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Home Electric Power Monitoring System Based on Internet of Things Using the Telegram Application

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Abstract

Work and human needs are very dependent on the presence of electrical energy, especially for household needs. Human negligence in using electrical energy will lead to wasteful use of electrical energy which causes payments to soar among households. Research was conducted to examine the application of monitoring the electrical power used by the device remotely via an internet connection. The system can be implemented using a NodeMCU ESP32, PZEM-004T sensor, 16x2 LCD, and the Telegram application as the system user interface on a smartphone. To be able to monitor via the Telegram application the user must be connected to the internet and the microcontroller must be connected to the internet network. This system using the internet network will make it easier to monitor the electrical power of electronic devices in the home every day. The result of this research is that an Internet of Things-based home electrical power monitoring system using the Telegram application can help and make it easier for home owners to monitor electrical power when the home owner is not at home.

Keywords: *Internet of Things, Electric Power, and Telegram.*

1. Introduction

When This electricity is source all- encompassing power all aspect in life everyday, because That electricity is absolute necessity for everyone, for That need exists system that can monitor usage electricity for use electricity become more under control. Remember many incident like users who don't know related use meter the electricity , so when token or the pulse Already finished user That must quick fill in return the token to the meter electricity without knowledge related details of use electricity the, with possibility user the must leave work moderate importance done. Incident like This can cause disturbed work, because That besides it needs system that can carry out monitoring, system the must displays data in great detail for users more easy in management related use electricity prepaid (Tukadi et al ., 2019).

Ordinary electricity used originate from A generator originating electricity from nature , for example Where is the Hydroelectric Power Plant (PLTA). generator This originate from utilization water flow by the turbine then made current electricity, then There is Where is the Solar Power Plant (PLTS). generator This utilise ray sun For produce current electricity via solar panels. With exists statement above, yes said If use electricity should done with effective and efficient so as not to happen possible waste harm self yourself and others, then user must know more in related use tool electronic everyday where each tool electronic naturally need energy electricity with different amounts (Rustandi, 2020).

Problem above give proof it needs capable system describe use electricity prepaid detailed can make it easier user For know need electricity from tools ordinary electronics used with use ESP32 microcontroller based on the Internet of Things (IoT), then using PZEM-004T as a current sensor electricity For retrieve data from meter electricity later will displayed in writing on the 20x4 LCD in the form kWh usage, then system can give report related to the total energy electricity used, with like this user can know around tool possible electronics risky related use energy excess electricit.

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2. Research Methodology

2.1. Research and Prototype Design

On research This method used in development tool Internet Of Things is method development Prototype. Prototype model capable offer the best approach in matter efficiency a algorithm, capabilities device soft For adapt with operating system that will used. The goal that is help development stekholder for understand more Good what is being developed moment specification need Not yet clear (Pressman, 2019).

On method development prototype this also works as framework explanatory work what is the research process this taking place so that study This can done in accordance with sequential stages.

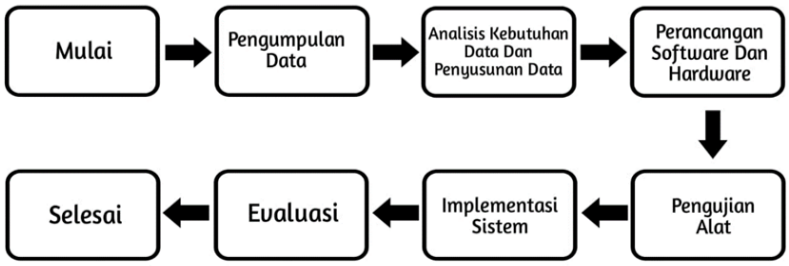

Figure 1. Stages Study

a) Data collection
At stage This there is a previous data collection process taken through reference on stage studies literature, existing data collected will filtered so that the data is specified can developed more Good in study This. In method development, there is more from One reference used reject measuring For do development system so that when system finished built will seen comparison and development from systems built on research This with systems built on research previous.

