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Highlights

- Antenna Factor Calibration
- Assessment of Energy Security
- The Example of Pridnestrovye
- WiFi Trading System with Metal

Discovering Thoughts, Inventing Future

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Classification of States of Power Systems

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Pridnestrovian State University

Abstract- The article suggests a classification of states of the power system. The descriptions of each state are given. The point scale of states of the power system have had been formed. The examples describe the state of the real power system with the application of this scale of states are given.

Keywords: *the indicator method, power system.*

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Classification of States of Power Systems

Fedorcenco G.S. [α] & Fedorcenco S.G. [σ]

Abstract- The article suggests a classification of states of the power system. The descriptions of each state are given. The point scale of states of the power system have had been formed. The examples describe the state of the real power system with the application of this scale of states are given.

Keywords: the indicator method, power system.

I. Introduction

To describe the state of the power system of the country (territory, region, locality) is formed the list of indicators (indicators), the values of which allow to describe from different direction of its current state. However, the interpretation of the same value of the indicator will depend on what tasks currently are solved for the power system, or in other words, in what mode it operates. In this paper, we tried to identify possible modes of operation of the power system and their relationship with the state of country economic complex. The power system includes the following major components:

1. The electricity sector;
2. Gas pipeline complex (natural gas);
3. Liquid gas complex (LPG);
4. Providing liquid fuels (gasoline, diesel fuel, fuel oil, etc.);
5. Providing solid fuels (coal, wood, etc.).

Obviously, these components are working, at first glance independently of each other, but in fact, they are interacting with each other and form a single energy complex. Energy complex provides operation of economic complex, in particular:

- Enterprises;
- Institutions;
- Transport;
- Infrastructure (eg, housing, water supply, sewerage, heating, communications), etc.

To describe the state of the power systems is used the indicative analysis method [1]. For each indicator is formed its own scale of points, which permits to pass from the named values of the indicators to their dimensionless evaluation, which is expressed in points of scale. Let us try to apply this approach to the entire energy system entirety with some modifications.

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II. The Basic Modes of Operation of the Power System

Consider the possible modes of the operation of the power system (Table 1). As a first approximation, by analogy with [1] it is distinguished three basic modes of operation, shown in the first column of Table 1:

- Normal;
- The pre-crisis;
- Crisis.

Table 1: Modes of operation of the power system

Modes of operation of the power system		Points
Basic	Detailed	
Normal	Normal 1	1
The precrisis	The initial precrisis	2
	The developing pre-crisis	3
	The critical pre-crisis	4
The crisis	The unstable crisis	5
	The threatening crisis	6
	The critical crisis	7
	Extraordinary crisis	8

Consider these three basic modes of operation of the power system more detailed

Normal mode of operation: The power system provides the uninterrupted supply energy of all types of the consumers in any time of the day, in any day of the week, in any time of year.

The pre-crisis mode of operation of power system: Power system mainly provides the supply the customers with all kinds of energy, except:

- The number of cases of periodic failures in securing energy resources in some time intervals (time of the day, certain days of the week, few times of the year), that has a significant, but not critical impact on the work of the national economic complex and infrastructure;
- It is fixed the lack of a number of types of energy resources; for minimizing the damage it is formed a coordinated work schedules of different users, including segments of the national economy, transport; execution of the basic functions of the national economic complex, infrastructure it is provided with energy resources.

III. Detailed Modes of Operation of Power System

As more detailed inspection, by analogy with [1], can be separated 8 modes of operation of the power system:

- Normal;
- The Initial precrisis;
- The developing precrisis;
- The critical precrisis;
- The unstable crisis;
- The threatening crisis;
- The critical crisis;
- Extraordinary crisis.

To describe the state of the power system we can use a scale of points, that is given in the last column of Table 1.

Let us examine those modes of power system more detailed.

Normal mode: power system provides an uninterrupted supply of all types of energy consumers at any time of the day, any day of the week, and any time of the year. Crashes, that occur, satisfy the accepted norms.

The initial precrisis: Energy system basically ensures uninterrupted supply to customers of all kinds of energy, except:

- A number of cases of failure of providing energy at some time intervals (some time of the day, some days of the week, few times a year), the duration of them do not significantly interfere with the operation of an economic complex, infrastructure of the region;
- The lack of a number of individual types of energy resources, but the lack of them does not have a significant impact on the work of the national economic complex, infrastructure;
- Operation of economic complex, infrastructure, mainly, is provided by energy.

*The developing precrisis: E*nergy system basically ensures uninterrupted supply to customers all kinds of energy, except:

- A number of cases of failure in supplying of energy at some time intervals (some time of the day, some days of the week, a few times a year), the duration of them is taken into account in the formation of an agreed schedule of institutions, organizations, but has no significant effect on the operation of an economic complex, infrastructure;
- The lack of a number of some types of energy resources, for them compensation is necessary to do corrections in the work schedule of the equipment, vehicles, infrastructure component;
- Operation of the economic complex, infrastructure basically ensured with energy resources.

The critical precrisis: Power system, mainly, provides the supply to customers all kinds of energy, except:

- A number of cases of failure to provide energy at some time intervals (some time of day, some days of the week, a few times a year), the duration of them is taken into account in the formation of the work schedule, institutions and organizations, which limits the operation of the national economic complex, infrastructure and hinders their development;
- The lack of a number of some types of energy, to compensate them, it need to make adjustments in the list (or schedule) of work of the equipment, vehicles, infrastructure;
- Operation of a number of segments of the economy, transport, infrastructure is under the strict administrative regulation;
- Operation of economic complex, infrastructure basically ensured by energy resources, but in clearly marked limits.

The unstable crisis: Power system provides an uninterrupted supply of all types of energy consumers by all types of energy resources, except for:

- A number of cases of failure in providing of energy resources at some intervals of the time (some time of the day, some days of the week, a few times a year). Their duration is taken into account in the formation of the schedule of work of the institutions, organizations, companies, which limits the operation of the national economic complex, infrastructure and hinders their development;
- Are possible unexpected failures in the operation of the energy complex, which leads to a halt of the work organizations, enterprises, transport, components of infrastructure, but their total duration does not pass over of the critical values;
- There is shortage of some types of energy resources to compensate them is necessary to correct the timetable or list of the work of the equipment, vehicles, infrastructure component, some number of them are stopped or are rarely used;
- Operation of economic complex, infrastructure are ensured with energy resources, but into clearly defined limits, there are unexpected disruptions in energy supply.

The threatening crisis: Power system provides supply to the consumers the main types of energy resources, however:

- Providing with energy resources taking place only in some intervals of time (some time of the day, some days of the week, a few times a year). Their duration is taken into account in the formation of the schedule of work, institutions, organizations, enterprises and leads to a substantial restriction of functioning of some segments of the economy, transport and infrastructure;

- There are unexpected failures in work of the energy sector, that leads to a halt the work of organizations, enterprises, transport components of infrastructure and have a significant impact on the efficiency of their operation;
- It is fixed shortages of some types of energy resources, for their compensation it is stopped the work of some enterprises, transport segments, infrastructure, that results to the significant adjustments to the list of works or work schedule of the equipment, vehicles, infrastructure components;
- Basically, energy resources are ensured the functioning of energy economic complex, infrastructure, but its performance falls.

The critical crisis: Power system is not able to ensure the supply of energy consumers with all kinds energy resources, thus:

- There are periodic disruptions in supply the energy resources in some intervals of time (some time of the day, some days of the week, a few times a year). Their duration is taken into account in the formation of the schedule of work, institutions, organizations, enterprises and leads to a substantial restriction of functioning of some segments of the economy, transport, infrastructure, the closure of some companies, the cessation of the operation of a number of transport and infrastructure segments;
- There are periodic disruptions in supply of the energy resources in some intervals of time (some time of the day, some days of the week, a few times a year). Their duration of is taken into account in the formation of the schedule of work, institutions, organizations, enterprises and leads to a substantial restriction of functioning of some segments of the economy, transport, infrastructure, the closure of some companies, the cessation of the operation of a number of transport and infrastructure segments;
- The development of all spheres of economic complex, transport, infrastructure is impossible.

Extraordinary crisis: Power system provides the main types of energy resources only critical segments of the national economic complex, infrastructure:

- It is fixed the significant interruptions in energy supply, which leads only to the work of limited number of critical institutions, organizations, enterprises, functioning only partially a number of segments of transport, infrastructure;
- It is fixed an acute shortage of certain types of energy resources, which leads to a significant restriction in work of enterprises, transport segments, infrastructure;
- It operates a small part of the national economic complex, infrastructure, which have critical important value.

IV. Classification of States of the Power Energy System, Examples

Example 1: The Blackout in the Crimea, November 22, 2015 Electricity supplies to the Crimea from Ukraine completely are stopped. Power grids of Peninsula operate in standalone mode. Own generation of electrical energy, about 350 megawatts - a CHP mobile gas turbine power plants, solar sources and wind generators. However, this is less than half of the required power. Crimean power grid needs about 800 megawatts to work without constraints. Only the big cities of the peninsula supplied with electricity. Rolling blackouts are carried out every four hours. The uninterrupted supply with electricity is available only for hospitals and critical infrastructure - bakeries, treatment facilities, etc. The kindergartens and schools are not completely provided with electricity. As a results, some schools have short mode of working, kindergartens are temporarily closed. The commercial office of State Electricity Company makes electricity supplies the consumers in the alternate mode: two hours the electrical energy is switched on and six hours is switched off.

After shutting down the electrical supply, mainly part of constructions are frozen. Deliveries of natural and liquefied gas, fuel oil remain in the previous volumes. Communication and public transport, covering the needs of the population and enterprises are worked. [2]. in our opinion, the grid of the Crimea state can be classified as 6 points.

Example 2: In 2000, in Pridnestrovie there was a severe accident with falling poles, breakage of wires and large power outages. It started in the night of 26 to 27 November as a result of intensive icing HVL 330 kV and below. Damage occurred due to the fact, that the values of ice load were many times higher, than permissible values by the project. As a result of massive outages have been completely de-energized Rybnitsa and Kamenka regions, as well as partially Dubossary and Grigoriopol districts. The fall of supports are continued until 6 December 2000. Without electricity have remained 88 settlements, most of the industrial enterprises and farms. The water supply was stopped and, as a result, the normal work of the hospitals, schools, kindergartens, etc. in Rybnitsa and Kamenka. All transit HVL which could provide electricity the region from Ukraine and Moldova through substations Rybnitsa and Kamenka were damaged. On our opinion, the state of the grid Rybnitsa and Kamenka regions can be classified as 7 points.

V. Conclusion

In the present article is described the classification of the possible grid conditions. Each state is assigned a certain number of points. This

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classification can be used when considering the country's power grid, region, city, etc.

List of used Sources

1. Методы расчета и анализ показателей энергетической безопасности: [Моногр.]/ Быкова Е.В.; под ред.: В.М. Постолатия; Акад наук Молдовы, Ин-т энергетики. – К.: Б. и., 2005 (Tipogr. A.S.M) – 158 p. – (Сер. "Энергетическая безопа сность республики Молдова").
2. http://www.rbc.ru/business/30/11/2015/565afa7c9a794701e74d90ee

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Receiving Antenna Factor Calibration Improvement

By Valentino Trainotti

Abstract- In a radio link two different or identical antennas are used each one performing a different role. For electromagnetic compatibility activities the receiving antenna factor is of paramount importance in order to measure the incoming spurious power density or electric field of any electrical or electronic device. Calculations as well measurements are performed to achieve this task using traditional equations and antenna software to get quick and simple results. Power transmission loss (Friis Equation) is only valid in free space as a general belief but in this paper it is proven that this principle is valid also for radio links over perfect ground [16], [17]. This statement permits the exclusion of any artificial factor to achieve the radio link power budget and power reciprocity principle [12], [21]. This fact takes into account the lack of losses in the natural space between both antennas as well in the perfect ground plane. At the same time, over perfect ground the total EM energy is travelling in a straight line connecting the transmitting (Tx) antenna radiation center and the center of the receiving (Rx) antenna, exactly like a radio link in free space, [16]. In order to improve the antenna factor calculation and calibration the procedure analizes all the parameters at any height of the Rx antenna for a fixed height of the Tx antenna at not only the maximum radiation over perfect flat ground plane. Result is achieved by a metallic ground plane where the conductivity is higher than 107S/m, so the reflexion coefficient module is exactly one.

Keywords: antenna factor, antenna gain, effective area, effective length, perfect ground plane, free space, half-wave dipole antenna.

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RECEIVINGANTENNAFACTORCALIBRATIONIMPROVEMENT

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Receiving Antenna Factor Calibration Improvement

Valentino Trainotti

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Keywords: antenna factor, antenna gain, effective area, effective length, perfect ground plane, free space, half-wave dipole antenna.

I. Introduction

In a radio link over perfect ground traditionally two antennas are used for calibration of antenna factors. Independent of distance parameters of a receiving antenna are the effective length L_{eR} or effective height H_{eR} as well the antenna factor $AF(dB/m)$. These specific parameters depend only on the current distribution along the antenna physical structure. Other parameters like effective area A_e and gain g are strongly dependent of the antenna location and precisely in the free space far field over ground. This condition is obtained when the wave impedance Z_w achieves the value of $Z_w = Z_{oo} = 120\,\pi \cong 377\,(\Omega)$. The wave impedance is the relation between the electric and magnetic fields. Also, over perfect ground it depends, on the transmitting antenna radiation pattern elevation angle α_L and distance r over ground between both antennas. This condition is not achieved at a fixed distance r but at a different distance depending by the corresponding radiation at any angle α_L. This condition is achieved at a shorter distance r' when the maximum radiation is obtained by the transmitting antenna. r' is the distance along a straight line of an elevation angle α_L departing from the ground plane shown in Figure 1. This point is the radiation phase center of the transmitting antenna. This distance r' is not obtained by a simple task but nowaday it can be determined by an antenna software [13]. This way the far field condition can be obtained and verifying it if at standard distances r the task is fulfilled [17].

