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MESSAGE FROM THE CHAIRMAN OF ICOM'19

SYAMSUL BAHRIN ABDUL HAMID
Chairman
7th IEEE International Conference on Mechatronics Engineering 2019 Chairman

Assalamu'alaikum Warahmatullahi Wabarakatuh and warmest greetings to all the participants of ICOM 2019.

I am very happy to welcome all the participants of the 7th International Conference on Mechatronics (ICOM 2019). The first ICOM was organized in 2001 with an overwhelming response from the researchers from more than ten different countries. So far, the Department of Mechatronics of IIUM has successfully organized six ICOMs. We believe we would be able to maintain the continuity of ICOM from now onwards, inshaAllah. The discipline of Mechatronics has now started to become main stream with most nations including Malaysia started to update its policy to be more industrial 4.0 ready. The discipline now has penetrated into all walks of life with its products alleviating the current standard of life that we have. Specifically, recent advances in mechatronics are being extended from precision agriculture to healthcare. In the recent past, robots were mostly found to be used in the manufacturing industries. Now, with the advancement of mechatronics, the use of robots started to take a firm footing in the areas of underwater robotics, driverless cars, autonomous aerial vehicles, microsurgery, Brain Machine Interaction (BMI) and so on. In the future, robots in various form are expected to be as ubiquitous as what mobile phone is in this century. With this idea forward and considering the United Nations Sustainable Development Goals (SDGs) 2030, we would foresee that Mechatronics discipline would definitely play an active role in pushing forward towards achieving goal number 9: Industry, Innovation and Infrastructure and goal number 11: Sustainable Cities and Communities of the SDGs. Thus, it is my firm believes and expectation that ICOM will be the platform for interaction and exchange of ideas among the scientists and engineers to bring about new knowledge and sustainable technology especially those that links to UN SDGs - establishing a better tomorrow for the future generations to come. I would like to take this opportunity to express my sincere appreciation to the members of the International Advisory board, the keynote speakers, all committee members of ICOM 2019 and the reviewers of papers for their efforts in making this event successful. My sincere gratitude is extended to the sponsors for their cooperation and contribution in realizing the event.

Wassalam and May this conference be a pivotal moment in improving the life of humanities!

Wassalam.

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A Cloud-Based Bus Tracking System Based on Internet-of-Things Technology

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Abstract: The technological rise in public transportation is on the horizon, but the bus network structure and intelligent bus tracking system should first be in place. Bus transpo... **View more**

Metadata

Abstract:
The technological rise in public transportation is on the horizon, but the bus network structure and intelligent bus tracking system should first be in place. Bus transport service is on the edge of digital revolution, generating real-time tracking information about the bus service using smartphones. In this paper, a cloud-based bus tracking system based on IoT is proposed to reduce human intervention, waiting time and energy. The exact location and arrival time of the bus can be tracked dynamically by using a mobile application to provide better and efficient bus service. Furthermore, passengers can buy tickets without queueing and book the available seats by making online payments. The proposed scheme allows more flexibility and user satisfactory service to the rider in terms of time loss and encourages more people to ride by providing real-time bus tracking information to improve passenger satisfaction. The main objective is to minimize the unnecessary waiting and queueing time uncertainty of passengers. Riders can utilize their waiting time more productively by choosing the nearest route and alternative transportation. The sustainability of public transport service can be maintained by providing noteworthy benefits to the passengers using the proposed cloud-based bus tracking system.

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SECTION I.
Introduction

In the early stage of human civilization, people depended on animals for moving goods and themselves from one place to another. The invention and proper uses of the wheel were the great blessings of human life. As a sequence, vehicular transportation brings a new era of human movement. Since the beginning of the transportation system, public transport especially the bus plays important roles in moving faster [1]. With passage of time, the demand for public transport has increased due to the need to convey more passengers at a time and cost-effectiveness [2]; [3].

However, the accessibility of public transport is never an easy go by issue. People always have to go through hard times getting public transport on time due to mismatch in the bus schedule. Consequently, passengers have to face tremendous trouble in almost every country in the world. This is the case most especially during festive moods, it gets really tasking getting ticket for public transportation because of the high demand and low cost [5]; [6]. To cap it all, there is tendency to waste valuable working hours and energy every single day for waiting and queueing for the public bus services.

