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Preserving the Architectural Heritage within an Academic Framework

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ABSTRACT

The Arab region is one of the areas rich in architectural heritage associated with historical and religious events. It is replete with Roman, Byzantine and Islamic monuments that must be preserved as much as possible by rehabilitating those monuments and investing this heritage which reflects the experience of intellectual creativity of ancient human societies through different civilization ages.

This research discusses the methods of conservation and restoration in one of the most important cities in that region, namely the village of Al-Zafeer and located in Saudi Arabia, which is one of the most important landmarks of the architectural heritage in the Kingdom. However, the village suffers from neglect and failed restoration efforts. The local municipality tried to save the village, but the efforts lacked a comprehensive strategy to revive it as a part of its cultural heritage and identity.

The present research aims to develop a plan and strategy to preserve the old city in order to improve its visual image and rely on the involvement of restoration experts with local people and municipalities in a scientific academic framework as a means to provide cadres of students and professionals in the rehabilitation work and preservation. . To achieve this goal, the research adopted a clear methodology for the descriptive analytical approach along with field observations and preliminary surveys.

The conclusion would clarify a strategy and a proposal to maintain the mechanism followed by advance planning which helps to Revitalize the village with all its components in line with the identity of the local community and meet the requirements of contemporary architecture.

Keywords: Architectural Heritage, rehabilitating , conservation , restoration , cultural , identity, local municipalities , academic framework , contemporary

I. INTRODUCTION

Protection and preservation of architectural heritage are national duty to protect the cultural identity of urban communities. It is considered the index of differentiating between ancient civilizations and traditional cultures. In spite of the kingdom's efforts to preserve the architectural heritage and the traditional cultures by taking appropriate measures and legislations, a clear strategy for rehabilitating and revitalizing the areas to its origin is almost lacking.

Investment projects in the village of Al-Zafeer, the ancient city of Al-Baha led to demolishing some traditional buildings. In addition, many individual restoration works carried out by local contractors and engineers were not reasonably successful because of deficiency in experience especially when dealing with building materials of different qualities and characters.

Using of modern materials as well, cause serious damage in the long run. Other traditional buildings were neglected and left to the harsh climate and disintegration to the extent that any restoration attempts are nearly impossible.

The historic village of Al-Zafeer is located about one kilometer southeast of AL-Baha (figure:1&2). In the southeast, the Buraida Mountains are located in the back of a hill extended to the northeast of the Valley (National Authority of tourism and archaeology), (General Authority for Tourism,2010).

Figure 1: shows the Al Baha city and the al-dhafeer village location to KSA
Source: Google Earth

Figure 2: shows the village of al-dhafeer site for the Baha city
Source: Google Earth

One of the principal objectives of this work is to survey and collect data about these buildings in order to authenticate them before putting architectural solutions.

The study and documentation of these buildings and the architectural solutions to restore and revive them would be important elements of touristic attraction, both local and international.

This work is also aiming at achieving an optional balance between the process of reviving the heritage and the protection of the environment, The current project also tries to develop an awareness among citizens of the importance of heritage preservation and national identity
The results would clarify the importance of preservation and the possibility of restoration. Facing problems in this approach are outlined in the following:

- The absence of surveys and scientific documents of the sites of architectural heritage.
- lack of attention to the rehabilitation of the heritage village both culturally and economically.
- Destruction of many of the historical buildings as a result of randomized investments in the near by urban planning activities.
- Discouraging of the activities of traditional industrial crafts related to the old environment prevailing in these villages(General Authority for Tourism,2010).

The restoration projects carried out by the KSA varied in terms of both quality and efficiency, also in terms of followed strategy and the authorities' point of view. This is due to the divergence in general sponsors and managers. In addition to many administrative and financial factors which led to canceling of projects in some areas. For example, the project carried out by the Municipality of Al-Baha city in the village of Al-Zafeer, which has been charged with inexperienced contractors in the field of restoration led to some kind of distortion of old buildings.

II. METHODOLOGY, CONCEPTS AND APPROACHES.

The descriptive analytical approach was adopted. Field observations and preliminary surveys were carried out, documented by photography and sketching as supporting activities. Restoration images were then elaborated.

The following concepts, and approaches are discussed

Defined policies dealing with architectural heritage comp1rise the following trends:

- The first trend looking at old cities and villages with a kind of idolatry and sacred vision so that preserving of archeological ruins is the only trend, (Najdi Naji al-Masri Magd, 2010).
- The second trend is including the old city or any part of it as a part of the contemporary city. The old city, therefore, should be restored or even revived with its accompanied activities including economy, industry, and environmental conditions. This way of the application must be integrated with the modern urban and social development of the contemporary city (Amir, Saleh, 1998).
- The third trend is viewing the old village as a separate living entity with its cultural heritage preserved, without considering its alignment in the vicinity of the surrounding modern communities.
- Kingdom's efforts in preserving the Architectural heritage varied between; keeping it without change after the minor restoration of the traditional buildings or the documentation of the ruins before complete demolishing. Since 1408(H) the kingdom is adopting an architectural heritage program for studying, documenting, and preservation. This program is aiming at preserving and taking care of detected heritage together with the rehabilitation and revitalization.

III. PRESERVATION PROPOSAL AT AL-DHAFEER VILLAGE

A. Urban Planning and Designing of Houses in the Village.

The Urban planning of the old village is characterized by simplicity and uniformity and reflects the design style of buildings. The pattern of the urban planning reflected the security aspects at that time where buildings were built in a compact form without large spaces between them, and generally on a hilly terrain. (Figure:3)

The design of Houses consist of a set of common walls. The division of the house on the ground floor is devoted to livestock and warehouses. The first ground is specified to receive guests, in addition to two rooms for the family and a toilet, also has a place to store agricultural yields and food. The second floor has a kitchen and the family room together with an open court (Mastaba), generally used to sit and watch the family in case of a third floor it often contains a main room for the Lord family in addition to a kitchen, which is called «Asall».

The stairs are designed to be outside the building, constructed with elongated flat stones. and the diversity of windows are all depending on the financial level of the owner and his social stand. Some important houses are including a multi-storey fort in the middle to store supplies and crops and also to be used as a defensive mean in the case of wars. In most cases, the roofs were made of trunks of trees as a skeleton, covered with stacks of leaves of trees and then covered by a layer of a clay paste. The houses usually have a front courtyard used as a guest area.

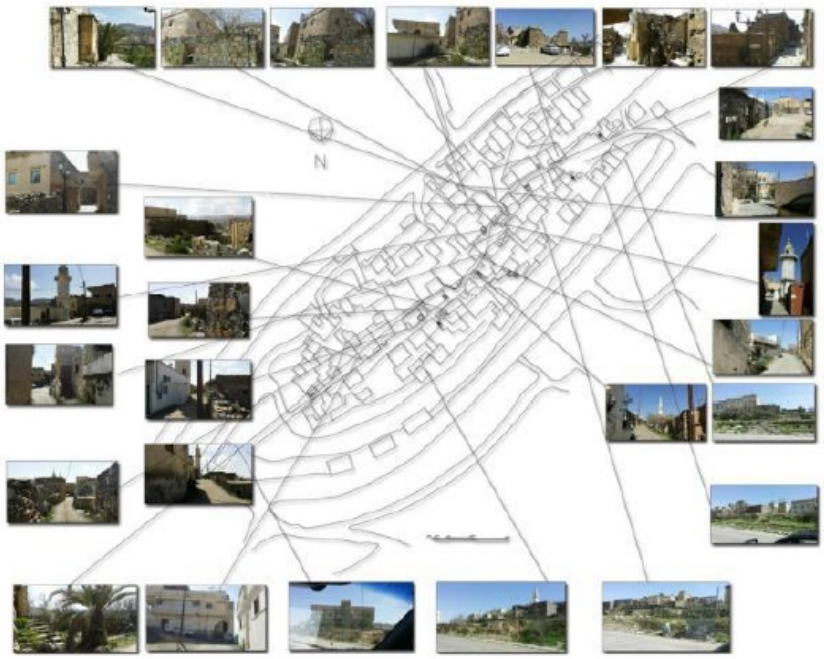

Figure 3: Organization diagram of buildings located longitudinally at the main path of the village Source: researcher

B. The Current State of the Old Village

As a result of the improvement of the financial situation and the increase in revenues in the country, new ways of living emerged. Some inhabitants were encouraged to add a concrete store above their old buildings which caused a partial or total collapse of the whole building. Others were urged to leave the old city and to build modern houses. The new extensions were made north and south of the old village. Most of their buildings were made of concrete and other modern building materials. The situation of the old village became too critical, where many existing buildings are almost rubbles. Restoration efforts were actually in vain, due to several reasons. Important of which is assigning restoration projects to unspecialized contractors. Random restoration of some buildings in the village led to incomplete restoration processes. The following consequences were noticed:

1. Random stone types paving pedestrian routes and plazas.
2. The lack of spaces between elements of movement especially between pedestrians and vehicles.
3. Random and dissonant treatments of walls looking on squares.
4. The poor distribution of flowerbeds in a way inconsistent with the distinctive characteristics of the old architecture.
5. Scattering of seats and lighting units in squares and main tracks.

C. Intervention Works to Revive the Heritage Village of Al-Zafeer.

The basics of a strategy when planning to revive the heritage village of Al Zafeer was developed by the research team. Primarily, to improve permeability within the village through the main longitudinal path in the village, which is running northeast - southeast. This path is overlooked by a group of mainly and secondary spaces. Improving the existent spaces, creating new ones together with reviving important buildings surrounding this path such as Emarah building are proposed. A preservation of the pedestrian zone will offer suitable locations for Bazaars and a tourist center for crafts and traditional ornaments. Coordination of yards and the separation of movement elements including parking zones would provide and facilitate several activities concerning the local inhabitants, tourists, and casual visitors. To achieve

all these solutions, technical comprehensive efforts are needed. Suitable and appropriate investments should be allocated. Application of this strategy includes simultaneous and integrated activities summarized as shown in (Figure:4&5)

Figure 4: The proposed strategy to preserve the heritage village
Source: researcher

Figure 5: Buildings that will be dealt with in the village
Source: researcher

D. Academic and Field Training School.

A school of academic and field training has been postulated as a way of providing cadres of local students and professionals in the rehabilitation and preservation works supervised by a committee of professors from the Faculty of Engineering. It is an educational and training establishment, at the same time providing the trainers with lectures and workshops, and carrying out documentation works and surveys.

E. Elements to be Considered.

The longitudinal path which runs through the middle of the village of Al-Zafeer and extends longitudinally from northeast to the southwest has been identified to be the scope of the current study and as a main foundation of the current project. This path has a set of mainly and secondary spaces where collections of heritage buildings are overlooking (figure:6).

Improving this path is considered the main pillar of the process of maintaining the old village of Al-Zafeer. Finding suitable solutions to re-coordinate and rehabilitate the constituent elements of the path are highly recommended.

The following operations are recommended along that path:

Figure 6: The proposed strategy after and before rehabilitating operations
Source: researcher

- Highlighting the ancient buildings surrounding the spaces and confirming its characteristics and architectural value.
- Excluding and removing all the random and inappropriate elements that encroached on the site.
- The simplicity and clarity of squares design taking into account the physical aspects with surrounding buildings.
- Choosing carefully the flooring and the furniture material of the Spaces, including, settings, lighting units, and flowerbeds that combine simplicity and functionality to be in harmony with the surrounding architecture.
- In addition to the configuration works and re-employment, it has been suggested new establishments that contribute to tourism recovery. A project of three parts is extended to be implemented along the axis of the main path. The first part is a craftsmen business center, the second part is a collection of crafts shops in the central square of the path. The third part is intended to be a commercial center including restaurant and some shops at the end of the path.
- Reviving the old residential and abandoned buildings representing the basic services. The old residential buildings still existing should be restored and improved to encourage people to live their, especially those involved in the village activities.

Alemarah compound buildings which is located on the main longitudinal path penetrating the middle of Al-Zafeer village consists of three main buildings together with a group of secondary buildings. One of them is overlooking the old market square where the main mosque of the village is located. The other two secondary buildings are overlooking the main large yard.

In the past the buildings were originally used as administrative and residential places. For more specification, the first building is overlooking a large yard including a reception hall and many important offices. The second one is used as an extension of the first one . The third building was used as a temporary prison (transit prison) for outlaw prison.

Al-Emarah compound was documented in the current situation (drawing of plans, facades, and sections) as shown in (Figures:7),and Several photographs from different angles were taken as shown in (Figures: 8&9). The buildings are not currently occupied or used, but neglected completely. Parts of the buildings and their accessories are collapsed. The roofs are those parts heavily ruined due to the effect of rains in a condition of abandonment and neglect.

The idea of this project is mainly aimed at reviving the whole group by rebuilding the ruined parts in coordination with other buildings and to reuse it as a museum for local and traditional arts and handicrafts. The suggested museum is expected to revive and stimulate tourism both local and regional, providing and creating jobs opportunities for inhabitants of the village and the surrounding population.

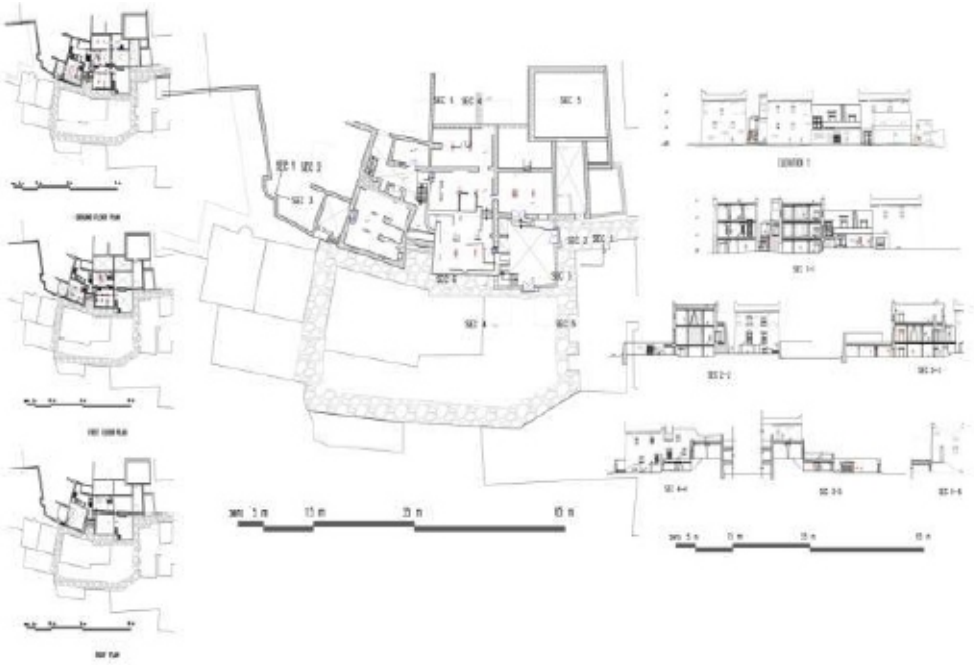

figure 7: The current plan of the Emarah
Source: researcher

F. The reuse of Al -Emarah Building.

The current project proposes a re-use of the El-Emarah building after the renovation to become a museum of the region heritage. The principal condition of this proposal is not to abuse interior spaces and their functional relationship. The changed functions of the restored buildings should comply with the current design. The museum will include halls of artifacts and small cafeteria for visitors, an educational library, some crafts workshops and educational classes all recommended is shown in (Figures 10). A compilation of perspective perception before and after the rehabilitation proposal is shown in (Figure 11).

Figure 8: shows the Photographic documentation of the Emarah from abroad
Source: researcher

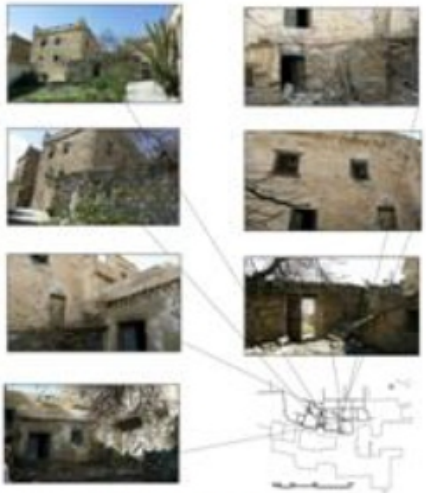

Figure 9:shows the Photographic documentation of the Emarah from inside
Source: researcher

G. General Precautions to be considered during Strengthening and Retoration operations the Heritage Village of Al-Zafeer

Dealing with restoration works, the following Precautions should be taken into consideration:

figure 10: re-employment proposal plan of the Emarah
Source: researcher

1. Repair works should be carried out in the parts of buildings to be preserved. The materials used in the consolidation and restoration must be compatible with the characteristics of the original materials. In any case, it is preferred to use the traditional materials and the handicrafts techniques.
2. Strengthen Work of T stones must be implemented according to specific techniques approved by the engineer in charge of the site to fit in with the existing elements. At the same time, it must be distinguished from the original stones. Using materials of different physical and chemical characteristics than the original ones would result in a different reaction with the environment leading to gradual collapse of the repairs. (Najdi Naji al-Masri Magd,2010).

Partial replacement of the collapsed walls technique

figure 11: perception perspective of the Emarah before and after the rehabilitation
Source: researcher

3. should aim to restore the structural continuation of the previous elements without affecting the stability of the existing elements.
4. In case of damage in the foundation, consolidation by injection with cement or through encircling with iron cages is recommended.
5. Strengthening of vulnerable parts or incoherent arches resulted from human or natural activities should be undertaken according to the state of the building.

H. Reconstruction Techniques.

It is known that the structural system used in the village of Al- Zafeer is depending on load-bearing walls. This technique is applied almost in all other heritage villages. In many cases, foundation parts are founded on loose clayey soils that swell upon wetting with seepage water. In this particular case, strengthening may include expanding foundations by very careful drilling and adding of the concrete mixture. However, this technique may not be followed literally and it depends on the case in the field where engineers can evaluate.

Concerning roofs strengthening, Preparation and restorations should be undertaken carefully taking into consideration all possible safety factors. The process according to what is available is applied by wooden pillars, and bars to loosen loads on walls needed to be rebuilt or for the reestablishment of doors, windows or arches. Carpentry works may be followed after balancing roofs with walls. Walls of the first floor if they are partially damaged, may pose an intricate situation. Engineers are enhanced in this case either to demolish the building or to rebuild the whole building in its former construction. (The Aga Khan Trust for Culture, 2005).

It is natural that walls of the upper floors are affected by rain waters more than others. It is imperative when exchanging stones, bricks or mortar as well as the components in the new parts, to be similar to those used materials. This precaution is considered to prevent cracks resulting from the differences in expansion coefficients of different materials, (Alsaied Hassan, Rafeay Yousef, 2008).

The stones in the village of Al-Zafeer heritage village are of local origin. They are mainly of igneous and metamorphic origin. These types of stones are irregularly shaped and used in general for external interfaces. In restoration works, these stones must be given priority and could be reused from other ruins. Reformation of stone elements, architectural blocks and columns should follow previous forms. Proposed new materials must be largely homogeneous with the existing elements in terms of, mechanical resistances, mineral composition, and colors...etc. Documented problems were noticed between the stones used in the construction of the village such as trees and herbs. Stones also accidentally came under fire, covered with cement mortar, paints and stains as shown in (Figure 12). Techniques used to treat the outlined problems could be implemented;

1-Cleaning the stones from dust and weathered products, by applying a wet process using water and sometimes vapor is recommended.

2- cleaning the stones otherwise, by following dry methods using simple tools like chisel and hammer. Sand spray pumps may be used in case of fire exposed stones, (General Authority for Tourism and Antiquities,1430).

3- Chemicals or detergents may be used to remove surface stains.

figure 12: the problems that have been detected in the stones of the village
Source: researcher

IV. Comprehensive Development of Al-zafeer Village and Its Vicinity.

Beside renovation and restoration work in the old village to preserve its history and to gain at most benefit for the presence of such a heritage village, it was proposed to implement a comprehensive development program in the village. The proposed strategy would bring the region to be a part of a touristic and historical system. It could be a model for other areas in the kingdom to be adopted. This may encourage the present architecture to benefit from the simple methods used to overcome harsh environment, including climate, wind erosion, Pollution, and other environmental problems. A project of three stages was extended;

Along the principal axis of the main path in the village, a center of commercial handicrafts in the northern part at the beginning of the path is to be established. The second stage will include a compound of commercial activities in the middle part of the path. At the end of the principle part, a center of services including paramedic, security, rescue communications and customer services is proposed. Principles and criteria for new buildings in the surrounding region should be in harmony with those followed in the heritage buildings. It is proposed to maintain a height criteria in transition zones (Buffer Zone) with the old ones. The height of new buildings should rise gradually to afford a skyline view to the heritage areas.
The proposed design is inspired by the design of the old village in which the main pedestrian path is an extension of the main village one, thus linking the present to the past imparting unique characteristics of the local environment and gives comfort to both visitors and inhabitants. It was taken into account to choose building materials from the surroundings as much as possible. Open spaces are also taken into account in order to achieve ventilation and regulating the temperature of all the project elements (Figures 13).

Figure 13: The drawings of The proposed commercial handicraft project
Source: researcher

V. CONCLUSIONS

The work presented discussed principal axes in the preservation and conservation fields of Al-Zafeer Architectural heritage. The concept proceeded in this strategy was clear in concentrating on the rehabilitation of important traditional buildings for the intention of reusing them in a modern image. Building materials previously used for this purpose were inconsistent with the original materials to attain sustainability. The proposed project was considered to evaluate and confirm the importance and the value of the architectural heritage along the intellectual genius of El-Baha community across the various ages. This is very important in differentiating the role of this heritage to ascertain the identity of the region.

The study provided valuable data about restoration and repairing technologies that are intended to be a reference for those concerned with the field. Avoiding the problems faced by El Baha municipality council in dealing with this subject was intentionally considered. The proposed plan proceeded according to scientific bases known in the field of rehabilitation of traditional buildings. Consequently, all buildings along the principal axes of the town were authenticated. Developed procedures for coordination (assortment) of open spaces and urban voids were attempted. Appropriate restoration materials conforming to original building materials were identified and selected.

The proposal of establishing a school of municipal activities was being in effect where a teamwork trained in restoration works were accommodated in most of the stages of this work. Students, technicians, and local volunteers were all individuals engaged. This achievement will provide future candidates for future similar projects. Establishing of the commercial and technical center would revive old handicrafts and will accordingly help in conserving and developing traditional buildings in the region, and in creating of several work chances. The resultant will certainly revive economic and touristic status of the region.

The popular participation would play a clear role in the rehabilitation and conservation processes proposed, which strengthens the population's affiliation and their connection to their heritage.

The academic role has a great impact on conservation proposals. The organization of lectures and teaching workshops for students and local people engaged in developing should lead for more sustainable solutions commensurate with the size of facing problems and complexities. The dissemination of awareness among citizens of the importance of conservation processes following the correct methods of restoration will flourish.

The conservation and rehabilitation operations carried out by the General Secretariat of the Heritage City should be carried out by professional companies in preservation field, and should not be focused only on the restoration of buildings.

