

PORTABLE AUTOMATED NUMBER PLATE  
RECOGNITION (ANPR) SYSTEM WITH DATABASE  
LABELLING INTERFACE



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2020



## **UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

### **PORTABLE AUTOMATED NUMBER PLATE RECOGNITION (ANPR) SYSTEM WITH DATABASE LABELLING INTERFACE**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor of Computer Engineering Technology (Computer Systems) with Honours.

اونيورسي تيكنيكل مليسيا ملاك by

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**TAN WAI KEAT**

**B071710637**

**970223-07-5403**

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

TECHNOLOGY

2020

**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA**

Tajuk: **PORTABLE AUTOMATED NUMBER PLATE RECOGNITION (ANPR) SYSTEM WITH DATABASE LABELLING INTERFACE**

Sesi Pengajian: 2020

Saya **TAN WAI KEAT** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **\*\*Sila tandakan (X)**

- SULIT\*** Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.
- TERHAD\*** Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.
- TIDAK TERHAD**

Yang benar,



.....  
**TAN WAI KEAT**  
Alamat Tetap: 1006, Lorong Angsana  
16/2, Taman Angsana 09000 Kulim  
Kedah.

Disahkan oleh penyelia:

.....  
**SHAMSUL FAKHAR BIN ABD GANI**

**SHAMSUL FAKHAR BIN ABD GANI**  
Penyelaras Program BEEC / Pensyarah  
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer  
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik  
Universiti Teknikal Malaysia Melaka

Tarikh: 12/02/2021

\*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

## DECLARATION

I hereby, declared this report entitled PORTABLE AUTOMATED NUMBER PLATE RECOGNITION (ANPR) SYSTEM WITH DATABASE LABELLING INTERFACE is the results of my research except as cited in the references. The thesis has not been accepted for any other degree and is not concurrently submitted in the candidature of any other degree.

Signature:  .....

Author : TAN WAI KEAT

Date: 12/02/2021



اونيورسيتي تيكنيكل مليسيا ملاك  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as partial fulfillment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer Systems) with Honours. The supervisory members are as follow,



**SHAMSUL FAKHAR BIN ABD GANI**

Penyelaras Program BEEC / Pensyarah  
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer  
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik  
Universiti Teknikal Malaysia Melaka

Signature: .....

Supervisor : SHAMSUL FAKHAR BIN ABD GANI

اونيورسيتي تيكنيكل مليسيا ملاك  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Signature: .....

Co-supervisor: NADZRIE BIN MOHAMOOD

**Ts. NADZRIE BIN MOHAMOOD**

Jurutera Pengajar Kanan  
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer  
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik  
Universiti Teknikal Malaysia Melaka

## ABSTRAK

Kebelakangan tahun ini, sistem pengenalpastian nombor plat kereta automatik memainkan peranan penting dalam isu sekuriti. Sistem pengenalpastian nombor plat kereta automatik adalah satu sistem yang boleh mengenalpasti number plat kereta secara automatik daripada imej yang ditangkap dari kamera. Disebabkan kebilangan kereta sekarang meningkat banyak, system pengenalpastian nombor plat kereta automatik disyorkan untuk membanteras jenayah, perlindungan sekuriti, ataupun sistem parking. Namun begitu, harga sistem pengenalpastian nombor plat kereta automatik di pasaran sekarang agak mahal. Bukan begitu sahaja, process pemasangan dan yuran penyelenggaraan juga tidak murah. Oleh itu, project ini bertujuan untuk merangkan satu sistem pengenalpastian nombor plat kereta automatik yang mudah alih dan bajet supaya sistem ini boleh dimiliki oleh orang ramai. Projek ini menggunakan Raspberry Pi 4 Model B untuk menggantikan computer traditional yang mahal dan besar. Compenen penderia pengerakkan diguna untuk mengesan kereta. Camera juga digunakan untuk menangkap gambar kereta apabila kereta dkesan oleh penderia pengerakkan. Selepas itu, imej yang ditangkap itu akan dijalani beberapa imej proses untuk ekstrak nombor plat dari imej yang ditangkap. Selepas nombor plat kereta diekstrak, maklumat-maklumat akan disimpan dalam pangkalan dalam dan boleh rujuk balik menggunakan antara muka “database labelling”.

