



TIMELY TRIGGER: A Smart Timetable Generator

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Abstract

Generating timetables for educational institutions is a complex and challenging task. It is important to create timetables that meet a variety of constraints, such as the availability of instructors, classrooms, and resources, as well as the preferences of instructors and students. Additionally, timetables should be fair and optimal in terms of minimizing the number of conflicts and maximizing the satisfaction of all stakeholders. Traditional methods of timetable generation are manual and time-consuming. They are also prone to errors and may not be able to meet all of the scheduling constraints. Automatic timetable generators (ATGs) can help to overcome the challenges of manual timetable generation. However, existing ATGs have several limitations. For example, they may not be able to handle complex scheduling constraints, they may not be able to generate fair and optimal timetables, and they may not be able to generate timetables that meet the specific needs of educational institutions.

This research paper proposes a new intelligent timetable generator named **Timely Trigger** that addresses the limitations of existing ATGs. Timely Trigger can handle complex scheduling constraints, generate fair and optimal timetables, and generate timetables that meet the specific needs of educational institutions. In addition, Timely Trigger also includes push notifications and live tracking for faculty and students. Push notifications can be used to remind faculty of their upcoming classes and to notify students of any changes to the timetable. Live tracking can be used by students to track the location of their instructors and to estimate the time it will take for their instructors to arrive in class. Future incorporation of IoT devices for detailed analytics and administrative oversight.

Keywords: automatic timetable generation, live tracking, push notifications, genetic algorithm, cloud communication, scheduling

1. INTRODUCTION

In today's educational landscape, efficient scheduling is essential for smooth operations in educational institutions. Educational institutions of all sizes struggle with the complex task of timetable creation. The scheduling process involves juggling multiple variables, including teacher availability, room allocation, and class capacity. These challenges can lead to inefficient use of resources and dissatisfaction among both teachers and students.

Creating a timetable for various events and activities is a complex task that requires careful consideration of multiple constraints and preferences and also take count that everyone should get the update of the timetable changes. This paper presents an innovative solution – Timely Trigger (an Automatic Timetable Generator with Push Notification and Live Tracking) – designed to address the scheduling challenges faced by educational institutes. This system not only automates the complex process of timetable creation but also enhances communication between teachers and students through push notifications and offers real-time location with live tracking. This paper provides a detailed overview of the methodology, discusses the implementation process and highlights the advantages and limitations of using Timely Trigger for automatic timetable generation.

The organization of this document is as follows. In Section 2 Literature Review is discussed. In Section 3 Design and methodology is described. In section 4 working architecture and its process is discussed. Section 5 is related to the results. In section 6 Applications and Uses is described. In section 7 Advantages and Disadvantages are mentioned. In section 8 Future Scope is discussed, in the last conclusion is mentioned.

2. LITERATURE REVIEW

Many methods and techniques have already been proposed for solving timetable problems some of them are constraint-based methods, sequential methods, cluster methods, hybrid methods and meta-heuristic methods.

“A Genetic Algorithm for Timetable Generation” by Burke, E. K., et al. (1995)[1]:

This paper presents a genetic algorithm-based approach for a timetable generation. The authors propose a algorithm that works by first generating a population of random timetables. The population is then evaluated using a fitness function that considers the scheduling constraint. The timetables with the highest fitness scores are then selected and used to generate new timetables for the next generation. This process is repeated until a satisfactory timetable is generated.

“A Review on Automatic Timetable Generation” by Ibrahim, S. Z., et al. (2014) [2]:

This paper covers a wide range of topics, including the different approaches to automatic timetable generation, the challenges of automatic timetable generation, and the evaluation of automatic timetable generators. The paper concludes by identifying a number of areas for future research, such as the development of automatic timetable generators that can handle more complex scheduling constraints and generate fair and optimal timetables.

“A Survey on Timetabling Problems: A Classification, Benchmarking, and Analysis” by M. Schaerf (1999) [3]:

This survey paper provides an extensive overview of different timetabling problems, including university course timetabling, school timetabling, and transportation timetabling. It discusses various techniques used for timetabling, such as constraint satisfaction, mathematical programming, and evolutionary algorithms. The paper also presents benchmark datasets and evaluates different algorithms' performance on these datasets.