b) Analysis data requirements and data preparation
At stage This there is analysis future data needs will become need system in test functions contained in the power monitoring system electricity House IOT (Internet Of Things) based For service electricity home, in data preparation there are various information that makes things easier in matter related stage development and stages planning system.

c) Planning software and hardware
At stage This There is a special process in design or assembling software and hardware, each component will connected One with each other microcontroller as center system so that become A later tools will connected with software components For do programming.

d) Testing tool
At stage This there is a testing process where is each function from system will tested start from resulting value until data accuracy, after That will done testing through tool ordinary electronics used, then results from testing the will submitted to the research this.

e) Implementation System
At stage This will specific to use electricity later daily will connected with tools, then system will carry out the process overall For adapt results with the testing process previously.

f) Conclusion
At stage This is conclusion from system built or study these, each point will explained in accordance with process results from study this.

3. Results and Discussion

3.1. Analysis Need

Based on study previously there is a number of need from analysis already done related monitoring system power electricity House IoT based (Internet of things) with use application telegram.

3.1.1. Input Requirements

Input requirements from monitoring system power electricity House IoT based (Internet Of Things) is as following:

a) Voltage sensor data.
b) Current sensor data.
c) Power sensor data.
d) Energy sensor data.

3.1.2. Output Requirements

Monitoring system output requirements power electricity House IoT based (Internet of Things) is as following:

a) Information voltage sensor value.
b) Information current sensor value.
c) Information power sensor value.
d) Information energy sensor value.

3.1.2. Software Requirements

Software requirements from monitoring system power electricity House IoT based (Internet of Things) is as following:

a) Arduino IDE
b) Telegram

3.1.4. Hardware Requirements

Hardware requirements of monitoring system power electricity House IoT based (Internet of Things) is as following:

a) ESP32.
b) PZEM-004T.
c) 16x2 LCD.
d) Male to female jumper cable.
e) Micro USB cable.

3.2. Planning channel Work system

Planning channel Work meter monitoring system electricity based Internet of Things can seen in the picture following:

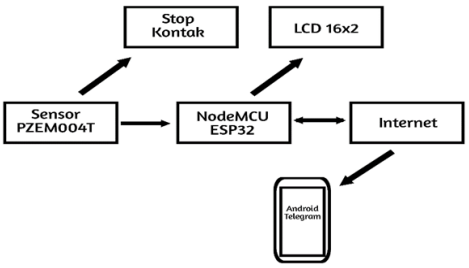

Figure 2. Workflow System

Based on Figure 1, this is the display from all over channel Work Meter monitoring system electricity based Internet Of Things with use ESP32 microcontroller will detect current electricity via the PZEM-004T sensor placed on the part containing cable current

electricity, then current data flowing electricity will processed on the ESP32 microcontroller then is displayed via a 16x2 LCD that can seen in a way straight away, Then can monitored through Telegram application .

3.3. Planning Hardware Components

On planning device hard This done planning component system controlling and monitoring consisting of from module NodeMCU ESP32, PZEM-004T, LCD 16x2, and socket. Current sensor PZEM-004T electric will give number related current electricity flowing in the system, the value given by PZEM-004T will be displayed on the 16x2 LCD, value the can processed return so that can monitoring through application Telegram messages as sending media order to NodeMCU ESP32.

Figure 3. Plan Design Hardware Components

3.4. Arduino configuration to ESP32

At stage configuration this, the ESP32 microcontroller requires intake power that can be streamed through USB cable already connected with computer, then ensure readiness microcontroller through Arduino IDE application, after the Arduino IDE is necessary add type microcontroller special for ESP32 via existing preferences provided Image below explains the configuration process from Arduino to ESP32.

Figure 4. ESP32 configuration

Figure 4 is the process for connecting the ESP32 microcontroller with a computer device. This process uses a Micro USB cable as a link between the ESP32 microcontroller and the computer.

