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Smart Timetable Scheduler and Management System for Campus

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ABSTRACT

Department timetable scheduling is a challenging and complex problem and has been confirmed to be an NP-complete problem. In this paper, Hybrid GA-PSO algorithm is used to overcome the timetable scheduling problem and to meet all constraints of the department for automated time table generation. Algorithm is designed by performance analysis of two Artificial Intelligence Algorithms which are Particle Swarm Optimization Algorithm (PSO) and Genetic Algorithm (GA). Machine learning Algorithm is used to develop hardware model for the automatic time table scheduler to send notifications to intimate faculties about the class, based on face recognition. The Haar-cascade Algorithm is used for face detection and Local Binary Pattern Histogram Algorithm (LBPH) for face recognition to train the data. Python programming languages and the OpenCV library are used because they enable a higher level of precision and adequacy to be achieved. Training and identification are done in embedded device known as Raspberry Pi and GSM module is used to send notifications to faculties to achieve an effective time table management system for smart campus.

Keywords: *Artificial Intelligence, Particle swarm optimization, Genetic Algorithm, Machine Learning, Haar-cascade, LBPH, Raspberry PI, GSM.*

1. INTRODUCTION

A well-educated Organization make use of networked robotics to ease transmission, strengthen security, employ methods more effortlessly for the purpose to upgrade the circumstance, capability, and coaching. Composition of timetables in the sector is a mixture of the total classes, lecturers, time slots, and days that set up on an obtained lecture requirement. This indicated mixture is recognized as departmental methods, for which the timetable is allotted. A flawless timetable initiates an essential pattern and procedure so as to achieve successful training and literacy activity. While most college institution task has been automated, even now the course timetable composition is regularly settled before hand owing to its intrinsic hardness. The present work put forward a foundation to automatize the timetable scheduling method employing Artificial Intelligence algorithmic program together with upgradation of the administration beside expanding a hardware segment applying Machine learning algorithmic program.

1.1 Automated Timetable Scheduler

Artificial Intelligence and Machine Learning Algorithmic programs grasps a union of the twosome inputs and outputs at once that it would be possible to “learn” the details in addition to construct outputs at the time of specified latest inputs. PSO as well as GA are two Artificial Intelligence methods utilized in order to optimize difficulties. PSO is an artificial intelligence approach employed to discover an estimated result in a minimization and numeric maximization problems. The theory of PSO is carried out manipulating the unsystematic classification of the particle and its connection to worldwide with a logical result about certain complexity. Genetic algorithmic programs are a sort of brilliant transformative algorithmic programs which are encouraged

by the operation of common selection. The operation of common selection commences with the selection of suitable persons belonging to community. An Algorithmic program is originated using PSO for universal optimization and GA operators for localized optimization for timetable scheduler.

1.2 Timetable Management System

Face detection is a data processor mechanism being utilized in a category of applications in order that recognizes human faces inside digital images. Haar-like characteristics are digital image attributes utilized in object detection and recognition. They owe their name belonging to inherent affinity with Haar wavelets and were utilized in the initial real-time face detector. This Machine Learning algorithmic program is applied to attain face detection and recognition of faculties utilizing raspberry pi model. It incorporates capturing the images, storing the image data, training and joining the data to the timetable and contrasting the data to transmit and present information to the faculty. To eliminate manual work the hardware module uses GSM modem which is a wireless technology to remind the faculty about his duties. [19] GSM (global system for mobile communication) normally the data required is been loaded in raspberry pi's memory i.e.SD card and the total schedule of the department is considered here. This will help to avoid the complexity of setting and managing Timetable manually by saving time and allowing optimal use of departmental resources and also helps to achieve an effective time table management system for smart campus[16,17].

2. RELATED WORKS

Department Course timetabling is a N-P (non-deterministic polynomial)complete problem for which the solution can only be achieved at near best level. Perfect solution cannot to be achieved only the optimal solution can be obtained by various traditional and new Artificial Intelligence techniques. This section describes some of the approaches used to tackle the problem.

year	Method	Observation
2010	Tabu Search Algorithm	Authors D. Nguyen, K. Nguyen, K. Trieu, and N. Tran have used Tabu search algorithm to automate university timetabling problem [17]. Set of achievable solutions to the problem is known as search space. Author make use of fundamental elements called "Tabu". Tabus exists to move aside along non-improving moves and from local optima to stop cycling. Feasible results are observed in search space which is utilized by Tabu Search Algorithm. Tabu search predominantly keep away from getting trapped at local maxima [17]. For the same reason, when it is trapped in local optima this search permits non-improving moves. Benefit of Tabu Search procedure restrains cycling back to the earlier results by the use of memories therefore making added possible development, but evaluating resources is expensive and formulating the problem is hard which is the drawback of this approach.
2013	Graph Colouring Heuristic Method	Timetable scheduling difficulty is dealt as graphical representation problem. Events are ordered using specific domain heuristics and then events are assigned subsequently into reasonable time intervals, thus no rules are vandalized for every time slot. Scheduling difficulty is deteriorated to basic portions employing graph colouring method [16]. Node depicts subject and edge depicts conflicts in this graph method. The prime part is that the construction phase which produces an occupant of prime solutions. The next phase is improvement phase where it produces

		the ultimate best solution. In this method, very prolonged time is taken to resolve a problem and it does not schedule soft constraints.
2017	Fuzzy Logic Algorithm	Authors W. F. Mahmudy and R. E. Febrita (2017), use Fuzzy logic for achieving and implementing timetable scheduling including various genetic operators incorporated [12]. A Multivalent logic known as Fuzzy logic is used to solve the constraints. This is obtained from fuzzy set theory to alter approximate reasoning instead of precise. The membership values of formal fuzzy logic variables may not be solely 0 or 1, statement's percentage of truth may vary between the range 0 and 1 [12]. Unlike the classic logic, Fuzzy logic is not constrained to two value logic. Results obtained depict that this approach usage can optimize complex scheduling goals and provide a result similar to the real world. More stable situation is reached in less time by using linguistic variables. Membership function evaluation is difficult, hard to create a fuzzy logic model, more calibrate tuning and simulation is required before using for any application. These are some of the major drawbacks of this method.
2017	Constraint Satisfaction Modelling	Author T. Elsaka (2017), make use of constraint satisfaction modelling for Automated generation timetable [11]. Constraint Programming is focused on the constraints and variables domain rather than the objective function and depends on viability rather than improvisation. Author represents the time table generation procedure that minimizes domains of variables, combined with backtracking search by controlling the constraints along a system of constraints propagation Constraint programming is significantly a precise statement of the constraints that serves as part of the program, is a vital advantage of this programming. This is disapproving in timetable issues, that makes the program straightforward to alter. Constraints and data are main components in this methodology [11]. Struggling to indicate soft constraints, potential complicated problems with intensifying the initial suitable solution and Time consuming are some of the hindrances of this process.
2018	Genetic Algorithm	Authors S. Ab Saad, F. A. Adnan, W. Z. A. Wan Muhamad and Z. R. Yahya (2018) [4], analyses the utilization of Genetic algorithm in timetable scheduling difficulty by carrying out an inspection. Genetic algorithms are influenced by the procedure of natural selection and is a type of gradual developmental algorithms. The procedure of natural selection begins with the selection of appropriate individuals from a population [2]. Production with the appropriate individuals is established at the end in this procedure while it keeps on iterating. The prime timetabling problem terminates certain dimensions of the problem and consolidates those dimensions into constraints with multitude binary variables diminishing to the sustainable

