ISSN No:-2347-6532

International Journal of Engineering & Scientific Research

Volume No. - 13
Issue No. - 2
May - August 2025

ENRICHED PUBLICATIONS PVT.LTD

JE - 18,Gupta Colony, Khirki Extn,
Malviya Nagar, New Delhi - 110017.
E- Mail: info@enrichedpublication.com
Phone :- +91-8877340707

ISSN No:-2347-6532

International Journal of Engineering & Scientific Research

Aims and Scope

The International Journal of Engineering & Scientific Research (IJESR) is aimed at providing a platform for researchers, engineers, scientists, or educators to publish their original research results, to exchange new ideas, to disseminate information in innovative designs, engineering experiences and technological skills. All papers submitted to the Journal will be blind peer-reviewed. Only original articles will be published. The papers for publication in The International Journal of Engineering & Scientific Research are selected through rigorous peer reviews to ensure originality, timeliness, relevance, and readability. Theoretical work submitted to the Journal should be original in its motivation or modeling structure. Empirical analysis should be based on a theoretical framework and should be capable of replication. It is expected that all materials required for replication (including computer programs and data sets) should be available upon request to the authors.

The current emphasis of the journal includes the following areas: Life Sciences: Agricultural, Biological Sciences, Biochemistry, Genetics, Molecular Biology, Environmental Science, Immunology and Microbiology, Neuroscience, Marine Biology. Physical Sciences and Engineering: Chemical Engineering, Chemistry, Computer Science, Earth and Planetary Science, Energy, Mathematics, Physics and Astronomy, Engineering, Material Science, Statistics. Health Science: Medicine and Dentistry, Nursing and Health Professions, Pharmacology and Toxicology, Pharmaceutical Science, Veterinary Science, Veterinary Medicine. Social Science and Humanities: Arts and Humanities, Business Management, Management, Accounting, Decision Science, Economics, Econometrics, Finance, Psychology, Social Sciences by publishing original research work, short communications and review articles.

ISSN No:-2347-6532

International Editorial Board of IJESR

Editor-in-Chief

Associate Editors

ISSN No:-2347-6532

Editorial Board Members

Dr Shujaat Yar Khan, Ph.D IIT Delhi Associate Professor, Faculty of Engineering & Technology Aligarh Muslim University, Aligarh	**Dr.N Jaisankar** Professor and Head M N M Jain Engineering College, Chenna
Dr. Mohammad Akram lecturer, Jazan University, Kingdom of Saudi Arabia,	**Prof. Richard Remedios** I/c PRincipal, S.V.E.T Commerce & BBA College, Jamnagar, INDIA
Dr. Ravi Kumar Bommisetti Sree Sainath Nagar - Senior Lecturer, Sree Vidyanikethan Engineering College,517102 , TIRUPATI, Andhra Pradesh - INDIA	**Prof. (Dr.) Anand Kumar Tripathi** Director, Ishwarchand Vidya Sagar Institute of Technology (IVSIT-239), Mathura (UP), INDIA
Dr. Vijay Kantilal Chavada Associate Professor, Dept of Community Medicine, Indira Gandhi Medical College & Research Institute, Vazhudawur Road, Pondicherry, INDIA	**SHAILENDRA KUMAR DEWANGAN** Assistant Professor, Department of Electronics & Instrumentation Engineering, Chhatrapati Shivaji Institute of Technology (CSIT), Durg, INDIA
Shekhar. R Asst. professor, Department of Computer Science, Alliance College of Engineering & Design[ACED], ALLIANCE_UNIVERSITY, INDIA	**Shubhendu S. Shukla** Asst professor, SR Group of Institutions, Lucknow, INDIA
Dr. M. Jaya H.O.D., Asan Memorial College of Arts & Science, Chennai 600 100. INDIA	**Amar Saraswat** Assistant Professor, Dronacharya College Of Engineering, Gurgaon, B.E.- IT, M.Tech-CSE, MIET, INDIA
Dr. M.Ganesh Babu Associate Professor, Acharya Institute of Technology, Bangalore, VTU University, Belgaum INDIA	**Dr. Shaijumon C S** Assistant Professor, Indian Institute of Space Science and Technology, Thiruvananthapuram, Kerala INDIA
Dr. Davod Kiany Assistant Professor, Institute for international energy studies (IIES), Ministry of petroleum, republic Islamic of Iran, Tehran, IRAN	**Dr. Krishnanaik Vankdoth** Professor, Dept of Electornics and Communication Engineering Vaagdevi College of Engineering Bollikunta Warangal
Dr Nageswara Rao Moparthi Associate Professor, Velagapudi Ramakrishna Siddhartha Engineering College Chalasani Nagar, Kanuru, Vijayawada, Andhra Pradesh 520007	**Dr. Mustafa Mohamed Sabry Bakry** Head of Research at the Institute of Plant Protection Research, Station of Agricultural Research El-Matanaa, Esna, Luxor, Egyp

Dr R. Shivaraman
Associate Professor of Mathematics

D.G.Vaishnav College,
Arumbakkam, Chennai

ISSN No:-2347-6532

International Journal of Engineering & Scientific Research

(Volume No. - 13, Issue No. - 2, May - August 2025)

Contents

ISSN No:-2347-6532

Comparative Study P&O and Fuzzy Logic MPPT System for Solar Energy Conversion System

Prashant Upadhyay*
Bheru Das Vairagi*
Vinod Kumar**
R. R. Joshi***

ABSTRACT

Maximum power point trackers are so important to improve the efficiency of photovoltaic systems. Many methods have been proposed to achieve the maximum power that the PV modules are capable of producing under different atmospheric conditions. This paper proposed a fuzzy logic based Maximum Power Point Tracking (MPPT) algorithm for solar system. The solar panel is simulated and analyzed in MATLAB/SIMULINK. Photovoltaic system is connected to a DC-DC Buck-boost converter. The Solar panel can produce maximum power at a certain operating point called Maximum Power Point (MPP).To achieve maximum power and to get maximum efficiency, the whole system must operate at that Maximum Power point. Maximum power point of PV panel keeps same on changing with changing solar irradiance and temperature of cell. Then to obtain maximum power from a PV system, MPPT algorithms are implemented. So that, fuzzy logic based MPPT is developed and Simulation results show the effective of the fuzzy based controller to produce more stable power.

Keywords: MPPT, Fuzzy Logic, PV Modeling, Buck-Boost Converter.

1. Introduction:

As we know energy has the great role in our life and economy. The energy demand has greatly increased day by day due to the technical revolution. Fossil fuels have been started to be gradually depleted. On the other hand the greenhouse gases emissions are increasing due to the conventional generation of energy. It is a really critical challenge to reduce carbon dioxide emissions and ensuring safe, improve and affordable energy, and to achieve better energy systems. Renewable energy sources are considered for generation of clean and sustainable energy.[1,2] There are many available renewable energy sources are such as solar energy, wind energy, etc. Photovoltaic (PV) system has a huge research area for upcoming energy requirement.[4] So it taken a great attention by the researchers and it appears to be one of the most sustainablerenewable energy sources. Solar energy is a secure, less maintenance, pollution free andnoiseless generation due to absence of moving parts.[3,5]

However, two important factors affect the implementation of photovoltaic systems. These are high initial cost and less efficient at energy conversion. So to reduce photovoltaic system costand to increases the conversion efficiency of solar energy, the maximum power point tracking system of photovoltaic modules is one of the effective method. Maximum power point tracking, frequently referred to as MPPT, is a system used to extract the maximum power of the PV module to deliver it to the load, and system efficiency increases.[6,7]PV systems are dependent power sources with nonlinear I-V characteristics under different environmental (insolation and temperature) conditions. In addition they have high installationcost and low energy conversion efficiency. These are the reasons for the less efficiency of PVsystems. To overcome the problems, the Maximum power point tracking of the PV system is used (at a given condition) at on-line or off-line algorithms and the system operating point is forced toward this to desired condition.In literature, various maximum power point tracking (MPPT) techniques are proposed and implemented. These techniques include look-up table methods, perturbation and observation (P&O) methods and computational methods. One of the computational methods which havedemonstrated fine performance using fuzzy-based MPPT technique.[7-11]The fuzzy theory based on fuzzy logic sets and fuzzy algorithms provides a general method of expressing linguistic rules so that they may be processed quickly by a computer. Recently some application of fuzzy control has been successful in photovoltaic applications. The fuzzy controller introduced in uses dP/dI and its variations D(dP/dI) as the inputs and computes MPPT converter duty cycle. The shortcoming of this approach is the ignorance of duty cycle variations, which results in an acceptable accuracy level with improved dynamic characteristics. The fuzzy tracker of reference considers variation of duty cycle, but replaces dP/dI by the variation of panel power. This tracker has fine dynamic behavior with limited accuracy.[9,10]This paper presents a photovoltaic system including a solar panel, a fuzzy MPP tracker and a resistive load is designed, simulated and constructed. Simulated and measured results are presented.

II. The Photovoltaic System

There are many equivalent circuits of a solar cell, where the single-diode and two-diode models could be the mostly used. So that the single-diode model is simple and accurate enough in many cases. Its equivalent circuit with series and parallel resistance is shown in Figure 1.[2,4]

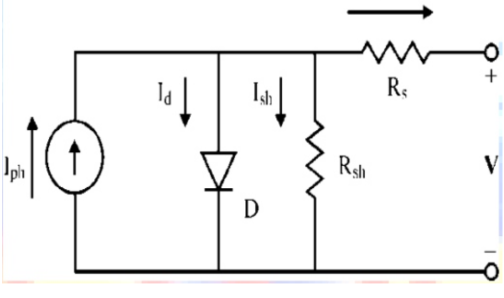


Fig. 1: Equivalent circuit of a single solar cell

The symbols in Fig. 1 are defined as follows:

I_{ph} : photocurrent;
I_d : current of parallel diode;
I_{sh} : shunt current;
I : output current;
V : output voltage;
D : parallel diode;
R_{sh} : shunt resistance;
R_s : series resistance;

Using the equivalent circuit of Fig.1, the nonlinear I-V characteristics of solar cells is given by the following equation:

$$I = I_{ph} - I_0\left\{e^{\frac{q(v+R_sI)}{AKT}} - 1\right\} - \frac{V+R_sI}{R_{sh}} \quad \ldots.(1)$$

Where I_o is the reverse saturation current of the diode, q is the electron charge (1.602 × 10−19 C), A is the curve fitting factor, and K is Boltzmann constant (1.38 × 10−23J/K).

Model of a PV Module

If a solar cell type tends to have an I–V curve in which the slope at short circuit is almost zero, the value of R_{sh} can be assumed to be infinite. In this case, the last term in (1) could be ignored. And taking I_{ph} as I_{SC}, (1) will become

$$I = I_{SC} - I_0\left(e^{\frac{q(v+R_sI)}{AKT}} - 1\right) \quad \ldots.(2)$$

Where ISC is the short-circuit current. Equation (2) is valid for a solar cell. For the accurate application of this equation for a PV module, the term of q(V + R_s I)/AKT is changed to q(V + Rs I)/NsAKT, in which N_s is the number of series-connected solar cells in a PV module.

…(3)

A simple PV module model will be derived from (2) in this section. When a PV module is in a open-circuit situation, I = 0 and the item q/N_sAKT in (2) will be solved as follows:

$$\frac{q}{N_s AKT} = \frac{\ln\left(\frac{I_{SC}}{I_0}+1\right)}{V_{OC}} \quad \text{....(3)} \qquad \text{...(4)}$$

where VOC is the open-circuit voltage of a PV module. Substituting (3) into (2), we get

$$I = I_{SC}\left[1 - \frac{I_o}{I_{SC}}\left(e^{\ln\left(\frac{I_{SC}}{I_o}+1\right)\frac{(v+R_s I)}{V_{OC}}} - 1\right)\right] \quad \text{....(4)} \qquad \text{...(5)}$$

Fig. 2 shows the P-V curves of the PV module under changing solar radiation from 200W/m²to 1000W/m² while keeping the temperature constant at 25°C. Fig. 3 shows the P-V curves of the PV module under changing temperature from 10°C to 55°C while keeping the solar radiation constant at 1000W/m².

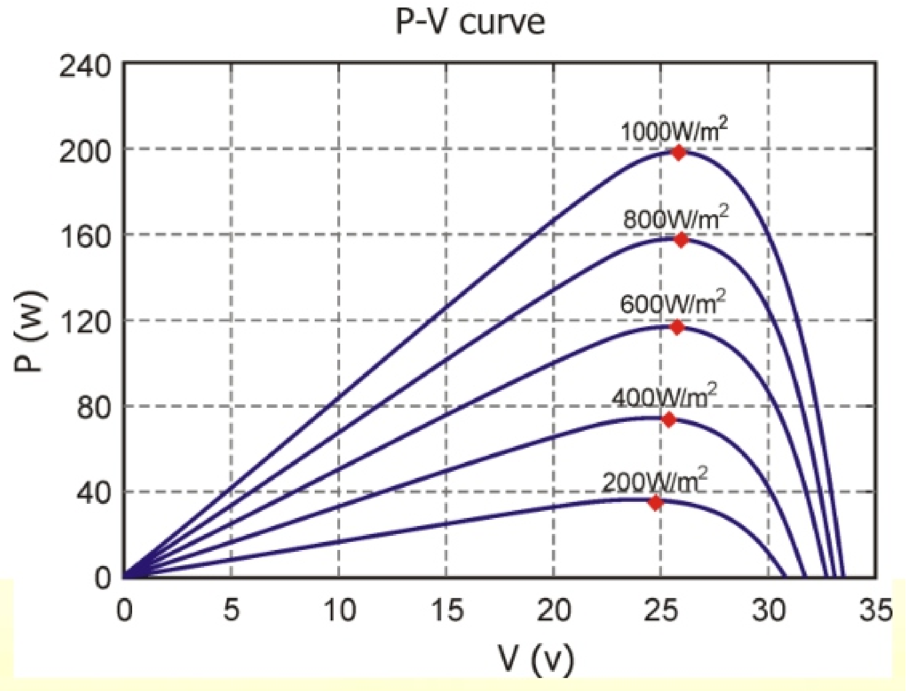


Fig. 2: P-V curves under changing the solar radiation

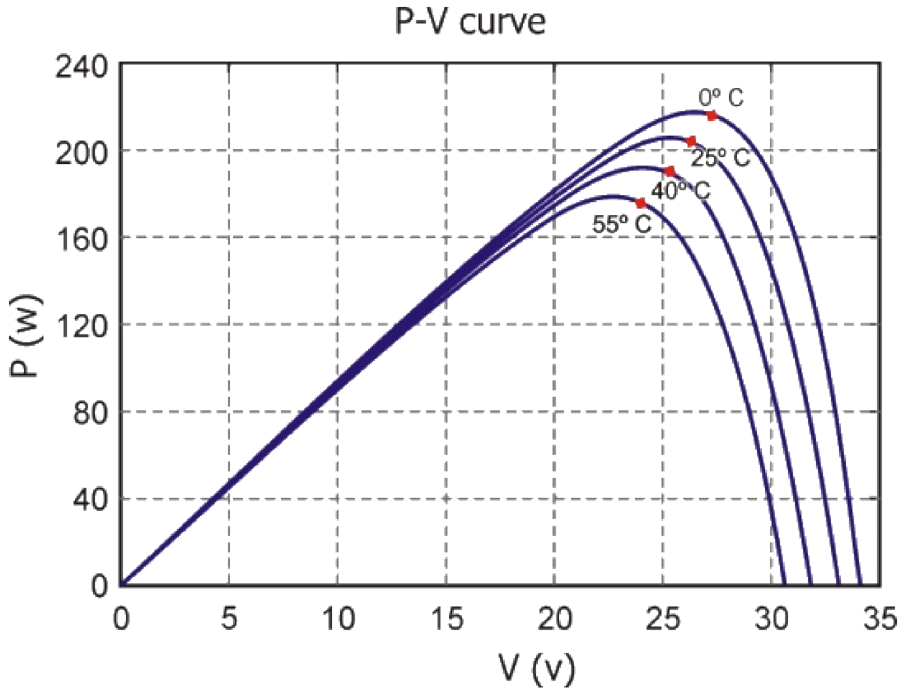


Fig. 3: P-V Curves under changing the temperature

III. Dc-Dc Buck-Boost Converter

The DC-DC converter is an electronics circuit which is used to provide a loss less transfer of energy between different circuits at different DC voltage levels. There are many DCDC converters. One of the popular types of DC-DC converters is buck-boost converter. Buckboost converter is circuit that operating using switching mode power supply. Buck-boost converter used to step up and step down the DC voltage by changing the duty ratio of the switch. When the duty ration is less than 0.5, the output voltage is less than the input voltage and vice versa. The buck-boost converter circuit is shown in Fig. 4.[2,3]

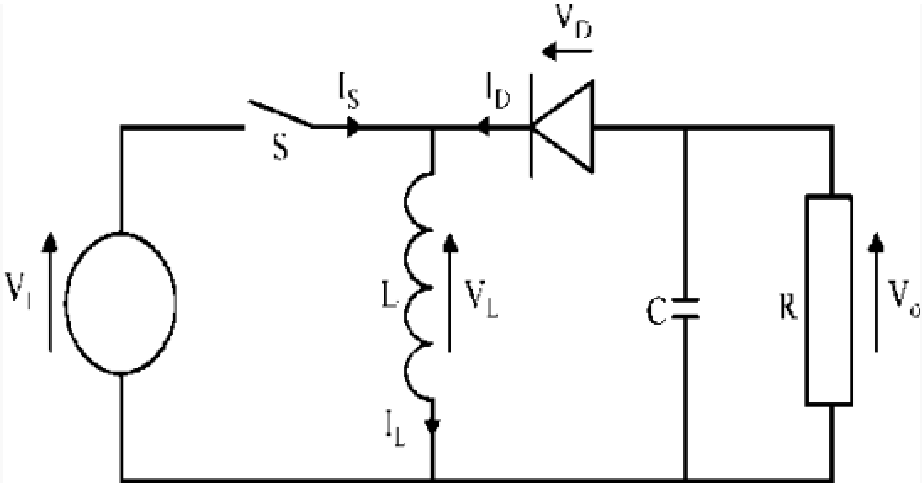


Fig. 4: Schematic of a buck–boost converter.

