AUTOMATING AND OPTIMIZING TIMETABLE ON MUNTINLUPA ELEMENTARY SCHOOL USING FIREFLY SWARM ALGORITHM

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This thesis hereto entitled:

AUTOMATING AND OPTIMIZING TIMETABLE ON MUNTINLUPA ELEMENTARY SCHOOL USING FIREFLY SWARM ALGORITHM

prepared and submitted by **EUCLIDE ANDRAE F. ARROYO, CAMILA D. FUNCLARA, ELIJAH RAVEN G. PADLAN, GENESIS DANE C. PALLARCO** in partial fulfillment of the requirements for the degree **BACHELOR OF SCIENCE IN COMPUTER SCIENCE** has been examined and is recommended for approval and acceptance.

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ABSTRACT

Manual scheduling at Muntinlupa Elementary School has caused inefficiencies and conflicts in timetables. Teachers' schedules were not optimized, and conflict in class schedules were prominent in manual scheduling. This research automates and optimizes the school's timetable using the Firefly Swarm Algorithm to help the Muntinlupa Elementary School optimize the teachers' schedules and classes per grade level. A quantitative approach with historical data was employed to develop and test a simulation model. Findings show that the algorithm significantly reduces conflicts and improves resource allocation. The automated system is adaptable and scalable, proving more effective than manual methods. The study concluded that the Firefly Swarm Algorithm enhances timetable efficiently, promoting a more organized educational environment for both teachers and students.

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THE PROBLEM AND ITS SETTINGS

Introduction

The scheduling of activities and events in accordance with the resources that are available, as well as any limits that are relevant to the circumstance, is what is meant to be expressed by the term "timetabling," according to what is intended to be communicated by the phrase "timetabling" This is done so that we may achieve the highest possible level of productivity. This can be carried out in a way that is compatible with the multiple constraints that may be imposed. Furthermore, according to (Carter, 2021), this is something that can be carried out in a manner that is compatible with the numerous limits that may be applied. In the context of traditional public schools, this may include matching instructors with certain courses and organizing pedagogical programming such that it is delivered at regular intervals of time. There is also the chance that it will use a hybrid technique, a combination of the two different tactics explained in this paragraph. Creating a strategy that is not just doable but also feasible is often an NP-hard problem, which means that there is no answer that can handle the issue in a period that is polynomial. This implies that the problem is difficult to solve. Creating a schedule that is not only sensible but also doable is often a difficult thing to take on. As a result of this, designing a schedule that achieves both goals may prove to be rather difficult. To put it another way, no solution can be provided for the issue that has been posed. This is since the problem must be addressed and is relatively difficult to tackle (Dayagbil et al., 2021).

Over the last few years, the use of metaheuristic algorithms has evolved into a strategy that is gaining popularity to address the challenges associated with scheduling. This method was developed as a way of overcoming the challenges that are associated with scheduling. The challenges that relate to scheduling led to the development of this approach as a means of finding a solution to such challenges. It is expected that this trend will continue in the future. It is expected that this trend will continue for at least the foreseeable future. Researchers working in search algorithms referred to as metaheuristics have access to a source of inspiration in the form of natural norms, which they can use to inspire themselves (Ezugwu et al., 2021). The activity of fireflies, which consists of flashing their lights in fast succession, was the motivation for the invention of a kind of algorithm known as the Firefly Swarm Algorithm. This method is used to solve problems that include swarms of fireflies. Finding patterns in large amounts of data may be possible with the use of this technique. The FSA was effective in finding answers to a broad variety of problems that were associated with optimization. The problems that had the most significant influence on the timetable were the ones for which the FSA was able to find a solution. The use of the FSA was the most important component that led to the accomplishment of this mission.

After this study has completed, it would be possible to construct, based on the FSA, a schedule that was appropriate for use in primary public schools and aided in attaining the goal indicated earlier in this paragraph. This schedule was acceptable for use in primary public schools because it will consider the FSA. The FSA was used as the basis for constructing this schedule as it will act as the foundation. In addition, with the assistance of this timeline, the goal mentioned earlier in this paragraph will be simpler to achieve. The

FSA was utilized as a basis for the establishment of this schedule, which then served as its beginning point. This timetable then served as its starting point. In addition, the tactic that was discussed in the section of this paragraph that came before it was assisting in working toward the attainment of the desired aim. It has been agreed that changes were made to the system to bring it into accordance with the criteria that were placed on public primary schools. These requirements were intended to ensure that students were prepared for secondary education. It has been decided that certain prerequisites were required to meet the standards. We reached this conclusion after reaching a resolution that the researchers all agreed upon. These kinds of modifications were carried out to bring the system up to the requirements established in this regard. According to the prior agreement, it was reached that these standards would use these criteria as their primary point of comparison in line with the decision that was made. After reaching a decision, the researchers proceeded to to the next stage of the negotiation process for the settlement. This included, among other things, lowering the number of arguments that break out in the classroom and making sure that all the children have access to the same range of educational opportunities that the other children do.

Background of the study

Due to the limited number of teachers, they are constrained by various obstacles and circumstances, such as the overloading of classes and the loads they are handling. Nonetheless, primary public schools are compelled to construct their class schedules when the time comes for them to do so. In addition, they are driven to think of new approaches

to discover answers to the challenges they face while going through the process of doing so to find a solution. Even though primary public schools have limited access to a variety of resources, they are nonetheless required to develop their own timetables for the many subjects they teach. These educational institutions need to develop a plan that will help them go beyond the restrictions and difficulties they are now dealing with to be successful. They will not be able to reach their full potential unless this condition is met. Even though it is of the utmost importance to consider the preferences of both the students and the members of the teaching staff, it is likely that there will not be enough classrooms, instructors, or other resources to satisfy the requirements of every person. This is even though it is of the utmost relevance to consider the preferences of both the students and the teaching staff members. Even though it is of the utmost significance to take into consideration the preferences of both the students and the members of the teaching team, this does not seem to be the case. The preferences of both the students and the teaching team members have not been considered, even though it is of the highest significance to do so, and this has not been the case. The preferences of the students and the teaching team members are not being considered, even though this is of the utmost significance and should be done to ensure that all bases are covered. When additional concerns like topic requirements, class sizes, and available time slots are considered, the work at hand, which was already tough, becomes substantially more tedious (Dayagbil et al., 2021).

It is possible for manual scheduling techniques to provide results that are not suitable, which may eventually lead to issues such as arguments over the timetable, underutilized instructors and classrooms, and unhappiness among a varied range of stakeholders. Since this is the case, it was suggested that it is of the highest significance to

study the many different computing strategies that may be engaged in the process of automating and optimizing the timetabling operation. Specifically, they believe that it is of the utmost relevance to research the many different computing strategies that may be utilized to automate and optimize the scheduling process. Specifically, they feel that it is of the highest necessity to examine the many alternative computing methodologies that may be used to automate and improve the timetabling procedure. This is something that they believe should be done as soon as possible. They are of the belief that it is of the utmost significance to investigate the many diverse computational techniques that are capable of being used in the process of event scheduling. This is because there are many ways in which events may be scheduled. They have this viewpoint because they are operating on the presumption that acting in this manner would bring about the best beneficial effects possible because of one's actions. They have concluded that this is the case since they feel that carrying out such an investigation may possibly result in significant changes. For this reason, they have concluded that this is the case. As a direct consequence of this, people hold the belief that this is the situation (Mittermeier & Benade, 2023).

The fact that it has been used in the production of schedules shows that it can be used to generate schedules, and the Firefly Swarm Algorithm (FSA) has proved that it can handle a wide range of complicated optimization issues. This is in addition to the fact that it has been used in the production of schedules, which indicates that it can be used to create schedules. The fact that it was used in the process of developing schedules is evidence that it could be utilized in generating schedules. This has been shown by the fact that it has been used in the construction of schedules, which exemplifies the argument being made. Although it also has another function, one of its numerous uses is the generation of

schedules. In addition to that, there is the prospect that it will, at some point in the not-too-distant future, be rendered in this capacity as a service. The FSA proved beyond a reasonable question that it had the capabilities required to carry out these actions, which was the primary goal of its demonstration. In addition to its use in the development of schedules, which is another reason for it, it is possible to use it in this application; this is one of the ways that it may be exploited. Using it in the construction of schedules is another reason for this. In addition, it may be used in the construction of timetables if one so chooses. Its adaptability to various applications and limits, in addition to its wide search capabilities, makes it a fantastic choice for this activity, making it an incredible selection for the development of essential public school schedules (Kumar & Pandey, 2020). It can do so because of its adaptability to a diverse range of uses and limits, which enables it to accommodate a broad range of these uses and restrictions. This is made feasible because of its adaptability to a broad range of limits and objectives, which also makes it possible to cater to various demands and ambitions. As a direct consequence of this, it is an excellent option to consider to design acceptable timetables for public schools.

Objectives of the Study

General Objective

The general objective of the study was to create an optimized timetable for elementary teachers and classes.