## ABSTRACT

Over the years, an automated number plate recognition system (ANPR) has played a significant role in security issues that arise globally. An automated number plate recognition (ANPR) system is a system that able to recognition number plates from image capture in a computer. As the number of vehicles on road is getting more nowadays, the ANPR system was introduced to help identify vehicles that may help in criminal deterrent, security problems, or parking systems. With the current market, the price of the ANPR system is overpriced. Moreover, the installation of the current ANPR system is complex. The maintenance fee of the ANPR system is also costly. The purpose of this project is to design a low-cost Portable Automated Number Plate (ANPR) system with database labelling interface. In this project, the Raspberry Pi board is used to replaced conventional large-size personal computers as central processing units in the ANPR system. A motion sensor acts as a vehicle detector. Raspberry Pi NoIR Camera can capture a moving vehicle when the motion sensor detects an object moving at a certain distance. Once the image is captured, number plate extraction, number plate segmentation, and number plate recognition will be done by Raspberry Pi. This paper will study and analyse the functionality and efficiency of the method used in the ANPR system. The extracted plate number will then be saved into the database and displayed in the user-friendly database labelling interface.

## DEDICATION

This thesis is dedicated to my parents and family member who gave me moral support and encouragement during the duration of completing this report. I would also like to dedicate this to my friends and supervisor that always possibly help me when I have trouble with this project.





## ACKNOWLEDGEMENTS

I would like to show my deepest gratitude to all the people who gave me support, guidance, and commitment to my project, especially to my supervisor, Mr. Shamsul Fakhar Bin Abd Gani, and co-supervisor, Mr. Nadzrie Bin Mohamood. I felt grateful I managed to complete my project under the supervision of both of my supervisors as they always share their pearls of wisdom with me. Without their help, I would not be able to complete my project. Besides, those lectures that taught me would not be left out too. I would like to show my appreciation to them as I gained a lot of knowledge from them in university. These knowledge, skills, and tips are very important for me to complete this project. For sure, I would also like to say thank you to my fellow friends in university who always making suggestions and improvements on my project. Their point of view is always useful for my project. Lastly, I can accomplish my project under blessing and support from parents, elders, and friends.

## TABLE OF CONTENTS

	<b>PAGE</b>
<b>DECLARATION</b>	<b>III</b>
<b>APPROVAL</b>	<b>IV</b>
<b>DEDICATION</b>	<b>V</b>
<b>ABSTRACT</b>	<b>VI</b>
<b>ABSTRAK</b>	<b>VII</b>
<b>ACKNOWLEDGEMENTS</b>	<b>VIII</b>
<b>TABLE OF CONTENTS</b>	<b>IX</b>
<b>LIST OF TABLES</b>	<b>XIII</b>
<b>LIST OF FIGURES</b>	<b>XIV</b>
<b>LIST OF APPENDICES</b>	<b>XVIII</b>
<b>LIST OF ABBREVIATIONS</b>	<b>XIX</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 Introduction	1
1.2 Problem statement	2
1.3 Objectives	2
1.4 Project scope	2
<b>CHAPTER 2 LITERATURE REVIEW</b>	<b>4</b>
2.1 Introduction	4
2.2 Literature Review	6

2.2.1	Automatic License Plate Recognition Using Mobile Device	6
2.2.2	Automatic Number Plate Recognition System for Vehicle Identification Using Optical Character Recognition	8
2.2.3	Automatic License Plate Recognition (ALPR) using OpenCV	10
2.2.4	Automatic Car-plate Detection and Recognition System	11
2.2.5	Blob Extraction based Character Segmentation Method for Automatic License Plate Recognition System	12
2.2.6	Automatic Number Plate Recognition	13
2.2.7	Detection and Recognition of Multiple License Plate from Still Images	14
2.2.8	Artificial neural networks based vehicle license plate recognition	15
2.2.9	Malaysian Automatic Number Plate Recognition System using Pearson Correlation	16
2.2.10	Development of portable automatic number plate recognition (ANPR) system on Raspberry Pi	17
2.3	Comparison Between Automated Number Plate Recognition (ANPR) System	19
2.4	Raspberry Pi 4 Model B	27
2.5	Raspberry Pi Camera NoIR Module	28
<b>CHAPTER 3            METHODOLOGY</b>		<b>29</b>
3.1	Introduction	29
3.2	Overview of Project Methodology	29
3.3	Hardware Implementation	31

