E-commerce development using AngularJS framework and RESTful API

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Abstract. There are many social enterprises that use e-commerce in running their business, Emcekaqu is one of them. It wants to change hygiene and sanitation behaviours by building a non-subsidized latrines. This achieved by selling local products to people in the city. E-commerce becomes a solution to maximize the usability of the web as a media transaction. Frontend systems are built using AngularJS framework and backend systems are built using the RESTful API. System test is done using user acceptance test that has two stages, are alpha testing and beta testing. The testing technique is black box testing. In addition, application responsiveness testing is also done to prove that the web is accessible from multiple platforms. Based on the tests, functional system is running in accordance with business processes.

Keywords: AngularJS, RESTful API, E-commerce, Rapid Application Development

1. Introduction
Emcekaqu is a pre-social enterprise that focus on eradicating open defecation in remote area of Pandeglang, Banten. This business was built by students of the Faculty of Nursing University of Indonesia from a sense of caring for the low level of community sanitation in Cinibung village, Pandeglang. Emcekaqu will build a non-subsidized latrines by selling local products, such as rengginang and some other snacks.

Website is one of the most popular promotion media today. The use of websites can help businesses to reach more customers with unlimited reach of space and time. In starting the business, emcekaqu created a website, namely www.emcekaqu.com as a media campaign to the people in the city. In 2016, emcekaqu.com is built with mobirise. Mobirise is a free app for building a mobile-friendly web without coding experience. However, the web is static, so the business process in selling the product can’t be achieved on this web.

Based on the explanation, emcekaqu website needs to be maximized by build an e-commerce. AngularJS framework has been selected, it’s because AngularJS has the ability to create a Single Page Application (SPA) website.

2. Literature Review
E-commerce is the use of the internet, web, and application to perform business transactions. Formally, the transaction is done digitally between organizations and individuals. E-commerce is divided into six kinds, namely Business-to-Consumer (B2C) E-commerce, Business-to-Business (B2B) e-commerce,
Consumer-to-Consumer (C2C) e-commerce, Social E-commerce, Mobile E-commerce, and Local E-commerce. The project is a B2C e-commerce because of the online transaction is conducted from online businesses (emcekaqu) to the individual consumer [1].

Single Page Application (SPA) is composed of individual component that can be replaced or updated independently, without refreshing whole page so that the entire page does not need to be reloaded on each user action, which saves bandwidth as well as no loading of external files every time when page is loaded, such as images or CSS files, etc. The purpose behind this is to make the subsequent page loads very fast as compared to traditional Request-Response cycle [14].

AngularJS is one of the widely used frameworks for modern single-page web application development which is designed to support dynamic views in the applications [13]. AngularJS is a front-end JavaScript Framework that used to build a Single Page Application uses the Model View Controller (MVC) architecture. The approach used by AngularJS is to extend the functionality of HTML using JavaScript custom attributes tied to the HTML tag. AngularJS ability to expand HTML functionality, enables DOM manipulation becomes easier. It’s done through the client-side and two way data binding, when it’s synchronizing the model and the view. AngularJS using MVC and dependency injection to facilitate the code structure organizing and testing process [2]. AngularJS has several advantages, that are [3]:

- Provides capability to create Single Page Application in a very clean and maintainable way
- Provides data binding capability to HTML. Thus, it gives user a rich and responsive experience
- Code is unit testable
- Uses dependency injection and make use of separation of concerns
- Provides reusable components
- With AngularJS, the developers can achieve more functionality with short code
- Views are pure html pages, and controllers written in JavaScript do the business processing

Web service is software designed to provide communication and interaction of two or more applications with the nature of the program-to-program [4]. Web service can be divided into two types, namely Simple Object Access Protocol (SOAP) and Representational State Transfer (REST). REST is a kind of API that uses the HTTP protocol as data communication lines. REST web using a standard format, such as HTTP, HTML, XML, JSON, URI, and MIME. REST web service architecture came to be known as a RESTful Web Service [5].