		size. Genetic algorithm approach remarkably decreases the individual size with by assembling several binary variables into one gene value. Involving lot of parameters and Time consuming as it gives results with iterative approach are some of the flaws in this approach [10][14][15].
2019	Hybird particle Swarm Optimizatio n Method	Authors D. Apostolou and E. Psarra (2019), proposed an approach using hybrid optimization procedure which sorts out the difficulty of producing timetable of an educational institution. PSO is an artificial intelligence methodology utilized to obtain a significant result in a figure maximized and minimized difficulties [1]. PSO defeats the problem by integrating with local search. This problem is addressed with productive results by collaborating the classic PSO upgradation technique with prototype methodology. Time taken for the optimization procedure is up to the mark which varies from few couple of seconds to few minutes [9]. Merits of this approach is that particles upgrade themselves with the internal velocity and they also have memory, that is supreme to the algorithm. PSO does not have genetic operators like crossover and mutation which is a drawback.

Table I: Approaches to solve timetabling problem

Authors P. Kanvitha, M. Sirisha, and M. Kalpana Chowdary (2018) [7], started and implemented a Raspberry Pi 2 model for time table administration. RFID(Radio Frequency Identification) innovation is utilized to screen the staff participation. In brief term, worth's of execution for a RFID card-based admission bunch framework can be fairly costly. A RFID based passage group framework has the capability of truly abusing human's security or protection. This kind of environment will be enduring an onslaught of programmers. Disadvantage: If the workforce fails to remember RFID card, the participation isn't thought of. In [6] Authors, have prepared a Raspberry Pi 2 model with biometric module for time table administration. To conquer the disadvantages of RFID biometric module was use where staff finger impressions are utilized to know the participation. This framework utilizes finger impression as a special personality. It is perhaps the most precise frameworks running successfully today. Be that as it may, acknowledgment of an individual unique mark from a bunch of enlisted fingerprints is a troublesome cycle. The unique finger impression framework doesn't uncover any data with respect to the first finger impression. This may have been proved to be false as many algorithms reveal that a fingerprint can be reconstructed with minute templates.

Authors S. Singh, Ramya, Sushma, R. S, and Pavithra manages the execution of AI calculation for ongoing facial picture acknowledgment [5]. Two predominant techniques out of numerous facial acknowledgment strategies are examined utilizing Raspberry Pi. The facial acknowledgment programming utilizes calculations to look at an advanced picture caught through a camera, to the put away face print in order to confirm an individual's personality. Haar-cascade algorithm shows better result and is faster to detect the faces in front of the camera. Advantage of this method is that Haar features face detection is easier to use and faster to train.

There are various approaches as described, to solve the timetable scheduling problem that has been proposed. Being an N-P Complete problem, an approximate near solution can only be found with different advantages and disadvantages in each method. In the new era of Artificial Intelligence, different combination of Algorithms can be combined to obtain more better results.

3. COMPARISON OF GA AND PSO

Genetic Algorithm (GA) is a method for optimizing and searching, altogether being an improvement method with reference to the principles of Natural Selection and Genetics. The PSO calculation was enlivened by

friendly conduct of bird rushing or fish tutoring. Utilizations various particles that establish a multitude moving around in the space of search, searching for the best arrangement. Each of the particle in search space changes its velocity and flying as per its own flying experience and experience of other particles.

Genetic Algorithm	PSO Algorithm
▪ A significant category of Evolutionary Algorithm is Genetic Algorithm (GA) which is derived from the idea of genetics and natural selection. ▪ Approximate solutions are imparted by GA to numerous problems. Several biological methods are utilized by GA for example selection, inheritance, reproduction, mutation, crossover and recombination.	▪ Evolutionary Algorithm comprises another significant algorithm known as Particle Swarm Optimization (PSO) which is based on the concept of food searching theory used by flock of birds. ▪ Swarm of particles are defined which are possible solutions to the given problem. Swarm particle's values are then replaced with new values based on rules which are preset.
▪ Complexity handling is not managed in a productive way. The total number of elements going through mutation is substantial which creates a significant rise in the search space.	▪ PSO is the preferable substitute in case of complex problems, while it needs not many parameters and correspondingly lesser number of iterations.
▪ GA normally focuses to provide a local optimum rather than that of the problem's global optimum. ▪ GA provides selection, crossover and mutation operators. ▪ GA does not involve use of any memory.	▪ Global optimum is the main focus in case of PSO. ▪ No crossover, selection and mutation operators are present in PSO. ▪ PSO involves memory for storing particle best position and global best position value.
▪ Characteristic of GA is to solve discrete issues easily by converting variables to binary 1's and 0's, and therefore it is discrete in nature.	▪ Characteristic of PSO is mainly to handle continuous problems and therefore modification is required to manage discrete problems.
▪ Solutions in GA are ranked with respect to the fitness values. Individuals for crossover and mutation are selected with respect to probabilities that prefers parents with better fitness to produce the offspring.	▪ New swarm of particles is produced via the velocity and position update equations. By this process it is ensured that new particles are much different from old particles and close to the solution.
▪ Genetic algorithms are employed in various domains. Solving optimization difficulty is its major application. GA applications include manufacturing, bioinformatics, and engineering in electronics and electricals, genetics and computational science.	▪ PSO was first employed in the domain to train the neural network. Thereafter, its application is increasing in various domains such as control and design, power systems, telecommunication, robotics. Its extensive usage is found to be in minimum and maximum optimization problems.

TableII: GA and PSO comparison

Both GA an PSO are population-based optimization techniques and randomly generated population is used as initial step. They both use evaluation based on fitness and population is updated search optimum with random techniques. Also, no success is guaranteed by both algorithms.

4. PROPOSED FRAMEWORK

Literature review performed, showed that, compared to all other approaches Particle swarm optimization algorithm is better suited for global optimization in timetable scheduling problem but does not have operators for better accuracy in local optimization. Genetic algorithm is better suited for local optimization in timetable scheduling problem with good accuracy but number of iterations is more and lot of time is consumed for computation to achieve global optimization and solution.