The operation of the Buck-boost converter is as follows:

- When the transistor is turned ON, the diode is reverse-biased and being not conducting.Turning on the transistor is accomplished during o < t < DT s interval. The voltage across the inductor in this stage is given as:

$$V_I = V_L \ldots.(5)$$

- When the transistor is turned off, the diode is conducting. Turning on the transistor is accomplished during DTs< t < Ts interval. The voltage across the inductor in this stage is given as:

$$V_L = V_O \ldots.(6)$$

It is known that for steady-state operation, the net change in the inductor current must be zero over one switching cycle. By applying volt-second balance we get:

$$V_I D + V_O(1 - D) = 0 \ldots.(7)$$

Where D is the duty cycle of the converter which is given as:

$$D = \frac{T_{on}}{T} \ldots.(8)$$

From (7) the relation between the input voltage to the output voltage of the buck-boost converter is given as[3]:

$$\frac{V_o}{V_i} = \left(\frac{D}{D - 1)}\right) \ldots.(9)$$

IV. Perturb and Observe

Perturb and observe (P&O) method is widely used to track the MPP of the PV module. The algorithm applies a small increment or decrement of perturbed voltage ΔV to the PV module operating voltage. The operation of the P&O MPPT can be shown as in Fig. 5.

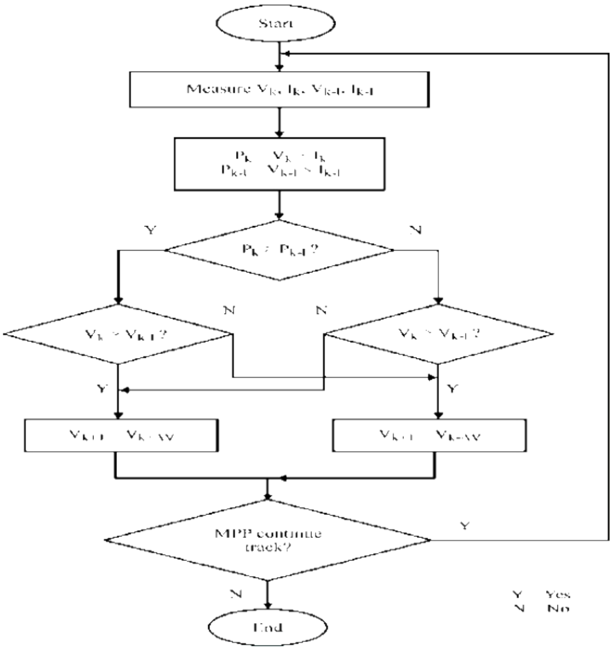


Fig. 5: Flowchart shows the operation of P&O MPPT

The measurement of actual state k and previous state k-1 of parameters V and I are taken. Comparison has been made between the actual and previous state of the parameters power, P and voltage, V. Based on the conditions as stated in Fig. 5, increment or decrement of perturbed voltage, ΔV will be applied to the PV module operating voltage. Fig. 6 shows the power-voltage characteristic of PV model which is used to discuss the principle of MPP tracking. There are four possible cases which will influence the direction of the tracking in P&O MPPT.

Case I where $P_k > P_{k-1}$ and $V_k > V_{k-1}$, the situation can be described as path α in Figure 6. When the operating voltage is increased, the PV power is increased also. Therefore, a small change of voltage ΔV need to be added to the present PV operating voltage followed by monitoring of the PV power. The process is continued until the MPP is identified.

Case II where $P_k > P_{k-1}$ and $V_k < V_{k-1}$ referred to path β in Fig. 6. It can be noticed that when the operating voltage is decreased, the PV power is increased. In order to identify the MPP operating point, reduction of ΔV should be made on the present PV operating voltage and the parameters P_k and P_{k-1} are compared. If the condition $P_k > P_{k-1}$ is fulfilled, the decrement of ΔV will be continued until the MPP is successfully spotted.

Case III where $P_k<P_{k-1}$ and Vk>Vk-1 can be described as path β in Fig. 6. In this case, the PV power is decreasing as the increased of PV operating voltage. Thus, it should have a reduction of ΔV on the present PV operating voltage.

Case IV where $P_k<P_{k-1}$ and $V_k<V_{k-1}$ is illustrated as path α in Fig. 6. The PV power is reducing where $P_k<P_{k-1}$ and $V_k<V_{k-1}$ is illustrated as path α in Fig. 6. The PV power is reducing as the decreasing of PV operating voltage. Thus the PV operating voltage should have an increment of ΔV to track the PV maximum power point.

The main weakness of P&O MPPT algorithm is the PV module's operating voltage is perturbed every cycle. The algorithm will always perform an increment or decrement of ΔV to the PV operating voltage.

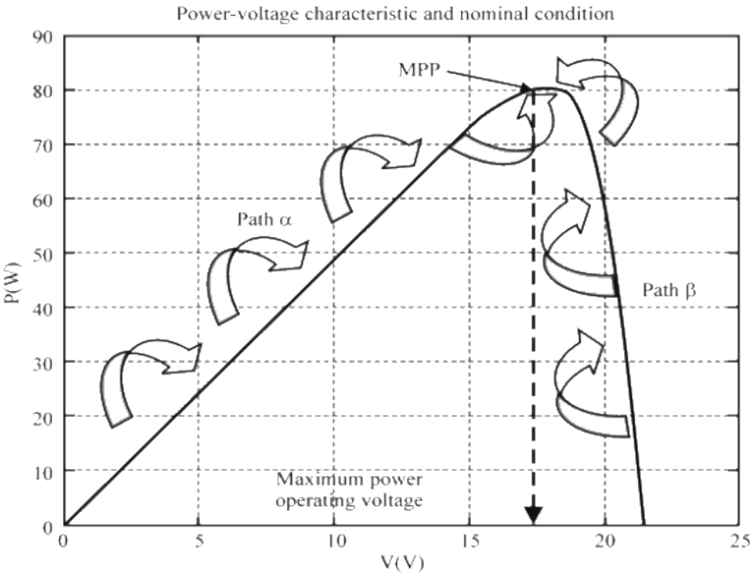


Fig. 6: Principle for MPP tracking

V. The Proposed MPPT Fuzzy Logic Base Method

A Fuzzy Logic Controller (FLC) is designed to work as an MPPT controller. Fig. 7 shows the FLC.

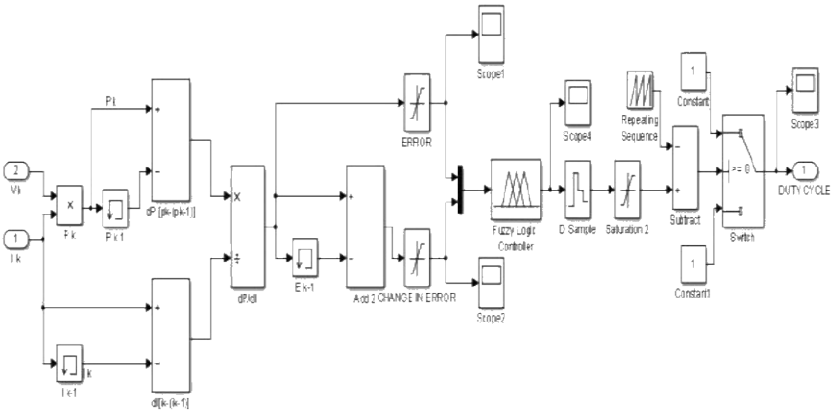


Fig. 7: Fuzzy logic controller

The FLC contains a Fuzzy Inference System (FIS) whose structure is shown in Fig. 7. The FIS inputs, error (E) and change in error (CE), are obtained using the following equations:[10]

$$E(k) = \frac{P_{PV}(k) - P_{PV}(k-1)}{I_{PV}(k) - I_{PV}(k-1)} \quad \text{....(10)}$$

$$CE(k) = E(k) - E(k-1) \quad \text{....(11)}$$

Where:

P_{PV}: The power of the PV system

I_{PV}: The current of the PV system

E: Error

CE: Change in error

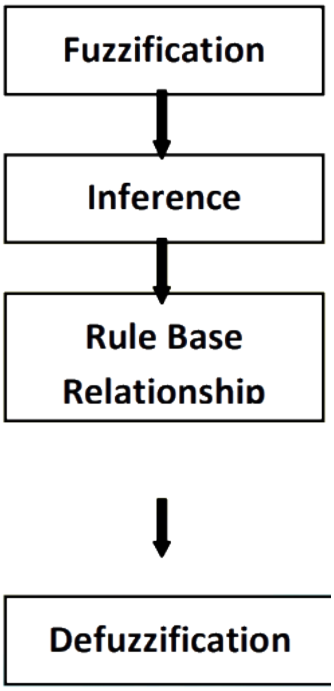


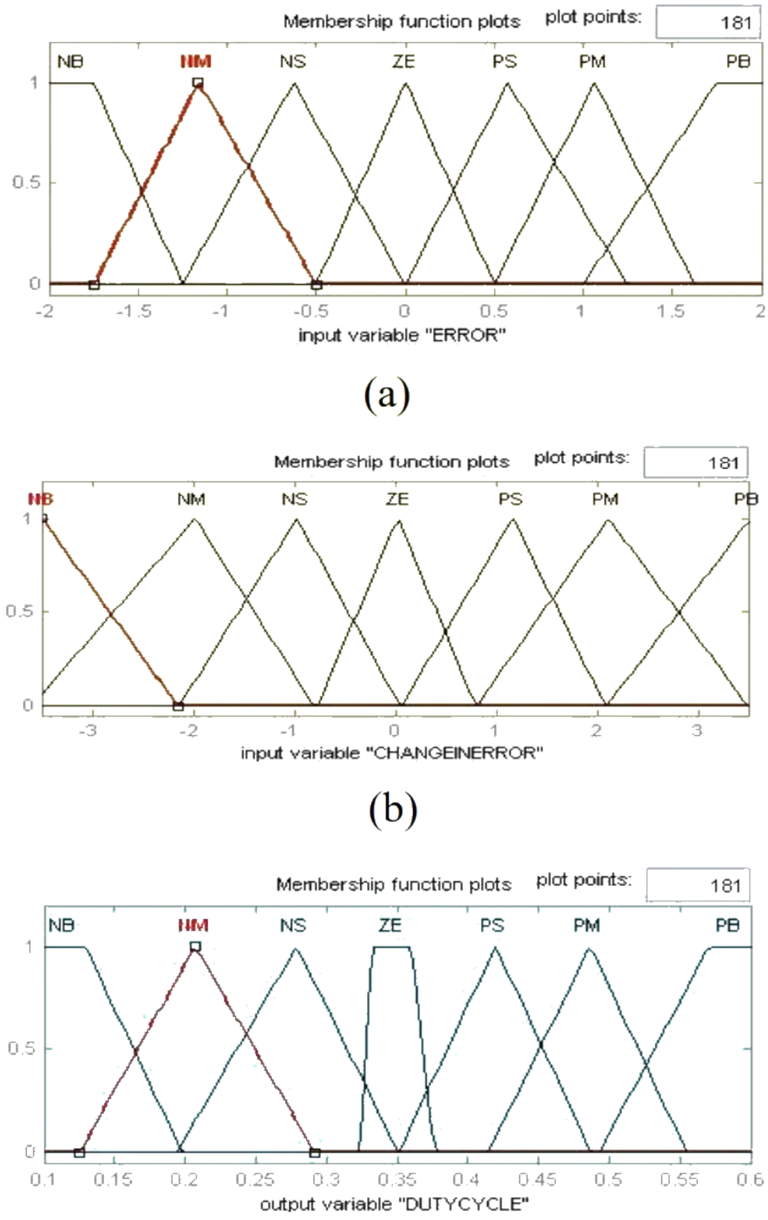
Fig. 8: Fuzzy Interface System

A. Fuzzification

1) Fuzzification of Error-Signal: The range of error-signal is partitioned into seven regions with triangular and trapezoidal membership functions labelled as: Negative Big, Negative medium, Negative small, Zero error, positive small, positive Medium and positive big over Universe of Discourse (UoD) of -0.8 to 0.8 as shown in fig.9.

2) Fuzzification of Change in Error-Signal: The second input parameter is Change in Error-Signal. The range of signal is partitioned into seven regions with triangular membership functions labelled as: Negative Big, Negative medium, Negative small, Zero error, positive small, positive Medium and positive big over UoD of -3 to 3 same as shown as eroor signal.

3) Fuzzification of PWM Duty cycle-Signal: Defuzzification converts membership functions into Crisp value for PWM signal. Seven regions with triangular and trapezoidal membership partitions are labelled as: Negative Big, Negative medium, Negative small, Zero error, positive small, positive Medium and positive big over UoD of 0.1 to 0.7 counts.



(a)

(b)

(c)

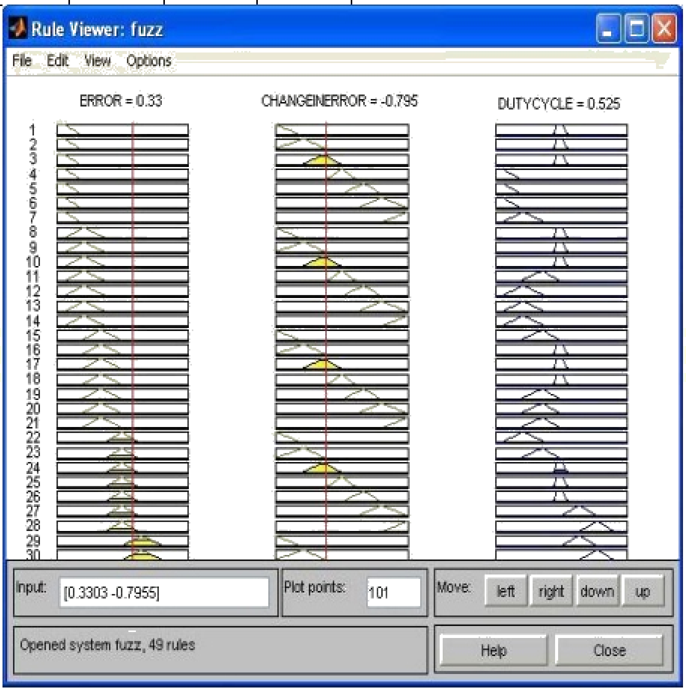
Fig.9: Graphical view of the membership function error signal

B. Fuzzy Inference System

The Fuzzy Inference forms a key part of Fuzzy Logic Control. The Fuzzy IF-THEN rule base matrix is in

Table 1: Rule Based Matrix

E/CE	NB	NM	NS	ZE	PS	PM	PB
NB	ZE	ZE	ZE	NB	NB	NB	NM
NM	ZE	ZE	ZE	NS	NM	NM	NM
NS	NS	ZE	ZE	ZE	NS	NS	NS
ZE	NM	NS	ZE	ZE	ZE	PS	PM
PS	PS	PM	PM	PS	ZE	ZE	ZE
PM	PM	PM	PM	ZE	ZE	ZE	ZE
PB	PB	PB	PB	ZE	ZE	ZE	ZE



Input: [0.3303 -0.7955]

Plot points: 101

Opened system fuzz, 49 rules

Fig.10: Rule Viewer

C. Defuzzification:

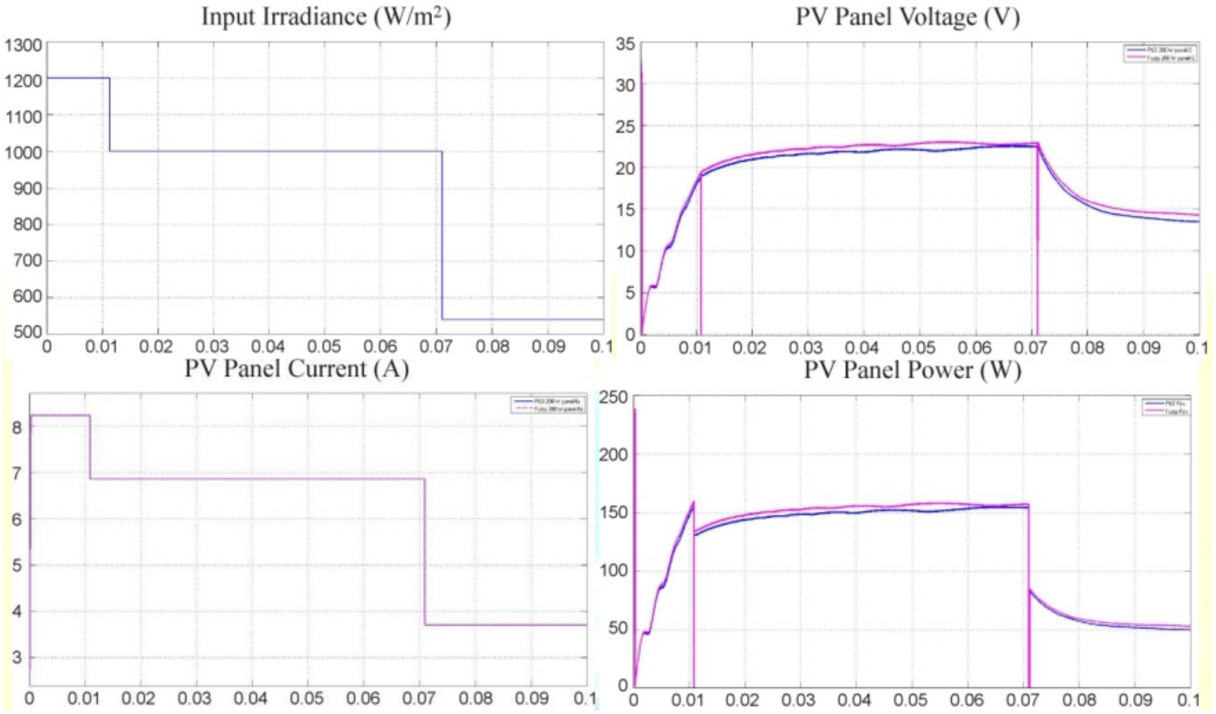
The Fuzzy Inference based on Mamdani's scheme is shown in fig.10 for present Error of 0.33, change of error is -0.79 thereby suggesting a PWM duty cycle of 0.525.

VI. Experimental Result

In order to verify the MPP tracker for the photovoltaic simulation system with step decay in solar irradiance, the proposed fuzzy MPPT method can effectively and accurately tracks the maximum power. The simulation is done using MATLAB/STMULINK and comparison study of the results are taken from P&O and Fuzzy MPPT. The output of the fuzzy MPPT control block is the gating signal which is used to drive the MOSFET. With further tuning of fuzzy sets and fuzzy rules theprocess of output power can be more and more power efficient. Results are shown in fig. 11.

VI. Conclusion

Fuzzy MPPT model using Matlab/SIMULINK and design of appropriate DC-DC buck-boost converter with a maximum power point tracking facility are presented in this paper. A new method for MPPT based fuzzy logic controller is presented. The model is tested under 1200W/m2to 540 W/m2solar radiation and 250C photovoltaic temperature. Simulation results show that the proposed method effectively tracks the maximum power point as compared to P&O MPPT technique. The oscillation around MPP is decreased and the response is faster in compared with the conventional methods.



