Custom Membership Providers

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This article concentrates on implementing forms authentication for an ASP.NET MVC application.

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GitHub Link For the New MVC 3 & Entity Framework Project

Introduction

Authentication is an integral part of every web application. A number of ways exist to provide authentication support to your websites. But, I personally found that

ASP.NET's authentication model is good for this purpose. ASP.NET supports a number of authentication models such as forms, windows, passport, etc. Using one of these methods is surprisingly simple. This article concentrates on implementing forms authentication for an ASP.NET MVC application. The `MembershipProvider` class acts as the basis for this article. So, initially, I will be briefly explaining how to use the built-in membership provider. After that, I will go into details of how to implement a custom membership provider. At the end of this article, I will make sure that you have a fully working application that implements authorization.

> Part 2 of the article can be found here.
> Part 3 of the article (custom role providers) can be found here.

Background - Using the Default MembershipProvider

Using the default membership provider that comes with ASP.NET is simple and straightfoward. To get started with default membership providers, just create an ASP.NET MVC 2 Web Application (or 3, if installed) application. Remember not to choose the ASP.NET MVC 2 Empty Web Application. After this step, you now have an ASP.NET MVC 2 application that has the basic requirements like forms authentication, few views and related controllers. As this article is about membership providers, I am not going to elaborate on the folder structure or about the MVC architecture in general.

The main emphasis lies on the following files - *AccountController.cs* and *web.config*. Following is a section of the *web.config* file that requires our attention. We instruct the ASP.NET server to use forms authentication using the `<authentication />` element. Mode is an attribute that indicates the type and possible values that include forms, windows, passport and none. This article is about forms authentication and so the mode is set to be "forms" and the `<forms />` element indicates the login URL and the timeout. This article concentrates only in the membership part. In future, I am planning to extend this to include roles, profiles, etc. So those parts are not shown in the *web.config* file. Thus, the `<membership />` element indicates that the default membership provider is being used. An important attribute in the `<add />` element is the `connectionStringName` attribute. That points to the database connection string that will hold the membership information. AS this is a default application, I have let it use the default connection string, which is the *aspnetdb.mdf* database. This mdf file will be created the first time you run your sample application.

Hide Copy Code

```
<connectionStrings>
    <add name="ApplicationServices"
         connectionString="data source=.\SQLEXPRESS;Integrated Security=SSPI;
                  AttachDBFilename=|DataDirectory|aspnetdb.mdf;User Instance=true"
         providerName="System.Data.SqlClient" />
</connectionStrings>

<authentication mode="Forms">
  <forms loginUrl="~/Account/LogOn" timeout="2880" />
</authentication>

<membership>
  <providers>
    <clear/>
    <add name="AspNetSqlMembershipProvider"
        type="System.Web.Security.SqlMembershipProvider"
        connectionStringName="ApplicationServices"
```

```
        enablePasswordRetrieval="false"
        enablePasswordReset="true"
        requiresQuestionAndAnswer="false"
        requiresUniqueEmail="false"
        maxInvalidPasswordAttempts="5"
        minRequiredPasswordLength="6"
        minRequiredNonalphanumericCharacters="0"
        passwordAttemptWindow="10"
        applicationName="/" />
  </providers>
</membership>
```

Without further ado, if you run the application, you will be able to see the home page with a link for logging in as shown in the image below. Clicking on it will take you to the login page. A register link is present in the login page, which allows you to register with your choice of a user name and a password. Simple, isn't it? Now if you navigate to the *App_Db* folder, you will be able to notice that the *aspnetdb.mdf* file has been created. As you have used the default membership provider, ASP.NET uses its own table structure with tables like `aspnet_Users`, `aspnet_Membership`, etc., which contains the membership information. Now you have a working version of an MVC web site with authentication. But it does not end there. Let us now see how to implement a custom membership provider instead of using the default membership provider.

Custom Membership Providers

From this point, you will see a lot of code instead of just descriptions. In case you have questions, please do not hesitate to ask them in the comments section below. At the beginning of this article, you have a section that lists the downloads associated with this article. Listed there is a link to download the entire project that implements a custom membership provider. I will use that as a reference, so that it is easier for you to follow.

