SMART ANIMAL SENSOR FOR VEHICLE

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This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Computer Network) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DECLARATION

I hereby declare that this project report entitled

SMART ANIMAL SENSOR FOR VEHICLE

is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : NUR AMIRAH BINTI SHAHADAN Date : 9/9/2021

I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of Bachelor of Computer Science (Computer Network) with Honours.

SUPERVISOR : _____ Date : 9/9/2021

([ERMAN BIN HAMID])

DECLARATION

DEDICATION

Especially committed
towards my helpful and supportive friends and sibling, whom always encouraged, lead the right way, motivated myself on my educational journeys.

Special thanks because encouragement from beginning of the start and completion of my project, to my supportive lecturer.

ACKNOWLEDGEMENTS

All praises to Allah, I eventually manage to succeed and complete my final year project (FYP). I would like to thank the supervisor of my project, TS. Erman Bin Hamid for the important roles and position, dedication also of his huge tolerance through this project's enhancement and examination of me. Without his guide, the project's report may not be completed successfully. I also want to thank my beloved family, who always supported and encouraged me through this hard journey, especially during this pandemic. Moreover, I would like to thank everyone who has been involved in the successful completion of this report. My research and study for the Smart Animal Sensor for Vehicle project appear to be filled out. I will use this acknowledgment and experience for the incoming project in the future.

ABSTRACT

This project is about developing the smart sensor features, including the design of the application interface and the IoT body structure. This project aims to be able to use a smart sensor that can ease the human problem in daily life. All the quality criteria must be included in the system to achieve the project goals. The proper research and study have been developed to get the system to work efficiently and effectively. Other than that, this project also allows me to use my knowledge to make an additional feature to turn into an IoT device. In this project schedule, the most significant that I had to do is the ESP32-CAM set up to ensure the system can be controlled by the developed application. The Smart Animal Sensor for Vehicle relies on the PIR sensor, ESP32-CAM, the application's interface, and other various components. The main focus of this project is to reduce the number of animals killed and ensure user safety while using their vehicle. Besides, the users can control this system wirelessly from the application. This action can ensure safety for both of vehicle and the users.

ABSTRAK

Projek ini adalah untuk mengembangkan ciri sensor pintar, termasuk reka bentuk aplikasi dan struktur reka bentuk IoT. Projek ini bertujuan untuk menggunakan sensor pintar yang dapat mengurangkan masalah manusia dalam kehidupan seharian. Semua kriteria yang berkualiti mesti dimasukkan ke dalam sistem untuk mencapai matlamat projek. Penyelidikan dan kajian yang tepat telah dijalankan agar sistem berfungsi dengan cekap dan berkesan. Selain itu, projek ini juga membolehkan saya menggunakan ilmu pengetahuan untuk membuat sistem telah dirancang berubah menjadi peranti IoT yang baik. Dalam jadual projek ini, hal yang paling penting yang harus saya lakukan adalah pemasangan ESP32-CAM di mana untuk memastikan sistem dapat dikendalikan oleh aplikasi yang telah dibina. Smart Animal Sensor for Vehicle bergantung pada sensor PIR, ESP32-CAM, reka bentuk aplikasi dan komponen lain yang terlibat. Fokus utama projek ini adalah untuk mengurangkan bilangan haiwan yang terbunuh dan memastikan keselamatan pengguna semasa menggunakan kenderaan mereka. Selain itu, pengguna dapat mengendalikan sistem ini secara tanpa wayar dari aplikasi. Tindakan ini dapat menjamin keselamatan kenderaan dan pengguna.

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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Smart Animal Sensor for vehicle is necessary to detect the presence of animals entering the vehicle engine. This system is also capable of notifying the owner of the vehicle through the developed application if there is a presence of animals. It is because the animals such as rats, cats, and others love to stay in the car engine as their shelter to keep warm and safe, especially at night and rain. The small and compact spaces in an engine block are the best refuge from the cold weather and predators. An engine also stays warm for a while after it has been shut off, and this heat can entice the animals to climb into the engine. Sometimes these animals will enter and leave without the user ever knowing, but they can accidentally cause damage that can be obvious and severe. Besides, as the engine starts, it can cause injury and death to the animal that is using it for the shelter of animals.

Moreover, there are few features that will be added to the system, which is the camera has been used so that the user can monitor from everywhere. And, if the sensor has detected the presence of animals, it will send the notification to the users via the Blynk application. By adding these features, it will increase the security of the vehicle and will prevent any damage to the engine.

1.2 BACKGROUND

When the animals stay in the vehicle, there are a lot of problems that occur where it is inconvenient for many vehicle users. One of the problems is the animals such as rats, cats, and others love to stay in the car engine as their shelter to keep warm and safe, especially at night and rain. When the engine started, it can get the animals injured and killed while staying at the car engine. Other than that, these animals can cause damage to the vehicle, such as electrical, air-condition, heating, and sanitary problems for the vehicle, which are the electrical shorts caused by the wires that are chewed. Moreover, these animals can cause health problems to the users as the animal urine can increase the chance of disease transmission.

Due to this problem, a smart sensor will be developed into this system as it can help to detect the animals when they are in the car engine.

1.3 PROBLEM STATEMENT

In this section, there are the problem that occur which lead into developing this system. The description for the problem will be explained in the Table 1.

Table 1: Problem Statement Summary

PS	Problem Statement
PS_1	The users does not notice when animals staying in the vehicles.
PS_2	The project limit to the one type of vehicle.
PS_3	The ability to understand how the system works.

1.4 PROJECT QUESTION

In this section, there are some project question has been stated based on the problem statement. The description for the project question will be illustrated in Table 2.

Table 2: Project Question Summary

PQ	Project Question
PQ_1	How to alert the users when animals staying in the vehicles?
PQ_2	What is suitable medium that can fit to all type of vehicle?
PQ_3	How to make users understand the way system works?

1.5 PROJECT OBJECTIVE

In this section, the project objective will be explained which to lead the project to be successful develop in order to achieve its goals. The description for project objective will explained in Table 3.

Table 3: Project Question Summary

PS	PQ	PO	Project Objective
PS	PQ	PO_1	To design the smart sensors that could alert the users when animals in vehicles.
		PO_2	To develop the system that suitable to all type of vehicle engine structure.
		PO_3	To test the system that easier to user understand.

1.6 HYPOTHESIS

In hypothesis, the users do not notice when animals staying in the vehicle is one of the main problems for this project. In order to overcome this problem, a smart sensor equipped with a monitoring system will be developed, which is a suitable camera will be used that users can monitor from smartphones. Other than that, a PIR sensor will be used which is to detect animal movement in a required range. Next, the alert notification will be included that it will send the notification through Blynk.

1.7 IMPORTANCE OF PROJECT

The importance of the project is to ease many vehicle users by reducing the problems that occur to them, such as damage in the vehicle produce by animals. Other than that, it can minimize user's effort, which is this system communicate with each other and do a lot of task for us, for example, notify the users when the sensor has detected the animals that the users do not need to check their vehicle when they want to use it. Moreover, this project also improves the security of the vehicle as it was

equipped with a smart sensor that can detect the animals when they jumped into the vehicle.

1.8 PROJECT SCOPE

1. The platform will be used is ESP32-CAM with an integrated WiFi module.

2. Users must know how to interact with the computer or the product.

3. The HCI will be used is Blynk application in mobile phone.

1.9 PROJECT SIGNIFICANT

In this section, the project significant will explain the significant of the project based on the problem statement and project objective. The description will explained in Table 4.

Table 4: Project Significant Summary

PS	PQ	PO	Project Significant
PS	PQ	PO_1	Can reduce the number of animals killed.
		PO_2	The system can applied to various type of vehicle.
		PO_3	Ease the users to use the system.

1.10 CONCLUSION

In conclusion, this chapter begins with an introduction to the background of the study, which is it describes the specific research such as objectives, problem statement, scope, and project question. This project work on the studies and analysis of how the implemented system can help to reduce the problem stated, which is to reduce the number of animals get killed while staying in the car engine and also to prevent damage to the car engine. Developing this project, it can make life easier for users, which is the system can help to reduce the problem occur.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

IoT is a system that interconnected computing machines and digital machines, objects, animals, or people that has the capability to transfer data without requiring human-to-human or human-to-computer interaction. The smart animal sensor is very important for vehicle safety and to reduce the number of animals getting killed. The implementation that has been made to the system can make people's life become easier. There are many issues that occur if this system is not proposed which are affected human health, causing damage to the car engine, and get the animal to be injured and killed.

Besides, we will analyze the previous work problem which including the solution that will be applied. There are ten previous work has been discovered, and the proposed solution has been made to overcome the problem.

2.2 RELATED WORK/PREVIOUS WORK

2.2.1 An efficient animal detection system for smart cars using cascaded classifiers

From the journal A. Mammeri, D. Zhou, A. Boukerche, and M. Almulla (2014), this system was equipped to the vehicles that be able to detectanimals and warn the drivers about the danger. In this system, they have been developing a new animal detection system based on the detection accuracy and detection speed. There are two-stage strategies which by usingthe LBP-Adaboost algorithm and a set of ROIs that contain animal data. The second stage is based on the HOG-SVM classifier, which is the non- animal data ROIs will be rejected. Other than that, they develop their own dataset that it will updated by adding the new images.

For the architecture, they set the detection accuracy to reduce the false positive rate. The reliability of the system will be increased, which allow the detecting animal correctly. Other than that, the speediness of recognition is used to get a real-time system to allow recognizing the target fast. The Figure 1 below show the architecture design of the system.

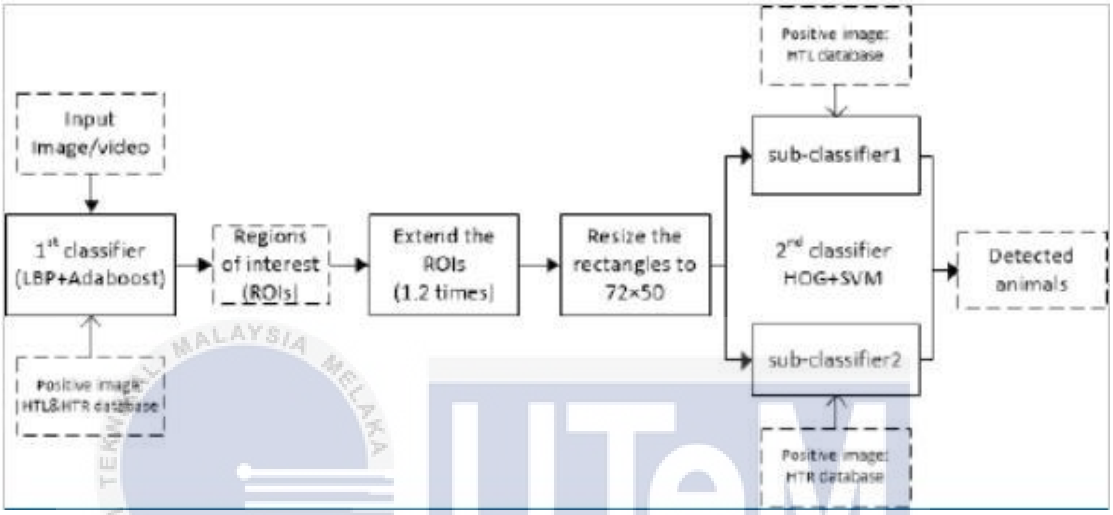

Figure 1: Architecture design of the system

2.2.2 Implementation of Smart Animal Tracking System Based on Artificial Intelligence Technique

From the journal W. -T. Peng and C. -Y. Chang (2020), this system was implemented according to an artificially intelligent technique whichis a deep learning technique. This system is mainly proposed by using image recognition and tracking technique, Arduino board, and image processor that can allow users to observe animals more conveniently and quickly.The implementation of the system is classify into two types which is hardware architecture and real-time image processing. It includes an Arduino board, Logitech HD network camera C310, and MG995 server motor. The latter uses Python programs, image processing, and deep learning techniques for performing animal recognition and tracking operations.

For animal detection, the original image is extracted by the CCD camera that used the recognition algorithm. This system has used the YOLOv2 algorithm instead of the original YOLO algorithm to increase the recognition speed. In order to increase the detecting and recognizing rate, the proposed system will extract the samples of images from the area at the five corresponding angle positions by controlling the motor to rotate the CCD camera.

2.2.3 Mobile animal tracking systems using light sensor for efficient power and cost saving motion detection

From the journal Chakchai So-In et al. (2012), this system has the animal tracking systems using an Arduino board that is equipped withmany sensors. This sensor consist of GPS and public Google Map APIfunctionalities, global location, and sensor. All the data are sent over SMS-GSM networks to an Android mobile phone embedded with simplified RF technology used to detect the animals that including with alert sound and bar sign. Moreover, practicalusage of a simple analog light sensor with motion logic is investigated and then implemented to save the battery power and reduce the cost of system. The Figure 2 below shows an overall tracking and searching system for animals by using a mobile phone.

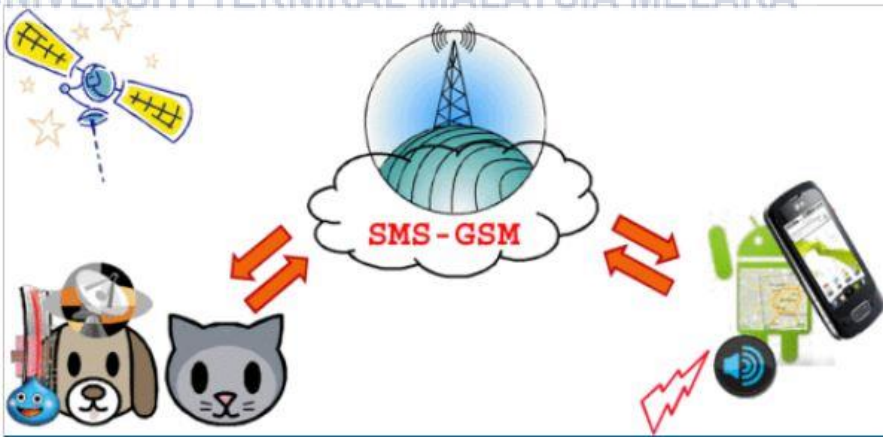

Figure 2: Architecture for the tracking system

There are two main components which are sensing and tracking devices. The sensing device that will be used is Arduino Uno SMD with an ATmega328 microcontroller that consists of five modules which are motion detection, environmental sensing, GPS Location Processing, SMS-GSM processing, and RF location processing. This component will be major interaction to the human for tracking, searching, tracing, and monitoring. There are four types for mobile uses, which are SMS-GSM processing, environmental monitoring, map and tracking, and RF location and sound processing.

2.2.4 Sensor for Real-Time Animal Condition and Movement Monitoring

From this journal, A. Kaidarova et al., this system has been created to assess animal's behavioral responses. This proposed system has used wearable composite magnets and magnetic sensors integrated into a wireless communication module with a flexile battery. The composite magnet is observed by a 3-axial magnetic sensor, and the measured data is wirelessly transmitted by using Bluetooth to a smartphone and dashboard. Also, the system has been developed for real-time monitoring of animals, indicating its potential for novel and affordable animal monitoring applications. Besides, the wireless monitoring system receives the signals from the sensor and transmits them by a Bluetooth, and also displays the measured data on a smartphone and dashboard of the computer.

