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DEVELOPMENT OF DROWSINESS DETECTION APPLICATIONS ANDROID BASED

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ABSTRACT

Drowsiness detection applications is an application built for driver and aims to awaken drivers who are experiencing sleepiness. The development of this drowsiness detection app is using a tool that is smartband. Smartband used to take the driver's heart rate and send it to the smartphone to calculate the average heart rate of the driver. If the driver's heart rate is below 60 bpm then the driver will be declared sleepy and the smartphone will send a function to sound the alarm and vibrate the smartband. This drowsiness detection app also uses features of the Google Maps API, the Geocoding API and the Distance Matrix API. By using these features the driver's location will be found and will be used as an evaluation material for the company to evaluate the location of the rest area where appropriate for the resort.
Keyword: Drowsiness, Heart Rate, Smartband.

1. INTRODUCTION

1.1 Background

There are problems that many drivers who are often sleepy on the way and causes the driver's lose focus. Drowsiness and fatigue is one cause of accidents in driving [1]. According to the results of research conducted, the driver feels sleepy due to the physical readiness of the driver who is less ready because of the division of a solid schedule and time of varying driving and there is no tool to awaken the driver who drowsy while driving. The management also find it difficult to evaluate the driver because there is no tool for monitoring the driver's performance in driving. The current evaluation is based solely on interviews with drivers only, which is subjective. The problem also occurs when the management to evaluate the rest area is less effective due to the absence of drowsy location data that can assist the evaluation process.

With the tools that can help to awaken the driver while drowsy, providing information on the time to rest while driving and display driving history, is expected to help companies to get data as a decision-making assistant. It is also part of the anticipation of the occurrence of things that are not desirable and to monitor the driver to be more alert in driving. This smartphone application uses a tool that is Smartband that used to detect the heartbeat of the driver to be a reference to detect sleepiness or fatigue of the driver. Drowsiness arises from slowing heart rate. The slowing of the heartbeat is because when the body is more silent then the brain tends to send signals to the heart to slow the heart rate up to 60 bpm which is called the resting heart phase pulse. As slowing of the automatic heartbeat oxygen supply leading to the brain tends to decrease [2]. Use of this Smartband aims to streamline the activities of the driver so as not to need to make a difficult suit when driving. Based on the background above, the researcher took the title on "DEVELOPMENT OF DROWSINESS DETECTION APPLICATIONS ANDROID BASED".

1.2 Research's Purposes

The purpose of this research is as follows:

1. Awaken the driver who is in a state of sleepiness.
2. 2Knowing which drivers are often drowsy on the way in order to conduct an objective evaluation activity that is based on observation.
3. 3Knowing at what distance the average driver is sleepy so it can be used as an evaluation material by the company.

1.3 Research's Method

This research, uses descriptive method that is collecting data then analyze it and explain the result of observation in the field.