Specific Objectives

The study has the following specific objectives:

1. To design the system with the following features:
    a. Step-by-step guide input:
        1. Ability to define size of section and classification of school day per level.
        2. Listing of subjects in accordance with its time, color code, and level.
        3. Listing teachers in each level with their name, subject areas, and time of in, out, and away.
    b. Automated Timetabling:
        1. Use of Firefly Algorithm for generating optimal timetables.
        2. Consideration of constraints of the input values in each step.
    c. Interactive Timetable Editing:
        1. Manual adjustment of generated timetables per cell.
        2. Real-time feedback on changes to avoid conflicts.
        3. Export the timetabling in CSV format.
2. To develop a timetabling system using the Firefly Algorithm with the following tools:

a. Figma – UI design and wireframing

b. GitHub – collaboration and version control

c. TypeScript, HTML, SCSS – for primary language application development

d. Angular – for cross-platform application

e. Visual Studio 2024 – for IDE

3. To test and evaluate the system in terms of system functionality and reliability.

4. Determine the acceptability level of the system using ISO 25010 with the following criteria:

    a. Functional Suitability

    b. Performance Efficiency

    c. Reliability

    d. Interaction Capability

    e. Maintainability

Scope and Limitations of the Study

The scope of the study encompasses three main areas: class timetabling, teacher scheduling, and constraint allowance. In the domain of class timetabling, the study focuses on the development of an automated system aimed at creating class schedules. Notably, it

prioritizes flexibility to accommodate diverse academic requirements and employs intelligent algorithms and optimization techniques to eliminate conflicts efficiently. Regarding teacher scheduling, the study endeavors to automate the scheduling process while considering individual constraints and fostering adaptability through flexible scheduling options. Additionally, it aims to address conflicts and optimize teacher assignments to enhance overall efficiency. Finally, in the realm of constraint allowance, the study aims to identify and incorporate various constraints pertinent to class timetabling and teacher scheduling. It endeavors to balance these constraints to ensure equitable distribution and effective utilization of resources while also designing a system that allows for constraint adjustments based on user preferences.

However, this study has limitations that encompass several key areas. First, there is a notable omission regarding the management of physical infrastructure, such as classrooms and maintenance procedures, which falls beyond the scope of the program. Second, although the system permits user edits to accommodate flexibility, there is a potential constraint on the extent of modifications achievable without jeopardizing scheduling efficiency. Last, an acknowledgement is made regarding the learning curve users may encounter, implying that a period of acclimatization to the system may be necessary, along with potential initial usability challenges. These limitations collectively highlight areas for potential improvement and consideration in future endeavors.

Significance of the Study

The purpose of this study was aimed to develop an optimized and automated timetable for the Muntinlupa Elementary School using the Firefly Swarm Algorithm, which could be beneficial to the following:

Administrators. School administrators, especially those making the school's scheduling system, are the main beneficiaries of this study. It aims to help them make their job easier.

Teachers. Teachers who want to adjust their schedules also benefit from this study as it will help them easily view and organize all their classes using the system.

Student. Students can also benefit from this study as it can help them to have a conducive learning schedule without compromising the other classes and their subjects.

Future Researchers. Future researchers could benefit from this study as a reference if they wanted to try other algorithms in making timetabling systems. As well as also applying the system in other education levels.

Chapter 2

CONCEPTUAL FRAMEWORK

This chapter provides an overview of related literature, related studies, the conceptual model of the study, and the operational definition of terms relevant to this study.

Review of Related Literature and Studies

This section presents key concepts and ideas on the topic of the study.

Introduction

From the time of independence in 1946 until the Marcos administration, the Philippine educational system was extended to fulfil the needs of a fast-expanding, predominantly Catholic population (Toh & Floresca-Cawagas, 2003). The current educational system in the Philippines, implemented on June 4, 2012, consists of mandatory kindergarten and 12 years of basic education, called the "K-12" program. This program aims to promote lifelong learners, give students enough time to understand concepts and skills and prepare them for university education, middle-level skill development, employment, and entrepreneurship (Official Gazette, 2018). However, following the COVID-19 pandemic, the schools and institutions were forced to suspend face-to-face classes, leading to school closures (Toquero, 2021). Therefore, the mode of classes was changed from face-to-face to blended learning through various experiments to prevent the spread of the virus. Some of the protocols implemented include putting plastic barriers in the desk and limiting the number of students in a room (Tupas & Linas-Laguda, 2020).

Time and Subject Workload Management

Gul, Tahir, Ishfaq, and Batool (2021) cited in their study that the term "workload" has been used to describe a situation where factors associated with the employee's job are thought to be detrimental to their comfort and health. They also added that workload includes time commitments, paperwork pressure, excess monotony, and lack of stimulation. On the other hand, Zafarullah, Mumtaz, Murad, Abida, & Humera (2016) discussed that people try to reduce time spent doing things by eating more quickly, sleeping for shorter periods of time, and making phone calls while working and eating lunch. This is because life is becoming more and more hurried. This shows how time is perceived, its significance, and management practices in corporate settings that cause workers to feel under time constraints. They also included that time management is the most effective use of time for productivity and achievement. To accomplish the goals and objectives of the organizations, it deals with the management of work schedules through prior planning, organizing, and implementation.

In the Philippines, together with the rules outlined in DepEd Order No. 31 s. 2012, which based on DepEd Order No. 20 s. is still fully operative. DepEd-NCR Memorandum No. 105 s. was issued in 2014 with a focus on time allocation for each learning area and the creation of lesson plans. The memorandum, entitled "Teaching Loads and Assignments of Public School Teachers" dated May 29, 2015, was provided to schools to help school administrators allocate teaching loads. (Llego, n.d.). In response to the problems posed by the pandemic, the DepEd Sample Class Program for SY 2022–2023 offers its sample class

programs. It has supported the government's initiative to promote rigorous adherence to public health guidelines while putting into place regulations ensuring high-quality education throughout this health crisis. (DepEdTambayan, 2022). Furthermore, Llego (2022) added that the DepEd wants to provide schools with enough time to gradually adjust to the necessity to resume five days of in-person instruction because of the COVID-19 pandemic. To comply with the necessary number of school days to meet the learning standards, schools and community learning centers (CLCs) are recommended to follow the academic calendar. This Policy is meant to give schools and CLCs direction and guidance in the resumption of classes, the gradual introduction of the five days of in-person learning, and the organization of curricular and co-curricular activities within the stipulated number of school days.

Strategies for Effective Time and Subject Load Management

Organizing their schedules in advance, determining their highest objectives, and assigning responsibilities to their students are just some of the tactics that may be used. The need for effective time management for elementary school teachers is the topic of discussion in this essay, which strongly emphasises the relevance of the concern. These strategies may be used in the classroom immediately. As for the subject load, the article provides several options for successfully managing the subject load in elementary schools and an analysis of the challenges involved with maintaining control of the subject load in primary schools. The article also discusses the concerns related to managing the subject load in elementary schools. Providing students with the chance to make their own choices, customizing education depending on the needs of individual students, and implementing a variety of instructional methodologies are a few examples of these ideals. The ways in

which these two aspects can be properly controlled are going to be the primary focus of the research. Some of the elements that contribute to effective time and subject load management, such as instructional alignment, student involvement, and teacher preparation, are described in this article, along with a wide variety of additional aspects that contribute in various ways. In Somalia, 80 students from four colleges in Mogadishu, Somalia, participated in the present research, which employed an explanatory and descriptive method to investigate the connection between time management and academic success. Study participants' short-term planning, time attitude, and long-term planning were analyzed. After removing outliers and breaches of the collinearity assumption, we used regression analysis to test three hypotheses on the impact of independent factors on the dependent variable. At schools in Mogadishu, Somalia, two characteristics of time management were shown to have a very substantial, favorable impact on students' grades. The findings of this study may help students learn to better manage their time while attending college.

Challenges and Solutions

It is no secret that teachers in the Philippines' public schools are overburdened (Esguerra, 2018). Teachers in public schools have a heavy schedule that includes both classroom instruction and administrative duties. As a result of all the other things teachers must do, classroom instruction is being pushed to the side. The Department of Education (DepEd) has promised to lower teachers' workload after two public school teachers committed suicide in 2018 (Mateo, 2018), although the specifics have been vague. Moreover, Llego (n.d.) added that the allotted time for each topic is the very minimum needed to facilitate student-teacher dialogue. To facilitate the transfer of classroom

knowledge to real-world contexts, the curriculum allows for additional out-of-school learning opportunities. It is important to keep track of and provide credit for the work that students produce outside of the classroom.

The difficulties and achievements of five first-year instructors were analyzed. Junior high school (JHS) educators have started using the concept of integrated science with their 12–15-year-old pupils. The information was gathered through content analysis, in-depth interviews, and participant observation. We used both inductive and deductive reasoning to determine that the most common problems encountered by NQTs were (a) a lack of teaching and learning resources, (b) time management, (c) a lack of content knowledge, (d) students who didn't understand what they were being taught, (e) student disobedience, (f) students who weren't interested in science, and (g) completing the integrated science syllabus. It's common for first-year educators to feel lost and unprepared. They (a) used what they had, (b) came up with solutions during class, and (c) sought advice from their parents. There have been calls for more financing for elementary schools and preservice teacher education programs to provide children with the finest education possible. Since most instructors already have full workloads, doing educational research has become one of the most difficult duties. The following hypotheses were tested in the study: To what extent do teachers in Masbate Province Division also do research? a. b) What kinds of problems do teacher-researchers encounter when they try to study the classroom? c. what kind of commitments have you made to your own growth and development as a researcher in the field of education? and what potential remedies have been suggested for problems that have arisen for teacher-researchers when doing studies in the field of education? Descriptive research is being conducted. The 50 educator-

researchers' data was subjected to qualitative analysis. Most respondents reported difficulties with research, such as a lack of time, anxiety about writing and performing the study, and seeing it as an extra responsibility. It has also been difficult for them to analyze both quantitative and qualitative data to determine which problems need further investigation. Fortunately, many respondents had participated in learning and development activities such as Division Training, Graduate studies, and LAC sessions, all of which likely helped to the development of their study. Thus, the study's researchers have developed a strategy that future teacher-researchers will utilize to address the problems encountered by those educators doing action research.