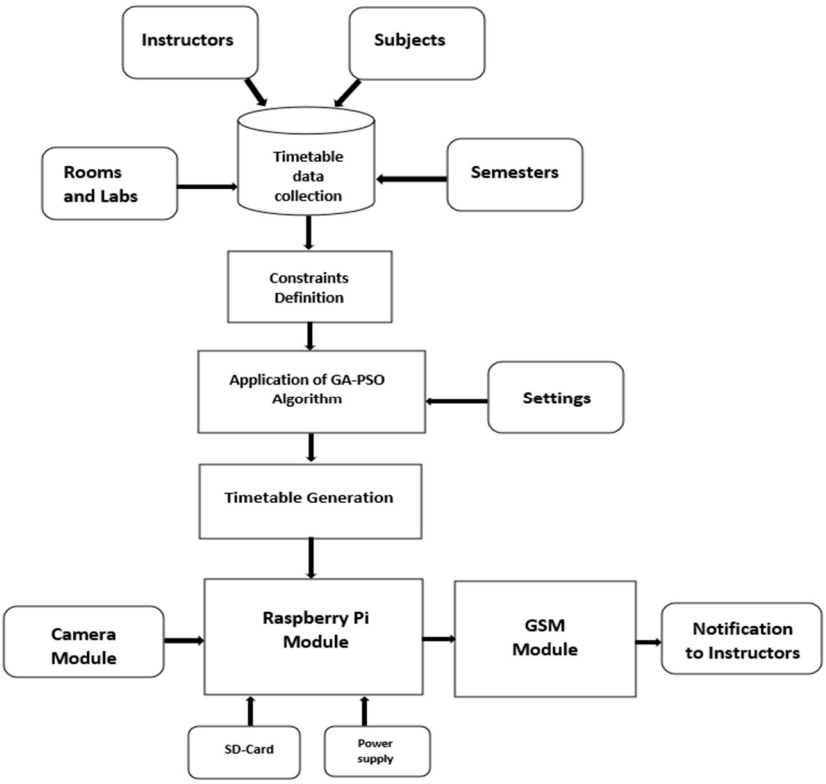

Figure 1 – Proposed Framework for timetable generation and management system

In recent approaches for timetable management, RFID and biometric modules were used and found to have security issues hence an efficient and faster approach can be used by real time face recognition using embedded device, with Haar-cascade face detection algorithm and LBPH, which are easier to use and faster to train with respect to computational speed. The Proposed framework as shown in Figure 1, involves application of Hybrid GA-PSO algorithm for timetable generation using Python. Raspberry Pi board and Raspberry Pi camera module is used for face detection and face recognition using OpenCV libraries, Haar-cascade Algorithm and LBPH Algorithm.

Steps involved to achieve face detection and recognition is shown in Figure 2. The data is stored in Raspberry Pi SD card. Generated timetable is notified to faculties once the face is recognized, through text message and email by using GSM module interfaced with the Raspberry Pi module.

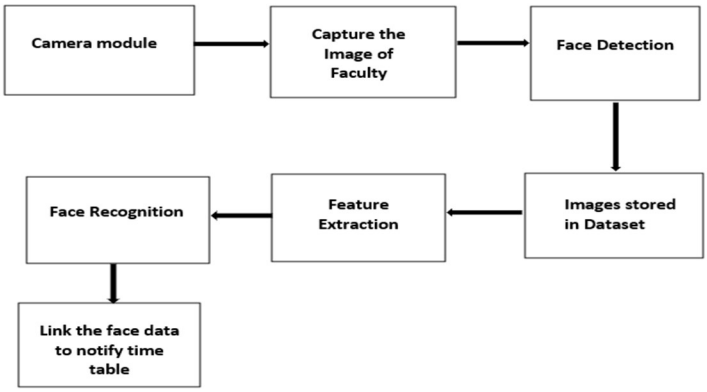

Figure 2 – Steps involved in face Detection and Recognition

5. METHODOLOGY

Smart timetable scheduler and management system for campus can be achieved by three steps, first is automated timetable generation using hybrid GA-PSO Algorithm which involves collection of departmental data, defining the constraints to be met, setting the algorithm parameters, application of proposed algorithm, generating the output and exporting the output in csv format. Second step is to store the generated output in Raspberry Pi SD card and to carry out face detection and recognition using OpenCV. Third step involves notifying the faculties with the generated timetable based on the recognized face using GSM module. The below figure shows the hardware architecture for timetable management system with the flow. All the mentioned above steps are explained in detail below.

5.1 Hybrid GA-PSO for Timetable Generation

The data set acts as input to get structured output result. Process model for input output is shown below in Figure 3. The inputs are updated using a standard Database Browser for SQLite for creating and editing the dataset.

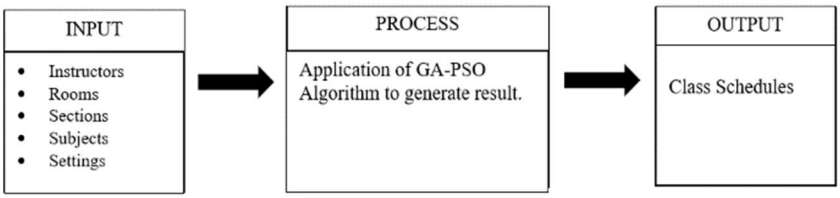

Figure 3: Input-Output Process model

Instructors, rooms, sections, subjects and sharing acts as input parameters. QT and PyQt5 is used for Graphical User Interface for the scheduler. Inputs can be selected, edited and deleted using the GUI as shown below figures. Instructor and rooms names, available hours are selected. Available hours are indicated in green color and unavailable hours are indicated in red color.

