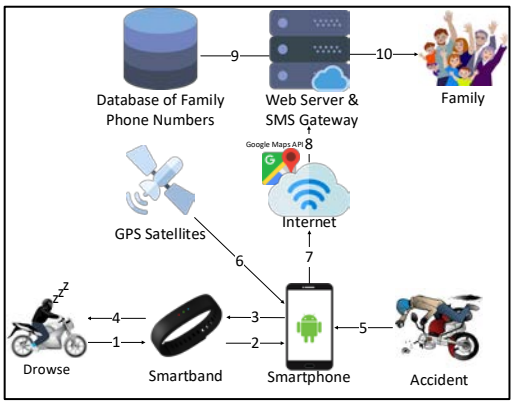


Fig. 4. System architecture.

The system procedure describes the activity process from the side of the driver, the system, and the family. A description of a system procedure in this research is shown in Fig. 5.

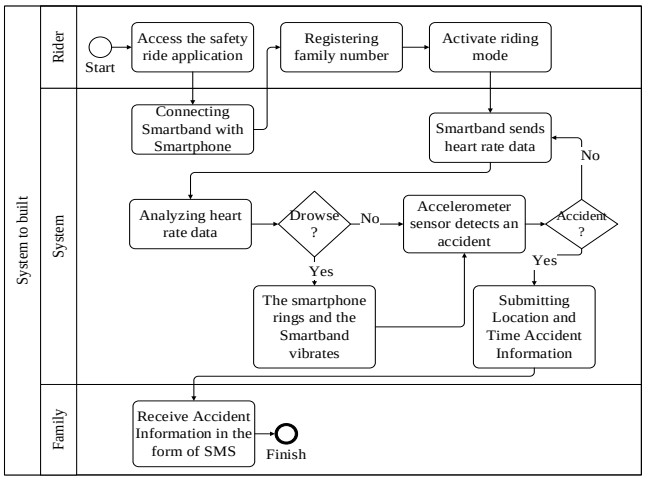
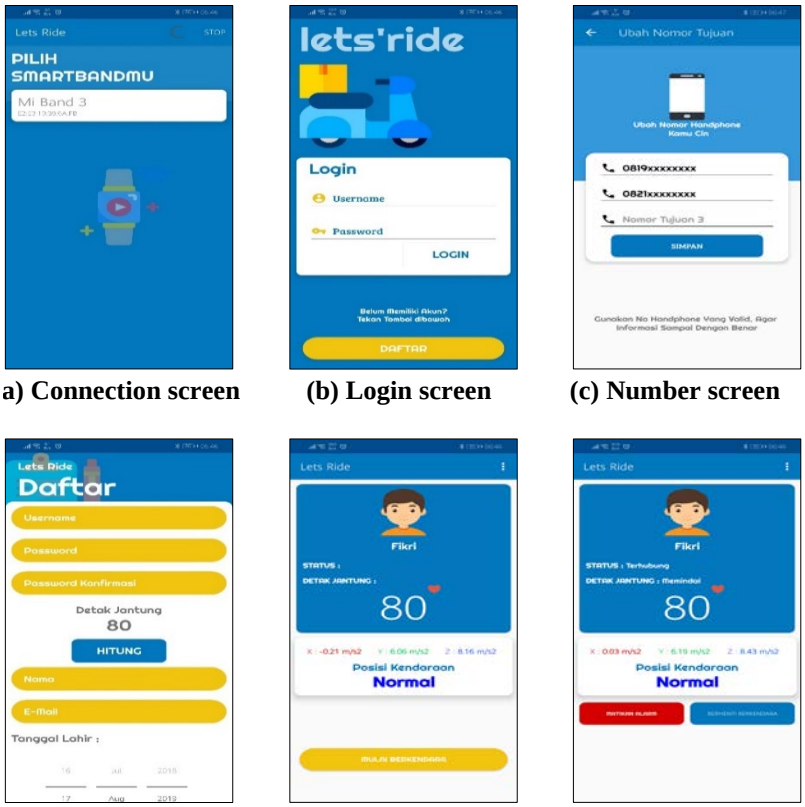


Fig. 5. System procedure.

3.4. System Implementation

This application requires installation on Android smartphone with minimum version of 5.1 (Lolipop). Figure 6 shows the system implementation result. The interface for the coupling smartband and smartphone shown in Fig. 6(a). On this page, there is a list of devices that can be connected. The login screen is shown in Fig. 6(b), which this page use to log in. Figure 6(c) shows the destination phone number to send information about the location and time if an accident occurred. Figure 6(d) is the registration menu. The main screen shows in Fig. 6(e). This page displays the heart rate and accelerometer value equal to Fig. 6(f). This figure shows the riders condition while riding.



a) Connection screen **(b) Login screen** **(c) Number screen**

(d) Register screen **(e) Main screen** **(f) Riding screen**

Fig. 6. Application display results.

3.5. Results of drowsiness detection test

Drowsiness detection test was done by calculating the heart rate of 30 respondents. The results are shown in Table 11. It presents that the accuracy of sleepiness detection calculations reached 80% following the formula stated by the expert doctor. The accuracy rate during the day only reached an accuracy value of 75%. While the accuracy at night is 90%.

Table 11. Results of drowsiness detection test.

No.	Age	Time	Normal Heart Rate	Heartbeats While Drowsy	Result
1	21	10:13	80	59	Corresponding
2	22	10:15	81	63	Corresponding
3	21	10:17	82	69	Not Corresponding
4	23	10:20	79	57	Corresponding
5	22	10:22	80	67	Not Corresponding
6	22	12:43	75	67	Not Corresponding
7	22	12:46	82	65	Corresponding
8	22	12:48	87	66	Corresponding
9	20	12:50	86	58	Corresponding
10	24	12:54	85	59	Corresponding
11	22	13:05	86	62	Corresponding
12	24	13:08	75	68	Not Corresponding
13	21	13:11	80	66	Not Corresponding
14	23	13:13	81	63	Corresponding
15	23	13:16	87	56	Corresponding
16	21	15:25	83	57	Corresponding
17	21	15:27	82	55	Corresponding
18	22	15:30	88	70	Corresponding
19	23	15:33	81	61	Corresponding
20	20	15:36	89	60	Corresponding
21	20	19:45	78	60	Corresponding
22	22	19:49	82	61	Corresponding
23	22	19:54	89	57	Corresponding
24	22	19:58	84	60	Corresponding
25	24	20:05	88	60	Corresponding
26	22	03:04	80	69	Not Corresponding
27	21	03:07	86	60	Corresponding
28	20	03:09	83	61	Corresponding
29	23	03:13	79	58	Corresponding
30	24	03:16	87	55	Corresponding

3.6. Results of Drowsiness while Riding Test

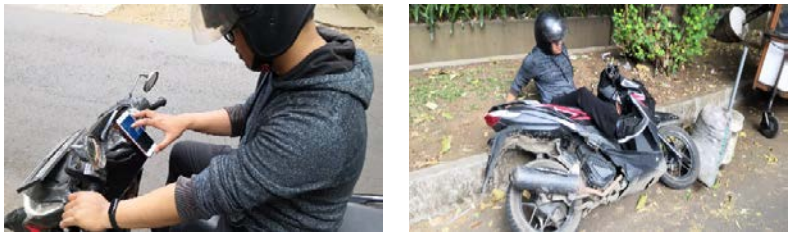
We tested drowsiness while riding a motorbike by cyclically calculating the heart rate with a regular rate of 80. The results of it are shown in Table 12. From the five times test, the alarm on smartphone and vibration on smartband function well when it detects drowsiness.

Table 12. Test results drowsiness while riding.

	Heart Rate	Vibrate Smartband	Vibration and Sound
Test 1	59	Yes	Yes
Test 2	61	Yes	Yes
Test 3	57	Yes	Yes
Test 4	60	Yes	Yes
Test 5	65	Yes	Yes

3.7. Results of Accident Detection Test

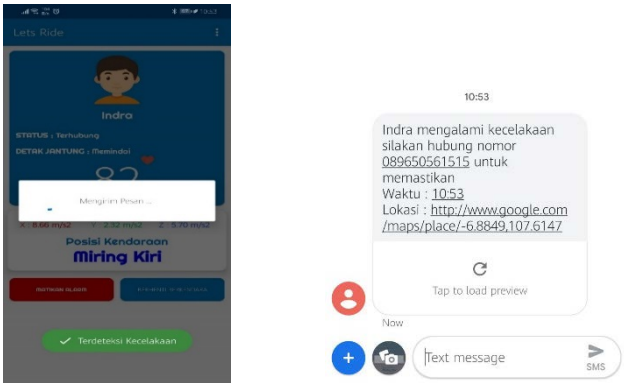
Accident test detection calculates the accelerometer sensor in a smartphone. Figure 7(a) shows the smartphone position on the speedometer for obtaining motor vehicle accelerometer data, and Fig. 7(b) shows the driver has an accident. Moreover, the application sends information to the rider's family that an accident has occurred.



(a) smartphone position. **(b) accident position.**

Fig. 7. Accident detection test.

When an accident is detected, the application will send information in the form of a short message service to the registered destination number. The information sent contains name, the phone number that can contact, time, and coordinates of the accident's location. Figure 8(a) is the display when the application sends a message, while Fig. 8(b) is the result of the short message service that has been sent.



(a) Sending message **(b) Message content**

Fig. 8. Sending information when accident.

Tests accident detection conducted six times as shown in Table 13.

Table 13. Accident detection tests.

Position	Accelerometer Value	Message	Information
Tilt Left	X-axis: 8.66 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -7.79 m / s	sent	Detected Leaning Right
Tilt Left	X-axis: 7.56 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -8.16 m / s	sent	Detected Leaning Right
Tilt Left	X-axis: 8.66 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -8.17 m / s	sent	Detected Leaning Right

The experiment detected the accident and information messages sent to the destination number. These results mean that the level of accuracy in accident detection gets an accuracy rate of 100%. The overall results of the tests conducted on the application of functional aspects of suitability testing, compatibility, usability, and efficiency criteria as shown in Table 14.

Table 14. Software testing result.

	Score	Result
Suitability	100 %	Very decent
Compatibility	100 %	Very decent
Usability	84.71 %	Very decent
Efficiency	3.88 seconds	Satisfied

4. Conclusion

This research has successfully used accelerometer sensors on smartphone Android and wearable devices to detect and prevent motorbike driver accidents. The results of tests carried out showed that the accuracy of detecting drowsiness is equal to 80% and the accident detection test gets an accuracy of 100 %. From the results of software testing also get good grades according to the criteria of suitability, compatibility, usability, and efficiency. The difference in accuracy when detecting drowsiness during the day and night becomes a subject for further research.