The first step in implementing a custom membership provider is to create a class that extends the `MembershipProvider` class. This class has a long set of methods. At this point, the emphasis is on 3 methods and 2 properties - one to validate a user, one to find a user by username and one to register a new user and the properties to return the minimum password length and whether duplicate email is allowed. To get started, create a new ASP.NET MVC 2 project (not an empty project) and name it `CustomMembershipProvider`. Then in your *Models* folder, create a class called `CustomMembershipProvider`. This class will be extending the `abstract MembershipProvider` class. Given below is the `CustomMembershipProvider` provider class, with only the 3 methods we require being listed. `MembershipProvider` is included in the `System.Web.Security` and so you may have to add a reference to that namespace.

Hint: To add all the methods to be implemented, place your cursor at the beginning (or end) of the word `MembershipProvider`, press Ctrl + . and then choose `Implement abstract` class '`MembershipProvider`'.

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```
public class CustomMembershipProvider : MembershipProvider
{
    public override MembershipUser CreateUser(string username,
       string password, string email, string passwordQuestion,
       string passwordAnswer, bool isApproved,
       object providerUserKey, out MembershipCreateStatus status)
    {
```

```
        throw new NotImplementedException();
    }

    public override MembershipUser GetUser(string username, bool userIsOnline)
    {
        throw new NotImplementedException();
    }

    public override bool ValidateUser(string username, string password)
    {
        throw new NotImplementedException();
    }

    public override int MinRequiredPasswordLength
    {
        get { throw new NotImplementedException(); }
    }

    public override bool RequiresUniqueEmail
    {
        get { throw new NotImplementedException(); }
    }
}
```

Let us get to the implementation part later. Now open the *web.config* file and change the value in the `connectionString` attribute under the `<add />` element within the `<connectionStrings />` element to point to your database. Then leave the `<authentication />` element as is and replace the default `<membership />` element with the ones given below. The following *web.config* assumes that you have named the project as `CustomMembershipProvider` and added the *CustomMembershipProvider.cs* file to the *Models* folder.

Points of Interest

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```
<connectionStrings>
    <add name="ApplicationServices"
      connectionString="Server=your_server;Database=your_db;
                        Uid=your_user_name;Pwd=your_password;"
      providerName="System.Data.SqlClient" />
</connectionStrings>

<authentication mode="Forms">
  <forms loginUrl="~/Account/LogOn" timeout="2880" />
</authentication>

<membership defaultProvider="CustomMembershipProvider">
  <providers>
```

```
    <clear/>
    <add name="CustomMembershipProvider"
        type="CustomMembership.Models.CustomMembershipProvider"
        connectionStringName="AppDb"
        enablePasswordRetrieval="false"
        enablePasswordReset="true"
        requiresQuestionAndAnswer="false"
        requiresUniqueEmail="false"
        maxInvalidPasswordAttempts="5"
        minRequiredPasswordLength="6"
        minRequiredNonalphanumericCharacters="0"
        passwordAttemptWindow="10"
        applicationName="/" />
  </providers>
```

If you notice, you will be able to see a few differences. One, in the element we need to have a "`defaultProvider`" attribute to specify that this is the default provider and not `MembershipProvider`. Then, in the element, the `type` attribute is the fully qualified name of the class we created (in the "*Models*" folder"). The next step is to create a table that will hold your users. Given below is the `create` script that you could run to create the table in your database.

Hide Copy Code

```
CREATE TABLE [dbo].[Users](
    [UserID] [int] IDENTITY(1,1) NOT NULL,
    [UserName] [varchar](50) NOT NULL,
    [Password] [varchar](50) NOT NULL,
    [UserEmailAddress] [varchar](50) NOT NULL,
 CONSTRAINT [PK_Users] PRIMARY KEY CLUSTERED
(
    [UserID] ASC
)WITH (PAD_INDEX  = OFF, STATISTICS_NORECOMPUTE  = OFF,
    IGNORE_DUP_KEY = OFF, ALLOW_ROW_LOCKS  = ON, ALLOW_PAGE_LOCKS  = ON) ON [PRIMARY]
) ON [PRIMARY]
```

Now, we need to create a class that will represent this table for us to operate on. The code listing below represents that class. I guess the code is self-explanatory. But, still, some details won't hurt. The `Table` attribute indicates that this class represents a table with the name "`Users`". Every column in the table above is present in the class and is decorated with the `Column` attribute. `UserID`, if you notice in the table definition has been set to auto increment. This has been specified using `IsDbGenerated` for the `UserID` column.

