I J C T A, 9(4), 2016, pp. 2015-2023

WIFI Enabled IoT for real time control with android app

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ABSTRACT

The aim of this paper is tointegrate android OS, multiple sensing units, arduino and multiple real time elements for enabling IoTcontrol. As an application, temperature and humidity sensor obtain the room temperature information and this information is used to regulate the use of room coolers like air conditioners. Boolean expression with input values is used to control the objects at remote end through the android app. The access points of the real time device are shortlisted automatically, once the android app is opened. In this work, app developed as it connects to the ardunio controller IP automatically when it is started. If communication between android and real time device established, the connection information is stored in arduino controller. The proposed model automatically reconnects to the real time device on startup.

Keyword: Arduino, Smart Switching, Android processor, sensor and real time device

1. RELATED WORKS

Manfred Sneps-Sneppe and Dmitry Namiot presented the web-based domain-specific language for Internet of Things applications. The approach presented in this paper aims at simplifying the access to IoT information within web applications. The proposed model supports both synchronously and asynchronously updates. Proposed model is responsible for the operations required to perform the communication between process instances and sensors.

Anders Lindgren et al., described the tradeoffs involved inutilizing Information-Centric Networking (ICN) for Internet of Things (IoT) scenarios. This paper describes some advantages and inconveniences of using an ICN for the IoT architecture, and helps finding the right tradeoff between using an ICN or an HCN (Host-Centric Networking), depending on the context.

Ryan Yong Kim and OhadZeria (2016) described setup of IoT network devices and specifically to setup of multiple similar IoT devices at substantially the same time using joint authentication.

Swarnalatha et al., (2016) proposed architecture to enable the users to control and monitor smart devices through internet. It creates an interface between users and smart home by using GSM and internet technologies, or it simply creates GSM based wireless communication from the web server into the smart home. In this architecture the users give commands through web then the users inputs are converted into GSM-SMS commands. This paper introduces an IoT agent which is brain of this architecture and it controls web server and remote embedded system module.

Shiu Kumar (2014) presented a flexible standalone, low cost smart home system, which is based on the Android app communicating with the micro-web server providing more than the switching functionalities. The Arduino Ethernet is used to eliminate the use of a personal computer (PC) keeping the cost of the

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overall system to a minimum while voice activation is incorporated for switching functionalities. An embedded micro-web server with real IP connectivity is used for accessing and controlling appliances and other devices remotely from an Android based app, which can be used from any Android supported device.

2. PROPOSED SYSTEM

Arduino board and android processor connects with WIFI. The objects and multiple sensing and switching units are connected with Arduino. The App allows for controlling objects with a number combination[in this work 64] for switching by providing a dynamic Boolean expression. The App sends Boolean expression to the Arduino board through WIFI and the Arduino board dynamically interacts and controls the objects connected to it. The block diagram of proposed system sis shown in figure 1.

