eecsi 2018

Organizer:

UMM
UNIVERSITAS MUHAMMADIYAH MALANG

Sponsored by:

RISTEKDIKTI

Technical Co.Sponsorship:

IEEE
INDONESIA SECTION

PROCEEDING

2018 5th International Conference on Electrical Engineering, Computer Science and Informatics

Indexed by:

Scopus®

October
16 - 18, 2018

Ijen Suites
Resort & Convention
Malang, Indonesia

Co.Organizers:

Universitas Diponegoro Semarang

Universitas Ahmad Dahlan

Universitas Siliwangi

Universitas Islam Sultan Agung UNISSULA

iaes
Institute of Advanced Engineering and Science

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

PROCEEDINGS

2018 5th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI 2018)

16-18 October 2018, Malang, Indonesia

Editors:
Anton Yudhana, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
Zulfatman, Universitas Muhammadiyah Malang, Indonesia
Deris Stiawan, Universitas Sriwijaya, Palembang, Indonesia
Munawar A. Riyadi, Universitas Diponegoro, Semarang, Indonesia
Imam Much Ibnu Subroto, Universitas Islam Sultan Agung, Semarang, Indonesia
Agus Eko Minarno, Universitas Muhammadiyah Malang, Indonesia
Christian Sri Kusuma Aditya, Universitas Muhammadiyah Malang, Indonesia

PROCEEDINGS

2018 5th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI 2018)

ISBN : 978-1-5386-8401-6 (USB, Part Number : CFP18B51-USB)
ISBN : 978-1-5386-8400-9 (DVD, Part Number : CFP18B51-DVD)
ISBN : 978-1-5386-8402-3 (XPLORE COMPLIANT, Part Number : CFP18B51-ART)

Additional copies may be ordered to:
Lembaga Pengembangan Publikasi Ilmiah (LPPI)
Universitas Muhammadiyah Malang
Gedung Perpustakaan Pusat UMM, Jl. Raya Tlogomas No. 246, Malang, 65144.
+62341-464318 Ext. 243

EECSI 2018 Partners and Supporters

Organizer:

Sponsored by:

Technical Co. Sponsorship:

Co. Organizers:

Foreword from General Chair EECSI 2018

Foreword General Chair

In the name of Allah, the Most Beneficent, the Most Merciful.
Welcome to the 2018 5th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI 2018) in Malang, Indonesia.

The 5th EECSI 2018 is themed "Toward the Next Generation of Technology". This conference provides academicians, researchers, professionals, and students from various engineering fields and with cross-disciplinary working or interested in the field of Electrical Engineering, Computer Science, and Informatics to share and to present their works and findings to the world.

I would like to express my highly gratitude to all participants for attending, sharing and presenting your ideas and experiences in this interesting conference. Almost 300 papers had been submitted to EECSI 2018. However, the only high quality papers are selected and accepted to be presented in this event. We are also thankful to all the international committee, international reviewers, and steering committee for their valuable support. I would like to give a praise to all partners in publications and sponsorships for their valuable supports, especially for Ministry of Research and Higher Education (Kemenristekdikti) Indonesia.

Organizing a prestigious conference was incredibly challenging and would have been impossible to be held without outstanding committees. Such that, I would like to extend my sincere appreciation to all organizing committees and volunteers from Universitas Muhammadiyah Malang as a host and all colleagues from Universitas Diponegoro, Universitas Ahmad Dahlan, Universitas Sriwijaya, Universitas Islam Sultan Agung, Universitas Gadjah Mada, Universitas Budi Luhur, Universiti Teknologi Malaysia, and IAES Indonesia Section for providing me with much needed support, advice, and assistance on all aspects of the conference. A special thanks also for lEEE Indonesia Section for their contribution as technical co-sponsorship of the conference. We do hope that this event will encourage the collaboration among us now and in the future.

We wish you all find opportunity to get rewarding technical program, intellectual inspiration, renew friendships and forge innovation, and that everyone enjoys Malang.

Assoc. Prof. DR. Tole Sutikno
General Chair EECSI 2018

Foreword from IAES Indonesia Section

Bismillahirrohmannirrahim,
In the name of Allah Al Mighty, The Most Gracious, The Most Merciful

We are pleased to welcome our colleagues in the International Conference on Electrical Engineering, Computer Science and Informatics (EECSI 2018) in Malang, City of Heritage on October 16-18th, 2018.

It must be said proudly that the EECSI has been rolled out for five times since it was firstly initiated on year 2014 in Yogyakarta. Our colleagues all over the world supporting by many tops universities have successfully organized the conference to become the prestigious international annual event in Indonesia.

A highest appreciation is addressed to The Ministry of Research, Technology and Higher Education (Kemenristekdikti) Republic of Indonesia for a worthy technical and financial support during the conference and special thanks for IEEE Indonesia Section for the technical co-sponsorship for this prominent occasion. We do hope that this event will strengthen the collaboration among us now and in the future.