REFERENCES

1. *Amir, Saleh Ahmad Amin. Towards a vision of operations heritage preservation to strengthen the identity of the Islamic communities in the era of globalization, (in Arabic), Master Thesis, Department of Architecture - Fayoum University, 1998.*
2. *Isis Mohiuddin Abdo Fahd, the experience of restoration and preservation of heritage in Italy(in Arabic), "Orvieto Case Study" and the possibility of their application in Palestine "Iraq Burin Case Study", Architecture Graduate School of Engineering, Master Thesis, An-Najah National University, Nablus / Palestine.2010.*
3. *Abdul Hadi, Mohammed. Scientific studies in the restoration and maintenance of monuments inorganic,(in Arabic), Zahra Middle Cairo Library, 1997.*
4. *Najdi Naji al-Masri Magd, evaluate the methods and repair techniques in Nablus, (in Arabic), Palestine Case Study, Architecture Graduate School of Engineering, Master Thesis, An-Najah National University, Nablus / Palestine.2010.*
5. *Saeed Abdul Ghani Nagiah, towards a national plan to maintain a positive environmental heritage, (in Arabic), the Ninth Conference of the Egyptian architects, architectural heritage and Urban Development, Cairo, April 1999. "Renovate and rebuild bridges Medina and improve the surrounding area, the engineering magazine Al-Azhar University, Vol. III, No. VII 2008.*
6. *General Authority for Tourism and Antiquities, the rehabilitation project report and the development of the village ever eye heritage,(in Arabic), .2010.*
7. *General Authority for Tourism and Antiquities, the General Authority for Tourism and Antiquities initiatives towards architectural heritage, (in Arabic), Riyadh, 1431.*
8. *General Authority for Tourism and Antiquities, restoration work mud and stone buildings guide, (in Arabic), First International Conference on Urban Heritage in Islamic countries, 1430.*
9. *The Azhar Park Project in Cairo and The Conservation and Revitalization of Darb Al-Ahmar The Aga Khan Trust for Culture – Geneva, Switzerland, 2005.*
10. *Ballard .C,. Preservation of Man-made Resources, school of Environmental Design ,U.G.A ,Athens Georgia, U.S.A, 1976.*

Websites

Google Earth, Satellite Images

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- Egyptian Environmental Affairs agency (EEAA)
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-Egyptian Architects Association.
-Engineers Syndicates of Engineers

5. Principle Publications (Last Five Years)

1. Tarek, M. The Challenge Between Traditional And Environmental Aspects Against Modern Architectural Design, a Case Study. Proceedings of the 3rd International Multi- conference on Engineering and Technological Innovation (IMETI 2010) Volume 1, Orlando, Florida,USA
2. H.M. Shokry, M.T.Hammad . CONTREPUTION OFHISTORICAL BUILDINGS TO THE SUSTAINABLE FUTURE ARCHITECTURE DEVELOPMENT.
3. Tarek,M, Nagy,G Hexagonal plan as a pattern For ideal sustainable city (A study on the impacts of variation of form on healing and behavior), Journal of Al Azhar University, Faculty of Engineering, Al Azhar University,May 2013,Cairo Egypt.
4. طارق,محمود . الحفاظ على استمرارية التراث المعماري فى عمارة العلا المعاصرة , العدد 31 , المجلد 2133 .
5. طارق,محمود . استراتيجيات الحفاظ على التراث العمرانى فى المملكة العربية السعودية ,دراسة حالة) تجربة تاهيل و تطويرz قرية ذى العين التراثية (, العدد ٣١ , المجلد ٢١٣١
6. Tarek, M. Sustainable planning of the national parks as a tool for the development of eco-tourism through development and planning of Raghadan Park at Al-Baha, Saudi Arabia) Journal of Al Azhar University, Faculty of Engineering, Al Azhar University, May 2017,Cairo Egypt.

7. Tarek,M, Nagy,G Hexagonal plan as a pattern For ideal sustainable city (A study on the impacts of variation of form on healing and behavior) Journal of Al Azhar University, Faculty of Engineering, Al Azhar University,May 2031,Cairo Egypt.
8. طارق,محمود . استراتيجيات الحفاظ على التراث العمرانى فى المملكة العربية السعودية
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Five Legged Power Converter (FLPC) for Augmenting Power Quality in Hybrid Solar-Wind System

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ABSTRACT

Solar and wind energy become auspicious electricity generation resources. Integrating these resources provide greater advantages, yet the power system quality is affected because of the varying nature of wind and solar energies that cause voltage problems, high harmonic distortion and less transient stability issues. To combat these problems, we proposed a five-legged harmonic remover based on time-invariant power converter, which initially converts alternative current (AC) obtained from the plant into direct current (DC) without any power loss using three-phase bridge rectifier. Then the high frequency component in DC is blocked by a nonlinear capacitor. Subsequently, the false current is removed using Fault current remover and sent to Diode based DC to AC converter for transforming DC into AC. Finally, the converted AC is passed over a bridge based c type filter to remove harmonics. By this way, the proposed system has achieved better power quality.

Keywords: Three phase bridge rectifier, Nonlinear capacitor, Fault current remover, DC to AC converter, C type filter.

I. INTRODUCTION

Over the past few years, renewable energy resources attained major observation. Among those wind and solar energy are universally available and eco-friendly resources. Hence, combining these two sources profitably gives prominent consistency as the strength of one system overwhelms the weakness of other [1].

Furthermore, combining this hybrid system with grid enhances the consistency of renewable electricity generation to fulfill the loads [2]. However, a prominent optimum sizing method is essential to utilize renewable energy resources effectively, which ensures a complete usage of system components at low investment and makes the hybrid system to run properly. Some optimization techniques established for ideal hybrid renewable energy systems are probabilistic approach, linear programming, and graphic construction methods.

Moreover, the energy storage system was utilized for providing a continuous supply of electricity and for facing the shortage of power generation, which includes battery banks, fuel cells, etc. but it increases the investment. Hence, another method should be utilized for attaining ideal hybrid renewable energy framework [3]. In remote areas, it is impossible to get long-term climatic conditions like wind speed and penetration of solar irradiance, which is necessary for sizing procedures. Therefore, artificial intelligence approaches are utilized for replacing conventional sizing procedures.

Grid-connected systems influence, power quality, like harmonics, frequency, and voltage changes [4]. Moreover, the fluctuating natural surroundings of solar and wind energies affect the consistency of the

system. This may be reduced by exact predicting and scheduling [5]. Hence, many methods and algorithms were developed for forecasting the climatic changes which enable the system operator to alter other available generating systems, while any deficit rises, which in turn minimizes the fluctuations [6]. Energy stocking components were utilized to balance the shortage and to stock the energy while a large amount of energy is generated [7].

However, voltage fluctuation remains the main concern which is caused by irregular solar irradiance and varying wind speed. The fluctuations of voltage mainly depend upon the type of load and its dimension along with dimension and strength of the integrated grid. Certain dynamic power filters like static synchronous compensators, integrated power quality conditioners, and dynamic voltage regulators were developed as a solution for this voltage wavering problem [8]. Likewise, power compensators were utilized for diminishing the dynamic power issues due to wavering voltage issue, which are the recent interface among user consumption and grid.

Abrupt dynamic power variations caused by the load produce frequency variation in AC grids, which symbolizes the unsteady state among generation and load. Hence, a pulse width modulation (PWM) inverter is designed for controlling frequency and power to diminish quality issues [9]. Certain filters and PWM inverter reduce harmonic distortion, which usually arises in all non-linear appliances and power electronic devices [10]-[12]. Albeit they fail to deluge the multi-order harmonics along with frequency and voltage wavering which demands a proficient harmonic remover. Besides, an appropriate optimization technique is obligatory to guarantee partaking ideal quantity and dimension of solar panel and wind turbine [13]. Furthermore, an optimum sizing technique is essential to effectively predict solar radiation and wind speed [14] for keeping enough source of electricity to fulfill the demand.

Thus, the hybrid system includes both wind and solar have been in very much need of incorporation of the best optimization along with the robust forecaster to efficiently and economically utilizes the electricity generated from the hybrid system. The residual outline of our research paper is specified underneath. Section 2 explains some researches associated with this proposed paper, Section 3 describes the entire working procedure of our proposed five-legged power converter, Section 4 illustrates the results and discussions obtained by implementing the proposed method and Section 5 provides the conclusion of this framework.

II. LITERATURE WORK

Certain prevailing researches related to our proposed framework discussed briefly underneath:
Merabet et al. [15] presented rationality depended on a power administrative scheme for program swapping of lights' banks. This system utilized the power generated through wind turbine, which gets regulated through a pitch angle regulator approach. An enhanced PI regulator was developed to mitigate the wavering issues. The results corroborate the efficacy of the power management system in the wind turbine. However, high harmonics and frequency components were ignored in this method.

Karakasis et al. [16] developed an initialization procedure for a doubly-fed induction generator (DFIG) wind system. It gives the smooth initialization procedure along with the least power depletion from the energy stocking unit. To give less iron rotor losses, the DFIG functions at the synchronous speediness in the stand-by circumstance. Numerous implementation outcomes were provided to show the proficiency of their stratagem.

Sitharthan et al. [17] proposed a Feed Forward Back Propagation Neural Network (FFBP-NN) depend upon the pitch angle regulator output and the power wavering in the grid integrated wind turbine. In this, the ideal output power is predicted and smoothened. Moreover, the Levenberg–Marquardt (LM) procedure was utilized for training FFBP-NN. Results proved that their proposed network performed well.

Yazan M. Alsmadi et al. [18] presented a complete review on the LVRT of grid-connected DFIG-based wind turbines. This paper specifies active performance as well as the transient features during the voltage drops along with implementations. Also, it developed an innovative rotor side regulating strategy to DFIG-based wind turbines for improving LVRT competence while major voltage drop occurs, which in turn enhance the performance of DFIG. Its proficient enactment was verified by comparing it with prevailing regulating strategies.

Hector Pulgar-Painemal [19] developed logical lexes for applying rotor and stator power restrictions utilizing DFIG capability curve (DFIG-CC), which was compared with two generally utilized stratagems. Logical lexes was checked in 15-bus test system comprises of five wind turbine generators (WTG) and attained greater accuracy when compared to prevailing strategies.

From these researches discussed above, it is obvious that our proposed methodology has to overcome the voltage fluctuation problem, harmonic distortion, transient stability issues by designing a robust converter which can manage constant voltage, low harmonic distortion and obtaining constant optimal transient stability.

III. FIVE LEGGED POWER CONVERTER (FLPC)

Demand for current is growing vastly; hence, substitution is necessary for generating electricity without affecting the environment and should be an easily available resource. Hybrid systems become a promising source as it integrates wind and solar resources for generating electricity. An assembly of connected solar cells known as the solar panel utilized for generating electricity. Similarly, a wind turbine contains an electric generator, which generates electricity by converting wind energy into electrical energy. The solar panels and wind turbines greatly depend upon the fluctuating climatic conditions. If solar and wind gets combined as one system, the solar system generates high electricity during summer as the solar radiance is high, whereas the wind turbine generates high electricity during winter since the velocity is high. However, the generated current has a variable frequency, which is transferred to the desired grid voltage using these hybrid solar-wind systems. The power system quality is affected because of the varying nature of solar and wind energies that causes voltage problems, high harmonic distortion, and less transient stability issues. Fluctuating wind velocity affects the voltage of the DC link and also produces fluctuating torque. Moreover, since most of the converter uses nonlinear elements to store energy intermediary and voltage and current filtering; the cost, weight, and size of the converter get increased, and this leads to degradation in power quality and less transient stability.

As a solution to the problems, this work has proposed a five-legged harmonic remover based on time-invariant power converter, which avoids high harmonic distortion and upgrade the quality of power in power plants. Since this system has taken into account the following criteria: power loss, fault current and high-frequency component, this system can combat high harmonic distortion and maintains power quality and transient stability. Figure 1 describes the overall procedure of the Five Legged Power Converter (FLPC).

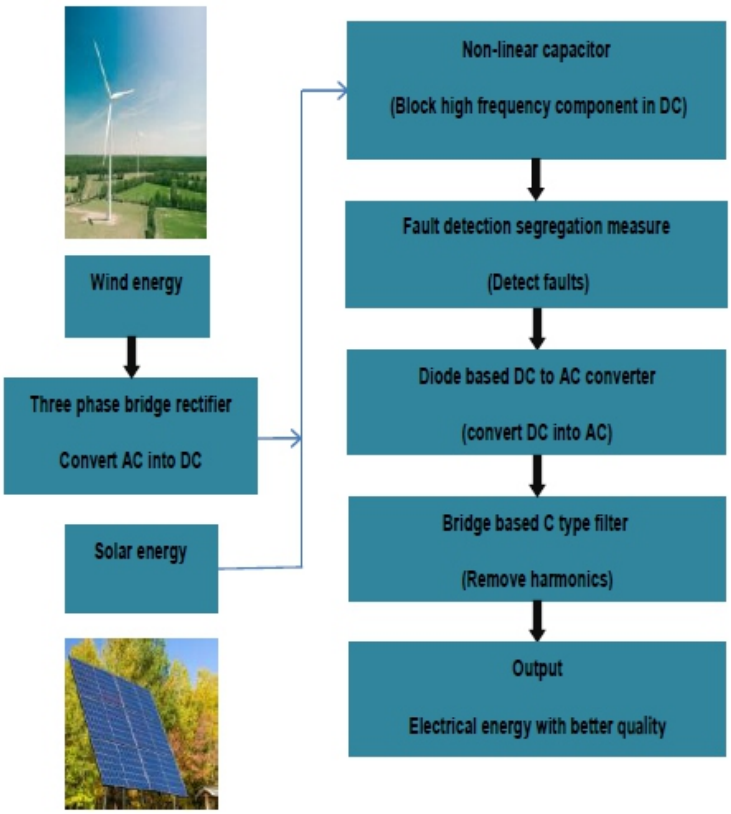

Figure 1: Block diagram of the Five Legged Power Converter (FLPC)

Initially, alternative current from the plant would be converted into direct current without any power loss using three-phase bridge rectifier then to block the high- frequency component in the direct current nonlinear capacitor is adapted. Subsequently, the false current is removed by incorporating Fault current remover. After being removed the fault, the direct current permitted through Diode based DC to AC converter for altering DC into AC. Finally, the alternative current experiences harmonics, hence abridge based c type filter is adapted to remove harmonics. By this way, the proposed system has achieved better power quality.

A. Three Phase Bridge Rectifier

A three-phase bridge rectifier, utilized for converting AC that sometimes flows in the reverse direction into DC that flows in a single direction. It comprises of six thyristors and utilizes controlled solid state gadgets such as IGBT's, MOSFET's, SCR's, etc. for varying the power at diverse voltages. The output power at the load is changed suitably by activating these gadgets. The diagrammatic representation of the three-phase bridge rectifier circuit, displayed in figure 2.

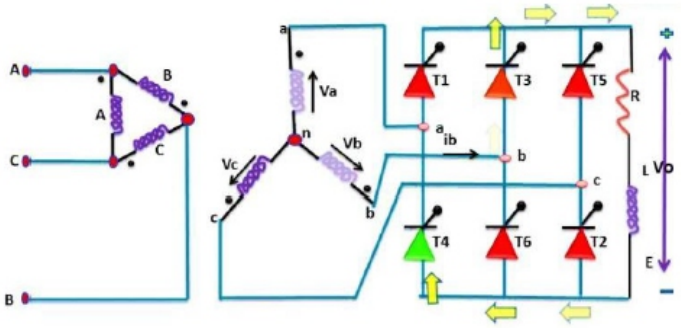

Figure 2: Three phase bridge rectifier

If the current has to flow, anyone gadget from the upper set (T1, T3, T5) and anyone from the lower set (T2, T4, T6) should conduct electricity. Generally, every thyristor conducts at 120o of the input cycle, and its conducting is in the series T1 → T2 → T3 → T4 → T5 → T6 → T1 along with an interval of 60o among every conducting. Hence the thyristors conduct at 180o interval along the same phase leg and are not capable of conducting instantaneously, which in turn provides six probable modes for conducting, i.e., T1T2, T2T3, T3T4, T4T5, T5T6, T6T1. Every conducting way has 60° interval and seems like the above-said series. To minimize the voltage of the output,

$$D_v = A_v = \frac{3 \cdot \sqrt{3} \cdot P_v}{\pi} \cdot \cos(\theta) \quad (1)$$

(Or)

$$D_v = A_v = \frac{3 \cdot P_{L-Lvolt}}{\pi} \cdot \cos(\theta) \quad (2)$$

Here:

D_v represents the DC output voltage, A_v represents the average output voltage.

$L_{P-Lvolt}$, the peak voltage of the line to the line input,

Pv , the peak voltage of phase input,

θ Symbolizes the angle of conducting of the thyristors.

These conditions (1) and (2) reduce the output voltage only when the current is not obtained from the AC source or else if the AC source has no inductance as in theory. But practically, the output voltage decreases when the load is increased, which is caused by the source inductance. Consequently, every conversion among a set of gadgets causes overlap while three gadgets conduct instantaneously, which is usually 20-30o at the fully loaded condition.

While considering the source inductance, the output voltage will be:

$$D_v = A_v = \frac{3 \cdot P_v}{\pi} \cdot \cos(\theta + \lambda) \quad (3)$$

(Or)

$$D_v = A_v = \frac{3 \cdot P_{L-Lvolt}}{\pi} \cdot \cos(\theta) - 6\gamma I_c P_d \quad (4)$$

Here:

I_c , the commutating inductance per phase,

P_d , the direct current,

γ denotes the frequency.

Thus the entire AC obtained from the renewable resources is converted into DC without any power loss; though it contains high frequency. Hence it is to be removed to obtain better power quality.

B. Nonlinear Capacitor

The non-linear capacitor used for reducing high-frequency constituents exist within the converted direct current (DC). Surface-based packages are tiny, and shortage linking leads utilized for capacitors. These modules prevent unwanted high-frequency impacts because of the leads as well as its simple automated assemblage. The value of capacitance based on the voltage applied. Figure 3 presents the diagram of the nonlinear capacitor with a rectifier. It also smoothes the DC obtained from the rectifier. The primary function of the nonlinear capacitor is to destroy the high frequency in the source and to smooth the output waveform of the rectifier.

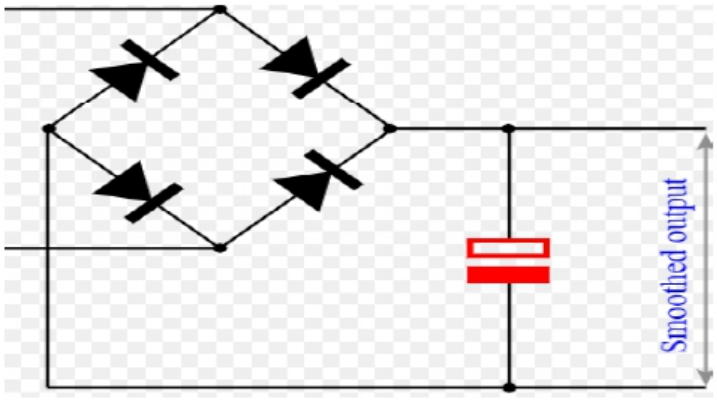

Figure 3: Rectifier with capacitor

The capacitance is represented by,

$$C = \frac{E}{C_v} \qquad (5)$$

Where C is the capacitance, E is the charge through the capacitor, and C_v is the voltage on the capacitor.

The high-frequency signals removed from the entire direct current, and thus the DC signals are free from higher frequencies. These signals are passed to the current fault remover to nullify the fault current.

C. Fault detection segregation measure

Fault detection segregation measure (FDSM) detects the faults without a whole breakdown. FDSM is added to show the output of the uncertain input observer when faults are effectively observed and isolated

. A simple circuit diagram of FCR shown in figure 4

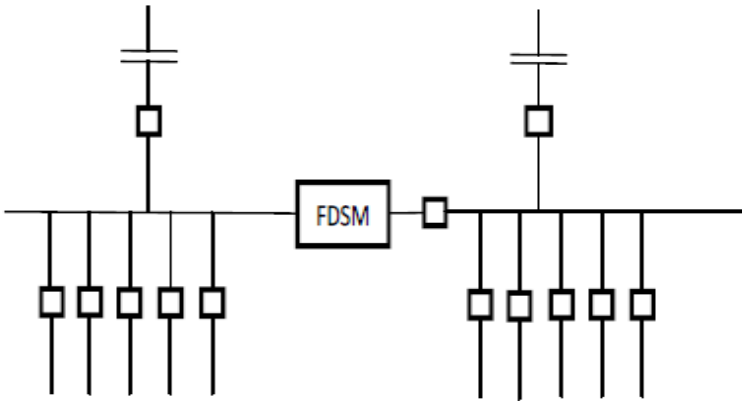

Figure 4: Simple circuit with FCR

Generally, a circuit breaker is provided in large power systems to cut off power supply while a fault arises, however, for enhancing reliability, a smaller region where the fault present should be detached. The circuit breaker can't withstand while incorporating other sources such as wind turbines and solar panels. Hence, we utilize current fault remover for eradicating the fault currents present in the system.

A current fault remover is a nonlinear component that has high impedance during fault current and low impedance during the normal current. Thus the current fault remover detaches the section which contains fault current and again does the regular function. The current removal section includes a switch and limiting resistance and has two dissimilar restraining characteristics for removing temporary as well as permanent faulty states. While a fault occurs, it is removed by restricting the impedance of the main circuit. The load gets supplied to the main circuit after the fault gets repaired. If the fault is permanent, the faulty features limited for a certain specified time after that the connection is detached.

The restricting resistance required to obtain an assured voltage regulation is

$$\frac{\Delta V}{V_p} = \frac{R_e}{R_e + R_l} \times 100 \qquad (6)$$

Here V_p represents the voltage in the power system,

R_e , equivalent resistance,

R_l , limiting resistance.

The fault current gets removed using limiting resistance, and the entire operation does not get stopped because of the fault; instead, a small unit is shutting down.

D. DC to AC Converter

DC to AC Converter is an electronic equipment that alters DC into a suitable AC which gets mixed into the electricity grid network. The foremost function of these converters is to keep up a higher the output voltage than the grid and also it should be suitable for the grid. It generally contains a sensor that continuously monitors the waveforms and the voltage of the grid. A figure 5. shows primary DC to AC converter. The DC output of current fault remover is transformed, to provide electricity in the form of AC, using the DC-AC converter. It reduces the intricacies produced during operation and also the expense.