At the same time, it is important to know that the wave power density flows in space travelling along the r' straight line between the radio link antennas [16]. In the radio link in free space the distance r' is exactly equal to the distance r if both antennas are identical. The transmitting antenna works over perfect ground with its image under ground and constitutes an array of two elements [2]. Its radiation pattern depends on the separation S between them, exactly like a two element array works in free space. For this reason for horizontal polarization the maximum radiation has an elevation angle α_L according to this separation S or its height over ground H_T and a null of power density on the perfect ground. Over ground this separacion is $S = 2\,H_T$. Figure 1 shows a sketch of a transmitting antenna over perfect ground. Rx antenna receives the EM waves from the actual antenna and its image and it delivers the received power on only its load resistance R_L and no EM waves are received on its image. This statement is very important. This way the Rx antenna in its receiving role is working like in free space even if it is working over perfect ground [2],[3],[17].

II. Calculation

The transmitting antenna (half-wave dipole) has a radiation pattern over perfect ground permitting to calculate its gain G_T (dBi) for horizontal polarization. The original Dr. Kraus electric field gain equation over perfect ground is being updated to provide the power gain in dBi as a function of antenna height H_T for various elevation angles α_L of the radiating element, to be [2]:

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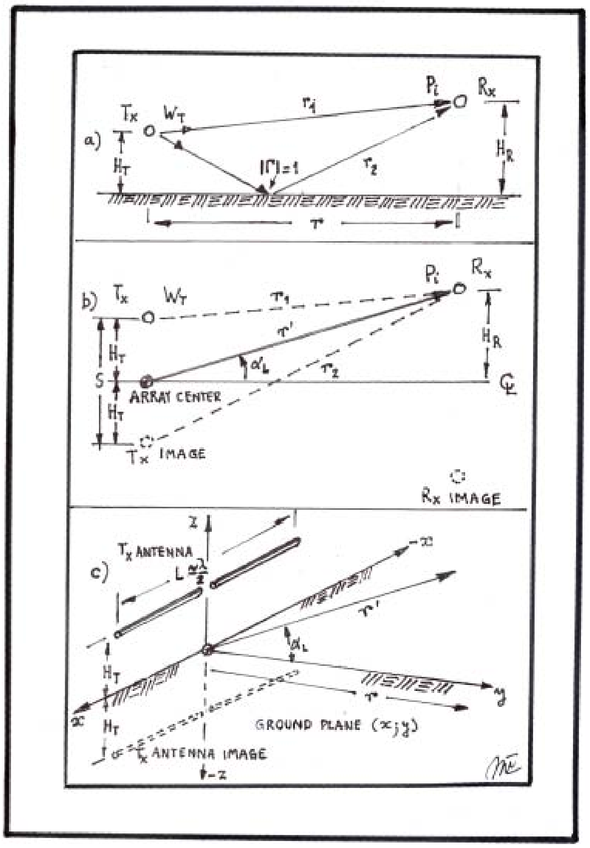

Figure 1: Transmitting Antenna over perfect ground. The elevation angle α_L starts from the physical array center or transmission center phase. Antennas are shown for horizontal polarization

$$G_T = 10\,log[F\,(2(\,sin(\beta\,H_T\,sin\alpha_L)))^2] + 2.15 \quad [dBi] \quad (1)$$

Where:

$2.15dBi$ **is the half wave dipole antenna gain over an isotropic source in dB.**

F is a factor taking into account the radiation resistance in free space and over perfect ground, or:

$$F = \frac{R_{a(FF)}}{R_{a(OG)}} \quad (2)$$

$$R_{a(OG)} = R_{a(FF)} \pm R_m \quad [\Omega] \quad (3)$$

$R_{a(FF)}$ **Tx antenna radiation resistance in free space.**
$R_{a(OG)}$ **Tx antenna radiation resistance over perfect ground.**
R_m **is the mutual resistance between Tx antenna and its image.**
β **is the space phase constant [Rad/m] or** $[°/m]$**.**
H_T **is the transmitting antenna height over perfect ground [m].**
α_L **is the elevation angle over ground from the array center phase located in the ground plane.**
r' **is the distance between the array phase center and the receiving antenna center over ground.**
$0.9 \leq F \leq 1.1 for H_T \leq \lambda$
You may use this simple equation to calculate the gain radiation pattern of a very thin half wave dipole antenna at any height H_T **and obtain the far field gain. However, for more data result for this antenna at any frequency the aid of a software program will help reduce the tediousness of individual calculation to generate the radio link geometry for the specific antenna parameters [13]. These paramenters are: the input antenna impedance, the current distribution on the antenna structure, the electric and magnetic fields, the power density on the location of the Rx antenna in space over ground, as well the gain radiation pattern in dBi in the far field. From the electric and magnetic field relation the wave impedance** Z_w **is determined at a specific location in space. Also from the radiation pattern the antenna gain in the far field for any elevation angle is obtained [13].**
This procedure is performed easily at any frequency in the wanted spectrum.
Here an example at the frequency of $f = 30$ **[MHz] is shown.**
A radio link has two horizontally polarized half-wave dipole antennas as recommended by the Standard ANSI-IEEE C 63-5-2017 [18].
Tx antenna is resonant with a radiation resistance:
$R_{aT} = 62.6\Omega.(VSWR_{73} = 1.16)$
Tx antenna height $H_T = 2[m]$**.**
Rx receiving antenna is located at a distance $r = 10[m]$**.**

Results:

Tx antenna power input $W_T = 1$ **[W], [0 dBW].**

Tx antenna length at resonance $L = 4.693[m]$ **for a radius** $a = 1.5[mm]$**.**
Tx antenna height over ground $H_T = 2$ **[m].**
Tx antenna input resistance $R_{aT} = 62.6\ [\Omega]$ **in resonance.**
Distance between antennas measured on the ground plane $r = 10$ **[m].**
Tx antenna radiation elevation angle $\alpha_L = 21.8$ **[°].**
Rx antenna height for relative maximum power density or field $H_R = 4[m]$**. Maximum Rx antenna height available.**
Electric field $E_i = 6.232E - 1$ **[V/m], (-4.11 [dBV/m]).**
Magnetic field $H_i = 1.777E - 3$ **[A/m].**
Power density $P_i = 1.107E - 3\ [W/m^2]$**.**
Wave impedance $Z_w = 350.7\ [\Omega]$**.**
True Tx antenna numerical gain $g_T = 1.61$**.**
True Tx antenna gain $G_T = 2.08$ **[dBi].**
True Tx antenna gain $G_T = 10 log g_T$ **[dBi].**
Rx antenna effective length $L_{eR} = 3.1831[m]$**.**
Distance between Tx center phase and Rx antenna center r' = 10.77 [m].
Rx antenna induced voltage $V_i = 1.98$ **[V].**
Rx antenna current $I_R = 1.36E - 2$ **[A].**
Rx antenna receiving voltage $V_R = 9.92E - 1$ **[V].**
Rx antenna receiving power $W_R = 1.34E - 2$ **[W].**
Radio link transmission loss or site attenuation $A_w = -18.70$ **[dB] [4],[10].**

Free space loss $A_{FS} = -22.63$ [dB] [1].
Loss Relationship $K = A_w - A_{FS} = 3.93$ [dB][14].
Rx antenna effective area $A_{eR} = 12.17$ [m^2][6].
Rx antenna numerical gain $g_R = 1.53$.
Rx antenna gain $G_R = 1.85$ [dBi].
Rx antenna gain $G_R = 10 log g_R$ [dBi].
Friis equation gain, Tx antenna gain check [1].
$G_T = K - G_R = 2.08$ [dBi] (Friis Power Budget fulfilled).
Rx antenna factor $aF_{R73} = 0.628$ [1/m].
Rx antenna factor $AF_{R73} = -4.04$ [dB/m].
Rx antenna factor $AF_{R50} = -2.40$ [dB/m].
Tx antenna factor $aF_{T73} = 0.612$ [1/m].
Tx antenna factor $AF_{T73} = -4.27$ [dB/m].
Tx antenna factor $AF_{T50} = -2.02$ [dB/m].
Normalized Site Attenuation
$NSA = A_w - AF_{R50} - AF_{T50}$ [dB].
$NSA = 18.70 - (-2.4) - (-2.02) = 23.12$ [dB].

Using the equation [7] of Standard C 63-5-2004, [18]. the result is found to be:

$AF_{50} = 10 log f_{MHz} - 24.46 + 1/2[E_{iM} + A_w]$.
$AF_{50} = 14.77 - 24.46 + 1/2[-4.11 + 18.70] = -2.40$ [dB/m].

The result is exactly the same as obtained by the Rx antenna factor AF_{R50} so it cannot be used for the Tx antenna factor AF_{T50} because it has a different value. In this case two identical antennas has been used and this equation [7] cannot solve the problem.
The Federal Communication Commission (F.C.C.) are giving an equation to calculate the transmitting or receiving antenna factor if the far field distance is fulfilled ($Z_w = Z_{oo} = 120\pi$) and for $R_L = 50\Omega$.
In EMC activities this task is generally not achieved because the distance r or the antenna height H_R over ground is not large enough. At the frequency of $f = 30MHz$ this distance it is not really achieved to fulfill the intrinsic impedance but quite close to it ($Z_w = 350.7(\Omega)$). However, this equation is calculated by the radio link obtained results, thus:
$AF_{50FCC} = 20 log f_{MHz} - 29.78 - 10 log g_R$ [dB/m]
$AF_{R50FCC} = 29.54 - 29.78 - 1.85 =$ -2.09 [dB/m]
$AF_{T50FCC} = 29.54 - 29.78 - 2.08 =$ -2.32 [dB/m]

The small difference in the Tx and Rx antenna factors are due to the $Z_w \cong Z_{oo}$.
In order to check the performed procedure, the power budget obtained by the Friis Equation [1], valid also over perfect ground, is checked. The results are presented for the frequency of f= 30 MHz. They also are fulfilling the Friis Equation at any frequency in the spectrum of 30 to 1000 MHz as were checked accordingly.
Verification of the radio link behaviour is performed by the power budget of the Friis Equation [1] and the Power Reciprocity Principle by Schelkunoff and Friis [3],[17], thus:
Friis Equation for f= 30 MHz calculation

Table 1: Results of Antenna Gains (G_R; G_T) and Factors (AF_{R50}; AF_{T50}) and RX Antenna Effective Area (A_{eR}) FOR (H_T = 2 [M] and r = 10 [M]

f (MHz)	H_R (m)	G_R (dBi)	G_T (dBi)	AF_{R50} (dB/m)	AF_{T50} (dB/m)	A_{eR} (m^2)
30	4.00	1.85	2.08	-2.40	-2.02	12.17
50	4.00	2.11	3.52	2.04	-0.51	4.65
70	4.00	2.19	6.65	4.96	0.25	2.41
100	4.00	2.21	8.67	8.06	2.43	1.19
200	1.91	2.23	7.53	14.08	8.48	0.30
300	1.25	2.24	7.92	17.60	11.98	0.13
500	0.75	2.24	7.75	22.06	16.43	0.05
700	0.54	2.24	7.99	24.96	19.36	0.02
1000	0.37	2.24	7.97	28.06	22.40	0.01

Table 2: Results of TX Antenna effective area (A_{eT}), Transmission Loss or Site Attenuation (A_w), Free Space Attenuation (A_{FS}), Wave Impedance (Z_w), Normalizes Site Attenuation (NSA) and Maximum Electric Field Strength (E_{iM}), As a Function of Frequency for (H_T = 2 [M] and r = 10 [M]

f (MHz)	A_{eT} (m^2)	A_w (dB)	A_{FS} (dB)	Z_w (Ω)	NSA (dB)	E_{iM} (dBV/m)
30	12.81	18.70	22.63	350.7	23.12	-4.11
50	6.45	21.43	27.07	372.6	19.90	2.40
70	6.77	22.16	29.99	378.6	15.95	0.80
100	5.27	22.21	33.09	381.4	11.72	2.85
200	1.02	28.83	38.62	383.5	6.27	2.25
300	0.49	31.89	42.05	383.8	2.31	2.70
500	0.17	36.46	46.45	384.0	-2.03	2.57
700	0.09	39.12	49.35	384.0	-5.20	2.84
1000	0.04	42.23	52.45	384.2	-8.23	2.82

$G_T + G_R$ = $A_w - A_{FS}$ [dB].
$G_T + G_R$ = 2.08 + 1.85 = 3.93 [dB].
$A_w - A_{FS}$ = -18.70 -(-22.63) = 3.93 [dB].
3.93 = 3.93.
Friis radio link Power Budget is perfectly fulfilled.