This paper proposes a mobile application architecture on the Internet of Things, IoT, for public bus service, so that, passengers can be able to track the specific location of bus and know when the next bus is coming to a particular stoppage. Besides, this app will allow a passenger to buy a ticket online via an online wallet or mobile banking system that reduce the queueing time for buying ticket manually. In addition, the user will be able to choose available seat via the proposed app.

SECTION II.
Functionalities

The core functionalities of this proposed cloud-based application are-

- Nearest Stoppage: This application will show the nearest bus stoppage from the current location, so that customer can easily
- Real- Time tracking: Tracking any specific public bus real-time via Global Positioning System (GPS). This functionality allows

A Cloud-Based Bus Tracking System Based on Internet-of-Things Technology

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***Abstract*— The technological rise in public transportation is on the horizon, but the bus network structure and intelligent bus tracking system should first be in place. Bus transport service is on the edge of digital revolution, generating real-time tracking information about the bus service using smartphones. In this paper, a cloud-based bus tracking system based on IoT is proposed to reduce human intervention, waiting time and energy. The exact location and arrival time of the bus can be tracked dynamically by using a mobile application to provide better and efficient bus service. Furthermore, passengers can buy tickets without queueing and book the available seats by making online payments. The proposed scheme allows more flexibility and user satisfactory service to the rider in terms of time loss and encourages more people to ride by providing real-time bus tracking information to improve passenger satisfaction. The main objective is to minimize the unnecessary waiting and queueing time uncertainty of passengers. Riders can utilize their waiting time more productively by choosing the nearest route and alternative transportation. The sustainability of public transport service can be maintained by providing noteworthy benefits to the passengers using the proposed IoT-based bus tracking system.**

Keywords*— *Bus Tracking, Cloud Computing, Internet of Things

I. INTRODUCTION

In the early stage of human civilization, people depended on animals for moving goods and themselves from one place to another. The invention and proper uses of the wheel were the great blessings of human life. As a sequence, vehicular transportation brings a new era of human movement. Since the beginning of the transportation system, public transport especially the bus plays important roles in moving faster [1]. With passage of time, the demand for public transport has increased due to the need to convey more passengers at a time and cost-effectiveness [2; 3].

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This paper proposes a mobile application architecture on the Internet of Things, IoT, for public bus service, so that, passengers can be able to track the specific location of bus and know when the next bus is coming to a particular stoppage. Besides, this app will allow a passenger to buy a ticket online via an online wallet or mobile banking system that reduce the queueing time for buying ticket manually. In addition, the user will be able to choose available seat via the proposed app.

II. FUNCTIONALITIES

The core functionalities of this proposed cloud-based application are-

- Nearest Stoppage: This application will show the nearest bus stoppage from the current location, so that customer can easily able to move forward [7; 8].
- Real-Time tracking: Tracking any specific public bus real-time via Global Positioning System (GPS). This functionality allows tracking the current position and movement of the vehicle where all the audience will be notified [10; 11].
- Approximate Time: Based on the current position and after calculation of the road traffic, this application will show approximately what time the bus will arrive in any specific stoppage [12].
- Available Ticket: Instead of buying ticket physically by queuing up, this application will allow the user to buy a ticket for the specific bus trip [11]. In addition, if a passenger has missed the bus, it would allow changing the ticket for any other suitable time.
- Payment: Besides, the functionalities of buying a ticket via the application, it allows passenger to

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pay ticket price through mobile banking or global online wallet like google wallet [10; 11].

- Book a seat: Sometimes it is hard to get a proper seat for a couple or family members in the bus. This application will allow users to choose specific seat for the trip.

Besides, the proposed application stores all of the trip of a user for further documentation.

III. ARCHITECTURE

The architectural process for this application has been divided in few processes that has been listed in the sub category in this section.