This year, the achievement in this conference is due to valuable contributions from our colleagues from Universitas Muhammadiyah Malang supporting by Universitas Diponegoro, Universitas Ahmad Dahlan, Universitas Sriwijaya, Universitas Islam Sultan Agung, Universitas Gadjah Mada, Universitas Budi Luhur and Universiti Teknologi Malaysia. I would like to express my sincere gratitude and appreciation for all partners, friends, Organizing committee, reviewers, keynote speakers, and participants who have made this event as great as today.

I would also like to extend my gratitude to Rector of Universitas Muhammadiyah Malang who friendly becomes a main host for this great conference. We optimist many following collaborative works will be carried out among us and all participants.

I hope you all had a nice time at the conference where all of you are able to learn something new, renewed and created new networks and at the same time have some fun in Malang City during the conference and Mount Bromo during the cultural tour.

Thank you.

Assoc. Prof. Mochammad Facta, Ph.D
IAES – Indonesia Chapter

Foreword from Rector of Universitas Muhammadiyah Malang

The advent of the next generation of technology, renown as Technology 4.0, is unavoidably incessant. This so-called technology has offered a new horizon in various aspects of man-beings' lives. To be particular in the fields of electrical engineering, electronics, computer science, computer engineering, and informatics, Technology 4.0 plays its potent role to underpin the future advancement of technology for the coming generations. Scientific forum titled as the 2018 5th International Conference on Electrical Engineering, Computer Science, and Informatics (EECSI 2018) hosted by University of Muhammadiyah Malang in collaboration with a number of universities is the manifestation of continuous effort to aim for the ever-changing technology.

Hereby, I would like to congratulate the Faculty of Engineering, University of Muhammadiyah Malang for their effort in organizing the 2018 5th International Conference on Electrical Engineering, Computer Science, and Informatics (EECSI 2018). I appreciate all co-organizers such as Universitas Diponegoro, Universitas Ahmad Dahlan, Universitas Sriwijaya, Universitas Islam Sultan Agung, Universitas Budi Luhur, and Universiti Teknologi Malaysia for their support in this mutual collaboration. Without the full and valuable supports from the international committee, international reviewers, and steering committee, this international conference remains a detached discourse without high commitment to conduct.

The expression of my high gratitude is devoted to the Ministry of Research, Technology, and Higher Education (Kemenristekdikti) Republic of Indonesia, IEEE Indonesia Section, and IAES Indonesia Section for their support to this event as the sponsors and technical co-sponsorship, respectively. Expectantly, this would be the initial and continual collaboration in the future.

To all speakers, presenters, and participants, thank you for participating and welcome to this conference. The success of this conference owes so much on your participation and contribution in promoting the knowledge, information, and robust creativity. To end with, this conference expectedly becomes an arena to build mutual ties among the academicians, researchers, industries, and society.

All the best to EECSI 2018

Dr. H. Fauzan, M.Pd.
Rector
Universitas Muhammadiyah Malang - Indonesia

ORGANIZING COMMITTEE OF EECSI 2018 CONFERENCE

Steering Committee

- Adam Skorek, IEEE MGA Awards and Recognation Chair (R7) Trois-Rivières, QC, Canada
- Pekik Argo Dahono, IEEE Indonesia Chapters Chair (EdSoc/EDS/PELS/SPS)
- Mochamad Ashari, Telkom University, Bandung, Indonesia
- Tumiran, Universitas Gadjah Mada, Yogyakarta, Indonesia
- Hermawan, Universitas Diponegoro, Semarang, Indonesia
- Zainudin Nawawi, Universitas Sriwijaya, Palembang, Indonesia
- Rahmat Budiarto, Albaha University, Baha, Saudi Arabia
- Sri Arttini Dwi Prasetyowati, Universitas Islam Sultan Agung, Semarang, Indonesia
- Kartika Firdausy, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
- Siti Nurmaini, Universitas Sriwijaya, Palembang, Indonesia
- Ahmad Mubin, Universitas Muhammadiyah Malang, Indonesia

General Chair

- Tole Sutikno, IAES Indonesia

Finance Chairs and Treasurer

- Wiwiek Fatmawati, Universitas Islam Sultan Agung, Semarang, Indonesia
- Lailis Syafa'ah, Universitas Muhammadiyah Malang, Indonesia
- Lina Handayani, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

Program Chairs

- Deris Stiawan, Universitas Sriwijaya, Palembang, Indonesia
- Mochammad Facta, Universitas Diponegoro, Semarang, Indonesia
- Agus Eko Minarno, Universitas Muhammadiyah Malang, Indonesia
- Machmud Effendy, Universitas Muhammadiyah Malang, Indonesia
- Fauzi Sumadi, Universitas Muhammadiyah Malang, Indonesia
- Christian Sri Kusuma Aditya, Universitas Muhammadiyah Malang, Indonesia

General Co-Chair

- Zulfatman, Universitas Muhammadiyah Malang, Indonesia
- Anton Yudhana, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

Publication Chairs

- Munawar A. Riyadi, Universitas Diponegoro, Semarang, Indonesia
- Balza Achmad, Universitas Gadjah Mada, Yogyakarta, Indonesia
- Yuda Munarko, Universitas Muhammadiyah Malang, Indonesia
- Wahyu A. Kusuma, Universitas Muhammadiyah Malang, Indonesia

