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# Automation of Frequency Control in Microhydro Power Plant with Load using Arduino UNO and Lab view

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ABSTRACT: Micro hydro power plants are small-scale power plants that use hydropower as their driving force. Hydropower can come from irrigation channels, rivers or natural waterfalls, which are used by utilizing the waterfall height (head) and the amount of water discharge. The main components of this plant are the turbine and generator. The load on the micro hydro generator will affect the value of the voltage and frequency generated. This research attempts to make a micro hydro generator with automatic frequency control using dummy load in the form of inductance which is obtained using Verica. The generator output voltage and current will be read by Arduino as a control center using the AC voltage sensor and current sensor. From the observations of the research data, it was revealed that the frequency output of the micro hydro generator with an automatic dummy load controller was close to the value of the mesh frequency, namely 51 - 52 Hz.

**KEYWORDS:** Arduino, DC Motor, IR sensor.

## I.INTRODUCTION

Micro-hydro or Micro-hydro Power Plant (MHPP) is a power plant which uses hydropower as its driving force such as irrigation channels, rivers or natural waterfalls by utilizing the head and the amount of water discharge. PLTMH is used to meet energy needs in line with the increasing human need for huge electrical energy. However, it is not balanced with the distribution of electricity networks, especially in remote areas, such as in mountainous areas that have high water potential.

Micro hydro power plants are an efficient and reliable form of clean, renewable energy. These generators can be an excellent method of harnessing renewable energy from creeks and streams. The micro-hydro plant is designed to be a run-of-river type, as it requires little without a reservoir to power the turbine. The water will flow directly through the turbine and back into the river to be used for other purposes. The plant has minimal environmental impact on the local ecosystem. The procedure for designing a micro hydro power plant is implemented with the MATLAB Simulink computer program to calculate all design parameters. The choice of turbine type depends primarily on the head and flow rate. Turbine power and speed are directly proportional to site head, but there are specific points for maximum turbine power and speed with variations in site water flow rate.

The problem that often occurs in micro hydro generating systems is that the generator frequency is not constant. It is due to changes in the connected load which causes frequent system frequency fluctuations which can cause damage to electrical equipment. Therefore, Load Frequency Control (LFC) is used for regulation, the frequency can be more. To obtain optimal control parameters in a micro hydro power plant system, an Artificial Intelligence (AI) is employed, which is the Adaptive Neuro Fuzzy Inference System (ANFIS) method. ANFIS data is obtained from PID controller training data The use of micro-hydro power plants is increasingly being chosen, because it has advantages economically, technically, and is environmentally friendly. The operation of micro-hydro requires the right control technology. Micro hydro is very suitable for use in areas that are difficult to reach by the electricity grid. A common problem with micro-hydro systems is unstable turbine rotation, which is caused by changes in load from consumers. The majority of micro-grid systems are isolated from the grid and to ensure voltage and frequency stability at different loads a good control system is required. A new approach with Synchronous Generator in Electronic Load Controller (ELC) is discussed here. The ELC design was tried using an uncontrolled bridge rectifier, the chopper using IGBT was designed to control resistive loads

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## II.LITERATURE SURVEY

- K. Gaiser, P. Erickson, P. Stroeve, and J. P. Delplanque proposed a millions of off-grid homes in remote areas around the world have access to pico-hydro (5 kW or less) resources that are undeveloped due to prohibitive installed costs ($/kW). The Turgo turbine, a hydroelectric impulse turbine generally suited for medium to high head applications, has gained renewed attention in research due to its potential applicability to such sites. Nevertheless, published literature about the Turgo turbine is limited and indicates that current theory and experimental knowledge do not adequately explain the effects of certain design parameters, such as nozzle diameter, jet inlet angle, number of blades, and blade speed on the turbine's efficiency. In this study, these parameters are used in a three-level (34) central composite response surface experiment. A low-cost Turgo turbine is built and tested from readily available materials and a second order regression model is developed to predict its efficiency as a function of each parameter above and their interactions. The effects of blade orientation angle and jet impact location on efficiency are also investigated and experimentally found to be of relatively little significance to the turbine. The purpose of this study is to establish empirical design guidelines that enable small hydroelectric manufacturers and individuals to design low-cost efficient Turgo Turbines that can be optimized to a specific pico-hydro site. The results are also expressed in dimensionless parameters to allow for potential scaling to larger systems and manufacturers.