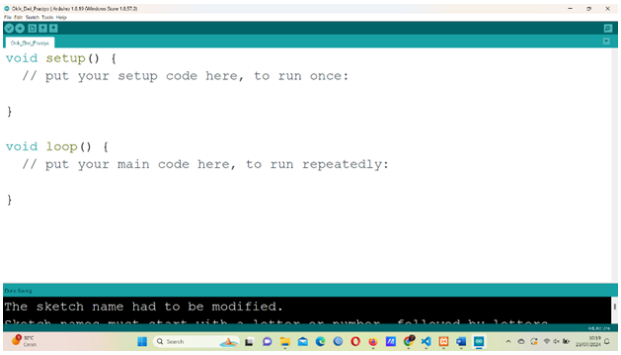

Figure 5. Arduino ID

Figure 5 is a basic view of the Arduino IDE which acts as a container or place for programming, then provides commands to the ESP32 microcontroller, any desired commands can be written and uploaded on the platform and can be passed on to other connected components.

3.5. Configuration PZEM-004T and ESP32 Electric Current Sensor

At this configuration stage, the PZEM-004T electric current sensor component will be connected to two parties, namely with the ESP32 and with a socket which will later be used as a test to find out in detail the electric current data used by each electronic device.

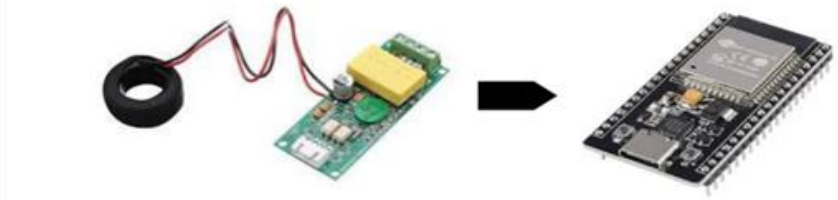

Figure 6. PZEM-004T configuration with ESP32

In Figure 6, the PZEM-004T component is the link between the electric current and the ESP32 microcontroller, where the PZEM-004T component takes the negative current flowing in the socket so that it can then be processed by the PZEM-004T component. The data taken by the PZEM-004T component is real-time where every change that occurs in the electric current will provide changes to the data which will be managed by the ESP32 microcontroller.

3.6. Implementation Results System

In part This will discuss related implementation from electricity monitoring system based Internet of Things (IoT), then will discuss related program writing via scripts or the source code will used in electricity monitoring systems, then lastly is testing from electricity monitoring system based Internet of Things (IoT) with use NodeMCU ESP32, PZEM-004T and LCD 16x2 as well with discuss advantages and disadvantages from electricity monitoring system based Internet of Things (IoT).

3.6.1. Hardware Implementation

On manufacture electricity monitoring system based Internet of Things (IoT), there is a number of components used among them is ESP32 microcontroller, PZEM-004T and 16x2 LCD. Each component own different positions, the ESP32 microcontroller as center control, PZEM-004T as related components direct with Electric current and a 16x2 LCD that has role as place data visualization. System will Work with stages beginning namely on the ESP32 microcontroller for carry out the initialization process system, then later PZEM-004T components will provide related data use current electricity in a way real-time, then the data provided by the PZEM-004T component will processed on the ESP32 microcontroller, after That ESP32 microcontroller will give order to 16x2 LCD components for displays existing data accepted from PZEM-004T components. In addition, the data displayed by the 16x4 LCD can be processed return so that can monitoring through Telegram Bot application as sending medium order to NodeMCU ESP32.