To enhance Edukasyon sa Pagpapakatao, teachers' methods and obstacles were explored. Using descriptive, comparative, and correlative methodologies, the researcher studied respondents' characteristics, instructional techniques, and obstacles. Pilot, validation, and reliability testing updated this study's questionnaire checklist. 103 EsP teachers from Educational District IV's public junior high schools were studied. The information is given in textual, tabular, and nominal forms after being examined using a Chi-square test for independence and a one-way analysis of variance. The only demographic variable that exhibited statistically significant changes was the number of years someone had taught EsP, whereas other demographics, including age, gender, marital status, educational level, and conference/workshop attendance, did not. Only chronological age is related to EsP pedagogical approaches. With a mean score of 3.23 and a standard deviation of 0.48, the EsP teaching approach generally performed well. The difficulty of teaching EsP may be broken down into many categories: teacher preparation (2.17), actual classroom instruction (1.84), materials (2.24), and student-family participation (2.69).

Most teachers were 36–40, female, married, had M.A. units, had taught EsP for less than five years, and had attended one- to three-day school-level seminars. Except for parental participation, most responders taught EsP without issues, according to the survey. EsP pedagogy may alter as instructors learn. Age may also impact EsP teaching.

Swarm Intelligence Approach in Timetabling

Significant progress has been made in the field of automated timetabling systems throughout the years (Burke, 2002). One of the most recent and promising ways among these breakthroughs is the use of swarm intelligence systems and algorithms. Swarm intelligence provides a distinct viewpoint by pulling inspiration from natural swarm collective behavior and applying it to problem-solving settings.

Swarm intelligence refers to a class of algorithms that display self-organization and emergent behavior, resulting in efficient and effective solutions. Researchers in this arena have investigated several algorithms, each with its unique set of traits and benefits (Salem, 2015; Tassopolous, 2012; Turabeiah, 2010). The Particle Swarm Algorithm and the Artificial Bee Algorithm are two notable examples that have proven their promise in tackling numerous optimization issues. However, among the several swarm intelligence algorithms available, the Firefly Algorithm has garnered comparatively less attention from academics in the context of timetabling (Musa, 2019). The Firefly Algorithm is inspired by firefly mating behavior and uses their attractive and repulsive qualities to optimize solutions. This technique has received little attention in the timetable arena despite its promise. Considering this research gap, the current study investigated the effectiveness of the Firefly Algorithm in solving the timetabling problem within the framework of the

"Swarm Intelligence Approach in Timetabling." The researchers determined the algorithm's viability as a solution for timetabling optimization by exploring the algorithm's capabilities and evaluating its performance against established benchmarks. This research project revealed an innovative and powerful technique that might change the field of automated timetabling systems, helping industries such as education, transportation, and logistics.

Conceptual Model of the Study

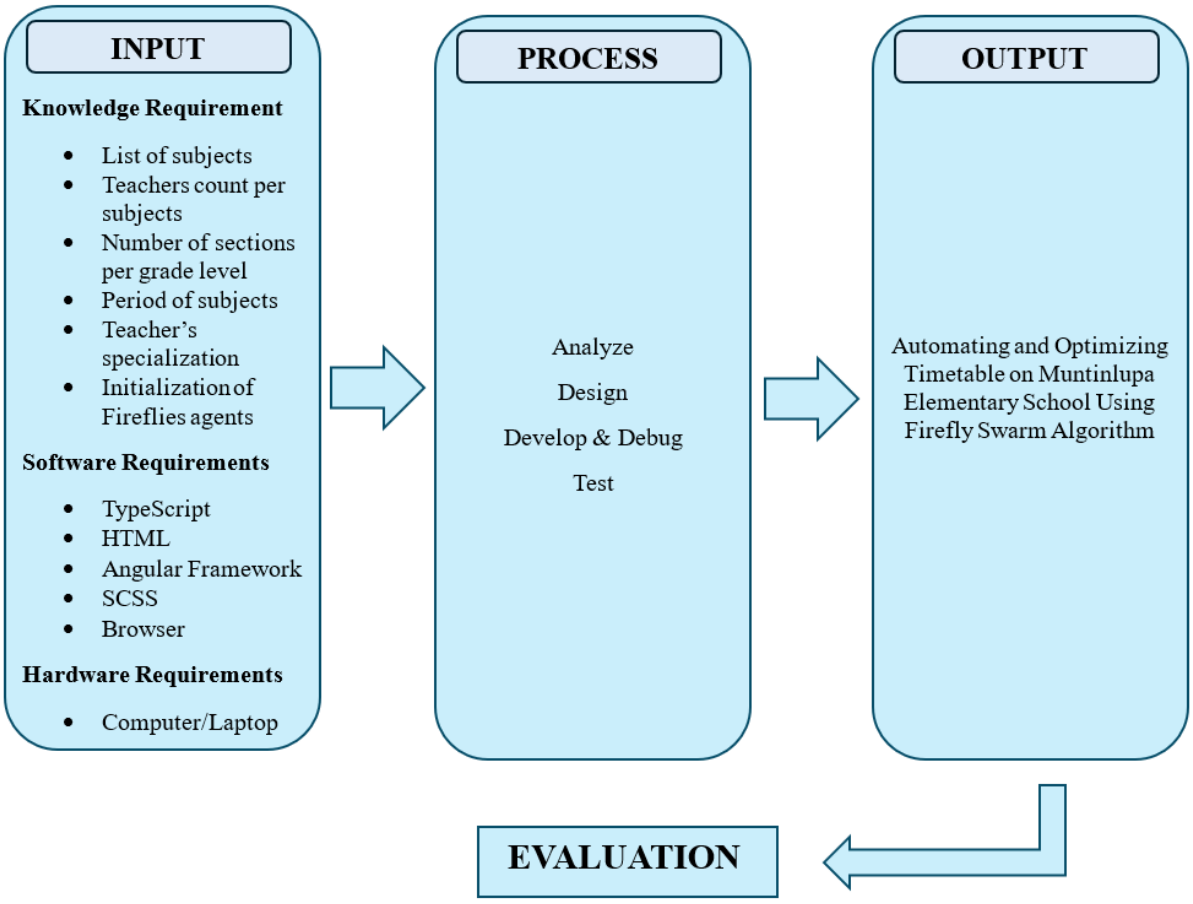


Figure 1. *Conceptual Model of the Study*

Figure 1 presents the conceptual model of the study using the input-process-output (IPO) model.

Input

The input block contains several inputs for the Firefly Swarm Algorithm to create a timetabling system for a public primary school. The number of periods, length of each period, break times, and time slots for certain topics or activities are all examples of inputs that make up a school's scheduling limitations. Teachers' preferences and limitations should

also be considered, such as the number of hours per week they may work or the kind of courses they are certified to teach. Details on the availability of classrooms, such as their size, amenities, and the needs for certain topics or activities, require input. It's important to consider subject requirements, including the quantity of needed periods each week or any qualifications. Finally, enrollment data, such as the number of students in each grade or class, any criteria for student groupings, and individual student needs or preferences, should be included in the input.

Process

The use of the Firefly Swarm Algorithm in establishing a timetable for a basic public school involves a number of phases that need to be completed to be successful. To begin, the algorithm will produce a population of fireflies, which will serve as a stand-in for the various class schedules that are feasible at the school. After that, the fitness of each firefly is evaluated based on objective criteria, such as the reduction in the number of disagreements, the enhancement of the use of the instructor and the classroom, and the observance of the allotted amount of time. Following that, the algorithm is utilized to update the firefly positions, leading them toward better solutions while maintaining a healthy balance between exploration and exploitation. In order to further improve the quality of the timetables, several local search techniques, such as switching periods or modifying schedules, are used. The method analyzes the potential of reaching a termination condition, which may be the accumulation of a maximum number of iterations or the discovery of the best solution that could be found. As soon as the termination condition has been met, the algorithm will provide the best schedule that can be generated from the

available options. This schedule will achieve all of the objectives and work within all the limits provided.

Output

An optimal school schedule that complies with the input requirements and goals would be the result of developing a timetable for an elementary public school using the Firefly Swarm Algorithm. This would be the desired end result. The schedule should contain the distribution of topics to certain times and the allocation of instructors to classes and classrooms to each class. In addition to this, it should consider several criteria, including the reduction of potential conflicts, the maximization of resource usage, and the accommodation of any particular needs or preferences.

Operational Definition of Terms

The following terminologies are defined for a better understanding of the study:

Firefly Algorithm. An optimization algorithm inspired by the flashing patterns of fireflies. It mimics the social behavior of fireflies to solve optimization problems.

Meta Heuristically. In a manner related to or utilizing metaheuristics. Metaheuristics are high-level problem-solving strategies that are designed to find approximate solutions for complex optimization problems.

NP-Hard. A complex class in computational theory that represents a set of problems that are at least as hard as the hardest problems in the class NP (nondeterministic polynomial time). NP-Hard problems are difficult to solve and require exponential time.

Timetabling. The process of scheduling and organizing time slots for various activities, such as classes, meetings, or events. Timetabling problems involve finding an optimal arrangement of tasks within a given time frame, often subject to constraints and preferences.