Power Reciprocity Principle for f= 30 MHz according to Schelkunoff and Friis is also perfectly well fulfilled, or:

$$\frac{A_{eT}}{g_T} = \frac{12.81}{1.61} = 7.96 \tag{4}$$

$$\frac{A_{eR}}{g_R} = \frac{12.17}{1.53} = 7.96 \tag{5}$$

Using the same procedure for all the frequencies in the spectrum from 30 MHz to 1000 MHz the results are presented in table I and table II. Only some frequencies are presented in these tables.
Calculation of several frequencies for the radio link of $H_T = 2[m]$ and $r = 10[m]$ along the spectrum from 30 to 1000 MHz are presented in Figure 2, Figure 3 and Figure 4.
The transmission loss or site attenuation A_w results are located on a straight line as plotted for the logaritmic of frequency. A deviation is shown in the lower part of the spectrum where the transmitting antenna (Tx) height (H_T) do not permit to get its maximum radiation between

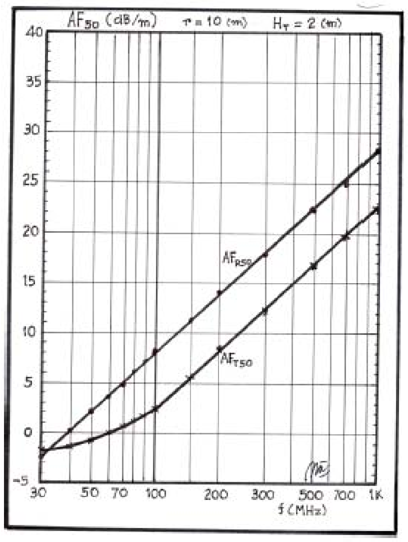

Figure 2: Radio link (H_T = 2[m] and r = 10[m]) Antenna Factors AF_{R50} and AF_{T50} shown in the spectrum of 30 to 1000 MHz

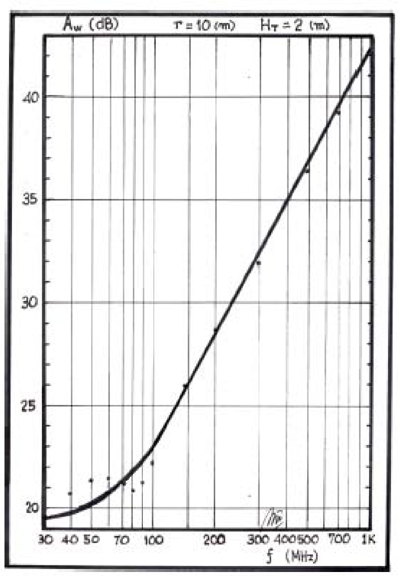

Figure 3: Radio link (H_T = 2[m] and r = 10[m]) Transmission Loss or Site Attenuation A_w shown in the spectrum of 30 to 1000 MHz

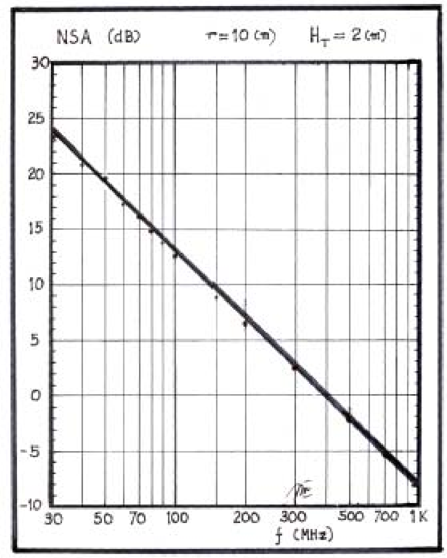

Figure 4: Radio link (H_T = 2[m] and r = 10[m]) Normalized Site Attenuation *NSA* shown in the spectrum of 30 to 1000 MHz

Table 3: Results of Antenna Gains (G_R, G_T), Antenna Factors (AF_{R50}, AF_{T50}) and RX Antenna Effective Area (A_{eR}) for (H_T = 4 [M] AND r = 30 [M]

f (MHz)	H_R (m)	G_R (dBi)	G_T (dBi)	AF_{R50} (dB/m)	AF_{T50} (dB/m)	A_{eR} (m^2)
30	6.00	2.05	0.63	-2.40	-1.96	12.77
50	6.00	2.16	6.00	2.04	-0.99	4.71
70	6.00	2.18	6.70	4.96	0.07	2.41
100	5.72	2.19	7.69	8.06	2.27	1.19
200	2.84	2.19	8.25	14.08	8.31	0.30
300	1.86	2.19	7.86	17.60	12.00	0.13
500	1.13	2.19	8.12	22.04	16.23	0.05
700	0.79	2.19	7.95	24.96	19.21	0.02
1000	0.58	2.19	8.00	28.06	22.19	0.01

antennas in the radio link. This effect can be avoided increasing the Tx antenna height. At the same time, the perfect far field is really not achieved and for this reason the Rx antenna gain is not exactly 2.15 dBi. However, the conditions of far field are quite close if the maximum radiation is fulfilled. The wave impedance are presented in the table II permitting to know its value. Perfect far field corresponds when the wave impedance is exactly the space intrinsic impedance or $Z_w = Z_{oo} = 120\pi \cong 377[\Omega]$. The plot of the antenna factors have a difference close to 6 dB when the Tx antenna can develop the maximum radiation. The normalized site attenuation (NSA) is also located on a straight line as plotted for the logaritmic of frequency. This is very important to take it into account.

If the radio link distance r between antennas is increased it is important to determine its results because as distance is increased the Tx antenna elevation angle decreases and the far field conditions are obtained at a larger distance. Here a calculation can be seen for the Tx antenna height H_T= 4 [m] and r= 30 [m]. The receiving antenna (Rx) is scanned between H_R= 1 [m] and H_R= 6 [m]. These results are presented in table III and table IV. Only some frequencies are presented in these tables.

At the same time, all the results for several frequencies in the radio link of $H_T = 4[m]$ and $r = 30[m]$ along the spectrum from 30 to 1000 MHz are presented in Figure 5, Figure 6 and Figure 7. Here, also, the site attenuation must be on a straight line but at lower frequencies it has a deviation if the Tx antenna height is not at the proper height H_T. This effect is avoided if the Tx antenna is at larger heights as shown here in Figure 6.

An additional calculation is performed for a radio link with a distance $r = 10$ [m] and an increase of the Tx antenna height to $H_T = 4$ [m]. This permits to observe if an improvement on its results could be obtained at the lower frequencies.

Table 4: Results of Tx Antenna Effective Area (A_{eT}), Transmission Loss or Site Attenuation (A_w), Free Space Attenuation (A_{FS}), Wave Impedance (Z_w), Normalized Site Attenuation (NSA) and Maximum Field Strength (E_{iM}) for (H_T = 4 [M] AND r = 30 [M]

f (MHz)	A_{eT} (m^2)	A_w (dB)	A_{FS} (dB)	Z_w (Ω)	NSA (dB)	E_{iM} (dBV/m)
30	9.19	29.02	31.70	368.0	33.38	-14.42
50	11.40	27.98	36.13	376.7	26.93	-8.94
70	6.84	30.17	39.06	378.8	25.14	-8.22
100	4.20	32.26	42.14	379.7	21.93	-7.21
200	1.20	37.60	48.04	386.3	15.21	-6.53
300	0.49	41.49	51.54	380.1	11.89	-6.89
500	0.10	45.65	55.97	380.1	7.38	-6.62
700	0.09	48.75	58.89	380.1	4.58	-6.79
1000	0.04	51.79	61.99	380.0	1.64	-6.73

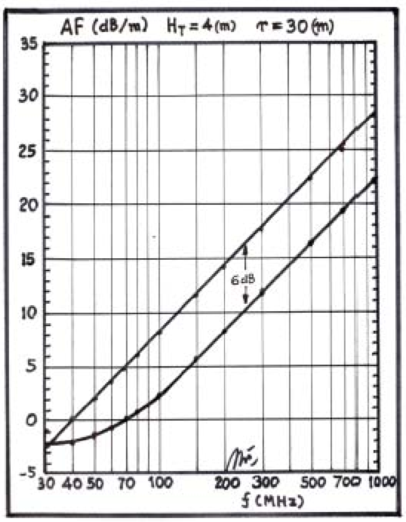

Figure 5: Radio link (H_T = 4[m] and r = 30[m]) Antenna Factors AF_{R50} and AF_{T50} shown in the spectrum of 30 to 1000 MHz

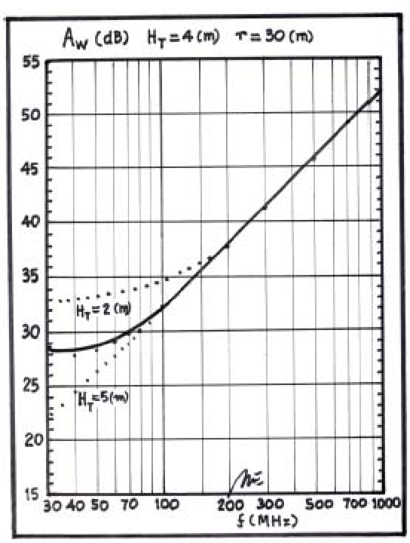

Figure 6: Radio link (H_T = 4[m] and r = 30[m]) Transmission Loss or Site Attenuation A_w shown in the spectrum of 30 to 1000 MHz

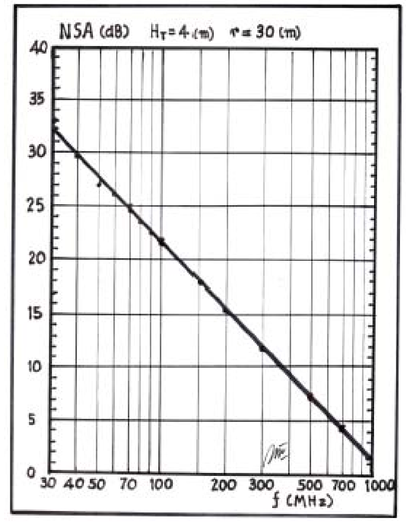

Figure 7: Radio link (H_T = 4[m] and r = 30[m]) Normalized Site Attenuation NSA shown in the spectrum of 30 to 1000 MHz.

Table 5: Results of Antenna Gains (G_R, G_T), Antenna Factors (AF_{R50}, AF_{T50}) And RX Antenna Effective Area (A_{eR}) for (H_T = 4 [M] AND r = 10 [M]

f (MHz)	H_R (m)	G_R (dBi)	G_T (dBi)	AF_{R50} (dB/m)	AF_{T50} (dB/m)	A_{eR} (m^2)
30	4.00	2.11	4.30	-2.40	-5.58	12.93
40	4.00	2.29	7.45	0.10	-4.40	7.59
50	4.00	2.36	8.14	2.04	-2.92	4.93
60	3.30	2.39	6.92	3.62	-1.25	3.45
70	2.77	2.42	6.94	4.96	0.10	2.55
80	2.40	2.43	7.70	6.12	1.35	1.96
90	2.13	2.44	7.48	7.15	2.48	1.55
100	1.91	2.45	6.86	8.06	3.37	1.26
150	1.26	2.46	7.20	11.58	6.91	0.56
200	0.95	2.47	7.36	14.08	9.46	0.32

These results are presented in table V and table VI. Only some frequencies are presented in these tables.
According to calculations the results are giving interesting results.
Rx antenna factors are obtained with exactly the same values as in the radio link with Tx antenna at the $H_T = 2$ [m]. More constant site attenuation values in the lowest frequencies between 30 MHz and 70 MHz are seen. The site attenuation values are practically on a straight line with $H_T = 4\,[m]$ but it could be even better if its height is $H_T = 5\,[m]$. No difference occurs for the Rx antenna factors because they are independent from the Tx antenna heights and distances.

All results for several frequencies in the radio link of $H_T = 4[m]$ and $r = 10[m]$ along the spectrum from 30 to 200 MHz are presented in Figure 8, Figure 9 and Figure 10.

Far field do not only depends on distance r like in free space. Over a ground plane a radio link has a far field strongly dependent of the radiating elevation angle α_L from the Tx antenna. For this reason in Figure 11, Figure 12 and Figure 13 the radio link wave impedance Z_w is

Table 6: Results of Tx Antenna Effective Area (A_{eT}), Transmission Loss or Site Attenuation (A_w); Free Space Attenuation (A_{FS}), Wave Impedance (Z_w), Normalized Site Attenuation (NSA) and Maximum Field Strength (E_{iM}) For (H_T = 4 [M] and r = 10 [M])

f (MHz)	A_{eT} (m^2)	A_w (dB)	A_{FS} (dB)	Z_w (Ω)	NSA (dB)	E_{iM} (dBV/m)
30	21.41	16.22	22.63	372.6	24.20	-1.62
40	24.84	15.39	25.13	388.7	19.69	1.71
50	18.65	16.57	27.07	394.8	17.45	2.46
60	9.79	19.14	28.45	397.8	16.77	1.47
70	7.22	20.31	29.67	399.9	15.25	1.64
80	6.60	20.61	30.74	401.0	13.14	2.51
90	4.94	21.80	31.72	402.0	12.17	2.34
100	3.47	23.29	32.60	402.8	11.86	1.76
150	1.67	26.37	36.03	404.2	7.88	2.21
200	0.97	28.68	38.51	404.9	5.14	2.40

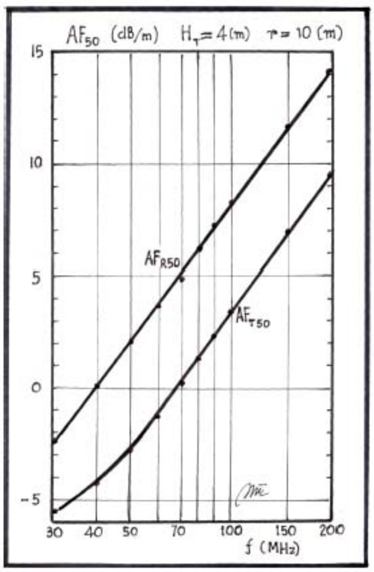

Figure 8: Radio link (H_T = 4[m] and r = 10[m]) Antenna Factors AF_{R50} and AF_{T50} shown in the spectrum of 30 to 200 MHz