Acknowledgments

We would like to thank Universitas Komputer Indonesia, Kementerian Pendidikan dan Kebudayaan and Deputi Bidang Penguatan Riset dan Pengembangan (DPRM) Kementerian Riset dan Teknologi/ Badan Riset dan Inovasi Nasional Republik Indonesia for supporting this research with applied research grants for the second-year implementation (2020), based on a letter decision number B / 87 / E3 / RA.00 / 2020 and number 045 / SP / LPPM / UNIKOM / III / 2019.

Nomenclatures

A_{BL}	Boolean value when the tilt motorcycle
H_{beat}	Heartbeats value when drowsy
N_{beat}	Normal heartbeats value
X_{axis}	Value on the x-axis accelerometer

Abbreviations

BPM	Beats Per Minute
BPS	*Badan Pusat Statistik*
LED	Light Emitting Diode
NTSC	National Transportation Safety Committee
SMS	Short Message Services
UNIKOM	Universitas Komputer Indonesia

References

1. Amirullah, M.; KusumaHendra, K.; and Tasripan, T. (2019). Sistem peringatan dini menggunakan deteksi kemiringan kepala pada pengemudi kendaraan bermotor yang mengantuk. *Jurnal Teknik Institut Teknologi Sepuluh Nopember (ITS)*, 7(2), 281-286.
2. Vicente, J.; Laguna, P.; Bartra, A.; and Bailón, R. (2016). Drowsiness detection using heart rate variability. *Medical and Biological Engineering and Comput*ing, 54(6), 927-937.
3. Poe, G.R. (2017). Sleep is for forgetting. *Journal of Neuroscience*. 23(3). 464-473.
4. Caponecchia, C.; and Williamson, A. (2018). Drowsiness and driving performance on commuter trips. *Journal of Safety Research*, 66, 179-186.
5. Irawan, J.D.; and Adriantantri, E. (2019). Pendeteksi mengantuk menggunakan library python. *Jurnal Mnemonic*, 2(1), 22-27.
6. Sharma, S.; Reddy, R.K.; and Karthik, A. (2016). S-carcrash: real-time crash detection analysis and emergency alert using smartphone. *International Conference on Connected Vehicles and Expo (ICCVE)* 2016, 36-42.
7. Alfaeru, F.; Setiawan, A.B.; Nachrowi, N.; and Hidayat, R. (2017). Implementation of accelerometer sensor and GPS module for smart bike design. *International Conference Sustainable Development Goals (SDGs)s 2030 Challenges and Solution.*, 1(1), 299-311.
8. He, J.; Choi, W.; Yang, Y.; Lu, J.;Wu, X.; and Peng, K. (2017). Detection of driver drowsiness using wearable devices: a feasibility study of the proximity sensor. *Applied Ergonomics*, 65, 473-480.
9. Pranoto, H.; and Setiawan, E.B. (2017). Android smartphone remote monitoring application using sms service. *International Journal of New Media and Technology*, 4(2), 112-119.
10. Menon, S.S.; Dosher, D.J.; and Christensen, S.T. (2018). System and method for identifying idling times of a vehicle using accelerometer data. *U.S. Patent* No. 10,019,762.
11. Setiawan, E.B.; and Nurdin, H. (2019). Road quality assessment using international roughness index method and accelerometer on android. *Lontar Komputer*, 10(2), 62-72.
12. Attaur-Rasool, S. (2020). Use of wearable technology to measure influence of driving stress on heart rate of professional drivers. *Journal of Saidu Medical College*, 10(1), 35-38.
13. Ameen, M.S.; Cheung, L.M.; Hauser, T.; Hahn, M.A.; and Schabus, M. (2019). About the accuracy and problems of consumer devices in the assessment of sleep. *Sensors*, 19(19), 4160.
14. Rao, R.R.; Singh, A.; and Kamath, V. (2018). Assessment of step accuracy and usability of activity trackers. *In 2018 3rd International Conference on Contemporary Computing and Informatics (IC3I) IEEE*, 38-42.
15. Aloul, F.; Zualkaenan, I.; Abu-Salma, R.; Al-Ali, H.; and Al-Merri, M.(2015). iBump: Smartphone application to detect car accidents. *Computer and Electrical Engineering*, 43 (2015), 66-75.
16. Bener, A.; Yildirim, E.; Özkan, T.; and Lajunen, T. (2017). Driver sleepiness, fatigue, careless behavior and risk of motor vehicle crash and injury:

population based case and control study. *Journal of Traffic and Transportation Engineering (English edition)*, 4(5), 496-502.

17. Goel, V.; Srivastava, S.; Pandit, D.; Tripathi, D.; and Goel, P. (2018). Heart rate monitoring system using finger tip through IOT. *International Research Journal of Engineering and Technology (IRJET)*, 5(03), 1114-1117.
18. Song, M.; and Vega, K. (2018). HeartMe: Thermochromic display as an expression of heart health. *In Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*, 311-314.
19. Hardiyanti, N.; Lawi, A.; Diaraya.; and Aziz, F. (2018). Classification of human activity based on sensor accelerometer and gyroscope using ensemble svm method. *In 2018 2nd East Indonesia Conference on Computer and Information Technology (EIConCIT)*, Makasar, Indonesia, 304-307.
20. Windarni, V.A.; Sediyono, E.; and Setiawan, A. (2016). Using GPS and google maps for mapping digital land certificates. *Proceeding In 2016 International Conference on Informatics and Computing (ICIC)*, Mataram, Indonesia, 422-426.
21. Bautista, J.M.; Tapic, L.; Base, G.; and Cabrera, E. (2019). Real-time vehicle accident alert system based on arduino with SMS notification. *Southeast Asian Journal of Science and Technology*. 4(1), 98-100.
22. Wagner, S. (2013). *Software product quality control*. Berlin: Springer.
23. Gao, M.; Kortum, P.; and Oswald, F. (2018). Psychometric evaluation of the use (usefulness, satisfaction, and ease of use) questionnaire for reliability and validity. *In Proceedings of The Human Factors and Ergonomics Society Annual Meeting*. Sage CA: Los Angeles, 62(1), 1414-1418. CA: SAGE Publications.
24. Guritno, S.; and Rahardja, U. (2011). *Theory and application of IT research: Metodologi penelitian teknologi informasi.* Penerbit Andi. Yogyakarta.
25. Yoon, H.J.; (2012). A Study on the performance of android platform. *International Journal on Computer Science and Engineering*. 4(4), 532-537.
26. Niknejad, A.(2011). *A quality evaluation of an android smartphone application. master thesis*. Swedia: Goteborgs Universitet.
27. Hoxmeier, J.A.; and DiCesare, C. (2000). System response time and user satisfaction : An experimental study of browser-based applications. *America Conference on Information Systems (AMCIS) 2000 Proceedings*. Long Beach, California, 347.

Driving Safety Application Using Wearable Device and Mobile Technology

by Eko Budi Setiawan

Submission date: 16-Nov-2021 01:38PM (UTC+0700)

Submission ID: 1704353102

File name: 3441_Eko_Budi_Setiawan_Driving_Safety_Application_Using_Wearable_Device_and_Mobile_Technology_55060_1325828282.pdf (404.6K)

Word count: 4980

Character count: 25814

Journal of Engineering Science and Technology
Vol. 16, No. 4 (2021) 3343 – 3357
© School of Engineering, Taylor's University

DRIVING SAFETY APPLICATION USING WEARABLE DEVICE AND MOBILE TECHNOLOGY

EKO BUDI SETIAWAN*, TUBAGUS F. FATONI

Informatics Engineering, Universitas Komputer Indonesia,
Jl. Dipatiukur 102-116 Bandung, West Java, Indonesia, 40132
*Corresponding Author: eko@email.unikom.ac.id

Abstract

This research is conducted to help motorbike riders in avoiding accidents caused by drowsiness. The wearable device technology used was smartband and accelerometer from Android smartphone. It was used to obtain heart rate data and detect drowsiness experienced by motorbike riders. An accelerometer was used to detect if an accident occurs and send the information to the driver's family. The method in this research was quantitative research and development. The results obtained showed that detecting drowsiness is equal to 80% and the accident detection test gets an accuracy of 100%. The accuracy of drowsiness detection during the day is 75% and testing that carried out at night has an accuracy rate of 90%. Functional suitability test results obtained a value of 100%, compatibility aspects have 100%, usability aspects of 84.7%, and performance aspects in terms of response time are in the range of satisfaction equal to 3.88 seconds. The tests conducted using Likert scale showed that the application is feasible to use, and the driving safety application has reached its desired purpose. This research impacts on driving safety that must prioritize safety both for self and for others.

Keywords: Accelerometer, Drowsiness, Motorbike driver, Safety ride, Smartband,.

1. Introduction

Based on data released by the NTSC Indonesia from 2010 to 2016, 41 accident investigations caused as many as 443 fatalities. One of the causes of accidents comes from driver error. There were 69.7% of motor vehicle accidents caused by sleepy motorists [1]. Drowsiness is a condition where someone feels like sleeping. Drowsiness can happen at the inappropriate time, for example working, studying, or driving. Sleepiness is usually characterized by fatigue, loss of consciousness, falling asleep, interference with activity [2], and forgetting [3]. Besides of hurting oneself, it can also harm other motorbike riders.

Drowsiness can trigger various problems, such as disturbing driving performance [4], productivity, affecting one's emotions, disturbing social interactions, and the most fatal is accidents both on the road and in the work environment [5]. Accidents can occur not only because of human factors but also road or vehicle factors. Accident can be handled well if the driver is still conscious and asks for help or a family member knows if there is an accident just occurred. There are cases of late accident handling because the family do not know [6]. An accelerometer sensor can detect the tilt or change the position of an object so that family can know information about accidents [7].

Several studies have been conducted related to this research such as wearable device technology use for drowsiness detection [8], text messaging use to control smartphones remotely [9], accelerometer data use to identify idling times of a vehicle [10] and assess road quality [11]. In this research, to detect drowsiness is the Mi Band 3 smartband because it can track the user's activities such as heart rate [12], sleep quality [13], and activity trackers [14].

In contrast to Aloul's research which uses smartphones to detect car accidents, this research uses smartphones and wearable devices to detect motorbike rider accidents [15]. A smartband retrieved the motorbike driver's heart rate data and sent it to Android smartphone to calculate the average heart rate. If it is categorized as sleepy, the smartband will vibrate and the smartphone will sound an alarm. When an accident driving is occurred, the accelerometer sensor on Android smartphone will detect the location and time data then send it to the family. This research aims to build a driving safety application and uses a software development life cycle method for the system development process.

2. Method

This research consisted of several stages. The initial stage is to carry out case analysis to obtain accident-related data, analyse sleepiness, and accidents up to the implementation stage, and system testing. Figure 1 shows the stages flow carried out in this research.

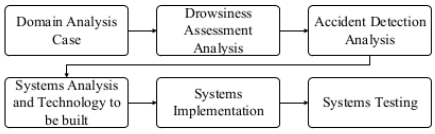


Fig. 1. Stage of research method.

