Making a Basic Platformer

Introduction

This tutorial will go over some basic mechanics that you can use to make a platformer in Visual Basic. This is not the only, or necessarily the best way to implement mechanics for a 2D platformer. Making subtle changes to the code can have large effects on the mechanics for the game. While you go through this tutorial, I will make some suggestions at various points for mechanics that you can experiment with by modifying the code. Interesting or unique mechanics can make a game much more fun.

In order to successfully complete this tutorial, I would recommend that you are familiar with the following topics:

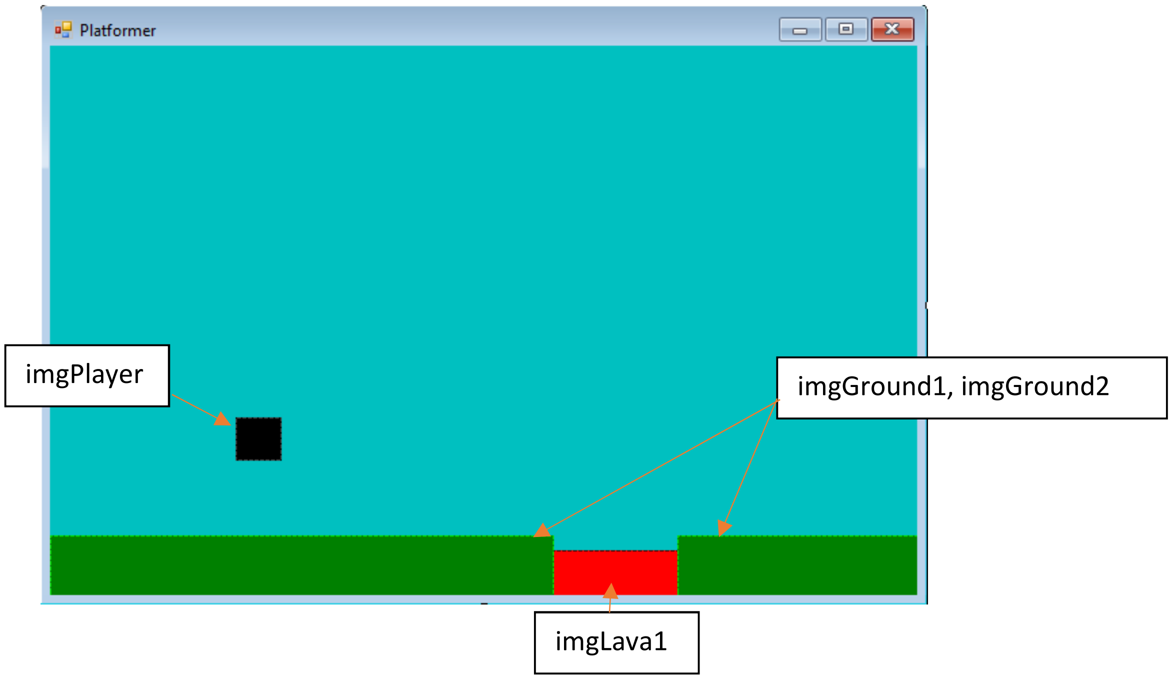
- Loops
- Timers
- Moving **PictureBoxes** with both the **Location** property (using **Points**), and the **Top** and **Left** properties (includes an understanding the coordinate system of a **Form**)
- Key Events: **KeyUp** and **KeyDown** specifically
- Lists

Part 1 – Setup Our Basic Form

Create a new project. Change the **Name** property of your **Form** to `frmPlatformer` and set its **BackColor** property to Blue. Add four **PictureBoxes** and give them the following names and properties:

Name: `imgPlayer` **BackColor**: `Black`	**Name**: `imgLava1` **BackColor**: `Red`
Name: `imgGround1` **BackColor**: `Green`	**Name**: `imgGround2` **BackColor**: `Green`

Once you have made them, lay them out on the **Form** so they look similar to this:



Part 2 - Gravity

The first thing we are going to add to our program is gravity. We will use a **Timer** that will attempt to pull our player down at all times, except when we are jumping.

Add a **Timer** to your **Form** and change its **Name** property to `tmrGravity`. Change the following properties to the specified values:

Enabled: True	**Interval:** 25

This **Timer** will act much like gravity here on earth does, and will attempt pull our player down when they are not jumping.