My Structured Query Language (MySQL) is a open source Database Management System (DBMS) program. MySQL is a database program that can be accessed over a network, so it can be used for multiple users. Another advantage of MySQL is using a SQL standard. SQL is a Structured Query Language. SQL has been standardized for all DBMS program [6].

Rapid application development (RAD) is an object-oriented approach to systems development that includes a method of development as well as software tools. RAD aim is to shorten the system development cycle. RAD can be adapted in user requirements quickly. Figure 1 represents the stage in the RAD cycles [7].

![Figure 1. Stage in the RAD cycles](image)
- Requirements Planning Phase
  - In the requirements planning phase, users and analysts meet to identify objectives of the application or system and to identify information requirements arising from those objectives.
- RAD Design Workshop
  - The RAD design workshop phase is a design-and-refine phase that can best be characterized as a workshop. During the RAD design workshop, users respond to actual working prototypes and analysts refine designed modules based on user responses.
- Implementation Phase
  - As soon as previous stage is agreed on and the systems are built and refined, the new systems or part of systems are tested and then introduced to the organization.

User Acceptance Test (UAT) is an information system testing that refers to the perspective of the end-user or system owner. UAT focuses on generating systems that can deliver the expected business benefits when operated by the users [8]. UAT is divided into two stages, that are alpha and beta testing. Alpha testing is a repeated test by the developer to ensure that there is no error in the application. Beta testing is performed by end-users by entering real data and observing displayed errors [9].

Black box testing is one type of testing technique that is also called behavioral testing. Black box testing focuses on software functional testing. It’s mean, black box testing allows developers to create some input conditions that will be tested on the program function [10]. Black box testing has four testing design techniques, that are equivalence classes, boundary value analysis, expected result coverage, and intuition & experience. This research uses the expected results coverage design technique, which is a technique that focuses on the expected output results of the various input types entered [11].

3. Result and Analysis
3.1. Requirements Planning Phase

This study aims to generate e-commerce on emcekaqu.com, that can be accessed from various platform, so the process of promotion and ordering products becomes easier.

![The proposed business process](image)

**Figure 2.** The proposed business process

Figure 2 represents the proposed business process. It begins when admin upload a product and customer view and order products from the web. Buyer need to makes a payment at ATM and send the payment confirmation in the web. Admin will update the order status and send receipt number when the order is being delivered. Buyer can track the package from the shipping provider’s web official.

To realize the goal, we need minimum requirements, i.e.

**Programming Language:**
- AngularJS 1.2.16
- Angular-bootstrap 0.12.0
- Bootstrap 3.1.1
- Code Igniter 3.0.3

**Hardware:**
- Minimum processor version: Intel Celeron
- Minimum RAM memory: 1 GB
- Minimum hard disk memory: 10 GB

**Software:**
Based on business process analysis, there are admin, member, and guest as actors. Table 1 shows the activity of each actor.

| Activity                                         | Actor   | Admin                                                                 | Member                                                                 | Guest                                                                 |
|-------------------------------------------------|---------|----------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Update the order status and send it to the buyer's email |         | Update the order status and send it to the buyer's email             | Order the product                                                      | Send message                                                         |
| Product management                               |         | Access the order status and get it via email                         | Access the order status and get it via email                           | Access emcekaqu news                                                 |
| Category management                              |         | Payment confirmation                                                 | Address management                                                     | -                                                                    |
| News management                                  |         | Address management                                                   | -                                                                      | -                                                                    |
| Know the donation progress                       |         | Login to member area and edit profile                               | -                                                                      | -                                                                    |
| Login to admin area and edit profile             |         | -                                                                   | -                                                                      | -                                                                    |

4. RAD Design Workshop

The design and repair process is carried out if there is still a design nonconformity. Outputs from this stage are database design, backend design, frontend design, and interface design.

**Database design.** Figure 3 represents the entity relational diagram of the system. Data in the news management menu is stored in the mck_news table. While other tables are used in the process of e-commerce transactions.

**Backend design.** Backend systems are built from various classes. Figure 4 represents the class diagram of the backend system. The MyModel class is used to authenticate the user. Other classes are connecting to database to display the specific data.