2.1. Domain Analysis Case

At this stage, an analysis of cases is carried out in the form of an analysis of common problems when driving accidents. There is up to 69.7% of motor vehicle accidents caused by rider drowsiness. Every day many riders are passing by on the highway. Based on data from BPS Indonesia (Central Bureau of Statistics) recorded that until 2017, there were 138,556,699 motor vehicles units in Indonesia. This number is increasing every time and it can also cause higher accident rates.

Drowsiness while riding can occur due to several factors such as fatigue or the urge to sleep at night [16], long travel, or less fit body condition. Drowsy while also riding can-do harm to other riders. Drowsiness is a condition in which a person feels like to sleep. It can happen at the most opportune times, such as at work while studying or while riding. Thus, the results of the domain analysis case stage in this study are that several reasons can cause driving accidents, one of which is sleepy.

2.2. Drowsiness assessment analysis

At this stage, an analysis of the heartbeat data obtained from the smartband was calculated based on previous studies to determine the driver's condition. It is because drowsiness usually occurs because of lack of sleep. Everyone has different sleep needs, depending on age and daily activities. Ideally, adults need 7-9 hours of sleep per day, while children and teenagers need 9 hours, toddlers need 10-12 hours, and the new-born takes 16-18 hours. The following workflow of drowsiness assessment in this research is shown in Fig. 2.

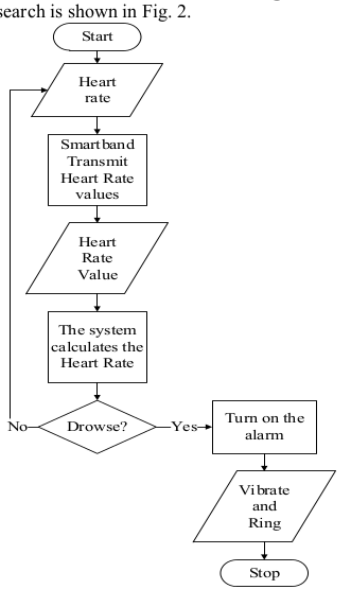


Fig. 2. Drowsiness assessment workflow.

Drowsiness detection application was made using smartband. It can be used on the left or right wrist to detect the heart rate. Mi Band 3 uses green LED light paired with a light-sensitive photodiode to detect the heart rate flowing through the wrist. When the heart beats, the smartband will reflect light and its reflections is readable by a photodiode. If it does not reflect light, this means that the heart rate is high. Through the observation, the sensor analyses the data and calculates the heart rate. Through blinking LED lights hundreds of times per second, Mi Band 3 can calculate the heartbeat frequency.

The heart rate is the number of heartbeats per unit of time, usually expressed in beats per minute (bpm) [17]. The normal heart rate of adults is 60-100 bpm with the heart rate maximum is 220 - age [18]. Table 1 below shows a normal heartbeat.

Table 1. Normal heart rate.

Age	Normal Heart Rate
1-2 years	80-130
2-6 years	70-120
6-10 years	70-110
Ten years and over	60-100

The time body relaxes either at rest, drowsiness, sleep, and heart rate is relatively slower than doing the activity. In general, the decline ranges from 10-20% of the current state of operation. This value has been validated by an expert Doctor.

2.3. Accident detection analysis

At this stage, an analysis of the smartphone slope data was calculated based on the data from previous studies. It is done to determine the position of the motor falls is to the left or right. A smartphone today generally already has an accelerometer sensor for various needs, such as changing the display from portrait to landscape by tilting the body of the phone. It happens because of a change to the coordinates x, y, and z smartphone. The x-axis is the form of a horizontal line, a vertical line forming the y-axis, and a z-axis pointing to the front and rear of the display device. Accelerometer values is shown in Table 2.

Table 2. Accelerometer axis value.

Position	X	Y	Z
Vertical	0	1	0
Vertical reversed	0	-1	0
Left landscape	1	0	0
Right landscape	-1	0	0
Flat	0	0	1
Flat reversed	0	0	-1

The calculation of the value of the accelerometer is focused on the x-axis. This is because the amount of x to determine the slope of smartphone, which is placed on the speedometers to find out the overall effect accelerometer and to detect an accident. The following workflow drowsiness ratings is shown in Fig. 3.

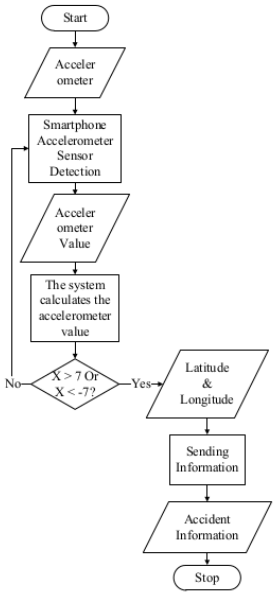


Fig. 3. Accident detection workflow.

2.4. Tools and technology

The technologies used in this research are as follows:

a. Smartband
Smartband was used to get the heart rate that detects drowsiness. Smartband is a device or application for monitoring and keeping track of fitness-related metrics such as walking or running distance, calorie consumption, heart rate, and sleep quality.

b. Accelerometer
This technology was used to get slope data of the smartphone and identify an accident. In this research, the accelerometer was used as a detector of the wave of the vehicle due to holes or damaged roads. It can change the display from portrait to landscape by tilting the smartphone to read three axes from different directions [19].

c. Google Maps API
It is used to get the latitude and longitude values in detecting the location of current accident [20].

d. SMS Gateway
This technology is used to provide and send information to a registered destination phone number when accident occurs [21].

2.5. System implementation

At the application development, along with the implementation of technology, it has been analysed previously. At this stage, the start of implementation drowsiness assessment, implementation of crash detection, smart band linking implementation, and the implementation of the SMS Gateway was done.

2.6. System testing

The results of this stage are testing process analysis technique based on functional suitability, compatibility, usability, and efficiency. The functional suitability test was assessed by the Guttman scale. After getting the test results in the form of points, it was then analysed using criteria in the document quality for Android applications as shown in Table 3.

Table 3. Functional Quality Standards Suitability.

Rankings	Warning	Critical
No error	0 points	0 points
An easy mistake	1 point	-
Difficult errors	2 points	-
Fatal error	4 points	-
The test fails	-	5 points

Compatibility analysis was conducted by operationally test series with the commencement of the installation of applications on different versions of operating systems and various specifications of smartphones based on the Android platform [22]. The next stage of calculating the percentage score test results is to determine the quality level of compatibility aspects, namely:

$$\text{Percentage of Eligibility} = \frac{\text{Score obtained}}{\text{Maximum Score}} \text{ x } 100\ \% \quad (1)$$

The usability aspect test was used Likert scale. The instrument's use questionnaire consisted of 30 questions for users to show the attitude towards ease of use of the application [23]. After finding the results of the calculations score, then a comparison with the criteria in Table 4 was made [24].

Table 4. Criteria interpretation score.

Percentage (%)	Interpretation
0% - 20%	Very unfit
21% - 40%	Less worthy
41% - 60%	fairly decent
61% - 80%	worthy
81% - 100%	very decent

Quality analysis of the efficiency performance was done by calculating the average response time of each activity. It was executed using program function trace view [25]. Tests on the performance aspect performed at least five times the amount calculated average response time when an application retrieves data from the server and then shown into the system [26]. The results are then compared in Table 5 user satisfaction with the response time [27].

Table 5. User satisfaction predicate.

Response Time (seconds)	Predicate
<3	Very satisfied
3-9	Satisfied
9-12	Quite happy
> 12	Not satisfied

3. Results and Discussion

These stages include results from testing assessment and discuss the results obtained for the implementation of further research.

3.1. Drowsiness assessment

Calculation of heart rate obtained are sent to the smartphone using Bluetooth 4.0 connection from Mi Band 3. The heartbeat data received by smart band are reprocessed to get the average heart rate. Here is the value of heart rate in normal conditions of 5 samples at the age of 21-23. The calculation of the average calculation of each sample are obtained while relaxing, during activity, sport, or at rest which is shown in Table 6.

Table 6. Calculation of heart rate average (BPM).

Sample	Age	Relaxing	Activity	Sport	Rest
1st sample	23	65	85	105	56
2nd sample	21	72	91	112	64
3rd sample	22	64	82	102	60
4th sample	22	62	80	98	54
5th sample	22	68	88	101	58

A summary from Table 6 is the average heart rate when relaxing = 66 BPM, during activity = 85 BPM, sport = 104 BPM, and rest = 58 BPM. Based on Table 6, it can be concluded that if the average heart rate of each person is different. Moreover, the theory from an expert doctor claim that if a person experiences drowsiness, the heart rate will decrease by approximately 10 to 20%. Calculation of the average heart rate was done in 15 seconds. The example of drowsiness assessment was a rider aged 22 years with a fit condition and has a regular heart rate of 80 BPM. From the theory when a person experiences drowsiness heart rate decreases by 10-20% from the current normal circumstances, the following formula determines the heart rate when a person is drowsy.

$$H_{beat} = N_{beat} - \frac{20}{100} \text{ x } N_{beat} \quad (2)$$

If N_{beat} = 80, then :
H_{beat} = 80 - 16
H_{beat} = 64 BPM
If the rider's heart rate is less than 64 BPM or 64 BPM, it is considered drowsy.

3.2. Detection of accident assessment

In this study, the smartphone was attached to the top speedometer. Table 7 shows the standard minimum values and maximum values accelerometer in a normal condition.

Table 7. Testing standard value accelerometer.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-0.13	0.16
Y	3.12	3.23
Z	8.70	9.65

Table 8 shows the minimum and maximum value from the accelerometer when receiving shocks while riding. The shocks that occurred were small to moderate shocks.

Table 8. Testing shock value accelerometer while riding.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-2.91	3.48
Y	2.61	5.44
Z	4.69	12.68

The occurrence of sudden braking also causes shocks. Table 9 shows the minimum and maximum values from the accelerometer when receiving shocks and a sudden brake is applied.

Table 9. Testing value accelerometer when brakes sudden shocks.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-3.52	3.86
Y	0.38	8.02
Z	0.28	20.20

Table 10 shows the minimum and maximum values from the accelerometer when receiving a shock during an accident occurs with the motorbike position falls to the right. While riding, it will declare in a motorbike accident in which position fell to the right.

Table 10. Accelerometer shock value current testing accident occurs.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-23.06	9.87
Y	-4.38	10.67
Z	-17.20	24.74

For the example assessment of the accident, a 22-year-old motorbike driver suffered an accident that caused the motor to fall to the right and give the accelerometer value on the x-axis of -7.56 m/s. After several experiments conducted in this research, it can ensure that the motorbike is said to have fallen when the value of the axis x>7 m / s or x<-7 m/s. To determine an accident occurred used a logical formula, which show as follows:

$$A_{BL} = X_{axis} > 7 \vee X_{axis} < -7 \quad (1)$$

If X_{axis} = -7.56, then:
A_{BL} = -7,56>7 ∨ -7,56 <-7
A_{BL} = false ∨ true
A_{BL} = true
When A_{BL} is true, then it will be detected as an accident.