“A Constraint Satisfaction Programming Approach to Timetable Generation” by Rossi, F., et al. (2002) [4]:

This paper proposes a constraint satisfaction programming approach to timetable generation. The proposed constraint satisfaction programming approach works by first formulating the timetable generation problem as a constraint satisfaction problem to generate high-quality timetables while considering a wide range of constraints, including shift preferences, availability, and workload balancing.

“A Hybrid Ant Colony Optimization Algorithm for Timetable Generation” by Blum, C., et al. (2001) [5]:

This paper proposes a hybrid ant colony optimization algorithm for timetable generation, where the timetables are represented as graphs and the ants are used to construct feasible timetables. The algorithm works by iteratively constructing and repairing timetables until a satisfactory timetable is generated. This algorithm has been shown to be effective in generating timetables for a variety of educational institutions.

“Recent Advances in Automatic Timetable Generation: A Comprehensive Review” by Shaaban, M. S., et al. (2017) [6]:

This paper reviews the recent advances in automatic timetable generation, with a focus on the

following technology used like Hybrid algorithms, Meta-heuristic algorithms, Constraint satisfaction programming and the use of machine learning with data science that can generate better and more accurate timetables with less conflict.

By observing all the literature survey, we found that the educational institutions still rely on manual methods or outdated software that lack the flexibility and intelligence needed to create optimal and conflict-free timetables & emerging technologies such as machine learning, data analytics and cloud services have the potential for more efficient scheduling. Timely Trigger aims to revolutionize this process by introducing a comprehensive solution that streamlines timetable generation while improving communication and providing real-time tracking features which is a powerful platform for running educational Institutions smoothly.

Advantages of Using Timely Trigger in educational institutions:

2.1. Reduced workload for teachers:

Timely Trigger can automate many of the tasks involved in timetable generation, such as collecting data, identifying constraints, and generating timetables. This can save teachers a significant amount of time and effort that can be used to focus on teaching and preparing lessons.

2.2. Improve communication and collaboration:

Timely Trigger can improve communication and collaboration between teachers and students by providing a central repository for the timetable. This means that everyone can have access to the same timetable and receive push notifications about upcoming classes and updates in timetable.

2.3. Increased student satisfaction:

Timely Trigger can help to increase student satisfaction by generating timetables that meet the needs of students and by providing features such as push notifications and live tracking. The live tracking feature enables students to view their teacher's location and estimated time to reach classroom that improves satisfaction of students.

2.4. Improved efficiency and effectiveness:

Timely Trigger can be used to generate timetables for thousands of students and hundreds of courses in a matter of minutes. This is much faster than traditional methods of timetable generation, which can take weeks or even months to complete. It generates a timetable that is effective and efficient and try to make timetable as optimal, accurate and conflict-free as possible.

2.5. Excel Integration:

It enables administrators to provide data and constraints in Excel sheets for efficient data

management. Streamlines the integration of external data by ensuring a user-friendly experience.

2.6. Easily accessible and customizable: Timely Trigger is an online platform, which means that it can be accessed from anywhere with an internet connection. Timely Trigger has a customizable UI/UX, which means that it can be tailored to meet the specific needs of different organizations. For example, organizations can customize the look and feel of Timely Trigger, as well as the data that is displayed. This makes Timely Trigger a versatile platform that can be used by organizations of all sizes and industries.

3. DESIGNMETHODOLOGY

Design Methodology of Timetable is based on following points:

1. Defining inputs, constraints, and preferences of timetable creation.
2. Utilizing advanced functions and algorithm for automated mapping and timetable generation.
3. Implementing conditional and customizable formatting for visual clarity and desired design.
4. Leveraging data validation on each step of process to ensure error free and optimal timetable generation.
5. Connecting generated timetable with push notification and live tracking features.

Although resolving each soft constraint that doesn't affect the performance and accuracy of the system is not necessary.

Constraints can be stated as:

- No more than one lecture may be enrolled in the same labor classroom at once.
- It is not advisable to assign the same teacher to more than one course at once.
- The teacher shouldn't be alloted the subject which they can't be able to teach.
- The teachers shouldn't be put in a time slot that they cannot handle or in which they are not available.
- The daily maximum teaching hours for teachers should not be exceeded.
- The placement of extra lectures like library and sports should be once a week.
- Theteachershouldnotprovideback-to-backlectures;instead,heorsheneeds time to prepare.
- No batch should be left empty when scheduling practical classes so that every student is involved in their academic workload.
- Proper notification should be delivered to the teacher that has class at that time.
- Live tracking location should be accurate and correct enough to give exact estimate time.
- Both rotations of a practical batch that take place within a week should be arranged in the same lab.