2.2.5 Surveillance of Rouge Wild Animals Using Image Processing and IOT

From the journal Harish S, Sudesh Rao, Chethan P, Chandra Naik G (2019), this system has design of a framework which recognized the movement of the animal by used PIR sensors, then the camera will capture the image of movement, and the images is sent to the picture handling sensors where it is characterized as an animal using content-based image classification. The captured images will be processed in Mat Lab CBIC algorithm for classifying whether it is animal or human and if it is detected as animal, then suitable repellent technique such as ultrasonic

sound. In the proposed system, users are alerted about the intrusion immediately. Other than that, the overview for the system has been illustrated in the Figure 3.

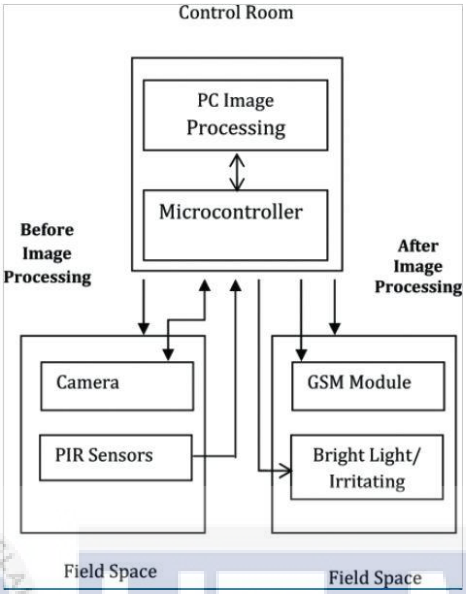

Figure 3: System Overview for Surveillance of Rouge Wild Animals

This algorithm is to sense the object and organize it into specific objectclasses. Once the sensor detects the movement, it gives the signal to the nearby camerathrough an RF transmitter placed in the sensor. Then the camera will starts live streaming video of the current activity in that place, and that recorded video will be submitted tothe control room. The control room consists of a hardware device which is FPGA, that does the work of image processing.

2.2.6 GPS-Arduino based Tracking and Alarm system for protection of wildlife animals.

From this journal, M. Gor et al. (2017), the proposed system called GATA is used for tracking and alarming for the protection of animals. GATA is the combination of the Wireless Sensor Network (WSN) and Global Positioning System (GPS) technologies that are used to resolve the problem. The animals that are straying out of wildlife sanctuaries will be tracked by auto generative location tracking and movement pattern. Automatic location and movement tracking has beenimplemented using GPS with the accelerometer and the WiFi shield. For the proposed system, Arduino board and a WiFi shield were also used in the BS and wireless network that BS is monitored

by using the modeling that can display the motion path and specific location of the animal.

The GPS module supply the microprocessor with various types of data related to the location of the animal which the connection will be made which is transmitter pins of the GPS module are connected with the receiver pins of the Arduino, and also the receiver pins of the GPS module are connected with the transmitter pin of the GPS module. The Arduino will act as a link betweenthe user and the GPS module, which provides a path to read the data from the GPS module. For Arduino Wi-Fi, it will connect the Arduino board to the Internet. It connects to the Arduino board with wire-wrap headers, whichmove all through the shield, keeping the pin layout intact. The Figure 4 shows an architecture for the system.

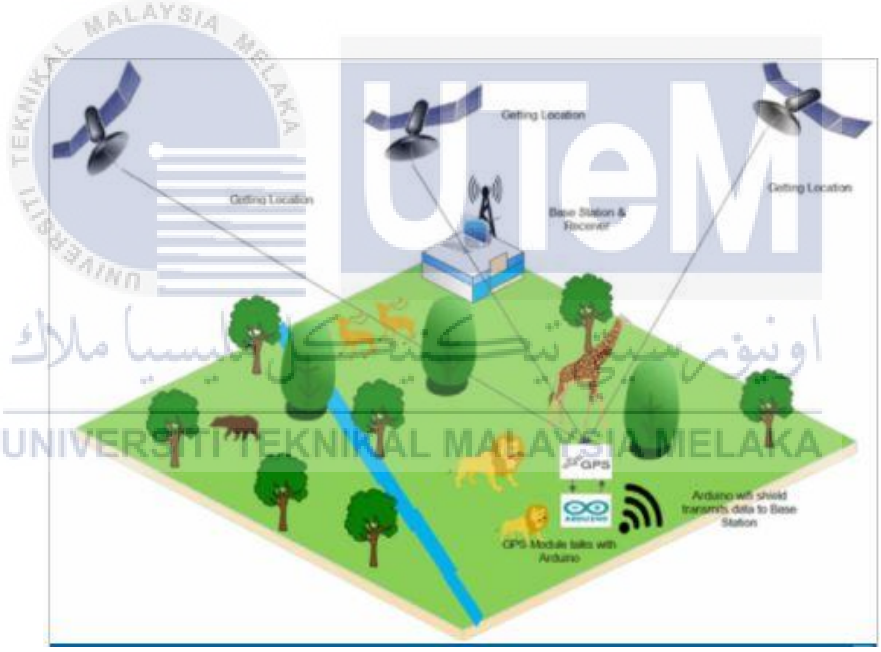

Figure 4: System architecture for Tracking and Alarm system

2.2.7 Farm Animal Location Tracking System Using Arduino and GPS Module

From the journal G. Ramesh (2021), this system has been develop the animal tracking system to use the relevant technologies such as GPS and Internet of Things. This method allows simultaneous tracking of a many animals with transmitters that are light weighted, long-standing, more precise, and economical. The proposed system will be using GPS, and the WIFI Module utilizes Arduino-ATmega328P in real-time. The GPS will send longitude and latitude that has same to the position of the animal to ESP8266-12E through Arduino. IoT stores that data in the cloud. The web application installed in the device is used to receive the location from the ESP2866. By using the coordinates, the similar location of animals can be obtained. The block diagram of a real-time GPS tracking system has been illustrated in the Figure 5.

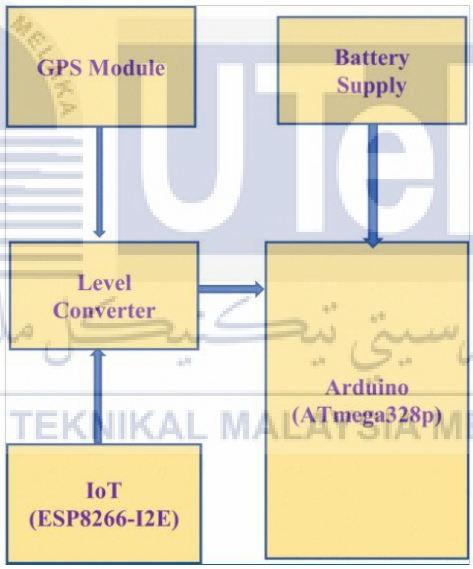

Figure 5: The block diagram of a system

2.2.8 Ultrasonic sensor animal safety system.

From the journal Vijayaraghavan Sundararaman, Vijayalakshmi T G, Swathi Venkatadri (2014), this system developed an ultrasonic sound generator that could be used to warn the animals. They construct an ultrasonic generator that can generate and emit the sound in the ultrasonic range. The ultrasonic sound generator is used the solar power as a power supply. The ultrasonic generator transmits the sound in all directions, and when the animals hear this high-pitched sound, it alerts the animals and makes them leave the place. By this action, it can reduce the accidentsthat are caused by the animals. This module can be used in the forestroutes in the dawn time to protect the wild animals that cross the roads from accidents.

2.2.9 A Study on Sensor Based Animal Intrusion Alert System Using Image Processing Techniques.

From the journal S. Jeevitha, S.Vengatesh Kumar (2019) this system is developed by implementing wireless sensors for sending the notification to both the owner and forest official with an image which makes an early warning to take immediate action. The sensor will detect themotion of the animal, and the camera will capture the image. The image is classified by a microcontroller, and the GSM module will send the alert message to the forest department and owner. For better understanding, the flows has been illustrated in the Figure 6.

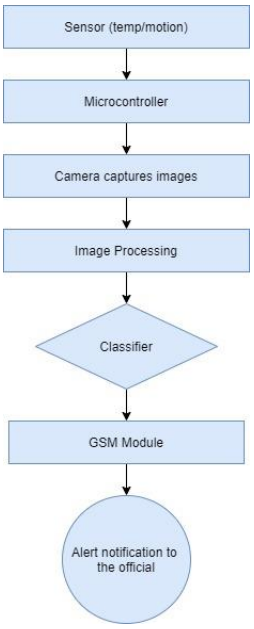

Figure 6: The flowchart of the system

By referring to the Figure 6 above, the sensor will detect the animal movement and sends the signal to the camera via a microcontroller. Next, the microcontrollerwill obtain the captured image and sends it to the image processing module, then captured images is processed using three-level segmentation, feature extraction, and classification. In classification, if the captured images is found identical with the stored image in the database, then it sends signals to the GSM module, and an alert message is sent to the owner. If the captured images has not found a match in the database, then no alert message will be sent.

2.2.10 Smart Intrusion Detection System for Crop Protection by using Arduino.

From the journal Srushti Yadahalli, Aditi Parmar, Amol Deshpande (2020),this system will detects intruders, monitor any malicious activity, and then warn it to the users of the system. The use of the PIR sensor is used for the detection, and Global System for Mobile Communications (GSM) module is used forthe transmission of information to the owner. Apart from that, this system involves theuse Arduino Uno board which difference sensors and cameras are interfaced with the board. When motion is detected, the PIR sensors turn to high mode, and the camera present will turn on. The camera will capture the picture of the intruder, and then thisimage will be displayed on the TFT display. After that, the message will alert the owner about the intrusion and will be sent automatically to the registered number of the owner using

a GSM module in message format along with the readings of the different sensors attached. Additionally, the buzzer also generates an alarm that attracts the attention of the people. For better understanding, the block diagram has been illustrated in the Figure 7.

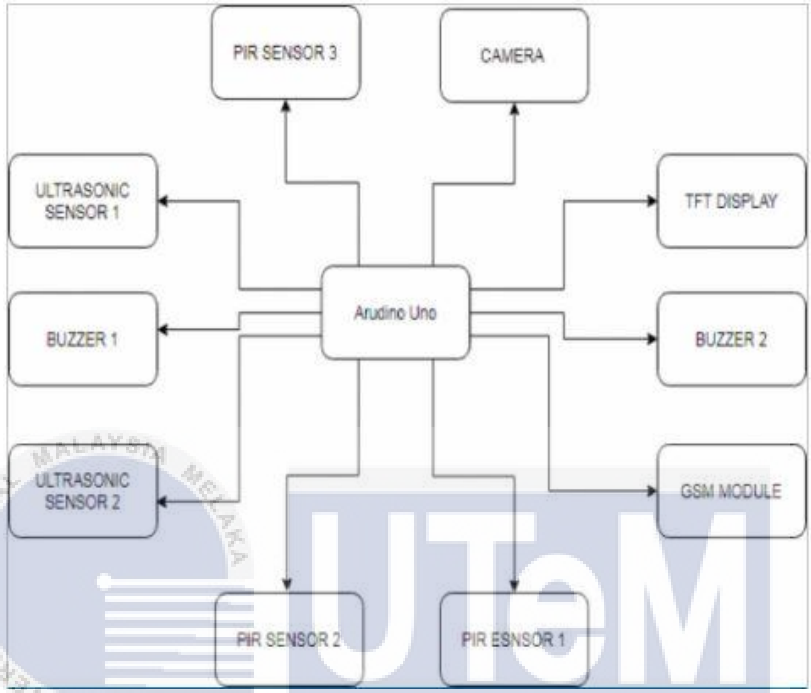

Figure 7: The block diagram of Smart Intrusion Detection System

2.3 CRITICAL REVIEW OF CURRENT PROBLEM AND JUSTIFICATION

2.3.1 An efficient animal detection system for smart cars using cascaded classifiers.

From the journal A. Mammeri, D. Zhou, A. Boukerche, and M. Almulla (2014), this system was equipped to the vehicles that be able to detectanimals and the drivers about the danger. In this system, they have been developing a new animal detection system by following two criteria, for example, detection accuracy and detection speed. The description of the system is stated in the Table 5.

Table 5: The summary for animal detection system

Research Title / Product	An efficient animal detection system for smart cars using cascaded classifiers
Purpose	This paper proposes the smart system using a cascaded classifier that contains the LBP-Adaboost algorithm and a set of ROIs that contain animal data that is used to classify the animals and non-animals.
Problem	The problem with this system is the system required the CCD camera to detect the animals from the front, backside, and right-left side, which is the CCD camera is too large and takes up a lot of space.
Solution	In order to overcome this problem, the system should make the improvement for the sensor and use a camera that is compatible with the system.

2.3.2 Implementation of Smart Animal Tracking System Based on Artificial Intelligence Technique.

From the journal W. -T. Peng and C. -Y. Chang (2020), this smart animal tracking system was implemented based on an artificially intelligent technique which is a deep learning technique. The proposed system is mainly implemented by using image recognition and tracking technique, Arduino development board, and image processor that can allow the users to observe animals more conveniently and quickly. The latter uses Python programs, image processing, and deep learning techniques for performing animal recognition and tracking operations. The description of the system is stated in the Table 6.

Table 6: The summary of Implementation of Smart Animal Tracking System

Research Title / Product	Implementation of Smart Animal Tracking System Based on Artificial Intelligence Technique
Purpose	This paper proposed using image recognition and tracking techniques technique, Arduino development board, and image processor that allowing the users to observe animals more conveniently and quickly.
Problem	The YOLO algorithm that has been used in this system is struggling to detect small objects and is also hard to detect close objects because each grid can propose only two bounding boxes.
Solution	For the solution, a suitable algorithm that can detect the small objects and the close object should be included in the system, for example, Single Shot Detector (SSD) algorithm.

2.3.3 Mobile animal tracking systems using light sensor for efficient power and cost saving motion detection.

From the journal Chakchai So-In et al. (2012), this system has the animal tracking systems using an Arduino board that is equipped withmany sensors. This sensor consist of GPS and public Google Map APIfunctionalities, global location, and sensor. All the data are sent over SMS-GSM networks to an Android mobile phone embedded with simplified RF technology used to detect the animals that including with alert sound and bar sign.The description of the system is stated in the Table 7.

Table 7: The summary for the mobile animal tracking system

Research Title / Product	Mobile animal tracking systems using light sensor for efficient power and cost saving motion detection
Purpose	This paper proposed the SMS-GSM networks to an Android OS phone that is embedded with a simplified RF technology that is used to track animals when closing by with an adaptive alert sound and bar sign for mobile monitoring and searching.
Problem	The system does not have a monitoring system, such as the notification message to alert the owner through the phone.
Solution	The notification message should be applied to the system as it is used to alert the owner, for example, via Telegram or other applications.

