

WIRELESS POWER USAGE MONITOR BASED ON ANDROID
TECHNOLOGY

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A thesis submitted in partial fulfillment of the requirements for the award of
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Tajuk Projek : WIRELESS POWER USAGE MONITOR BASED ON ANDROID TECHNOLOGY.

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*A universal appreciation to my beloved parents, best friends, and all of those who
have encouraged me throughout the journey of life.*

Warmest thanks to all of you...

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ABSTRAK

Projek tesis ini membentangkan pembangunan aplikasi Android berasaskan dengan pelaksanaan penggunaan web menggunakan MATLAB. Objektif projek ini adalah untuk membuat ia boleh digunakan kepada pekerja TNB untuk meringankan beban mereka dengan hanya menggunakan telefon pintar dengan cara menyimpan alat dalam poket sahaja. Selain itu, projek ini mempunyai potensi kebolehpasaran untuk dikomersilkan untuk kegunaan syarikat-syarikat yang memerlukan permohonan tertentu untuk kegunaan mereka. Secara keseluruhannya, projek ini adalah satu cara yang inovatif dan kreatif dalam menguruskan premis dan memberi pra-ukuran tentang situasi sesebuah tempat. Permohonan ini adalah benar-benar berguna untuk semua lapisan masyarakat. Monitor Penggunaan Kuasa Secara Wayarles Berdasarkan Teknologi Android diwujudkan dan dilaksanakan sebagai kemudahan pengguna menggunakan telefon pintar. Ia adalah salah satu alat yang berkesan yang dibangunkan dengan banyak ciri-ciri pelbagai yang boleh memudahkan kerja keras menjadi kerja mudah. Permohonan itu direka menggunakan Eclipse sebagai platform penting dalam penghasilannya. Eclipse merupakan bahagian penting dalam membuat projek ini berjaya. Fungsi utama permohonan ini adalah keupayaan untuk mengimbas meter elektrik semua premis yang terdapat di Malaysia dan dapat lihat berapa nilai penggunaan dalam kWh atau penggunaan kuasa elektrik yang telah digunakan untuk tempat yang tertentu. Data maklumat yang telah diimbas boleh disimpan ke web server Matlab untuk merekodkan setiap bacaan yang telah dibuat. Rekod data ini boleh terus diproses untuk memaparkan berapa banyak harga dalam (RM) setiap premis yang telah menggunakan elektrik untuk tempoh bulan dalam tahun tersebut.

ABSTRACT

This project thesis presents the development of an Android based application with the implementation of web server using MATLAB. The target of this project is to make it available to the TNB workers to ease their burden by just using a smartphone that they can just carry in their pockets. Moreover, this project has the potential of marketability to be commercialized for the use of companies that requires such an application for their use. In overall, this project is an innovative and creative way in managing peoples premises and give early pre-measurements about a situation. This application is really useful for all walks of life. Wireless Power Usage Monitor Based on Android Technology is created and implemented as a user's work using smartphone. It is one of the effective tool that are developed with lots of various features that can ease hard work to simple work. The application is designed using Eclipse as a medium platform. Eclipse is an important part in making the project successful. The main function of this application is the ability to scan an electric meter of any premises available in Malaysia and in an instance see how much kWh or power usage have been consumed for a specific place. The data of information that being scanned can be stored to the web server of Matlab to record each reading that has been made. The record of these data can be further processed to display how much each premise have been using the electric for the month period in that year.

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LIST OF ABBREVIATIONS

ADT	–	Android Developer Tools
API	–	Application Programming Interface
AVD	–	Android Virtual Device
GUI	–	Graphical User Interface
HTML	–	Hyper-Text Markup Language
IDE	–	Integrated Development Environment
IEEE	–	Institute of Electric & Electronics Engineers
kWh	–	kilowatt per hour
MLL	–	Machine Learning Library
NCSA	–	National Center for Supercomputing Applications
OCR	–	Optical Character Recognition
OpenCV	–	Open Source Computer Vision
OS	–	Operating System
RIM	–	Research In Motion
SDK	–	Software Development Kit
TCP/IP	–	Transmission Control Protocol/Internet Protocol
TNB	–	Tenaga Nasional Berhad
UML	–	Unified Modeling Language
VM	–	Virtual Machine

CHAPTER 1

INTRODUCTION

1.1 Introduction

This final year project will involve the android platform. The main aim here is to develop an application on smartphones using the Eclipse software tool. The hardware to be used is the phones camera and several buttons if needed.