Publicity Chairs

- Imam Much Ibnu Subroto, Universitas Islam Sultan Agung, Semarang, Indonesia
- Maskur, Universitas Muhammadiyah Malang, Indonesia
- Son Ali Akbar, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
- Sam F. Chaerul, Universitas Islam Sultan Agung, Semarang, Indonesia
- Ahmad Heryanto, Universitas Sriwijaya, Palembang, Indonesia

Public Relations Chairs

- Aina Musdholifah, Universitas Gadjah Mada, Yogyakarta, Indonesia
- Amrul Faruq, Universitas Muhammadiyah Malang, Indonesia
- Reza Firsandaya Malik, Universitas Sriwijaya, Palembang, Indonesia
- Muhammad Syafrullah, Universitas Budi Luhur, Jakarta, Indonesia
- Muhammad Qomaruddin, Universitas Islam Sultan Agung, Semarang, Indonesia
- Krisna Adiyarta, Universitas Budi Luhur, Jakarta, Indonesia

Technical Program Chairs

- Munawar A. Riyadi, Universitas Diponegoro, Semarang, Indonesia
- Balza Achmad, Universitas Gadjah Mada, Yogyakarta, Indonesia
- Deris Stiawan, Universitas Sriwijaya, Palembang, Indonesia
- Arief Marwanto, Universitas Islam Sultan Agung, Semarang, Indonesia
- Mudrik Alaydrus, Universitas Mercu Buana Jakarta, Indonesia
- Teddy Mantoro, Sampoerna University, Jakarta, Indonesia
- Sidiq Syamsul Hidayat, Politeknik Negeri Semarang, Semarang, Indonesia

Technical Program Members

- Syed Mohsen Naqvi, Newcastle University, UK
- Peter Balazs, Austrian Academy of Sciences, Austria
- Mohammed Alghamdi, Al-Baha University
- Marco Baldi, Università Politecnica delle Marche
- Ihsen Ben Mbarek, National Engineering School of Tunis
- Suryadip Chakraborty, Johnson C. Smith University
- July Díaz, Universidad Distrital Francisco José de Caldas
- Saurabh Dixit, Babu Banarsi Das University, Lucknow
- Wajeb Gharibi, Jazan University, KSA
- Visvasuresh Victor Govindaswamy, Concordia University
- Muhammad Abu Bakar Sidik, Universitas Sriwijaya, Indonesia
- Saied Abd El-atty, Menoufia University-Faculty of Electronic Engineering
- K. M. Mahtab Hossain, University of Greenwich
- Ahmed Mobashsher, The University of Queensland
- Ratan Kumar Mondal, Queensland University of Technology
- Kun-Da Wu, HTC Corporation
- Quanxin Zhao, University of Electronic Science and Technology of China
- Tresna Dewi, Polytechnic of Sriwijaya, Indonesia
- David Luengo, Universidad Politecnica de Madrid, Spain
- Maria Chiara Caschera, Consiglio Nazionale delle Ricerche, Rome, Italy
- Amir Nakib, Universite de Paris Est Creteil, Vitry-sur-Seine, France
- Pujianto Yugopuspito, Universitas Pelita Harapan, Indonesia
- Jens Klare, Fraunhofer-Gesellschaft, Munich, Germany
- Ramy Atawia, Queen’s University, Kingston, Kingston, Canada
- Maxime Leclerc, Thales Research & Technology (TRT), Canada
- Sanjoy Debbarma, National Institute of Technology Meghalaya, Shillong, India
- Bo Kong, PLA University of Science and Technology, Nanjing, China
- Noha El-Ganainy, Arab Academy for Science & Technology and Maritime Transport, Egypt

- Rodrigo Montufar-Chaveznava, Facultad de Ingeniería, Universidad Nacional Autonoma de Mexico
- Michel Owayjan, American University of Science & Technology
- Ljiljana Šeric, University of Split, Crotia
- Hengky Susanto, Hong Kong University of Science and Technology
- Khoirul Anwar, Telkom University, Indonesia
- Muhammad Raza, HUST Wuhan, China
- Xiaojun Li, Texas A&M University, United States
- Marco Guazzone, University of Piemonte Orientale, Italy
- Indra Riyanto, Universitas Budi Luhur, Indonesia

Local Arrangement, Exhibits & Registration Chairs

- Ermanu Azizul Hakim, Universitas Muhammadiyah Malang, Indonesia
- M. Irfan,Universitas Muhammadiyah Malang, Indonesia
- Galih Wasis Wicaksono, Universitas Muhammadiyah Malang, Indonesia
- Lailatul Husniah, Universitas Muhammadiyah Malang, Indonesia
- Ilham Pakaya, Universitas Muhammadiyah Malang, Indonesia
- Novendra Setiawan, Universitas Muhammadiyah Malang, Indonesia

