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Wireless Data Log & Control ῖ - Supervisory Control and Data Acquisition (SCADA)

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Abstract

The wireless data log & control - ῖ – SCADA is new control system designed for the industrial SCADA purpose with in capability of the new version of the industry 4.0. The total system from the RTU, Processors, HMI etc. will be wireless communicating with worlds most common protocol HTTP transmitted over the TCP. The (Human Machine Interface) HMI has the total control of the system with wireless to data log and to control the system. The HMI is any device which can communicate with HTTP protocol. The RTU is the built in standard type of input for sensor like viz. Temperature, Pressure, Inductive, Ultrasonic etc. and also trigger the output to inbuilt machinery relays. The output is triggered based on the decision made by the CPU. The RTU acts both as input and output. The data from RTU, HMI is sent to the central server for the process and control by the standard HTTP protocol. The alert algorithm handles the HMI direct alerts and indirect alerts like SMS and E-mail. Each individual RTU can be handled separately in the bus and have a M-Address for authentication and identification.

Keywords*: SCADA, RTU, HMI, Wireless communication*

1. INTRODUCTION

The current system is based on the conventional SCADA system. Where the connections are made through physical lines between every part system. Every connector has its own size and shape of the RTUs, HMIs, and Central Units etc. The PLC is used to trigger the relays and control other units. Each talking in its own standard protocol like Modbus, Since H1, OPE etc. These are the ways by which the conventional system is made. The current system has several drawbacks and to overcome those, alternative system with HTTP protocol over TCP where the data is sent from every nodes of RTU, PLC, HMI for more easier integration and cost reduction. The data is been totally secured through SSL and HTTPS. The communication is being stored in MySQL database and secured, at the time of storage zipped to a minimum sensor data of 9 Bytes.it can be availed any time.

The control team can monitor the data persistently to get updated on real time. Mostly the Touch interface can be optimal as the device can be handheld and carried to the machinery or in remote location. The RTU processor BCM2837, where the chip can handle all the HTTP protocol, input and outputs. Where the protection for some range is by ARM-A53 SOC and external protection for the high voltage inputs. Totally the system is connected by Wi-Fi based Internet Protocol (IP) communication.it can relay on IPv4 and also support new IPv6 version. It is to lower the overall configuration. The HMI can also be loaded by XML response. The central servers relays on PHP language and MySQL database storage.

2. LITERATURE SURVEY

S.B Belekar et al. [1] stated the SCADA systems involving of SCADA hosts, Remote Terminal Units (RTUs) and field devices monitor and control process equipment and systems from multiple locations and exchange data from various distributed control systems along the local and wide area networks. Main concept of our paper is “Data Acquisition and Control using PC". We are going to read the electrical data

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by the use of PLC and SCADA. Then the entire data will be displayed on SCADA. According to the readings controlling actions will be taken by the operator. A.Hossain and T.Zaman [2] describes the process automation factory operator interface is generally a Unit. HMI serves a highly vital role in developing a friendly visual environment between the client and the technology. It is considered to be the window to the automation control system. Controlling via finger touch has replaced the use of hammers and manual switches enormously. With the increasing application of HMIs in industry, a good number of software tools are being introduced and to develop the HMI display designing is incredibly increasing. This paper focuses on various important aspects in designing HMI displays to meet the quality criteria such as ease and seamlessness in user understanding. W.Stallings [3] stated the IPv6 is the latest version of the IP, the communications protocol (CP) that offers an detection and location system for computers on networks and methods traffic across the Internet. IPv6 was developed by IETF to deal with the long-anticipated problem of IPv4 address exhaustion. IPv6 is intended to replace IPv4. IPv6 is an inter-networking and provides end to end datagram transmission across multiple IP networks, closely adhering to the design principles developed in the previous version of the protocol, IPv4. IPv6 was first formally described in Internet standard document RFC 2460

3. OBJECTIVES

The foremost benefits of the proposal is

- To generate a control system for a test rig with data logging and alerts.
- The control relay of the test rig should be activated and triggered when it changes beyond the threshold.
- The control panel should have all control and Data log should start with search.
- The RTU should be at low cost and all controls and emergency stop.