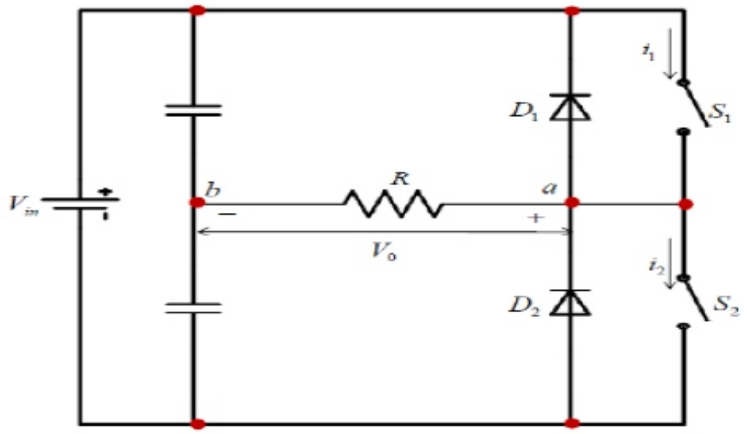

Figure 5: Basic DC to AC converter

The switch S_1 is on at duration $0 \le t \le T_1$ and the switch S_2 is on at duration $T_1 \le t \le T_2$. The voltages through a load while either S_1 or S_2 are on

$$V_l = \frac{V_i}{2} \quad (7)$$

The output voltage has aRMS value of

$$RMS_v = \left(\frac{1}{T_1} \int_0^{T_1} \frac{V_i^2}{4} dT \right) = \frac{V_i}{2} \quad (8)$$

The output voltage waveforms of ideal converters are sinusoidal. Though, the waveforms hold definite harmonics.

III.5. C Type Filter

C-type filters eradicate harmonic constituents effectively. For that here L_2C_2 section has been finely modified to a necessary harmonic frequency which in turn diminishes the dynamic power losses. Hence the harmonics are not able to pass the R resistor, and thus they prevent major losses. The entire circuit of the C-type filter shown in figure 6.

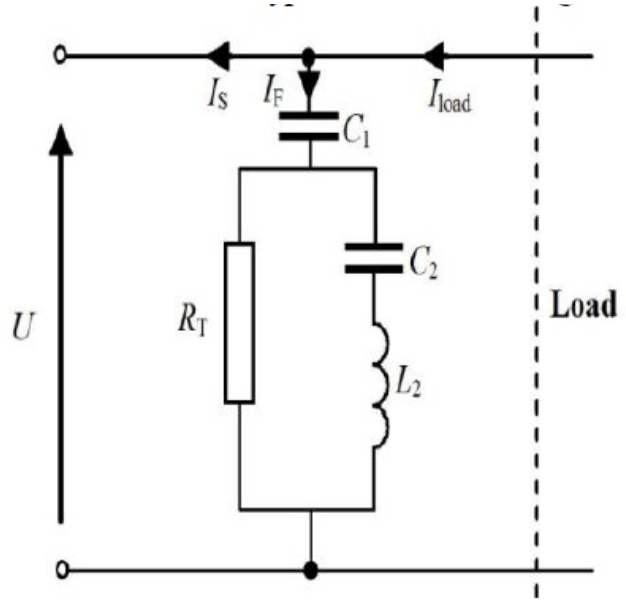

Figure 6: C-type filter

Likewise n[th], harmonic wave constituent transferred via a filtering capacitor C; the capacitance should be lesser when compared to the impedance, i.e.,

$$\left|\Im_L\right| = \sqrt{(R)^2 + (n\omega L)^2} >> \frac{1}{n\omega C} \quad (9)$$

It should fulfill the following condition:

$$\left|\Im_L\right| = \frac{10}{n\omega C} \text{ (Or) } \frac{\left|\Im_L\right|}{10} = \frac{1}{n\omega C}$$

As well as the impact of the load is insignificant. Similarly, the capacitance selected is the entire load impedance divided by 10. Thus the harmonics in the alternating current are nullified, and the power transferred to the grid.

IV. METHODOLOGY, RESULTS AND DISCUSSION

After Executing the circuit used in our proposed five-legged power converter, their results are presented in this section to corroborate the proficiency of this proposed framework.

In this method, at first, we convert AC obtained from the renewable energy resources into DC utilizing three phase bridge rectifier. The DC coming out of the three-phase bridge rectifier has high frequency; hence, this high frequency has to be avoided using a nonlinear capacitor. Then the high frequency removed DC is allowed to pass through the Fault current remover to eradicate the fault current present in it. Consequently, the DC is converted into AC to utilize by the utility grid. For that, here in our framework, we provide Diode based DC to AC converter that alters DC into AC. Finally, the AC attained from Diode based DC to AC converter still has harmonics; and hence remove the harmonics. Hence, we utilize a bridge based c type filter for eradicating the harmonics in AC.

A. System Specification And Experimental Setup

MATLAB/Simulink executes our projected system in the working platform of MATLAB with the following system specification. The simulation results for this methodology discussed below.

Platform : MATLAB 2015a
OS : Windows 8
Processor : Intel core i5
RAM : 8 GB RAM

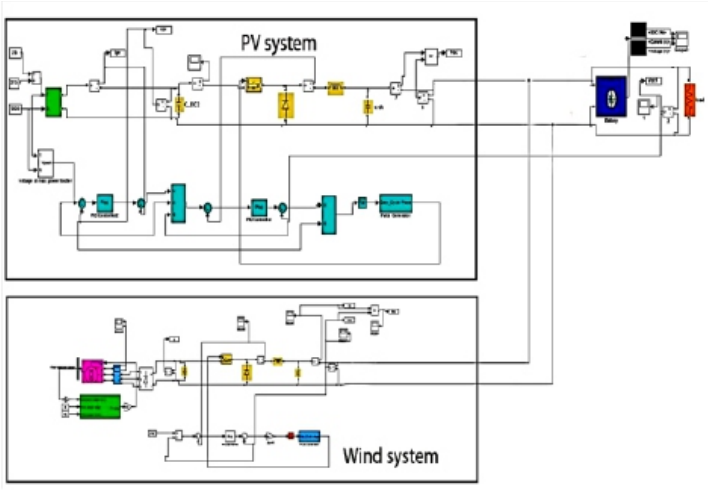

Figure 7: System architecture of proposed FLPC

Fault Current Remover:

Fault current remover performs removing false current arising in three phases; the table shows the current removed esteems. The outcome obtained by using current fault remover, tabulated in the table, and also the simulated results presented in figure 8.

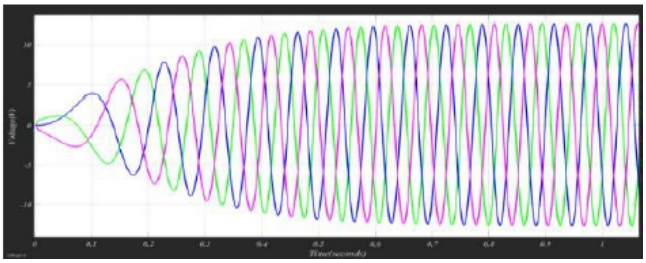

Figure 8: Output of voltage after feeding with Fault Current Remover

Table 1: Output of Fault Current Remover

Time	Phase 1	Phase 2	Phase 3
0.0566	0.954111445718174	1.48946544885249	-2.44357689457066
0.0874	-1.193708385818 00	3.46817736505849	-2.27446897924049
0.1333	-4.725183698998 24	0.81850174390842 2	3.90668195508983
0.1876	6.566058048678 48	-4.52573875138444	-2.04031929729403
0.2459	-8.194710153480 42	2.99892374809389	5.19578640538653
0.2930	8.862605185062 04	-1.84691010605079	-7.01569507901124
0.3612	8.872396716140 82	-9.36021643825522	0.48781972211439 9
0.4637	-6.541616245130 99	11.623080630438 6	-5.08146438530759

C-Type Rectifier:

The C-type rectifier eliminates the harmonics that present in the alternating current. The below tables 2 and 3 provides the results before and after passing through the C-type filter. The simulation results obtained by implementing the method specified in figure 9 and 10.

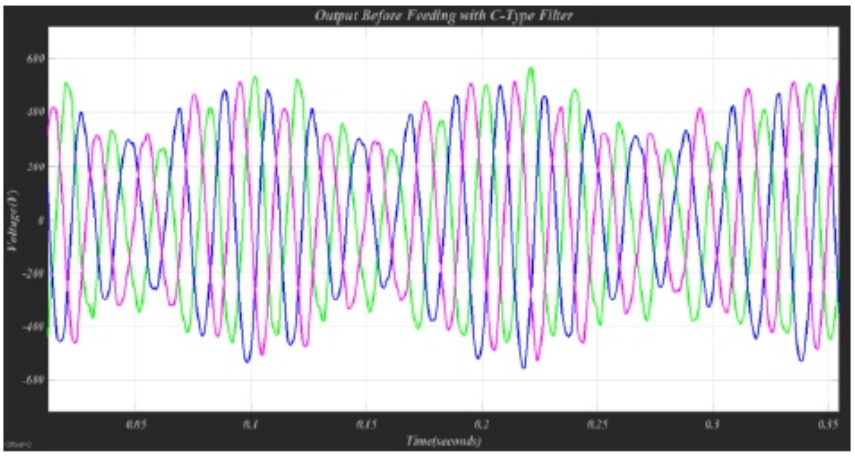

Figure 9: Output before Feeding into the C-Type Filter

Table 2: Output of Voltage before C-Type Filtering

Time	Phase 1	Phase 2	Phase 3
0.0604	110.255978485910	-145.236999418236	34.9810209323294
0.1203	253.825943995602	-259.045625048347	5.21968105276397

0.1804	104.199956932179	-216.293200561568	112.093243629386
0.2403	251.331384251916	-228.272724560411	-23.0586596914694
0.3004	84.5655105860001	-154.315325787988	69.7498152019846
0.3603	208.633653306810	-325.025923356449	116.392270049652
0.4204	247.625063147645	-177.578034946010	-70.0470282015832
0.4803	103.166620255859	-134.621522969276	31.4549027133762

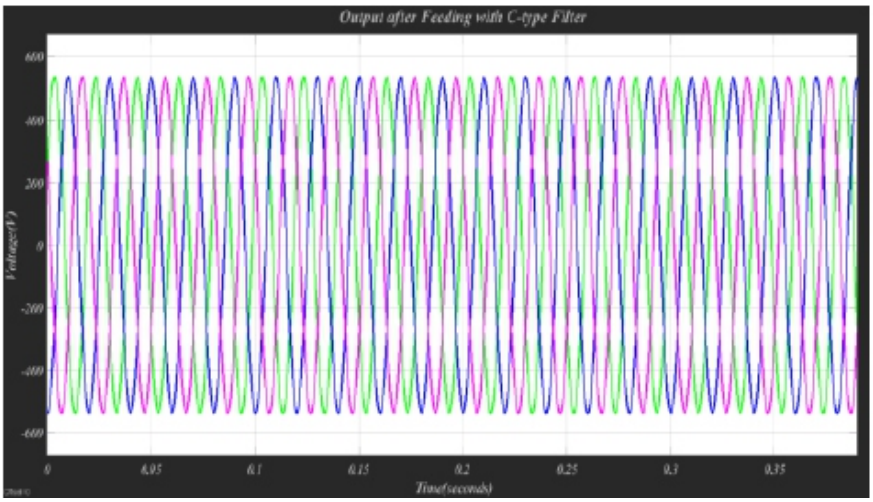

Figure 10: Output after Feeding with C-Type Filter

Table 3: Output of Voltage after C-type Filtering

Time	Phase 1	Phase 2	Phase 3
0.0604	43.1810572145814	-287.676129915165	244.495072700584
0.1203	28.8394325856906	-281.957032094028	253.117599508337
0.1804	43.1810572145798	-287.676129915165	244.495072700586
0.2403	28.8394325856902	-281.957032094028	253.117599508338
0.3004	43.1810572145838	-287.676129915167	244.495072700583
0.3603	28.8394325856897	-281.957032094028	253.117599508338
0.4204	43.1810572145789	-287.676129915163	244.495072700583
0.4803	28.8394325856937	-281.957032094027	253.117599508333

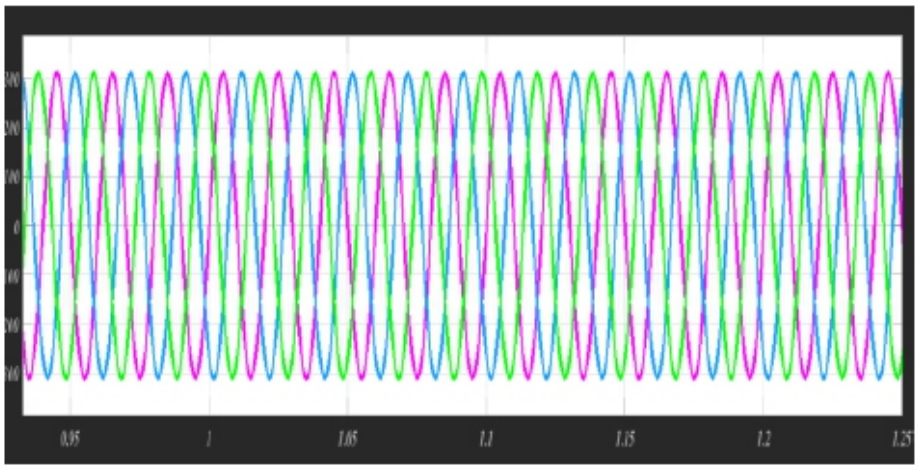

Figure 11: Voltage output for existing

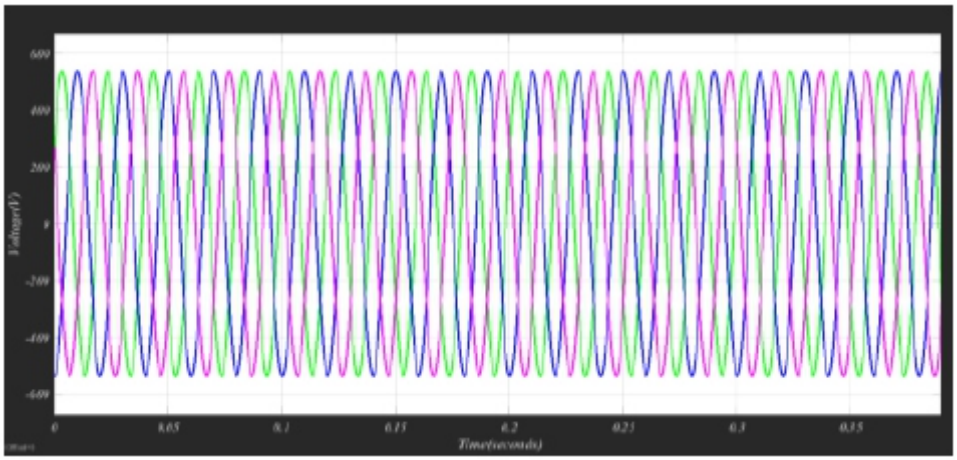

Figure 12: Voltage Stability for Proposed System

Voltage stability of our proposed system corroborated in figure 12. Thus, our proposed method Five Legged Power Converter attains high voltage stability than the existing techniques.

B. Experimental Metrics

The simulation of the proposed Five Legged Power Converter (FLPC) evaluated with the metrics such as

i. Electrical Efficiency η_e ,
ii. Frequency Variations,
iii. Voltage Imbalance/Unbalance V_i ,
iv. Voltage Dip (Sag) and Swells,
v. Deviation of Supply voltage magnitude,
vi. Total Harmonic Distortion (THD).

1) Electrical Efficiency

Electrical efficiency by the proportion of the amount of electrical energy given as input to the amount of electrical energy obtained as output. Generally, Electrical efficiency expressed in terms of percentage.

$$\eta_e = \frac{I_{out}}{I_{in}} \times 100 \qquad (16)$$

$$= \frac{I_{in} - losses}{I_{in}} \times 100$$

$$\eta_e = 1 - \frac{losses}{I_{in}} \times 100 \qquad (17)$$

2) Frequency Variations

Frequency is a change in the way, alternating current (AC) flows. The Indian utility power grid provides a frequency standard value of 48.5 Hz to 51.5 Hz.

3) Voltage Imbalance/Unbalance

Voltage imbalance demarcates as the proportion of negative series constituents to positive serve constituent usually expressed in terms of percentage.

$$V_i = \frac{Negativeseriesvoltage}{Positiveseriesvoltage} \times 100 \qquad (18)$$

4) Voltage Droop and Surges

Voltage droop represents the drop of Root Mean Square (RMS) voltage amongst 0.1 to 0.9 Pu in at a period of 0.5 cycles to 1min.

A surge represents the rise of RMS voltage within 1.1 and 1.8 Pu at a period of 0.5 cycles to 1 min.

5) Deviation of Supply voltage Magnitude

Long-term deviations of supply voltages include RMS deviances of power frequencies for more than 1 min.

6) Total Harmonic Distortion (THD)

The primary metric for ensuring quality is Total Harmonic Distortion (THD). THD demarcates as the proportion of the RMS esteem of the entire harmonics to the RMS esteem of its fundamental signal. Here, the signal is the quantified current or voltage.

THD is represented by

$$\text{Total Harmonic Distortion (THD)} = \frac{\mathrm{I_H}}{I_F} \qquad (19)$$

Where $\mathrm{I_H} = \sqrt{I_2^2 + I_3^2 + \ldots + I_n^2}$, and

$\mathbf{I_H}$ RMS esteem of $\mathbf{H_{th}}$ harmonic;

I_F signify RMS esteem of fundamental current.

$I_F$signify RMS esteem of fundamental current.

Evaluation metrics that are estimated to prove the efficacy of FLPC described in terms as above tabulated in table 4. The evaluation metrics taken in our method are:

i. Electrical Efficiency η_e ,
ii. Frequency Variations,
iii. Voltage Imbalance/Unbalance V_i ,
iv. Voltage Dip (Sag) and Swells,
v. Deviation of Supply voltage Magnitude,
vi. Total Harmonic Distortion (THD).

Table 4: Esteems of evaluation metrics

Sl. No	Parameter	Inverter with general HPS	MG with refabricated HPS	FLPC
1	Electrical Efficiency	91%	90%	92.34%
2	Frequency	±0.40%	±0.21%	±0.19%
3	Deviation of the load voltage	Noisy	Smooth	Very Smooth
4	Deviation of grid voltage	Noisy	Smooth	Very Smooth
5	Voltage Droop	44%	29%	25%
6	Voltage Surges	41%	32%	31%
7	Voltage Imbalance	12.50%	2.13%	2.02%
8	Total Harmonic Distortion	4.89%	4.59%	4.06%

The values of evaluation metrics obtained for proposed framework Five Legged Power Converter (FLPC depicts as table 4), justifies that our proposed method attains efficient power quality in terms of low power loss, low frequency, minor harmonic distortion and reduced false current.

V. CONCLUSION

This paper proposed a Five Legged Power Converter (FLPC) to provide better power quality for hybrid wind and solar systems as the existing systems have certain drawbacks such as power loss, the uncertainty of wind energy nature and solar irradiance which causes voltage problems, high harmonic distortion and less transient stability issues. Hence, our proposed framework FLPC has taken into account the following criteria: power loss, fault current and the high-frequency component, this system can combat with the high harmonic distortion and maintained the power quality and the transient

stability of the wind turbine. Henceforth, we utilized three-phase bridge rectifier to convert alternating current-direct current without any power loss, then a nonlinear capacitor is adapted for blocking high-frequency component. Moreover, to nullify the false current, Fault current remover is incorporated. Subsequently, the direct current is transformed into AC utilizing Diode based DC to AC converter. Consequently, the harmonics existing within the alternating current are removed using a bridge based c type filter. Thus, our proposed system FLPC has achieved better power quality. The simulation results substantiate that our proposed system has a low power loss, low frequency, reduced false current and, minor harmonic distortion. Therefore, the proficiency of the proposed framework Five Legged Power Converter (FLPC) presented in this paper.

REFERENCES

1. *H. Babazadeh, "Optimal Energy Management of Wind Power Generation System in Islanded Microgrid System, North American Power Symposium," 2013.*
2. *Q. Fu, "Microgrid Generation Capacity Design with Renewables and Energy Storage Addressing Power Quality and Surety", IEEE Smart Grid, vol.3, no.4, 2012, pp. 2019-2027.*
3. *Mahmud, Rasel, and ArashNejadpak, "Laboratory-Scale Microgrid System for Control of Power Distribution in Local Energy Networks– Part II: Implementation and Case Study," In Smart Microgrids, 2019, pp.29-40.*
4. *Y. Zhang, "Synchrophasor Measurement-Based Wind Plant Inertia Estimation," in IEEE Green Technologies Conference, 2013.*
5. *Y. Zhang, "Angle Instability Detection in Power Systems with High- Wind Penetration using Synchrophasor Measurements," IEEE Power Electronics, vol.1, no.4, 2013, pp.306-314.*
6. *Sharma, Rahul, "Survey on hybrid (Wind/Solar) renewable energy system and associated control issues," In 2014 IEEE 6th India International Conference on Power Electronics (IICPE), 2014, pp.1- 6.*
7. *Rao, YerraSreenivasa, A. Jaya Laxmi, and Mostafa Kazeminehad, "Modeling and control of a hybrid photovoltaic-wind energy conversion system," International Journal of Advances in Engineering & Technology, vol.3, no.2, 2012, pp.192.*
8. *Pourmousavi, S. Ali, M. Hashem Nehrir, and Ratnesh K. Sharma, "Multi-timescale power management for islanded microgrids, including storage and demand response," IEEE Transactions on Smart Grid, vol.6, no.3, 2015, pp.1185-1195.*
9. *M. Falahi, S. Lotfifard, M. Ehsani, and K. Bulter-Purry, "Dynamic Model Predictive-Based Energy Management of DG Integrated Distribution Systems," IEEE Trans. Power Delivery, vol.28, no.4, 2013, pp. 2217-2227.*
10. *J. de Matos, "Power Control in AC Isolated Microgrids with Renewable Energy Sources and Energy Storage Systems," IEEE Transactions on Industrial Electronics, 2014.*
11. *M.J. Hossain, R. Pota, and M. Alden, "Robust Control for Power Sharing in MicrogridsWith Low-Inertia Wind and PV Generators," IEEE Trans. Sustain. Energy, 2014.*
12. *Sandoval-Moreno, John, GildasBesançon, and John J. Martinez, "Observer-based maximum power tracking in wind turbines with only generator speed measurement," In 2013 European Control Conference (ECC), 2013, pp.478-483.*
13. *N.A. Orlando, M. Liserre, R.A. Mastromauro, and A.Dell'Aquilla, "A Survey of Control Issues in PMSG-Based Small Wind-Turbine Systems, IEEE Trans. Ind. Informat., vol.9, no.3, 2013, pp.1211-1221.*
14. *C.N. Bhende, S. Mishra, Permanent Magnet Synchronous Generator- Based Standalone Wind Energy Supply System," IEEE Trans. Sustain. Energy, 2(4) 2011, pp.361-373.*
15. *A. Merabet, R. Keeble, R. Vigneshwaran, R. Beguenane, and H. Ibrahim, "Logic-based power management system for pitch controlled wind turbine," In 2012 IEEE Electrical Power and Energy Conference, 2012, pp.280-284.*
16. *Karakasis, Nektarios, Christos Mademlis, and IordanisKioskeridis, "Improved start-up procedure of a stand-alone wind system with a doubly-fed induction generator, 2014, pp.4-4.*
17. *R. Sitharthan, K.R. Devabalaji, and ArunJees, "A Levenberg–Marquardt trained feed-forward back-propagation based intelligent pitch angle controller for wind generation system," Renewable Energy Focus, vol.22, 2017, pp.24-32.*
18. *Y.M. Alsmadi, L. Xu, F. Blaabjerg, A.J. Ortega, A.Y. Abdelaziz, A. Wang, Z. Albataineh, "Detailed Investigation and Performance Improvement of the Dynamic Behavior of Grid-Connected DFIG-Based Wind Turbines under LVRT Conditions," IEEE Transactions on Industry Applications, vol.54, no.5, 2018, pp.4795-812.*

19. Pulgar-Painemal, Héctor, "Enforcement of Current Limits in DFIG-Based Wind Turbine Dynamic Models through Capability Curve," IEEE Transactions on Sustainable Energy, vol.10, no.1, 2019, pp. 318-320.