3.3. System architecture

The system architecture in this research is shown in Fig. 4. The smartband is used to detect the motorbike driver heartbeat. When the system detects drowsiness, it will sound an alarm and vibrate to riders. If an accident occurs, the system will detect it, take the scene, and send the location information via SMS to the family of the victim or the destination number that has been registered in the application.

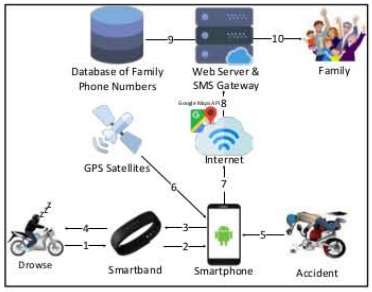


Fig. 4. System architecture.

The system procedure describes the activity process from the side of the driver, the system, and the family. A description of a system procedure in this research is shown in Fig. 5.

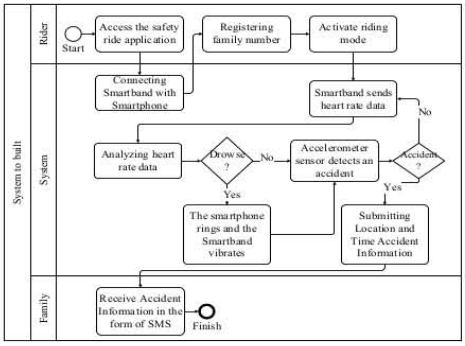


Fig. 5. System procedure.

3.4. System Implementation

This application requires installation on Android smartphone with minimum version of 5.1 (Lolipop). Figure 6 shows the system implementation result. The interface for the coupling smartband and smartphone shown in Fig. 6(a). On this page, there is a list of devices that can be connected. The login screen is shown in Fig. 6(b), which this page use to log in. Figure 6(c) shows the destination phone number to send information about the location and time if an accident occurred. Figure 6(d) is the registration menu. The main screen shows in Fig. 6(e). This page displays the heart rate and accelerometer value equal to Fig. 6(f). This figure shows the riders condition while riding.

a) Connection screen (b) Login screen (c) Number screen

(d) Register screen (e) Main screen (f) Riding screen

Fig. 6. Application display results.

3.5. Results of drowsiness detection test

Drowsiness detection test was done by calculating the heart rate of 30 respondents. The results are shown in Table 11. It presents that the accuracy of sleepiness detection calculations reached 80% following the formula stated by the expert doctor. The accuracy rate during the day only reached an accuracy value of 75%. While the accuracy at night is 90%.

Table 11. Results of drowsiness detection test.

No.	Age	Time	Normal Heart Rate	Heartbeats While Drowsy	Result
1	21	10:13	80	59	Corresponding
2	22	10:15	81	63	Corresponding
3	21	10:17	82	69	Not Corresponding
4	23	10:20	79	57	Corresponding
5	22	10:22	80	67	Not Corresponding
6	22	12:43	75	67	Not Corresponding
7	22	12:46	82	65	Corresponding
8	22	12:48	87	66	Corresponding
9	20	12:50	86	58	Corresponding
10	24	12:54	85	59	Corresponding
11	22	13:05	86	62	Corresponding
12	24	13:08	75	68	Not Corresponding
13	21	13:11	80	66	Not Corresponding
14	23	13:13	81	63	Corresponding
15	23	13:16	87	56	Corresponding
16	21	15:25	83	57	Corresponding
17	21	15:27	82	55	Corresponding
18	22	15:30	88	70	Corresponding
19	23	15:33	81	61	Corresponding
20	20	15:36	89	60	Corresponding
21	20	19:45	78	60	Corresponding
22	22	19:49	82	61	Corresponding
23	22	19:54	89	57	Corresponding
24	22	19:58	84	60	Corresponding
25	24	20:05	88	60	Corresponding
26	22	03:04	80	69	Not Corresponding
27	21	03:07	86	60	Corresponding
28	20	03:09	83	61	Corresponding
29	23	03:13	79	58	Corresponding
30	24	03:16	87	55	Corresponding

3.6. Results of Drowsiness while Riding Test

We tested drowsiness while riding a motorbike by cyclically calculating the heart rate with a regular rate of 80. The results of it are shown in Table 12. From the five times test, the alarm on smartphone and vibration on smartband function well when it detects drowsiness.

Table 12. Test results drowsiness while riding.

	Heart Rate	Vibrate Smartband	Vibration and Sound
Test 1	59	Yes	Yes
Test 2	61	Yes	Yes
Test 3	57	Yes	Yes
Test 4	60	Yes	Yes
Test 5	65	Yes	Yes

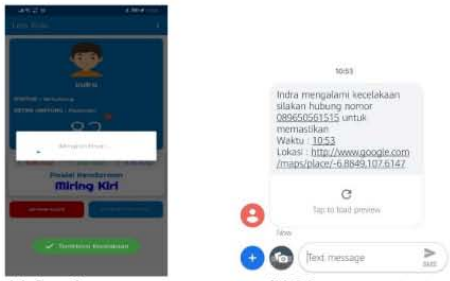
3.7. Results of Accident Detection Test

Accident test detection calculates the accelerometer sensor in a smartphone. Figure 7(a) shows the smartphone position on the speedometer for obtaining motor vehicle accelerometer data, and Fig. 7(b) shows the driver has an accident. Moreover, the application sends information to the rider's family that an accident has occurred.

(a) smartphone position. **(b) accident position.**

Fig. 7. Accident detection test.

When an accident is detected, the application will send information in the form of a short message service to the registered destination number. The information sent contains name, the phone number that can contact, time, and coordinates of the accident's location. Figure 8(a) is the display when the application sends a message, while Fig. 8(b) is the result of the short message service that has been sent.



(a) Sending message **(b) Message content**

Fig. 8. Sending information when accident.

Tests accident detection conducted six times as shown in Table 13.

Table 13. Accident detection tests.

Position	Accelerometer Value	Message	Information
Tilt Left	X-axis: 8.66 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -7.79 m / s	sent	Detected Leaning Right
Tilt Left	X-axis: 7.56 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -8.16 m / s	sent	Detected Leaning Right
Tilt Left	X-axis: 8.66 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -8.17 m / s	sent	Detected Leaning Right

The experiment detected the accident and information messages sent to the destination number. These results mean that the level of accuracy in accident detection gets an accuracy rate of 100%. The overall results of the tests conducted on the application of functional aspects of suitability testing, compatibility, usability, and efficiency criteria as shown in Table 14.

Table 14. Software testing result.

	Score	Result
Suitability	100 %	Very decent
Compatibility	100 %	Very decent
Usability	84.71 %	Very decent
Efficiency	3.88 seconds	Satisfied

4. Conclusion

This research has successfully used accelerometer sensors on smartphone Android and wearable devices to detect and prevent motorbike driver accidents. The results of tests carried out showed that the accuracy of detecting drowsiness is equal to 80% and the accident detection test gets an accuracy of 100 %. From the results of software testing also get good grades according to the criteria of suitability, compatibility, usability, and efficiency. The difference in accuracy when detecting drowsiness during the day and night becomes a subject for further research.

Acknowledgments

We would like to thank Universitas Komputer Indonesia, Kementerian Pendidikan dan Kebudayaan and Deputi Bidang Penguatan Riset dan Pengembangan (DPRM) Kementerian Riset dan Teknologi/ Badan Riset dan Inovasi Nasional Republik Indonesia for supporting this research with applied research grants for the second-year implementation (2020), based on a letter decision number B / 87 / E3 / RA.00 / 2020 and number 045 / SP / LPPM / UNIKOM / III / 2019.

Nomenclatures

A_{BL}	Boolean value when the tilt motorcycle
H_{beat}	Heartbeats value when drowsy
N_{beat}	Normal heartbeats value
X_{axis}	Value on the x-axis accelerometer

Abbreviations

BPM	Beats Per Minute
BPS	*Badan Pusat Statistik*
LED	Light Emitting Diode
NTSC	National Transportation Safety Committee
SMS	Short Message Services
UNIKOM	Universitas Komputer Indonesia

References

1. Amirullah, M.; KusumaHendra, K.; and Tasripan, T. (2019). Sistem peringatan dini menggunakan deteksi kemiringan kepala pada pengemudi kendaraan bermotor yang mengantuk. *Jurnal Teknik Institut Teknologi Sepuluh Nopember (ITS)*, 7(2), 281-286.
2. Vicente, J.; Laguna, P.; Bartra, A.; and Bailón, R. (2016). Drowsiness detection using heart rate variability. *Medical and Biological Engineering and Comput*ing, 54(6), 927-937.
3. Poe, G.R. (2017). Sleep is for forgetting. *Journal of Neuroscience*. 23(3). 464-473.
4. Caponecchia, C.; and Williamson, A. (2018). Drowsiness and driving performance on commuter trips. *Journal of Safety Research*, 66, 179-186.
5. Irawan, J.D.; and Adriantantri, E. (2019). Pendeteksi mengantuk menggunakan library python. *Jurnal Mnemonic*, 2(1), 22-27.
6. Sharma, S.; Reddy, R.K.; and Karthik, A. (2016). S-carcrash: real-time crash detection analysis and emergency alert using smartphone. *International Conference on Connected Vehicles and Expo (ICCVE)* 2016, 36-42.
7. Alfaeru, F.; Setiawan, A.B.; Nachrowi, N.; and Hidayat, R. (2017). Implementation of accelerometer sensor and GPS module for smart bike design. *International Conference Sustainable Development Goals (SDGs)s 2030 Challenges and Solution*., 1(1), 299-311.
8. He, J.; Choi, W.; Yang, Y.; Lu, J.;Wu, X.; and Peng, K. (2017). Detection of driver drowsiness using wearable devices: a feasibility study of the proximity sensor. *Applied Ergonomics*, 65, 473-480.
9. Pranoto, H.; and Setiawan, E.B. (2017). Android smartphone remote monitoring application using sms service. *International Journal of New Media and Technology*, 4(2), 112-119.
10. Menon, S.S.; Dosher, D.J.; and Christensen, S.T. (2018). System and method for identifying idling times of a vehicle using accelerometer data. *U.S. Patent* No. 10,019,762.
11. Setiawan, E.B.; and Nurdin, H. (2019). Road quality assessment using international roughness index method and accelerometer on android. *Lontar Komputer*, 10(2), 62-72.
12. Attaur-Rasool, S. (2020). Use of wearable technology to measure influence of driving stress on heart rate of professional drivers. *Journal of Saidu Medical College*, 10(1), 35-38.
13. Ameen, M.S.; Cheung, L.M.; Hauser, T.; Hahn, M.A.; and Schabus, M. (2019). About the accuracy and problems of consumer devices in the assessment of sleep. *Sensors*, 19(19), 4160.
14. Rao, R.R.; Singh, A.; and Kamath, V. (2018). Assessment of step accuracy and usability of activity trackers. *In 2018 3rd International Conference on Contemporary Computing and Informatics (IC3I) IEEE*, 38-42.
15. Aloul, F.; Zualkaenan, I.; Abu-Salma, R.; Al-Ali, H.; and Al-Merri, M.(2015). iBump: Smartphone application to detect car accidents. *Computer and Electrical Engineering,* 43 (2015), 66-75.
16. Bener, A.; Yildirim, E.; Özkan, T.; and Lajunen, T. (2017). Driver sleepiness, fatigue, careless behavior and risk of motor vehicle crash and injury:

population based case and control study. *Journal of Traffic and Transportation Engineering (English edition)*, 4(5), 496-502.