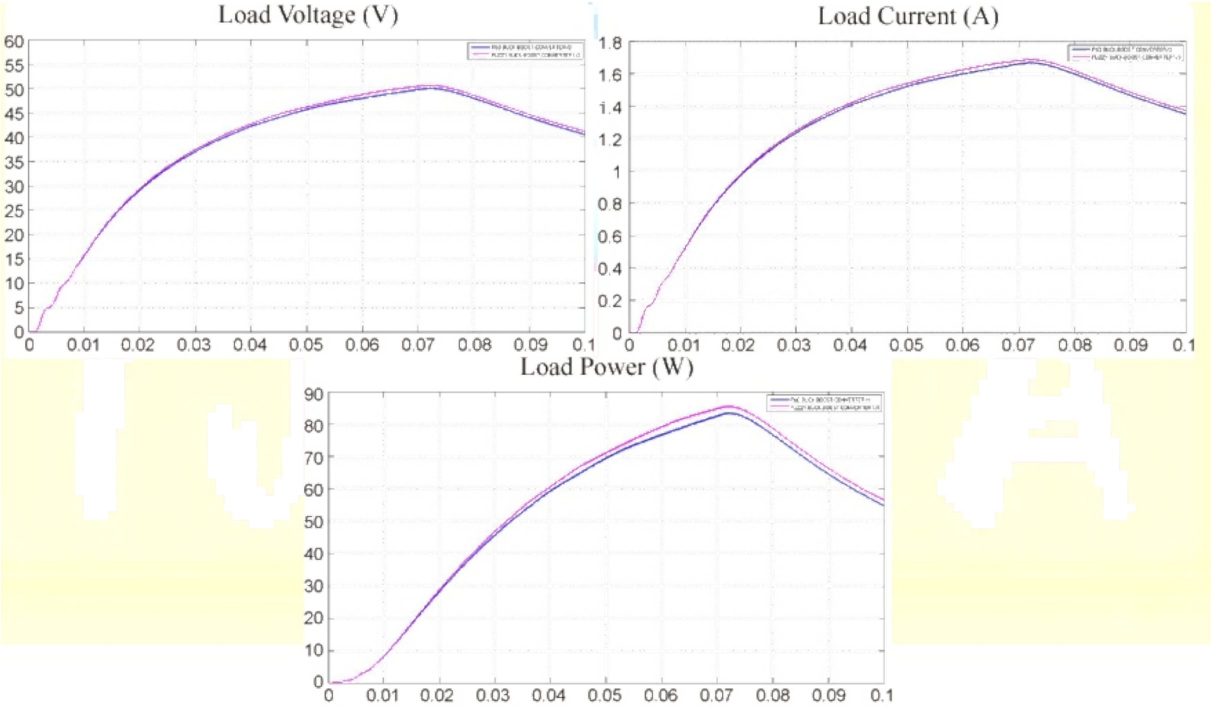


Fig. 11: Performance of Fuzzy MPPT over P&O MPPT

References

1. *S. Chowdhury and S. P. Chowdhury, "Mathematical modelling and performance evaluation of a stand-alone polycrystalline PV plant with MPPT facility", IEEE Power and Energy Society General Meeting, pp. 1-7, July 2008.*
2. *Zheng Zhao, Ming Xu, Qiaoliang Chen, Jih-Sheng Lai and Younghoon Cho, "Derivation, Analysis, and Implementation of a Boost–Buck Converter-Based High-Efficiency PV Inverter", IEEE Transactions on Power Electronics, vol. 27, No. 3, pp. 1304-1313, March 2012.*
3. *E. Babaei, Esmaeel Sayed and H.M. Marhery, "Operational Modes and Output-Voltage-Ripple Analysis and Design Considerations of Buck–Boost DC–DC Converters", IEEE Transactions on Industrial Elect. vol. 59, No. 1, pp. 381-391, Jan. 2012.*
4. *Kun Ding, XinGao Bian, HaiHao Liu and Tao Peng, "A MATLAB-Simulink-Based PV Module Model and Its Application Under Conditions of Nonuniform Irradiance", IEEE Transactions on Energy Conversion, vol. 27, No. 4, pp. 864-872, Dec. 2012.*
5. *D. Peftitsis, G. Adamidis, P. Bakas and A. Balouktsis, "Photovoltaic system MPPTracker Investigation and Implementation using DSP engine and Buck-Boost DC-DC converter", IEEE Power Electronics and Motion control conference, vol. 13, pp. 1840-1846, Sept. 2008.*

6. *F.Z. Hamidon, P.D. Abdul Aziz and N.H. Mohd Yunus, "Photovoltaic array modelling with P&O MPPT algorithm in MATLAB", IEEE international conference on Statistics in Science, Business, and Engineering, pp. 1-5, Sept. 2012.*

7. *N. Ravishanker and J. Kohila, "Tracking maximum power point from photovoltaic system using fuzzy logic technique", IEEE conference on Information and Communication Tech., pp. 93-97, April 2013.*

8. *M.A.S. Masoum and M. Sarvi. "A new fuzzy-based maximum power point tracker for photovoltaic applications", Iranian Journal of EE Engg., vol. 1, pp. 28-35, Jan. 2005.*

9. *C.S. Chin, P. Neelakantan, H.P. Yoong and K.T.K. Teo, "Fuzzy logic MPPT for photovoltaic modules influenced by solar irradiation and cell temprature", International conference on modeling and simulation, vol. 13, pp. 376-381.*

10. *A.M. Norman, K.E. Addoweesh and H.M. Mashaly, "A fuzzy logic control method for MPPT of PV systems", Annual conference on IEEE industrial elec. Society, vol. 38, pp. 874-880, Oct. 2012.*

11. *Shijie Yan and Lei Xu, "Fuzzy logic control of MPPT for photovoltaic power system",International conference on fuzzy system and knowledge discovery, vol. 9, pp. 448-451, May 2012.*

ISSN No:-2347-6532

MONITORING AND CONTROL SYSTEM FOR THREE PHASE INDUCTION MOTOR FED BY INVERTER DRIVE USING PLC AND SCADA

Adarsh.R.J*
Narsimpur Tushar.S**
Sujatha.M.S***

ABSTRACT

Induction motors has increased tremendously since the day of its invention. They are being used as actuators in various industrial processes, robotics, house appliances and other similar applications. The reason for its day by day increasing popularity can be primarily attributed to its robust construction, simplicity in design and cost effectiveness. Modern industrial processes which involve multimotor drives require a co-ordinated sequential control through PLC and SCADA system. An integrated system comprising of a Workstation (PC), the PLC (SIEMENS S7 300), SIEMENS MM420 DRIVE, Three phase INDUCTION MOTOR and the software for Supervisory Control and Data Acquisition system are configured and developed in co-ordination with each other to ultimately control the three phase induction motor drive in multiple ways. The Induction motor is configured and controlled during normal operation and trip conditions, an effort is made to monitor the induction motor runtime variables like speed, voltage, temperature and current. The necessary Communication protocols are established between PC-PLC-DRIVE to ensure flawless communication. The real time Performance of the three phase induction motor is experimentally verified and captured on the Drive software. Various virtual animated screens are developed to explain the three phase induction motor speed control applications.

IndexTerms—Programmable Logic Controller, SCADA, Inverter Drive, Induction Motor.

A PLC-based system for the control and monitoring of a Three-Phase Induction motor showed the efficiency and speed regulation increased by using a PLC as compared to the conventional V/f control system Maria G Ioannides et.al [3]. A control program has been developed, in accordance of which PLC continuously monitors the inputs and activates the outputs accordingly. A speed sensor is employed for speed feedback. Protection scheme to protect induction motors against possible failures thereby increasing reliability, efficiency and performance of the system. proposed approach is a sensor-based technique, therefore, currents, voltages, speed and temperature values of the induction motor were measured with sensors and whenever any fault is detected during operation of the motor, PLC controlled on-line operation system activates immediately. The motor protection achieved is much reliable than classical techniques and can be applied even to larger motors [2].A power factor controller for a 3-phase induction motor, utilizing Programmable Logic Controller.

This focuses on the implementation of a model for a PLC based power factor controller to improve the power factor of a 3-phase induction motor. Voltage to frequency ratio has been maintained constant to obtain maximum toque. The power factor controller hardware comprises of S7-PLC, a 3-phase squirrel cage induction motor coupled with a dc shunt generator and an electronic conditioning circuit [4]. An industrial PLC used for controlling five-axis rotor position, direction and speed, thereby decrementing circuit components and cost and at the same time enhancing reliability. Ladder diagram has been used to control robot through PLC. The robustness of the PLC controller has been achieved by rotating the motor in both clockwise as well as counter-clockwise directions. Consequently, the PLC controller proves to be a simple tool for controlling robot by extremely simple algorithm [5].Recent advances in DSP and ASIC technology, plus the theoretical concepts developed for Direct Torque Control combines the benefits of direct flux and direct torque control into sensor less variable frequency drive that does not require a PWM modulator. The theory of DTC for three phases Induction Motor Drive is developed. The mathematical model of the drive is developed and simulated. From the simulation transient and steady state performance of the drive is obtained [6].By considering efficient monitoring & control & customized application product development for a induction motor drive automation leads to this present work carried out, which was intended to configure and develop an easy control strategy for induction motor speed control with the help of PLC, and also simple monitoring available in automation industry with the help of SCADA.

I. INTRODUCTION

Automation of electric machines helps in precise control of industrial processes with higher productivity and product quality. The combinational use of both PLC and SCADAsystems helps in continuous monitoring, supervising and controlling process plants, has led to new heights in the field of automation for ac machines and processes., The development of the microprocessor from the mid 1970's have allowed them to take on more complex tasks and larger functions as the speed of the processor increased. SCADA which is actually the combination of telemetry and data acquisition involves the collection of the information via Remote Terminal Unit (RTU), transferring it back to the central site, carrying out any necessary analysis and control and then displaying that information on a number of operator screens or displays. The required control actions are then conveyed back to the process. The overall system set up which forms an integral part of this dissertation work aims to provide a fairly good platform for developing the concepts, methodologies and the complete understanding of an industrial automated system comprising of the commonly used components like PLC, SCADA, Drive and Motor along with SCADA. The PLC proves to be a very versatile and effective tool in the control of the Three Phase induction motor drive.

The experimental setup consists of a 0.75KW Three Phase Induction Motor, Siemens MM420 AC drive, PG/PC and Siemens PLC. The Induction motor is fed through a PWM based Siemensdrive, which provides high frequency controlled voltage to stator windings of motor. The feedbacks like speed, current, temperature and voltage of induction motor are fed back to the PLC.Initially Ladder logic programming is performed according to the customised logic using S7 Simatic Manager software platform on a PC offline, and then it is made online by running the developed program in the PLC. Similarly for SCADA using WinCC Explorer software platform.

II. SYSTEM OPERATION

Main control program is developed on PLC programming space using S7 Simatic Manager (SIEMENS). In this control method application specific PLC ladder logic programsare written in software tool and are communicated to PLC through industrial Ethernet or MPI cable. This software integrates all the modules of PLC as well as the devices connected to its networking module. Block diagram of Experimental setup is shown in Fig 1.The following sections briefs about Induction motor closed loop feedback technique and role of PLCs in induction motor automation.

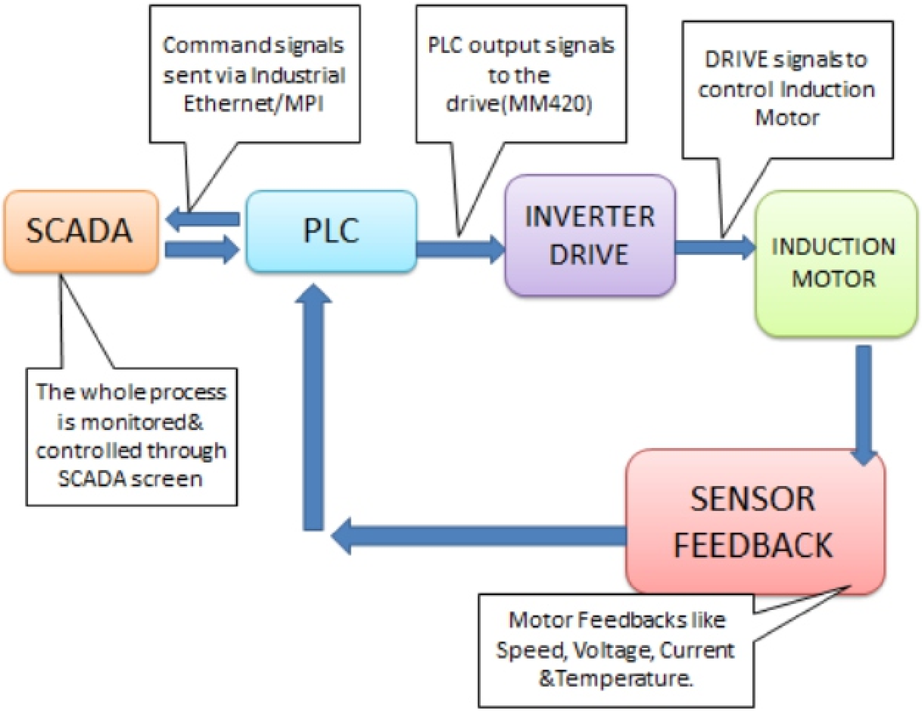


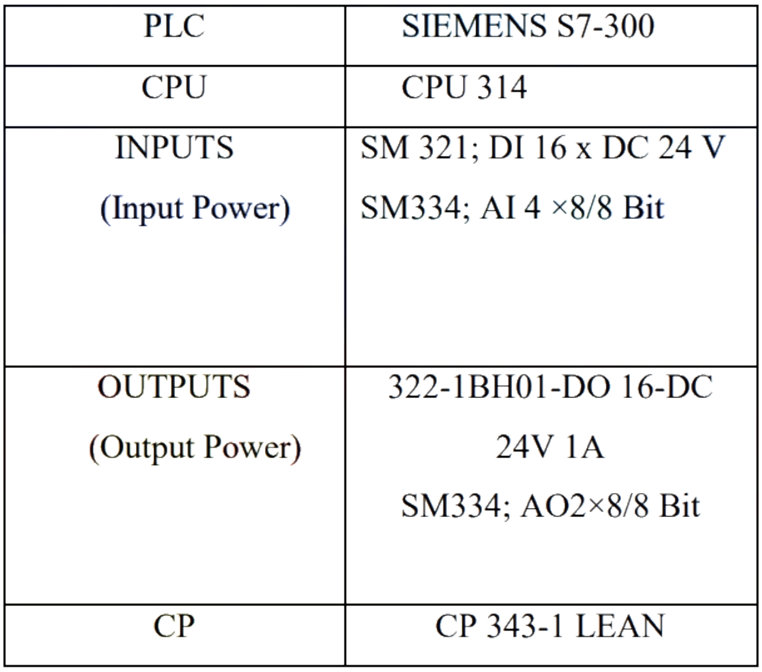
Fig 1 Block Diagram of Experimental setup

A.CLOSED LOOP FEEDBACK TECHNIQUE

Because of self adjusting nature, closed loop control systems are more complex in design. In induction motor closed loop control, feedback sensors can return data to the input stage, i.e.the control element generally PLC, which can self adjust itself based on the information received. For efficient and accurate control operations, the system should be a closed loop system, requiring feedback information signals to be satisfied according to PLC Input modulestandards. The feedback signal here provides information about actual speed, voltage, temperature and current drawn by motor. This obtained feedback information is signal conditioned to match the PLC input module ranges. If the PLC detects a difference between the obtained and desired values, an Alarm is generated and if it crosses the limits, it just trips of the PLC outputs. When inverter drives are used for motor control, the feedback signals are the important issue. If an error occurs the controller should react to it and take actions as per the program and guide the Inverter Drive, inturn Drive will control the motor operation. The user must know the limitations of the process and the motor conditions and design the exact program for controller. This signal conditioning circuits alters the actual sensed input signals to the desired form to match I/O module ranges. The address used in PLC program(ladder logic) and taken as tags in SCADA software and assigned to the design elements and developed screen acts as the graphical representation and human machine interface.

B.INDUCTION MOTOR AUTOMATION USING PLC

Programmable controller is a digital computer which accepts inputs from switches and sensors, stores instructions using programmable memory, evaluates these in accordance with astored program, executes specific functions that include ON/OFF control, timing, counting, sequencing, etc. and generates outputs to control machines and processes involved. The PLC processor sends all the direction and information like actuating particular outputs at desired timings to the drive. It uses a programmable memory to store instructions and execute specific functions that include ON/OFF control, timing, counting, sequencing, arithmetic and data handling. The inputs are connected to the input module of the PLC and the outputs are connected to the output module of the PLC. In an automated system, a PLC controller is usually the centralpart of a process control system. In this project, control of three phase induction motor and monitoring of its parameters as well as evaluation based on our requirements under different condition is carried out using PLC. Based on the required application, a ladder logic program is developed and downloaded to PLC. Once the program is downloaded and PLC is in RUN mode the system works automatically on user defined instruction. Before loading program in to the PLC, inSiemens S7 300 PLC we have a simulator where logic can be verified without hardware setup and online corrections are made easy.



PLC	SIEMENS S7-300
CPU	CPU 314
INPUTS (Input Power)	SM 321; DI 16 x DC 24 V SM334; AI 4 ×8/8 Bit
OUTPUTS (Output Power)	322-1BH01-DO 16-DC 24V 1A SM334; AO2×8/8 Bit
CP	CP 343-1 LEAN

TABLE 1 :SIEMENS S7-300 series PLC Specifications

PLC based systems are cost effective and comparatively require less downtime compared to previous controls, are less manual labor intensive, can be networked together and enables “realtime” monitoring, troubleshooting, and adjustments to set points. Present day PLCs are extensively used for controlling, manufacturing and treatment processes.

C.OVERVIEW OF AC MM420 DRIVE

Figure 2 shows a three-phase Siemens AC Drive. The rectifier circuit converts 1ph or 3 ph AC voltage source into DC voltage which is then fed to three-phase inverter through a DC link (choke coil) and capacitor. The DC link capacitor removes ripples in the converted voltage.

