

# Computational intelligence for the internet of things

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**Abstract.** The paper considers the classification of computational intelligence methods and their further development with the use of hybrid technologies for managing the Internet of things. The new paradigm of the Internet of Things allows the use of various objects in a wider range of tasks. In healthcare, devices are being developed for many purposes, such as monitoring patients to help them cope with chronic illnesses, recover from injuries, or prevent strokes. Thus, in order to realize a dynamic new generation technology, corresponding to the new paradigm of the "Internet of Things", it is proposed to use machine-learning algorithms in hybrid technology, which will make it possible not only to protect confidential patient data, but also to analyze them and make assumptions.

## 1 Introduction

At present, the development of decision support systems provides for a greater intellectualization of decision-making processes, which gives rise to the desire to transfer to computers some of the intellectual tasks performed by the decision maker (decision maker) using the Internet of things.

### 1.1 Definition of Computational Intelligence (CI)

Under computational intelligence we will understand a set of technologies, models, methods and software designed to solve informal, creative problems in various areas of human activity using the apparatus and logic, to a certain extent identifying human mental activity (fuzzy reasoning, quality and intuitive approaches, creativity, inference, self-learning, etc.) in particular decision making, classification, pattern recognition, etc. [1-7].

## 2 Main Part

It is possible to strengthen a number of components of smart cities - from sustainable mobility in tourism development to economic development. This is very difficult as it requires a combination of social investment and advanced smart and efficient tools.

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IoT design solutions, various ideas can be used that are aimed at improving the comfort of tourists. Since these decisions relate to the tourism activities of the region, then the analysis should be carried out in the concept of "Smart City" or "Smart Home".

Here we consider one of IoT solutions, which is suitable for use in tourism activities and its aggregation into existing APCS in the tourism industry - an intelligent video recorder, which also belongs to the concept of a "smart" home.

Development of an intelligent video recorder.

It requires a webcam to work, as well as a Raspberry board. Pi 3 Model B" to receive and transmit data to a computer or phone.

The Typical design solution (TPR) "Intelligent DVR" being developed belongs to the TPR of the "Technique" class, that is, the TPR should include: composition, procedure for placement and use of technical means.

The TPR complex for the technical support of IS of enterprises in the tourism sector includes:

1. TPR for IP projects of tourism enterprises;
2. TPR on the use of peripheral technical means in the IS of enterprises in the tourism sector.

The internal structure of each standard solution is built on a modular basis. At the same time, the TPR Technique module is understood as the minimum set of design documentation for the IoT element, which has independent use in the design or addition of a specific IS in the tourism sector.

IoT TPR, modules are implemented in the form of specific design solutions and contain the following materials on IoT technical support:

- "Recommendations for the use of TPR", including general recommendations for the use of TPR;
- recommendations on the use of individual modules (functions) of the TPR;
- flowchart "Content and sequence of work on the IoT project when applying the IoT TPR";
- sanitary and special requirements for the IoT project for the placement of peripheral and technical IoT facilities;
- "Technological process of information processing on IoT ", including the organization of the reception of primary information, etc.

The task of the TPR "Intelligent video recorder" of the "Technology" class: eo and audio broadcasting from a webcam to modern browsers.

Recommendations for the use of TPR. The introduction of the TPR will enable tourists to view the eo and audio broadcast at a distance through the IP address of the portable board in the browser, as well as take pictures and video-audio recording with subsequent storage of these files.

Recommendations for the use of individual modules (functions) of the TPR. To view the broadcast on another network, you need to use ngrok (a service that allows you to "throw" a local web server on the Internet in the public domain or with a password) to display the local tunnel.

Once downloaded, you need to run ngrok with/ngrok http 5000 and go to one of the generated links in your browser. This device is easy to place in the house or near it, to control what is happening at the moment when the owner is, for example, at work or on vacation in another city. Direct data transfer takes place on Microsoft Azure.

Microsoft Azure is a cloud computing service created by Microsoft to build, test, deploy, and manage applications and services through Microsoft's global network of data centers. It provides Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) and supports many programming languages, tools and frameworks, including Microsoft and third party specific software and systems.

Using this service, it is possible to manage your devices connected to the IoT hub with a set of built-in functions:

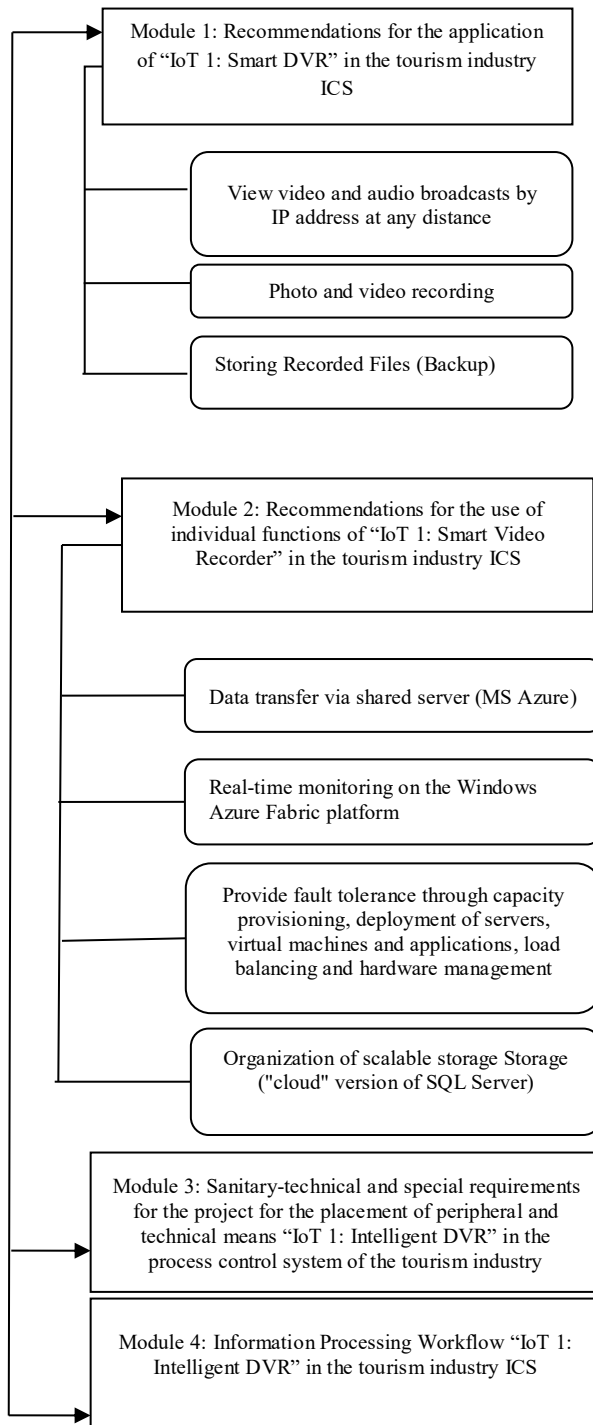
- Compute - a component that implements calculations on the Windows platform Azure.
- Storage - the storage component provides scalable storage. The repository does not have the ability to use the relational model and is an alternative, "cloud" version of SQL Server.

Fabric - Windows \_ Azure Fabric is intended to be the “controller” and core of the platform, performing the functions of real-time monitoring, fault tolerance, capacity provisioning, deployment of servers, virtual machines and applications, load balancing and equipment management.

Wi - fi module is used to send data to the server. It provides a good ability to embed Wi-Fi capabilities into other systems or function as a standalone application with minimal cost and minimal space requirements. ESP8266EX offers a complete and standalone Wi-Fi solution; it can be used to host an application or to offload Wi-Fi network functions from another application processor. Alternatively, acting as a master adapter, wireless internet access can be added to any microcontroller based on a simple communication design (SPI/SDIO or I2C/UART interface). ESP8266EX is one of the industry's most integrated Wi-Fi chips; it integrates, power amplifier, low noise amplifier, filters, power management modules, requires minimal external circuitry, etc. All solutions, including the interface module, are designed to work with a minimum PCB area.

In the data receiving block, we receive all data from the server using a WI-FI router. Then, using an Ethernet cable, the data is displayed on a monitor. In this way, the data of different devices is stored on the server, and the administrator can control the different devices, and also record all the data, which then provide a graphical representation on the IOT server at the same time.

Figure 1 shows the modules of design solutions for the technical support of the TPR “IoT: Intelligent Video Recorder”.



**Fig. 1.** Modules of design solutions for the technical support of the TPR "IoT: Intelligent video recorder".

Program code for the project "Intelligent video recorder".

```

.<Page
x: Class="WebCamSample.MainPage"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
xmlns:local="using:WebCamSample"
xmlns:d="http://schemas.microsoft.com/expression/blend/2008"
xmlns:mc="http://schemas.openxmlformats.org/markup-compatibility/2006"
mc:Ignore="d">

<Grid Background="{ ThemeResource ApplicationPageBackgroundThemeBrush }">
< Grid.ChildrenTransitions >
<TransitionCollection> __
< EntranceTheme Transition />
</TransitionCollection> __
</Grid.ChildrenTransitions >
< Grid.RowDefinitions >
< RowDefinitionHeight ="Auto"/>
< RowDefinitionHeight ="Auto"/>
< RowDefinitionHeight ="Auto"/>
< RowDefinitionHeight ="Auto"/>
< RowDefinitionHeight ="Auto"/>
</Grid.RowDefinitions >

< TextBlock Grid.Row ="0" x :Name ="pageTitle" Text="Web Camera Sample"
Style="{ StaticResource HeaderTextBlockStyle }"
IsHitTestVisible ="false" TextWrapping =" NoWrap " HorizontalAlignment ="Center"
VerticalAlignment ="Center"/>

< StackPanel Grid.Row ="1" x :Name ="ContentRoot" HorizontalAlignment ="Center"
VerticalAlignment ="Center" Orientation="Horizontal" Margin="12,0,0,0">
<Button x :Name ="video_init" Content="Initialize Audio/Video" Click="
initVideo_Click " HorizontalAlignment ="Left" Margin="0,0,30,20" Width="180"/>
<Button x :Name ="audio_init" Content="Initialize Audio Only" Click="
initAudioOnly_Click " Margin="0,0,30,20" Width="120"/>
<Button x :Name ="cleanup" Content="Close Camera" Click=" cleanup_Click "
Margin="0,0,30,20" Width="120"/>
</StackPanel> __

< StackPanel Grid.Row ="2" x :Name ="ContentRootActions" HorizontalAlignment
="Center" VerticalAlignment ="Center" Orientation="Horizontal" Margin="12,0,12,0">
<Button x :Name ="takePhoto" Content="Take Photo" Click=" takePhoto_Click "
Margin="0,0,30,0" Width="120" IsEnabled ="False" Visibility="Collapsed"/>
<Button x :Name ="recordVideo" Content="Start Video Record" Click="
recordVideo_Click " Margin="0,0,30,0" Width="150" IsEnabled ="False"
Visibility="Collapsed"/>
<Button x :Name ="recordAudio" Content="Start Audio Record" Click="
recordAudio_Click " Margin="0,0,0,0" Width="150" IsEnabled ="False"
Visibility="Collapsed"/>
</StackPanel> __