International Committee

- Lech M. Grzesiak, Warsaw University of Technology, Poland
- Leo P. Ligthart, Delft University of Technology, Netherlands
- Malaoui Abdessamad, University of Beni Mellal
- Muhammad Ishtiaq Ahmad, Beijing Institute of Technology
- Diego Arcos-Aviles, Universidad de las Fuerzas Armadas ESPE
- Eduard Babulak, Fort Hays State University
- Alper Bereketli, ASELSAN Inc.
- Tugçe Bilen, Istanbul Technical University
- Yue Cao, Northumbria University
- Arcangelo Castiglione, University of Salerno, Italy
- Di Chen, University of Rostock, Germany
- Paolo Crippa, Università Politecnica delle Marche
- George Dekoulis, Aerospace Engineering Institut
- Muftah Fraifer, IDC-University of Limerick
- Felix J. Garcia Clemente, University of Murcia, Spain
- Srideep Ghosh, ELTRON Wireless
- Nagendra Kumar Nainar, CISCO
- Abdellah Najid, Institut National des Postes et Télécommunications
- Gabriele Piantadosi, University of Naples Federico II
- Nadia Qasim, King’s College London
- Abdalhossein Rezai, ACECR
- Zulhisyam Salleh, Universiti Teknikal Malaysia Melaka
- Hans Schotten, University of Kaiserslautern
- Min Keng Tan, Universiti Malaysia Sabah
- Revak Tyagi, Cisco Systems
- Marcel Wagner, University of São Paulo
- Hao Wu, ZTE Corporation
- Kishore Yalamanchili, Google
- Mohammed Younis, University of Baghdad
- Jing Zhou, University of Science and Technology of China
- Olympia Roeva, Institute of Biophysics and Biomedical Engineering
- Deepika Koundal, National Institute of Technology, Hamirpur
- Domenico Ciuonzo, University of Naples Federico II

- Henry Griffith, Michigan State University
- Berkin Güler, Koc University
- Jun He, University of New Brunswick
- Zhaozheng Hu, Georgia Institute of Technology
- Dimitrios Kallergis, University of Piraeus, Greece
- Fukuro Koshiji, Tokyo Polytechnic University
- Sunil Kumar, The LNM Institute of Information Technology, India
- Takashi Kurimoto, National Institute of Informatics, Japan
- Jia-Han Li, National Taiwan University
- Xiangguo Li, Henan University of Technology, China
- Sukadev Meher, National Institute of Technology, India
- Ronald Mulinde, University of South Australia
- Fernando Mussoi, Federal Institute of Santa Catarina, Brazil
- Ravi Subban, Pondicherry University, Pondicherry, India
- Andrea Fiaschetti, Universita degli Studi di Roma La Sapienza, Italy
- Murali Krishna Kadiyala, Wichita State University, United States
- Zhe Zhang, Electrical and Computer Engineering Department, George Mason University
- Parag Chatterjee, Universidad Tecnologica Nacional, Buenos Aires, Argentina
- Mohamed Rehan, AvidBeam Technologies, Cairo, Egypt
- Ahmed Helmy, University of Texas at Dallas, Richardson, United States
- Harikumar Rajaguru, Anna University Chennai, India
- Feng Ouyang, Johns Hopkins University, United States
- Xuanxuan Tang, PLA University of Science and Technology, China

TABLE OF CONTENTS

TRACK-9 : Soft Computing and Intelligent System

Smart Traffic Light based on IoT and mBaaS using High Priority Vehicles Method

Muhammad Izzuddin Mahali
Department of Electronics and Informatics Education
Yogyakarta State University
Yogyakarta, Indonesia
izzudin@uny.ac.id

Eko Marpanaji
Department of Electronics and Informatics Education
Yogyakarta State University
Yogyakarta, Indonesia
eko@uny.ac.id

Satriyo Agung Dewanto
Department of Electronics and Informatics Education
Yogyakarta State University
Yogyakarta, Indonesia
satriyoad@uny.ac.id

Bekti Wulandari
Department of Electronics and Informatics Education
Yogyakarta State University
Yogyakarta, Indonesia
bektiwulandari@uny.ac.id

Umi Rochayati
Department of Electronics and Informatics Education
Yogyakarta State University
Yogyakarta, Indonesia
umi@uny.ac.id

Nur Hasanah
Department of Electronics and Informatics Education
Yogyakarta State University
Yogyakarta, Indonesia
nurhasanah@uny.ac.id

Abstract-An increase of the number of vehicles which is not followed by the number of roads can lead to the increase of congestion, especially in big cities. Regulation of law no 22 Year 2009 explains that there are seven types of vehicles prioritized on the road. This research aims to build a Smart Traffic Light as a solution with the goal of making the prioritized vehicle journey smooth when crossing the road with Smart Traffic Light. The proposed system is "Smart Traffic Light on IoT and mBaaS (Mobile Backend As a Service) using High Priority Vehicles Method". The Smart Traffic Light has three important parts, including: (1) Smart Traffic Application; (2) Smart Traffic Controller; and (3) mBaaS. Prioritized vehicle drivers cross the road using the Smart Traffic Application when they are in an emergency situation. Smart Traffic Application and Smart Traffic Controller communicate using mBaaS. Smart Traffic Application has a vehicle track search facility as well as identification of traffic light location. A few meters before crossing, Smart Traffic Application will send the location to mBaaS and continue to be read by Smart Traffic Controller using internet. If it meets the criteria of High Priority Vehicle, then Traffic Light will be changed to green in the same path. The results show that when testing the data rate from Smart Traffic Application to Smart Traffic Controller, it takes no later than 8.15 seconds and 1.2 seconds (the fastest) with the average data transmission time of 3.39 seconds. Smart Traffic Light is able to identify the direction of the vehicle before passing through the Smart Traffic Application.

