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Mobile Balance Charging Using Ml Kit and Number Recognition

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Abstract

The current progress of technology led to use the electronic devices in every part of our daily life. Mobile charging is one of these daily habits that occur every few days. The use of technology helps persons to compromise many problems.

In this paper, an auto charge application is modified as an automatic packing application for the balance through the mobile camera and without writing any numbers or symbols; it provides solutions to some problems for users who suffer from vision problems or some technical difficulties such as mobile keyboard problems. So the facilities of this application are use the mobile camera to take a picture for the secret number (PIN code) that is on the packing card for mobile networks that are available in Iraq (Zain Iraq, Asiacell and Korek), apply preprocessing techniques for image enhancement, extract the features, recognize the numbers and convert them into a digital form; all this steps applied using image processing techniques (Optical Character Recognition (OCR), Machine Learning Kit (ML Kit)), the final step is add some header and trailer symbols to the recognized numbers and then complete the process of charging.

Keywords: ML Kit, Mobile Balance Charging, Number Recognition, OCR

شحن رصيد الموبايل باستخدام (Ml Kit) و تمييز الارقام

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الخلاصة

ان تطور التكنولوجيا السريع في الوقت الحالي ادى الى استخدام الاجهزة الالكترونية في كل تفاصيل حياتنا اليومية. شحن رصيد الموبايل او عملية تعبئة الرصيد هي احد الامور المعتادة والتي نقوم بها كل عدة ايام واستخدام التكنولوجيا ساعد الاشخاص في التغلب على العديد من الصعاب.

في هذه الورقة العلمية سيتم انشاء تطبيق شحن تلقائي يستخدم لتعبئة الرصيد بشكل اوتماتيكي من خلال الكاميرا في جهاز الموبايل بدون كتابة أي ارقام او رموز, هذا التطبيق يوفر حلول لمشاكل يعاني منها بعض الاشخاص الذين لديهم مشاكل بالرؤية او مشاكل تقنية مثل مشاكل كيبورد الموبايل. لذلك يوفر هذا التطبيق تسهيلات من خلال استخدام كاميرا الموبايل لالتقاط صورة للارقام السرية الموجودة في كارت التعبئة لشبكات الموبايل المتوفرة في العراق (زين عراق, اسيا سيل و كورك), يتم تطبيق بعض التقنيات التي تحسن من الصورة الملتقطة, استخلاص الصفات او المميزات للصورة, تمييز الارقام من الصورة و تحويلها الى صيغة رقمية, كل هذه الخطوات تمت باستخدام تقنيات معالجة الصور (تمييز الارقام الضوئية, ادوات تعليم الالة(ML Kit)), بعد الحصول على الرقم السري بصيغة رقمية يتم اضافة رموز خاصة قبل و بعد الرمز السري و بعدها تكتمل عملية شحن الرصيد.

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1. Introduction

The ability to read and write and most function that founded in the human create nature are obsessive to this creature, this ability be a challenge to the world to invent a machine simulate the human behavior in thinking and making decision. However, over the last few decades, the capability of a machine to learning and reading has become a fact in the reality. Recognition function such as (optical characters, car number plants, city guide labels and so on) was in the front of the application list in the pattern recognition and artificial intelligence. Although the machine ability to reading like a human was a challenge, Optical Character Recognition (OCR) one of the applications that improved successfully and there are many commercial systems are existed for applying these applications in different fields of our today live [1].

There are some problems in the recognition of optical characters, the performance of the OCR systems that based on the quality of the written or printed characters that forms the entered file to the system, and the other challenge of most systems and many researchers is the cursive state (the online and the offline cursive writing), and the hand printed characters. In this matter we need pattern recognition and a classification of the entered characters. Today the cost of software of OCR be less than these that need some optical hardware (like optical page reader in order to read typed earning reports at the social security administration) that may be cost many millions dollars, and these software sometimes added on to scanner of desktop and not costly [2].

The mechanism of OCR is by taking the entered text or handwritten text and transferred it into encoded text (digital form). This process is done through document scanning or takes a photo of document and converting them to digitized form that can be processed by the computer in a direct manner (machine translation, text-to-speech and text mining). When the entered text is with fixed font size and style or handwritten style text with clear style, the OCR will be simple, efficient and less cost. It is widely used as a form of information entry from printed paper data records(as passport document ,invoices, bank statements, computerized receipts, business cards, mail ,printouts of static data) or any standard documentation [3].