Workload. The amount of work or tasks assigned to an individual, team, or system within a specific period. Workload can refer to the quantity or complexity of tasks and is often used to measure and manage the distribution of work to ensure efficiency and productivity.

Chapter 3

METHODOLOGY

This chapter contains the project design, project development, operation and testing procedure, and evaluation procedure of the study.

Project Design

Integrating the FSA into a web application, schools can automate and optimize their timetables, leading to improved efficiency and reduced scheduling conflicts.

Key Features of the System:

1. **Firefly Swarm Algorithm Integration**.

   The FSA should be employed to optimize the generated timetables, minimizing conflicts and maximizing resource utilization.

2. **User-Friendly Web Application Interface.**

   A user-friendly web application interface should be developed to provide a seamless experience for viewing, editing, and managing the generated timetable.

   a. **Automated Timetable Generation.**

      The system automatically generates timetables based on user-defined constraints, ensuring compliance with school policies and regulations. The timetable should contain:

      i. **Subjects Scheduling.**

         The system is based on the number of subjects, teachers, and available class times. It should consider factors

such as teacher availability, subject prerequisites, and student preferences to create a conflict-free schedule.

ii. **Teacher Assignment.**

The system optimally assigns teachers to courses based on their qualifications, experience, and teaching preferences. It should also consider factors like teacher workload and expertise to ensure a balance in teaching responsibilities.

iii. **Room Allocation**.

The system allocates classes to available rooms based on class size, equipment requirements, and any special room requirements. It should optimize room usage to minimize room conflicts and maximize space utilization.

b. **Conflict Detection and Resolution**

The system continuously monitors the timetable for potential conflicts, such as teacher availability clashes or room allocation overlaps. It provides suggestions for resolving these conflicts and optimizes the timetable accordingly.

c. **Interaction**

The system allows users to highlight, copy and paste, drag and drop elements inside, adjust preference in a slider for the FSA run, and update an element by renaming and configuring preference.

3. **Data Import and Export.**

   The system facilitates the import of relevant data, such as course information, teacher details, and room specifications. It allows for exporting the timetable in various formats, such as PDF and Excel sheets, for sharing and further analysis.

4. **Performance Monitoring and Reporting.**

   The system provides performance monitoring tools to track the timetable's effectiveness and identify areas for improvement. It should generate reports on teacher workload, room utilization, and student satisfaction.

5. **User Access Management.**

   The system implements a secure user access management system to restrict access to sensitive data and ensure that only authorized users can make changes to the timetable. It should also provide different access levels for administrators, teachers, and students.

Project Development

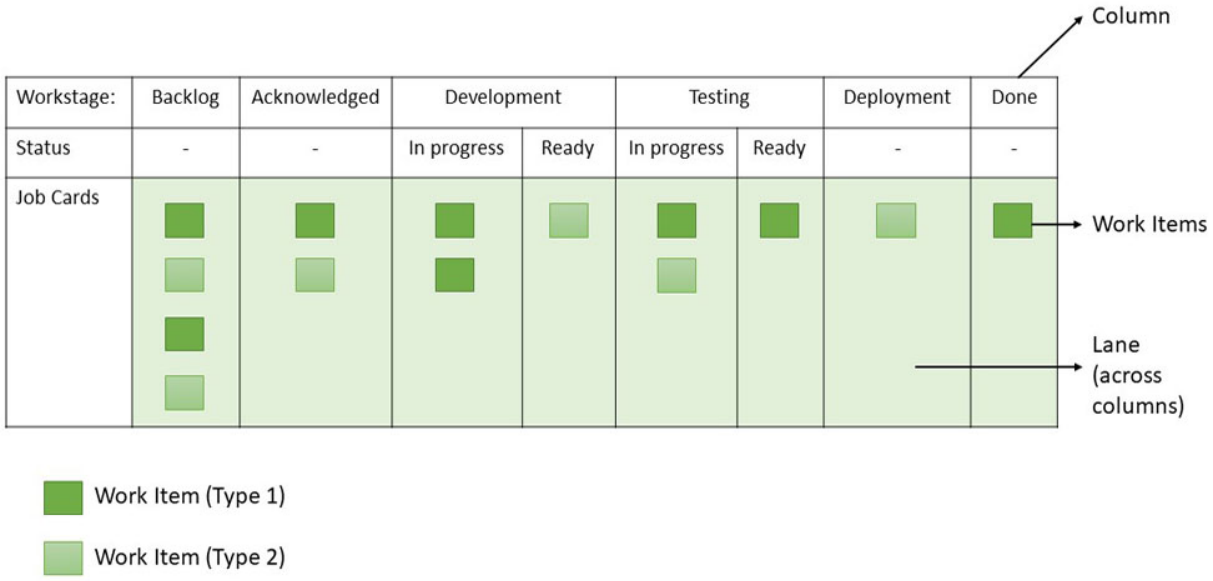


***Figure 2**: Kanban Sample Board*

The researchers have chosen the Kanban workflow for the key development of the project. According to Aderson et al. (2011), it is a visual and structured process for managing work that emphasizes limiting work in progress (WIP) to improve efficiency and reduce waste. It relies on a Kanban board, which is a physical or digital board that displays tasks in various stages of completion. Tasks are represented as cards, which are moved through the different stages of the workflow as they progress.

Kanban board

Kanban board is the visual representation of the workflow, displaying tasks in columns representing different stages of completion.

Cards

Cards include individual tasks, carrying essential information like task description, priority, and due date.

Stages

It refers to the Columns on the Kanban board representing different phases of the workflow, such as To-Do, In Progress, and Done.

WIP limits

It refers to the maximum number of tasks allowed in each stage, preventing overburdening the system and promoting efficient task completion.

Pull system

Tasks are pulled from upstream and downstream stages based on capacity and need, ensuring work flows smoothly without overloading any team or stage.

Visual cues

These cues are colors, symbols, or icons which are used on the Kanban board to indicate task status, priority, or other relevant information.

Feedback loops

These loops refer to the continual monitoring and evaluation of the Kanban workflow to identify bottlenecks, optimize processes, and make necessary adjustments.

Operation and Testing Procedure

The study focused on the development of a website application for automating and optimizing timetables at an elementary school using the Firefly Swarm Algorithm. It involves a well-structured operating and testing procedure to ensure the application's functionality, usability, and performance. The researchers considered the following operating and testing procedures.

Operating Procedure

1. **Gathering Requirements**

   Before developing the website application, gathering all necessary requirements from the school administration, including the number of subjects, teachers, students, classes, and their respective constraints, is crucial.

2. **Data Input**

   Create a user-friendly interface for inputting the gathered requirements into the system. This includes selecting subjects, assigning teachers to subjects, specifying class sizes, and defining teacher availability and preferences.

3. **Timetable Generation**

   Implement the Firefly Swarm Algorithm to generate an initial timetable that satisfies all constraints and minimizes conflicts. The algorithm should be able to handle various scheduling scenarios, such as teacher availability, student preferences, and subject combinations.

4. **Timetable Optimization**

Employ the Firefly Swarm Algorithm to optimize the generated timetable by iteratively improving the solution. This may involve adjusting class times, teacher assignments, and subject combinations to reduce conflicts and increase satisfaction.

5. **Output and Visualization**

   Provide a clear and intuitive interface for displaying the optimized timetable. This may include a table format, graphical representation, or a combination of both.

6. **User Feedback**

   Allow users to provide feedback on the generated timetable. This feedback can be used to further refine the algorithm and improve the overall user experience.

7. **Implementation**

   Implement the website application using appropriate web development technologies and frameworks. Ensure the application is responsive, accessible, and compatible with several browsers and devices.

Testing Procedure

The researchers performed the following procedures:

1. **Unit Testing**

   Conduct unit testing to ensure individual components of the application function correctly. This includes testing data input validation, algorithm implementation, timetable generation and optimization processes.

2. **Integration Testing**

   Perform integration testing to verify that different components of the application work together seamlessly. This involves testing data flow between different modules, user interaction with the interface, and overall system functionality.

3. **User Acceptance Testing**

   Conduct user acceptance testing to evaluate the application's usability and acceptability from the end-user perspective. This involves involving actual school staff and students to test the application in a real-world scenario and provide feedback.

4. **Performance Testing**

   Perform performance testing to assess the application's ability to handle large datasets and multiple users simultaneously. This involves generating scenarios with varying data sizes and user loads to identify potential bottlenecks and optimize performance.

5. **Deployment and Monitoring**

   Deploy the application to a production environment and monitor its performance and usage patterns. This involves tracking user activity, identifying potential issues, and addressing any reported bugs or performance bottlenecks.

6. **Continuous Improvement**

   Continuously improve the application based on user feedback, performance metrics, and emerging requirements. This involves

incorporating new features, refining the algorithm, and optimizing the user experience.

Evaluation Procedure

POINT	SCALE RANGE	EXPLANATION
4	4.00 - 3.00	Strongly Agree
3	2.99 – 2.00	Agree
2	1.99 – 1.00	Disagree
1	1.00 – 0.99	Strongly Disagree

Table 1: *Likert Four-Point Scale Range Interpretation*

The researchers used the ISO 25010 software evaluation instrument to assess the system's level of acceptability. The criteria to be employed in the rating method, which uses a 4-point Likert scale, are Functional Suitability, Performance Efficiency, Reliability, Interaction Capability, and Maintainability. It was evaluated by the users, such as the school administrators who handle elementary school scheduling and teacher allocation.

Chapter 4

RESULTS AND DISCUSSION

This chapter discusses findings from the implementation and testing of the project description, project structure, project capabilities and limitations, and project evaluation.