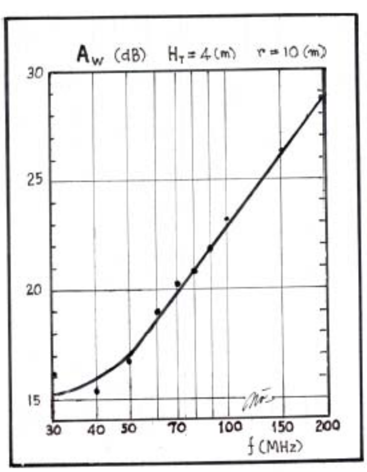

Figure 9: Radio link (H_T = 4[m] and r = 10[m]) Transmission Loss or Site Attenuation A_w shown in the spectrum of 30 to 200 MHz

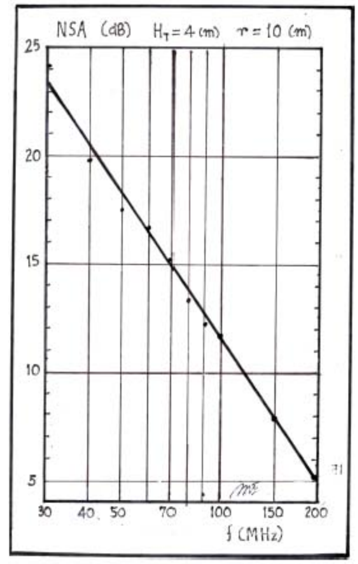

Figure 10: Radio link (H_T = 4[m] and r = 10[m]) Normalized Site Attenuation NSA shown in the spectrum of 30 to 200 MHz

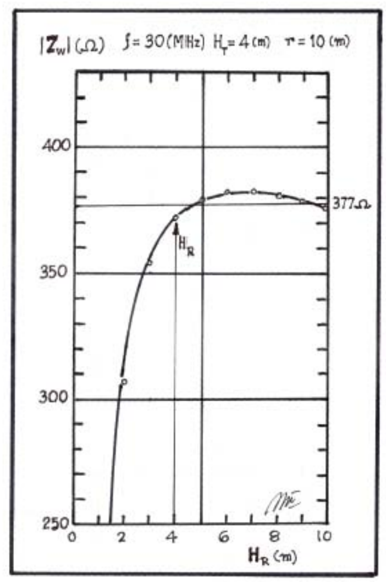

Figure 11: Radio link (H_T = 4[m] and r = 10[m]) wave impedance Z_w as a function of Rx antenna height H_R and frequency f = 30[MHz]

plotted as a function of the Rx antenna height H_R for the frequencies of 30, 50 and 70 MHz where $H_T = 4[m]$ and $r = 10[m]$.

Wave impedance Z_w at short distances when real far field is not reached have large variation in its value as shown in several figures. This value is following the Tx antenna radiating lobes. Of course, increasing the distance r between antennas the wave antenna is reaching the far field value for any elevation angle α_L.

Nevertheless, a calculation for $f = 200[MHz]$ and $r = 100[m]$ ($r/\lambda = 66.67$) shows a sharp wave impedance

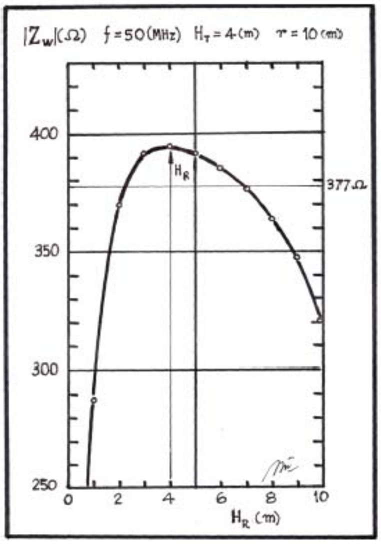

Figure 12: Radio link (H_T = 4[m] and r = 10[m]) wave impedance Z_w as a function of Rx antenna height H_R and frequency f = 50[MHz]

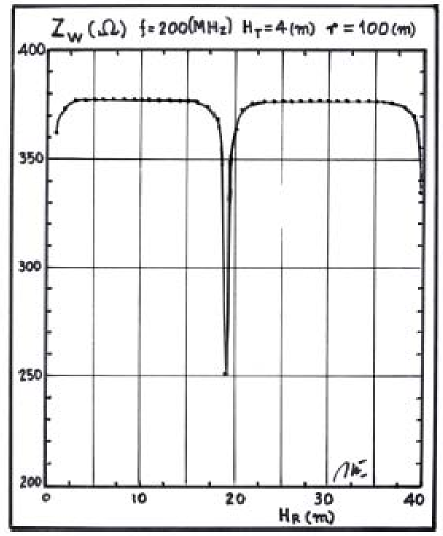

Figure 14: Radio link (H_T = 4[m] and r = 100[m]) wave impedance Z_w as a function of Rx antenna height H_R and frequency f = 200[MHz]

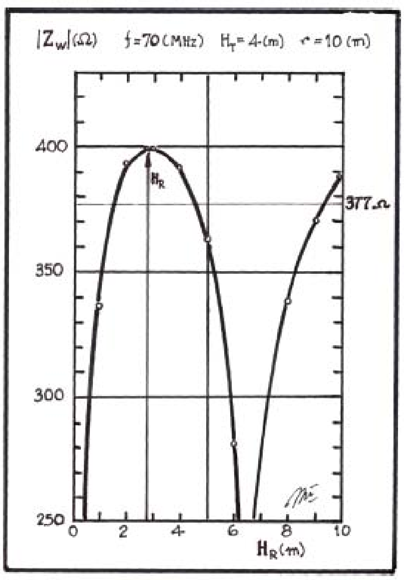

Figure 13: Radio link (H_T = 4[m] and r = 10[m]) wave impedance Z_w as a function of Rx antenna height H_R and frequency f = 70[MHz]

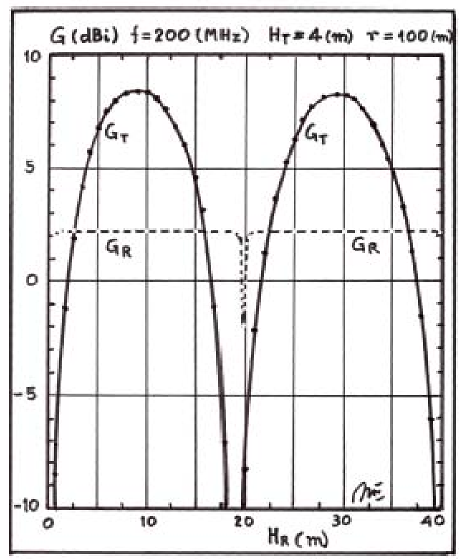

Figure 15: Radio link (H_T = 4[m] and r = 100[m]) half-wave dipole antenna gains G as a function of Rx antenna height H_R and frequency f = 200[MHz]

value minimum as shown in Figure 14. This effect is also visible on the Rx antenna gain G_R in Figure 15. However, no effect in the Rx antenna factor AF_{R50} is shown in Figure 16. In this case the Rx antenna factor is independent of the distance r like the effective length L_{eR}. This constant antenna factor do not occur for the Tx antenna because it is strongly dependent on the Tx antenna gain (G_T) according to the Rx antenna height (H_R). In the Tx antenna radiation pattern the minimum between lobes in the far field distance r' is obtained at more than 100 wavelengths. For this reason far field Rx antenna gain (G_R) and effective area (A_{eR}) values are practically very difficult to be achieved. These parameters are shown here to be really dependent of the far field condition or when the wave impedance is $Z_w = Z_{oo} = 120\pi\ (\Omega)$.

III. Measurement

Measurement needs an antenna range in order to verify the antenna parameters. To determine antenna gains the antenna range needs a proper site to fulfill the far field distance. This task is difficult to achieve at the lower frequencies between 30 and 100 MHz because the wave impedance must achieve a value very close or exactly $Z_w = Z_{oo} = 120\pi \cong 377\Omega$. It was determined here that this value depends not only of the distance r but also by the elevation angle α_L of the Tx radiation pattern.

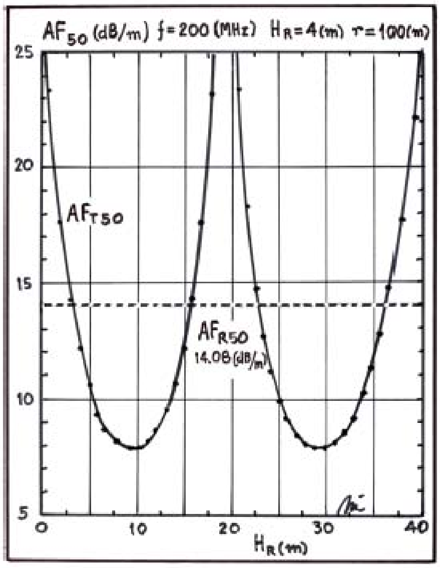

Figure 16: Radio link (H_T = 4[m] and r = 100[m]) half-wave dipole antenna factors AF50 as a function of Rx antenna height H_R and frequency f = 200[MHz]

This task was practically achieved very closely with an anechoic chamber of INTI, Buenos Aires, Argentina. This chamber was used in order to verify the antenna factor of a Rohde und Schwarz precision half-wave dipole antennas model HZ-12 [19]. The useful range of these antennas is between 30 and 300 MHz and recommended for horizontal polarization [18]. Horizontal polarization at the frequency of $f = 150\,[MHz]$, $\lambda = 2\,[m]$ was performed for this task. Taking into account the coaxial transmission and receiving lines as well the balun with matching system losses the radio link was deployed with a distance of $r = 10\,[m]$ and the Tx antenna was located at a fixed height of $H_T = 2\,[m]$. Rx antenna had the possibility to be scanned between 1 and 4 [m]. Transmitted and received power were obtained by a Rohde und Schwarz generator and a Rohde und Schwarz spectrun analyzer. Transmitted power W_T was adopted as 0 dBW and the received power was obtained as $W_R = -26.79\,[dBW]$. Maximum power density or electric field was obtained at the Rx antenna height $H_T = 2.70\,[m]$ and the elevation angle from the Tx antenna center phase and the center of the Rx antenna is close to $\alpha_L = 15°$. With this angle α_L the distance between the Tx center phase and the Rx center is r' = 10.35 [m] so the free space loss results $A_{FS} = -36.26\,[dB]$.

Loss relation:

$K = A_w - A_{FS} = -26.79 - (-36.26) = 9.47\,[dB]$

On the equivalent Thevenin Rx antenna circuit the current I_R results in:

$$I_R = \left(\frac{W_R}{R_L}\right)^{1/2} = 5.36E-3\,[A] \tag{6}$$

Rx antenna load voltage V_R results in:

$$V_R = (W_R R_L)^{1/2} = 3.91E-1\,[A] \tag{7}$$

Induced Voltage on the Rx antenna V_i results in:

$V_i = 2\,V_R = 7.82E-1\,[V]$

Rx antenna effective length:

$$L_{eR} = \frac{\lambda}{\pi} = 6.37\,E-1\,[m] \tag{8}$$

Incoming electric field E_i results in:

$$E_i = \frac{V_i}{L_{eR}} = 1.23\,[V/m] \tag{9}$$

Incoming power density P_i results in:

$$P_i = \frac{E_i^2}{Z_{oo}} = 4.002E-3\,[W/m^2] \tag{10}$$

Rx antenna effective area A_{eR} results in:

$$A_{eR} = \frac{W_R}{P_i} = 5.23E-1\,[m^2] \tag{11}$$

Rx antenna numerical gain g_R:

$$g_R = \frac{4\pi\,A_{eR}}{\lambda^2} = 1.64 \tag{12}$$

Rx antenna gain $G_R = 2.16\,[dBi]$

Friis equation permits to know the true Tx antenna gain G_T, thus:

$$G_T = K - G_R = 9.47 - 2.16 = 7.31\,[dBi] \tag{13}$$

Tx antenna numerical gain $g_T = 5.38$.

Checking the Tx antenna gain at the distance r':

$$g_T = 4\,\pi\,(r')^2\,P_i = 5.38 \tag{14}$$

Tx antenna gain $G_T = 7.31\,[dBi]$ was calculated correctly.

Rx antenna factor aF_{R73} results in:

$$aF_{R73} = \frac{E_i}{V_R} = 3.14\,[1/m] \tag{15}$$

Rx antenna factor $AF_{R73} = 9.94\,[dB/m]$

Rx antenna factor $AF_{R50} = 11.58\,[dB/m]$

Tx antenna factor aF_{T73} results in:

$$aF_{T73} = \frac{\pi}{\lambda}\left(\frac{480}{g_T\,R_{aT}}\right)^{1/2} = 1.74\,[1/m] \tag{16}$$

Tx antenna factor $AF_{T73} = 4.79\,[dB/m]$
Tx antenna factor $AF_{T50} = 6.43\,[dB/m]$

Normalized Site Attenuation (NSA) results in:

$$NSA = A_w - AF_{R50} - AF_{T50} = 8.78\,[dB] \quad (17)$$

Using the Equation (7) of Standard C 63-5-2004:

$$E_{iM} = 20\,log(E_i) = 1.79\,[dBV/m] \quad (18)$$

$$AF_{50} = 10logf_{MHz} - 24.46 + \frac{1}{2}[E_{iM} + A_w]\,[dB/m] \quad (19)$$

$$AF_{50} = 11.59\,[dB/m]$$

With equation (7) the result is the same as Rx antenna factor AF_{R50} previously obtained.