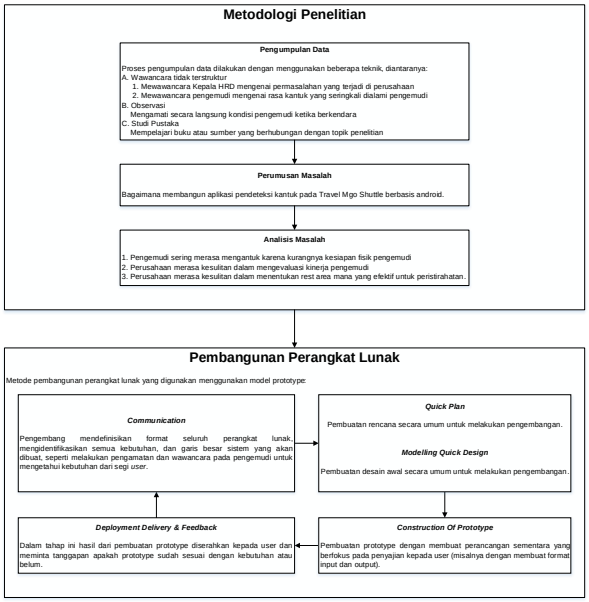


Figure 1.1 Research's Method

2. CONTENT RESEARCH

2.1 Heart Rate

The heart rate is the frequency of rhythm pulse / palpable pulse (palpable) on the surface of the skin at certain places. The heart cycle consists of a period of relaxation called diastole and is followed by a period of contraction called systole. The strength of blood into the aorta during systolic not only moves blood in the vein forward but also compounds a pressure wave along the artery. Pressure waves push the arterial wall as it travels and the pusher is palpable. The normal sequence of pulsed heart parts is atrial contraction (atrial systolic) followed by vertical contraction (vertical systolic) and during the fourth diastolic relaxation room.

The heart rate is a frequency of heart rate and has units of beats per minute (bpm). The quantity with a unit of bpm states the number of heartbeats per minute. The normal human heart rate is 60-100 bpm. [2]

2.2 Drowsiness

Drowsiness is a tendency to fall asleep. Drowsiness can decrease human performance, such as reduced reaction rate, decreased alertness, and decrease the ability to process information. Therefore, drowsiness while driving is classified as a dangerous action [2]. Sleepiness can affect the process while driving and the performance of the driver may drop below the standard required by the traffic situation.

Broadly speaking the factors that affect the sleepiness level especially when driving include: [7]:

1. Quantity Sleep
   Sleeping before work is the factor that most affects the conscious state and the driver's level of alertness. Chronic sleep deprivation is the result of prolonged sleep deprivation, while acute sleep deprivation results from a lack of sleep within a short night. The need for sleep hours is usually influenced by age, the more a person ages the less time he sleeps.
2. Sleep Quality
   Good sleep quality will be characterized by quiet sleep, feeling very refreshed when waking up in the morning and individuals feeling energized for other life activities.
3. Nutrition Status
   The results showed that the highest body mass index (BMI) is owned by respondents who have sleep duration is less often drowsy. Other studies have suggested an increase in BMI as sleep duration diminishes.
4. Health Factors
   Health factors according to the National Transport Commission (2007) associated with drowsiness while driving include:
   a. Sleep apnea occurs when the throat collapses during sleep so that too little reaches the lungs, so often wake up because of lack of oxygen.
   b. Narcolepsy occurs when a person sleeps in the day without a clear and has trouble sleeping at night.
   c. Some people also suffer from anxiety at night that keeps them awake.
   d. Some diseases such as diabetes, if not contested, can also lead to fatigue.
   e. Being overweight or obese is usually not considered a disease. However, obesity can cause sleep problems and greatly contributes to the occurrence of sleep apnea.
   f. Fatigue and sleepiness after sufficient sleep can indicate a medical problem.
8. Age
   Research has shown that although shift is associated with sleep, subjective drowsiness, performance and social life, age only affects changes in sleep, subjective drowsiness and psychomotor awareness.
9. Working Period
   Professional or long-term drivers, because the nature of their work has spent most of their working hours driving. In addition to driving time, many professional drivers work in shifts, have irregular working hours, and work at night.
10. Shift Work
    Work shifts are work schedules with different hours worked by standard hours (8 am to 5 pm) or work schedules that differ from standard weekly work schedules on Monday to Friday in the United States. Work shift is a term that describes nonstandard work schedules, related to the underlying physiological disorder of the individual. Work shift forces the worker to

change his bedtime based on work time and rest time, so this can disrupt the normal cycle of physical activity.

11. Work Pattern / Rotate Shift
    The thing the company should consider in choosing short or long shift rotation is at least one week for circadian rhythms adapting to schedule changes. The long shift rotation consists of a range of night shift work for 4-6 weeks, then a worker will probably need to work nights for 2 times a year. Meanwhile, short shift rotation will involve no more than 3 night shifts at the same time.
12. Driving Duration
    Driving duration has been known for a long time as one of the most important risk factors in the incidence of falling asleep while driving. Although driving duration is not a crucial factor, for example 60% of accidents that are fatal to the driver occur within 1 hour of driving.