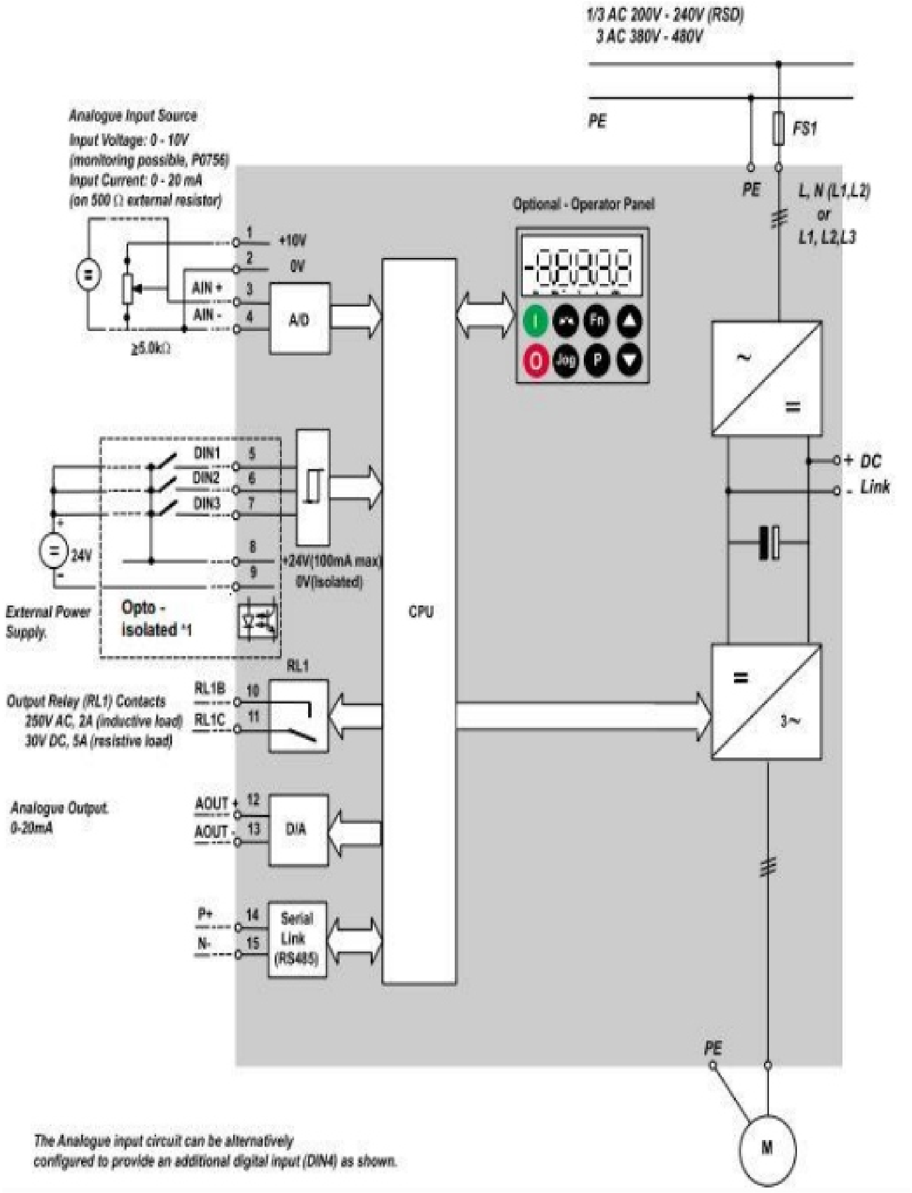


Fig 2:Block diagram of MM420 drive

The drive has a protection circuit which protects motor against under overloading, faults, etc. MM420 drive works on V/F principle... The pulses to the gate circuitry of IGBTs are controlled by gating circuits and in turn AC induction motor operation is controlled. The drive has a display screen to view and change various parameters as and when required. The commissioning of drive can be done in 3 ways i.e. using BOP (Basic Operator Panel), terminal blocks and through PG/PC.in quick commissioning the typical name plate readings should be fed in to the drive.

III. SOFTWARE REQUIREMENT FOR MONTIORING AND CONTROL OF THREE PHASEINDUCTION MOTOR

A PLC and SCADA based monitoring and control systems for induction motor have been successfully implemented and tested for application development. The drive system provides precise control and also enables an online monitoring of drive speed, voltage, temperature and current drawnetc. through SCADA System. The following software's are used in the monitoring and control of the three phase induction Motor.

SIMATIC MANAGER

This is software specially meant for SIEMENS S7 seriesPLC. The ladder logic programs are developed according to the control logic required so that same can be downloaded to the PLC, it also has the option of running in PLC offline mode where the developed ladder diagrams can be run without any PLC by simulating and running using simulator where the status of inputs and outputs can be monitored and controlled according to the requirement.

WinCC Explorer

This software is used to create SCADA screens graphically which provides user interface to control the process, creating tags in WinCC Explorer based on I/O addresses used in simatic manageris important. Different screens are developed in SCADA for monitoring and control of three phase induction motor. This makes the system/process to be controlled in an efficient manner.

COMMUNICATION PROTOCOLS

Protocols are used to communicate between PG/PC and the PLC. MPI (Multi Point Interface) and Industrial Ethernet can be used in the process as per the situation and requirements.

IV. OBJECTIVE FULFILLMEN

Following sections deals with the scope of the present work. The control schemes developed are able to control and monitoring of servo motor used for application specific requirement.

A.Development of PLC ladder logic program to control induction motor

An experimental setup comprising of a AC Three phase induction motor, PLC & PC will be designed and implemented to control Three phase induction motor for different process applications. In this method, V/F control of Siemens MM420 Three phase drive through PLC and SCADA has been implemented. The developed ladder logic is downloaded into PLC processor and control of motor is achieved by simply activating the particular logical inputinvolved, which ultimately results in instigation of ladder logic program developed.

In this method,control of three phase induction motor drive through PLC has been implemented. The developed ladder logic is downloaded into PLC processor and control of motor is achieved by actuating the particular logical output involved, which ultimately results in instigation of ladder logic program developed.The experimental work involves parameter grouping for monitoring feedbacks of motor like motor voltage, temperature, speed and current drawn.

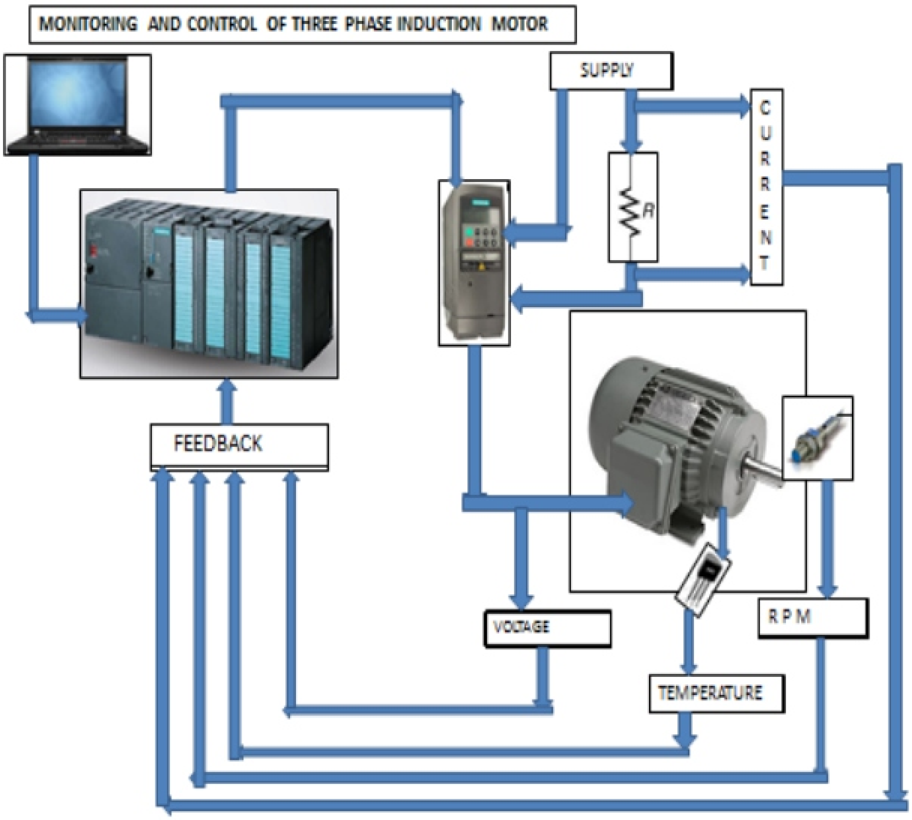


Fig 3 :Experimental setup to control induction motor using PLC

In order to provide convenient control using MM420 drive, the control mode parameters are listed, configured and commissioned in to the drive using BOP.Then the ladder logic program is developed in the PLC to satisfy the application requirement.The operational criteria and the limitations to be maintained of the process is completely written in the program logicand purely dependent on the user.

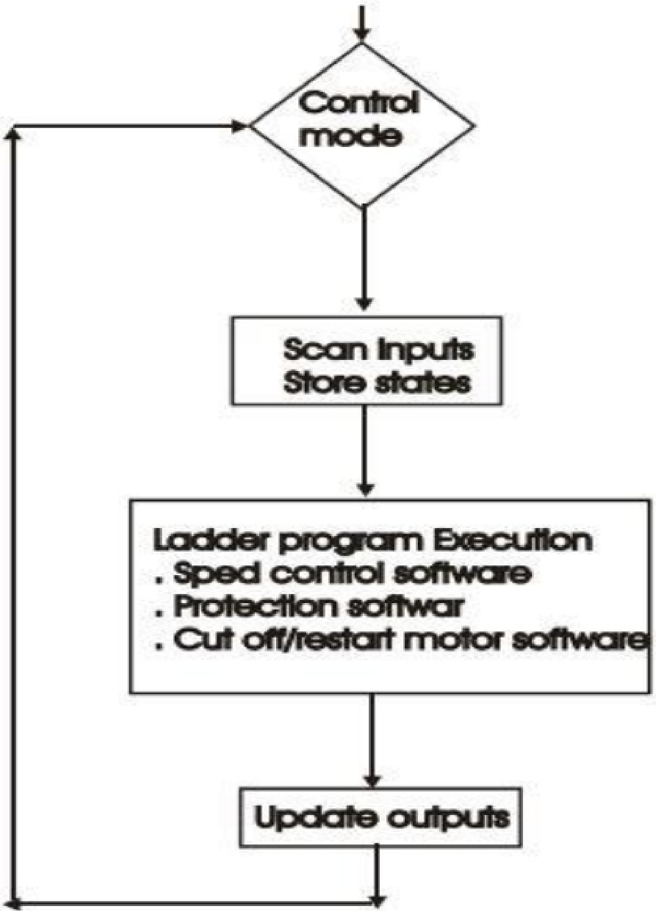
B. To read analog and digital inputs in PLC ladder logic

Micro Master 420 drive present in the system provides operation and monitoring of three phase induction motor. Simultaneously analog and digital input signals are read in data monitor window in PLC as a feedback of speed, voltage, current and temperature. This comprises of both digital and analog inputs, the analog inputs with high ranges which cannot be read directly by PLC to monitor, so an attempt has been made to overcome this problem by using signal conditioning circuits and scaling down the inputs equivalent to decimal values readable format in PLC ladder logic.

C.Interfacing of SCADA, PLC with Siemens MM420 drive

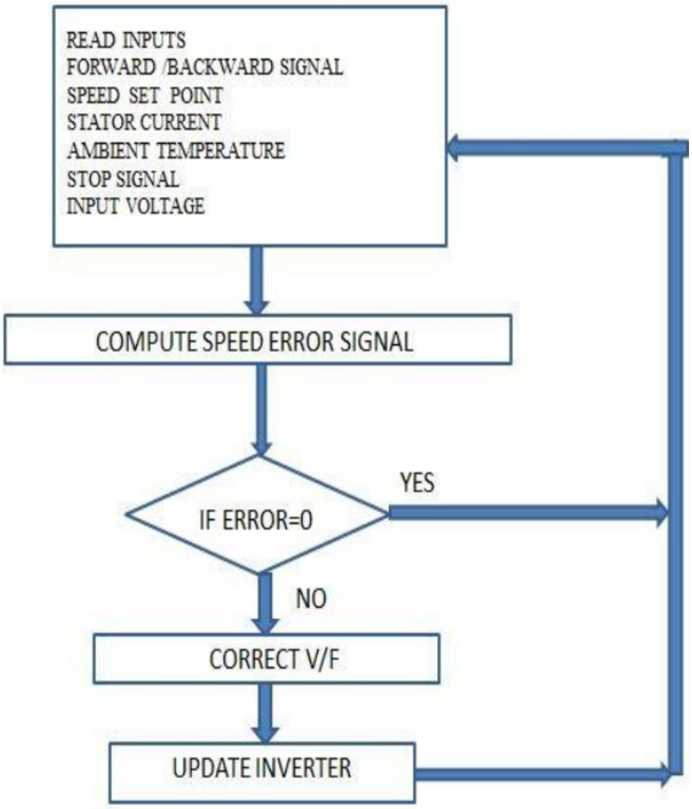
This method is meant for semi-automated control of field devices through a control panel; by designing PC monitor as SCADA screen using different graphics having the same address as that of logical inputs involved in motor control. SCADA allows control systems to be much more interactive than before. The basic purpose of SCADA is to allow easy graphical interface with control processes. SCADA allows an operator to use simple displays for determining machine parameters like Speed, voltage, temperature and current for supervising control processes.

1. Flow chart for the main program



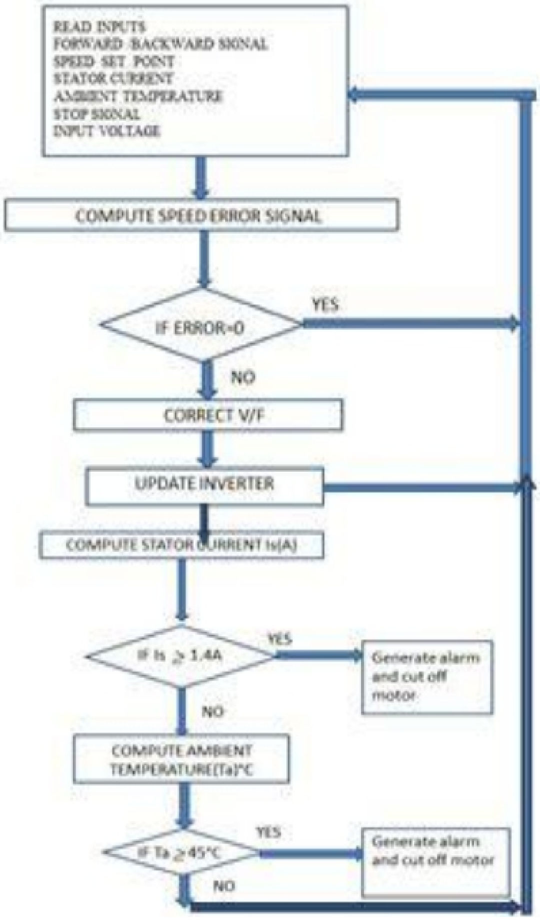
The software regulates the speed and monitors the constant speed control regardless of torque variation. The inverter being the power supply for the motor executes this while, at the same time, it is controlled by plc.'s software. The inverter alone cannot keep the speed constant without the control loop with feedback and plc. From the control panel, the operator selects the speed set point nsp and forward/backward direction of rotation. Then, by pushing the manual start pushbutton, the motor begins the rotation. If the stop button is pushed, then the rotation stops.

2.Flowchart of speed control software



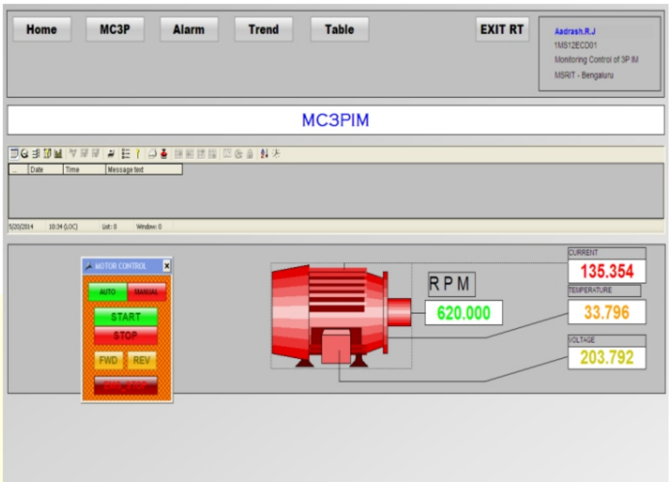
The corresponding input signals are interfaced to the DIM and the output signals to the DOM. The AIM receives the trip signal from the stator current sensor and from temperature sensor, the speed feedback signal from the speed sensor, and the signal from the control panel. In this way, the PLC reads the requested speed and the actual speed of the motor. The difference between the requested speed by the operator and the actual speed of the motor gives the error signal. If the error signal is not zero, but positive or negative, then the PLC according to the computations carried out by the CPU decreases or increases the V/f of the inverter and, as a result, the speed of the motor is corrected.

3. Flow chart for monitor and protection software



In the above flow chart we have a program for controlling, monitoring and protection software. First the inputs are read by the PLC and other protection parameters like stator current and ambient temperature is sensed and checks for the errors .If there are any errors occurring the control program shuts off the motor through the output command.

4. SCADA monitoring and controlling screen



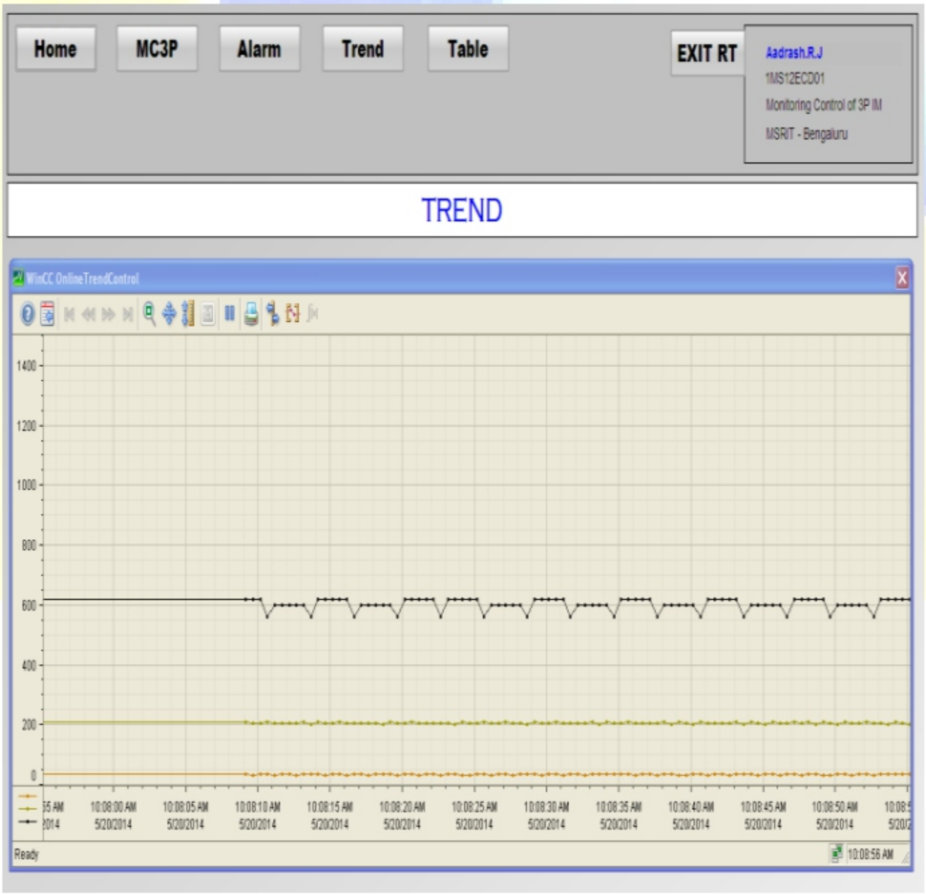
Aadrash.R.J
1MS12ECD01
Monitoring Control of 3P IM
MSRIT - Bengaluru

5/20/2014 10:34 (LOC) List: 0 Window: 0

RPM 620.000
CURRENT 135.354
TEMPERATURE 33.796
VOLTAGE 203.792

The above Screen presents the control of motor that is auto, manual, start, and stop; forward, reverse, emergency stop controlling FACEPLATE is designed. All the sensor outputs like speed, current, temperature and voltage readings of the induction motor are displayed as shown

5. SCADA TREND screen



Trend represents the speed, voltage and temperature in the form of graph.The x-axis represents the time domain and y-axis represents the speed temperature and voltage values as shown

6. RESULTS& DISCUSSIONS

Successful experimental results were obtained from the monitoring and control scheme indicating that the PLC can be used in automated systems with an induction motor. The monitoring control system of the induction motor driven by inverter and controlled by PLC and SCADA proves its high accuracy in speed regulation at constant-speed variable-load operation. Despite the simplicity of the speed control method used, this system presents

Monitoring and control using SCADA.
Constant speed for changes in load torque.