PROJECT DESCRIPTION

The application is a platform for teachers that provides easy implementation and scheduling of classes based on the DepEd Curriculum provided. The inputs are teachers, subjects, class time per subject, and grade level. The output schedule was an optimized schedule for all grade-level input.

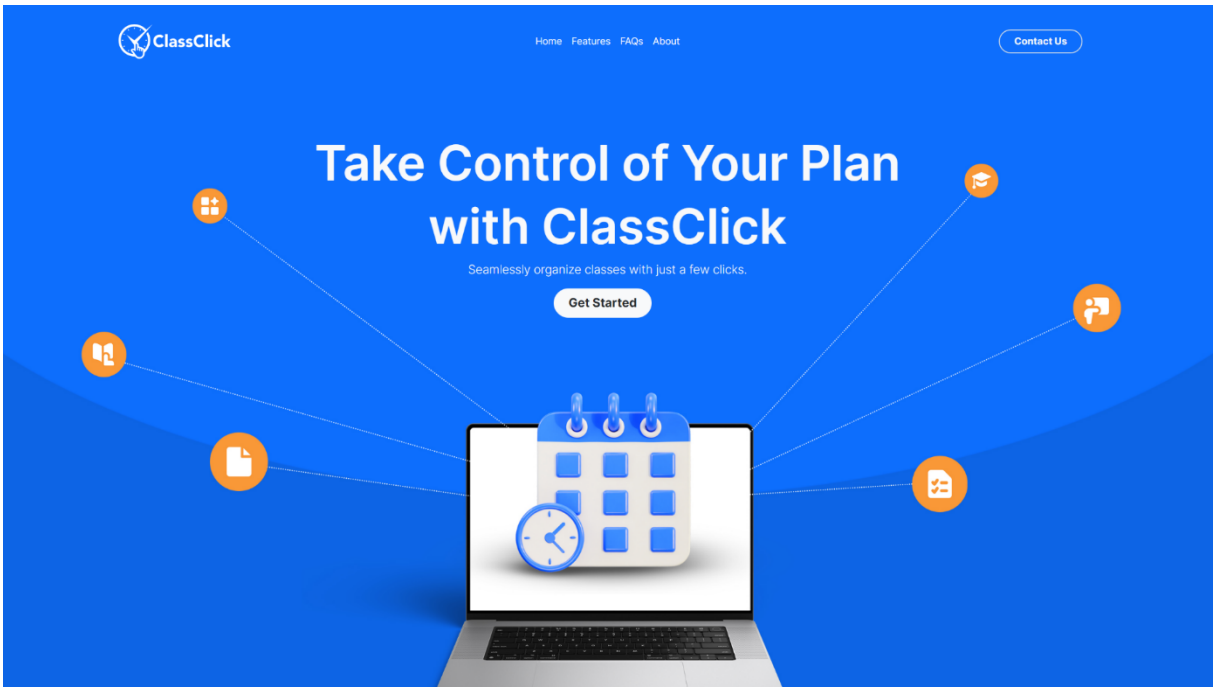


***Figure 3**. Landing Page*

PROJECT STRUCTURE

The system consists of these steps: uploading files such as the list of teachers and subjects. Once the results are generated, the user can export them in an Excel file format for easy access.

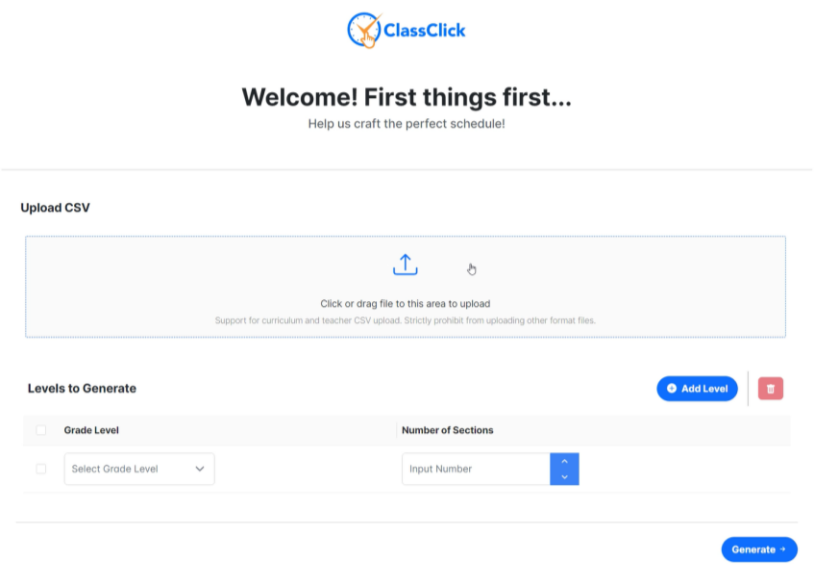


***Figure 4**. File Uploading*

In the figure above, the user can upload the file containing their list of teachers, subjects per grade level, and class schedules. The user can generate a schedule based on the sections available per grade level, optimizing the teacher's time and number of teachers available.

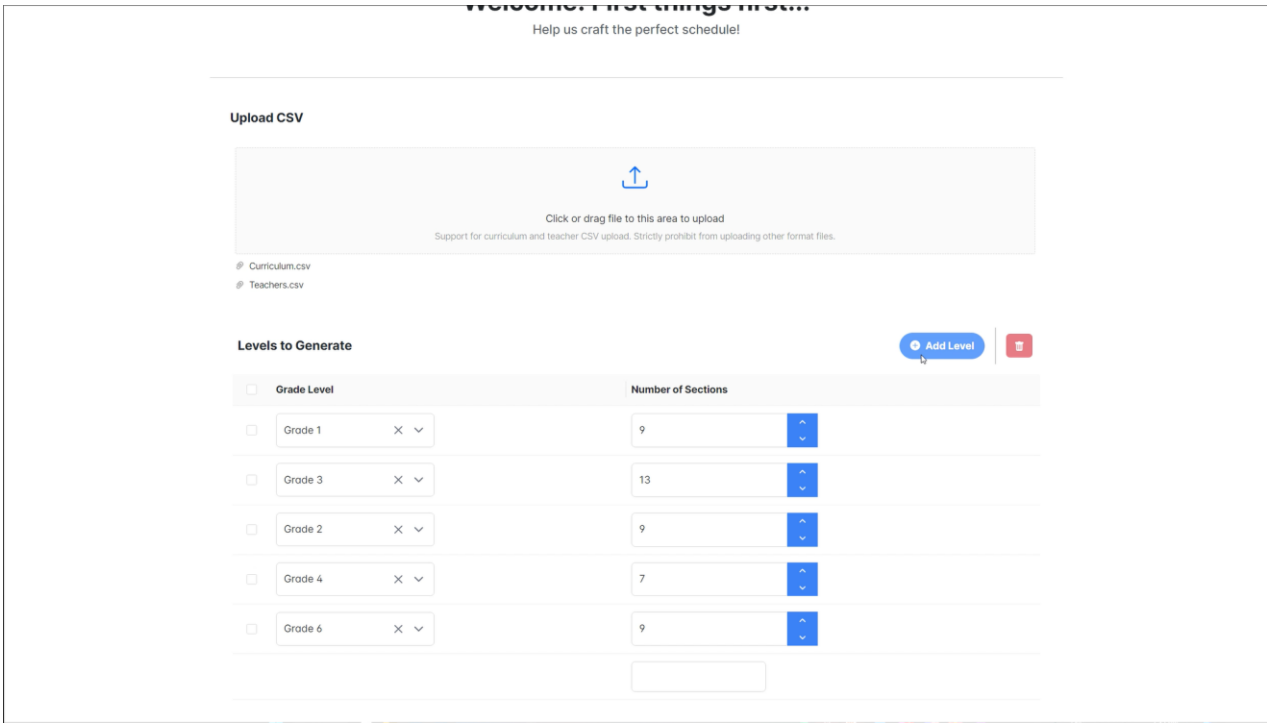


***Figure 5**. Grade Level Generation*

Subject details lane requires the different subjects' names, subject time, color code of each subject if needed, and recess time.

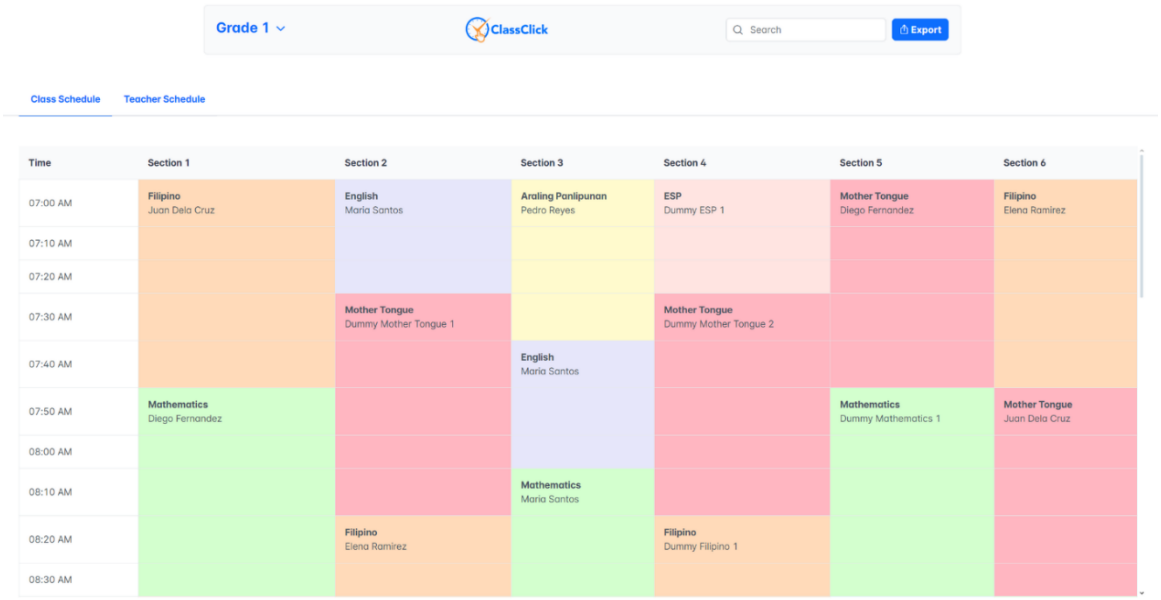


Figure 6. *Class Schedule Result*

The figure shows the result of the generated class schedule per subject per grade level. This includes the number of sections, subject per time, and the possible teacher to handle the subject.