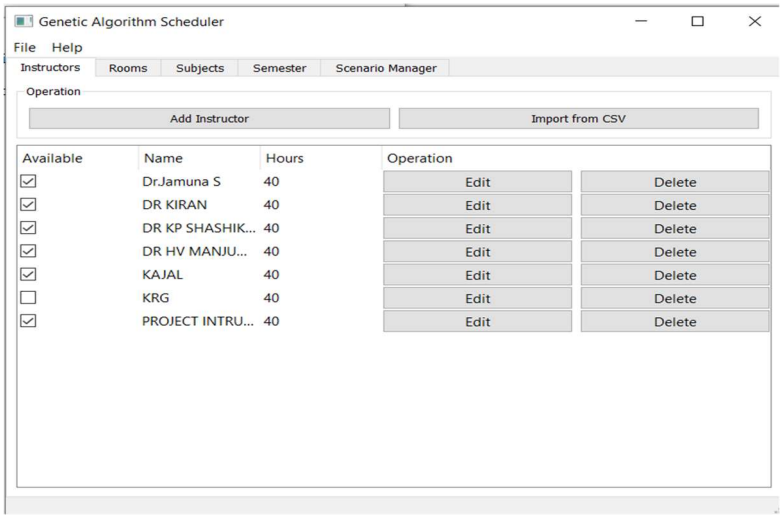

Figure 4- Instructor names and available hours per week

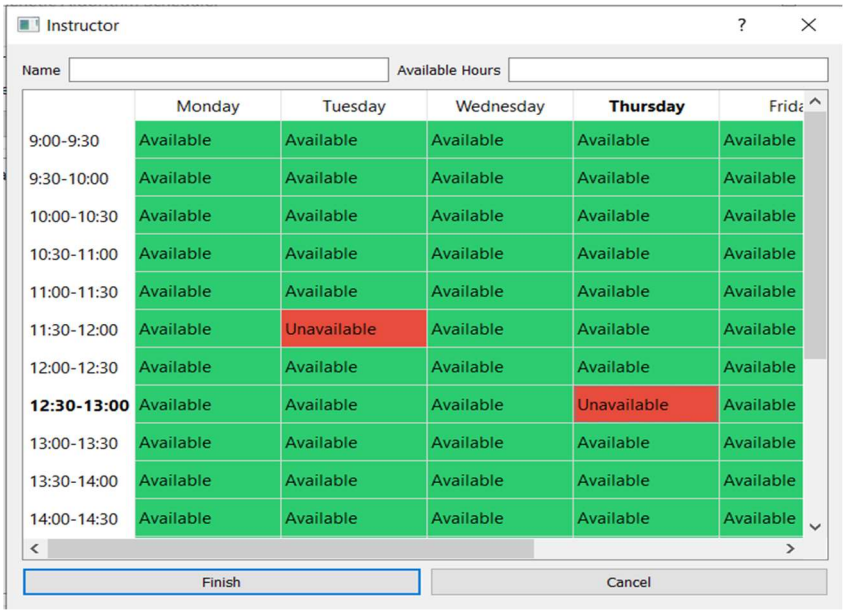

Figure 5- Selecting/Editing Available hours

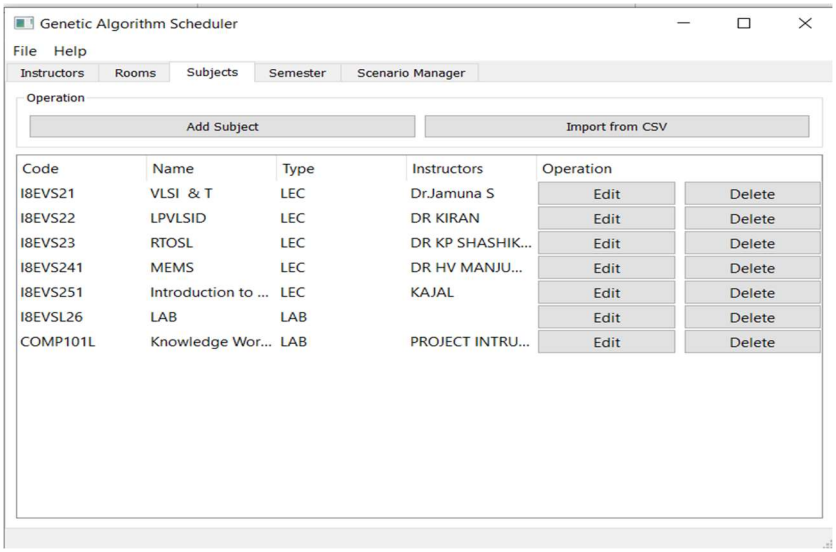

Figure 6- Selection of subjects for inputs

Subjects are selected with the name, subject code, related instructor name and type that can be lecture (LEC) or laboratory (LAB). Number of hours that the subjects should be allotted is updated as shown in Figure 6. Different number of sections can be selected with the related subjects and rooms. After the selection of inputs through GUI or using standard database, algorithm settings have to be set with the values which includes starting and ending time, minimum population, maximum population and mutation rate.

The constraints that have to be met are defined. Hard constraints are the conditions that have to be completely satisfied and cannot be violated and soft constraints are the conditions that must be satisfied but can have violation.

Hard Constraints:

- Not more than one class can be taught by an instructor at the same time.
- Not more than one instructor and subject can be assigned to a classroom at the same time.
- The lecture hours for a course should be scheduled consecutively.
- Equal distribution of time slots for every subject.
- Appropriate subject and lab sessions assigned.

Soft Constraints:

- Lunch break have to be scheduled between 11 AM to 1PM all the days.
- valid schedule to be created for all the subjects of all sections.
- 30 minutes break to be given for class as well as for instructors for every 3 hours of consecutive classes.
- Classes should have little or no idle time for the day.
- Instructors assigned loads must be balanced with respect to subjects and hours of classes.
- Ensure all shared subjects are scheduled with respect to a pattern.

The automated generation of timetable is achieved by application of proposed hybrid GA-PSO Algorithm for the input selected data set and parameters. Genetic algorithm is used for optimization and PSO is used for fitness

calculation. Random initial population with minimum defined size value in settings is generated with chromosome. Chromosome contains gene values which are instructor, room, subject, sharing for timetable. Chromosomes are generated as per genetic algorithm such that all hard constraints are satisfied. These chromosomes are considered as particles and fitness is evaluated for particles as per particle swarm optimization technique. For every particle fitness calculation takes place based on the soft constraints defined. Subject placement is the given the highest priority. The flowchart of the proposed hybrid GA-PSO Algorithm is shown in Figure 7. Fitness is calculated by the below formula:

$$\text{Fitness}(x)=(a(x)*aW)+(b(x)*bW)+(c(x)*cW)+(d(x)*dW)+(e(x)*eW)+(f(x)*fW) \quad \text{.....(5.1)}$$

Where x=particle/chromosome and a, b, c, d, e and f represent soft constraint functions that have to be met.

Example of some soft constraint's fitness is:

Fitness of subject placement = *(Number of subject slots allotted/total number of committed subjects' slots) *100……(5.2)*

Fitness of Instructor load=$(\Sigma instructor\ load(instructors)/\ total\ number\ of\ active\ instructors)*100$*……(5.3)*