2.3.4 Sensor for Real-Time Animal Condition and Movement Monitoring.

From this journal, A. Kaidarova et al., this system has been created to assess animal's behavioral responses. This proposed system has used wearable composite magnets and magnetic sensors integrated into a wireless communication module with a flexile battery. Besides, the wireless monitoring system receives the signals from the sensor and transmits them by a Bluetooth, and also displays the measured data on a smartphone and dashboard of the computer. The description for the system has been explained in the Table 8.

Table 8: The summary for the Sensor for Real-Time Animal Monitoring system

Research Title / Product	Sensor for Real-Time Animal Condition and Movement Monitoring
Purpose	This paper proposed the sensor for animal monitoring by using Bluetooth low energy communication standard to a smartphone and dashboard, indicating its potential for novel and affordable animal monitoring applications.
Problem	This system used Bluetooth Low Energy to transferred data wirelessly, which is BLE cannot be used for long-distance wireless communication.
Solution	The system should use Wi-Fi devices since it supports long-distance wireless communication that has higher data rates.

2.3.5 Surveillance of Rouge Wild Animals Using Image Processing and IOT

From the journal Harish S, Sudesh Rao, Chethan P, Chandra Naik G (2019), this system has design of a framework which recognized the movement of the animal by used PIR sensors, then the camera will capture the image of movement, and the images is sent to the picture handling sensors where it is characterized as an animal using content-based image classification. The description of the system has been explained in the Table 9.

Table 9: The summary for the Surveillance of Rouge Wild Animals system

Research Title / Product	Surveillance of Rouge Wild Animals Using Image Processing and IOT
Purpose	This paper proposed a system that identifies the movement of the animals by utilizing PIR sensors, then the camera will capture the image of interruption, and it will be sent to the picture handling sensors.
Problem	The problem with this system is it does not consist of any monitoring system to notify and alert the owner. It is very important as a monitoring system manage to overcome the problem.
Solution	The monitoring system should be included in the system, for example, the notification alert message to the owner through the Android mobile.

2.3.6 GPS-Arduino based Tracking and Alarm system for protection of wildlife animals

From this journal, M. Gor et al. (2017), this proposed system called GATA is used for tracking and alarming for the protection of animals. GATA is the combination of the Wireless Sensor Network (WSN) and Global Positioning System (GPS) technologies that are used to resolve the problem. The animals that are straying out of wildlife sanctuaries will be tracked by auto generative location tracking and movement pattern. Automatic location and movement tracking has beenimplemented using GPS with the accelerometer and the Wi-Fi shield. The description of the system will be explained in the Table 10.

Table 10: The summary for the GATA system

Research Title / Product	GATA: GPS-Arduino based Tracking and Alarm system for protection of wildlife animals
Purpose	This paper proposes a system that has been called GATA, which combined Wireless Sensor Network (WSN) and Global Positioning System (GPS) technologies that are used for tracking the animals and alarming for the protection.
Problem	This system uses a lot of battery power when using the tracking system, which drains fast than it should.
Solution	The analog light sensor with motion logic will be implemented to save the battery power of the tracking system.

2.3.7 Farm Animal Location Tracking System Using Arduino and GPS Module

From the journal G. Ramesh (2021), this system has been develop the animal tracking system to use the relevant technologies such as GPS and Internet of Things. This method allows simultaneous tracking of a many animals with transmitters that are light weighted, long-standing, more precise, and economical. The proposed system will be using GPS, and the WIFI Module utilizes Arduino-ATmega328P in real-time. The GPS will send longitude and latitude that has same to the position of the animal to ESP8266-12E through Arduino. The description of the system will be explained in the Table 11.

Table 11: The summary for the Animal Location Tracking System

Research Title / Product	Farm Animal Location Tracking System Using Arduino and GPS Module
Purpose	This paper proposed a system for monitoring and tracking the animals that used the Global Positioning System (GPS) and ESP8266.
Problem	The problem for the system is the lead-acid battery goes down quickly, and it affected the other component in the device.
Solution	In order to avoid this situation, the high voltage battery will be used to avoid the battery level down.

2.3.8 Ultrasonic sensor animal safety system

From the journal Vijayaraghavan Sundararaman, Vijayalakshmi T G, Swathi Venkatadri (2014. this system developed an ultrasonic sound generator that could be used to warn the animals. They construct an ultrasonic generator that can generate and emit the sound in the ultrasonic range. The ultrasonic sound generator is used the solar power as a power supply. The ultrasonic generator transmits the sound in all directions, and when the animals hear this high-pitched sound, it alerts the animals and makes them leave the place. By this action, it can reduce the accidentsthat are caused by the animals. The description of the system will be explained in the Table 12.

Table 12: The summary for Ultrasonic sensor animal safety system

Research Title / Product	Ultrasonic sensor animal safety system
Purpose	This paper proposed the system to design an ultrasonic sound generator that is further energized with solar power that is used to warn the animals which they can hear the ultrasonic sound that humans cannot.
Problem	The problem with this system is the ultrasonic sound is limited to cats and dogs only since the animals have a different frequency that they can hear.
Solution	The system should be allowed the ultrasonic sound to be heard for all animals, for example, by using the high pitch sound that successful enough to warn the animals.

2.3.9 A Study on Sensor Based Animal Intrusion Alert System Using Image Processing Techniques.

From the journal S. Jeevitha, S.Vengatesh Kumar (2019), this system is developed by implementing wireless sensors for sending the notification to both the owner and forest official with an image which makes an early warning to take immediate action. The sensor will detect themotion of the animal, and the camera will capture the image. The description of the system has been explained in the Table 13.

Table 13: The summary for the Sensor Based Animal Intrusion Alert System

Research Title / Product	A Study on Sensor Based Animal Intrusion Alert System Using Image Processing Techniques
Purpose	This paper proposed an animal intrusion alert system by employing wireless sensors for sending an automatic alert message to the owner which the sensor will detect the movement of the animal, and the camera will capture the image.
Problem	There are some issues that occur in this system, whereas it has a problem with the short battery life and is also incompatible with the sensor component. And also, it has a problem in transferring larger video files.
Solution	It can be improved by using a new long-life solar energy battery and expanding integrated sensor components. Other than that, the problem of large data transfer can be solved by developing quality services techniques to make stable data transfer.

2.3.10 Smart Intrusion Detection System for Crop Protection by using Arduino

From the journal Srushti Yadahalli, Aditi Parmar, Amol Deshpande (2020), this system will detects intruders, monitor any malicious activity, and then warn it to the users of the system. The use of the PIR sensor is used for the detection, and Global System for Mobile Communications (GSM) module is used forthe transmission of information to the owner. The description of the system has been explained in the Table 14.

Table 14: The summary for the Smart Intrusion Detection System

Research Title / Product	Smart Intrusion Detection System for Crop Protection by using Arduino
Purpose	This paper proposed a system that detects the intruders and monitors any malicious activity and then notifies to the owner of the system by using Arduino Uno, PIR sensor, ultrasonic sensors, camera, GSM Module, and buzzers.
Problem	The problem with this system is the system used electricity as the source of power, which is when there is no electricity, the system cannot be used completely.
Solution	The solution is the system should have a high power battery as the preparation if the electricity cannot be used.

2.4 PROPOSED SOLUTION/FURTHER PROJECT

From the previous project, we can observe many problems occur, such as the battery problem, low security in the monitoring, the poor connection between the system and others. The second article stated that the problem occurs due to the algorithm used, which struggles to detect small objects and is also hard to detect close objects. The ninth article shows that the system has a problem with the short battery life and is also incompatible with the sensor component. Other than that, it has a problem in transferring larger video files. Most of the problems occur due to the short battery life, which can affect the whole system.

The solution for this problem has used an algorithm that can detect small objects and also close objects, for example, Single Shot Detector (SSD) algorithm. Next, the battery problem can be improved by using a new long-life solar energy battery for the system and used the expanding integrated sensor components that are compatible with the sensor component. Furthermore, large data transfer can be solved by developing quality services techniques to make stable data transfer. Based on the proper research, all the proposed solutions can be illustrated in Figure 8.

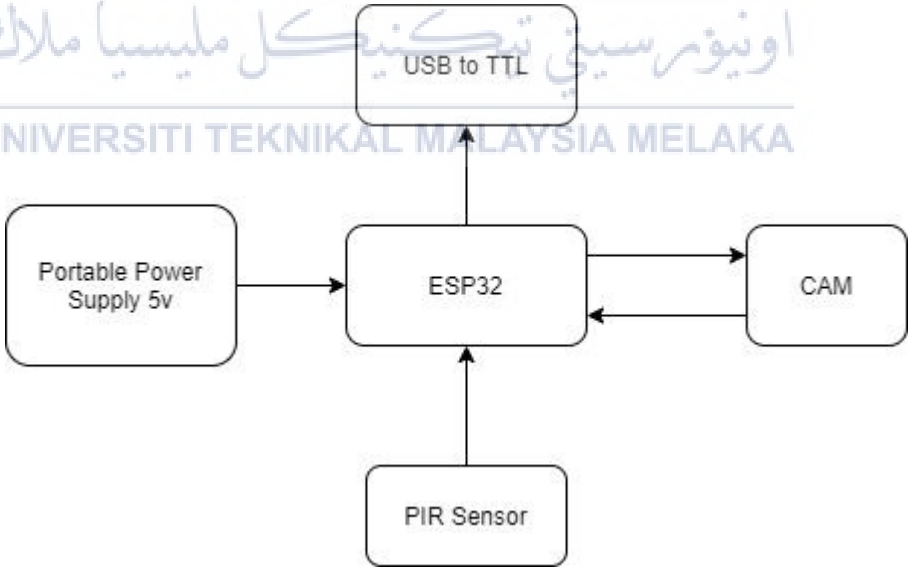

Figure 8: The Block diagram for Smart Sensor Animal for Vehicle

2.5 CONCLUSION

In conclusion, we can learn that the previous system has its own weakness that cannot be prevented. Some system has the problem with the battery life which is an affected the system. Other than that, some of the systems do not have good safety for the users. For example, the system used electricity as their source of power, which is when the electricity is unable to use, the system will completely down. But, all the problems can be improved in the next proposed system, whereas the improvement will be made for each problem.

CHAPTER 3: PROJECT METHODOLOGY

3.1 INTRODUCTION

This chapter will describe more on the methodology that will be implemented in this project to make this project complete and work well. The first section will discuss the Software Development Life Cycle that consists of three main steps, which are planning, implementing, and analysis. Other than that, the project has contained the schedule and milestone in a table form which to explain each activity performed during the engagement process.

3.2 PROJECT METHODOLOGY

The project methodology is used as the guideline with the right methods and flow of the project in order to achieve the goals of the project that will accomplish a perfect result. There are many methodology or findings from this field mainly generated for others to take advantage of and improve as upcoming studies.

The prototyping model phase is the most suitable software development methodology where a prototype will be created, tested, and rebuild until the prototype is successfully acceptable. It contains six system development life cycle which is requirement gathering and analysis, quick design, create a prototype, initial user evaluation, refining the prototype, and implementing product maintenance. It can be explained by the prototype model in the Figure 9.

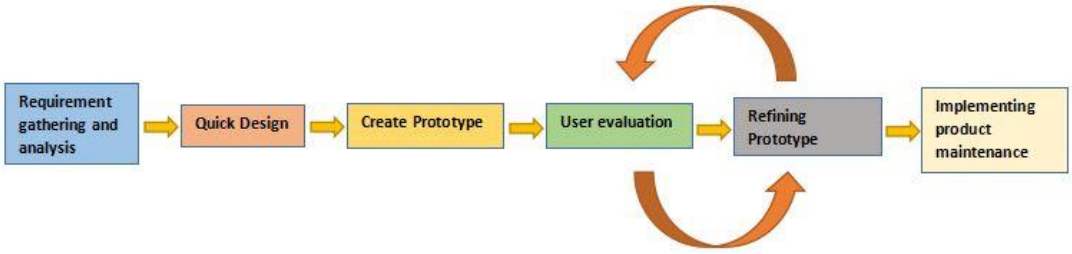

Figure 9: The Prototype Model for the Smart Animal Sensor for Vehicle

3.2.1 Requirement Gathering

During requirement gathering, the requirement of the project will be stated in detail which is the list of requirement that need to be used to build smart animal sensor according to the hardware and software.

(a) Hardware

- ESP32-CAM Development Board
- HC-SR501 PIR Sensor
- USB to TTL FT232RL
- Portable Power 5V Supply Battery Shield
- Jumper Wire
- Breadboard
- USB cable to male-male pin
- Android phone

(b) Software

- Arduino IDE
- Blynk Application

.

3.2.2 Quick Design

In this quick design, a simple design will be created for the smart animal sensor, which is a brief about how the system is working for the user. Furthermore, this phase can help to lead to the right ways in implementing the system and in developing the prototype.

Figure 10 shows the quick design that has been illustrated for the better understanding.

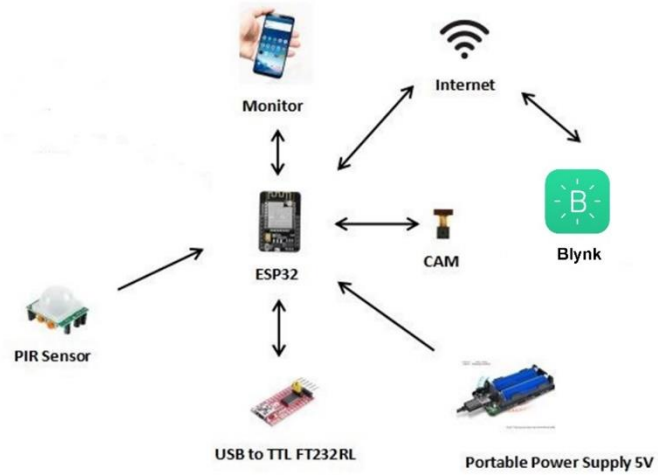

Figure 10: Quick Design for Smart Animal Sensor

For the better understanding, the block diagram has been created in the Figure 11 in order to show how the system will be implemented.

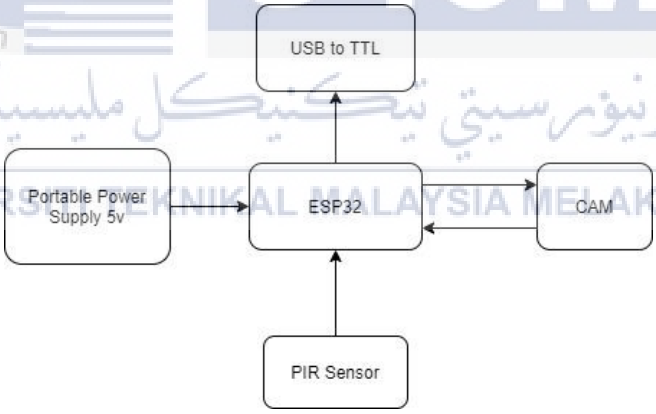

Figure 11: Block Diagram design for Smart Animal Sensor in Vehicle

3.2.3 Build Prototype

During the building prototype, the first prototype will be build based on the design created. All the hardware and software that are stated will be used in the project. The first software that will be installed in Arduino IDE contains a text editor for writing code to connect ESP32-CAM to the hardware to upload programs and communicate with them. After the software is successfully installed, all the required packages, such as the PIR sensor, will be installed.