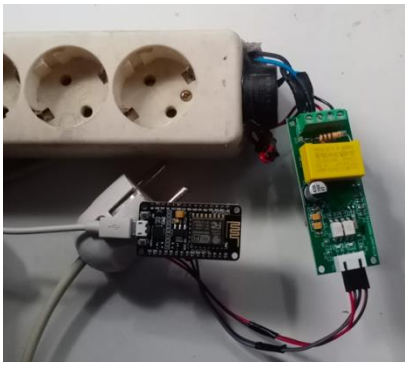

Figure 7. Initialize ESP32 with Computer and PZEM-004T

Figure 7 explains related installation the ESP32 microcontroller will role as the inner core system, then after ESP32 microcontroller is connected with computer, required installation or installation of libraries from other components such as PZEM-004T and 16x2 LCD. The purpose of installation or installing the library is For possible system in call and also operate other components through ESP32 microcontroller and Arduino IDE. Installation PZEM-004T components that have function For detect current flowing electricity, before PZEM-004T components are connected with ESP32 microcontroller, PZEM-004T components necessary connected with current flowing electricity, in research This socket is used For connected with later PZEM-004T components when there is a number of tool electronics used via the socket the then usage data current electricity from tools electronics used can is displayed through system.

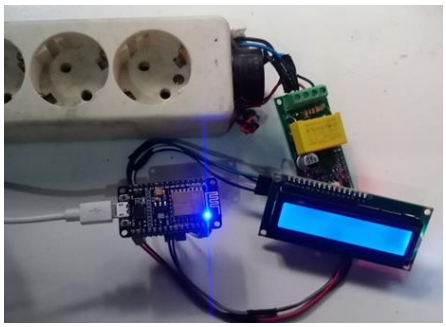

Figure 8. Installation 16x2 LCD components

In figure 8 there is an installation process Where will the 16x2 LCD components be 20x4 LCD components will own role as a visual medium that displays existing data taken by the PZEM-004T component later processed through ESP32 microcontroller.

3.6.2. Hardware Testing

In part This there is testing related existing hardware created, then will there is a number of points For tested later will become material development from study previous. On testing system will need tool commercial as reject measuring level accuracy system with objective For reduce mark error in the system. That matter required For ensure eligibility from existing electrical monitoring tools built, when mark errors that appear in the results testing of two tools the own a low number, then built electrical monitoring equipment can implemented in accordance with need from user.

3.7. Testing of the PZEM-004T Electrical Monitoring Tool

Testing electrical monitoring tool will leads in a way specifically on function main system, ie For monitor current electricity used then on to use energy will calculated become rupiah currency. At stage here, there is tool commercial power meter which is

function own level high suitability, so can made as standard functional system For measurement voltage, power, current and energy. Testing This done with use tool commercial power meters Then use Electrical monitoring tool built in research this, each tool will given sample tool the same electronics and also the time the same test, with so the results given can made reject measuring for determine suitability from two different tools. After results from testing the can seen, the resulting value of two tools the will processed and determined mark error that appears from second tool that, increasingly small mark error from second tool the Eat the more will Good level eligibility from existing tools built on research This. Following This is part from testing system with compare results from tool commercial power meter and results from tools built on research This.

Figure 9. Initial System Testing

In part beginning testing above, each of tool commercial and research - based tools This own the same value, with numbers starting with 0, later will can compared to along walking time, then in count time certain will known mark the comparison. Electronic devices used as a trial system this time is a laptop adapter, charger Power cell phone, fan wind and monitor. Each of tool electronic the connected with the existing socket integrated with tool commercial power meters and also electricity monitoring tools built in research where is this tool commercial power meter is connected with a socket that uses usage data the electricity Already can seen via a serial monitor from Arduino and also a 16x2 LCD component, with so in a way No direct second tool the own the same load. The time specified on the test This nature flexible, because during measured load reduced or plus, the results given to the tool commercial power meter or Electrical monitoring tool built in research This will give the same value.

Figure 10. Final System Testing

In part end study there is development mark along walking time already more from ten minutes, with energy that gives value 0.03 on the tool commercial and 0.02 on meter monitoring systems electricity IoT based. Value provided from second party own very small error value that is not enough than 1%, as well with results testing from voltage ,

power and current used from second tested tool. With So, you can concluded that given value own level high accuracy and built system can carry out electricity monitoring.