Using the FCC Equation obtained from $aF_R = E_i/V_R$ and far field condition, results in:

$$AF_{50} = -29.78 + 20logf_{MHz} - 10log\,g\,[dB/m] \quad (20)$$

$$AF_{R50FCC} = 11.58\,[dB/m] \quad (21)$$

$$AF_{T50FCC} = 6.43\,[dB/m] \quad (22)$$

These values are equal to that obtained previously by calculation.
Applying the Friis equation in dB over perfect ground (metallic $\sigma = 10^7 (S/m)$), the result is:

$$G_T + G_R = 7.31 + 2.16 = 9.47[dB] \quad (23)$$

$$A_w - A_{FS} = -26.79 - (-36.26) = 9.47[dB] \quad (24)$$

It can be seen here that the Friis Power Budget is perfectly fulfilled.
Tx antenna effective area A_{eT}:

$$A_{eT} = g_T\frac{\lambda^2}{4\pi} = 1.71\,[m^2] \quad (25)$$

Applying the Schelkunoff and Friis Power Reciprocity Principle:

$$\frac{A_{eT}}{g_T} = 3.18E-1 \quad (26)$$

$$\frac{A_{eR}}{g_R} = 3.18E-1 \quad (27)$$

Table 7: Comparison between Simulated (S) and Measurement (M), H_T = 2 [M] and r = 10 [M], F = 150 (MHZ)

	S	M	S	M	S	M
H_R	E_i	E_i	P_i	P_i	G_T	G_T
(m)	(V/m)	(V/m)	W/m^2	(W/m^2)	(dBi)	(dBi)
1.0	0.795	0.817	1.71E-3	1.77E-3	3.37	3.52
1.5	1.089	1.080	3.13E-3	3.10E-3	6.04	6.00
2.0	1.276	1.230	4.26E-3	4.01E-3	7.46	7.20
2.5	1.348	1.190	4.74E-3	3.76E-3	8.02	7.02
3.0	1.309	1.190	4.48E-3	3.76E-3	7.88	7.12
3.5	1.176	1.090	3.63E-3	3.15E-3	7.09	6.48
4.0	0.973	0.983	2.51E-3	2.56E-3	5.63	5.72

Table 8: Comparison between Simulated (S) and Measurement (M), H_T = 2 [M] and r = 10 [M], F = 150 (MHZ)

	S	M	S	M	S	M
H_R	G_R	G_R	A_{eR}	A_{eR}	A_w	A_w
(m)	(dBi)	(dBi)	m^2	(m^2)	(dB)	(dB)
1.0	2.08	2.16	0.51	0.52	30.56	30.33
1.5	2.20	2.15	0.53	0.52	27.83	27.90
2.0	2.22	2.14	0.53	0.52	26.47	26.80
2.5	2.22	2.14	0.53	0.52	25.98	27.07
3.0	2.22	2.18	0.53	0.53	26.23	27.04
3.5	2.20	2.16	0.53	0.52	27.16	27.83
4.0	2.15	2.16	0.53	0.52	28.82	28.74

The Power Reciprocity Principle is also fulfilled. For this measurement it was supposed that the wave impedance $Z_w = Z_{oo} = 120\pi$ or at the real far field. Calculation with the same radio link geometry are giving a wave impedance $Z_w = 382\,[\Omega]$. This value is very close to the real far field for the radiation maximum of the Tx antenna at the elevation angle $\alpha_L = 15[°]$, and its result error is negligible. Other possible difference could be using the radiation resistance of both antenna as $73\,\Omega$. In this case if the mismatch is lower than 1.5 in VSWR the mismatching losses could produce an error lower than 0.2 dB.
In order to make the task more complete measurements were performed at several Rx antenna heights and simulated at the same Rx heights. These results are compared in table VII, table VIII and table IX. Results are also presented in Figure 17 and Figure 18.

Table 9: Comparison between Simulated (S) and Measurement (M), H_T = 2 [M] and r = 10 [M], F = 150 (MHZ)

	S	M	S	M	S	M
H_R	AF_{R50}	AF_{R50}	AF_{T50}	AF_{T50}	W_R	W_R
(m)	(dB/m)	(dB/m)	(dB/m)	(dB/m)	(W)	(W)
1.0	11.58	11.58	10.35	10.22	30.56	30.33
1.5	11.57	11.58	7.79	7.74	27.83	27.90
2.0	11.59	11.58	6.40	6.54	26.47	26.80
2.5	11.58	11.59	5.85	6.73	25.98	27.07
3.0	11.58	11.60	5.98	6.63	26.23	27.04
3.5	11.59	11.56	6.74	7.27	27.16	27.83
4.0	11.60	11.58	8.18	8.01	28.82	28.74

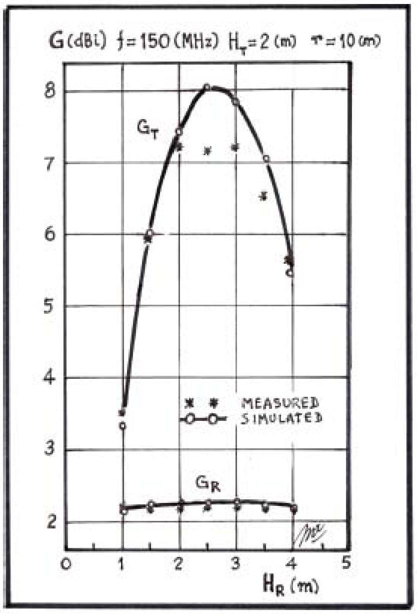

Figure 17: Radio link (H_T = 2[m] and r = 10[m]) half-wave dipole antenna gains G as a function of Rx antenna height H_R and frequency f = 150[MHz] for horizontal polarization

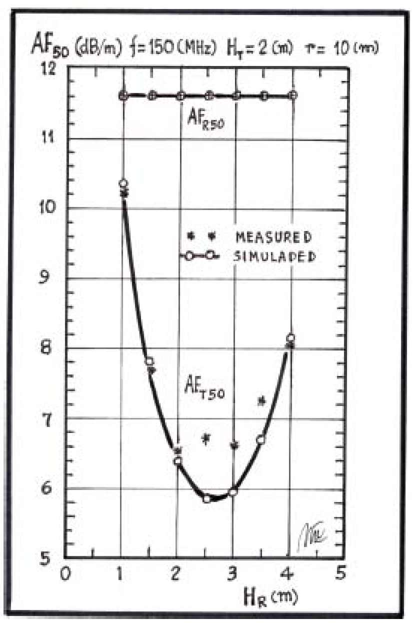

Figure 18: Radio link (H_T = 2[m] and r = 10[m]) half-wave dipole antenna factors AF_{50} as a function of Rx antenna height H_R and frequency f = 150[MHz] for horizontal polarization

IV. Conclusions

In conclusion it was found to be correct the power gain and antenna factor from Rohde und Schwarz model HZ-12 antenna manual [19]. Rx antenna factor as well its effective length are parameters not depending on the far field of the electromagnetic waves. It was determined that the effective length depends from the current distribution on its physical structure but if the current distribution is unknown it can be determined by the relation between the induced voltage V_i at open circuit on the Rx antenna and the incoming electric field E_i [14].

Simulation and measurements are confirming this statement. This relation is valid in near and far field and it produces always the same results. Rx antenna factor is also independent of its height over ground and distance because it operates practically like in free space. For this reason a half-wave dipole antenna can be adopted as a natural standard sensor useful to calibrate any other antenna at any frequency between 30 and 1000 MHz [11]. On the contrary, the Tx antenna factor is not constant and depends on its gain over perfect ground considering it is an array of two elements [2],[3],[6], the actual antenna and its image. Of course its factor is different as well the gain from that of the Rx antenna as was shown in this paper results [8].

Rx antenna gain G_R and effective area A_{eR} are far field parameters and they acquire the proper value when the wave impedance is $Z_w = Z_{oo} = 120\pi$. In this paper it was clearly obtained the Rx antenna factor AF_{R50} with exactly the same value in any radio link for several distance r and for any Tx antenna height H_T using the relation E_i/V_R. Main Friis equation is useful and valid over perfect ground [1], as was perfectly demostated and it gives a perfect power budget between losses (A_w, A_{FS}) and gains (G_R, G_T). No additional factors are needed, as was published [12], [21], but only the true gains (G_R, G_T) as was determined here. Also with these results, the reciprocity power principle (A_{eT}/g_T = A_{eR}/g_R) is fulfilled according to Schelkunoff and Friis [3]. The transmitting antenna is a simple devise and it only needs to radiate the EM energy in the surrounding space. Receiving antenna is a more complex device because it needs to operate in two roles, the receiving role and the retransmitting or scattering role. For this reason, in a radio link with two identical half wave dipole antennas in horizontal polarization, the theoretical transmitting antenna gain is $G_T = 8.15[dBi]$, the receiving antenna gain is $G_R = 2.15[dBi]$ and the scattering gain is $G_s = 5.15[dBi]$. The effective receiving area A_{eR} is the relation between the power received W_R and the incoming power density P_i. The scattering effective area A_{es}, according to Friis, is the product between the isotropic source area and the scattering numerical gain g_s. The gain difference between the transmitting antenna gain G_T and the receiving antenna gain G_R is really 6 dB, according to calculations and measurements.

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References Références Referencias

1. H. T. Friis A Note on a Simple Transmission Formaula. Proc. I.R.E., Vol. 34, pp. 254-256, May. 1946.
2. J. D. Kraus Antennas. Mc. Graw Hill, N.Y. 1950.
3. S. A. Schelkunoff, H.T. Friis Antennas, Theory and Practice. Wiley and Sons, N.Y. 1952.
4. K. A. Norton Transmission Loss in Radio Propagation. Proc. I.R.E., Vol. 41, pp. 146-152, Jan. 1953.
5. K. A. Norton System Loss in Radio Propagation. Jour. Res. Nat. Bur. of STD. Radio Propagation, Vol. 63 D, N 1. pp. 53-73, July-Aug. 1959.
6. E.A. Wolff Antenna Analysis. Wiley and Sons, N.Y. 1966.
7. A.A. Smith, R.F. German and J.B. Pate. Calculation of Site Attenuation from Antenna Factors. IEEE Transaction on EMC. Vol. 24, pp. 301-316, Aug. 1982.
8. J.W. Ames and W.A. Edson, Gain, Capture Area and Transmission Loss for Grounded Monopoles and Elevated Dipoles. R:F: Design, Part I. Nov.-Dec. 1983, Part II. Jan.-Feb. 1984.
9. W.S. Scott Bennett Properly Applied Antenna Factors. IEEE Transaction on EMC. Vol. 28, pp.2-6, Feb. 1986.
10. R. G. Fitzgerrell Site Attenuation. IEEE Transaction on EMC. Vol. 28, pp.38-40, Feb. 1986.
11. R. G. Fitzgerrell Linear Gain-Standard Antenna Below 1000 MHz. N.B.S. Tech. Note 1098, May 1986 (CODEN: NBTNAE).
12. J. C. Logan, J. W. Rockway Dipole and Monopole Antenna Gain and Effective Area for Communication Formulas. Naval Command, Control and Ocean Surveillance Center, San Diego, CA, 92152-5001, Tech. Rpt 1756, Sep. 1997.
13. B. M. Kolundzija, J. S. Ognjanovic, T. K. Sarkar WIPL-D Software Electromagnetic Modeling of Composite Metallic and Dielectric Structures. Artech House, Boston, 1999.
14. V. Trainotti, G. Figueroa Vertically Polarized Dipole and Monopoles, Directivity, Effective Height and Antenna Factors. IEEE Trans. On Broadcasting, Vol. 56, N 3, pp. 376-409, Sep. 2010.
15. V. Trainotti Electromagnetic Compatibility (ECM) Antenna Gain and Factor. IEEE Trans. on EMC, Vol. 59, N 4, pp. 1006-1015, Aug. 2017.
16. V. Trainotti Radio Link Power Density and Antenna Factor. IEEE Trans. on EMC, Vol. 61, N 1, pp. 288-294, Feb. 2019.
17. V. Trainotti Antenna Characteristics Over Perfect Ground. IEEE EMC Magazine, Vol. 7, Quarter 4 pp. 52-58, Dec. 2018.
18. American National Standard for Electromagnetic Compatibility Radiated Emission Measurements in Electromagnetic Interference (EMI) control Calibration and Qualification of Antennas (9 kHz to 40 GHz), 2017, ANSI C 63-5-2017 (revision of ANSI c 63-5-2005).
19. Rohde Schwarz, Precision Half Wave Dipole Set HZ-12 and HZ-13. Rohde Schwarz, Munich, Germany, POB 801469.
20. V. Trainotti Radio Link and the Receiving Antenna Calibration over Perfect Ground. Power Point IEEE International Symposium on EMC, Signal and Power Integrity, 19-26, Jul. 2019. Ernest N. Morial Convention Center, New Orleans, USA.
21. G.A. Thiele, Friis Transmission over Ground Plane, IEEE Antennas and Propagation Magazine, vol.61, Feb. 2019.

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Assessment of Energy Security of the Region on the Example of Pridnestrovye

By S.G. Fedorchenko & G.S. Fedorchenko
Pridnestrovye state university

Abstract- Article is devoted to a problem of assessment of energy security of the region. The indicative analysis, function of usefulness of Harington-Menchera is applied. While assessing the level of energy security it is offered to consider the mode of functioning of the region power system. The offered technique is used for assessment of energy security of Pridnestrovye.

Keywords: energy security, the generalized function of usefulness, indicator method, correlation groups.