Full torque available over a wider speed range.
Very good accuracy in closed-loop speed control scheme.
Overload protection.

7. CONCLUSION

The present work was motivated to develop an online scheme to Monitor and Control a Three Phase induction motor using PLC and SCADA. A thorough study of all the hardware components was done including their Specifications, functioning and overall performance. Two software platforms namely step 7 SIMATIC manager and WinCC explorer Software were comprehended, analyzed and implemented step by step. A 0.75KW, 1415 rpm, three phase induction motor monitoring and control was fully automated using PLC and Siemens MM420 Drive with the help of SCADA system its remote start, stop control operations and monitoring too were demonstrated. An effort was also made to configure the PLC device and its ports in SCADA to monitor the real-time values of the three phase induction motor variables like Speed, current, voltage and temperature.The necessary settings and software implementation of the algorithms needed for, Speed control operation of the drive were developed and tested for real-time implementation of the motor drive. The motor drive used in this set-up offered v/f control mode of motor operation. The configuration and settings to run the three phase induction motor in v/f control mode was done systematically and its characteristics were captured on the data scope and interpreted successfully. Other than practically implementing the above schemes an important aspect of the present work which was successfully carried out was to completely identify study and summarize the communication ports, standards and protocols used between the various components of the entire industrial set-up including the PC – PLC – Drive –Induction motor – SCADA.

A complete study and practical hands on the PLC and the drive operation have imparted a fairly good idea about the industrial automation systems.

8. FUTURE SCOPE OF WORK

The following aspects can be explored as an extension to this dissertation work. More emphasis can be given to the real-time monitoring of processes using the SCADA software to obtain complete control of a real-time process including monitoring of more variables and incorporating some error control element too. Also the Programming methodology used in this dissertation work is Ladder Programming. The STEP 7 SIMATIC manager also offers various other programming platforms like FBD, STL, IL etc. Programs can be developed using these platforms.

ACKNOWLEDGEMENT

I wish to place record of thanks to project mentor at M/s Vasundara Automations & Engg Services Pvt.LtdSmt. Sujatha M.S, Manager for her periodic inspection, time to time evaluation of the progress of the project and guidance provided to bring the project to its present form.I sincerely thank Sri. Tushar Narsimpur.S Assistant Professor, EEE Dept., MSRIT for his valuable support and guidance.

REFERENCES

1. Anirudha Upadhyay and Abhishek Agarwal, "Controller design and analysis for automation of Chemical Water Treatment system" 10th International Conference on Control, Automation, Robotics and Vision, pp. 1625-1629, December 2008.

2. Colak, R. Bayindir, A. Bektas, I.Sefa and G. Bal, "Protection of Induction Motor Using PLC" International Conference on Power Engineering, Energy and Electrical Drives,pp.96-99, April 2007.

3. Maria G. Ioannides, "Design and implementation of PLC-based monitoring control system for induction motor" IEEE Transactions on Energy Conversion, vol. 19, No.3,pp. 469-476 , September 2004.

4.A. R. Al-Ali, M. M. Negm, and M. Kassas, "A PLC based power factor controller for a 3-phase induction motor" in Proceedings of Conference Records IEEE Industry Applications, vol. 2, pp. 1065–1072, 2000.

5. A. S. Zein El Din, "High performance PLC controlled stepper motor in robot Manipulator" in proceedings of IEEE International Symposium on Industrial Electronics, vol.2, pp. 974–978, 1996.

6. Vaibhav B. Magdum, Ravindra M. Malkar ‖Study & Simulation Of Direct Torque Control method for three phase induction motor drives —International Journal of Electrical Engineering and Technology (IJEET), ISSN 0976 – 6545(Print) ISSN 0976 – 6553(Online), Volume 2.

7. V. Chitra, and R. S. Prabhakar,” Induction Motor Speed Control using Fuzzy Logic Controller” World Academy of Science, Engineering and Technology 23 2006.

8. Microchip application note An889,” VF Control of 3-Phase Induction Motors Using PIC16F7X7 Microcontrollers”

9. Majidsalim , Mohammad sarvi ,”Induction Motor Speed Control using Indirect Z-source Matrix Converter with PSO-PI Controller under Various Break Conditions “International Journal of Power Electronics and Drive System (IJPEDS) Vol. 3, No. 1, March 2013, pp. 41~52ISSN: 2088-8694.

10. M. Iacob, G.-D.Andreescu, and N. Muntean, "SCADA system for a central heating and power plant" in Proceedings of 5th International Symposium on Applied Computational Intelligence and Informatics , pp. 159–164, May 2009

11. Cristina Anita Bejan, MihaiIacob and Gheorghe-Daniel Andreescu, "SCADA Automation System Laboratory, Elements and Applications " IEEE, pp.181-186,2009

12. Mini S. Thomas, Pramod Kumar, V.K. Chandna, "Design, development, and commissioning of a supervisory control and data acquisition (SCADA) laboratory for research and training" IEEE transactions on Power System,vol.19,No. 3,pp.1582- 1588, August 2004.

ISSN No:-2347-6532

DESIGN SCHEMATIC OF ANDRIOD SMART BOX USING CADENCE ORCAD 16.5

Lavanya Thunuguntla*
Rajath Vennavelly*
Bindu Madhavi K*

ABSTRACT

Android Smart box tunes TV into smart TV, which can be used as Game station, supports office works and media player and also comes with internet access. It can be used as a WI-FI router which supports WEP and WAP protocol for security. It can be used as a game station by using joystick. It consists of HDMI, USB, memories and protocols such as I2C, I2S. In this paper, we presented a complete design schematic of ANDROID smart box using Cadence ORCAD 16.5. OrCAD Capture CIS is a software tool used for circuit schematic capture. It is part of the OrCAD circuit design suite. Capture CIS is nearly identical to the similar OrCAD tool, Capture. The difference between the two tools comes in the addition of the component information system (CIS).

1. INTRODUCTION:

OrCAD is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and electronic technicians to create electronic schematics and electronic prints for manufacturing printed circuit boards. OrCAD Capture CIS is a software tool used for circuit schematic capture. It is part of the OrCAD circuit design suite. Capture CIS is nearly identical to the similar OrCAD tool, Capture. The difference between the two tools comes in the addition of the component information system (CIS). The CIS links component information, such as printed circuit board package footprint data or simulation behavior data, with the circuit symbol in the schematic. When exported to other tools in the OrCAD design suite, the data stored in the CIS is also transferred to the other tool. Thus, when a design engineer exports a schematic to the circuit board layout utility, the majority of the circuit elements have footprints linked to them. This saves time for the design engineer.

2.1 ANDRIOD SMART BOX:

T The CIS links component information, such as printed circuit board package footprint data or simulation behavior data, with the circuit symbol in the schematic. When exported to other tools in the OrCAD design suite, the data stored in the CIS is also transferred to the other tool. Thus, when a design engineer exports a schematic to the circuit board layout utility, the majority of the circuit elements have footprints linked to them. This saves time for the design engineer.

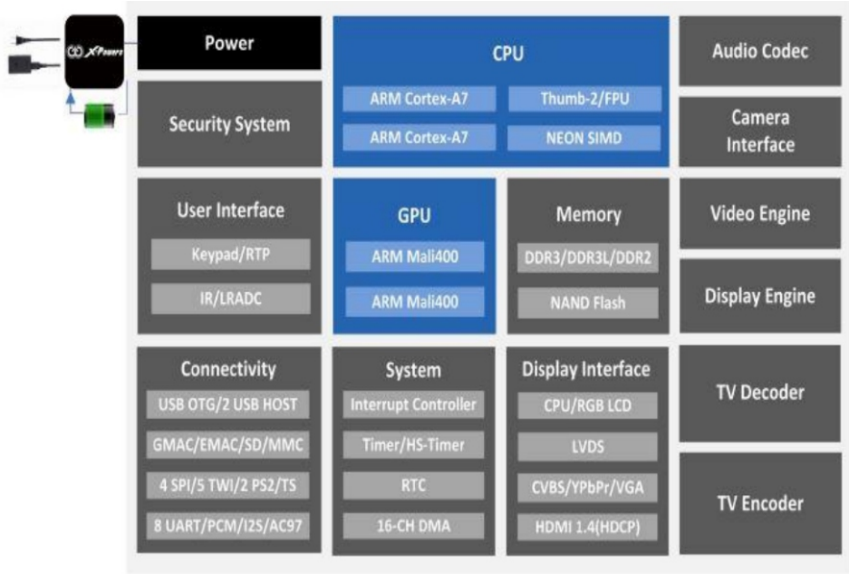


Fig.2.1 : Block diagram of andriod smart box

Block diagram of andriod smart box consists of CPU, GPU, Connectivities such as USB, MMC, I2S, system connectivities such as Interrupt controller,RTC, DMA, display interfaces like LVDS, VGA, HDMI and etc.

2.2 GPU-ARM Mali 400 :

The Mali series of graphics processing units (GPUs) are semiconductor intellectual property cores produced by ARM Holdings for licensing in various ASIC designs by ARM partners. Like other embedded IP cores for 3D support, the Mali GPU does not feature display Controllers driving monitors (such as the combination often found in common video cards).

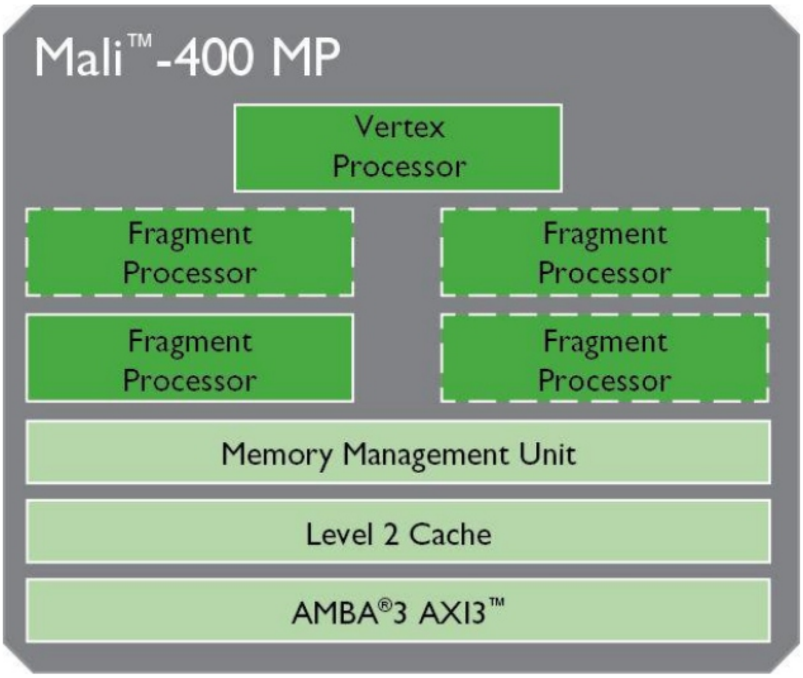


Fig 2.2: Block diagram of Mali 400

With support for 2D vector graphics through OpenVG™ 1.1 and 3D graphics through OpenGL ES 1.1 and 2.0, the Mali™-400 MP provides a complete graphics acceleration platform, based on open standards. Scalable from 1 to 4 cores the Mali-400 MP enables a wide range of different use cases, from mobile user interfaces up to smartphones, tablets and DTVs, to be addressed with a single IP. One single driver stack for all multi-core configurations simplifies application porting, system integration and maintenance. Multicore scheduling and performance scaling is fully handled within the graphics system, with no special considerations required from the application developer.

2.3 TV ENCODER:

TV Encoder provides high-quality MPEG-4 AVC, MPEG-4 part 2, and H.263 encoding to simultaneously support a variety of mobile applications (DVB-H, DVB-SH, ATSC-M/H, 3G, etc.) and various receiver types. For a better end-user experience, the Mobile TV encoder embeds a patented Grass Valley technology to automatically repurpose content. Such real-time technology enables the encoder to automatically adapt (detection of regions of interest, automatic cropping, etc.) the video content to the mobile TV display. As a cost-effective, multi-codec, and multi-stream encoder, it also features versatile inputs (analog, digital, ASI, and IP), statistical encoding, simultaneous multi-conditional-access (CA) system content protection (OSF and OMA-BCAST Smart Card profile, and DRM profile), multi-stream generation, and more

2.4 TV DECODER:

A digital TV decoder converts digital signals into analog signals; this technology allows information to be received digitally, but viewed on televisions that are not equipped with digital capabilities. Many countries have already or are in the process of switching from analog to digital broadcasting, commonly known as digital television (DTV), and the digital TV decoder Collects the digital signals from the airwaves and translates them for use on a non-digital television. With the use of a decoder, digital stations can be viewed in either standard digital format, or high-definition (HD), depending on the device and television. Other names for the decoder include digital television adapter (DTA), digital-to-analog converter box, and converter box; these devices may be purchased at most stores that sell electronic devices. Not all decoders are physical boxes, though; most newer televisions have the decoder built-in, and therefore eliminate the need for a converter box.

The Flash memory is an electronic non-volatile computer storage medium that can be electrically erased and reprogrammed. Flash memory was developed from EEPROM(electrically erasable programmable read-only memory). There are two main types of flash memory, which are named after the NAND and NOR logic gates. The internal characteristics of the individual flash memory cells exhibit characteristics similar to those of the corresponding gates. The Multimedia Card (MMC) is a flash memory card standard. Unveiled in 1997 by SanDisk and Siemens AG, it is based on Toshiba's NAND-based flash memory, and is therefore much smaller than earlier systems based on Intel NOR-based memory such as Compact Flash. MMC is about the size of a postage stamp: 24 mm × 32 mm × 1.4 mm. MMC originally used a 1-bit serial interface, but newer versions of the specification allow transfers of 4 or 8 bits at a time. MMC can be used in most devices that support SD cards

3. SOFTWARE TOOL

Cadence OrCAD:

The Cadence OrCAD PCB Designer suite comprises three main applications. Capture is used to draw the circuit on the screen (schematic capture). A netlist, which describes the components and their interconnections, is the link to PSpice and PCB Editor.PSpice simulates a captured circuit. I do not describe PSpice in this tutorial. PCB Editor (Allegro) is the application for laying out a printed circuit board. It includes an automatic router that works out the arrangement of tracks needed to connect the components on the PCB. The output from PCB Editor is a plot or a set of files that can be sent to a manufacturer.PCB Editor replaces the earlier application, Layout, which is now discontinued. OrCAD PCB Designer is the most basic version of Cadence‘s Allegro suite for PCB design and much of the documentation refers to ‘Allegro’ rather than ‘PCB Editor’.

The libraries for Capture and PCB Editor have some incompatibilities that must be corrected by fix-ups.

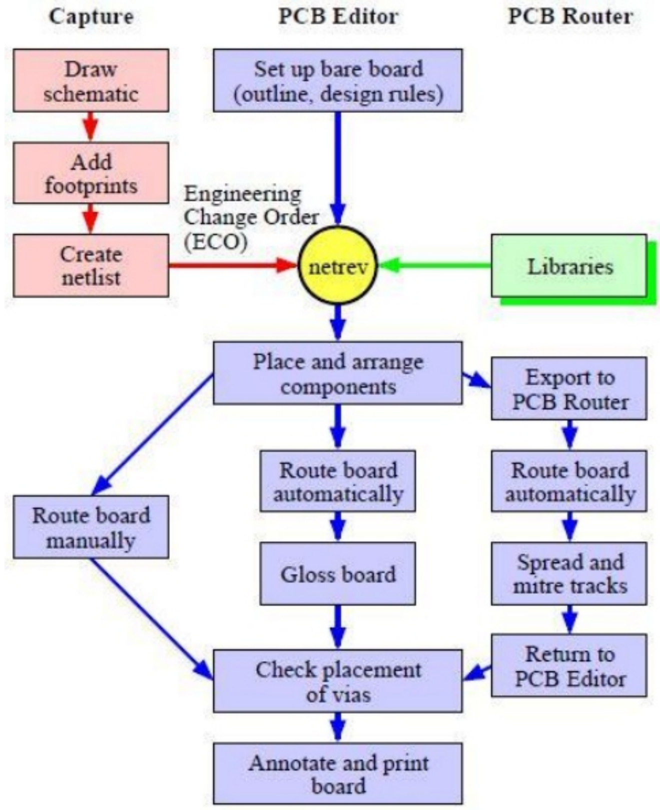


Fig3.1 : Design flow for making a PCB with Capture and PCB Editor

3.1 STARTING THE SOFTWARE:

Figure 1 shows the "Orcad Family Release 9.2 Lite Edition" folder (go into the programs menu and then look for Orcad Family Release 9.2 Lite Edition). The main components that will be utilized this semester are:

CAPTURE CIS Lite Edition (referred to as just CAPTURE in this tutorial), and
PSPICE Model Editor.

The CAPUTRE CIS Lite Edition is used to set up the schematics as well as simulations (it has SPICE built-in). The step-by-step procedure for this will be detailed in the rest of this tutorial. The PSPICE Model Editor can be used to create new models. However, for this course it will be typically used for looking at pre-existing transistor parameters (i.e. thoseComponents that are supplied with the PSPICE Student version).