- M.Djalal M. R., Fakhrurozi M.,Kadaryono, Budiman, Ajiatmo D presented the use of micro hydro power generation is increasingly chosen, because it has advantages economically, technically, and environmentally friendly. Operation of micro hydro requires appropriate control technology. Micro hydro is very suitable for use in areas that are difficult to reach the central power grid. A common problem with micro-hydro systems is the unstable turbine spin, caused by changes in loads from consumers. This causes a change in the frequency fluctuations in the system that can cause damage from the factory side and from the side of the consumer electrical appliances. Therefore, in this research we will discuss the strategy of load frequency control based on Capacitive Energy Storage (CES). CES is a tool that can store energy quickly and release energy in a certain time. In its use required proper adjustment for CES parameters. To obtain optimum CES parameter on micro hydro artificial intelligence method based on Flower Pollination Algorithm (FPA). The simulation results show that FPA application to test CES parameter add Proportional Integral Derivative (PID) controller to micro-hydro, can accelerate response time of change of frequency change and also increase overshoot frequency response system, that is equal to -2.325e 06 to 5,197 e-07 pu

- Andik, M, Farul, M, Cahyono, I, Rukslin, R. proposed a microhydro power plant is a small-scale power plant.Microhydro plants are built in areas where there is no power grid. In areas with sufficient water potential to generate electrical energy. The problem that often occurs in the micro-hydro generator system is the occurrence of non-constant generator. This is caused by changes in connected loads. Thus causing frequent fluctuations in the frequency of the system that can cause damage to electrical equipment. Therefore used Load Frequency Control (LFC) in order to control the frequency can be more stable.To get the optimal control parameter in micro hydro power plant system is used an Artificial Intelligence (AI) that is Adaptive Neuro Fuzzy Inference System (ANFIS) method. ANFIS data is taken from PID controller training data. By using PID-ANFIS control method, microhydro generating system can accelerate settling time and minimize overshoot.

- Medilla Kusriyanto, Handry Setya Utama, Irfan Effendi presented a micro hydro power plants are small-scale power plants that use hydropower as their driving force. Hydropower can come from irrigation channels, rivers or natural waterfalls, which are used by utilizing the waterfall height (head) and the amount of water discharge. The main components of this plant are the turbine and generator. The load on the micro hydro generator will affect the value of the voltage and frequency generated. This research attempts to make a micro hydro generator with automatic frequency control using dummy load in the form of inductance which is obtained using variac. The generator output voltage and current will be read by Arduino as a control center using the ZMPT101B AC voltage sensor and ACS712 current sensor. The generator output frequency is read by reading the travel time of 1(one) full wave. This research is also equipped with a variable monitoring system for micro hydro generator using Labview. From the observations of the research data, it was revealed that the frequency output of the micro hydro generator with an automatic dummy load controller was close to the value of the mesh frequency, namely 51 - 52 Hz.

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## III. PROPOSED SYSTEM

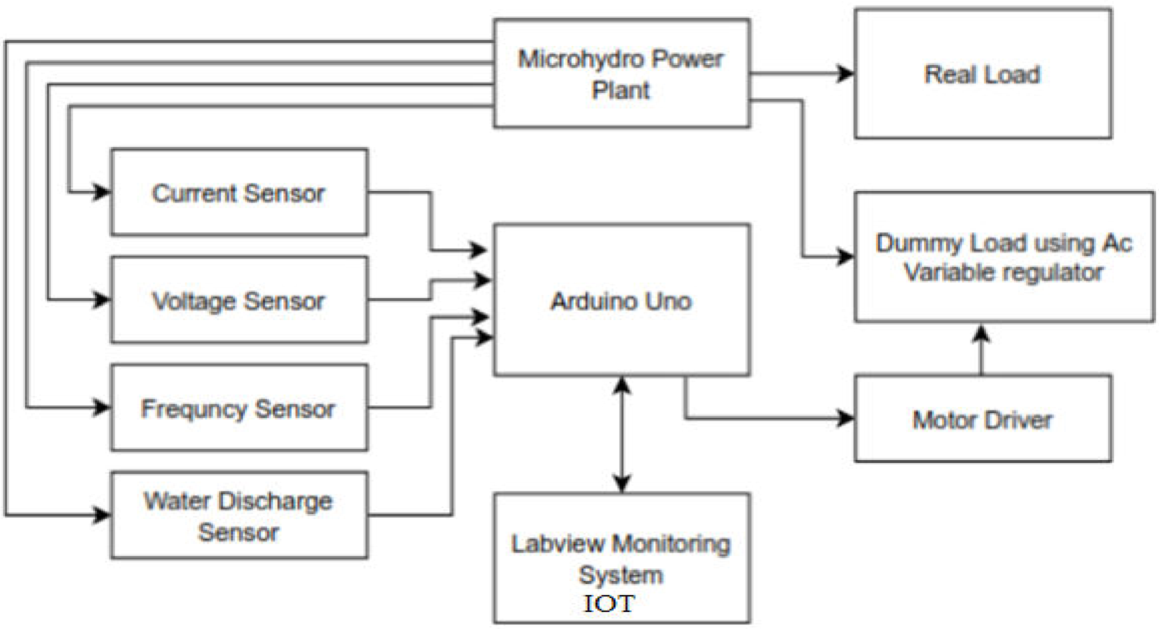


Fig. 1 Block diagram of the proposed system

Fig.1 shows the proposed system consists of Adruino, transformer, voltage regulator, DC motor and IR sensor.