Furthermore, these applications are made for the purpose of reading, scanning, monitoring the 'home meter' electric box which every home owns. When installed on smartphones, people are able to scan the 'meter reading' by using via the phone's camera only. This is the great part that will be perform when everything is successful.

Other platforms involved are sending the scanned readings to the internet via Wifi or Data Plan Usage used by user's phone. The internet is compulsory to send the statistics on everything that the software performs at every house and place that it records value of. The website that receives the readings is made using the MATLAB software platform. MATLAB will be a standalone server to receive the data send by smartphone via the internet.

When object are scanned, the following features can be seen:

- i) Number recognition.
- ii) Address of homes.
- iii) Send to server box option.

1.1.1 Number Recognition

The number that the phone will recognize is the alphanumerical value of numbers of the reading meter. Every home does have the meter reading; there are no homes without an electric meter reading. When the smartphone does the scanning approach, it takes the value of numbers using an image processing process to capture and scan the numbers and to execute further actions.

1.1.2 Address of Homes/Premises

When the reading occurs, it also displays the correct address of the place that it will capture so that the places are correct. If the address is wrong, it will rescan and take the new address again so that it matches with the correct address to be recorded.

1.1.3 Server Record

When the record scans are taken successfully, a pop-up displays to send the scanned values to the MATLAB server via an internet. MATLAB will be the server to take and record the data that are being taken by smartphone. In the MATLAB, it will run further actions of simulation of how much cost had the house has been using and how many kWh powers that the houses consumed.

1.2 Objectives

- To develop new Meter Reading android applications.
- To upgrade the meter scanning method by TNB.
- To execute a computer vision algorithm to decode the character numbers.
- To integrate database and android application correctly.

1.3 Problem Statement

At this time, the Tenaga Nasional Berhad (TNB) will always carry out their duty of visits to every homes, factories and every buildings to get the reading amount of power usage that the premises use in a monthly period basis.

The readings that were carried out will always happen in two tasks that will be carried out every leap month. The first one is by taking the analysis of the average use of 20 – 30 days and they will send it to the premises in a white envelope. This white envelope contains the pre-readings of the power used by every premises in the area. The second reading is the real reading, that the TNB person will conduct by triggering a big device to read the actual meter reading at the premises and print out a clean long shimmering smooth paper and tuck it somewhere at the house or in the mail box of the place.

Here, the problems are the conventional method that they currently use which are using a big bulk size of the device. Moreover, the device are also really expensive to be developed in which it is priced at a range of thousands of ringgit to be produced. And only one sole company that invents the trigger device. Hence, the latter monopolizes the benefit by being the sole corporation to sell the device to the TNB.

In addition, the bulk size as previously stated is not much mobility to be used as the device are really heavy and it cannot be carried or kept in a pocket like other devices should. This project aims to create it so that the device will be smaller and easy to be carried around. Not to forget, that the maintenance cost are also expensive due to the complexity of the device to be checked and troubleshoot if anything wrong happens to the trigger device. But by this project if successful, the maintenance costs much cheaper and more flexible to be maintained since there are lots of companies that can do it.

1.4 Scope Of Project

The Android application software is developed by using a Java Eclipse SDK for all the tools, source code, and documents that need to be created in the application. The server and receiving program is designed using MATLAB with an interactive user interface and the MATLAB .mat file is used as database for the received data. The server program is a program that enables the Android application created to be connected to a server, run related queries and views the outcome. The hardware communication that is used in this project is the TCP/IP protocol using through JAVA socket communication which is interfaced by sending or receiving information via WIFI (internet) or Data Plan [1]. The Android application also integrates optical character recognition (OCR) functionality for number processing systems by utilizing computer vision action which are the parts of image processing and also embedded system applications.

1.4.1 Study & Research

- Find information related to the project will be designed.
- Understand on the project.

1.4.2 Software Design

- Develop the android applications software by using Java Eclipse SDK for the tools, source.
- Involves computer vision (camera), image & signal processing.
- There will also use the MATLAB interface to develop server in receiving the scanned images taken by the camera phone.