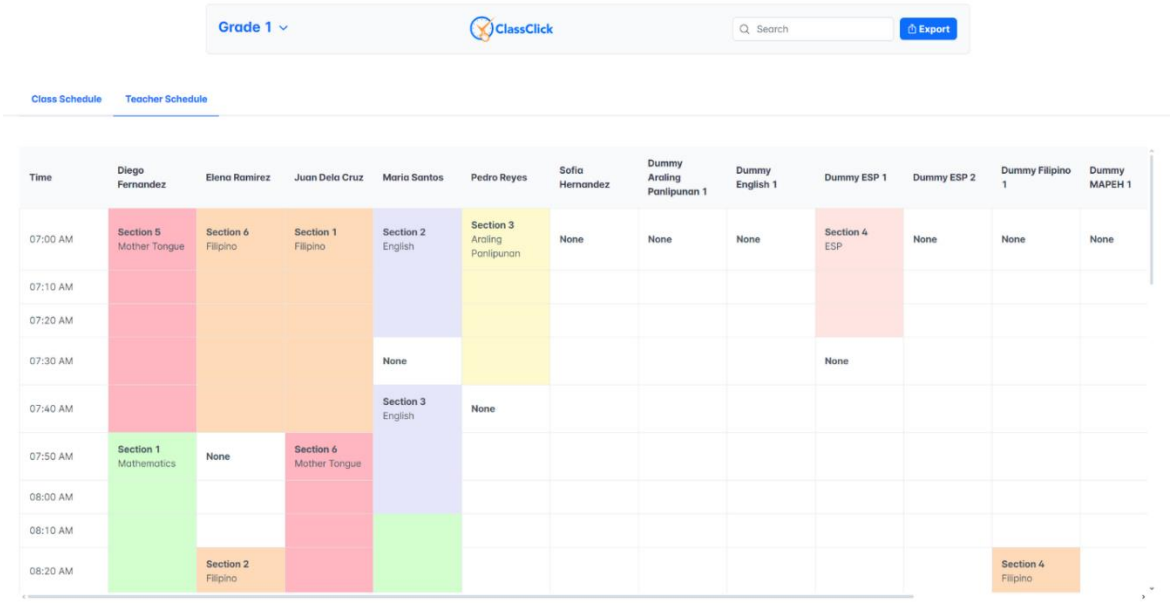


Figure 7*. Teacher's Schedule Result*

The figure shows the generated teacher's schedule from the file uploaded. The sheet shows the teachers' schedule per grade level.

PROJECT CAPABILITIES AND LIMITATIONS

Scheduling in elementary schools involves balancing numerous constraints and preferences. Traditional manual methods are time-consuming and error-prone. This automated scheduling system aims to enhance efficiency, reduce errors, and adapt to varying input parameters.

Project Capabilities

- **Class and Section Schedules**
  - The system generates schedules for grades 1 to 6, automating a traditionally manual process.
- **Teacher Schedules**
  - It also creates conflict-free schedules for teachers, optimizing resource utilization.
- **Optimized Timetabling**
  - Advanced algorithms optimize schedules to minimize gaps and maximize resource use.
- **Flexible Input Parameters**
  - Users can input various parameters, such as class sizes and teacher availability, to tailor schedules to specific needs.
- **User-Friendly Interface**

- The intuitive interface allows easy data entry, schedule generation, and adjustments without extensive technical knowledge.

- **Offline Operation**
    - The system functions without an internet connection, benefiting schools with limited internet access.

Limitations

- **Lengthy Process**
    - Generating schedules can be time-consuming, especially for large schools.

- **Non-Responsive Interface**
    - Despite its dynamic capabilities, the interface may experience delays.

- **Inability to Save Values**
    - Users must re-enter data each time, which can be time-consuming and prone to errors.

- **Lack of Built-In Database**
    - The system lacks a built-in curriculum and teacher database, requiring manual data entry each time.

PROJECT EVALUATIONS

The automated scheduling system's assessment demonstrated its effectiveness in revolutionizing schedule construction by seamlessly integrating the Firefly Swarm Algorithm, which ensured automated scheduling, resource optimization, and conflict reduction. Extensive testing, excellent user feedback, and adherence to ISO 25010 requirements all support the system's usefulness, dependability, and performance efficiency. Improvement recommendations included increasing processing speed, interface responsiveness, data-saving capabilities, and assuring interoperability with numerous devices. The system's success in developing optimum schedules represented a significant step forward in educational management systems, establishing the groundwork for future improvements and wider use.

	Functional Suitability	Performance Efficiency	Reliability	Interaction Capability	Maintainability
Respondent 1	3	3	3	3	3
Respondent 2	3	4	3	4	3
Respondent 3	3	3	3	3	3
Respondent 4	4	4	4	4	3

Respondent 5	3	3	3	3	3
Total	**16**	**17**	**16**	**17**	**15**
Average	**3.2**	**3.4**	**3.2**	**3.4**	**3**

Table 2. *System's Evaluation Table*

Based on the calculated result, the system exhibits a good response from the respondents. Based on the survey conducted among the Muntinlupa Elementary School teachers, as the main user of the system, it passed the usability and functionality required by the users. The system passed the acceptability level based on the ISO 25010 criteria using the 4-point Likert Scale.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY OF FINDINGS

The Firefly Algorithm effectively addresses the complex constraints of elementary school timetable scheduling. By leveraging attraction proportional to brightness, it efficiently explores large search spaces and rapidly converges on high-quality solutions, handling constraints such as teacher availability and classroom capacity with flexibility. Comparative analyses show that the Firefly Algorithm outperforms traditional methods like genetic algorithms and simulated annealing in optimization and robustness. Implementation involves formulating the problem, initializing random schedules, and evaluating and adjusting them iteratively based on brightness until convergence. Case studies confirm the Firefly Algorithm's ability to reduce scheduling conflicts and improve resource utilization. Despite challenges with highly complex scenarios, integrating the Firefly Algorithm with other techniques and developing real-time adaptive variants hold promise for future enhancements. Firefly Algorithm offers a robust and efficient solution for elementary school timetable scheduling.

CONCLUSIONS

The automated scheduling system for elementary schools uses the Firefly Swarm Algorithm to automate scheduling, improve resource allocation, and reduce conflicts. Its user-friendly interface and customizable input settings offer simplicity of use and versatility. The project incorporates cutting-edge technologies for UI design, collaboration, and cross-platform development, ensuring a reliable and scalable solution. Extensive testing validates the system's functionality, dependability, and performance, while good user feedback confirms its usefulness and efficiency. By effectively fulfilling its goal of establishing optimum schedules, the initiative provides the framework for future improvements and expanded implementation, eventually improving educational administration operations.

