Development of internet-based (IOT) smart tv assistant prototype

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Abstract. This study aims to develop a prototype system that is independent and capable of controlling TV automatically via an Android smartphone using the Arduino Uno Microcontroller. This is different from the usual TV remote where the control is limited to standby mode, the system / hardware that is built can control power on and off, so there is no electricity waste due to the TV not being watched by the owner. As it is known that the standby mode on the TV still consumes 10.96 watts of electricity. The media used for control are Bluetooth and Wi-Fi. Control with Bluetooth via an Android smartphone has 3 features which by pressing the on-off button, with voice commands and time settings, while controlling via Wi-Fi is by accessing the website. The test results show control via Bluetooth gives a response less than 1 second with a distance of less than 11 meters, via Wi-Fi gives a response of 1-4 seconds. If the TV owner has set the time the TV will be automatically controlled by the power off hardware as an assistant even though the TV owner has fallen asleep and the electricity is not wasted because the TV is still on.

1. Introduction

Various breakthroughs and movements have been carried out by the government in order to save energy in Indonesia. In 2016 the Government launched an energy conservation movement with the tagline "Cut 10 percent" to encourage people to save electricity and not be apathetic in terms of electricity utilization. Many patterns of behavior in people's daily lives unknowingly make electricity bill costs increase. This also wastes electrical energy, even though it is well known that energy sources such as petroleum, coal, natural gas are limited, Aris Yuananto as Director of PT Energy Management Indonesia (EMI) explained, the use of electricity in Indonesia is not yet efficient. Viewed from the situation of households, private offices, markets, shops, industries to the government to make electricity waste. Based on studies conducted by EMI, the average of energy waste in government offices is 25-30%, shops and markets 25%, industries 25%, private offices 20%, while households are 10%. EMI stated that energy waste often occurs because they leave electronic devices such as TVs, air conditioners, radios, microwaves, fans in standby mode when not in use. Aris said that even if the electronic device was on standby, it still consumed electricity. This means that there is energy wasted through the habits of this patterned society.

According to the International Energy Agency standby mode is where electronic equipment still consumes electricity (wasted) is not like working on its main function where power on / switch on (live / electrified). Energy wasted in this mode is usually referred to as “standby loss” and “leaking electricity”

[1]. According to Hamer (2008) standby mode is the definition of electricity usage by electronic equipment that is not turned off (power off) or does not perform its main function. Even though the estimation of electricity usage is relatively small around 0.5-10 Watt, even though the use of large amounts still triggers the emergence of significant problems that become an issue for the nation. Industry experts estimate that in OECD (Organization for Economic Co-operation and Development) countries, 4% to 10% of their housing electricity consumption is closely related to standby mode [2].

Kompas in 2012 stated that there were differences in electricity consumption for different types of TVs. LCDs usually consume 110 watts of electricity per hour when active, while LEDs are more efficient at 50 watts per hour. For CRT TVs, Solanki stated that electricity consumption is up to 78.10 watts per hour. If the average of the 3 TV types is obtained, the figure is 79.3 watts per hour consumption of electricity.

In standby mode Solanki stated that in 2008 electricity consumption on TV (CRT) of Oman's population reached 10.96 Watts per hour during standby [3]. The electricity consumed by electronic equipment on standby varies, depending on the type and technology applied. But in principle the standby mode still consumes electricity as shown in the following block diagram [4]: With the continuous growth of mobile devices in its popularity and functionality the demand for advanced ubiquitous mobile applications in people's daily lives is continuously increasing. Utilizing web services is the most open and interoperable way of providing remote service access or enabling applications to communicate with each other. An attractive market for home automation and networking is represented by busy families and individuals with physical limitations [5] for monitoring the environment [6]. With the development of modern technology and Android Smartphone, Smart Living is gradually changing people's life [7].