3.2.4 User evaluation

After complete the prototype, the evaluator will evaluate the prototype that has been created in the user evaluation. The evaluation will comment on the strength and weaknesses and what should be improved on the prototype. Hence, the evaluation result will be taken for the further analysis process.

3.2.5 Refining prototype

During this phase, the prototype's weakness will be refined from the evaluation result according to the evaluator's feedback and suggestion. The refining prototype phase will not be over until the final prototype met all the requirements and is satisfied.

3.2.6 Implement and maintain

In this phase, the prototype will undergo routine maintenance once the final system is developed and satisfied to minimize any downtime that might occur and prevent a large-scale failure.

3.3 PROJECT MILESTONES

The project milestone will be the guideline to ensure the project's timeline and to guarantee the continuous running of the project. The table 15 below shows the milestones designed according to the project.

Table 15: Project Milestone for Smart Animal Sensor for Vehicle

Activity	Responsibility	Date Start	Date End
Gathering requirement	Student Supervisor	Week 1	Week 2
Analyse the requirement	Student	Week 2	Week 4
Designing project	Student	Week 5	Week 7
Gathering hardware	Student	Week 4	Week 10
Installing the Arduino IDE	Student	Week 5	Week 5
Building prototype	Student	Week 10	Week 12
Progress evaluation	Student and supervisor	Week 12	Week 13
Testing prototype	Student	Week 12	Week 13
User (supervisor and evaluator) evaluation	Student , evaluator and supervisor	Week 13	Week 13

Drafting new design based on evaluation	Student	Week 1	Week 3
Refined prototype	Student	Week 4	Week 5
Progress evaluation	Student and supervisor	Week 4	Week 5
Building full project	Student	Week 6	Week 6
Refined prototype tested again	Student and supervisor	Week 7	Week 7
User (supervisor and evaluator) evaluation	Student , evaluator and supervisor	Week 8	Week 8

3.4 PROJECT GANTT CHART

This section will explain the project Gantt chart in the PSM 1 and PSM 2. Table 16 below will describe the project Gantt chart.

Table 16: Gantt Chart for PSM1 and PSM2 for this project

Week / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Requirement gathering and analysis																							
Quick Design																							
Building Prototype																							
User Evaluation																							
Refining prototype																							
Implement and maintain																							

3.5 CONCLUSION

In conclusion, by using project methodologies, this project can be developed in a manageable timeline according to the six stages in the prototype model. In the requirement gathering phase, there are including with reasearchactivity of requirements of hardware and software to be used. In the reading activity, Ido research through several sources such as textbooks, journals, paper references, theinternet, and more sources due to get information about the related project. Moreover, the process of completing the project can be managed wisely and will be making a good result with appropriate steps and methodology.

CHAPTER 4: ANALYSIS AND DESIGN

4.1 INTRODUCTION

In this chapter, the method of the analysis is the process of sorting the problem has become the main elements that need to be studied in order to ease the solving problem of an information system. Other than that, this method will obtain the best decision point that will determine whether the running system will be expanded or replaced. Next, the first in the system analysis phase is identifying the problem, which is the problem that can be identified as the question that wants to solve. Therefore, this stage should have an effective and efficient analysis.

4.2 PROBLEM ANALYSIS

In the problem analysis, it will describe the problem occur that will be analyse to achieve the project goals. The Figure 12 shows the flowchart of current system.

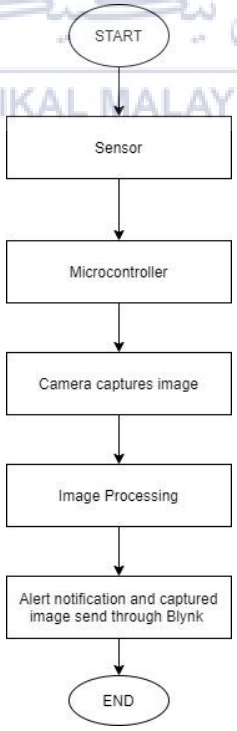

Figure 12: Flowchart of the current system

The problem statement stated that the main problem of the system is the user does not notice when animals staying in the vehicles, which it can cause the animals to get injured or killed while staying in the car engine. Other than that, it can harm the user of the vehicle which they did not notice any damage of the car engine as the animals make the damaged such as chewing the wire, clogging caused of nest and others.

Next, this project is also limited to one type of vehicle, which is not all vehicles is suitable to use this system. Other than that, the third problem statement is the ability to understand how the system works which to understand how to control and manage the system properly without having any disruption.

4.3 REQUIREMENT ANALYSIS

4.3.1 Data Requirement

The input data of the device is the motion alert from the PIR sensor and the image captured, which is from OV2640 CAM. If any movement has been detected, the motion sensor will generate the data and send it through the microcontroller, which is the ESP32 development module. Then, it will send the alert message through the Blynk. Users will control the system via Blynk, which is monitoring the animals from the application. Other than that, if the movement has been detected, the OV2640 CAM will capture the image of the animals and send it through the Blynk. The data flow in

Figure 13 below shows the diagram has been illustrated in order to make it more understanding

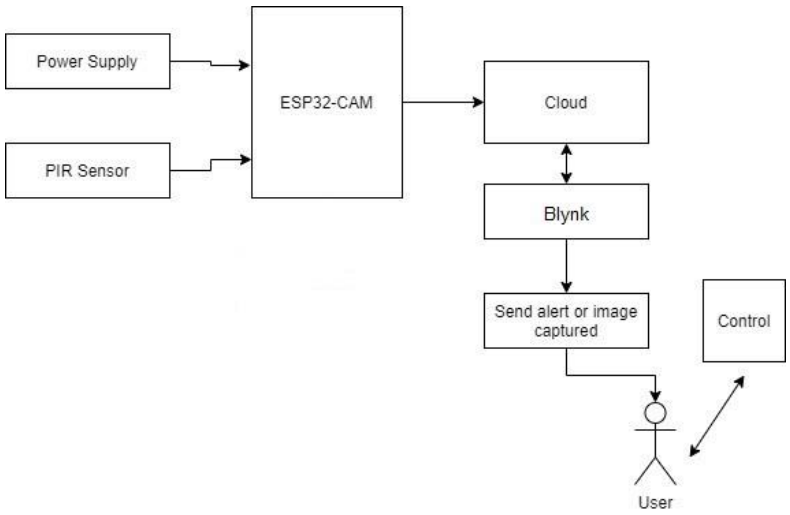

Figure 13: Data flow of the system for data requirement

4.3.2 Functional Requirement

In the Figure 14 below, the ESP32-CAM needs internet access to enable the device to work properly. If any movement has been detected by the PIR sensor, it will capture the image of the animals and send it through Blynk. Then, it will also generate the alert message via Blynk. Moreover, the user also can control the system in the Blynk by capturing the image of the animals.

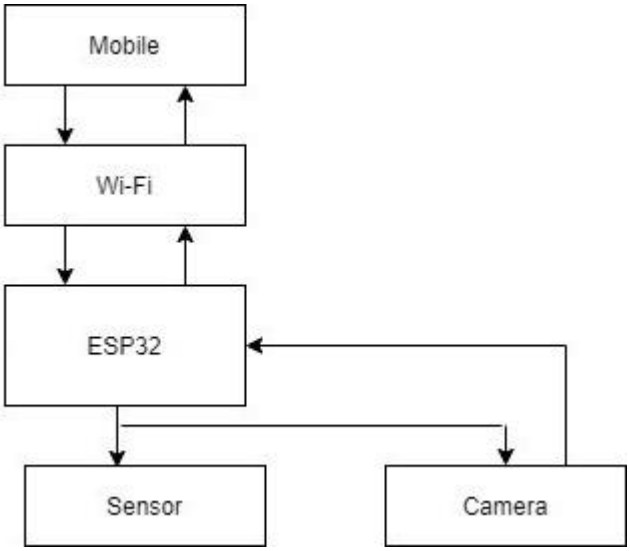

Figure 14: Data flow diagram of the system for the functional requirement

4.3.3 Non-functional Requirement

In the non-functional requirement shows the description for ESP32-CAM in the Table 17. It will shows that the main function of the ESP32-CAM.

Table 17: Non-functional requirement for the proposed system

Features	ESP32-CAM Development Module
RAM	520KB SRAM +4M PSRAM
Bluetooth	Bluetooth 4.2 BR/EDR and BLE standards
Wi-Fi	802.11 b/g/n/
Image Output Format	JPEG(OV2640 support only),BMP,GRAYSCALE
Transmit Power	802.11b: 17±2 dBm (@11Mbps); 802.11g: 14±2 dBm (@54Mbps); 802.11n: 13±2 dBm (@MCS7)
Security	WPA/WPA2/WPA2-Enterprise/WPS
Operating Temperature	-20 ℃ ~ 85 ℃
Storage Environment	-40 ℃ ~ 90 ℃ , < 90%RH

The ESP32-CAM is a microcontroller that has a video camera and MicroSD slot. It has both Bluetooth and Wi-Fi special features, which can easily be connected to a smartphone wirelessly. Other than that, it also consists of WPA, WPA2, WPA2-Enterprise, and WPS for network security by knowing that WPA2 has the stronger security and is easier to configure.

4.3.4 Others Requirement

4.3.4.1 Hardware Requirement

(a) ESP32-CAM Development Module

ESP32-CAM is a camera module based on ESP32, which consists of an OV2640 camera and an onboard TF microsd slot. It has been widely used in intelligent IoT applications such as wireless video monitoring, Wi-Fi image upload, QR identification, and others. Figure 15 below shows the ESP32-CAM device.

Figure 15: The ESP32-CAM device

(b) USB to TTL Adapter FT232RL

USB to TTL serial adapter is the high quality and most used FTDI FT232RL chipset, which is used to connect TTL serial devices to a PC through a USB port. It can be used on Arduino Pro mini, ESP8266 boards, and more. Figure 16 below shows the USB to TTL adapter device.

Figure 16: USB to TTL Adapter FT232RL device

(c) PIR Sensor

PIR sensor is used for the sensing of infrared that is radiated from all objects that discharge heat. It will not become visible to human eyes, but the sensors that operate using infrared wavelength can detect such activity. This PIR sensor can completely work in the darkness, which can detect changes in the level of received infrared. Figure 17 shows the PIR sensor device.

Figure 17: PIR Sensor device

(d) 5V portable power

Portable power is used to charge an Arduino, ESP8266, ESP32 expansion board by using the USB output. An LED will indicate the progress of the battery charge, which is green for charged and red for charging. Figure 18 shows the 5V portable power device

Figure 18: 5V portable power device

4.3.4.2 Software Requirement

(a) Arduino IDE

Arduino IDE software consists of a text editor for writing code, message area, text console, and more for common functions. It connects to the Arduino and hardware to upload and communicate with the program. Arduino IDE is written functions from C and C++. Figure 19 shows the Arduino IDE software.

Figure 19: Arduino IDE software

(b) Blynk Application

Blynk is an application was designed for IoT, which is used to control the hardware remotely, display the sensor data, store data, visualize data, and others. There are three-component in the Blynk, which are Blynk App, Blynk Server, and Blynk Libraries. Blynk App is used to create the interfaces for the projects by using the various widgets that have been provided. Next, Blynk Server is used for the communications between the smartphone and the hardware. Lastly, Blynk Libraries is used to enable communication for the server and process the income and outcome commands. Figure 20 shows the Blynk application.

Figure 20: Blynk application that will used on the system

4.4 HIGH-LEVEL DESIGN

In High-Level design, the connection between smartphone and ESP32-CAM is very important which the device will communicate with each other by using wireless communication. An alert notification will send when any movement has been detected via the PIR sensor. The user is also enabled to control the system by using the command in the Blynk.

4.4.1 System Architecture

In the system architecture, the system has been illustrated based on the hardware and software that has stated. In the Figure 21, it shows the system architecture for Smart Animal Sensor.

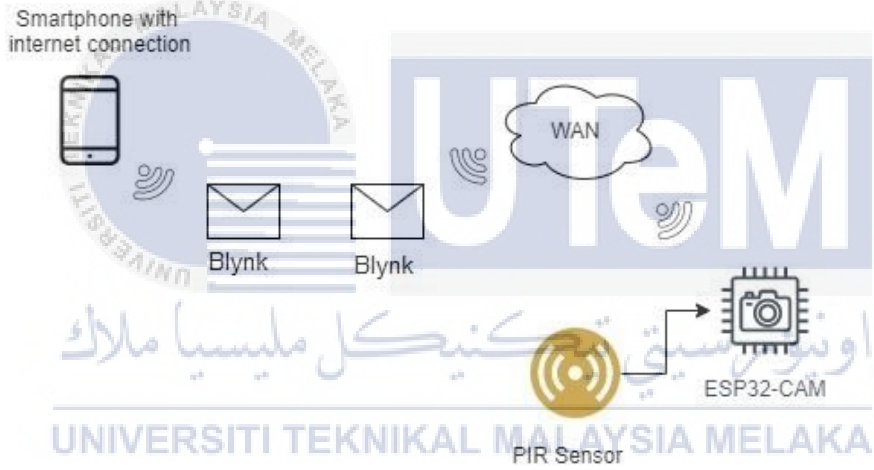

Figure 21: System Architecture for Smart Animal Sensor

4.4.2 User Interface Design

4.4.2.1 Navigation Design

The figure 22 shows the flowchart that describe the logic communicating of the system.

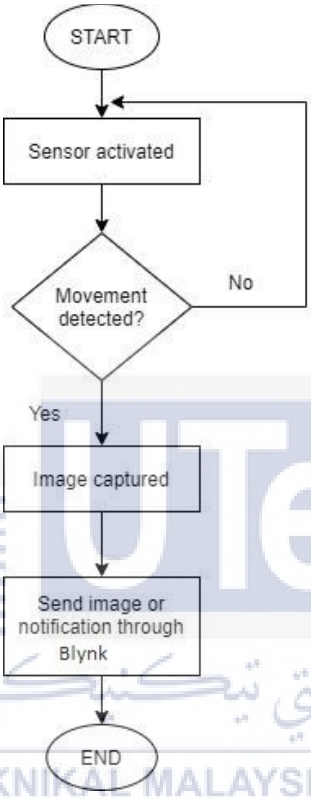

Figure 22: The flowchart of Smart Animal Sensor

A) Input Design

The figure 23 below shows the example of input design in Blynk. The display below is received from ESP32-CAM and PIR sensor.

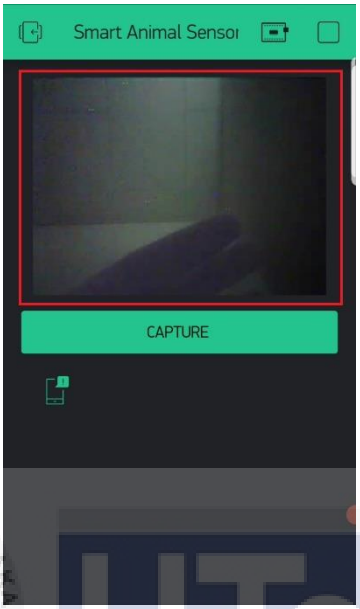

Figure 23: The monitoring system of Input design

In the Figure 24, it shows the input design which is the notification that receives from the PIR sensor.

