

**UNIVERSITI TEKNOLOGI MARA**

**ESPoll: Advance & Efficient Tolling  
System**

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## **ABSTRACT**

An effective toll system is essential for a country's transportation infrastructure because it provides the funds necessary for constructing and maintaining the highways in general. However, current tolling system mainly in Malaysia have problems such as non-standardize payment system since there are inconsistent of transaction such as used of smart cards, Radio Frequency Identification (RFID) and currently debit card for cashless transactions at toll plazas. The inconsistency can cause traffic congestion at toll plaza itself. Furthermore, the needs of user to utilize external device is problematic since user must purchase and register the payment device. This study presents Automatic License Plate Recognition (ALPR) at toll plaza as solution using ESP32 microcontroller to control tolling system and webcam on computer to capture license plate. The study utilizes Proteus 8 software by constructing the circuitry for Printed Circuit Board (PCB) and simulate the system virtually. Moreover, this study utilizes multiple Integrated Development Environment (IDE) such as PlatformIO for embedded system development and PyCharm for ALPR processing. The input for this system consists of camera to capture license plates and infrared sensor to detect the vehicle. Meanwhile, the output is Liquid Crystal Display (LCD) for information display, servo motor for control barrier, and Neo-pixel LED for lane conditioning. The problems brought on by a lack of standardization can be solved by implementing the proposed system. However, it might be challenging to accurately capture license plates with cameras. Thus, adding QR-code based payment as a backup option in the future greatly improves the system's overall effectiveness..

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Research Background

Road pricing or tolling serves as a pivotal mechanism for financing and maintaining a country's transportation infrastructure, particularly for vital components such as bridges, tunnels, and highways. This system involves the imposition of fees on users, essentially creating a paywall for accessing these essential road facilities. Historically, toll collection relied on traditional cash payments at toll plazas, but this method has weaknesses in general. The need for users to provide exact change for payment and toll operators to manage change for cash transactions for users that overpaid that resulted in delays, especially during peak hours, contributing to traffic congestion.

The traditional cash-based payment systems are inefficient ways to perform payment at toll plaza during and after peak hours. There has been a significant shift towards embracing Electronic Toll Collection (ETC) in the past decade. This technological advancement has revolutionized toll collection, making it more efficient and convenient for most users in general. The transition to a cashless payment system has not only streamlined the toll collection process but has also addressed issues associated with delays at toll plazas. For example, in Malaysia, the introduction of smartcards that can store electronic wallets such as Touch 'N' Go, Toll Network Automatic Payment System (smartTAG) and Radio Frequency Identification (RFID) is not only for the convenience of road users but also for the overall management, maintenance, and improvement of the critical transportation infrastructure that facilitates the movement of people and goods in the country. Automatic License Plate Recognition (ALPR) are now becoming increasingly popular as new types of transactions at toll plazas to significantly reduce traffic delay entering and performing payment transactions.