17. Goel, V.; Srivastava, S.; Pandit, D.; Tripathi, D.; and Goel, P. (2018). Heart rate monitoring system using finger tip through IOT. *International Research Journal of Engineering and Technology (IRJET)*, 5(03), 1114-1117.
18. Song, M.; and Vega, K. (2018). HeartMe: Thermochromic display as an expression of heart health. *In Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems,* 311-314.
19. Hardiyanti, N.; Lawi, A.; Diaraya.; and Aziz, F. (2018). Classification of human activity based on sensor accelerometer and gyroscope using ensemble svm method. *In 2018 2nd East Indonesia Conference on Computer and Information Technology (EIConCIT)*, Makasar, Indonesia, 304-307.
20. Windarni, V.A.; Sediyono, E.; and Setiawan, A. (2016). Using GPS and google maps for mapping digital land certificates. *Proceeding In 2016 International Conference on Informatics and Computing (ICIC)*, Mataram, Indonesia, 422-426.
21. Bautista, J.M.; Tapic, L.; Base, G.; and Cabrera, E. (2019). Real-time vehicle accident alert system based on arduino with SMS notification. *Southeast Asian Journal of Science and Technology*. 4(1), 98-100.
22. Wagner, S. (2013). *Software product quality control*. Berlin: Springer.
23. Gao, M.; Kortum, P.; and Oswald, F. (2018). Psychometric evaluation of the use (usefulness, satisfaction, and ease of use) questionnaire for reliability and validity. *In Proceedings of The Human Factors and Ergonomics Society Annual Meeting*. Sage CA: Los Angeles, 62(1), 1414-1418. CA: SAGE Publications.
24. Guritno, S.; and Rahardja, U. (2011). *Theory and application of IT research: Metodologi penelitian teknologi informasi.* Penerbit Andi. Yogyakarta.
25. Yoon, H.J.; (2012). A Study on the performance of android platform. *International Journal on Computer Science and Engineering*. 4(4), 532-537.
26. Niknejad, A.(2011). *A quality evaluation of an android smartphone application. master thesis*. Swedia: Goteborgs Universitet.
27. Hoxmeier, J.A.; and DiCesare, C. (2000). System response time and user satisfaction : An experimental study of browser-based applications. *America Conference on Information Systems (AMCIS) 2000 Proceedings*. Long Beach, California, 347.

Driving Safety Application Using Wearable Device and Mobile Technology

ORIGINALITY REPORT

5%	5%	0%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	jestec.taylors.edu.my Internet Source	4%
2	ojs.unud.ac.id Internet Source	2%

Exclude quotes	On	Exclude matches	< 2%
Exclude bibliography	On		

Korespondensi / Proses Review

Reviewer #1:

1. Add impact on your abstract

Response to the Reviewer #1:

The impact of the research has been added to the abstract section. Thank you for the revision given.

Reviewer #1

2. Move the impact to your abstract and add purpose and method in the last paragraph of introduction

Response to the Reviewer #1:

The impact has been moved to the abstract section. The last paragraph in the introduction has added a purpose and method. Thank you for the revision given.

Reviewer #1

3. Add discussion before Figure

Response to the Reviewer #1:

We already added additional information and discussion before the figure. Thank you for the revision given.

Reviewer #1

4. Combine all these paragraph into one

Response to the Reviewer #1:

We already combined these sentences into one paragraph. Thank you for the revision given.

Reviewer #1

5. Add discussion before all Tables

Response to the Reviewer #1:

We already added additional information and discussion before all tables. Thank you for the revision given.

Reviewer #1

6. Check your grammar in all parts of paper

Response to the Reviewer #1:

We already double checked the grammar of the paper/manuscript

Reviewer #1

7. Use illustration for the Figure

Response to the Reviewer #1:

We already added additional information and use illustration for that figure. Thank you for the revision given.

Reviewer #1

8. Delete nomenclatures

Response to the Reviewer #1:

Thank you for the advice given. We cannot delete the nomenclature section, because the camera ready JESTEC template has a nomenclature section.

Reviewer #1

9. Adjust the reference to the JESTEC format

Response to the Reviewer #1:

Thank you for reminding us. We already adjust the reference to the JESTEC camera ready template. We already double chek about the reference.

Journal of Engineering Science and Technology
Vol. XX, No. Y (Year) PPP - QQQ
© School of Engineering, Taylor's University

DRIVING SAFETY APPLICATION USING WEARABLE DEVICE AND MOBILE TECHNOLOGY

EKO BUDI SETIAWAN[1,*], TUBAGUS F. FATONI[2]

[1, 2] Informatics Engineering, Universitas Komputer Indonesia, Jl. Dipatiukur 102-116
Bandung, West Java, Indonesia, 40132
*Corresponding Author: eko@email.unikom.ac.id

Abstract

This research conducted to help motorbike riders to avoid accidents caused by drowsiness. The wearable device technology used is smartband and accelerometer from an android smartphone. Smartband in this research is used to get heart rate data to detect drowsiness experienced by motorbike riders. An accelerometer uses to detect if an accident occurs so that it can send information to the driver's family when an accident is detected. The method in this research is quantitative research and development. The results obtained that the accuracy of detecting drowsiness equal to 80% and the accident detection test gets an accuracy of 100% accuracy. The accuracy of drowsiness detection during the day getting value 75%, and testing at night have the accuracy rate is 90%. Functional suitability test results obtained a value of 100%, compatibility aspects have 100%, usability aspects of 84.7%, and performance aspects in terms of response time are in the range of satisfaction equal to 3.88 seconds. The results of tests conducted on a Likert scale formula shows that the application can use, and the driving safety application has reached its desired purpose. This research have an impact on driving safety that must prioritize and prioritize safety, both for self and for others.

Keywords: Safety ride, Motorbike driver, Drowsiness, Smartband, Accelerometer.

1. Introduction

Based on data released by the NTSC Indonesia from 2010 to 2016, there have been 41 accident investigations that caused as many as 443 fatalities. One of the causes of accidents comes from driver error. There were 69.7% of motor vehicle accidents caused by sleepy motorists [1]. Drowsiness is a condition where someone feels like sleeping. Drowsiness can happen at the wrong time, for example, when working, while studying, or while driving. Sleepiness usually characterized by fatigue, loss of consciousness, falling asleep, and interference with activity [2] and forgetting [3]. Besides being able to hurt self sleepy while driving, it can also harm another motorbike driver.

Drowsiness can trigger various problems, such as disturbing driving performance [4], productivity, affecting one's emotions, disturbing social interactions, and the most fatal is that it can cause accidents both on the road and in the work environment [5]. Accidents can occur not only because of human factors but also because of road or vehicle factors. Accident handling is if the driver is still conscious and then asks for help or a family who knows when the accident occurred. There are cases of late accident handling because no family knows [6]. Accelerometer sensor can use to detect the tilt or change the position of an object [7] so that can know the information about accidents.

Several studies have conducted related to this research. Such as wearable device technology use for drowsiness detection [8]. SMS use to control smartphones remotely [9]. Accelerometer data use to identify idling times of a vehicle [10] and assess road quality [11]. In this research, to detect drowsiness is the Mi Band 3 smartband because it can track the user's activities such as heart rate [12], sleep quality [13], and activity trackers [14].

In contrast to Aloul's research [15] which uses smartphones to detect car accidents, this research use smartphone and wearable device to detect motorbike driver accident. A smartband retrieved the motorbike driver's heart rate data and sent it to a smartphone to calculate the average heart rate which, if declared sleepy, the smartband will vibrate, and the smartphone will sound an alarm. When an accident driving is detected using the accelerometer sensor on an android smartphone, the location, and time data when the accident occurred sent to the family. This research aims to build a driving safety application and uses a software development life cycle method during the system development process.

2. Method

This research consists of several stages. The initial stage is to carry out case analysis to obtain accident-related data, analyze sleepiness and accidents up to the implementation stage and system testing. Fig. 1 is the stages carried out in this research.

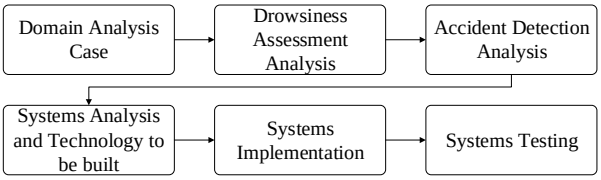


Fig. 1. Stage of Research Method

2.1. Domain Analysis Case

At this stage, an analysis of cases is carried out in the form of an analysis of common problems when driving accidents. Amounting to 69.7% of motor vehicle accidents caused by rider drowsiness. Every day many riders are passing by on the highway. Due to data from BPS Indonesia (Central Bureau of Statistics) recorded until 2017, there were 138,556,699 units of motor vehicles in Indonesia. This number is increasing every time so that it can cause higher accident rates.

Drowsiness while riding can occur due to several factors such as fatigue or the urge to sleep at night [16], travel that far, less fit body condition. Drowsy while also riding can-do harm to other riders. Drowsiness is a condition in which a person feels like to sleep. It can happen at the most opportune times, such as at work while studying or while riding. Thus, the results of the domain analysis case stage in this study are getting that driving accidents can be caused by several reasons, one of which is sleepy.

2.2. Drowsiness Assessment Analysis

At this stage, an analysis of the data obtained heartbeat from the smartband will be calculated based on previous studies to determine if someone is drowsy or not. Drowsiness usually occurs because of a lack of sleep. Everyone has different sleep needs, depending on age and daily activities. Ideally, adults need 7-9 hours of sleep during hours per day, children and teenagers need 9 hours, toddlers need 10-12 hours, and the newborn takes 16-18 hours. The following workflow of drowsiness assessment in this research can see in Fig. 2.