2.3 Drowsiness Detection Using Xiaomi Mi Band 2

Application of drowsiness pendants that are being built using a tool that is smartband. Smartband can be used on the left and right wrists that will serve to detect the amount of blood taken. Mi Band 2 uses a green LED light paired with a light-sensitive photodiode to detect the amount of blood flowing through the wrist. As the heart throbs, the blood flowing on the wrist reflects light and the reflection is read by the photodiode, the non-reflective blood means higher blood volume. Through the reflection of light, the sensor analyzes the data and calculates the heart rate. By flashing the LED lights hundreds of times per second, Mi Band 2 can calculate the pulsed heart frequency.

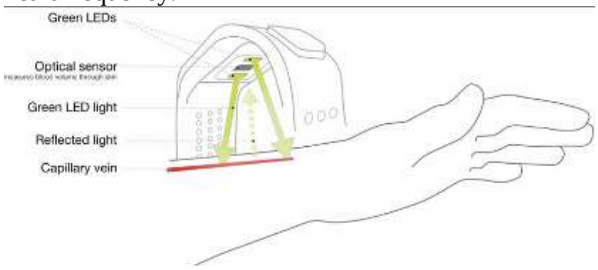


Figure 2.1 Taking The Heart Rate Using Xiaomi Mi Band 2

Calculation of heart rate obtained will be sent to the smartphone using Bluetooth 4.0 connection contained in Mi Band 2. Heartbeat data received smartband will be processed again to get the average heart rate. The average heart rate calculation will be performed with the following formula [2]:

$$\text{Heart Rate Average} = \frac{\sum_{i=1}^{3} H}{3}$$

H = Heart Rate which is taken from Mi Band 2

The results of the average heart rate calculation will be again calculated by the system, if the average driver's heart rate <60 bpm then the driver will be declared sleepy. Heart rate calculation is performed for 15 seconds. Here is an example case if the driver is detected drowsy:

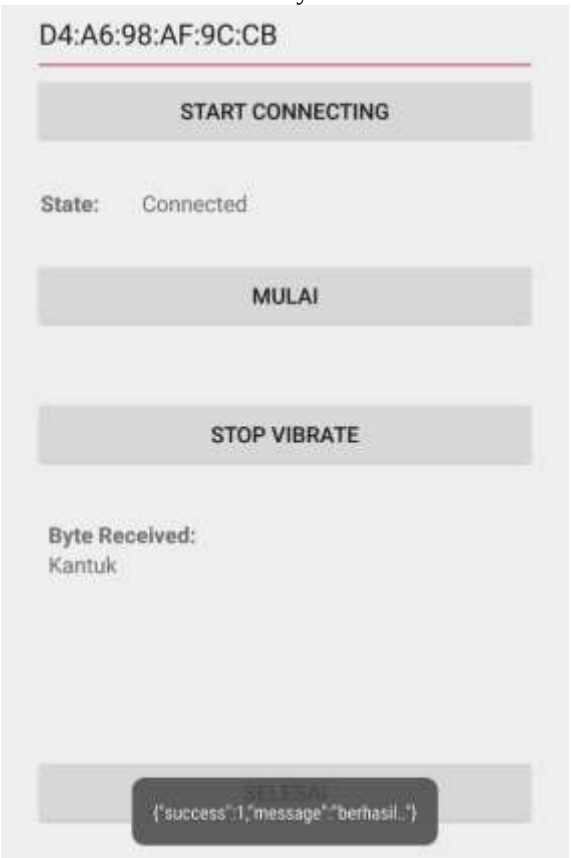


Figure 2.2 Diver is detected drowsy

2.4 Driver's Monitoring Analysist

In the development of drowsiness applications is built back end that aims to monitor the condition of the driver's performance in driving. Good and bad driver performance conditions will be judged by how much the driver is sleepy on the way. The more drivers are often sleepy it will reduce the assessment of the driver at the time of employee evaluation conducted every 6 months.