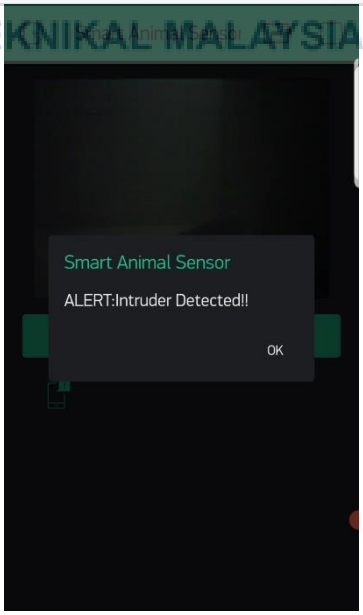

Figure 24: The alert notification of Input design

4.4.2.2 Output Design

The Figure 25 below shows the example of output design in Blynk. The button below used to capture image from ESP32-CAM.

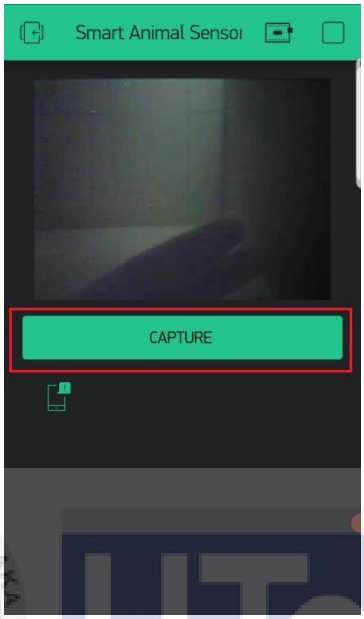

Figure 25: The example of Output design

The Figure 26 below shows the ESP32-CAM flashing to capture the image of the animals when the capture button has been clicked.

Figure 26: The example of Output design

4.5 CONCLUSION

In conclusion, the analysis and design are very important in order to receive the success of the project development. In the problem analysis, we have been stated that there is some problem occur in the current system which needs some improvement. Also, in the requirement analysis, the hardware and software that are needed to control the system are ESP32-CAM, PIR sensor, and Arduino IDE. Moreover, the flowchart of the project has been decided and will be used as a guideline through the development of the system. By using system analysis and design, it will identify both opportunities and problems by recognizing the strengths and weaknesses of the system.

CHAPTER 5: IMPLEMENTATION

5.1 INTRODUCTION

This chapter summarizes the efforts to implement the result and products developed during the research phase of the system. The implementation is about making a program work which includes how the program is set up and run. The quality of implementation plays an important role in bringing about outcomes which if a system is implemented poorly, its goals are unlikely to be achieved.

5.2 SOFTWARE DEVELOPMENT ENVIRONMENT SETUP

In software development environment setup, it will describe the system development setup for better understanding of the project.

(a) Setup Environment of ESP32-CAM

The environment of the ESP32-CAM will explain how the microcontroller manages to control the system properly. Moreover, this section will also describe the requirements of the software and hardware for the environment of the ESP32-CAM.

(b) Smart Animal Sensor for Vehicle environment setup

This section will explain how PIR Sensor and ESP32-CAM will be developed and communicate with each other to ensure the project will run properly and effectively. The configuration of the Smart Animal Sensor for vehicle need to work smoothly to ensure the users be able to use the system easily.

(c) Application setup

The application setup for this project will explain the application interface and functionality. This application can be accessed by users to control the system from everywhere.

5.2.1 ESP32-CAM Environment Setup

In ESP32-CAM environment setup, it will explain the setup of the ESP32-CAM in more detail. Which is the main component of the project is ESP32-CAM to make the system run properly. The ESP32-CAM will act as the microcontroller for the Smart Animal Sensor to operate properly and effectively. Therefore, the hardware and software need to implement with it to make the ESP32-CAM fully functional to work. There is hardware and software requirement for ESP32-CAM environment setup is stated as below:

(a) Hardware Requirement

- ESP32-CAM
- FTDI 232 USB to Serial Interface board

(b) Software Requirement

- Arduino Software IDE
- C++ Language

Each of the device has their own functionality and specification which has been described in the Table 18.

Table 18: The summary of the system configuration for ESP32-CAM environment setup in the project

No.	System Configuration	Specification
1.	Hardware	ESP32-CAM • Speed of the clock: 160 MHz • Voltage for operating:5V • Voltage for the supply:5V • IO port: 9 • Wi-Fi: 802.11 b/g/n

		• Bluetooth: Bluetooth 4.2 BR/EDR and BLE standards • SPI Flash: Default 32Mbit USB to TTL Adapter FT232RL • Operating Voltage: 5V/3.3V DC • Max Current Draw: 5V - 500mA; 3.3V - 50mA • Connector: Mini USB • Fully integrated clock generation with no external crystal required
2.	Software	Arduino Software IDE

The hardware and software requirements are very important in developing the ESP32-CAM environment setups. The requirements are chosen to set up the environment of ESP32-CAM. Figure 27 below shows the ESP32-CAM environment configuration.

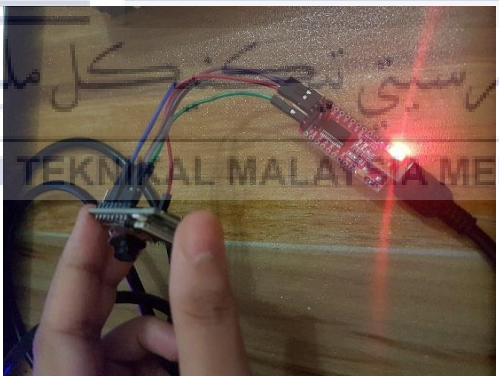

Figure 27: ESP32-CAM environment configuration

5.2.2 Smart Animal Sensor in the Vehicle Environment Setup

The smart animal sensor environment will be set up and integrated with Arduino Uno. The configuration needs to be done for the smart animal sensor in order to be able to detect the animal's movement in the car engine by using a PIR sensor. Figure 28 below shows the smart animal sensor in the vehicle environment setup.

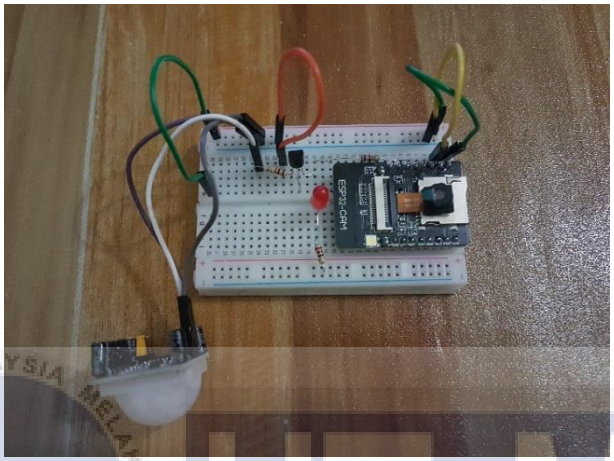

Figure 28: Smart Animal Sensor for Vehicle environment setup

Besides, the smart animal sensor needs to connect properly in order to make the system run smoothly. It needs to be connecting with the GPIO pins of the ESP32-CAM. The ESP32-CAM will be connected with the PIR Sensor, Battery Module, transistor, resistor and through the jumper wires connected. All the connection details are listed below:

(a) FTDI 232 USB to Serial Interface board to ESP32-CAM

Figure 29 below shows the connection between ESP32-CAM with FTDI USB that connected by using a jumper wire.

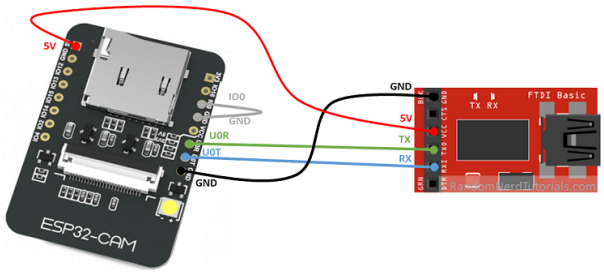

Figure 29: The connection between ESP32-CAM and FTDI 232 USB

The detail for the each connection between ESP32-CAM and FTDI programmer can be stated in the Table 19 below:

Table 19: The connection between ESP32-CAM and FTDI Programmer

ESP32-CAM	FTDI Programmer
GND	GND
5V	VCC (5V)
U0R	TX
U0T	RX
GPIO 0	GND

(b) PIR Sensor to ESP32-CAM

The detail for each connection for the PIR sensor and ESP32-CAM can be stated in Table 20 below:

Table 20: The connection between ESP32-CAM and PIR Sensor

PIR Sensor	ESP32-CAM
GND	GND
OUT	GPIO 13
VCC	5V

5.2.3 Application Setup

The smart animal sensor environment will be designed and incorporated with application in this portion. For the smart animal sensor, the setup needs to be done in order to make the system connect with the application. The Blynk Apps will be used to communicate the system through the smartphone. Since the ESP32-CAM has a Wi-Fi module, the Blynk Apps be able to connect to ESP32-CAM with Wi-Fi username and password authentication.

5.3 PROJECT CONFIGURATION MANAGEMENT

For software configuration management, it will address the specifics configuration for the smart animal sensor, which is it needs to be properly managed to ensure the system fully functional. The setting is mentioned as below:

(a) Configuration of ESP32-CAM

The ESP32-CAM setup will explained step by step which the configuration of ESP32-CAM will involve the software listed as below:

- Arduino IDE

(b) Smart Animal Sensor

This section will explain the script used to run the project, which is the FTDI 232 USB to Serial Interface board to ESP32-CAM wire plug need to be set up to ensure the plug is available to use. The configuration is stated as below:

- ESP32-CAM Setup

(c) Application Configuration

This section will explain the application's setup to ensure users can access the system everywhere through the application. The application involved is listed as below:

- Blynk Apps

5.3.1 Configuration Environment Setup

(a) ESP32-CAM Configuration

- Download the USB-UART driver

In order to make the ESP32-CAM port available in Arduino IDE, the USB-UART need to be installed. USB to UART is a controller that manages the USB connectivity to devices with a UART interface. Determine the USB-UART bridge chip that is used in the ESP32-CAM, which is in this system is used CP2102. Once the model number has been determined, the driver will be downloaded, which is the example cable is shows in Figure 30 below:

Figure 30: The USB-UART cable

The driver's package for the USB-UART can be obtain from the source in the Figure 31 below:

Figure 31: The driver package download website

- Install the board driver

In step 1, open the device manager as stated in Figure 32 to connect the USB2Serial breakout board to the system using the USB cable. Search Ports (COM & LPT) tab.

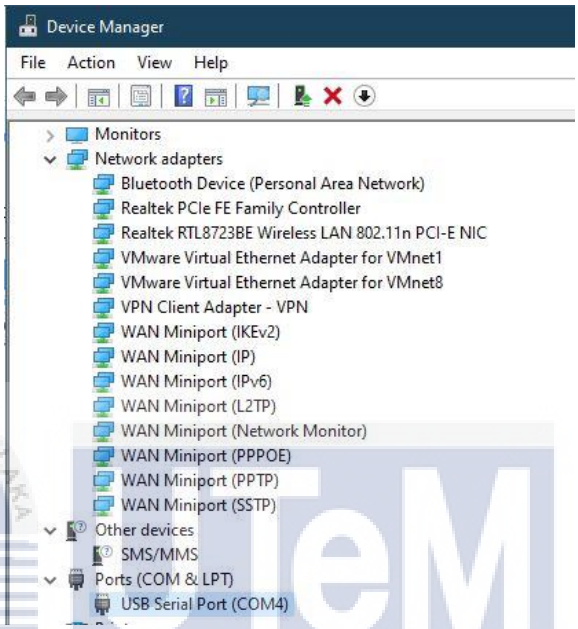

Figure 32: Device Manager tabs

In step 2, right-click at the Ports (COM & LPT) and select the update drivers. In the Update Drivers browser, select the "Browse my computer for driver software" to install the driver into the computer as shown in Figure 33.

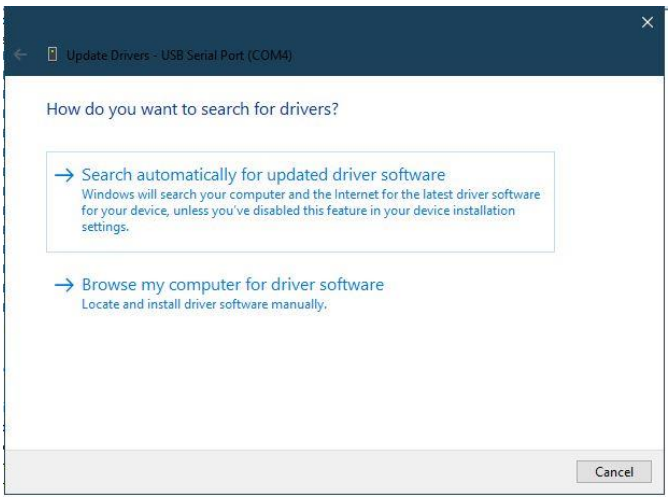

Figure 33: Update Driver for USB Serial Port tabs

In step 3, search for the downloaded driver's package on the computer and click next as stated in Figure 34.

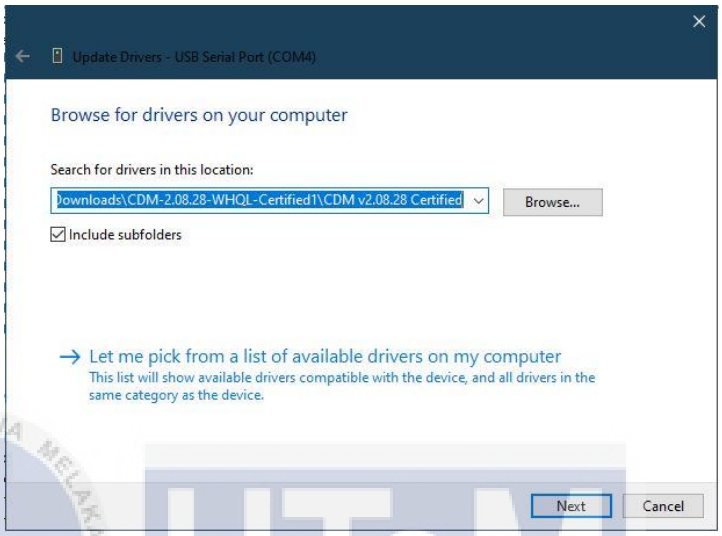

Figure 34: Update Driver for USB Serial Port

In step 4, once the driver has been chosen, it will automatically installed in the computer as shown in Figure 35.