```

```

    < StackPanel Grid.Row ="3" HorizontalAlignment ="Center" VerticalAlignment
    ="Center" Orientation="Horizontal" Margin="0 ,0,0,10 ">
    <StackPanel> __
    < TextBlock Name=" PreviewTitle " Grid.Row ="0" Grid.Column ="0" Text="Preview "
    Height ="30" HorizontalAlignment ="Center" Margin="0,20,0,0" Visibility=" Visible"/>
    <Canvas Name=" PreviewCanvas " Grid.Row ="1" Grid.Column ="0" Width="200"
    Height="200" Background="Gray " Margin ="0,0,0,0" Visibility=" Visible">
    < CaptureElement x :Name ="previewElement" Width="200" Height="200"
    HorizontalAlignment ="Left" Visibility="Visible"/>
    </canvas>
    </StackPanel> __
    <StackPanel> __
    < TextBlock Name=" ImageTitle " Grid.Row ="0" Grid.Column ="1" Text="Last
    captured photo" Height="30" HorizontalAlignment ="Center" Margin="0 ,20,0,0 " Visibility
    ="Visible"/>
    <Canvas Name=" PhotoCanvas " Grid.Row ="1" Grid.Column ="1" Width="200"
    Height="200" Background="Gray " Margin ="20,0,0,0" Visibility=" Visible">
    <Image x :Name ="captureImage" Width="200" Height="200" Visibility="Visible"/>
    </Canvas> </StackPanel> _
    <StackPanel> __
    < TextBlock Name=" VideoTitle " Grid.Row ="0" Grid.Column ="2" Text="Last
    Recorded Video" Height="30" HorizontalAlignment ="Center" Margin="0 ,20,0,0 "
    Visibility ="Visible"/>
    <Canvas Name=" VideoCanvas " Grid.Row ="1" Grid.Column ="2" Width="200"
    Height="200" Background="Gray" Margin="20 ,0,0,0 " Visibility=" Visible">
    < MediaElement x :Name ="playbackElement" Width="200" Height="200"
    Visibility="Visible"/>
    </canvas>
    </StackPanel> __
    <StackPanel> __
    <!--< TextBlock Grid.Row ="0" Grid.Column ="3" Text='Last Recorded Audio'
    Height='30' Margin='10,20,0,0'/>-->
    <Canvas Grid.Row ="1" Grid.Column ="3" x :Name ='playbackCanvas3' Width='0'
    Height ='0' Margin="0,0,0,0">
    < MediaElement x:Name ='playbackElement3' Width="0" Height="0"/>
    </canvas>
    </StackPanel> __
    </StackPanel> __

    < TextBlock Grid.Row ="4" Text="status" HorizontalAlignment ="Center"
    VerticalAlignment ="Top" Margin="19,-10 ,0,0 ">
    < scrollviewer Grid.Row ="5" Margin="12 ,10,12,0 " HorizontalAlignment ="Center"
    VerticalAlignment ="Center" >
    < TextBox
    x: Name="status" TextWrapping ="Wrap" IsReadOnly ="True" Height="60"
    Width="400" HorizontalAlignment ="Left" VerticalAlignment ="Top"
    ScrollViewer.HorizontalScrollBarVisibility ="Disabled"
    ScrollViewer.VerticalScrollBarVisibility ="Auto"/>
    </scrollviewer> __
    </grid> __
    </page> __

```

### 3 Conclusions

This project was developed in Visual Studio 2017 with IoT programming add-on called Windows IoT extensions for the UWP projects that can be opened on any device running Windows 10 IoT core. This add-on can support C # and C ++ programming. Also, the advantage of this add-on is that it is one of the easiest to learn in general.

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