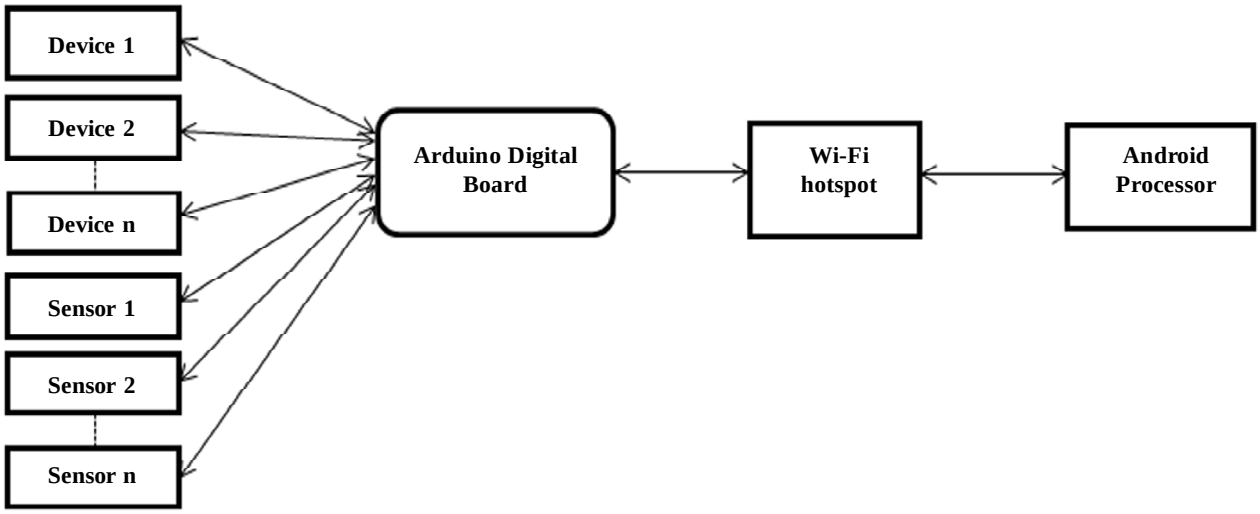

Figure 1: Block Diagram of proposed system

2.1. Proposed system components

2.1.1. Android processor

On the Android processor, there are widgets used to change Boolean expression and input for multiple real time elements, and it is easily allows user to control them. Evaluate button bring up current status of multiple sensor unit from Arduino board and a virtual keyboard will appear for controlling devices.

2.1.2. Arduino board

In arduino board, relays and instrument connectors are used to connect arduino and the real time devices are controlled from the android processor. It is possible to control a device by engaging a number of relays. Arduino board does the wiring to control the real time elements. Arduino connect with device is shown in figure 2. Functionality of Arduino board in proposed system is process the expression given by android processor from left to right based on priority and parenthesis. Provides the input to the real time devices connected to Arduino. Arduino reads the output from the sensor unit output pins provide this measured value back to the Android processor. The possible switching operation in the proposed system such as

- Parallel switching
- Series switching
- Invert current switching status
- Switch when measured output different from other

- Switch when all measured output greater than threshold value
- Switch when any one measured output greater than threshold value
- Switch when measured output greater than threshold value and measured output lesser than threshold value

The combination of various switching is generated by possible switching operation.