A. Database Relationships

This study basically focused on developing the API for the cloud-based bus tracking system. In this stage, it will show the major database relationships. The main entities of this application are- users, buses, tickets, stations, available seats, trips, payments, cancel tickets, current, and locations. The structure of database entities is given in the Appendix 1.

B. Database Relationships

The database for this application depends on each other via eloquent relationships. The following structure defines the relationships among database tables-

- User: A User can have many Payments, Many Tickets, Many Stations, Many Seats, Many Buses, Many Trips, and Many Cancel Tickets.
- Payment: A Payment belongs to a User.
- Bus: A Bus has Many Tickets, Many Current Locations, Many available seats, Many Seats, Many Stations, and Many Trips.
- Ticket: A Ticket belongs to a Bus, belongs to a User, has one Source (station), has One Destination (station), and belongs to a Trip.
- Station: A Station has many Buses, and Many Users
- Available Seat: An Available Seats belongs to a Ticket, to a Bus, and to a Trip.
- Trip: A Trip belongs to a Bus, has many Available Seats, and has Many Tickets.
- Cancel Ticket: A Cancel Ticket belongs to a Ticket, to a User, to a Trip, to a Bus, and to a Station.
- Current Location: A current location belongs to a Bus and to a trip.

C. Architectural Design

Architecturally the entire process has two main entities controlling the overall workflow of this application. The two entities are User and Bus who are inter-connected with other sub-entities.

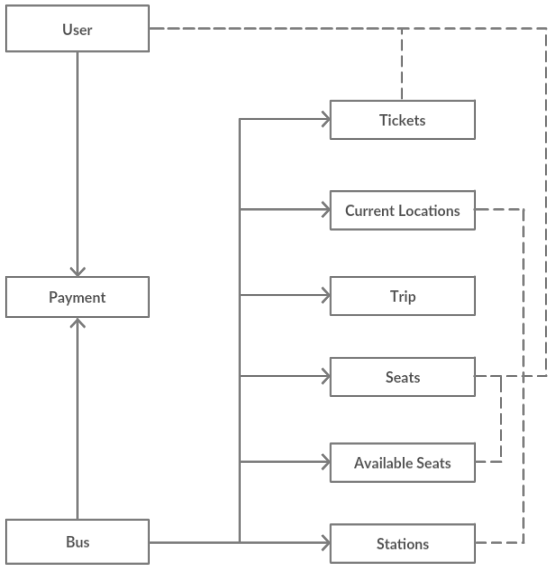

Figure 1: Architectural design of the Application

The Figure 1 shows the main entity bus has some properties; tickets, current locations, trips, seats, available seats, payment, and stations. Furthermore, the user entity involved with payment, tickets and seat properties.

In addition, some properties are inter-connected. In Figure 1, the properties station is connected with the current location, the available seats are connected with seats and the ticket properties is connected with seat properties.

D. Real-Time Tracking

In order to track a vehicle in real time, the application uses Google Global Positioning System (GPS) API to get longitude and latitude of the vehicle as an object. The Google API returns update movement of the object in every second to the client tracking the real-time object movement. The real-time tracking code has been included in the Appendix 2. Figure 2 depicts the flow chart of real-time tracking.