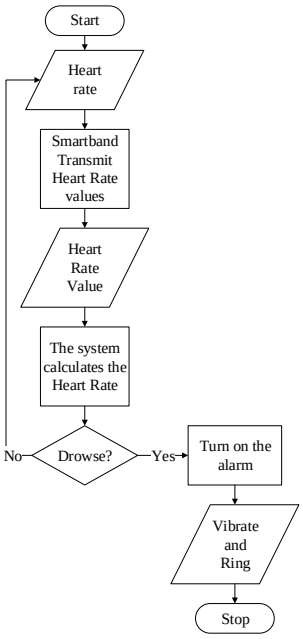


Fig. 2. Drowsiness Assessment Workflow

Drowsiness detection applications built using tools that smartband. The smartband can use on the left or right wrist that will use to detect the amount of

blood. Mi Band 3 uses a green LED light that is paired with a light-sensitive photodiode to detect the amount of blood flowing through the wrist. When the heartbeats, the blood flowing in the wrist will reflect light, and its reflections readable by a photodiode, the blood does not reflect light means a higher blood volume. Through the observation of view, the sensor analyzes the data and calculates the heart rate. By blinking LED lights hundreds of times per second, Mi Band 3 can calculate the frequency of the heartbeat.

The hear rate is the number of heartbeat per unit of time, usually expressed in beats per minute or beats per minute (bpm) [17]. In adults, the normal heart rate is 60-100 bpm [18] with the heart rate maximum is 220 - age. Table 1 included a normal heartbeat.

Table 1. Normal Heart Rate.

Age	Normal Heart Rate
1-2 years	80-130
2-6 years	70-120
6-10 years	70-110
Ten years and over	60-100

The time body relaxes either at rest, drowsiness, or sleep, and heart rate is relatively slower than when doing the activity. In general, the decline ranges from 10-20% of the current state of operation. This value has validated by expert Doctor.

2.3. Accident Detection Analysis

At this stage, an analysis of the data value of the slope of the smartphone, which will be calculated based on the data values from previous studies to determine the position of the motor falls to the left or the right. A smartphone today generally already has an accelerometer sensor for various needs, such as changing the display from portrait to landscape by tilting the body of the phone, this happens because of a change to the coordinates x, y, and z smartphone. The x-axis is the form of a horizontal line, a vertical line forming the y-axis and z-axis pointing to the front and rear of the display device. Accelerometer values can see in Table 2.

Table 2. Accelerometer Axis Value.

Position	X	Y	Z
Vertical	0	1	0
Vertical reversed	0	-1	0
Left landscape	1	0	0
Right landscape	-1	0	0
Flat	0	0	1
Flat reversed	0	0	-1

The calculation of the value of the accelerometer will be focused on the x-axis because the amount of x to determine the slope of the smartphone, which is placed on speedometers overall effect accelerometer to detect an accident. The following workflow drowsiness ratings can see in Fig. 3.

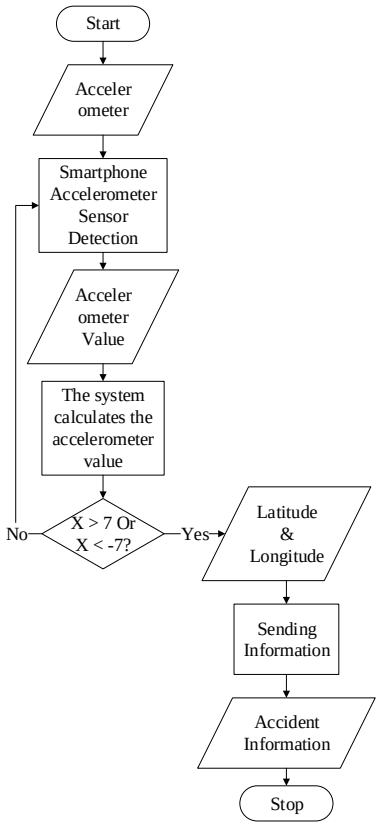


Fig. 3. Accident Detection Workflow

2.4. Tools and Technology

Some of the technology used in this research is :

a. Smartband
   This technology used to get the heart rate value that detects drowsiness. The smart band is a device or application to monitor and keep track of fitness-related metrics such as walking or running distance, calorie consumption, heart rate, and sleep quality.
b. Accelerometer
   This technology used to get the value of the slope of the smartphone to identify a crash. In this research, the accelerometer in the android smartphone used as a detector of the wave of the vehicle due to holes or damaged roads. The accelerometer in a smartphone can change the display from portrait to landscape by tilting the body smartphone because that reads three axes from different directions [19].
c. Google Maps API
   This technology used to get the latitude and longitude values [20] to determine the accident's current location is detected.
d. SMS Gateway
   This technology used to provide and send information to a predetermined destination number when detected accidents [21].

2.5. System Implementation

At this stage of the application development, along with the implementation of technology, it has been analyzed previously. At this stage, the start of implementation drowsiness assessment, implementation of crash detection, smart band linking implementation, and the implementation of the SMS Gateway.

2.6. System Testing

The results at the testing stage of the system by testing process analysis technique based on functional suitability, compatibility, usability, and efficiency. The functional suitability test assessed by the Guttman scale. After getting the test results in the form of points, then analyzed using criteria in the document quality for android applications can see in Table 3.

Table 3. Functional Quality Standards Suitability.

Rankings	Warning	Critical
No error	0 points	0 points
An easy mistake	1 point	-
Errors that are difficult	2 points	-
Fatal error	4 points	-
The test fails	-	5 points

Compatibility analysis conducted by operationally test series with the commencement of the installation of applications on different versions of operating systems and various specifications of smartphones based on the Android platform [22]. The next stage of calculating the percentage score test results to determine the quality level of compatibility aspects, namely:

$$\text{Percentage of Eligibility} = \frac{\text{Score obtained}}{\text{Maximum Score}} \text{ x } 100\ \% \quad (1)$$

The usability aspect testing is using a Likert scale as the scale of measurement. The instruments use questionnaire contains 30 questions to be answered by the user to show the attitude towards ease of use application [23]. After finding the results of the calculations score in the obtained, then make a comparison with the criteria in Table 4 for the interpretation of scores [24].

Table 4. Criteria Interpretation Score.

Percentage (%)	Interpretation
0% - 20%	Very unfit
21% - 40%	Less worthy
41% - 60%	fairly decent
61% - 80%	worthy
81% - 100%	very decent

Analysis of quality in the performance aspect of efficiency done by calculating the average response time of each activity that executed using the program function trace view [25]. Tests on the performance aspect performed at least five times the amount calculated average response time when an application retrieves data from

the server and then shown into the system [26]. The results are then compared Table 5 user satisfaction with the response time [27].

Table 5. User Satisfaction Predicate.

Response Time (seconds)	Predicate
<3	Very satisfied
3-9	Satisfied
9-12	Quite happy
> 12	Not satisfied

3. Results and Discussion

These stages include results from testing assessment and discuss the results obtained for the implementation of further research.

3.2. Drowsiness Assessment

Calculation of heart rate obtained will be sent to a smartphone using bluetooth 4.0 connection from Mi Band 3. Data received smart heartbeat band reprocessed to get the average heart rate. Here is the value of heart rate normal conditions of 5 samples 21-23 age range. The calculation of the average cost of each sample obtained heart rate while relaxing, during activity, sport, or at rest can see in Table 6.

Table 6. Calculation of Heart Rate Average (BPM).

Sample	Age	Relaxing	Activity	Sport	Rest
1st sample	23	65	85	105	56
2nd sample	21	72	91	112	64
3rd sample	22	64	82	102	60
4th sample	22	62	80	98	54
5th sample	22	68	88	101	58

A summary from Table 6 is the average heart rate when relaxing=66 BPM, during activity =85 BPM, sport=104 BPM and rest=58 BPM. Based on Table 6 can be concluded if the average heart rate of each person is different, then taken the theory from an expert doctor who claims that if a person experiences drowsiness, heart rate will decrease by approximately 10% to 20%. Calculation of the average heart rate done for 15 seconds. The example of drowsiness assessment, a rider aged 22 years is in a fit condition and has a regular heart rate of 80 BPM. Using the theory is when a person experiences drowsiness heart rate decreases of 10-20% from the current normal circumstances, this formula determines the heart rate when the drowsy.

$$H_{beat} = N_{beat} - \frac{20}{100} \text{ x } N_{beat} \quad (2)$$

If N_{beat} = 80, then :
H_{beat} = 80 – 16
H_{beat} = 64 BPM
When the value of a rider heart rate less than 64 BPM or 64 BPM otherwise drowsy.

3.3. Detection Accident Assessment

In this case, the smartphone will affix to the top of the speedometer of the motorbike. Table 7 shows the standard minimum values, and maximum values accelerometer in normal position.

Table 7. Testing Standard Value Accelerometer.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-0.13	0.16
Y	3.12	3.23
Z	8.70	9.65

Table 8 show the minimum and maximum value from the accelerometer when receiving shocks when riding. The shocks that occurred were small to moderate shocks.

Table 8. Testing Shock Value Accelerometer While Riding.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-2.91	3.48
Y	2.61	5.44
Z	4.69	12.68

The occurrence of sudden braking also causes shocks. Table 9 show the minimum and maximum values from the accelerometer when receiving shocks when a sudden brake is applied.

Table 9. Testing Value Accelerometer When Brakes Sudden Shocks.

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-3.52	3.86
Y	0.38	8.02
Z	0.28	20.20

Table 10 show the minimum and maximum values from the accelerometer when receiving a shock when an accident occurs with the motorbike position fell to the right. While riding, it will declare in a motorbike accident in which position fell to the right.

Table 10. Accelerometer Shock Value Current Testing Accident Occurs

Axis	Minimum (m/s^2)	Maximum (m/s^2)
X	-23.06	9.87
Y	-4.38	10.67
Z	-17.20	24.74

For the example assessment of the accident, a 22-year-old motorbike driver suffered an accident that caused the motor to fall to the right and give the accelerometer value on the x-axis of -7.56 m/s. After several experiments conducted in this research, it can ensure that the motorbike is said to have fallen when the value of the axis x>7 m / s or x<-7 m/s. To determine whether an accident occurred or not with a logical formula:

A_{BL}= X_{axis}>7 ∨ X_{axis} <-7
If X_{axis} = -7.56, then:
A_{BL} = -7,56>7 ∨ -7,56 <-7
A_{BL} = false ∨ true
A_{BL} = true
When A_{BL} is true, then it will be detected an accident.

3.4. System Architecture

The system architecture in this research can see in Fig. 4. The smartband used to detect motorbike driver heartbeat. When the system detects drowsiness, it will sound an alarm and vibrate to riders. If an accident occurs, the system will detect and take the scene and then sends the location information using SMS to the family of the crash or the destination number that has registered in the application.

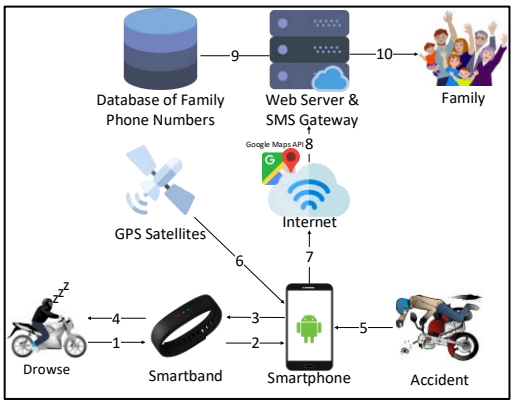


Fig. 4. System Architeture

The system procedure describes the activity process from the side of the driver, the system, and the family. A description of a system procedure in this research can see in Fig. 5.