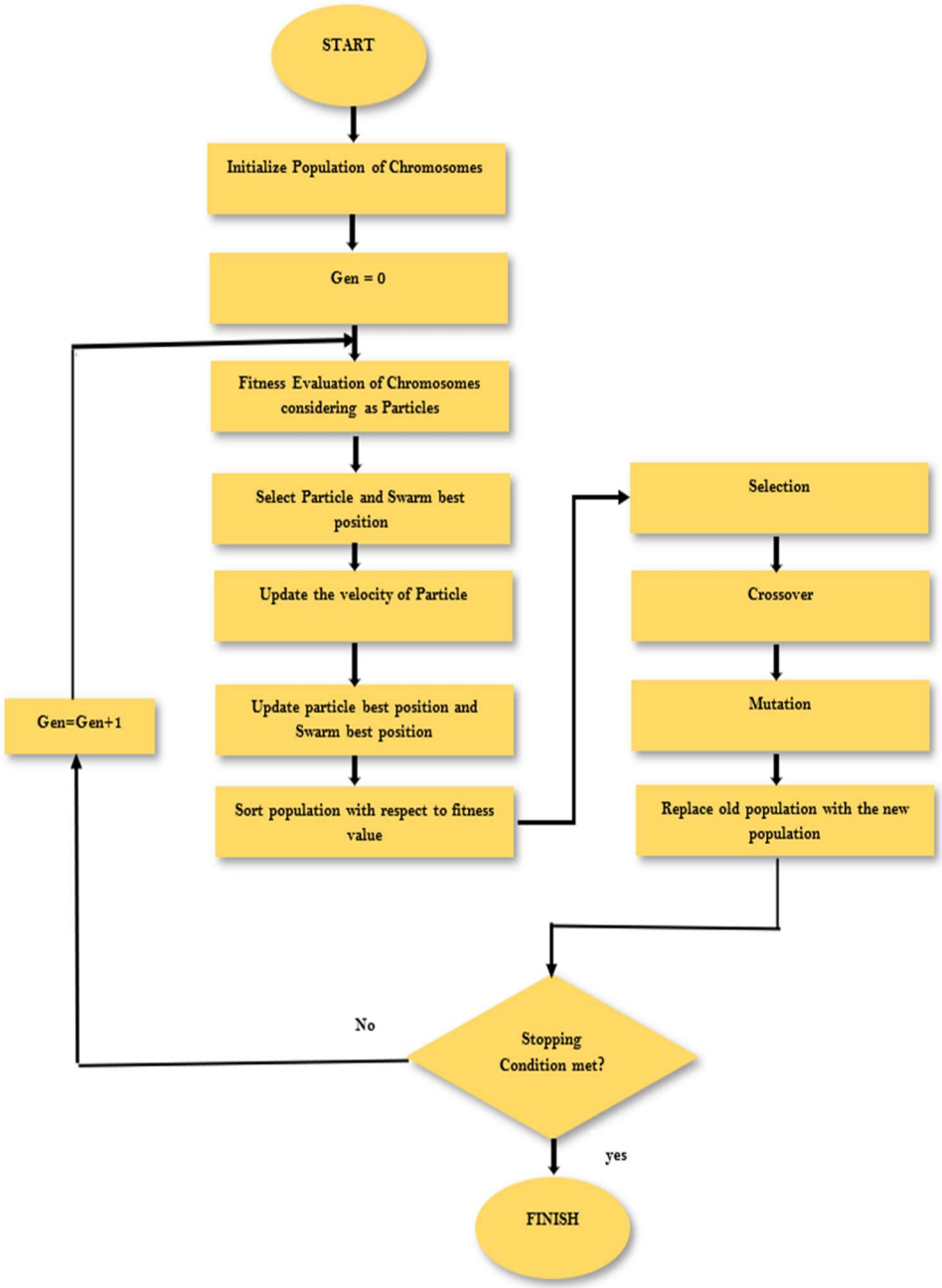

Figure 7- Flow chart of Proposed GA-PSO Algorithm

All the fitness of soft constraints is added to get the total fitness. Once the fitness calculation is completed, the particles update their velocity based on particle and swarm best position using below formula:

$v = wv + c1 * rand * (pBest - p) + c2 * rand * (gBest - p)$……..(5.4)

where v is the new velocity, w is the inertia to keep the particle in same direction, c1 and c2 are acceleration constants for self-best and swarm best positions respectively, pBest is particle best position and global best position. Based on the fitness value the population is sorted and further is selected using tournament selection

for reproduction. Selected chromosomes are sent to crossover and mutation to get the most suitable solution to the problem.

5.2 Face Detection and Recognition using OpenCV

Raspberry Pi is a low-cost mini or a card sized computer that can be connected to monitor or laptop to build projects or execute codes. It has USB ports to connect mouse and Keyboard.

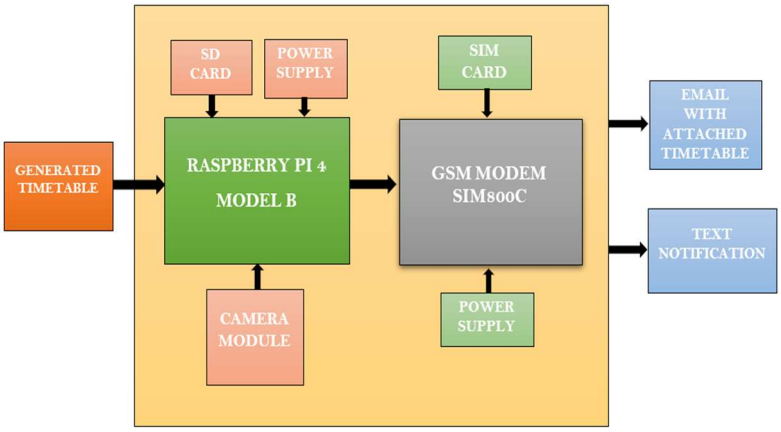

Figure 8- Timetable Management System Overview

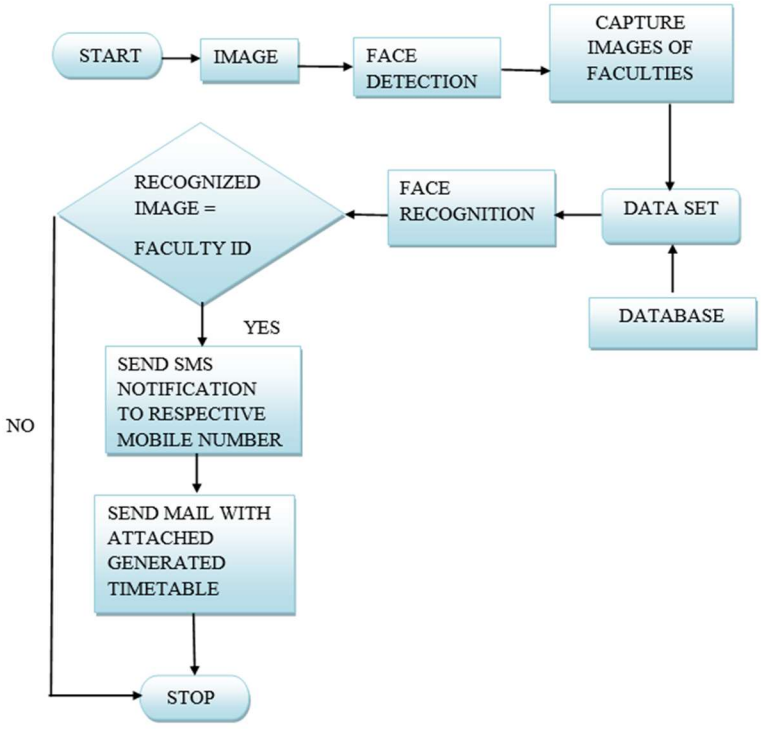

Figure 9- Flowchart of Timetable Management System

Raspberry pi 4 Model B and Raspberry Pi camera is used for face detection and recognition. OpenCV is a real time computer vision-based library tool. It supports cross platforms and is an open source with C++, java, python

and MATLAB interfaces. Hardware architecture proposed Timetable Management System is shown in the Figure 8 below. Generated timetable is stored in the SD card of Raspberry Pi. Camera module acts as input and based on the captured images, face recognition is achieved and subsequently mail and SMS notification is sent to the respective faculties as per the data. These steps are explained in detail in the subsections.