GJRE-F Classification: FOR Code: 290901

ASSESSMENTOFENERGYSECURITYOFTHEREGIONONTHEEXAMPLEOFPRIDNESTROVYE

Strictly as per the compliance and regulations of:

Assessment of Energy Security of the Region on the Example of Pridnestrovye

S.G. Fedorchenko [α] & G.S. Fedorchenko [σ]

Abstract- **Article is devoted to a problem of assessment of energy security of the region. The indicative analysis, function of usefulness of Harington-Menchera is applied. While assessing the level of energy security it is offered to consider the mode of functioning of the region power system. The offered technique is used for assessment of energy security of Pridnestrovye.**

Keywords: energy security, the generalized function of usefulness, indicator method, correlation groups.

I. Introduction

Earlier we offered [1, 2, 3] to use an integrated indicator while forming the assessment of the region energy security:

- A set of the indicators characterizing energy security of the explored region [3];
- The range of critical variables they relate to energy independence as set up by the individual conducting the study [1, 2];
- Harington-Menchera function [8].

We use the technique offered by us of creation of an integrated indicator of energy security of Pridnestrovye.

II. Pre-Processing of Data

We use the technique offered by us of creation of an integrated indicator of energy security of Pridnestrovye.

According to our technique previously it is necessary to transform values of indicators to values of dimensionless function of usefulness which we will call as private indicators of quality. This transformation is described in detail [4].

The technique used while forming an integrated indicator of energy security demands the values of the indicators used by us to be not correlated. For checking of implementation of this requirement we use the method of correlation groups [5].

At assessment of the size of energy security of Pridnestrovye we used 16 indicators. The range of critical variables was borrowed (with some changes) from [6].

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The columns of correlation groups received by us for indicators of energy security of Pridnestrovye at the 1st, 2nd iteration, are submitted on Fig 1, 2.

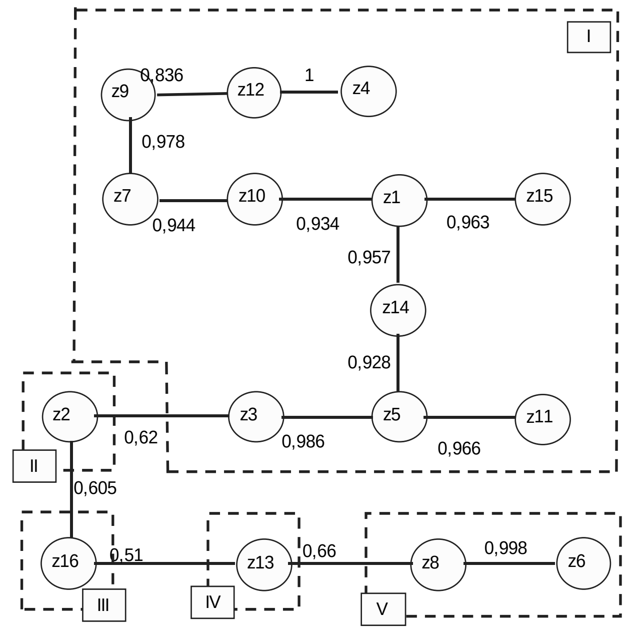

Fig. 1: The count of correlation groups for indicators of energy security of Pridnestrovye, the 1st iteration

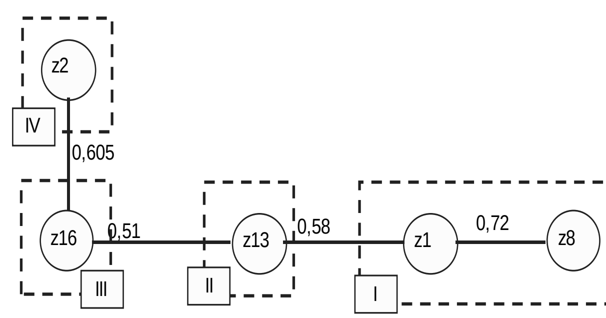

Fig. 2: The count of correlation groups for indicators of Pridnestrovye energy security, the 2nd iteration

After the 1st iteration we received 5 groups presented on Fig 1. Let's choose as the representative of the 1st group the z1, the 5th group – z8, other galaxies contain only one indicator, each they are z2, z16, z13. Let's execute the 2nd iteration – we will construct a new count of correlation groups, for the above-stated representatives of groups. The result is presented on Fig 2.

III. The Assessment of Pridnestrorvian Energy Security

As a result of the done work we received 4 groups, and one of them (No. 1) contains 13 indicators, and the others – only one indicator. There is a question how to deal with a set of the indicators belonging to the 1st galaxy. We cannot take one indicator and consider it as a representative of the whole group, as the values of the function of usefulness of the indicators entering galaxy No. 1, presented in Table 1, are various.

Table 1: Values of function of usefulness for the indicators belonging to the 1st galaxy

Codes	Description of the indicator	Weight of indicators
z1	Fuel consumption per capita	0.5
z3	Power production per capita.	0.5
z4	Development of heat power per capita.	0.5
z5	The Share of own power sources in a balance covering in a year.	0.9
z7	Share of block stations in the general rated capacity.	0.6
z9	Level of wear of substations.	0.6
z10	Carbon dioxide Emissions.	0.4
z11	Electricity consumption per capita.	0.6
z12	Consumption of the centralized heat power per capita.	0.8
z14	Power consumption of GDP.	0.5
z15	Electric capacitance of GDP.	0.5
z6	Share of hydroelectric power station in the general power consumption.	0.8
z8	Share of power of the largest power plant.	0.6

Let's find the average value of private functions of usefulness of the indicators entering galaxy No. 1 and designate it as.

As the value characterizing a group is used the average value of private indicators of quality along all the members of a group. The values of the scales received by us as a result of poll experts' are presented in the right TABLE I column.

Data for calculation of the generalized function of usefulness are consolidated in Table 2.

Table 2: The data used for calculation of the generalized function of usefulness

Codes	Description of an indicator	Group	Weight of groups α_i
d_1*	The average d1 value d1* on group No. 1	1	0,6
d_2	Share of the dominating fuel in total fuel quantity.	2	0,8
d_{16}	Energy investments.	3	0,5
d_{13}	Ratio of energy resources cost and average per capita income.	4	0,7

Table 3: The combined integrated indicator values depending on working hours of power supply system

Mode of power supply system functioning	Values of weight coefficients				The combined integrated indicator value of D
	Z1*	z2	z16	z13	
Normal	0,8	0,1	0,5	0,9	0,545
Pre-crisis initial	0,8	0,2	0,45	0,75	0,444
Pre-crisis developing	0,8	0,3	0,4	0,7	0,363
Pre-crisis critical	0,8	0,4	0,4	0,65	0,301
Crisis unstable	0,8	0,5	0,35	0,6	0,254
Crisis menacing	0,8	0,7	0,3	0,55	0,184
Crisis critical	0,8	0,8	0,3	0,5	0,16
Crisis extraordinary	0,8	0,9	0,25	0,4	0,128

Calculations given in Table 2 are executed for normal working hours of power supply system [7]. It is obvious that in other working hours of power supply system, weight coefficients of indicators will change that will affect value of an integrated indicator. The example of similar calculations is given in Table 3. We received the values of scales as a results of experts' poll.

It is visible in Table 3 that weight of indicators very strongly depend on working hours of power supply system, so, at critical operating modes the value of economic indicators decreases (z13, z16) and the role of the indicator (z2) increases.

IV. Analysis of the Obtained Results

On closer examination Table 3 it is visible that in process of deterioration in a working hours of power supply system, the value of the combined integrated indicator of energy security of D falls. We need to find the reason causing this change.

Let's transform the formula on which there is a calculation of the generalized function of usefulness, as follows:

$$D = \sqrt[\Sigma=\alpha_1+\alpha_2+\alpha_3+\alpha_4]{d_1^{\alpha_1} d_2^{\alpha_2} d_3^{\alpha_3} d_4^{\alpha_4}} = d_1^{\alpha_1/\Sigma} d_2^{\alpha_2/\Sigma} d_3^{\alpha_3/\Sigma} d_4^{\alpha_4/\Sigma} = D_1 D_2 D_3 D_4 \qquad (1)$$

Here D1, D2, D3, D4 are factors of the combined integrated indicator of EB.

Let's execute calculations of D1, D2, D3, D4 values and we will construct on them the schedules presented on Fig 3, 4.

These schedules show that in process of working hours of power supply system changing (at invariable values of indicators, but the changing values of their scales), D2 factor size – a share of the dominating fuel in total fuel quantity falls that involves falling of size of all integrated indicator of ES.

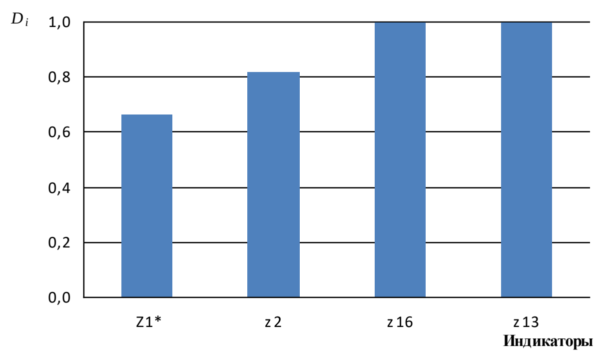

Fig. 3: Factors of an integrated indicator, the functioning mode – the 1st

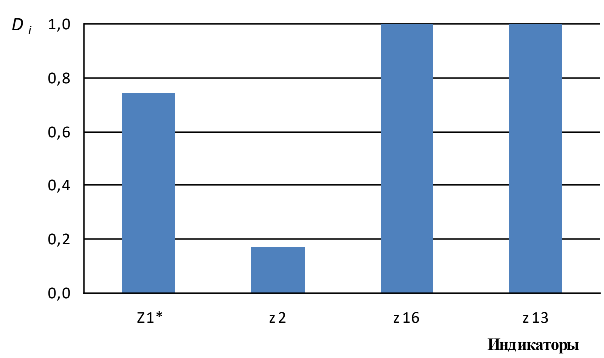

Fig. 4: Factors of an integrated indicator, the functioning mode – the 8th

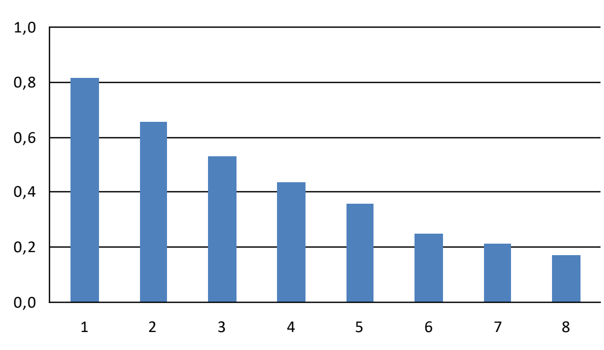

Fig. 5: The change of D2 depending on the mode of functioning of power supply system

The schedule of size D2 dependence on working hours of power supply system is presented on Fig 5 it is visible that to a measure of deterioration in a working hours of power supply system size D2 decreases, and since the mode of functioning No. 5, passes into a zone of values "unsatisfactorily" (size D<0.37).

We made an attempt to number the estimate influence of possible values z2 indicators on energy security of the region, at invariable values of other indicators. Values of the indicator from 50% to 98% are for this purpose changed and the size of the combined integrated indicator of energy security of the region – D is counted. Calculation results are given in Table 4, 5.

Table 4: D for various z2 values (values <0.37) are marked out

		Values of the z2 indicator, in %						
		78	80	82	86	90	94	98
No. of functioning of a system mode	1	0,701	0,692	0,681	0,656	0,628	0,596	0,564
	2	0,627	0,610	0,591	0,547	0,498	0,446	0,398
	3	0,580	0,556	0,530	0,472	0,410	0,348	0,293
	4	0,550	0,520	0,488	0,420	0,350	0,282	0,226
	5	0,518	0,483	0,447	0,370	0,294	0,225	0,170
	6	0,457	0,416	0,375	0,291	0,214	0,149	0,103
	7	0,434	0,391	0,348	0,262	0,186	0,124	0,082
	8	0,394	0,350	0,306	0,221	0,149	0,094	0,058

Table 4 contains the values D calculated for various values of the z2 indicator. In the table values which are less, than 0.37 are highlighted in bold. It demonstrates that the power supply system of the region is in an unsatisfactory state. Values, smaller, than 0.2 are corresponded to a condition of the system "very badly". It is visible that these estimates depend on the mode of functioning of the region power system. So in modes No. 1, 2 at any values of the z2 indicator the system will not be in an unsatisfactory state, in modes No. 7, 8, for ensuring satisfactory work of power supply system, the value of the z2 indicator has to be less than 82%.

Table 5: D for various z2 values (values are marked out <0.63, are underlined <0.37)

		Values of the z2 indicator, in %							
		66	68	70	72	74	76	78	90
No. functioning of a system mode	1	0,738	0,734	0,729	0,723	0,717	0,709	0,701	0,628
	2	0,699	0,69	0,681	0,67	0,657	0,643	0,627	0,498
	3	0,682	0,67	0,656	0,64	0,622	0,602	0,580	0,410
	4	0,678	0,663	0,645	0,625	0,602	0,577	0,550	0,350
	5	0,674	0,654	0,632	0,608	0,580	0,551	0,518	0,294
	6	0,65	0,625	0,597	0,566	0,532	0,496	0,457	0,214
	7	0,644	0,617	0,586	0,552	0,515	0,476	0,434	0,186
	8	0,620	0,590	0,556	0,519	0,480	0,438	0,394	0,149

For comparison we will consider the same results of calculation, but we will compare the received values to number 0.63 – border of good and satisfactory functioning of power supply system. The received results are given in Table 5. From the table it is visible that for ensuring good functioning of a system the value of the z2 indicator in the 8th mode has to be less than 66%, and in the 1st mode – less than 90%.