In this paper we use the OCR systems to capture a photo of the balance number (secret number written on the charging card), recognize the numbers and transfer these numbers to accepted form to charging the mobile with the balance. The mobile networks cards that are used here are: Zain Iraq, Asiacell and Korek.

The paper is ordered as follow, section 2 OCR is introduced and defines the OCR on smart phone& ML Kit, section 3 introduce the related works, the modified application and its implementation steps in section 4, and finally conclusion is presented in section 5.

2. Optical Character Recognition (OCR)

The ability of a machine to simulate the human behavior has been an interested field of researches in the computerized live style, so we tend to do every think in our daily live in a digital manner. Intelligent is required to perform some function similar to the human action (such as number crunching or chess playing), some function such as human vision need most intelligence and powerful computers. Off-line character recognition (or known as Optical Character Recognition OCR) transfers the written characters or images of characters into a digital form (bit pattern), then recognize these bit pattern data. The main benefit of OCR is to process the documents that are written in the past and convert them to a digital and recognized form, while the mistakes of it are: first " Off-line conversion usually requires costly and imperfect pre-processing techniques prior to feature extraction and recognition

stages" and second " The lack of temporal or dynamic information results in lower recognition rates compared to on-line recognition "[4].

OCR steps to recognize an image are: "scanning or capturing", "region segmentation", "preprocessing", features extraction", and "recognition". The first step can be made using mobile camera, this steps explained in the Figure 1

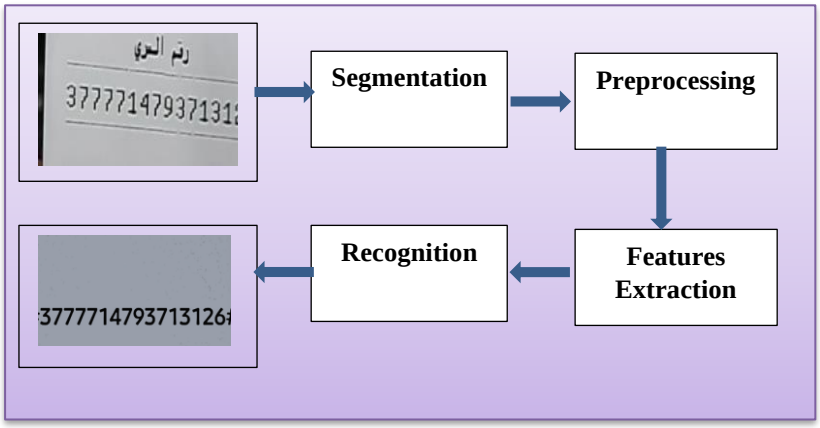

Figure -1 OCR Steps

The "segmentation" step differs the numbers or characters from figures or graphics, in "preprocessing" step apply smoothing (filling and thining techniques) and normalization (slant and rotation of characters), features extraction step will characterize the features (symbols are characterized and unimportant attributes are left out) and the recognition (identifies characters in foreground pixels, called as blobs, and then it finds lines) [5].

2.1 OCR on Smart Phone

Our mobiles became a necessary requirement of our daily live (more important and more useful). Smart phone is an electronic small device that cannot be ignore its facilities in the live. These devices have many features (powerful microprocessors, high resolution cameras, and a variety of embedded sensors), such properties make mobile becoming powerful portable computing platforms, manipulating many programs and work in the real time [6].

Many operating system applications have been developed (Android, iOS, Windows and so on). These applications have the ability to make OCR (optical character recognition) from taken pictures, this benefit can be defined as recognizing the symbols or the characters in the image by performing many steps of processing and preprocessing (such as alignment, lighting, feature extraction, matching and discrimination)[7].

The preprocessing steps are essential to eliminate unwanted details from the image. So that image light should be normalized as well as the image alignment. Some enhancement methods are used to enhance the image quality to obtain a modified image [8] [9].