5.2.1 Face Detection:

Face detection incorporates segregating image windows into two categories; one holding faces. Even if commonalities exist between faces, it is hard since they can differ significantly with regard to age, facial expression and skin colour. This issue farther adds complexity by contradicting image qualities, lighting conditions along with geometries, additionally the probability of limited obstruction and disguise.

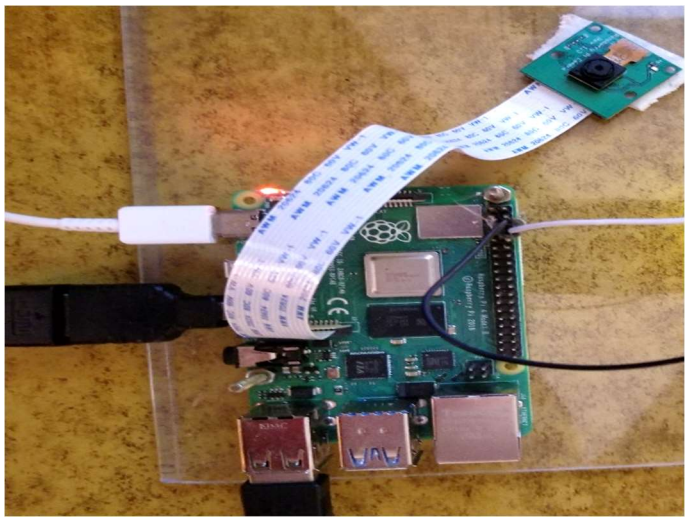

Figure 10-RaspberryPi interfaced with camera module

A perfect face detector may perhaps be able to detect the appearance of any face under any deck of lighting conditions, on top of any background. The face detection job can be fragmented into two stages. The first stage is a categorization task that grasps some unpredictable image as input and a binary value of yes or no as output, demonstrating even if there are any faces appear in the image. The second stage is the face determination task that focus on taking an image as input and the location of any face or faces inside that image as some bounding box with (x, y, width, height) as output. OpenCV allows to capture images from a video file. This step captures the human face appearing in front of camera with the id number as input. Haar-cascade algorithmic program is utilized to detect the human faces in frontward of camera. Line or edge feature detection is used by this algorithm. Total sum of images to be captured is calibrated to 200. Non identical images with distinct angles are captured and is saved in the dataset for each user id as shown in Figure 12.

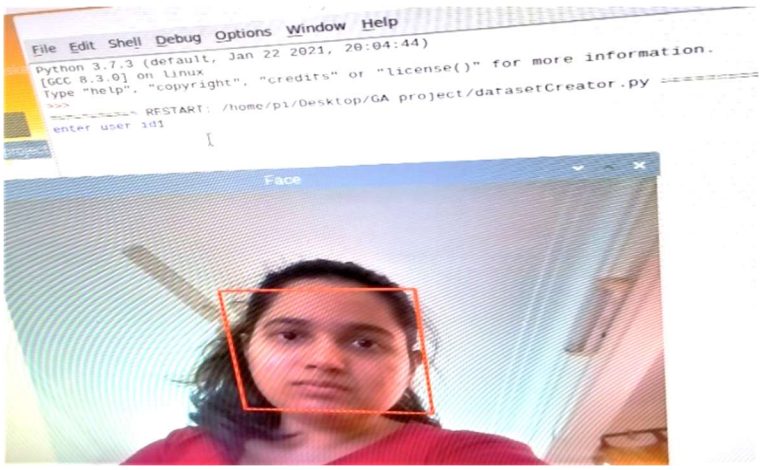

Figure 11-Face detection using OpenCV

Figure 12- Images stored in dataset

5.2.2 Feature Extraction:

Following the face detection stage, human-face patches are taken out from images. Straight away making use of these patches for face recognition possess some drawbacks, firstly, each and every patch normally accommodates above 1000 pixels, which are excessively big to assemble a powerful recognition system. Secondly, face patches might be drawn from different camera adjustments, with dissimilar face expressions, lightings and could potentially undergo obstruction and clutter.

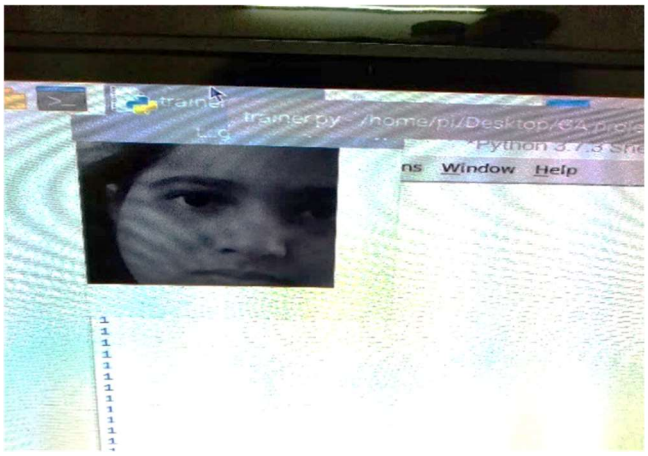

Figure 13-Feature extraction for training

To get over these drawbacks, feature extractions are carried out to do data packing, dimension depletion, eminence extraction, and noise cleansing. After this stage, a face patch is normally modified into a vector with stable dimension or a set of confident points and their relative locations. Local Binary Pattern Histogram (LBPH) Algorithm is used for training the images and uses mainly four criteria which are radius, neighbors, Grid X and Grid Y.

5.2.3 Face Recognition

Face recognition is the task of recognizing an earlier discovered object as a familiar or unfamiliar face. The difficulty of face recognition is perplexed with the difficulty of face detection frequently. Face Recognition however, is to choose if the "face" is any person familiar, or unfamiliar, utilizing for this reason a database of faces for the purpose to verify the indicated input face.

Thereafter formulating the portrayal of each face, the final stage is to recognize the identification of these faces. A face database is necessary to build, with the view to attain automatic recognition. For each and every person, various images are extracted and their attributes are taken and gathered in the database. Then, when an input face image approaches in, execute face detection and feature extraction, and differentiate its feature to each face class saved in the database. Face identification imply specified face image, we want the system to tell who he / she is or the most probable identification. This is achieved using Local Binary Pattern Histogram Algorithm.