We will make an **Integer** variable called `intVSpeed` to store how fast we want our player to fall (and jump later on). Assign it a value of 5 in the **Form Load** event.

```
Public Class frmPlatformer
    Dim intVSpeed As Integer
    Private Sub frmPlatformer_Load(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles MyBase.Load
        intVSpeed = 5
    End Sub
End Class
```

*You should experiment with values of the **Interval** properties of your gravity **Timer** (`tmrGravity`), and the size of your gravity variable (`intVSpeed`) until you are satisfied with how it works.*

We are going to add the following line of code to the **Tick** event of **tmrGravity** so that each time the **Tick** event code runs, our player moves downwards:

```
        imgPlayer.Top += intVSpeed
```

Run your program. Notice that the player falls off the bottom of the screen.

Part 3 – The Ground

In order to keep our player from falling off the bottom of the screen, we will need to add some collision detection. We want to detect when `imgPlayer` collides with any of the **PictureBoxes** we are using for the ground (and any platforms that we add later on).

Each time `tmrGravity` ticks, we will need to see if `imgPlayer` collides with the ground, or any other obstacle as a result of falling. Eventually we will check to see if we fall into lava as well.

In order to save time repeating similar code over and over, we are going to store our **PictureBoxes** in Lists. This will save us coding by allowing us to use loops to do all of our collision checks.

Use the following code to declare a **List** called `platforms`, another **List** called `lava` and a **Boolean** variable called `bolOnGround` in the same place you declared `intVSpeed` (at the top of your program):

```
Dim platforms As New List(Of PictureBox)
Dim lavas As New List(Of PictureBox)
Dim bolOnGround As Boolean
```

As we add more platforms or lava, we will add them to our lists in the same way.

We now need to add the **PictureBoxes** we created to these lists. Add this code to your **FormLoad** event:

```
platforms.Add(imgGround1)
platforms.Add(imgGround2)
lavas.Add(imgLava1)
```

Now that we have our platforms stored in **Lists**, we can use a **For…Each** loop to see if `imgPlayer` will land on any of them in our gravity **Timer**. Add the following code to the `tmrGravity` tick event:

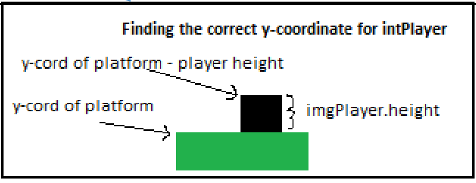
Moves `imgPlayer` down

This will loop through our **List** of platforms. We can use the variable `platform` to reference each one.

Determines if `imgPlayer` is intersecting (overlapping) with a platform.

```
imgPlayer.Top += intVSpeed
For Each platform In platforms
        If platform.Bounds.IntersectsWith(imgPlayer.Bounds) Then
                imgPlayer.Top = platform.Top - imgPlayer.Height
        End If
Next
```

If `imgPlayer` is intersecting/overlapping with the `platform`, we want to change its *y-coordinate (Top)* of its **Location** property to be just above it, **not** overlapping it. *Recall that y-coordinates INCREASE as you go down!*


Finding the correct y-coordinate for intPlayer
y-cord of platform - player height
y-cord of platform
imgPlayer.height

Important Information: The **Bounds** property of a **PictureBox** is stored as type **Rectangle**. This is like a variable (that is called a **Class**) that stores 4 pieces of information. The *(x, y)* coordinate of the upper left corner of a rectangle, its *width* and *height.* This **Rectangle** class has some useful built-in functions for us to use.

The function `IntersectsWith` will allow us to determine whether two **Rectangles** are intersecting/overlapping. It takes the format: `rectangle1.IntersectsWith(rectangle2)` and gives us a **True** if they intersect or a **False** otherwise.

Run your program.

You may notice an occasional flicker of your `imgPlayer`. This will get worse as we add more **Timers** to our program. The reason for this flicker is that we are first moving `imgPlayer`, then looking for an overlap, and then moving `imgPlayer` again right above our platform if there is an overlap detected. This causes us to draw our player in places we don't want it to be and then re-drawing it again in the correct place. We can fix unnecessary drawing by changing our gravity **Timer** to the code below.

```
bolOnGround = False
For Each platform In platforms
        If New Rectangle(imgPlayer.Location.X, imgPlayer.Location.Y + intVSpeed, imgPlayer.Width,
imgPlayer.Height).IntersectsWith(platform.Bounds) Then

                imgPlayer.Top = platform.Top - imgPlayer.Height
                bolOnGround = True

        End If
Next
If Not bolOnGround Then
        imgPlayer.Top += intVSpeed
End If
```

We are on the ground.