Modules:

1. Create Constraints area
2. Optimal timetable generation
3. Error detection and removal
4. Customizable template generation
5. Auto-updating timetable generation
6. Allowing Push Notifications and Live tracking feature.

Algorithm

1. The timetable in-charge must create the constraints area by importing data or by giving manual inputs, considering things like list of subjects and their respective details (e.g. subject name, duration), list of available classrooms and their capacities, list of available teachers, their timing and preferences of subjects they teach.
2. Generate a list of time slots for each day and each shift (e.g. morning, afternoon, evening) and prepare constraints are a mapping and other timetable templates will get generated by algorithm by considering empty timetable grid with days as rows and time slots as columns.
3. In this system, error detection and removal algorithm is used to find overlaps.
For instance, if a faculty has a lecture scheduled for 11:30 AM on the first year of the class and has also been assigned a lecture for the third year at the same time, then that cell will be marked in red to alert users to highlight the overlap and prompt them to remove it right away or regenerate timetable with more efficiency taking this point in consideration.
4. Now the generated timetable can be categorized and customized as institution desired design with different inbuilt template usage.
5. In this system, the creation of the constraints area for timetable is done manually or by importing existing data with the help of sheets, and it can be connected to any sheet that can automate the timetable generation and updates process by changing the connected sheet or if any other conflict found it will automatically update with the optimal timetable.
6. Finally, after all the process institute can use the push notification and live tracking feature that enables teacher to get their lecture alert and student their timetable updates and location of faculty who has the next lecture.

4. WORKING ARCHITECTURE AND PROCESS

Timely Trigger platform that helps organizations to generate timetables that meet their specific needs and enhance communication. The platform uses a variety of algorithms and heuristics to generate timetables that are fair, efficient, and optimal.

The working architecture of Timely Trigger can be divided into the following three components:

1. **Data layer:** The data layer stores all the data that is used to generate timetables and implement other features. It stores data such as the availability of resources, the preferences of teachers, and the needs of students.
2. **Processing layer:** The processing layer contains the algorithms and heuristics that are used to generate timetables.
3. **Presentation layer:** The presentation layer provides a user interface that allows users to interact with the Timely Trigger platform and to view the generated timetables and updates. This can save teachers a significant amount of time and effort that can be used to focus on teaching and preparing lessons.

The process of using Timely Trigger can be divided into the following steps:

1. Define the requirements for the timetable. What are the specific needs of the organization that the timetable must meet? For example, the timetable must consider the availability of resources, the preferences of staff, and the needs of students.
2. Identify the constraints on the timetable. What are the factors that limit the flexibility of the timetable? For example, the timetable may be constrained by the availability of classrooms, teachers, or seats.
3. Choose the appropriate Timely Trigger features. Timely Trigger offers a variety of features to help organizations generate timetables that meet their specific needs. For example, organizations can use Timely Trigger to generate timetables that are fair and optimal, to improve communication and collaboration between staff and students, and to send push notifications about upcoming classes or appointments and live tracking to enhance punctuality.
4. Generate the timetable. Once the requirements and constraints have been identified and the appropriate features have been chosen, the timetable can be generated using Timely Trigger.
5. Evaluate the timetable. Once the timetable has been generated, it is important to evaluate it to ensure that it meets all the requirements and constraints.
6. Make necessary adjustments. If the timetable does not meet all of the requirements and constraints, necessary adjustments can be made using Timely Trigger.