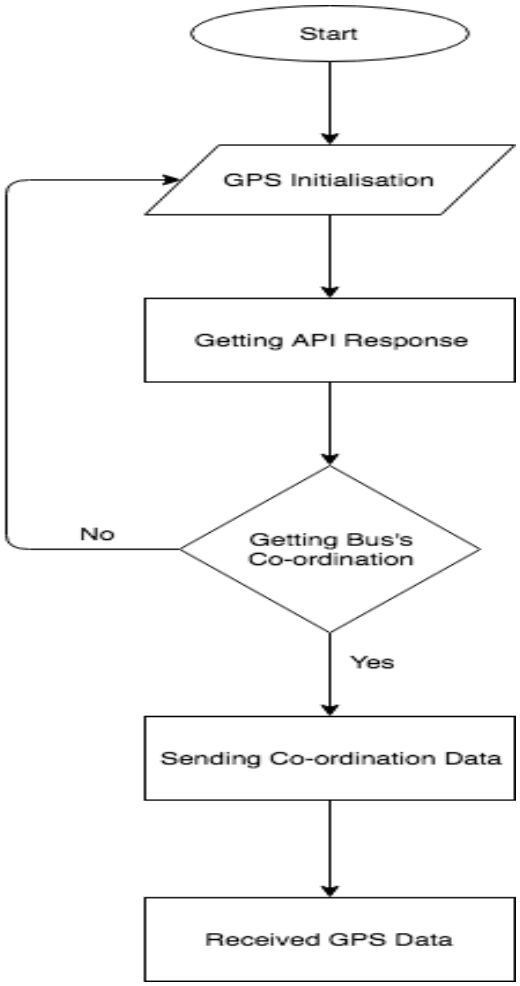

Figure 2: Flow chart of real-time tracking

E. Real-Time Tracking

The payment system mainly depends on Credit cards where the user can easily connect bank card with the system. Besides, most commonly used online payment system PayPal, and Google Wallet will be considered as a payment system. Security of sensitive transactional information to be exchanged is a major issue. To address this issue, Secure Socket Layer (SSL) and PCI compliance is being considered. Beside CloudFlare has been suggested as a Content Delivery System (CDN) to prevent request overflow and Denial of Service (DOS) Attack.

F. Approximate Time Calculation

The approximate arrival time will be calculated based on real-time vehicle congestion. The Google traffic API will be used to get real-time data on road traffic.

IV. DEVELOPING TECHNOLOGIES

The development process of this application can be split into two parts, Application Interface API and consume API for the mobile client.

API: The API is driven on top of the Laravel framework based on the PHP language. Mysql has been used for database API to store information. Laravel 5.7 version has been used to develop API. Amazon AWS used as a server to host the API code to make it succeed. Besides that, GitHub is used for code version control.

Mobile Client: The Android Application is the only consumer for this API. The android application client has been developed via android studio.

V. CONCLUSION

Over the years, the improvement of public transport become more efficient and comfortable. Nevertheless, the uncertainty of bus arrival time leads to unpredictable waiting time experienced by passengers causing unwillingness to use public transport. The proposed solution concept of a Cloud-based bus tracking system using IoT integrates many functionalities such as current locations and arrival time of the bus, buy tickets, booking available seats, making an online payment by using a mobile app. This application benefits the passengers especially physically challenged individuals by saving their waiting and queueing time as well as energy. It makes life easier to take a decision to select the bus route on the basis of arrival time and seat availability. The proposed solution is worthwhile to provide a reliable bus transport service most efficiently with passenger satisfaction.

ACKNOWLEDGMENT

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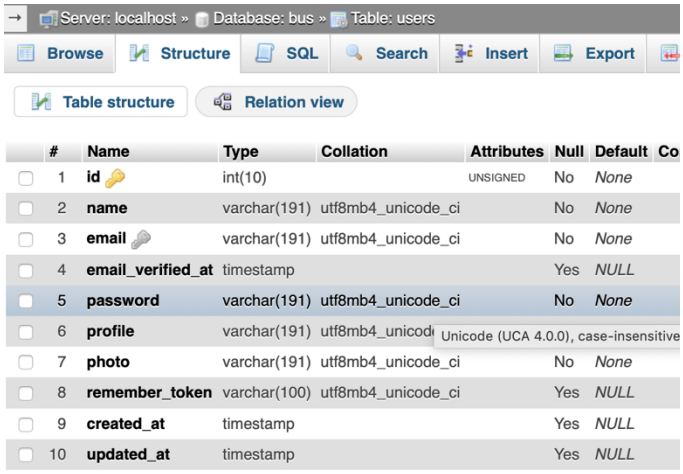
APPENDIX I

Users.