Keywords—smart traffic light, IoT, mBaaS

I. INTRODUCTION

"Internet of Things (IoT) is a network of physical objects embedded in electronics, software, sensors and connectivity which enables it to achieve greater value and services by exchanging data with manufacturers, operators and / or other connected devices. Each unique thing is identified through an embedded computing system, but it is able to operate within the existing Internet infrastructure. So far, IoT is the most closely related to machine-to-machine (M2M) communications in manufacturing and electricity, petroleum, and gas. Products built with M2M communication capabilities are called smart or smart systems (e.g. smart label, smart meter, smart grid sensor). According to research results obtained from Juniper's study, there is a growth of IoT devices three times greater from 2016 to 2021. According to the results of research from Juniper, it is estimated that the number of IoT equipment connected to the internet either device, sensor or actuator is approximately more than 46 billion within the next four years.

Mobile Backend as a Services (mBaaS) is one of the categories of cloud computing services that are usually used by mobile application developers. MBaaS helps developers by connecting applications with backend cloud database as well as other features such as user management, push notification and Authentication integration. These services are provided through the support of Software Development Kits (SDK) and Application Programming Interface (API). The Cloud Computing platform, which supports all smart agents, empowers specialized resources [1]. Internet of Things connected with mBaaS is able to create smart systems that can be used with various purposes. Integrated IoT and Cloud computing applications enabling the creation of smart environments such as Smart Cities need to be able to (a) combine services offered by multiple stakeholders and (b) scale to support a large number of users in a reliable and decentralized manner [2].

Figure 1 An Ambulance Stucked In Traffic Jam

According to Law No. 22 of 2009 on Road Traffic and Transportation Article 134 related to road users, those who have the primary right to take precedence are listed as follows: (1) fire-fighting vehicles carrying out duties (2) ambulances carrying sick people (3) vehicles to provide

assistance to Traffic Accidents (4) vehicles led by the State Institution of RI (5) vehicles of leaders and officials of foreign countries as well as international institutions who are guests of the state (5) a funeral parade/procession (7) convoys and / or vehicles for particular circumstances.

A good driving behavior is shown when there is an ambulance, they should give a way to it. However, when at the intersection of roads that have traffic light facing long congestion even up to hundreds of meters, ambulance sirens are not heard up to the vehicle at the end of the traffic light. Then, the ambulance has to wait for its turn to cross the intersection as shown in Fig.1.

I. Related Work

Another traffic light system is also proposed by [3] who proposes intelligent traffic signal control system by connecting RFID technology system, Microcontroller Unit, Cloud storage and Android App. In a study proposed by [3], when implemented in real terms RFID utilization, it would have difficulty when it is in a junction that had long congestion. RFID technology has difficulty in detecting vehicle distance. In different scenarios, if failing in detecting using RFID, android Application can be used. In the study [3], the number of points passed by the vehicle and how the alternative methods in the detection of lanes and the location of the crossing which is passed are not mentioned.

Firebase usage as mobile Backend as a Service is the use of database in the form of Cloud. The utilization of firebase in the IoT field has been done by [4]. The study discussed the use of cloud databases and authentication used for home automation. Firebase has many features such as Analytical, Authentication, Cloud Messaging, Real-Time Database, Storage, REST, Hosting, Test Lab, Crash Reporting and Cloud Functions [4]–[6]. Utilization of Scientific Cloud (Infrastructure as a Service) in IoT [7] can bridge the communication between hadware that has limited ability in data access. Things in IoT can be either input sensor or output actuator [8], [9].

The research of Smart Traffic Light Solution for High Priority Vehicle has been done by [10]. This study is devoted to ambulance that will be given a priority when crossing the intersection. In the research that has been done using the parameters Amount of ambulance requesting, the ambulance emergency level, minimum distance and waiting time Smart Traffic Light Solution for High Priority Vehicle research have been conducted by [10].