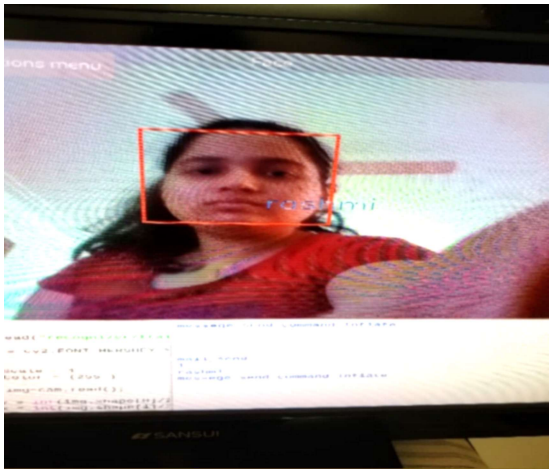

Figure 14-Face recognition after training

5.3Notification using GSM Module

GSM stands for "global system for mobile communications," and it is a relatively recent advancement in the field of mobile phone technology. GSM employs narrowband Time Division Multiple Access (TDMA) techniques for signal transmission. GSM SIM800C module is interfaced with Raspberry Pi 4 Model B to achieve RS232 serial communication as shown in Figure 15. GPIO configurations is done and baud rate is set to 9600. Programming is achieved using Python language. SIM card is inserted into the GSM module. Based on the different ID of faculties, different SMS and mail functions are defined with respective mobile numbers and email ids. Once the face of the faculty is recognized based on the trained data, a notifying message is sent to the respective faculty number and the timetable is sent to the respective faculty mail id. AT commands acts as guidelines to control the GSM module to send messages. Steps to achieve the SMS notification using the interface is described in the flowchart (Figure 16).

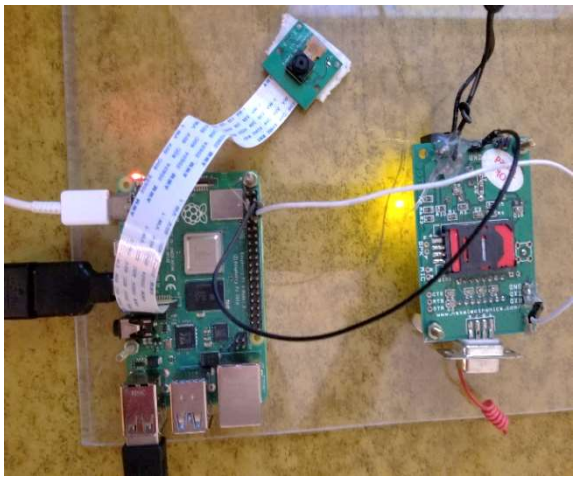

Figure 15- experimental setup with interface with GSM module

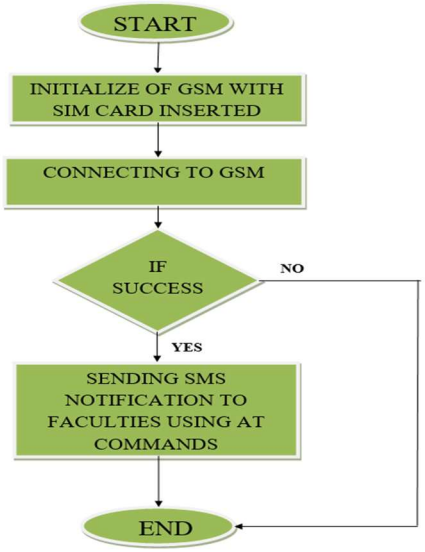

Figure 16- Flow chart for SMS notification

After the real time face recognition, the connectivity between Raspberry Pi and GSM modem is checked and if connected the notification is sent as a text message to the receiver faculty member. Next step involves attaching the Automatically generated timetable in the mail and sending it to respective faculty member. Simple Mail

Transfer Protocol (SMTP)is used to achieve this. Multipurpose Internet Mail Extension (MIME) is a module providing greater flexibility in order to define the sender and receiver information, to attach the required document and to start communication sessions. Steps involved in sending the mail is described in the flowchart below (Figure 17).

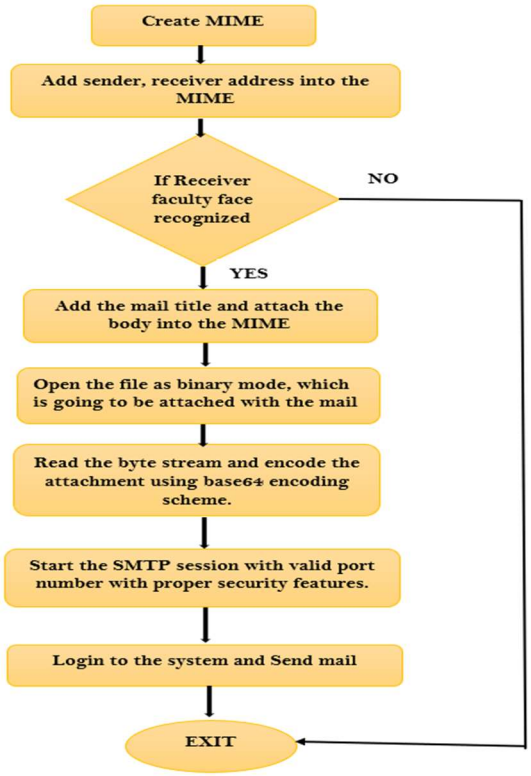

Figure 17- Flow chart of sending email with attached timetable

6. RESULTS AND DISCUSSION

Timetable is generated using hybrid GA-PSO algorithm meeting all defined hard constraints and most of the soft constraints. Subjects are allocated consecutively without any clashes. Most of the slots are allotted with maximum priority to subject placement, all the hard constraints are achieved as represented in generated output in Figure 18.

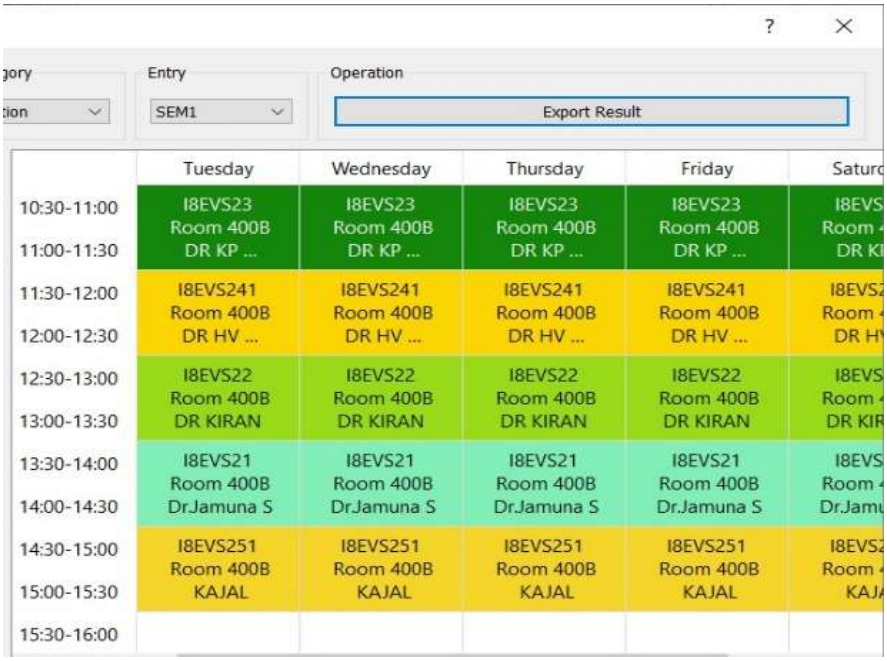

Figure 18-Generated timetable

Generated timetable is exported in CSV format as shown in figure and can be manually modified for the required changes in the scheduled and is stored in the Raspberry Pi SD card. This file is used for notifying the instructors. Fitness evaluation using GA-PSO is compared with the evaluation using only GA (Figure 20). It is observed that only GA gives largely varying fitness values and GA-PSO gives more constant fitness values by enhancing the global optimization.