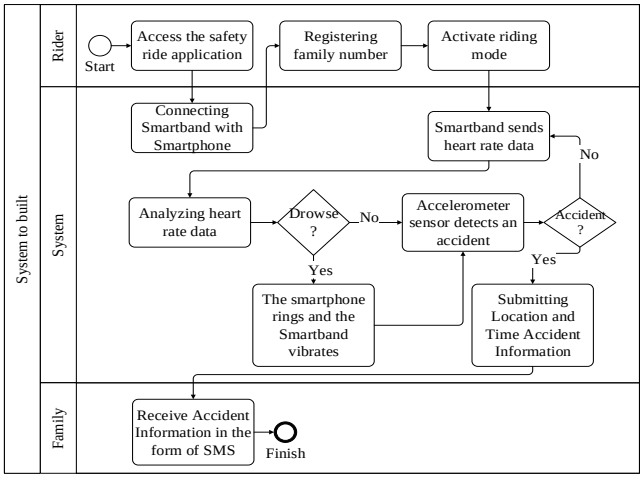
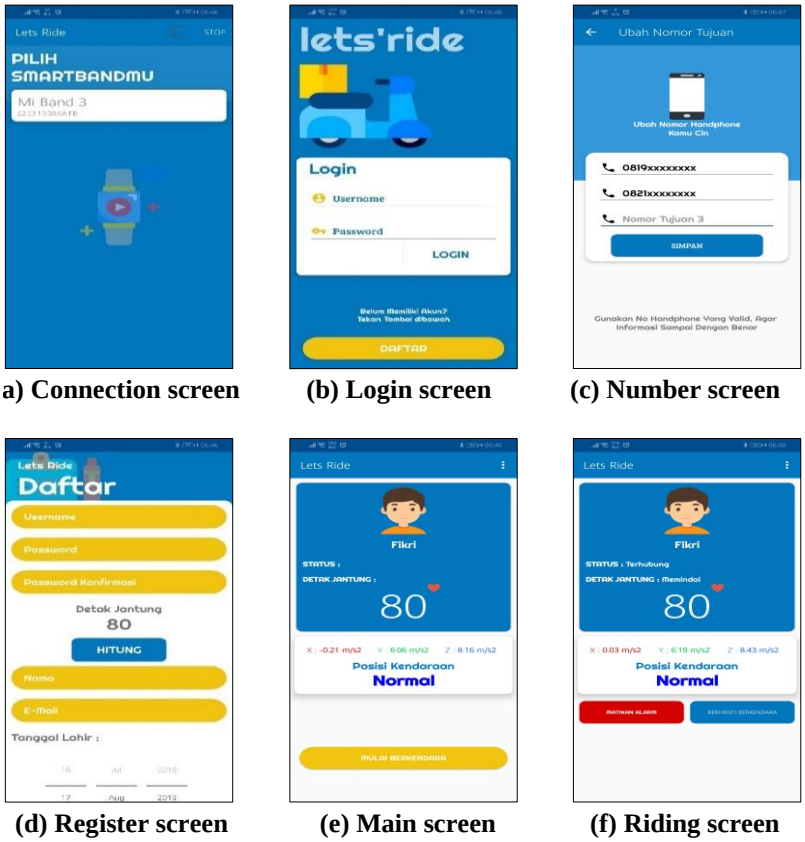


Fig. 5. System Procedure

3.5. System Implementation

These applications require installation on an android smartphone device with minimum version 5.1 (Lolipop). Fig. 6 show the system implementation result. The interface for the coupling smartband and smartphone shown in figure (a). On this page, there is a list of devices that can be connected. The login screen sees in figure (b), in which this page use to log in. Figure (c) shows the destination number that will send information about the location and the time when the accident occurred. Figure (d) used to register a new account. The main screen show in figure (e). This page indicator displayed the heart rate and accelerometer value equal to the image (f) only in this figure when started riding.



a) Connection screen **(b) Login screen** **(c) Number screen**

(d) Register screen **(e) Main screen** **(f) Riding screen**

Fig. 6. Application display results

3.6. Results of Drowsiness Detection Test

Drowsiness detection testing by calculating the heart rate of 30 respondents. Here are the test results, which can see in Table 11. The test results presented that the accuracy of sleepiness detection calculations reached 80% following the formula stated by the expert doctor. The accuracy rate when testing during the day only getting an accuracy value of 75%. The accuracy when testing at night is 90%.

Table 11. Result of Drowsiness Detection Test

No	Age	Time	Normal Heart Rate	Heartbeats While Drowsy	Result
1	21	10:13	80	59	Corresponding
2	22	10:15	81	63	Corresponding
3	21	10:17	82	69	Not Corresponding
4	23	10:20	79	57	Corresponding
5	22	10:22	80	67	Not Corresponding
6	22	12:43	75	67	Not Corresponding
7	22	12:46	82	65	Corresponding
8	22	12:48	87	66	Corresponding
9	20	12:50	86	58	Corresponding
10	24	12:54	85	59	Corresponding
11	22	13:05	86	62	Corresponding
12	24	13:08	75	68	Not Corresponding
13	21	13:11	80	66	Not Corresponding
14	23	13:13	81	63	Corresponding
15	23	13:16	87	56	Corresponding
16	21	15:25	83	57	Corresponding
17	21	15:27	82	55	Corresponding
18	22	15:30	88	70	Corresponding
19	23	15:33	81	61	Corresponding
20	20	15:36	89	60	Corresponding
21	20	19:45	78	60	Corresponding
22	22	19:49	82	61	Corresponding
23	22	19:54	89	57	Corresponding
24	22	19:58	84	60	Corresponding
25	24	20:05	88	60	Corresponding
26	22	03:04	80	69	Not Corresponding
27	21	03:07	86	60	Corresponding
28	20	03:09	83	61	Corresponding
29	23	03:13	79	58	Corresponding
30	24	03:16	87	55	Corresponding

3.7. Results of Drowsiness While Riding Test

We are testing drowsiness while riding a motorbike by cyclically calculating the heart rate with a regular heart rate of 80. The test result can found in Table 12, from the test results as many as five times, when detected vibration on smartband drowsiness and alarm on the smartphone turns on which function well.

Table 12. Testing Result Drowsiness While Riding

	Heart Rate	Vibrate Smartband	Vibration and Sound Phone
Test 1	59	Yes	Yes
Test 2	61	Yes	Yes
Test 3	57	Yes	Yes
Test 4	60	Yes	Yes
Test 5	65	Yes	Yes

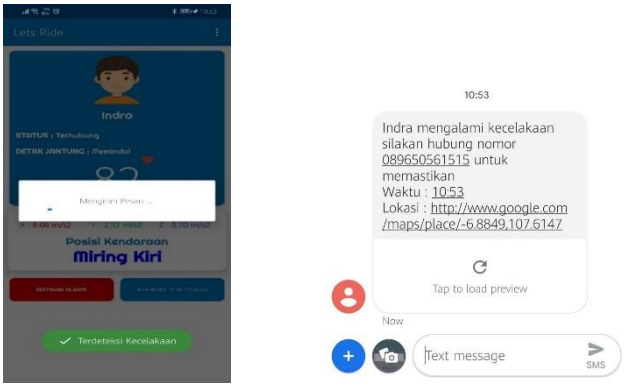
3.8. Results of Accident Detection Test

Accident test detection by calculates the accelerometer sensor in a smartphone. Fig. 7 (a) show the position a smartphone stored at the motorbike speedometer to obtain motor vehicle accelerometer data, and (b) show a driver has an accident so that the application sends information an accident has occurred to the rider's family.

(a) smartphone position **(b) accident position**

Fig. 7. Accident Detection Test

When an accident is detected, the application will send information in the form of a short message service to the destination number that has registered. The information sent contains detailed information such as the name detected in the accident, the number that can contact, and the time and coordinates of the accident's location. Fig. 8 (a) is the display when the application sends a message, while Fig. 8 (b) is the result of the short message service that has sent.



(a) Sending message **(b) Message content**

Fig. 8. Sending Information When Accident

Tests accident detection conducted six times that can seen in Table 13.

Table 13. Accident Detection Tests

Position	Accelerometer Value	Message	Information
Tilt Left	X-axis: 8.66 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -7.79 m / s	sent	Detected Leaning Right
Tilt Left	X-axis: 7.56 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -8.16 m / s	sent	Detected Leaning Right
Tilt Left	X-axis: 8.66 m / s	sent	Detected Leaning Left
Tilt Right	X-axis: -8.17 m / s	sent	Detected Leaning Right

The experiment detected the accident and information messages sent to the destination number. These results mean that the level of accuracy in accident detection gets an accuracy rate of 100%. The overall results of the tests conducted on the application of functional aspects of suitability testing, compatibility, usability, and efficiency criteria can see in Table 14.

Table 14. Software Testing Result

	Score	Result
Suitability	100 %	Very decent
Compatibilty	100 %	Very decent
Usability	84.71 %	Very decent
Efficiency	3.88 seconds	Satisfied

4. Conclusion

This research has successfully used accelerometer sensors on smartphone android and wearable devices to detect and prevent motorbike driver accidents. The results of tests carried out show that the accuracy of detecting drowsiness is equal to 80%, and the accident detection test gets an accuracy of 100 %. From the results of software testing also get good grades, seen from the criteria of suitability, compatibility, usability, and efficiency. The difference in accuracy when detecting drowsiness during the day and night becomes a subject for further research.

5. Acknowledments

Authors wishing acknowledge to Universitas Komputer Indonesia, Kementerian Pendidikan dan Kebudayaan and Deputi Bidang Penguatan Riset dan Pengembangan (DPRM) Kementerian Riset dan Teknologi/ Badan Riset dan Inovasi Nasional Republik Indonesia for supporting this research with applied research grants for the second year implementation (2020), based on a letter decision number B / 87 / E3 / RA.00 / 2020 and number 045 / SP / LPPM / UNIKOM / III / 2019.