II. Proposed Methodology

A. System Diagram

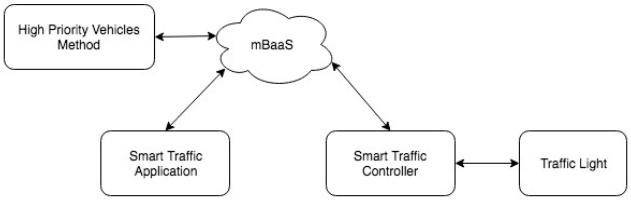

Fig. 2 General System Diagram

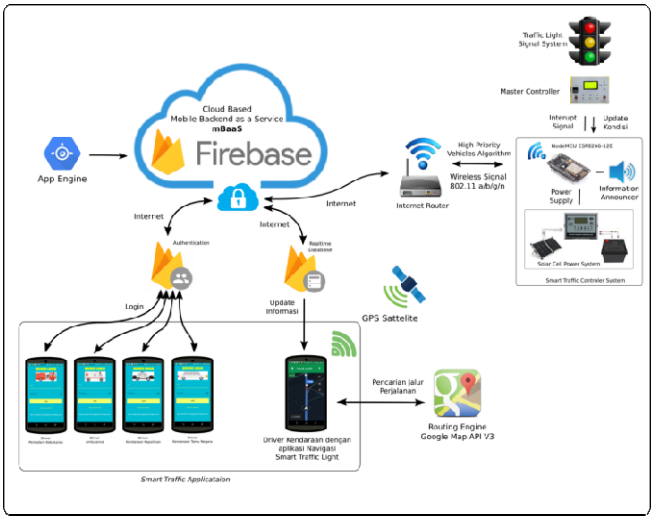

Fig. 3 System Diagram Detail

Broadly speaking, Smart Traffic Light System based on IoT and mBaas using High Priority Vehicles method has five main parts as in Fig-2. (1) *Smart Traffic Application* (2) *Smart Traffic Controller* (3) mBaaS (4) High Priority Vehicles Method and (5) Traffic Light.

B. Mobile Backend as a Service

The Smart Traffic Light system uses the Backend as a Service (mBaaS) Firebase mobile service in the form of Realtime Database, Authentication, Android SDK and REST Suport services. The firebase usage allows the use of data stored in the cloud. Communications that occur between Smart Traffic Controller System and Cloud utilize API (Application Program Interface) [5]. Smart Traffic Application communicates with Firebase using Android SDK.

C. Smart Traffic Application

Smart Traffic Application is an Android-based Operating System application used by vehicle drivers. This application has authentication login facility to maintain system security as well as identification of the vehicle type. In addition to using the application authentication feature, smart traffic also has Cloud Database facility that allows storage of cloud-based data (Cloud Database). The use of GPS facility from smart phone is used to know the position of the vehicle in real time. To support the map and navigation path, Smart Traffic Application uses API services from Google Maps [11] that provide digital map data, navigation routing and traffic density.

D. Smart Traffic Controller

Smart Traffic Controller is a hardware device that plays as Things in the Internet of Things system [3], [4], [12]. Smart Traffic Controller uses nodeMCU main device with base ESP-8266. To support energy independence, this system uses a battery with a solar cell that is used to recharge the battery. Traffic Light on this system is APPIL traffic light system that has been installed as a traffic control tool.

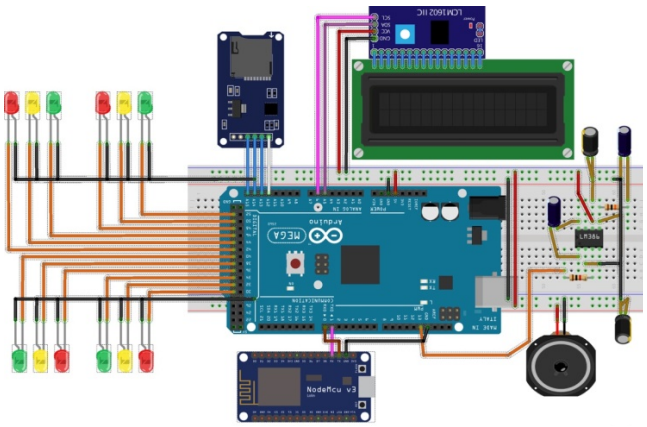

Fig. 4. Smart Traffic Controller System

Smart Traffic Controller Fig 3 is a hardware device used to control Traffic Light. This system consists of Controller Chip based on ESP8266 which has the function to read Realtime Database Firebase data using internet. The system is equipped with speakers used to play sound when there is a vehicle with a High Priority Vehicle crossing the traffic light. Voice mail files are stored in memory cards. The output is in the form of 12 output lines that functioned as input Traffic Light at the time of simulation.

E. High Priority Vehicle

Smart Traffic Light can be according to the rules of law requiring the system to apply High Priority Vehicles on App Engine. High Priority Vehicles are the implementation of regulation no 22 of 2009 which give priority of certain vehicles when passing on the road including at the intersection. The algorithm used to determine the most prioritized vehicles passes in the same location was the Analitycal Hyrarchy Process base. The determination of the value of High Priority Vahicles refers to the Journal written by [10] by introducing High Priority Vehicles (HPV) using 4 parameters while in this study three pieces were used, namely:

1. The type of vehicle is a sequence of priority passing vehicle users grouped in three types (Fire extinguisher, ambulance and vehicles with special interests)
2. The minimum distance is the calculation between the vehicle and the traffic light
3. Traffic Density Level

III. IMPLEMENTATION OF WORKING

A. Smart Traffic Application

Smart Traffic Application is developed using android studio software and Java programming language. The Smart Traffic application has the following features:

- Cloud Database (Firebase)
- SignUp and Login
- Location Determination by using GPS
- Loading Referral Hospital List for Locations
- Selecting a Destination Location using the map
- Displaying the Route of vehicle travel
- Displaying the level of Road density
- Location determination of Smart Traffic Light System