IoT (Internet of Thing) can be described as connecting everyday objects like smart phones, internet televisions, sensors and actuators to the internet where the devices are intelligently linked together to enable new forms of communication amongst people and themselves [8]. With the IoT concept various electronic devices like home appliances can be controlled via Bluetooth [9, 10], internet, short message service (SMS) based, etc. Because of its development, now IoT has been implemented in various industries and cities to make life and work easier [11].

This research uses a concept of IoT for the implementation of Smart Home with TV as an object. The system was developed without compromising the function of the TV itself, where the system was built separately and stand alone. Hardware that is developed is placed or taped around the TV power button which acts as an assistant to the TV owner to interact with the power button on the TV. The system that has been developed is able to turn off (power off) the TV even when the homeowner falls asleep while in front of the TV after the time setting is done. In addition, with this system, the TV in a power off condition can be turned on and vice versa through voice commands or pressing the button on the home smartphone Android app owner. In addition, the system can be controlled with a Wi-Fi connection so that the TV can be controlled with no distance restrictions while connected to the internet network.

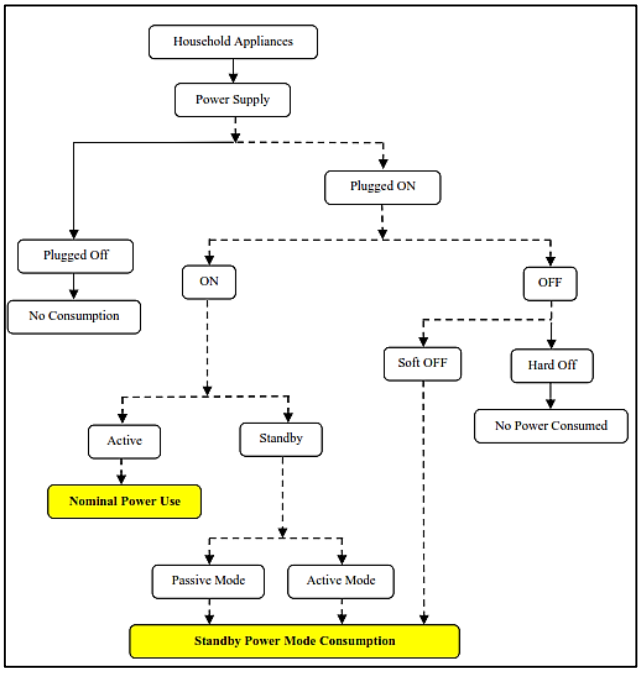

Figure 1. Standby mode power consumption block diagram.

This research uses a concept of technological development called IoT (Internet of Thing) for the implementation of Smart Home with TV as an object. The system was developed without compromising the function of the TV itself, where the system was built separately and stand alone. Hardware that is developed is placed or taped around the TV power button which acts as an assistant to the TV owner to interact with the power button on the TV. The system that has been developed is able to turn off (power off) the TV even when the homeowner falls asleep while in front of the TV after the time setting is done. In addition, with this system, the TV in a power off condition can be turned on and vice versa through voice commands or pressing the button on the home smartphone Android app owner. In addition, the system can be controlled with a Wi-Fi connection so that the TV can be controlled with no distance restrictions while connected to the internet network.

2. Methodology

This research was built using a prototype model. The selection of this model is based on the purpose of the research results which are still in the form of prototypes, this is not a complete product, but it still needs to be evaluated and modified again. All forms of modification / change can occur when the prototype is built in order to meet the needs of users and also allows developers to understand user needs better [12]. Stages of research carried out in accordance with the model chosen (prototype): communication, quick plan-modelling quick design, construction of prototype, deployment, delivery and feedback.

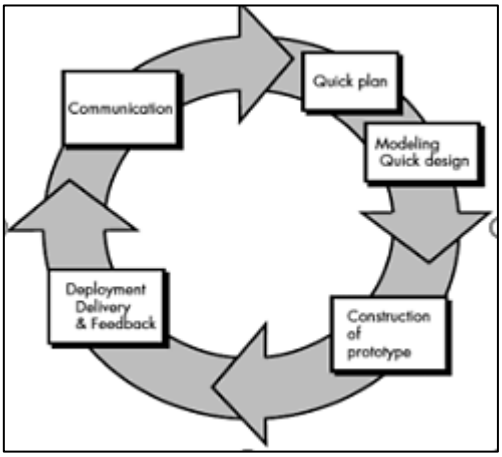

Figure 2. Prototype model.