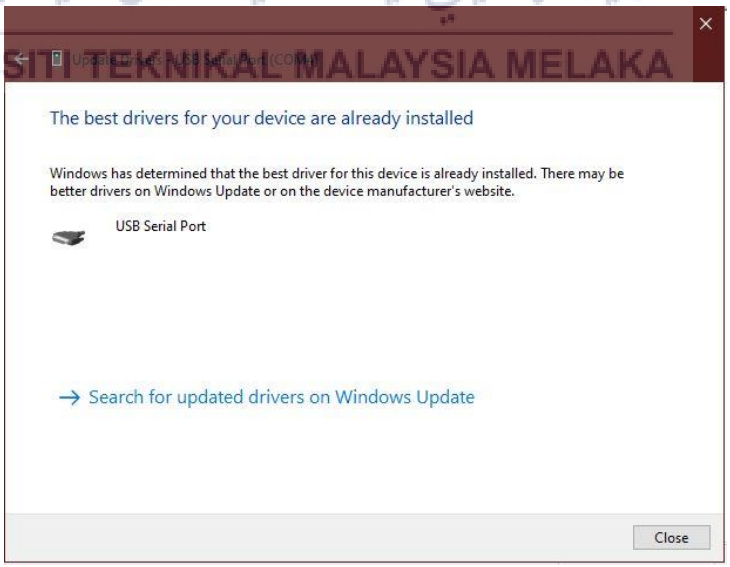

Figure 35: Update Driver for USB Serial Port has successfully updated

- Install esp32 module in Arduino IDE

In step 1, install the esp32 module in the Arduino IDE at the Boards Manager as shown in Figure 36.

- *Tools > Boards > Board Manager.*

Figure 36: The Board Manager to install esp32

In step 2, after install the esp32 module, paste the following URLs at the Additional Boards Manager URLs as shown in Figure 37.

- *Files > Preferences.*

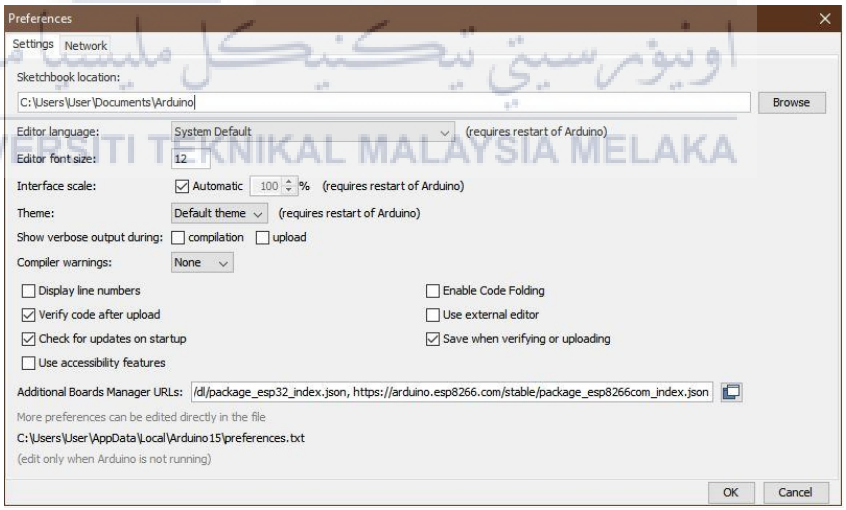

Figure 37: The Preference to install esp32

- Connect ESP32-CAM to FTDI 232 USB

In step 1, connect the ESP32-CAM to FTDI 232 USB by using female to female jumper wire as shown in Figure 38.

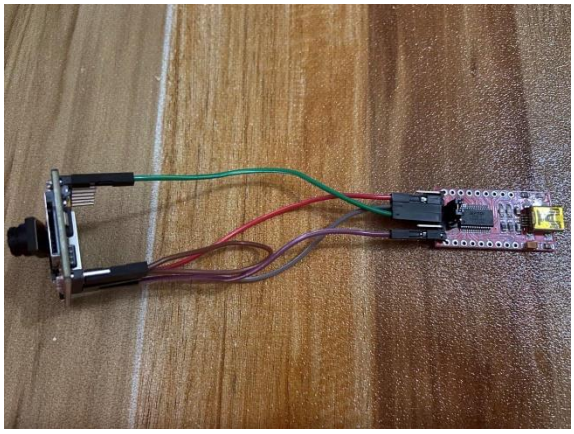

Figure 38: The connection of ESP32-CAM and FTDI USB

The detail for each connection for ESP32-CAM and FTDI programmer can be stated in the Table 21 below:

Table 21: The connection between ESP32-CAM and FTDI Programmer

ESP32-CAM	FTDI Programmer
GND	GND
5V	VCC (5V)
U0R	TX
U0T	RX
GPIO 0	GND

- Open the sketch at Arduino IDE

In step 1, open the sample sketch of Wi-Fi at Arduino IDE as shown in Figure 39.

- File > Examples > WiFi > WiFiScan.

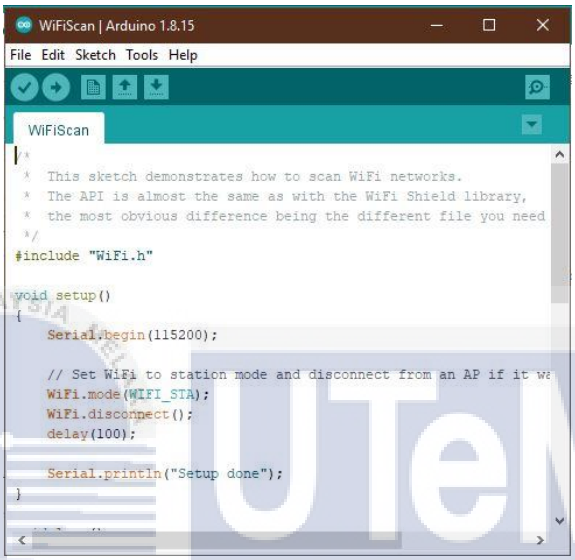

Figure 39: The example sketch to scan the Wi-Fi

In step 2, choose the correct description for the device as stated in Figure 40 below:

- Board: ESP32 Wrover Module
- Upload Speed: 921600
- Flash Frequency: 80MHz
- Flash Mode: QIO
- Partition Scheme: Huge APP (3MB No OTA/1MB SPIFFS)
- Core Debug Level: None

- Port: COM4

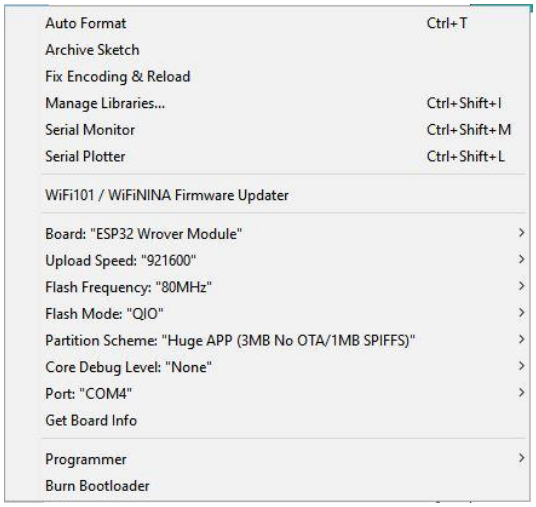

Figure 40: The description to install esp32

In step 3, upload the device. When the ESP32-CAM has successful flashing as shown in Figure 41, it shows that ESP32-CAM is ready to use.

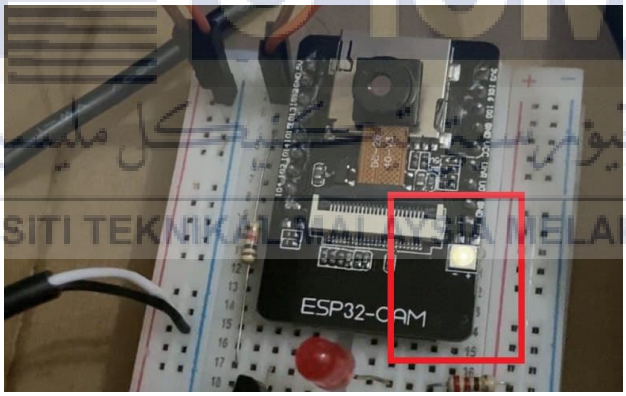

Figure 41: ESP32-CAM flashing after installation

5.3.2 Smart Animal Sensor in the Vehicle

(a) ESP32-CAM setup

In step 1, install the ESP32-CAM by attaching into the breadboard. Then, attach the jumper wire at 5V and GND of ESP32-CAM and resistor at IO13 as shown Figure 42.

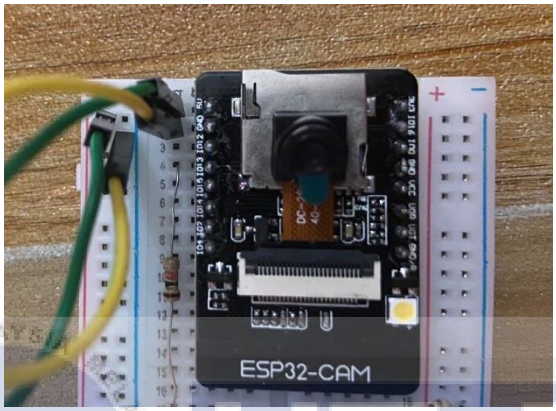

Figure 42: The ESP32-CAM connection

(b) PIR sensor setup

In step 1, get the PIR sensor by inserting the jumper cable into the breadboard. The table below shows the connection between ESP32-CAM and PIR sensor as shown in Figure 43.

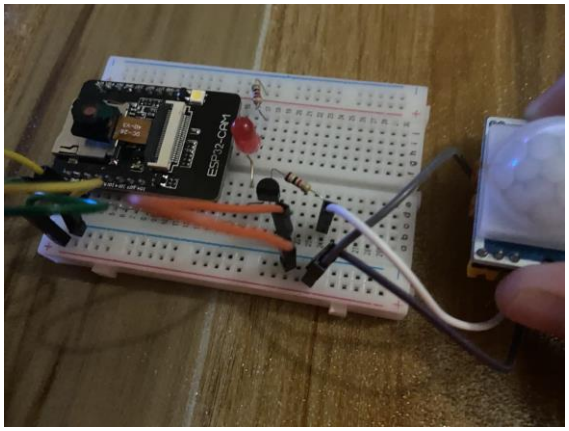

Figure 43: PIR sensor connection.

The detail for each connection for PIR sensor and ESP32-CAM can be stated in the Table 22.

Table 22: The PIR sensor and ESP32-CAM connection

PIR Sensor	ESP32-CAM
GND	GND
OUT	GPIO 13
VCC	5V

(c) 5V Portable Power setup

In step 1, install the 5V portable power by inserting into the 5V and GND of ESP32-CAM as shown in Figure 44.

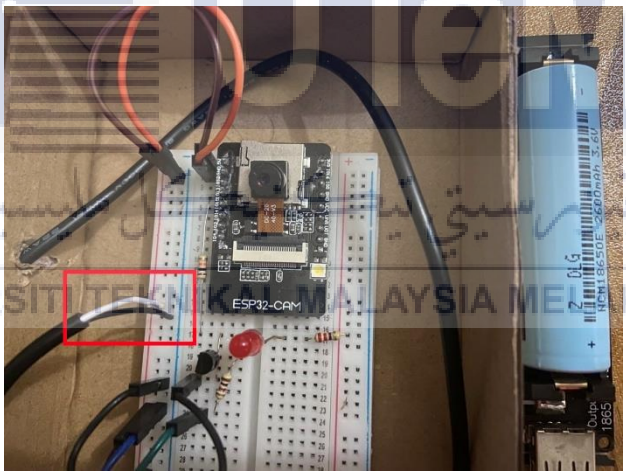

Figure 44: 5V portable power connection

5.3.3 Application Configuration

- Blynk account setup

In step 1, sign in into Blynk or create new account if there no account has been made yet as shown in Figure 45.

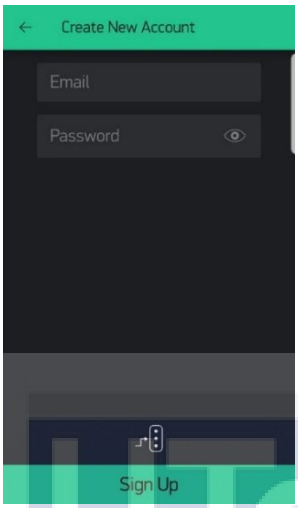

Figure 45: The Blynk Sign up page

- New Project setup

In step 1, after log in into the account, select "New Project" to create the project as shown in Figure 46.

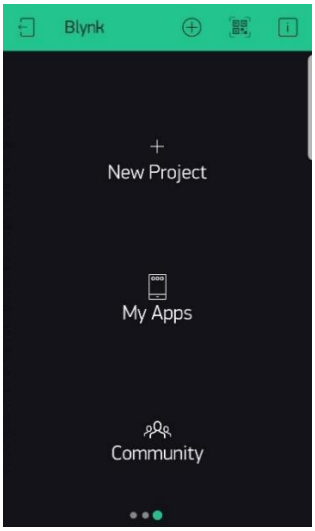

Figure 46: Blynk home page

In step 2, insert the new project title and choose the suitable device for project hardware as shown in Figure 47.

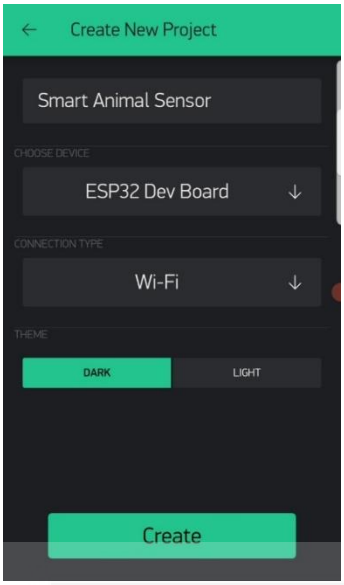

Figure 47: Blynk create new project page

In step 3, after create the new project, the authentication token will be sent through the email. The authentication token will be used to connect the ESP32-CAM and Blynk as shown Figure 48.

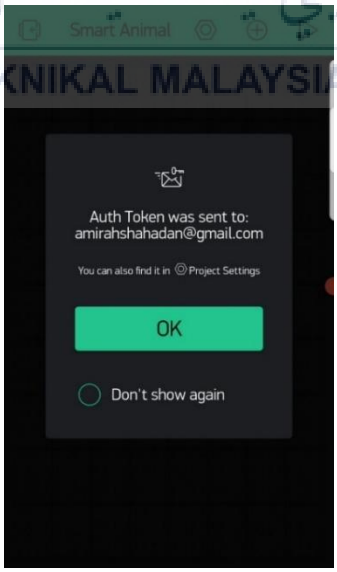

Figure 48: Blynk authentication token has sent to the register email

- Smart Animal Sensor application interface setup

In step 1, create the graphical user interface for the application of the project as shown in Figure 49.