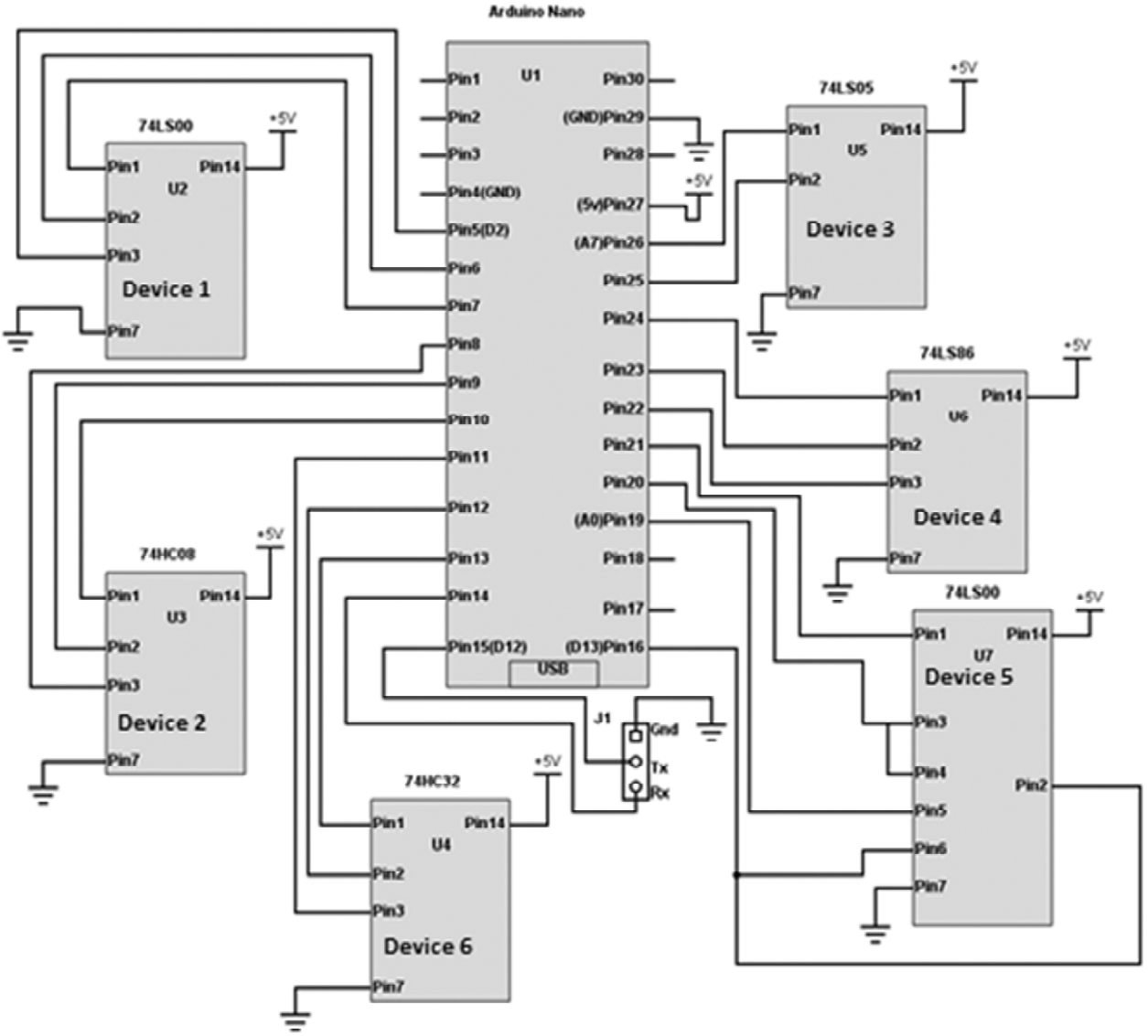

Figure: 2 Hardware architecture of proposed system

2.1.3. Pseudo code

Android processor

Android send to validation request to arduino
if (measured value> threshold value)
arduino send expression for controlling real time device
else
android send ack for received measured values

Arduino board

loop: execution
expression divided into sub-blocks
adjust real time device
end loop

loop1: verification
measure values from sensor unit
o/p value send to the Android processor
end loop1
verification loop1
While (expression received)
Check for syntax error
if(error)
send error in expression
else
execution loop
end if

The work flow of Arduino for controlling real time device is shown in figure 3.