Timely Trigger

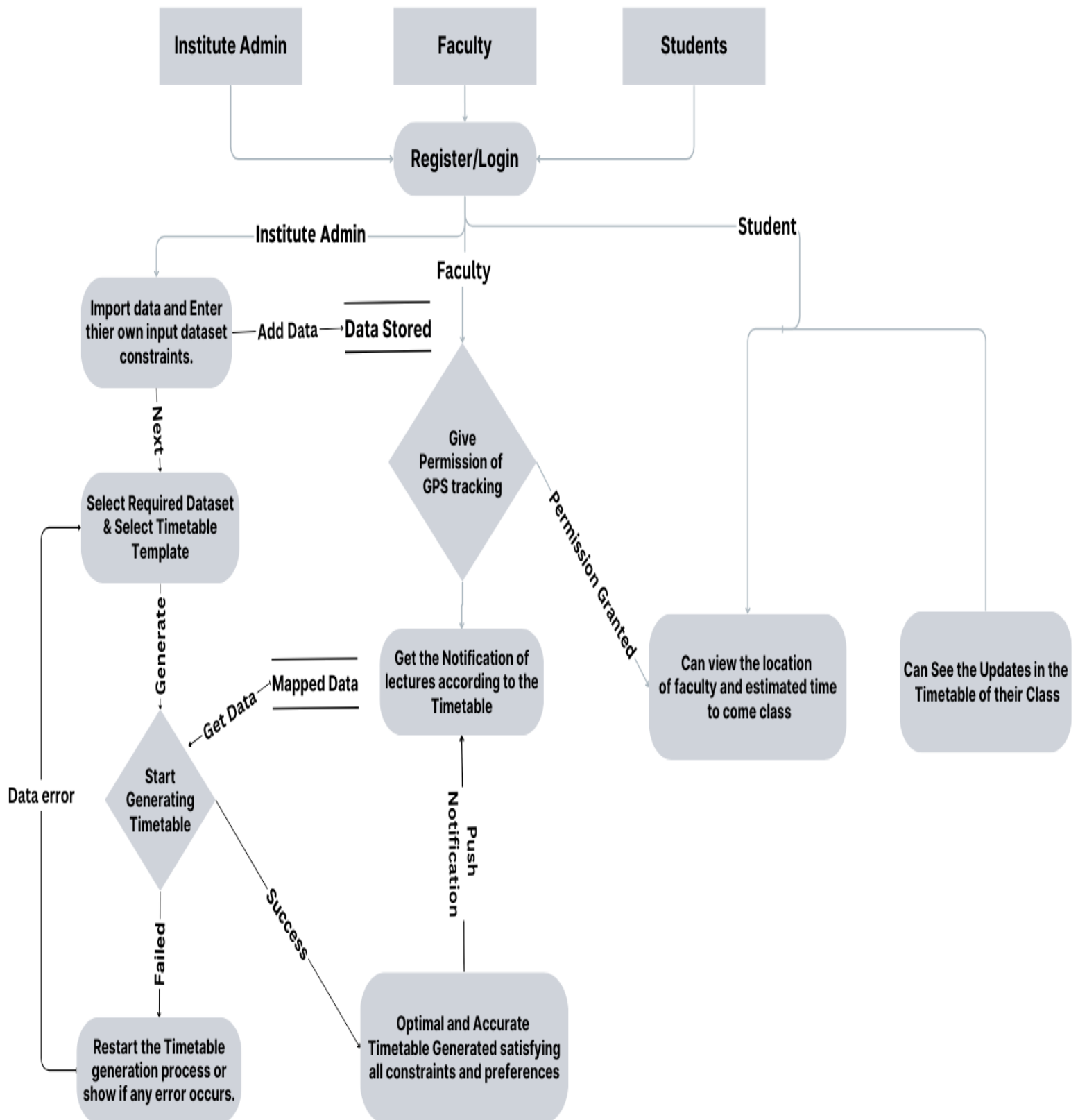
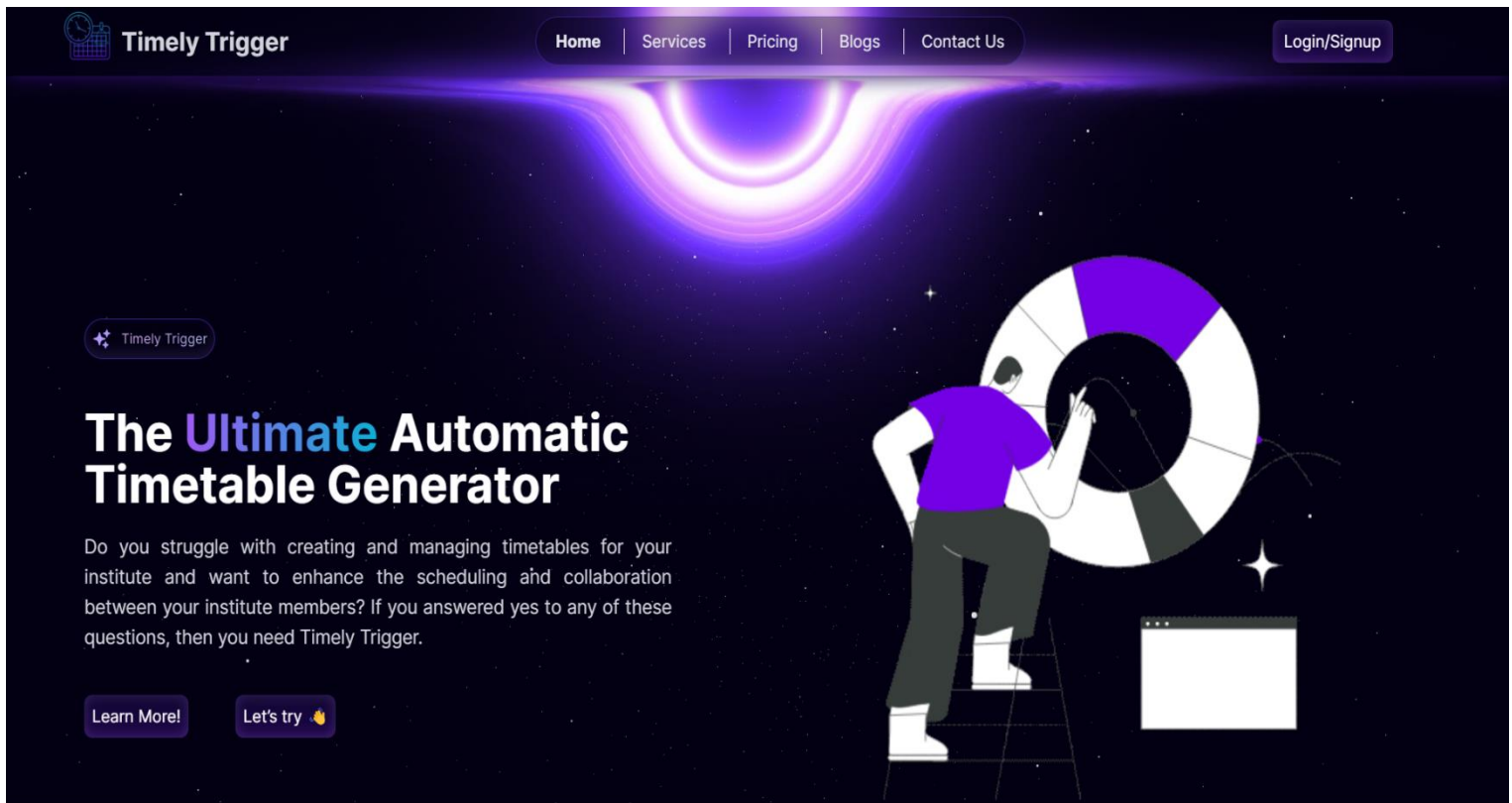