The used OS is "open source Android operating system" it is from Google and any one can use this code freely and can be modified. Portable devices like "smartphone" or "tablet" can run this code, which is very useful and easy to use [10].

2.2 Machine Learning Kit (ML Kit)

ML Kit is a mobile Software Development Kit (SDK). It was designed to provide the abilities of Google (Google's machine learning expertise) to smart phone and use the libraries with simple knowledge in the field of machine learning. If you a new user or have some outlines or experiences in machine learning, you can deal with the functions and tools in this Kit with no need to have more knowledge or experiences in the neural networks and model optimization [11].

ML Kit APIs works both on the device and on the cloud. The on-device APIs are designed to work fast with no internet connection. On the other hand, cloud-based APIs uses Google Cloud Platform's machine learning technology which gives more accurate results but requires an internet connection. In the table below features of ML Kit that are work on device or cloud as Table 1 explain [12].

Table 1- Features of ML Kit That Are Work on Device or Cloud

Feature	*On Device*	*Cloud*
Text Recognition	✓	✓
Face Detection	✓	
Barcode Scanning	✓	
Image Labeling	✓	✓
Landmark Recognition		✓
Language Detection	✓	
Smart Reply	✓	
Custom Tensorflow Lite Models	✓	

3. Retated Work

OCR systems are available in the commercial markets and most of them can be used by ever one who interesting in this field of research, examples of them are: "ABBYY FineReader", "OmniPage", and" Microsoft Office Document Imaging". Other comparable systems (GOCR [13], OCRAD [14], Tesseract [15] and OCROPUS [16]) these systems are present and offered by opensource communities. A real-time processing and excellent accuracy is provided by "Mobile OCR Engine [17]", this system for mobile phone. More over projects that are presented for marketing or academic purposes tend to use mobile' camera to implement such applications. In [18], the text recognition accuracy adjusted by designing preprocessing suite to adjust the images on the top of "OCR engine" in the natural images. In [19] and [20], the authors use mobile phone with the card reader for business application or for get details for products (such as price and rating).

4. The Modified Application

In this mobile application we take a picture to the packing card using mobile camera, select the interesting region that contain PIN code, this selected image will be an input to the application.

The steps include: convert the hardcopy card into softcopy card (digitize the card), convert the numbers in to a digital form by applying image preprocessing and processing techniques,

after obtain the digital form of the numbers (PIN code) we add some header and trailer to these recognized numbers and then complete the process of charging. These steps instead of typing 16 numbers at least and retype these numbers in case of any error in any number among them, which causes a loss of time and more focus on numbers. Figure 2 show a simplified flowchart to how the packing of balance is doing.