1	SEM1						
2	Time	Monday	Tuesday	Wednesda	Thursday	Friday	Saturday
3	9:00-9:30						
4	9:30-10:00						
5	10:00-10:3	I8EVS241 -	I8EVS241 -	I8EVS241 -	I8EVS241 -	I8EVS241 -	I8EVS241 - Room 402 - DR HV MANJUNATH
6	10:30-11:0	I8EVS241 -	I8EVS241 -	I8EVS241 -	I8EVS241 -	I8EVS241 -	I8EVS241 - Room 402 - DR HV MANJUNATH
7	11:00-11:3	I8EVS251 -	I8EVS251 -	I8EVS251 -	I8EVS251 -	I8EVS251 -	I8EVS251 - Room 402 - KAJAL
8	11:30-12:0	I8EVS251 -	I8EVS251 -	I8EVS251 -	I8EVS251 -	I8EVS251 -	I8EVS251 - Room 402 - KAJAL
9	12:00-12:3	I8EVS23 - I	I8EVS23 - I	I8EVS23 - I	I8EVS23 - I	I8EVS23 - I	I8EVS23 - Room 402 - DR KP SHASHIKALA
10	12:30-13:0	I8EVS23 - I	I8EVS23 - I	I8EVS23 - I	I8EVS23 - I	I8EVS23 - I	I8EVS23 - Room 402 - DR KP SHASHIKALA
11	13:00-13:30						
12	13:30-14:0	I8EVS21 - I	I8EVS21 - I	I8EVS21 - I	I8EVS21 - I	I8EVS21 - I	I8EVS21 - Room 402 - Dr.Jamuna S
13	14:00-14:3	I8EVS21 - I	I8EVS21 - I	I8EVS21 - I	I8EVS21 - I	I8EVS21 - I	I8EVS21 - Room 402 - Dr.Jamuna S
14	14:30-15:0	I8EVS22 - I	I8EVS22 - I	I8EVS22 - I	I8EVS22 - I	I8EVS22 - I	I8EVS22 - Room 402 - DR KIRAN
15	15:00-15:3	I8EVS22 - I	I8EVS22 - I	I8EVS22 - I	I8EVS22 - I	I8EVS22 - I	I8EVS22 - Room 402 - DR KIRAN

Figure 19-Generated timetable in CSV format

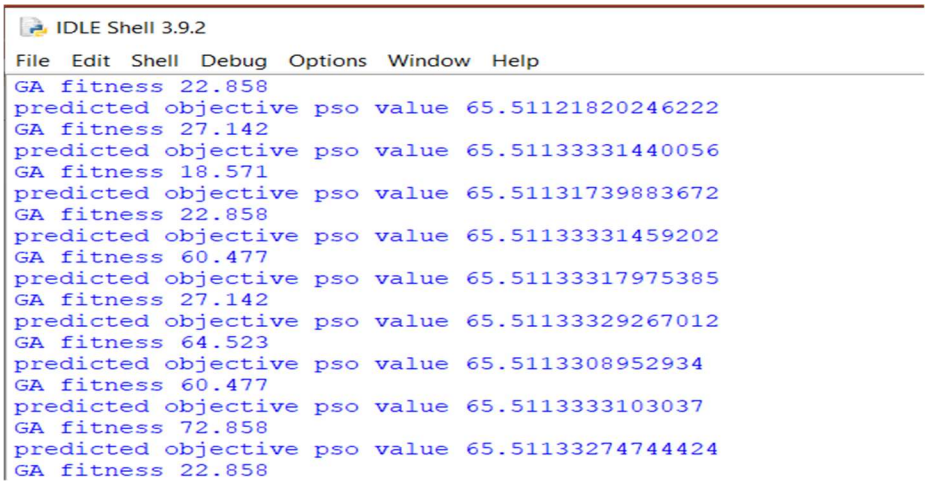

Figure 20-Comparison of fitness values

Based on the facial recognition of the faculties from the trained dataset, timetable is attached and sent to their respective mail id and a message is sent to their mobile number notifying to check their mail for timetable. Mail sent with attached semester timetable is shown in Figure 21 and Figure 22 shows the SMS text notification sent after face recognition.

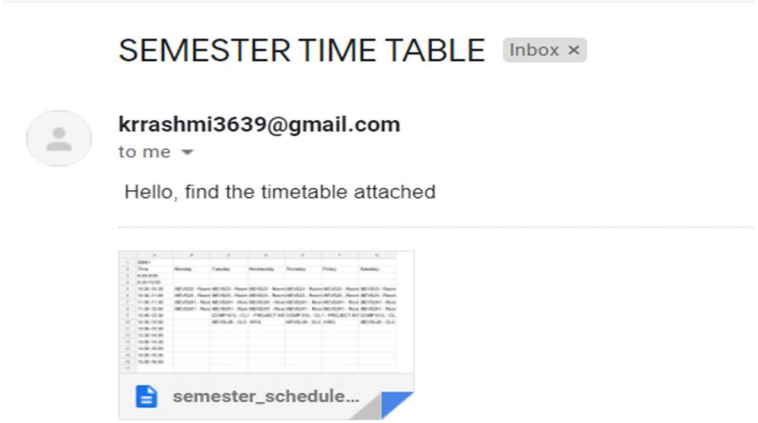

Figure 21-Mail sent after Facial recognition

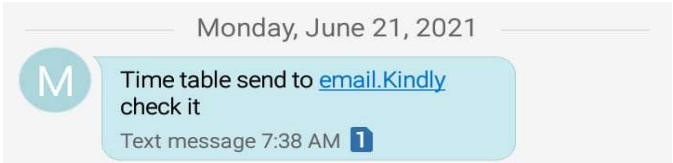

Figure 22- SMS Text notification

7. CONCLUSION

Automated time table scheduler and management system acts as efficient resource in a smart campus and saves lot of time and manual efforts in timetable preparation. Genetic Algorithm and PSO Algorithm both being population-based algorithms are effective methods to solve timetable optimization problem. Hybrid GA-PSO helps to provide a good stable output meeting most of the constraints. Although the system may not provide

perfect solution but provides a valid output, that could be easily modified as per the needs. This system can be used in various departments as well as in different educational institutes. Face detection and recognition in management system enhances the security. Haar-cascade Algorithm used for detection increases the speed of computation and LBPH algorithm used for training provides a main advantage by not getting affected by lighting conditions. The management system provides and advantage of sending the notification through a text message as well as through mail for faculties.

Automated time table scheduler and management system can be improved in future with additional features like adding the display and the database created can be used for many other applications like attendance registration and for sending other notifications like syllabus change, management notifications to faculties supporting quality technical education in campus.

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