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Machine learning based load forecasting system

Dr.P.Arul Kumar *, Nandhini K ,#Deepa.S # , Sowmiya R # , Lalitha K #
** Professor, Department of Electrical and Electronics Engineering, VSB Engineering College, Karudayampalayam, Karur-639111.*
#Final year student, Department of Electrical and Electronics Engineering, VSB Engineering College, Karudayampalayam, Karur-639111.

ABSTRACT:
This paper proposes a machine learning based load forecasting system, integrated with current transformer, potential transformer, PIC controller, LCD, relay and solar/EB sources. The system uses the data collected from the CT, PT and the solar/EB sources to generate predictive models, which can be used to forecast the load in an electrical system. The PIC controller is used to monitor the system, while the LCD and relay are used to display and control the system, respectively. The proposed system was tested and results show that it can accurately predict the load in the electrical system. This system can be used to reduce energy costs and optimize energy consumption.
Key Words: *PIC controller, LCD, relay and solar.*

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I. INTRODUCTION

Electricity is the spinal cord of our modern lives and commodities. It is also, extremely crucial to the national security, social and economic growth of any country. Therefore, the security and sustainability of electricity sources and the continuity of generation are vital topics, and for that, electrical load forecasting can be tremendously helpful.

Load forecasting (LF) is the expectation and prediction of the demand load that is calculated using a systematic procedure to adjust future expectation based on available parameters and information in order to determine future needs and system requirements. Precise load prediction or forecasting can serve energy and power producers to aid in ensuring the security and continuity of the power supply with no (or minimal) interruptions. As well as, in scheduling and reducing energy waste, given that electrical power is challenging to store.

In the age of technology, conventional methods are being automated, and computers are taking over. Similarly, for energy distribution, smart grids are replacing traditional energy distribution grids which allow efficient distribution and demand-side management. This integrated C development environment gives developers the capability to quickly produce very efficient code from an easily maintainable high level language. The compiler includes built in functions to access the PIC hardware such as READ_ADC to read a value from the A/D converter. Discrete I/O is handled by describing the port characteristics in a PRAGMA. Functions such as INPUT and OUTPUT_HIGH will properly maintain the tri-state registers. Variables including structures may be directly mapped to memory such as I/O ports to best represent the hardware structure in C. The microcontroller clock speed may be specified in a PRAGMA to permit built in functions to delay for a given number of microseconds or milliseconds. Serial I/O functions allow standard functions such as GETC and PRINTF to be used for RS-232 like I/O. The hardware serial transceiver is used for applicable parts when possible. For all other cases a software serial transceiver is generated by the compiler. The standard C operators and the special built in functions are optimised to produce very efficient code for the bit and I/O functions. Functions may be implemented inline or separate. Function parameters are passed in reusable registers. Inline functions with reference parameters are implemented efficiently with no memory overhead. During the linking process the program structure including the call tree is analysed. Functions that call one another frequently are grouped together in the same page. Calls across pages are handled automatically by the tool transparent to the user. Functions may be implemented inline or separate. RAM is allocated efficiently by using the call tree to determine how locations can be re-used. Constant strings and tables are saved in the device ROM. The output hex and debug files are selectable and compatible with popular emulators & programmers including MPLAB for source level debugging. The Professional Package (PCW) provides both compilers in a powerful Windows environment.

II. WORKFLOW OF THE PROPOSED APPROACH

In modern times, classical approaches have become outdated due to their limitations and machine learning has emerged as a field and has evolved in application variety and become quite known in the power analysis and forecasting field for its many merits. Machine Learning is a subsidiary branch of the expanding field of artificial intelligence, and it centers around employing data and algorithmic principles to improve the accuracy of machines and models progressively through analysis and recognition of patterns, almost replicating the human learning process. In Figure 1 is a general structure for an Proposed approach.

With an increase in population and an overall expansion of the energy infrastructure, electricity demand is increasing rapidly. To manage this increasing demand efficiently, so-called smart grids are used. The cardinal feature of demand-side management in smart grids is load forecasting, as it allows the operators of the smart grid to make efficient and effective decisions, which is the topic of interest of this blog post.