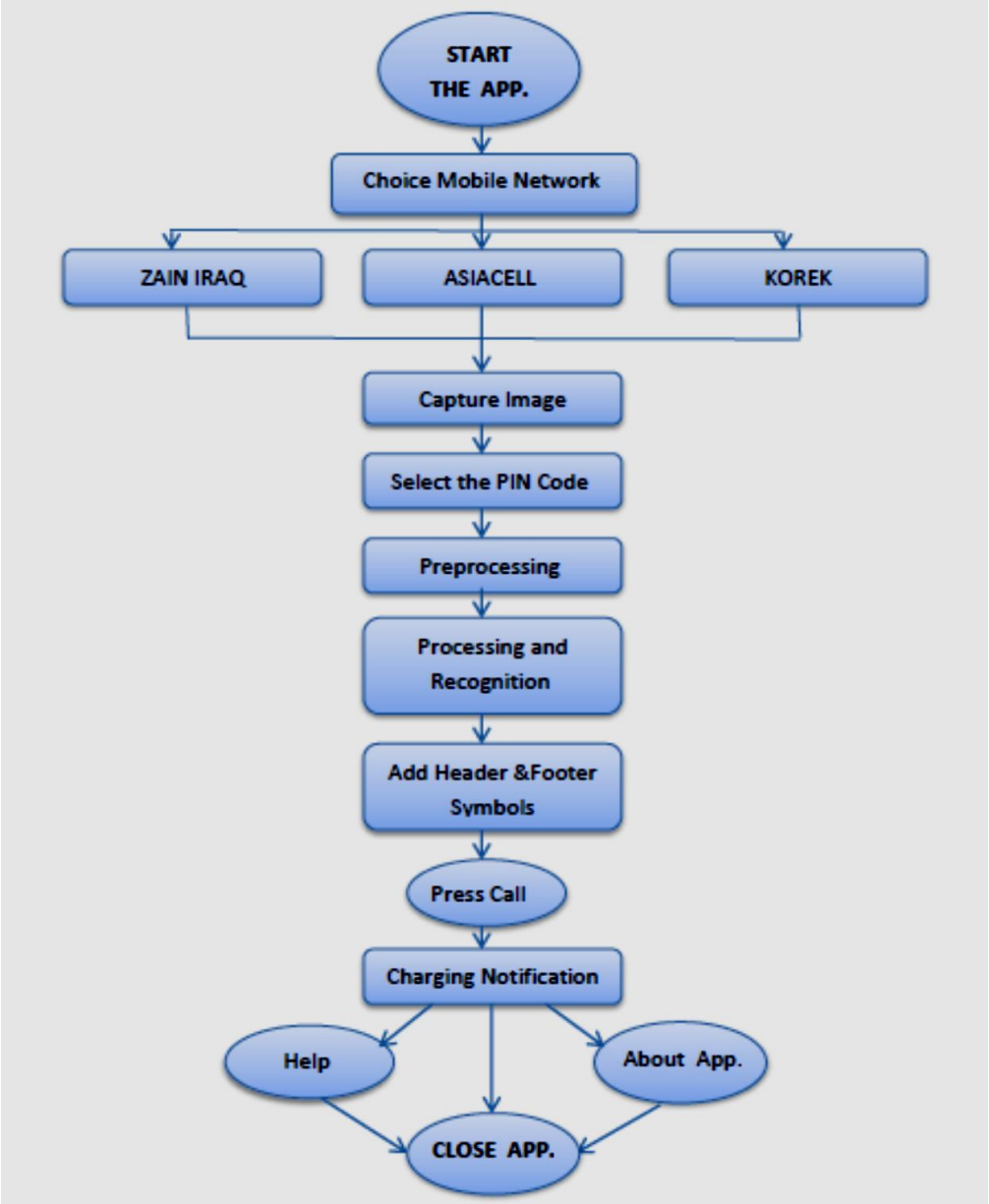

Figure -2 Flowcharts for Packing Process

In preprocessing, processing and recognition we use the (ML Kit's Text Recognition) to implement all above steps. ML Kit's Text Recognition provides both on-device and cloud-based APIs, we choose the on-device APIs. It segments text into blocks, lines, and elements, "Block is a contiguous set of text lines, such as a paragraph or column", "Line is a contiguous set of words on the same vertical axis", "Element is a contiguous set of alphanumeric characters on the same vertical axis", as follow:

"Add Firebase to your app", "include the ML Kit dependency in your app-level", "Specify the ML models", "Get the Image, "Set the Model", Finally, "we can pass our image to the model for Text Recognition", Extract the information, all this step are done with ML Kit's Text Recognition API.

4.1 Steps of Packing Process

Step1: Start the application and select the user's service provider as shown in Figure 3(a).