**Frontend design.** Frontend design is represented by Unified Modelling Language (UML). UML used is use case and activity diagram. Figure 5 represents use case diagram of the system. Scenarios of the actors are based on Table 1.
Figure 5. Use Case Diagram

Figure 6. Activity diagram of order management
The activity diagram is representing activity flow in the system, about how the flow is started until ended. The example of activity diagram shows in Figure 6.

**Interface Design.** Figure 7 represents the shopping area design. This page is main page of the purchase process. On product page, user can search product by name or category. Users choose the product by pressing the buy button, then the product will enter into the basket. To add or decrease the number of products, the user can press the plus (+) or minus (−) button. To delete the entire contents of the baskets, user can press the clear button. When finished shopping, user can press the checkout button.

![Figure 7. Shopping area design (product page)](image)

5. **Implementation Phase**  
5.1. **Web Realization**  
Shopping area consists of three different pages, are product page, shopping cart, and checkout page. Figure 8 is the realization of product page in web view and Figure 9 is the realization of product page in mobile view.

![Figure 8. The realization of product page in web view](image)
Figure 9. The realization of product page in mobile view

Figure 10. The realization of shopping cart page

Figure 10 is the realization of the shopping cart page. On this page users can edit the number of products to be purchased. Purchased product data will be stored on the local storage browser so it can be loaded by another page. The checkout page has three sections, i.e. login, shipping form, and bill. Figure 11 is the realization of checkout page.

Figure 11. The realization of checkout page
• Testing
  The author performs a user acceptance test that has two stages, alpha testing and beta testing. The testing technique is black box testing that focuses on application behaviour when receiving input. Table 2 presents the test detail. Alpha and beta testing results earn 100% success percentage. All modules can run according to the functionality.
• In addition, application responsiveness testing is also done to prove that the web is accessible from multiple platforms. It is also important to provide a support system to handle potential issues with products and services that are acquired through the platform [12].

Table 2. Test result

| Test Item             | Test Detail                  |
|-----------------------|------------------------------|
| Authentication Module | Login                        |
|                       | Logout                       |
| User Module           | Edit profile                 |
|                       | Change password              |
|                       | Forgot password              |
|                       | Add user admin               |
|                       | Delete user admin            |
|                       | Add user member (sign up)    |
| Contact module        | Send message                 |
| Product Module        | Read product data            |
|                       | Add product data             |
|                       | Edit product data            |
|                       | Delete product data          |
| Category Module       | Read category data           |
|                       | Add category data            |
|                       | Edit category data           |
|                       | Delete category data         |
| Address Module        | Read address data            |
|                       | Add address data             |
|                       | Edit address data            |
|                       | Delete address data          |
| News Module           | Read news data               |
|                       | Add news data                |
|                       | Edit news data               |
|                       | Delete news data             |
| Order Module          | Put the product into shopping cart |
|                       | Make an order (checkout)     |
|                       | Read order detail            |
|                       | Edit order status            |
| Payment Confirmation Module | Read payment confirmation detail |
Application Responsiveness Testing

Testing is done by using toggle device toolbar feature in Google Chrome. This test is performed to prove that the application is responsive and can be accessed on various platforms. Figure 12 represents the application display when loaded on iPad Pro screen with 1024 x 1366 resolution. Figure 13 represents the application display when loaded on Samsung Galaxy S5 with 360 x 640 resolution.

![App display on iPad Pro screen](image1)

**Figure 12.** App display on iPad Pro screen

![App display on Samsung Galaxy S5 screen](image2)

**Figure 13.** App display on Samsung Galaxy S5 screen
6. Conclusion
Based on the implementation of the research that has been done, can be concluded that this research produces e-commerce on the emcekaqu.com which can be used as media for buying and selling emcekaqu products. The application was developed using AngularJS framework with features: order, payment confirmation, product management, category management, address management, user management, authentication, contact, and news management. Alpha and beta testing results earn 100% success percentage. All modules can run according to the functionality. The results of application responsiveness testing prove that the emcekaqu.com can be accessed from various platforms.

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