3.3.1	Raspberry Pi 4 Model B	31
3.3.2	Raspberry Pi Camera NoIR Module	33
3.3.3	HC-SR501 PIR Sensor	34
3.4	Software Implementation	35
3.4.1	OpenCV Libraries	35
3.4.1.1	Colour Conversion	35
3.4.1.2	Bilateral Filter	36
3.4.1.3	Canny Edge Detection	37
3.4.1.4	Contour	37
3.4.1.5	Threshold	38
3.4.1.6	Contour	39
3.4.1.7	Convolutional Neural Network	39
3.4.2	Python Programming Language	40
3.4.3	MySQL	40
3.5	Circuit Diagram	41
3.6	Operational Flow	43
3.7	Preliminary Results	45
<b>CHAPTER 4 RESULT AND DISCUSSION</b>		<b>46</b>
4.1	Introduction	46
4.2	Hardware Implementation	46
4.3	Software Implementation	48
4.3.1	Deep Learning Model	48
4.3.2	Image Acquisition	53

4.3.3	Image Processing of Number Plate Extraction	54
4.3.4	Image Processing of Character Segmentation	60
4.3.5	Optical Character Recognition Using CNN Model	62
4.3.6	Database Labelling Interface	66
4.4	Result Analysis	72
4.4.1	PIR Sensor	72
4.4.2	Number Plate Localisation	75
4.4.3	OCR Accuracy	77
4.4.4	Comparison Between Keras and TensorFlow Lite Model	84
4.5	Discussion	86
4.6	Project Limitation	88
<b>CHAPTER 5</b>	<b>CONCLUSION AND RECOMMENDATION</b>	<b>89</b>
5.1	Introduction	89
5.2	Conclusion	89
5.3	Recommendation	90
5.4	Project Potential	91
<b>REFERENCES</b>		<b>92</b>
<b>APPENDICES</b>		<b>94</b>

## LIST OF TABLES

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
Table 2.3.1	Comparison Between Number Plate Detection/Extraction	19
Table 2.3.2	Comparison Between Number Plate Segmentation	21
Table 2.3.3	Comparison Between Number Plate Recognition	22
Table 2.3.4	Comparison Between Hardware/Software Used	25
Table 4.4.1.1	Percentage of Acquire an Image of Vehicle with Number Plate	72
Table 4.4.3.1	Percentage of Accuracy of OCR for Model A	77
Table 4.4.3.2	Percentage of Accuracy of OCR for Model B	78
Table 4.4.3.3	Percentage of Accuracy of OCR for Model C	79
Table 4.4.3.7	Recognition Error from Model	83

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
Figure 2.2.1.1	Candidates from contours method	6
Figure 2.2.1.2	Candidates of Character Contour Method	7
Figure 2.2.1.3	Kohonen Self-Organizing Maps	7
Figure 2.2.2.1	Colour Searching Method in Number Plate Extraction	8
Figure 2.2.2.2	Row and Columns Segmentation Methods	9
Figure 2.2.3.1	Segmented area in Haar-like features	10
Figure 2.2.3.2	Edge detection in a binary image	11
Figure 2.2.4.1	Number Plate Extraction Using Colour Contrast Method	12
Figure 2.2.5.1	Blob Analysis Extraction	13
Figure 2.2.6.1	Sample of Template	14
Figure 2.2.7.1	Support Vector Machine (SVM) algorithm sample	15
Figure 2.2.8.1	Overview of Artificial neural networks (ANN)	16
Figure 2.2.9.1	Formula of Pearson Correlation and Scatterplots	17
Figure 2.2.10.1	Classification of New Data Point	18
Figure 2.4.1	Raspberry Pi Model	27
Figure 2.5.1	Raspberry Pi Camera NoIR Module	28
Figure 3.2.1	General flow chart of Project Methodology	29
Figure 3.3.1.1	Raspberry Pi 4 Model B	31
Figure 3.3.1.2	Raspberry Pi 4 Model B GPIO pins diagram	32
Figure 3.3.2.1	Raspberry Pi Camera NoIR Module	33

Figure 3.3.3.1	HC-SR501 PIR Sensor Model	34
Figure 3.4.1.1.1	Sample of Image Before and After Grayscale Conversion	36
Figure 3.4.1.2.1	Sample of Image Before and After Bilateral Filter	36
Figure 3.4.1.3.1	Sample of Image Before and After Canny Edge Detection	37
Figure 3.5.1.4.1	Sample of Image Before and After Contour with Cropped Area	38
Figure 3.4.1.5.1	Sample of Image Before and After Thresholding	38
Figure 3.5.1.6.1	Sample of Image Before and After Contour Finding	39
Figure 3.4.1.8	Convolutional Neural Network Architecture	40
Figure 3.6.1	Circuit Diagram of ANPR system	41
Figure 3.6.2	Block diagram of ANPR System	42
Figure 3.7.1	Flowchart of the operation of the ANPR system	43
Figure 4.2.1	Internal View	46
Figure 4.2.2	Front View	47
Figure 4.2.3	Side View	47
Figure 4.3.1.1	Summary of CNN Model	49
Figure 4.3.1.2	Classes in Dataset	49
Figure 4.3.1.3	Samples in Class	50
Figure 4.3.1.4	Summary of Training Process for Model A (6400 samples)	50
Figure 4.3.1.5	Summary of Training Process for Model B (12800 samples)	51
Figure 4.3.1.6	Summary of Training Process for Model C (25600 samples)	51
Figure 4.3.1.7	Accuracy of Valid and Train Datasets for Each Epoch in Model A	51
Figure 4.3.1.8	Accuracy of Valid and Train Datasets for Each Epoch in Model B	51
Figure 4.3.1.9	Accuracy of Valid and Train Datasets for Each Epoch in Model C	51
Figure 4.3.2.1	Message in Terminal During Image Acquisition Process	53