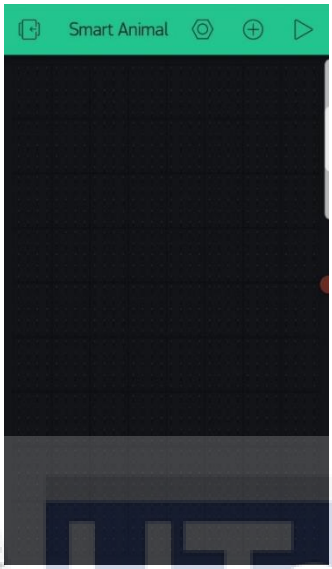

Figure 49: Blynk new project blank page

5.4 CONCLUSION

In conclusion, the procedures and tasks involved in this chapter are step-by-step for this project to make it run smoothly and efficiently. The environment and configuration have been set up wisely during the implementation stage in order to make the system work perfectly. All the research and information collected during this chapter have been used for testing and analysis in the next chapter.

CHAPTER 6: TESTING

6.1 INTRODUCTION

This chapter will explain the project's testing process that the testing steps are very critical to ensure that the developed system will meet the requirement and work perfectly. Furthermore, testing will improve the project's role to achieve the project's objective, which is all the components and modules will be checked to ensure the result is effective.

In this project, the ESP32-CAM will be the main component to monitor the processes of the system in this project. Until the required result is obtained, the testing will be carried out many times. There are several test planning discussions based on this point, for example, test plan, test schedule, test design, and result from analysis.

6.2 TESTING PLANNING

During this segment, the basis of each device test will be clarified and also describe the scope of research and the tasks that will be carried out during the testing process.

6.2.1 Testing Organization

The organization that participates in this testing process is to validate the project, which including the developer and the target users that are suitable to use this system for their daily lives. In order to make the target users understand how the system works, the developer will explain and clarify the system features.

6.2.2 Test Environment

In this section, the test environment will include the prototype of the Smart Animal Sensor hardware and the graphical user interface of the application for this portion which the user interface will manage and control the system. Due to project development, the test environments will be developed for an efficient and effective testing process.

6.2.3 Test Schedule

For the test schedule, the testing process needs to be conducted consistently and simultaneously over a period of time. During that period, the errors and problems will be found, and in order to solve the problem, the basic implementation process will be corrected. The testing process will be repeated continuously until the system reaches its objective. For this project, the required time to complete this project is approximately six months.

6.3 TESTING DESIGN

The testing design will test the designed component or modules for the system's accuracy and effectiveness. Each part of the modules will be checked to validate the device to ensure that the device meets requirements and specifications to operate perfectly. Other than that, monitoring can help enhance the system process to achieve the system's goal.

6.3.1 Test Description

For test description, it will managed all the element and modules that used to produce the productive and efficient performance. Therefore, the table below will shows all the test cases:

i. Testing the display of Camera OV2640 with ESP32-CAM

Table 23 below shows the description about the display of Camera OV2640 with ESP32-CAM which the display camera will be shown in the application.

Table 23: The description about the display of Camera OV2640 with ESP32-CAM.

Test	The Camera OV2640 can be used only after the ESP32-CAM connected to the application
Test Purpose	To test the integration between Camera OV2640, ESP32-CAM and application.
Test Environment	In order to run this pre situation test, ESP32-CAM must be set up. Installation and setup procedure stated in section 5.3.1
Test Setup	1. Download the application 2. Apply the power supply on ESP32-CAM 3. Go to application. 4. Click on "ON".
Expected Result	User cannot use the camera if the ESP32-CAM is not connected to the application. The camera can be used after it connected to the application and activated properly.

ii. Testing the power ON ESP32-CAM

Table 24 below shows the testing for ESP32-CAM when it power ON which is to record the integration between PIR sensor and ESP32-CAM.

Table 24: The testing of ESP32-CAM when power ON

Test	The PIR sensor only can be used if the ESP32-CAM is power ON.
Test Purpose	To test the integration between PIR Sensor and application.
Test Environment	In order to run this pre situation test, ESP32-CAM and the application must be set up. Installation and setup procedure stated in section 5.3.1
Test Setup	1. Download the application 2. Apply the power supply on ESP32-CAM 3. Detect any flashing light from ESP32-CAM 4. Go to the application. 5. Click on "ON".
Expected Result	User can receive the notification and monitor from application.

iii. Testing the Blynk application when power ON.

Table 25 below shows the testing for the application while ON which to test the integration between ESP32-CAM, PIR sensor and Blynk. Blynk is the application in this project that has been used to monitor and control the system by user.

Table 25: The testing of Blynk application

Test	The PIR sensor can send notification after Blynk ON.
Test Purpose	To test the integration between ESP32-CAM, PIR Sensor and Blynk
Test Environment	In order to run this pre situation test, ESP32-CAM must be set up. Installation and setup procedure stated in section 5.3.1
Test Setup	1. Download the application 2. Apply the power supply on ESP32-CAM 3. Go to application. 4. Click on “START”. 5. Test the sensor.
Expected Result	User can receive the notification and monitor through application after Blynk ON.

iv. Testing the functionality of PIR sensor.

Table 26 below shows the testing for the functionality of the PIR sensor. PIR sensor is a device that is used to detect the presence of animals. This test has used human detection as animals for example hands movement because there are some limitations occur for this testing.

Table 26: The testing of PIR sensor

Test	The PIR sensor can detect the movement in the short distance.
Test Purpose	To test the integration between ESP32-CAM and PIR Sensor.
Test Environment	In order to run this pre situation test, ESP32-CAM must be set up. Installation and setup procedure stated in section 5.3.1
Test Setup	1. Download the application 2. Apply the power supply on ESP32-CAM 3. Go to application. 4. Click on "START". 5. Test the sensor with human movement.
Expected Result	The PIR sensor can detect the movement and it will trigger the ESP32-CAM to capture the images.

v. Testing the ESP32-CAM power supply with power bank

Table 27 shows the testing of ESP32-CAM when using the power supply with the power bank. This test is to identify whether this project is suitable to use a power supply of more than 5V.

Table 27: The testing of ESP32-CAM when using power bank

Test	The ESP32-CAM can be used after applied to power bank.
Test Purpose	To test the integration between ESP32-CAM, PIR Sensor and Blynk
Test Environment	In order to run this pre situation test, ESP32-CAM must be set up. Installation and setup procedure stated in section 5.3.2
Test Setup	1. Download the application 2. Apply the power bank on ESP32-CAM 3. Go to application. 4. Click on “ON”.
Expected Result	User can used the application but camera cannot connected to the ESP32-CAM.

vi. Testing the ESP32-CAM power supply with 5V portable power.

Table 28 shows the testing of ESP32-CAM when using the power supply with 5V portable power. This test is to identify whether this project is suitable to use the power supply which is 5V.

Table 28: The testing of ESP32-CAM when using 5V portable power

Test	The ESP32-CAM can be used after applied to 5V portable power.
Test Purpose	To test the integration between ESP32-CAM, PIR Sensor and Blynk.
Test Environment	In order to run this pre situation test, ESP32-CAM must be set up. Installation and setup procedure stated in section 5.3.2
Test Setup	1. Download the application 2. Apply the 5V portable power on ESP32-CAM 3. Go to application. 4. Click on "ON".
Expected Result	User can use the application usually.

6.4 RESULT AND ANALYSIS

6.4.1 The display of Camera OV2640 with ESP32-CAM

Project Name : Smart Animal Sensor for Vehicle

Component/Function: The functionality of the camera OV2640 with ESP32-CAM before and after connected to the application.

Prepared by : Nur Amirah Binti Shahadan

Date Complete : 25 August 2021

The research and the final outcome were carried out, as the information provided, as shown in table 29.

Table 29: The result of the display of Camera OV2640 with ESP32-CAM

Test Number	Action	Result Expectation	Success/Fail
1.	Click on “START” button on the application.	The camera can displayed on the application.	Success
2.	Click on “OFF” button on the application.	The camera will not displayed on the application.	Success

The function can work easily and properly to use which based on the test performed to test the Camera OV2640 with ESP32-CAM at the application. Figure 50 below shows how the testing occur.

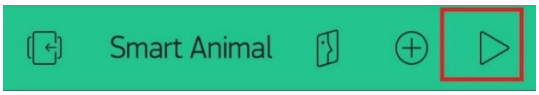

Figure 50: START button from the Application

Figure 51 shows the display of the Camera OV2640 on the Blynk application after the Blynk "START" button.

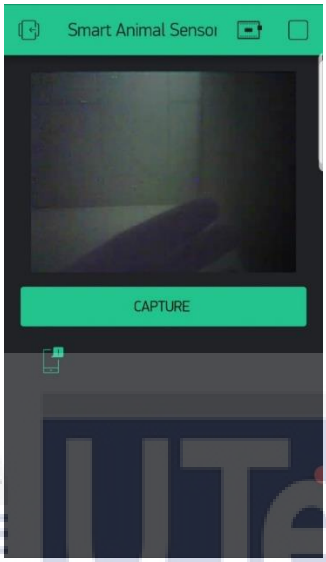

Figure 51: The camera display after Blynk ON

Once the Blynk has been power off, the display of the camera cannot be shown from the application as shown in the Figure 52.

Figure 52: The camera display after Blynk OFF

6.4.2 The function of ESP32-CAM when power ON.

Project Name : Smart Animal Sensor for Vehicle

Component/Function: The functionality of the ESP32-CAM when power ON.

Prepared by : Nur Amirah Binti Shahadan

Date Complete : 25 August 2021

The research and the final outcome were carried out, as the information provided, as shown in Table 30.

Table 30: The function of ESP32-CAM when power ON

Test Number	Action	Result Expectation	Success/Fail
1.	Power ON the ESP32-CAM and click on "START" button on the application.	PIR sensor can send the notification through the application and ESP32-CAM can be used as usual.	Success
2.	Power OFF the ESP32-CAM and click on "START" button on the application.	PIR sensor cannot send the notification through the application and the ESP32-CAM cannot be used as usual.	Success

The function can work easily and properly to use which based on the test perform. The research outcome as shown in figure 53.

Figure 53: 5V portable power for power supply

The figure 54 shows the notification alert from PIR sensor after ESP32-CAM has been power "ON" which it can detect any movement of animals.

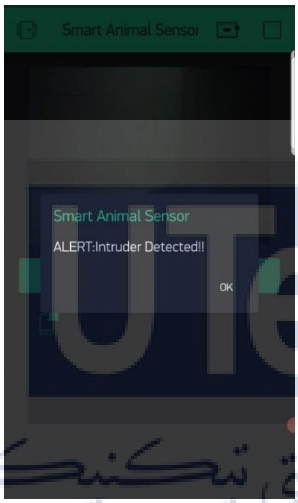

Figure 54: The application after ESP32-CAM power ON

The Figure 57 shows the application after the ESP32-CAM has been turn "OFF" which the function cannot be used by user.

Figure 55: The application after ESP32-CAM power OFF

6.4.3 The functionality of Blynk when power "ON".

Project Name : Smart Animal Sensor for Vehicle

Component/Function: The functionality of the ESP32-CAM when Blynk "ON".

Prepared by : Nur Amirah Binti Shahadan

Date Complete : 25 August 2021

The research and the final outcome were carried out, as the information provided, as shown in Table 31.

Table 31: The testing of Blynk application

Test Number	Action	Result Expectation	Success/Fail
1.	Power ON the ESP32-CAM and click on "START" button on the application.	PIR sensor can send the notification through the application and ESP32-CAM can be used as usual.	Success
2.	Power ON the ESP32-CAM and click on "OFF" button on the application.	PIR sensor cannot send the notification through the application	Success

The function can work easily and properly to use which based on the test perform. The Figure 56 shows the notification alert in the application after Blynk has been turn on.

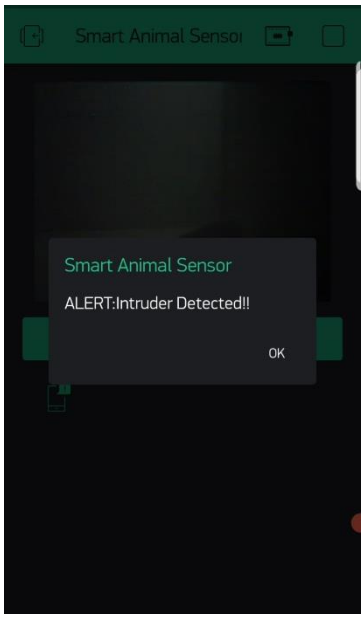

Figure 56: Blynk after turn ON

Figure 57 shows the Blynk application after has been turn off which the users cannot receive the notification.

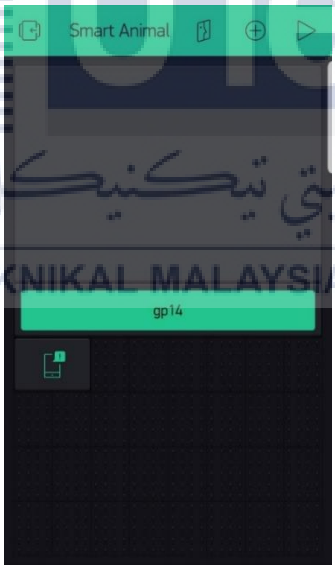

Figure 57: Blynk after turn OFF

6.4.4 The functionality of the PIR sensor

Project Name : Smart Animal Sensor for Vehicle

Component/Function: The functionality of the PIR sensor after the testing using the human hand's movement to assume it as the animal.

Prepared by : Nur Amirah Binti Shahadan

Date Complete : 25 August 2021

The research and the final outcome were carried out, as the information provided, as shown in Table 32.

Table 32: The testing of PIR sensor

Test Number	Action	Result Expectation	Success/Fail
1.	Power ON the ESP32-CAM and click on "START" button on the application. Assume the gesture of hand is an animals.	PIR sensor can send the notification through the application but if there movement detected the ESP32-CAM will flashing.	Success

The function can work easily and properly to use which based on the test perform. The research outcome as shown in Figure 60 which the hand gesture has used to assume it as the animals.

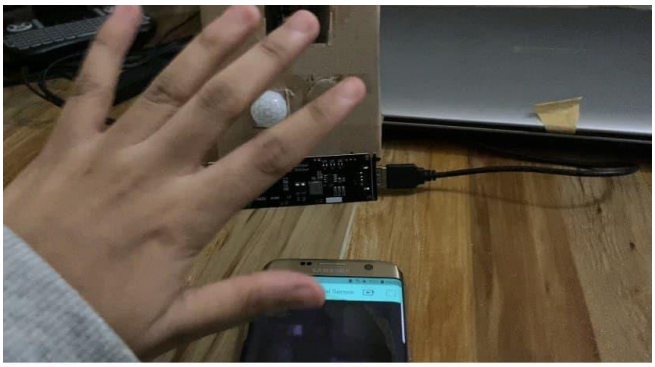

Figure 58: Hand gesture for PIR sensor's testing

Figure 59 below the notification has successfully receives by the Blynk application after the testing.