2.1. Communication

The research began with communication to 5 respondents who had TVs in their homes. Communication results show that 4 out of 5 respondents often fall asleep in front of the TV when the TV is on (power on). At this stage there is a problem regarding excessive electricity usage when the TV is not being watched. The solution to this problem is to build a system that turns the TV off when the viewer falls asleep in front of the TV.

2.2. Quick plan – modelling quick design

The solution of the problem is obtained through communication after which the model is made in the form of mock up interface to then be presented to respondents. mock-up system is built as user friendly as possible so that users are facilitated in controlling TV.

2.3. Construction of prototype

Modelling design that has been accepted is then done by developing prototype. The system built consists of software and hardware. Software as a medium of communication between users and hardware. While the hardware interacts directly with the TV via a relay so that you can press the power on / off button on the TV.

2.4. Deployment, delivery and feedback

Prototype that has been built is done by writing program code and deployment. Deployment on the software side is in the form of application files used for installation [there is an android smartphone and a hosted website so the system can be accessed by Wi-Fi. While the deployment through hardware is done by transferring the program code that has been written into the hardware that has been designed. The system that has been built is then presented to respondents to get feedback, if it is not as expected, improvements can be made as needed.

3. Results and discussions

3.1. Results

The system is built with software and hardware. The software functions for the user's communication media with hardware while the hardware functions to interact with the TV's on / off power button.

3.1.1. Hardware. Hardware is built separately from the TV components so that no changes and modifications are made to the TV. Hardware is placed in front of the TV button to become the TV owner's assistant to reach the button. The hardware is portable so it can be removable to adjust the type of TV and its placement. The total power consumed by the system built is 36 watts per hour.

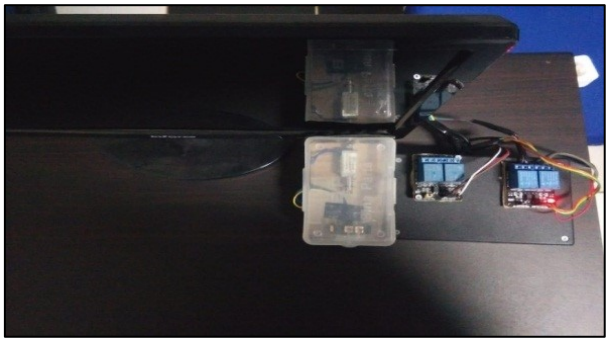

Figure 3. The look of hardware from the top.

Figure 4. The look of hardware from the front.

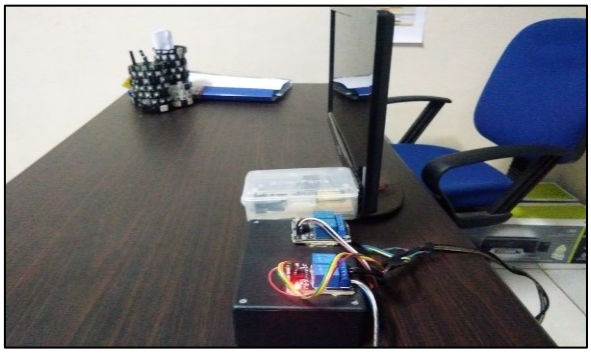

Figure 5. The look of hardware from the beside.

3.1.2. Website. Control through the website (Wi-Fi) can be done by registering and granting access rights to new users. The owner of full access rights on the website is the admin.