Hide Copy Code

```
[Table(Name="Users")]
public class UserObj
{
    [Column(IsPrimaryKey=true, IsDbGenerated = true, AutoSync=AutoSync.OnInsert)]
    public int UserID { get; set; }
    [Column] public string UserName { get; set; }
    [Column] public string Password { get; set; }
    [Column] public string UserEmailAddress { get; set; }
```

```
}
```

Managing Creation/Validation of Users

The next step would be to create a user repository that would do the actual creation/validation of users. This class is listed below. The `CustomMembershipProvider` uses this repository to validate (`GetUserObjByUsername`) and create users(`RegisterUser`).

Hide Shrink Copy Code

```
public class User
{
    private Table<UserObj> usersTable;
    private DataContext context;

    public User()
    {
        string connectionString =
          ConfigurationManager.ConnectionStrings["AppDb"].ConnectionString;
        context = new DataContext(connectionString);
        usersTable = context.GetTable<UserObj>();
    }

    public UserObj GetUserObjByUserName(string userName, string passWord)
    {
        UserObj user = usersTable.SingleOrDefault(
          u => u.UserName == userName && u.Password == passWord);
        return user;
    }

    public UserObj GetUserObjByUserName(string userName)
    {
        UserObj user = usersTable.SingleOrDefault(u => u.UserName == userName);
        return user;
    }

    public IEnumerable<UserObj> GetAllUsers()
    {
        return usersTable.AsEnumerable();
    }

    public int RegisterUser(UserObj userObj)
    {
        UserObj user = new UserObj();
        user.UserName = userObj.UserName;
        user.Password = userObj.Password;
        user.UserEmailAddress = userObj.UserEmailAddress;
```

```
        usersTable.InsertOnSubmit(user);
        context.SubmitChanges();

        return user.UserID;
    }
}
```

Now that we have the repository that does the actual work, let's get back to the `CustomMembershipProvider` class. An important point to note is that, the class that uses this `CustomMembershipProvider` is already available for you in the *Models* folder - *AccountModels.cs* file. If you notice that file, you will be able to find these lines:

Hide Copy Code

```
public class AccountMembershipService : IMembershipService
{
    private readonly MembershipProvider _provider;

    -- cut for brevity --
}
```

If you could recollect, in the *web.config* we have already defined the `CustomMembershipProvider` to be the `defaultProvider`. So the linkage between the `AccountMembershipService` and `CustomMembershipProvider` has already been set. So once you complete the required methods in the `CustomMembershipProvider` class, you will be all set to go! Now, given below is a version of `CustomMembershipProvider` class that has the methods left unimplemented before implemented.

Hide Shrink ▲ Copy Code

```
public class CustomMembershipProvider : MembershipProvider
{
    public override MembershipUser CreateUser(string username, string password,
           string email, string passwordQuestion, string passwordAnswer,
           bool isApproved, object providerUserKey, out MembershipCreateStatus status)
    {
        ValidatePasswordEventArgs args =
           new ValidatePasswordEventArgs(username, password, true);
        OnValidatingPassword(args);

        if (args.Cancel)
        {
            status = MembershipCreateStatus.InvalidPassword;
            return null;
        }

        if (RequiresUniqueEmail && GetUserNameByEmail(email) != string.Empty)
        {
            status = MembershipCreateStatus.DuplicateEmail;
            return null;
```

```
        }

        MembershipUser user = GetUser(username, true);

        if (user == null)
        {
            UserObj userObj = new UserObj();
            userObj.UserName = username;
            userObj.Password = GetMD5Hash(password);
            userObj.UserEmailAddress = email;

            User userRep = new User();
            userRep.RegisterUser(userObj);

            status = MembershipCreateStatus.Success;

            return GetUser(username, true);
        }
        else
        {
            status = MembershipCreateStatus.DuplicateUserName;
        }

        return null;
    }
    public override MembershipUser GetUser(string username, bool userIsOnline)
    {
        User userRep = new User();
        UserObj user = userRep.GetAllUsers().SingleOrDefault
                (u => u.UserName == username);
        if (user != null)
        {
            MembershipUser memUser = new MembershipUser("CustomMembershipProvider",
                                        username, user.UserID, user.UserEmailAddress,
                                        string.Empty, string.Empty,
                                        true, false, DateTime.MinValue,
                                        DateTime.MinValue,
                                        DateTime.MinValue,
                                        DateTime.Now, DateTime.Now);
            return memUser;
        }
        return null;
    }

    public override bool ValidateUser(string username, string password)
    {
        string sha1Pswd = GetMD5Hash(password);
        User user = new User();
        UserObj userObj = user.GetUserObjByUserName(username, sha1Pswd);
```

```
        if (userObj != null)
            return true;
        return false;
    }

    public override int MinRequiredPasswordLength
    {
        get { return 6; }
    }

    public override bool RequiresUniqueEmail
    {
        // In a real application, you will essentially have to return true
        // and implement the GetUserNameByEmail method to identify duplicates
        get { return false; }
    }

    public static string GetMD5Hash(string value)
    {
        MD5 md5Hasher = MD5.Create();
        byte[] data = md5Hasher.ComputeHash(Encoding.Default.GetBytes(value));
        StringBuilder sBuilder = new StringBuilder();
        for (int i = 0; i < data.Length; i++)
        {
            sBuilder.Append(data[i].ToString("x2"));
        }
        return sBuilder.ToString();
    }
}
```