Fig3.2 : CAPTURE CIS Lite Edition folder

3.2 RUNNING CAPTURE:

Start CAPTURE (Go into Start, the Orcad Family Release 16.5 Lite Edition folder/menu , then click once or twice depending on the configuration of the computer).

The basic screen (as seen on the front cover of this tutorial) will be instantly seen as the Program starts.

Step C-0: Click on “file.” Click on “New project

The following selections must be done:

Ensure that the “Analog or Mixed A/D” is selected,

the location path (if the directory already exists, CAPTURE will append it, or else it will create a new one) must be specified (please ensure this is on a read/write hard-disk or it can be alternatively on your own disk – the latter would be slower), and

Specify a filename (this can be any name – a useful name may help you to recall it easier later).

Example: Location: H:\ENE310

Name: ENE_PRAC0

Press OK. You will be prompted to either "Create based upon an existing project" or to "Create a blank project." Select the latter (as at this stage, the earlier option may have noFields defined). Press OK.

CAPTURE environment:

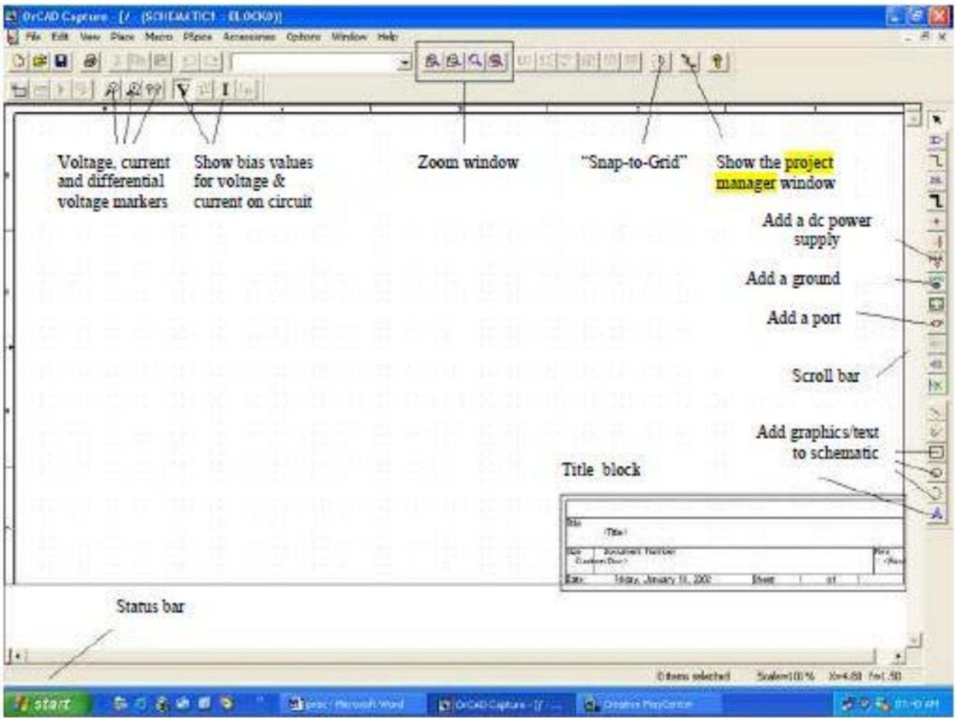


Fig 3.3 : Basic features of the CAPUTRE

schematic window.

Click on project manager. To expand the “directory” structures, simply click the “+” next to the given “directory.” Names may be modified, for example to change “PAGE”, simply right click on the name, click rename and rename it (for example to
block0). To go back to the schematic page (figure 3), click edit page or just double click on

3.3 RUNNING PSPICE MODEL EDITOR:

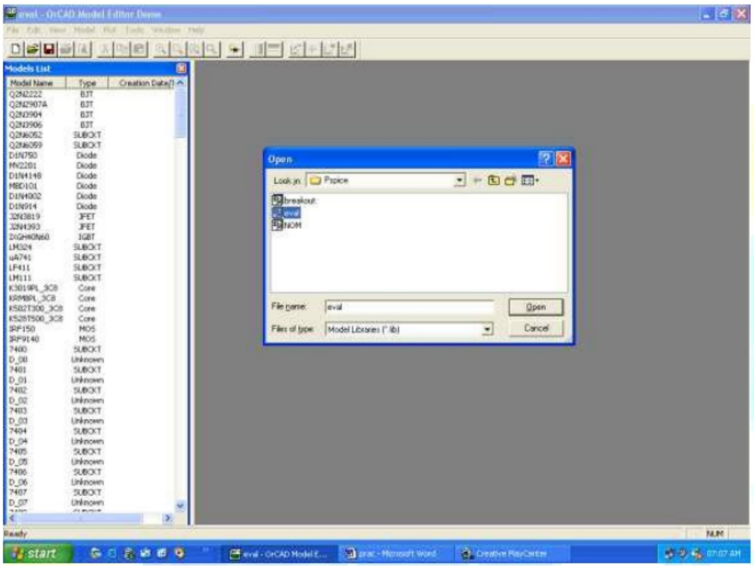
Start PSPICE Model Editor (Go into Start, the Orcad Lite folder/menu (see figure 1), then click once or twice depending on the configuration of the computer).Step P-0: Click on “file.” Click on “Open” The dialog box will appear as shown Type in the path to the directory containing the PSPICE libraries:
C:\Program Files\OrcadLite\Capture\Library\PSpice

CAPTURE is often used merely for schematics; hence additional libraries may be also given in the

"C:\Program Files\OrcadLite\Capture\library\" directory. However, these may not be used for simulation (they are merely symbols/‘‘pictures”). Generally, the libraries in the PSPICE directory (C:\Program Files\ OrcadLite\Capture\library\PSpice) have complete implementations given. Step P-1: In the demo version, the EVAL and Breakout libraries may be opened for

viewing or editing. It is sometimes useful to use these as a “template” to create your own parts or libraries. Once this is opened, it will appear as in the background (list of components). A click on any component will show its

Parameters (PSPICE parameters) that will be used for simulation. For example click on Q2N2222. The f used by PSPICE for this transistor will be 255.9.



File name: eval

Files of type: Model Libraries (*.lib)

Fig 3.4 : “Open” dialog box of the PSPICE model editor.

INTERFACES Used:

Different interface used in this project are USB, HDMI, TV OUT, Speaker, microphone, headphone jack, I2C, I2S (Inter IC Sound) , Card.

Fig. 3.5 Andriod Smart Box

CONCLUSION

Thus schematic of andriod smart box is sucessfully designed using Cadence ORCAD 16.5 tool and different interfaces like USB, HDMI,MIC,TVOUT and protocols such as I2c,I2s are used in this project and power delivery of the platform is theoritically completed.

FUTURE SCOPE:

The television industry is changing so rapidly on all fronts"hardware, software, and the content we call "TV" "that consumers are rightfully cautious about investing in any new technology that might be obsolete by next year. But future-proofing electronics is a fool‘s game. Screen quality, the most important feature of any TV, can‘t really be upgraded without buying an entirely new device, and there are easier ways to keep up with the latest internet-connected apps. Samsung‘s cartridge solution feels like an admission that souped-up smart TVs favored by it and other manufacturers, like Panasonic and Sony, needlessly combine excellent hardware, which people do want from their TVs, with mediocre software, which they don‘t.

REFERENCES

[1] Andriod Smart Box in Wall Street Journal.

[2] Complete PCB Design Using OrCad Capture and Layout by Kraig Mitzner.

[3] ARM System-on-Chip Architecture by Steve Furber.

[4] ARM Architecture Reference Manual by David Seal.

[5] http://www.altera.com/literature/an/an574.pdf

[6] http://www.analog.com/en/content/ta_fundamentals_of_voltage_regulators/fca.html

[7] http://www.hdmi.org/manufacturer/hdmi_1_4/ Magazines:

[8] Electronics today, Electronics India

Author 1

Ms Lavanya Thunuguntla has **8** years of Teaching experience and presently working as an Associate Professor in the Department of ECE in Hyderabad Institute of Technology and Management (HITAM), Hyderabad, TS(India).She received Best Faculty Award in 2013 in HITAM. She received her B.Sc degree in ComputerScience from Acharya Nagarjuna University in 2002, M.Sc degree in

Physics from University of Hyderabad, Hyderabad in 2004 and M.Tech from Indian Institute of Technology (IIT) Kharagpur in 2007. She has Professional Membership in IEEE,WIE. She has various National & International journal publications.. She has strong motivation towards research in the fields of Nano Technology, Microwave and Optical & Analog Communications, VLSI system design etc.

Author 2

Mrs K Bindu Madhavi, working as an Associate Professor in the Department of ECE in Hyderabad Institute of Technology and Management (HITAM) and she has completed her M.Tech from JNTUH. She has 11 years of teaching and industrial experience. She has various journal publications. She has professional membership in IEEE. She attended various national and international conferences. Her interested areas of research are Communication Systems, VLSI system Design etc.

Author 3

Mr.Rajath Vennavelly is pursuing Fourth Year B.Tech in Electronics & Communication Engineering branch in Hyderabad Institute of Technology and Management (HITAM), Hyderabad, TS(India). He gave presentations in various National level contests. He has Professional Membership in IEEE.His areas of interests are Communications, VLSI system Design, Embedded Systems etc.

ISSN No:-2347-6532

Improvement and Performance Evaluation of Stationary Combine Thresher

Mohammed Ahmed AbdElmowla*
Mohamed Hassan Dahab**
***** Fatah ElRahman Ahmed EL Mahie**
Farid Eltoum, A.E**

ABSTRACT

This study was conducted at the Faculty of Agriculture, Nile Valley University, Darmali, North of Atbara. The main objective of this study was to develop and improve the stationary threshingmachine by adding a diesel engine 49 hp and gearbox to become self operated. The diesel engine and gearbox were installed in the rear side of the thresher. Three iron frames were used to link the diesel engine and gearbox. The power was transmitted from the installed diesel engine through pulleys and belts to the threshing unit. The improved machine was evaluated and compared with the convention one through threshing two crops, faba bean and wheat. The time of linking thresher to the tractor, field efficiency, field capacity, fuel consumption and weight of seed and straw were measurement in all plots with three replications.

The results indicated Low field operation time (0.03 hr) for improved thresher compared to (0.25 hr) for the conventional thresher. Higher field efficiency and capacity were observed for the improved thresher. They were 85% and 1.43 fed/ hr for the improved machine compared to 25% and 1.0 fed/hr for the conventional one respectively. Low fuel consumption of 3.5 liter/hr for the improved threshing machine compared to 7.57 litter/hr forthe conventional one.Statistical analysis showed highly significant difference (at $p > 0.01$) between the improved thresher and conventional threshing machine for the time taken for linking, field efficiency, field capacity and Fuel consumption. No significant difference was observed between the two threshers for the weight of seed and straw output.The improved threshing machine is durable, portable, easy to operate and of Low maintain costs, All components of the machine were fabricated from local materials and total cost for the design and improvement of the threshing machine was only SDG (2500).

Keywords: Stationary thresher, power, diesel engine, gearbox,performance

1. INTRODUCTION:

Agricultural engineering is the science and art of engineering, mathematical and physical theories application to solve some agricultural problems and to increase production beside good work environment for farmers (Elsanoberi 1993). Power source in agricultural farms is of great importance in determining the level of agricultural mechanization and development, there are three sources of power for carrying out operations, the human power (about 0.07 – 0.1 kw) l, animal power and mechanical power (Grossly andKilgour1983). Mechanical power through tractors will continue to be an absolute necessity for agricultural production (Hunt 1983). The tractor engine can be used as a prime mover for active (moving) tools or stationary farm machinery through the power take off shaft (PTO) or belt pulley (Rodicher and Rodicheva 1984).Transmitting of power from its source to the points of use is one of the important variables to the farm equipment designers. Krutzet. al. (1984) cited that the selection of proper power transmission systems on mobile agricultural machinery must take into account the customer requirements, cost constraints, field usage, operator safety and reliability. The primary function of the transmission member is to affect the change in speed between the two shafts as well as in linking them. It is generally required that the transmission system should have adequate reliability, service life, simple in construction, little resistance to motion, produce little noise, offers substantial resistance to vibration and easy to control. There are many power transmission systems used, but the most extensively used in agricultural machinery applications are V-belts (Kepneret. al., 1982, Krutzet. al (1984). Shigley and Mitchell (1983) stated that, the efficiency of V-belts ranges from 70 – 95 %. Gears and chains are also widely used for power transmission as linear or rotary motion (Hunt and Garver 1973, Spotts 1978, Crouse 1980, Liljedahlet. al. 1984).

Other power transmission systems included bearings, shafts and universal joints. Rotating shafts are of various lengths, diameters and types and they may be subjected to bending, tension, compression or torsion loads, acting singly or in combination with one another (Shigley and Mitchell.1983,). Therefore it is important to locate the PTO shaft of the tractor with respect to the draw bar because of the telescoping action of the drive member.

The goal of good crops harvesting is to ensure maximum grain yield through minimizing grain loss and the prevention of quality deterioration. A wide variety of tools is used in harvesting, such as knives, sickles, animals, stationary threshing machines, tractor-mounted harvesters, and self-propelled combine harvesters.Stationary threshers which are drawn and operated by tractors PTO are now of great important in the Sudan for threshing many crops. Since stationary threshers are tractor engine operated, it was important to improve the operational performance of threshers to make the harvesting operation more efficient and economical. Therefore, the objectives of this present study are:

1- to install a diesel engine and conveyor belt on a stationary thresher as a technical and economic improvement.
2- to evaluation e the field performance of the improved threshing machine and to compare with the conventional thresher.

MATERIALS AND METHODS

The study was carried out in Darmally village, 13 km north of Atbara city and 325 km north of Khartoum city.

Diesel engine (49,26hp), with technical specifications given in (Table1),and gearboxand Massey Fergeson (290) tractor of 74.8 hp (maximum PTO),were used as source of power for a stationary combiner thresher (Elshams) improvement. The technical specifications of the thresher are shown in (Table2). Other materials and tools used to carry out the installation included, iron sheets, iron angles, iron flanges, fixing bolts, nuts, shims, pulleys and other workshop equipment.

1. The Frame

A metal engine and gearbox frame was fixed in the rear part of the thresher (Fig 1). All design criteria were considered when fixing the frame strongly with fixing bolts. The frame is composed of three components: The main frame (A) made of mild steel U -sections angles 15 x7 x 0.5 The main frame supports are frame (B) and frame (C). Farm (B) stands made of mild steel angle 2.5 x 2 x 0.3 in and frame (C) 2.5 x 2.5x 0.3 inof mild steel.They are used tomount the engine and bolts and nuts were used to fix the U-section in grooves at both ends of the frame(Fig2).

2. Transmission of power

The power to operate thresher unit was transmitted from gearbox shaft to flywheel thresher through a coupling, belts and pulley.

3. The coupling

Couplings are used to connect a driver gearbox (power source) shaft to the shaft of the driven unit (combiner thresher shaft) such a connection allows torque to be torsion lead to the driven unit. The details of couplings are shown in Table 3.

Table 1: Technology specification of Engine

Technology specification	Engine
Displacement	1.8L (1839 cc)
Cylinder bore	83 mm
Piston stroke	85 mm
Valve train	SOHC
Fuel type	diesel
Power	49,26 Kw

Table2: Technological specification Combiner thresher (ElSHAMS)

Technology specification	ElSHAMS
Length (mm)	4020
Width (mm)	2200
Height (mm)	24000
Drum type:	Mobile finger
Drum length (mm)	1200
Drum diameter (mm)	75/120
Rows pegs	4
Numbers of pegs	44
Out put (kg)	2300
Tire size	16x600
Flywheel diameter(mm)	732
Flywheel weight (kg)	130
Main bearing inner diameter (mm)	70
Cardanshaft	Standard
Belt tension	Standard
Bag filling possibility (seed diameter)	All sizes

Fig 1. The rear part of the thresher

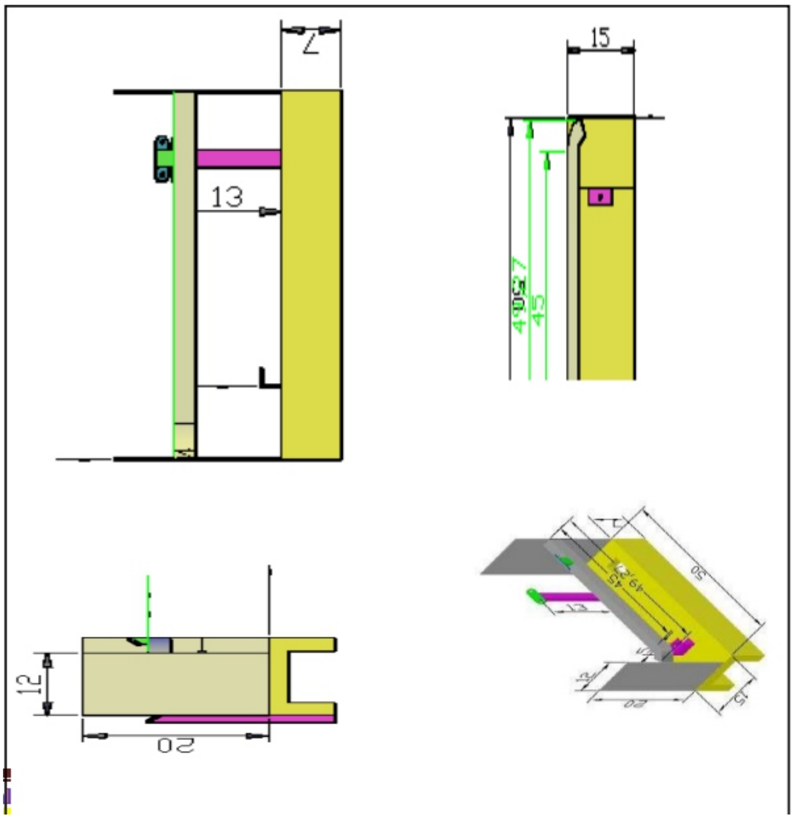
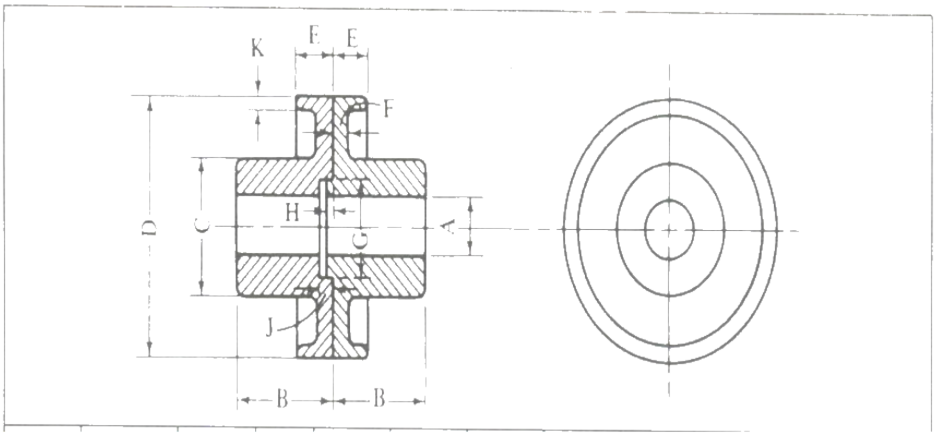


Fig2. Side view of the main frames used

Table 3: Groove Dimensions and Tolerances for the Coupling



A	B	C	D	E	F	G	H	J	K	Blots	
										NO	Dia
1	1.72	2.25	4	0.60	0.31	1.5	0.25	0.20	0.25	5	0.38
1.25	2.1	2.75	5	0.81	0.37	1,87	0.25	0.20	0.25	5	0.43

Source: Machinery's Handbook (2000)

4.Power calculation:

The following formula mentioned by (Shigley and Mischke 1983) was used to calculate the design power for the diesel engine:

Design power = Service Factor × Transmitted power

The service factor was used by assuming the overload75% ((Shigley and Mischke 1983).