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Optimization of Machining Parameters on 7075 Aluminum Alloy using Taguchi and ANOVA for Surface Roughness

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A B S T R A C T

Optimization of the parameter to provide best solution to reduce the tool wear , surface roughness, cutting forces presented using optimization technique .In present work an experimental study is made. In this Taguchi design of experiment methodology for optimization of parameters on 7075Aluminium alloy using tungsten coated electrode . Experiments were conducted based on L27 standard orthogonal array with three processes parameters are cutting speed, feed, depth of cut . Electrical discharge machining is generally calculated on the basis of Surface Roughness (SR),Tool wear rate (TWR) and cutting force (CF) .The ANOVA(Analysis Of Variance) is used to study the performance characteristics in turning operation . ANOVA placed an important role for producing higher roughness . Finally the software ,MINITAB 17 was used and results obtained .

Keywords : 7075 Alumimium alloy, SR, Taguchi, ANOVA.

I. INTRODUCTION

Taguchi method is developed by Dr, Genichi Taguchi . Taguchi method is statistical method to to improve the product quality .In this method two stages are involved : system design ,parameter design , by using Taguchi design to reduce the number of experiments .It also best technique for high quality system design .The manufacturing industries are continuously challenged for achieving higher productivity within less time . Engineers faced a problem to find out the optimal parameters for the output and to increase the output by using available resources . 7075 Aluminum alloy is widely used in non- ferrous material in engineering applications .It is used for manufacturing of gears , regulating valve parts , meter shaft , aircraft, keys, gearsand defense applications .Analysis of Variance is used to study the performance characteristics .Aluminum alloy used in advanced applications because of high strength ,durability ,low density ,machinability and relatively lower cost . Productivity play main role in today's manufacturing market. Taguchi method is used to improve the product quality . EDM (Electrical Discharge Machining) is a non-traditional manufacturing process used in industry for machining of all types of materials .In EDM material is removed by melting and vaporization of work material due to occurring electrical sparks with in a dielectric medium .

II. LITERATURE SURVEY

Payaghan et al., [1] results revealed that pulse current and on time are significant factors in MRR. The value of MRR steadily increases with increase in values of current and pulse on time. Gopalakannan et

al., [2] stated that material removal rates, SR and tool wear rates are incremented as with increment in pulse current and on time. Nanimina et al., [3] results revealed that MRR is increasing as the levels of pulse on time and current are growing. However, TWR showed decreasing trend with increase in above parameters. Karthikeyan & Sornakumar [4] observed that MRR and SR are increased by the increase in current. The material removal rate was found to be decreasing with increase in the percent weight of silicon carbide. Nagit et al., [5] found that an increase in pulse duration will results in increased electrode wear and increased material removal rates. EWR was also found to be more with small values of diameter. High value of pulse-on time decreased the dimensional accuracy. Adrian et al., [6] stated that an increase in electrode diameter increase the MRR and reduce the tool wear rate. Increasing pulse on time gives more tool wear rates. Also, increase in pulse on time increase metal removal rate. Lin et al., [7] assisted the standard EDM with magnetic force and obtained better MRR, SR and lesser TWR. Assisted magnetic force helped to expel debris from the machining gap more easily and quickly. Yilmaz et al.,[8] machined Inconel 718 and Ti-6Al-4V with single and multichannel electrodes and revealed that single channel electrodes give better MRR but had made more damage to surface. Ahamed et al., [9] stated that MRR and SR are increasing as current is increasing, while MRR decreased as pulse on time increased. MRR showed rise with increasing pulse off time levels. Khan [10] found that the increase in current and gap voltage values increased the electrode wear rates. Wear ratio was also found to be increasing with increasing current.Mohan et al., [11] found that the positive polarity gives high MRR and increase in current levels increased the MRR further. TWR also increased with increase in current levels, while decreased pulse on time values decreased the SR. Karthikeyan et al., [12] reported that the increase in current increases MRR, TWR and SR. Also, increase in pulse time, decreases the MRR, TWR and slightly increases the surface roughness.Muller & Monaghan [13] reported increasing MRR with increasing pulse on time and current levels, but upto an optimal value.Hocheng et al., [14] stated that MRR was proportional to input current and pulse on time values. They recommended short pulse on time and large current combination to obtain minimal crater size while machining. Ramulu & Taya [15] found that material removal rate show growth with increase made in the power of the electrode while machining 2124 Aluminium MMC. S. S. Mahapatra et al. [16] investigated Optimization of WEDM process parameters using Taguchi method. Machining operation in WEDM is a challenging one because of more responses like metal removal rate (MRR), surface finish (SF) and cutting width (KERF). The relationship between control factors and responses are recognized by nonlinear regression analysis through mathematical model, GA and , a popular revolutionary approach were employed to multiple objectives optimisation. Spedding and Wang [17]formed a mathematical models to forecast material removal rate Ra and MRR during WEDM of D-2 tool steel for various machining conditions. Zahid A.Khan et al.[18] carried out multi objective optimization of WEDM Control process parameters using Taguchi Grey Relational Analysis method. Taguchi's L 16 Orthogonal Array have been used for conducting experiments and investigates the effect of the WEDM process parameters on the average surface roughness and the KERF width of the stainless steel (SS 304).

III. EXPERIEMTAL PROCEDURE

The tests on the work piece were conducted on ELECTRONICA EZEE Cut NXG WEDM Machine shown in fig 1. 7075 aluminium is used to this experiments . DOE are designed by full factorial design experiments . In this work turning of 7075 alumimum alloy , experiments were conducted by considering these main processes parameters such as speed , feed , depth of cut at 3 level –low, medium and high .According to the 3 level full factorial design of experiments 27 were designed and conducted .CNC machine play an main role in modern machining industry .

Figure 1. Electronica Ezee Cut Nxg Wedm Machine

Table 1 : Chemical composition 7075 Aluminium alloy

Element	Weight (%)
Aluminium	87.1-91.4
Zinc	5.1-6.1
Copper	1.2-2.0
Chromium	0.18-0.28
Iron	Max 0.5
Magnesium	2.1-2.9
Manganese	Max 0.4
Silicon	Max 0.4
Titanium	Max 0.2
Other	0.05

Table 2 : Mechanical Properties of 7075 Aluminium alloy.

Property	Value	Units
Ultimate strength	572	Mpa
Yield strength	503	Mpa
Fatigue strength	159	Mpa
Shear strength	331	Mpa
Hardness	150	BHN
	53.5	Rockwell A
	87	Rockwell A
	175	Vickers
Density	2.8	gm/cm^3
Elongation	9-Mar	%
Modulus of elasticity	71.7	GPa
Poisson's ratio	0.33	-
Thermal conductivity	130	W/m-K
Melting point	477-635	^0C

1. Control factors : Experiments were planned using 3 level full factorial design .These cutting parameters are : cutting speed (m/min), feed (mm/sec) , depth of cut (mm) and over all 27 experiments were conducted .

2. Instruments used for measuring weight of work piece in initial and final weight .

$MRR = (Wc - Wf) / \rho \times T \text{ mm}^3/\text{sec}$

W_c = Initial weight of work piece (gm)

W_f = final weight of work piece (gm)

T= machining time (sec)

ρ = density of material (kg/m^3)

3.Taguchi approach : It used to determine the quality of characteristics . Loss function value are connected to S/N ratio. ' Signal ' represents the desired values for output characteristics and 'Noise ' represents the undesirable value for output characteristics . These categories are used to analyze S/N ratio i.e lower is better , nominal is better ,higher is better .

Table 3 : Parameters with Levels

S.No	Parameters	Units	Level 1	Level 2	Level 3
1	Cutting speed	rpm	150	200	250
2	feed	mm/rev	0.1	0.15	0.2
3	Depth of cut	mm	0.25	0.5	1

Table 4: Response table for Material Removal Rate (MRR)

Level	Cutting speed	Feed rate	Depth of cut
1	4.606	6.606	5.236
2	5.426	5.152	5.268
3	5.862	4.135	5.39
Delta	1.257	2.471	0.154
Rank	2	1	3

Table 5: Machining conditions of for full factorial design .

	Cutting speed	Feed rate	Depth of cut	Surface roughness	Tool wear
1	200	0.2	1	1.5	0.31
2	200	0.1	0.25	1.23	0.21
3	150	0.1	0.5	1.59	0.14
4	200	0.1	1	1.62	0.11
5	250	0.2	1	1.29	0.27
6	250	0.15	0.25	1.85	0.28
7	150	0.1	0.25	1.45	0.16
8	150	0.15	0.5	1.78	0.28

9	200	0.15	1	1.65	0.26
10	250	0.1	0.5	1.15	0.13
11	250	0.15	0.5	1.72	0.27
12	150	0.15	0.25	1.82	0.3
13	250	0.15	1	1.24	0.21
14	200	0.15	0.25	1.89	0.35
15	150	0.2	0.25	2.12	0.35
16	200	0.2	0.25	2.31	0.4
17	250	0.1	0.25	1.15	0.15
18	150	0.2	0.5	1.98	0.33
19	250	0.2	0.25	2.5	0.35
20	200	0.1	0.5	1.39	0.18
21	150	0.2	1	1.7	0.27
22	250	0.2	0.5	2.1	0.32
23	250	0.1	1	1.14	0.07
24	200	0.15	0.5	1.78	0.32
25	150	0.1	1	2.13	0.08
26	200	0.2	0.5	2.04	0.37
27	150	0.15	1	1.89	0.22

Table 6 : Response table for Machining time

Level	Cutting speed	Feed rate	Depth of cut
1	1.829	1.428	1.813
2	1.712	1.736	1.726
3	1.571	1.949	1.573
Delta	0.258	0.521	0.24
Rank	2	1	3

IV. RESULT AND DISCUSSIONS :

Minitab 17 statistic software has been used for analysis of experiential work .It provides for calculation results of S/N ratio .The objective of present work is to reduce the machining time and increase the MRR and SR in turning processes operation.

a) Analysis for Signal -to- noise ratio

Larger is better performance characteristics is selected to obtain material removal rate .Smaller the better performance characteristics is selected to obtain machining time .

b) Response table for machining time

S =0.298941 R-sq =50.19% R-sq(adj) = 35024% R-sq(pred)=9.22%

(c) Regression Equations

Surface roughness = 1.7041 + 0.1248 cutting speed_150 + 0.0081 cutting speed_200
- 0.1330 cutting speed_250 - 0.2763 feed rate_0.10

+ 0.0315 feed rate_0.15 + 0.2448 feed rate_0.20
+ 0.1093 depth of cut_0.25 + 0.0215 depth of cut_0.50
- 0.1307 depth of cut_1.00

Cutting force = 13.94 - 2.19 cutting speed_150 + 0.34 cutting speed_200
+ 1.85 cutting speed_250 + 4.31 feed rate_0.10 - 0.50 feed rate_0.15
- 3.82 feed rate_0.20 - 0.33 depth of cut_0.25 - 0.12 depth of cut_0.50
+ 0.45 depth of cut_1.00

Tool wear = 0.247778 - 0.01111 cutting speed_150 + 0.03111 cutting speed_200
- 0.02000 cutting speed_250 - 0.11111 feed rate_0.10 + 0.02889 feed rate_0.15
+ 0.08222 feed rate_0.20 + 0.03556 depth of cut_0.25 + 0.01222 depth of cut_0.50
- 0.04778 depth of cut_1.00

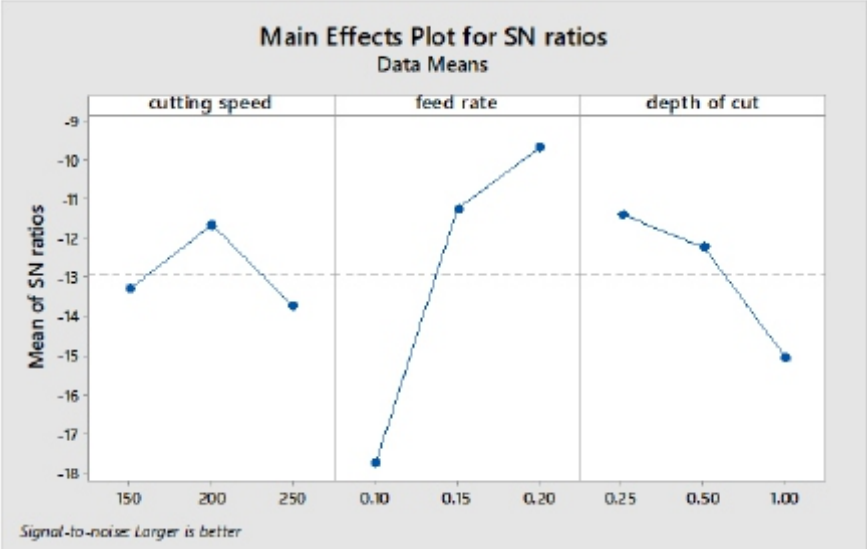

Figure 2. Main effect and S/N ratio for MRR

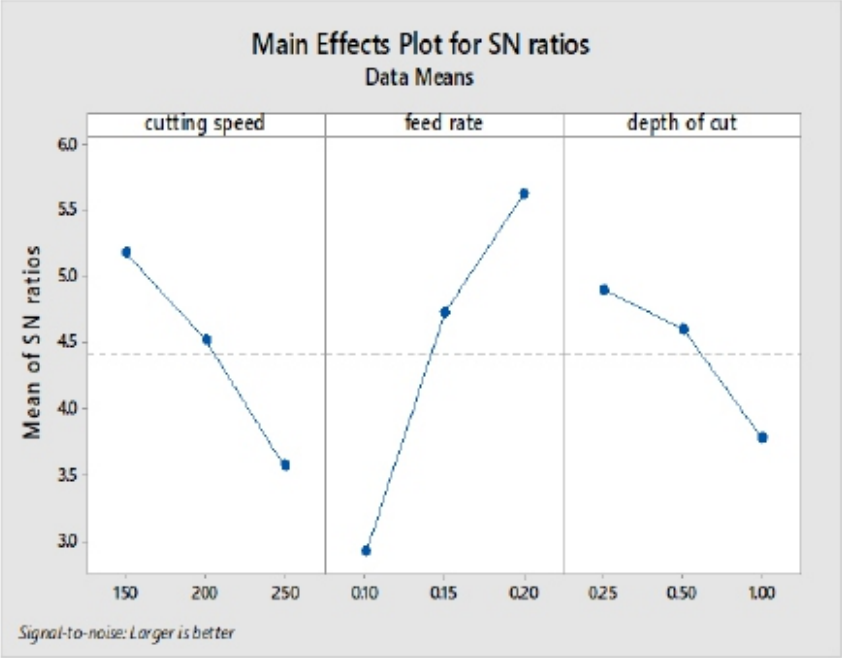

Figure 3.: Main effect plots for machining time

a) Analysis Of Variance (ANOVA)

The experimental results of surface roughness values were analyzed. The percentage of individual parameters were well determined using ANOVA. Taguchi cannot create and find the effect of individual parameters on entire processes . Using MINITAB17 software and ANOVA module is used to investigate the effect of parameters .

Table 7 : ANOVA –Result for surface roughness

Source	DOF	Adj SS	Adj MS	F-value	P-value
Cutting speed	2	0.2999	0.14996	1.68	0.212
Feed rate	2	1.2354	0.61769	6.91	0.005
Depth of cut	2	0.2654	0.13271	1.49	0.25
Error	20	1.7873	0.08937		
Total	26	3.5881			

b) Analysis for Signal -to- noise ratio

Larger is better performance characteristics is selected to obtain material removal rate .Smaller the better performance characteristics is selected to obtain machining time .

S =0.0050553 R-sq =99.77% R-sq(adj) =99.71% R-sq(pred)=99.59%.

Table 7 shows the results of ANOVA for surface roughness .From the results , it is observed that the feed is the most significant parameter followed by cutting speed and depth of cut has less significant in controlling the surface roughness values . P-Value of feed (0.005) which is less than 0.05.It means the feed influence significantly on work piece surface roughness between three cutting parameters.

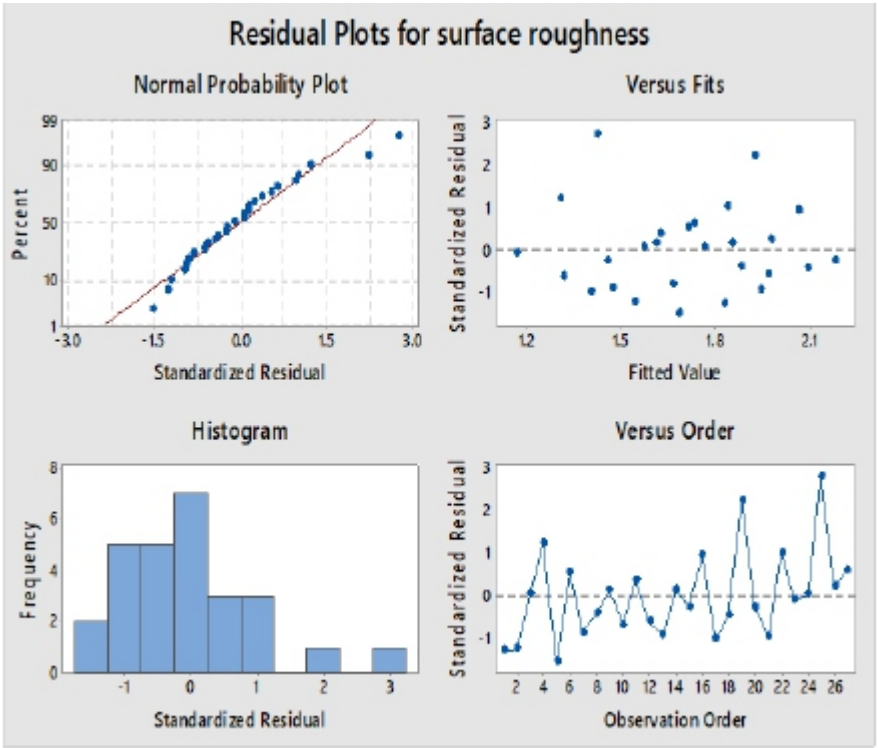

Figure 4 . Residual Plots for Surface Roughness

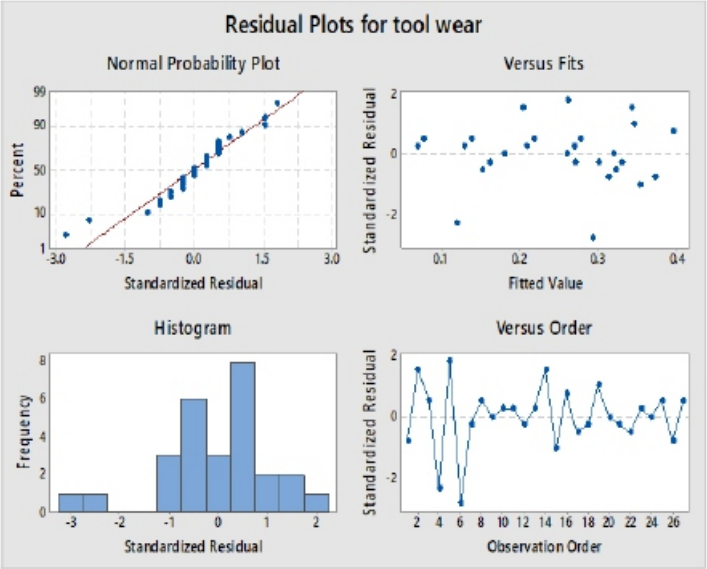

Figure 5. Residual plots for Tool Wear

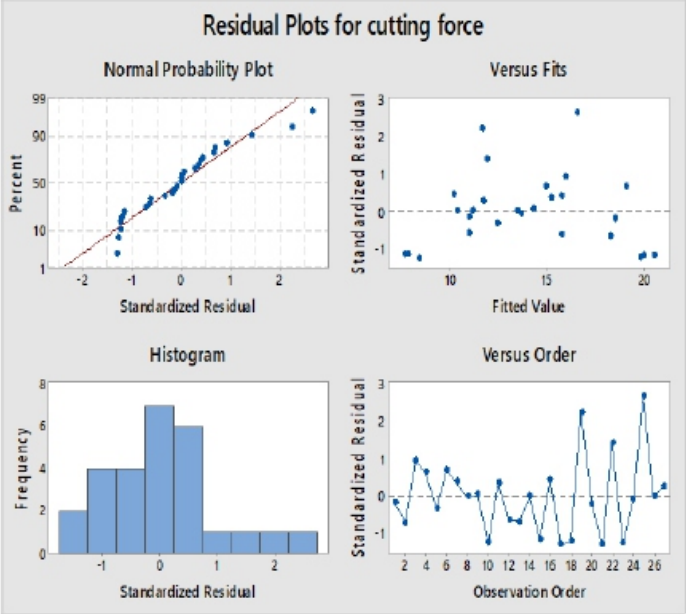

Figure 6. Residual plots for cutting force

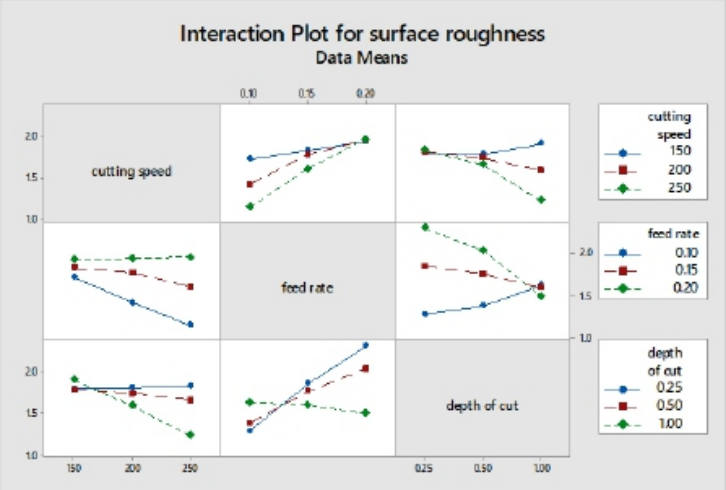

Figure 7. Interaction plots for Surface Roughness

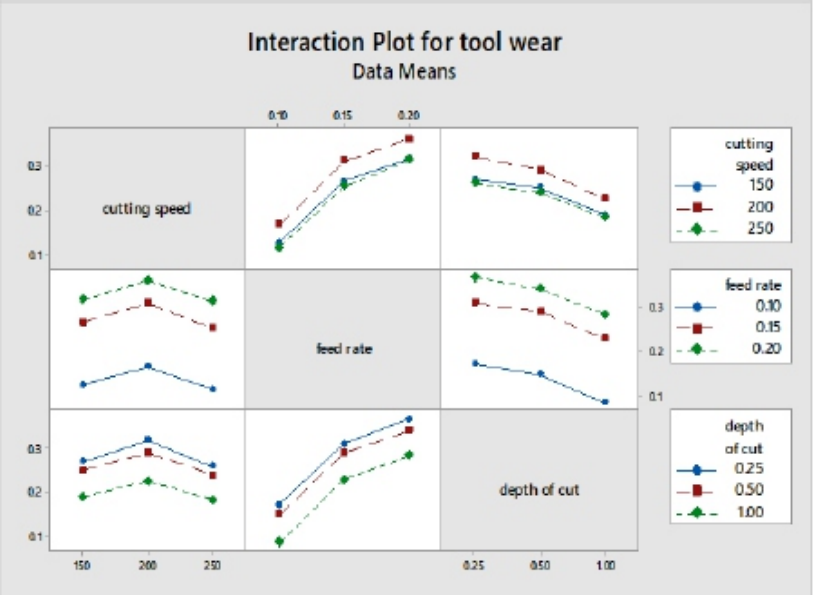

Figure 8 . Interaction plots for Tool wear

V. CONCLUSION

1. It is observed that the speed is most influence the MRR and less significance of depth of cut .In case of machining time speed is most significance parameter followed by feed rate . The combination of cutting parameters to achieve a high material removal rate (MRR) and low surface roughness (SR) is obtained .
2. From Taguchi results, the optimal combinations of cutting parameters for low surface roughness was found.
3. From ANOVA results , for achieving minimum surface roughness values, fed has high influence followed by speed and depth of cut has low influence .