If you notice, at the minimum we just require 3 methods and 2 properties to be implemented - `ValidateUser`, `CreateUser`, `GetUser` and the properties `MinRequiredPasswordLength`, `RequiresUniqueEmail`. `GetMD5Hash` is the method that is used to calculate the MD5 hash of the password entered by the user. MD5 is NOT a safe algorithm and so I recommend you to use another hashing (/ encryption) algorithm to save passwords. Never, never ever store passwords as clear text! Also, you will be able to notice that we are using the user repository created in the previous steps.

Final Steps

Now that we have come this far, first navigate to the register link, register and then go back to the login screen and login. If you are successfully able to login, you have completed 75% of what you intended! But, if you notice, you will be able to visit every page in the "Views" section regardless of whether you were authenticated or not. Don't worry, authentication is working. But you need to add another attribute that stops this behavior. Let's do this in 2 steps. Before that, log out from the application. Firstly, open the *HomeController.cs* file in the *Controllers* folder and add the code below:

Hide Copy Code

```
public ActionResult Protected()
```

```
{
    return View();
}
```

Now right-click inside the `Protected` method and choose "Add View...". This will add a View called *Protected.aspx* in the *Views/Home* folder. Add the following to this file:

Hide Copy Code

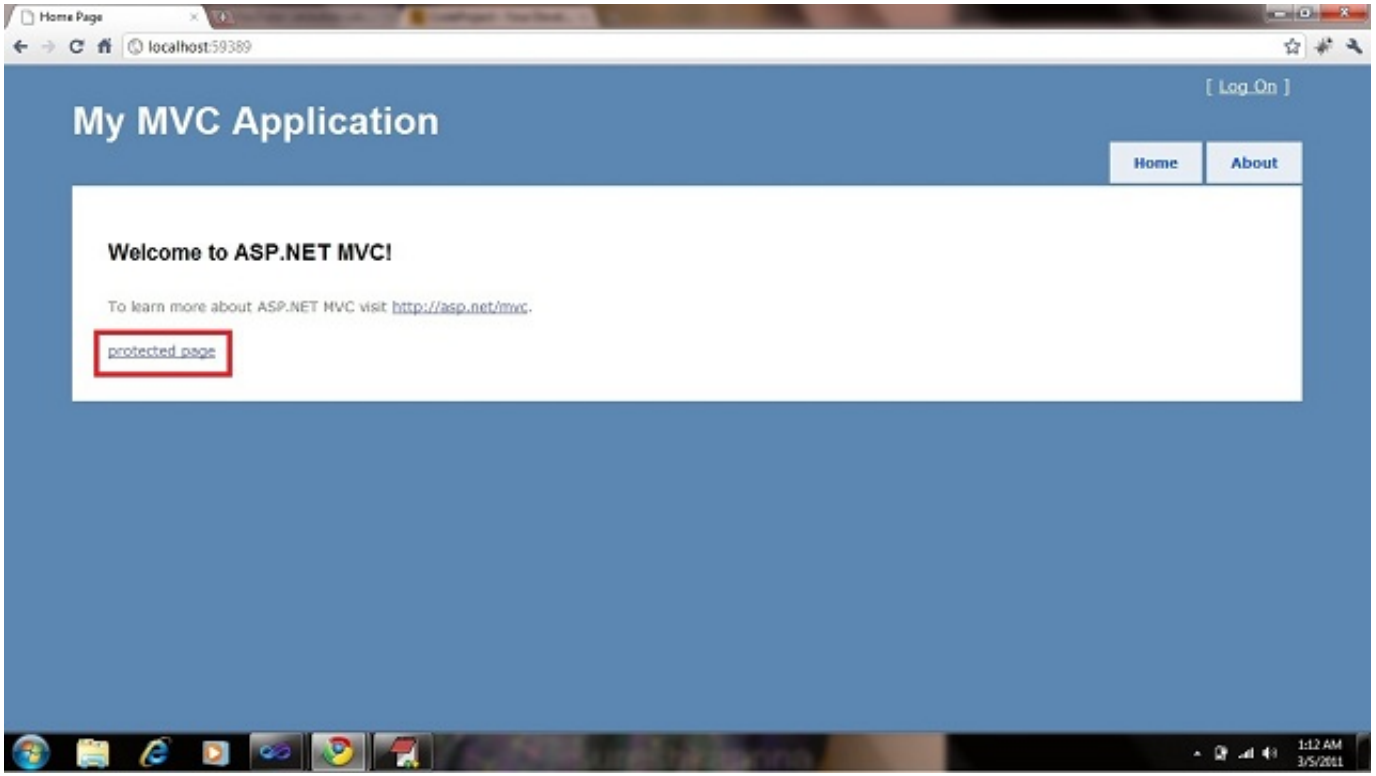
```
<%@ Page Title="" Language="C#"
  MasterPageFile="~/Views/Shared/Site.Master"
  Inherits="System.Web.Mvc.ViewPage<dynamic>" %>

<asp:Content ID="Content1"
        ContentPlaceHolderID="TitleContent" runat="server">
    Protected
</asp:Content>

<asp:Content ID="Content2"
  ContentPlaceHolderID="MainContent" runat="server">

    <h2>Protected</h2>

    This is a protected page!

</asp:Content>
```