Design power = 1.3 ×35 = 45.5 hp(the selected diesel engine of 1c and 49 hp).

a) Pulley selection:

The drive and driven pulleys may be selected as follows (Krutzet. at., 1984):

$$\frac{PDr}{PDn} = \frac{(rpm)r}{(rpm)n}$$

Where:

PDr = pitch diameter for the driver pulley (inch).

PDn = pitch diameter for the driven pulley (inch), proposed 8 inch.

(rpm)r = driver pulley speed (1000rpm).

(rpm)n = driven pulley speed (1000rpm).

Then:

$$PDr = \frac{1000 \times 8}{1000} = 8 \text{ inch (Table5)}$$

b) V-Belts selection:

For V-belts design and selection the computations made follows the methodology mentioned by Shigley and Mischke (1983). The center distance between drive and driven pulleys was 29 inch and this was found to fulfill the following equation:

$$C \; 3 \; (d + D)$$

Where:

C = center distance.

D = large pulley diameter.

d = small pulley diameter

Therefore from Table (4), a V- belt section A- was selected.

The pitch length of the belt calculated as follows:

$$Lp = 2C + 1.57(D + d) + \frac{(D - d)^2}{4C}$$

Where:

C = center distance.

D = pitch diameter large pulley.

d = pitch diameter small pulley.

Lp = pitch length of belt.

= 2 × (29) +25.12 = 83.12 in

Table 4: standard V-belts sections

Belt section	Width a (in)	Thickness b (in)	Hp range one or more belts	Minimum Sheave diameter- in
A	½	11/32	¼ - 10	3.0
B	21/32	7/16	1 –25	5.4
C	7/8	17/32	15 –100	9.0
D	11/4	¾	50 –250	13.0
E	11/12	1	100 and up	21.6

Source:Shigley and Mitchell (1983)

The shaft threshing and driver pulley is designed as one body to contain only four belts.So that four belts transmitting power rang of 1-25 hpwas selected (Fig.3 and Table 5).

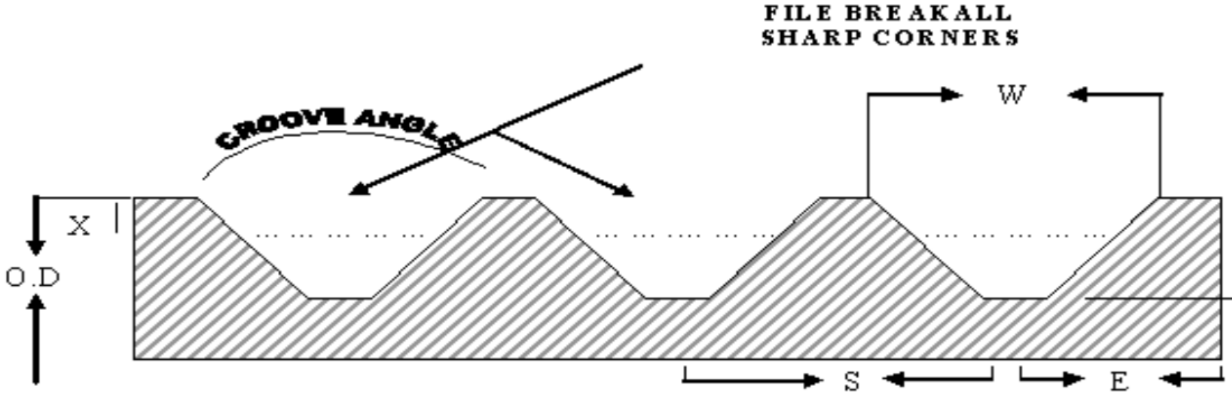


Table 5: Groove Dimensions and Tolerances for Multiple V- belt Sheaves

	Pitch Diameter		Groove Angle	Standard Groove Dimensions					Deep Groove Dimensions				
Belt	Minimwn Recommended	Range		W	D	X	S’	E	W	D	X	S’	E
B	3.0	2.6 to 5.4 over 5.4	±1/2°	(2)	±.031	…	±.031	(3)	(2)	±.031	…	±.031	(3)
			34° 38°	.494 .504	.490	.125	5/8	3/8	.589 .611	.645	.280	3/4	7/16

Source: Machinery's Handbook (2000

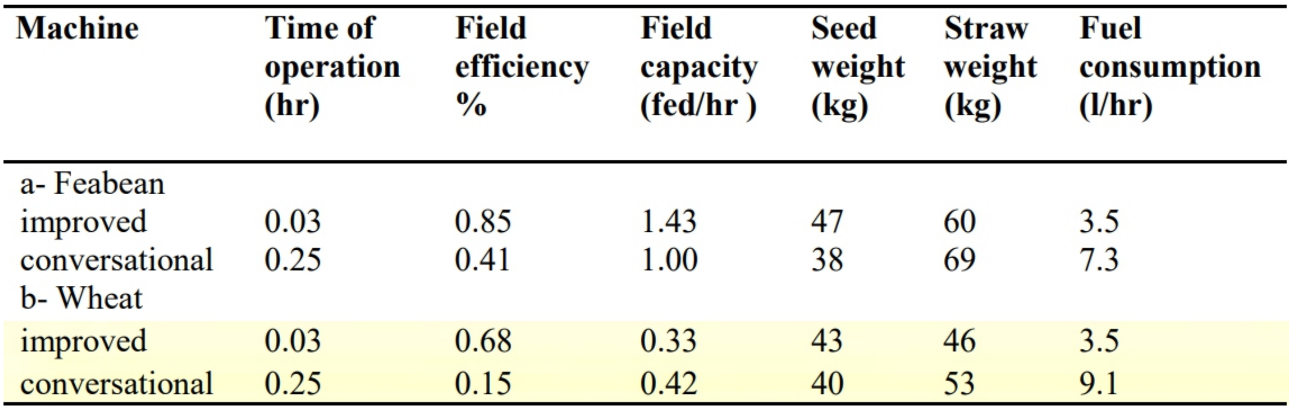
RESULTS AND DISCUSSION

A diesel engine was installed to the conventional thresher to improve its operational performance. The power transmitted from the gearbox shaft of the diesel engine to operatethe combiner thresher (35hp) through belts and pulleys as shown in Fig.3.Table (6) shows the field performance evaluation parameters measured for improved thresher compared to the conventional thresher using two crops. All measured parameters were improved when using the improved thresher.

Fig 3.The Improved thresher

The results showed that the time taken to carry out the threshing time was decreased by the improved thresher by 0.22hr for faba bean and wheat crops. This may be due to the higher waste of time by stopping during the operation and in turning at the ends of the field.

Table 6: The average operation time, field efficiency and capacityand fuel consumption



Machine	Time of operation (hr)	Field efficiency %	Field capacity (fed/hr)	Seed weight (kg)	Straw weight (kg)	Fuel consumption (l/hr)
a- Feabean						
improved	0.03	0.85	1.43	47	60	3.5
conversational	0.25	0.41	1.00	38	69	7.3
b- Wheat						
improved	0.03	0.68	0.33	43	46	3.5
conversational	0.25	0.15	0.42	40	53	9.1

The average field efficiency was increased by the improved thresher by 103% for the faba bean and by 450 % for thewheat compared to the conventional thresher.Analysis of variance of the data indicated highly significant difference between the two threshers. It was noticed that the machine efficiency is generally low; which may be due to the high waste of time by stopping during field operation and high waste time in turnings at the ends of the.

The improved thresher was also increased the average actual field capacity by 0.43 fed/hr. for the faba bean and by 0.09 fed/hr for wheat crop compared to the conventional thresher. This is mainly due to the time taken in linking and preparing and the higher efficiency of the improved thresher. This finding agreed with that of Dahabet.al. (2007). The averagemeasured fuel consumption (l/h) for the improved thresher during threshing of fababean and wheat was reduced by 3.8 liter/hr and 5.6 liter/hrfor the two crops respectively(Table6). Therefore more fuel was saved and the threshing operation was economical compared to the conventional. This finding is consistent with the findings of El-Awad (2007) and compared well with those reported by Snighel.al. (2007).Statistical analysis showed highly significant difference between the two threshers at 1 % level for all measured parameters. It was observed that the added parts in the improved thresher .didn't change the threshing mechanism of the machine.

CONCLUSION

The following conclusionsmay be drawn from the results obtained:

-The improved threshing machine helped to do the threshing operation without a tractor.

-The Field efficiency and effective field capacity of the improved thresher were increased resulting in time and cost saving of the threshing operation.

-The installed and designed parts of the improved thresher were found of low energy consumption and low production costs.

- Further work is neededto make the thresher more efficient by developing and fixing front cutter and pickup reel.

REFERENCES

[1] Crouse, W. H. (1980). Automotive Mechanics. Eighth Edition. McGraw Hill Book Company.

[2] Dahab M.H, Hassan .E.H. Naye, M.H. (2007) Modification of Power Transmission System to the Stationary Combine Thresher. Agricultural Mechanization in Asia, Africa and Latin America 38(.3), 1-9

[3] El-Awad, Sh. A, A. E. S and M. A. A (2007). Improvement of the Modified Grain Thresher for Groundnut Threshing. Agricultural Mechanization in Asia, Africa and Latin America 38(3): 67-72

[4] Elsanoberi, B. (1993). Principles of agricultural machinery. University of Al-Gods Almaftoha. Philistine.

[5] Grossley, P. and kilgour, J. (1983). Small farm mechanization for developing countries. Silsoe, England, pp. 59-70.

[6] Hassan .E.H. 2002. Modification of Power Transmission System to the Stationary Combine Thresher. Unpublished M. Sc. Thesis, Taculty of Agriculture., Nile Valley University, Sudan.

[7] Hunt, D. R. and Gaiver, L. W. (1973) Farm Machinery Mechanisms. The Iowa State University Press Ames, Iowa.

[8] Hunt,D.R. (1983). Farm Power and Machinery Management.8th edition. Iowa StateUniversity Press. P(3-25, 129-148).

[9] Kepner R. A., Roy Bainer, and Barger E. L. (1982). Principle of Farm Machinery 3rd edition. Avi Publishing Company. Inc. West port Connecticut.

[10] Krutz, G., Thompson, L. and Claar, P. (1984). Design of agricultural machinery. John Wiley & Sons, New York. Pp. 222-270.

[11] Liljedahl,J. B; Carleton, W. M; Turnquist, P. K. and Smith,D. W. (1979). Tractors and Their Power Units, 3rd edition. John Willey and Sons New York.

[12] Rodicher, V. and Rodicheva (1984). Agricultural Machines. Theory of operation computation of controlling Parameter and the conditions of operation.

[13] Shigley J.E., and Mischke L.D. (1989). Mechanical Engineering Design. 5th Edition. McGraw-Hill Book Company.

[14] Spotts, M. F. (1978). Design of machine elements. 5th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, pp. 269, 396-425.

ISSN No:-2347-6532

A Computer System for Prediction of Farm Machinery Workable Days in Rain-fed Areas of Sudan

Lotfie A.Yousif*
Mohamed H. Dahab**
Haitham R. El Ramlawi***
Farid Eltoum, A.E**

ABSTRACT

Management of rainfed farm is a complex process, due to the nature of various factors involve in crop production; such as machineries selection and their available workdays. Computer systems can improve farm management through facilitating planning and decision making processes. The objective of this study was to develop a computer system to predict machinery workable days in rain-fed areas. The system was built in Excel-Visual basic computer software using soil moisture balance equation. Data entry is a step by step process. Input datainclude: starting month, starting decade and number of decades in which workdays needed to be estimated beside climate and soil parameters. The soil workability criterion, 80% of field capacity (FC) was used. The system calculates daily soil moisture content, evaluates them. Then it predicts workdays for any month and arranges them in decade order for period up to 100 years. As verification the system has the ability to predict workable days once entering input data. System validation showed a high correlation (R^2= 0.89) between the predicted and actual workdays. The system was sensitive to changes in soil workability criterion reflecting it's dynamic. The system was applied for Gedarif rainfed area by using data from Sudan Metrological Authority for Gedarif Metrological Station, for period of 33 years (1977-2009). The average predicted workdays for seedbed preparation, seeding and weeding operations were 27, 24 and 23, respectively. These results help in selecting machinery and scheduling operations. Therefore, the system can be used for proper machinery management and decision making in rain-fed areas.

Keywords: computer system, machinery workdays, rain-fed agriculture, Sudan

1. INTRODUCTION:

Accurate information on the days suitable for field operations is important in the design, development, and selection of efficient machinery system for crop production. The period of time when land is considered workable is expressed as machinery work-day. A work day depends upon the soil's ability to withstand loads applied by tractor and implement. The number of days suitable varies widely with climate, soil characteristics, and type of machine and operation. Thomason, (1982) reported that the effect of workability and machinery work days are complex and difficult to separate from other physical and management factors.

Different criteria were used to determine soil workability and working days. Godwin and Spoor (1977) mentioned that, the lower plastic limit is a condition frequently acceptable as upper moisture content for working soils in agriculture. Terzaghi, et al, (1988) stated that land quality “workability" expressed as the upper tillage limit; depend mainly on clay and organic matter content of the soil. Mohamed, (2001) studied the working days in the mechanized rainfed areas using the criterion that workable day is a day of no rains and if any, the amount is less than 5 mm. On the other hand, several models are developed to predict available working days elsewhere (Rounsevell and Jones, 1993; ASABE, 2004 and Rotz and Harrigan, 2005). These models integrated soil properties with long-term weather records. Predicted work days are extremely sensitive to variation in the weather (Rounsevell and Jones, 1993), moderately sensitive to some soil characteristics and highly sensitive to the workability coefficients used to determine a suitable day (Rotz and Harrigan, 2005). Witney, et al. (1982) modified and simplified the soil moisture balance equation to predict daily fluctuation in soil moisture content. This equation was further used by Simalenga and Have (1994), Elfadil, et al. (2004a), and Mas’oud (2005) to determine the suitable field workdays for machinery field work.

The mechanized rainfed agriculture in Gedarif state is one of most important sector in Sudan for it secures food and cash crops. Farm management of a rainfed farm is a complex process. The complexity is a nature of various and interrelated factors which involve in crop production process. These factors include; selection of crops and agricultural machinery (tractors &implements), the expected available working time for field operation, inputs cost and outputs prices. It was trusted that promotion of farm management can be realized by the use of modern aids like computer systems which facilitate the process of planning and decision making. The main objective of this study was to develop a computer system to predict available workdays in the mechanized rainfed areas.

2. MATERIALS AND METHODS

2.1 Characteristics of the study area

The study was conducted in Gedarif State, Sudan, which lies in the Eastern part of the Sudan between latitudes 12.67º and 15.75º N and longitudes 33.57 º and 37.0º E, where about 3 million ha are put under mechanized agriculture. Rainfall is always in summer and effective rainfall occurs within June to October and the peak rainfall occurs in July- August. The soil is heavy cracking clay soils (Vertisols), which characterized by shrinking when dry and swelling when moistened. The clay content ranged between 65% and 75%.

2.2Type of Data Collected

The collected data include; Climatological and soil data. Daily rainfall and evapotranspiration data were collected from Sudan Metrological Authority for Gedarif Metrological Station, for period of 33 years (1977-2009). The average soil field capacity (FC), permanent wilting point (PWP) and initial soil moisture content; were taken as 42.18, 30.55 and 12.0%, respectively.Also optimum soil moisture content, at which machinery works, was taken at 20 cm depth.

2.3 System structure

The system was developed in Excel -Visual basic computer software. Data entry is a step by step process. Firstly the user has to enter starting month, starting decade and number of decades in which he need to estimate workdays. Then the user has to enter daily rainfall and potential evapotranspiration, some soil physical properties, correction factors and constants then the system calculates soil moisture content of specified day. After that the system evaluates the soil moisture content of the day, if the soil moisture content is < = 0.8 F.C., the system writes 1(one) (workable day), and if it is > 0.8 F.C., the system writes 0 (zero) (non- workable day). Finally, the system sums-up all the workdays in each ten days a month (decade). The systemallows the user to predict available working days for the twelve months a year and for number of years up to 100 years for any location. The system flow chart is shown in Fig. 1. The systemoutput can be displayed on the screen or print out.

The following equations were used to determine the daily soil moisture content.

$$M = Mp + R - Q - D - AET \text{ -- } (1)$$

Where:

M = Soil moisture content of a day (mm).

Mp = Soil moisture content of the previous day (mm).