4. METHODOLOGY

4.1. PROPOSED METHODOLOGY

The ϔ – SCADA is concept of the wireless data logging and control of the system in smaller footprint. The RTU's are made to accept inputs of various industrial standard sensors viz. temperature, Pressure , Inductive , Signal etc [4-5]. and also the RTU's will drive output relays which can trigger the machine stop , start and other actuators. The control system is designed in PHP language which runs a Apache server. The Database storage is by MySQL which has the best integration with PHP. The central system has the API for both the RTU and HMI integration. The multiple units of RTU's and HMI's can be connected and work in 802.11 a/b/g/n standard with IPv6 support. Each RTU is assigned with standard MAC Address and the Unique self-assigned M Address. The data is fetched by the microprocessor ARM Cortex A-53 SOC in the RTU with 64 bit. The processor has the ability of One-Wire, analogue, digital, i2C, Serial communication.so there will be more room for more channels. The One-wire sensors can handle multiple inputs in the single channel as it has digital input. Its digital data will not be interfered with other sensors. The HMI is made more general that any device with ability of HTTP protocol can work. The usual PC, Mobile, Tablet or industrial PC. The HMI will work in the browser and all the communication with the machine will work from there and the control centre can be made by using multiple same device HMI's without any external drivers. Overall the system is accessed wireless.

4.2. WORKING METHODOLOGY

The RTU's get the sensor data and has the M. Address which represents the particular machine. The access point connected sends the encrypted data to the central server and stores in MySQL database. The HMI when opened, the selection of the machine number which opens the Dials, Log chart. The HMI shows the real time data from the sensors. The machine is switched off when the threshold exceeds.

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4.3. SYSTEM ARCHITECTURE

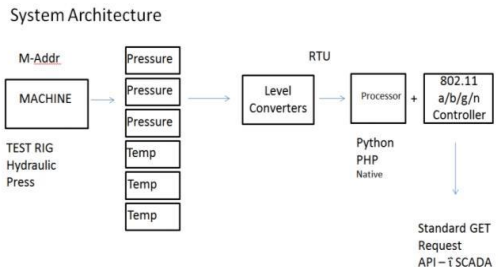

Fig.1. System Architecture RTU

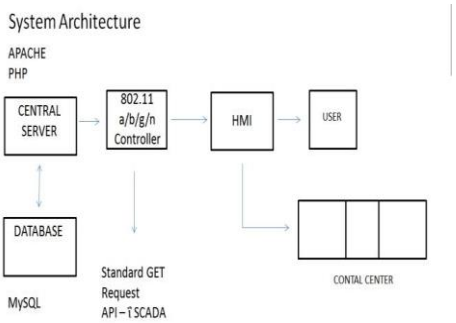

Fig.2. System Architecture HMI

4.4.PROGRAMMING ARCHITECTURE

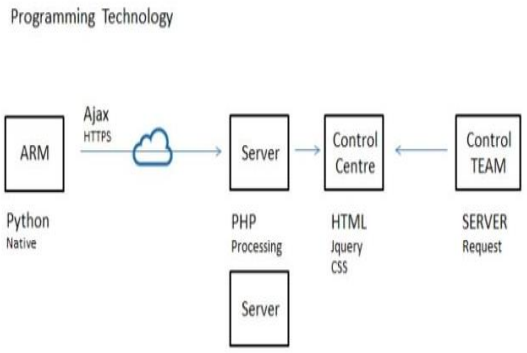

Fig.3. Programming Architecture

4.5.RTU CODE - PYTHON

```
import os
import glob
import time
import urllib.request
import button
button_shutdown=button(input , 2)
button_reset=button(input,3)
os.system('modprobe w1-gpio')
os.system('modprobe w1-therm')
```


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```
base_dir = '/sys/bus/w1/devices/'
device_folder = glob.glob(base_dir + '28*')[0]
device_file = device_folder + '/w1_slave'

def read_temp_raw():
   f = open(device_file, 'r')
   lines = f.readlines()
   f.close()
   return lines

def read_temp():
   lines = read_temp_raw()
   while lines[0].strip()[-3:] != 'YES':
      time.sleep(0.2)
      lines = read_temp_raw()
   equals_pos = lines[1].find('t=')
   if equals_pos != -1:
      temp_string = lines[1][equals_pos+2:]
      temp_c = float(temp_string) / 1000.0
      temp_f = temp_c * 9.0 / 5.0 + 32.0
      return str(temp_c)
while True:
      if(button_shutdown.pressed()):

os.system(‚sudo shutdown -h now‘)

     elif(button_reset.pressed()):

  output(4,high)

     else:

       print(read_temp())
 url =
"http://192.168.43.54/wabco/www/controllers/data_store.process.php?m=1&
p1="+read_temp()
response = urllib.request.urlopen(url).read().decode(‚UTF-8‘)
print(response)

if(response == ‘1!’)
led_error(10,high)
output_error(11,high)
elif(response = ‚1!‘)

led_error(10,low)
```


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```
output_error(11,low)
time.sleep(0.01)
```