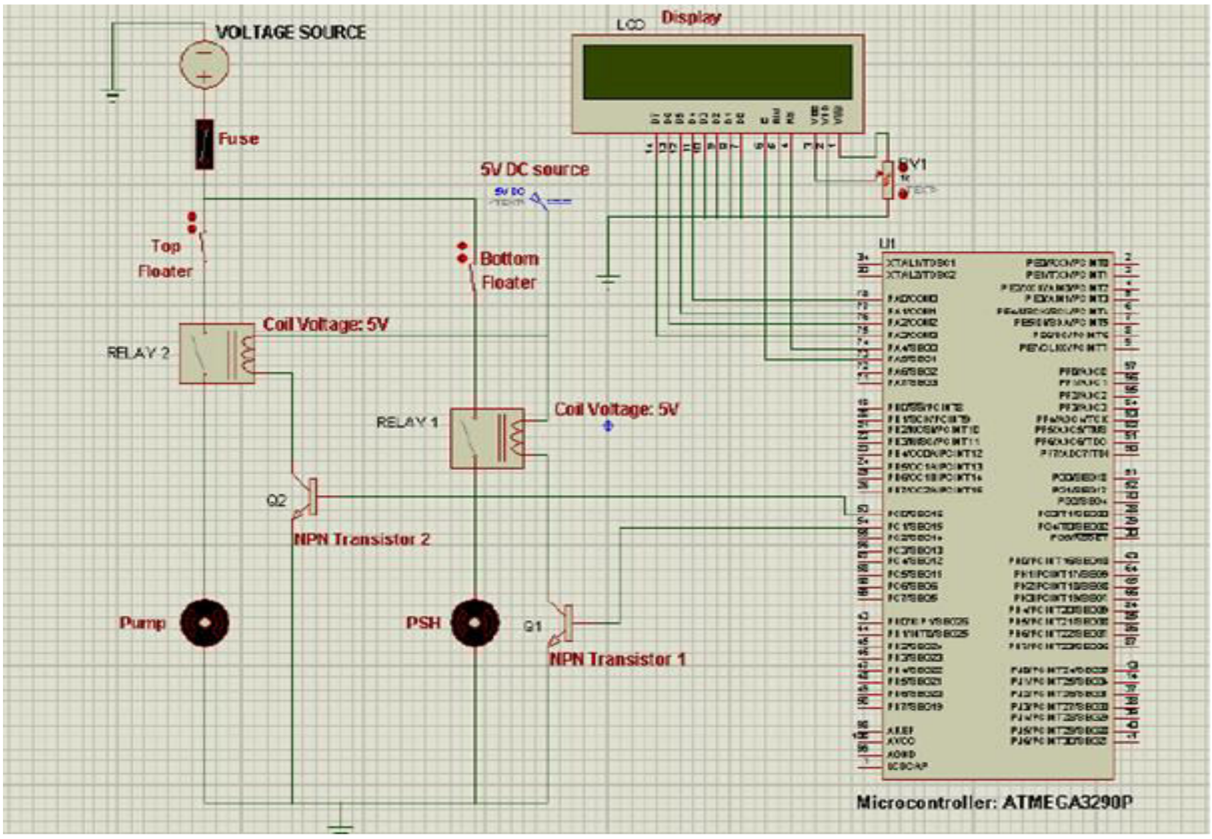


Fig.2 Equivalent circuit of proposed system

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Fig.2 shows the circuit diagram of design of Automation of Frequency Control in Microhydro Power Plant with Load using Arduino UNO And Lab view. The components used are Arduino, transformer, voltage regulator, DC motor and IR sensor works as a main function.

## IV. WORKING PRINCIPLE OF PROPOSED SYSTEM

In order to make the wind turbines smart, we used Arduino Uno based on an ATMEL microcontroller and an Infrared (IR) sensor. The IR sensor measures the speed in Rotations per Minute (RPM) of the blades and interfaces with Arduino. We have designed an algorithm to guarantee safety If the speed goes above the maximum safe limit, Arduino interacts with a 12V DC motor on the wind turbine tail vane to move the turbine blade out of the wind. It does this by activating a 5V DC single-channel relay module to switch on the DC motor. The wind interacts with the wind turbine blades as a prime mover and rotates the generator which produces electricity. The IR sensors and relay module are connected to Arduino. As mentioned before, the IR sensor measures the speed of the blades and when the speed is within safety limits specified, a green LED indicating safety turns on. A 12V DC motor is placed to control the tail vane. If the speed of the blades goes beyond safety limits, the microcontroller triggers the relay connected to the DC motor and switches it on. As a consequence, the windmill is rotated in a direction perpendicular to the wind flow to break the operation.