When the driver starts the journey then the system will automatically start the calculation of the driver's heart rate which will produce the average heart rate, if the heart rate is below 60 bpm then the system will state that the driver is sleepy [2]. Each time the system detects that the driver is in a sleepy condition then the system will retrieve the data coordinates of the driver at that time from the GPS sensor that is latitude and longitude which will then be sent to the database. The website will display the markers on the maps, by calling the function of the Google Maps API in accordance with the coordinates already stored in the database. Markers appearing on maps will indicate that the driver has been sleepy at that location. Figure 2.2 is an example of a map image showing the driver's location marker drowsiness:

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Figure 2.2 Location Marker of drivers who was detected sleepy

The marker shown in the picture above will be calculated by the system, how many drivers are sleepy. Head Branch can monitor every day the driver who is sleepy and at the location where the driver is sleepy. Monitoring the driver can be done by looking at table 2.1:

Table 2.1 Example Of Daily Driver's Monitoring

Num	Driver's Name	Sleepy Number	Departure	Start	Finish
1	Asep Kusdinar	4	Bandung City	6-17-2017 08.00	6-17-2017 11.00
2	Tatang	6	Bandung City	6-17-2017 10.00	6-17-2017 14.00
3	Yoke Kurnia	1	Bandung City	6-17-2017 12..00	6-17-2017 15.00
4	Rohimat	2	Jakarta	6-17-2017 10.00	6-17-2017 13.00

From the table above can be seen the number of sleepiness experienced by each driver. The number of daytime sleepiness will be used for the calculation of the number of drowsiness at the time of the employee's evaluation every six months. The amount of sleepiness will be accumulated for 6 months and will be used as a reference for employee performance evaluation, for drivers who experience the most sleepiness during the last 6 months will get a bad score at the time of evaluation. The number of drowsiness while working or driving indicates a lack of physical readiness of the driver that will lead to things that are not desirable like an accident. Therefore, the result of monitoring this driver is a suggestion to provide a warning to the driver to more attention to his physical condition.

2.5 Analysist of Driver's Sleepy Locations

The system will show which areas are often the driver's sleepy places as shown in Figure 2.3:

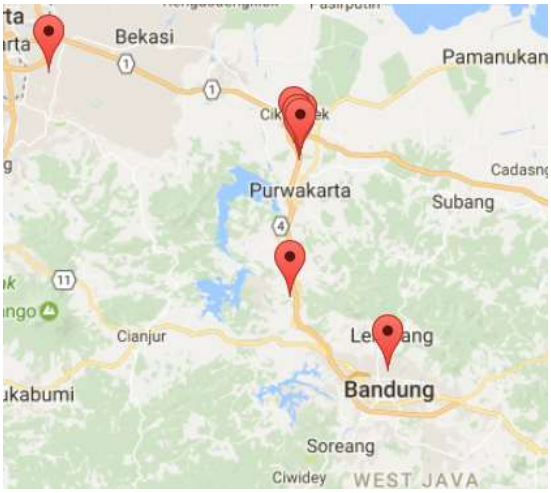


Figure 2.3 Marker Location of Driver Often Detected Sleepy

Figure 2.3 is a toll road image from Bandung to Jakarta. To find out how many drivers are sleepy, the system will take the distance from the first point where it is at the toll gate to the location where the sleepy driver will be taken using longitude and latitude using the Distance Matrix API. The distance from Bandung to Jakarta is 150.0 KM. The distance will be divided into several sections and will also be mapped based on the rest area closest to that part which can be seen in table 2.2.

Tabel 2.2 Pembagian Jarak Pada Tol

Part	Distance	Rest Area Bandung – Jakarta	Rest Area Jakarta - Bandung
A	1-10 KM	Rest Area KM 125	Rest Area KM 19
B	11-20 KM	Rest Area KM 125	Rest Area KM 19
C	21-30 KM	Rest Area KM 97	Rest Area KM 19
D	31-40 KM	Rest Area KM 97	Rest Area KM 19
E	41-50 KM	Rest Area KM 97	Rest Area KM 39
F	51-60 KM	Rest Area KM 88	Rest Area KM 50
G	61-70 KM	Rest Area KM 72B	Rest Area KM 57
H	71-80 KM	Rest Area KM 61	Rest Area KM 57
I	81-90 KM	Rest Area KM 61	Rest Area KM 72A
J	91-100 KM	Rest Area KM 42	Rest Area KM 88
K	101-110 KM	Rest Area KM 42	Rest Area KM 88
L	111-120 KM	Rest Area KM 32	Rest Area KM 88
M	121-130 KM	Rest Area KM 32	Rest Area KM 88
N	131-140 KM	Rest Area KM 32	Rest Area KM 88
O	141-150 KM	Rest Area KM 32	Rest Area KM 88