Figure 4.3.2.2	File Directory Where the Image Saved	54
Figure 4.3.3.1	Original Image	55
Figure 4.3.3.2	Grayscale Conversion	55
Figure 4.3.3.3	Bilateral Filter	56
Figure 4.3.3.4	Canny Edge Detection	56
Figure 4.3.3.5	Image with Labelled Number Plate Area	57
Figure 4.3.3.6	Cropped Number Plate Area	57
Figure 4.3.3.7	Sample of Failed Labelled Number Plate Area	58
Figure 4.3.3.8	Sample of Failed Labelled Number Plate Area	59
Figure 4.3.3.9	Sample of Failed Labelled Number Plate Area	59
Figure 4.3.3.10	Sample of Failed Labelled Number Plate Area	60
Figure 4.3.4.1	Character Segmentation Process	61
Figure 4.3.4.2	Sample of Failed Character Segmentation	61
Figure 4.3.5.1	OCR Result from Model A (6400 Samples)	62
Figure 4.3.5.2	OCR Result from Model B (12800 Samples)	62
Figure 4.3.5.3	OCR Result from Model C (25600 Samples)	63
Figure 4.3.5.4	OCR Result of Standard Number Plate Font	64
Figure 4.3.5.5	OCR Result of Special Font I	64
Figure 4.3.5.6	OCR Result of Special Font II	65
Figure 4.3.5.7	OCR Result of Special Font III	65
Figure 4.3.6.1	Login Interface	66
Figure 4.3.6.2	Database Interface	67
Figure 4.3.6.3	View the Entire Data in Database	67
Figure 4.3.6.4	Search Data by Date	68

Figure 4.3.6.5	Search Data by Location	68
Figure 4.3.6.6	Search Data by Number Plate	68
Figure 4.3.6.7	View Image of Data by Entering the ID	69
Figure 4.3.6.8	Export Data in Current Table to CSV	69
Figure 4.3.6.9	Data Inside CSV	70
Figure 4.3.6.10	Database in PhpMyAdmin	71
Figure 4.3.6.11	Structure of Table	71
Figure 4.4.1.2	Sample of Failed Image Captured in Range of 1 Meter with 0 °PIR Sensor Placement	73
Figure 4.4.1.3	Sample of Success Image Captured in Range of 3 Meter with 0 °PIR Sensor Placement	73
Figure 4.4.1.4	Sample of Success Image Captured in Range of 3 Meter with 45 °PIR Sensor Placement	74
Figure 4.4.1.5	Sample of Failed Image Captured in Range of 1 Meter with 0 °PIR Sensor Placement	74
Figure 4.4.2.1	Sample of Constraint 1	75
Figure 4.4.2.2	Sample of Constraint 2	76
Figure 4.4.3.4	Graph Analysis of Percentage of Accuracy of OCR for Model A	80
Figure 4.4.3.5	Graph Analysis of Percentage of Accuracy of OCR for Model B	80
Figure 4.4.3.6	Graph Analysis of Percentage of Accuracy of OCR for Model C	81
Figure 4.4.3.7	Graph Analysis of Percentage of Accuracy of OCR for All Model	81
Figure 4.4.4.1	Runtime of Program by Using Keras Model	84
Figure 4.4.4.2	Runtime of Program by Using TensorFlow Lite Model	85
Figure 4.4.4.2	Comparison Between Keras and Tensorflow Lite Model	85

## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix 1	Gantt Chart of the project	93
Appendix 2	Main Program Code	94
Appendix 3	Coding for Training CNN Model by Using Keras	98
Appendix 4	Coding for Database Login GUI	101
Appendix 4	Coding for Database GUI	105