The big change here is we are going to create a *virtual* **Rectangle** where we plan on moving `imgPlayer` to. This allows us to check for a collision with this virtual **Rectangle** BEFORE we actually move `imgPlayer`. This saves our program from drawing it overlapping with our platform for an instant before re-drawing it just above the platform.

We will only move **imgPlayer** down if we know it will not collide with any platforms.

Part 4 – Jumping

We are now ready allow our player to jump. Add a **Timer** to your **Form** and set the following properties:

Name: `tmrJump`	**Enabled:** `False`	**Interval:** `20`

This **Timer** will subtract our vertical speed (`intVSpeed`) from the y coordinate of `imgPlayer` for a set certain number of ticks.

Create an **Integer** variable called `intJumpCounter` at the top of your program. We will use this variable to keep track (count) of our how many times `tmrJump` has ticked, which will allow us to control how high `imgPlayer` can jump.

```
Dim intJumpCounter As Integer
```

When `tmrJump` ticks we will increase `intJumpCounter` so that we know how many times we have moved `imgPlayer` up. The larger this number, the higher our jump will be.

Add the following code to `tmrJump`.

```
intJumpCounter += 1
If intJumpCounter >= 15 Then
       tmrJump.Enabled = False
       tmrGravity.Enabled = True
Else
       imgPlayer.Top -= intVSpeed
End If
```

Once **intJumpCounter** reaches 15, we turn off this timer and re-enable gravity. Otherwise we move **intPlayer** up. You can experiment with different values to determine the maximum height of your jump.

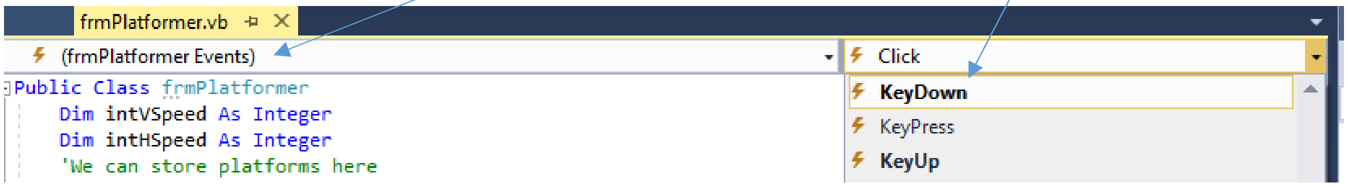
You can make this a **variable** so that your maximum jump height can change while during your game.

Run your program. Notice nothing happens! Why??

Part 4.1 – Keyboard Events

In order to make our player jump, we need to detect a keyboard event so we can turn on our jump **Timer**. We are going to listen for the up arrow. You can make jump any key you wish.

In the **Code Editor** window, select **frmPlatformerEvents** and then select the **KeyDown** event.



```
Public Class frmPlatformer
    Dim intVSpeed As Integer
    Dim intHSpeed As Integer
    'We can store platforms here
```

Add the following code to the **KeyDown** event and *run your program*.

```
If e.KeyCode = Keys.Up Then
       tmrGravity.Enabled = False
       tmrJump.Enabled = True
       intJumpCounter = 0
End If
```

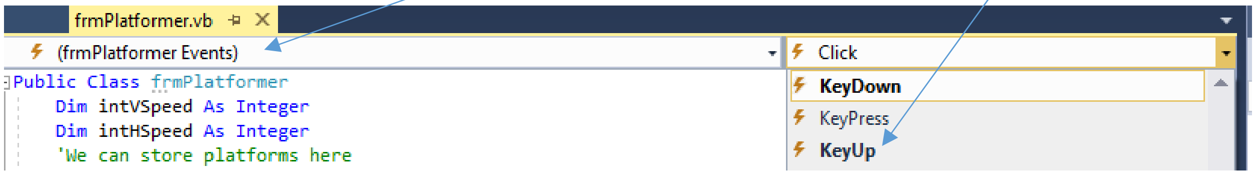
We can hold down the jump key (up arrow) which keeps resetting `intJumpCounter` causing us to keep jumping. We don't want to enable our jump and reset our counter unless we are on the ground.