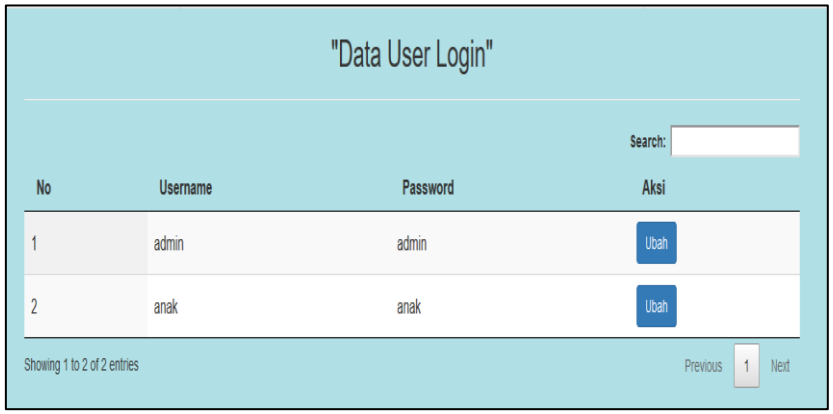

Figure 6. User data through website.

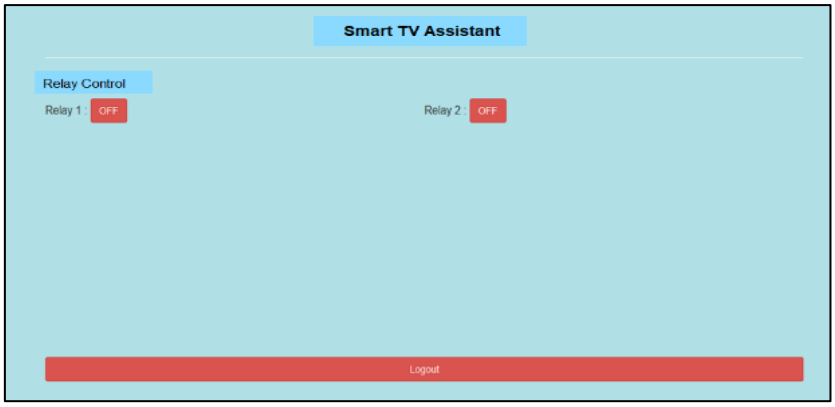

Figure 7. Control menu.

3.1.3. Smartphone android. Control via an Android smartphone can be done in 3 ways by pressing the on-off button, with voice commands and time settings. These 3 methods use Bluetooth media to communicate with hardware.

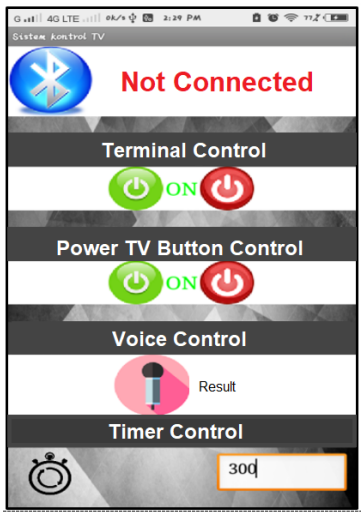

Figure 8. Prototype model.

3.1.4. Schematic hardware design. Some hardware used to build the prototype of this system include: Atmega328p Arduino Uno R3 DIP, IR Sensor MLX90614, 12V Solenoid ZYE1-0503 electromagnet, 20cm Male-Female Dupont Jumper Cable, SYB170 Mini Solderless PCB Breadboard, X5 Black Box Plastic Box Component Casing XY -5, Bluetooth module HC05 HC-05 serial pass-through for Arduino, NodeMcu ESP8266 esp12e WIFI CH340 development board, 2 Channel 5V Relay Module, and Power Supply Switching Adapter for 12V 3A LED Strip Transformer.