Nomenclatures

H_{beat}	Heartbeats value when drowsy
N_{beat}	Normal heartbeats value
A_{BL}	Boolean value when the tilt motorcycle
X_{axis}	Value on the x-axis accelerometer

Abbreviations

JESTEC	Journal of Engineering Science and Technology
NTSC	National Transportation Safety Committee
SMS	Short Message Services
BPS	Badan Pusat Statistik
LED	Light Emitting Diode
UNIKOM	Universitas Komputer Indonesia
BPM	Beats Per Minute

References

1. Mustofa, A.; Hendra, K.; and Tasripan, T. (2019). Sistem peringatan dini menggunakan deteksi kemiringan kepala pada pengemudi kendaraan bermotor yang mengantuk. *Jurnal Teknik ITS*, 7(2), F281-F286.
2. Vicente, J.; Laguna, P.; Bartra, A.; and Bailón, R. (2016). Drowsiness detection using heart rate variability. *Med. Biol. Eng. Comput*, 54(6), 927–937.
3. Gina, R.P. (2017). Sleep is for forgetting. *Journal of Neuroscience*. 23(3). 464-473.
4. Caponecchia, C.; and Williamson, A. (2018). Drowsiness and driving performance on commuter trips. *Journal of safety research*. 66, 179-186.
5. Irawan, S.D.; and Adriantantri, E. (2019). Pendeteksi Mengantuk Menggunakan Library Python. *Jurnal Mnemonic*, 2(1), 22-27.
6. Sharma, S.; Reddy, R.K.; and Karthik, A. (2016). S-CarCrash: Real-time crash detection analysis and emergency alert using smartphone. *International Conference on Connected Vehicles and Expo (ICCVE) 2016*, 36–42.
7. Alfaeru, F.; Setiawan, A.B.; Nachrowi, N.; and Hidayat, R,. (2017). Implementation of accelerometer sensor and GPS module for smart bike design. *International Conference SDGs 2030 Challenges and Solution.*, 1(1), 299-311.
8. He, J.; Choi, W.; Yang, Y.; Lu, J.;Wu, X.; and Peng, K. (2017). Detection of driver drowsiness using wearable devices: A feasibility study of the proximity sensor. *Applied ergonomics*, 65, 473-480.
9. Pranoto, H.; and Setiawan, E.B. (2017). Android smartphone remote monitoring application using SMS service. *International Journal of New Media and Technology*. 4(2). 112–119.
10. Menon.; Shreenarayan, S.; Dosher, D.J.; and Christensen, S.T. (2018). System and method for identifying idling times of a vehicle using accelerometer data. *U.S. Patent No. 10,019,762*.
11. Setiawan, E.B.; and Nurdin, H. (2019). Road quality assessment using international roughness index method and accelerometer on android. *Lontar Komputer*. 10(2). 62-72.
12. Attaur-Rasool, S. (2020). Use of wearable technology to measure influence of driving stress on heart rate of professional drivers. *Journal of Saidu Medical College*. 10(1). 35-38.
13. Ameen, M. S.; Cheung, L. M.; Hauser, T.; Hahn, M. A.; and Schabus, M. (2019). About the accuracy and problems of consumer devices in the assessment of sleep. *Sensors*. 19(19), 4160.
14. Rao, R. R.; Singh, A.; and Kamath, V. (2018). Assessment of step accuracy and usability of activity trackers. *In 2018 3rd International Conference on Contemporary Computing and Informatics (IC3I) IEEE*. 38-42.
15. Aloul, F.; Zualkaenan, I.; Abu-Salma, R.; and Al-Ali, H. (2015). iBump: Smartphone application to detect car accidents. *Computer and Electrical Engineering*. 43 (2015), 66–75.
16. Bener, A.; Yildirim, E.; Özkan, T.; and Lajunen, T. (2017). Driver sleepiness, fatigue, careless behavior and risk of motor vehicle crash and injury:

Population based case and control study. *Journal of Traffic and Transportation engineering (English edition)*. 4(5). 496-502.

17. Goel, V.; Srivastava, S.; Pandit, D.; Tripathi, D.; and Goel, P. (2018). Heart rate monitoring system using finger tip through IoT. *International Research Journal of Engineering and Technology (IRJET)*. 5(03). 1114-1117.
18. Song, M.; and Vega, K. (2018). HeartMe: Thermochromic Display as An Expression of Heart Health. *In Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems.* 311-314.
19. Hardiyanti, N.; Lawi, A.; and Aziz, F. (2018). Classification of Human Activity based on Sensor Accelerometer and Gyroscope Using Ensemble SVM method. *In 2018 2nd East Indonesia Conference on Computer and Information Technology (EIConCIT)*. 304-307.
20. Windarni, V. A.; Sediyono, E., and Setiawan, A. (2016). Using GPS and Google maps for mapping digital land certificates. *Proceeding In 2016 International Conference on Informatics and Computing (ICIC)*. 422-426.
21. Bautista, J. M.; Tapic, L.; Base, G.; and Cabrera, E. (2019). Real-Time vehicle accident alert system based on arduino with SMS notification. *Southeast Asian Journal of Science and Technology*. 4(1). 98-100.
22. Wagner, S. (2013). *Software Product Quality Control*. Springer-Verlag Berlin Heidelberg.
23. Gao, M.; Kortum, P.; and Oswald, F. (2018). Psychometric evaluation of the use (usefulness, satisfaction, and ease of use) questionnaire for reliability and validity. *In Proceedings of the human factors and ergonomics society annual meeting*. 62(1). 1414-1418.
24. Guritno, S.; Sudaryono; and Rahardja, U. (2011). *Theory And Application Of It Research Bukukita*. Yogyakarta: Andi.
25. Yoon, H. (2012). A Study on the Performance of Android Platform. *International Journal on Computer Science and Engineering*. 4(4). 532–537.
26. Niknejad, A.; and Aida. (2011). *A Quality Evaluation of an Android Smartphone Application*. Master thesis. Goteborgs Universitet Goteborgs Universitetsbibliotek.
27. Hoxmeier, J.; and DiCesare, C. (2000). System Response Time and User Satisfaction : An Experimental Study of Browser-based Applications. *AMCIS 2000 Proceedings*. 347.

Gmail

Eko Budi Setiawan
<eko@email.unikom.ac.id>

[JESTEC] Manuscript ID: JESTEC007_EKO BUDI S- Submission Received

1 message

Editorial Office <jjestec@gmail.com> 22 February 2021 at 15:06
To: Eko Budi Setiawan <eko@email.unikom.ac.id >

Dear Author,

Thank you very much for uploading the following manuscript to the submission system. One of our editors will be in touch with you soon.

Journal Name	Journal of Engineering, Science and Technology
Manuscript ID	JESTEC007_Eko Budi S
Authors	Eko Budi Setiawan, Tubagus F. Fatoni
Title	Driving Safety Application using Wearable Device And Mobile Technology

If you have any questions, please do not hesitate to contact editorial office.

Kind regards,

Editorial Office
Journal of Engineering, Science and Technology
E-Mail: jjestec@gmail.com

*** This is an automatically generated email ***

Gmail

Eko Budi Setiawan
<eko@email.unikom.ac.id>

[JESTEC] Manuscript ID: JESTEC007_EKO BUDI S– Major Revisions

1 message

Editorial Office <jjestec@gmail.com> 22 April 2021 at 15:06
To: Eko Budi Setiawan <eko@email.unikom.ac.id >

Dear Author,

Thank you for submitting the following manuscript to Journal of Engineering, Science and Technology:

Journal Name	Journal of Engineering, Science and Technology
Manuscript ID	JESTEC007_Eko Budi S
Authors	Eko Budi Setiawan, Tubagus F. Fatoni
Title	Driving Safety Application using Wearable Device And Mobile Technology

It has been reviewed by experts in the field and we request that you make major revisions before it is processed further. Please find the comments from reviewer in the attached file.

Please revise the manuscript according to the reviewers' comments and upload the revised file within 10 days. Use the version of your manuscript found at the above link for your revisions, as the editorial office may have made formatting changes to your original submission. Any revisions should be clearly highlighted, for example using the "Track Changes" function in Microsoft Word, so that changes are easily visible to the editors and reviewers. Please provide a cover letter to explain point-by-point the details of the revisions in the manuscript and your responses to the reviewers' comments. Please include in your rebuttal if you found it impossible to address certain comments. The revised version will be inspected by the editors and reviewers. Please detail the revisions that have been made, citing the line number and exact change, so that the editor can check the changes expeditiously. Simple statements like ‘done’ or ‘revised as requested’ will not be accepted unless the change is simply a typographical error.

If the reviewers have suggested that your manuscript should undergo extensive English editing, please address this during revision. We suggest that you have your manuscript checked by a native English speaking colleague or use a professional English editing service.

Do not hesitate to contact us if you have any questions regarding the revision of your manuscript or if you need more time. We look forward to hearing from you soon.

Kind regards,

Editorial Office
Journal of Engineering, Science and Technology
E-Mail: jjestec@gmail.com

Gmail

Eko Budi Setiawan
<eko@email.unikom.ac.id>

[JESTEC] Manuscript ID: JESTEC007_EKO BUDI S– Revised Version Received

1 message

Editorial Office <jjestec@gmail.com> 22 May 2021 at 15:06
To: Eko Budi Setiawan <eko@email.unikom.ac.id >

Dear Author,

Thank you very much for resubmitting the modified version of the following manuscript:

Journal Name	Journal of Engineering, Science and Technology
Manuscript ID	JESTEC007_Eko Budi S
Authors	Eko Budi Setiawan, Tubagus F. Fatoni
Title	Driving Safety Application using Wearable Device And Mobile Technology

A member of the editorial office will be in touch with you soon regarding progress of the manuscript.

Kind regards,

Editorial Office
Journal of Engineering, Science and Technology
E-Mail: jjestec@gmail.com

*** This is an automatically generated email ***

Gmail

Eko Budi Setiawan
<eko@email.unikom.ac.id>

[JESTEC] Manuscript ID: JESTEC007_EKO BUDI S– Accepted

1 message

Editorial Office <jjestec@gmail.com> 22 June 2021 at 15:06
To: Eko Budi Setiawan <eko@email.unikom.ac.id >

Dear Author,

We are pleased to inform you that the following paper has been officially accepted for publication:

Journal Name	Journal of Engineering, Science and Technology
Manuscript ID	JESTEC007_Eko Budi S
Authors	Eko Budi Setiawan, Tubagus F. Fatoni
Title	Driving Safety Application using Wearable Device And Mobile Technology

We will now make the final preparations for publication, then return the manuscript to you for your approval.

If, however, extensive English edits are required to your manuscript, we will need to return the paper requesting improvements throughout.

Kind regards,

Editorial Office
Journal of Engineering, Science and Technology
E-Mail: jjestec@gmail.com

Gmail

Eko Budi Setiawan
<eko@email.unikom.ac.id>

[JESTEC] Manuscript ID: JESTEC007_ EKO BUDI S– Published Online

1 message

Editorial Office <jjestec@gmail.com> 03 August 2021 at 15:06
To: Eko Budi Setiawan <eko@email.unikom.ac.id >

Dear Author,

We are pleased to inform you that your article:

Journal Name	Journal of Engineering, Science and Technology
Manuscript ID	JESTEC007_Eko Budi S
Authors	Eko Budi Setiawan, Tubagus F. Fatoni
Title	Driving Safety Application using Wearable Device And Mobile Technology

is available online:

Please take a moment to check that everything is correct. You can reply to this email if there is a problem. Note that at this stage we will not accept further changes to the manuscript text.

Thank you for choosing our journal to publish your work, we look forward to receiving further contributions from your research group in the future.

Kind regards,

Editorial Office
Journal of Engineering, Science and Technology
E-Mail: jjestec@gmail.com