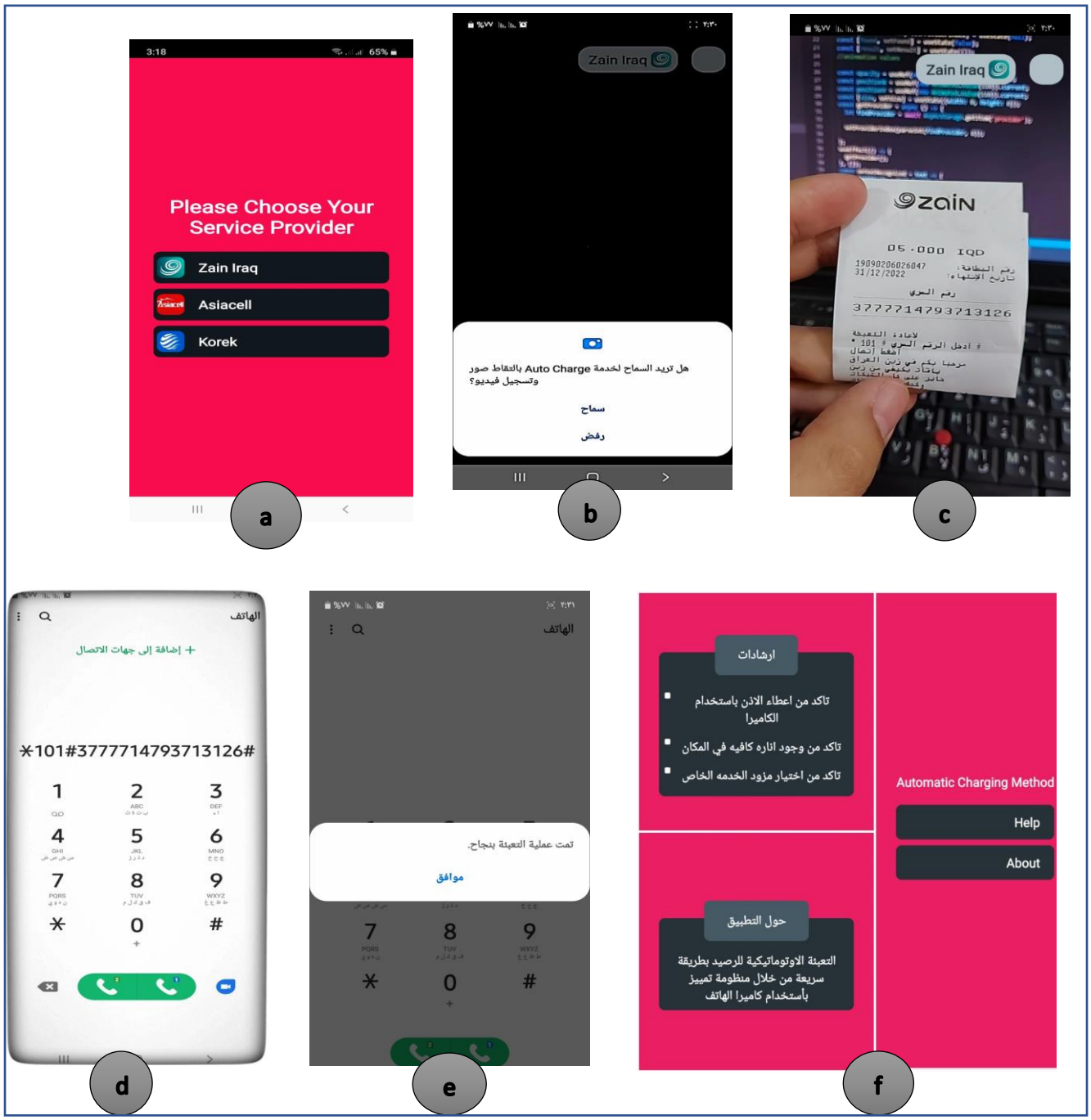

Figure -3 Steps of Packing Process

Step2: Camera activity starts the imaging process, as shown in Figure 3 (b).

Step3: Detect the PIN code on the packing card, as shown in Figure 3 (c).

Step4: Convert the scanned numbers into a digital form and add the appropriate header and trailer, as shown in Figure 3 (d).

Step5: Press the call button to complete the charging, as shown in Figure 3 (e).

Step6: To get more information about the application "About" button is chosen and help found in Help button, as shown in Figure 3 (f).

As shown in the figure above, when the application start we need to choose one the mobile networks that are available in Iraq, the mobile camera is activated to capture a photo for charging card, a secret number written on the card will be recognized and digitized, some symbols need to be added to it and press the call to complete the process.

4.2 Results

As we know that the packing cards all printed in uniform with white background and black numbers, this form make the processing easily with very low error percentage, as we capture image of about 70 packing cards, nearly 05% of them not accepted by the service provider network. As a result the accuracy percentage of this application is 95%.

5. Conclusion

By using the developed mobile application, the task of printing PIN code by mobile keyboard will be completely replaced. The time and the effort are less. Rather than there are users suffer from vision problems in numbers recognition, so such application facilities input numbers into their mobile phones. It can be utilized from anyplace with no establishment issues by using ML Kit software.

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