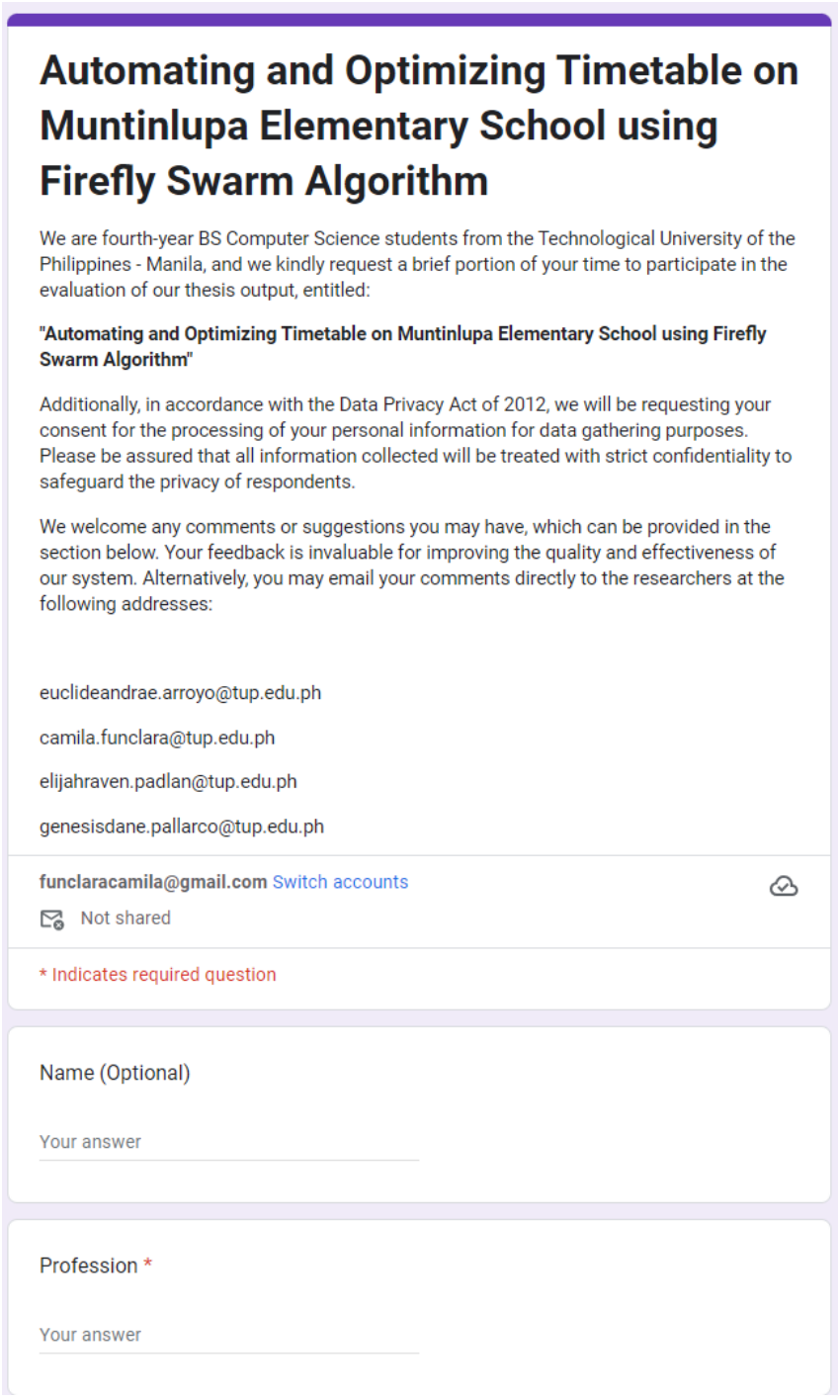
RECOMMENDATION

A series of recommendations have been proposed to refine the automated scheduling system. Foremost among these is the need to enhance processing speed, especially for larger educational institutions, to efficiently generate schedules and boost user satisfaction. Additionally, improving interface responsiveness is crucial to providing a seamless user experience, minimizing delays and fostering better interaction with the software. The implementation of data-saving capabilities is also highlighted, as it would reduce the necessity for redundant data entry, ultimately saving time and diminishing

errors. Moreover, the development of built-in databases for curriculum and teacher information is seen as pivotal in streamlining the scheduling process, making the system more comprehensive and user-friendly. Furthermore, expanding the range of input parameters would allow for the creation of more detailed and tailored schedules, addressing the diverse needs of schools. Ensuring compatibility with various devices, such as tablets and smartphones, is considered essential to enhance accessibility for users. Finally, providing input templates would simplify data entry, mitigate errors, and expedite user scheduling.

APPENDIX A

SURVEY QUESTIONNAIRE FORM



Automating and Optimizing Timetable on Muntinlupa Elementary School using Firefly Swarm Algorithm

We are fourth-year BS Computer Science students from the Technological University of the Philippines - Manila, and we kindly request a brief portion of your time to participate in the evaluation of our thesis output, entitled:

"Automating and Optimizing Timetable on Muntinlupa Elementary School using Firefly Swarm Algorithm"

Additionally, in accordance with the Data Privacy Act of 2012, we will be requesting your consent for the processing of your personal information for data gathering purposes. Please be assured that all information collected will be treated with strict confidentiality to safeguard the privacy of respondents.

We welcome any comments or suggestions you may have, which can be provided in the section below. Your feedback is invaluable for improving the quality and effectiveness of our system. Alternatively, you may email your comments directly to the researchers at the following addresses:

euclideandrae.arroyo@tup.edu.ph

camila.funclara@tup.edu.ph

elijahraven.padlan@tup.edu.ph

genesisdane.pallarco@tup.edu.ph

funclaracamila@gmail.com Switch accounts

Not shared

* Indicates required question

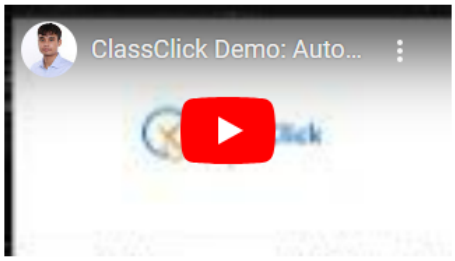
Name (Optional)

Your answer

Profession *

Your answer

System Demo



Functional Suitability
This feature indicates the extent to which a system or product fulfills explicit and implicit demands when utilized in accordance with predetermined guidelines.

Functional completeness *
The system covers all the specified tasks and intended users' objectives.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Functional correctness *
The system provides accurate results when used by intended users.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Performance Efficiency
This characteristic represents the degree to which a product performs its functions within specified time and throughput parameters and is efficient in the use of resources (such as CPU, memory, storage, network devices, energy, materials...) under specified conditions.

Time behavior *
The system is capable with the response time and throughput rates of a product or system, when performing its functions.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Capacity *

The system can maximize the limits of a product or system parameter.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Interaction Capability

Degree to which a product or system can be interacted with by specified users to exchange information in the user interface to complete specific tasks in a variety of contexts of use.

Operability *

The system has attributes that make it easy to operate and control.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

User engagement *

The system can present functions and information in an inviting and motivating manner encouraging continued interaction.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Reliability

Degree to which a system, product or component performs specified functions under specified conditions for a specified period of time.

Availability *

The system is operational and accessible when required for use.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Fault tolerance *

The system can operates as intended despite the presence of hardware or software faults.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Flexibility

Degree to which a product can be adapted to changes in its requirements, contexts of use or system environment.

Adaptability *

The system can effectively and efficiently be adapted for or transferred to different hardware, software or other operational or usage environments.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Scalability *

The system can handle growing or shrinking workloads or to adapt its capacity to handle variability.

	1	2	3	4	
Strongly Disagree	○	○	○	○	Strongly Agree

Suggestions/Comments

Your answer

Submit Clear form

APPENDIX B

THESIS GRAMMARIAN CERTIFICATION

	TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES Ayala Blvd., Ermita, Manila, 1000, Philippines Tel No. +632-5301-3001 local 608| Fax No. +632-8521-4063 Email: cos@tup.edu.ph | Website: www.tup.edu.ph	Index No.	REF-COS-3.5-INT-TGC
		Revision No.	00
		Effectivity Date	06132022
VAA-COS	**THESIS GRAMMARIAN CERTIFICATION**	Page	1 / 1

THESIS GRAMMARIAN CERTIFICATION

This is to certify that the thesis entitled,

AUTOMATING AND OPTIMIZING TIMETABLE ON MUNTINLUPA ELEMENTARY SCHOOL USING FIREFLY SWARM ALGORITHM

authored by

Euclide Andrae F. Arroyo
Camila D. Funclara
Elijah Raven G. Padlan
Genesis Dane C. Pallarco

has undergone editing and proofreading by the undersigned.

This Certification is being issued upon the request
for whatever purposes it may serve them.

Assoc. Prof. JENNIFER P. ALINSUNOD, CHRA, LPT
Grammarian

Technological University of the Philippines

June 13, 2024

APPENDIX C

CERTIFICATION OF SIMILARITY INDEX USING TURNITIN

Similarity Report

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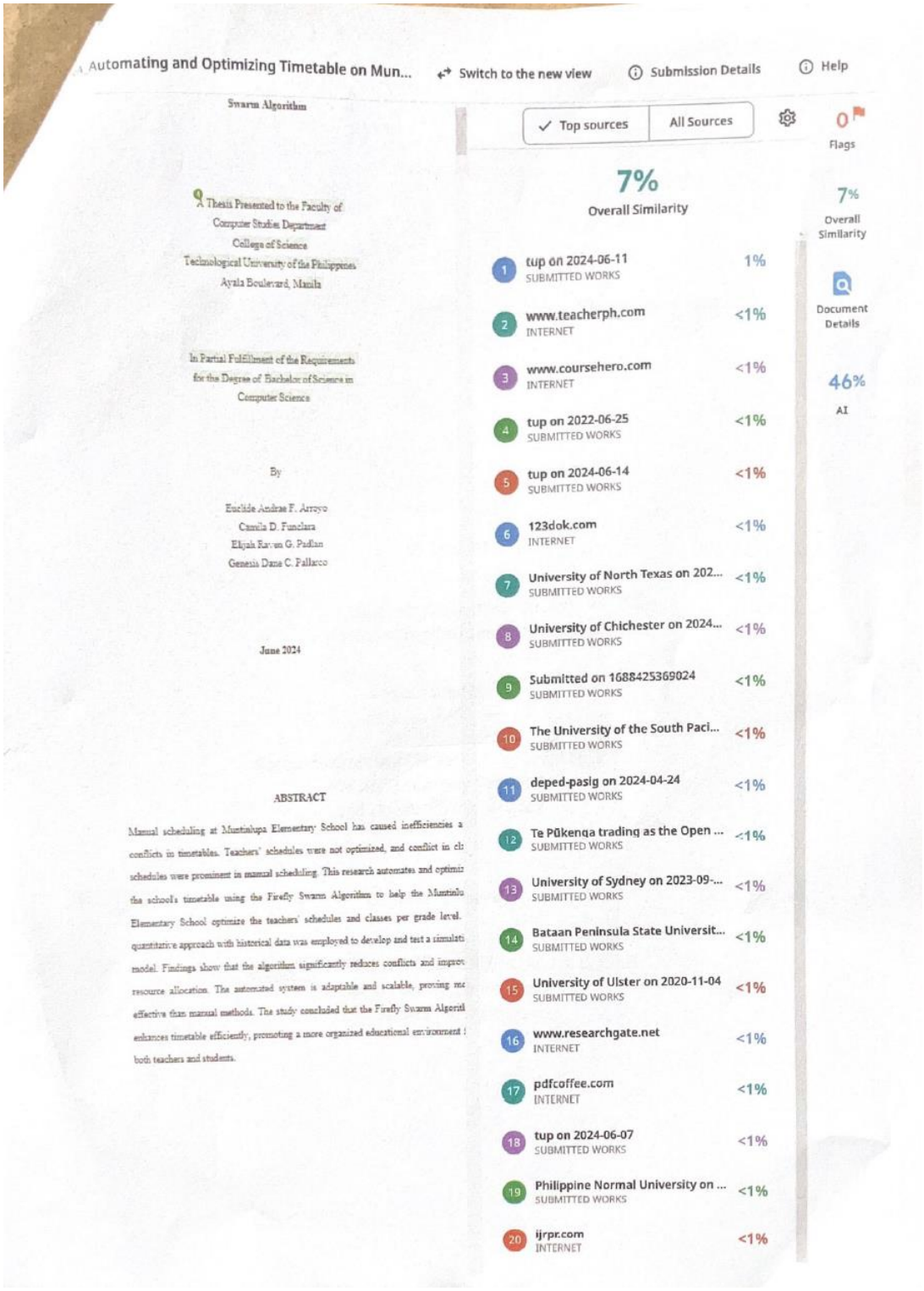
Summary

