Mobile App for Image based Bill Data Processing

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ABSTRACT

Bill payment is a part of mobile banking solution provided by banks to its consumers. Traditionally biller data and payment details are entered manually by the consumer on banking application. We have ideated and prototyped a mobile based application for reading bill related details from their image data. Image data is captured using the mobile based application which is cleaned and converted to structured bill data. This structured data which is otherwise entered manually by consumer is automatically extracted and sent to banking systems for bill processing. This opens several new avenues for bill data analytics at financial institutions. We have developed a computer vision based application on a smart phone and evaluated it on real utility bill data.

1. INTRODUCTION

Mobile based transactions have become a way of life and there is an increased demand by consumers for improving their lifestyle using mobile technology. It provides higher accessibility, rapidity and flexibility in financial transactions. Financial institutions are continuously investing in innovative ideas, in mobile technology which can help existing customers to make their day-to-day transactions hassle-free and also attract new customers. Mobile Truncated bill payment is new way of transacting payments of utility bills. Large segment of consumers don't use online mobile banking bill payment method [1] as it takes lot of time to set up new billers, needs lot of text key-in effort to enter all biller and payment details. Entering those significant details in small mobile devices is error prone and may result in typographical error leading to failed transaction or mistaken payments. To address these critical issues and empower customers to pay their hardcopy bill, we developed a computer vision based mobile application which allows consumers to process their hard copy bills simply by capturing a picture of physical bill using their smart phones. Essential transaction related data is captured intelligently and payment process happens seamlessly by communicating with mobile banking applications. Embedded software on the smart phone is used to capture bill image and server side software recognizes payment related details.

The 19th International Conference on Management of Data (COMAD), 19th-21st Dec, 2013 at Ahmedabad, India.

Figure 1 Workflow for utility bill image processing to capture and manage bill data

Relevant bill data recognized from the image is shared with the financial institution for further transaction.

2. PROPOSED SOLUTION

A computer vision based approach for capturing and managing bill data is proposed from utility bills. Similar solutions [2] are in development and are progressively adding features proposed here to achieve complete functionality. Challenges in developing this solution are in handling complex scenarios arising because of dynamic imaging environment. Among them, non-uniform illumination, geometric distortion in the bill image and consistent character recognition of sensitive financial data from images are the foremost challenges. Workflow for the proposed solution and a system design for handling most challenging issues in the solution are discussed.

2.1 Workflow

Proposed solution workflow is depicted in figure 1. In the first phase of the solution, consumers capture digital image of hardcopy bill using their smart phones (*Image Data Capture*). Part of the proposed solution is developed as a mobile application, which assists the user in capturing a useful image by setting required image resolution and other necessary camera parameters. Captured image data undergoes *Data Cleaning* where quality check and enhancement of the captured image data is performed. In the next *Recognition* phase, enhanced image data is first mapped to a bill type and further processed using text recognition technology. Mapping with a bill type helps is extracting bill regions in the image which containing transaction related data. Each extracted region in the bill image is processed using text recognition for conversion of image data to text.

Once the required bill data is intelligently extracted and converted to text format, these details are displayed on mobile device to enable consumer to verify the recognized data and confirm their correctness. If there are any errors noticed in the extracted text, consumer is provided an editable window to correct those details. Once consumer confirms the details,

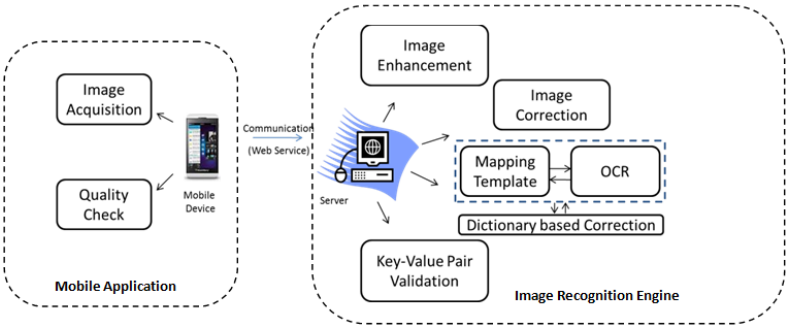

Figure 2 System design for the proposed solution

mobile will transfer these data to the associated backend payment system to trigger the subsequent payment processing.

2.2 Solution Design

Solution design for the proposed system is illustrated in figure 2. Mobile Application (MA) handles capturing an image of the utility bill and transferring it to the Image Recognition Engine (IRE). In this process, MA checks for the quality of bill image. Only images with required definition (well illuminated, no motion blur, in focus) are sent to IRE [3]. Transfer of image and bill type happens as secure HTTP communication between MA and IRE. Before transmission, image data is converted into a byte array and compressed using data compression algorithms. Image is recovered at the server side (IRE). IRE in turn performs image enhancement for handling illumination issues due to shadow and non-uniform illumination. Minor skew arising in the bill image is corrected in the *Image Correction* step. This is followed by mapping of a known bill template on the captured bill image. The fields in the bill which are identified for recognition are sent to an Optical Character Recognition (OCR) system [4]. In order to achieve high recognition accuracies for OCR, the data type of the fields are used. For example, *Amount* field in the utility bill is processed for recognition of only numbers and decimal whereas the *Name* field is processed only for English characters. A domain dictionary is created based on known bill fields and English language dictionary. Recognized fields from the bill image are verified and corrected using domain dictionary. A Key-Value pair validation is performed for recognized fields where Field Type is mapped with Field Value. Result is converted to structured data format (XML) and sent for bill payment.

3. Experiments and Demo

Proposed solution is experimentally validated on real utility bills captured from mobile devices. All the mobile devices are based on Android [5] and have embedded cameras which can capture images at resolutions between 2-8 megapixels.

3.1 Dataset and Results

BSNL bill images containing 117 image files were captured between 2-8 megapixels. Out of 117 images, the mobile application identified 97 to be of good quality for processing bills using IRE. Each bill has 11 unique fields to be extracted and recognized. Recognition accuracy for bill fields from bill images is found to be 91.5 percent.

3.2 Demo

Initial prototype of bill image data processing system on Android platform containing three screens is shown in figure 3. First image in figure 3 (from left-right) shows screen 1 of the MA which is used for capturing image of a bill. Second image illustrates screen 2 which provides an option to the user to accept or reject the image. Screen 3 in the third image shows results of the structured Key-Value pairs returned by IRE.

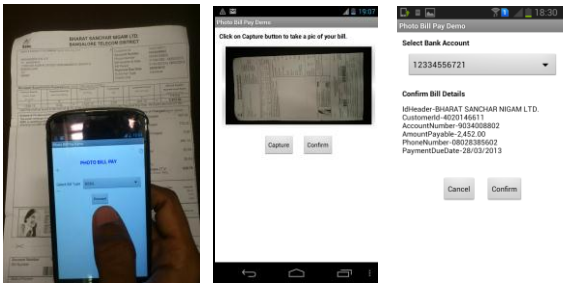

Figure 3 System design for the proposed solution

4. Summary and Conclusion

Proposed system addresses the challenges in processing bill image data captured from mobile devices for financial transactions. Each captured image first undergoes data cleaning, where it is checked for quality and also preprocessed for recognition. A geometrical bill template is mapped to the bill image in order to extract and recognize the necessary bill fields. An android based application is implemented to prototype and validate the system on real bills. Database created from our proposed bill payment solution will enable banks to mine bill related data. This can be used for payment data analysis/prediction, alerts and detecting duplicate payments based on historical data.

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