REFERENCES

1. *Payaghan, N. S., Ubale, S, B. and Kadam, M. S. (2014), "Modeling and Analysis of Effects of Machining Parameters on MRR in EDM Process of Copper Tungsten Metal Matrix Composite (MMC)", International Journal of Engineering Research & Technology, Vol. 3 Issue 6, pp: 1343-13492.*
2. *Gopalakannan, S., Senthilvelan, T. and Kalaichelvan, K. (2012), "Modeling and Optimization of EDM of Al 7075/10wt% Al2O3 Metal Matrix Composites by Response Surface Method", Advanced Materials Research, Vols. 488-489, pp: 856-860*
3. *Nanimina, A., Abdul, R., Ahamd, F., Zainuddin, A. and Jason, S.H. (2010), "Effect of EDM on aluminum metal matrix composites", Journal of applied science, vol. 39, pp: 1-5*
4. *Karthikeyan, M. and Sornakumar, T. (2010), "EDM studies on aluminum alloy-silicon carbide composites developed by vortex technique and pressure die casting", Journal of minerals and material characterization & Engineering, Vol. 9, No. 1, pp: 77-88*
5. *Nagit, G., Adrian I. and Negoescu, F. (2009), "Tool wear investigation in electric discharge machining of aluminum matrix composite materials", The Annals Of 'Dunărea De Jos" University Of Galaţi, vol. 5, pp: 225-228*
6. *Adrin, I., Nagit, G. and Florin N., (2009). "Tool wear investigation in EDM of aluminum matrix composites", The annas of Duharea De Jos, University of galati, ISSN 1221-4566, pp: 225-228*
7. *Lin, Y., Chen, Y., Wang, D. and Lee, H. (2009), "Optimization of machining parameters in magnetic force assisted EDM based on Taguchi method", journal of materials processing technology, vol., 209, pp: 3374–3383*
8. *Yilmaz, O., Bozdana, A.T., Okka, M.A. and Filiz, I.H. (2009), "A comparative investigation of the effects of single and multi-channel electrodes in EDM fast hole drilling of aerospace alloys", 5th International Conference and Exhibition on Design and Production of MACHINES and DIES/MOLDS, 18-21 JUNE 2009 Pine Bay Hotel - Kusadasi, Aydin, TURKEY*

9. *Ahamed A. R., Asokan, P. and Aravindan, S. (2009), "EDM of hybrid Al–SiCp–B4Cp and Al– SiCp– Glassp MMCs", Int J Adv Manuf Technol, vol. 44, pp: 520–528*
10. *Khan, A. A. (2008),"Electrode wear and material removal rate during EDM of aluminum and mild steel using copper and brass electrodes", Int J Adv Manuf Technol, vol. 39, pp: 482–487*
11. *Mohan, B., Rajadurai, A. and Satyanaray, K. G. (2002), "Effect of SiC and rotation of electrode on electric discharge machining of Al-SiC composite", Journal of Material Science, vol. 124, pp: 297–304*
12. *Karthikeyan, R., Raju, S. and Nagavazen, R.S. (2001). "Optimization of EDM characteristics of SiC/LM 25 Al composite using goal programming", Journal of material science technology, Vol. 17, pp: 57-60*
13. *Muller, F. and Monaghan, J. (2000), "Non conventional machining of particle reinforced aluminum matrix composites", International journal of machine tools and manufacture, vol 40, pp: 1287-1300*
14. *Hocheng, H., Lei, W. T. and Hsu, H.S. (1997), "Preliminary study of material removal in electricaldischarge machining of SiC/Al", Journal of Materials Processing Technology, vol. 63, pp: 813–818*
15. *Ramulu, M. and Taya, M. (1989),"EDM machining of SiCw/Al Composite", Journal of Material Science, volume 24, pp: 1103–1108*
16. *Mahapatra, S.S. & Amar Patnaik (2006). "Optimization of wire electrical discharge machining (WEDM) process parameters using Taguchi method", international journal of advanced manufacturing technology. pp. 1-15.*
17. *surface characterization of wire electrical discharge machining process", Precision Engineering, 20(1), 5-15.*
18. *Zahid A. Khan, Arshad N. Siddiquee, Noor Zaman Khan , Urfi Khan, G. A. Quadir (2014). "Multi response optimization of Wire electrical discharge machining process parameters using Taguchi based Grey Relational Analysis" , Procedia Materials Science 6, pp. 1683-1695.*

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A Cloud Based Smart Parking System using Iot Technology

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ABSTRACT

Car parking is the major problem faced in the current major city. There are more number of vehicles around the city and the parking spaces are less in number and we need to solve this problem in the efficient parking management system. By this we demonstrate the use of IoT based Parking system that allows the effective parking space shown in the system utilization using IoT technology. The project we use IR sensors to demonstrate for the sensing things in the parking slots available in the particular parking area along with dc motor to simulate the gates open and close. We use the Wi-Fi modem for internet connectivity and a micro controller for operating system. The system detects the parking slots are occupied using IR sensors. The system reads the number of available parking slots or occupied and updates the data through the cloud based server to allow to check the parking slots are availability in online. This allows the system to check available parking spaces in online from anywhere in the world. This solution is reliable in any circumstances.

Keywords—ThingSpeak; IR Sensors; IoT; Node MCU; LED;MicroUsbCable;Jumper Wires.

I. INTRODUCTION

The parking system is controlled by the cloud system. In the recent times car parking in congested cities. So we go for an easy method using the IoT parking system. In this project we use ir sensor to detect the slot is occupied or available and the data is send through the microcontroller.

The microcontroller will send the data to the cloud server (web page). This displays the users to verify the available parking slots online from anywhere and available free parking. Thus this proposed system rectify the parking issues for metropolitan cities and gets the users an efficient IoT based parking management system. Previously in the parking area there is no automatic system to park the car in the parking slot. They will be collecting an amount from the owner of the vehicle at the free space and then allow the vehicle to park in the parking slot.

To resolve this regular problems with IoT (Internet of Things).IoT revolution helping in many ways to solve the issue. The present situation proposes taking effective help from Cloud based systems model called smart-parking system (SPS). Here with the parking data additionally added GPS(Global Position

System) data to Cloud Data. The data of Parking information will update frequently in every 10 seconds in the cloud, then SPS system will display how many parking's are available to park at respective building lobby or anywhere according to building. Each parking having it's own identity like typical praking.

II. RELATEDWORKS

More research is going on in this subject. We mainly focus on a managemaent system that assists drivers to find parking spaces in a specific parking district, and satisfies the needs of both parking providers and drivers. In addition, an important goal of the system is to reduce the traffic searching for parking, hence reduce energy consumption and air pollution. In this paper, we review background on smart parking systems, including the perfoemance metrics, exsiting solutions and challenges. We also brefely discuss the related work.

III. MODEL OF THESYSTEM

This system system is the combination of smart parking and slot allocation with the android application and web application. The SPS paking is shown in below figure

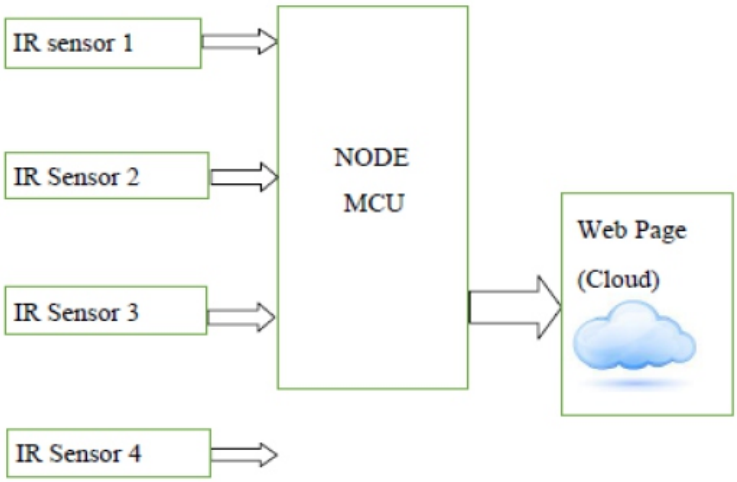

Fig.1.Architecture of the system

Here IR Sensors will sense the parking whether car was parked or on the other hand not.It recognizes the obstruction in stopping territory or in the surrounding .The transmitter will transmit IR beams which will be reflected once more from a some article like humans, living things, non living things or vehicles,etc to photo diode. The reflected beam will be gotten by photograph diode and henceforth will affirm the nearness of article and the relating. This creates logic 0 as digital output of the sensor will go to input for NODE MCU digital pin .IR sensor consists of 3 pins, which are VCC and ground and one is Digital output pin. After this receiving input to the microcontroller ,That Car Parked info Node MCU sends the data to ThingSpeak cloud.

In order to create new account in Thingspeak.com ,initially the user have to signup or can login with MATLAB account Credentials.

Presently click on new channel and afterward give some name to your channel and afterward fill the fields as demonstrated as follows. Field 1 chart,Field 2 chart,Field 3 chart,Field 4 chart are displayed as result in their fields with a graph.After filling the credentials go to "Save Channel."

Channel will be created, Then you will have the option to see field outlines..The cloud will will give you Write API(Application Program Interface) key and Read API key..These keys are used to upload the info to Cloud for further posting .On successfully uploading, test your code by copying API keys to Embedded C Code after uploading code to Node MCU Thing Speak charts will be updated for each adjustment in estimations of IR sensors where we continued detecting the vehicle Parking space. Here we are setting field 1,field 2,field 3,field

IV. SYSTEM DESIGN

The system design totally based on Microcontroller Node MCU Here the Node MCU acts as a main controlling unit. As we continuously monitor the data will received by Node MCU from sensors and GPS it first decodes, fetches and will execute its operation finally. Here the simulation circuit of system design is shown below. we can Node MCU as main controlling unit in this connected with Infrared radiation sensors(IR sensors),Web Page(Things Speak).

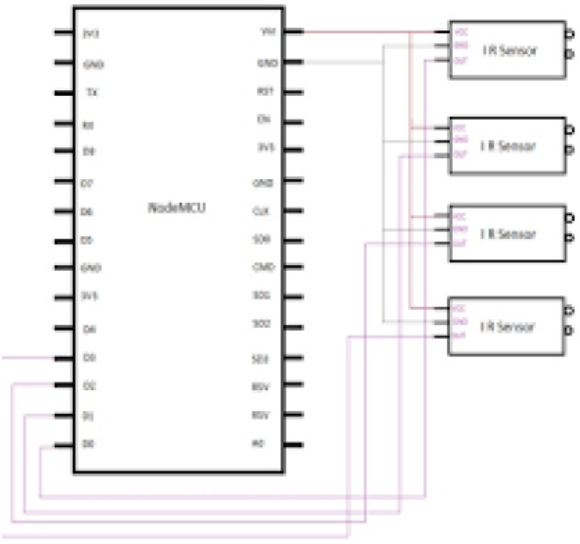

Fig.2. Simulated circuit diagram

A. Node MCU:

Espressif Systems Smart Connectivity Platform (ESCP) of high performance wireless SOCs, for mobile platform designers, provides unsurpassed ability to embed Wi-Fi capabilities within other systems, at the lowest cost with the greatest functionality.

Node MCU is a free source for IoT projects. It have a firmware which can run on the ESP8266 Wi-Fi Espressif systems.

Fig .3. Node MCU

B. IR Sensors:

This sensor is a short range obstacle detector with no dead zone. It has a reasonably narrow detection area which can be increased using the dual version. Range can also be increased by increasing the power to the IR LEDs or adding more IR LEDs.

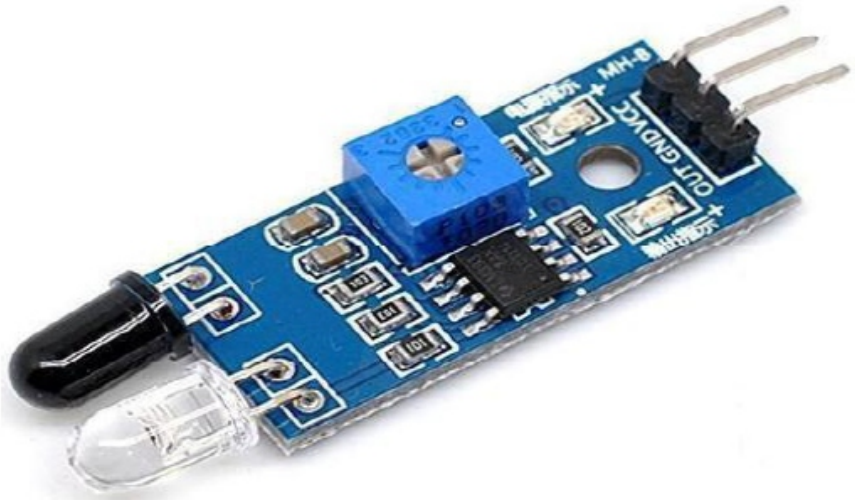

Figure.4. Infrared(IR) Module

C. Things Speak Website:

Thingspeak is an open source web of things (IoT) application and API to store and the recover information from Cloud utilizing HTTP convention over the web.

Thingspeak fields production of sensor logging information, area following sensors, and will send this data to interpersonal organization with notices.

Thingspeak clients to breaks down and imagine transferred information utilizing Matlab without signing into account with Matlab permit from Mathworks.

D. Micro Usb Cable:

Universal Serial Bus (USB) was developed in the 1990s in an effort to simplify the connections between computers and pheriperaldevices. It has become widely popular due to its compatibility with many platforms and operating systems, its low cost of implementation, and its ease to use .Most computers that are built today come with several USB ports, and USB is the interface of choice for most home and office periperals including printers,cameras,modems,and portable storage devices.

USB standards are developed and maintained by an industry body called the USB Implementers Forum(USB-IF).In its original specification,USB defined only two connectors types:A and B.Revisions to the specification and demands on manufacturers have expanded the breadth of connectors used for USB devices,but the majority of USB products still use these A and B connector interfaces

Fig .5.Micro USB Cable

E. Jumper Wirers :

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires. Though jumper wires come in a variety of colors, the colors don't actually mean anything. This means that a red jumper wire is technically the same as a black one. But the colors can be used to your advantage in order to differentiate between types of connections, such as ground or power. Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female.The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into. Male-to-male jumper wires are the most common and what you likely will use most often. When connecting two ports on a breadboard, a male-to-male wire is what you'll need.

Fig .6.Jumper Wires.

V. HARDWARE CIRCUIT

The implemented hardware circuit is shown in Fig. 6. I2C An instrumental part of our projected was the designing and implementation of a backend hardware system. This system will undertake the task. For powering the Node MCU and IR Sensor modules we used a 12v and 2A power supply

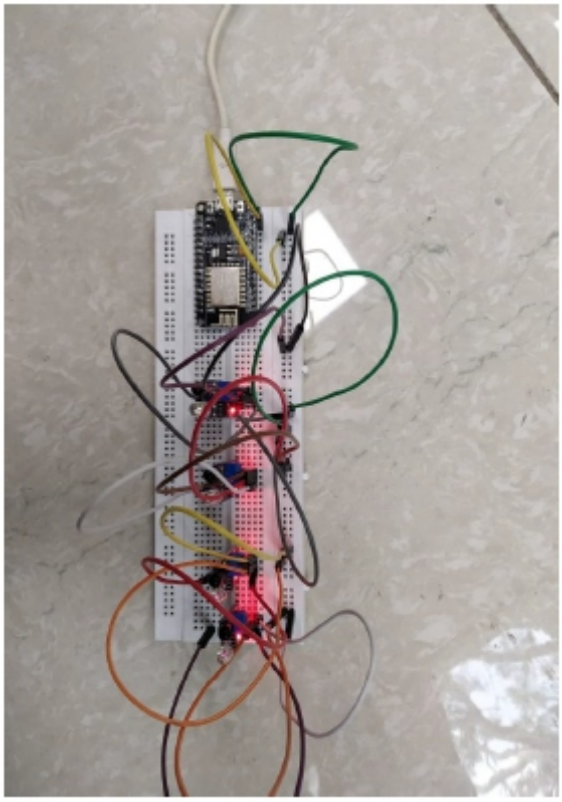

Fig.7.Implemented Hardware circuit

VI. RESULTS ANALYSIS

The project "IOT based Smart Parking system" was designed such that the status of parking slots can be known from anywhere in the users webpage. This is achieved using Wi-Fi communication.

In this system, the user has to be connected to the Wi-Fi network of that particular parking area through which he is given access to the webpage and can know about the status of the parking slot.

The Microcontroller processes this data and transmits over Wi-Fi, which will be received from MOBILE. In achieving the task the controller is loaded with a program written using Embedded „C" language. The user who wants to park the vehicle is connected to the Wi-Fi network of that particular parking lot through the password. The IR sensors send the status to the microcontroller where the data processing is done. The microcontroller sends information to the webpage about the status of the slot to the user using IOT. This way the user can easily find a parking slot without any congestion and in less time.

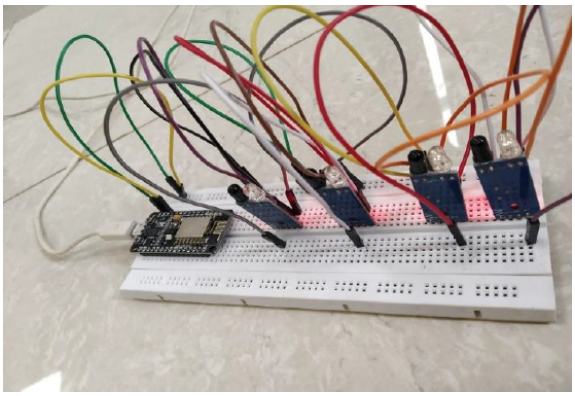

Fig.8.Implemented Hardware circuit.

Fig. 9.1. Result of Thing Speak Field 1 Chart

Fig.9.2.Result of ThingSpeak Field 2 Chart.

Fig.9.3.Result of ThingSpeak Field 3 Chart.

Fig.9.4.Result of Thing Speak Field 4 Chart

VII. CONCLUSION

The objectives of the Smart Parking project have been obtained. .. This security includes the feature of the system is enhanced with the password entrance to the parking IoT. This proposed system could be applied everywhere due to its ease and effectiveness. This project can be extended by adding an application of booking the parking slot before reaching the destination. This can be achieved by using GSM and RFID communication.

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REFERENCES

1. *Almagambetov. A, Velipasalar. S, and Casares. M, (2015) "Robust and Computationally Lightweight Autonomous Tracking of Vehicle Taillights and Signal Detection by Embedded Smart Cameras" IEEE Trans., vol. 62, no. 6, pp. 3732-3741.*
2. *V.P.Bilodeau,"Intelligent parking technology adoption," University of Southern Queensland,2010.*
3. *Kaempchen .N, Franke . U, and Ott .R, (2002) "Stereo vision based pose estimation of parking lots using 3-D vehicle models," in Proc. IEEE Intel. Veh. Symp., pp. 459–464.*
4. *AbdulAhad, Zishan Raza Khan, Syed Aqeel Ahmad,"Intelligent Parking System" Scientific Research Publishing, Vol.4,No.2, pp. 160-167, May 2016.*
5. *Dr Y Raghavender Rao," Automatic Smart Parking System using Internet of Things (IOT)" International Journal of Engineering Technology Science and Research, Vol.4,No.5,pp.225-258,May 2017*
6. *Suprit Atul Gandhi, Hasan Mohammad Shahid," Smart Parking System" Asian Journal of Convergence in Technology, Vol.4,No.1,May 2017*
7. *A.Thusoo,J.S.Sarma,N.Jain,Z.Shao,P. Chakka, N. Zhang, et al., "Hive-a petabyte scale data waraehouse using Hadoop," presented at the IEEE 26th International Conference on Data Engineering, Long Beach, CA, USA 2010*
8. *R. Hall, K. Pauls, S. McCulloch, and D. Savage, OSGi in action: Creating modulator application in Java: Manning Publications Co., 2011.*
9. *J. L. Carlson, Redis in Action: Manning Publication, 2013.*
10. *I.Ganchev, M. O'Droma, and D. Meere, "Intelligent Car Parking Locator Service," International Journal ITK, vol. 2,pp. 166-173, 2008.*

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Dynamic Behavior of Earth Dam under Non-Stationary Kinematic Effect

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A B S T R A C T

In connection with the large-scale design, construction and operation of earth dams (the number of which exceeds 50), in the Republic of Uzbekistan which is situated in a seismic region, the mechanics are faced with the task of improving the design methods for calculating main and dynamic loads, including seismic ones. This paper presents a solution to the non-stationary dynamic problem for a particular earth dam taking into account the elastic and inelastic characteristics of soil, the methods used are revealed, instability zones are identified, and the use of the numerical finite element method to solve such problems is justified. The purpose of this work is the development of the methods for solving dynamic problems for earth hydro-technical structures (dams, levees, reservoirs) in a plane statement taking into account the elastic and inelastic properties of soil material. The calculation results make it possible to predict the stress-strain state and determine the vulnerable zones of an earth dam, where loss of stable operation of the structure under dynamic load is possible.

Keyword: The purpose of this work is the development of the methods for solving dynamic problems for earth hydro-technical structures (dams, levees, reservoirs)

I. INTRODUCTION

Design and construction of high rise earth dams require attention to the long-term processes occurring in their body and affecting the quality of construction. There are known catastrophes that occurred during the destruction of the arch dam at Malpas in France or during a landslide in the reservoir of the arch dam Vayont in Italy, the destruction of the earth dam in Teton, USA. In 2017 there was a panic in California (USA) when the threat of the Oroville dam destruction appeared; more than two hundred thousand people were evacuated from the settlements near the dam. This suggests the need to meet the requirements for the safety of dams, including the safety of earth dams.