## LIST OF ABBREVIATIONS

<b>ALPR</b>	Automated License Plate Recognition
<b>ANN</b>	Artificial Neural Network
<b>ANPR</b>	Automated Number Plate Recognition
<b>CCTV</b>	Closed-circuit Television
<b>CNN</b>	Convolutional Neural Network
<b>CPU</b>	Central Processing Unit
<b>CSI</b>	Camera Serial Interface
<b>FGPA</b>	Field-programmable Gate Array
<b>GPIO</b>	General Purpose Input/Output
<b>GPS</b>	Global Positioning System
<b>KNN</b>	K-nearest Neighbour
<b>MLP</b>	Multilayer Perceptron
<b>NoIR</b>	No Infrared
<b>OCR</b>	Optical Character Recognition
<b>OpenCV</b>	Open Source Computer Vision Library
<b>PIR</b>	Passive Infrared
<b>SVM</b>	Support Vector Machine

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Wisconsin (1941) stated that a legally registered vehicle will have a registration plate, also called a license plate or number plate. A registration plate is a plastic plate with a unique ID attached at the front and rear part of a vehicle. This may differ from countries and types of vehicles according to the law set by the countries. According to Boerwald et al. (2005), the unique ID on the registration plate is made up of a combination of alphanumeric and numeric ID which is used as a vehicle identifier. Information such as ownership of the vehicle, type of vehicle, the colour of the vehicle is recorded under the registration plate. In short, the registration plate act as a unique identifying tag of the vehicle which can be traced when needed. Over the years, the registration plate has a significant role in security issues that arise globally. CCTV is installed on the roadside or at the entrances of the location to trace the vehicle. Andrzej Dziech et al. (2013) stated that the problem arises when someone has to review back the CCTV frame to frame to identify certain registration plates. Soon, the registration plate recognition system called Automated Number Plate Recognition (ANPR) was developed to reduce the burden. According to Du et al. (2013), Automated Number Plate Recognition (ANPR) is a system using a computer with a camera that is used to capture the registration plate of the vehicle then being processed to extract the unique ID on the registration plate. Once the information is being extracted successfully, it will be saved in the computer with several pieces of information such as date and time, location, etc. Ozbay & Ercelebi, (2005) stated

that the existing Automated Number Plate Recognition (ANPR) System is facing several issues such as high cost, complex installation, and high maintenance fees. The purpose of my project is to develop a low-cost Automated Number Plate Recognition (ANPR) System with database labelling.

## **1.2 Problem statement**

Automated Number Plate Recognition (ANPR) System is now widely required in various fields such as traffic departments, security companies, parking system, auto-pay system, etc. There are still a lot of fields using a video camera or closed-circuit television (CCTV) to record the incoming vehicles. Manually checking images or videos and matching the license plates with registered vehicles are time-consuming. The existing Automated Number Plate Recognition (ANPR) System is high in cost as it required a high-resolution camera and a good performance computer. Moreover, the installation of an Automated Number Plate Recognition (ANPR) System is complex and maintenance cost is high.

## **1.3 Objectives**

The main objectives of this project are:

1. To develop and study the method used in a Portable Automated Number Plate Recognition (ANPR) System with database labelling interface.
2. To analyse the functionality and reliability of the system in detecting the number plate and recognising characters.

#### 1.4 Project scope

- Use Raspberry Pi 4 Model B as a computer
- Use a camera and sensor to capture the image of a vehicle
- Designed to recognize unique ID on the number plate
- The result will be saved in a database with a database labelling interface
- The database is a local server database
- Exterior design is not covered



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

According to Du et al. (2013), the Portable Automated Number Plate Recognition (ANPR) System is mainly a real-time system used to automatically detect and recognize number plates from the captured image by using image processing techniques. This system is now widely used globally as the number of vehicles increase day by day. According to Peter Joyce (2010), his system was firstly invented by the Police Scientific Development Branch in Britain in 1976. The main purpose of this system during those days was to help in a criminal deterrent. However, nowadays ANPR is widely used for several purposes such as electronic payment systems, smart parking systems, garden-surveillance systems, etc.

A Portable Automated Number Plate Recognition (ANPR) System is mainly divided into five main stages which are image acquisition, number plate detection/extraction, number plate segmentation, number plate recognition, and database labelling. Image acquisition is a procedure to obtain an image with a possible existence of a number plate. Number plate detection/extraction is mainly a stage to detect a number plate region on a captured image. Number plate segmentation is a procedure to segment each character on the number plate into several sub-image. Number plate recognition is a procedure to recognize the character in the sub-images segmented on the previous procedure. Database labelling is a procedure to collect data extracted by the system and label them with little extra information such as date and time and GPS coordinates.