3.7.1. Testing Calibration System with Telegram Bot

Testing calibration done with objective For ensure mark or generated data when user do monitoring from distance far, where testing This done with method operate second system in a way simultaneously , the value produced by the 16x2 LCD component will be compared to with value generated by the Telegram Bot platform, if the results given by both system own similar values , then can confirmed If system can do monitoring from distance Far . Figure 10 will explain results from testing calibration system with paltofrm Telegram Bot.

Figure 1. Testing Calibration System with Telegram Bot

3.7.2. Testing System with tools Electronic

After system own mark low error when compared to with tool commercial The Power Meter and results provided by the Telegram Bot platform are compatible with system , then system can do testing with use tools ordinary electronics used . So that later each of them tool electronic can total consumption is known or use power used . There is a number of tool electronics used in testing system this , among others are laptop adapters, monitors, fans wind and filler Power cell phone . Following is results measurement from tools electronic with use system meter monitoring system electricity already built.

Table 1 Laptop Adapter Measurement Table

No	Measurement Time	Measurement Data Current	Power Measurement Data	Measurement Data Voltage	Measurement Data Energy
1	10 minutes	0.17A	18.90	219V	0.019 kWh
2	30 minutes				0.058 kWh
3	60 Minutes				0.125 kWh

Table 2 Monitor Measurement Table

No	Measurement Time	Measurement Data Current	Power Measurement Data	Measurement Data Voltage	Measurement Data Energy
1	10 minutes	0.16A	22.10	214V	0.026 kWh
2	30 minutes				0.069 kWh
3	60 Minutes				0.145 kWh

Table 3Measurement Tables Fan Wind

No	Measurement Time	Measurement Data Current	Power Measurement Data	Measurement Data Voltage	Measurement Data Energy
1	10 minutes	0.226A	22.70	221V	0.024 kWh
2	30 minutes				0.053 kWh
3	60 Minutes				0.075 kWh

Table 4. Measurement Tables Cell Phone Charger

No	Measurement Time	Measurement Data Current	Power Measurement Data	Measurement Data Voltage	Measurement Data Energy
1	10 Minutes	0.7A	7.20	228V	0.011 Kwh
2	30 Minutes				0.031 Kwh
3	60 Minutes				0.046 Kwh

4. Conclusions

The conclusions that can be drawn taken from System Monitoring Power Electricity House Based Internet Of Things Use Application Telegram is as following :

a) Designed tool succeed built become capable system monitor consumption Power of each equipment House ladder use between the face of telegram bots as an internet of things platform. For can know current and voltage PZEM-004T sensor is used . Data from the sensor processed from microcontroller NodeMCU ESP32.
b) Telegram can connect and communicate with tool or prototype with use intermediary API Telegram tokens are entered into the Node MCU ESP32 program. With use Telegram chat bot service as sender command and recipient reply from orders sent .
c) Testing tool This done with use burden from equipment electricity House ladder namely laptop adapter (0.17 A), monitor (0.16 A), fan wind (0.226 A) mobile phone adapter (0.7 A). Testing equipment electricity This done with same time namely 1 hour. Laptop adapter testing spent energy as much as 0.125 kWh, monitor testing consumes energy as much as 0.145 kWh, testing fan wind use up energy as much as 0.075 kWh, and cellphone adapter testing use up energy as much as 0.48 kWh. From testing This can We look at that one tool This can makes it easier in monitoring consumption on equipment electricity House ladder.

After progress of the research process with title system monitoring Power electricity House based Internet of Things with use application telegram, there is some necessary suggestions delivered with objective For give increase to study the kind that would done, the suggestions will be delivered is as following:

a) System can developed so that possible For displays usage data electricity in the meter electricity.
b) For processing usage data electricity can done from distance Far with using another platform.
c) On the system controlling namely telegram bot if possible For made more menu display interactive or user friendly . Even If possible Can use application more other online messengers common and numerous used.
d) Built system can do recapitulation use electricity during specified time.
e) System can developed For increase stable performance in term long time..

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