We can fix this by using our `onGround` **Boolean**. We only start a jump when it is **True,** and then set it to **False** when we start jumping. Put the code in the **KeyDown** event that we used to stop the gravity **Timer**, start the jump **Timer** and reset our jump counter into an **If** statement as shown here.

```
If e.KeyCode = Keys.Up Then
  If onGround Then
       onGround = False
       tmrGravity.Enabled = False
       tmrJump.Enabled = True
       intJumpCounter = 0
   End If
End If
```

You also may have noticed that the jump height is always the same. If we want to stop our jump early by releasing the jump button, we can do that with a **KeyUp** event.

In the Code Editor window select `frmPlatformer` **Events** and then select the **KeyUp** event.



```
Public Class frmPlatformer
    Dim intVSpeed As Integer
    Dim intHSpeed As Integer
    'We can store platforms here
```

In the **KeyUp** event, disable `tmrJump`, and enable `tmrGravity` as shown here.

```
If e.KeyCode = Keys.Up Then
       tmrGravity.Enabled = True
       tmrJump.Enabled = False
End If
```

Run your program to test it.

Part 5 – Moving Left and Right

Let's make `imgPlayer` move left and right with the arrow keys. To make it smooth, we are going to put our movement code into timers, and turn them on and off using **KeyDown** and **KeyUp** events.

Add a two **Timer** controls to your **Form** and set their properties as follows:

Name: `tmrLeft`	**Enabled:** `False`	**Interval:** `25`
Name: `tmrRight`	**Enabled:** `False`	**Interval:** `25`

Add an **Integer** variable to the top of your program called `intHSpeed`. We will use this variable to change the horizontal position of `imgPlayer`.

```
Dim intHSpeed As Integer
```

In the **Form_Load** event, set the value of `intHSpeed` to 3. You can experiment with the value of `intHSpeed` and the **Interval** property of your **Timers** to change the speed and smoothness of your movement.

Add the following code to the specified **Timers** so that when activated, `imgPlayer` will move.

```
tmrRight:   imgPlayer.Left += intHSpeed
```

This will **increase** the distance of `imgPlayer` from the left side of the game **Form**, thus moving it to the right.

Note: `imgPlayer.Right` *is read only, so we must use* `imgPlayer.Left` *for movement.*

```
tmrLeft:    imgPlayer.Left -= intHSpeed
```

This will **decrease** the distance of `imgPlayer` from the left side of the game **Form**, thus moving it to the left.

We now need to add to our **KeyUp** and **KeyDown** events so that we can enable `tmrLeft` and `tmrRight` when the appropriate arrow key is pressed, and disable them when that key is released.

KeyDown:

```
If e.KeyCode = Keys.Up Then
        If bolOnGround Then
                bolOnGround = False
                tmrGravity.Enabled = False
                tmrJump.Enabled = True
                intJumpCounter = 0
        End If
ElseIf e.KeyCode = Keys.Right Then
        tmrRight.Enabled = True
ElseIf e.KeyCode = Keys.Left Then
        tmrLeft.Enabled = True
End If
```

KeyUp:

```
If e.KeyCode = Keys.Up Then
        tmrJump.Enabled = False
        tmrGravity.Enabled = True
ElseIf e.KeyCode = Keys.Right Then
        tmrRight.Enabled = False
ElseIf e.KeyCode = Keys.Left Then
        tmrLeft.Enabled = False
End If
```