R = Rainfall on that day (mm)

Q = Run off (mm)

D = Drainage (mm)

AET = Actual evapotranspiration (mm)

The system calculates actual evapotranspiration (AET) according to equation (2) as follows.

$$AET = (PET)\,(K_d)\,(K_s)\,(K_r) \text{ -------------------------------------- } (2)$$

Where:

PET = potential Evapotranspiration (mm)

K_d = Soil dryness factor = 0.55

K_s = surface cover factor (percent soil cover)

K_r = rain distribution factor = 0.55

$$K_s = 1 - 0.005\ PSC \text{ --- } (3)$$

Where:

PSC = percent soil cover = 0, $K_s = 1$

If the amount of rainfall is enough to cause runoff, then the system calculates the runoff according to equation (4).

$$Q = (R - 0.25S)^2 / (R + 0.8S) \text{ ------------------------------------ } (4)$$

Where:

S = maximum potential difference between rainfall and runoff (mm)

The model then, calculates drainage (D) according to equation (5)

$$D = (\text{Free water above FC}) / (2PWP) \text{ ------------------------------ } (5)$$

Where:

FC = Soil field capacity (mm)

PWP = permanent welting point (mm)

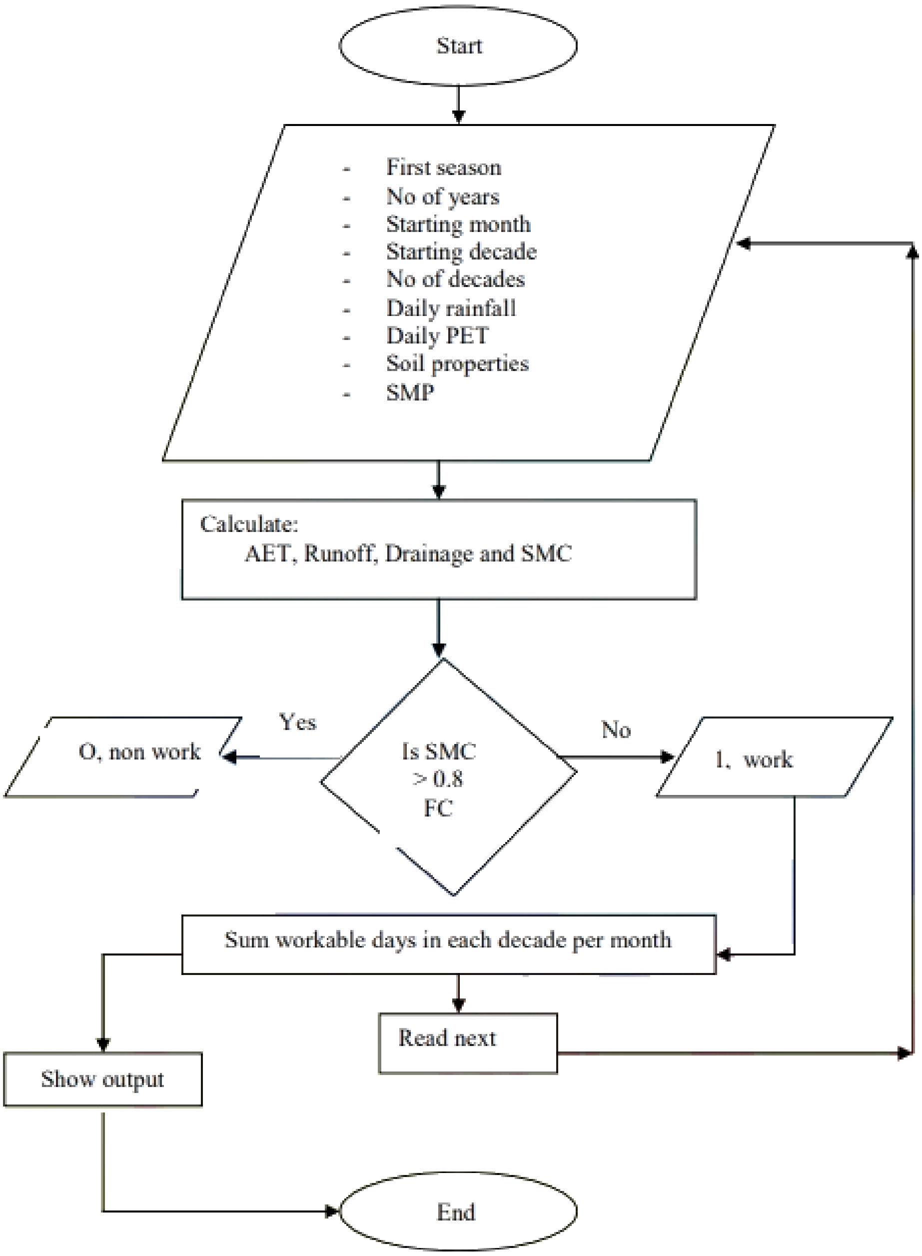


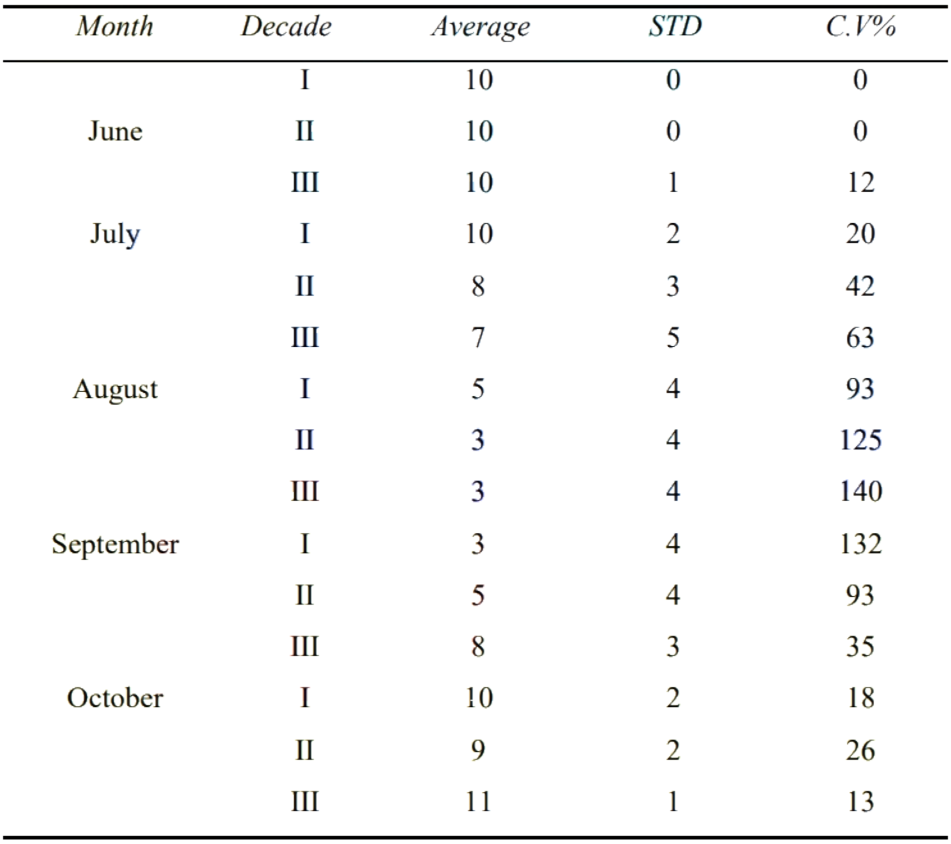
Fig 1. Available workable days system flow chart

3. RESULTS AND DISCUSSION

3.1System verification and validation

The developed system was used to predict workable days in the mechanized rainfed agriculture of .Gedarif State- Sudan. Soil criterion for machinery workability was taken as 80% of field capacity (0.8 FC) according to Elfadil, et al. (2004a), and Mas'oud (2005). Table1 shows average the estimated workdays for Gedarif for months from June to October for 33 years (1977 to 2009) on decade base. It was observed that, as soon as the user enters the required . data, thesystem estimates the number available workdays on decade base.

Table1. Average estimated field workdays in Gedarif (1977 - 2009)



Month	*Decade*	*Average*	*STD*	*C.V%*
June	I	10	0	0
	II	10	0	0
	III	10	1	12
July	I	10	2	20
	II	8	3	42
	III	7	5	63
August	I	5	4	93
	II	3	4	125
	III	3	4	140
September	I	3	4	132
	II	5	4	93
	III	8	3	35
October	I	10	2	18
	II	9	2	26
	III	11	1	13

As verification for the system, the same input data for the months June to August for the years from 1991 to 2000 were used for comparison with Mas'oud (2005). Statistical analysis showed close agreement between the two results with high correlation coefficient (R^2) of 0.84 (Table2).One limitation of the system which is worth noting is that it does not take into account the time of day when rainfall occurs. For example, a heavy rain in the late evening would result in a nonworking day according to the system, even though the soil may have been dry enough to be tilled during the day time.

For system validation the system prediction and observed values of available workdays during seasons 2008 and 2009 in Gedarif showed close agreement (Table3). The correlation analysis between the predicted and actual workdays gave a correlation coefficient of (R^2= 0.89). This proves that the system is able to estimate the available workdays with a high level of
accuracy.

Table2. predicted workdays in 1991 to 2000 as compared with Mas’oud, 2005

Years	*June*		*July*		*August*	
	Mas’oud-2005	Model prediction	Mas’oud-2005	Model prediction	Mas’oud-2005	Model prediction
1991	30	30	31	27	24	27
1992	30	29	29	26	3	25
1993	30	29	31	30	12	24
1994	30	30	31	28	31	26
1995	27	26	5	22	14	25
1996	30	30	31	27	5	22
1997	30	30	18	26	11	25
1998	30	29	24	26	7	20
1999	30	30	13	22	12	25
2000	30	28	31	28	31	27

Table3. Observed and estimated field workdays in Gedarif (2008 - 2009)

Month	*Decade*	*Season 2008*		*Season 2009*	
		Observed	Estimated	Observed	Estimated
June	I	10	10	10	10
	II	10	10	10	10
	III	9	10	10	10
July	I	10	10	10	10
	II	9	10	5	4
	III	11	11	5	0
August	I	8	10	2	0
	II	4	10	8	0
	III	5	6	6	0
September	I	5	0	2	0
	II	6	0	3	0
	III	10	9	8	6

3.2 Sensitivity of the system

The sensitivity analysis was made to study the effect of changing soil workability criterion on the estimated workdays. The soil workability criterion 0.8 FC and 0.6 FC were used and keeping others inputs parameters constant for months August and September for season 2008. Changing soil workability criterion from 0.8 FC to 0.6 FC decreased the total number of working days from 26 to 20 and 9 to 1 days for August and September, respectively (Table4). This mainly due to the effect of the changed in soil workability criterion, and this means that the system is dynamic and can successfully estimate the number workdays according to careful definition of soil workability criterion and other input data.

Table4. Effect of changing soil workability criteria on the estimated workdays

Month	*Decade*	*0.8 FC*	*0.6 FC*
August	I	10	10
	II	10	10
	III	6	0
	Total	**26**	**20**
September	I	0	0
	II	0	0
	III	9	1
	Total	**9**	**1**

3.3 System application

The system was applied to estimate field workdays for three field operations, seedbed, seeding and weeding in mechanized rain fed sector of Gedarif State. The results in Table5showed that the average workdays for the three operations were 27, 24 and 23 days, respectively. It is obvious that the system saves much of human efforts, time and even financial expenses that spend for obtaining such results.

Table5. Estimated workdays for three field operations in Gedarif area

Crops	*Seedbed preparation*	*Seeding operation*	*Weeding operation*
Sorghum	28	23	14
Sesame	28	18	23
Sunflower	20	25	20
Cotton	30	28	36
Average	27	24	23

4. CONCLUSONS

A computer system was developed to predict machinery workdays in rainfed areas, where soil workability criterion is known and soil and climate data are available. The system predictsdays suitable for machinery field work in decade base for any month during the year and for years up to 100 years. As soon as the user enters the required input data, the system displays the results. The system predictions were compared with actual workdays for two consecutive seasons. There were strong correlations between system predictions and actual data. The system was applied to estimate field workdays for three field operations, seedbed, seeding and weeding in mechanized rainfed sector of Gedarif area, the average workdays for the three operations were 27, 24 and 23 days, respectively.

5. REFERENCES

ASABE. (2004). American Society of Agricultural and Biological Engineers (ASABE). Predicting suitable days for field operations in a whole farm simulation.(ASABE, St. Joseph, Michigan.www,asab.org. paper number 043037, 2004 ASAE annual meeting,@2004).

Elfadil, A. .; M. A. Ali and H. I. Mohammed (2004a). Soil moisture content as a determining factor for machinery selection. I- Development of computerized simulation model for the prediction of daily fluctuations in soil moisture content. Gezira J. Agric. Sci. 2(2):131-142.

FMO, (1976). Fundamentals of Machine Operation – Tillage. Deere & Company, Moline, Illiois.U.S.A.

Gauji, . A.; Mittal, J. P,; Bass, S. Y. (1984). Design Criteria of Farm Machinery From Management Point of View. Development of the agricultural machinery industry in developing countries. Proceeding of the 2nd international conference (Amsterdam 23-26 January) 317-321.

Godwin, R. J. and G. Spoor (1977). Soil factors influencing work days. Paper presented at the Autumn National Conference (in association with South Eastern Branch) of the institution of Agricultural Engineering at Marks Hotel.

Mas'oud, F. H. (2005). A computer Model for Farm Machinery Selection. Ph.. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, University of Khartoum, Sudan.

Mohamed, A. M. (2001). Working Days in the Mechanized Rainfed Agriculture-Damazine and Gedarif areas. M.Sc. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, University of Khartoum, Sudan.

Rotz, C. A. and Harrigan, .M. (2005). Predicting Suitable Days for Field Machinery Operation in a Whole Farm Simulation. Applied Engineering in Agriculture, American Society of Agricultural Engineers, Vol.21(4): 563 – 571.

Rounsevell, M. . A. and Jones, R.J.A. (1993). A soil and agro-climatic model for estimating machinery work-days: the basic model and climate sensitivity. Soil and tillage research 26: 179-191.

Simalenga, . E and H. Have (1994) predicting soil moisture status and suitable field workdays under tropical conditions. AMA (25)3: 9-12.

Terzaghi, A. W. B. Hoogmoed and R. Miedema (1988). The use of wet workability limit predict the land quality " workability " for some Uruguayan soils. Nether land Journal of Agricultural science. 36, 91-103.

Thomason, A.J. (1982). Soil and climatic aspects of workability and traficability. International Soil Tillage Research Organization (ISTRO). 9th conference proceeding. Osijek, Yugoslavia.

Witney, B. . and K. Eradat Oskoui (1982). The basis of tractor power selection on arable farm.Journal of Agricultural Engineering Research 27:513 – 527.

Will Critchley and Klaus Seigert (1991). Water harvesting. Food and Agriculture Organization of the United Nations. AGL/MISC/17/91, Rome, pp. 1- 133.

Instructions for Authors

Essentials for Publishing in this Journal

1 Submitted articles should not have been previously published or be currently under consideration for publication elsewhere.

2 Conference papers may only be submitted if the paper has been completely re-written (taken to mean more than 50%) and the author has cleared any necessary permission with the copyright owner if it has been previously copyrighted.

3 All our articles are refereed through a double-blind process.

4 All authors must declare they have read and agreed to the content of the submitted article and must sign a declaration correspond to the originality of the article.

Submission Process

All articles for this journal must be submitted using our online submissions system. http://enrichedpub.com/ . Please use the Submit Your Article link in the Author Service area.

Manuscript Guidelines

The instructions to authors about the article preparation for publication in the Manuscripts are submitted online, through the e-Ur (Electronic editing) system, developed by **Enriched Publications Pvt. Ltd**. The article should contain the abstract with keywords, introduction, body, conclusion, references and the summary in English language (without heading and subheading enumeration). The article length should not exceed 16 pages of A4 paper format.

Title

The title should be informative. It is in both Journal's and author's best interest to use terms suitable. For indexing and word search. If there are no such terms in the title, the author is strongly advised to add a subtitle. The title should be given in English as well. The titles precede the abstract and the summary in an appropriate language.

Letterhead Title

The letterhead title is given at a top of each page for easier identification of article copies in an Electronic form in particular. It contains the author's surname and first name initial .article title, journal title and collation (year, volume, and issue, first and last page). The journal and article titles can be given in a shortened form.

Author's Name

Full name(s) of author(s) should be used. It is advisable to give the middle initial. Names are given in their original form.

Contact Details

The postal address or the e-mail address of the author (usually of the first one if there are more Authors) is given in the footnote at the bottom of the first page.

Type of Articles

Classification of articles is a duty of the editorial staff and is of special importance. Referees and the members of the editorial staff, or section editors, can propose a category, but the editor-in-chief has the sole responsibility for their classification. Journal articles are classified as follows:

Scientific articles:

1. Original scientific paper (giving the previously unpublished results of the author's own research based on management methods).
2. Survey paper (giving an original, detailed and critical view of a research problem or an area to which the author has made a contribution visible through his self-citation);
3. Short or preliminary communication (original management paper of full format but of a smaller extent or of a preliminary character);
4. Scientific critique or forum (discussion on a particular scientific topic, based exclusively on management argumentation) and commentaries. Exceptionally, in particular areas, a scientific paper in the Journal can be in a form of a monograph or a critical edition of scientific data (historical, archival, lexicographic, bibliographic, data survey, etc.) which were unknown or hardly accessible for scientific research.

Professional articles:

1. Professional paper (contribution offering experience useful for improvement of professional practice but not necessarily based on scientific methods);
2. Informative contribution (editorial, commentary, etc.);
3. Review (of a book, software, case study, scientific event, etc.)

Language

The article should be in English. The grammar and style of the article should be of good quality. The systematized text should be without abbreviations (except standard ones). All measurements must be in SI units. The sequence of formulae is denoted in Arabic numerals in parentheses on the right-hand side.

Abstract and Summary

An abstract is a concise informative presentation of the article content for fast and accurate Evaluation of its relevance. It is both in the Editorial Office's and the author's best interest for an abstract to contain terms often used for indexing and article search. The abstract describes the purpose of the study and the methods, outlines the findings and state the conclusions. A 100- to 250-Word abstract should be placed between the title and the keywords with the body text to follow. Besides an abstract are advised to have a summary in English, at the end of the article, after the Reference list. The summary should be structured and long up to 1/10 of the article length (it is more extensive than the abstract).

Keywords

Keywords are terms or phrases showing adequately the article content for indexing and search purposes. They should be allocated heaving in mind widely accepted international sources (index, dictionary or thesaurus), such as the Web of Science keyword list for science in general. The higher their usage frequency is the better. Up to 10 keywords immediately follow the abstract and the summary, in respective languages.

Acknowledgements

The name and the number of the project or programmed within which the article was realized is given in a separate note at the bottom of the first page together with the name of the institution which financially supported the project or programmed.

Tables and Illustrations

All the captions should be in the original language as well as in English, together with the texts in illustrations if possible. Tables are typed in the same style as the text and are denoted by numerals at the top. Photographs and drawings, placed appropriately in the text, should be clear, precise and suitable for reproduction. Drawings should be created in Word or Corel.

Citation in the Text

Citation in the text must be uniform. When citing references in the text, use the reference number set in square brackets from the Reference list at the end of the article.

Footnotes

Footnotes are given at the bottom of the page with the text they refer to. They can contain less relevant details, additional explanations or used sources (e.g. scientific material, manuals). They cannot replace the cited literature.

The article should be accompanied with a cover letter with the information about the author(s): surname, middle initial, first name, and citizen personal number, rank, title, e-mail address, and affiliation address, home address including municipality, phone number in the office and at home (or a mobile phone number). The cover letter should state the type of the article and tell which illustrations are original and which are not.

Notes