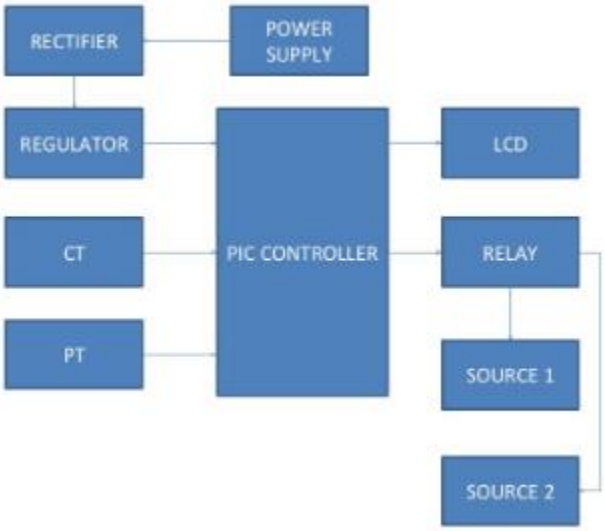


Fig.1.Block diagram

In Fig.3 as illustrated the layers and model Simulink diagram .There are three different categories of load forecasting, namely short-term load forecasting (STLF, ranging from a few hours to a few days), medium-term load forecasting (MTLF, several days up to a few months), and long-term load forecasting (LTLF, greater than or equal to one year). This study focuses on STLF which is a particularly challenging problem because decisions need to be made within a very short span of time and there is less room for error.

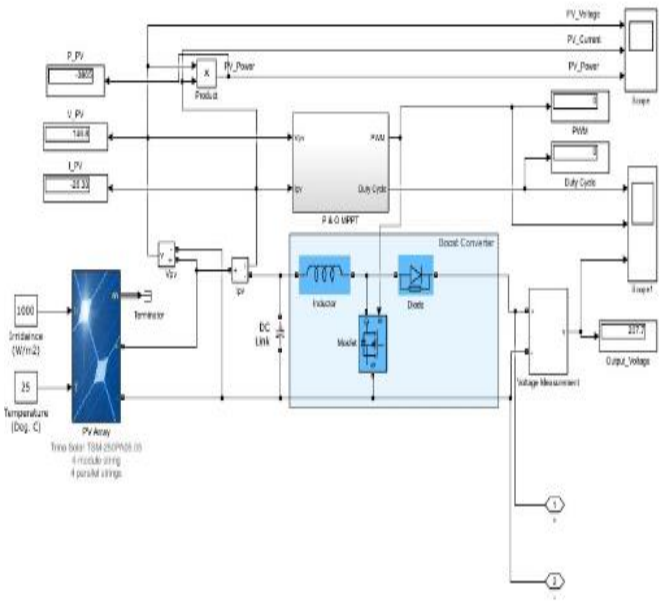


Fig.2. Simulink diagram for Machine learning based load forecasting system

However, they perform poorly for huge sums of data. Simulated in Figure 2.