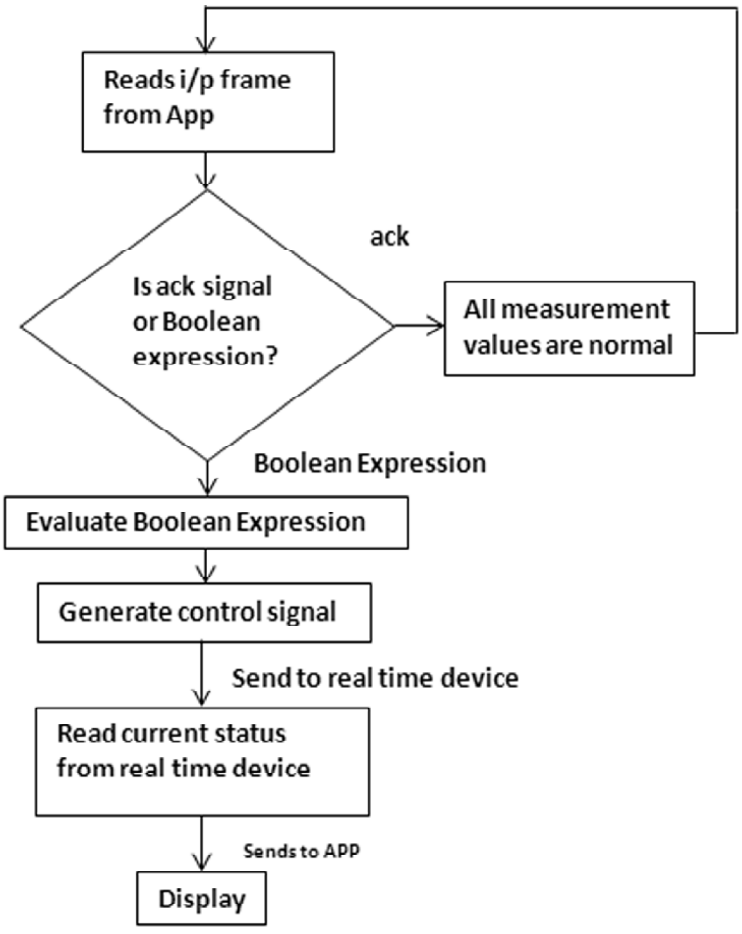

Figure 3: Work Flow of Arduino controller

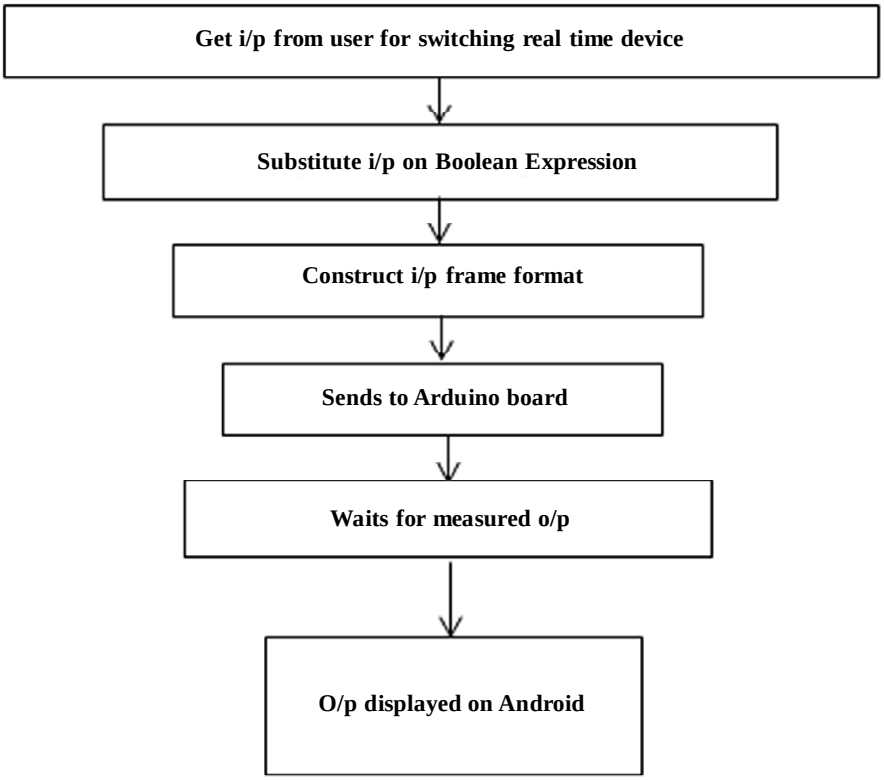

Figure 4: Work Flow of Android Processor

The work Flow of Android processor for controlling real time device from remote area is shown in figure 4.

3. BOOLEAN EXPRESSION

A Boolean expression is used to switching real time devices according to the sensor unit measurement values using Logic operators. The control operation of real time device is mentioned using the Boolean expression. Logical operators such as *, + and # are used for respectively parallel switching, series switching and Switch when any one measured output greater than threshold value. The valid Boolean expression designed only by logical operators and control signal for real time device(generated by sensor unit output) named as variables (In this work A, B, C and D used for four devices). Switching operations executed by precedence order of opposite switching, parallel switching and serial switching. Switching operations (mentioned by logical operators) with brackets () are always executed ûrst, before the precedence order.

3.1. Boolean expression error check

i. Boolean expression with switching conditions (“ON” and “OFF”) consider as syntax error.

ii. Consider Boolean expression (A+C) +AB. Android processor returns syntax error for this Boolean expression. Because of ignoring AND (*) symbol considered as syntax error. The correct Boolean Expression is (A+C) + A*B.

3.2. Evaluating Boolean expressions

In switching operation by Boolean expressions, initially, the number of real time device to be involved in switching operation is calculated. The switching operation is done by the Arduino using parenthesis and order of precedence.

Consider (A*D)+(C#D!), four different switching operation (*, +, # and D) are required for smart real time controlling of four devices through arduino. Input values for the switching operation is given by the APP and applied on the Boolean expression. The order of precedence for this Boolean expression is shown in table 1.

Table 1
Order of Precedence

Switch operation	*Order of precedence*
Parenthesis	Highest priority 1
Invert current status of device (!)	Highest priority 2
Switch when measured output differ from other (#)	Highest priority 3
Parallel switching (*)	Highest priority 4
Series switching (+)	Lowest priority

1. Parenthesis has highest priority. Next highest priority is invert current status of device in second parenthesis (C#D!). Then the device D switched to "ON" (OFF) condition if it is in "OFF" (ON) condition.
2. Switch operation done on C and D device if the measured output from sensor unit is different from other.
3. Next parallel switching between devices A and B is done.
4. Finally, series switching done in four devices (A, B, C and D).