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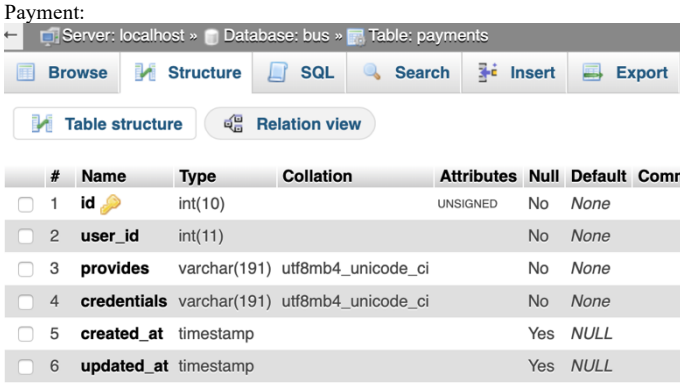
3	email	varchar(191)	utf8mb4_unicode_ci		No	None	
4	email_verified_at	timestamp			Yes	NULL	
5	password	varchar(191)	utf8mb4_unicode_ci		No	None	
6	profile	varchar(191)	utf8mb4_unicod				
7	photo	varchar(191)	utf8mb4_unicode_ci		No	None	
8	remember_token	varchar(100)	utf8mb4_unicode_ci		Yes	NULL	
9	created_at	timestamp			Yes	NULL	
10	updated_at	timestamp			Yes	NULL	

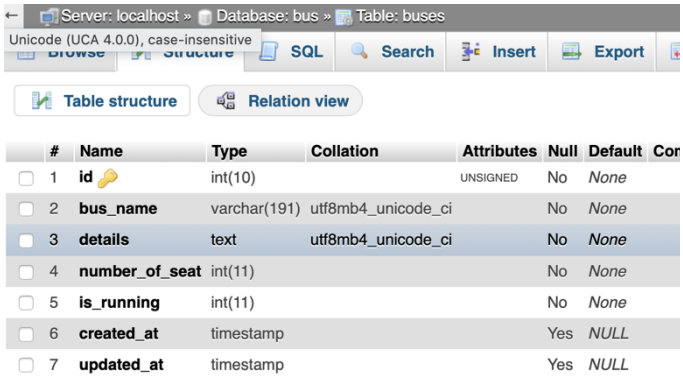
Unicode (UCA 4.0.0), case-insensitive

Payment:



#	Name	Type	Collation	Attributes	Null	Default	Comr
1	id	int(10)		UNSIGNED	No	None	
2	user_id	int(11)			No	None	
3	provides	varchar(191)	utf8mb4_unicode_ci		No	None	
4	credentials	varchar(191)	utf8mb4_unicode_ci		No	None	
5	created_at	timestamp			Yes	NULL	
6	updated_at	timestamp			Yes	NULL	

Buses:



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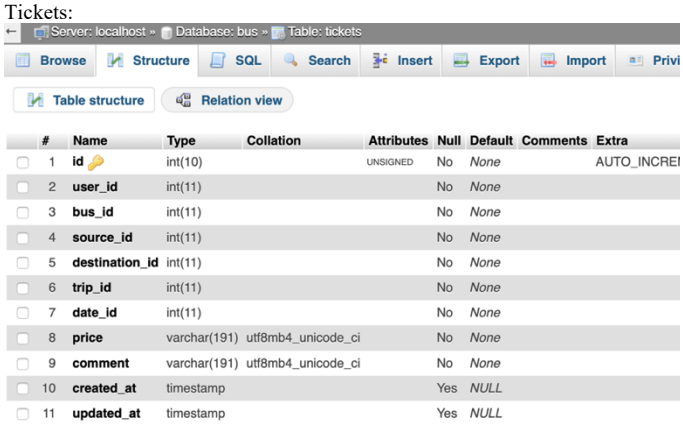
2	bus_name	varchar(191)	utf8mb4_unicode_ci		No	None	
3	details	text	utf8mb4_unicode_ci		No	None	
4	number_of_seat	int(11)			No	None	
5	is_running	int(11)			No	None	
6	created_at	timestamp			Yes	NULL	
7	updated_at	timestamp			Yes	NULL	

Tickets:



#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra
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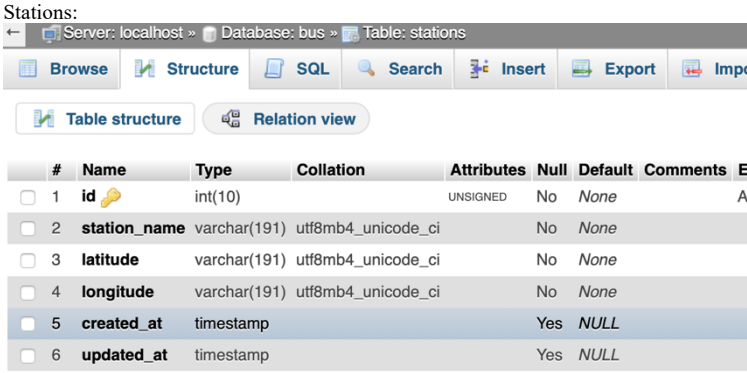
2	user_id	int(11)			No	None		
3	bus_id	int(11)			No	None		
4	source_id	int(11)			No	None		
5	destination_id	int(11)			No	None		
6	trip_id	int(11)			No	None		
7	date_id	int(11)			No	None		
8	price	varchar(191)	utf8mb4_unicode_ci		No	None		
9	comment	varchar(191)	utf8mb4_unicode_ci		No	None		
10	created_at	timestamp			Yes	NULL		
11	updated_at	timestamp			Yes	NULL		

Stations:



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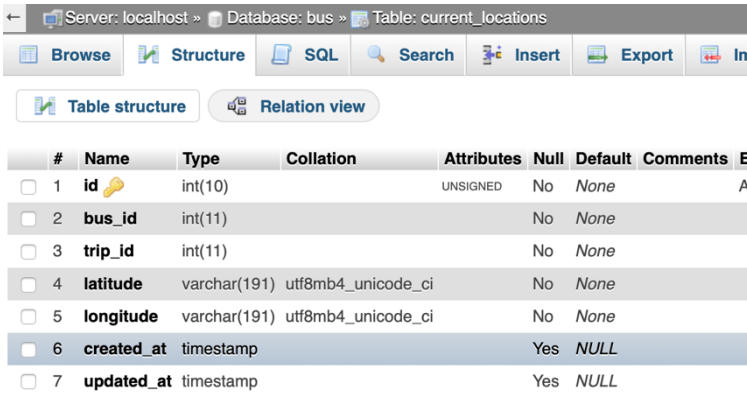
2	station_name	varchar(191)	utf8mb4_unicode_ci		No	None		
3	latitude	varchar(191)	utf8mb4_unicode_ci		No	None		
4	longitude	varchar(191)	utf8mb4_unicode_ci		No	None		
5	created_at	timestamp			Yes	NULL		
6	updated_at	timestamp			Yes	NULL		

Current Locations:



#	Name	Type	Collation	Attributes	Null	Default	Comments	E
1	id	int(10)		UNSIGNED	No	None		A
2	bus_id	int(11)			No	None		
3	trip_id	int(11)			No	None		
4	latitude	varchar(191)	utf8mb4_unicode_ci		No	None		
5	longitude	varchar(191)	utf8mb4_unicode_ci		No	None		
6	created_at	timestamp			Yes	NULL		
7	updated_at	timestamp			Yes	NULL		

APPENDIX II

```
<script type="text/javascript">
  var map, getDataFromInfo;
  function initMap() {
    map = new google.maps.Map(#map), {
      center: {lat: -34.397, lng: 150.644},
      zoom: 6
    });
    getDataFromInfo = new google.maps.InfoWindow;
    // Try HTML5 geolocation.
    if (navigator.geolocation) {
      navigator.geolocation.getCurrentPosition(function(position) {
        var pos = {
          lat: position.coords.latitude,
          lng: position.coords.longitude
        };

        getDataFromInfo.setPosition(pos);
        getDataFromInfo.setContent('Location found.');
        getDataFromInfo.open(map);
        map.setCenter(pos);
      }, function() {
        handleLocationError(true, getDataFromInfo,
map.getCenter());
      });
    } else {
      // Browser doesn't support Geolocation
      handleLocationError(false, getDataFromInfo,
map.getCenter());
    }
  }
</script>
```