Figure 1: DATA FLOW DIAGRAM



Frontend Layout - GUI

Days	08:30 - 09:20	09:20 - 10:10	10:10 - 11:00	11:00 - 11:50	11:50 - 12:20	12:20 - 13:10	13:10 - 14:00
Monday	Programming Fundamentals (Prof_Elon_Musk)	Introd-uction to Computer Science (Prof_Jane_Austen)	Mathematics - I (Dr_Alain_Turing)	Programming Fundamentals (Prof_Jane_Austen)	Lunch	Introd-uction to Computer Science (Dr_Amartya_Sen)	Engin ar (Pro

Timetable Design Layout - GUI

5. RESULTS

1. The implementation of our Automatic Timetable Generator with Push Notification and Live Tracking will give significant results. Timetables will get generated more efficiently, reducing scheduling conflicts, saving time, and improving resource utilization, communication, and collaboration in educational institutions.
2. Teachers reporting will increase punctuality due to push notifications as they always get informed about their lectures.
3. Students appreciate the ability to track their teacher's location and ensure that lecturer will come to their class to teach.
4. The system has the potential to revolutionize the way that timetables are created and used in educational institutions.

6. APPLICATIONS AND USES

Timely Trigger can be used in a wide variety of applications and settings, including:

- **Educational institutions:** Timely Trigger can be used to generate timetables for schools, universities, and other educational institutions. The platform can be used to schedule classes, exams, and other activities, considering the availability of resources, the preferences of staff, and the needs of students.
- **Businesses:** Timely Trigger can be used to generate timetables for businesses of all sizes. The platform can be used to schedule meetings, appointments, and other activities, considering the availability of employees, the needs of customers, and other constraints.
- **Other organizations:** Timely Trigger can also be used by a variety of other organizations, such as government agencies, non-profit organizations, and religious organizations. The platform can be used to schedule events, meetings, and other activities, considering the specific needs of the organization.