Calculation of distance made by the system then will proceed by determining where the distance is located. The system will show how many drivers are drowsy in each section so that the company can conduct an evaluation of the driver's sleepy location and provide rest area recommendations.

2.5 Analysist of Architectures System

In the development of drowsiness detection application has two systems namely the front end and back end. Where the front end is the application used by the driver when driving with a smartphone. As for the back end is an application used for head branches in monitoring the performance of drivers in driving.



Figure 2.4 Architectures System

Here is an explanation of the existing system architecture in Figure 2.4:

1. Driver
   The driver is an actor as a front end system user.
2. Smartphone
   Smartphones as devices used to run the front end system used by actors. Smartphone is used by the driver to run the main function of the system by logging in and running the command start_sesi, then the system will send commands to retrieve data jatung driver who then processed.
3. Mi band 2
   Mi band 2 is a device used to extract driver's darts and sent to Smartphone for processing, and as a device that will wake the driver by vibration.
4. Internet
   The Internet connects all existing systems to the entire system: front end, back end, web server, Distance Matrix API, Google Maps API, and Geocoding.
5. Web Server
   Web Server is a device that will send data in the database to the smartphone and as the recipient of data sent from the smartphone and save it to the database. The Web Server is also a device that runs a back end system that will be displayed to the branch header and invokes the used functions that exist on any API like Distance MatrixAPI, Google Maps API, Geocoding over the internet network.
6. Database
   Database is a data storage container such as employee data, branch head data and others that will be processed by the back end system and front end and also container data storage sent by smartphone to web server through internet network.
7. Distance Matrix API
   Distance Matrix API is an API used by the back end system to process data latitude and longitude sent Smartphone using internet network as data drowsiness of the driver to know the distance between the main coordinate point and drowsiness of the driver.
8. Google Maps API
   The Google Maps API is a service used by the back system to display views of maps or maps on the back end system used by the branch head.
9. Geocoding
   Geocoding is a service used by a back end system to convert coordinate address data of longitude and longitude addressed by a smartphone to be converted into an appropriate address under the actual address condition.
10. Head Branch
    Head Branch is an actor who uses a back end system such as mengimputkan employee data and see data that has been processed by the system shown as a driver monitoring system.

2.6 Use Case Diagram

Use case diagram is a construction to describe the relationship - the relationship that occurs between the actors to the functional contained in the system designed. From the results of the analysis, the use case diagram in this application can be seen in Figure 2.5.

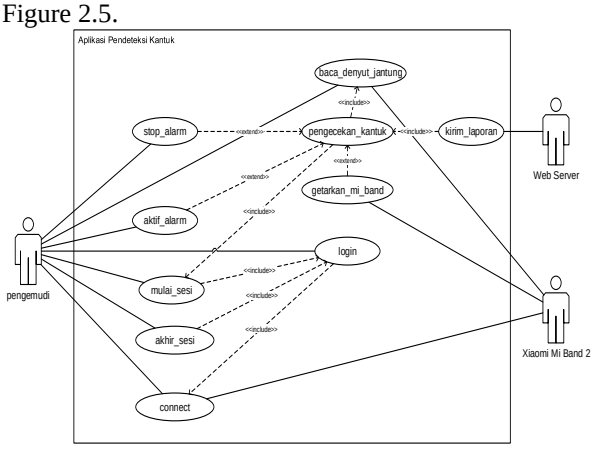


Figure 2.5 Use Case Diagram

Here is a description of the actor who is on the use case diagram:

Table 2.3 Actors Descriptions

No	Actor	Descriptions
1	Driver	Is an actor who will manage the functions on the system to be built. Connect smartphones and smart bands, start sessions when they arrive at tolls, end sessions when out of tolls.
2	Xiaomi Mi Band 2	Is an actor who will manage the functions on the system to be built. The actor will perform the connect function on the system.