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The current state of the theory of seismic stability of hydrotechnical structures erected from local materials is characterized by the use of refined assumptions and reliable information regarding the choice of computational models that take into account real geometry, design features, piecewise-inhomogeneous soil properties, changing under the influence of filtration flows, the nature of static, hydrostatic and dynamic effects, features of the stress-strain state of the structure.

Identification of the basic laws of stress-strain state and behavior of hydrotechnical structures under seismic effects, taking into account these factors, will allow creating and conducting effective anti seismic measures that ensure trouble-free operation of the existing and projected earth dams [1,2,3,4,5].

A great contribution to the development of methods for calculating and studying the statics and dynamics of earth dams was made by scientists of the Uzbek school of Mechanics [6,7,8,9,10]. In these papers, on the basis of plane and spatial design schemes, the issues related to seismic resistance of designed and operated structures in areas of Uzbekistan that are subject to high seismic risk are considered. Different soil properties are taken into account - plasticity, water-content, non-linear properties and the construction features of structures.

II. METHODOLOGY

As is known, the spectral method of calculating structures for seismic effects, regulated by normative documents, is produced on conditional seismic loads, determined using the assumption of elastic deformation of the cantilever model with concentrated mass along the height [11,12]. Such a model justifies itself when calculating high compact in plan structures, the forms of oscillations of which are of a pronounced bending character. Oscillations of massive earth dams are more complex and include not only horizontal shear, but also vertical displacements, which cannot be determined using the cantilever model. Therefore, in the cited papers, calculations of static and dynamic behavior of earth hydrotechnical structures (earth dams) were performed using:

- a plane model (plane-deformable) (Fig. 1a) representing the cross section of the dam [9,13,14,15];
- a spatial model [7-8], representing the real body of the dam (Fig. 1.b);
- a model consisting of two intersecting planes, one of which represents the transverse section, and the second - the longitudinal section of the dam, which coincides with the cross section of the dam gate (Figure 1 c).

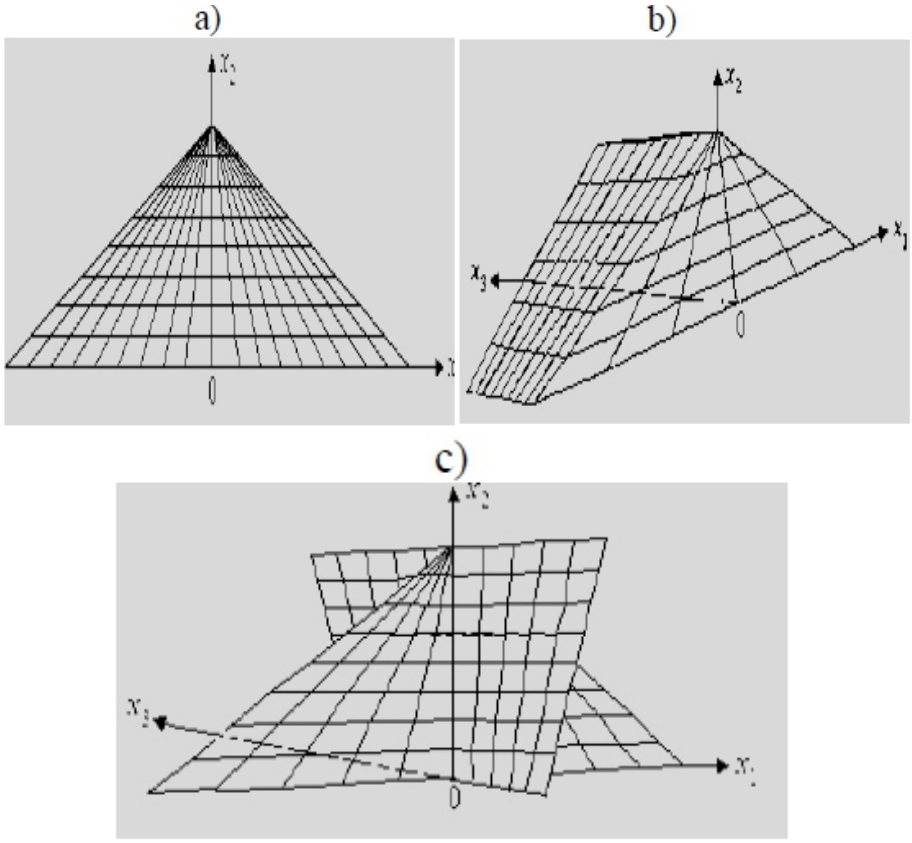


Figure 1. Calculated models of the earth dam on rigid foundation

The lower faces of the calculated models (Figure 1) are fixed, i.e. the dam foundation is assumed to be absolutely rigid. However, to account for non-uniform deformation, subsidence, bulging of part of soil

or any other negative manifestation of a weak foundation, the construction models are used with the foundation having sliding side faces (Figure 2), i.e. only the vertical displacement of the infinite foundation strip is taken into account.

Such models were considered in [9], where the effect of a weakened fractured section on the stress-strain state of a high earth dam and the surrounding rocky base with a weakened fractured section was studied; soil parameters were obtained from the results of experimental drilling. The studies had a practical implementation for issuing recommendations for further increase in height of the considered earth dam, taking into account the data of test drilling.

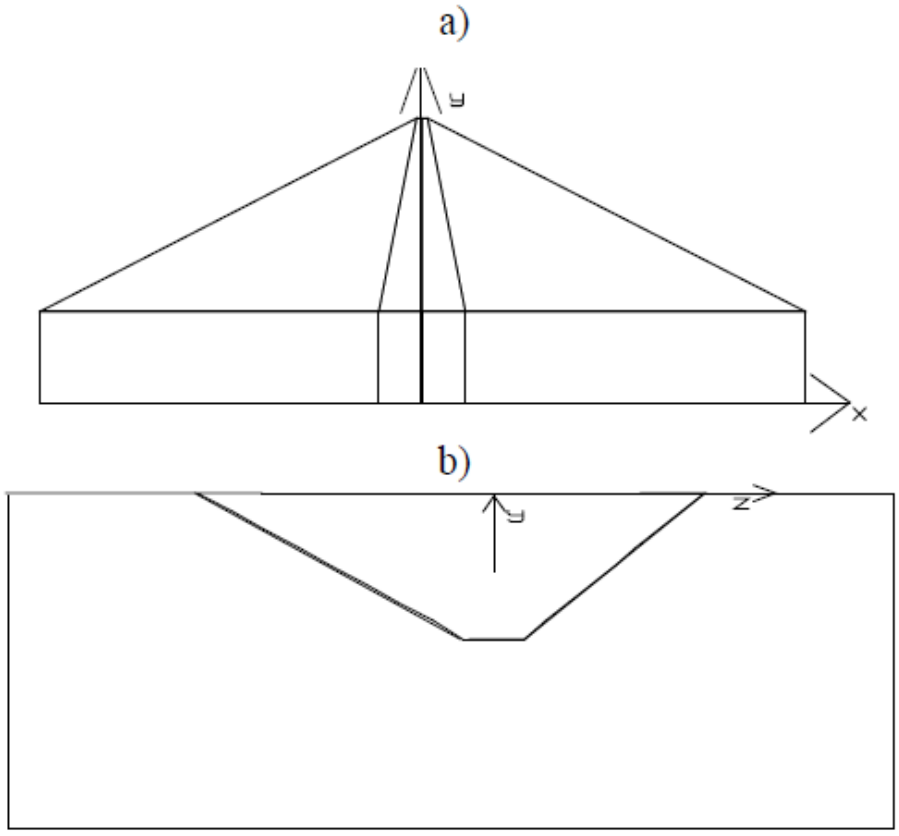


Figure 2 Dam models with foundation: transverse - a; longitudinal (in a canyon) – b

In study of the stress-strain state (SSS) and the dynamic behavior of an earth dam using the models for static, hydrostatic and dynamic effects, the numerical method is used; in most cases, it is the finite element method. This method allows taking into account the real geometry, design features of the objects and various properties of soil under loading and wetting [10,16], such as plasticity, fracturing, geometric and physical nonlinearity. To account for the nonlinear properties of material (soil), special calculation methods were developed based on solving linear and nonlinear systems of algebraic, differential, and high-order integro-differential equations.

The study of the SSS of soil structures (dams) is an extremely difficult task, since the deformation properties of soil depend on many factors: the effective average stress; stress deviation component; applied load; water-content; degrees of fracturing, etc. Nonlinear laws of soil deformation in a structure, implemented in the specified calculation programs include consideration of structural damage at volume deformation; water-content; geometrical (for high dams) and physical nonlinearity under loading, as well as dry and viscous friction.

The developed methods of static and dynamic calculation and the solution of complex problems of the SSS and dynamic behavior of earth structures allowed to analyze the effect of hydrostatic pressure, viscosity, nonlinear strain and water-content in soil on the SSS of specific earth dams of Uzbekistan [13,14,15,16,17,18]. The analysis of possible destruction zones in dams with a variety of static and dynamic effects allows a reasonable and economical approach to the issues of operation of selected earth protective structures - this determines the relevance and practical value of the carried out studies.

To create a mathematical model the following parameters are used [15,16,17,18,19]:
1) The variational principle of the minimum total energy of the system:

$$\delta\Pi - \delta' W = 0 \qquad (1)$$

where $\delta\Pi$ is the increment of potential energy of the system, and $\delta' W$ is the sum of the work of external forces on possible displacements;

2) The equation of state expressing the relationship between the components of stresses σ_{ij} and strains ε_{ij} for an elastic medium

$$\sigma_{ij} = \lambda \varepsilon_{kk} \delta_{ij} + 2\mu \varepsilon_{ij} \qquad (2)$$

3) The Cauchy relations, connecting strains with displacements

$$\varepsilon_{ij} = \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right) \qquad (3)$$

4) Boundary conditions on a rigid foundation, showing the absence of possible displacements $\delta\overline{u}$:

$$\delta \overline{u} = 0 \qquad (4)$$

5) An external effect is represented by volume forces - $\overline{P}$ (by weight) applied throughout the entire volume of the structure, and surface forces $\overline{f}$, acting on the parts of the structure surface, being a hydrostatic pressure.

Here $\overline{u} = \{u_i, u_j\}$ are horizont al and vertical displacements of a body point with coordinates $\{x_i, x_j\}$; $\sigma_{ij}, \varepsilon_{ij}$ are the components of the stress and strain tensor; λ, μ are the Lame constants.

For the numerical solution of the problem, the finite element method [15,16,17,18,19] is used, which is currently one of the main numerical methods in the mechanics of a deformable rigid body. This method is invariant with respect to the geometry of the object under study and mechanical characteristics of material (earth and concrete). In addition, the finite element method is characterized by the simplicity of accounting the structure interaction with environment, various mechanical (static and dynamic) loads, and various types of boundary conditions.

Mathematically, the problem of unsteady forced oscillations is reduced to solving a matrix system of inhomogeneous second-order differential equations with the right-hand side being a function of time

$$[M]\{\ddot{q}\}+[C]\{\dot{q}\}+[K]\{q\}=\{P(t)\} \quad (5)$$

where [M] is the mass matrix; [K] is the stiffness matrix; $\{P(t)\}=[M]\{\ddot{u}_0\}$ the damping matrix [C] describes the internal friction caused by the viscosity of medium. The question of choosing the type of matrix [C] is discussed below.

The solution of the system of equations (5) under appropriate initial conditions can be obtained by the Newmark method [20]. The Newmark method is based on expansions of q(ti+τ) and $\dot{q}(t_i+\tau)$ nto the series in powers of τ (the integration step):)

$$q(t_i+\tau)=q_i+\tau\dot{q}_i+\frac{\tau^2}{2}\ddot{q}_i+\alpha\tau^3\dddot{q}_i \ldots;$$

$$\dot{q}(t_i+\tau)=\dot{q}_i+\tau\ddot{q}_i+\beta\tau^2\dddot{q}_i,$$

where α and β are chosen so that unconditional convergence of the integration process is ensured: β≥0,5; α≥0,25(β+0,5)2.

The solution for the nodal displacements qi+1 at the end of the i-th time step is determined from an algebraic system of equations [20]:

$$[A]\{q_{i+1}\}=\{P_{i+1}\},$$

solved by the Gauss method.
Here

$$[A]=[K]+[C]\beta/(\alpha\tau)+[M]/(\alpha\tau^2);$$

$$\{P_{i+1}\}=\{R_{i+1}\}+[M]\left[\frac{\{q_i\}}{\alpha\tau^2}+\frac{\{\dot{q}_i\}}{\alpha\tau}+\left(\frac{1}{2\alpha}-1\right)\{\ddot{q}_i\}\right]+$$

$$+[C]\left[\frac{\beta\{q_i\}}{\alpha\tau}+\left(\frac{\beta}{\alpha}-1\right)\{\ddot{q}_i\}+\frac{\tau}{2}\left(\frac{\beta}{\alpha}-2\right)\{\ddot{q}_i\}\right],$$

$\{q_i\},\{\dot{q}_i\},\{\ddot{q}_i\}$ are the displacements, velocities and accelerations of nodal points found at the previous time step.

The described algorithm of the Newmark method is applied to solving problems on unsteady forced oscillations of the considered earth dams, the dynamic effect for each structure is chosen individually.

The calculations were made on the example of the Rezaksay reservoir located in the Rezaksay valley (a tributary of the Syr Darya river) in the Chust district of the Namangan region of the Republic of Uzbekistan. The dam, which generates a reservoir, is made of a blind earth fill with an inclined core of sandy-loamy soil and retaining prisms of gravel-pebble soil (Fig. 3). The maximum height of the dam in the channel part is 80 m, the length of the crest is 3323 m, the greatest rise in the level of the reservoir is 77 m.

Retaining prisms of the dam are filled by gravel-pebble soil with sand filling and rolling to the density of dry soil ρ=2.1 t/m^3. The rate of the dam slopes is determined by calculations and is m^1 = 2.5 for the upper slope, and m^2 = 1.9 for the lower slope.

The inclined core is made of a mixture of loam and sandy loam with rolling to the density of dry soil ρ = 1.7 t / m^3. The base of the core along the entire length of the dam is an array of aleurolite and sandstone, covered with layers of soil of various thickness, consisting of pebbles, loams and sandy loam.

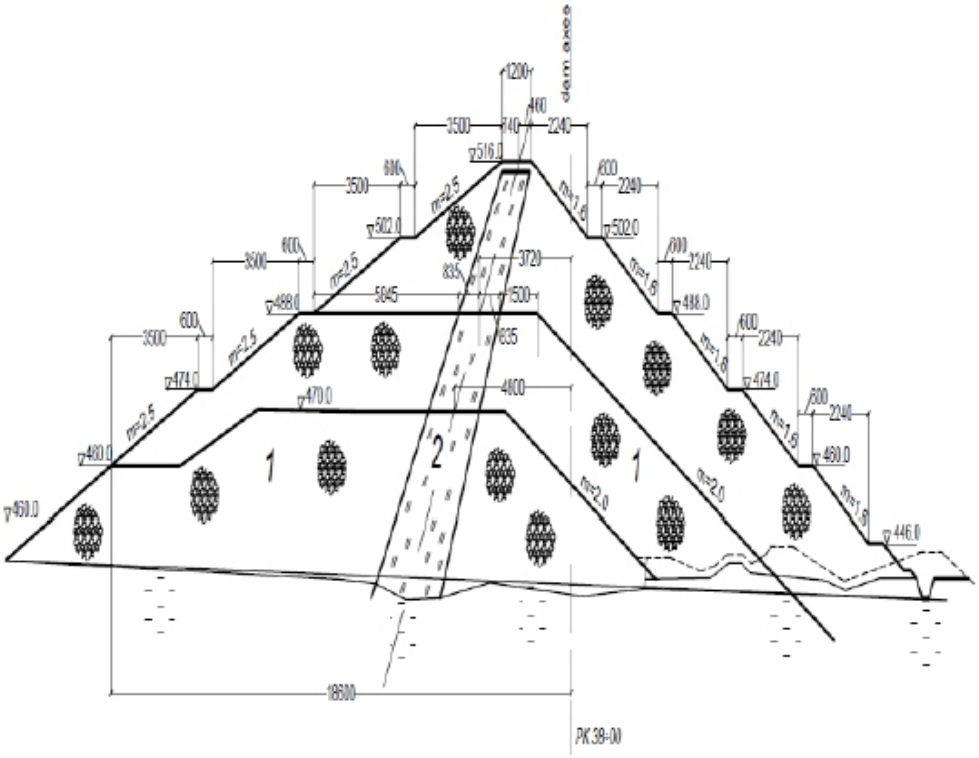


Figure 3.Rezaksay earth dam

1- gravel-pebble soil with sand filling;
2 - a mixture of loam and sandy loam.

III. RESULTS

Consider non-stationary forced oscillations on the example of the above earth dam. The initial conditions are assumed to be homogeneous (zero):

$$\text{at } t=0: \{q0\}=0, \{\dot{q}_0\}=0.$$

Let the kinematic effect be represented as a harmonic function with eigenfrequency of the structure, and its duration is 2 seconds. The entire time interval is 3-4 seconds:

$$\ddot{u}_0 = \begin{cases} A\sin(2\pi pt) & 0 \le t \le 2c \\ 0 & t > 2c \end{cases} \quad (6)$$

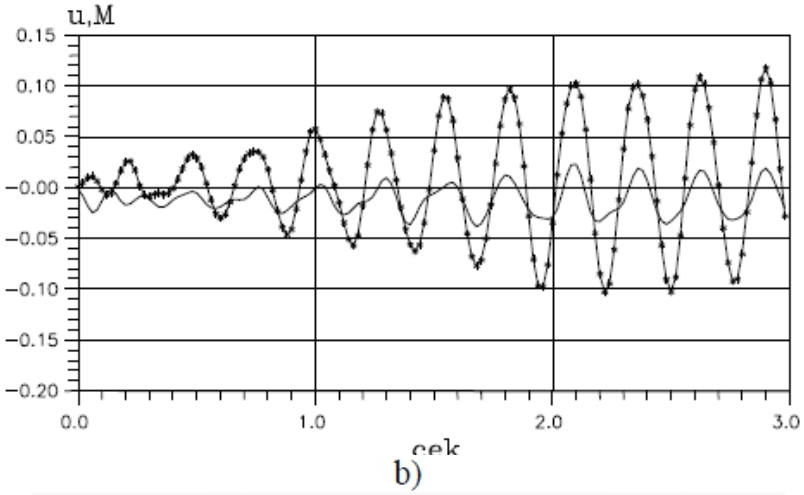
After the effect cessation a free oscillation mode is set in the structure. In 2 seconds, the construction in the resonant mode makes 6-7 oscillations, by analyzing which it is possible to draw the necessary conclusions about its dynamic behavior in seismic process.

This kinematic effect with a frequency equal to the basic frequency of natural oscillations of the structure (p=ω1=3,1 Hz) is used to demonstrate the dynamic behavior of the structure in a dangerous resonant mode. Besides, it should be noted that such a harmonic effect with a period of T = 0.05÷0.3s can be classified as a seismic one, since its frequency range coincides with the frequency range of seismic effects. For example, the predominant period of the 1976 Gazli earthquake was about T = 0.1 sec. Thus, an artificially chosen effect may be a substitute for a real accelerogram.

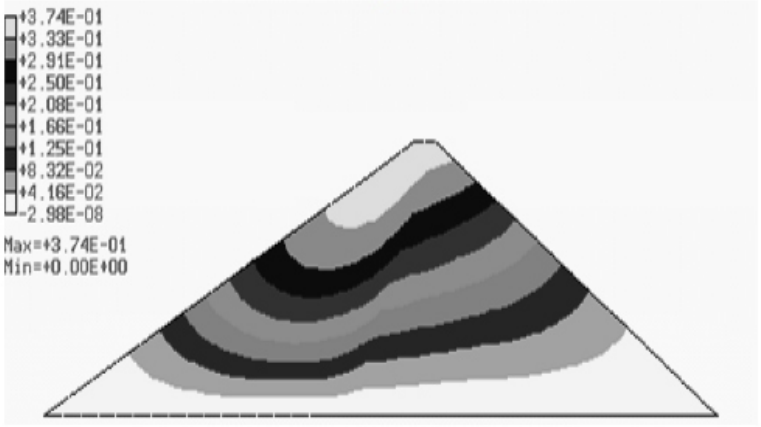
In the absence of energy dissipation ([C] = 0), system (2) describes the motion of an elastic dam without attenuation. The horizontal and vertical displacements of a point near the dam crest under its own weight and given kinematic action, obtained in this case by the Newmark method with zero initial conditions are shown in Figs. 2.a. The frequency of the kinematic (harmonic) effect at the base of the dam is equal to the natural oscillation frequency of the Rezaksay dam ω0= 3.1 sec-1, and the amplitude of the effect A=0.1 corresponds to the soil acceleration at a seven-point earthquake.

As expected, under the effect of a frequency equal to the basic natural frequency of the structure, i.e. p=ω1, the latter oscillates with a linearly increasing amplitude, which by the end of the effect reaches 0.1 m (10 cm) for horizontal vibrations and 0.02 m (2 cm) for vertical ones. Such a linear increase in the amplitude when the frequency of the effect coincides with the basic oscillation frequency of the structure (resonance) is predictable and proves the reliability of the results obtained according to the developed program.

The same figure shows the distribution of maximum displacements (horizontal - fig.4.b and vertical - fig.4.c) over the entire section of the dam for the entire period of the effect.



b)



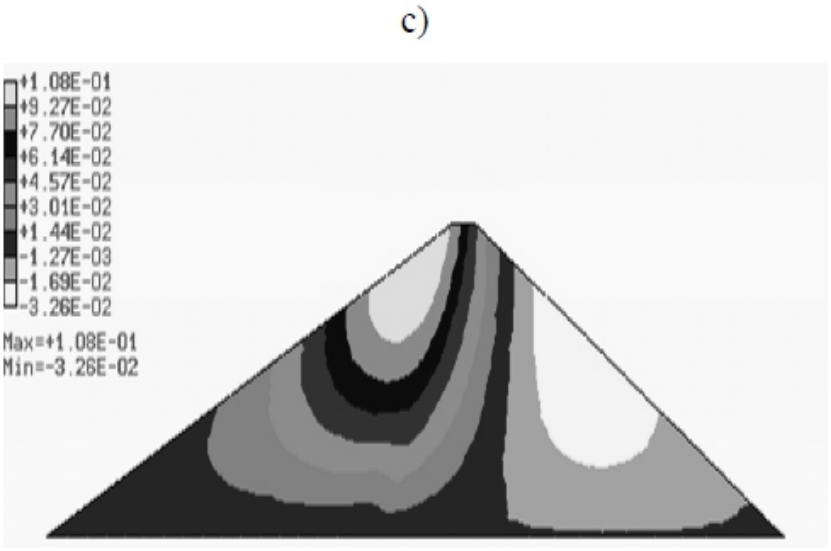


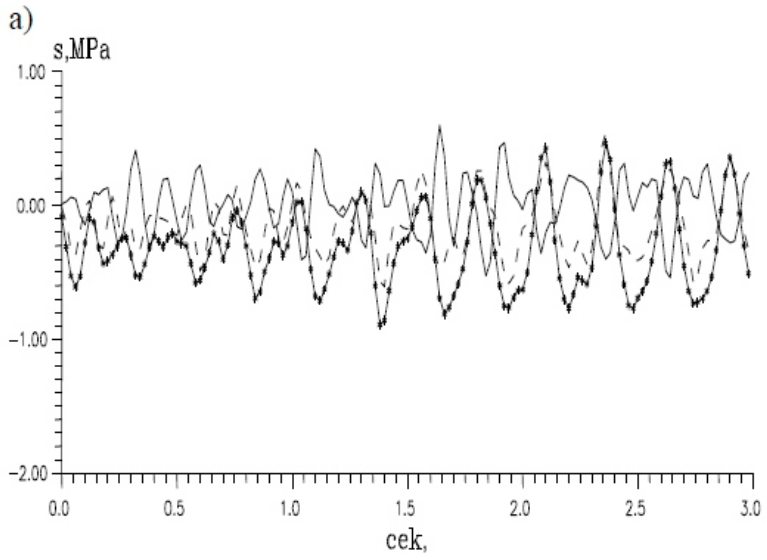
Figure 4. Horizontal (—*—*—) and vertical (————) displacements of the center point (a) and the distribution of maximum horizontal (b) and vertical (c) displacements of the dam section for the entire period of the effect

After the effect cessation, the free oscillation mode is set in the dam; vertical oscillations occur relative to the position of static equilibrium, determined by the weight of the structure (Fig. 4 - thin line).