Relying on the values given above, it is possible to claim that for increase in level of energy security of power supply system of the region, it is necessary to have an opportunity, to reduce a share of the dominating fuel at the modes of functioning of power supply system other than normal. Let's consider one of possible options of such actions is the translation of the unit of the Pridnestrovian state district power plant which provides with the electric power Pridnestrovye on other type of fuel – coal. It is known that the Pridnestrovian state district power plant has the corresponding equipment which is in the preserved state now.

The state district power plant uses from 30% to 40% of the gas consumed by Pridnestrovye. It allows to claim that conversion of the corresponding unit of state district power plant to coal will allow to reduce a share of the dominating fuel by 27-36%, that is the indicator that accepts values in the range from 60% up to 55%. From tables 4, 5 it is clear that it will allow, to increase the level of energy security of the region for satisfactory condition, regardless of the mode of functioning of power supply system.

References Références Referencias

1. Fedorchenko G.S., Fedorchenko S. G. Integrated measure of assessment of a condition of energy security//Problem of regional energy. Academy of Sciences of the Moldova Republic. Institute of power, electronic edition. 2014
2. Fedorchenko G.S., Fedorchenko S. G. Multiplicative integrated measure of assessment of a condition of energy security//Messenger Pridnestr. university, Series: Physical. - a mat. and техн. sciences, No. 3/2014. – page 86-94
3. Fedorchenko G.S., Fedorchenko S. G. Multiplicative integrated assessment of a condition of energy security)//Problems of regional energy. Academy of Sciences of the Moldova Republic. Institute of power, electronic edition. No. 1, 2016
4. Fedorchenko G.S. Calculation of values of the indicators characterizing energy security of Pridnestrovye//the Messenger Pridnestr. un-that. Series: Physical. - a mat and technical. sciences. - 2017.-No. 3(57).-Page 144-149.
5. Bykovo E.V., Mikhaylevich E.V., Postolaty V.M. Methodical recommendations of the solution of problems of energy security of Moldova and Belarus. Chisinau 2010. – 100 pages.
6. Druzhinin G. V. Methods of assessment and forecasting of quality. – M.: Radio and communication, 1982. - 160 pages.
7. Fedorchenko G.S. Classification of the modes of functioning of power supply system of the region//Messenger Prinestr. university. Series: Physical. - a mat and technical. Sciences. - 2018.- No. 3(60).-Page 32-138.
8. Fedorchenko S. G., Dolgov Yu.A., Kirsanova A.V., etc. The generalized function of usefulness and its application / Under the editorship of, Fedorchenko. - Tiraspol: Pridnestr. university publishing house., 2011. - 196 pages.

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Aluminum can to WiFi Trading System with Metal can and Plastic Bottle Collector and Monitoring System

By Michelle Caranguian, Arthur Michael Abiad, Dorethy Jean De Vera, Dexter Gallema, Job Samuel Rosario & Moises Pataueg

Abstract- Through the decades, the price of aluminum has been accumulative due to economic influences globally. In spite of it, people still incline to overlook the fact that the aluminum scrap thrown away is recyclable and beneficial. Hence, the authors came up with an idea to create a machine that will serve as a recycle bin. Through problems identification, the objectives were identified as guides in the establishment of "Aluminum Can to WiFi Trading System with Metal Can and Plastic Bottle Collector and Monitoring System" for the school. This machine is designed having a ramp and dimension that serves as the pathway of the collected metal cans and plastic bottles and houses a bin designated for each material. It is equipped with ultrasonic, inductive, and infrared sensor to sort, monitor, and count the metal cans and plastic bottles. It displays information, terms and condition, and transaction through the TFT LCD screen with three push buttons as its user input. It was installed with an Access Point that serves as the Network Address Translator to provide internet access to the user.

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ALUMINUMCANTOWIFITRADINGSYSTEMWITHMETALCANANDPLASTICBOTTLECOLLECTORANDMONITORINGSYSTEM

Aluminum can to WiFi Trading System with Metal can and Plastic Bottle Collector and Monitoring System

Michelle Caranguian [α], Arthur Michael Abiad [σ], Dorethy Jean De Vera [ρ], Dexter Gallema [Ѡ], Job Samuel Rosario [¥] & Moises Pataueg [§]

Abstract- Through the decades, the price of aluminum has been accumulative due to economic influences globally. In spite of it, people still incline to overlook the fact that the aluminum scrap thrown away is recyclable and beneficial. Hence, the authors came up with an idea to create a machine that will serve as a recycle bin. Through problems identification, the objectives were identified as guides in the establishment of "Aluminum Can to WiFi Trading System with Metal Can and Plastic Bottle Collector and Monitoring System" for the school. This machine is designed having a ramp and dimension that serves as the pathway of the collected metal cans and plastic bottles and houses a bin designated for each material. It is equipped with ultrasonic, inductive, and infrared sensor to sort, monitor, and count the metal cans and plastic bottles. It displays information, terms and condition, and transaction through the TFT LCD screen with three push buttons as its user input. It was installed with an Access Point that serves as the Network Address Translator to provide internet access to the user. This paper is about a microcontroller based project, with microelectronics devices namely, Ultrasonic Sensor (HCSR04), TFT LCD Display (MD070SD), IR proximity sensor, NPN Inductive Sensor LJ12A3-4-Z/BX NPN, a MG996R Servo and SG90 Micro Servo, ESP8266 node MCU, Arduino MEGA and push button. These were carefully programmed and patiently tested to ensure its working conditions. Through well-planned design, data gathering and testing its reliability, the authors came up with an aluminum can trading system in a robotic application with features like Access Point, monitoring system and sorting metal cans and plastic bottles. The authors concluded that this project is reliable and can help the school in managing the plastic bottles and metal cans used by the students.

I. Introduction

The problems of waste generation and management have become a severe issue of concern to lots of the scholars in environmental studies[1]. There are a lot of human activities that donate to waste generation and these waste materials if unsuccessful to be predisposed in the proper manner and in the proper place it will produce a serious complication to humans and threat to nature[8]. As the world becomes more industrial and technologically advanced consumption rates are on the rise and a certain value of more consumption is the rapid increase in the amount of waste that is produced[10]. Recycling is one of the most important actions currently available to reduce these impacts and represents one of the most dynamic areas in the industry today[2].

Through this, the authors come up with a sorting bin application intended for metal can and plastic bottle collection that can detect and sort object with monitoring system composed of LED and push button, a node MCU for notification and access point and servos to sort the metal cans and plastic bottles. The combination of these functions makes the authors challenged to establish a research that can help our environment.

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II. Experimental Methods

a) General System Design

The general concept of this paper is illustrated through figure 1. These figures are the system architectures that explains the functionalities of the Aluminum Can to WiFi Trading System with Metal Can and Plastic Bottle Collector and Monitoring System. Figure 1 is the diagram that shows the left side as the inputs and the right side as the output while the microcontroller acts as the main controller of the device.

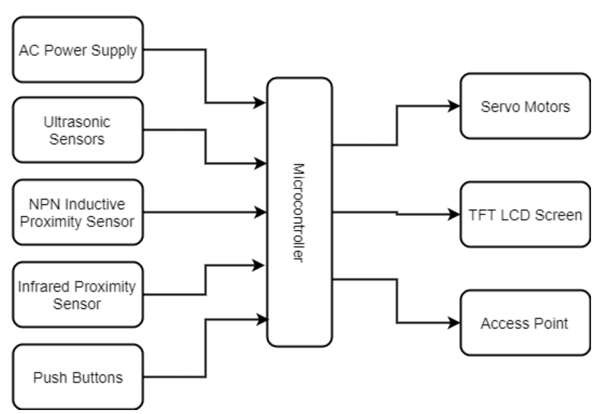

Fig. 1: System Architecture of the Aluminum Can to WiFi Trading System with Metal Can and Plastic Bottle Collector and Monitoring System

b) System Flowchart

Figure 2 illustrates the detailed task of the robot. It explains the step-by-step process on how the system operates. It is equipped with sensors capable of detecting 3 major inputs which are plastic bottle, tin can, and aluminum can. The inductive sensor that triggers the sorting system of the machine. The ultrasonic sensor detects the cans and bottles allowing the machine to guide them using the servos. Infrared sensor counts the aluminum can. Finally, the LCD will display the SSID, password and time. Then the user will access the internet through Access Point.

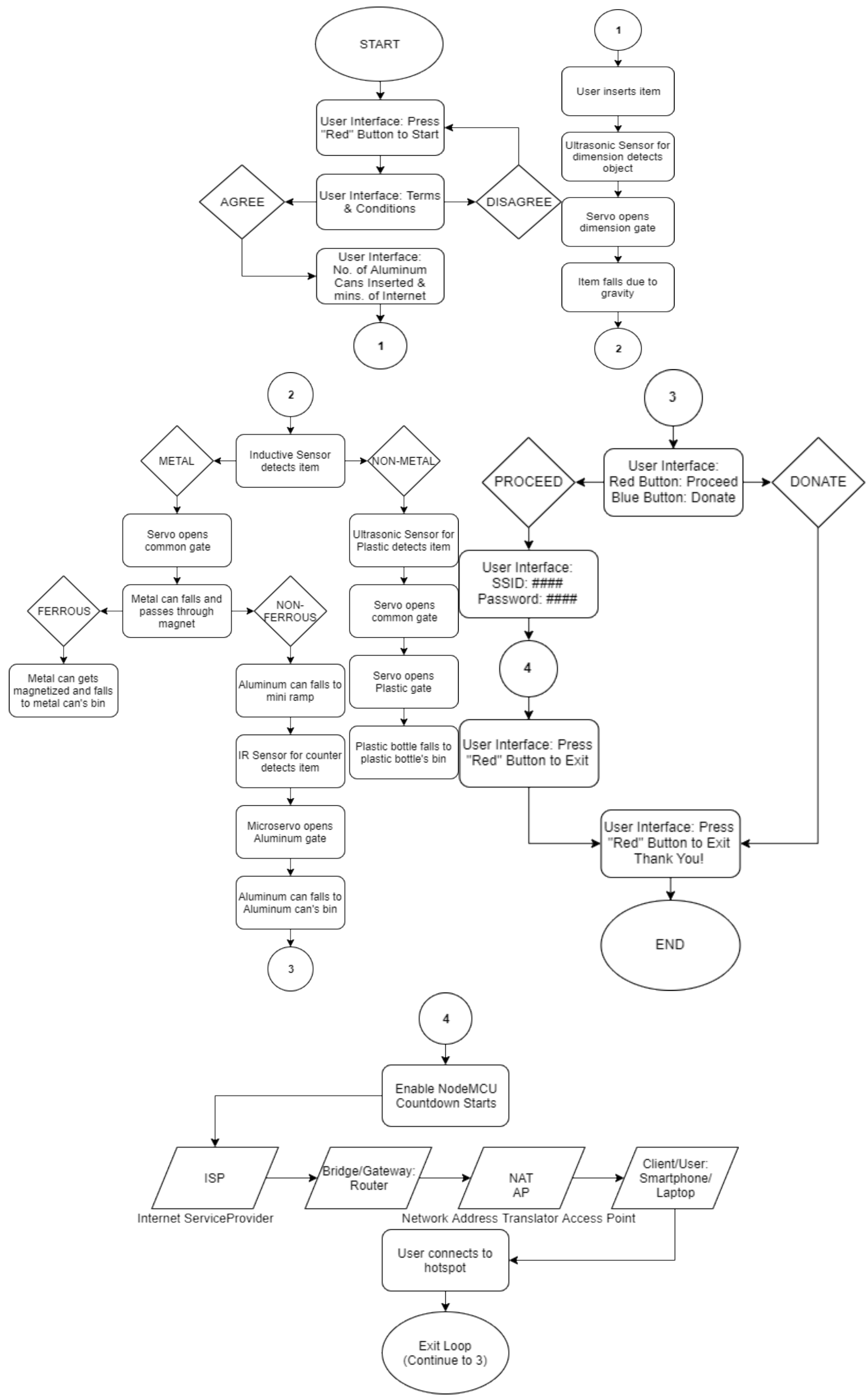

Fig. 2: System Flowchart

c) Wiring Diagram

The wiring diagram of its circuitry is shown in figure 3.1 and 3.2. It illustrates as a guide in connecting each of the components used for the project. In figure 3.1, the main device used is the Arduino Mega microcontroller that serves as the brain of all the components connected. The infrared sensor, inductive sensor, and ultrasonic sensor serves as the input sensors which triggers different operations and activate other devices like servo which will guide the inputs to the bin, LCD that will display the information and transaction, and the Access Point that will provide the user internet access. In figure 3.2, the ultrasonic sensors serve as counters that send data to the Access Point.