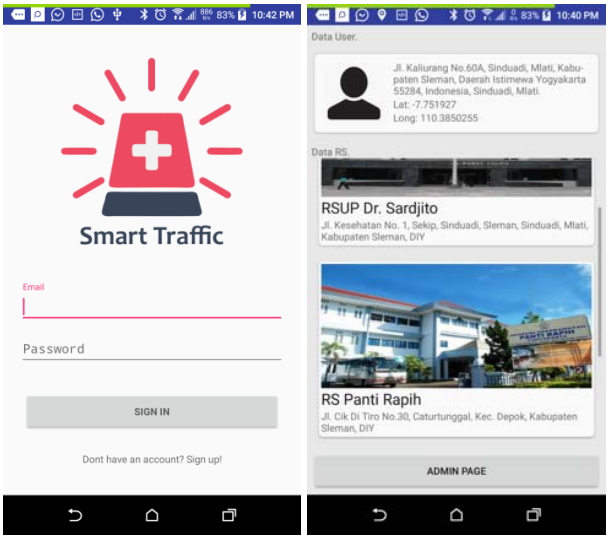

Fig. 5. Smart Traffic Application Authentication

Smart Traffic Application has a service for user account registrar. It aims at facilitating the addition of application users. Smart Traffic Application users should always be connected to the internet because user location updates will always be sent to the Firebase. When the Smart Traffic application is first opened, the user is prompted to enter a login username and password. All Smart Traffic Application users can use the same application simultaneously on the same or different Smart Traffic Light location.

Using the GP in the Smartphone Application will send the vehicle location update data to the Firebase using an internet connection such as a journal written by [8] that mentions that Science Cloud for IOT that we can use servers accommodating calculations on the Internet of Things system. Smart Traffic Application utilizes Google Map API V2 [11] to access digital maps, route searches, distance calculations, Smart Traffic System Location search and Traffic Level Traffic. This application is able to be used jointly by other users with unlimited amount.

B. mBaaS

Realtime Database Firebase Services are as Cloud data storage base for the communication bridging Smart Traffic Controller with Smart Traffic Application. Realtime databases on firebase have data structures in the JSON format (Java Script Object Notation) shown in bottom. The data which are saved include: user profile, traffic light location, Hospital location and Trip Log Request. Each location of traffic light that is added in the database is added with the detailed data about the traffic light. The stored data include name, location, coordinates, number of lights, detailed condition of each lamp direction, lamp flame condition, status request, emergency state, voice control and also activation threshold reference distance.

C. Traffic Light on Route Vehicle

Smart Traffic Light System has stored all coordinates of the traffic light location. The system will identify the path as well as the amount of traffic light that the vehicle will pass. The best route search takes the Google Maps V2 digital map. Once the route is obtained, it will be followed

by searching the location of traffic light that has been inputted in the database.

Smart Traffic Application continues to update user position and distance with the nearest traffic light. The calculation of the distance between two coordinates of longitude and latitude is calculated using the Harversine formula [13].

$$d = 2r \sin^{-1} \sqrt{\sin^2\left(\frac{\Delta\varphi}{2}\right) + \cos\varphi_1 \cdot \cos\varphi_2 \cdot \sin^2\left(\frac{\Delta\lambda}{2}\right)}$$

d is the distance between two point with longitude and latitude (φ, λ) and r is the radius of earth

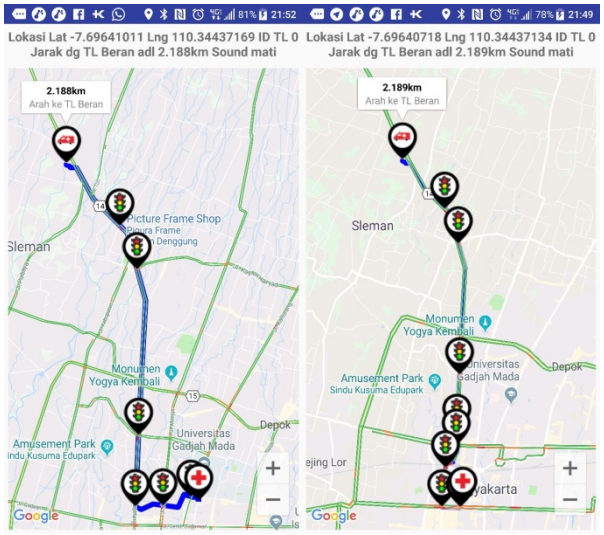

Fig. 6 Smart Traffic Application Route

Fig. 7 Smart Traffic Application Route

High Priority Vehicles algorithm on this system is used to determine the path priority which will cross first. The distance between the vehicle and the nearest traffic light will be shown on the following icon of the nearest Traffic Light when the application is used in emergency conditions as shown in Fig-6. Several meters before the vehicle crossing, the green light signals will be generated on the same line with the vehicle in an emergency so that the path accumulation on the path no longer exists.

D. Internet of Things

The Internet of Things Principle on Smart Traffic Controllers uses NodeMCU (ESP8266-12E) devices. NodeMCU has the facility to communicate with other devices by using wireless 802.11 that is able to communicate utilize port 43 (https) so that it makes the communication with Cloud Server becomes more secure. NodeMCU when communicating with mBaaS uses Authentication Key. The Database in Real Time Database with JSON format is translated directly in NodeMCU before send signal control to the actual Traffic Light.