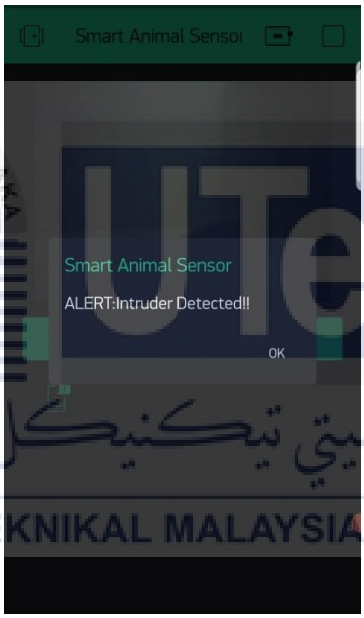

Figure 59: The notification in the Blynk application

6.4.5 The function of ESP32-CAM after applied power supply powerbank.

Project Name : Smart Animal Sensor for Vehicle

Component/Function: The functionality of the ESP32-CAM when using powerbank.

Prepared by : Nur Amirah Binti Shahadan

Date Complete : 25 August 2021

The research and the final outcome were carried out, as the information provided, as shown in Table 33.

Table 33: The function of ESP32-CAM when using power bank

Test Number	Action	Result Expectation	Success/Fail
1.	Power ON the ESP32-CAM with powerbank and click on "START" button on the application.	PIR sensor can send the notification through the application and ESP32-CAM can be used as usual.	Fail
2.	Power ON the ESP32-CAM with powerbank and click on "OFF" button on the application.	PIR sensor cannot send the notification through the application and the ESP32-CAM cannot be used as usual.	Success

The function cannot work easily and properly to use which based on the test perform. The research outcome as shown in Figure 63.

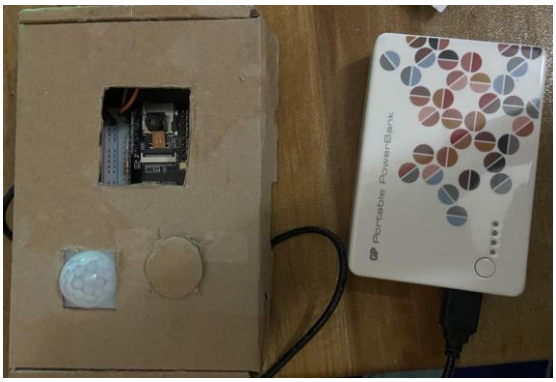

Figure 60: The ESP32-CAM has connected to power bank

The Figure 64 below show the Blynk application after ESP32-CAM connected to powerbank.

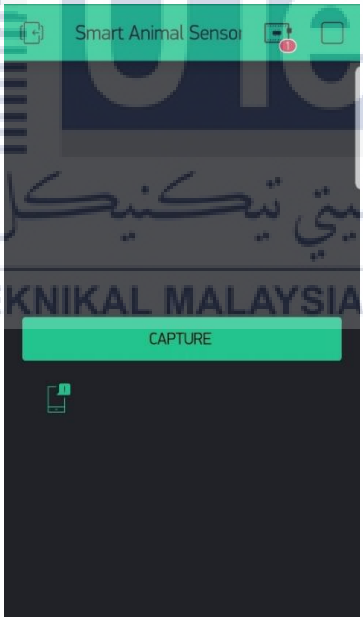

Figure 61: The application after ESP32-CAM connected to power bank.

6.4.6 The function of ESP32-CAM after applied power supply 5V portable power.

Project Name : Smart Animal Sensor for Vehicle

Component/Function: The functionality of the ESP32-CAM when using 5V portable power.

Prepared by : Nur Amirah Binti Shahadan

Date Complete : 25 August 2021

The research and the final outcome were carried out, as the information provided, as shown in Table 34.

Table 34: The function of ESP32-CAM when using 5V portable power

Test Number	Action	Result Expectation	Success/Fail
1.	Power ON the ESP32-CAM with 5V portable power and click on “START” button on the application.	PIR sensor can send the notification through the application and ESP32-CAM can be used as usual.	Success
2.	Power OFF the ESP32-CAM with 5V portable power and click on “OFF” button on the application.	PIR sensor cannot send the notification through the application and the ESP32-CAM cannot be used as usual.	Success

The function can work easily and properly to use which based on the test perform. The research outcome as shown in Figure 62.

Figure 62: The ESP32-CAM has connected to 5V portable power

Figure 63 below show the application after ESP32-CAM connected to 5V portable power.

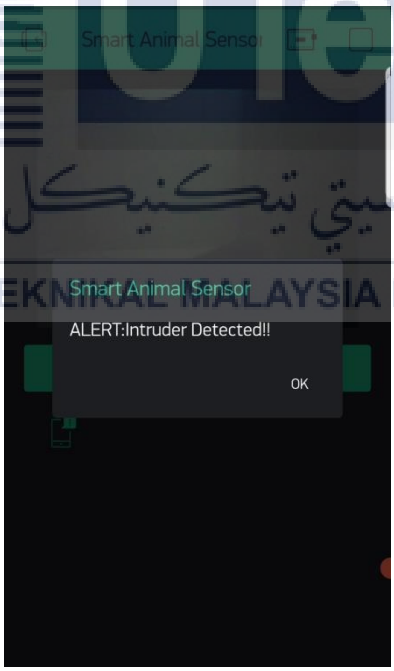

Figure 63: The application after ESP32-CAM connected to 5V portable power

6.5 USER ACCEPTANCE TESTING

For this section, the end-user will be test by using survey form which is to identify whether this project has achieve its goals. The figures below shows the result of the some questions that being asked in the survey form.

From the result in Figure 64, it shows that most of the users agreed that this product is easy to use which the system and the application are easy to understand.

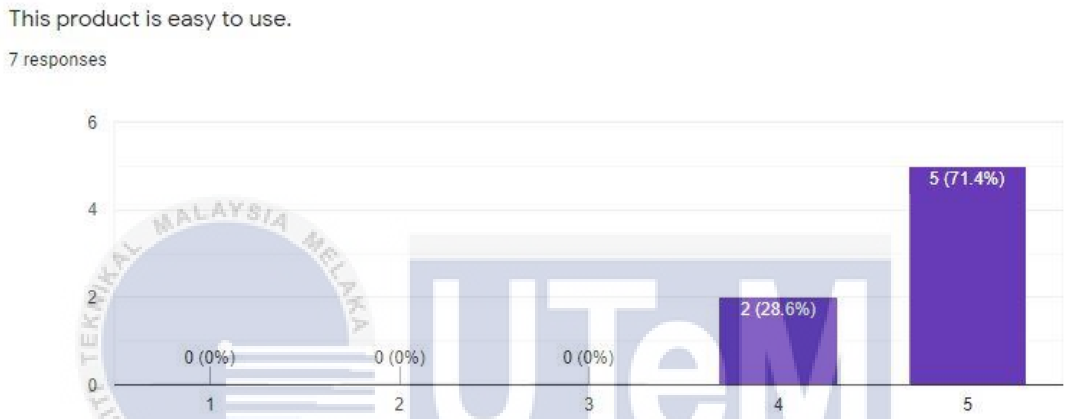

Figure 64: he result from survey form about system functionality

From the result in Figure 65, it shows that the system can work properly without having problem occur that most of the users choose the system can respond consistently all the time.

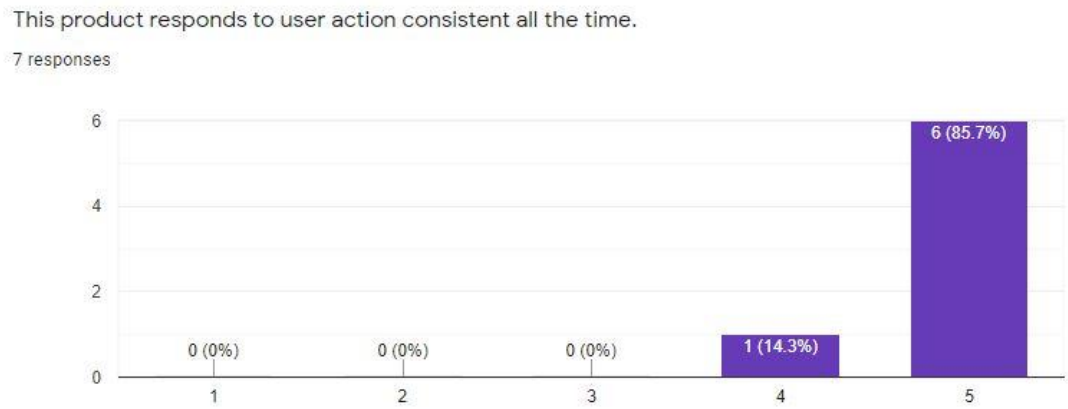

Figure 65: The result from survey form about system action

From the result in Figure 66 below, it shows that this project can help to achieve the users goals which is can be used easily and can reduce their problem in daily life.

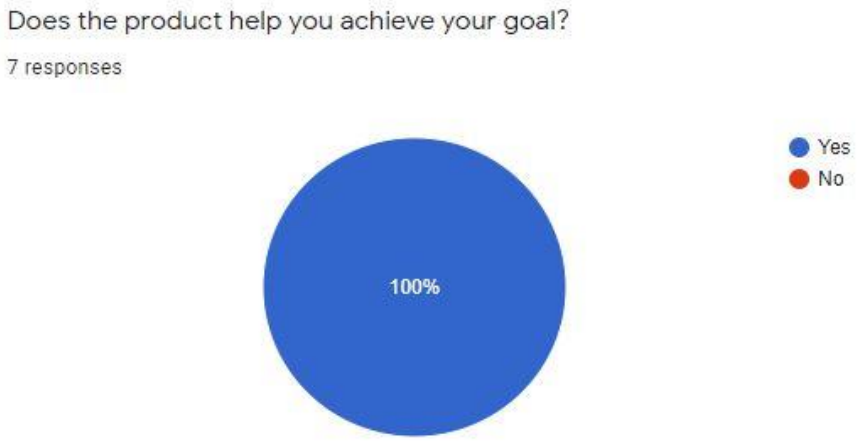

Figure 66: The result from survey form about system goals

6.6 CONCLUSION

In conclusion, the test phase is performed to analyze the Smart Animal Sensor for Vehicle prototype's features, including ESP32-CAM, PIR Sensor, Mobile Application, and others are involved in this project. To make this Smart Animal Sensor be able to use by authorized users, it will execute the functions successfully and effectively. Furthermore, the next chapter will discuss the project participation, limitation, summarization, and future implementation.

CHAPTER 7: CONCLUSION

7.1 INTRODUCTION

This chapter will summarize the conclusion and progress for this project which will describe the overall progress and achievement of the project capacity, weakness, contribution, and future improvement. Furthermore, all the project detail will be made more understandable by describing the project summary. Moreover, this chapter will discuss the future improvement and implementation for the next continuation of this system.

7.2 PROJECT SUMMARIZATION

7.2.1 Project objective

In this section, project goals which were set up during the entire project. The development of the project will be explain is listed below:

I. To design a smart sensor that could alert the users when animals are in the vehicles. In order to develop the Smart Animal Sensor in the Vehicle, research was carried out in the literature review process to obtain information related to the development system. Furthermore, the required hardware and software have been implemented to achieve the goals. The Smart Sensor is composed of ESP32-CAM, PIR sensor, mobile application, and Arduino IDE software.

II. To develop the system that is suitable for all types of vehicles which are the system will be created based on the design of the vehicle engine and the conditions in the car engine that users can easily install the system into their vehicle.

III. To test the system that easier to user understand where the suitable element will be used in this system, such as the mobile application that is more updated and most users are used to using a mobile application.

During the implementation of the project, all the specified goals has reach its objective and work smoothly and effectively which is the most important all the users can understand and used this system easily.

7.2.2 Project strength and weakness

For this project, there is consist of strengths and weaknesses during and after implementation. The first strength of this project is that this Smart Animal Sensor has a low cost of production that is very affordable. The users interested in using it can also afford a low price since the element that in this system is intelligible. Other than that, this system is also user-friendly, which is it the user can understand how to handle this system easily and quickly. Moreover, this system also uses the mobile application, making the user use it easily since most of the users have their smartphone and are familiar with the technology. Besides, the mobile application can also improve the system functions' effectiveness, which the users can easily interact with the interface. Moreover, this system has a notification message which can warn the users to take immediate action.

However, this project also consists of its weakness during the development process of Smart Animal Sensor for Vehicle. The first weakness is this system cannot be tested by using the animals, which is during the testing, the hand movement has been used to test the PIR sensor in order to assume it as the animals. Other than that, the ESP32-CAM can overheat if left for a long time. During the test, it has been stated that the ESP32-CAM will overheat if it is left out for a long time. Due to this, the system cannot be used for a long time. If not, the ESP32-CAM will be broken. Besides, the display of the camera is not clear enough to monitor from the application. The quality of the camera is quite low which some enhancement should be develop on the camera ESP32-CAM.

In conclusion, this Smart Animal Sensor has several advantages and disadvantages for this project which the disadvantages can be overcome through the proper solution and research. At this moment, a better quality of Smart Animal Sensor will be produced in the future.

7.3 PROJECT CONTRIBUTION

This project was developed to increase user safety and also to prevent any damage to the vehicle caused by animals. Other than that, this project is also important to reduce the number of the animal killed by the vehicle. By this project, users can easily alert if there are any animals present in the car vehicle.

Therefore, the users can monitor this project through a mobile application which the application is the main feature that has the monitoring and security function of the Smart Animal Sensor. This application can enhance the user-friendly of the system because it made the project easy to understand and use.

7.4 PROJECT LIMITATION

For project limitation, the constraint of this project includes the relation between the ESP32-CAM and PIR Sensor. When ESP32-CAM captures the image of the animals, the users cannot view back the captured images. It is because the system does not have access to mobile storage. Other than that, the application can be used only for one device, which is when two devices are connected to the system, ESP32-CAM cannot work properly.

Another limitation is it cannot use the animals during testing due to the limitation occur which the hand's movement of humans has used to assume it as the animals. Besides, the camera display is delayed or cannot be used when the power supply system is more than 5V. The testing phase has shown that the system cannot work properly when connected to the power bank or other power supply that is more than 5V, which means this system can only run with a 5V power supply.

7.5 FUTURE WORKS

In the future works, this project will improve its functionality by adding the new implementation and improving the latest output features. The enhancement that can discussed to include:

- The database system can be included in the project which is to make the system become more effective. The database system can help users to improve the security and tighten the application authentication by adding the username and password.

- Other than that, the Smart Animal Sensor can be improved by adding functionality to it. For example, the image can be saved on mobile storage, which is the user can view the captured image on their mobile.

- In future works, the animals can be used for testing in order to get the exact result for the system.

- Lastly, the function can be added is the battery meter in the application, which is the user can view the battery level through the application.

7.6 CONCLUSION

In conclusion, the Smart Animal Sensor for Vehicle project has completed its development which the goals have been running perfectly and smoothly. Furthermore, the Smart Animal Sensor can help many people to overcome their problems in daily life which can enhance their safety while using the vehicle. Besides, this project is suitable for all types of vehicles because it is easy to use and installed. Lastly, the Smart Animal Sensor is very suitable for everyone regardless of age or gender.

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APPENDICES

(SOURCE CODE)

APPENDIX A