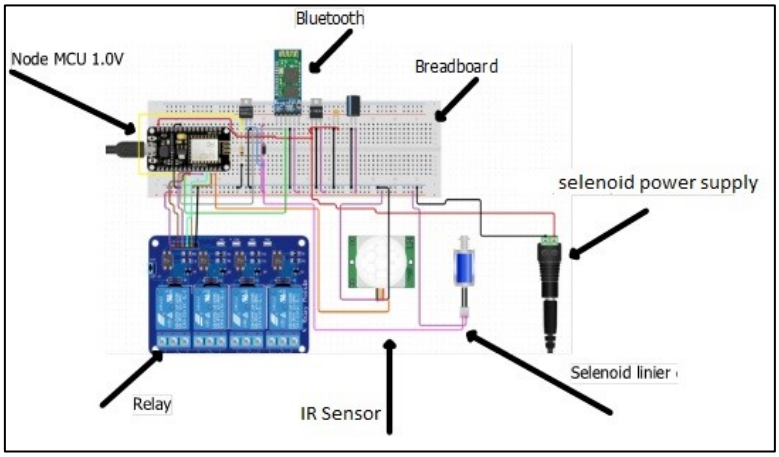

Figure 9. Schematic design.

3.2. Testing

3.2.1. Functionality. The functionality testing is performed on applications installed on Android smartphones. Testing refers to the ISO 9126-2 black box method with the quality factor functionality with the sub factor being suitability quality. There are 3 matrices in this sub-factor, they are Functional Adequacy, Functional Implementation Coverage, and Functional Implementation Completeness. 6 test cases were performed on the features found on Android smartphones and 4 test cases on website features. The range of values in the ISO 9126-2 standard is 0-1 with a value of 0 declared not good and a value close to or equal to 1 otherwise good (0 <= X <= 1).

Table 1. Result of functionality testing.

Feature	Media	FA	FIC	FICM
Electric socket button ON	Android	1	1	1
Electric socket button OFF	Android	1	1	1
Button Power ON	Android	1	1	1
Button Power OFF	Android	1	1	1
Sound Control	Android	1	1	1
Set Timer	Android	1	1	1
Login	Website	1	1	1
User Control	Website	1	1	1
Relay Control 1	Website	1	1	1
Relay Control 2	Website	1	1	1

3.2.2. Time response. Testing is done by comparing the 2 media used in applications installed on Android smartphones through access through the website. Each distance was tested 3 times.

Table 2. Testing result of time respons.

Distance (m)	Android (s)	Website (s)
1-2	< 1	1-3
3-4	< 1	1-3
5-6	< 1	1-3
7-8	< 1	2-3
9-10	< 1	2-3
>10	Not connected	2-3

3.2.3. Summary of the respondent's interview. Interviews were conducted to get feedback on the system that was built. There are 3 families of respondents who provided feedback in this study. Questions asked related to user experience when controlling via android and website.

Table 3. The results of the interview.

No	QUESTIONS	ANSWERS	
		YES	NO
1	Is this application easy to learn and use?	3	0
2	Does this system have an attractive appearance?	3	0
3	Are you having trouble finding all the features available on the system?	0	3
4	Is there a difference that you feel when using the system without using the system?	0	3
5	Are there any bugs / errors that occur while using this system?	0	3
6	Does this system have a positive impact on you?	3	0
7	Can the system make it easier for you to control the TV?	3	0
8	Are there other features that need to be added to this system?	1	2
9	Are there any criticisms and suggestions regarding the system in this study?	2	1

4. Conclusions

The prototype system was successfully built which consisted of software and hardware. Control of TV can be done using 2 media namely Android smartphones and Websites. Response time using an Android smartphone is faster than the website which is <1 second but is limited to a maximum distance of 10 m, in contrast to websites that are not limited to distance while connected to the internet. However, control over the internet depends on the quality of the provider network used by the user. The response of respondents to the system built showed positive results. There is a suggestion from the respondent that if the system can control power off automatically on a TV that is on when the owner is asleep or leaves the TV, it will be better. Electricity consumption in hardware that is built is 36 watts per hour, while in LCD TVs that are on is 110 watts per hour so if the TV owner has set the time then the TV will be automatically controlled power off by the hardware as an assistant even though the TV owner has fallen asleep and electricity was not wasted because the TV was still on.

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