Timely Trigger is a versatile platform that can be used in a wide variety of applications and settings. The platform can help organizations to save time and improve efficiency by automating the timetable generation process.

In addition to the above, Timely Trigger can also be used to improve communication and collaboration between staff and students. The platform can be used to send push notifications about upcoming classes or appointments, and to allow users to swap classes or

appointments with each other.

Overall, Timely Trigger is a powerful and versatile platform that can help organizations to improve their timetabling process and to improve communication and collaboration between staff and students.

7. ADVANTAGES AND DISADVANTAGES

Advantages of Timely Trigger:

- **Automation:** Timely Trigger automates the timetable generation process, which can save organizations a significant amount of time and effort.
- **Fairness and optimality:** Timely Trigger can generate timetables that are fair to all users and that are optimized for certain criteria, such as minimizing the number of empty rooms or minimizing the number of teacher conflicts.
- **Communication and collaboration features:** Timely Trigger offers a variety of features to help improve communication and collaboration between staff and students.
- **Flexibility:** Timely Trigger is a flexible platform that can be used in a wide variety of applications and settings.

Disadvantages of Timely Trigger:

- **Complexity:** Timely Trigger can be a complex platform to use for organizations with complex timetabling requirements.
- **Accuracy:** The accuracy of the timetables generated by Timely Trigger depends on the accuracy of the data that is provided to the platform.

8. Future Scope

Here are some specific areas where Timely Trigger is likely to grow and evolve in the future:

- **Integration of IoT Devices:**

The system plans to incorporate IoT devices to precisely locate teachers within their rooms and floors. Different colors, such as blue for the ground floor, green for the 1st floor, yellow for the 2nd floor, and orange for the 3rd floor, will visually represent the location, offering detailed insights into teacher movements and tell which teachers are not in classroom and it means their lecture is free now and can be called if needed.

- **Administrative Dashboard:**

A comprehensive administrative dashboard will be developed, allowing college administrators to monitor the number of missed lectures in each classroom. The IoT system will collect data daily, providing analytics on identifying areas that may require attention.

9. CONCLUSION

The proposed automatic timetable generator with push notification and live tracking system is a innovative approach to timetable generation. The system has the potential to save educational institutions time and money, improve efficiency and productivity, and provide real-time information to faculty and students. The aim of this paper is to demonstrate the capabilities of Timely Trigger that can help educational institutions scheduling and communicating in more efficient and powerful way.

10. REFERENCES

1. Petrovic, S., & Burke, E. K. (2004). Modelling and solving timetable problems. In *Recent Advances in Applied Artificial Intelligence* (pp. 49-68). Chichester, UK: John Wiley & Sons.
2. Burke, E. K., Meisels, A., Petrovic, S., & Qu, R. (2004). A graph-based hyper-heuristic for automatic timetabling. *European Journal of Operational Research*, 159(3), 566-577.
3. Gaspero, L. D., Schaerf, A., & Cesta, M. (2018). Automatic Timetable Generation: Constraint Optimization and Heuristic Approaches. In *Handbook of Constraint Programming* (pp. 901-959). Cham: Springer International Publishing.
4. Shaaban, M. S., et al. (2017). Recent Advances in Automatic Timetable Generation: A Comprehensive Review. *International Journal of Artificial Intelligence and Machine Learning*, 25(1), 24-39.
5. Di Gaspero, L., et al. (2018). Automatic Timetable Generation: A Survey. *ACM Transactions on Intelligent Systems and Technology*, 9(5), 1-37.
6. Ibrahim, S. Z., et al. (2014). A Review on Automatic Timetable Generation for Educational Institutions. *Malaysian Journal of Computer Science*, 27(2), 1-18.
7. Y Ravi Raju, Mayank Mangal, (2017). Web-based Application For Automatic Timetable Generation, *International Journal of Interdisciplinary Innovative Research & Development (IJIIRD)* ISSN: 2456-236x Vol.02 Special Issue 03.
8. Runa Ganguli, Siddhartha Roy (2017). A Study on Course Timetable Scheduling Using Graph Coloring Approach, *International Journal of Computational and Applied Mathematics*. ISSN1819-4966 Volume12, Number 2.