3	Web Server	Is an actor who will manage the functions on the system to be built. The actor will perform the report send function on the system.

Here is a description of Use Case Diagram:

Table 2.4 Use Case Diagram Descriptions

No	Use Case	Spesifications
1	*Login*	The process to enter into the sleepiness detection system
2	Mulai_sesi	The process of starting a session while driving
3	Akhir_sesi	Process to stop a session while driving
4	Aktif_alarm	Process to sound an alarm
5	Stop_alarm	Process to stop alarm sound on smartphone and vibration on smartband
6	Connect	Process to stop alarm sound on smartphone and vibration on smartband
7	Getarkan_mi_band	Process for vibrating mi band
8	Pengecekan_kantuk	The process of calculating the heart rate is below 60 or not
9	Baca_denyut_jantung	The process of detecting the driver's heartbeat
10	Kirim_laporan	The process of submitting the driver drowsiness evaluation report

2.7 Context Diagram

Context diagram is a diagram that consists of a process and describes the scope of a system. Context diagram is the highest level of DFD (Data Flow Diagram) which describes the input into the system or output of the system. Context diagram gives an overall picture of the system. Figure 2.6 is a context diagram of the application to be built.

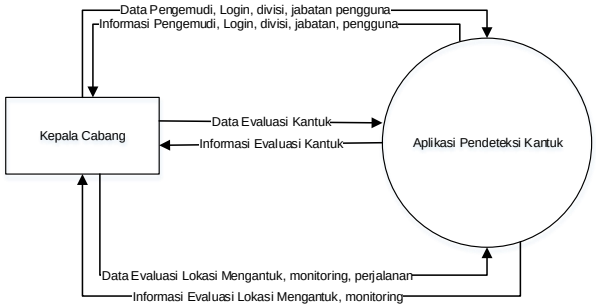


Figure 2.6 Context Diagram

2.7 Scheme Relations

In data modeling, entities are presented with entity tables that exist on E-R charts written with a framework of tables containing their attributes called relations schemes. Entity table creation is always guided by the provisions on the way table preparation. So that will be obtained arrangement entity table which is table free from existence of data. Relationship diagram of drowsiness detection application system can be seen in Figure 2.7.