1.4.3 Networking

- Connection process as an interface through which processes can send or receive information via Wifi (internet) to the MATLAB server. A wireless connection is made in this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

This chapter contains the literature review on theoretical and practical concepts applied in this project made. It contains the related information gathering of the project in order to complete the whole project. Further theoretical and research on Android applications, Emulators, OpenCV, MATLAB will be seen throughout this chapter.

2.2 Smartphone Era

The next generation of mobile computing will foster the convergence of communication, computing, and consumer electronics, three traditionally distinct industries with quite low interoperability. On the front end, a smart phone is likely to become a universal mobile terminal carrying integrated functionalities augmented by mobility and ubiquitous network access [2].

In 2003, Microsoft Corp. announced Windows Mobile, a new global brand for Microsoft software on mobile devices such as pocket PCs and smartphones. The Windows Mobile brand is aimed at extending the Windows brand to the full range of mobile devices. Microsoft continues to use the terms Pocket PC and Smartphone to describe categories. “Pocket PC software” became “Windows Mobile software for pocket PCs” and “smartphone software” became “Windows Mobile software for smartphones”. The mobile malware evolutions will most likely progress along a similar pattern to those experiences on desktop computer. Symbian OS currently holds the largest portion of the user device market however Android is part away at market share [3].

2.2.1 Android Operating System Designs & Development

Apple, Microsoft, RIM, and Nokia all had their respective ‘smartphone’ platforms well underway by the time Google released the first version of Android back in 2007. In this respect Android was very much an underdog in the developing smartphone space – it had no traction, no brand, and very few hardware partners.

Android operating system (OS) has gone from a virtually unknown open source solution to the current mobile OS market leader among all mobile handsets, with over one-third of the market share, and it’s still climbing rapidly. Android has even started to dominate the tablet OS marketplace [4]. Android is an open source mobile operating system that combines and builds upon parts of many different open source projects. Android is an operating system based on Linux with a Java programming interface.

The first commercial version, Android 1.0, was released in September 2008. Android is under ongoing development by Google and the Open Handset Alliance, and has seen a number of updates to its base operating system since its original release. These updates typically fix bugs and add new features.

Between 2007 and 2008 it was clear that the mobile space was at the cusp of something big. But no one could have imagined that Android would, in the space of several short years, eclipse everybody else in the space, including Apple and the then-dominant Symbian platform. Andy Rubin, along with Rich Miner, Nick Sears, and Chris White, founded Android Inc. in 2003 with the intention of building a class of smarter mobile device which was ‘more aware of its owner’s location and preferences.’

Google unveiled Android on November 5, 2007. It was the first product of the Open Handset Alliance and was the start of Google’s movement towards the mobile sector. The idea behind Android, at least according to Google’s official spiel, was to introduce an open-source solution to a market completely dominated by closed-source systems like iOS, Symbian, and BlackBerry OS. It also gave the search giant another medium for generating advertising revenues.

2.2.2 Android Architecture

The Android OS can be referred to as a software stack of different layers, where each layer is a group of several program components. Together it includes operating system, middleware and important applications.

The following diagram shows the major components of the Android system architecture system overall:

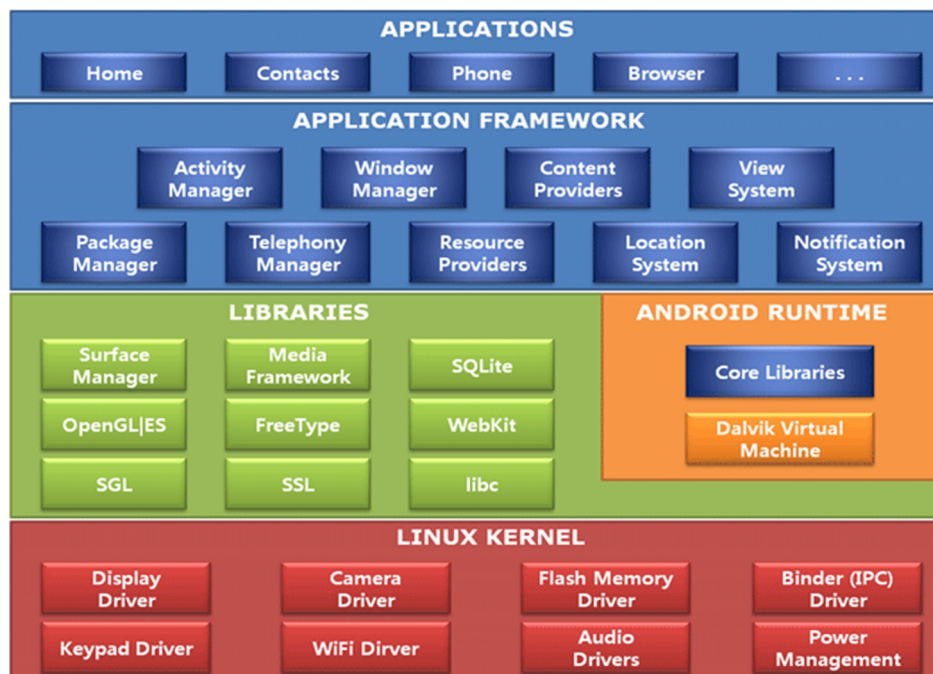


Figure 1: Android System Architecture

Here, all of the explanations of every section are as follows:

- i) **Linux Kernel:** The basic layer is the Linux kernel. The whole Android OS is built on top of the Linux 2.6 Kernel with some further architectural changes made by Google. It is this Linux that interacts with the hardware and contains all the essential hardware drivers. Drivers are programs that control and communicate with the hardware. Android uses the Linux for all its core functionality such as security settings, memory and process management, and also network communications
- ii) **Libraries:** this is the android's native libraries. It is this layer that enables the device to handle different types of data. These libraries are written in c or c++ language and are specific for a particular hardware. Some of the core libraries include SQLite, WebKit, OpenGL, and also Surface Manager.
- iii) **Android Runtime:** Android Runtime consists of Dalvik Virtual machine and Core Java libraries. The Dalvik VM relies on the Linux kernel for underlying functionality such as threading and low-level memory management.
- iv) **Application Framework:** These are the blocks that our application directly interacts with. These programs manage the basic functions of phone like

resource management, voice call management etc. By providing an open development platform, Android offers developers the ability to build extremely rich and innovative applications.

v) Applications: Applications are the top layer in the Android architecture and this is where our applications are going to fit. Several standard applications comes pre-installed with every device are:

- Messages client app
- Phone Dialer
- Web Browser
- Clock Manager
- Settings
- Maps etc.

2.2.3 Android Platform Versions

The Android era has always been updated at every year since it was been released. These new updates came with bug fixes and with newer functionalities. Each update has their own special names to it. Table below shows the overview of various android platform versions till today:

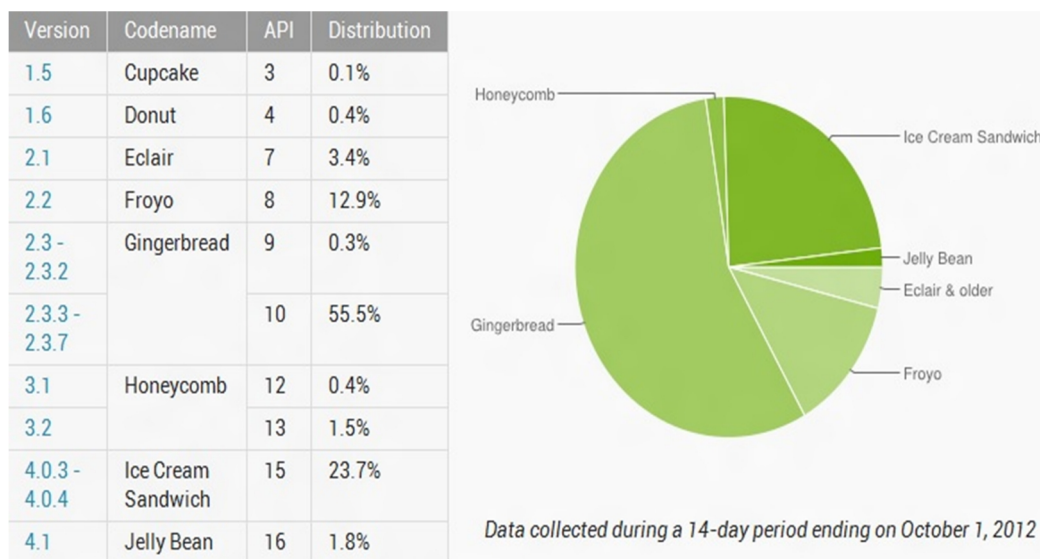


Table 1: Android Versions