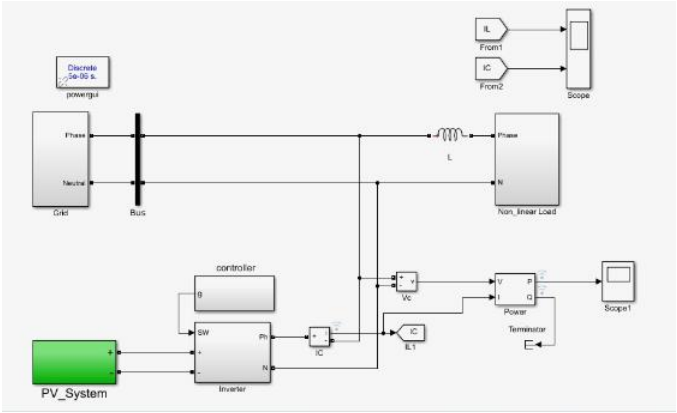


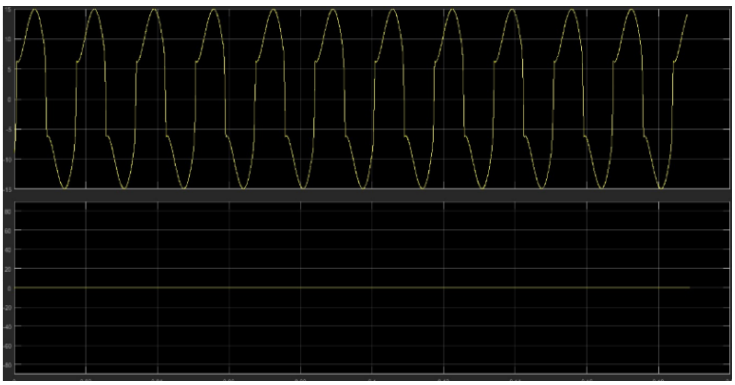
Fig.3. The layers and model Simulink diagram

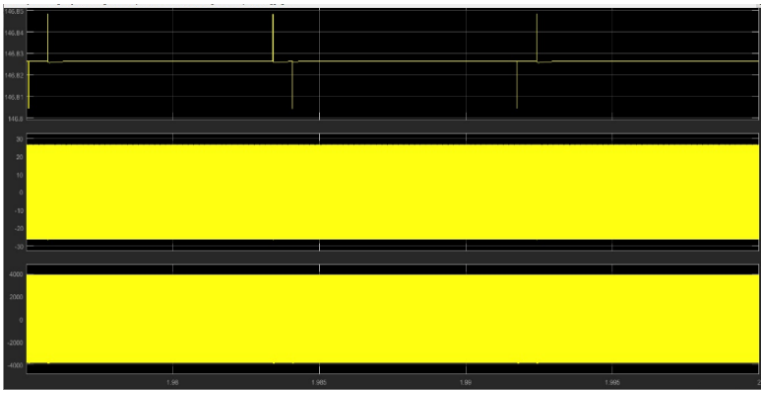
The World is filled with Embedded Systems. The development of Microcontroller has paved path for several Embedded System application and they play a significant role (and will continue to play in the future as well) in our modern day life in one way or the other.

IV.RESULTS AND DISCUSSION

This program implements a machine learning based load forecasting system using a photovoltaic (PV) module, Maximum Power Point Tracking (MPPT) module, irradiance, temperature, PV array, boost converter, voltage measurement, output voltage, scope 1, duty cycle, Pulse Width Modulation (PWM), PV voltage, PV current, PV power, and scope. First, the PV module, MPPT module, irradiance, temperature, PV array,boost converter, voltage measurement, output voltage, scope 1, and duty cycle are initialized.Next, PWM, PV voltage, PV current, and PV power are measured and recorded. Finally, the measured and recorded data is used to generate a load forecasting system using machine learning techniques. The output of the forecast is displayed on the scope.

Machine learning is a rapidly evolving field, that has left an impact in many other areas. Load forecasting is no exception, as several approaches pertaining to machine learning have been developed, investigated and tested in order to tackle the deficiencies of some of the prior techniques of load forecasting. The review of cutting-edge machine learning techniques utilized in various research for load forecasting was the main subject of this paper. Generally, training wise, more data would yield more accurate predictions and more relevant input features to consider while predicting and forecasting loads using these methods. Machine learning methods need more studying and further research to be able to incorporate it towards creating more efficient, reliable systems and an important milestone in smart grids. It significantly outperformed several applications and offered various methodological advantages.





V.CONCLUSION

A machine learning based load forecasting system is a powerful tool that can provide invaluable insights into energy demand. It can be used to predict future energy usage, assess the impact of changes in energy sources, and analyze customer behavior. By leveraging the power of machine learning, this system can help utilities more accurately forecast energy loads and provide better service to customers. With the help of this system, utilities can reduce energy costs and increase customer satisfaction.

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