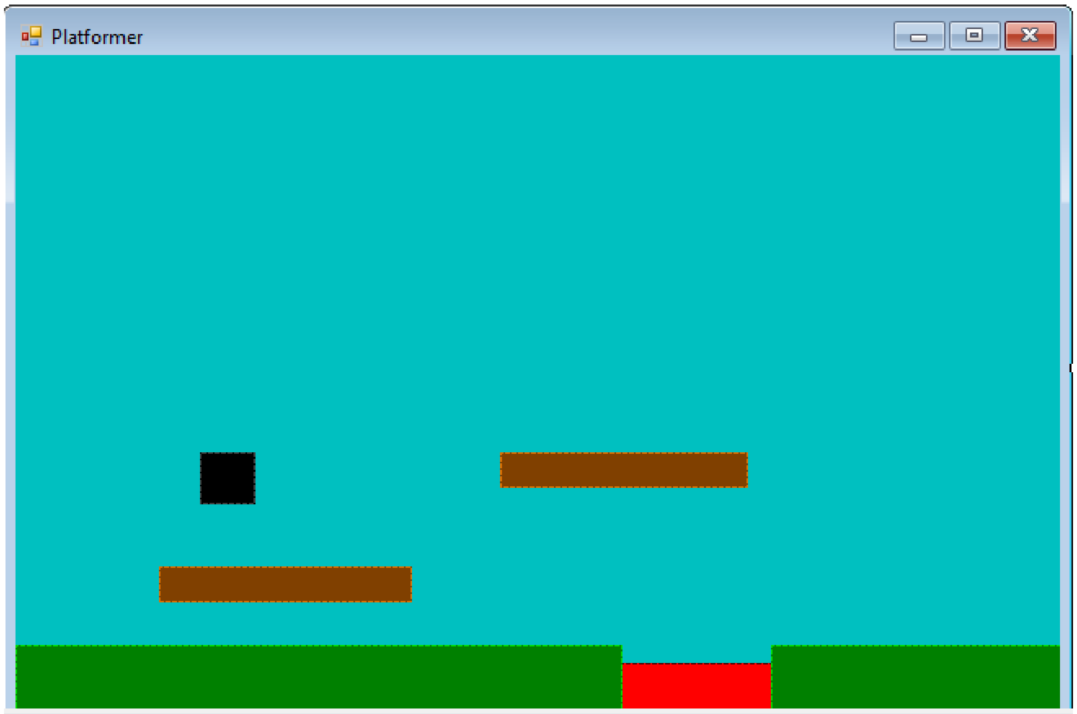
Run your program.

Part 6 – Adding Platforms

We are going to add two **PictureBoxes** to our **Form** and give them the following properties:

Name: `imgPlatform1` **BackColor**: `Brown`	**Name**: `imgPlatform2` **BackColor**: `Brown`

Lay them out so they look like this, and then run your program:



Notice that player falls right through them. All we have to do is add them to our **List** `platforms` and `tmrGravity` will automatically check for collisions with them as well. Ahh, the beauty of loops.

In our **Form_Load** event, we will also need to add these two **PictureBoxes** to our **List** using the following lines of code:

```
platforms.Add(imgPlatform1)
platforms.Add(imgPlatform2)
```

Run your program.

Our player moves around pretty well at this point, and the jumping and gravity work. You may have noticed however that when we jump into the bottom of a platform or hit it from the sides, we are transported on top of it. This is because `tmrGravity` is running, and doesn't distinguish whether we collide with a platform from the side, top or bottom. If we make sure that our player doesn't collide with the sides or bottom of a platform, we won't have this issue.

Try to solve at least one of these problems on your own. If you can't, you may look at the solutions below.

The easiest way to solve this problem is to add checks to `tmrJump`, `tmrLeft` and `tmrRight` that check for collisions in the same way that we did in `tmrGravity`. We just need to adjust them for the direction each **Timer** is moving us, and what position we should place `imgPlayer` if that move causes a collision.

Part 7 - Fixing Collisions

tmrJump

```
Dim bolHitsPlatform As Boolean
For Each platform In platforms
        If New Rectangle(imgPlayer.Location.X, imgPlayer.Location.Y - intVSpeed, imgPlayer.Width,
imgPlayer.Height).IntersectsWith(platform.Bounds) Then
                imgPlayer.Top = platform.Bottom
                bolHitsPlatform = True
        End If
Next
intJumpCounter += 1
If intJumpCounter >= 15 Or bolHitsPlatform Then
        tmrJump.Enabled = False
        tmrGravity.Enabled = True
Else
        imgPlayer.Top -= intVSpeed
End If
```

We can use this **Boolean** to check whether we hit the bottom of a platform so we can turn off our `tmrJump`.

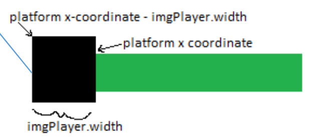
Just like with `tmrGravity`, we are going to create a virtual **Rectangle** in the position where `imgPlayer` will be after we move it. If there will be a collision, we will place it right up against the **bottom** of the platform. This will also prevent `tmrGravity` from detecting a collision and putting `imgPlayer` on top of the platform.