Then in the *Home.aspx* page in the *Views/Home* folder, add the following:

Hide Copy Code

```
<%= Html.ActionLink("protected page","Protected") %>
```

Build the application and run it. Go the home page and you should be able to see the protected page link. If you click on it, you will be able to see the page even when you are not authenticated! So here is the key to really protect this page. Use the `Authorize` attribute to "actually" use the feature that we built.

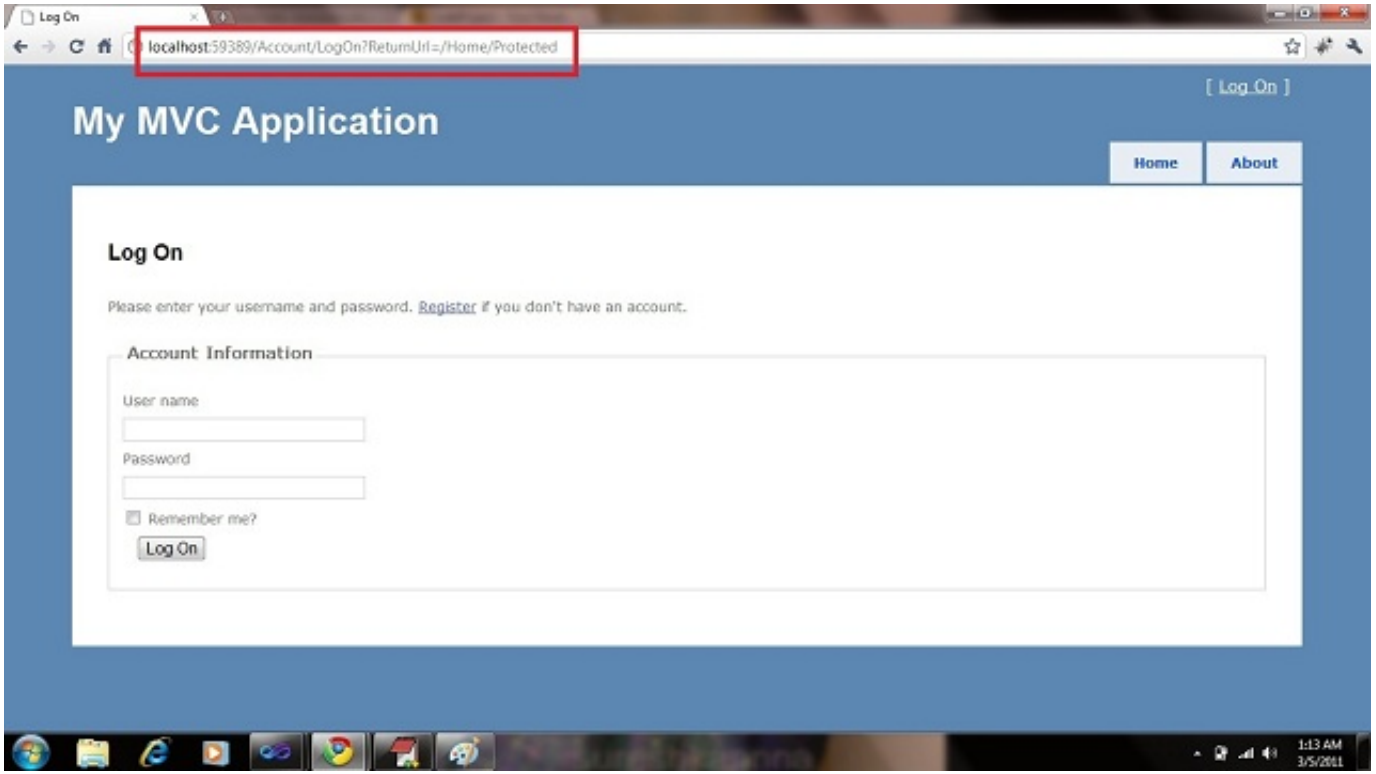


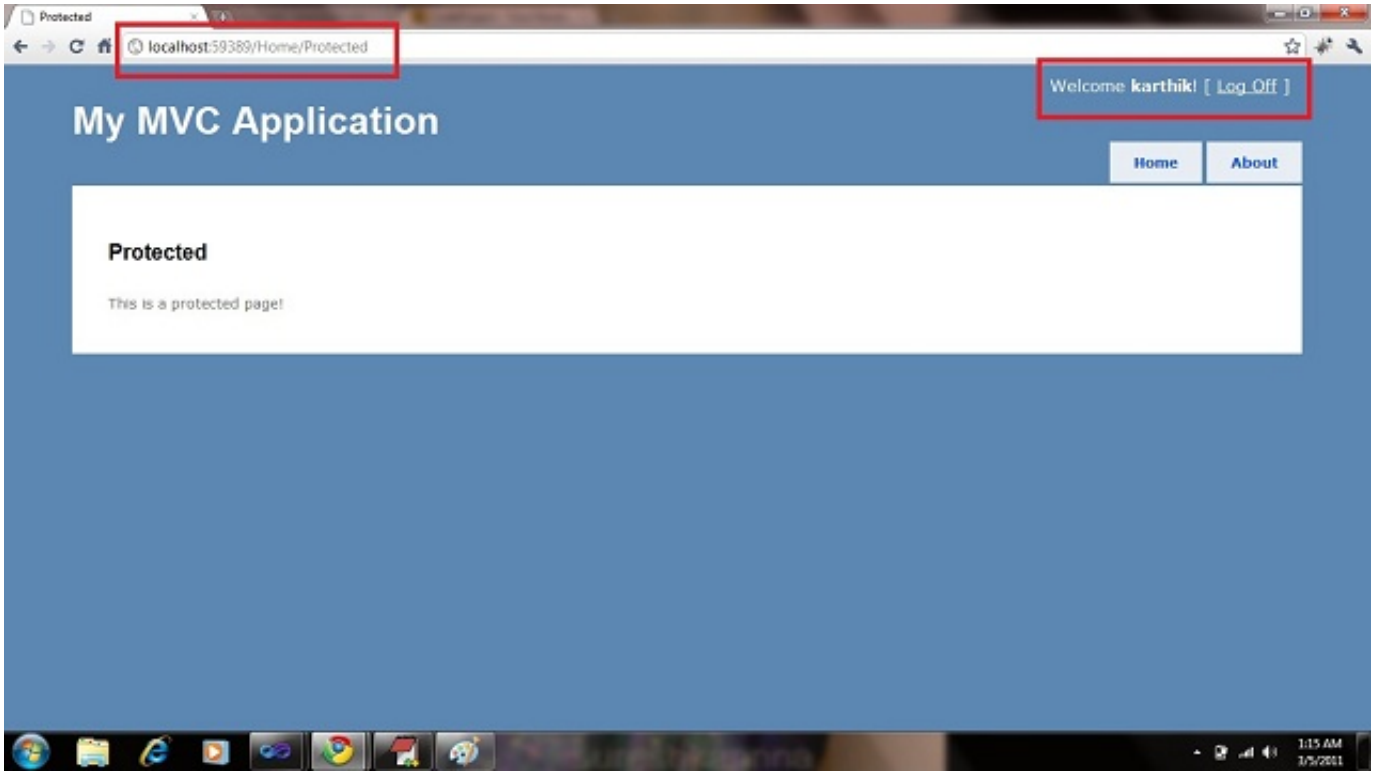
Given below is the updated code:

Hide Copy Code

```
[Authorize]
public ActionResult Protected()
{
    return View();
}
```

Now, build the application. If you try to refresh your page, you will be taken to the login page. If you notice the URL, you will see a query parameter called `returnUrl` that is set to */Home/Protected*. So when you login, you will be redirected to the protected page. This is the point at which you have really implemented (and used) custom authentication!


Log On
localhost:59389/Account/LogOn?ReturnUrl=/Home/Protected
[Log On]
My MVC Application
Home
About
Log On
Please enter your username and password. Register if you don't have an account.
Account Information
User name
Password
Remember me?
Log On
1:13 AM
3/5/2011



Quick Guide to Entity Framework (Code First) Based Implementation

If you notice, in the discussion/comments section, there were always questions about implementing the project using MVC 3 and Entity Framework (code first). So, I thought that it would be definitely helpful for a lot of people if I update the article with a MVC 3/EF implementation. The same table definition given earlier in the article can still be used for this project. Just in case, I have also added a `Setup.sql` file, that contains the script to be ran for creating the table. The downloads section now has a new addition - Custom-Membership-Providers-Using_Entity-Framework.zip that just does what a lot of people want!

A few words, about this new addition...

This project consists of the `User` class that represents a user in the system. This is the plain old c# object that would represent a row in the `Users` table.

Hide Copy Code

```
public class User
{
    public int UserID { get; set; }
    public string UserName { get; set; }
    public string Password { get; set; }
    public string UserEmailAddress { get; set; }
```

```
}
```

Now, lets add the data context that will manage the entries in the table. It's given below:

Hide Copy Code

```
public class UsersContext : DbContext
{
    public DbSet<user> Users { get; set; }

    // Helper methods. User can also directly access "Users" property
    public void AddUser(User user)
    {
        Users.Add(user);
        SaveChanges();
    }

    public User GetUser(string userName)
    {
        var user = Users.SingleOrDefault(u => u.UserName == userName);
        return user;
    }

    public User GetUser(string userName, string password)
    {
        var user = Users.SingleOrDefault(u => u.UserName == userName && u.Password == password);
        return user;
    }
}
```

All data contexts using the entity framework has to inherit from the `DbContext` class. Every table is exposed using a `DbSet` property. In this case, the `Users` table. I have also added a few helper methods in order to add a new user and get a user. Now, the custom membership provider can utilize this data context to manipulate the `Users` table, as shown below:

Hide Copy Code

```
public override bool ValidateUser(string username, string password)
{
    var md5Hash = GetMd5Hash(password);

    using (var usersContext = new UsersContext())
    {
    var requiredUser = usersContext.GetUser(username, md5Hash);
    return requiredUser != null;
    }
}
```

Note that in line 5, an instance of `UsersContext` is created to verify if the username and password entered is valid. A catch with entity framework is that, whenever the

application starts, it attempts to create the database again. In order to stop entity framework from doing this, the following has to be done in the `Application_Start` method in `Global.asax.cs`. Note line 8 in the snippet below, `Database.SetInitializer` generic method (with type parameter `UsersContext`) is called by passing in a `NULL`. This stops the database from being initialized/dropped every time.

Hide Copy Code

```
protected void Application_Start()
{
    AreaRegistration.RegisterAllAreas();

    RegisterGlobalFilters(GlobalFilters.Filters);
    RegisterRoutes(RouteTable.Routes);

    Database.SetInitializer<UsersContext>(null);
}
```

I have also modified the layout page to provide a link to the protected page. Without logging in, the user will be unable to view this page as it is protected by using the `Authorize` attribute. Just download the project and start exploring! Hope this little update proves helpful! Thanks!

Please feel free to let me know your comments in the "Comments and Discussions" section below.

History

Version 2 of the article released - this adds a new download of the same project using mvc 3 and entity framework and the corresponding discussion

Version 1 of the article published

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