Horizontal displacements at the first resonance, as shown by the results of Figs. 4 b, c, reach the maximum value on the dam crest and uniformly decrease to the rigid foundation. The displacements of the upper prism are positive, and the lower ones are negative, i.e. during the shift, the slope and the near-crest zone of the upper prism shift upwards, and the symmetrical part of the lower prism moves downward.

The results in Fig.4. obtained without taking into account dissipation in soil, therefore, free oscillations of the dam occur with a constant amplitude.

Graphs of changes in the normal - horizontal and vertical one, and tangential stresses for the entire period considered are shown in Fig.5.



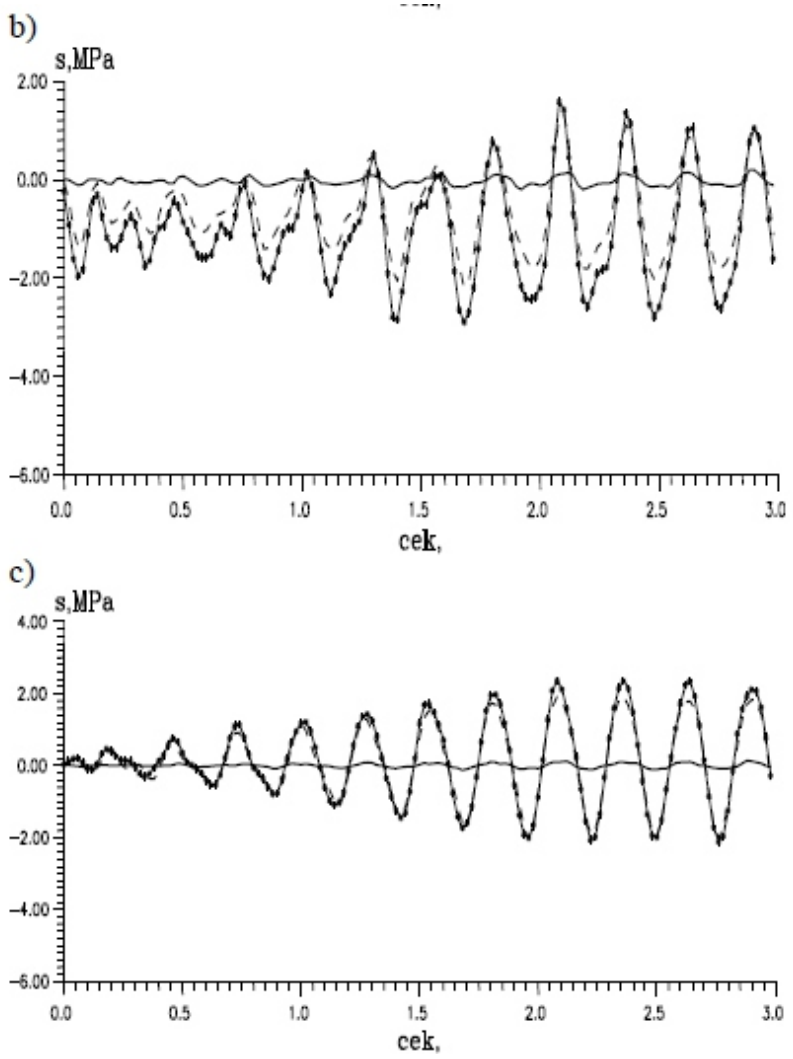


Figure 5. Change of the normal - horizontal (a) and vertical (b), and tangential (c) stresses at the points of central section (—*—*— - at the bottom; - - - in the middle; ————at the top) under resonant oscillation mode

IV. DISCUSSION

Graphs of stress changes over time show an increase of vertical (σy) and tangential (τxy) stresses in this mode during the entire time of load effect. The maximum stress values (taken as an absolute value) are observed at points near the foundation. The predominance of negative values of vertical stresses means that oscillations of earth structure occur relative to the level of static equilibrium, characterized by structure compression under its own weight. Over time, the amplitudes of vertical stresses at the bottom and in the center (the —*—*— and - - - - lines in Figure 5b) extend into the positive half-plane, which means that positive tensile vertical stresses appear, weakening soil connection with the foundation.

Next, consider the dynamic behavior of earth dam, taking into account the dissipative properties of soil under the same dynamic effects.

The reasons that lead to energy dissipation can be caused by energy loss to the environment ("external" friction), and the loss caused by internal processes in material of the system ("internal" friction). In the first case, it is believed that dissipative forces are proportional to inertial forces, the second case is related to the viscous behavior of material under strain.

To describe the absorbing, dissipative properties of soil, and to obtain a resolving system of equations, the Kelvin- Voigt dynamic model of viscoelastic medium is applied.

$$\sigma_{ij} = \lambda\theta\delta_{ij} + 2G\varepsilon_{ij} + \lambda'\theta\delta_{ij} + 2G'\dot{\varepsilon}_{ij} \quad (7)$$

whereσij is the component of stress tensor;

ε_{ij} , $\dot{\varepsilon}_{ij}$ - are the components of strain tensor and strain rate tensor;

λ, G - are the Lame constants;

λ', G' - are the corresponding viscosity coefficients of medium;

$\theta = \frac{1}{3}(\varepsilon_1 + \varepsilon_2 + \varepsilon_3)$ $\dot{\theta} = \frac{1}{3}(\dot{\varepsilon}_1 + \dot{\varepsilon}_2 + \dot{\varepsilon}_3)$ is an average strain and strain rate;

$$\delta_{ij} = \begin{cases} 1, i = j \\ 0, i \neq j \end{cases}$$ - is the Kronecker symbol.

The use of such a model in calculations of structures made of earth materials on seismic effects makes it possible to take into account the energy absorption in soil due to the viscosity of material, the friction between solid particles, the water-soil skeleton interaction under irreversible plastic strain, etc. In addition, this model makes it possible to evaluate absorptive capacity of earth structures depending on the frequency spectrum of the structure.

The description of viscoelastic behavior is achieved by the representation of the components of strain and the average deformations in a complex form $\varepsilon_{ij} = \varepsilon_{0ij} \exp(i\omega t)$, $\theta = \theta_0 \exp(i\omega t)$; a result, the strain rates and the rate of volume change are equal to

$$\dot{\varepsilon}_{ij} = i\omega\varepsilon_{0ij} \exp(i\omega t), \quad \dot{\theta} = i\omega\theta_0 \exp(i\omega t)$$

To obtain an explicit expression for the dissipation matrix [C], which enters the equation (5), we transform (7) using the complex modules

$$\lambda(i\omega) = \lambda - i\omega\lambda'; \qquad G(i\omega) = G - i\omega G'$$

Then equation (26) with complex modules takes the form similar to Hooke's law

$$\sigma_{ij} = \lambda(i\omega)\theta\delta_{ij} + 2G(i\omega)\varepsilon_{ij}$$

,an explicit expression for the dissipation matrix [C], which enters the equation (5) before the derivatives of nodal displacements, is obtained as

$$[C] = \eta[K]$$

where $\eta = \lambda' + 2G'$ - is the positive constant.

Thus, the use of this model in the finite element discretization of a structure leads to a resolving system of differential equations

$$[M]\{\ddot{q}\} + \eta[K]\{\dot{q}\} + [K]\{q\} = \{P(t)\} \qquad (8)$$

where η - is the viscosity coefficient.

In (8), the matrix of damping coefficients is proportional to the matrix of quasi-elastic coefficients; this case is called internal friction and is related to the manifestation of viscous properties in material. If to transform (8), multiplying it from the left by the matrix inverse to the mass matrix ([M] - 1), we get

$$\{\ddot{q}\} + \eta[M]^{-1}[K]\{\dot{q}\} + [M]^{-1}[K]\{q\} = [M]^{-1}\{P(t)\},$$

or, given that $[M]^{-1}[K] = diag(\omega_i^2)$ - is the diagonal matrix of squares of natural frequencies the following system of separate equations is obtained

$$\{\ddot{q}\} + \eta diag(\omega_i^2)\{\dot{q}\} + diag(\omega_i^2)\{q\} = [M]^{-1}\{P(t)\} \qquad (9)$$

To select the value of η we use known data, according to which the values of $0{,}2 \le \psi \le 0{,}35$ are given for the coefficient of the internal absorption of soil ψ. Then, from the formula relating the coefficient ψ to the coefficients of friction (coefficients of the derivative of displacements η) and frequencies (ω_i), we obtain

$$\psi = \frac{2\pi\eta_i\omega_i^2}{\omega_i}, \text{ hence } \eta_i = \frac{\psi}{2\pi\omega_i}$$

Taking into account the range of variation of $\psi\,(0{,}2 \le \psi \le 0{,}35)$ and the spectrum of the principal frequencies (3÷5.4 Hz), the following limits of variation of the coefficient η for the soils of Rezaksay dam are obtained

$$0{,}006 \le \eta \le 0{,}0175,$$

from which we choose the mean value η = 0.01, used later to calculate the dynamic behavior of soil structure (Rezaksay dam) on dynamic load. The effect, as before, is harmonic with a frequency that coincides with the main oscillation frequency of the structure. Initial conditions are zero. The method for solving system (8) is the Newmark method [20]. The result of the solution is the displacements of the nodal points of the structure shown in Fig.6.

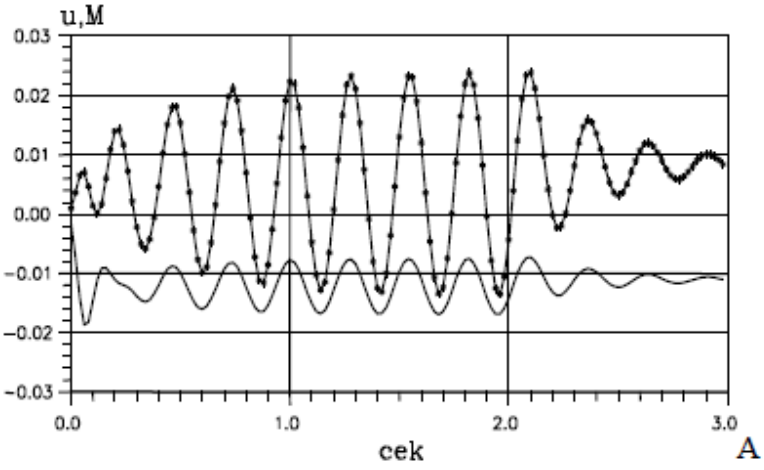
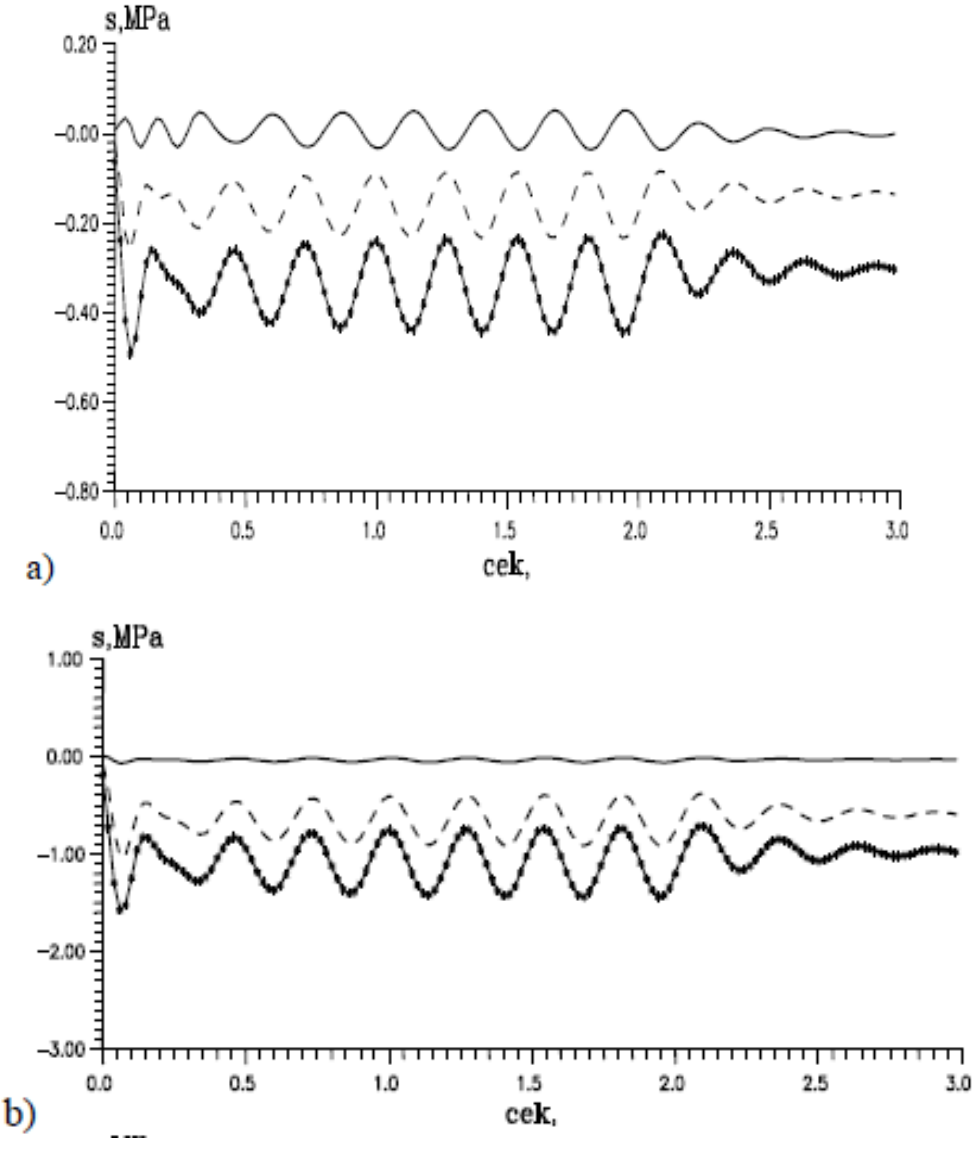


Figure 6. Horizontal (—*—*—) and vertical (———) displacements of the Rezaksay dam crest, taking into account internal friction

A comparative analysis of the behavior of an elastic dam (Fig. 5) and a dam with internal friction in material (Fig. 6) shows that in the second case, both horizontal and vertical oscillations occur with an amplitude much lower than the amplitude of the elastic case. Moreover, even under kinematic action, the amplitude of oscillations of a dam with internal friction does not constantly increase. This indicates a change in frequency spectrum of a structure with damping properties of soil. In other words, the absence in this case of a resonance, i.e. unlimited rise in the amplitude of oscillations, indicates a change (decrease) in the basic frequency of the system, caused by rheological processes in the soil of the dam.

Horizontal oscillations occur relative to the neutral position (line —*—*— in Fig. 6), and vertical oscillations in relation to the position of static equilibrium, determined by the displacement of the structure under its own weight (line _____ in Fig. 6). After the effect cessation (t> 2 sec), the oscillations quickly damp out, and the strained state of the dam at the end of the process is characterized by an axis shift in horizontal direction (horizontal displacements of the crest are set above the neutral line) and vertical settlement at the level of static equilibrium.

The change in the components of the stress state under kinematic effect with the principal frequency of the oscillations of elastic structure, taking into account internal friction in soil, is shown in Fig.5.



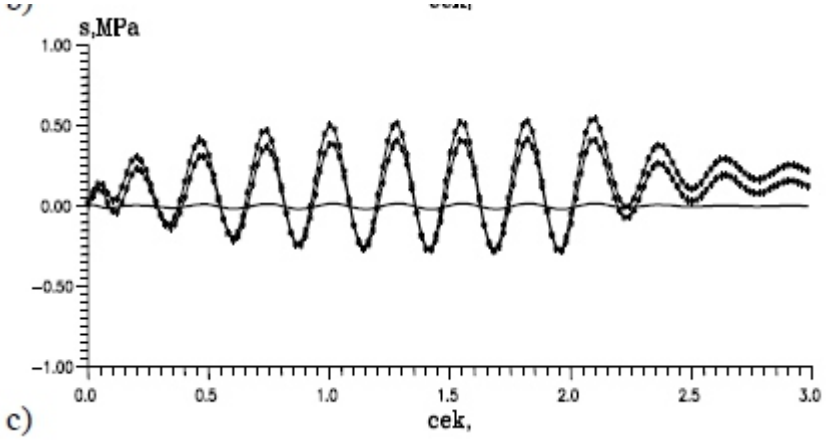


Figure 7. Variation of horizontal (a), vertical (b) and tangential (c) stresses in central section (—*—*— at the bottom; - - - in the middle; —— at the top) of the Rezsaksay dam with internal friction in soil under harmonic effect with own frequency

Therefore, an account of internal friction in soil reduces the amplitude of oscillations and the level of stresses in earth structures. In addition, the effect of weakening of structure-foundation connection, noted in the elastic case, disappears, as indicated by the output of the amplitude of vertical displacements into the positive half-plane. Here (Figure 7 b) such a phenomenon is not observed.

V. CONCLUSIONS

The statement of the problem of forced oscillations of an earth dam under dynamic effect with and without taking into account internal friction in soils is given; an algorithm for solving non-stationary problems by the numerical finite element method using the Newmark method is presented. The analysis of numerical results is given. The obtained dependences of the displacements and stresses of the vulnerable points of earth structure over the time of dynamic effect showed that taking into account internal friction in soil leads to a decrease in the amplitude of the forced vibrations, which is necessary in calculations.

REFERENCES

1. *Zabala F, Rodari R D and Oldecop L O (2008)Seismic analysis of earthdams using a lagrangian particle method, The 14 World Conference on Earthquake Engineering October 12-17 (Beijing, China)pp240-255.*
2. *Glagovsky V B and Kourneva E V (2008)Numerical modeling of concrete face rockfill dam at seismic impact The 14 World Conference on Earthquake Engineering October 12-17, (Beijing, China)pp150-165.*
3. *Salyamova KD, Rumi DF andTurdikulovKhX(2018) Analysis of seismic stability of retaining earth structures with account of dissipative properties of soil. Europeansciencereview 11–12 November–December Vol.1 (Vienna, Austria)pp 81-84.*
4. *Goldin AL and Rasskazov LN (2001) Design of earth dams.(Moscow)p 384.*
5. *Dalmatov BI (1981) Soil Mechanics, Bases and Foundations. (Moscow:Stroiizdat) p 319*
6. *Mirsaidov MM (2010) Theory and methods of calculating earth structures for strength and seismic resistance. (Tashkent:Fan) p 312.*
7. *Mirsaidov MM and Matkarimov PZh (2003) Investigation of the stress-strain state of earth dams in a three-dimensional statement, J.FerPI, 2 (Fergana).pp 57-61.*
8. *Mirsaidov MM,Matkarimov PZh andYuldashev BSh 2005 Study of the dynamic behavior of earth structures taking into account the different strain properties and water saturation of soils. J. Earthquakeresistantconstruction. Safetyofbuildings. 5(Moscow) pp 15-20.*
9. *Rumi DF and Salyamova KD(2015) Influence of rock fracturing on the stress-strain state of an earth dam J. Vestnik Tashkent State Technical University. 3. (Tahkent) pp253-256.*
10. *Sultanov KS andMirzaev AG(1999) Model of deformation of subsiding soils taking into account water contentDAN RUz. 7.(Tashkent) pp32-35.*

11. *Guidelines for accounting for seismic effects in design of hydro-technical structures(1977)Building norms SNiP II-A.12-7). - L.: VNIIG named after Vedeneev. p 164.*
12. *Construction in seismic areas. Hydro-technical structures (2004)ShNK 2.06.11-04 (Gosarchitekstroy. Tashkent) p 54.*
13. *Salyamova KD and Rumi DF (2015)The dynamics of earth hydrotechnical structures, taking into account the rheological properties of soil. Scientific-theoreticaljournal 3 (Vestnik BGTU) pp16-35.*
14. *Salyamova KD and Rumi DF(2015)The dynamics of earth structure, taking into account dry and viscous friction in soil Scientific-technical and production journal 1 (GorniyVestnik Uzbekistan)pp78- 61.*
15. *Salyamova KD and Rumi DF(2015) Dynamics of earth dams. (LAP LAMBERT Acad. Publishing) p 150.*
16. *Sultanov KS and Khusanov BE(2001) Equations of state of subsiding soils, taking into account water content. 3. Foundations, basesandsoilmechanicspp7-11.*
17. *Mirsaidov MM,Sultanov TZ and RumiDF (2010) Assessment of dynamic behavior of "structure-foundation" system with regard to the wave energy entrainment 4.Engineering and Construction Journal –(St. Petersburg) pp 94-105.*
18. *Salyamova KD and Rumi DF(2016) Numerical analysis of the stress-strain state of the system "earth structure-base" 9 J. Siberian Federal University.(SFU.Tekhnika.Tekhnologii) pp516-535.*
19. *Zenkevich OK(1975)The Finite Element Method in Engineering. (Moscow:Mir) p 542.*
20. *Obraztsov IF,Saveliev LM and KhazanovKhS(1985)The Finite Element Method in Problems of Structural Mechanics of Aircraft (Moscow: Higher School) p 392.*

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A Pattern Recognition Model of Python Programming using Artificial Neural Network via NeMo

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ABSTRACT

Background/Objectives: In the field of software development, the diversity of programming languages increases dramatically with the increase in their complexity. This leads both programmers and researchers to develop and investigate automated tools to distinguish these programming languages. Different efforts were conducted to achieve this task using keywords of source codes of these programming languages. Therefore, instead of using keywords classification for recognition, this work is conducted to investigate the ability to detect the pattern of a programming language characteristic by using NeMo(High-performance spiking neural network simulator) of neural network and testing the ability of this toolkit to provide detailed analyzable results. Methods/Statistical analysis: the method of achieving these objectives is by using a back propagation neural network via NeMo based on pattern recognition methodology. Findings: The results show that the NeMo neural network of pattern recognition can identify and recognize the pattern of python programming language with high accuracy. It also shows the ability of the NeMo toolkit to represent the analyzable results through a percentage of certainty. Improvements/Applications: it can be noticed from the results the ability of NeMo simulator to provide beneficial platform for studying and analyzing the complexity of the backpropagation neural network model.