The execution step is shown in table 2

Table
2 Execution Process

	Steps	*Device 1*	*Device 2*	*Device 3*	*Device 4*
	Initial	OFF	OFF	OFF	OFF
	Step 1	OFF	OFF	OFF	ON
Step 2	All Measured output value are same	OFF	OFF	ON	OFF
	Measured output value are different from other	OFF	OFF	OFF	ON
	Step 3	ON	ON	OFF	ON
	Step 4	ON	OFF	OFF	OFF

4. ANDROID APP DEVELOPMENT

In this work, android app is developed for user interfacing with real time device from remote area. The xml code and java code is used in the android software development kit (SDK). In development process, ImageView layout component is used for displaying images in Android. "android: scale Type" function used to resize or moved to match the size of this ImageView.In this work, Xamarin studio is an open source tool which is integrated development Environment (IDE) used to developiOS and Android applications. The android app developed as package. Finally .apk file is generated.

4.1. Implemented hardware setup

The implemented hardware setup is shown in figure 5.

The connection setup includes

1. Connect Power Adaptor of WIFI Module to Power Socket
2. Connect powers supply to the arduino board by using USB adapter
3. Open app in android processor

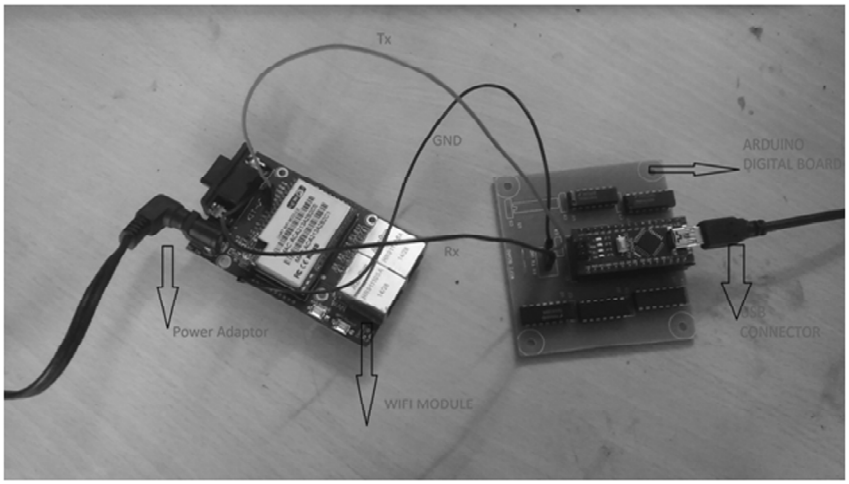

Figure: 5 Implemented Hardware

5. EXECUTION PROCESS AND RESULT

In android processor, the Boolean expression with corresponding inputs for controlling real time device is given to the android processor. Android processor generates input frame format and sends to Arduinocontroller through WIFI. The corresponding switching operation is done on the real time device byArduinocontroller. The new measured output after the switching operation is received from sensor unit and arduinosent this measured output to the android process through WIFI.The Boolean expression (A*B)+(C#D!) is entered in android processor. The arduino executes the switch operation in real time device shown in figure 6. The inputs (A, B, C and D) for Boolean expression are given respectively as 0, 1, 1 and 0. If the evaluate button is clicked the measured output value is displayed on android processor. The device B and device C is switched ON. This is shown in figure 6

In figure 7, device “B” switched “OFF” and device “C” is in “ON” condition.

Figure: 6 Output screen shot 1

Figure: 7 output screen shot 2

Figure: 8 Output screen shot

In figure 8, device “B” is in “OFF” condition and remaining all devices are switched “ON”.

CONCLUSION

The proposed smart IoT enabled multiple sensing and switching improves real time control technology and achieves energy preservation and environmental protection. In this paper, heat dissipation in room is measured remotely and objects interact with one another and provide an efficient control (air conditioner, Fan, etc.). The idea of measure-and-control together by one system improves the performance. The hardware implementation gives real time measureand control objects through WIFI. This paper provides a novel solution to control object by measuringreal time value from sensors from remote area. The measured output value is compared with threshold value and actions are taken.

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