We end our jump if we reach the maximum height, **OR** we have hit the bottom of a platform.

tmrRight

Try this on your own first before copying code. Use the same **For...Each** loop to iterate through all platforms. Create a virtual **Rectangle** in the location `imgPlayer` will be after moving to the right. If you detect a collision move `imgPlayer` so that its right side is against the left side of the platform. This will differ from our gravity and jump checks in that we will be changing the **x-coordinates** instead of the **y-coordinates**, and will need to use the **Width** properties instead of the **Height** properties.

```
Dim bolHitPlatform As Boolean
For Each platform In platforms
        If New Rectangle(imgPlayer.Location.X + intHSpeed, imgPlayer.Location.Y, imgPlayer.Width,
imgPlayer.Height).IntersectsWith(platform.Bounds) Then
                imgPlayer.Left = platform.Left - imgPlayer.Width
                bolHitPlatform = True
        End If
Next
If Not bolHitPlatform Then
        imgPlayer.Left += intHSpeed
End If
```



tmrLeft

Try this on your own, using the same idea as `tmrRight`. You will need to use a similar idea to place `imgPlayer` against the right side of the platform if you detect a collision with your virtual **Rectangle**. *Draw a sketch to help!*

```
Dim bolHitPlatform As Boolean
For Each platform In platforms
        If New Rectangle(imgPlayer.Location.X - intHSpeed, imgPlayer.Location.Y, imgPlayer.Width, 
imgPlayer.Height).IntersectsWith(platform.Bounds) Then
                imgPlayer.Left = platform.Right
                bolHitPlatform = True
        End If
Next
If Not bolHitPlatform Then
        imgPlayer.Left -= intHSpeed
End If
```

Part 8 – Colliding with Lava

We are going to have our player 'die' when it touches any platform in our **List** of lava. Since our level design makes it only possible to hit this on the way down, we only need to check it when `tmrGravity` moves our player. To keep our code cleaner, we are going to create a **Sub Procedure** that scans through the lava obstacles for us. You can also use this idea to detect collisions with other types of items that you may wish to add to your program later on.

What kinds of things do we want to happen when we hit the lava? For our example, we will stop all of our **Timers**, pop up a **MessageBox**, and then close our program. You should customize this to suit the needs of your game.

Add the following code to your program:

```
Sub deathDetectFall()
       For each lava In lavas
              If imgPlayer.Bounds.IntersectsWith(lava.Bounds) Then
                tmrGravity.Enabled = False
                tmrLeft.Enabled = False
                tmrRight.Enabled = False
                MsgBox("You are dead")
                Me.Close()
              End If
        Next
End Sub
```

We can call this **Sub Procedure** at the end of `tmrGravity` by adding the following line of code at the end of it:

```
deathDetectFall()
```

This is the end of the detailed tutorial. Below, I will suggest some mechanics that you may want to experiment with, and provide some basic ideas of how you may do some of them. At this point, you can either attempt them on your own, or do some research online to help. Good luck and have fun.

Part 9 – Things to Try

This is a very basic framework for a platformer. Here are some things you may want to try:

Staying on the Form

You already have experience keeping your player on the Form from previous tutorials. It is no different here. You could even add wrap around so your player leaves the left side of the form and returns on the right.

Health and Lives

Keep track of health or lives. Reset your player's location when a life is lost.

Add Enemies

You may want to make a List of enemies so that you can use a loop within a single **Timer** to move them all and check for collisions.

Add Obstacles and Items

Use the same idea as above. If obstacles are similar, and will exhibit similar collision behaviour (such as disappearing, or removing health/lives), group them together in a List.

Powerups and Other Effects

You can change the speed and jump height easily by setting Timer Intervals, and speed values from a variety of events.   For example, a collision with a certain type of item may allow a player to jump higher for a certain amount of time, or you could change the size of your player.

Ducking

Allow your player to duck while holding a certain key down by changing the Height property. A KeyUp event for that same key could return the player to its original size.

Hanging

Your player could hang on the bottom of a platform if you hit it. This could be done by turning off gravity when hitting the bottom of a platform. You must decide how and when you want to re-enable it.

Falling Death from Heights

When your gravity timer ticks, keep a count of how far you fall. Use this count to decide what happens when you hit the ground (death, loss of health etc.). Make sure you reset this falling counter each time you land.

Visuals

Put images in your PictureBoxes instead of just changing the BackColor. You can have pictures change when certain events occur, such as jumping, or landing on a platform if you wish. To help with performance, resize the image files to the exact size you need before adding to them to your project resources in order to save your game from having to scale the images over and over.

Breaking Platforms

Have your player smash a platform if they hit it from the bottom.

Transporter

Have some type of portal that transports your player to another spot on the map.