## V. CONCLUSION

The floaters provide an accurate result for balanced operation of the hybrid plant. The governing control strategy worked for the proposed plant with quick response at any given time any excess power was available from the primary hydropower plant. Flowcode and Proteus proved to be relevant in the management of the plant control. The display aspect provided ease of identifying which of the plant system was working at a particular time and which was not working. It would also reveal the reason why the expected one to be working is not working especially when it has to do with floater control.

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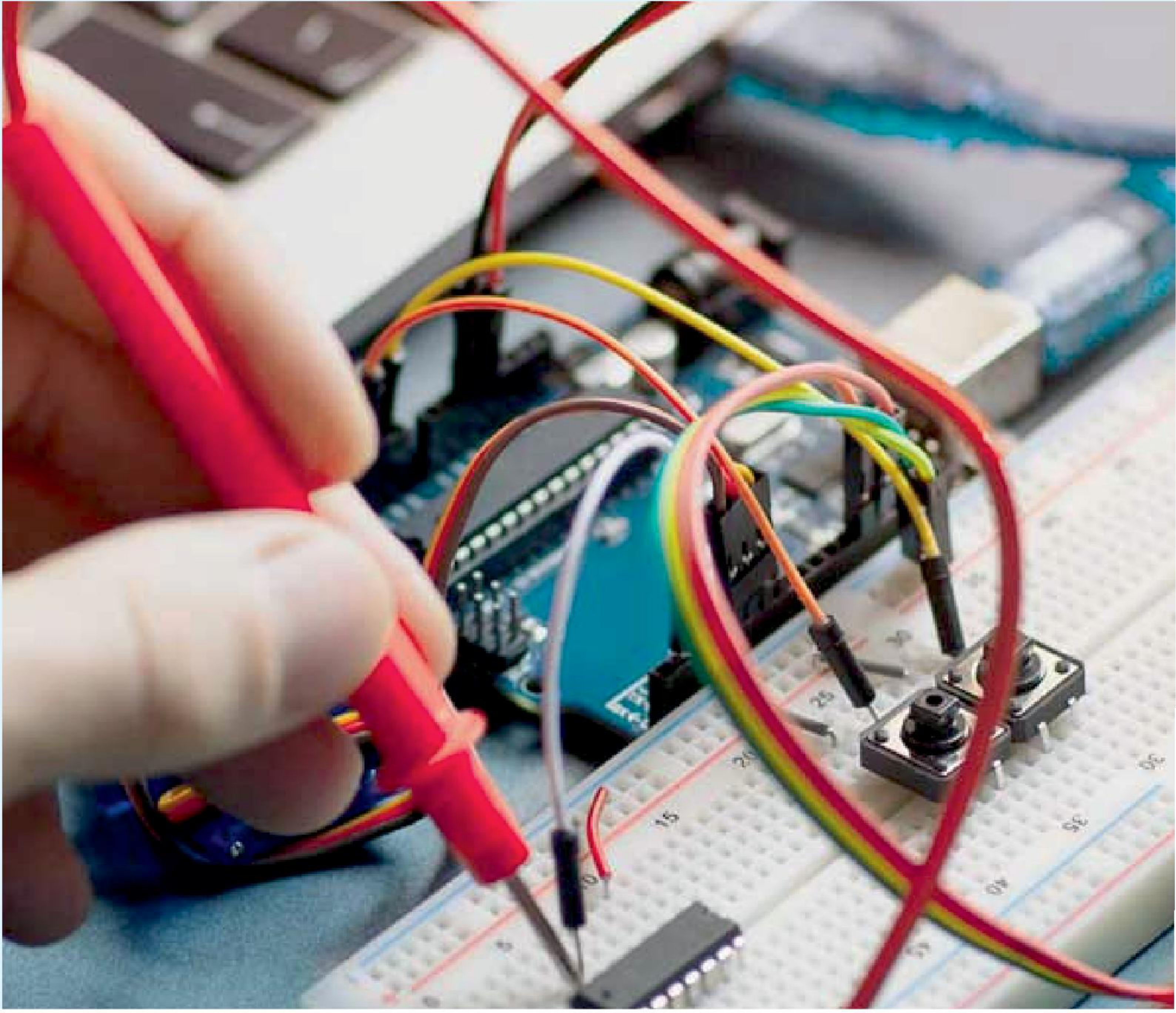


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