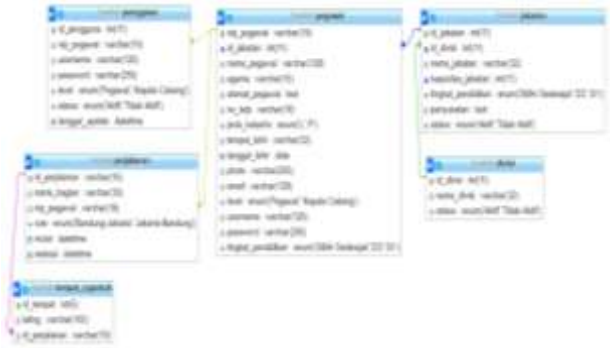


Figure 2.7 Scheme Relations

2.8 Designing Structure Menu

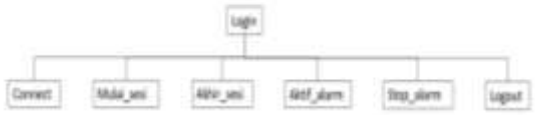


Figure 2.8 Structure Menu Front-End

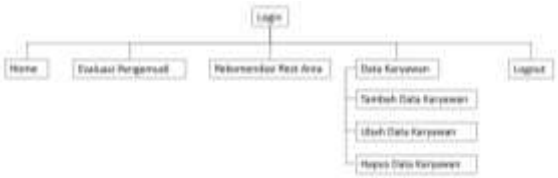


Figure 2.9 Structure Menu Back-End

2.9 Designing interface

1. Designing interface of Home (Back-end)

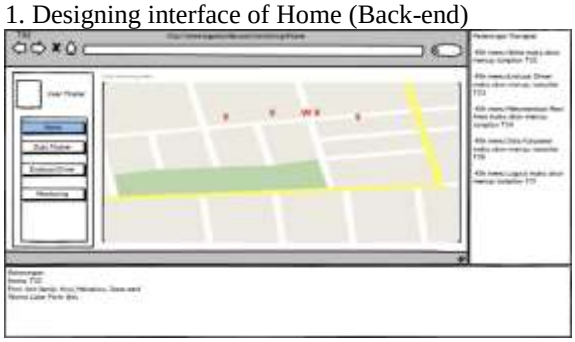


Figure 2.10 Designing interface of Home (Back-end)

2. Designing interface of Evaluation Driver (Back-end)



Figure 2.11 Designing interface of Evaluation Driver

3. Designing interface of Evaluation Driver's sleepy locations (Back-end)



Figure 2.12 Designing interface of Evaluation of Driver's sleepy locations

4. Designing interface of Mulai Sesi (Front-end)



Figure 2.13 Designing interface of Mulai Sesi

5. Designing interface of Login (Front-end)



Figure 2.14 Designing interface of Login

2.10 Designing Semantic Network

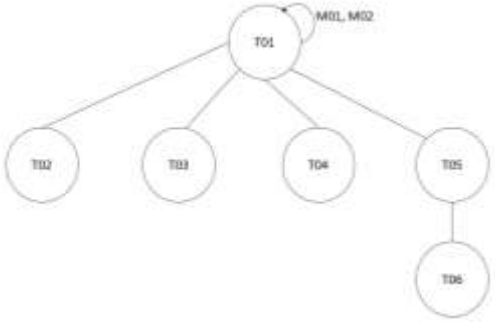


Figure 2.15 Designing Back-End's semantic

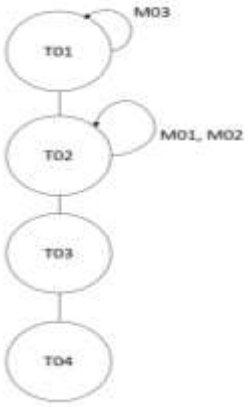


Figure 2.16 Designing Front End's semantic

2.11 Conclusion Black Box Testing

Based on the tests that have been done, then the conclusion obtained that the process - the process on the development of drowsiness detection applications have gone through the stage of improvement and has been maximized, as well as functionally already

produce the expected output so that the application is feasible to use.

2.12 Kesimpulan Pengujian Beta

Based on the results of beta testing, it can be concluded that:

1. Drivers strongly agree that drowsiness detection applications can accurately detect drowsiness.
2. Drivers strongly agree drowsy detection apps can help alert drivers when they're sleepy.
3. Drivers agree drowsy detection applications can assist drivers in obtaining objective evaluation results.
4. The Branch Head feels the drowsiness monitoring application can assist the Branch Head in monitoring the driver's state in driving.
5. The Branch Head feels the drowsiness monitoring application can help in providing objective evaluation.
6. The Branch Head feels the drowsiness monitoring application can provide clear information.

3. CLOSING

3.1 Conclusion

Based on the results of testing and discussion that has been made then can be drawn conclusion as follows:

1. Applications Drowsiness Detector provides ease in awakening drivers who are in a state of sleepiness.
2. Drowsiness Detection Application provides convenience in providing information to the head of the branch about which drivers are often sleepy in the way.
3. Drowsiness Detection Application provides convenience in providing information to the head of the branch about the average distance the driver experienced drowsiness.

3.2 Suggestions

Suggestions that can be given to the development of systems that have been made for further system development are:

1. Adding evaluation driver criteria by not only looking at driver conditions in driving for evaluation to be more objective.
2. Using smartband / smartwatch type that has longer dayatahan, because in this case Xiaomi Mi Band 2 only lasted for approximately 12-15 hours.
3. Use a smartphone specifically for drowsiness applications to maximize battery usage, no incoming interruptions while driving, and no errors in data transmission.

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