4.6. DATABASE FETCH CONTROL CENTRE CODE – MySQL

```
<?php
   header('Content-Type: application/json');
include_once
$_SERVER['DOCUMENT_ROOT'].'/wabco/includes/db_connect_1.inc';
//include_once
$_SERVER['DOCUMENT_ROOT'].'/wabco/includes/session_start.class.inc';

include_once
$_SERVER['DOCUMENT_ROOT'].'/wabco/classes/data_read/value_read.class.ph
p';  // machine parameters get / set

if(isset($_GET['m']) && $_GET['m'] != '')
{
      $m_no=$_GET['m'];
      $array[0][]=$m_no;
      for($i=1;$i<6;$i++)
      {
       $par='p'.$i;
       $p=new value_read_class;
       $data_p=$p->read($m_no,$par,$mysqli);

       if($data_p[0] == '-1')
       {
        break;
        }
       $p_d=array($par,$data_p);
       $array[1][]=$p_d;       //  $value,$min,$max,$status,$m_status  Parameters}
      for($i=1;$i<5;$i++)
   {
       $par='t'.$i;
       $t=new value_read_class;
       $data_t=$t->read($m_no,$par,$mysqli);

       if($data_t[0] == '-1')
       {
        break;
       }
       $t_d=array($par,$data_t);
       $array[2][]=$t_d;       // $value,$min,$max,$status,$m_status  - Parameters
      }
```


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```
if($data_p[0] == '-1' || $data_t == '-1')
{
 $array[1][]='Machine Not Exists';
 echo json_encode($array);
}
else
{
 echo json_encode($array);
}
}
else
{
echo 'Empty Machine';
}
?>
```

4.7. CONTROL CENTRE DISPLAY CODE – PHP – HTML – MATERIALIZE FRAMEWORK

```
<!DOCTYPE html>
<html>
<head>
<title>
 POLLING PANEL
  </title>

      <meta name="viewport" content="width=device-width, initial-scale=1" />
    <link rel="stylesheet" href="/store/materialize/materialize.min.css"
type="text/css" />


<link rel="stylesheet" href="/store/materialize/iconfont/material-
icons.css" type="text/css" />


<script src="/store/javascript/jquery-2.1.4.min.js"
type="text/javascript">

</script>
  <script src="/store/materialize/materialize.min.js"
type="text/javascript">
  </script>
       <script>

$(document).ready(function()
   { setInterval(function() {
      $('tbody').empty();
```


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```
        var id=1;
        $.ajax({
           type: 'GET',
           url: 'poll_process.php',
           data: {id:id},
           dataType: 'json',
           cache: false,
           success: function(result)
           {   var n1=parseInt(result.length);
             for(var j=1;j<=n1;j++)
              {
              for(var i=0;i<4;i++)
                  { $('tbody').append('<tr>'+

                  '<td>'+j+'</td>'+

                  '<td>'+result[j-1][i]+'</td>'+

                  '<td>'+result[j-1][i+4]+'</td>'+

                  '</tr>');

                }
            }

         }
     });

     }, 500);

     $('#ref').click(function(){
        window.location.replace('home.php');
     });
  });
                        </script>
          </head>
          <body class="blue-grey lighten-5">
     <div class="navbar-fixed">
                                  <nav>
<div class="nav-wrapper
blue accent-2  ">
<a class="brand-logo">    
   VOTE CASTING SYSTEMS </a>
                                  </div>
                        </nav>
```


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```
            </div
              >
<br />
            <br
              />
          <div class="row">
          <div class="col  s12  l6 m8 offset-l3  offset-m2" id="list1">
```

4.8.PROGRAM OUTCOMES

Fig.4. HMI Virtual Simulator

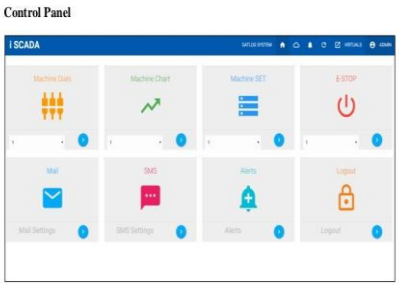

Fig.5. Control Panel

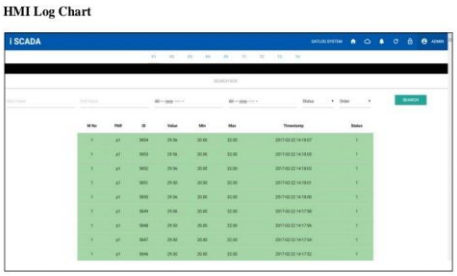

Fig.6. HMI Data Log-chart

Fig.7. HMI Dials Machine Data

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5. CONCLUSION

The i-SCADA system is being implemented and tested in the company in with the real time data logging and the HMI is accessible remotely with all systems and mobile phones. The test rig when it crosses it's threshold the alerts are shown in HMI and also with SMS and EMAIL. The working prototype is completed and the project is ready to make it in large scale RTU. The central system is equipped with the PHP and MySQL installed for the process and the database.

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