Keywords: NeMo, Pattern recognition, artificial neural network, Backpropagation neural network.

I. INTRODUCTION

NeMo (Neural Modules) is a Python framework-agnostic toolkit for creating AI applications through re-usability, abstraction, and composition. NeMo is built around neural modules, conceptual blocks of neural networks that takes typed inputs and produce typed outputs. Such modules typically represent data layers, encoders, decoders, language models, loss functions, or methods of combining activations. NeMo makes it easy to combine and re-use these building blocks while providing a level of semantic correctness checking via its neural type system. In the last decade, a wide range of programming languages for a variety of tasks have been created in the software development field (philip Mayer ،April 2015). This diversity makes it difficult for new students and developers to recognize the exact programming language that been used in complex systems.

Especially in the systems that require using a combination of programming languages such as python, Java or Ruby (philip Mayer ،April 2015). Therefore, it would be beneficial to develop a tool for identifying programming language codes based on its pattern. One of the attempts to achieve this task is conducted by M. Robson (Montenegro ، 2016) and (Jyotiska Nath Khasnabish, 2014) through training a

neural network model to classify programming codes based on its language. According to M. Robson (Montenegro ، 2016) , this classifier identifies programming languages based on syntax codes in the form of words. Robson suggests using the characters' patterns of the programming language instead of these keywords. Therefore, instead of using the classification of keywords in the codes for different programming languages, this work aims to investigate the ability of back propagation neural network (BNN) to identify and recognize the programming language (python) based on the pattern of each particular code characteristics. This paper also aims to investigate the ability of NeMo, a neural network simulation, to represent analyzable results.

II. BACKGROUND

2.1 Pattern Recognition

Pattern recognition can be defined as a methodology of designing systems that can identify or classify patterns in complex environment (Sargur N. Srihari ، 1993) . It also “can be seen as a classification process” (SALIBA ، 2014) . It aims to study and monitor environment for a potential pattern and make a proper decision about it (Jayanta Kumar Basu ، 2010) .

According to Sharma and Kaur (Priyanka Sharma 2013) the basic algorithm of pattern recognition can be illustrated in Figure 1

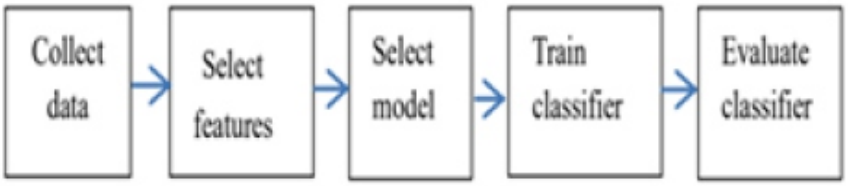

Figure 1. Algorithm of pattern recognition (Priyanka Sharma ، 2013) .

shown in Figure 1, the first part of this algorithm is collecting data then selecting the features from the data to be recognized. After preparing input data, suitable recognition model is selected. This model is trained to recognize the potential pattern. Finally, the system is evaluated to check it behavior. In addition, Based on Sharma and kaur classification, the main model of pattern recognition are statistical model, syntactic model, template matching model, and Artificial neural network which is characterized for “ the ability to learn complex nonlinear input- output” (Priyanka Sharma ، 2013) .

2.2 Artificial Neural Network

Essentially, the idea of artificial neural network (ANN) is based on the concept of how the information processes inside humans and animals brains. This concept can be oversimplified as a complex network of trillions of nerve cells interconnected with each other via pulses called action potentials (Smith ، 1997) . According to Steven W. S.

(Smith ، 1997) , ANN aims to mimic this process as much as possible. Which means mimicking the most important ability in human mind, which is the ability of learning. This is differs from the linear algorithm of regular machine methodology to solve problems. In other words, ANN can be simply defined as computer algorithms that consist of simple entities interconnect with each other to form an interaction of behaviour in response to different states of input (Gurney ، 1997) . It is structured in the form of layers each of which is consisting of a number of nodes that interconnected with each other through mathematical functions. According to Krenker A. et al (Andrej Krenker ، 2011) the basic element of any

ANN is a neuron, which is designed based on the neuron in a biological neural network. This neuron is structured as shown in Figure 2.

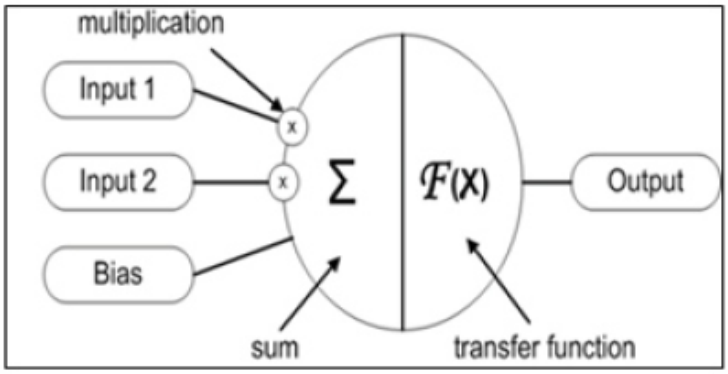

Figure 2. The structure of the artificial neuron (Andrej Krenker, 2011)

Each neuron operates by receiving inputs, which are either the system inputs or the output from other neurons that are connected with this neuron. These inputs are weighted Each neuron operates by receiving inputs, which are either the system inputs or the output from other neurons that are connected with this neuron. These inputs are weighted individually and the neuron sums it with each other and with the bias, and then the result of this summation is processed through transfer function.

In addition, According to Haykin S. (Haykin ، 2008) , the learning concept of ANN is categorized as the following:

Supervised learning: In this learning methodology of neural network , the system is trained by providing it with desired behavior (output data) for a set of specific inputs.

Unsupervised learning: This type of learning algorithm does not require providing target output. it may seems difficult to illustrate , however it can be simplified as an algorithm that aims to find a pattern in given input data , which can be used for decision making , prediction and so on (Ghahramani, 2004).

Reinforcement learning: This type of learning algorithm aims on interacting with its environment "to learn to act in a way that maximizes the future rewards it receives (or minimizes the punishments) over its lifetime" (Ghahramani, 2004).

2.3 Backpropagation Neural Network

Backpropagation neural network (BNN) is a one of the most popular supervised ANN, which is, as the name implies, uses the backpropagation algorithm concept for learning. It is developed in 1970 to solve the limitation of neural network (NN) algorithm, which failed to address XOR issue (Shihab, 2006). According to shihab K. the BNN is basically consist of a small pieces that interconnect together to solve complex issues (Shihab, 2006). It is a feed forward with a structure of Multi-layer, which is learning based on error back feeding (Jing Li, 2012).

According to (RashmiAmardeep, 2017) , BNN is considered as a type of learning and training algorithm rather than being a type of neural network. In order to train this network, it is required to provide the BNN with output data for specific input. After training the network, it will be ready to recognize any input pattern based on the pattern of training data (RashmiAmardeep, 2017). Typically, the structure of a

standard backpropagation network consist of three layers: input, hidden layer and output layer (Mutasem Alsmadi, 2009). This structure is shown in Figure 3.

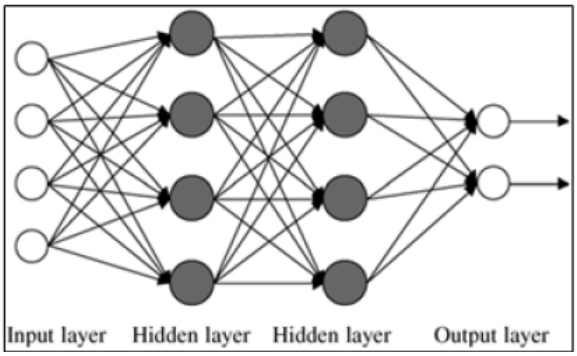

Figure 1 The structure of Backpropagation network (Mutasem Alsmadi, 2009)

The learning algorithm of backpropagation is essentially based on the theory of error –correction-learning concept "which uses the error function in order to modify the connection weights to gradually reduce the error (Alaeldin Suliman, 2015).

In another word, the network modifies the connections between its layers' neurons by changing the weights that related to each of these neuron functions as illustrated in the previous section. The weight changing aims to minimize the differences between current output of the network and desired target output. Many applications can be used to build and design a neural network with backpropagation methodology such as Simbrain and Matlab.

2.4 NeMo

The core building block in NeMo is called Neural Module (NM). A Neural Nodule represents a logical part of a neural network such as a language model, an encoder, a decoder, a data augmentation algorithm, a loss function, or other sets of layers and functions. As the primary abstraction in NeMo, NMs form the basis for describing a model and the process by which that model is trained. Formally, a Neural Module is a component that computes a set of typed outputs given a set of typed inputs. Inputs and outputs are collections of multidimensional tensors. In the same way that a programmer in an object-oriented language can choose at what level of granularity to define an object, a NeMo user can choose the level of granularity of a Neural Module. A basic rule is that inputs and outputs should "make sense" to expose via an interface. This suggests that a Neural Module is not typically a single neural network layer, but rather a collection of connected layers that "do something useful" such as an encoder, a concatenation operation, a loss function, or a data augmentation.

NeMo Core

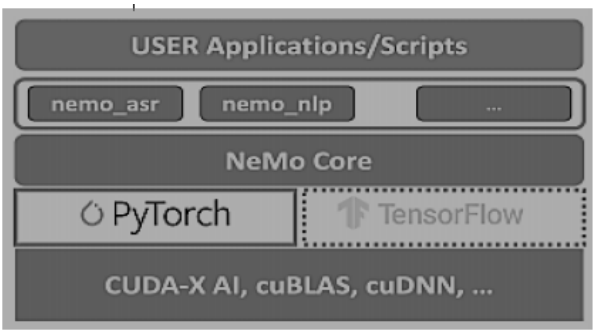

Figure 4: NeMo is a framework-agnostic toolkit which serves as abstraction l evel between application and DL frameworks

NeMo allows users to create callbacks for routines performed during training such as evaluation, logging, and performance monitoring.

III. METHODOLOGY

The aim of this work is to test and investigate the ability of BNN via NeMo toolkit to distinguish and recognize the pattern of python programming language. This is conducted by applying the algorithm of pattern recognition, which is presented by Sharma and Kaur (Priyanka Sharma, 2013); see Figure 1. Firstly, the data are collected from the most common syntax codes of python language. Then these codes are converted into a form of binary array, from which the features of potential pattern are selected. This is follow by selecting BNN as the model used for pattern recognition. This model is then trained using the collected data. Finally, the trained BNN model is evaluated by applying three tests. In the first test, the evaluation is conducted by applying the proposed BNN with ten arbitrary python syntax codes to check how it behaves. While in the second test, the system is checked using ten words and sentences to investigate its ability to recognize non-python pattern. Eventually, the third test check the confusion behavior of the system when it is applied with ten confusion data. In addition, another objective of this work is to check the ability of NeMo toolkit to represent analyzable, measurable results. This is conducted by observing the results of each of above results numerically.

3.1 Collected Data

The input data for this work are collected from the most used addition of two number python program programming syntax codes that distinguish python programming language from other languages. Instance for these codes can be as the following:

```
a = 1
b= 2
sum = a + b
print ("sum ",sum)
```

Table 1. Sample of input data representation

Tim	a	b	c	d	e	f	g	h	I	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	;	(	)	“	“	=	+	,	1	2
a=1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	01	0	1	0	0	1	0
b=2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Sum=a+b .	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Print(“sum:”,sum)	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0

IV. DESIGNING THE BACKPROPAGATION NEURAL NETWORK

As presented previously, the proposed neural network is designed and implemented using NeMo toolkit. This is conducted by creating a neural network with 36 input neurons in in the first layer, 16 neurons in the hidden layer, and 2 neurons in the output layer.

The 36 input neurons represent the signs for python programming code, while the 2 neurons in output layers represent the indication part of the model that detect whether the inputs pattern is python programming language or not . This is shown in Figure 4 and 5

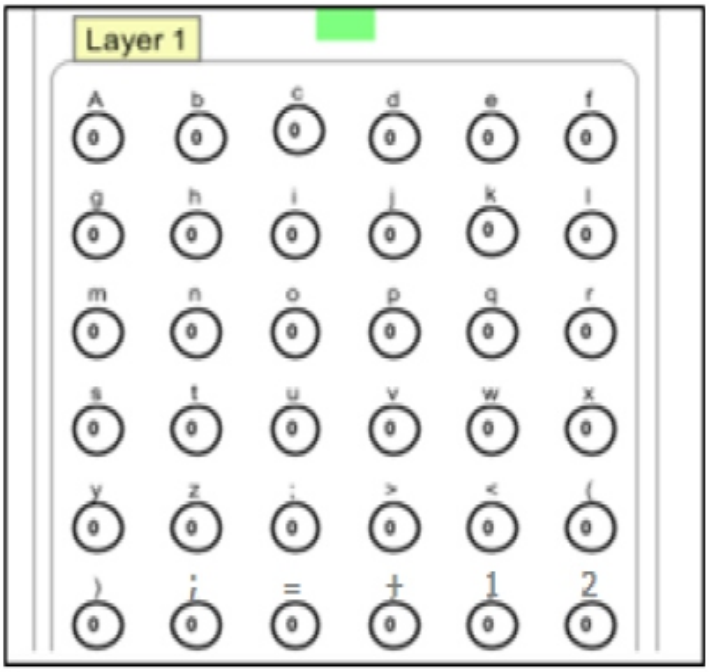

Figure 4. The first layer of the network

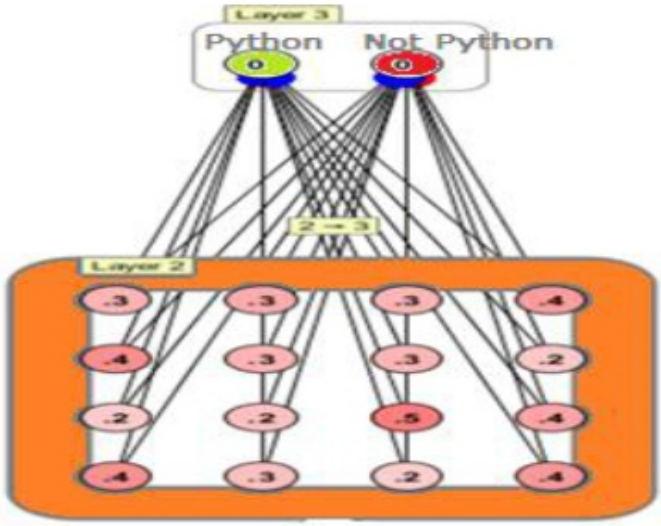

Figure 5. The second and the third layer of the neural network

It can be noticed that the NeMo platform provides the ability to illustrate the interconnection between these layers.

V. TRAINING THE MODEL

The proposed NeMo back propagation neural network (SBNN) is trained in this work by applying the network with 1500 training inputs and 1500 target outputs. As presented previously, these inputs are structured in a form of zero-one, which are imported into the system in CSV file. A sample of these inputs is shown in Figure 6.

The training inputs can be classified into two groups. First group is a data set of python codes, while the second group is a data set of non-python words pattern.

Table 2: Training input in .CSV file

Input data

#	Neuron_1	Neuron_2	Neuron_3	Neuron_4	Neuron_5	Neuron_6	Neuron_7	Neuron_8	Neuron_9	Neuron_
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
3	0.0	0.0	1.0	1.0	11.0	0.0	0.0	0.0	11.0	0.0
4	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.0	0.0	1.0	0.0	11.0	0.0	1.0	0.0	1.0	0.0
6	1.0	0.0	1.0	1.0	1.0	0.0	1.0	0.0	11.0	0.0
7	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
8	11.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0
10	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0
11	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0
12	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0
13	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
16	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
18	1.0	0.0	1.0	1.0	11.0	0.0	0.0	0.0	11.0	0.0
19	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1.0	0.0	1.0	0.0	11.0	0.0	1.0	0.0	1.0	0.0
21	1.0	0.0	1.0	1.0	1.0	0.0	1.0	0.0	11.0	0.0
22	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
23	11.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0

Target data

#	Neuron_53	Neuron_54
1	0.0	0.0
2	1.0	0.0
3	1.0	0.0
4	1.0	0.0
5	1.0	0.0
6	1.0	0.0
7	1.0	0.0
8	1.0	0.0
9	1.0	0.0
10	1.0	0.0
11	1.0	0.0
12	1.0	0.0
13	1.0	0.0
14	1.0	0.0
15	1.0	0.0
16	1.0	0.0
17	1.0	0.0
18	1.0	0.0
19	1.0	0.0
20	1.0	0.0
21	1.0	0.0
22	1.0	0.0
23	1.0	0.0
24	1.0	0.0
25	1.0	0.0

Let's train the Neural Network for 1500 iterations and see what happens. Looking at the loss per iteration graph below,

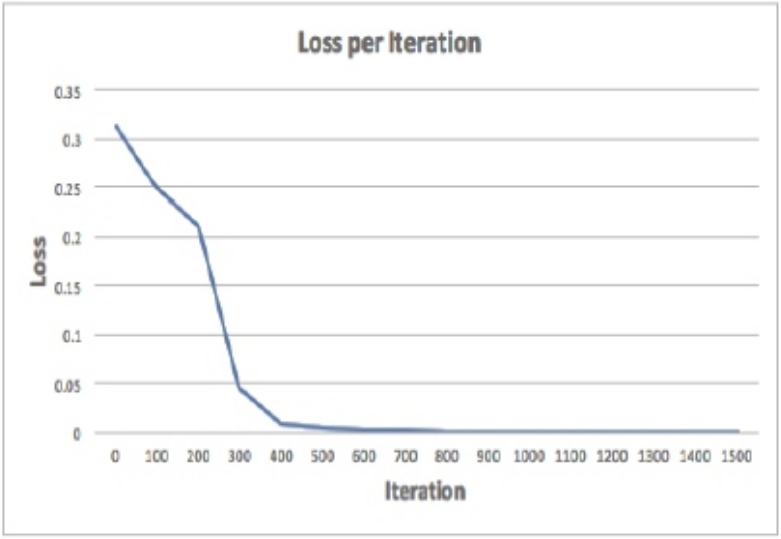

Figure 6: Loss per Iteration rate

IV. ANALYSIS AND DISCUSSION

According to the results presented in previous section, the behavior of SBNN model shows high accuracy of pattern recognition. This ability to measure the accuracy and certainty of the system can be noticed from the results, for instance when the pattern is more likely python, the network gives more probability for python than not python in the output layer. The network shows this probability in the form of a range of number between 0 and 1. When 0 represent 0% while 1 represent 100%. This range and certainty depends on the quantity and the quality of the data used in the system training. Furthermore, the results also show the high numerical and graphical ability of NeMo toolkit for analysis and study this can be seen in the behaviour of the second layer, see Figure 5. This gives an opportunity to study the model in more details for future works.

VII. CONCLUSION

By growing the diversity of software applications, the programming languages that are used to develop these applications upturn too. Consequently, taking an automated tool to differentiate these programming languages would be very useful for developers and scholars. In this paper we demonstrated a pattern recognition model using back propagation neural network via NeMo toolkit to recognize python programming language codes. This model success to identify the patterns of different inputs with high accuracy. The result also shows a high ability of NeMo to provide numerical and graphical results for both research study and analysis. For future work, it is recommended to increase training data and perform more tests on the model. In addition, it is suggested to test the proposed pattern neural network via matlab toolkit and using the matlab model to conduct a comparative evaluation study with the current NeMo model.

REFERENCES:

1. *A. B. Philip Mayer, "An Empirical Analysis of the Utilization of Multiple," in 19th International Conference on Evaluation and Assessment in Software, April 2015.*
2. *R. Montenegro, "Source Code Classification Using Deep Learning," 30 8 2016. [Online]. Available: http://blog.aylien.com/source-code-classification-using-deep-learning/. [Accessed 7 8 2019].*
3. *M. S. J. D. G. S. Jyotiska Nath Khasnabish, "Detecting Programming Language from Source Code Using Bayesian Learning Techniques," Springer International Publishing Switzerland 2014, p. 513–522, 2014.*
4. *C. Sargur N. Srihari, "pattern recognition," London, Chapman, 1993, pp. 1034-1041.*
5. *E. SALIBA, "An overview of Pattern Recognition," University of Burgundy, Antonine University, pp. 1-7, 2014.*
6. *D. B. ,. T.-h. K. Jayanta Kumar Basu, "Use of Artificial Neural Network in Pattern Recognition," International Journal of Software Engineering and I International Journal of Software Engineering and Its Applications, vol. 4, no. 2, pp. 23-34, 2010.*
7. *M. K. Priyanka Sharma, "Classification in Pattern Recognition: A Review," International Journal of Advanced Research in Computer Science and Software Engineering, vol. 3, no. 4, pp. 298-306, 2013.*
8. *S. W. Smith, "Chapter 26: Neural Networks (and more!)," in The Scientist and Engineer's Guide to digital signal processing, California, California Technical Pub; 1st edition (1997), 1997, p. 626.*
9. *K. Gurney, An introduction to neural networks, london, new york: UCL Press, 1997.*
10. *J. B.,. A. K. Andrej Krenker, "Introduction to the Artificial Neural Networks," in Artifital neural network, In Tech, 2011, p. 362.*
11. *S. Haykin, Neural Networks and Learning Machines Third Edition, Hamilton, Ontario, Canada: Pearson, 2008.*
12. *Z. Ghahramani, "Unsupervised Learning," Springer-Verlag Berlin Heidelberg, pp. 72-112, 2004.*
13. *K. Shihab, "A Backpropagation Neural Network for Computer Network Security," Journal of Computer Science, vol. 2, no. 9, pp. 710-715, 2006.*
14. *J.-h. C. J.-y. S. F. H. Jing Li, "Brief Introduction of Back Propagation (BP) Neural," springer, vol. 2, pp. 553-558, 2012.*
15. *K. T. RashmiAmardeep, "Training Feed forward Neural Network With Backpropogation Algorithm," International Journal Of Engineering And Computer Science, vol. 6, no. 1, pp. 19860-19866, 2017.*
16. *K. O. . S. A. M. N. Mutasem Alsmadi, "Back Propagation Algorithm: The Best Algorithm among the Multi-layer Perceptron Algorithm," International Journal of Computer Science and Network Security, vol. 9, no. 4, pp. 378-383, 2009.*
17. *Y. Z. Alaeldin Suliman, "A Review on Back-Propagation Neural Networks in the Application of Remote Sensing Image Classification," Journal of Earth Science and Engineering, vol. 5, pp. 52-65, 2015.*
18. *j. y. Zachary Tosi, "Simbrain 3.0: A flexible, visually-oriented neural network simulator," Elsevier journal neural network, vol. 83, pp. 1-10, 2016.*
19. *W.-L. L. ,. L. L. Tung-Hsu Hou, "Intelligent remote monitoring and diagnosis of manufacturing processes using an integrated approach of neural networks and rough sets," Journal of Intelligent Manufacturing , vol. 14, no. 2, pp. 239-253, 2003.*

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