APPENDIX D

CERTIFICATION OF SIMILARITY INDEX USING TURNITIN



APPENDIX E

CURRICULUM VITAE

Arroyo, Euclide Andrae F.

(+63) 920 410 7894 | euclide.arroyo@gmail.com | Philippines
https://www.linkedin.com/in/euclide-andrae-arroyo-a536242b3

RESUME OBJECTIVE

Passionate fourth-year Computer Science student seeking an internship to apply theoretical knowledge to practical IT (Information Technology solutions, particularly in Cloud development. Dedicated to innovative and efficient solutions, I possess strong research skills and prioritize security. With expertise in troubleshooting, I'm eager to contribute to cutting-edge projects, demonstrating my commitment to staying updated with the latest technological advancements.

SKILLS

TECHNICAL SKILLS

- Microsoft and Google Office
- Web Programming (HTML, PHP, CSS, JavaScript, Laravel Framework, Bootstrap, Livewire, Angular)
- C++, C#, and Java
- MySQL
- GitHub
- Oral and Written Communication Skills
- Basic Core Competencies acquired from CSS NC II
- Installing and Configuring Computer Systems
- Setting up Computer Networks and Servers
- Maintaining and Repairing Computer Systems and Network

EDUCATION

2020 – Current **Bachelor of Science: Computer Science**
Technological University of the Philippines - Taguig
- President's Lister S.Y. 2020-2022
- DOST Scholar

2018 – 2020 Senior High School – Science, Technology, Engineering, and Mathematics Strand
De La Salle Santiago Zobel – Brother Rafael Donato FSC Night High School
- Scholar of La Salle

2014 –2018 **Junior High School**
De La Salle Santiago Zobel – Brother Rafael Donato FSC Night High School
- Scholar of La Salle

EXPERIENCE

2018 **Work Immersion at Muntinlupa City Library**
- Learned to participate in workplace communication.
- Learned to work in team environment.
- Learned to practice career professionalism.

2023 - Present **Thesis Project: School Scheduling System**
- Project Manager
- Full Stack Developer
- Main Back-End Developer

REFERENCE

Director Jhun Paculan

CAMILA FUNCLARA

COMPUTER SCIENCE STUDENT

Contact

0920-550-2197

funclaracamila@gmail.com

Mandaluyong City, Philippines

About Me

I am an enthusiastic and motivated computer science student eager to contribute to the development of the fast-growing IT industry. I wish to utilize my academic background in technology and problem-solving abilities in a dynamic team environment while improving my personal and professional skills.

Skills

- Microsoft Office
- Adobe Photoshop
- Adobe InDesign
- HTML, C, C++
- Web Development
- Web Design
- Problem-solving
- Critical Thinking
- Communication
- Time management
- Adaptability
- Teamwork
- Detail-oriented

Award

DOST- SEI RA 7687 Scholarship Program

Education

BS Computer Science
Technological University of the Philippines - Manila 2020 - 2024

Senior High School
Centro Escolar Integrated School - Manila 2018 - 2020

Junior High School
Mataas Na Paaralang Neptali A. Gonzales 2014 - 2018

THESIS/PROJECTS

Automating and Optimizing Timetable on Muntinlupa Elementary School Using Firefly Swarm Algorithm
Thesis Study

Brand Building: Color Palette and Font Recommendation Web Application System
Software Engineering Project - 2023

Optimizing Class Schedule on Muntinlupa Elementary School Using Firefly Algorithm
Artificial Intelligence Project - 2023

Modeling and Simulation of Ate Nene's Shake Store
Modeling and Simulation Project - 2023

Dataset Maker Using OpenCV2: Affine Transformation
Data Analytics Project - 2022

Song Title Identifier by Lyrics Search using Lyrics Genius
Automata Theory and Formal Languanges Project - 2022

Ate Nene's Shakes Target Sales Setter using Probabilistic Modeling
CS Professional Elective 2 (Decison Theory) Project - 2022

School Organization/s

Computer Students' Association - TUP Manila

TUPM - DOST Scholars' Club

GOOGLE Developer Student Clubs - TUP Manila

ELIJAH PADLAN

WEB DEVELOPER

09452702170 ravenpadlan@gmail.com
https://www.linkedin.com/in/elijah-padlan/

SUMMARY

Elijah leverages his well-rounded background in both computer science and graphic design to craft user-friendly and visually appealing web experiences. His technical skills allow him to translate design concepts into functional websites, while his design sensibilities ensure a creative and engaging user interface

SKILLS

- Figma
- Photoshop
- Microsoft Office
- GitHub
- Web Programming (HTML, SASS, JavaScript, Bootstrap, Angular)
- C++, C#, and Java

EDUCATION

TERTIARY EDUCATION

Bachelor of Science: Computer Science

- Technological University of the Philippines • 2020–Current
  - President's Lister 2020-2023

SECONDARY EDUCATION

Senior High School: STEM

- Dasmarinas Integragted High School • 2019–2020
  - With High Honor
- Congressional Integrated High School • 2018–2019
  - With Honor

Junior High School

- Dasmarinas Integragted High School • 2014–2018
  - With Honor

ORGANIZATIONS

Google Developer Student Clubs TUP Manila

Member • 2021-2022

The Glimpse - The Oracle - Silayan

Graphic and Layout Artist • 2018-2020

GENESIS DANE PALLARCO

COMPUTER SCIENCE STUDENT

CAINTA RIZAL, PHILIPPINES | 0961-013-6767 | genesisdane.pallarco@tup.edu.ph

PERSONAL SUMMARY

I am a driven and enthusiastic Computer Science student with a strong academic background, practical skills, problem-solving abilities, and a passion for continuous learning. I am eager to bring my energy, creativity, and dedication to your internship program and contribute to the innovative projects at your organization.

EDUCATION

College 2020 -2024 (Expected)
Technological University of the Philippines
Consistent *Dean's Lister*

Senior High School 2018-2020
Our Lady of Fatima University
Graduated *With Honors*

Junior High School 2014-2018
Kaypian National High School
Graduated *With Honors and Leadership Awardee*

THESIS & PROJECTS

Automating and Optimizing Timetable on Muntinlupa Elementary School Using Firefly Swarm Algorithm
THESIS - *ONGOING*

Brand Building: Color Palette and Font Recommendation Web Application System
SOFTWARE ENGINEERING PROJECT - 2023

Optimizing Class Schedule on Muntinlupa Elementary School Using Firefly Algorithm
ARTIFICIAL INTELLIGENCE PROJECT - 2023

Modeling and Simulation of Ate Nene's Shake Store
MODELLING AND SIMULATION PROJECT - 2023

Dataset Maker Using OpenCV2: Affine Transformation
DATA ANALYTICS PROJECT - 2022

Song Title Identifier by Lyrics Search using Lyrics Genius
AUTOMATA THEORY AND FORMAL LANGUANGES PROJECT - 2022

SCHOOL ORGANIZATION/S

COMPUTER STUDENTS' ASSOCIATION - TUP MANILA
Member

SKILLS

TECHNICAL	Programming languages (HTML, CSS, C), Graphic Design, Video Editing, Web Design, Mobile App Development, Modeling & Simulation
SOFTWARE	Adobe Photoshop, Figma, Adobe Premiere Pro, Adobe After effects, Adobe illustrator, Microsoft Office Suite, Canva, AnyLogic
SOFT	Detail-oriented, Leadership, critical thinking, problem-solving, teamwork, written and verbal communication (in both English and Filipino), and work ethic.

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Boakye, C., & Ampiah, J. G. (2017b). Challenges and solutions: The experiences of newly qualified science teachers. *SAGE Open*, 7(2), 215824401770671. https://doi.org/10.1177/2158244017706710

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