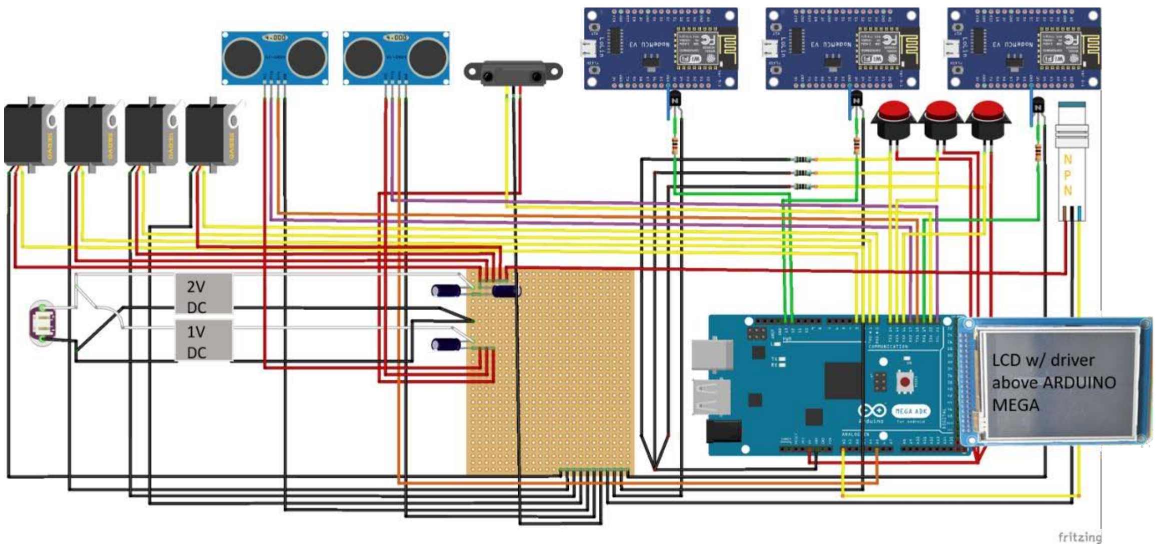

Fig. 3.1: Wiring Diagram

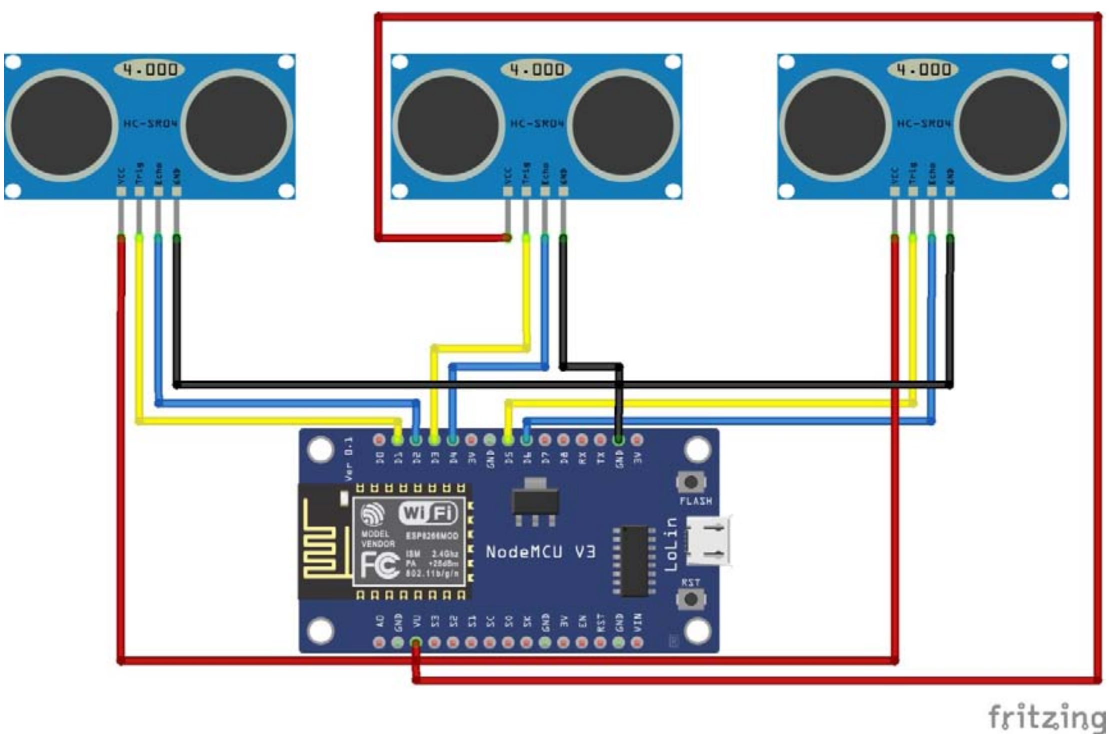

Fig. 3.2: Wiring Diagram for Monitoring System

III. Results and Discussion

One important phase in establishing this paper is the testing the functionalities of the prototype or the robot itself. It was put into several tests to come up with a desirable output. Tests include unit testing, acceptance testing and integration testing. Unit testing was established to assess all the components used and make sure that all are functioning. Acceptance and integration testing guaranteed that all runs according to its objectives. Detailed tests in the given next tables which showed the reliability of the robot.

a) Results of Testing

Table 1: Ultrasonic Sensor Dimension Test

Trial	Material	Ultrasonic Status	Servo Status
1	Plastic Bottle	DETECTED	OPEN
2	Plastic Bottle	DETECTED	OPEN
3	Plastic Bottle	DETECTED	OPEN
4	Tin Can	DETECTED	OPEN
5	Tin Can	DETECTED	OPEN
6	Tin Can	DETECTED	OPEN
7	Aluminum Can	DETECTED	OPEN
8	Aluminum Can	DETECTED	OPEN
9	Aluminum Can	DETECTED	OPEN
10	Aluminum Can	DETECTED	OPEN

Table 1 shows the ultrasonic sensor dimension test. It shows the response of the ultrasonic sensor and servo with three different materials. The number of trials given in the table are just samples extracted from several trials made by the authors. There are 3 trials with plastic bottle, 3 trials with tin can and 4 trials with aluminum can were tested. If the ultrasonic sensor detects the material inserted in the dimension, the servo will open to collect the material.

Table 2: Ultrasonic and Inductive Sensor Segregation Test

Trial	Material	Inductive Status	Ultrasonic Status	Servo1 Status	Servo2 Status
1	Plastic Bottle	UNDETECTED	DETECTED	OPEN	OPEN
2	Plastic Bottle	UNDETECTED	DETECTED	OPEN	OPEN
3	Plastic Bottle	UNDETECTED	DETECTED	OPEN	OPEN
4	Tin Can	DETECTED	DETECTED	OPEN	CLOSED
5	Tin Can	DETECTED	DETECTED	OPEN	CLOSED
6	Tin Can	DETECTED	DETECTED	OPEN	CLOSED
7	Aluminum Can	DETECTED	DETECTED	OPEN	CLOSED
8	Aluminum Can	DETECTED	DETECTED	OPEN	CLOSED
9	Aluminum Can	DETECTED	DETECTED	OPEN	CLOSED
10	Aluminum Can	DETECTED	DETECTED	OPEN	CLOSED

Ultrasonic and inductive sensor segregation test was also established to determine the sorting function of the machine. Table 2 shows the result of ultrasonic and inductive sensor segregation test made by the authors. The number of trials given in the table are just samples extracted from several trials made by the authors. There are 3 trials with plastic bottle, 3 trials with tin can and 4 trials with aluminum can collected. In here, it shows that when there is a plastic bottle, both servo will open. However, if the material is tin can or aluminum can, only the first servo will open. Also, the inductive sensor can't detect the plastic bottle. Hence, the table has proven the good performance of segregation according to its desired function.

Table 3: Tabulated Access Point time limit test

Trial	Remaining Time	Access Point Status
1	45 mins	RUNNING
2	40 mins	RUNNING
3	35 mins	RUNNING
4	30 mins	RUNNING
5	25 mins	RUNNING
6	20 mins	RUNNING
7	15 mins	RUNNING
8	10 mins	RUNNING
9	5 mins	RUNNING
10	0 min	OFF

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The Access Point time limit test shows that the access point will only turn off when there is no remaining time left. The remaining time is displayed on the LCD while the access point runs when the user as accessed the internet.

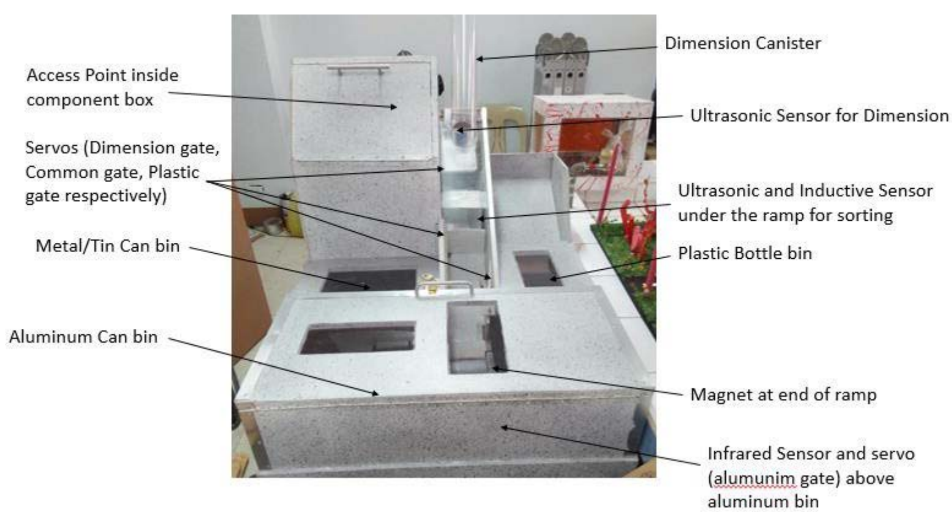
Table 4: Tabulated Access Point distance limit test

Trial	Distance	Phone Status	Access Point Status
1	3 meters	CONNECTED	RUNNING
2	4 meters	CONNECTED	RUNNING
3	5 meters	CONNECTED	RUNNING
4	6 meters	CONNECTED	RUNNING
5	7 meters	CONNECTED	RUNNING
6	8 meters	CONNECTED	RUNNING
7	9 meters	CONNECTED	RUNNING
8	10 meters	CONNECTED	RUNNING
9	11 meters	DISCONNECTED	OFF
10	12 meters	DISCONNECTED	OFF

Table 4 shows the access point distance limit test to determine the range of the device. It shows that the access point shuts down when the user is disconnected. It also shows that the maximum range of the access point is 10 meters.

b) Design Output

(a)



(b)

Fig. 4: Final design output of the Aluminum Can to WiFi Trading System with Metal Can and Plastic Bottle Collector and Monitoring System (a) front view (b) back view

Figure 4 shows the final design output of the Aluminum Can to WiFi Trading System with Metal Can and Plastic Bottle Collector and Monitoring System. It also shows the labeled location of every component integrated inside. The device will work if it is turned on using the AC found at the back of the device. Every labeled component has its own functions. Its main body is made up of plywood and glass for protection of the electronic components. Inside the casing are the devices used such as ultrasonic sensor, infrared sensor, inductive sensor, node MCU, TFT LCD, push button, servo, and three bins as storage for aluminum can, tin can, and plastic bottle.

IV. Conclusion

This paper presented the specifics of the structure of the device as well as the details of the experimental data showing the desired outputs of the device. The components used in this project includes sensors that could detect plastic bottles, tin cans, and aluminum cans. It is stationary and runs on AC.

The project was made possible through different processes and steps and studies addressing the university staff's problems in collecting and segregating plastic bottles, metal cans, and aluminum cans. The project was proven working with its intended function. The researchers concluded that this project is working and is proven effective. This project can deal with plastic bottles, metal can and aluminum can management.

References Références Referencias

1. A. Asuquo, K. Joseph, J. Atu, "ATTITUDE OF URBAN DWELLERS TO WASTE DISPOSAL AND MANAGEMENT IN CALABAR, NIGERIA," European Journal of Sustainable Development Volume 1 No. 1, 2012.
2. J. Hopewell, "Plastics Recycling: challenges and opportunities," US National Library of Medicine National Institutes of Health, 2009.
3. M. Agueda, "Successful Strategies to Generate Community Involvement In Solid Waste Management: Three Case Studies in the Philippines," University of Toronto, 2008.
4. P. Margarita, "Awareness and Practices on Solid Waste Management among College Students in Mindanao State University Maigo School of Arts and Trades," Advances in Social Science, Education and Humanities Research Volume 128, 3rd International Conference on Education and Training (ICET 2017), 2017.
5. S. Melanie, "Solid Waste Management," De La Salle University, 2008.
6. Prof .Mayur Tiwari, Aboli Deshmukh, Kshitija Boke, Netra Deshmukh, Ashwini Dhurve "SMART WASTE MONITORING SYSTEM" International Research Journal of Engineering and Technology (IRJET) Volume 06 Issue 04, 2019.
7. B. Nilo, "Development of an Automated Reverse Vending Aluminum Cans Crusher," url: https://www.researchgate.net/publication/294424981_Development_of_an_Automated_Reverse_Vending_Aluminum_Cans_Crusher, 2009.
8. A. Ferdinand, "Village-Level Solid Waste Management in Lahug, Cebu City, Philippines," url: https://www.researchgate.net/publication/319502638_Village-Level_Solid_Waste_Management_in_Lahug_Cebu_City_Philippines, 2015.
9. P. Christos, "A case study of Internet of Things based on wireless sensor networks and smart phone," url: https://www.researchgate.net/publication/257840438_A_case_study_of_Internet_of_Things_based_on_wireless_sensor_networks_and_smartphone, 2012.
10. M.A. Jessica, "Factors Influencing Solid-Waste Management in the Developing World," Utah State University, 2015.
11. N. John, "AFTER PISONET, HERE COMES PISOWIFI," url: https://www.unbox.ph/gadget/after-pisonet-here- comes-piso-wifi/, 2016.
12. U. Irfan, "A Study and Analysis of Public WiFi," Linköpings universitet, 2012.
13. Nino, "The positive impact of WiFi at schools," url: https://www.tanaza.com/blog/positive-impact-wifi-schools/, 2016.

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c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Engineering Research Paper

Techniques for writing a good quality engineering research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of research engineering then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.
22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.
23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.

- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- o Single section and succinct.
- o An outline of the job done is always written in past tense.
- o Concentrate on shortening results—limit background information to a verdict or two.
- o Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- o Explain the value (significance) of the study.
- o Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- o Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- o Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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