E. Data Delivery Speed

Smart Traffic Application and Smart Traffic Controller communicate using internet network. The level of signal stability and internet speed depends on location and internet service provider. Table-1 is the test results of speed data transmission from the application and is received by the hardware Smart Traffic Light. The test of data transmission is done 10 times. Testing is done by utilizing manual configuration form that has been integrated in the application Fig-8. The calculation of time from the change in application happens until the data are received by Smart Traffic Controller. Data were obtained for each direction for north light traffic data with an average of 3,702 seconds, for the average speed of the eastern acceptance of 2.968 seconds, for the average speed of traffic data of the southern light is 1.857 and the last average speed of traffic reception Light west is 5.07 seconds. The fastest time of data transmission is 1.2 seconds and the longest time is 8.15 seconds. The average data transmission speed is 3.39 seconds.

Fig. 8. The Data Delivery Speed Test

Table 1 Speed of data transmission

Test Data	Data Delivery Time (s)			
	North	East	South	West
Data 1	8.15	2.39	3.09	4.03
Data 2	4.05	2.3	1.35	4.75
Data 3	3.05	1.64	1.94	3.1
Data 4	3.53	2.41	1.87	2.39
Data 5	4.29	5.38	1.55	6
Data 6	2.08	3.28	1.36	13
Data 7	2.29	4.05	2.27	5

Data 8	3.26	2.35	1.2	3.27
Data 9	2.62	2.92	2.09	6.16
Data 10	3.70	2.96	1.85	3
Average	3.702	2.968	1.857	5.07

IV. CONCLUSION

In this paper, a solution is proposed to reduce the travel time of the vehicle with special criteria (Fire Department, Ambulance, Special Vehicle) prioritized on the road. The travel time of the vehicle due to being trapped in long queues in traffic light can be reduced with Smart Traffic Light technology. Vehicle users can activate the Smart Traffic Application when in an emergency situation to get to a certain location e.g. ambulance that will take the patient to the hospital. Smart Traffic Application will find the fastest route and identify the Smart Traffic Light location to be traversed. Smart Traffic Light Application will send a location update to mBaaS which will be read by Smart Traffic Controller. Smart Traffic Controller will send commands to Traffic Light to provide green light signals before the vehicle passes on the same line. Smart Traffic Light can be used together for the same location or different location.

REFERENCES

[1] G. Fortino, A. Guerrieri, W. Russo, and C. Savaglio, "Integration of agent-based and Cloud Computing for the smart objects-oriented IoT," in *Proceedings of the 2014 IEEE 18th International Conference on Computer Supported Cooperative Work in Design, CSCWD 2014*, 2014.

[2] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions," *Futur. Gener. Comput. Syst.*, vol. 29, no. 7, pp. 1645–1660, 2013.

[3] B. J. Saradha, G. Vijayshri, and T. Subha, "Intelligent traffic signal control system for ambulance using RFID and cloud," *2017 2nd Int. Conf. Comput. Commun. Technol.*, pp. 90–96, 2017.

[4] A. Daramas, S. Pattarakitsophon, K. Eiumtrakul, T. Tantidham, and N. Tamkittikhun, "HIVE: Home Automation System for Intrusion Detection," in *Proceedings of the 2016 5th ICT International Student Project Conference, ICT-ISPC 2016*, 2016, pp. 101–104.

[5] N. Singh, "Study of Google Firebase API for Android," *Int. J. Innov. Res. Comput. Commun. Eng.*, vol. 4, no. 9, pp. 16738–16743, 2016.

[6] Firebase, "Firebase Realtime Database | Firebase," *April 13*, 2017. [Online]. Available: https://firebase.google.com/docs/database/.

[7] A. Menon and R. Sinha2, "IMPLEMENTATION OF INTERNET OF THINGS IN BUS TRANSPORT SYSTEM OF SINGAPORE," *Asian J. Eng. Res.*, vol. I, no. 4, pp. 8–17, 2013.

[8] B. B. P. Rao, P. Saluia, N. Sharma, a Mittal, and S. V Sharma, "Cloud computing for Internet of Things & sensing based applications," *Sens. Technol. (ICST), 2012 Sixth Int. Conf.*, pp. 374–380, 2012.

[9] E. Marpanaji and M. Izzuddinmahali, "Internet of Things for Survey of Renewable Energy Potential (SREP) as the Basis for Hybrid Power Plant Development," vol. 06003, p. 6003, 2016.

[10] D. Dang, J. Tanwar, and S. Masood, "A Smart Traffic Solution for High Priority Vehicles," in *2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India, 4-5 September 2015*, 2015, no. September, pp. 467–470.

[11] G. Developers, "Google Maps Android API | Google Developers," *Google Developers*, 2015. [Online]. Available: https://developers.google.com/maps/documentation/android-api/.

[12] R. Davies, "The Internet of Things The Internet of Things," no. May, p. 6, 2015.

[13] N. Chopde and M. Nichat, "Landmark Based Shortest Path Detection by Using A* and Haversine Formula," *GH Raisoni Coll. Eng. ...*, 2013.