INTRODUCTION

The wide deployment of wireless networks and mobile technologies and the significant increase in the number of mobile device users have created a very strong demand for emerging mobile commerce applications and services. Barcode-based identification and validation solutions are considered an important part of electronic commerce systems, particularly in electronic supply chain systems. This paper reports a mobile-based 2D barcode validation system as part of mobile commerce systems. This barcode-based validation solution is developed based on the Data Matrix 2D-Barcode standard to support barcode-based validation in mobile commerce systems on mobile devices. The paper demonstrates its application by building a mobile movie ticketing system.
mobile devices to become a point-of-sale device that reads the barcode and facilitates payment transactions. After a payment transaction, 2D barcodes can be used by customers as a receipt or proof of purchase to gain access to the purchased goods and services with their mobile phones. Recently, people have gradually realized the importance of 2D barcodes and their great application value in M-Commerce because of the following (Gao, Prakash, & Jagatesan, 2007):

- 2D barcodes provide a new effective input channel for mobile customers carrying mobile devices with inbuilt cameras.
- 2D barcode is becoming a popular approach to present semantic mobile data with standard formats.
- 2D barcodes support a new interactive and efficient approach between mobile customers and wireless application systems.
- 2D barcode technology can be and is being used in diverse applications in mobile commerce.

Similar to RFID-based technology and solutions, barcode-based identification and validation solutions have been considered an important part of electronic commerce systems, particularly in electronic supply chain systems. However, although there are many benefits of using 2D barcodes, they are not widely utilized in the United States, especially in mobile commerce. This paper reports the research, architecture, design, security, and issues of implementing a 2D barcode validation system to encourage readers to adopt this technology into mobile commerce systems. This barcode-based validation solution is developed based on the Data Matrix 2D-Barcode standard. Furthermore, the paper also demonstrates its application by building a mobile movie ticketing system.

This paper is structured as follows. The next section covers the basics of 2D barcodes and related supporting technologies. Furthermore, it reviews the related work and applications in mobile commerce and presents a 2D barcode based validation system, including the system architecture, functional components, and used technologies as well as its secure 2D barcode-based framework. In addition, it reports its application in a movie ticketing prototype system in mobile commerce. Finally, the conclusion remarks are given in the last section.

UNDERSTANDING 2D BARCODES AND SUPPORTING TECHNOLOGIES

Although there are a number of widely used 2D barcodes today, different barcodes and standards are used in different countries and industry segments. Figure 1 shows the samples of three popular types of 2D barcodes. Quick Response

![2D barcode samples](image-url)